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ISSN:2394-2606

JOURNAL OF ADVANCED STUDIES IN AGRICULTURAL, BIOLOGICAL AND ENVIRONMENTAL SCIENCES (JABE)

Special Issue on

"IMPACTS OF CHEMICAL FERTILIZERS – USE OF BIOFERTILIZERS FOR ENVIRONMENTAL PROTECTION"

PROCEEDINGS OF THE **TWO DAY NATIONAL SEMINAR**

11th&12th, December, 2014.

Department of Chemistry

SRI SUBBARAYA & NARAYANA COLLEGE

NAAC "A" Grade Institute, NARASARAOPET – 522 601,

Guntur Dist, Andhra Pradesh.

Sponsored by

UNIVERSITY GRANTS COMMISSION,

SERO,

Hyderabad.

PREFACE

Fertilizer is any substance used to add nutrients to the soil to promote soil fertility and increase plant growth. A chemical fertilizer is an inorganic material of wholly or partially synthetic origin that is added to the soil to sustain plant growth. A "chemical fertilizer" by definition is that it is composed of raw chemicals that have been manufactured at a factory into liquid or solid forms that specifically target plants' nutritional needs. A chemical fertilizer is essentially designed to mimic naturally occurring nutrients. The essential nutrients contained in these fertilizers are nitrogen, phosphorous, and potassium (NPK), as well as other nutritional substances in smaller amounts – all presented in a form that can easily be absorbed and metabolized by plants.

The biggest issue facing the use of chemical fertilizers is groundwater contamination. Nitrogen fertilizers break down into nitrates and travel easily through the soil. Because it is water-soluble and can remain in groundwater for decades, the addition of more nitrogen over the years has an accumulative effect.

Biofertilizers are the substances which make use of microorganisms to fertile the soil. These fertilizers are not harmful to crops or other plants like the chemical fertilizers. They are actually taken from the animal wastes along with the microbial mixtures.

Biofertilizers help to get high yield of crops by making the soil rich with nutrients and useful microorganisms necessary for the growth of the plants. They decrease the growth of the plants and make the environment polluted by releasing harmful chemicals. Plant growth can be increased if Biofertilizers are used, because they contain natural components which do not harm the plants but do the vice versa. Biofertilizers destroy those harmful components from the soil which cause diseases in the plants. Biofertilizers are not costly and even poor farmers can make use of them. They are environment friendly and protect the environment against pollutants.

Researchers believe that the "**Impacts of Chemical Fertilizers – Use of Biofertilizers for Environmental Protection"** is an untapped area. Search for new technological improvement is driving further advance in the field. Knowledge in this field is crucial for understanding of several applications. This is an important field of research for Scientists of many disciplines.

ABOUT THE COLLEGE

Sri Subbaraya and Narayana College which was established in 1950 is being run on sound lines craving high reputation in this region of South India. It is one of the few colleges in the state of Andhra Pradesh to get \`A\` grade in the reaccreditation process in 2013. The college is affiliated to Acharya Nagarjuna University. The college is spread across a vast and sprawling campus located in the heart of Narasaraopet with good infrastructure. Ever since the inception of the College all Departments have been ample fortunate to have members of great erudition be its faculty members who have contributed their best in moulding the career of the students in all aspects by way of organizing various programmes throughout the year like Seminars, Workshops and Guest lectures.

DEPARTMENT OF CHEMISTRY

The department of Chemistry is one of the prestigious departments of the college. The post graduate department was established in 2005. The department has a great reputation and distinction in producing illustrious students who have become great personalities in various fields.

SUBBARAYA & NARAYANA COLLEGE

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Dr. Muvvala S. Sudhir
Convener,
National Seminar (ICFUBEP – 2014),
Department of Chemistry,
Sri Subbaraya and Narayana College,
NARASARAOPET – 522 601,
Guntur Dist., Andhra Pradesh

The task of conducting this National Seminar on "Impacts of Chemical Fertilizers – Use of Biofertilizers for Environmental Protection" sponsored by UGC was entrusted to me by the Principal Sri. P. V. Srinivasa Rao. I wish that this seminar would bring a marginal shift to promote Environmental research and focus on the recent developments in the different areas of it. I seek the earnest support and contribution of eminent academicians and the young researchers to share their latest ideas and help one another on the topics of common interest in the research programmes which will eventually contribute to the creation of a better academic atmosphere in the field of research.

This proceedings consists of invited lectures and contributions of research paper presentations at the National Seminar on "Impacts of Chemical Fertilizers – Use of Biofertilizers for Environmental Protection" sponsored by UGC and organized by the Department of Chemistry, Sri Subbaraya and Narayana College, Narasaraopet on 11th & 12th December, 2014.

The main objective of the seminar is to give a flavour of the advanced topics on current trends and future directions in the field of environmental and chemical sciences. This seminar is initiated to provide a common platform for graduates, researchers, scientists, and other professionals throughout India to present their latest findings ideas, developments and applications.

I express my gratitude to the University Grants Commission, Sri. K. Vijaya Kumar, President, S. S & N. College Committee, Sri. N. Subbaraya Gupta, Secretary & Correspondent, S. S & N. College, Sri. V. Venkateswara Paavan, Treasurer, S. S & N. College Committee, Sri. P. V. Srinivasa Rao, Principal (F.A.C.), S. S & N. College, Vice Principal, In-charges of the Departments, Members of the Department of Chemistry and all those who have contributed their might in making this event memorable and useful.

I express special thanks to the invited speakers and paper presenters for sending their valuable manuscripts, papers and abstracts to include in the Proceedings of the National Seminar.

Finally, I would like to thank the Press and Electronic media for their extensive coverage of the news of the event.

With regards,
DR. MUVVALA S. SUDHIR

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P.V.SRINIVASA RAO
PRINCIPAL (F.A.C)
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MESSAGE

I am all the more delighted that the Department of Chemistry of Sri Subbaraya and Narayana College is organizing a two day UGC Sponsored National Seminar on ***"Impacts of Chemical Fertilizers – Use of Biofertilizers for Environmental Protection (ICFUBEP-2014)"*** during 11th and 12th of December 2014. The theme of the seminar is of topical significance and plays a prominent role in the field of scientific research aimed at saving the whole mankind from the harmful fertilizers. In fact several researchers and scientists from various places are participating in this important event. I do firmly believe that the seminar would be a good platform providing many opportunities for the participants to exchange views and network with persons and institutions of similar research students. I wish all the Delegates and Resource Persons a comfortable stay and intellectually enriching experience. I also wish the organizers of the seminar a grand success. I am sure that the participants and the organizers will benefit academically from the seminar.

Sd/–

P. V. SRINIVASA RAO

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P. N. V. D. MAHESH
Vice– Principal
Mobile: 9247824441
Date: 06 – 12 – 2014

MESSAGE

I am pleased to know that the Department of Chemistry of Sri Subbaraya and Narayana College is granted by the U.G.C. to organize a two day National Seminar on ***"Impacts of Chemical Fertilizers – Use of Biofertilizers for Environmental Protection (ICFUBEP-2014)"*** during 11th and 12th of December 2014. The seminar is aimed at discussing various important issues related to the use of chemical fertilizers and bio–fertilizers in terms of protecting the environment. I hope that the knowledge shared at the seminar will motivate many upcoming researchers as well as the delegates attending the conference. I appreciate the Department of Chemistry for the conduct of the seminar and I wish the seminar a grand success

Sd/-
Dr. P. N. V. D. Mahesh

SUBBARAYA & NARAYANA COLLEGE COMMITTEE

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KAPILAVAI VIJAYA KUMAR
President
Mobile: 9848157411
Date: 08 – 12 – 2014

MESSAGE

I am happy to note that the Sri Subbaraya and Narayana College is undertaking a great task of conducting National Seminar on ***"Impacts of Chemical Fertilizers – Use of Biofertilizers for Environmental Protection"*** sponsored by UGC on 11th & 12th December, 2014.

This 64 years old institution through its tireless efforts in spreading the light of education throughout the country has served the community in an exceptional way.

I congratulate the Principal Sri P. V. Srinivasa Rao under whose able leadership the college is moving forward in leaps and bounds, the Convener Dr. Muvvala S. Sudhir and their team for undertaking the onerous task of organizing the National Seminar.

Sd/–
KAPALAVAI VIJAYA KUMAR

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NAGASARAPU SUBBAAYA GUPTA
Secretary & Correspondent
Mobile: 9848157403
Date: 05 – 12 – 2014

MESSAGE

It is noteworthy and a matter of pride and pleasure that the Department of Chemistry of Sri Subbaraya and Narayana College is organizing a two day UGC Sponsored National Seminar on ***"Impacts of Chemical Fertilizers – Use of Biofertilizers for Environmental Protection"*** during 11th & 12th December, 2014. I understand that various Professors and Lecturers of different states are participating in the seminar to deliberate on the impacts of chemical fertilizers and the advantages of substituting bio–fertilizers to protect the environment in view of common good of the world. I am ample confident that the seminar could provide an opportunity to Research scholars budding post graduates and academicians to interest mutually through deliberations and discussions to have academic research collaboration amongst the universities and scientific laboratories for progress and development in research and development in the field chosen for the seminar.

I thank the UGC – SERO for granting us the funds to conduct this seminar. I believe that this endeavour would be fruitful and useful to the students and staff of Sri Subbaraya and Narayana College and other institutions.

I appreciate Dr. Muvvala S. Sudhir, the organizers and the supporting staff for their ceaseless efforts in making this seminar a grand success.

Sd/–

NAGASARAPU SUBBARAYA GUPTA

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VUPPALAPANCHU VENKATESWARA PAAVAN
Treasurer
Mobile: 9866230579
Date: 06 – 12 – 2014

MESSAGE

It is matter of joy for me to know that Sri Subbaraya and Narayana College is organizing a two day National seminar on ***"Impacts of Chemical Fertilizers – Use of Biofertilizers for Environmental Protection"*** sponsored by UGC on 11th & 12th December, 2014.

The seminar is a mile stone in the eventful history of the college. The college is a pioneer institution with the vision of dispelling the darkness of ignorance through education.

I congratulate the Convener, Dr. Muvvala S. Sudhir and members of the Department of Chemistry for organizing this seminar, which I hope, will generate much discussion along with papers from distinguished Professors and Scholars of Chemistry and Environmental Sciences.

Sd/–

VUPPALAPANCHU VENKATESWARA PAAVAN

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Journal of Advanced Studies in Agricultural, Biological and Environmental Sciences (JABE)
A Peer Reviewed & Refereed, International Open Access Journal
www.jabe.in **Vol.1.S1.2014,** **ISSN:2394-2606**

IMPACTS OF CHEMICAL FERTILIZERS ON ENVIRONMENT POLLUTION

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INTRODUCTION

Consumer society, in order to meet the growing need for food, agricultural land per unit area required to achieve maximum efficiency and highest quality product. It is known that the nutrition of the plant is the one of the most important factors to control agricultural productivity and quality. Rates of nutrients in the soil affects the quality of yield as well. In the permanent agricultural land, the soil will be very poor in nutrients, as a result, inefficient. Therefore, producers, fertilize the soil, combat pests, irrigation and process of agricultural activities to make more efficient to soil. Fertilization among these activities remains a priority at all times. Recent studies, however, indicate that excessive use of fertilizers is the need for additional land outside the public and environmental health of the reported adverse effects. Excessivefertilization and mindless, but there were soil salinity, heavy metal accumulation, water eutrophication and accumulation of nitrate, to consider in terms of air pollution in the air of gases containing nitrogen and sulfur, giving and can lead to problems such as the greenhouse effect. In this review, aims to reveal environmental and health problems caused by improper fertilization provides recommendation toward solving these problems.

Fertilization increases efficiency and obtains better quality of product recovery in agricultural activities. It is one of the most important ways. Non-organic fertilizers mainly contain phosphate, nitrate, ammonium and potassium salts. Fertilizer industry is considered to be source of natural radionuclides and heavy metals as a potential source. It contains a large majority of the heavymetals like Hg, Cd, As, Pb, Cu, Ni, and Cu; naturalradionuclide like 238U, 232Th, and 210Po.

However, in recent years, fertilizer consumption increased exponentially throughout the world, causes serious environmental problems. Fertilization may affect the accumulation of heavy metals in soil and plant system. Plants absorb the fertilizers through the soil, they can enter the food chain. Thus, fertilization leads to water, soil and air pollution.

For the next 30 years, more fertilizer will be used to obtain more products. Excessive use of chemical fertilizersin agriculture, resulting in a large number of environmental problems because some fertilizers contain heavy metals (eg. cadmium and chromium) and high concentrations ofradionuclides. Later these fertilizers agro-ecosystem constitutes the main source of heavy metals and radionuclides in plants and some results in the accumulation of inorganic pollutants [3]. Greenhouses, aquaculture especially large amounts of chemical fertilizers used during the peak season, so dangerously polluted well water, especially water resources, crop production quantity and quality of product deteriorates. Problems caused by too much fertilizer: The amount of nitrate may increase in drinking water and rivers as a result of high levels of nitrogen fertilizer use. The amount of phosphate may increase in drinking water and rivers as a result of the transport of phosphorous fertilizer with the flow of surface. High level of Nitrogen fertilizer used plants grown in soils. It consists of carcinogenic substances such as nitrosamines, especially plants such as lettuce and spinach leaves are eaten. There are harmful accumulation of $NO_3$and NO_2.

EFFECTS OF CHEMICAL FERTILIZERS ON WATERPOLLUTION

Nowadays, human beings aware of harmful effects on the environment of the use of nitrogenous fertilizers. Nitrogen in agricultural areas reach the water environment by three ways: Drainage, leaching and flow. Nitrate leaching particularly linked to agricultural practices such as fertilizing and cultivation. Irrigated agricultural land in some of the arid and semiarid regions, increased amounts of nitrate accumulation in the soil used and along with the evaporation of water. According to the conditions, nitrate accumulated leached in varying amounts.

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www.jabe.in Vol.1.S1.2014, ISSN:2394-2606

It reaches the depth of soil. In the soil, fertilizers converted to nitrate through nitrification by microorganisms. Due to negatively charged of nitrate can reach ground water. Even in ideal conditions, Plants use 50% of nitrogenous fertilizers applied to soil, 2-20% lost evaporation, 15-25% react organic compounds in the clay soil and the remaining 2-10% interfere surface and ground water [4-5]. The majority of nitrogenous fertilizers aren't absorbed products and they interfere with both underground and surface water. Groundwater nitrate problem should be considered in a global context. 22% of cultivated areas in Europe for the international recommended drinking water nitrate concentration in groundwater concentration (≥ 11.3 mg/L) above. Research results showed that deep groundwater contains low concentrations of ammonium (less than 0.3 mg-N/L) throughout, however much higher nitrate concentrations (less than 1.0 mg/N/L to 28.0 mg-N/L). Most remaining groundwater samples have a nitrogen fertiliser source, possibly derived from an influent river draining a rural catchment. Groundwater quality is approximately 14% of the wells were found to be over the limit values of NO_3-N concentration. A total of between 1000 and 1500 wells could realisticallybe included in the study. Nitrate concentration was measured spectrophotometrically.

One of the most important parameters of the pollution of water is nitrate which is the basic component of fertilizer. Both the nitrate concentration of groundwater and surface water is increased by agricultural activities. Nitrate is the most common form of dissolved nitrogen in groundwater. However, It can be found in the form of nitrite (NO2-), nitrogen (N2), nitrogen oxide (N2O) and organic nitrogen.

Nitrates from drinking water of the body is absorbed in the intestinal tract 4-12h and is exceted by the kidneys. The mechanism, as well as the salivary glands can concentrate nitrate. As a result, the mouth is reduced to nitrite in the anaerobic environment. It is possible to examine the toxicological effects of nitrate in three stages. The primary toxic effect of nitrate concentrations in drinking water of 50 mg NO3- /L exceeds the value of the bowel in adults, digestive and urinary systems, inflammation is seen. Seconder toxicity, high nitrate concentration in drinking water caused disease in infants methamoglobianemi. Stomach acid does not occur in infants younger than six months. In this environment, nitrate nitrite reacts with hemoglobin in the blood is minimized methamoglobin consists of nitrite in the digestive system. Meanwhile, iron contained in hemoglobin and blood oxygen transport function lost. As a result, infants are found stragled to death. Advancing age, it is eliminated as a result of the increase in stomach acids. Toxicity in acid medium of secondary and tertiary amines tertiory nitrites, alkylammonium bases and react accordingly amides occurs a s a result nitrosamines occurs, as a result of this and nitrosomines. Strong carcinogenic effects of these compound has been identified in recent studies.

One of the most important negative effects of intensive fertilizer use is water eutrophication. Increased amounts of nitrogen andphosphorous compounds in water as a result of the increase in the amount of higher aquatic plants and algae formation and degradation of water quality and water environment in the event of life is defined as eutrophication. Eutrophication in the bottom layer, oxygen-free environment as a result, not suitable for drinking and water supply, reduction in the number of living species in the aquatic environment fish kills, proliferation of unwanted species, odour problem, the media appear to be unsuitable for recreation.

EFFECTS OF CHEMICAL FERTILIZERS ON SOIL POLLUTION

According to the researches and studies the effects of chemical fertilizers on the soil is not immediately obvious. Because soils have strong buffering power due to their components. Over the time, it states that emerged from the pollution, deterioration of soil fertility, soil degradation reactions occurring in the soil leads to deterioration of the balance of the current element. In addition, toxic substances

Accumulate within the vegetables and causing negative effects in humans and animals are fed. Soil structure in agricultural productivity are very important and it is regarded as an indicator.

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www.jabe.in Vol.1.S1.2014, ISSN:2394-2606

Unconsciously, fertilizing the soil, just as in the deterioration of the structure is caused by industrial emissions. Especially NaNo3, NH_4NO_3, KCl, K_2SO_4, NH4Cl demolish the structure, such as fertilizers, soil, soil structure, deterioration is difficult to obtain high-quality and efficient product.

Particularly high level of sodium and potassiumcontaining fertilizers, make a negative impact on soil, pH, soil structure deterioration and the increasing feature of acid irrigation or other agricultural operations or from the benefits derived from it is not possible or very scarce. Continuous use of acid-forming nitrogen fertilizers causes adecrease in soil pH, liming, if not carried to prevent the declining efficiency of field crops. Basic use of fertilizers in the soil leads to an increase in pH. Increaeses in soil and plants, seedlings pH circuit of a sudden drop in the yield and quality drops, but causes harmfulness. In addition expanding the size of soil pollution by accumulation in thesoil.

Research in the province of Rize in the territory of our country, one-way ammonium sulfate fertilization of tea, actually led to an increase in acidity of soils with low pH. Today 85% of the territory has dropped below pH 4 which is considered as the critical level. Granting the land, excessive nitrogen fertilizers Rhizobium sp. activities, such as symbiotic nitrogen fixing microorganisms is negatively affected.

In addition, more nitrogenous fertilizers limit the activities of nitrifying bacteria. Thus, the cost of the second nitrogen source is damaged. Given large amounts of potassium fertilizers in the soil of Ca and Fe with Zn disrupt the balance of nutrients by the plants and prevent the receipt. However, the negative effects on organisms, given the variety of worms and soil mite has been devastating and lethal effect.

EFFECTS OF CHEMICAL FERTILIZERS ON AIRPOLLUTION

It is known to be one of the most important inputs of fertilizers in agricultural production. When it is applied inadequate, rates of productivity and quality are caused significant losses. When it is too much applied, it causes air pollution by nitrogen oxides (NO, N_2O, NO_2) emissions. Nowadays, there are some gases in the atmosphere. Their names are water vapor, carbon dioxide, methane, hydrogen sulfide (H_2S) with chloro-fluoro hydrocarbons, such as halogen gases associated with these compounds. Also there are some gases on lower layers of tropospheric ozone. These gases contribution to the greenhouses effect. As a global, atmospheric N2O increases from 0.2 to 0.3% each year. Also in case of excessive use of nitrogenous fertilizers, especially nitrate content of levels of the plant would threaten human health level reaches the leafy vegetables eaten.

Calcareous and alkaline soils, especially applied to the soil surface structure and ammonium fertilizers with urea, can result in evaporation of NH3. Evaporation of ammonia, a large number of soil and environmental factors can be controlled and directly proportional to the concentration of ammonia in the soil solution.

Conclusion: Today, use of fertilizers is seen as a necessary agricultural technology because soil restores nutrients. However, firstly soil analysis should be performed carefully. After then, fertilizer should be given to soil. The structure and chemical content of the soil should be identified and the most appropriate type of fertilizers should be selected. The most suitable method should be processed. Otherwise, the fertilizer should be noted that errors will result in the loss of both energy and finance. Fertilizing should be done in time, should not be inappropriate times. For example a heavy rainfall to the seasons, fertilization, and fertilizers water will mix with the surrounding soil by leaching. For this reason, fertilizer will be lost from soil, as well as pollution of surrounding water and therefore it will result in Eutrophication. Water caused by chemical fertilizers is the most effective way to prevent eutrophication, especially in the form of phosphorus flow will stop. In addition, sedimentation, nutrients, dilution, pressure water application, filtration, water alga sit or herbicides, such as the addition of some physical and chemical methods can be effective.

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www.jabe.in Vol.1.S1.2014, ISSN:2394-2606

BIOFERTILIZERS FOR ENVIRONMENTAL PROTECTION

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Bio fertilizer is a substance which contains living microorganisms which, when applied to seed, plant surfaces, or soil, colonizes the rhizosphere or the interior of the plant and promotes growth by increasing the supply or availability of primary nutrients to the host plant. Bio-fertilizers add nutrients through the natural processes of nitrogen fixation, solubilizing phosphorus, and stimulating plant growth through the synthesis of growth-promoting substances. Bio-fertilizers can be expected to reduce the use of chemical fertilizers and pesticides. The microorganisms in bio-fertilizers restore the soil's natural nutrient cycle and build soil organic matter. Through the use of bio-fertilizers, healthy plants can be grown, while enhancing the sustainability and the health of the soil. Since they play several roles, a preferred scientific term for such beneficial bacteria is "plant-growth promoting rhizobacteria" (PGPR). Therefore, they are extremely advantageous in enriching soil fertility and fulfilling plant nutrient requirements by supplying the organic nutrients through microorganism and their byproducts. Hence, bio-fertilizers do not contain any chemicals which are harmful to the living soil (Vessey, 2003).

Increasing use of chemical fertilizers in agriculture make country self dependent in food production but it deteriorate environment and cause harmful impacts on living beings. Due to insufficient uptake of these fertilizers by plants results, fertilizers reaches into water bodies through rain water, causes eutrophication in water bodies and affect living beings including growth inhabiting micro organism. The excess uses of chemical fertilizers in agriculture are costly and also have various adverse effects on soils i.e. depletes water holding capacity, soil fertility and disparity in soil nutrients. It was felt from a long time to develop some low cost effective and eco-friendly fertilizers which work without disturbing nature. Now, certain species of micro-organism are widely used which have unique properties to provide natural products, and serve as a good substitute of chemical fertilizers.

Bio-fertilizers provide eco-friendly organic agro-input and are more cost-effective than chemical fertilizers. Bio-fertilizers such as Rhizobium, Azotobacter, Azospirilium and blue green algae (BGA) have been in use a long time. Rhizobiuminoculant is used for leguminous crops. Azotobacter can be used with crops like wheat, maize, mustard, cotton, potato and other vegetable crops. Azospirillum inoculations are recommended mainly for sorghum, millets, maize, sugarcane and wheat. Blue green algae belonging to a general cyanobacteria genus, *Nostoc* or *Anabaena* or *Tolypothrix* or *Aulosira*, fix atmospheric nitrogen and are used as inoculations for paddy crop grown both under upland and low-land conditions. *Anabaena* in association with water fern Azolla contributes nitrogen up to 60 kg/ha/season and also enriches soils with organic matter. The utilization of biofertilizer opens a new advanced technology for combating drought, salinity and improving soil health (Adesemoye et al. 2008). Plant beneficial microorganisms such as nitrogen fixer, phosphate solubilizer, and mycorrhizae are main sources for biofertilizer (Maheshwari et al. 2011).

Biofertilizers based on PGPR can ensure a plenty environmental benefits as well as helps resource – poor farmers for crop cultivation. Evidently, bacterial inoculants hold enormous prospects in improved and sustainable plant production (Adesemoye and Egamberdieva 2013). The use of beneficial microbes in agricultural production systems started long time ago and there is increasing evidence that beneficial microbes can enhance plants' tolerance to adverse environmental stresses, which include salt and drought stress, weed infestation, nutrient deficiency, and heavy metal contaminations (Compant et al. 2005). Biofertilizers are usually prepared as carrier based inoculants containing effective microorganisms.

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Incorporation of microorganisms in carrier material enables easy handling, long-term storage and high effectiveness of biofertilizer (Mohammadi and Sohrabi 2012). The roles of bacterial fertilizers in nutrient uptake, stress and disease management are emerging areas in agriculture that is not yet well understood; consequently, the benefits are yet to be maximized anywhere in the world.

Types of Biofertilizers

Rhizobium: Rhizobium is a soil habitat bacterium, which can able to colonize the legume roots and fixes the atmospheric nitrogen symbiotically. The morphology and physiology of Rhizobium will vary from free-living condition to the bacteroid of nodules. They are the most efficient biofertilizer as per the quantity of nitrogen fixed concerned. They have seven genera and highly specific to form nodule in legumes, referred as cross inoculation group. The group of bacteria that colonize roots or rhizosphere soil and beneficial to crops are referred to as plant growth promoting rhizobacteria (PGPR).

Azotobacter: Of the several species of *Azotobacter*, *A. chroococcum* happens to be the dominant inhabitant in arable soils capable of fixing N2 in culture media.The bacterium produces abundant slime which helps in soil aggregation. The numbers of *A. chroococcum* in Indian soils rarely exceeds 105/g soil due to lack of organic matter and the presence of antagonistic microorganisms in soil.

Azospirillum: *Azospirillum lipoferum* and *A. brasilense* (*Spirillum lipoferum* in earlier literature) are primary inhabitants of soil, the rhizosphere and intercellular spaces of root cortex of graminaceous plants. They perform the associative symbiotic relation with the graminaceous plants. The bacteria of Genus *Azospirillum* are N2 fixing organisms isolated from the root and above ground parts of a variety of crop plants. They are Gram negative, *Vibrio* or *Spirillum* having abundant accumulation of polybetahydroxybutyrate (70 %) in cytoplasm. Five species of *Azospirillum* have been described to date *A. brasilense*, *A.lipoferum*, *A.amazonense*, *A.halopraeferens* and *A.irakense*. The organism proliferates under both anaerobic and aerobic conditions but it is preferentially micro aerophilic in the presence or absence of combined nitrogen in the medium. Apart from nitrogen fixation, growth promoting substance production (IAA), disease resistance and drought tolerance are some of the additional benefits due to *Azospirillum* inoculation.

Cyanobacteria: Both free-living as well as symbiotic cyanobacteria (blue green algae) have been harnessed in rice cultivation in India. A composite culture of BGA having heterocystous *Nostoc*, *Anabaena*, *Aulosira etc*. is given as primary inoculum in trays, polythene lined pots and later mass multiplied in the field for application as soil based flakes to the rice growing field at the rate of 10 kg/ha. The final product is not free from extraneous contaminants and not very often monitored for checking the presence of desirable flora.

Azolla: *Azolla* is a free-floating water fern that floats in water and fixes atmospheric nitrogen in association with nitrogen fixing blue green alga *Anabaena azollae*. *Azolla* fronds consist of sporophyte with a floating rhizome and small overlapping bi-lobed leaves and roots. Rice growing areas in South East Asia and other third World countries have recently been evincing increased interest in the use of the symbiotic N2 fixing water fern *Azolla* either as an alternate nitrogen sources or as a supplement to commercial nitrogen fertilizers. *Azolla* is used as biofertilizer for wetland rice and it is known to contribute 40-60 kg N/ha per rice crop.

Phosphate solubilizing microorganisms (PSM): Several soil bacteria and fungi, notably species of *Pseudomonas, Bacillus, Penicillium, Aspergillus etc*. secrete organic acids and lower the pH in their vicinity to bring about dissolution of bound phosphates in soil. Increased yields of wheat and potato were demonstrated due to inoculation of peat based cultures of *Bacillus polymyxa* and *Pseudomonas striata*. Currently, phosphate solubilizers are manufactured by agricultural universities and some private enterprises and sold to farmers through governmental agencies. These appear to be no check on either the quality of the inoculants marketed in India or the establishment of the desired organisms in the rhizosphere.

AM fungi: The transfer of nutrients mainly phosphorus and also zinc and sulphur from the soil *milleu* to the cells of the root cortex is mediated by intracellular obligate fungal endosymbionts of the genera *Glomus, Gigaspora, Acaulospora, Sclerocysts* and *Endogone* which possess vesicles for storage of nutrients and arbuscles for funneling these nutrients into the root system. By far, the commonest genus appears to be *Glomus*, which has several species distributed in soil. Availability for pure cultures of AM (Arbuscular Mycorrhiza) fungi is an impediment in large scale production despite the fact that beneficial effects of AM fungal inoculation to plants have been repeatedly shown under experimental conditions in the laboratory especially in conjunction with other nitrogen fixers.

Conclusions: Biological fertilization techniques are pertinent strategies for an efficient and rational use of agricultural resources with minimal generation of adverse environmental impacts that may affect water resources, ecosystems or the quality of human life. In addition, biological fertilizers provide a wide range of possibilities for the development of conservative agriculture (CA) in different geographic, economic, and cultural backgrounds. Bio-fertilizers are cost-effective relative to chemical fertilizers. They have lower manufacturing costs, especially regarding nitrogen and phosphorus use.

- Current researches clearly show that biofertilization techniques require less chemical inputs on the soil and facilitate the incorporation of residues that would otherwise go to dumping sites and landfills, which represents relevant reductions on the environmental impacts associated to agriculture activities globally.
- Limitations of biological fertilization require future research focused on identifying the options available to tackle the issues and offer valid frameworks for development of environmentally friendly practices around the world that allows improvements on the efficiency and consequent supply of product for the industry in the global economies.
- Although several options for application of biofertilizers are available, feasibility studies should be carried out by producers and farmers to effectively select the best option that offers better results and allows minimizing environmental impacts.
- Biosolids, animal manures, green manures, composting, microbial inoculants and seaweeds extracts are techniques widely used in today's agriculture, however, their implementation still requires research, investment, and technological development to fully understand their impacts on the soil, flora, fauna and, ultimately, on human health.

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A Peer Reviewed & Refereed, International Open Access Journal
www.jabe.in **Vol.1.S1.2014,** **ISSN:2394-2606**

EFFECTS IN NITROGEN FERTILIZERS ON SOIL

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Abstract:A fertilizer is a material that furnishes one or more of the chemical elements necessary for the proper development and growth of plants. The most important fertilizers are fertilizer products. Manures and plant residues. A fertilizer product is a material produced by industrial processes with the specific purpose of being used as a fertilizer. Fertilizers are essential in today's agricultural system to replace the elements extracted from the soil in the form of food and other agricultural products.

Fertilizer: A material the main function of which is to provide plant nutrients.

Fertilizer grade: All fertilizer labels have three bold numbers the first number is the amount of nitrogen (N) the second number is the amount of phosphate (P_2O_5) and the third number is the amount of potash (K_2O). These three numbers represent the primary nutrient – N, P, and K

Soil nitrogen: Nitrogen is a component of amino acids, which make up proteins, chlorophyll, enzymes, and the genetic material, nucleic acids. Therefore, this nutrient is needed in large amounts by all plants. Plants that do not have adequate N are yellowish have yellowing and browning older leaves are stunted and have poor root systems, without additions of N. the nutrients are practically uniformly deficient for all grasses and cultivated crops.

Nitrogen uptake depends on the relatively small amount of available N forms in soil solution the soils ability to replenish the available forms and the growth conditions for the plant of course, any condition that inhibits plant growth such as other nutrient deficiencies, poor rooting conditions, poor weather, etc .will reduces N uptake.

Nitrate (NO_3^-) is the main form of N available to upland crops, where as ammonium (NH_4^+) is the main form taken up by plants growing under flooded conditions notably rice. Nitrate moves through soils with the soil water, since soils have little anion – absorbing capacity. Some fertilizers are containing nitrogen they are ammonium nitrate, ammonium sulphate, calcium nitrate, ammonium chloride, sodium nitrate, urea, ammonia, nitric acid.

Key words: fertilizer, fertilizer grade, soil nitrogen, ammonium nitrate, ammonium sulphate, calcium nitrate, ammonium chloride, sodium nitrate, urea, ammonia, nitric acid.

Introduction:A fertilizer is a material that furnishes one or more of the chemical elements necessary for the proper development and growth of plants. The most important fertilizers are fertilizer products, manures , and plant residues. A fertilizer product is a material produced by industrial processes with the specific purpose of being used as a fertilizer. Fertilizers are essential in today's agricultural system to replace the elements extracted from the soil in the form of food and other agricultural products.

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This label known as the fertilizer grade is a national standard. A bag of 10 – 10 – 10 fertilizer contains 10 percent nitrogen. 10 percent phosphate and 10 percent potash.

Soil nitrogen:Nitrogen is a component of amino acids, which make up proteins. Chlorophyll , enzymes and the genetic material. Nucleic acids . Therefore, this nutrient is needed in large amounts by all plants. Plants that do not have adequate nare yellowish have yellowing and browning older leaves are stunted and have poor root systems. Without additions of N. the nutrients are practically uniformly deficient for all grasses and cultivated crops.

The availability of N to plants is largely controlled by soil microbial processes. The N cycle in soils is

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complex and under certain conditions large amounts of plant available N can be lost from the soil in drainage water or to the atmosphere. In this way N is different from the other nutrients, which are not as readily lost from soils.

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While the denitrification process is lamented by agronomists as a loss of plant available N from the soil systems .it is the only way that N is recycled back to the atmosphere as N_2 . Without this process, lower soil layers and ground waters would become large reservoirs of NO_3^- and the oxygen enticed atmosphere would support continual conflagrations and thus make life difficult. Therefore the N cycle is just as important as the carbon and the hydrologic cycles to the life support system of the earth

Nitrogen of all plant nutrients, nitrogen is the most effective in economic terms but in ecological terms the most problematic. The plant absorbs nitrogen mainly as nitrate (NO_3^-) but partly as ammonium (NH_4^+). The plant's ability to assimilate larger molecules with organically bound nitrogen is limited. Some fertilizers are contains nitrogen they are ammonium nitrate, ammonium sulphate, calcium nitrate, ammonium chloride, sodium nitrate, urea, ammonia, nitric acid.

Nitric acid: Nitric acid (HNO_3) also known as aqua fortis and spirit of niter is a highly corrosive and toxic strong mineral acid which is normally colorless but tends to acquire a yellow cast due to the accumulation of oxides of nitrogen if long stored. Ordinary nitric acid has a concentration of 68% when the solution contains more than 86% HNO_3. It is referred to as fuming nitric acid. Depending on the amount of nitrogen dioxide present.

Pure anhydrous nitric acid is a colorless mobile leaned with a density of 1.512 g/cm^3 .which solidifies at -42^{o}c to form white crystals and boils at 83^{o}c. anhydrous nitric acid should be stored below o^o c to avoid decomposition.

Ammonium nitrate: Ammonium nitrate is in the first place a nitrogenous fertilizer. Representing more than 10% of the total nitrogen consumption worldwide. It is more readily available to crops than urea in the second place due to its powerful oxidizing properties is used with proper additives as commercial explosive.

Ammonium nitrate is a white crystalline substance with a nitrogen content of 35% and a density of about 1.725 kg/m^3. The melting points depend on the content of the water and it is practically impossible to obtain dry product in the industrial conditions.

1. It is quite hygroscopic
2. There is some risk of fire or even explosions unless suitable precaution is taken.
3. It is less effective for flooded rice than urea or ammonical nitrogen fertilizer.

Ammonium sulphate:Ammonium sulfate was once the leading form of nitrogen fertilizer. But it now supplies a relatively small percentage of the world total nitrogen fertilizer because of the rapid growth in use of urea. Ammonium nitrate the main advantages of ammonium sulfate are its low hygroscopicity goodphysical properties. Chemical stability and good agronomic effectiveness. It reaction in the soil is strongly acid forming.

Calcium nitrate: As a fertilizer, calcium nitrate has special advantages for use on saline soils because the calcium displaces the sodium that is absorbed by clay in soils. For the reason, it may be preferred for use in areas with soil salinity problems. In addition calcium nitrate has the advantage of being non acid forming. It imporves the physical properties of exhausted and acidifed soils and can be used as a topdressing.

Ammonium chloride: Ammonium chloride ride is used fertilization either .such or inavariety of compound. Ammonium chloride is used in other grades of compound fertilizers in combination with urea or ammonium sulfate . advantages of ammonium chloride are that it has a higher concentration than ammonium sulfate and a some what lower cost per unit N . it has some agronomic advantages for rice, nitrification is less rapid than with urea or ammonium sulfate and there fore N losses are lower and yields are higher.

Ammonium chloride is best known as a rice fertilizer. It has been successfully tested and used on other crops. Such as wheat, barley, sugar cane, maize, fiber crops and sorghum in a variety of climatic conditions.

Sodium nitrate: As a fertilizer, sodium nitrate has long been applied as a surface dressing for cotton, tobacco, and some vegetable crops. However, its use as a straight nitrogen fertilizer has declined considerably during the past century. As with other nitrate is prone to leaching in the soil. But it has the advantage of possessing a metallic cation .un like ammonia and its derivatives including urea.

Urea: Urea or carbamide is an organic compound with the chemical formula $CO(NH_2)_2$. Urea serves an important role in the metabolism of nitrogen – containing compounds by animals and is the main nitrogen-containing substances in the urine of mammals . it is solid colourless and odorless. It is highly soluble in water and practically non-toxic dissolved in water, it is neither acidic nor alkaline urea is widely used in fertilizers as a convenient sources of nitrogen urea is also an important raw material for the chemical industry.

More than 90% of world production of urea is destined for use a nitrogen-release fertilizer. Urea has the highest nitrogen content of all solid nitrogenous fertilizers in common use. There fore it has the lowest transportation cost per unit of nitrogen nutrient. The standard crop nutrient rating of urea is 46-0-0.

Ammonia: Ammonia or azane is a compound of nitrogen and hydrogen with the formula NH_3 .It is a colourless gas with a character istic pungent smell. Ammonia contributes significantly to the nutritional needs of terrestrial organisms by serving as a precursor to food and fertilizers. Organisms by serving as a precursor to food and fertilizers. Pharmaceutical and is used in many commercial cleaning products. Ammonia as used commercially is often called anhydrous ammonia. This term emphasizes the absence of water in the material because NH_3 boils at -33.34^{0}c at a pressure of 1 atmosphere. The liquid must be stored under high pressure or at low temp. house hold ammonia. Although in wide use ammonia is both caustic and hazardous in 2007 world wide production was estimated at 146.5 million tones. Approximately 86% of ammonia is used as fertilizers either as its salts or as solutions . when applied to soil. It helps provide increased yields of crops such as corn and wheat consuming more than 1% of all man – made power. The production of ammonia is a significant component of the world energy budget.

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PERSISTENT ORGANIC POLLUTANTS - IMPACT ON HUMAN HEALTH

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Abstract: Persistent organic pollutants (POPs) have been used in a wide range of agricultural and industrial commodities, resulting in vigorous deterioration of environment and human health. A number of studies on the occurrence of POPs confirm their presence in various environmental compartments and human body. Common beliefs point at India as a hot spot of POP contamination and human exposure; however no systematic analysis was ever performed so far considering all available past data on POP occurrence. In order to deal with this global concern, India has recently prepared the National Implementation Plan. Bearing in mind the serious and frequently irreversible adverse impact of POPs on human health and ecosystems and following the adage that "an ounce of prevention is worth a pound of cure," all measures conducive to limiting the production, emission and use of these chemical substances as much as possible are discussed.

Key words: Persistent organic pollutants, deterioration of environment and human health, risk assessment, measures for control.

Introduction

The last century can easily be called the era of chemicals. Unfortunately, not all of them were safe from an environment and human health standpoint. In 1995 the United Nations Environmental Program (UNEP) decided to eliminate 12 such chemicals called as "Persistent Organic Pollutants" owing to their similar toxicity in behavior. Persistent organic pollutants (POPs) are organic compounds that, to a varying degree, resist photolytic, biological and chemical degradation and tend to bio accumulate due to low water solubility and high lipid solubility[1]leading to global pollution as POPs are semi-volatile, including regions where they have never been used.[2]

This group of priority pollutants consists of pesticides (such as DDT), industrial chemicals (such as polychlorinated biphenyls, PCBs) and unintentional by-products of industrial processes (such as dioxins and furans) produced in processes such as the manufacture of paper and pulp, and the incineration of waste, particularly medical waste, containing plastics like polyvinyl chloride (PVC).

The greatest part of human exposure to the 12 specified POPs is attributed to the food chain. Contamination of food may occur through environmental pollution of the air, water and soil, or through the previous use or unauthorized use of organo chlorine pesticides on food crops.[3]

Humans can be exposed to POPs through diet, occupation, accidents and the environment, including the indoor environment. Exposure to POPs, either acute or chronic, can be associated with a wide range of adverse health effects, including illness and death.

Laboratory investigations and environmental impact studies in wildlife have provided evidence that persistent organic pollutants may be involved with endocrine disruption, reproductive and immune dysfunction, neurobehavioral and developmental disorders and cancer.[4]

Although POPs are stored primarily in body fat, it is important to note that they pass through the placenta and are excreted in breast milk, increasing exposure to these substances throughout the breast-feeding period. Levels of certain POPs in breast milk have been reported to approach or exceed tolerable recommended international levels. A study published in 2006 suggests that an increased level of POP.s in human blood serum can be linked to Diabetes .[5]

Effects on Reproduction: The adverse effects of dioxin-like compounds on the development of the

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reproductive system in both men and women have been widely documented.[6] For example, very limited development and even the failure to reach sexual maturity was demonstrated in fish, birds, and mammals exposed to these substances. A mere 1 ug of TCDD on the 15th day of gestation produces the de-masculinization of rats, including a reduction in the number of sperm cells and anomalies in sexual behavior after puberty.[7] Adverse effects on reproductive development have been reported in females as well, for example, malformations of the clitoris and the absence of a vaginal opening, suggesting that these malformations can be considered a result of estrogen effects.[8]

Effects in humans similar to those described for other mammals have been reported, and it is important to note out that *in utero* exposure can lead to delays in puberty, in the development of secondary sexual characters and in growth. This is even more the case after puberty, where we may see reduced fertility, abnormal menstrual cycles, and premature menopause. In males, changes were also detected in the quality of semen.[9]

Effects on nervous system development and behavior: The behavioral evaluation of children exposed to PCBs during gestation whose mothers had eaten contaminated fish from Lake Michigan showed reduced precision in intellectual processes.[10] The neurological changes most frequently recognized in adults exposed to these substances include sexual dysfunction (lack of libido and impotence), headache, neuropathies, alterations in vision and visual memory, the sense of taste and smell, and psychiatric effects such as changes in sleep, depression, loss of vitality, and anxiety.

