Research Article

Copy Right ©KY Publications

Journal of Advanced Studies in Agricultural, Biological and Environmental Sciences (JABE) www.jabe.in

A Peer Reviewed & Refereed, International Open Access Journal

Vol.5.Issue.2.2018 (April-June) **ISSN:2455-0221(P), 2394-2606(O)**

MORPHOLOGICAL EFFECTS OF GRAFTING AND SEASONAL VARIATIONS ON SOME GROWTH PARAMETERS ON THREE VARIETIES OF TOMATO (SOLANUM LYCORPERSICUM MILL.)

Aminu, Y*., Fatima, S.H., Fa`iza A. M.

Biological Sciences Department, College of Arts, Sciences and Remedial Studies, Kano.

*Corresponding Author: Email: aminuyahayafagge@gmail.com

ABSTRACT

Three different varieties of tomato (*Lycopersicon lycopersicum* Mill) with different phenotypic traits were grafted with the aim of inducing variability that could be used in the improvement of some quality traits of tomato. Tongue approach grafting was applied on to the seedlings of three tomato varieties *(Roma, UC82B and a Local variety*). The result obtained revealed highly significant difference (P≤0.01) in the number of fruits, fruit weight, fruits diameter, pericarp thickness and number of seeds/fruit of the grafted tomatoes with respect to the controls. Similarly, significant improvement (P≤0.05) was also recorded on the pH of the fruit juice. The result implies that grafting induces important quality traits that are of high economic value in tomato. It was deduced that variety Roma responds more to grafting treatment when used as parent stock. The grafted tomato could be grown both during the rainy and dry seasons, and it also improve some important quality traits of tomato that could be utilized for further improvement of tomato crop. Based on the findings, the study concluded that, grafting improves some important quality traits of tomato that are of high economic value and possible recommendations that could be made.

Key Words: Grafting, Roma, UC82B, Local varieties, Tomato, Seasons, Variations

INTRODUCTION

The cultivated tomato (*Solanum lycopersicum* Mill.) which belongs to the family Solanaceae considered as the second most important vegetable crop in the world after potato. (Adamu, *et al.,* 2007). Tomato ranks third among vegetable crops with an annual production of 283 million metric tons in the year 2009. Tomato have a nutritional and medicinal value for its content of vitamin A and C.(Haq, *et: al.,* 2011) beside Carotenoids pigments which considers as an antioxidant that protect humans body from free radicals damages and reduce the risk of getting cancer and also cholesterol free. Tomato is sometime rightly referred to as poor man's orange.(El- Khaaby, *et al.,* 2012).

It belongs to the small genus *Lycopersicum* consisting of nine species within the large family *Solanaceae* (Mann *et al*., 2003). It is nowadays one of the major vegetable crops cultivated throughout the world and is grown in a wide range of environments comprising natural and protected conditions (Dhaliwal *et al.,* 2002) of both the tropical, sub-tropical and temperate parts of the world. The stem can be determinate or indeterminate with reddish to yellowish glandular hairs having monopodium branching system. The root is of tap-root system. The leaves are opposite and pinnately compound with lobed margins which are ovate to oblong and petiolated. The flowers form raceme inflorescence, perfect, actinomorphic and pentamerous with superior ovary. The fruit is a berry with smooth skin which is reddish to yellowish succulent at maturity and many seeded. The seeds are flat and kidney shaped (Johnson, 2005).

The plant is of high medicinal importance as the fruit is a good remedy for preventing or inhibiting various forms of venous and arterial thrombosis and fibrin clots formation in veins. It is a valuable food mineral

Research Article

Copy Right ©KY Publications
Journal of Advanced Studies in Agricultural, Biological and Environmental Sciences (JABE) www.jabe.in
A Peer Reviewed & Refereed, International Open Access Journal
Vol.5.Issue.2.2018 (April-June) ISSN:2455-0221(P), 2394-2606(O)

and vitamins particularly vitamin A and C. Studies have shown that people who ate tomatoes or tomato products may be at lower risks of some kind of cancer, particularly cancer of the prostate gland, lungs and stomach (Anonymous, 2009). The fruits are recommended for patients suffering from obesity, hormone replacement therapy, anti phospho-lipid syndrome, cancer or patients suffering from genetic and plasmic risk factors as well as those that had recently undergone surgical operations (Anonymous, 2010).