Endocrine effects: Perinatal exposure to dioxin-like compounds may produce endocrine effects in the absence of signs of toxicity in the mother. Adverse effects include 1) deficiency in the development depends on male hormones and in neurological development, and 2) alterations in homeostasis of the thyroid function. These effects may be interrelated. Epidemiological studies indicate that exposure *in utero* or through breast-feeding may be associated with a reduction in neurological and physical development.[11]

Immunological Effects: Alterations in the immune response may result, in the case of immune supression, in an increase in infectious diseases and tumors, while an increase in the activation or reduction of suppression that normally exists may result in allergic reactions, hypersensitivity and autoimmune diseases.

Carcinogenic effects: The International Agency for Research on Cancer has classified PCBs as **probably carcinogenic to humans** - eight (8) others on the specified list are classified as **possibly carcinogenic to humans**.

While convincing substantive evidence exists for the actual and potential toxic impact of these substances to both human health and the environment, a comprehensive, accurate and reliable inventory of global manufacture, use and disposition must be developed to allow the effective and efficient elimination of these substances throughout the world.

National implementation plan: The main objective of the NIP is to enable India to comply with the obligations of the Stockholm Convention, to reduce, eliminate and prevent the health and environmental risks posed by POPs, thereby promoting human health, ecological and environmental safety and overall sustainable development. The Government of India has identified the following priorities for the implementation of the NIP:

- Environmentally Sound Management and Final Disposal of PCBs
- Environmentally Sound Management of Medical & hazardous wastes
- Development and promotion of non POPs alternatives to DDT
- Inventorization of newly listed POPs
- Implementation of the BAT/ BEP strategies for elimination / reduction of U POPs emissions Management of PVC plastic waste to avoid incineration / dumping the landfill for preventing releases of Dioxins and Furans due to burning.
- Capacity building, demonstration of production and promotion of bio-botanical

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Neem derived bio-pesticides as viable, eco-friendly, bio-degradable alternatives to POPs pesticides

- Identification and remediation of sites contaminated by POPs chemicals
- Monitoring of POPs in the core media- Air, Sediment and human milk and blood.
- Environmentally sound management of un-intentional release of PCDDs and PCDFs in the metallurgical Industry in India .
- Equal public and private and NGO stakeholders participation;
- Commitment to public awareness and education.

CONCLUSION: Humans encounter a broad range of exposure to a mixture of POP's which can have the potential for a significant impact on human health either in the short or long term. High (over) exposures of some POPs can lead to acute effects, including death, while at lower exposure levels long term effects can occur. Prevention or reduction of human exposure is best done via source-directed measures, i.e. strict control of industrial processes to reduce formation of POP's. Amongst the alternatives, use of biologically derived pesticides has been found to be effective, safe and eco-friendly. Also organic farming is looked upon as a sustainable alternative to chemical intensive farming. These could provide viable solutions to replace POP pesticides.

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www.jabe.in **Vol.1.S1.2014,** **ISSN:2394-2606**

ENVIRONMENTAL EFFECTS OF NITROGEN FERTILIZER USE — AN OVERVIEW

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- Equal public and private and NGO stakeholders participation;
- Commitment to public awareness and education.

Conclusion: Humans encounter a broad range of exposure to a mixture of POP's which can have the potential for a significant impact on human health either in the short or long term. High (over) exposures of some POPs can lead to acute effects, including death, while at lower exposure levels long term effects can occur. Prevention or reduction of human exposure is best done via source-directed measures, i.e. strict control of industrial processes to reduce formation of POP's. Amongst the alternatives, use of biologically derived pesticides has been found to be effective, safe and eco-friendly. Also organic farming is looked upon as a sustainable alternative to chemical intensive farming. These could provide viable solutions to replace POP pesticides.

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www.jabe.in Vol.1.S1.2014, ISSN:2394-2606

BIOFERTILIZERS - RELATED ISSUES IN INDIA

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Abstract: Biofertilizers are supposed to be a safe alternative to chemical fertilizers to minimize the ecological disturbance. Biofertilizers are cost effective, eco-friendly and when they are required in bulk can be generated at the farm itself. They increase crop yield upto 10-40% and fix nitrogen upto 40-50 Kg. The other plus point is that after using 3-4 years continuously there is no need of application of biofertilizers because parental inoculums are sufficient for growth and multiplication. They improve soil texture, pH, and other properties of soil. They produces plant growth promoting substances IAA amino acids, vitamins etc. They have 75% moisture and it could be applied to the field directly. Biofertilizers contained 3.5% - 4% nitrogen, 2% - 2.5% phosphorus and 1.5% potassium. In terms of N: P: K, it was found to be superior to farmyard manure and other type of manure.

Chemical fertilizers at the farm level have been ensured only through imports and subsidies. Dependence on chemical fertilizers for future agricultural growth would mean further loss in soil quality, possibilities of water contamination and unsustainable burden on the fiscal system. The Government of India has been trying to promote an improved practice involving use of bio-fertilizers along with fertilizers. These inputs have multiple beneficial impacts on the soil and can be relatively cheap and convenient for use. Consistent with current outlook, the government aims not only to encourage their use in agriculture but also to promote private initiative and commercial viability of production.

Bio-fertilizers such as Rhizobium, Azotobacter, Azospirilium and Blue green algae (BGA) have been in use a long time. Rhizobium inoculant is used for leguminous crops. Azotobacter can be used with crops like Wheat, Maize, Mustard, cotton, potato and other vegetable crops. Azospirilium inoculations are recommended mainly for sorghum, millets, maize, sugarcane and wheat. Blue green algae belonging to a general cyanobacteria genus, Nostac or Anabina or Tolypothrix or Aulosira, fix atmospheric nitrogen and are used as inoculations for paddy crop grown both under upland and low-land conditions. Anabina in association with water fern Azolla contributes nitrogen up to 60 kg/ha/season and also enriches soils with organic matter

A Bio fertlizer (also bio-fertilizer) is a substance which contains living microorganisms which, when applied to seed, plant surfaces, or soil, colonizes the rhizospere or the interior of the plant and promotes growth by increasing the supply or availability of primary nutrients to the host plant. Bio-fertilizers add nutrients through the natural processes of nitrogen fixation, solubilizing phosphorus, and stimulating plant growth through the synthesis of growth-promoting substances. Bio-fertilizers can be expected to reduce the use of chemical fertilizers and pesticides. The microorganisms in bio-fertilizers restore the soil's natural nutrient cycle and build soil organic matter.

Plants have a number of relationships with fungi, bacteria, and algae, the most common of which are with mycorrhiza, rhizobium, and cyanophyceae. These are known to deliver a number of benefits including plant nutrition, disease resistance, and tolerance to adverse soil and climatic conditions. These techniques have proved to be successful biofertilizers that form a health relationship with the roots.

Different types of biofertilizers

Rhizobium: Rhizobium is a soil habitat bacterium, which can able to colonize the legume roots and fixes the atmospheric nitrogen symbiotically. The morphology and physiology of Rhizobium will vary from free-living condition to the bacteroid of nodules. They are the most efficient biofertilizer as per the quantity of nitrogen fixed concerned. They have seven genera and highly specific to form nodule in legumes, referred as cross inoculation group. Rhizobium inoculant was first made in USA and commercialized by private enterprise in 1930s and the strange situation at that time has been chronicled by Fred (1932). Initially, due to absence of efficient bradyrhizobial strains in soil, soybean inoculation at that time resulted in bumper crops but incessant inoculation during the last four decades by US farmers has resulted in the build up of a plethora of inefficient strains in soil whose replacement by efficient strains of bradyrhizobia has become an insurmountable problem.

Azotobacter: Of the several species of Azotobacter, A. chroococcum happens to be the dominant inhabitant in arable soils capable of fixing N2 (2-15 mg N2 fixed /g of carbon source) in culture media.The bacterium produces abundant slime which helps in soil aggregation. The numbers of A. chroococcum in Indian soils rarely exceeds 105/g soil due to lack of organic matter and the presence of antagonistic microorganisms in soil.

Azospirillum: Azospirillum lipoferum and A. brasilense (Spirillum lipoferum in earlier literature) are primary inhabitants of soil, the rhizosphere and intercellular spaces of root cortex of graminaceous plants. They perform the associative symbiotic relation with the graminaceous plants. The bacteria of Genus Azospirillum are N2 fixing organisms isolated from the root and above ground parts of a variety of crop plants. They are Gram negative, Vibrio or Spirillum having abundant accumulation of polybetahydroxybutyrate (70 %) in cytoplasm. Five species of Azospirillum have been described to date A. brasilense, A.lipoferum, A.amazonense, A.halopraeferens and A.irakense. The organism proliferates under both anaerobic and aerobic conditions but it is preferentially micro-aerophilic in the presence or absence of combined nitrogen in the medium.Apart from nitrogen fixation, growth promoting substance production (IAA), disease resistance and drought tolerance are some of the additional benefits due to Azospirillum inoculation.

Cyanobacteria: Both free-living as well as symbiotic cyanobacteria (blue green algae) have been harnessed in rice cultivation in India. A composite culture of BGA having heterocystous Nostoc, Anabaena, Aulosira etc. is given as primary inoculum in trays, polythene lined pots and later mass multiplied in the field for application as soil based flakes to the rice growing field at the rate of 10 kg/ha. The final product is not free from extraneous contaminants and not very often monitored for checking the presence of desiredalgal flora.

Once so much publicized as a biofertilizer for the rice crop, it has not presently attracted the attention of rice growers all over India except pockets in the Southern States, notably Tamil Nadu. The benefits due to algalization could be to the extent of 20-30 kg N/ha under ideal conditions but the labour oriented methodology for the preparation of BGA biofertilizer is in itself a limitation. Quality control measures are not usually followed except perhaps for random checking for the presence of desired species qualitatively.

Azolla: Azolla is a free-floating water fern that floats in water and fixes atmospheric nitrogen in association with nitrogen fixing blue green alga Anabaena azollae. Azolla fronds consist of sporophyte with a floating rhizome and small overlapping bi-lobed leaves and roots. Rice growing areas in South East Asia and other third World countries have recently been evincing increased interest in the use of the symbiotic N2 fixing water fern Azolla either as an alternate nitrogen sources or as a supplement to commercial nitrogen fertilizers. Azolla is used as biofertilizer for wetland rice and it is known to contribute 40-60 kg N/ha per rice crop.

Phosphate solubilizing microorganisms(PSM)

Several soil bacteria and fungi, notably species of Pseudomonas, Bacillus, Penicillium, Aspergillus etc. secrete organic acids and lower the pH in their vicinity to bring about dissolution of bound phosphates in soil. Increased yields of wheat and potato were demonstrated due to inoculation of peat based cultures of Bacillus polymyxa and Pseudomonas striata. Currently, phosphate solubilizers are manufactured by agricultural universities and some private enterprises and sold to farmers through governmental agencies. These appear to be no check on either the quality of the inoculants marketed in India or the establishment of the desired organisms in the rhizosphere.

AM fungi: The transfer of nutrients mainly phosphorus and also zinc and sulphur from the soil milleu to the cells of the root cortex is mediated by intracellular obligate fungal endosymbionts of the genera Glomus, Gigaspora, Acaulospora, Sclerocysts and Endogone which possess vesicles for storage of nutrients and arbuscles for funneling these nutrients into the root system. By far, the commonest genus appears to be Glomus, which has several species distributed in soil.Availability for pure cultures of AM (Arbuscular Mycorrhiza) fungi is an impediment in large scale production despite the fact that beneficial effects of AM fungal inoculation to plants have been repeatedly shown under experimental conditions in the laboratory especially in conjunction with other nitrogen fixers.

Do’s and Don’t for Entrepreneurs, Dealers and farmers:

Do

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www.jabe.in Vol.1.S1.2014, ISSN:2394-2606

- Keep Bio-fertilizers bottles away from direct heat and sunlight. Store it in cool and dry place
- Sell only Bio-fertilizers bottles which contain batch number, the name of the crop on which it has to be used, the date of manufacture and expiry period
- If the expiry period is over, then discard it as it is not effective.
- Keep Bio-fertilizers bottles away from fertilizer or pesticide containers and they should not be mixed directly

Don't

- Don't store Bio-fertilizers bottles under heat and sunlight
- Don't sell Bio-fertilizers bottles after their expiry period is over.
- Don't prick holes into the bottles or puncture them to pour the content
- Do not mix the Bio-fertilizers with fungicides, insecticides, herbicides, herbicides and chemical fertilizers.

Constraints in Biofertilizer Technology

Though the biofertilizer technology is a low cost, ecofriendly technology, several constraints limit the application or implementation of the technology the constraints may be environmental, technological, infrastructural, financial, human resources, unawareness, quality, marketing, etc. The different constraints in one way or other affecting the technique at production, or marketing or usage.

Technological constraints

- Use of improper, less efficient strains for production.
- Lack of qualified technical personnel in production units.
- Unavailability of good quality carrier material or use of different carrier materials by different producers without knowing the quality of the materials.
- Production of poor quality inoculants without understanding the basic microbiological techniques
- Short shelf life of inoculants.

Infrastructural constraints

- Non-availability of suitable facilities for production
- Lack of essential equipments, power supply, etc.
- Space availability for laboratory, production, storage, etc.
- Lack of facility for cold storage of inoculant packets

Financial constraints

- Non-availability of sufficient funds and problems in getting bank loans
- Less return by sale of products in smaller production units.

Environmental constraints

- Seasonal demand for biofertilizers
- Simultaneous cropping operations and short span of sowing/planting in a particular locality
- Soil characteristics like salinity, acidity, drought, water logging, etc.

Human resources and quality constraints

- Lack of technically qualified staff in the production units.
- Lack of suitable training on the production techniques.
- Ignorance on the quality of the product by the manufacturer
- Non-availability of quality specifications and quick quality control methods
- No regulation or act on the quality of the products
- Awareness on the technology
- Unawareness on the benefits of the technology
- Problem in the adoption of the technology by the farmers due to different methods of inoculation.
- No visual difference in the crop growth immediately as that of inorganic fertilizers.

Awareness on the technology

- Unawareness on the benefits of the technology.
- Problem in the adoption of the technology by the farmers due to different methods of inoculation.
- No visual difference in the crop growth immediately as that of inorganic fertilizers.
- Unawareness on the damages caused on the ecosystem by continuous application of inorganic fertilizer.

Marketing constraints

- Non availability of right inoculant at the right place in right time.
- Lack of retain outlets or the market network for the producers.

Due to "chemical pesticide" problems in India, there is an urgent need to Promote environmental friendly 'Biopesticides' in the country. Moreover, recent Government policies also favour "Biopesticides and Biofertilizer. More over "Biofertilizers" also stimulate plant -growth through Production of "Plant growth promoting substances3". Application of Biofertilizers and biopesticides has thus become an integral component of nutrient management system. Apart from these, they play a vital role in increasing the agricultural production, a need of the day4-7-13 International 3rd Eco Expo Asia, October, conference and trade fair has already given emphasis on "Green Technologies". Govts. of Environmental Bureau decided to minimize - a low carbon environment and introduction of Bio-Organic Fertilizers including other policies in 2011.13 Finally, it can be concluded that our newly constructed " B.t. Based biopesticides" and the " Liquid USHA - PUCHI" Biofertilizer which seem to be very much efficient against the Paddy pest in the experimental paddy fields (plots) is really in the final trial stage. Inspite of that it needs an " Indepth" study and application before their marketing and commercialization, after fulfillment of all these requirements :- including patent, registration etc. Only then we now can say, "yes, these biopesticide and biofertilizer are definitely the substitute of chemical pesticide/fertilizer - atleast for paddy (rice) cultivation in India especially for Rice eaten states including West Bengal.

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A Peer Reviewed & Refereed, International Open Access Journal
www.jabe.in **Vol.1.S1.2014,** **ISSN:2394-2606**

EUTROPHICATION

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ABSTRACT:

Eutrophication is a process by which water bodies acquire a high concentration of nutrients that stimulate excessive plant growth. Eutrophication results from continuous enrichment of water bodies by nutrients especially nitrogen and phosphorus.These nutrients are generally low in acqatic environment there by, limiting the growth of algae and other plants.But with an increased amount of in flow of these nutrients more plants are able to grow,disrupting the natural environment.Now a days Eutrophication has become a world wide environmental issue.

Eutrophication occurs naturally or influenced by human activities that include excess use of fertilizers and chemicals in agriculture,aquaculture and sewage effluent creating inflow of high amount of phos phorus and nitrogen nutrients in to water bodies of ponds ,lakes,rivers ,seas and oceans. Eutrophication mainly leads to excess growth of algal populations the, algal blooms and many other macro algae, phyto planktons and cyano bacteria, of which, some also change the water colour, release toxins in to water, deplete oxygen making it hazardous . The major consequence of Eutrophication is the depletion of oxygen in water,causing BOD due to explosive growth and severe bio mass accumula-tion which consumes all the available oxygen leading to death and disappearance of aquatic life.

So, reducing eutrophicants, especially fertilizers should be a key concern and sustainable solution for maintaining the balance of the ecosystem and protection of the environment.

INTRODUCTION

Eutrophication is a process by which water bodies acquire a high concentration of nutrients that stimulate excessive plant growth. Eutrophication results from continuous enrichment of water bodies by nutrients especially nitrogen and phosphorus. These nutrients are generally low in acquatic environment there by, limiting the growth of algae and other plants. But with an increased amount of inflow of these nutrients more plants are able to grow, disrupting the natural environment. Excess growth of algal populations the, algal blooms and many other macro algae, phytoplanktons and cyanobacteria pollute the water by depleting the oxygen concentration and releasing toxins. Now a days Eutrophication is recognized as a water pollution and has become a worldwide environmental issue . Based on the nutrient values and trophic state index water bodies have been classified in to four trophic states

TROPHIC STATE	BIOLOGICAL ASPECTS	Water quality	CHLOROPHYLL& PHOSPHORUS	Sechhi depth	Trophic index
Oligotrophic	Low nutrient content, low primary productivity, low algal production, support many fish species	Clear, transparent, well oxygenated, high drinking water quality	0-2.6mcg/lit chlorophyll 0-12mcg/lit phosphorus	4->8m	<30-40
Mesotrophic	Intermediate level of productivity, medium level of nutrients, submerged aquatic plants	Clear, Filtered water can be used for drinking	2.6-20mcg/lit chlorophyll 12-24mcg/lit phosphorus	2-4m	40-50
Eutrophic	High productivity, excessive nutrients, abundance of algae and aquatic plants	Dark & turbid , depleted oxygen levels, not suitable for drinking	20-56mcg/lit chlorophyll 24-96mcg/lit phosphorus	0.5-2m	50-70

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Hypereutrophic	Excessive algal blooms	Highly turbid, toxic	56>155mcg/lit Chlorophyll >100mcg/lit phosphorus	<0.25-0.5m	70->100

Mechanism of eutrophication:

Eutrophication is the process of convertion from oligotrophic to eutrophic level due to high productivity and bio mass accumulation.It occurs naturally or influenced by human activities that include excess use of fertilizers and chemicals in agriculture,aquaculture and sewage effluent creating inflow of high amount of phosphorus and nitrogen nutrients in to water bodies . Nitrogen and phosphorus are two main nutrients for aquatic life. Phosphorus is generally limiting factor for phytoplankton in fresh waters. For large marine areas frequently have nitrogen as the limiting nutrient. Water is so enriched with nitrogen and other nutrients, that it feeds massive blooms of algae near the surface. When the algae die, sink to the bottom and are decomposed, the decomposers use tremendous quantities of oxygen, depleting its concentration in the water thereby, resulting in BOD(biological oxygen demand). This zone is devoid of bottom-dwelling fish and crustaceans, which can't compete with the decomposers for oxygen.. The hypoxic (< 2 ppm dissolved O2) and the anoxic (zero dissolved oxygen or anaerobic) conditions ensue, promoting growth of bacteria such as Clostridium botulinum that produces toxins deadly to birds and mammals favouring dead zones to occur. Eventually, the entire aquatic ecosystem changes with eutrophication.

Sources of eutrophication: There are three main sources of anthropic nutrient input, **runoff, erosion and leaching from fertilized agricultural areas,** and sewage from cities and industrial wastewater. The main source of nitrogen and phosphorus pollutants leading to eutrophication is run-off from agricultural lands.

Impacts of fertilizers on eutrophication: Modern agriculture often involves the application of nutrients onto fields in order to maximise production. However, farmers frequently apply more nutrients than that are taken up by crops. Usage of nitrogen and phosphorus fertilizers in agricultural practices, saturation of soils with phosphorus can be noted in some areas where spreading of excessive manure from animal husbandry occurs. India's fertilizer consumption is consistently increasing. The intensity of fertilizer use varied greatly from about 55 kg per hectare in Rajasthan to as high as 254 kg per hectare in Andhra Pradesh.

Indian imports, which were about 2 million tons in early part of 2000, increased to 11.69 million tons of fertilizer in 2010-11.

Growth in fertilizer consumption in India:

Year	**Fertilizer (NPK) consumption**	
	(million tonnes)	**(kg/ha)**
1969/70	1.98	11.04
1979/80	5.26	30.99
1989/90	11.57	63.47
1999/2000	18.07	94.90
Source : Fertilizers association of India		

Nitrogen fertilizers generally applied in the form of urea, DAP, Ammonium sulphate, readily hydrolised to NH_4 ion and other nitrate fertilizers comprising NO3, NO2 are highly water soluble, and so move readily with surface runoff into rivers or with water percolating through the soil profile into the groundwater below. Only about 40 - 60% of nitrogen applied as fertilizers is actually used by plants, and the remaining is left behind as residue or in soils, where it either accumulates, erodes with soil to surface waters, leaches to groundwater, or volatilizes into the atmosphere. Maize, rice and wheat are the most heavily fertilized crops, where the leaching of nitrogen is especially noticeable.

Phosphates are also applied abundantly in fertilizer, and contaminate water. Unlike nitrate, however, phosphate is not water soluble, it adheres to soil particles and erodes on soils from agricultural fields, and it is essentially nonrecoverable, washing into sediments in oceans. Phosphorus inputs

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www.jabe.in **Vol.1.S1.2014,** **ISSN:2394-2606**

accumulating in the soils largely from fertilizers, animal feeds, are greater than removals in harvested crops and meat). The result of this imbalance between input and output is that the net Phosphorus storage in soil and fresh water ecosystems of the world is estimated to be about 75% higher. A large portion of this Phosphorus accumulation is in agricultural soils, as might be expected. A major problem associated with this increased Phosphorus content of soils is that any factors that increase soil erosion will also increase runoff of Phosphorus with soil to streams, rivers, lakes and coastal regions resulting in eutrophication.

The runoff of nitrate and phosphate into lakes and streams fertilizes them, and causes accelerated eutrophication which shows undesirable consequences as listed below-

1. Changes in algal population: During eutrophication water is so enriched with nitrogen ,phosphorus and other nutrients, it feeds massive blooms of algae near the surface. Macroalgae, phytoplankton (diatoms, dinoflagellates , chlorophytes) and cyanobacteria experience excessive growth and some of these organisms release toxins in to the water making it unpalatable .Coloured toxic tides caused by algal overgrowth have been known to exist for many centuries.

2. Penetration of light into the water is diminished due to formation of algal mats. The water becomes depleted in oxygen. When the abundant algae die and decompose, much oxygen is consumed by those decomposers.. all the available oxygen even the oxygen contained in sulphates (SO42-) will be used up.

3. Changes in zooplankton, fish and shellfish population: Lowered oxygen results in the death of fish that need high levels of dissolved oxygen The community composition of the water body changes and such changes in fish communities changes the rest of the aquatic ecosystem due to changes in food web

4. Being, sensitive to oxygen availability, these species may die from oxygen limitation(BOD) or from changes in the chemical composition of the water . There by valuable coastal fisheries are imperiled and dead zones occur. The number of "dead zones" has been increasing exponentially threatening the coastal fisheries

5. Ammonia toxicity in fish is much higher in alkaline waters where Eutrophication occurs due to fertilizers .

6. The effects of eutrophication on the environment may, have deleterious consequences for the health of exposed animal and human populations, through various pathways. Specific health risks appear when fresh water, extracted from eutrophic areas, is used for the production of drinking water. Severe impacts can also occur during animal watering in eutrophic waters. The first scientific report of domestic animals dying from poisoning as a consequence of drinking water that was affected by a blue/green algae bloom was in 1878 in lake Alexandrina, Australia.

7. Much of the concern about fertilizers and water quality relates to nitrates, which can cause health problems in humans .When ingested, nitrates are converted into nitrite in the intestine, which then combines with hemoglobin to form met-hemoglobin. Met-hemoglobin has a reduced oxygen-carrying capacity, and is particularly problematic in children, who are most readily affected by this "nitrite poisoning" or "blue baby syndrome."

Measures for reducing fertilizer induced eutrophication: All of these fertilizer-related problems can be minimized by more careful and efficient application of fertilizer and by soil conservation strategies which decrease erosion.

1. The best way to avoid eutrophication is to reduce the input of nutrients into the water basins. For this, Regular soil nutrients analysis, fertilization plans at plot. adequation of nutrients supply to the needs of the crop with reasonable expected yields, taking into account soil and atmospheric N supply.

2.Agronomic balance (ratio of fertilizer contribution to plant use) optimize the loss of nutrients and also more efficient and well-timed application of fertilizers is important as a part of the control strategy.

3. Vegetation buffers should be enhanced along the streams and rivers to slow erosion and also take up some of the excess nutrients themselves.

4. Wetland restoration and enhancement programs are also likely to be important, as wetlands are an important site of denitrification, the process by which bacteria reduce nitrates (NO3) to molecular N2 orN2O_

5 Nutrient sources can be controlled by soil conservation techniques and fertilizer restrictions besides, Precise irrigation management (e.g. drip irrigation, fertilisation, soil moisture control) , Knowledge of the hydrodynamics of the water and use of specific denitrification or phosphorus removal treatments.

CONCLUSION

Identification of all nutrient sources, areas of water supply, particularly agricultural practices (fertilizer contribution/plant use and localization of crops) is necessary in order to plan and implement actions for limiting nutrient enrichment of water bodies. Thus, effective planning and management of lakes and reservoirs depends not only on a sound understanding of these water-bodies as ecological systems but also of their value to people as recreational areas and water So, reducing eutrophicants especially fertilizers should be a key concern and sustainable solution for maintaining the balance of the ecosystem and protection of the environment.

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SOIL ACIDIFICATION [CAUSES, EFFECTS, CONTROLLING FACTORS]

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Abstract: Soil acidification is a process where the soil pH decreases over time. This process is accelerated by agricultural production and can affect both surface soil and sub-soil. Soil pH decreases because of proton donor which can be acid such as sulphuric acid and nitric acid.

Soil acidification is the buildup of hydrogen cations also called reducing the soil pH when proton donor is added to the soil. The donor can an acid such as nitric acid and sulphuric acid. Many compounds Aluminumsulphate and nitrogen in the form of fertilizer also acidify soil by the process of nitrification.

Application of high levels of ammonium based nitrogen fertilizers.Leaching of nitrogen nitrate from ammonium based fertilizers.Harvesting plant materials.Plant leaves on soil produce organic acids like Humic acid, Oxalic acid, acetic acid.Weathering of igneous and sedimentary rocks like granite shale and coal which are rich in sulphides produce sulphuric acid.Pollution by nitrogen emission also increases soil acidification. Soil pH increases by acidifying like Aluminum sulphate, ammonium sulphateand phosphate, ammonia, urea, alum are some Contributing factors.

Soil acidification leads to decline in crop and pasture production because of pH of soil changes the availability of soil nutrients. Helpful micro-organisms can be prevented. Phosphorus may be less available. Deficiency of Calcium, Magnesiumand Molybdenum occurs. Less availability of sub soil moisture.Aluminum, Magnesium which are toxic released from soil. Heavy metal contaminant cadmium may increase.

Soil acidity can be treated at an early stage

- The use of less acidifying farming particles.
- Application of agricultural lime.

INTRODUCTION

Acidic soils create production problems by limiting the availability of some essential plant nutrients and increasing that of the soil solution's toxic elements, such as aluminum and manganese, the major cause of poor crop performance and failure in acidic soils. Below soil pH 5.5 (pH is the measurement of soil acidity–the lower the pH, the higher the soil acidity), aluminum may be concentrated enough to limit or stop root development. As a result, plants cannot absorb water and nutrients, are stunted, and exhibit nutrient deficiency symptoms (especially those for phosphorus). Toxic levels of manganese interfere with normal growth processes in the aerial plant parts, which stunts the plant, discolors it, and causes poor yields.

Soil acidification is mainly caused by the release of protons (H^+) during the oxidation of carbon (C), sulphur (S) and nitrogen (N) compounds in soils. In this review the processes of H^+ ions release during N cycling and its effect on soil acidification are examined. The major processes leading to acidification during N cycling in soils are: (i) the imbalance of cation over anion uptake in the rhizosphere of plants either actively fixing N_2 gas or taking up NH_4^+ ions as the major source of N, (ii) the net nitrification of N derived from fixation or from NH_4^+ and R-NH_2 based fertilizers, and (iii) the removal of plant and animal products containing N derived from the process described in (i) and losses of NO_3-N by leaching when the N input form is N_2, NH_4^+ or R-NH_2. The uptake of excess cations over anions by plants results in the acidification of the rhizosphere which is a “localized” effect and can be balanced by the release of hydroxyl (OH^-) ions during subsequent plant decomposition. Nitrification of fixed N_2 or NH_4^+ and R-NH_2 based fertilizers, and loss of N from the soil either by removal of products or by leaching of NO_3-N with a companion basic cation, lead to ‘permanent’ acidification.

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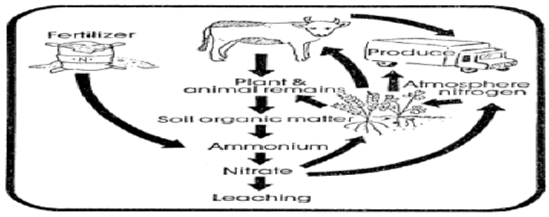

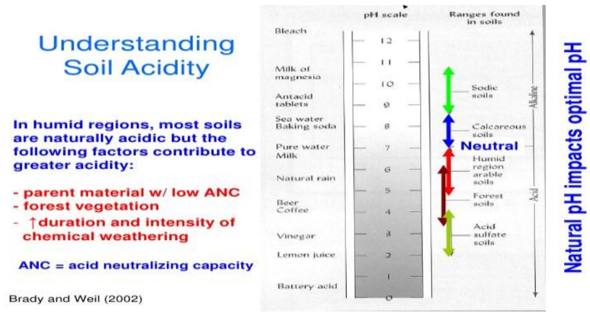

Methods

Determining pH: ***Methods of determining pH include:***

- Observation of soil profile: Certain profile characteristics can be indicators of either acid, saline, or sodic conditions. Strongly acidic soils often have poor incorporation of the organic surface layer with the underlying mineral layer. The mineral horizons are distinctively layered in many cases, with a pale eluvial (E) horizon beneath the organic surface; this E is underlain by a darker B horizon in a classic podzol horizon sequence. This is a very rough gauge of acidity as there is no correlation between thickness of the E and soil pH. E horizons a few feet thick in Florida usually have pH just above 5 (merely "strongly acid") while E horizons a few inches thick in New England are "extremely acid" with pH readings of 4.5 or below. In the southern Blue Ridge Mountains there are "ultra-acid" soils, pH below 3.5, which have no E horizon. Presence of a caliche layer indicates the presence of calcium carbonates, which are present in alkaline conditions. Also, columnar structure can be an indicator of sodic condition.
- Observation of predominant flora. Calcifuge plants (those that prefer an acidic soil) include *Erica*, *Rhododendron* and nearly all other Ericaceae species, many birch (*Betula*), foxglove (*Digitalis*), gorse (*Ulex* spp.), and Scots Pine (*Pinus sylvestris*). Calcicole (lime loving) plants include ash trees (*Fraxinus* spp.), honeysuckle (*Lonicera*), *Buddleja*, dogwoods (*Cornus* spp.), lilac (*Syringa*) and *Clematis* species.
- Use of an inexpensive pH testing kit, where in a small sample of soil is mixed with indicator solution which changes colour according to the acidity/alkalinity.
- Use of litmus paper. A small sample of soil is mixed with distilled water, into which a strip of litmus paper is inserted. If the soil is acidic the paper turns red, if alkaline, blue.
- Use of a commercially available electronic pH meter, in which a rod is inserted into moistened soil and measures the concentration of hydrogen ions.

Sources: Acidity in soils comes from H^+ and Al^{3+} ions in the soil solution and sorbed to soil surfaces. While pH is the measure of H^+ in solution, Al^{3+} is important in acid soils because between pH 4 and 6, Al^{3+} reacts with water (H_2O) forming $AlOH^{2+}$, and $Al(OH)_2^+$, releasing extra H^+ ions. Every Al^{3+} ion can create 3 H^+ ions. Many other processes contribute to the formation of acid soils including rainfall, fertilizer use, plant root activity and the weathering of primary and secondary soil minerals. Acid soils can also be caused by pollutants such as acid rain and mine spoilings.

- Rainfall: Acid soils are most often found in areas of high rainfall. Excess rainfall leaches base cation from the soil, increasing the percentage of Al^{3+} and H^+ relative to other cations. Additionally, rainwater has a slightly acidic pH of 5.7 due to a reaction with CO_2 in the atmosphere that forms carbonic acid.
- Fertilizer use: Ammonium (NH_4^+) fertilizers react in the soil in a process called nitrification to form nitrate (NO_3^-), and in the process release H^+ ions.
- Plant root activity: Plants take up nutrients in the form of ions (NO_3^-, NH_4^+, Ca^{2+}, $H_2PO_4^-$, etc.), and often, they take up more cations than anions. However plants must maintain a neutral charge in their roots. In order to compensate for the extra positive charge, they will release H^+ ions from the root. Some plants will also exude organic acids into the soil to acidify the zone around their roots to help solubilize metal

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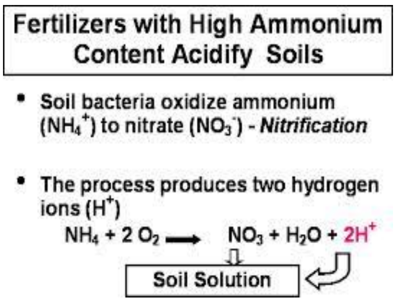
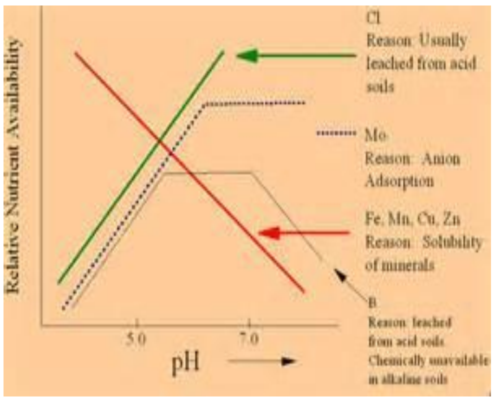
nutrients that are insoluble at neutral pH, such as iron (Fe).

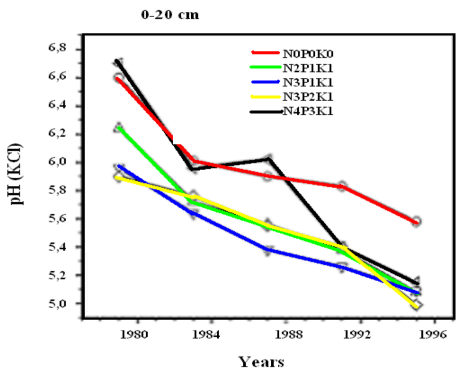
- Weathering of minerals: Both primary and secondary minerals that compose soil contain Al. As these minerals weather, some components such as Mg, Ca, and K, are taken up by plants, others such as Si are leached from the soil, but due to chemical properties, Fe and Al remain in the soil profile. Highly weathered soils are often characterized by having high concentrations of Fe and Al oxides.
- Acid Rain: When atmospheric water reacts with sulfur and nitrogen compounds that result from industrial processes, the result can be the formation of sulfuric and nitric acid in rainwater. However the amount of acidity that is deposited in rainwater is much less, on average, than that created through agricultural activities.
- Mine Spoil: Severely acidic conditions can form in soils near mine spoils due to the oxidation of pyrite.
- Potential acid sulfate soils naturally formed in waterlogged coastal and estuarine environments can become highly acidic when drained or excavated.
- Decomposition of organic matter by micro-organisms releases CO_2 which when mixed with soil water can form carbonic acid (H_2CO_3)



Causes: There are four major reasons for soils to become acidic: rainfall and leaching, acidic parent material, organic matter decay, and harvest of high-yielding crops. Wet climates have a greater potential for acidic soils. In time, excessive rainfall leaches the soil profile's basic elements (calcium, magnesium, sodium, and potassium) that prevent soil acidity. Soils that develop from weathered granite are likely to be more acidic than those developed from shale or limestone. Organic matter decay produces hydrogen ions (H^+), which are responsible for acidity (an ion is a positively or negatively charged element). Like that from rainfall, acidic soil development from decaying organic matter is insignificant in the short term. Harvest of high-yielding crops plays the most significant role in increasing soil acidity. During growth, crops absorb basic elements such as calcium, magnesium, and potassium to satisfy their nutritional requirements. As crop yields increase, more of these lime like nutrients are removed from the field. Compared to the leaf and stem portions of the plant, grain contains minute amounts of these basic nutrients. Therefore, harvesting high-yielding forages such as Bermuda grass and alfalfa affects soil acidity more than harvesting grain does.

Nitrogen fertilizer has been blamed for the increase in soil acidity problems throughout the region. Yes, when ammoniacal fertilizer materials are applied to the soil, acidity is produced, but the form of nitrogen removed by the crop is similar to that found in fertilizer. In reality, nitrogen fertilizer increases soil acidity by increasing crop yields, thereby increasing the amount of basic elements being removed.





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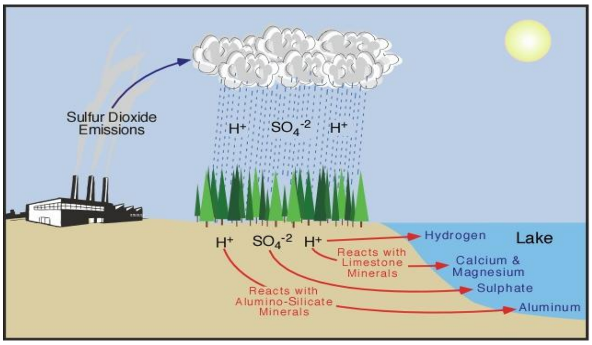
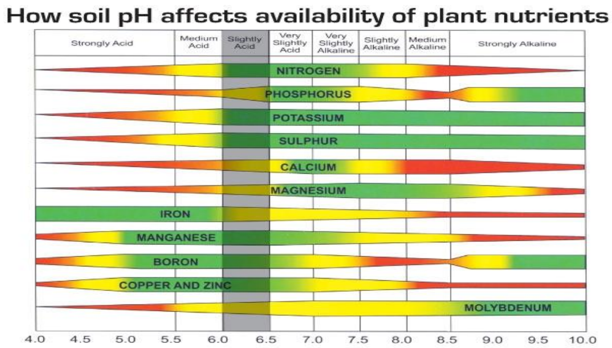
Effects: Plants grown in acid soils can experience a variety of symptoms including aluminium (Al), hydrogen (H), and/or manganese (Mn) toxicity, as well as nutrient deficiencies of calcium (Ca) and magnesium (Mg). Aluminium toxicity is the most widespread problem in acid soils. Aluminium is present in all soils, but dissolved Al^{3+} is toxic to plant; Al^{3+} is most soluble at low pH, above pH 5.2 little Al is in soluble form in most soils Aluminium is not a plant nutrient, and as such, is not actively taken up by the plants, but enters plant roots passively through osmosis. Aluminium inhibits root growth; lateral roots and root tips become thickened and roots lack fine branching; root tips may turn brown. In the root, Al has been shown to interfere with many physiological processes including the uptake and transport of calcium and other essential nutrients, cell division, cell wall formation, and enzyme activity. Below pH 4, H^+ ions themselves damage root cell membranes. In soils with high content of manganese-containing minerals, Mn toxicity can become a problem at pH 5.6 and lower. Manganese, like aluminium, becomes increasingly soluble as pH drops, and Mn toxicity symptoms can be seen at pH levels below 5.6. Manganese is an essential plant nutrient, so plants transport Mn into leaves. Classic symptoms of Mn toxicity are crinkling or cupping of leaves





Management of acidic soils: Soil testing

Knowledge of how soil pH profiles and acidification rates vary across the farm will assist effective soil acidity management. Ideally, soil samples should be taken when soils are dry and have minimal biological activity. It is standard to measure pH using one part soil to five parts 0.01 M $CaCl_2$. Soils with low total salts show large seasonal variation in pH if it is measured in water. pH measured in water can read 0.6 – 1.2 pH units higher than in calcium chloride (Moore *et al.*, 1998). Soil sampling should take paddock variability into consideration. For example, clays have greater capacity to resist pH change (buffering) than loams, which are better buffered than sands. Samples should be taken at the surface and in the subsurface to determine a soil pH profile. This will detect subsurface acidity, which may underlie topsoils with an optimal pH. Samples need to be properly located (e.g. GPS) to allow monitoring. Sampling should be repeated every 3 – 4 years to detect changes and allow adjustment of management practices.

Interpreting pH results: Depending on soil pH test results, agricultural lime may need to be applied to maintain pH, or to recover pH to an appropriate level. If the topsoil pH is above 5.5 and the subsurface pH above 4.8, only maintenance levels of liming will be required to counter on-going acidification caused by productive agriculture. If the topsoil pH is below 5.5, recovery liming is recommended. Keeping the topsoil above 5.5 will treat the on-going acidification due to farming and ensure sufficient alkalinity can move down and treat subsurface acidity. Liming is necessary if the subsurface pH is below 4.8, whether or not the topsoil is acidic. If the 10 – 20 cm layer is below 4.8 but the 20 – 30 cm layer above 4.8, liming is still

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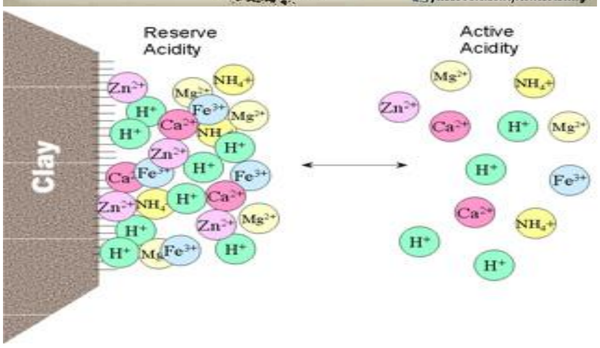
required. In this case the band of acidic soil will restrict root access to the more suitable soil below.

Liming: Liming is the most economical method of ameliorating soil acidity. The amount of lime required will depend on the soil pH profile, lime quality, soil type, farming system and rainfall. Limesand, from coastal dunes, crushed limestone and dolomitic limestone are the main sources of agricultural lime. Carbonate from calcium carbonate and magnesium carbonate is the component in all of these sources that neutralises acid in soil. The key factors in lime quality are neutralising value and particle size. The neutralising value of the lime is expressed as a percentage of pure calcium carbonate which is given a value of 100 %. With a higher neutralising value, less lime can be used, or more area treated, for the same pH

Table 1. Tons of ECCE* lime needed to raise soil pH to 6.8 or 6.4

	Lime required	
Buffer index	pH 6.8	pH 6.4
>7.1	none	none
7.1	0.5	none
7.0	0.7	none
6.9	1.0	none
6.8	**1.2**	**0.7**
6.7	1.4	1.2
6.6	1.9	1.7
6.5	2.5	2.2
6.4	3.1	2.7
6.3	3.7	3.2
6.2	4.2	3.7

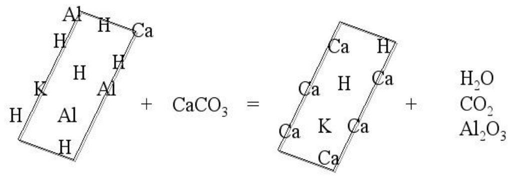
*Effective calcium carbonate equivalent.



Nitrogen source	N content (%)	Lime requirement*
Ammonium sulphate	21	5.2
Anhydrous ammonia	82	1.8
Ammonium nitrate	34	1.8
Urea	46	1.8
UAN solution	28–32	1.8
MAP	10–11	5.0
DAP	18	3.1
CAN	26	0.3–0.7

How lime neutralizes acidic soil

Acidic soil + Lime = Neutral Clay + Water, Carbon Dioxide, Aluminum Oxide



Conclusion: Soil acidity can be corrected easily by liming the soil, or adding basic materials to neutralize the acid present. The most commonly used liming material is agricultural limestone, the most economical and relatively easy to manage source. The limestone is not very water-soluble, making it easy to handle. Lime or calcium carbonate's reaction with an acidic soil is described, which shows acidity (H) on the surface of the soil particles. As lime dissolves in the soil, calcium (Ca) moves to the surface of soil particles, replacing the acidity. The acidity reacts with the carbonate (CO_3) to form carbon dioxide (CO_2) and water (H_2O). The result is a soil that is less acidic (has a higher pH)

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www.jabe.in **Vol.1.S1.2014,** **ISSN:2394-2606**

ADVANTAGES OF BIO-FERTILISERS

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Abstract: Current soil management strategies are mainly dependent on inorganic chemical-based fertilizers, which caused a serious threat to human health and environment. The exploitation of beneficial microbes as a biofertilizer has become paramount importance in agriculture sector for their potential role in food safety and sustainable crop production.

The eco-friendly approaches inspire a wide range of application of plant growth promoting rhizobacteria (PGPRs), endo- and ectomycorrhizal fungi, cyanobacteria and many other useful microscopic organisms led to improved nutrient uptake, plant growth and plant tolerance to abiotic and biotic stress. The present review highlighted biofertilizers mediated crops functional traits such as plant growth and productivity, nutrient profile, plant defense and protection with special emphasis to its function to trigger various growth- and defense-related genes in signaling network of cellular pathways to cause cellular response and thereby crop improvement. The knowledge gained from the literature appraised herein will help us to understand the physiological bases of biofertlizers towards sustainable agriculture in reducing problems associated with the use of chemicals fertilizers. The increasing impacts on the environment due to agricultural practices in the world have gradually affected the quality of the soil in terms of structure and biological equilibrium, which has required the development of alternative practices to minimize and mitigate those impacts, parallel to the improvement on the yield per cultivated area and economical benefits for producers and farmers. In addition, the amount of food that society of today require for processing and supply of the industry has encouraged the creation of new options for agricultural practices, tending to be: i) less invasive to the environment, ii) cheaper than conventional techniques, iii) able to increase efficiency at low costs, iv) able to obtain better characteristics on harvests and, v) ease of use and implementation with no excessive technical requirements.

As a result, technologies such as biofertilization have emerged in order to minimize environmental impacts and take advantage of the resources available in the field. The main scope of this paper is to assess researches performed with the use of biofertilization, mentioning their advantages and limitations, reviewing some results on efficiency and benefits acquired in recent years and highlighting their potential for better agricultural practices worldwide.

Keywords: Biofertilizer, Sustainable, Affordability, Improved soil, Improved plants, Agricultural expansion, biological fertilizers, nutrients, sustainability

INTRODUCTION

A biofertilizer is not just any organic fertilizer or manure. It consists of a carrier medium rich in live microorganisms. When applied to seed, soil or living plants, it increases soil nutrients or makes them biologically available. Biofertilizers contain different types of fungi, root bacteria or other microorganisms. They form a mutually beneficial or symbiotic relationship with host plants as they grow in the soil. Biofertilizers have many advantages and a few disadvantages.

Bio-fertilizers are natural fertilizers which are microbial inoculants of bacteria, algae, fungi alone, or in combination, and they augment the availability of nutrients to the plants. The use of bio-fertilizers, in preference to chemical fertilizers, offers economic and ecological benefits by way of soil health and fertility to farmers. These are products containing living cells of different types of microorganisms, which have the ability to convert nutritionally important elements from unavailable to available form through biological processes. They are involved in symbiotic and associative microbial activities with higher plants. These are natural mini-fertilizer factories that are economical and safer source of plant nutrition for increasing the

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agricultural production and improving soil fertility. The microorganisms colonize roots of rice, wheat, maize, sugarcane and form root nodules in leguminous plants. Different biofertilizers have shown nitrogen fixing, phosphorus solubilizing and phytohormone producing abilities that are used for increasing the agricultural productivity, e.g. (Bradyrhizobium for legumes (grain, fodders), plant growth promoting rhizobacteria (PGPR) for cereals (wheat, rice, grasses etc.), Azolla for rice ecosystem, and actinomycetes (Frankia spp.) for forest trees. These microorganisms convert atmospheric nitrogen to plant usable form and can provide up to 200 kg N/ha/crop. Next to nitrogen, phosphorus is essential for crop production. Although our soils have sufficient phosphorus but this phosphorus is not available for plants and most (>90%) of our soils are phosphorus deficient. Usually the pH of our soils is more than 7.5 and at this pH, very low amount (3-10 mg/ kg) of phosphorus is in available form. In such soils, when phosphatic fertilizers are added only a part of it is utilized by the plants and remaining part is precipitated due to the presence of calcium and with time it is converted into highly insoluble forms of calcium. In recent years, biofertilizers have emerged as an important component of the integrated nutrient supply system and hold a great promise to improve crop yields through environmentally better nutrient supplies. However, the application of microbial fertilizers in practice, somehow, has not achieved consistent results.

A group of bacteria referred to as plant growth-promoting rhizobacteria (PGPR), which participate in many key ecosystem processes such as those involved in the biological control of plant pathogens, nutrient cycling and seedling establishment, and, therefore, deserve particular attention for agricultural or forestry purposes. PGPR may colonize the rhizosphere, the surface of the root, or even superficial intercellular spaces of plants. It has been revealed that the effect of nitrogen fixation induced by nitrogen fixers is not only significant for legumes, but also non-legumes. Moreover, some strains have multiple functions for plant growth. Phosphate (P) – and potassium (K)-solubilizing bacteria may enhance mineral uptake by plants through solubilizing insoluble P and releasing K from silicate in soil. Soil microorganisms are important components in the natural soil sub ecosystem because not only they contribute to nutrient availability in the soil, but also bind soil particles into stable aggregates, which improve soil structure and reduce erosion potential.

Sustainability: Biofertilizers increase the nitrogen and phosphorus available to plants more naturally than other fertilizers.The different varieties available allow growers to tailor the microorganisms used to the needs of particular plants. Biofertilizers are simple to use, even for novice small growers. Biofertilizers do not pollute the soil or the environment, whereas chemical fertilizers often result in too much phosphate and nitrogen in the soil. The excess then leaches into lakes and streams through runoff. Waters decline in quality and suffer from overgrowth of algae and the death of fish**.**

Affordability: Biofertilizers reduce dependence upon expensive petroleum sources of chemical fertilizers. According to the "Journal of Phytology," demand for chemical fertilizers will exceed the supply by more than 7 million tons by 2020. The shortage of fossil fuels to produce chemical fertilizers may drive up prices beyond the reach of small users. Biofertilizers are a cheap, easy-to-use alternative to manufactured petrochemical products.

Improved Soil: Biofertilizers restore normal fertility to the soil and make it biologically alive. They boost the amount of organic matter and improve soil texture and structure. The enhanced soil holds water better than before. Biofertilizers add valuable nutrients to the soil, especially nitrogen, proteins and vitamins. They take nitrogen from the atmosphere and phosphates from the soil and turn them into forms that plants can use. Some species also produce natural pesticides.

Improved Plants: Biofertilizers increase yield by up to 30 percent because of the nitrogen and phosphorus they add to the soil. The improvement in soil texture and quality helps plants grow better during periods of drought. Biofertilizers help plants develop stronger root systems and grow better. Biofertilizers also reduce the effects of harmful organisms in the soil, such as fungi and

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nematodes. Plants resist stress better and live longer.

Advantages of biofertilizers over chemical fertilizers: The utilization of microbial products has several advantages over conventional chemicals for agricultural purposes. Microbial products are considered safer than many of the chemicals now in use, neither toxic substances nor microbes themselves will be accumulated in the food chain, self-replication of microbes circumvents the need for repeated application, target organisms seldom develop resistance as is the case when chemical agents are used to eliminate the pests harmful to plant growth and properly developed biocontrol agents are not considered harmful to ecological processes or the environment.

Azotobacter: Azotobacter is a free-living, gram negative, aerobic, nitrogen-fixing bacterium and is therefore being used as biofertilizer to replace chemical fertilizers. It grows from 28 – 30 ^{0}C and a pH range 7.0 to 7.5. It uses sugars, alcohols and salts of organic acid for growth. Generally it fixes non-symbiotically about 10 mg of atmospheric nitrogen/gm of carbohydrates (usually glucose) consumed. It is non-spore forming but can form cyst in adverse conditions and in older cultures grown with sugar as the carbon source. Cyst has a characteristic structure a central body surrounded by a cyst coat, consisting of an exocystorium and an exine. Cysts accumulate poly B- hydroxyl butyric acid (PHB). With the onset of favourable conditions they give rise to vegetative cells. On nitrogen free agar medium with sugar as carbon source colonies appear within 48 hr at 30 ^{0}C. The colonies are smooth, opaque, low convex and viscid.

Azotobacter : Azotobacter biofertilizers contain very high number of live Azotobacter bacteria. It can be used in any non-legume crop of short, medium and long duration. Besides fixing nitrogen these bacteria secrete certain growth promoting hormones such as indole acetic acid, gibberellic acid and cytokinins, which promote vegetative growth and root development. Azotobacter cultures used as inoculants have been reported to produce gibberellic acid, indole 3-acetic acid and cytokinin, which may promote seedling development and plant growth. The potential use ofAzotobacter spp. was reviewed by Brown (1982), who concluded that inoculation with A. chroococcum occasionally promoted yields, probably by mechanisms other than biological N fixation.

Carrier-based biofertilizers: Carrier-based biofertilizers are prepared with the help of activated charcoal, which act as a carrier for microbial inoculants. Biofertilizer consumption is not very satisfactory due to certain disadvantages associated with carrier-based biofertilizers like low shelf life (3-4 months), storage condition (stored in cool temperature) as it is temperature sensitive, bulky to transport, therefore, high transport cost, less scope for export, more chances of contamination, problem of proper packing, poor cell protection, poor moisture retention capacity and restriction on use of charcoal as a measure of conservation.

Liquid Biofertilizers: solution to carrier based biofertilzers: The strength of biofertilizers is determined by two basic parameters 1. Number of cells 2. Efficiency of the microorganisms to fix nitrogen or solubilize phosphates. Liquid biofertilizers are liquid formulation containing the dormant form of desired microorganisms and their nutrients along with the substances that encourage formation of resting spores or cysts for longer shelf life and tolerance to adverse conditions. The dormant form on reaching the soil, germinate to produce fresh batch of active cells. These cells grow and multiply by utilizing the carbon source in the soil or from root exudates.

The advantages of liquid biofertilizers over conventional carrier based biofertilizers are: longer shelf life (12- 24 months), no effect of high temperature and no contamination, no loss of properties due to storage at high temp. up to 45^0 C, high populations can be maintained more then 10^9 cells/ ml up to 12 to 24 months, easy to use by the farmers, high export potential, dosages are 10 times less then carrier-based, quality control protocols are easy and quick. Lot of work has been done on carrier-based biofertilizers in the context of organic food production. In view of the advantages of liquid biofertilizers over carrier based formulations, research has now been started on the production and testing of liquid biofertilizers.

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Biofertilizers are low cost, renewable sources of plant nutrients which supplement chemical fertilizers. Biofertilizer is one of the best modern tools for agriculture. Use of Biofertilizer is one of the important components of integrated nutrient management, as they are cost effective and renewable sources of plant nutrients to supplement the chemical fertilizers for sustainable agriculture. The beneficial effect of legumes in improving soil fertility was known since ancient times.

Biological nitrogen fixation (BNF) :

Biological nitrogen fixation is considered a key process in the biosphere and fundamental constituent of sustainable agriculture. It allows the conversion of gaseous nitrogen (N_2) to the mainly forms of available nitrogen (e.g., nitrite, nitrate, and ammonium) for the development of metabolic processes of plants .The conversion process of gaseous nitrogen and similar products (more available for plant's growth) takes place by the action of microorganisms in the soil. These microorganisms include: Azospirillum, Azotobacter, Beijerinckia (i.e., microorganisms that establish associations with grass plants), Rhizobium, Bradyrhizobium, and Azorhizobium (i.e., bacteria establishing symbiosis with legumes), Frankia (i.e., symbiotic actinomycetes with woody plants), Nostoc (i.e., blue-green algae establishing symbiosis with different plants) or Anabahena (i.e., ferns) .

Development of BNF depends on specialized microorganisms, i.e., those who are carriers of nitrogenase enzyme. These are responsible for its production through biological and physicochemical processes. Additionally, BNF has shown minimal environmental impacts. Its usefulness and efficiency for the optimum physical plant development have been extensively recognized estimated that approximately 80% of fixed nitrogen on the planet is due to gram-negative activity of Rhizobium bacteria. The acquisition strategy for reducing atmospheric nitrogen by Rhizobium-legume-association is a complex process. Rhizobium induces the legume to form nodules, thereby establishing metabolic cooperation, in which the bacteria reduce nitrogen (N_2) to ammonia (NH_4). The latter is exported to the plant tissue to be assimilated into proteins and other complex nitrogenous compounds. Simultaneously, the leaves reduce carbon dioxide (CO_2) into sugars through photosynthesis and transport it to the roots. There, Rhizobium provides ATP for the diatomic nitrogen immobilization, taking advantage from that source of energy and facilitating the development of photosynthetic and growth processes of plants.

In addition, it is estimated that Rhizobium-legume association is responsible for setting annually 35 million tons of nitrogen .This amount significantly influences the fertilization of soils globally and favors the development of agriculture and forestry activities in several parts of the world.

Biological fertilization techniques : Society must meet its food needs through agricultural resources. Therefore, the use of methods that are effective and feasible to obtain better yields and meet global demand of inputs has become increasingly necessary. Similarly, alternative methods arise to increase the soil fertility. The main scope of these methods is to provide greater efficiencies, increase the quality of agricultural products, minimize crop time, and reduce costs. On the other hand, contamination of soils, extensive and continuous use of chemical inputs and monoculture has led to the need of incorporating fewer invasive fertilization methods. Next in this research article, some biological fertilization techniques, that represent lower environmental, implementation costs and efficiencies comparable to conventional chemical fertilizers used in the world, are presented and explored.

Benefits and limitations of biological fertilizers : Biological practices can offer a wide range of opportunities for the development of better agrarian practices due to the advantages and benefits provided for the soil, products and farmers. Nevertheless, limitations of these practices are also well studied and recognized, which implies that feasibility studies should be carried out to find out better solutions for each particular case in agricultural activities. Next in this section, some benefits and limitations are mentioned to highlight the need of future research on some issues.

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Table 1. Benefits and limitations of biological fertilizers (Chen 2006)

Benefits	**Limitations**
Biological fertilizers can mobilize nutrients that favor the development of biological activities in soils.	Compost products have highly variable concentrations of nutrients. In addition, implementation costs are higher than those of certain chemical fertilizers.
Maintenance of plant health is enhanced by the addition of balanced nutrients.	Extensive and long-term application may result in accumulation of salts, nutrients, and heavy metals that could cause adverse effects on plant growth, development of organisms of the soil, water quality, and human health.
Food supply is provided and growth of microorganisms and beneficial soil worms is impelled.	
As a result of the good structure provided to the soil, root growth is promoted.	Large volumes are required for land application due to low contents of nutrients, in comparison with chemical fertilizers.
The content of organic matter in soil is higher than normal levels.	
Promotes the development of mycorrhizal associations, which increases the availability of phosphorus (P) on the soil.	Main macronutrients may not be available in sufficient quantities for growth and development of plants.
Help to eliminate plantar diseases and provide continuous supply of micronutrients to the soil.Contribute to the maintenance of stable nitrogen (N) and phosphorus (P) concentrations.	Nutritional deficiencies could exist, caused by the low transfer of micro- and macro-nutrients.
Improvements on the capacity of nutrients' exchange in the soil.	

Animal manure: For several decades, animal manure has been widely used by farmers for soil fertilization, given the low costs associated with its production, transportation, and processing. This wide availability and the nutritional intake of trace elements make it an attractive alternative for the development of fertilization on soils suffering nutritional deficiencies.

Manure has many benefits which include:

- It is a biological fertilizer with high proportions of nitrogen (N) and potassium (K), medium proportions of calcium (Ca) and phosphorus (P), and low proportion of magnesium (Mg) and sulfur (S). It allows getting favorable effects on physicochemical stability of soils, plants growth, and development of beneficial microbial populations.
- Manure adds organic matter to the soil.
- The composition of organic solids is between 20% and 40%.
- Given the high nitrogen content, decomposition of organic matter is developed more quickly.
- Despite having low content of phosphorus (P), manure prevents blockage of this element, making it available for plants.

Aspects such as the type, age, and health of the animal affect the proportion of macro- and micro-nutrients available in the manure. For example, sheep and poultry manure contain high levels of nitrogen (N), while manure from pigs, cattle, and horses have lower proportions of this element. The type of bedding (i.e., ferns or other plants that serve as disposal of urine and excreta) also affects the quality of manure. Furthermore, the usefulness and usability of the product depends on the proportion of heavy metals and other chemical substances. The application of manure in the soil must be made in quantities or concentrations acceptable by rules and regulations from environmental and health authorities. In most cases, it is recommended that manure is sprayed in a thin layer over large portions of land, rather than stacked on a small portion. The purpose of the technique is to promote soil aeration, maximize the efficiency of agricultural production, and facilitate the development of biological activities that are able to create a medium rich in nutrients for plants growth.

Although animal manure provides improved availability of nutrients and facilitates plants growth, it also has disadvantages and limitations of particular interest. Some of the limitations are referred to possible risks on the safety of consumers, physicochemical, and biological stability of soils. In this regard, high contents of ammonia from manure can burn foliage and roots of plants; the presence of manure could increase the amount of weed flora and costs associated with transportation, and manure application are superior to those of traditional techniques. Besides that, the presence of heavy metals (e.g., mercury, chromium, lead) pose a threat as a result of their carcinogenic potential and their capability of bio-accumulation and bio-magnification in the food chain. For this reason, the use of manure to fertilize soils should be well assessed and considered in order to evaluate the cost-benefit ratio. Also, technical tests must be carried out to verify its safety. Finally, excessive application of manure can generate important reductions of plants growth, extreme levels of nitrogen, ammonia, and salts that could lead to different undesired scenarios for farmers and the soil itself.

Arbuscular mycorrhiza (AM): Most plants of agricultural interest are endomycorrhiza and belong to the arbuscular mycorrhiza type (AM)). Mycorrhiza is a mutualistic association existing between fungi and most land plants. These partnerships are easy to locate in distinct places, from aquatic to desert, occurring at different altitudes and latitudes. Therefore, its value in terms of availability and ease of use in various geographical conditions is widely recognized.

The fungi that form symbiotic associations are obligated bio trophic, meaning that they can only complete their life cycle by colonizing roots of host plants. This type of symbiotic association has been called bio-fertilizer and crop bio-protector. It is also considered relevant for integrated management programs of soils and crops. Arbuscular mycorrhiza fungi belong to Glomeromycota division. The most abundant and diverse is the genus' Glomus, consisting of fungal inoculants (i.e., mycorrhiza fungi widely used in agricultural activities worldwide). Mycorrhiza inoculants application in soils provides benefits for agricultural and forest crops such as increased growth rate and tolerance of plants to drought and soil salinity stated that Glomus (i.e., vesicular-arbuscular) could supplement or replace chemical fertilizers of crops in varying environmental conditions.

The proper selection and application of arbuscular mycorrhiza fungi improves plant nutrition and increases the resistance of plants against pathogens and stress conditions (both biotic and abiotic). Furthermore, the wide range of options and applicability of AM in different regions makes it an attractive technique to replace, partially or completely, chemical fertilization of soils.

Biosolids : Dumping of human waste treated at Sewage Treatment Plants (STP) on the soil has a fairly broad historical trajectory. In the early seventies, application of sewage sludge in soil or sediment began for agricultural and forestry purposes in the United States. In fact, the Environmental Protection Agency (U.S.EPA) estimates that half of the sludge produced in the United States are spread on the soil mostly applied as fertilizer in large portions of land. Biosolids can be applied to the soil through techniques such as dumping, injection, irrigation, among others, depending on the local environmental and financial conditions. These techniques help to decrease spreading of odors, insects influence on crops, minimize runoff losses, and loss of ammonia in the air.

Several options for using the sludge from STP are suitable, for example: landfill disposal, incineration, and direct application on the soil. The latter requires dissolving the sludge, before being applied to the soil, where it is decomposed by microorganisms and filtered by the soil matrix. Therefore, it is the most promising use from the economic and environmental perspective. Moreover, the composition of biosolids is useful for soil nutrition, which explains the increased rate of use as amendment in several countries. The U.S.EPA classifies biosolids according to their content of heavy metals. Those with lower concentrations can be applied under more flexible security controls.

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www.jabe.in **Vol.1.S1.2014,** **ISSN:2394-2606**

Biosolids with higher concentrations are not likely to be used. Hence, they must be incinerated or landfilled. The acceptance or denial of biosolids used as fertilizers is based on safety parameters, such as hazardous characteristics (i.e., corrosivity, reactivity, explosivity, toxicity, flammability, and biological hazards). If biosolids do not exhibit these characteristics, they can be certified as safe to the soil and may be applied. These sanitary regulations are primarily intended to reduce risks to human health and the environment based on the potential for contamination of water resources, crops, and ecosystems.

Composting : Composting is one of the oldest techniques used for the stabilization of natural wastes and soil biologic fertilization. The main objective of this practice is to obtain a stable, chemical and biological rich product with micro and macro nutrients.

The composting process works as follows: initially, strains of microorganisms break down living waste, generating temperature differentials, while the pH of the medium decreases as a result of the production of natural acids. Once the temperature gets close to 40°C, thermophilic bacteria initiate degradation processes, making the temperature to reach 65ºC (under these conditions the metabolism of certain fungi is deactivated). During this stage, biological transformation reactions are developed by actinomycetes and fungi spore forming bacteria. These quickly consume easily degradable compounds such as sugars, proteins, starch, and fat. In addition, the pH tends to be alkaline due to the release of ammonium ion. Once degraded the organic material, the reactions rate decreases as well as temperature. This stage is known as cooling. Both thermophilic and mesophilic fungi are capable of degrading cellulose during this phase. Finally, ripening process begins, which requires several months at least four to be completed. This stage can lead to the complete degradation of compounds and to obtain stable material. The composting process can lead to obtain: stable humus and humic- and fulvicin-acids; characterized by high nutritional value and potential for fertilization of soils with nutriment deficiencies.

Benefits provided by compost are broad and can be from the physical, chemical, biological and environmental realm. Application of compost depends on the conditions of organic matter, moisture, temperature, the pH and presence of microorganisms in the pile. For example, compost increases drainage and absorption of moisture in soils with structural deficiencies or lack of nutrients. It also permits to: (1) increase crop productivity, (2) promote plant growth by incorporation of essential nutrients, (3) facilitate implementation in different types of soil, (4) reduce runoff, and (5) obtain economic benefits for farmers.

Green manures : Green manures consist of green plant tissue incorporated on the soil to correct or improve physical characteristics or its chemical properties. Fast-growing crops such as oats, vetch, berseem clover, rye, and peas are mainly used as green manures. The use of green manure has a positive influence on certain soil characteristics. For example, soil nutrients susceptible to loss by drainage are retained. On the other hand, certain long-rooted manures capture nutrients from lower soil horizons and have the ability to transport them to the surface, which increases their availability for the development of metabolic processes of plants.

Green manures increase the amount of available organic matter in the soil for development of metabolic processes of native flowers and other plant species. Being in direct contact with the soil matrix, plant material is susceptible to microbial decomposition, which produces humic compounds that are able to increase the adsorption capacity of nutrients, promote drainage, aeration, and soil granulation. In addition, decomposition products serve as a substrate for those microorganisms responsible of biological transformation processes. These processes have a positive impact on the production of carbon dioxide, ammonia, nitrites, nitrates, and other simple compounds that are easily assimilated by plants for growth and development.

Finally, green manure applications can be combined with natural inputs to improve soil structure, minimize erosion, and increase water availability in the soil (i.e., trough evaporation reduction). For example, mineral fertilization with green manure increases yields per hectare and

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promotes development of mycorrhizal associations. It is also a source of essential nutrients and it is a way to foster development of AMF strains.

Microbial inoculants (MI): Microbial inoculants (MI) are substances or biological aggregates containing microbial populations as fermentation fungi, bacteria, and lactobacilli.Their high nutritional content of salts allows reactions with organic matter in the soil, producing favorable substances for plant nutrition (e.g., vitamins, organic acids, chelated minerals, and antioxidants). Microbial inoculants are capable to modify characteristics of the soil such as micro- and macro-flora and can improve biological balance. In addition, their antioxidant properties promote decomposition of organic matter and increase humus content in the soil matrix. The latter has positive effects on plant growth, quality of harvests, and improvement of chemical, physical and biological stability of soils. With a rational use of MI, certain physical, chemical, and biological properties can be improved and suppression of biological diseases can be achieved. In this regard:

- On physical conditions: improvement of structure and aggregation of soil particles, reducing compaction, and increasing the pore spaces and water infiltration.
- On chemical conditions: improvement of nutrients availability in the soil, leaving free elements to facilitate their absorption by the root system.
- On soil microbiology: suppression or control through competition of pathogenic populations of microorganisms present on the soil. MI increase microbial biodiversity creating suitable conditions for the development of beneficial microorganisms.

Seaweed extracts : *Seaweeds* are mainly composed by trace, and major- and minor-elements helpful for plant nutrition. Other natural substances can also be found, whose effects are similar to those of certain growth regulators, vitamins, carbohydrates, proteins, and biocidal substances. They act against some pests, diseases, and chelating agents such as organic acids and mannitol. The benefits of seaweed use in agriculture (greater efficiency and better fruit quality) may be evident from direct application of pure forms or its derivatives. Species such as Ascophyllum nodosum contain macronutrients and micronutrients needed for cellular nutrition. Recent research has showed that vitamin supplements coming from these species can increase agricultural productivity and revenues. Similarly, it can promote availability of sugars, increase fruit size, minimize the time of cultivation, and help to obtain better shapes and tones of agricultural .

On the other hand, cyanobacteria (i.e., blue-green algae) are good at obtaining phosphates and micronutrients from media that may contain insoluble minerals. This ability gives them a level of superiority over other species, since they can supply essential nutrients for fertilizing soil and other substrates. The Oregon State University evaluated the effects of applying seaweed extracts in apple orchards (i.e., apple trees). Two treatments were administered in areas of 1 acre. The first consisted on applying half pound of fungicides and herbicides, while the second on applying half pound of seaweed extracts. The authors concluded that 80% of orchards treated with seaweed extract produced fruits with better physical-chemical characteristics. Also 4% increases in yield per cultivated acre were reported by researchers .

Vermicomposting: Vermicomposting is a biological fertilization technique consisting on the use of earthworms' metabolism to produce humus with high nutrients content. To apply it, organic waste is required (e.g., manure, fruit peel, crop residues). The organic material passes through the digestive tract of worms, where it is transformed into a material rich in microorganisms, macro-, and micro-nutrients. Based on that process, a chemical and biological stable fertilizer is obtained. Use, storage, transport, and application of vermicompost in soils are of particular interest for those soils with nutritional shortages. This technique can be developed and applied successfully at both small and large-scale in various environments or under controlled laboratory conditions.

Most common earthworm species used in vermiculture are: Eisenia foetidal and Eudrilus eugeniae. The former presents advantages related to its rapid rate of reproduction under conditions of high temperature (above 40 ° C), high densities tolerance (10,000 to 50,000 worm/m2), and

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www.jabe.in Vol.1.S1.2014, ISSN:2394-2606

resistance to large variations in temperature, pH and moisture. In addition, this species have the ability to thrive in different substrates, under variable conditions. Therefore, Eisenia foetida is the most used worm in vermiculture. On the other hand, Eudrilus eugeniae is a rapidly growing worm, prolific, but difficult to manage, since removal from the substrate is much more complex than that of Eisenia foetidal.

Recently, effectiveness of vermicomposting in Havana, Cuba, has been proved). The research study conducted by Berc et al (2005) addressed the need to increase productivity and reduce adverse environmental impacts caused by indiscriminate use of chemical fertilizers and pesticides to get better agrarian practices in their geographical area. The authors emphasized on the need of taking advantage from climatic (e.g., solar radiation, rainfall, multi-year average temperature), economic (e.g., agricultural potential), and social (e.g. availability of cheap labor) conditions to incorporate vermicomposting techniques and identify their advantages, disadvantages, and limits. The authors got yields exceeding 1.5 tones of humus in a year (in tropical zones) from three tons of organic substrate and 1 m3 of treated soil. Humus resulting from the process exhibited physical, chemical, and microbiological properties suitable for application on local soils with nutrients deficiencies such as phosphorus (P), nitrogen (N), and potassium (K)).

Conclusions and recommendations

- Biological fertilization techniques are pertinent strategies for an efficient and rational use of agricultural resources with minimal generation of adverse environmental impacts that may affect water resources, ecosystems or the quality of human life. In addition, biological fertilizers provide a wide range of possibilities for the development of conservative agriculture (CA) in different geographic, economic, and cultural backgrounds.
- Current researches clearly show that biofertilization techniques require less chemical inputs on the soil and facilitate the incorporation of residues that would otherwise go to dumping sites and landfills, which represents relevant reductions on the environmental impacts associated to agriculture activities globally.
- Limitations of biological fertilization require future research focused on identifying the options available to tackle the issues and offer valid frameworks for development of environmentally friendly practices around the world that allows improvements on the efficiency and consequent supply of product for the industry in the global economies.
- Although several options for application of biofertilizers are available, feasibility studies should be carried out by producers and farmers to effectively select the best option that offers better results and allows minimizing environmental impacts.
- Biosolids, animal manures, green manures, composting, microbial inoculants and seaweeds extracts are techniques widely used in today's agriculture, however, their implementation still requires research, investment, and technological development to fully understand their impacts on the soil, flora, fauna and, ultimately, on human health.

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A Peer Reviewed & Refereed, International Open Access Journal
www.jabe.in Vol.1.S1.2014, ISSN:2394-2606

ENVIRONMENTAL IMPACT OF FERTILIZERS AND PESTICIDES

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Abstract: A chemical fertilizer is a fertilizer comprising chemically refined or otherwise processed compounds. Manufacturers create chemical fertilizers from inorganic materials, with the goal being to replicate (and increase the potency of) natural, organic nutrients. Many environmentalists are against the use of chemical fertilizers, as they can produce several negative environmental effects.

INTRODUCTION

The environmental impact of pesticides consists of the effects of pesticides on non-target species. Runoff can carry pesticides into aquatic environments while wind can carry them to other fields, grazing areas, human settlements and undeveloped areas, potentially affecting other species. Each pesticide or pesticide class comes with a specific set of environmental concerns. Pesticides have generally become less persistent and more species-specific, reducing their environmental footprint. In addition the amounts of pesticides applied per hectare have declined, in some cases by 99%.

Agriculture and the Environment:

The arrival of humans in an area, to live or to conduct agriculture, necessarily has environmental impacts. The use of agricultural chemicals such as fertilizer and pesticides magnify those impacts. While advances in agro chemistry have reduced those impacts, for example by the replacement of long-lived chemicals with those that reliably degrade, even in the best case they remain substantial. These effects are magnified by the use of older chemistries and poor management practices.

Environmental Impact of Chemical Fertilizers:

Impact on Infertile Soil: The synthesized materials manufacturers use in their chemical fertilizers may help plants grow, but they do not help the soil they grow in. In fact, they can do quite the opposite. According to Garden Counselor Lawn Care, the unnaturally high levels of nutrients that some chemical fertilizers contain can over saturate soil and cancel out the effectiveness of other vital nutrients.

Impact on Acidic Soil: Another way chemical fertilizers can make soil infertile is by increasing its acidity. Many chemical fertilizers contain sulfuric and hydrochloric acid, which if used in excess can cause serious harm to microorganisms (specifically the type that helps supply plants with nitrogen). This can have a serious impact on the soil's pH and adversely affect plant growth.

Increased Microorganisms: Nitrogen-rich chemical fertilizers can have the complete opposite effect on soil in comparison to more acidic fertilizers. Too much nitrogen can lead to a microorganism population boom. In large enough numbers, these microorganisms, instead of helping plants, will hurt them, as they will consume all of the organic material and nutrients in the surrounding soil.

Impact on Groundwater Pollution: Plants can only absorb a certain amount of nutrients. So if you over apply a chemical fertilizer, not all of the chemically synthesized nutrients within it will actually contribute to the plant's health and growth. Instead, the unused fertilizer will seep into the ground, where it can be carried by rain and irrigation ditches into streams, rivers, lakes, reservoirs and oceans. The chemical compounds in the fertilizer can contaminate drinking water supplies and disrupt ecosystems.

Impact on Salt Burns: Chemical fertilizers are often very salty. The over-application of chemical fertilizers can thus contribute to plants developing unsightly "salt burns." These occur when an over saturation of salt leads to certain areas of the plant becoming dehydrated, and plant tissues dry out.

Environmental Impact of Pesticides

Impact on Air: Pesticides can contribute to air pollution. Pesticides that are applied to crops can volatilize and may be blown by winds into nearby areas, potentially posing a threat to wildlife.

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www.jabe.in **Vol.1.S1.2014,** **ISSN:2394-2606**

Weather conditions at the time of application as well as temperature and relative humidity change the spread of the pesticide in the air. The amount of inhalable pesticides in the outdoor environment is therefore often dependent on the season. Also, droplets of sprayed pesticides or particles from pesticides applied as dusts may travel on the wind to other areas, or pesticides may adhere to particles that blow in the wind, such as dust particles.

Pesticides that are sprayed on to fields and used to fumigate soil can give off chemicals called volatile organic compounds, which can react with other chemicals and form a pollutant called troposphere ozone. Pesticide use accounts for about 6 percent of total troposphere ozone levels.

Impact on Water: Pesticide impacts on aquatic systems are often studied using a hydrology transport model to study movement and fate of chemicals in rivers and streams. There are four major routes through which pesticides reach the water: it may drift outside of the intended area when it is sprayed, it may percolate, or leach, through the soil, it may be carried to the water as runoff, or it may be spilled, for example accidentally or through neglect. They may also be carried to water by eroding soil. Factors that affect a pesticide's ability to contaminate water include its water solubility, the distance from an application site to a body of water, weather, soil type, presence of a growing crop, and the method used to apply the chemical.

Impact on Soil: Many of the chemicals used in pesticides are persistent soil contaminants, whose impact may endure for decades and adversely affect soil conservation. Degradation and sorption are both factors which influence the persistence of pesticides in soil. Depending on the chemical nature of the pesticide, such processes control directly the transportation from soil to water, and in turn to air and our food. Breaking down organic substances, degradation, involves interactions among microorganisms in the soil. Sorption affects bioaccumulation of pesticides which are dependent on organic matter in the soil. Weak organic acids have been shown to be weakly sorbed by soil, because of pH and mostly acidic structure. Sorbed chemicals have been shown to be less accessible to microorganisms.

Impact on Plants: Nitrogen fixation, which is required for the growth of higher plants, is hindered by pesticides in soil. The insecticides DDT, methyl parathion, and especially pentachlorophenol have been shown to interfere with legume-rhizobium chemical signaling. Reduction of this symbiotic chemical signaling results in reduced nitrogen fixation and thus reduced crop yields. Pesticides can kill bees and are strongly implicated in pollinator decline, the loss of species that pollinate plants, including through the mechanism of Colony Collapse Disorder in which worker bees from a beehive or Western honey bee colony abruptly disappear.

Impact on Animals: Animals including humans may be poisoned by pesticide residues that remain on food, for example when wild animals enter sprayed fields or nearby areas shortly after spraying. In eliminate some animals' essential food sources, causing the animals to relocate, change their diet or starve. Residues can travel up the food chain; for example, birds can be harmed when they eat insects and worms that have consumed pesticides. Earthworms digest organic matter and increase nutrient content in the top layer of soil. They protect human health by ingesting decomposing litter and serving as bioindicators of soil activity. Pesticides have had harmful effects on growth and reproduction on earthworms.

Impact on Birds: Some pesticides come in granular form. Wildlife may eat the granules, mistaking them for grains of food. A few granules of a pesticide may be enough to kill a small bird. The herbicide paraquat, when sprayed onto bird eggs, causes growth abnormalities in embryos and reduces the number of chicks that hatch successfully, but most herbicides do not directly cause much harm to birds. Herbicides may endanger bird populations by reducing their habitat.

Impact on Aquatic life: Fish and other aquatic biota may be harmed by pesticide-contaminated water. Pesticide surface runoff into rivers and streams can be highly lethal to aquatic life, sometimes killing all the fish in a particular stream. Application of herbicides to bodies of water can cause fish

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kills when the dead plants decay and consume the water's oxygen, suffocating the fish. Herbicides such as copper sulfite that are applied to water to kill plants are toxic to fish and other water animals at concentrations similar to those used to kill the plants. Pesticides can accumulate in bodies of water to levels that kill off zooplankton, the main source of food for young fish. Pesticides can also kill off insects on which some fish feed, causing the fish to travel farther in search of food and exposing them to greater risk from predators. The faster a given pesticide breaks down in the environment, the less threat it poses to aquatic life. Insecticides are typically more toxic to aquatic life than herbicides and fungicides.

Impact on Amphibians: Pesticide mixtures appear to have a cumulative toxic effect on frogs. Tadpoles from ponds containing multiple pesticides take longer to metamorphose and are smaller when they do, decreasing their ability to catch prey and avoid predators. The herbicide atrazine can turn male frogs into hermaphrodites, decreasing their ability to reproduce. Both reproductive and no reproductive effects in aquatic reptiles and amphibians have been reported. Crocodiles, many turtle species and some lizards lack sex-distinct chromosomes until after fertilization during organogenesis, depending on temperature.

Impact on Humans: The effects of pesticides on human health depend on the toxicity of the chemical and the length and magnitude of exposure. Farm workers and their families experience the greatest exposure to agricultural pesticides through direct contact. Every human contains pesticides in their fat cells. Children are more susceptible and sensitive to pesticides, because they are still developing and have a weaker immune system than adults. Children may be more exposed due to their closer proximity to the ground and tendency to put unfamiliar objects in their mouth. Hand to mouth contact depends on the child's age, much like lead exposure. Children under the age of six months are more apt to experience exposure from breast milk and inhalation of small particles. Pesticides tracked into the home from family members increase the risk of exposure. Toxic residue in food may contribute to a child's exposure. The chemicals can bioaccumulation in the body over time.

Developmental effects have been associated with pesticides. Recent increases in childhood cancers in throughout North America, such as leukemia, may be a result of somatic cell mutations. Insecticides targeted to disrupt insects can have harmful effects on mammalian nervous systems. Both chronic and acute alterations have been observed in exposes. DDT and its breakdown product DDE disturb estrogenic activity and possibly lead to breast cancer. Fetal DDT exposure reduces male penis size in animals and can produce un descended testicles. Pesticide can affect fetuses in early stages of development, in utero and even if a parent was exposed before conception. Reproductive disruption has the potential to occur by chemical reactivity and through structural changes.

CONCLUSIONS

Many alternatives are available to reduce the effects pesticides have on the environment. Alternatives include manual removal, applying heat, covering weeds with plastic, placing traps and lures, removing pest breeding sites, maintaining healthy soils that breed healthy, more resistant plants, cropping native species that are naturally more resistant to native pests and supporting biocontrol agents such as birds and other pest predators.

Biological controls such as resistant plant varieties and the use of pheromones, have been successful and at times permanently resolve a pest problem. Integrated Pest Management (IPM) employs chemical use only when other alternatives are ineffective. IPM causes less harm to humans and the environment. The focus is broader than on a specific pest, considering a range of pest control alternatives. Biotechnology can also be an innovative way to control pests. Strains can be genetically modified (GM) to increase their resistance to pests. However the same techniques can be used to increase pesticide resistance and was employed by Monsanto to createglyphosate-resistant strains of major crops. In 2010, 70% of all the corn that was planted was resistant

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www.jabe.in **Vol.1.S1.2014,** **ISSN:2394-2606**

to glyphosate; 78% of cotton, and 93% of all soybeans.