Research on the genetic control of fruit quality traits have been dominated by studies of the ripening process, since this specific developmental process in fruit greatly affects the evolution of several quality parameters, like colour, aroma, Soluble Solute Contents (SSC) and Titratable Acidity (TA). High SSC and TA are highly desirable not only in processing tomato cultivars but also in fresh-market cultivars due to the important contribution of sugars and acids to the overall flavor and nutritional value of tomatoes (Foolad, 2007).

Despite all the tremendous importance of tomato, little importance has been put into the improvements of its genetic diversity to meet the demand of the local populace in Nigeria. There is lack of proper attention given to the improvement of this plant to prevent its seizure at some period of the year to reduce its risen cost by both the governments and the scientific community. The lack of diversity in the cultivated tomato can be visualized using DNA technologies. However, very few polymorphisms within the cultivated tomato gene pool have been identified, even using sensitive molecular markers (Garcia-Martinez *et al*., 2005). Tomato suffers from several problems that include high disease incidence, pest infestations, and adverse effects of environmental stress e. t. c. that greatly affects its production (Encarta 2005). The results of a study on the effectiveness of inducing Grafting in tomato are presented. Therefore, this study aimed at improving some Morphological Effects of Grafting and Seasonal Variations on some
Tomato cultivars using tongue approach grafting.

MATERIALS AND METHOD

Study Site: The research was conducted in (September, 2013) at the Green House of the Botanical Garden of the Department of Biological Sciences, Ahmadu Bello University Zaria, Kaduna State. (Lat11^0 12^{1}N, Long 7^0,37^{1}E, Alt 550-700m above sea level).

Experimental Design: The seeds of three varieties of cultivated tomato (*Roma*, *UC* and a *local variety*) were collected from the Institute for Agricultural Research (I.A.R), Ahmadu Bello University Zaria, Nigeria. Roma was said to flourish successfully during the rainy season while UC flourishes and grows successfully during the dry season. The plants were grown during the 2013 rainy season. The treated plants were grown in 45 polythene bags arranged in a Completely Randomized Design (CRD) with three repetitions in each season. A total of 370 plants were raised after thinning. After two weeks of planting, the plants that germinated were grafted by transferring the scions of one variety to the stock of another variety; while the controls were allowed to grow without grafting.

Grafting Method: Tongue grafting approach was used. This is due to the relative advantage of the method over others such as its being used on larger plants, three times faster than other techniques, high success rate and is easy to handle. The seeds used for rootstocks were planted 2 days prior to that of the shoots. After two weeks of planting, and a day prior to grafting, the plants used for grafting were watered fully to make them turgid. One-fourth of the plants used for rootstock were cut at slant early in the morning. The shoot was also cut in the same way. The two cut ends were placed in direct contact and use a small clip to hold the cut surfaces together. This was repeated in the 3rd and 4th week of planting, while the remainder was left as control as described in McVoy (2005) protocol. The fruits quality of grafted plants was compared with those of non-grafted plants.

Research Article

Copy Right ©KY Publications

Journal of Advanced Studies in Agricultural, Biological and Environmental Sciences (JABE) www.jabe.in

A Peer Reviewed & Refereed, International Open Access Journal

Vol.5.Issue.2.2018 (April-June) ISSN:2455-0221(P), 2394-2606(O)

DATA COLLECTION: Data were obtained for number of fruits/plant, and diameter of the fruits, thickness of pericarp, number of seeds/fruit, fruit weight, and pH values.

Data Analysis: All the data obtained were analyzed using Analysis of Variance. The means were separated using Duncan's Multiple Range Test (Duncan, 1955).

RESULTS

The result obtained for the analysis of variance of the effect of grafting on some quality traits of tomato was presented in Table 1. The result showed highly significant difference (P≤0.01) among the grafted varieties in almost all the selected traits except in the pH of fruit juice where the effect is significant (P≤0.05). Similar result was found among the varieties except in pericarp thickness where no significant difference was found and fruit diameter where the effect of grafting is significant (P≤0.05).