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Journal of Advanced Studies in Agricultural, Biological and Environmental Sciences (JABE)
A Peer Reviewed & Refereed, International Open Access Journal
www.jabe.in **Vol.1.S1.2014,** **ISSN:2394-2606**

ALGINATE IMMOBILIZATION OF AZOSPIRILLUM FOR SUSTAINABLE AGRICULTURE

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ABSTRACT: Biofertilizer are the products containing cells of different types of beneficial microorganisms. They are cost effective, eco-friendly and renewable source of plant nutrients to supplement chemical fertilizers in sustainable agricultural system. The present paper is focusing on the formulation of Azospirillum inoculum to improve its performance as biofertilizer for use in agriculture, particularly for the purpose of plant nutrition. In pot trials sodium alginate beads of *Azospirillum* were used to study the inoculation effect of immobilized *Azospirillum* on growth and yield of sorghum. Enhanced growth and productivity were observed immobilized Azospirillum inoculum than non coated Azospirillum inoculum and supporting the possibility of producing a new kind of biofertilizer inoculum.

KEYWORDS: Biofertilizer, immobilized *Azospirillum* inoculum, sodium alginate beads

Introduction:

The Genus Azospirillum Belongs to family Spirilaceae, heterotrophic and associative in nature. In addition to their nitrogen fixing ability of about 20-40 kg/ha, they also produce growth regulating substances. Azospirillum, a bacterial biofertilizer is highly beneficial for cereals, millets, sugarcane, cotton sunflower and other crops. Azospirillum assimilates atmospheric nitrogen. It also secretes phyto-hormones in the plant root regions, which intern enhances the root growth. Although there are many species under this genus like, A.amazonense, A.halopraeferens, A.brasilense, but, worldwide distribution and benefits of inoculation

Among the PGPR, Azospirillum species heads the list of bacteria used in commercial products (Burdman et al., 2000; Lucy et al., 2004). Yet except those formulated with Azospirillum, all these products are applied to crops as biopesticides or biocontrol agents.

Recently, the use of biofilms has also been proposed as possible means to produce effective plant inocula. A biofilm consists of microbial cells embedded into a self-produced polymeric matrix (known as an extracellular polymeric substance—EPS) and adherent to an inert or living surface, which provides structure and protection to the microbial community. Three major types of biofilms can occur in the soil: bacterial (including Actinomycetes), fungal,and fungal-bacterial biofilms. Both bacterial and fungal biofilms are formed on abiotic surfaces, while fungi act as the biotic surface in formation of fungal-bacterial biofilms . The majority of plant-associated bacteria found on roots and in soil are forming biofilms . Therefore, using plant growth promoting microorganisms (PGPM) strains that are forming biofilms could be a strategy to ease the formulation and production of inocula. Furthermore, biofilm-based inocula could also facilitate the production of biofertilizers considering the biofilm as a carrier. The carrier is the major portion (by volume or weight) of the inoculant that helps to deliver a suitable amount of PGPM in good physiological condition . The materials constituting the carrier can be of various origins: organic, inorganic, or synthesized from specific molecules. Availability and cost are the main factors affecting the choice of a carrier.

Polymer-Based Carriers: The increased interest in the application of bacterial preparations as plant protection products has promoted studies aiming at improving their stability and increasing their shelf life. However, the same approach could be successfully applied to products containing PGPRs and AMF. Among the new materials utilized as carriers for PGPM, organic polymers have been evaluated. These are compounds (e.g., polysaccharides) that in the presence of ions or by changing chemical conditions (e.g., a change in pH of the medium) form cross-links that create a complex structure.The polymers encapsulate, or "immobilize", the microorganisms in the matrix and release them gradually through a degradation process. Polymer formulations offer a long shelf life

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www.jabe.in Vol.1.S1.2014, ISSN:2394-2606

even at ambient temperature since they provide protection against environmental stresses and a consistent batch quality due to standardized production. Nevertheless, storage at cool temperature (4°C) allows to maintain a longer viability of encapsulated cells. These inoculants can be added or mixed with nutrients to improve the survival of the bacteria upon inoculation.

Alginate, a natural polymer of D-mannuronic acid and L-glucuronic acid, is the most commonly used substance for microbial cell encapsulation. It is derived mainly from brown macroalgae such as Macrocystis pyrifera (kelp), but recently also another macroalga (Sargassum sinicola) has been shown to produce alginate of similar physical characteristics . The reaction between alginate and a multivalent cation (e.g., Ca2+) forms a gel consisting of a dense three-dimensional lattice with a typical pore-size range of 0.005 to 0.2 mm in diameter . When the alginate solution is dropped into the cation solution beads are formed. Alginate beads generally have a diameter of 2-3 mm, but microbeads with a size of 50 to 200 µm that can entrap up to 108 to 109 CFU g−1 have also been proposed [91].Inclusion of bacteria in alginate beads has been utilized for different species, either spore forming and non sporulating . Different AMF structures have also been entrapped into alginate matrixes or in beads formed with different polymers . Spores of mycorrhizal fungi were entrapped in alginate film formed in a PVC-coated fibreglass screen and roots of leek seedlings inoculated with this alginate film containing G. mosseae spores were heavily colonized after few weeks of growth in greenhouse conditions. Similar results were obtained with spores obtained from monoxenic cultures embedded into beads observations .Alginate beads can maintain a sufficient amount of live cells to assure inoculation up to several months.

Methodology:

Identification:

The soil samples were collected from various fields and serial dilutions were done. The organism were isolated by the analysis of the characteristics according to the Morphological and Biochemical characteristics. The various biochemical tests conducted were citrate utilization,catalase,urease,indole,methyl red,vogues prokauer,H2S and nitrate reduction test were performed and confirmed.Then using the specific medium. Azospirillum cultures synthesize considerable amount of biologically active substances like vitamins, nicotinic acid, and iodole acetic acids gibberellins. All these hormones/chemicals helps the plants in better germination, early emergence, better root development. Apart from nitrogen fixation, growth promoting substance production (IAA), disease resistance and drought tolerance are some of the additional benefits due to Azospirillum inoculation.

Azospirillum **:** Dobereiner's malic acid broth with NH_4Cl (1g per liter)

Composition of the N-free semisolid malic acid medium

- ✓ Malic acid - 5.0g
- ✓ Potassium hydroxide - 4.0g
- ✓ Dipotassium hydrogen orthophosphate - 0.5g
- ✓ Magnesium sulphate - 0.2g
- ✓ Sodium chloride - 0.1g
- ✓ Calcium chloride - 0.2g
- ✓ Fe-EDTA (1.64% w/v aqueous) - 4.0 ml
- ✓ Trace element solution - 2.0 ml
- ✓ BTB (0.5% alcoholic solution) - 2.0 ml
- ✓ Agar - 1.75 g
- ✓ Distilled water - 1000 ml
- ✓ pH - 6.8
- ✓ Trace element solution
- ✓ Sodium molybdate - 200 mg
- ✓ Manganous sulphate - 235 mg
- ✓ Boric acid - 280 mg
- ✓ Copper sulphate - 8 mg
- ✓ Zinc sulphate - 24 mg
- ✓ Distilled water - 200 ml

Immobilization of Azospirillum cells:

After 5days the culture was used to carry out immobilization with commercial grade sodium alginate. For producing best quality beads 1.5% alginate solution was prepared by suspending the polymer in Luke warm distilled water .The suspension was left over night on a rotary shaker at room temperature and filtered through a membrane filter. Then 50ml of alginate suspension was mixed with 50ml of *Azospirillum* suspension (100-170 cells)in distilled water and mixed thoroughly to get a final alginate solution of 1.5%. After proper mixing carrier containing inoculant was left for 7days and above formulated microbial inoculants was used as biofertilizer for sorghum plants that were under pot trials.

Results and Discussion:

Sorghum plants inoculated with immobilized Azospirillum showed 11-12% increased yields than the non immobilized *Azospirillum* . *Azospirillum* enhanced dry weight of seed by 59 percent and also the yield which was similar to 60 kg urea N ha-1. The results of the experiments conducted have clearly shown that *Azospirillum* can be used as a potential biofertilizer in both expensive and intensive agriculture. In developing countries like India, the use of *Azospirillum* as a biofertilizer would not only to the nitrogen supplementation to crops but also help in improving the fertility of soil in the long run.

Conclusion:

The use of ideal carrier material is necessary in the production of good quality biofertilizer. Peat soil, lignite, vermiculite, charcoal, press mud, farmyard manure and soil mixture can also be used as carrier materials. The neutralized peat soil/lignite are found to be better carrier materials for biofertilizer. Alginate beads can maintain a sufficient amount of live cells to assure inoculation up to several months. Considering the beneficial effects of PGPM studies using inoculant mixtures are opening a new approach to the subject. These studies would facilitate the designing of large consortia of inocula that bring about a synergistic promotion of plant growth or have multitasking features . The designing of biofilmed-based carriers or of encapsulation techniques which allow the production of macrocapsules consisting of a core and an envelope could facilitate the development of biofertilizers formed of microbial consortia.

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A Peer Reviewed & Refereed, International Open Access Journal
www.jabe.in Vol.1.S1.2014, ISSN:2394-2606

ENVIRONMENTAL PROTECTION – ADVANTAGES OF BIO-FERTILIZERS

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ABSTRACT: Sustainable crop production depends much on good soil health. Soil health maintenance warrants optimum combination of organic and inorganic components of the soil. Repeated use of chemical fertilizers destroys soil biota. In nature, there are a number of useful soil micro organisms which can help plants to absorb nutrients. Their utility can be enhanced with human intervention by selecting efficient organisms, culturing them and adding them to soils directly or through seeds. The cultured micro organisms packed in some carrier material for easy application in the field are called bio-fertilisers.

Bio-fertilisers are living microorganisms of bacterial, fungal and algal origin. Their mode of action differs and can be applied alone or in combination. By systematic research, eficient strains are identified to suit to given soil and climatic conditions. Such strains have to be mass multiplied in laboratory and distributed to farmers. They are packed in carrier materials like peat, lignite powder in such a way that they will have sufficient shelf life.

INTRODUCTION

Major advantages of Biofertilisers:

Biofertilisers enhance the nutrient availability to crop plants (by processes like fixing atmosphere N or dissolving P present in the soil) ; and also impart better health to plants and soil thereby enhancing crop yields in a moderate way. It is a natural method without any problems like salinity and alkalinity, soil erosion etc.. In the vast areas of low input agriculture and oil seeds production, as also in crops like sugarcane, etc, these products will be of much use to give sustainability to production. In view of the priority for the promotion of organic farming and reduction of chemical residues in the environment, special focus has to be given 'or the production of biofertilisers.

Commercial prospects

The biofertilisers are mainly purchased by State Agriculture Departments and distributed to the farmers at concessional rates. About 200 to 500 grams of carrier material is only needed per acre, costing about Rs.10/- to 25/-. In view of the above, if the units are selected carefully, there can be assured business. The benefits usually obtained by the use of biofertilizers will not be as visible as that of chemical fertilizers. As the results are not dramatic, many farmers are not aware of the significance, excepting in States like Maharashtra, Gujarat, parts of Karnataka and Tamil Nadu, these are more commonly used with Government's support. In the context of increasing awareness about the use of natural products and organic agriculture, these products will have good scope. Further, the organically grown produces fetch higher prices both in domestic and export markets.

It is estimated that the production of biofertilisers in the country by the existing units is about 7500 to 9000 TPA. This is far below the potential requirement of 7.6 lath TPA by the year 2000- 2001 as estimated by the National Biofertiliser Development Centre (NBDC) Ghaziabad. So far, the Ministry of Agriculture has supported establishment of 67 biofertiliser units in different parts of the country.

Estimated potential Demand for Biofertilisers by 2000-2001

Type of Biofetilizer	Demand(tones)
Rhizobium	34,999
Azotobacter	145,953
Azospirillurm	74,342
Blue-Green Algae	251,738
Phosphatesolublising microorganism	255,340
Total	762,372

Biofertilser Technology

The technology used were indigenous and the scientific aspects of production are standardised by Agricultural Universities and Research Laboratories of G01.. Machinaries and laboratory equipments are available from various manufacturers and are of BJS standards..

Objective of Biofertilser Project

The primary objective of biofertiliser projects could be production of various strains of good quality Biofertilisers using most modern technology. The infrastructure and laboratory facilities created, however, can be utilised for the production of bio - pesticides and bio control agents. Multi product range will increase the viability.

Requirements of Biofertilser Projects

The successful implementation of such projects which are In line with the technology and objective of .biofertiliser production, various facilities are required for indicated below:

Land

It is required to set up laboratory and other facilities and office. Space may also be required for installing tube well / dug well and parking of vehicles. A minimum of 1/2 acre of land is required for setting up a 150 TPA unit. Preferably, the entire site should be fenced with barbed wire or compound wall with gates at suitable places. The boundary may be planted with thick and tall growing species like Asoka, to filter air and reduce dust.

Layout and buildings

The civil works comprises of factory building for laboratory, Carrier preparation and enrichment, sterilisation, Inoculation and quality control, Maturation of culture, Mixing and packing, storage/ staff etc,. The total covered area of about 3000 sq ft is required for the product manufacturing and other utilities. Rest of the area of land will be enough for future expansion up to 300 to 600 Tonnes per Annum.

Plant and Machinery

Manufacture of biofertilisers needs a good number of laboratory equipments as well as other production facilities such as fennentors, culture medium tank, fermentor assembly, autoclaves, boiler, broth dispensers for sterlisation, deminralising plant, air compressor etc,. All the machinery are manufactured in the country. Some of the suppliers undertake the installing the units on a turn key basis.

Manufacturing process and Source of technology

The mother culture of various strains of biofertiliser are supplied from Agricultural Universities and Regional Biofertiliser Development centres (MOA). The operations involved in the manufacturing process are given in the form of a flow diagram. The unit generally comprises of media preparation room, media store room, inoculation room, growth room, culture transfer room, sterilization ,Mixing and packing, etc. The floor plan should be designed to promote maximum efficiency and minimum contamination. The design should facilitate maintenance of optimum temperature, humidity and ventilation. Inside air of the unit should be free from dust particles. Infrastructural Facilities for raw material, carrier material and utilities

The raw material required for biofertilser production include ingredients for growth median for the production of broth, carrier, packing materials like polythene packets. corrugated boxes, etc,.

Utilities

I) Power

Normally a three phase electric supply is required for these plants. The normal requirements of a 150 TPA unit is about 70 hp. Depending upon the position of power supply, stand by generator may be needed.

II) Water

A Biofertiliser production unit requires water mainly for steam generation for sterlisation of carrier, broth preparation and cleaning of equipments. Accordingly well/ bore well of designed size and according to the quality of water demineralisation equipments are to be installed. The average per day requirement of water for 150 TPA capacity will be about 2500 to 3000 liters

III) Compressed air

It will be required for various pneumatic operations as well as for controlled air supply to fermenters, sterlisation / cleaning operations etc,.

IV) Vehicles

The vehicles are required for procurement of carrier material and distribution of biofertilisers as well as for office use . Accordingly one LCV and a jeep have been included in the project.

V) Manpower

Unit Size

The size of a biofertiliser unit could be expressed in terms of the capacity of production of various types/ strains of biofertilisers per annum. The projects so far set up in our county vary from 75 TPA to 300 TPA. The size envisaged in the present model is 150

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www.jabe.in Vol.1.S1.2014, ISSN:2394-2606

TPA in one shift. The capacity can be easily expanded by adding a few additional equipment like a fermenter and/ or adding another shift.

Environmental Aspects and Pollution Control

No hazardous effluents are generated from a biofertiliser unit.

2. RESULT & DISCUSSION

NAME	CROPS SUITED	BENEFITS USUALLY SEEN	REMARKS
Rhyzobium strains	Legumes like pulses, groundnut, soyabean	10-35% yield increase,50-200kg N/ha	Fodders give better results.Leaves residual N in the soil.
Azotobacter	Soil treatment for non-legume crops including dry land crops	10-15% yield increase adds 20-25kg N/ha	Also controls certain diseases.
Azospirilum	Non-legumes like maize,barley,oats,sorghum, Millet,sugarcane,rice etc.	10-20% yield increase	Fodders give higher /enriches fodder response. Produces growth promoting substances. It can be applied to legumes has co-inoculant.
Phosphate Solubilizers* (*there are 2 bacterial and 2 fungal species in this group)	Soil applications for all crops	5-30% yield increase	Can be mixed with rock phosphate.
Blue-Green algae and Azolla	Rice/wet lands	20-30kg N/ha, Azolla can give biomass upto 40-50 tonnes and fix 30-100kg N/ha	Reduces soil alkalinity, Can be used for fishes as feed. They have growth promoting hormonal effects . TNAU has developed high yielding Azolla hybrids.
Microhizae(VAM)	Many trees, some crops and some ornamental plants.	30-50% yield increase, Enhances uptake of P.Zn,S and Water	Usually inoculated to seedlings.

Layout of the production unit:

Raw materials:

- Mother cultures.
- Carrier material- lignite or bentonite or peat of desired quality in powder from (70-100 mesh).
- Polythene bags, HDPE bags, cardboard cotans.
- Growth material- include Manital,sucrose and chemical nutrients.

CONCLUSION

Bio Fertilisers thus exercise an over all influence on farmers and also on environment. It is the main factor in the increase of production of the crop and it is beneficial to the farmer . The expenditure spent by the farmer on the crop and the income from the crop should have good margin. There are large possibilities for the development of Bio-Fertilisers. Effective steps are to be taken to save the crop production.

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A Peer Reviewed & Refereed, International Open Access Journal
www.jabe.in **Vol.1.S1.2014,** **ISSN:2394-2606**

BIOFERTILIZERS - RELATED ISSUES IN INDIA

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Abstract: Biofertilizers are supposed to be a safe alternative to chemical fertilizers to minimize the ecological disturbance. Biofertilizers are cost effective, eco-friendly and when they are required in bulk can be generated at the farm itself. They increase crop yield upto 10-40% and fix nitrogen upto 40-50 Kg. The other plus point is that after using 3-4 years continuously there is no need of application of biofertilizers because parental inoculums are sufficient for growth and multiplication. They improve soil texture, pH, and other properties of soil. They produces plant growth promoting substances IAA amino acids, vitamins etc. They have 75% moisture and it could be applied to the field directly. Biofertilizers contained 3.5% - 4% nitrogen, 2% - 2.5% phosphorus and 1.5% potassium. In terms of N: P: K, it was found to be superior to farmyard manure and other type of manure.

Chemical fertilizers at the farm level have been ensured only through imports and subsidies. Dependence on chemical fertilizers for future agricultural growth would mean further loss in soil quality, possibilities of water contamination and unsustainable burden on the fiscal system. The Government of India has been trying to promote an improved practice involving use of bio-fertilizers along with fertilizers. These inputs have multiple beneficial impacts on the soil and can be relatively cheap and convenient for use. Consistent with current outlook, the government aims not only to encourage their use in agriculture but also to promote private initiative and commercial viability of production.

Bio-fertilizers such as Rhizobium, Azotobacter, Azospirilium and Blue green algae (BGA) have been in use a long time. Rhizobium inoculant is used for leguminous crops. Azotobacter can be used with crops like Wheat, Maize, Mustard, cotton, potato and other vegetable crops. Azospirilium inoculations are recommended mainly for sorghum, millets, maize, sugarcane and wheat. Blue green algae belonging to a general cyanobacteria genus, Nostac or Anabina or Tolypothrix or Aulosira, fix atmospheric nitrogen and are used as inoculations for paddy crop grown both under upland and low-land conditions. Anabina in association with water fern Azolla contributes nitrogen up to 60 kg/ha/season and also enriches soils with organic matter

A Bio fertlizer (also *bio-fertilizer*) is a substance which contains living microorganisms which, when applied to seed, plant surfaces, or soil, colonizes the rhizospere or the interior of the plant and promotes growth by increasing the supply or availability of primary nutrients to the host plant. Bio-fertilizers add nutrients through the natural processes of nitrogen fixation, solubilizing phosphorus, and stimulating plant growth through the synthesis of growth-promoting substances. Bio-fertilizers can be expected to reduce the use of chemical fertilizers and pesticides. The microorganisms in bio-fertilizers restore the soil's natural nutrient cycle and build soil organic matter.

Plants have a number of relationships with fungi, bacteria, and algae, the most common of which are with mycorrhiza, rhizobium, and cyanophyceae. These are known to deliver a number of benefits including plant nutrition, disease resistance, and tolerance to adverse soil and climatic conditions. These techniques have proved to be successful biofertilizers that form a health relationship with the roots.

Different types of biofertilizers

Rhizobium: Rhizobium is a soil habitat bacterium, which can able to colonize the legume roots and fixes the atmospheric nitrogen symbiotically. The morphology and physiology of Rhizobium will vary from free-living condition to the bacteroid of nodules. They are the most efficient biofertilizer as per the quantity of nitrogen fixed concerned. They have seven genera and highly specific to form nodule in legumes, referred as cross

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www.jabe.in **Vol.1.S1.2014,** **ISSN:2394-2606**

inoculation group. *Rhizobium* inoculant was first made in USA and commercialized by private enterprise in 1930s and the strange situation at that time has been chronicled by Fred (1932). Initially, due to absence of efficient bradyrhizobial strains in soil, soybean inoculation at that time resulted in bumper crops but incessant inoculation during the last four decades by US farmers has resulted in the build up of a plethora of inefficient strains in soil whose replacement by efficient strains of bradyrhizobia has become an insurmountable problem.

Azotobacter: Of the several species of *Azotobacter*, *A. chroococcum* happens to be the dominant inhabitant in arable soils capable of fixing N2 (2-15 mg N2 fixed /g of carbon source) in culture media.The bacterium produces abundant slime which helps in soil aggregation. The numbers of *A. chroococcum* in Indian soils rarely exceeds 105/g soil due to lack of organic matter and the presence of antagonistic microorganisms in soil.

Azospirillum: *Azospirillum lipoferum* and *A. brasilense* (*Spirillum lipoferum* in earlier literature) are primary inhabitants of soil, the rhizosphere and intercellular spaces of root cortex of graminaceous plants. They perform the associative symbiotic relation with the graminaceous plants. The bacteria of Genus *Azospirillum* are N2 fixing organisms isolated from the root and above ground parts of a variety of crop plants. They are Gram negative, *Vibrio* or *Spirillum* having abundant accumulation of polybetahydroxybutyrate (70 %) in cytoplasm. Five species of *Azospirillum* have been described to date *A. brasilense*, *A.lipoferum*, *A.amazonense*, *A.halopraeferens* and *A.irakense*. The organism proliferates under both anaerobic and aerobic conditions but it is preferentially micro-aerophilic in the presence or absence of combined nitrogen in the medium.Apart from nitrogen fixation, growth promoting substance production (IAA), disease resistance and drought tolerance are some of the additional benefits due to *Azospirillum* inoculation.

Cyanobacteria: Both free-living as well as symbiotic cyanobacteria (blue green algae) have been harnessed in rice cultivation in India. A composite culture of BGA having heterocystous *Nostoc*, *Anabaena*, *Aulosira etc*. is given as primary inoculum in trays, polythene lined pots and later mass multiplied in the field for application as soil based flakes to the rice growing field at the rate of 10 kg/ha. The final product is not free from extraneous contaminants and not very often monitored for checking the presence of desiredalgal flora.

Once so much publicized as a biofertilizer for the rice crop, it has not presently attracted the attention of rice growers all over India except pockets in the Southern States, notably Tamil Nadu. The benefits due to algalization could be to the extent of 20-30 kg N/ha under ideal conditions but the labour oriented methodology for the preparation of BGA biofertilizer is in itself a limitation. Quality control measures are not usually followed except perhaps for random checking for the presence of desired species qualitatively.

Azolla: *Azolla* is a free-floating water fern that floats in water and fixes atmospheric nitrogen in association with nitrogen fixing blue green alga *Anabaena azollae*. *Azolla* fronds consist of sporophyte with a floating rhizome and small overlapping bi-lobed leaves and roots. Rice growing areas in South East Asia and other third World countries have recently been evincing increased interest in the use of the symbiotic N2 fixing water fern *Azolla* either as an alternate nitrogen sources or as a supplement to commercial nitrogen fertilizers. *Azolla* is used as biofertilizer for wetland rice and it is known to contribute 40-60 kg N/ha per rice crop.

Phosphate solubilizing microorganisms(PSM)

Several soil bacteria and fungi, notably species of *Pseudomonas, Bacillus, Penicillium, Aspergillus etc*. secrete organic acids and lower the pH in their vicinity to bring about dissolution of bound phosphates in soil. Increased yields of wheat and potato were demonstrated due to inoculation of peat based cultures of *Bacillus polymyxa* and *Pseudomonas striata*. Currently, phosphate solubilizers are manufactured by agricultural universities and some private enterprises and sold to farmers through governmental agencies. These appear to be no check on either the quality of the inoculants marketed in India or the establishment of the desired organisms in the rhizosphere.

AM fungi: The transfer of nutrients mainly phosphorus and also zinc and sulphur from the soil *milleu* to the cells of the root cortex is mediated by intracellular obligate fungal endosymbionts of the genera *Glomus, Gigaspora, Acaulospora, Sclerocysts* and *Endogone* which possess vesicles for storage of nutrients and arbuscles for funneling these nutrients into the root system. By far, the commonest genus appears to be *Glomus*, which has several species distributed in soil.Availability for pure cultures of AM (Arbuscular Mycorrhiza) fungi is an impediment in large scale production despite the fact that beneficial effects of AM fungal inoculation to plants have been repeatedly shown under experimental conditions in the laboratory especially in conjunction with other nitrogen fixers.

Do's and Don't for Entrepreneurs, Dealers and farmers:

Do

- ✓ Keep Bio-fertilizers bottles away from direct heat and sunlight. Store it in cool and dry place
- ✓ Sell only Bio-fertilizers bottles which contain batch number, the name of the crop on which it has to be used, the date of manufacture and expiry period
- ✓ If the expiry period is over, then discard it as it is not effective.
- ✓ Keep Bio-fertilizers bottles away from fertilizer or pesticide containers and they should not be mixed directly

Don't

- ✓ Don't store Bio-fertilizers bottles under heat and sunlight
- ✓ Don't sell Bio-fertilizers bottles after their expiry period is over.
- ✓ Don't prick holes into the bottles or puncture them to pour the content
- ✓ Do not mix the Bio-fertilizers with fungicides, insecticides, herbicides, herbicides and chemical fertilizers.

Constraints in Biofertilizer Technology

Though the biofertilizer technology is a low cost, ecofriendly technology, several constraints limit the application or implementation of the technology the constraints may be environmental, technological, infrastructural, financial, human resources, unawareness, quality, marketing, etc. The different constraints in one way or other affecting the technique at production, or marketing or usage.

Technological constraints

- Use of improper, less efficient strains for production.
- Lack of qualified technical personnel in production units.
- Unavailability of good quality carrier material or use of different carrier materials by different producers without knowing the quality of the materials.
- Production of poor quality inoculants without understanding the basic microbiological techniques
- Short shelf life of inoculants.

Infrastructural constraints

- Non-availability of suitable facilities for production
- Lack of essential equipments, power supply, etc.
- Space availability for laboratory, production, storage, etc.
- Lack of facility for cold storage of inoculant packets

Financial constraints

- Non-availability of sufficient funds and problems in getting bank loans
- Less return by sale of products in smaller production units.

Environmental constraints

- Seasonal demand for biofertilizers
- Simultaneous cropping operations and short span of sowing/planting in a particular locality
- Soil characteristics like salinity, acidity, drought, water logging, etc.

Human resources and quality constraints

- Lack of technically qualified staff in the production units.
- Lack of suitable training on the production techniques.
- Ignorance on the quality of the product by the manufacturer

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- Non-availability of quality specifications and quick quality control methods
- No regulation or act on the quality of the products
- Awareness on the technology
- Unawareness on the benefits of the technology
- Problem in the adoption of the technology by the farmers due to different methods of inoculation.
- No visual difference in the crop growth immediately as that of inorganic fertilizers.

Awareness on the technology

- Unawareness on the benefits of the technology.
- Problem in the adoption of the technology by the farmers due to different methods of inoculation.
- No visual difference in the crop growth immediately as that of inorganic fertilizers.
- Unawareness on the damages caused on the ecosystem by continuous application of inorganic fertilizer.

Marketing constraints

- Non availability of right inoculant at the right place in right time.
- Lack of retain outlets or the market network for the producers.

Due to "chemical pesticide" problems in India, there is an urgent need to Promote environmental friendly 'Biopesticides' in the country. Moreover, recent Government policies also favour "Biopesticides and Biofertilizer. More over "Biofertilizers" also stimulate plant -growth through Production of "Plant growth promoting substances3". Application of Biofertilizers and biopesticides has thus become an integral component of nutrient management system. Apart from these, they play a vital role in increasing the agricultural production, a need of the day4-7-13 International 3rd Eco Expo Asia, October, conference and trade fair has already given emphasis on "Green Technologies". Govts. of Environmental Bureau decided to minimize - a low carbon environment and introduction of Bio-Organic Fertilizers including other policies in 2011.13 Finally, it can be concluded that our newly constructed " B.t. Based biopesticides" and the " Liquid USHA - PUCHI" Biofertilizer which seem to be very much efficient against the Paddy pest in the experimental paddy fields (plots) is really in the final trial stage. Inspite of that it needs an " Indepth" study and application before their marketing and commercialization, after fulfillment of all these requirements :- including patent, registration etc. Only then we now can say, "yes, these biopesticide and biofertilizer are definitely the substitute of chemical pesticide/fertilizer - atleast for paddy (rice) cultivation in India especially for Rice eaten states including West Bengal.

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www.jabe.in Vol.1.S1.2014, ISSN:2394-2606

AN OVER VIEW OF MICROBIAL BIOFERTILIZERS

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Abstract : Increasing use of chemical fertilizers in agriculture make country self dependent in food production. But it deteriorate environment and cause harmful impacts on living beings. Due to insufficient uptake of these fertilizers by plants results – fertilizers reaches into water bodies through rain water, causes eutrophication in water bodies and effect living beings including growth inhabiting microorganism. The excess use of chemical fertilizers in agriculture are costly and also have various adverse effects on soils i.e., depletes water holding capacity, soil fertility and disparity in soil nutrients. As a result, technologies such as biofertilizers have emerged in order to minimize environmental impacts and take advantage of the resources available in the field. A biofertilizer is not just any organic fertilizer or manure. It consists of a carrier medium rich in live microorganisms. When applied to seed, soil or living plants, it increases soil nutrients or makes them biologically available. Biofertilizers contain different types of fungi, root bacteria or other microorganisms (Microbial Biofertilizers). They form a mutually beneficial or symbiotic relationship with host plants as they grow in the soil. Biofertilizers have many advantages and a few disadvantages. The main scope of this article is to assess the efficacy of certain microorganisms used as biofertilizers, mentioning their advantages and limitations.

Key words: Microorganisms, Eutrophication, Chemical fertilizers, Microbial Biofertilizers.

INTRODUCTION

'Biofertilizer' is a substance which contains living microorganism which, when applied to seed, plant surfaces, or soil, colonizes the rhizosphere or the interior of the plant and promotes growth by increasing the supply or availability of primary nutrients to the host plant. .Biofertilizers are not fertilizers. Fertilizers directly increase soil fertility by adding nutrients. Biofertilizers add nutrients through the natural processes of fixing atmospheric nitrogen, solubilizing Phosphorus, and stimulating plant growth through the synthesis of growth promoting substances (Auxins, Abscisic Acid, Gibberellic Acid, Cytokinins and Ethylene).

Biofertilizers increase crop yield upto 10-40% and fix Nitrogen up to 40-50 Kgs. They improve soil texture, pH and other properties of the soil. They produce plant growth promoting substances like IAA, Amino acids, Vitamins etc., They contained 3.5 – 4.0% Nitrogen, 2.0 -2.5% Phosphorous and 1.5% Potassium. In terms of NPK, biofertilizers are superior to farmyard manure and other types of manure.

Classification of Microbial Biofertilizers :

Groups of Biofertilizers based on their nature and function.

S. No.	Groups	Examples
N2 fixing Biofertilizers		
1	Free-living	Azotobacter, Clostridium, Anabaena, Nostoc,
2	Symbiotic	Rhizobium, Frankia, Anabaena azollae
3	Associative Symbiotic	Azospirillum
P Solubilizing Biofertilizers		
1	Bacteria	Bacillus megaterium var. phosphaticum
		Bacillus circulans, Pseudomonas striata
2	Fungi	Penicillium sp, Aspergillus awamori
P Mobilizing Biofertilizers		
1	Arbuscular mycorrhiza	Glomus sp.,Gigaspora sp.,Acaulospora sp.,

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www.jabe.in **Vol.1.S1.2014,** **ISSN:2394-2606**

		Scutellospora sp. & Sclerocystis sp.
2	Ectomycorrhiza	Laccaria sp., Pisolithus sp., Boletus sp., Amanita sp.
3	Orchid mycorrhiza	Rhizoctonia solani
Biofertilizers for Micro nutrients		
1	Silicate and Zinc solubilizers	acillus sp.
Plant Growth Promoting Rhizobacteria		
1	Pseudomonas	Pseudomonas fluorescens

Different types of microbial biofertilizers:

1. Rhizobium - This belongs to bacterial group and the classical example is symbiotic nitrogen fixation. The bacteria infect the legume root and form root nodules within which they reduce molecular nitrogen to ammonia which is reality utilized by the plant to produce valuable proteins, vitamins and other nitrogen containing compounds. The site of symbiosis is within the root nodules. It has been estimated that 40-250 kg N / ha / year is fixed by different legume crops by the microbial activities of Rhizobium. Table shows the N fixation rates.

2. Azotobacter - It is the important and well known free living nitrogen fixing aerobic bacterium. It is used as a Bio-Fertilizer for all non leguminous plants especially rice, cotton, vegetables etc. Azotobacter cells are not present on the rhizosplane but are abundant in the rhizosphere region. The lack of organic matter in the soil is a limiting factor for the proliferation of Azotobaceter in the soil.

3. Azospirillum - It belongs to bacteria and is known to fix the considerable quantity of nitrogen in the range of 20- 40 kg N/ha in the rhizosphere in non-non-leguminous plants such as cereals, millets, Oilseeds, cotton etc.

4. Cyanobacteria - A group of one-celled to many-celled aquatic organisms. Also known as blue green algae. Eg. Azotobacter, Clostridium, Anabaena, Nostoc,

5. Azolla - Azolla is a free-floating water fern that floats in water and fixes atmospheric nitrogen in association with nitrogen fixing blue green alga Anabaena azollae. Azolla fronds consist of sporophyte with a floating rhizome and small overlapping bi-lobed leaves and roots. Azolla is considered to be a potential biofertilizer in terms of nitrogen contribution to rice. Long before its cultivation as a green manure, Azolla has been used as a fodder for domesticated animals such as pigs and ducks. In recent days, Azolla is very much used as a sustainable feed substitute for livestock especially dairy cattle, poultry, piggery and fish

6. Phosphate solubilizing microorganisms(PSM) – Some fungi have phosphate dissolving ability. Eg. Aspergillus niger, A. awamori and Penicillium digitatum etc.

7. AM fungi- An arbuscular mycorrhiza (AM Fungi) is a type of mycorrhiza in which the fungus penetrates the cortical cells of the roots of a vascular plant. Eg . Glomus sp.,Gigaspora sp., Acaulospora sp, Laccaria sp., Pisolithus sp., Boletus sp.,

8. Silicate solubilizing bacteria (SSB)- Microorganisms are capable of degrading silicates and aluminum silicates. During the metabolism of microbes several organic acids are produced and these have a dual role in silicate weathering.
Eg. Bacillus sp.

9. Plant Growth Promoting Rhizobacteria (PGPR)- The group of bacteria that colonize roots or rhizosphere soil and beneficial to crops are referred to as plant growth promoting rhizobacteria (PGPR). Eg. Pseudomonas fluorescens.

Methods adopted for applying Biofertilizers to crop plants :

- **Seedling root dip** : This method is applied to the rice crop. A bed of water is spread on the land where the crop has to grow. The seedlings of rice are planted in the water and are kept there for eight to ten hours.
- **Seed treatment** : In this method, the nitrogen and phosphorus fertilizers are mixed together in the water. Then seeds are dipped in this mixture. After the applications of this paste to the seeds, seeds are dried. After they dry out,

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www.jabe.in **Vol.1.S1.2014,** **ISSN:2394-2606**

they have to be sown as soon as possible before they get damaged by harmful microorganisms.

- **Soil treatment** : All the biofertilizers along with the compost fertilizers are mixed together. They are kept for one night. Then the next day this mixture is spread on the soil where seeds have to be sown.

Advantages of Biofertilizers :

1. They help to get high yield of crops by making the soil rich with nutrients and useful microorganisms necessary for the growth of the plants.
2. These have replaced the chemical fertilizers as chemical fertilizers are not beneficial for the plants. They decrease the growth of the plants and make the environment polluted by releasing harmful chemicals.
3. Plant growth can be increased if biofertilizers are used, because they contain natural components which do not harm the plants.
4. If the soil will be free of chemicals, it will retain its fertility which will be beneficial for the plants as well as the environment, because the plants will be protected from getting any diseases and environment will be free of pollutants.
5. Biofertilizers destroy those harmful components from the soil which cause diseases in the plants. Plants can also be protected against drought and other strict conditions by using biofertilizers.
6. Biofertilizers are not costly and even poor farmers can make use of them.
7. They are environment friendly and protect the environment against pollutants.

Limitations:

1. Extensive and long-term application may result in accumulation of salts, nutrients, and heavy metals that could cause adverse effects on plant growth, development of organisms of the soil, water quality, and human health.
2. Large volumes are required for land application due to low contents of nutrients, in comparison with chemical fertilizers.
3. Main macronutrients may not be available in sufficient quantities for growth and development of plants.
4. Nutritional deficiencies could exist, caused by the low transfer of micro- and macro-nutrients.

Conclusions : Our dependence on chemical fertilisers and pesticides has encouraged the thriving of industries that are producing life-threatening chemicals and which are not only hazardous for human consumption but can also disturb the ecological balance. Biofertilizers can help to solve the problem of feeding an increasing global population at a time when agriculture is facing various environmental stresses. Biofertilizers are the only option to improve the soil organic carbon for sustenance of soil quality and future agricultural productivity (Ramesh 2008). They are of environment friendly non-bulky and low cost agricultural inputs. Biofertilizer have an important role to play in improving nutrient supplies and their crop availability in the years to come. Hope this technology will attract the attention of the farmers who are the direct stake holders just to uplift their financial conditions directly and country's economy as a whole.

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A Peer Reviewed & Refereed, International Open Access Journal
www.jabe.in **Vol.1.S1.2014,** **ISSN:2394-2606**

BIOFERTILIZERS IN AGRICULTURE AND ENVIRONMENT

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Abstract: Biofertilizer is the biologically active products or microbial inoculants of bacteria, algae and fungi, which may help biological nitrogen fixation for the benefit of plants. Biofertilizers also include organic fertilizers (manures, etc.), which are rendered in an available form due to the interaction of microorganisms or due to the interaction of micro-organisms or due to their association with plants. Biofertilzers thus include (i) symbiotic nitrogen fixers e.g. Rhizobium spp.; (ii) a symbiotic free nitrogen fixer e.g. Azotobacter, Azospirillum, etc. (iii) algae biofertilisers e.g. blue green algae or BGA in association with Azolla; (iv) phosphate solubilising bacteria; (v) mycorrhizae; (vi) organic fertilizers.

INTRODUCTION

The need for the use of biofertilzers has arisen, primarily of two reasons. First, because increase in the use of fertilizers leads to increased usage of chemical fertilizer leads to damage in soil texture and raises other environmental problems. Therefore, the use of biofertilzers is both economical and environments friendly. The pragmatic approach will be to develop the integrated nutrient supply system involving a combination of the use of chemical fertilizers and biofertilizers. Nitrogen fertilizers have been limited to either manures, which have low levels of nitrogen, or chemical fertilizers, which usually have high levels of nitrogen. However, the excess nitrogen in chemical fertilizers often runs off into nearby waterways, causing a variety of environmental problems.

Environmental Impact: Biofertilizers are the substances which make use of microorganisms to fertile the soil. These fertilizers are not harmful to crops or other plants like the chemical fertilizers. They are actually taken from the animal wastes along with the microbial mixtures. Microorganisms are used to increase the level of nutrients in the plants. They let the plants grow in a healthy environment. They are also environment friendly and do not cause the pollution of any sort. Use of biofertilizers in the soil, makes the plants as well as protect them from getting any diseases.

The use of animal and plant wastes in the field as manures will clean the environment. The organic wastes piled up everywhere can be used as compost reducing the environmental pollution. Besides, the deposits from ponds and aquatic systems can be used as bio-fertilizers and pesticides. This will clean the aquatic system while increasing productivity in the field. As against the poisonous chemical pesticides bio-pesticides prepared from natural biological resources like plants and standardized microbes have no harmful effects. Local bio-pesticides like neem leaf and oil, karanj (derris indica) extracts and oil, cow urine can be used as insecticide and fungicide. Unlike the chemical pesticides they do not hit the non-target pests nor do they pollute the environment.

Types of Biofertilizers: Types of biofertilizers are Nitrogen Biofertilizers, Phosphorus biofertilizers and Compost Biofertilizers.

Nitrogen Biofertilizers: This type of biofertilizers helps the agriculturists to determine the nitrogen level in the soil. Nitrogen is a necessary component which is used for the growth of the plant. Plants need a limited amount of nitrogen for their growth. The type of the crops also determines the level f nitrogen. Some crops need more nitrogen for their growth while some crops need fewer amounts. The type of the soil also determines that which type of biofertilizers is needed for this crop.

Phosphorus biofertilizers: Phosphorus biofertilizers are used to determine the phosphorus level in the soil. The need of phosphorus for the plant growth is also limited. Phosphorus biofertilizers make the soil get the required amount of phosphorus. It is not necessary that a particular phosphorus biofertilizers is used for a particular type of crop.

Compost Biofertilizers: Compost biofertilizers are those which make use of the animal dung to enrich the soil with useful microorganisms and nutrients.

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www.jabe.in Vol.1.S1.2014, ISSN:2394-2606

To convert the animals waste into a biofertilizers, the microorganisms like abcteria undergo biological processes and help in breaking down the waste.