Table 1: Mean Squares for the Effects of Grafting on some Quality Traits Three Different Tomato Varieties

Sources of Variation	DF	Number of Fruits	Fruit Weight	Pericarp Thickness	Number of Seeds/Fruit	Fruit Diameter	pH
Replication	2	11.87*	55.92**	0.01^{ns}	476.72*	0.12^{ns}	0.01^{ns}
Treatment	1	188.59**	383**	0.53**	5594**	0.28*	0.92**
Variety	2	37.26**	564.34**	0.07^{ns}	2892**	0.20*	0.42**
Error	142	2.78	7.53	0.05	105.50^{ns}	0.06	0.01

Keys: ns= No significant difference; * = Significant difference (P≤0.05); **= Highly significant difference (P≤0.01)

However, the result of the means for the effects of grafting on three varieties of tomato was shown in Table 2. The result indicated the effects of grafting to be higher on all the selected traits of variety UC except on number of fruits/plant; where the effects are higher on variety Roma. More so, the effects of grafting were found to be lower on the traits of the local variety of tomato.

Table 2 : Means for the Effects of Grafting on some Selected Tomato Traits

Treatment	Variety	Number of Fruits	Fruit Weight (g)	Pericarp Thickness (mm)	Number of Seeds/Fruit	Fruit Diameter (cm)	Ph
Grafted	**Local**	3.00^{c}	11.37^{c}	0.31^{c}	52.00^{b}	0.37^{b}	3.97^{c}
Control	**Local**	2.00^{d}	6.50^{f}	0.26^{e}	36.66^{e}	0.37^{b}	4.10^{b}
Grafted	**Roma**	5.41^{a}	12.25^{b}	0.36^{b}	50.25^{c}	0.28^{c}	4.18^{b}
Control	**Roma**	2.00^{d}	9.00^{e}	0.12^{f}	47.00^{d}	0.13^{d}	4.10^{b}
Grafted	**UC82B**	4.08^{b}	17.83^{a}	0.39^{a}	61.79^{a}	0.43^{a}	4.25^{a}
Control	**UC82B**	2.33^{d}	11.03^{d}	0.30^{d}	50.33^{c}	0.33^{a}	4.13^{b}
	Means						

N.B: $*^{1}$ Means within the columns with the same letter(s) are not significantly difference (P≤0.05)

The results from the combined analysis of variance on the effects of grafting on some selected traits of three tomato varieties are presented in (Table 4.3), the results showed no significant difference was found on the effect of the treatments on fruits number and weight, pericarp thickness and number of seeds. However, highly significant difference (P≤0.01) was found among the seasons in terms of fruit weight, seeds number and pH. While no significant difference was found among the seasons in terms of fruits number, thickness of pericarp and fruit diameter.

Similarly, highly significant difference (P≤0.01) was found in the interaction of varieties with treatments on fruit number, fruit weight and pH. While no significant difference was found in the interaction

Research Article
Copy Right ©KY Publications
Journal of Advanced Studies in Agricultural, Biological and Environmental Sciences (JABE) www.jabe.in
A Peer Reviewed & Refereed, International Open Access Journal
Vol.5.Issue.2.2018 (April-June) ISSN:2455-0221(P), 2394-2606(O)

of varieties with treatments on the other remaining selected traits. More so, highly significant difference (P≤0.01) was found in the interaction of varieties with seasons on the number of fruits except on pH; where significant difference (P≤0.05) was found. While no significant difference was found on fruit weight, pericarp thickness, seeds number, and fruit diameter.

Furthermore, highly significant difference (P≤0.01) was found in the interaction of the treatments with seasons on the selected traits of tomato varieties except on fruit number; where the interaction is significant (P≤0.05) and on seeds number and fruit diameter where no significant difference was found in the interaction. More so, no significant difference was found in the interaction of varieties with treatments and seasons on the selected tomato traits except on fruit weight, seeds number and pH; where highly significant difference (P≤0.01) was found in the interaction.