Advantages of biofertilizers:-

1) They help to get high yield of crops by making the soil rich with nutrients and useful microorganisms necessary for the growth of the plants.
2) Biofertilizers have replaced the chemical fertilizers as chemical fertilizers are not beneficial for the plants. They decrease the growth of the plants and make the environment polluted by releasing harmful chemicals.
3) Biofertilizers destroy those harmful components from the soil which cause diseases in the plants. Plants can also be protected against drought and other strict conditions by using biofertilizers.
4) Biofertilizers are not costly and even poor farmers can make use of them.
5) They are environment friendly and protect the environment against pollutants.

The Role of Biofertilizers in Agriculture: Biofertilizers are one such technique, which can be used in a scientific way to avoid environmental pollution. Biofertilizers not only keep the crops healthy, will change the micro environment of the soil and increases beneficiary microbial fauna. Biofertilizers are one such alternative fertilizer which is nothing but the preparation containing micro organisms that helps agricultural crops to uptake nutrients more efficiently. In nature beneficiary micro organisms may not present in optimal level in the fields to observe the required benefit. Therefore artificial cultures of selected micro organisms holds promising role in developing the microbial fauna in the field. The biofertilizers are used as one of the critical components of the nutrient management and are easily renewable and cost effective as compared to the artificial fertilizers.

Biofertilizers provides phosphorous and nitrogen nutrients to plants via N2 fixation and phosphorous solubilization mechanisms. Biofertilizers are one of the important components of organic farming that enhances the plant growth and yield; also improves health and fertility of soil. The application cost of Biofertilizers when compared to the synthetic fertilizer is very less, hence will lower the cost of agricultural activity and results in improved economic conditions of the farmer. The crops grown with biofertilizers are considered healthier as the plants are allowed to grow and produce fruits in a natural ways. Biofertilizers also gives protection to crops against diseases and insect pest, hence reduces the application of pesticides in the field.

The other class of bacteria's which colonizes roots and beneficial for crops are known as plant growth promoting rhizobacteria (PGPR). PGPR promote crops growth through either of the following mechanisms. PGPR might help in suppressing plant diseases called Bioprotectants or they might help in nutrient acquisition called Biofertilizers or might help in phytohormone production called Biostimulants. Bacteria with good competitive and high saprophytic mode become the critical factors determining the success of biofertilizers. More research is required in the field of biofertilizers to develop strains that can be easily inoculated into host systems and proves effective in field conditions. The current traditional chemical fertilizer applications has resulted in environmental pollution and increased cost of agricultural activity makes tremendous potential for Biofertilizers research in future.

Promoting Bio-fertilizers in Indian Agriculture: In India the availability and affordability of fossil fuel based chemical fertilizers at the farm level have been ensured only through imports and subsidies. Dependence on chemical fertilizers for future agricultural growth would mean further loss in soil quality, possibilities of water contamination and unsustainable burden on the fiscal system. The Government of India has been trying to promote an improved practice involving use of bio- fertilizers along with fertilizers. Institute of Economic Growth for the Ministry of Agriculture, Government of India. The author thanks Professor Kanchan Chopra of IEG for her comments and suggestions. The Fertiliser Association of India is acknowledged gratefully for data support and insightful discussions.

Biofertilizers make nutrients that are naturally abundant in soil or atmosphere usable for plants. Field studies have demonstrated them to be

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www.jabe.in Vol.1.S1.2014, ISSN:2394-2606

effective and cheap inputs, free from the environmentally adverse implications that chemicals have. Biofertilizers offer a new technology to Indian agriculture holding a promise to balance many of the shortcomings of the conventional chemical based technology. It is a product that is likely to be commercially promising in the long run once information becomes available adequately to producers and farmers through experience and communication.

The Government of India and the various State Governments have been promoting the nascent biofertilizer market both at the level of the user-farmer and the producer-investor through the following measures: (i) farm level extension and promotion programmes, (ii) financial assistance to investors in setting up units, (iii) subsidies on sales and (iv) direct production in public sector and cooperative organizations and in universities and research institutions. Indiscriminate use of fertilizers, particularly the nitrogenous, has led to substantial pollution of soil, air and water. Fertilizer contamination of ground waters has led to eutrophication of lake and river waters causing depletion of oxygen and even death of aquatic life, nitrate pollution, increased emissions of gaseous N and metal toxicities.

The role of biofertilizers in conventional production systems; technology transfers and promotional programs; rural production/multiplication systems; conservation of germplasm/agent; linkages for a sound use program; national and international linkages; simplified regulatory and registration procedures; media support; creation of data bank etc. deserve attention. Keeping in view the potential of biofertilizers as an important component of sustainable agriculture particularly on small-farmer holdings, the Asia-Pacific Association of Agricultural Institutions (APAARI) in its Tenth General Assembly Meeting held on 20th October 2008 at Tsukuba recommended to organize an Expert Consultation on Bio-fertilizers" as a part of work plan for 2009.

Responses, and Limitations: The nitrogen equivalences reported for biofertilizers are only indirectly approximated through controlled experiments since the way of accessing nutrients itself in indirect unlike nutrient *containing* chemical fertilizers and manures, and the comparative values of bulk and cost may not be realistic. Biofertilizers have various benefits. Besides accessing nutrients, for current intake as well as residual, different biofertilizers also provide growth-promoting factors to plants and some have been successfully facilitating composting and effective recycling of solid wastes. By controlling soil borne diseases and improving the soil health and soil properties these organisms help not only in saving, but also in effectively utilising chemical fertilizers and result in higher yield rates.

Biofertilizers, particularly Rhizobium, could be a bridge between removals and additions to soil nutrients where farmers can scarcely afford costly inputs and that too in a risky environment. The responses usually depend on several environmental factors. (a) The type of soil as measured by its water holding capacity, its levels of other nitrates, phosphate and even calcium and molybdenum (that help in protein synthesis in Rhyzobia) and the alkalinity, salinity and acidity of soil all affect the response. Higher dose of mineral nitrogen as starter suppresses nodulation, reducing response of Rhyzobium but phosphate deficiency can be an inhibitor also. (b) The inadequacy of organic matter especially common in dry land agriculture is a deterrent more for the non-symbiotic strains, which essentially depend on soil organic matter for energy.

Government Intervention in Biofertilizer Market: The Government of India implemented a central sector scheme called National Project on Development and use of Biofertilizers (NPDB) during the Ninth Plan for the production, distribution and promotion of biofertilizers. A National Biofertilizer Development Centre was established at Ghaziabad as a subordinate office of the Department of Agriculture and Cooperation with six regional centers. The purpose of the scheme covered organization of training courses for extension workers and field demonstrations and providing quality control services. Production and distribution of different biofertilizers were also undertaken but subsequently discontinued as the centers redefined their role towards R&D and HRD related activities.

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www.jabe.in Vol.1.S1.2014, ISSN:2394-2606

Success of Biofertilizer Technology: Government of India and the different State Governments have been promoting use of biofertilizers through grants, extension and subsidies on sales with varying degrees of emphasis. With time farmers too learn about the technology forming their perception on the basis of agronomic realities of their regions, the knowledge gained from experiences of farmers around them and including themselves and the information provided by different disseminating agents and form their own decisions of adoption.

Progress of the Industry: Based on the data for 1995, 1997 and 1999 it appears that the industry witnessed a steady increase in the number of units producing the input. Over the period of four years the number of units went up by 53% from 62 to 95 and further to 122 in 2002 (Ministry of Agriculture, GOI). The central government's role in the new biofertilizer technology would be justified by greater spatial dimension of the success. Since biofertilizers are perishable and sensitive to quality of handling, the distribution of plants would to some extent reflect the regional distribution pattern.

CONCLUSIONS

Government intervention in the market is concerned. Till date the central government has spent several crores of rupees as grants to invite investment and state governments have also spent large sums for subsidizing and promoting use. The government can act on behalf of the society through appropriate policy even if the market is otherwise competitive. Biofertilizers have important environmental and long-term implications, negating the adverse effects of chemicals. At the farm level, the gains from increased use of the technology can spill over to other farms and sectors through lesser water pollution than chemical fertilizers and even to an extent organic manures can create. The gains from the new technology coming through the arrest of soil damage may not be perceived over a short span of time unlike for chemical fertilizers, which yield quick returns. Biofertilizers have been promoted as supplement or complement of chemical fertilizers, in reality they are two alternative means of accessing plant nutrients. The strength of complementarities as against substitution between the two inputs is open to empirical verification, but there is no denying that farmers and producers do perceive the substitutability relation to an extent. The external or environmental cost of using chemical fertilizers, though not measurable may also be taken into account when comparing with biofertilizers if the latter is to be promoted.

A proposal to make it mandatory for biofertilizer units to contribute in the process through their own demonstration is a welcome step. Research and extension/promotion both must be to the extent possible specific to local conditions and constraints. It is a good practice to promote biofertilizers as an input conjunctive to other forms of fertilizers, but keeping in view the protection given to chemicals, there is some ground for subsidizing the former to encourage their use.

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A Peer Reviewed & Refereed, International Open Access Journal
www.jabe.in Vol.1.S1.2014, ISSN:2394-2606

A STATE-OF-THE-ART REVIEW OF BIOFERTILIZERS IN INDIA

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ABSTRACT: Biofertilizers are defined as preparations containing living cells of microorganisms that help crop plants' uptake of nutrients by their interactions in the rhizosphere when applied through seed or soil. They accelerate certain microbial processes in the soil which augment the extent of availability of nutrients in a form easily assimilated by plants. The full paper addresses the basics concerning biofertilizers-from their definition, classification and the advantages limitations in the modern agriculture. The state-of-the-art scenario of biofertilizer production in India and the contribution of Andhra Pradesh in particular have been highlighted in this paper. Although Southern India amounts to more than 50% of the total biofertilizer production in India, there still is a large scope of improvement in the productivity of biofertilizers in Andhra Pradesh. The statistics provided in this article offer a clear picture of the extent of biofertilizer production in India and the share of Andhra Pradesh in it. A few ideas to increase the production, as well as to improve the quality, of biofertilizers in India have been presented towards the end of the article.

INTRODUCTION:

A biofertilizeris an organic substance that contains living microorganisms which, when applied to seed or soil, colonizes the rhizosphere or the interior of the plant and promotes growth by increasing the supply of primary nutrients to the host plant [1].The mainsources of biofertilizers are bacteria, fungi andcynobacteria (blue-greenalgae) [2]. The most strikingrelationship that these microorganisms havewith plants is symbiosis, inwhich the partners derivebenefits from each other. In addition, they fix atmospheric nitrogen, make insoluble phosphates soluble and decompose farm wastes releasing plant nutrients. On a more encouraging note, they are cost-effective, eco-friendly and can be generated at the farm itself.

Biofertilizers usually contain 3.5-4% nitrogen, 2-2.5% phosphorous and about 1.5% potassium. In terms of the N:P:K ratio, it was found that biofertilizers are superior to farmyard manure or any other type of chemical fertilizers. They improve soil texture, pH and longevity, thus enhancing the quality of soil in the long run. They also produce plant growth substances like amino acids, vitamins etc.

Classification:

Different kinds of microorganism-based biofertilizers offer different advantages to the plant species and soil. Hence, the right choice of biofertilizer has to be made depending on the particular type of the soil and the type of the crop. The following flow chart (Figure 1) demonstrates different types of biofertilizers based on their function.

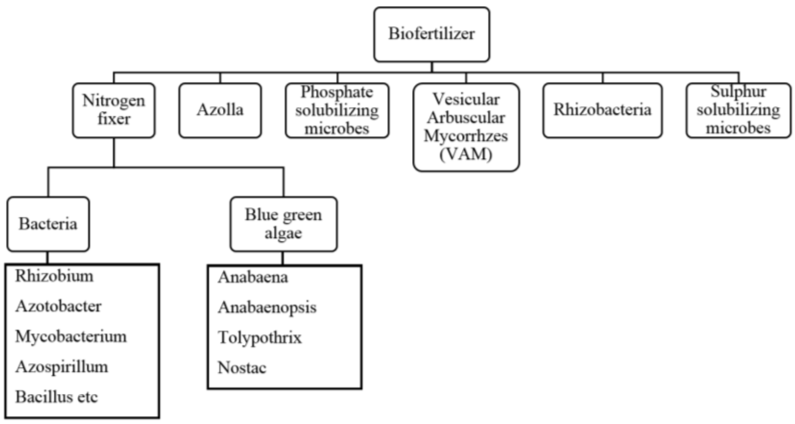

Figure 1: Classification of biofertilizers based on their function [3]

Advantages and limitations:

One of the most apparent advantages of using biofertilizers is that the soil is continuously enriched with minerals and nutrients that will not only promote the growth of crops, but also preserves the quality and usability of soil in the long run. On the other hand, chemical fertilizers tend to degrade the soil with respect to time, although they might offer attractive outputs temporarily. The following table (Table 1) clearly summarizes the various advantages and limitations of using biofertilizers for crop production.

Table 1: The most important advantages and limitations of using biofertilizers in agriculture [4]

Advantages	Limitations
1.Biological fertilizers can mobilize nutrients that favour the development of biological activities in soils.	1. Compost products have highly variable concentrations of nutrients. In addition, implementation costs are higher than those of certain chemical fertilizers.
2. Maintenance of plant health is enhanced by the addition of balanced nutrients.	2. Extensive and long-term application may result in accumulation of salts, nutrients, and heavy metals that could cause adverse effects on plant growth, development of organisms of the soil, water quality, and human health.
3. Food supply is provided and growth of microorganisms and beneficial soil worms is impelled.	3. Large volumes are required for land application due to low contents of nutrients, in comparison with chemical fertilizers.
4. As a result of the good structure provided to the soil, root growth is promoted.	4. Main macronutrients may not be available in sufficient quantities for growth and development of plants.
5. The content of organic matter in soil is higher than normal levels.	5. Nutritional deficiencies could exist, caused by the low transfer of micro- and macro-nutrients.
6. Promotes the development of mycorrhizal associations, which increases the availability of phosphorus (P) on the soil.	
7. Help to eliminate plantar diseases and provide continuous supply of micronutrients to the soil.	
8. Contribute to the maintenance of stable nitrogen (N) and phosphorus (P) concentrations.	
9. Improvements on the capacity of nutrients' exchange in the soil.	

Methods of application of biofertilizers:

The application of a particular biofertilizer depends again on the type of the crop. The three main methods of using a biofertilizer for crop production are listed below [5]:

1. Seed treatment or seed inoculation:

One packet of the inoculant is mixed with 200 ml of rice kanji to make a slurry. The seeds required for an acre are mixed in the slurry so as to have a uniform coating of the inoculant over the seeds and then shade dried for 30 minutes. The shade dried seeds should be sown within 24 hours. One packet of the inoculant (200 g) is sufficient to treat 10 kg of seeds.

2. Seedling root dip

This method is used for transplanted crops. Two packets of the inoculant is mixed in 40 litres of water. The root portion of the seedlings required for an acre is dipped in the mixture for 5 to 10 minutes and then transplanted.

3. Main field application

Four packets of the inoculant is mixed with 20 kg of dried and powdered farm yard manure and then

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broadcasted in one acre of main field just before transplanting.

Table 2 presents several examples of various common plant species and the recommended type of biofertilizer to be used, along with an approximate volume/dosage.

Table 2:Recommended liquid bio-fertilizers, their application method, quantity to be used for different crops [5]

Crop	Recommended Biofertilizer	Application method	Quantity to be used
Field crops Pulses Chickpea, Groundnut, soybean, beans, Lentil, Green gram, Black gram, Cowpea and pigeon pea	Rhizobium	Seed treatment	200ml/ acre
Cereals Wheat, oat, barley	Azotobacter/ Azospirillum	Seed treatment	200ml/ acre
Rice	Azospirillum	Seed treatment	200ml/ acre
Oil seeds Mustard, seasum, Linseeds, Sunflower, castor	Azotobacter	Seed treatment	200ml/ acre
Millets Pearl millets, Finger millets, kodo millet	Azotobacter	Seed treatment	200ml/ acre
Maize and Sorghum	Azospirillum	Seed treatment	200ml/ acre
Forage crops and Grasses Bermuda grass, Sudan grass, Napier Grass, ParaGrass, StarGrass etc.	Azotobacter	Seed treatment	200ml/ acre
Other Misc. Plantation Crops Tobacco	Azotobacter	Seedling treatment	500ml/ acre
Tea, Coffee	Azotobacter	Soil treatment	400ml/ acre
Rubber, Coconuts	Azotobacter	Soil treatment	2-3 ml/plant
Agro-Forestry/Fruit Plants All fruit/agro-forestry (herb,shrubs, annuals and perennial) plants for fuel wood fodder, fruits,gum,spices,leaves,flowers, and nuts	Azotobacter	Soil treatment	2-3 ml/plant
Leguminous plants/ trees	Rhizobium	Soil treatment	1-2 ml/plant

State-of-the-art scenario of biofertilizers in India:

The production of biofertilizers in India has been increasing steadily every year. The following figure (Figure 2) shows the statistics from 2005-2011. Although the figures are encouraging, more care needs to be taken in order to ensure a healthy production across the entire nation. Figure 3 presents a pie diagram indicating the relative percentage of production of biofertilizers in different parts of India. It is evident from this figure that South Indian states contribute to more than 50% of the total biofertilizer production in India. The production in the North, East and North-east states has been abysmally low. Proper measures have to be undertaken in order to uplift the production in these states of India. Figure 4 shows the states that contribute a major share and the rank of Andhra Pradesh among them.

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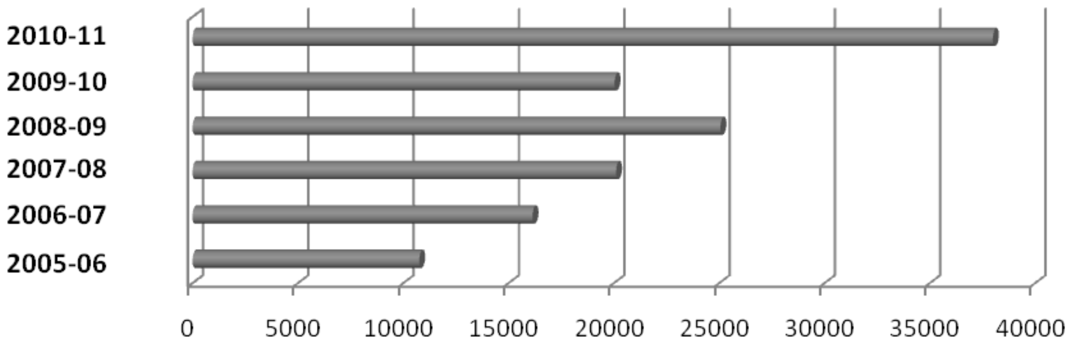

Figure 2: Annual production (in tons) of biofertilizers in India from 2005-2011 [6]

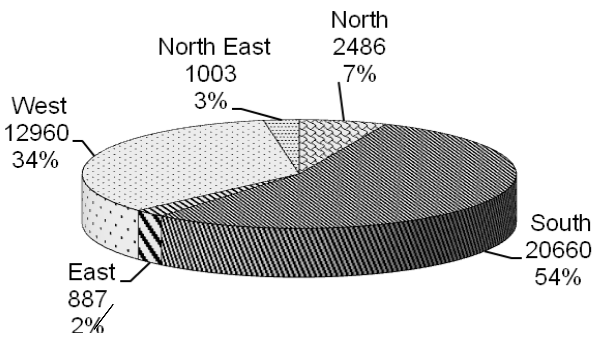

Figure 3: A pie diagram illustrating the contribution of different regions of the country to the production of biofertilizers in India during 2010-2011 [6]

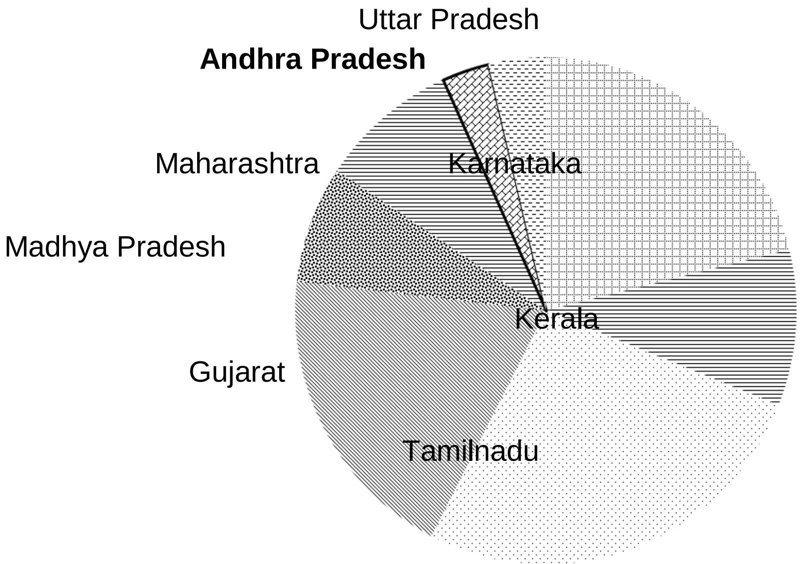

Figure 4: Pie diagram showing the contribution of Andhra Pradesh, along with other major states, to the production of biofertilizers in the year 2011 [6]

Ideas for increasing the production of biofertilizers in future:

In order to elevate the rank of Andhra Pradesh in terms of biofertilizer production, new and state-of-the-art production units have to be deployed that will ensure a consistent good quality of the biofertilizers. A fully automatic product handling and packaging system needs to be installed. Another major problem with maintaining the quality of biofertilizers is the purity of carrier system. A carrier system is the medium through which the microorganisms are supplied to the soil or the plant. For example, in the solid-state biofertilizers, the carrier system is usually charcoal or lignite (a type of coal). The microorganisms are dispersed in powdered charcoal and then applied to crops. Such carrier systems should be sterilized in future for obtaining better and consistent results [6].

Conclusions:

The practical capacity of biofertilizers in promoting the plant growth, particularly in India, has been discussed elaborately in this paper. There are several advantages of using biofertilizers in place of chemical manure. However, a few limitations like maintaining a consistent quality of the biofertilizers etc., have to be addressed more carefully in future in order to reap more benefits from organic farming (use of biofertilizers). The contribution of Andhra Pradesh has been highlighted and methods to increase the production have been formulated.

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www.jabe.in Vol.1.S1.2014, ISSN:2394-2606

IMPACT OF ALTERNATIVE METHODS TO REDUCE POLLUTION

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Abstract: The importance and the need of being all the major information regarding environmentalism and the issues related to environment. A brief introduction to environmentalism followed by a short history of environmentalism. you will get to know about the modern environmental movement, free market environmentalism and the criticism faced by the environmentalists and describe about the preservation and conservation of environment.

Find out how you can eliminate pollution; protect biodiversity as well as some simple ways to conserve natural resources. Further reveals how you can increase energy efficiency and conserve energy. Find basic details on green building and green living. Besides this, you will also come to know about different environmental organizations and conferences being held globally.

Introduction to environmentalism

Our planet, Earth is much like a home but we never care to look after it like our homes. We utilize its resources, we pollute it with waste or trash, and we never thought that what things will be like in the coming days or future, never thinking what shape things will be in for our children. Millions tons of waste is produced in the world every day. It a high time to think about our environment and what can we do to make our environment free from pollution. The given article shares brief introduction to environmentalism and the importance of being earth friendly.

Environmentalism can simply be considered as a social movement that mainly concerns for environmental conservation and improving the state of the environment. Green colour often represents environmentalism and environmental concerns. In simple words, it is just a social movement that strives to persuade or induce the political process by lobbying, activism as well as education for protecting natural resources & eco-systems. Talking about environmentalism, it has now become very essential for people to care about the planet Earth and the long term survival of life on this planet. The introduction to environmentalism clearly shows the importance of being earth friendly. We need to start recognizing the environment problems and should come up solutions to save our environment and make a healthy environment for living. In other words, recognizing a problem is the first step in finding the solution. For instance, environmental concepts like eco-system, sustainable development, biodiversity etc will help you understand the vulnerability of our environment, and framing our environmental problems as well as coming up with different solutions.

Going further with environmentalism introduction, the solutions actually come up with a mixture of several approaches which involves conservation, law, economics, technology, education, social justice, personal change, and activism. Moreover, it is important for all of us to be possible. It's in our hands as well as we have the ability to make our earth or world a better place for ourselves, our children and for future generations. The above introduction to environmentalism clearly shows exact meaning of environmentalism.

History of Environmentalism:

As we look into the history of environmentalism, we can say that the concern for the protection of environment has recurred in different forms, in several parts of the world, long time ago. In the Middle East, writing that mainly concerns with environmental pollution were found in Arabic medical treatises and were written during the Arab Agricultural Revolution. They were primarily concerned with air, water, soil contamination, solid waste mishandling as well as environmental assessments of certain localities. We can say that this was the beginning of environmentalism.

Looking at the environmentalism history, Edward I, the king of England also banned or prohibited the burning of sea coal in 1272 after its smoke became a main problem. Considering the origin of environmentalism, in Europe, the first large scale, current environmental laws came into being in the form of British Alkali Acts. The laws were passed in the year 1863 in order to regulate harmful air pollution given off by the Leblanc process which was used to produce soda ash. With the growth of industrialization air and water pollution also increase. In the history of environmentalism, the beginning of environmental movement in United States can be dated back to 1739 when Benjamin Franklin as well as other Philadelphia residents cited "public rights," requested the Pennsylvania Assembly to stop or restrict waste dumping as well as for removing workplaces from Philadelphia's commercial district. The US movement continues till 1800s with the concerned for the protection of natural resources of the West. John Muir and Henry David Thoreau were the main philosophical contributors to this movement.

In the history of environmentalism, environmental ideas became more popular with the beginning of 20th century. During this century efforts were being made to save wildlife and National Park Service was formed in 1916 by US president Woodrow Wilson. In 1972, the United States Environmental Protection Agency banned the agricultural use of DDT. People become more concerned with the problems of air pollution and petroleum spills as well as environmental interest grew in larger number. In India Chipko movement was formed in the year 1970. In 1979, James Lovelock, the former NASA scientist, published Gaia: A new look at life on Earth. Now, environmentalism has also changed to deal with new issues such as global warming and genetic engineering

Modern Environmental Movement:

Environmental movement can simply be defined as a social and political movement mainly concerning with the conservation of environment as well as improving the state of environment. It can also be said as green and conservation movement. Generally, environmentalists favor the sustainable management of natural resources as well as the protection of the environment via changes in public policy and individual behavior. In its recognition of humanity as a participant in ecosystems, the movement is centered on ecology, health and human rights.

The beginning of modern environmental movement can be dated back to attempts in 19th century Europe & North America to exhibit the costs of environmental negligence, especially disease, and widespread air as well as water pollution. But it was only after the World War II that the awareness begins to emerge. Environmental movement covers broad and different areas of institutional oppression. Such oppression may include consumptions of ecosystems and natural resources into waste. It also includes pollution of air and water, weak infrastructure, exposure of organic life to toxic and several other focuses. From the above mentioned divisions, we can classify the present environmental movement into these main focuses - Environmental Science, Environmental Activism, Environmental Advocacy, and Environmental Justice. The other focus points further include environmental conservation which is a process of conserving natural resources or aspects of the environment. However, environmental movement today like environmental health mainly deals with urban standards including clean water, effectual sewage handling as well as stable population control. The movement also concerned with nutrition, prevention medicine and other concerns specific to human well-being.

As we consider about environmental justice movement, the movement basically links with social and ecological concerns of environment as the same time prevents de facto racism as well as classism. This makes it especially acceptable for the construction of labor-environmental alliances. Environment movement like ecology movement mainly involves the Gaia Theory as well as Value of the Earth and other interactions between humans, science, and responsibility. Moreover, there are also anti-nuclear movement, deep ecology movement as well as Bright Green environmentalism.

Free Market Environmentalism: Environmentalism mainly concerns with the process of conserving environment and improvement of the state of environment. There is a theory of environmentalism which is called as free market environmentalism. This theory argues that the free market, property

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rights and tort law offer the best tools to preserve the health and sustainability of the environment. It considers environmental stewardship to be natural, as well as the expulsion of polluters and other aggressors through individual and class action. Let's gather brief information on free market environmentalism in the given article.

According to Robin Hahnel, an ecological economist, there are 4 basic defects or errors of economy of the market with respect to the environment. They are – overexploitation of property resources, over pollution, too little pollution cleanup and overconsumption. In response to these concerns, those economists who prefer free-market environmentalism and environmentalist express their views and argue that:

1) Overexploitation is mainly due to the lack of ownership incentives to care for the property. This communalization results the extent of multiplicity of ownership. Overexploitation minimizes the natural and retail value of the property, the effect of which is most distinctly felt by individual owners or via limited co-ownership.

2) Pollution take place where and to the extent that victims are obviated or hindered from seeking tort restitution for such aggression. Legislative and Judicial authorities have tended to favor heavy industries over individual or class action in favor of public property and common good.

3) Pollution cleanup also take place in a free market since minimizing the negative value of a property is a net gain, again leads to a higher natural or retail value, and thus marketability.

Criticism of Environmentalism: As we all know that environmentalism mainly deals with conversing environment as well as improving the state of environment. Different environment movements come up to conserve and for the protection of natural resources. These movements can simply be defined as a social and political movement mainly concerning with the conservation of environment as well as improving the state of environment. Environmentalists favor the sustainable management of natural resources as well as the protection of the environment via changes in public policy and individual behavior. In its recognition of humanity as a participant in ecosystems, the movement is centered on ecology, health and human rights. Environmentalism also faced criticism. Let's know in brief about the criticism of environmentalism.

According to a study reported in The Guardian, reveals that people who believe to have the greenest lifestyle can be viewed as culprits of global warming. Studies have revealed that, those individuals who were more earth friendly were more possible to take long-distance overseas flights, and thus leading to more carbon emissions outweighed the savings from green lifestyles at home. This report can be considered as one part of environmentalism criticism. Criticizing environmentalism, many of the people have views and feel that those environmental movements are more profoundly concerned and rooted in politics than science. According to them claims often made by environmentalist are often perceived as covert attacks on industry and globalization rather than legitimate environmental concerns. Talking about criticism of environmentalism, detractors are speedy to note that an important number of environmental theories as well as predictions have been not accurate and suggest that the regulations recommended by environmentalists will more likely harm society rather than help nature.

Some people have the view that today's environmental movement or environmentalism usually persists in various minute local groups especially within eco-regions. Also because of the political critique & confusion, and an increasing concern with the environment health problems basically caused by pesticides, some serious biologists and ecologists created the scientific ecology movement which would not confuse empirical data with visions of a desirable future world. Today it is the science of ecology, rather than any aesthetic goals, that provide the basis of unity to most environmentalists. The article above briefly reveals about criticism of environmentalism.

Preservation and Conservation of Environment:

People those who are mainly concerned with protecting the environment will often use the terms preservation and conservation. Let's know in details what preservation and conservation of environment exactly means. These two terms are often confused and are generally used to mean the same thing, although differences exist. In this article we will briefly discuss about environmental preservation and conservation and their major differences.

Conservation of environment simply implies the sustainable use as well as management of natural resources which include wildlife, water, air, and earth deposits. There are renewable and non-renewable natural resources. Conservation of natural resources generally focuses on the needs & interests of human beings, for instance the biological, economic, cultural and recreational values. Conservationists have the view that development is necessary for a better future, but only when the changes occur in ways that are not wasteful. Read on to know more about preservation and conservation of environment.

As far as preservation of environment is concerned, it tries to maintain the present condition areas of the nature or Earth which are not yet touched by humans. This is because of the fat that mankind is encroaching onto the environment at such a rate that various wild landscapes are being given over to farming, industry, housing, tourism and other human developments. And we lose much of the natural areas. Preservationists also strongly support the protection of nature for purely human-centered reasons. However, some adopts less human-centered approach to environmental protection, placing a value on nature that does not relate to the needs and interests of human beings. But is a fact that by preserving and conserving environment we can make a healthy atmosphere to live in.

Considering preservation and conservation of environment, the United States Environmental preservation is viewed or seen as the setting aside of earthly resources for preventing damage normally caused by contact with humans or by certain human activities, such as logging, mining, hunting, and fishing, only to replace them with new human activities such as tourism and recreation. Furthermore regulations and laws may be enacted for the preservation of natural resources. Being earth friendly is very essential as this will save our planet at the time making a better place to live in for us, for future generations

Eliminating Pollution: Pollution is increasing day by day and eliminating pollution has now become very important in the world since many big cities as well as smaller towns in many places are seeing the effects f pollution. There are many ways which one can help to eliminate pollution and make earth a better place for generations to come. As a part of pollution control one can choose to buy a hybrid type or a car that does not use fossil fuels at all. The use cleaner fuels like biodiesel and ethanol, or taking advantage of electric cars becoming available can reduce your personal emissions significantly.

For eliminating pollution one should plant trees, have a garden or putting plants inside your home. Plants and trees helps in reducing carbon dioxide. As plants take in carbon dioxide and release oxygen, if there are more plants or trees there will be more oxygen in the world. This in fact is one of the great ways for the elimination of pollution in the world. Recycling is also an essential step in reducing pollution since it saves new resources from being harvested and used. Recycling paper products can save thousands of trees from being used. It also saves energy and there will be less pollution. Reducing pollution simply implies recycling and conserving as much energy as possible because energy generally means pollution in some form.

Eliminating pollution could simply mean the use of alternative, renewable and earth friendly energy sources whenever possible. Recycling materials can be reused and we can conserve energy and take steps to keep the air clean. Energy conservation could be small steps that lead up to a large energy savings. To save energy one should turn off the light whenever they leave the room and don’t leave water running when washing dishes or brushing your teeth. One should avoid using aerosol sprays since it contain ingredients that can be harmful to the ozone layer as well as the air quality. You should choose to buy energy efficient appliances as this can save v energy as well as reduce both costs and pollution.

For eliminating pollution one can switch to alternative and renewable energy sources like bio fuels instead of depending on non-renewable fossil

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fuels that only helps in polluting our planet. However, bio fuels as well as other alternative sources of energy are cleaner and earth friendly. But until these technologies are widely used, conserving energy should be practiced in order to reduce pollution and your impact on the earth.

Protecting Biodiversity: Protecting biodiversity is now very essential since biodiversity is crucial for reducing climate pollution and dealing as well as adapting to the effects of climate change. If we don't protect biodiversity, the effects could be as harmful as the effects of global warming itself. This is especially true with tropical forests- they are critical to fighting climate change and home to more species than any other ecosystem type. In other words, protecting biodiversity is essential for our well being. Biodiversity helps to balance the nature.

Biodiversity has its own economic importance, so protection of biodiversity is important. As we all know farm crops as well as animals are mainly descendents of wild organisms. They are generally the component of biodiversity. Some varieties of old crops have more taste or disease resistance, and they may be more suitable to future changes in the climate. Most of the fruit crops depend on various insects for pollination of their flowers. Venison or salmon are also a source of food for human. Fishermen simply harvest or used natural biodiversity of the oceans & river.

Considering the essentiality of biodiversity, it is an important part of sustainable development. In simple words, biodiversity is a measure of sustainable development. As we know, sustainable development is considered as a major target for industry as well as planning system. However, the only way to achieve this target is to measure biodiversity. Apart from this biodiversity is essential a provider of natural services, although we may not readily recognize it. For instance Peat bogs, plays an important role in purifying water & also lock up carbon dioxide. Tiny plants that grow also absorb large amount of carbon dioxide. That is why protecting biodiversity is essential.

To be very precise biodiversity protection is very much important since biodiversity is a fundamental component of life on Earth. It creates complex ecosystems that could never be reproduced by humans. The value of that biodiversity, both intrinsically and to humans, is immeasurable, and thus must be protected. In the end, we both want and need biodiversity. We continue harming the natural environment without realizing the impact. We should be aware of protecting biodiversity. Moreover, we should know the importance of biodiversity for making good ad better life on the Earth.

Conserving Natural Resources: Resources are features of environment that are important and value of to human in one form or the other. However, the advancement of modern civilization has had a great impact on our planet's natural resources. So, conserving natural resources is very essential today. There are many ways that one can conserve natural resources. All you need to do is to look around and see what natural resources you are using and find out ways to limit your usage. Most of the people use natural gas to heat their water and their home. You can monitor how much you are using this resource to minimize its usage.

For conservation of natural resources like natural gas, one can get tank less water heater as it reduces the usage of natural gas. The other way to save natural gas is the use of another energy source for instance hydro, solar or wind power are all healthy and great alternatives to conserving natural resources. In fact these energy sources are clean and healthy for environment. Moreover, these energy sources do not emit or produced harmful gases or toxin into our environment like that of the burning fossil fuels at the same time they are renewable as well as are not easy to deplete.

Today, most of the people are finding many ways for conserving natural resources. One of the great option before is Hydro-power and solar power. Power can be generated from these sources and these are the best ways for natural resources conservation like fossil fuels. There is also way to conserve natural resource like trees. It can be conserve through recycling process. Many products come from the trees like papers, cups, cardboards and envelopes. By recycling these products you can reduce the number of trees cut down a year. One should make the most use of these paper products

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without being wasteful and then recycle them. This is one great way for conserving natural resources.

Fossil fuels on Earth will not last forever; we need to conserve these fossil fuels. To conserve fossil fuels one can choose to buy a hybrid car. Some of these cars will run on electricity combined with using small amounts of gas. Some hybrid cars just run on electricity. Either way it is a great way for conserving natural resources when it is concern with fossil fuels.

Recycling Waste: With the increasing human population the needs for the people also increases. But the point of concern is that are there enough natural resources to service all your needs. What if these resources finish, this is one thing we need to ponder upon. We need to start recycling waste to converse our natural resources. Recycling is simply the process of reusing the items from which utility can still be derived. It is important to recycle waste so that you can at least converse some of our natural resources for our generations to come.

Many products such as paper, cardboards, and cups come from trees. In fact trees are our natural assets, you can converse trees by recycling the paper products we can minimize the number of trees cut down a year. This is one form of waste recycling. One should understand and know the importance of recycling waste materials. One simple benefit of recycling is it saves our resources. It will be wise to reuse metal item as metal reserves may be depleting. You can sold your wore out metal items for recycling. As mentioned earlier, recycling of waste papers can save our forests.

Recycling waste not only save our natural resources but also help save energy. By simply recycling an item or making a basic fix to it, we can we save all the energy that would have been consumed in the process of making it. The same example can be taken with plastic items. A large amount of energy can be saved by simply reusing the plastic items. To recycle waste is to simply reduce pollution. By recycling plastic material we can reduce air pollution as well as water pollution. Plastic factories produced large amount of smoke when producing plastic material at the same time if we don't have proper waste disposal system those waste emissions will cause water pollution. Recycling waste in a way helps reduce pollution.

In simple words, recycling or recycling waste is essential to both natural environment and humans. To sum up, recycling minimizes the need for raw materials so that the rainforests can be preserved. Great amounts of energy are used when making products from raw materials. Recycling requires much less energy and therefore helps to preserve natural resources. One needs to know the importance of recycling at the same time being earth friendly can help our planet a better place to live in

Increase Energy Efficiency: Global warming is increasing every year and at the same time climate change is coming to light thus pointing the need to reduce our overall energy consumptions. In simple words, we need to increase energy efficiency. To fight global warming, it is absolutely necessary for us to reduce our energy consumption and look at ways of sustainable living. We can say that energy saving starts from home, whenever you save energy; you not only save money but also reduce the demand for such fossil fuels as coal, oil, and natural gas. So just read on to get key ideas for improving energy efficiency and be an earth friendly person.

Given below are some few effective ways for increasing energy efficiency in your home:

Buying energy efficient products – Purchasing efficient products is one of simple ways to increase energy efficiency. New electrical appliances such as refrigerators, dryers, washers and other appliances use less energy in comparison to older ones. While purchasing those electrical appliances you should look for those rated with 'energy star'. Smaller items like light bulbs have more energy efficient options.

Reduce standby/vampire power – Many of the appliances which include televisions, lamps as well as the phone chargers can continue consuming energy even when it is in off mode. You should unplug those appliances when not use as this will save energy at the same reduce your electric bill up to 20 percent. You should attach them to a surge protector & turn them off when you are not using it or unplug them completely. This is one effective way to increase energy efficiency.

Turn down thermostat & reduce heat transfer- Most of the people turn on heater during months of cold knowing much knowledge that heat produced up to 30 percent is escaping through the windows. To save this energy one can install energy efficient windows to minimize heat transfer. During summer, these windows reduce heat transfer into the house minimizing the need of air conditioning.

Go solar – This is one of the great options to increase energy efficiency. One can install solar panels for overall energy grid or just for the water heater. Depending on where you live, wind energy may be a more preferable option.The progress of modern civilization results in environmental degradation. This led to the increase of global warming, depletion of natural resources and energy crisis. Environment al Organizations And Conferences

We need to more earth friendly to save our planet. Many of the environmental organizations have also come up to make people aware of degradation of environment. Moreover many conferences regarding environment issues are also held all over the world. Here, we will discuss about environmental organizations and conferences being held to get aware of the changes in our planet.

Talking about the environmental organizations, organization that concerned with environmental issues can be global, regional, national or local. In fact these organizations can be government run or else can be private such as NGO. We can say that, in most countries of the world environmental activity exists. There are also certain groups that devotes to community development and social justice also focus on environmental issues. There are also volunteer organizations such as Ecoworld, which concerns totally on environment, an organization based in team work and volunteer work. Know more about environmental organizations and conferences.

Continuing with the information on environmental conferences and organizations, there are also radical groups of organizations like Greenpeace, Earth First as well as Earth Liberation Front. These organizations mainly concerns with the actions that can be harmful to environment. At global level, concern for environment was the main subject or topic of UN conference in Stockholm in 1972, attended by 114 nations. After this meeting, United Nations Environment Programmed developed, followed by United Nations Conference on Environment and Development in 1992. Other global organization that supports the concerns for environment includes the Commission Environmental Cooperation, the European Environment Agency and the Intergovernmental Panel on climate Change. The above article briefly informs you about the different environmental organizations and conferences being held on environmental issues

Green Building and Green Living: Being eco friendly will help save our planet as well as making a better place for future generations to come. It is in out hand to make our environment healthy to live in. Here in this article we will let you know about green building and green living and how it helps to make a good environment for living. Green building which is also called as green construction or sustainable building is simply the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life-cycle.

Green building principles aimed at minimizing impact upon the environment. In other words, these buildings are specifically designed to reduce the entire impact of the built environment on human health and the natural environment through the efficient use of the resources such as water, energy and other resources. They aimed to protect occupant health & improve employee productivity as well as to reduce waste, pollution and environmental degradation. The concept of building green provides the key advantages of - environment or earth friendly, energy efficient, water conservation, fire safety as well as excellent indoor air quality. Get to know more about green building and green living.