Table 4.3: Mean Squares for the Combined Effects of Grafting on Some Varieties of Tomato in Two Different Seasons

Sources of Variation	DF	Number of Fruits	Fruit Weight (g)	Pericarp Thickness (mm)	Number of Seeds/Fruit	Fruit Diameter (cm)	pH
Replication	2	11.87*	55.92**	0.01^{ns}	476.72*	0.12^{ns}	0.01^{ns}
Variety	2	37.26**	564.34**	0.07^{ns}	2892**	0.20*	0.42**
Treatments	2	5.26^{ns}	21.68^{ns}	0.16^{ns}	224.03^{ns}	0.53**	0.35**
Seasons	1	0.01^{ns}	189.84**	0.20^{ns}	6868.16**	0.08^{ns}	0.45**
Var x Trt	4	14.79**	70.64**	0.18^{ns}	279.45^{ns}	0.02^{ns}	0.12**
Var x Seas	2	95.56**	12.12^{ns}	0.04^{ns}	117.05^{ns}	0.001^{ns}	0.07*
Trt x Sea	2	12.22*	44.54**	0.30**	279.45^{ns}	0.02^{ns}	0.26**
Var x Trt x Sea	4	3.78^{ns}	54.43**	0.16^{ns}	699.65**	0.08^{ns}	0.13**
Error	142	2.78	7.53	0.05	105.50	0.06	0.01

Keys: ns= N significant difference * = Significant difference (P≤0.05) **= Highly significant difference (P≤0.01)

DISCUSSION

The distinct differences observed in most of the qualitative traits among the grafted tomato plants evaluated showed, though there were few characteristics with no significant differences in responses to the applied treatment. Higher fruit yield parameters found in this study could be due to the fact that grafting combines novel traits of the two grafted plants after grafting operation. This has also been reported by Tsouvaltzis *et al*. (2004). However, the increased pH values of the juice in grafted plants recorded by this work is in contrast to the findings of Leoni *et al*. (1990) and Romano and Paratore (2001) who found that fruit descriptive and qualitative characteristics were not affected by grafting. But Lee (1994) found an increase in yield which was attributed to the vigour of the rootstock and the higher uptake of water and nutrients. Passam *et al*. (2005) found that eggplants grafted on to two tomato rootstocks gave a higher yield and bigger fruit size than those grafted on to two eggplant rootstocks, but the mineral composition of fruits from grafted plants did not differ from that of non-grafted plants.

The fruit index (diameter/length, number of fruits and fruit weight) were significantly influenced by grafting. The results agree with those reported by Lee (1994) who concluded that fruit shapes are influenced by rootstocks. Pogonyi *et al*. (2005) reported that when Lemance F_1 was grafted onto Beaufort rootstock, increased yield was caused mainly by higher average fruit weight. Ibrahim *et al*. (2014) also found that the

Research Article

Copy Right ©KY Publications
Journal of Advanced Studies in Agricultural, Biological and Environmental Sciences (JABE) www.jabe.in
A Peer Reviewed & Refereed, International Open Access Journal
Vol.5.Issue.2.2018 (April-June) ISSN:2455-0221(P), 2394-2606(O)

total number of fruits per truss in non-grafted plants was statistically different from the total for grafted plants. In a similar study by Khah *et al*. (2006) fruit weight of grafted plants was found to be higher than in non-grafted plants and plants grafted onto Heman and Primavera produced more fruit than the non-grafted, both in the greenhouse and in the open field. In the present study, the number of fruits and fruit weights of non-grafted plants were significantly lower than the corresponding values for plants grafted onto both rootstock cultivars. The results of the study showed that tomato grafting on suitable rootstocks had positive effects on the yield. In grafted combinations, the total fruit yield per plant increased significantly in comparison with that of the control plants. Ibrahim *et al*. (2001) observed similar results in grafted and non-grafted tomato plants. These investigators suggested that the higher yield of fruit from grafted tomato plants was most likely an effect of the vigorous root system of the rootstock. According to Lee (1994), the increased yield of grafted plants is also believed to be due to enhanced water and mineral uptake. Similarly, Osvald (2004) reported that tomato grafting on suitable rootstocks has positive effects on cultivation performance, especially under greenhouse conditions.

The pH value also plays an important role in determining fruit quality characteristics. Many studies focused on pH as a key element in tomato selection as stressed by Hong and Tsou (1998). The analyzed results showed that the pH values of tomato fruit increased among the grafted plants. This is in conformity to the findings of Kuzucu *et al*. (2004) who also reported that Koral, Mobil and H-2274 (fresh tomato) have a pH value of 4.31, 4.33 and 4.33, respectively; but is contrary to the work of Khah *et al*. (2006) who found that fruit pH values were not affected by grafting.

CONCLUSION

The effect of grafting was found to be significant in improving the important quality traits of the three tomato varieties under study. It was concluded that, grafting is significant in inducing variability that could be exploited in the improvement of highly economic crops like tomato.

REFERENCES

Anonymous (2007): *Principles of Agricultural Botany*. Alexander Nelson Read books, NY pp 101.

Dhaliwal, M.S., Kaur, A., and Singh, S. (2002): Genetic analysis and correlationsinvolving populations derived from *L. esculentum* x *L. pimpinellifolium* crosses of tomato. *Journal of Genetics and Breeding* 56:345-352.

Hille,J., Koornneef, M., Ramanna, M.S., and Tabel,P. (1989): Tomato: A crop species amenable to improvement by cellular and molecular methods. *Euphytica* 42: 1-23.

Hong, T.L., and Tsou, S.C.S. (1998): Determination of tomato quality by near infrared spectroscopy. *Journal of Near Infrared Spectroscopy* 6: 321–324.

Ibrahim M., Munira, M.K., Kabir, M.S., Islam, A.K.M.S., and Miah, M.M.U. (2001): Seed germination and graft compatibility of wild Solanum as rootstock of tomato. *AsianJournalofBiologicalSciences*, 1: 701–703.

Ibrahim, A., Wahb-Allah, M., Abdel-Razzak, H., and Alsadon, A. (2014): Growth, Yield, Quality and Water Use Efficiency of Grafted Tomato Plants Grown in Greenhouse under Different Irrigation Levels. *Life Science Journal* 11(2):118-126

Khah, E.M., Kakava, E., Mavromatis, A., Chachalis, D., and Goulas, C. (2006): Effect of grafting on growth and yield of tomato (*Lycopersicon esculentum* Mill.) in greenhouse and open-field. *Journal of Applied Horticulture* 8:3-7.

Kuzucu, C., Kaynas K., Kuzucu F.C., Erken N.T., Kaya S., Daydır H.U.,(2004): Bazı domates çeşitlerinin verim ve kalite özelliklerinin belirlenmesi (Determination of yield and quality characteristics of some tomato varieties). In: VSebze tarımı sempozyumu bildiri kitabı, 21–24 September,2004. Çanakkale, Turkey: 288–294..

Research Article

Copy Right ©KY Publications

Journal of Advanced Studies in Agricultural, Biological and Environmental Sciences (JABE) www.jabe.in

A Peer Reviewed & Refereed, International Open Access Journal

Vol.5.Issue.2.2018 (April-June) ISSN:2455-0221(P), 2394-2606(O)

Lee, J. M. (1994): Cultivation of Grafted Vegetables I. Current Status,Grafting Methods, and Benefits.*Horticultural Science.* 29(4):235-239.

Leoni, S., R. Grudina, M. Cadinu, B. Madeddu and M.G. Carletti, (1990): The influence of four Root-stocks on some melon hybrids and a cultivar in greenhouse. *Acta Horticulturae* 287: 127-134.

McVoy, R. (2005): Grafting techniques for greenhouse tomatoes. A paper presented at the greenhouse tomato conference, NESARE and UMass Extension, Nov. 10, 2005.

Passam, H.C., Stylianoy, M., and Kotsiras, A.(2005): Performance of Eggplant Grafted on Tomato and Eggplant Rootstocks. *European Journal of Horticultural Science*, 70(30): 130-mnv134.

Pogonyi, A., Pek, Z., Helyes, L., and Lugasi, A.(2005): Grafting tomatoes for early forcing in spring has a major impact on the overall quality of main fruit components. *ActaAlimentaria* 34:453-462

Purseglove, J.W. (1968): *Tropical Crops: Dicotyledons*: vol 2 Wiley New York pp 523 –563

Romano, D., and Paratore, A. (2001): Effects of grafting on tomato and eggplant. *Acta Horticulturae* 559:149-153.

Tsouvaltzis, P.I., Siomos, A.S., and Dogras, K.C.(2004): The effect of the two tomatoes grafting on the performance, earliness and fruit quality. Proc. 21st Pan-Hellenic Congress of the Greek Society for Horticultural Science. Ioannina, Greece, 8-10 October 2003. Vol. 11: 51-55.