The increasing global warming, depletion of natural resources and the energy crises have made aware us and the government that the change is very much essentials for our world to survive. We should find a greener way to live our lives. Moreover, one needs to find necessary information that will make their home and family more environmentally friendly as well as more energy efficient. The above article will help you get a brief idea about green building and green living, furthermore helps you know its importance in making healthy environment to live in

Urban Hydroponic Gardeners: The safety of our food supply continues to concern many of us as we seek out organic solutions at affordable prices. However, space is at a premium in urban environments, and few of us have the luxury of being able to create expansive gardens. Hydroponics gardening may be the ideal solution that allows us to enjoy fresh, healthy produce and lush flowers whenever we want whether we are novice or experienced gardeners without the need for a major space investment.

More gardeners are discovering every day how easy and beneficial it is to get started with hydroponic growing techniques. Many pests live in the soil, which gives them easy access to plants, but when there is no soil, there is also no risk of insects, soil-borne diseases or even weeds. Plants will be healthier, and even though the garden may be small, that healthier environment can ensure greater productivity.

Whether you have made the decision to live a healthier lifestyle with home-grown produce or you simply want to try a new way to garden, hydroponic gardening may be right for you. A hydroponic garden can be created on the balcony of your apartment or in a corner of your kitchen and can provide you with fresh, juicy tomatoes, crisp lettuce and colorful peppers all year round. You can avoid the inconvenience of weeding and hoeing and have more control over what does and does not go into the foods you eat. The system can be completely automated and can be used in homes or greenhouses.

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A Peer Reviewed & Refereed, International Open Access Journal
www.jabe.in Vol.1.S1.2014, ISSN:2394-2606

BIO FERTILIZERS – ADVANTAGES AND DRAWBACKS

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Abstract: A bio fertilizer is not just any organic fertilizer or manure. It consists of a carrier medium rich in live microorganisms. When applied to seed, soil or living plants, it increases soil nutrients or makes them biologically available. Bio fertilizers contain different types of fungi, root bacteria or other microorganisms. They form a mutually beneficial or symbiotic relationship with host plants as they grow in the soil. Bio fertilizers have many advantages and a few disadvantages. This paper is intended to observe various advantages and drawbacks of Bio Fertilizers and give some suggestions to overcome the drawbacks.

Introduction: Bio fertilizers are low cost, renewable sources of plant nutrients which supplement chemical fertilizers. Bio fertilizer is one of the best modern tools for agriculture. Use of Bio fertilizer is one of the important components of integrated nutrient management, as they are cost effective and renewable sources of plant nutrients to supplement the chemical fertilizers for sustainable agriculture.

The beneficial effect of legumes in improving soil fertility was known since ancient times. The commercial history of Bio fertilizers began with the launch of 'Nitragin' by Nobbe and Hiltner, a laboratory culture of Rhizobiain 1895, followed by the discovery of Azotobacterand then the blue green algae and a host of other micro-organisms. Azospirillum and Vesicular-Arbuscular Micorrhizae (VAM) are fairly recent discoveries. In India the first study on legume Rhizobiumsymbiosis was conducted by N. V. Joshi and the first commercial production started as early as 1956. Commonly explored Biofertilizers in India are mentioned below along with some salient features.

Advantages: Sustainability: Bio fertilizers increase the nitrogen and phosphorus available to plants more naturally than other fertilizers. The different varieties available allow growers to tailor the microorganisms used to the needs of particular plants. Bio fertilizers are simple to use, even for novice small growers. Bio fertilizers do not pollute the soil or the environment, whereas chemical fertilizers often result in too much phosphate and nitrogen in the soil. The excess then leaches into lakes and streams through runoff. Waters decline in quality and suffer from overgrowth of algae and the death of fish.

Affordability: Bio fertilizers reduce dependence upon expensive petroleum sources of chemical fertilizers. According to the "Journal of Phytology," demand for chemical fertilizers will exceed the supply by more than 7 million tons by 2020. The shortage of fossil fuels to produce chemical fertilizers may drive up prices beyond the reach of small users. Bio fertilizers are a cheap, easy-to-use alternative to manufactured petrochemical products.

Improved Soil: Bio fertilizers restore normal fertility to the soil and make it biologically alive. They boost the amount of organic matter and improve soil texture and structure. The enhanced soil holds water better than before. Bio fertilizers add valuable nutrients to the soil, especially nitrogen, proteins and vitamins. They take nitrogen from the atmosphere and phosphates from the soil and turn them into forms that plants can use. Some species also produce natural pesticides.

Improved Plants: Bio fertilizers increase yield by up to 30 per cent because of the nitrogen and phosphorus they add to the soil. The improvement in soil texture and quality helps plants grow better during periods of drought. Bio fertilizers help plants develop stronger root systems and grow better. Bio fertilizers also reduce the effects of harmful organisms in the soil, such as fungi and nematodes. Plants resist stress better and live longer.

Disadvantages: Bio fertilizers require special care for long-term storage because they are alive. They must be used before their expiration date. If other

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www.jabe.in **Vol.1.S1.2014,** **ISSN:2394-2606**

microorganisms contaminate the carrier medium or if growers use the wrong strain, they are not as effective. The soil must contain adequate nutrients for bio fertilizer organisms to thrive and work. Bio fertilizers complement other fertilizers, but they cannot totally replace them. Bio fertilizers lose their effectiveness if the soil is too hot or dry. Excessively acidic or alkaline soils also hamper successful growth of the beneficial microorganisms; moreover, they are less effective if the soil contains an excess of their natural microbiological enemies. Shortages of particular strains of microorganisms or of the best growing medium reduce the availability of some bio fertilizers.

Application of Bio fertilizers

1. Seed treatment or seed inoculation
2. Seedling root dip
3 Main field application

Seed treatment

One packet of the inoculant is mixed with 200 ml of rice kanji to make a slurry. The seeds required for an acre are mixed in the slurry so as to have a uniform coating of the inoculant over the seeds and then shade dried for 30 minutes. The shade dried seeds should be sown within 24 hours. One packet of the inoculant (200 g) is sufficient to treat 10 kg of seeds.

Seedling root dip

This method is used for transplanted crops. Two packets of the inoculant is mixed in 40 litres of water. The root portion of the seedlings required for an acre is dipped in the mixture for 5 to 10 minutes and then transplanted.

Main field application

Four packets of the inoculant is mixed with 20 kgs of dried and powdered farm yard manure and then broadcasted in one acre of main field just before transplanting.

Conclusion:

Despite these factors Biofertilizers have made a rapid growth during last 15 years in country. National Biofertilizer. Development Centre has estimated the requirement of Biofertilizers to extent of 507032 MT of N_2 mixed, 255340 MT of Phosphate mobilizingBacteria. Though above figure represents theoretical potential of Bio fertilizers it reflects the immense scope of Biological Based Product though far from reality. Thus for this to turn into reality we could begin with the use of bio fertilizer reduce the doses of chemical fertilizers, Thus we could ensure that optimum productivity and healthy returns under Integrated Nutrient Management system. This would help in cost benefit analysis help the farmers realize the worth, potential, long term commercial benefits, economical aspects of using Bio fertilizers and Biological Based Product which would then result in acceptance of this new improving technology, thereby would go on a long way in encouraging investment in Biological Based Product sector. It would then result in standard new Biological Based Product entering the market and thereby this eco-friendly renewable product would become an indispensable part of sustainable agriculture which will usher in another environmental eco-friendly Green revolution.

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A Peer Reviewed & Refereed, International Open Access Journal
www.jabe.in **Vol.1.S1.2014,** **ISSN:2394-2606**

SOIL ACIDIFICATION

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Abstract: Soil acidification is the buildup of hydrogen cations, also called protons, reducing the soil pH. This happens when a proton donor gets added to the soil. The donor can be an acid, such as nitric acid and sulfuric acid (these acids are common components of acid rain). It can also be a compound such as aluminium sulfate, which reacts in the soil to release protons. Many nitrogen compounds, which are added as fertilizer, also acidify soil over the long term because they produce nitrous and nitric acid when oxidized in the process of nitrification. This paper mainly presents the impact of acid sulphates present in the soil and soil pH .

Introduction :

Acidification also occurs when base cations such as calcium, magnesium, potassium and sodium are leached from the soil. This leaching increases with increasing precipitation.Acid rain accelerates the leaching of bases. Plants take bases from the soil as they grow, donating a proton in exchange for each base cation. Where plant material is removed, as when a forest is logged or crops are harvested, the bases they have taken up are permanently lost from the soil.

Acids produced from the plants:

Many plants produce organic acids. Where plant litter accumulates on or is incorporated to the soil, these acids (including acetic acid, humic acid (seehttp://www.suprahumic.unina.it/) , oxalic acid, and tannic acid) are liberated. This is especially acute in soils under coniferous trees such as pine, spruce and fir, which return fewer base cations to the soil than do most deciduous trees.

Acids present in the rocks:

Certain parent materials also contribute to soil acidification. Granites and their allied igneous rocks are called "acidic" because they have a lot of free quartz, which producessilicic acid on weathering. Also, they have relatively low amounts of calcium and magnesium. Some sedimentary rocks such as shale and coal are rich in sulfides, which, when hydrated and oxidized, produce sulfuric acid which is much stronger than silicic acid. Many coal spoils are too acidic to support vigorous plant growth, and coal gives off strong precursors to acid rain when it is burned. Marine clays are also sulfide-rich in many cases, and such clays become very acidic if they are drained to an oxidizing state.

Acidification may also occur from nitrogen emissions into the air, as the nitrogen may end up deposited into the soil. The acidifying compounds are sulfate, Ammonia, Ammonium nitrate, Ammonium phosphate, sulfate, ferrous, phosphate, acid, Urea and Alum. These compounds cause pollution of the environment.

Acid sulphate soil:

Acid sulfate soils are naturally occurring soils, sediments or organic substrates (e.g. peat) that are formed under waterlogged conditions. These soils contain iron sulfideminerals (predominantly as the mineral pyrite) or their oxidation products. In an undisturbed state below the water table, acid sulfate soils are benign. However if the soils are drained, excavated or exposed to air by a lowering of the water table, the sulfides react with oxygen to form sulfuric acid.[1]

Release of this sulfuric acid from the soil can in turn release iron, aluminium, and other heavy metals (particularly arsenic) within the soil. Once mobilized in this way, the acid and metals can create a variety of adverse impacts: killing vegetation, seeping into and acidifying groundwater[2][3] and surface water bodies,[4][5] killing fish and other aquatic organisms, and degrading concrete and steel structures to the point of failure.[1]

Acid soil sulfate formation:

The soils and sediments most prone to becoming acid sulfate soils formed within the last 10,000 years, after the last majorsea level rise. When the sea level rose and inundated the land, sulfate in the seawater mixed with land sediments containing iron oxides and organic matter.[1] Under these anaerobic conditions, lithotrophic bacteria such as Desulfovibrio desulfuricansobtain oxygen for

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www.jabe.in Vol.1.S1.2014, ISSN:2394-2606

respiration through the reduction of sulfate ions in sea or groundwater, producing hydrogen sulfide. This in turn reacts with dissolved ferrous iron, forming very fine grained and highly reactive framboid crystals of iron sulfides such as (pyrite).[1] Up to a point, warmer temperatures are more favourable conditions for these bacteria, creating a greater potential for formation of iron sulfides. Tropical waterlogged environments, such as mangrove swamps or estuaries, may contain higher levels of pyrite than those formed in more temperate climates.[6]

The pyrite is stable until exposed to air, at which point the pyrite rapidly oxidises and produces sulfuric acid. The impacts of acid sulfate soil leachate may persist over a long time, and/or peak seasonally (after dry periods with the first rains). In some areas of Australia, acid sulfate soils that drained 100 years ago are still releasing acid.[7]

Chemical Reaction:

When drained, pyrite (FeS_2) containing soils (also called cat-clays) may become extremely acidic (pH < 4) due to the oxidation of pyrite into sulfuric acid (H2SO4). In its simplest form, this chemical reaction is as follows:

$2\ FeS_2 + 9\ O_2 + 4\ H_2O \rightarrow 8\ H+ + 4\ SO_4^{2-} + 2\ Fe(OH)_3$ (solid) [6][8]

The product $Fe(OH)_3$, iron(III) hydroxide (orange), precipitates as a solid, insoluble mineral by which the alkalinity component is immobilized, while the acidity remains active in thesulfuric acid. The process of acidification is accompanied by the formation of high amounts of aluminium (Al3+, released from clay minerals under influence of the acidity), which are harmful to vegetation. Other products of the chemical reaction are:

1. Hydrogen sulfide (H_2S), a smelly gas
2. Sulfur (S), a yellow solid
3. Iron(II) sulfide (FeS), a black/gray/blue solid
4. Hematite (Fe_2O_3), a red solid
5. Goethite (FeO.OH), a brown mineral
6. Schwertmannite a brown mineral
7. Iron sulfate compounds (e.g. jarosite)
8. H-Clay (hydrogen clay, with a large fraction of adsorbed H+ ions, a stable mineral, but poor in nutrients)

The iron can be present in bivalent and trivalent forms (Fe^{2+}, the ferrous ion, and Fe^{3+}, the ferric ion respectively). The ferrous form is soluble, whereas the ferric form is not. The more oxidized the soil becomes, the more the ferric forms dominate. Acid sulfate soils exhibit an array of colors ranging from black, brown, blue-gray, red, orange and yellow. The hydrogen clay can be improved by admitting sea water: the magnesium (Mg) and sodium (Na) in the sea water replaces the adsorbed hydrogen and other exchangeable acidic cations such as aluminium (Al). However this can create additional risks when the hydrogen ions and exchangeable metals are mobilised.

Impact of acid sulfate soil: Disturbing potential acid sulfate soils can have a destructive effect on plant and fish life, and on aquatic ecosystems. Flushing of acidic leachate to groundwater and surface waters can cause a number of impacts, including:[7]

- Ecological damage to aquatic and riparian ecosystems through fish kills, increased fish disease outbreaks, dominance of acid-tolerant species, precipitation of iron, etc.
- Effects on estuarine fisheries and aquaculture projects (increased disease, loss of spawning area, etc.).
- Contamination of groundwater and surface water with arsenic, aluminium and other metals.[10][11][12]
- Reduction in agricultural productivity through metal contamination of soils (predominantly by aluminium).
- Damage to infrastructure through the corrosion of concrete and steel pipes, bridges and other sub-surface assets.

Agricultural impacts: Potentially acid sulfate soils (also called cat-clays) are often not cultivated or, if they are, planted under rice, so that the soil can be kept wet preventing oxidation. Subsurface drainage of these soils is normally not advisable.

When cultivated, acid sulfate soils cannot be kept wet continuously because of climatic dry spells and shortages of irrigationwater, surface drainage may help to remove the acidic and toxic chemicals (formed in the dry spells) during rainy periods. In the long run surface drainage can help to reclaim acid sulfate soils. The indigenous population of Guinea

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www.jabe.in Vol.1.S1.2014, ISSN:2394-2606

Bissau has thus managed to develop the soils, but it has taken them many years of careful management and toil.

In an article on cautious land drainage, the author describes the successful application of subsurface drainage in acid sulfate soils in coastal polders of Kerala state, India.

Also in the Sunderbans, West Bengal, India, acid sulfate soils have been taken in agricultural use.

A study in South Kalimantan, Indonesia, in a perhumid climate, has shown that the acid sulfate soils with a widely spaced subsurface drainage system have yielded promising results for the cultivation of upland (sic!) rice, peanut and soybean. The local population, of old, had already settled in this area and were able to produce a variety of crops (including tree fruits), using hand-dug drains running from the river into the land until reaching the back swamps. The crop yields were modest, but provided enough income to make a decent living.

Reclaimed acid sulfate soils have a well-developed soil structure; they are well permeable, but infertile due to the leaching that has occurred.

In the second half of the 20th century, in many parts of the world, waterlogged and potentially acid sulfate soils have been drained aggressively to make them productive foragriculture. The results were disastrous.[8] The soils are unproductive, the lands look barren and the water is very clear, devoid of silt and life. The soils can be colorful, though.

The soil pH:

the soil pH is a measure of the acidity or alkalinity in soils. pH is defined as the negative logarithm (base 10) of the activity of hydronium ions (H_+ or, H_3O^+aq) in a solution. In water, it normally ranges from -1 to 14, with 7 being neutral. A pH below 7 is acidic and above 7 is alkaline. Soil pH is considered a master variable in soils as it controls many chemical processes that take place. It specifically affects plant nutrient availability by controlling the chemical forms of the nutrient. The optimum pH range for most plants is between 5.5 and 7.0 however many plants have adapted to thrive at pH values outside this range.

Acid affected soils:

Plants grown in acid soils can experience a variety of symptoms including aluminium (Al), hydrogen (H), and/or manganese (Mn) toxicity, as well as nutrient deficiencies of calcium (Ca) and magnesium (Mg).

Aluminium toxicity is the most widespread problem in acid soils. Aluminium is present in all soils, but dissolved Al3+ is toxic to plant; Al3+ is most soluble at low pH, above pH 5.2 little Al is in soluble form in most soils.[Aluminium is not a plant nutrient, and as such, is not actively taken up by the plants, but enters plant roots passively through osmosis. Aluminium inhibits root growth; lateral roots and root tips become thickened and roots lack fine branching; root tips may turn brown. In the root, Al has been shown to interfere with many physiological processes including the uptake and transport of calcium and other essential nutrients, cell division, cell wall formation, and enzyme activity.

Below pH 4, H+ ions themselves damage root cell membranes.

In soils with high content of manganese-containing minerals, Mn toxicity can become a problem at pH 5.6 and lower. Manganese, like aluminium, becomes increasingly soluble as pH drops, and Mn toxicity symptoms can be seen at pH levels below 5.6. Manganese is an essential plant nutrient, so plants transport Mn into leaves. Classic symptoms of Mn toxicity are crinkling or cupping of leaves.

Soil salinity is the salt content in the soil; the process of increasing the salt content is known as salinization. Salt is a natural element of soils and water. Salination can be caused by natural processes such as mineral weathering or the gradual withdrawal of an ocean. It can also be caused by artificial processes such as irrigation.

Causes of soil salinity

The excess accumulation of salts, typically most pronounced at the soil surface, can result in salt-affected soils. Salts may rise to the soil surface by capillary transport from a salt-laden water table and then accumulate due to evaporation. They can also become concentrated in soils due to human activity, for example the use of potassium as fertilizer, which can form sylvite, a naturally occurring salt. As soil salinity increases, salt effects can result in degradation of soils and vegetation.

Salinization as a process can result from:

- high levels of salt in water.

- landscape features that allow salts to become mobile (movement of water table).
- climatic trends that favor accumulation.
- human activities such as land clearing.

Consequences of salinity

The consequences of salinity are

- detrimental effects on plant growth and yield
- damage to infrastructure (roads, bricks, corrosion of pipes and cables)
- reduction of water quality for users, sedimentation problems
- soil erosion ultimately, when crops are too strongly affected by the amounts of salts.

Salinity is an important land degradation problem. Soil salinity can be reduced by leaching soluble salts out of soil with excess irrigation water. Soil salinity control involveswatertable control and flushing in combination with tile drainage or another form of subsurface drainage. A comprehensive treatment of soil salinity is available from the United Nations Food and Agriculture Organization.

High levels of soil salinity can be tolerated if salt-tolerant plants are grown. Sensitive crops lose their vigor already in slightly saline soils, most crops are negatively affected by (moderately) saline soils, and only salinity resistant crops thrive in severely saline soils.

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www.jabe.in **Vol.1.S1.2014,** **ISSN:2394-2606**

ADVERSE EFFECTS OF CHEMICAL FERTILIZERS & ADVANTAGES OF BIO – FERTILIZERS

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Fertilizer is any material of natural or synthetic origin that is applied to soils or to plant tissues (usually leaves) to supply one or more plant nutrients essential to the growth of plants. Conservative estimates report 30 to 50% of crop yields are attributed to natural or synthetic commercial fertilizer. Global value is likely to rise to more than US$185 billion until 2019. The European fertilizer market will grow to earn revenues of approx. €15.3 billion in 2018. Fertilizers enhance the growth of plants. This goal is met in two broad ways, the traditional one being additives that provide nutrients. The second mode by which some fertilizers act is to enhance the effectiveness of the soil by modifying its water retention and aeration.

ADVERSE EFFECTS OF CHEMICAL FERTILIZERS:

- Leaching effects of N based fertilizers
- Methemoglobinemia
- Marine dead zones
- Green house gases
- Acidity of soil
- Effect on symbiosis
- Heavy metal accumulation
- Radio active elements
- Fluorides
- Energy consumption
- Salt content is one of the most critical characteristic of chemical fertilizers.
- Depletes essential nutrients
- Hardening of soil
- Alkalinity of soil
- Imbalance of nutrients

SO TO AVOID THE ABOVE SAID ENVIRONMENTAL THREATS CAUSED BY CHEMICAL FERTILIZERS USE OF BIOFERTILIZERS IS THE BEST SOLUTION.

ADVANTAGES OF BIOFERTILIZERS:

- Renewable source of nutrients
- Sustain soil health
- Supplement chemical fertilizers.
- Replace 25-30% chemical fertilizers
- Increase the grain yields by 10-40%.
- Decompose plant residues, and stabilize C:N ratio of soil
- Improve texture, structure and water holding capacity of soil
- No adverse effect on plant growth and soil fertility.
- Stimulates plant growth by secreting growth hormones.
- Secrete fungistatic and antibiotic like substances
- Solubilize and mobilize nutrients
- Eco-friendly, non-pollutants and cost effective method.

ACCUMULATION OF RADIOACTIVE MATERIALS

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Abstract: We are now living in a period in which there is tremendous expansion in the use of atomic energy. There is great interest in possible hazards to man of the radioactivity associated with the release of the energy of the atom. Of considerable concern is the contamination of man's environment with radioactive materials. Such materials added to the atmosphere, soil, and natural waters may be taken in by man and levels of radioactivity may be built up in the body sufficient to be damaging. In marine environments radioactive contaminants may accumulate in seafood organisms and affect their utilization or availability.

In discussing radioactive materials we need to consider that these materials are radioactive isotopes of chemical elements. In most cases the atoms that compose a chemical element differ in mass and those of like mass members, the isotopes, are present in definite ratios. For instance carbon, wherever it is found in nature, is composed almost 99 per cent of carbon atoms of mass number 12 and about one per cent of carbon atoms of mass number 13. With the advent of man-made isotopes of

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www.jabe.in Vol.1.S1.2014, ISSN:2394-2606

carbon with other mass numbers, for example carbon-14, which is radioactive, it is possible to have carbon compounds in which the isotopic ratio is changed by inclusion of radioactive atoms. For the most part, the chemical and physiological processes of the body make use of elements to form compounds without discrimination as to their isotopic composition. Thus a radioisotope may be incorporated into the body tissues of marine plants and animals if present in their environment.

Living tissues accumulate chemical elements to different degrees. It is well known that certain elements, such as calcium and strontium, are concentrated in skeletal structures, such as bone and shell. Other elements are present in greater amounts in certain soft tissues and organs. Although maximum levels of concentration of an element exist, the elements composing the compounds of the body are constantly being replaced. Some compounds are broken down and reformed rapidly; others only slowly. If radioactive isotopes are included with the other isotopes of the element involved in the metabolism of marine organisms, an accumulation of radioactivity can result.

Radioisotopes may be added to a marine environment from the use of nuclear weapons and from the various operations required for the use of nuclear reactors. Some disposal may be made in coastal waters of a variety of radioisotopes used in industry, research, and medicine. They may be grouped into two general categories based on their origin. One includes the fission products resulting from the fission of uranium-235 and the other the radionuclides of elements produced from induced nuclear changes, generally from neutron bombardment resulting from the fission process.

Contamination of a marine environment from nuclear warfare can be from fission products and from induced radionuclides. Although there was an addition of fission products to the sea water from the testing of nuclear weapons in the Pacific Ocean, large contributions to the total radioactivity of certain fish were found to be from the non-fission product, zinc-65, and of certain molluscs from cobalt-60 (Weiss et al.,1956). Many other induced radionuclides were also present in the fish and shellfish. In the normal operations concerned with the use of nuclear reactors only insignificant amounts of radioactive materials are released to natural waters. Many reactors are cooled with water and the primary coolant water may contain radioactive materials. These may be radioisotopes of the elements normally present in water or present as corrosion products. They become radioactive from close association with the high neutron flux of the reactor core. Some fission products may be present if ruptures occur in the coverings of fuel elements. However, generally the primary coolant is contained within a closed system in which the heat is transferred through heat exchangers to a secondary coolant. Only through leaks within the heat exchangers would radioactive materials be passed to the secondary coolant. Small amounts of fission products are included in the waste effluents of chemical plants engaged in the reprocessing of irradiated and spent fuels. In a few instances low-level radioactive wastes from such plants are released into coastal waters. It is the purpose of this paper to discuss the accumulation of radioactivity by marine fish and shellfish when fission product radionuclides and other radioisotopes are present in sea water. For the most part the discussion is based on the experimental work of the Radiobiological Investigations of the Bureau of Commercial Fisheries carried on at the Beaufort, North Carolina, laboratory.

BIO- FERTILIZERS AND THEIR USE

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Abstract: The use of chemical fertilizers and pesticides has caused tremendous harm to the environment. Hence Biofertilizers can be expected to reduce the use of chemical fertilizer and pesticides. Biofertilizer are environmentally friendly fertilizer, and are used in most of the countries. Biofertilizers are organisms that enrich the nutrient quality of soil. The main sources of biofertilizers are bacteria, fungi, and cynobacteria (blue-green algae). **Different types of biofertilizers are Rhizobium,** *Azotobacter,* **Azospirillum, Cyanobacteria,** *Azolla,* **Phosphate solubilizing microorganisms (PSM), AM**

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www.jabe.in Vol.1.S1.2014, ISSN:2394-2606

fungi. They mainly promotes the growth of the plant by increasing the supply or availability of primary nutrients to the host plant. The microorganisms in biofertilizers are used to restore the soil's natural nutrient cycle and build soil organic matter. Through the use of biofertilizers, healthy plants can be grown while enhancing the sustainability and the health of soil. It increases crop yield by 20-30%, replaces chemical nitrogen and phosphorus by 25%, and stimulates plant growth. It can also provide protection against drought and some soil-borne diseases.

FERTILIZERS FOR ORGANIC FARMING: AN ECO-FRIENDLY-APPROACH

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Abstract: Today's world already suffering with lot of newer and newer problems related to water, petroleum's, climate change, CHG and Global Warming, air pollution, water pollution, carbon and toxic gases emission, foods and grains, energy secrecy and so on. And with inclusion in those " Soil pollution due artificial chemical fertilizers" which may increase crops, seeds & nuts, fruits, flowers, grains, cotton production, but in each farming attempt damaged soil in percent and responsible to change agricultural area into "non agricultural area". Hence one of the excellent practices is need to find out new strategies of "production and utilization of organic fertilizers for organic farming" .Fertilizer products supplement the nutrients already in the soil. Man-made (non-organic) fertilizers are concentrated and quick acting. Organic fertilizers release nutrients slowly and usually contain many trace elements your plants need that are not found in most chemical formulations. Not all organic fertilizers are useful to plants immediately. The soil must be warm enough for organic fertilizers to break down and nutrients to be released. For a quick response, try fish emulsion or seaweed extracts. These are water soluble and instantly available to plants. For early season feeding use foliar sprays. Too much fertilizer can burn plants and leach into the groundwater, causing pollution problems. Organic fertilizers are safer to use because they are not as concentrated as chemical fertilizers. This paper we prepared with the intention to permute organic fertilizers for organic farming and to save agriculture land for long time.

Key words: Fertilizers, Pollutants, Plants, Agriculture, Nutrients.

ORGANIC FERTILIZERS

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Abstract: Fertilizer is any material of natural or synthetic origin that is applied to soils or to plant tissues to supply plant nutrients essential to the growth of plants. Conservative estimates report 30 to 50% of crop yields are attributed to natural or synthetic commercial fertilizer. Organic Fertilizers are materials derived from plant and animal parts or residues. Examples are Blood Meal, Compost, Bat Guano, Manure, Seaweed, and Worm Castings. Advantages of Organic fertilizers arei. improves soil structure, resulting in a crumb-like structure. ii.Improves water retention and enhances soil fertility.iii. Microorganisms can break down contaminants in the soil and water to components that pose less of an environmental hazard.There are some disadvantages in using organic fertilizers, but the benefits outweigh the limitations. Limitations of organic amendments:a. the composition of organic fertilizers may be highly variable.b. Organic materials are a dilute source of nutrients compared to inorganic fertilizers.c.Organic fertilizers may be cost prohibitive on a large scale operation.d.Organic fertilizers can be messy, and may require more work to apply.e.The release of nutrients is highly variable, and reflects the number and work of microbiological activity, which generally rises and falls with soil temperature.

In conclusion, "Dirt" becomes good soil only when you have these other components; organic matter, living organisms, moisture, and nutrients for plants and microorganisms. Healthy plants require healthy soil!

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www.jabe.in Vol.1.S1.2014, ISSN:2394-2606

INFLUENCE OF BIO-FERTILIZERS AND NITROGEN SOURCE LEVEL TOWARDS SUSTAINABLE ENVIRONMENT

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Abstract: Inorganic fertilizer application enhances plant growth and yield because it absorbs quickly to soil and plants. Therefore, farmers apply maximum amount of inorganic fertilizers to their crops to achieve a higher yield. As a result of the excessive applications of inorganic fertilizer leaches to the ground causes water pollution. India, the second largest populous country, mostly depends on agriculture for living. The population explosion has created a tremendous pressure on agriculture. The use of agricultural land for various industrial purposes reduces the area for production. Most of Indian agricultural lands are deprived of some of the essential nutrients for growth and development of crop plants. One of the major essential elements for growth of plants is nitrogen. Nitrogen is required in large quantities for plants to grow, since it is the basic constituent of proteins, and nucleic acids. Nitrogen is provided in the form of synthetic chemical fertilizer (urea). Such chemical fertilizers pose a health hazard and microbial population problem in soil besides beings quite expensive and making the cost of production high. In such a situation the biofertilizers play a major role (Tiwary et al., 1998).

Biofertilizers are the formulation of living microorganisms, which are able to fix atmospheric nitrogen in the available form for plants either by living freely in the soil or being associated symbiotically with plants (Subba Rao,1993). Biofertilizers are inputs containi ng microorganisms which are capable of mobilizing nutritive elements from non-usable form to usable form through biological processes (Tienet al., 1979). Biological nitrogen fixation is carried out by both symbiotic and free living bacteria and blue green algae. Symbiotic nitrogen fixation provides 80% of the biologically fixed nitrogen on land.

Nitrogen fixing bacteria are very selective in choosing roots of particular legumes species to infect, invade and form root nodules (Subba Rao, 1993). A unique blend of organic manure using micro nutrients and some beneficial microorganisms with sugarcane press mud as base materials has been reported as useful (Arangarasan et al., 2000).

Echinochloa frumentacea (Robx.) Link is one of the important millets of India and, it is the quickest growing of all millets, in all conditions (Anonymous, 1952). The millet is cultivated in almost all the states in India as rain fed crop. It is grown as subordinate crop to sorghum or maize in the drier districts and, sometimes, as a fodder or green manure crop. The millet is consumed mostly by the poor classes either cooked in water like rice, or parched or boiled with milk and sugar. It is sometimes mixed with rice and fermented to produce a beer. The grains are also used for feeding cage birds. The grains have the follow contents (percentage): moisture 11.1; protein 6.2; other extracts 2.2; minerals 4.4; crud e fibre, 9.8; carbohydrates, 65.5; Ca 0.002; and P 0.28; Fe 2.9 mg/100g; and a carotene trace. The principal protein is a prolamine rich in lysine, cystine and his tideine, with a nutritive value markedly superior to that of polished rice. The presence of vitamin B1in sufficient amount to prevent vitamin B1 deficiency (Anonymous, 1952). In the present agricultural practices, there are number of microbial inoculants used as biofertilizers. They include Azospirillum and Azotobacter, and Phosphobacterium, which have been given much attention as they are responsible to plant growth and yield of crops under field inoculation.

To minimize tainted situation, a combination of inorganic fertilizer with biological ingredients can be a better alternative for crop cultivation (Urban Creeks Council, 2001). Mycorrhiza (family Endogone) is a symbiotic association between mycorrhizal fungi and higher plants roots an act as an organic fertilizer/bio fertilizer. Mycorrhizae improve crop yield and increase the use of inorganic fertilizer by forming a bridge between the roots and the soil (University of Washington, 2006) It indirectly enhances the structure of the soil and improves air and water infiltration.

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www.jabe.in Vol.1.S1.2014, ISSN:2394-2606

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ACCUMULATION AND DISTRIBUTION PROCESSES OF SMALL DISPERSE COAL DUST PRECIPITATIONS AND ABSORBED RADIOACTIVE CHEMICAL ELEMENTS IN IODINE AIR FILTER AT NUCLEAR POWER PLANT

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Abstract: The physical features of absorption process of radioactive chemical elements and their isotopes in the iodine air filters of the type of AU-1500 at the nuclear power plants are researched. It is shown that the non-homogenous spatial distribution of absorbed radioactive chemical elements and their isotopes in the iodine air filter, probed by the gamma-activation analysis method, is well correlated with the spatial distribution of small disperse coal dust precipitations in the iodine air filter. This circumstance points out to an important role by the small disperse coal dust fractions of absorber in the absorption process of radioactive chemical elements and their isotopes in the iodine air filter. The physical origins of characteristic interaction between the radioactive chemical elements and the accumulated small disperse coal dust precipitations in an iodine air filter are considered. The analysis of influence by the researched physical processes on the technical characteristics and functionality of iodine air filters at nuclear power plants is completed.

EFFECT OF PLASTIC POLLUTION ON ENVIRONMENT

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Abstract: Involves the accumulation of plastic products in the Environment that adversely affects wildlife, wildlife habitat, or humans. Plastic Pollution occurs in many forms, including but not limited to littering, marine debris (man-made waste that has released in a lake, sea, ocean, or water way), plastic particle water pollution, plastic netting and friendly Floaters. A large percentage of plastic produced each year is used to make single-use, disposable packaging items or products which will get permanently thrown out within one year. Often, consumers of the various types of plastics mainly use them for one purpose and then discard or recycle them.

Chlorinated plastics can release harmful chemicals into the surrounding soil, which can then seep into ground water or other surrounding water sources. This can cause serious harm to the species that drink this water. Nurdles are plastic pellets that are shipper in this form, often in cargo ships, to be used for the creation of plastics products. A significant amount of hurdles are spilled into oceans, and it has been estimated that globally, around 10% of beach litter is nurdles. Plastics in oceans typically polystyrene can leach into waters from some plastics. Polystyrene pieces and nurdles are the most common types of oceanic debris.

Animals can be significantly harmed or killed by plastic pollution. Plastic pollution has potential to poison animals, which can then affect human food supplies. Plastic pollution has been described as being highly detrimental to large marine mammals Plastics contain many different types of chemicals, depending on the type of plastics. The addition of chemicals is the main reason why these plastics have become so Multipurpose, however this has problems associated with it. Some of the chemicals used in plastic production have the potential to be absorbed by human beings through skin absorption.

Key words: environment, plastic, pollution

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www.jabe.in Vol.1.S1.2014, ISSN:2394-2606

DISADVANTAGES IN USING SYNTHETIC FERTILIZERS

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Abstract: Today the maximum cultivated people are using synthetic fertilizers to get more fruits but it effects and influences the environment more. But Synthetic are usually derived from by-products of petroleum industry which are Ammonium nitrate, Ammonium phosphate ,super phosphate and potassium sulphate .Except plant requires the nutrients these additional fertilization is not always needed. The small creatures are helpful and responsible to improve quality and fertility of soil. But synthetic fertilizers do not support microbiological life in the soil and its application actually kills a significant percentage of beneficial micro organisms and some covert nitrogen from the air into a plant usable form in the nature. It can also be washed away easily when watering or irrigating the plants i.e leeching.N2 is one of the elements that easily get washed away since it usually settles below the roots of the plants quickly. And it happens very often as you water your plants .Hence a lot of the fertilizer goes to waste. When you are using the synthetic fertilizers you need to pay special attention to the roots of the plants, when you are watering it and not over water the area that you do not suppose the leeching of the nutrients in the soil. So they often leech, because they dissolve easily and release nutrients faster than plants use them. This requires constant applications throughout the growing season to maintain soil nutrient levels. Irrigation and rainfall can leech artificial fertilizers" nutrients, specially high levels of N2, away from their direct application spot. This excess N2 can then end up in nearby waterways and ground water can cause various types of environment pollution and side effects lead to fish kills ,algae blooms in water ponds ,when algae populations get too large resulting death reduces O2 in the water ,suffocates fish and creates dead zones in the oceans. Overdose your soil with synthetic fertilizers can result in chemical burns to your plants roots and green tissue.N2 in fertilizer filters into ground water , thus ending up in drinking water .In the human body ,N2 becomes nitrate ,which inhibits the movement of O2 through the body. However if you give too much fertilizer the plants can suffer just as they would if they get too little.

BIOFERTILISERS AND THEIR ADVANTAGES

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Abstract: This paper answers the questions such as what are biofertilisers? What are the types of biofertilisers? What are the advantages of biofertilisers? What is needed today?
Biofertilisers are the substances, which make the soil rich with nutrients by using micro organisms. It can also be said that biofertilisers are natural fertilisers, which are microbial inoculants of bacteria, algae and fungi. Some types of biofertilisers are: phosphorus biofertilisers, nitrogen biofertilisers and compost biofertilisers. The following are some of the advantages of biofertilisers. (1) biofertilisers help to get high yield of crops, (2) biofertilisers improve soil health and fertility, (3) although they take time, biofertilisers show good results, (4) biofertilisers do not damage the environment, (5) biofertilisers destroy harmful components of the soil and (6) biofertilisers are cost-effective, when compared to chemical fertilisers.
What is needed today is: (1) to know importance of biofertilisers, (2) to continue to do research in biofertilisers and (3) to make proper use of biofertilisers for high yield of crops and consequent benefits.

ADVANTAGES OF BIOFERTILIZERS OVER CHEMICAL FERTILIZERS AND BIOTECHNOLOGICAL APPROACHES TO IMPROVE BIOFERTILIZERS FOR CONTROLLING CHEMICAL FERTILIZERS IMPACT ON SOILS

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Abstract: A chemical fertilizer is an inorganic material of synthetic origin that is added to the soil to sustain plant growth. Many chemical fertilizers

contain acids, such as sulfuric acid and hydrochloric acid, which tend to increase the acidity of the soil, reduce the soil's beneficial organism population and interfere with plant growth.

Bio fertilizers are microbial inoculants consisting of living cells of micro-organism like bacteria, algae and fungi alone or combination which may help in increasing crop productivity. Biological activities are markedly enhanced by microbial interactions in the rhizosphere of plants. They increases soil organic matter, improves soil structure, improves water holding capacity, reduces soil crusting problems, reduces erosion from wind and water, improves water holding capacity and improves buffering capacity against fluctuations in pH levels.

Till now there are no universal Biofertilizers which is suited for all crop plants has been identified. Gene manipulation technique and biotechnological approaches will make them possible to some extent and also restores soil nature. So biotechnology has profound effect on Biofertilizers development to improve crops productivity and also to maintain soil nativity.

Key words: Biofertilizers, Biotechnology, Microbial inoculants, Holding capacity, Buffer

BIOFERTILIZERS PLAYS A VITAL ROLES IN SUSTAINABLE AGRICULTURE BY IMPROVING SOIL FERTILITY, PLANT TOLERANCE AND CROP PRODUCTIVITY

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Abstract: Current soil management strategies are mainly dependent on inorganic chemical-based fertilizers, which caused a serious threat to human health and environment. The exploitation of beneficial microbes as a biofertilizer has become paramount importance in agriculture sector for their potential role in food safety and sustainable crop production. The eco-friendly approaches inspire a wide range of application of plant growth promoting rhizobacteria (PGPRs), endo- and ectomycorrhizal fungi, cyanobacteria and many other useful microscopic organisms led to improved nutrient uptake, plant growth and plant tolerance to abiotic and biotic stress. The present review highlighted biofertilizers mediated crops functional traits such as plant growth and productivity, nutrient profile, plant defense and protection with special emphasis to its function to trigger various growth- and defense-related genes in signaling network of cellular pathways to cause cellular response and thereby crop improvement. The knowledge gained from the literature appraised herein will help us to understand the physiological bases of biofertlizers towards sustainable agriculture in reducing problems associated with the use of chemicals fertilizers.

DETERMINATION OF As (III) AS DMDTP COMPLEX

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Abstract: Planned economic growth and integrated farm management have become responsible for the discharge of a spectrum of pollutants into the environment. The pollutants may differ widely in quality and quantity. They may contain impurities ranging from simple salts to deadly toxic materials like trace metals and pesticides. In view of this assessment of metal concentration in environment has acquired great importance to understand the degree of metal pollution.

The present paper deals with the development of a new spectrophotometric procedure for the determination of As (III).It is based on the reaction between As(III) and dimethyl dithio phosphate (DMDTP),it forms a complex As(III)- DMDTP and as a chloroform extract it aborbs strongly at 394.8nm and is stable up to 60 min.It is also a suggestive method to use reversibly to determine Malathion and its residues in water samples.

Keywords: Malathion, Dimethyl dithio phosphate (DMDTP)

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A Peer Reviewed & Refereed, International Open Access Journal
www.jabe.in **Vol.1.S1.2014,** **ISSN:2394-2606**

BIOFERTILIZERS FOR SUSTAINABLE CROP PRODUCTION IN AGRICULTURE

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Abstract: The green revolution brought impressive gains in food production but with insufficient concern for sustainability. In India the availability and affordability of fossil fuel based chemical fertilizers at the farm level have been ensured only through imports and subsidies. Dependence on chemical fertilizers for future agricultural growth would mean further loss in soil quality, possibilities of water contamination and unsustainable burden on the fiscal system. Bio-fertilizer is one of the important components of integrated Nutrient management, as they are cost effective and renewable sources of plant nutrients to supplement the chemical fertilizers for sustainable agriculture. Biofertilizers are defined as preparations containing living cells or latent cells of efficient strains of microorganisms that help crop plants in uptake of nutrients by their interactions in the rhizosphere. Biofertilizers have emerged as a potential environment friendly inputs that are supplemented for proper plant growth. Biofertilizer is one of the best modern tools for agriculture. They hold vast potential in meeting plant nutrient requirements while minimizing the use of chemical fertilizers.. They accelerate certain microbial processes in the soil which augment the extent of availability of nutrients in a form easily assimilated by plants. They help in restoring soil health and thus provide a cost effective way to manage crop yield along with balancing Biofertilizers are low cost, renewable sources of plant nutrients which supplement chemical fertilizers.

Keywords: chemical fertilizers, loss of soil quality, water contamination, biofertilizer, low cost microorganism, crop production.

BIOPESTICIDES FOR SUSTAINABLE ENVIRONMENTAL MANAGEMENT

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Sustainable environmental management is the management of natural resources in such a way that meets the needs of the present without compromising the ability of the future generations to meet their own needs. It is the management that lasts what should we leave to our children to maximize the chances that they will be no worse than ourselves. It is the environmentally responsible management and improving the well being of the people.

It is the management that not only generates economic growth but distributes its benefits equitably, that generates environment rather than destroy it, that empowers people rather than marginalizing them. It is the management that gives priority to the poor, enlarging their choices and opportunities and providing for their participation in decisions that affect their lives.

The world has enough resources to meet our long term human needs provided proper and efficient management strategies and methods for human development are followed. In the past two decades several environmentalists have identified that it is the need but not the greed that saves the environment from degradation globally considered enough for the needs of all but not for the greed of the selected few. In the absence of sustainable environmental management the entire space ship earth will sink and with it all might perish together viz the mis-managed masses an mis-managed masters as well.

Everything of creation has its uses and abuses. It is the human consciousness and psyche which governs its use are abuse .what to say of the immense power which has been vested in to the human hands by mammoth developments in the fields of science and technology .human society had never been richer in terms of material goods and comforts as it is in the present age.

Today the food production and quality have improved by multiple factors. nations are sitting on enormous stocks of food grains, enough to feed the masses and to take care of any natural adversity .rapid strides in irrigation facilities have freed

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agriculture from vagaries of nature and there by ensured a regular and continues production fertilizers, pesticides, advanced tools and machinery have worked wonders and have simplified the work of the farmers leading to enhanced productivity. The use of pesticides and fertilizers has been a boon in many respects, but out of a drive to yield more and more their input to the soil was increased so much that the danger of salinity of soil started arising and microbial biodiversity of soil is under lot of threat.

Our approaches to nature is to beat it into submission, we would stand a better chance of survival if we accommodated ourselves to this planet and viewed it appreciatively instead of skeptically and dictatorially

Primitive man learned lesson from hunting of animals for food, and realized that the excessive hunting of animals for food would diminish. The number of individuals in its population, which would result in scarcity of food for his own living. Likewise modern man had realized that when more and more inorganic and organic toxic pesticides, fungicides, insecticides and xeno bionics are released into the environment, mainly for the control of crop diseases, it will lead to an environmental degradation. Most of the complex man-made chemicals are non-biodegradable pollutants which would cause health hazards to human population. However ,consumers are very well aware that these pesticides may get carried over to the food products hence scientist are constantly looking for eco-friendly measures , which would be adopted for disease control .an obvious approach would be to use naturally occurring biological means of controlling these problems .

By the application of microbial controlling agents, man and other non-targeted organisms are protected from the harmful effects of the agents .there is also the safeguard against reduction of pesticide residues in food, preservation of other natural enemies and increased biodiversity in eco systems. Invertebrate pathology is a recently organized discipline, and its roots can be traced to ancient history with reference to disease in honeybees and silk worm's .so any living organisms that can be manipulated by man for pest control purposes are biological control agents.

Economic relevance of microbial biological control agents to agriculture

Biologically based pest control measures are heavily relied upon for meeting the objective of improving plant disease control for efficient and sustainable production systems .heavy losses up to 10 to20% are incurred in agricultural production worldwide due to plant pathogen inflating diseases on our economically important crop plants .the loss happens despite several billion dollars being spent on controlling crop diseases with synthetic chemicals .the biological control of plant pathogens has been identified as an integral component of of integrated pest management strategies. The primary targets for biological control are the pathogens belonging to fungi, nematode, and oomycete pathogens of field, nursery and green house crops.

New molecular and genomic tools are now available for improving the management methods to be employed in biological control, systematic investigations of the molecular mechanisms by which the pathogen incites disease and the way in which the bio-control agents work to reduce the severity of disease.

Examples of Biopesticides.

1. Bacillus cereus strain uw85- this bacterium is an effective Biocontrol agent of damping-off and root-rot diseases of soybeans and alfalfa under different conditions.

2. Bacillus subtitles' strainGBO3-The bacterium is ubiquitous in the agricultural system. It can be easily isolated from soil, plant and animal tissues and food stuffs.

3. Pseudomonas fluorescence strainA506-It frequently inhabits the rhizosphere of roots and is active primitive competitive exclusion of plant pathogens such as Ewinia amylovora. This strain is very effective and is an important biological agent in controlling fire blight of pear and apple. It has been registered as biological pesticide, and is commercially available as freeze-dried preparation called Blight ban a 506@

4. Biopesticides from neemseed-neem seeds are powdered and subjected to multi solvent extraction

which results in enriched powder containing 5to8% azadirachtin.

5. Use of pheromones in pest control .all female insects release an organic substance in to the air called pheromones or sex lures in order to attract the male insect for matting purposes.

Bio fest side formulations are not generally competitive with chemical pesticides' and unlikely to displace them entirely. But they are economically cheap and ecofriendly, so they are receiving increasing attention.

Conclusion: Serious questions remain about the safety of biopesticide products from both a human and ecosystem health standpoint. Current regulations do not go nearly far enough in evaluating systemic broader impacts of biopesticides. By definition, Green Chemistry is about continuous improvements aimed at reducing or eliminating hazard. Fully defining hazard is difficult. Even products hailed by Green Chemists and regulators alike as safer for human health may turn out to have unforeseen negative environmental health impacts. See for example, Spinosad, a green chemistry award winning biopesticide, which while significantly safer for humans than other pesticides but is toxic to bees.

We must encourage pest management solutions and regulations to continuously evolve. We must also ensure that multi-disciplinary teams, including Green Chemists, environmental health specialists and other scientists, approach these innovations holistically.

A COMPARATIVE STUDY OF BIO-FERTILIZERS AND ITS IMPORTANCE FOR ECO-FRIENDLY LIFE SYSTEMS

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Abstract: A pest is described as a troublesome or destructive organism and cide means slaughter of .Nowadays whole the world is contaminated with deferent types of cides like algaecide, avicide, fungicide and herbicide etc..Due to un control use of these cides the abotic and biotic factors in all eco-systems and are being polluted in multidimensional aspects. Now the ban to use these pollutants worldwide is a primary thing to fallow. In this scenario a good start to bio fertilizers or organic manures is really wanting.Bio fertilizers help for good yield of crops and also enriches the soil by increasing its nutrients and the content of microorganisms. A two years long survey and study of the fields which are use in bio fertilizers is done by the above authors and the results are to be published.

OBSERVATION OF ADVANTAGES AND DIS-ADVANTAGES OF BOTH CHEMICAL FERTILIZERS AND BIO-FERTILIZERS

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Abstract: We need more food to feed increased population. This is only possible through high yielding varieties of food grains and other food materials like Oilseeds, Sugar, Fruits etc. All these things need nutrition through roots - from soil. These nutrition's in large quantity can only be fortified to soil through use of Chemical fertilizers. Organic - manuaring is just not possible because of many limitations. Disadvantages of Chemical Fertilizers:- Excess or uncontrolled use can spoil the soil properties, Osmotic pressure, pH, Conductivity and water holding capacity. It may also affect adversely on population of micro-organisms and other parameters. Chemical pesticides can have far-reaching effects on human health. They can contaminate the quality of surface water and groundwater, as well as cause toxicity within most individuals who consume pesticide-sprayed fruits and vegetables. Since most farmers use these fertilizers on their farm, animals receive first-hand exposure to these toxins--thus causing people who ingest non-organic meat products to experience pesticide toxicity, too. Chemical fertilizer is more "hygienic" because natural fertilizer can cause viruses or bacteria in plants which leads to disease in humans who eats them. It is also much cheaper than natural fertilizer. The use of chemical fertilizers has a great importance for the worlds food production

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www.jabe.in Vol.1.S1.2014, ISSN:2394-2606

and food prices. If we didn't had the opportunity to use chemical fertilizers it would have been higher food prices. This would have affected poor people the most. Chemical fertilizers are very useful because it works as fast food for plants. They can absorb the nutrients immediately and the fertilizer works quickly. One of the benefits with chemical fertilizers is that it's custom-made for our requirement. If the soil is rich in nitrogen and potassium, it will need a fertilizer that will take care of the lack of phosphorus. Chemical fertilizers give us the option of using phosphorus-rich fertilizers. The three main nutrients that plants needs supplies of are nitrogen (N), phosphorus (P) and potassium (K). All fertilizers contain either one or more of these nutrients. Nitrogen makes sure that the plants evolve and lets the green parts grow. Phosphorus has a lot to say for the development of the root system and the plant quality. Big and strong roots provide a healthier and more resistant plant. Potassium is essential for the bud placement and fruit quality. Potassium also has much to say on the plants ability to endure the winter. Bio fertilizer is a loosely defined term that refers to a broad spectrum of soil amendments and growth stimulators. The common feature of all these products is that they do not contain actual nutrients, but help to cultivate soil fertility in other ways. One common example is the Rhizobium bacteria that lives on the roots of certain plants and concentrates nitrogen content in the soil. This phenomenon has been known since ancient times and has been documented extensively by modern science. The effectiveness of other forms of bio fertilizer is supported in theory by the science of soil biology, but there is limited empirical evidence of their benefits in gardening applications. One of the main advantages of using bio fertilizers is the diminished need to use other forms of fertilizer, many of which have negative effects in the environment. For example, synthetic nitrogen fertilizers are known to accumulate salts in the soil after prolonged use, making the soil less fertile over time. Concentrated applications of nitrogen and phosphates, whether from synthetic or organic sources, can run-off into waterways during heavy rains and disrupt the balance of aquatic ecosystems. If bio fertilizers are effective in promoting healthy soil and plant life, the overall environment is healthier, as air and water quality are inextricably linked to soil quality. Applying bio fertilizers is unlikely to harm plant life or the environment in any way, but there is little to guarantee that they will help either. This is a distinct disadvantage compared to nutrient-based fertilizers that reliably provide quantifiable results. The reason for this lies in the myriad factors that have to be aligned for the microbes in bio fertilizers to be effective for the purpose they are prescribed. Their effectiveness is a product of complex chemical and biological interactions that are themselves affected by moisture, temperature, pH and other environmental variables. If the conditions aren't right for the microbes to multiply and do their work, their populations are likely to peter out, and the user will have wasted time and money on a product that was not suitable for the soil conditions.

AN ECOFRIENDLY WAY TO REPLACE CHEMICAL FERTILIZERS

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Increasing use of chemical fertilizers in agriculture make country self dependent in food production but it deteriorate environment and cause harmful impacts on living beings. Due to insufficient uptake of these fertilizers by plants results, fertilizers reaches into water bodies through rain water, causes eutrophication in water bodies and affect living beings including growth inhabiting micro organism. The excess uses of chemical fertilizers in agriculture are costly and also have various adverse effects on soils i.e. depletes water holding capacity, soil fertility and disparity in soil nutrients. It was felt from a long time to develop some low cost effective and eco-friendly fertilizers which work without disturbing nature. Now, certain species of micro-organism are widely used which have unique properties to provide natural products,

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and serve as a good substitute of chemical fertilizers.

A number of micro-organisms (bacteria fungi and algae) are considered as beneficial for agriculture and used as biofertilizers. Biofertilizers are supposed to be a safe alternative to chemical fertilizers to minimize the ecological disturbance. Biofertilizers are cost effective, eco-friendly and when they are required in bulk can be generated at the farm itself. They increase crop yield upto 10-40% and fix nitrogen upto 40-50 Kg. The other plus point is that after using 3-4 years continuously there is no need of application of biofertilizers because parental inoculums are sufficient for growth and multiplication. They improve soil texture, pH, and other properties of soil. They produces plant growth promoting substances IAA amino acids, vitamins etc. They have 75% moisture and it could be applied to the field directly. Biofertilizers contained 3.5% - 4% nitrogen, 2% - 2.5% phosphorus and 1.5% potassium. In terms of N: P: K, it was found to be superior to farmyard manure and other type of manure (Mukhopadhyay, 2006).

Microbes are effective in inducing plant growth as they secrets plant growth promoters (auxins, abscisic acid, gibberellic acid, cytokinis, ethylene) and enhance seed germination and root growth. They also play a considerable role in decomposition of organic materials and enrichment of compost.

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HAZARDOUS HEALTH EFFECTS OF CHEMICAL FERTILIZERS AND PESTICIDES

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Introduction: Agriculture in modern times is getting more and more dependent upon the steady supply of artificial fertilizers and pesticides with the introduction of green revolution technologies. In the Andaman and Nicobar Islands about 1,50,000 hectares of forest was deforested to make way for agriculture and settlers. This resulted in the loss of top soil and reduction of soil fertility. Agriculture in Islands is new as most of the pests and diseases are introduced. Due to change in the cultivation practice and also due to the limiting factors of Island ecology, many of the minor pests and diseases became major. A total of 15556.62 lakhs fertilizer, pesticide and improved seeds which are imported from mainland and distributed to farmers at subsidized prizes. A track record the Andaman of over 20 years of agriculture in the Islands shows that the land which supported the giant evergreen forest has not been able to support worthwhile agriculture. The soil fertility map of Andaman Islands show medium availability of N and low availability of P and K. Hence it becomes necessary to enrich the soil quality using various artificial fertilizersis the crop loss estimated by CARI in the year 2008.

Agriculture in the islands started with the establishment of penal colony in 1858. The modernization of agriculture was started by advocating the use of chemical. Further toxic chemicals like insecticides pesticides, fungicides, rodenticides are generally used to kill insects, weeds fungi and rodents respectively to protect crop plants or their harvested parts against their attacks. These chemicals are collectively called biocides. The Islands man made ecosystems comprise of agricultural crops and plantations, to grow more and more crops chemicals are being used indiscriminately. This may cause environmental disaster especially in coastal zones.

How they work: Fertilizers and pesticides may be introduced directly into the environment in a liquid phase, as a dispersion or solution or in a solid form as powder or granular form. Sprays are directed to the foliage. Solids are applied to soil surface or foliage. Some fertilizers are systemic that is they get

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absorbed in the Plant tissues and end up in the consumers. Some of them are contact, which are applied on the surface to fight pests and diseases.

These biocides tend to remain active long after destroying the target i.e. pests weeds, fungi and rodents. On continued application these agrochemicals causes contamination of food of food materials, disruption of natural balance of ecosystem by killing non target species and gradual increase in the immunity of target organisms to these chemicals. Further since most of these chemicals are not biodegradable they enter the food chain and persist in plant and animal bodies.

Bioaccumulation and bio magnification of pesticide: Continued use of huge amounts of different kinds of poisonous agricultural pesticides increase their concentration in the organism and multiplies through food chain and a phenomenon called biomagnifications is caused which moves up in the food chain and affects the apex species in the food pyramid. Man also situated at the higher tropic level of food accumulates these poisons and many cases of food poisoning and contamination are reported.

What compounds are used: The most common fertilizers used are DAP, MOP, Urea and Rock phosphate. These fertilizers provide Nitrogen, phosphorous and potassium which are very vital to plant growth.

Nitrate: The dramatic response of this fertilizer has led many farmers to use it excessively which gets leached down to the ground water. In Neil Island ground water has been declared unfit for consumption because of leaching of fertilizers into the well. Nitrates cause eutrophication of water bodies. Nitrate causes health hazards like Methaemoglobnemia, cancer, and respiratory illness and toxicity to plants.

Fluoride pollution : Phosphates fertilizers and rock phosphate are very popular contain F as an impurity leading to high level of fluoride accumulation in soils and ground water leading to mottled teeth in children.

BIO-FERTILIZERS AN ECO-FRIENDLY ORGANIC FARMING FOR SUSTAINABLE ENVIRONMENT

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Abstract: The day day by growing society wants much more crop productions to satisfy their needs. To meet this, usage of fertilizers are essential. But over usage of organic fertilizers causes the damage of environment by means of soil erosion, ground water pollution and the environmental pollution. To overcome this problem, it is the hour to use biofertilizers. Biofertilizers are Eco-friendly organic agro-input and more cost effective than chemical fertilizers. Biofertilizers add nutrients through the natural processes of Nitrogen fixation, solubilizing phosphorus, and stimulating plant growth through the synthesis of growth promoting substances. Biofertilizers can be expected to reduce the use of chemical fertilizer and pesticides. The microorganisms in biofertilizers restore the soil's natural nutrient cycle and build soil organic matter. Through the use of biofertilizers, healthy plants can be grown while enhancing the sustainability and the health of soil. Biofertilizers like Rhizobium, Azetobacter, Azospirillum and blue green algae (BGA) are in use since long time ago. Rhizobiuminoculant is used for leguminous crops. Azetobacter can be used with crops like wheat, maize, mustard, cotton, potato and other vegetable crops. Azospirillum inoculants are recommended mainly for sorghum, millets, maize, sugarcane and wheat. Blue green algae belonging to genera Nostoc, Anabaena, Tolypothrix and Aulosira fix atmospheric nitrogen and are used as inoculants for paddy crop grown both under upland and low land conditions. Anabaena in association with water fern Azolla contributes nitrogen up to 60 kg/ha/season and also enriches soils with organic matter other types of bacteria, so-called phosphate solubilizing bacteria like Pantoea agglomerans strain P5, and Pseudomonas putida strain P13 are able to solubilize the insoluble phosphate from organic and inorganic phosphate source. In fact, due to immobilization of phosphate by mineral ions such as Fe, Al and Ca or

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www.jabe.in Vol.1.S1.2014, ISSN:2394-2606

organic acids, the rate of available phosphate (Pi) in soil is well below plant needs.

Use of biofertilizers is one of the important components of integrated nutrient management, as they are cost effective and renewable source of plant nutrients to supplement the chemical fertilizers for sustainable agriculture.

Key words: Bio fertilizers, Organic farming, Chemical fertilizers, Environment.

INDUSTRIALIZATION OF AGRICULTURE THROUGH BIO-FERTILIZERS

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Abstract: Fertilizers improve the fertility of the soil and increase the crop productivity. Application of fertilizers is an age old practice. Decomposed plant residues and animal excreta are employed to the fields since time immemorial. Chemical fertilizers played a pivotal role in Green Revolution in multiplying the crop productivity to several folds. But, there are several disadvantages in the use of these Chemical Fertilizers. The chemical fertilizer industries need large scale use of fossil fuels. With the depleting fossil fuel reserves and a steady increase in fuel costs, the cost for the production of chemical fertilizers is increasing day by day. Hence production cost of the crops reached to the peak. Large scale employment of chemical fertilizers becomes a cause for several evil effects such as the loss of soil fertility, environmental pollution, persistence of fertilizer residues in the produce etc... Moreover, the crop produce generated by using chemical fertilizers falls in demand. Hence the farmer is not getting even minimum returns from agriculture. Farming cannot be separated from the farmer. Owing to a great increase of production cost and a great depletion of returns, most of the farmers are withdrawing from the agriculture and some are even committing suicides.

A right alternative to improve the agricultural production by minimising the use of chemical fertilizers is use of Bio-fertilizers. Extensive use of Bio-fertilizers may support the Gene revolution a right alternative of Green revolution. Bio-fertilizers denote he nutrient input for plant growth which is biological in origin. Bio-fertilizers comprise of a variety of living microorganisms.

Rhizobium an endo-symbiont and a diazotroph. It can enhance the productivity in pulses. The legume plants which develop from the seeds treated with *Rhizobium* inoculants produce large number of root nodules with better growth and yield. *Azospirillum* an associate symbiont and a diazotroph. It can enhance the yield in maize, sorghum, wheat, barley, finger millet etc

Cyanobacteria are the blue green algae which can fix atmospheric nitrogen in both free living systems and symbiotic systems. Application of Cyanobacteria like *Anabaena* and *Nostoc* as Bio-fertilizers can boost up the rice production. Farmers can develop cyanobacterial inoculants in their fields by following simple procedures.

Azolla, a water fern that exhibits the symbiotic association with *Anabaena azollae* can add 30 to 40 kg of nitrogen per hectare. By using *Azolla* as a Bio-fertilizer in rice fields, yield can be increased.

Glomus, a fungus can establish endomicorrhizal associations with various crops like potato, wheat, maize, soybean and red gram etc..The *Glomus* increases the phosphate absorption by the host root and also provides resistance against environmental stresses and pests.

By the application of these Bio-fertilizers, the use of harmful chemical fertilizers can be curtailed substantially. As these Bio- fertilizers are Eco-friendly in nature there is no environmental pollution problem. Crop produce will not contain any toxins. Production of Bio-fertilizers need no energy input in the form of fossil fuels. The production cost is cheaper than chemical fertilizers. They can be produced through low cost and no cost methods. By following simple procedures even the farmers can also develop Bio-fertilizers on their own. Hence by employing the sophisticated techniques of biotechnology if we produce the transgenic Bio-fertilizers it will help the farmer a lot.

The farmer, the back bone of our Indian economy, is in doldrums now."If we support the farmer, he in

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turn will support the entire human community". This is the need of the hour.

Key words: Bio-fertilizers, endosymbiont, Diazotroph.

THE EFFECTS OF RADIATION ON PLANTS

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Plants do not have to worry much about radiation. Experiments have been conducted that show that radiation is really only a problem when a plant is in the stage of a seed. Still, large amounts of radiation can destroy any material, including plant material. High doses of radiation can cause seeds to not sprout, grow slowly, lose fertility or develop genetic mutations that can change characteristics of the plant.

The right amounts of radiation can kill microorganisms on seeds, protecting them from dangerous diseases early on. An experiment conducted by the San Antonio Community Hospital found that plants that have already germinated before radiation exposure are less likely to develop defects than plants that are dormant.All molecules, from water to animal and plant material, can be damaged by radiation, as it disrupts the normal flow of electrons surrounding an atom.

Biological effect of gamma-rays

Biological effect of gamma-rays is based on the interaction with atoms or molecules in the cell, particularly water, to produce free radicals, which can damage different important compounds of plant cell. The UV-B/C photons have enough energy to destroy chemical bounds, causing a photochemical reaction. The biological effect is due to these processes. This paper is focused on the structural and biochemical changes of the cell wall and plastids after gamma and/or UV-B irradiation. Gamma-rays accelerate the softening of fruits, causing the breakdown of middle lamella in cell wall. They also influence the plastid development and function, such as starch-sugar interconversion. The penetration of UV-B light into the cell is limited, while gamma-rays penetrate through the cells. For this reason, UV-B light has a strong effect on surface or near-to-surface area in plant cells. UV-B radiation influences plastid structure (mostly thylakoid membranes) and photosynthesis. Some kinds of pigments, such as carotenoids, flavonoids save plant cells against UV-B and gamma irradiation. Plant cells are generally ozone sensitive. The detoxifying systems operate at the cellular level. Methods for studying structural changes in plant cells develop in direction to molecular biology, combined with immunoassays and new microscopical techniques. Nowadays, UV-B radiation is undergoing much research, being an environmental factor which causes damage to both humans and plant cells.

Different species have different response to the level of UV-B irradiation (Matthew et al. 1996, Skorska 1996a, b).In the study of Furness et al. (1999) vertical leaf orientationand a concealed terminal bud may protect Tragopogon pratensis dicot from UV-B radiation. On the other hand, in the case of Cynoglossum officinale with the creeping leaves habit and exposure of shoot terminals toradiation resulted in higher susceptibility to UV-B radiation.Cline and Salisbury (1966) proposed that monocotsmight be less affected by UV-C radiation than dicots becauseof their vertical leaf orientation, protective basal sheath, and concealed apical meristem.

The changes in plants morphology induced by UV - Bmay affect competition for light (Barnes et al. 1988). Thenegative effects of UV-B radiation results in deformedmorphological parameters. Exposure to UV-B decreasedplant height, leaf area and plant dry weight increasedauxiliary branching and leaf curling (Dai et al. 1995, Greenberget al.1997, Furness et al. 1999). Dai et al. (1995) reportsthat after a few weeks of UV-B exposure, leaf areaand plant dry weight of rice were significantly reduced.Weigh et al. (1998) stated that enhanced UV-A decreasedleaf area per unit plant biomass (leaf area ratio)but increased biomass productivity both per unit leaf area(leaf area productivity) and per unit leaf nitrogen (leafnitrogen productivity). High levels of UV-B clearly decreased the relative growth rate and nitrogen productivity,as leaf area ratio, leaf area productivity and leaf nitrogen productivity were all decreased.The purpose of our study is (1) to assess the effect of UV-B radiation on some morphological and physiologicaltraits of two different species

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www.jabe.in Vol.1.S1.2014, ISSN:2394-2606

Avena fatua and Setariaviridis and (2) to estimate the interaction species different levels of UV-B radiation.

Whereas scientists seem to agree that for any individual species, changes may be observed in an organism's growth capacity, it is much trickier to make observations and forecasts for an entire ecosystem. The task is complicated by the fact that we cannot single out UV radiation and separate it from other changes in atmospheric conditions, such as higher temperatures and CO2 concentrations, or water availability. UV radiation might affect certain species but also insects and pests, thus counterbalancing the direct negative effects of increased UV radiation. Similarly it might change their ability to compete with other species. In the long term UV-resistant plants may prevail over more vulnerable ones.

Excessive exposure to UV radiation can cause cancers in mammals, much as humans, and damage their eyesight. Fur protects most animals from overexposure to harmful rays. But radiation may nevertheless damage their nose, paws and skin around the muzzle.Experiments on food crops have shown lower yields for several key crops such as rice, soy beans and sorghum. The plants minimize their exposure to UV by limiting the surface area of foliage, which in turn impairs growth. However the observed drop in yield does not seem serious enough for scientists to sound the alarm Phytoplankton are at the start of the aquatic food chain, which account for 30 per cent of the world's intake of animal protein. Phytoplankton productivity is restricted to the upper layer of the water where sufficient light is available. However, even at current levels, solar UV-B radiation limits reproduction and growth. A small increase in UV-B exposure could significantly reduce the size of plankton populations, which affects the environment in two ways. With less organic matter in the upper layers of the water, UV radiation can penetrate deeper into the water and affect more complex plants and animals living there. Solar UV radiation directly damages fish, shrimp, crab, amphibians and other animals during their eary development. Pollution of the water by toxic substances may heighten the adverse effects of UV radiation, working its way up the food chain. Furthermore less plankton means less food for the animals that prey on them and a reduction in fish stocks, already depleted by overfishing.

COMPARATIVE EFFICIENCY OF HEAVY METALS ABSORPTION BY TWO GRASS SPECIES

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Abstract: The heavy metal contamination of soils increased with increasing industrialization as well as through ruthless application of chemical fertilizers, weedicides, pesticides, etc in agriculture. Primary sources of pollution is from the burning of fossil fuels, mining and smelting, municipal wastes, fertilizers, pesticides, and sewage sludge. Remediation of heavy metals polluted soil could be carried out using physico-chemicals processes such as ion-exchange, precipitation, reverse osmosis, evaporation and chemical reduction, the measures required external man-made resources and costly. Attention was given to phytoremediation by which plant is applied to absorb, transform and detoxify heavy metals. Phytoremediation an environmentally sound technology for pollution prevention, control and remediation. Phytoremediation is the direct use of living green plants for removal, degradation, or containment of contaminants in soil, sludges, sediments, surface water and groundwater. The phytoremediation method was simple, efficient, cost effective and environmental friendly. Pot experiments were conducted to investigate the potential of two grass species *Echinochloa colona, L* and *Cyperus rotundus, L* for phytoremediation of soil contaminated with lead and nickel. In these two species lead and nickel highly accumulated in *Cyperus rotundus* than *Echinochloa colona.*

CAUSES FOR EUTROPHICATION

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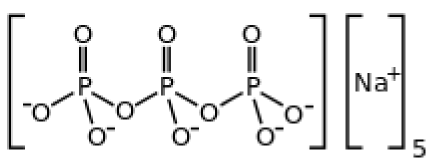
Eutrophication (Greek: *eutrophia*—healthy, adequate nutrition, development; German: *Eutrophie*) or more precisely **hypertrophication**, is the ecosystem response to the addition of artificial or natural substances, mainly phosphates, through detergents, fertilizers, or sewage, to an aquatic system. One example is the "bloom" or great increase of phytoplankton in a water body as a response to increased levels of nutrients. Negative environmental effects include hypoxia, the depletion of oxygen in the water, which causes a reduction in specific fish and other animals.

MECHANISM OF EUTROPHICATION

Eutrophication arises from the oversupply of nutrients, which induces explosive growth of plants and algae which, when such organisms die, consume the oxygen in the body of water, thereby creating the state of hypoxia.

According to Ullmann's Encyclopedia, "the primary limiting factor for eutrophication is phosphate." The availability of phosphorus generally promotes excessive plant growth and decay, favouring simple algae and plankton over other more complicated plants, and causes a severe reduction in water quality. Phosphorus is a necessary nutrient for plants to live, and is the limiting factor for plant growth in many freshwater ecosystems. Phosphate adheres tightly to soil, so it is mainly transported by erosion. Once translocated to lakes, the extraction of phosphate into water is slow, hence the difficulty of reversing the effects of eutrophication.

The source of this excess phosphate are detergents, industrial/domestic run-off, and fertilizers. With the phasing out of phosphate-containing detergents in the 1970s, industrial/domestic run-off and agriculture have emerged as the dominant contributors to eutrophication.



LAKES AND RIVERS

Eutrophication in a canal

The addition of phosphorus increases algal growth, but not all phosphates actually feed algae. Algal blooms are associated with assimilate the other necessary nutrients needed for plants and animals. When algae die they sink to the bottom where they are decomposed and the nutrients contained in organic matter are converted into inorganic form by bacteria. The decomposition process consumes oxygen, depriving fish and other organisms. Also the nutrients are concentrated at the bottom of the aquatic ecosystem and if they are not brought up closer to the surface, where there is more available light allowing for photosynthesis for aquatic plants, a serious strain is placed on algae populations.

Enhanced growth of aquatic vegetation or phytoplankton and algal blooms disrupts normal functioning of the ecosystem, causing a variety of problems such as a lack of oxygen needed for fish and shellfish to survive. The water becomes cloudy, typically coloured a shade of green, yellow, brown, or red. Eutrophication also decreases the value of rivers, lakes and aesthetic enjoyment. Health problems can occur where eutrophic conditions interfere with drinking water treatment.[4]

Human activities can accelerate the rate at which nutrients enter ecosystems. Runoff from agriculture and development, pollution from septic systems and sewers, sewage sludge spreading, and other human-related activities increase the flow of both inorganic nutrients and organic substances into ecosystems. Elevated levels of atmospheric compounds of nitrogen can increase nitrogen availability. Phosphorus is often regarded as the main culprit in cases of eutrophication in lakes subjected to "point source" pollution from sewage pipes. The concentration of algae and the trophic state of lakes correspond well to phosphorus levels in water. Studies conducted in the Experimental Lakes Area in Ontario have shown a relationship between the addition of phosphorus and the rate of eutrophication. Humankind has increased the rate of phosphorus cycling on Earth by four times, mainly due to agricultural fertilizer production and application. Between 1950 and 1995, an estimated 600,000,000 tonnes of phosphorus were applied to Earth's surface, primarily on croplands. Policy changes to control point sources of phosphorus have resulted in rapid control of eutrophication.

NATURAL EUTROPHICATION

Although eutrophication is commonly caused by human activities, it can also be a natural process, particularly in lakes. Eutrophy occurs in many lakes in temperate grasslands, for instance. Paleolimnologists now recognise that climate change, geology, and other external influences are critical in regulating the natural productivity of lakes. Some lakes also demonstrate the reverse process (meiotrophication), becoming less nutrient rich with time. The main difference between natural and anthropogenic eutrophication is that the natural process is very slow, occurring on geological time scales.

OCEAN WATERS

Eutrophication is a common phenomenon in coastal waters. In contrast to freshwater systems, nitrogen is more commonly the key limiting nutrient of marine waters; thus, nitrogen levels have greater importance to understanding eutrophication problems in salt water. Estuaries tend to be naturally eutrophic because land-derived nutrients are concentrated where run-off enters a confined channel. Upwelling in coastal systems also promotes increased productivity by conveying deep, nutrient-rich waters to the surface, where the nutrients can be assimilated by algae.

The World Resources Institute has identified 375 hypoxic coastal zones in the world, concentrated in coastal areas in Western Europe, the Eastern and Southern coasts of the US, and East Asia, particularly Japan.

In addition to runoff from land, atmospheric fixed nitrogen can enter the open ocean. A study in 2008 found that this could account for around one third of the ocean's external (non-recycled) nitrogen supply, and up to 3% of the annual new marine biological production. It has been suggested that accumulating reactive nitrogen in the environment may prove as serious as putting carbon dioxide in the atmosphere.

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FERTILIZER WITH PESTICIDE

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FERTILIZER AND PESTICIDE

In 1972–1973, Philippines was beset by rice production shortfalls resulting from the series of typhoons and floods and fertilizer shortages spawned by the oil crisis. The resulting fourfold drop in rice production prompted the government to directly intervene in the operations of the fertilizer industry through the issuance of Presidential Decree (P.D.) No. 135 dated 22 February 1973, creating the Fertilizer Industry Authority (FIA).

Fertilizer and pesticide are vital agricultural inputs in food production and must be supplied in adequate quantities at reasonable costs at all times. The fertilizer and pesticide industries have much in common in terms of clientele, distribution channels, system of application in farmers' fields and technical supervision by the same farm management technicians under the government's food production program. In view hereof, the government abolished the FIA and created the Fertilizer and Pesticide Authority on 30 May 1977 by virtue of P.D. 1144.

The FPA is mandated to assure adequate supplies of fertilizer and pesticide at reasonable prices; rationalize the manufacture and marketing of fertilizer; protect the public from the risks inherent in the use of pesticides; and educate the agricultural

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sector in the use of these inputs. It is attached to the Department of Agriculture.

Vision

Sustained agricultural productivity in a wholesome environment through integrated plant nutrients management and safe crop protection systems.

Mission

To be a catalyst in the empowerment of farmers and fisherfolk by helping them become better informed, and more efficient and conscientious in the management of their plant nutrition and crop protection requirements and preservation of marine and aquatic resources.

Strategic Thrusts

1. .Integrated Plant Nutrition System [IPNS] -a systematic approach that relates plant nutrition needs to actual soil fertility condition.
2. .Integrated Crop Protection System [ICPS] -wholistic crop protection system that relates farm productivity to the protection of human health and the environment.
3. .Empowerment of Farmers/ Fisherfolk – helping farmers/fisherfolk become more self-reliant in meeting their needs for vital agricultural inputs.
4. .Close Networking with Stakeholders in Achieving Sustainable Farm Productivity thru IPNS & ICPS.

Program Thrusts

1. .Empower farmers/fisherfolk
2. .Protect human health and the environment
3. .Use indigenous resources
4. .Develop and sustain partnership with all stakeholders.

Institutional Activities

Regulation of the fertilizer and pesticide industries efficacy and quality standards – environmental impact – product safety and agri-occupational health

Outreach services for farmers/ fisherfolk– plant Health Clinics – on-site capability-building programs

R & D– organic fertilizers – natural pesticidesMonitoring of pesticide residues in selected crops-Public Information Campaign– health and environmental information – techno-tips-Crop Pest Infestation Monitoring

Reference:

"Allocated Budget in the 2012 General Appropriations Act for the Fertilizer and Pesticide Authority". Department of Budget and Management

ADVANTAGES & DISADVANTAGES OF BIOFERTILIZERS

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ADVANTAGES OF BIOFERTILIZERS

Biofertilizers have the potential to increase the health and productivity of plant life and reduce the need to use synthetic fertilizers. The term refers to the use of micro-organisms and organic compounds that improve the ability of plants to assimilate nutrients -- as opposed to the conventional purpose of fertilizer, which is simply to provide more nutrients. There is controversy over the advantages of using biofertilizers and their effectiveness as growth stimulators.

Background Information

Biofertilizer is a loosely defined term that refers to a broad spectrum of soil amendments and growth stimulators. The common feature of all these products is that they do not contain actual nutrients, but help to cultivate soil fertility in other ways. One common example is the Rhizobium bacteria that lives on the roots of certain plants and concentrates nitrogen content in the soil. This phenomenon has been known since ancient times and has been documented extensively by modern science. The effectiveness of other forms of biofertilizer is supported in theory by the science of soil biology, but there is limited empirical evidence of their benefits in gardening applications.

Soil and Plant Health

Most biofertilizers consist of microbes that are involved in the decomposition of organic matter and the breakdown of minerals into a soluble form that is useful to plants. Most of these microbes and the compounds they create are abundant in any compost pile, and most gardeners can attest to the advantages of incorporating compost in the soil.

Biofertilizers contain specific strains of these naturally occurring organisms that have been cultivated in a lab environment to use for a particular purpose -- some help to increase levels of major nutrients like nitrogen and phosphorus, while others help to fight off disease or provide beneficial trace elements in the soil.

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Environmental Health

One of the main advantages of using biofertilizers is the diminished need to use other forms of fertilizer, many of which have negative effects in the environment. For example, synthetic nitrogen fertilizers are known to accumulate salts in the soil after prolonged use, making the soil less fertile over time. Concentrated applications of nitrogen and phosphates, whether from synthetic or organic sources, can run-off into waterways during heavy rains and disrupt the balance of aquatic ecosystems. If biofertilizers are effective in promoting healthy soil and plant life, the overall environment is healthier, as air and water quality are inextricably linked to soil quality.

Disadvantages

Applying biofertilizers is unlikely to harm plant life or the environment in any way, but there is little to guarantee that they will help either. This is a distinct disadvantage compared to nutrient-based fertilizers that reliably provide quantifiable results. The reason for this lies in the myriad factors that have to be aligned for the microbes in biofertilizers to be effective for the purpose they are prescribed. Their effectiveness is a product of complex chemical and biological interactions that are themselves affected by moisture, temperature, pH and other environmental variables. If the conditions aren't right for the microbes to multiply and do their work, their populations are likely to peter out, and the user will have wasted time and money on a product that was not suitable for the soil conditions.

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BIOFERTILIZERS

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Abstract:_Biofertilizers are defined as preparations containing living cells or latent cells of efficient strains of microorganisms that help crop plants' uptake of nutrients by their interactions in the rhizosphere when applied through seed or soil. They accelerate certain microbial processes in the soil which augment the extent of availability of nutrients in a form easily assimilated by plants. Very often microorganisms are not as efficient in natural surroundings as one would expect them to be and therefore artificially multiplied cultures of efficient selected microorganisms play a vital role in accelerating the microbial processes in soil.

Introduction: Use of biofertilizers is one of the important components of integrated nutrient management, as they are cost effective and renewable source of plant nutrients to supplement the chemical fertilizers for sustainable agriculture. Several microorganisms and their association with crop plants are being exploited in the production of biofertilizers. They can be grouped in different ways based on their nature and function.

S. No.	Groups	Examples
N2 fixing Biofertilizers		
1.	Free-living	*Azotobacter, Beijerinkia, Clostridium, Klebsiella, Anabaena, Nostoc,*
2.	Symbiotic	*Rhizobium, Frankia, Anabaena azollae*
3.	Associative	*Azospirillum*

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	Symbiotic	
P Solubilizing Biofertilizers		
1.	Bacteria	*Bacillus megaterium* var. *phosphaticum*, *Bacillus subtilis* *Bacillus circulans*, *Pseudomonas striata*
2.	Fungi	*Penicillium sp*, *Aspergillus awamori*
P Mobilizing Biofertilizers		
1.	Arbuscular mycorrhiza	*Glomus sp.,Gigaspora sp.,Acaulospora sp., Scutellospora sp.* & *Sclerocystis sp.*
2.	Ectomycorrhiza	*Laccaria sp., Pisolithus sp., Boletus sp., Amanita sp.*
3.	Ericoid mycorrhizae	*Pezizella ericae*
4.	Orchid mycorrhiza	*Rhizoctonia solani*
Biofertilizers for Micro nutrients		
1.	Silicate and Zinc solubilizers	*Bacillus* sp.
Plant Growth Promoting Rhizobacteria		
1.	Pseudomonas	*Pseudomonas fluorescens*

Different types of biofertilizers: 1.***Rhizobium:*** Rhizobium is a soil habitat bacterium, which can able to colonize the legume roots and fixes the atmospheric nitrogen symbiotically. The morphology and physiology of Rhizobium will vary from free-living condition to the bacteroid of nodules. They are the most efficient biofertilizer as per the quantity of nitrogen fixed concerned. They have seven genera and highly specific to form nodule in legumes, referred as cross inoculation group. *Rhizobium* inoculant was first made in USA and commercialized by private enterprise in 1930s.

Initially, due to absence of efficient bradyrhizobial strains in soil, soybean inoculation at that time resulted in bumper crops but incessant inoculation during the last four decades by US farmers has resulted in the build up of a plethora of inefficient strains in soil whose replacement by efficient strains of bradyrhizobia has become an insurmountable problem.

2.Azotobacter: Of the several species of *Azotobacter*, *A. chroococcum* happens to be the dominant inhabitant in arable soils capable of fixing N2 (2-15 mg N2 fixed /g of carbon source) in culture media. The bacterium produces abundant slime which helps in soil aggregation. The numbers of *A. chroococcum* in Indian soils rarely exceeds 105/g soil due to lack of organic matter and the presence of antagonistic microorganisms in soil.

3.Azospirillum: *Azospirillum lipoferum* and *A. brasilense* (*Spirillum lipoferum* in earlier literature) are primary inhabitants of soil, the rhizosphere and intercellular spaces of root cortex of graminaceous plants. They perform the associative symbiotic relation with the graminaceous plants. The bacteria of Genus *Azospirillum* are N2 fixing organisms isolated from the root and above ground parts of a variety of crop plants. They are Gram negative, *Vibrio* or *Spirillum* having abundant accumulation of polybetahydroxybutyrate (70 %) in cytoplasm. Five species of *Azospirillum* have been described as 1. *brasilense*, 2.*lipoferum*, 3.*amazonense*, 4.*halopraeferens* and 5.*irakense*. The organism proliferates under both anaerobic and aerobic conditions but it is preferentially micro-aerophilic in the presence or absence of combined nitrogen in the medium. Apart from nitrogen fixation, growth promoting substance production, disease resistance and drought tolerance are some of the additional benefits due to *Azospirillum* inoculation.

4.Cyanobacteria: Both free-living as well as symbiotic cyanobacteria (blue green algae) have been harnessed in rice cultivation in India. A composite culture of BGA having heterocystous *Nostoc*, *Anabaena*, *Aulosira etc*. is given as primary inoculum in trays, polythene lined pots and later mass multiplied in the field for application as soil based flakes to the rice growing field at the rate of

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10 kg/ha. The final product is not free from extraneous contaminants and not very often monitored for checking the presence of desiredalgal flora.

Once so much publicized as a biofertilizer for the rice crop, it has not presently attracted the attention of rice growers all over India except pockets in the Southern States, notably Tamil Nadu. The benefits due to algalization could be to the extent of 20-30 kg N/ha under ideal conditions but the labour oriented methodology for the preparation of BGA biofertilizer is in itself a limitation. Quality control measures are not usually followed except perhaps for random checking for the presence of desired species qualitatively.

5.Azolla: *Azolla* is a free-floating water fern that floats in water and fixes atmospheric nitrogen in association with nitrogen fixing blue green alga *Anabaena azollae*. *Azolla* fronds consist of sporophyte with a floating rhizome and small overlapping bi-lobed leaves and roots. Rice growing areas in South East Asia and other third World countries have recently been evincing increased interest in the use of the symbiotic N2 fixing water fern *Azolla* either as an alternate nitrogen sources or as a supplement to commercial nitrogen fertilizers. *Azolla* is used as biofertilizer for wetland rice and it is known to contribute 40-60 kg N/ha per rice crop.

Benefits of Biofertilizers:

The advantages of Liquid Bio-fertilizer over conventional carrier based Bio-fertilizers are listed below:

- Longer shelf life -12-24 months.
- No contamination.
- No loss of properties due to storage upto 45º c.
- Greater potentials to fight with native population.
- High populations can be maintained more than 109 cells/ml upto 12 months to 24 months.
- Easy identification by typical fermented smell.
- Cost saving on carrier material, pulverization, neutralization, sterilization, packing and transport.
- Quality control protocols are easy and quick.
- Better survival on seeds and soil.
- No need of running Bio-fertilizer production units through out the year.
- Very much easy to use by the farmer.
- Dosages is 10 time less than carrier based powder Bio-fertilizers.
- High commercial revenues.
- High export potential.
- Very high enzymatic activity since contamination is nil.

Do's and Don't for Entrepreneurs, Dealers and farmers:

Do's	Don't
Keep Bio-fertilizers bottles away from direct heat and sunlight. Store it in cool and dry place.	Don't store Bio-fertilizers bottles under heat and sunlight
Sell only Bio-fertilizers bottles which contain batch number, the name of the crop on which it has to be used, the date of manufacture and expiry period.	Don't sell Bio-fertilizers bottles after their expiry period is over.
If the expiry period is over, then discard it as it is not effective.	Don't prick holes into the bottles or puncture them to pour the content
Keep Bio-fertilizers bottles away from fertilizer or pesticide containers and they should not be mixed directly.	Do not mix the Bio-fertilizers with fungicides, insecticides, herbicides, herbicides and chemical fertilizers.

BIOFERTILIZERS ROLE IN AGRICULTURE

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The increasing population puts considerable pressure on land and other natural resources of the world causing damage to the ecological base of

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agriculture and serious socio-economic problems. The increased crop production over years has accelerated the removal of plant nutrient four times during the last four decades putting fourfold pressure on soil resources. The replenishment of nutrients lost in crop removal through the use of chemical inputs is not considerable advise as their use on a long run has been found to decelerate the biological activities in the soil causing impaired soil health, consequently, increasing awareness is being created in favors of Organic farming which has emerged as an important priority area globally in view of the growing demand for safe and healthy food and long term sustainability and concerns on environmental pollution associated with indiscriminate use of agrochemicals. Bio-fertilizers are being essential component of organic farming are the preparations containing live or latent cells of efficient strains of nitrogen fixing, phosphate solubilizing or cellulolytic micro-organisms used for application to seed, soil or composting areas with the objective of increasing number of such micro-organisms and accelerate those microbial processes which augment the availability of nutrients that can be easily assimilated by plants. Biofertilizers play a very significant role in improving soil fertility by fixing atmospheric nitrogen, both, in association with plant roots and without it, solubilise insoluble soil phosphates and produces plant growth substances in the soil. They are in fact being promoted to harvest the naturally available, biological system of nutrient mobilization (Venkatashwarlu, 2008). The role and importance of bio-fertilizers in sustainable crop production has been reviewed by several authors. But the progress in the field of BF production technology remained always below satisfaction in Asia because of various constraints.

Biofertilizers: Biofertilizers or microbial inoculants can be generally defined as preparations containing live or latent cells of efficient strains of nitrogen fixing, phosphate solubilising or cellulolytic microorganisms used for application to seed, soil or composting areas with the objective of increasing the extent of the availability of nutrient in a from which can be easily assimilated by plants. Biofertiliser are the low cost source of plant nutrients, eco-friendly and have supplementary role with chemical fertilizers. The Bio-fertilizers are bacteria, algae & fungi and may broadly be classified into two categories viz. Nitrogen fixing like Rhizobium, Azotobactor, Azospirilum, Acetobacter, Blue Green Algae & Azola and Phosphorous solubilisers/ mobilisers like PSM & Mycorrizae. Recently, the Potash mobilisers like Frateuria aurentia Zinc & Sulphur solubilisers like thiobacillus species and manganese solubiliser fungal culture like pencillium citrinum have also been identified for commercial operations. These new strains would also address the issue of 'Fertilizer Use Efficiency' and would also enhance the efficacy of Bio-fertilizers.

- Biofertilizers fixed atmospheric nitrogen in the soil and root nodules of legume crops and make it available to the plant.
- They solubilise the insoluble forms of phosphates like tricalcium, iron and aluminium phosphates into available forms.
- They scavenge phosphate from soil layers.
- They produce hormones and anti metabolites which promote root growth.
- They decompose organic matter and help in mineralization in soil.
- When applied to seed or soil, biofertilizers increase the availability of nutrients and improve the yield by 10 to 25% without adversely affecting the soil and environment.

Rhizobium sp : These are gram positive soil bacteria and symbiotic nitrogen fixer which assimilates atmospheric nitrogen and fixes in the root nodule, formed in the roots of leguminous plants and also in some nonleguminous plants. The root nodulating rhizobia are as: R . leguminosarum nodulates pea ; R . phaseoli nodulates bean and Bradyrhizobium nodulates soybean. But Azorhizobium caulinodans is one such rhizobial species that nodulates the stems of Sesbania rostrata . Rhizobium cells contain genes for nitrogen fixation (nif genes) on a megaplasmid. The bacteria enter the roots through root hairs; interaction is progressing through several steps and it ultimately leads to nodule formation. Inside the nodule many bacterial cells changing into

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nondividing bacteroids, which produces nitrogenase enzyme which reduces atmospheric nitrogen to ammonia.

Uses:

- Rhizobium can fix 50-200 kgs N/ha in one crop season.
- It can increase yield up to 10-35%.
- Due to rhizobial activities, the root hairs and nodules secrete a mucous substance which enhances the soil fertility and growth of the plant.
- The enzyme nitrogenase will reduce the molecular nitrogen to ammonia which is readily utilized by the plant.
- By means of seed treatment, the germination of seeds gets stimulated and in turn increase crops yield potential

Azospirillum : It is the associate symbiotic nitrogen fixer, aerobic free living which makes the atmospheric nitrogen available to various crops. This nitrogen-fixing bacterium when applied to the soil undergoes multiplication in billions and fixes atmospheric nitrogen in the soil. Nitrogen fixation in the rhizosphere through the action of nitrogenase enzyme. The Scientists of Indian Agricultural Research Institute, New Delhi have isolates strains of Azospirillum from the roots of grasses, rice, sorghum and maize.

Uses:

- Azospirillum sp. have the ability to fix 20-40 Kgs N/ha.
- It results in average increase in yield of 15-30%.
- It also results in increased mineral and water uptake.
- It also promotes root development and vegetative growth.
- Fortification of the soils occurs with bacterial metabolites and by secreting growth promoters.

It is recommended for Paddy, Millets, Oilseeds, Fruits , Vegetables, Sugarcane, Banana, Coconut, Oil palm, Cotton, Chilly, Lime, Coffee , Tea, Rubber, Flower, Spices, Herbs, Ornaments, trees etc

Azolla: It is an aquatic heterosporus fern which contains an endophytic cyanobacterium Anabaena azollae in its leaf cavity. It is widely used in Vietnam as biofertilizer for rice. Dr. P.K. Singh at CRRI (Cuttak) has done work on mass cultivation of Azolla and its use in rice and other fields. Mass cultivation of Azolla is done as : firstly microplots are prepared in which sufficient water is added.Optimum pH (8. 0) and temperature (14- 30ºC) should be maintained. Then microplots are inoculated with fresh Azolla and an insecticide furadon is used to check the attack of insects. After 3 weeks Azolla mat is harvested and fresh Azolla is inoculated in same microplot to repeat the inoculation. Azolla mat is dried to use as green manure. Also Azolla shows tolerance against heavy metals e.g. A . pinnata absorbs heavy metals into cell walls and vacuoles due to specific metal resistant enzymes. It can also be incorporated as green manure in rice field near the polluted areas where heavy metal concentration is present.

Uses: It is mostly used in rice fields where water is available for its growth and multiplication. It is supplemented with 8-20 kg phosphate per hectare. It improves the height of rice plants, number of

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tillers, grains and straw yield. There is a 50% higher yield by using Azolla as biofertilizer

Azotobacter: It uses organic matter present in soil to fix nitrogen a symbiotically. It has been observed that inoculation of soil or seed with Azotobacter causes increase in yield of crops. This biofertilizer is mainly used in Russia and many European countries under the name Azotobacterin. The application of this is upto 20% increase in yield of crops such as wheat, barley, maize, carrot, cabbage etc.,

Mycorrhizal fungi: The term Mycorhiza was coined by Frank in 1885.It is a distinct morphological structure which develops as a result of mutualistic symbiosis. It is the symbiotic association between plant roots and soil fungus.The kinds of mycorrhizae are:

a) **Ectomycorrhiza:** Ectomycorrhiza arc found on the roots of forest trees (e.g. pine, oak, beech, eucalyptus, etc.).In general root hairs are absent on roots of some higher plants. Therefore roots are infected by mycorrhizal fungi and form a mantle. The hyphae grow intercellularly and develop Hartig net in cortex. So a bridge is established between the soil and root through the mycelia. They absorb nitrogen, phosphorus, potassium and calcium and produce growth promoting substances i.e. cytokinins. The major functions which ectomycorrhizae perform are: absorption of water; solubilisation of complex organic molecules into simplex inorganic nutrients then their absorption and transfer to roots; protection of plants from attack of inciting pathogens by secreating antimicrobial substances.

b) **Endomycorrhiza**: In this association fungus does not form an external sheath or mantle. The fungus lives in the intercellular spaces as well as intracellularly in the cortical cells of roots. Only a small portion of fungus lives outside the root.Endomycorrhiza are found in the roots of most fruits and other horticultural crops e.g. coffee, pepper, cardamom, and betelvine. They particularly help in phosphorus nutrition. They also produce growth promoting substances and offer resistance against pathogens.

c) **VesicularArbuscularMycorrhiza:** One of the important type ofendomycorrhizae, VAM plays a great role in inducing plant growth. VAM is highly versatile and colonizes 85% of the plant families. It penetrates the roots, forms arbuscules and vesicles in the cortical cells of the roots Vesicles are thick walled swollen structures and arbuscules are branched hautorial branches of mycelium .They serve as food storage organs of the fungus. VAM can be produced on a large scale by pot culture technique.

Uses:

- VAM fungi enhances water uptake in plants.
- They increase resistance in plants and reduce the effects of pathogens and pests on plant.
- The mychorrhiza penetrates the roots, mobilizes & supplies phosphorus and other micronutrients to the plants.
- VAM fungi reduce plant response to soil stress.
- Mycorrhizal plants show higher tolerance to high soil temperaturesand heavy metal toxicity

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ROLE OF STIMULANT FERTILIZERS

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ABSTRACT: Those fertilizers which help in keeping the soil's pH value suitable for plant growth, i.e. they make the plant food already present easily available to the plants.

Ex: Gypsum, lime and common salt.

Introduction: All the known fertilizers (Natural or artificial) may be classified into different groups.

1. **Direct fertilizers:** Those fertilizers which are directly absorbed by the plants are called direct fertilizers. They are further divides into three groups depending upon the nature of the element.

a) Nitrogenous fertilizers: These are potassium containing direct fertilizers.

b) Phosphate fertilizers : These are phosphorus containing direct fertilizers.

c) Potash fertilizers: These are potassium containing direct fertilizers.

2. **Indirect fertilizers or stimulant fertilizers**: those fertilizers which help in keeping the soil's pH value suitable for plant growth, i.e., they make the plant food already present easily available to the plants. Examples are gypsum, lime and common salt.

Essential requisites for a fertilizer: It is important to note that all substance having nitrogen, potassium or phosphorous can not serve as fertilizer, But it must satisfy the following conditions.

- ✓ It should be cheap and readily available.
- ✓ It must be readily soluble in water so that it can penetrate the soil and thus it may be easily assimilated by the plants.
- ✓ Its constituent element (N,P or K) must be easily available to the plants.
- ✓ The compound should be stable so that it is available for a longer time to the plant.
- ✓ It should not be harmful to the plant.
- ✓ It should have a property to current the acidity of the soil.
- ✓ It should have a high percentage of N,P or K so that minimum cost is involved in its handling, freight and package.
- ✓ Its storage properties must be good with little or no tendency to setting or deliquescence.

Fertilizers: Although as much as twelve elements namely C, H, O, N, P, S, Ca, Mg, K, Fe, B and Mn are found to be essential for the normal growth of the plants; the three elements(N,P and K) are the most common deficient elements in the soil.

Important functions of nitrogen:

- Nitrogen causes rapid growth.
- Nitrogen increases protein content.
- Nitrogen imparts green co lour to plants.

Important functions of phosphorus:

- It stimulates early root formation.
- It stimulates rapid growth and hastens maturity.

Important functions of potassium:

- It counteracts undesirable effect due to excessive supply of other nutrients, particularly nitrogen.
- It is necessary for the production of albuminoids.
- It helps in the formation of carbohydrates.
- It increases vigour and disease resistance.
- It makes stalks stronger and helps in the development of healthy roots.

These three elements are thus usually supplied to the plants in the form of chemical compounds called fertilizers. Thus fertilizer may be defined as those chemical compounds which are added to the soil to provide deficient constituent to plants for their normal growth. Fertilizers may be natural(e.g. animal manures, guano, slaughter etc) as well as synthetic(artificial).

Theme of Stimulate Fertilizers:

Some of the soils contains Basics nature because of the salt like Sodium Carbonate and sodium bicarbonate is present in that soil. Due to Basic nature ph in greater than 8-10 of that soil if the ph of the soil around 7 in natural nature conditions only plant can grow that type of soils stimulate fertilizers are add that can nutralise

The stimulate fertilizers are Gypsum, the Chemical name is Calcium Sulphate. The Gypsum is dissolved in water and react with water ions to form Calcium hydroxide and sulphuric acid calcium

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www.jabe.in **Vol.1.S1.2014,** **ISSN:2394-2606**

hydroxide and sulphuric acid calcium hydroxide is a weak due to that .this not dissociate completely . where as sulphuric acid in strong acid that is completely ionized and give H+ ions to that solution .the H+ ions are react with OH- Ions give by the sodium carbonate and sodium by carbonate that soil is neutralized and got the ph around 7 . so with that condition plant, will shown so salt like gypsum,caso4,Znso4,Zncl2,Cucl2 are act as a stimulate fertilizers

Conclusion: So stimulate fertilizers act as a key role in cultivation and also provide a calcium ions zinc ions necessary to that crop.

ARE WE RIGHT OR WRONG IN THE USE OF AGROCHEMICALS

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Abstract:
Today pesticides and fertilizers have become essential in Modern agriculture to feed the dramatically growing population. Use of **Chemical Fertilizers** has brought in blessings on humanity which helped contain hunger and death in different corners of the world. Though they increase crop production; their over-use has harden the soil, decrease fertility, strengthened pesticides, polluted air and water, and released Green house gases, thereby posing serious challenges to the balanced and sustainable agrogrowth and health hazards. Currently approximately 600 active pesticides ingredients are used, but adequate toxicogenic data are available for only 100 pesticides which are toxic for agriculture and lawn. **Environmental exposure** of humans to agrochemicals is common (ground water contamination, herbicides, pesticides, waste disposal ingredients of pesticides and fertilizers) and results in both **Acute and Chronic health hazards** including neurotoxicity, lung damage, chemical burns, infant methamoglobinemia(Blue baby syndrome), adverse reproductive and develop effects, immunological abnormalities, goitre, birth malformations, hypertensions, variety of cancers, several vector-borne diseases etc., and environmental imbalances like Eutrophications, death of aquatic fauna and flora, weather changes and Global warming. These facts are alarming and serious step needs to be taken as soon as possible to avoid more severe consequences. The use of these chemicals for growth and cultivation is keeping our stomach filled for now, but then if things keep on progressing the way they are, it won't take long to see the times where there is dry and usar land, lack of food, water and health. A simple and small step can also make a big difference and i.e. taking the help of **Our Very Good Soil Friendly Microbes-Biofertilizers and Biopesticides.** "**Lets hope for a healthy and safe tomorrow".**

TAKE THE HELP OF BIOMICROBES, NEVER FORGET U ARE BIO AND MAKE THE WORLD BIOENVIRONMENT.

Introduction:

Plants require a number of soil nutrients like nitrogen, phosphorus and sulphur for their growth. But, soil nutrient levels can decrease overtime when crop plants are harvested, as nutrients are not returned to the soil. Hence, these essential nutrients needs to be compensated either through the natural process of decomposition, when plants die and decay and the nutrients extracted from the soil return to the soil, Alternation of generations or by the easy means of adding fertilizers. The plants are mostly affected by pests and so pesticides are also as important as fertilizers in agriculture. They both are mostly chemical products which are fast growing and increasing crop production. But the fact beside is that their overuse has hardened the soil, decreased fertility, polluted air and water affected the climatic changes and released green house gases, thereby bringing hazards to human health and environment as well.

NEGATIVE SIDE EFFECTS

I. Environmental effects:

The biggest issue facing the use of chemical fertilizers and pesticides is ground water contamination. One popular fertilizer urea, produces ammonia emanation, contributes to acid rain and ozone depletion. Nitrogen ground water contamination also contributes to marine **"dead zones",** which has an impact not only on the aquatic ecosystem but on local societies. Another highly questionable use of raw sewer sludge is applied

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www.jabe.in Vol.1.S1.2014, ISSN:2394-2606

directly to crops and soil, a practice known as **"night soil"** and this practice should never be confused with "humanure" as the risk of disease is obvious and high.

According to the Environmental Protection Agency(EPA) consider that there are potential drawbacks, in an effort to be as environmentally conscious as possible, it is important to consider the potentially harmful effects as well as the benefits in case of chemical fertilizers.

(A)WATER POLLUTION:

Many of the quick-release of pesticides and fertilizers have been known to lead to oxygen loss in water ways due to run off into the street, as a result, into the water. High amounts of nitrogen causes an excess of algae (**Algal Blooms**) that have a negative effect on fish and other wild life in the water.

(B)TOXIC WASTE POTENTIAL:

Some chemicals made from the residuals of waste water treatment facilities or recycled from other areas cause them to test positive for toxic waste. According to the federation of Public Interest Research Groups(PIRG),29 positive fertilizers tested positive for 22 toxic heavy metals linking directly to human health hazards.

(C)DEPLETES THE QUALITY OF THE SOIL:

Though this may sound ironic to you, the fact is that these chemicals in the soil may alter the soil fertility by increasing the acid levels in the soil and making the land barren. They can cause root burn and donot allow enough water intake for the plants. They may also kill **soil friendly microorganisms**.

(D)CLIMATE CHANGES ACROSS THE GLOBE:

The chemicals contributed to a great extent in the quantity of green house gases present in the environment, thus leading to **global warming** and weather changes.

(E)ALTERS THE BIOLOGY OF WATER BODIES:

Too much use of agrochemicals in the soil and crops, it leads to **Eutrophication**. The substances like nitrates, phosphates etc., are flooded into lakes and oceans through rains and sewage. These substances prove to become toxic for aquatic life and leads to their death called eutrophication. We would be surprised that more than 50% of lakes are eutrophic.

Therefore, you can well imagine as to how harmful is the use of these agrochemicals for our environment……and the ongoing their use across the world will only make matters worse!

II. HUMAN HEALTH HAZARDS:

The most significant human effects come from fertilizer that is designed to kill or prevent weeds (i.e.) acting like pesticides. According to EPA's office of pesticide programs, 12 of the most popular pesticides have known to cause cancer. Evidence of serious health risks include cancers, nervous system diseases, reproductive problems etc.,

Research conducted was cited increased presence of neurological disorders, Parkinson's disease, childhood leukemia, lymphoma, asthma, female infertility, development of Autism, Infant Blue baby Syndrome, goitre, birth malformations, hypertension, respiratory ailments, cardiac disease, allergies, obesity, several vector-borne diseases like West Nile Virus, lung damage, chemical burns, various acute and chronic cancers like gastric, stomach, breast hematopoietic and testicular cancers etc.,and more unpleasant diseases.

Children's health Environmental Coalition says "while many pesticides decompose rapidly when exposed to outdoor light and heat, in an indoor environment they can persist, sometimes for years, buried in carpet fibers, furniture and stuffed toys. So, children and pets may be at serious risk in contact to the residues in our home.

CASE STUDIES

1. It is a violation of U.S .Federal law to claim pesticides are "safe when used as directed" since nothing can assure safety. However, Agriculture Canada, the federal agency responsible until recently for licensing pesticides in Canada, routinely used this statement, adding for good measure that "most pesticides are safer than table salt" and are now licensed by Health Canada but examples include Mancozeb, which degrades into a substance that is an EPA-classified probable carcinogen.

2. The Newyork state Attorney General's office used Dow Elanco chemical company when they claimed that Dursban shows "no evidence of

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www.jabe.in **Vol.1.S1.2014,** **ISSN:2394-2606**

significant risk to the environment" when right on the label is stated "this pesticide is toxic to birds and extremely toxic to fish and aquatic organisms". A few years later on may 2,1995, the EPA fined Dow Elanco for "failing to report to the agency information on adverse health effects (to humans) over the past decade involving a number of pesticides, including chloropyrifos (brand name Dursban)" which causes multiple sclerosis.

3. Some companies have even made claims that their products better the environment."Funk" lawn care of Newyork has coined the phrase "Growing A Better Environment" in order to fool consumers into believing lawn chemicals pose no ecological harm. Another states "a 50-by-50 foot lawn produces enough oxygen to sustain a family of four." But these practices actually create a net destruction.

4. Many victims include former lawn users, their families, and children. Sharon Malhotra, a registered nurse from Pittsburgh, would get so sick from lawn and tree spraying that she had to leave her home every spring. Otherwie she would suffer headaches, paralysis in her hands and feet, and muscle seizures, blurred vision, speech difficulties, and severe stomach cramps. Her husband, a doctor, suspected early on her symptoms were the result of nerve damage from organophosphates, which are widely used nerve-gas type insecticides, like Diazinon.

5. Karen James, a Michigan postal worker ,successfully sued ChemLawn in 1988.While walking past one of their trucks, a hose ruptured and she was drenched with chemicals. The employee told her not to worry, that only fertilizers were in the spray. But soon after she became seriously ill, and her eyes and skin burned. When her symptoms of fatigue, vomiting, diarrhea, and reduced vision didn't clear up, her doctor called ChemLawn to find out what chemicals she had been exposed to. He was told no pesticides had been involved, but after tests on karen's body tissue detected high levels of Dursban.

6. In 1985 a married couple in Sarasota, Florida, felt pressured by their neighbors to get their lawn treated. They hired a company, never thinking their 2-year-old daughter would be jeopardized. The company declared the yard would be safe about an hour soon after playing barefoot on the grass, the couple's daughter developed a rash all over her body, her urine turned dark brown, and she ran a high fever, her hands and feet swelled to twice normal size, blistered and pleaded, her lips turned black and bled. Years later she is still permanently prone to headaches and has 40% hearing loss in her right ear.

7. And more cases can be listed out like: Barry and Jackie Versey believe lawn chemicals were responsible for the death of their baby son. Kevin Ryan from Arlington height, Illinois, feels like a prisoner in his home. In 1986 Robin Dudek of Hamburg, New York pulled the garden hose off her lawn and used it to fill a wading pool for her daughters Amanda,3,and Kristen,2,sprayed with chemicals. Noticed burn marks on both of them, as well as the smell of chemicals on Amanda's breath.

8. Glyphosate, the active ingredient in Monsanto's broad-spectrum herbicide Roundup, which is generously, doused on genetically engineered (GE) Roundup Ready crops. A new peer-reviewed report authored by Anthony Samsel, a retired science consultant, and a long time contributor to the Mercola.com Vital Votes Forum, and Dr.Stephanie Seneff, a research scientist at the Massachusetts Institute of Technology (MIT), reveals how glyphosate wrecks human health. The two key problems includes glyphosate in the diet: Nutritional deficiencies and Systemic toxicity. In 2009, a French court found **Monsanto guilty of lying**; falsely advertising its roundup herbicide as "biodegradable," "environmentally friendly" and claiming it "left the soil clean."According to Dr.seneff, glyphosate is possibly" the most important factor in the development of multiple chronic diseases and conditions that have become prevalent in Westernized societies, which includes "Autism, Allergies, Cancer, Parkinson's disease, Gastrointestinal diseases, Cardiovascular disease, Infertility, Multiple sclerosis, Obesity, Depression, Alzheimer's disease and more.

And many more cases can be studied if we go on this topic.

EXPOSES THE AGROCHEMICALS FEAST YOU ARE EXPOSED TO:

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www.jabe.in Vol.1.S1.2014, ISSN:2394-2606

Agrochemicals became part of our nation's staple during the Green Revolution. It refers to phase when the country's crop production increased exponentially with increased use of fertilizers and irrigation. Genetically modified crops were introduced in 1963 by Dr.Norman Borlang. However the flipside of such a high yield has been the harmful effects the pesticides and fertilizers cause to everything associated humans, flora, fauna and the environment in general.

NOT REALLY HARMFUL?

Biggest agrochemical producers argue that without them the country's yield would go down and laughed off the suggestions that farmer's don't eat their own food. They also added that they helped thousands of farmers earn their livelihood and produce enough crops. They also pointed that only about 1% of the entire food produced in the world was 'organic' and rest did need agrochemicals. Scarily there are no rules and regulations to check the use of agrochemicals in the country.

FINDING SOLUTIONS.

SHORT-TERM SOLUTIONS:

Soaking the water, rinsing and leaching, washing in brine of groceries, all help reduce chemicals.

LONG-TERM SOLUTIONS:

The implementation of a policy that will subsidize farmers.

Conclusion

These facts are alarming and a serious step needs to be taken as soon as possible to avoid more severe consequences. The use of agrochemicals for growth, cultivation and prevention of diseases in agriculture is keeping our stomach filled for now, but then if things keep on progressing the way they are, it won't take long to see the times where there is lack of food, water and health. So, make sure that their use in moderation allow your soil to replenish its nutrients naturally by giving it a break from crop production and avoid using fertilizers during rains and pesticides only when necessary. A small step can also make a big difference. (i.e.) the use of simple **Biofertilizers and Biopesticides**. Already many countries are using them and they feel satisfactory and why not our country should try starting using them.

And now it is our turn to think whether "ARE WE RIGHT OR WRONG IN THE USE OF AGROCHEMICALS". As a microbiologist I love to prefer microbes in agriculture. And so …..

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-Lets hope for a healthy and safe tomorrow.

BIOFERTILIZERS –AN ECOFREINDLY APPROACH FOR SUSTAINABLE CROP PRODUCTION

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Abstract: The most important constraint in good crop yield in developing nations worldwide, and especially among resource-poor farmers, is soil infertility. Current soil management strategies are mainly dependent on inorganic chemical-based fertilizers, which cause a serious threat to human health. Therefore, maintaining soil quality can reduce the problems of land degradation, decreasing soil fertility and rapidly declining production levels that occur in large parts of the world needing the basic principles of good farming practice. Minerals, organic components and microorganisms are three major solid components of the soil. They profoundly affect the physical, chemical, and biological properties and processes of terrestrial systems. Biofertilizers has become paramount importance in agriculture sector for their potential role in food safety and sustainable crop production. They are the products containing cells of different types of beneficial microorganisms. The eco-friendly approaches inspire a wide range of application of plant growth promoting rhizobacteria (PGPRs), endo-and ectomycorrhizal fungi, cyanobacteria and many other useful microscopic organisms led to improved nutrient uptake, plant growth and plant tolerance to biotic and abiotic stress. These potential biological fertilizers would play key role in productivity and sustainability of soil and also protect the environment as eco-friendly and cost effective inputs for the farmers. This paper discuss about how the biofertilisers effect the

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www.jabe.in Vol.1.S1.2014, ISSN:2394-2606

nutrition of plants and increase agricultural productivity in an ecofreindly way.

Introducion

For optimum plant growth, nutrients must be available in sufficient and balanced quantities. The most important constraint limiting crop yield is soil infertility. Unless the fertility is restored in these areas, farmers will gain little benefit from the use of improved varieties and more productive cultural practices. Soil fertility can be restored effectively through adopting the concept of integrated soil fertility management (ISFM) encompassing a strategy for nutrient management-based on natural resource conservation, biological nitrogen fixation (BNF) and increased efficiency of the inputs . These potential biological fertilizers would play key role in productivity and sustainability of soil and they are cost effective, ecofriendly and renewable source of plant nutrients to supplement chemical fertilizers in sustainable agricultural system.

Biofertilizers when, applied to seed, plant surface or soil, colonize the rhizosphere or the interior of the plant and promotes growth by converting nutritionally important elements (nitrogen, phosphorus) from unavailable to available form through biological process such as nitrogen fixation and solubilization of rock phosphate. Beneficial microorganisms in biofertilizers accelerate and improve plant growth and protect plants from pests and diseases.

The term biofertilizer or called 'microbial inoculants' can be generally defined as a preparation containing live or latent cells of efficient strains of nitrogen fixing, phosphate solubilizing or cellulytic microorganisms used for application of seed, soil or composting areas with the objective of increasing the numbers of such microorganisms and accelerate certain microbial process to augment the extent of the availability of nutrients in a form which can assimilated by plant. In large sense, the term may be used to include all organic resources (manure) for plant growth which are rendered in an available form for plant absorption through microorganisms or plant associations or interact.

Making of biofrtilisers:

There are several things need to be considered in biofertilizer making such as microbes' growth profile, types and optimum condition of organism, and formulation of inoculums. The formulation of inoculum, method of application and storage of the product are all critical to the success of a biological product. In general, there are 6 major steps in making biofertilizer. These includes choosing active organisms, isolation and selection of target microbes, selection of method and carrier material, selection of propagation method, prototype testing and large scale testing. The isolation of desired microorganism isolation is made to separate target microbes from their habitation and will be grown on Petri plate, shake flask and then glasshouse to select the best candidates. Selection of propagation method is mainly to find out the optimum condition of organism. After that, prototype made and tested. Lastly, biofertilizer is testing on large scale at different environments to analyze its effectiveness and limitability at different surroundings.

Biofertilizers are usually prepared as carrier based inoculants containing effective microorganisms. Incorporation of microorganisms in carrier material enables easy-handling, long-term storage and high effectiveness of biofertilizers.Various types of material can be used as carrier or seed or soil inoculation. The properties of a good carrier material for seed inoculation are inexpensive and available in adequate amounts. It must non-toxic to inoculants bacterial strain and non-toxic to plant itself. Because it acts as carrier for seed inoculation, it should have good moisture absorption capacity and good adhesion to seeds.

Microorganisms used as biofertilisers

Organisms that are commonly used as biofertilizers component are nitrogen fixers (N-fixer), potassium solubilizer (K-solubilizer) and phosphorus solubilizer (P- solubilizer), or with the combination of molds or fungi. Rhizobium has symbiotic interaction with legume roots, the phospho-microorganism mainly bacteria and fungi make insoluble phosphorus available to the plants. Several soil bacteria and a few species of fungi possess the ability to bring insoluble phosphate in soil into soluble forms by secreting organic acids. These acids lower the soil pH

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www.jabe.in Vol.1.S1.2014, ISSN:2394-2606

and bring about the dissolution of bound forms of phosphate. While Rhizobium, Blue Green Algae (BGA) and Azolla are crop specific, bio-inoculants like Azotobacter, Azospirillum,

Phosphorus Solubilizing Bacteria (PSB), Vesicular Arbuscular Mycorrhiza (VAM) could be regarded as broad spectrum biofertilizer.VAM is fungi that are found associated with majority of agriculture crops and enhanced accumulation of plant nutrients (Gupta, 2004). It has also been suggested that VAM stimulate plant Examples of free living nitrogen fixing bacteria are obligate anaerobes (Clostridium pasteurianum), obligate aerobes (Azotobacter), facultative anaerobes, photosynthetic bacteria (Rhodobacter), cyanobacteria and some methanogens. The example of Ksolubilizer is Bacillus mucilaginous while for P-solubilizerare Bacillus megaterium, Bacillus circulans,

Nitrogen

Nitrogen is one of the major important nutrients very essential for crop growth. Atmosphere contains about80 percent of nitrogen volume in Free State. The major part of the elemental nitrogen that finds its way into the soil is entirely due to its fixation by certain specialized group of microorganisms. Biological Nitrogen Fixation (BNF) is considered to be an important process which determines nitrogen balance in soil ecosystem. Nitrogen inputs through BNF support sustainable environmentally sound agricultural production. The value of nitrogen fixing legumes in improving and higher yield of legumes and other crops can be achieved by the application of biofertilizers. Nitrogen fixers are grouped into free-living bacteria (Azotobacter and Azospirillium) and the blue green algae and symbionts such as Rhizobium, Frankia and Azolla. The N2-fixing bacteria associated with nonlegumes ncludesAchromobacter,Alcaligenes,Arthrobacter,Acetobacter,Azomonas,Beijerinckia,Bacillus,Clostridium,Enterobacter,Erwinia,Derxia,Desulfovibrio,Corynebacterium,campylobacter,Herbaspirillum,Klebsiella,Lignobacter,Mycobacterium,Rhodospirillum,Rhodopseudomonas,Xanthobacter,Mycobacterium and Methylosinus .

Rhizobium inoculation is well known agronomic practice to ensure adequate nitrogen of legumes instead on-Fertilizers. In root nodules the O2 level is regulated by special hemoglobin called leg-hemoglobin. This goblin protein is encoded by plant genes but the heme cofactor is made by the symbiotic bacteria. The plant root cells convert sugar to organic acids which they supply to the bacteroids. In exchange, the plant will receive amino-acids rather than free ammonia.Azolla biofertilizer is used for rice cultivation indifferent countries such as Vietnam, China, and Thailand and Philippines. Azobacter and Azospirillum can fix atmospheric nitrogen in cereal crops without any symbiosis while bluegreenalgae have been found to be very effective on the rice and banana plantation. Co-inoculation of some Pseudomonas and Bacillus strains along with effective Rhizobium spp. is shown to stimulate chickpea growth, nodulation and nitrogen fixation. Application of biofertilizer increased the number of leaves in believing and this could be due to properly colonized roots, increased mineral and water uptake from the soil and biological nitrogen fixation. It is also due to the production the IAA, gibberellins and cytokinins like substances produced by the bacterium

Phosporous

The fixed phosphorus in the soil can be solubilized by phosphate solubilizing bacteria (PSB), which have the capacity to convert inorganic unavailable phosphorus form to soluble forms HPO42- and H2PO4 -through the process of organic acid production, chelation and ion exchange reactions and make them available to plants. Therefore, the use of PSB in agricultural practice would not only offset the high cost of manufacturing phosphate fertilizers but would also mobilize insoluble in the fertilizers and soils to which they are applied .Bacteria are more effective in phosphorus solubilization than fungi. Among the whole microbial population in soil, phosphate solubilizing bacteria (PSB) constitute 1 to 50%, while phosphorus solubilizing fungi (PSF) are only 0.1 to 0.5% in Psolubilization potential.

Among the soil bacterial communities, ectorhizospheric strains from Pseudomonas and Bacilli, and endosymbiotic rhizobia have been described as effective phosphate solubilizers. Strains from bacterial genera Pseudomonas,Bacillus, Rhizobium solubilizers Bacillus megaterium,B.circulans,B.subtilis,B.polymyxa,B. sircalmous, Pseudomonas striata.Bacillus subtilis and Pseudomonas strata could be referred as the most important strains . A nematode fungus Arthrobotry soligospora also has the ability to solubilize the phosphate. Population of PSB depends on different soil properties (physical and chemical properties, organic matter, and P content and cultural activities. Some bacterial species have mineralization and solubilization potential for organic and inorganic phosphorus, respectively .Inorganic P is solubilized by the action of organic and inorganic acids secreted by PSB in which hydroxyl and Carboxyl groups of acids chelate cations (Al, Fe, Ca) and decrease the pH in basic soils. The pH of rhizosphere is lowered through biotical production of proton / bicarbonate release (anion /cation balance) and gaseous (O2/CO2) exchanges. Phosphorus solubilization ability

Rhizobacteria

A group of rhizosphere bacteria (rhizobacteria) that exerts a beneficial effect on plant growth is referred to as plant growth promoting rhizobacteria or PGPR. PGPR Arthrobacter,Actinoplanes,Azotobacter,Bacillus,Pseudomonas., Rhizobium, Bradyrhizobium, Erwinia, Enterobacter, Amorphosporangium, Cellulomonas, Flavobacterium, Streptomyces and Xanthomonas .PGPR increased recently as a result of the numerous studies covering a wider range of plant species and because of the advances made in bacterial taxonomy and the progress in our understanding of the different mechanisms of action of PGPR Interactions, the competence to colonize plant habitats is important.. Steps of colonization include attraction, recognition, adherence, invasion (only endophytes and pathogens), colonization and growth, and several strategies to establish interactions .Plant roots initiate crosstalk with soil microbes by producing signals that are recognized by the microbes, Which in turn produce signals that initiate colonization PGPR reach root surfaces by active motility facilitated by flagella and are guided by chemotactic responses.

Conclusion

Biofertilizer help in increasing crop productivity by way of increased BNF, increased availability or uptake of nutrients through solubilization or increased absorption stimulation of plant growth through hormonal action or antibiosis, or by decomposition of organic residues. Furthermore, biofertilizer as to replace part of the use of chemical fertilizers reduces amount and cost of chemical fertilizers and thus prevents the environment pollution from extensive application of chemical fertilizers. With using the biological and organic fertilizers low input system can be carried out, and it can be helped achievining Sustainability of crop production.

POTENTIAL ROLE OF BIO-FERTILIZERS IN AGRICULTURE

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Abstract: Among the various supplements that are used for the better growth and yield Biofertilizers are harmless and Ecofriendly unlike chemical fertilizers. Whenever these are administered these help for the supply of required nutrients that helps for the healthy growth of plants and improves the productive capacity also. They generate nutrients such as Nitrogen and Phosphorous through their activities in the soil or Rhizosphere and make available to plants slowly and for a longer duration. Production of these bio fertilizers is easy and can be achieved with minimum expenditure making use of the biodegradable garbage. Usage of these nutrients resulted in the production of organic products which are safe, non-hazardous and economical.

Key Words: Bio-Fertilizer, non-hazardous, production.

Introduction: Biofertilizers are environmentally friendly subsistents for harmful chemical fertilizers. They transform organic matter into nutrients that can be used to make plants to make healthy and productive. They have a low production cost because they can be prepared by using leftover vegetables, rice husk etc. The natural products

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www.jabe.in Vol.1.S1.2014, ISSN:2394-2606

leaving around farm can be turned into biofertilizers and used to make healthy and abundant crops. Biofertilizers are nothing but selected strains of beneficial soil microorganisms cultured in the laboratory and packed in suitable carriers. Biofertilizers can generate plant nutrients like Nitrogen and Phosphorous through their activities in the soil or Rhizosphere and make available to plants in a gradual manner. Biofertilizers are gaining momentum due to increasing emphasis on the maintenance of soil health and cut down on the use of chemicals in agriculture. Biofertilizer may be defined as a substance which contains living organisms which colonizes the rhizosphere or the interior parts of the plants and promotes the growth by increasing supply or availability of primary nutrient and growth stimulus to the target crop, when applied to the seed, plant surfaces or soil.

Types of Biofertilizers:

Biofertilizers are mainly classified into

1. Nitrogen fixing Biofertilizers eg-Rhizobium, Brady Rhizobium, Azospirillum, Azobacter
2. Phosphorous solubility Biofertilizers-e.g.-Bacillus, Psuedomonas, Aspergillums
3. Phosphate mobilizing Biofertilizers e.g.-Mycorhiza
4. Plant growth promoting biofertilizers—e.g.: Psuedomonas

Biofertilizers fix atmospheric Nitrogen in the soil and root nodules of legume crop and make it available to the plant .They solubilise the insoluble forms of phosphates like tricalcium, iron and aluminum phosphates into available form for plants. Thy produce hormones and anti metabolites which promote root growth. They decompose organic matter and help in mineralization of soil. When applied to seed or soil, biofertilizers increases the availability of nutrients and improve the yield by 10-25% without any adverse affecting the soil and environment.

Rhizobium belongs to bacterial group and is symbiotic Nitrogen fixer. The bacteria infect the legume root and form root nodules within which they reduce molecular Nitrogen to ammonia which is utilized by the plant to produce valuable proteins, vitamins and other Nitrogen containing compounds. Azobacter is an important and well known free living Nitrogen fixing aerobic bacterium. It is used as Biofertilizer for all non leguminous plants especially for rice, cotton, vegetables etc. Azospirillium Biofertilizer belongs to bacteria and fix considerable quantity of Nitrogen in the range of 20-40 Kg/N/Hectare in Rhizosphere in non leguminous plants such as cereals, millets, oil seeds, cotton etc. These organisms proliferate at both anaerobic aerobic conditions. This Biofertilizer stimulates the production of growth promoting substances, disease resistance and drought tolerance, Azola is used as Biofertilizer for wet land rice. It is known to contribute 40-60 Kg/N/ha per rice crop.

Phosphate solubility micro organisms such as Psuedomonas, Aspergillum secrete organic acid and lower the P^H in the vicinity to bring about dissolution of bound phosphates in soil.

Conclusion:

There are mainly two challenges before the Governments in the process of launching of Biofertilizer based technology in agriculture, one at the level of farmers and second one at the level of production units. It is strongly felt that the Governments should educate farmers and encourage the usage of Biofertilizers. The field level acceptance of technology will gradually bring commercial viability of producer. For greater farm level acceptance Governments and funding agencies should promote and fund the research for improved strains suitable for different conditions, for different crops and for different soils.