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INFLUENCE OF PLANT SPACING AND WEED MANAGEMENT PRACTICES ON THE GROWTH AND YIELD OF PADDY (*Oryza Sativa* L.)

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ABSTRACT
Studies to assess the influence of plant spacing and weed management practices in transplanted rice under the System of Rice Intensification (SRI) Mechanical method and Manual method of transplanting on growth and yield of paddy was conducted in farmer's field at Coimbatore district,
Tamil Nadu, during the kharif and rabi crop seasons of 2017 and 2018. The experiment was laid out in split plot design with three main plot spacing treatments and seven subplot treatments of weed management. Increase in crop density under closer spacing significantly reduced the number and dry matter production of weeds. Adopting closer spacing in rice by using of Cono weeder was not effective in controlling weeds. Number and dry matter production of weeds were lower in square planting plots. Weed control efficiency was maximum for square plant spacing of 25 cm x 25 cm. The highest grain yield of 5903 kg/ha and 5726 kg/ha during kharif and rabi seasons of study were observed in square plant spacing of 25 cm X 25 cm followed by 30 x 20 cm both under normal package of practices with weeding. The yield obtained from 25 x 25 cm plots and 30 cm x 10 cm weeding were on par showing the importance of spacing as a weed management strategy. Among the weeded plots, the lowest grain yield of 4203 kg/ha and 4077 kg/ha was observed in closer spacing of manual method of weeding during kharif and rabi season.

Key words: SRI, Plant Spacing, Weed control, Growth and yield

Introduction

Rice provides major food crop of the world which stands at the second place after wheat.

It is cultivated on 161 million hectares, with an annual average production of 769.9 million tons of paddy (FAO, 2018). About 90 percent of the world's rice is grown and produced (143 million hectare of area with a production of 695.5 million tons of paddy) in Asia (FAO, 2018). Rice provides 30-75% of the total calories to more than 3 billion Asians (Khush, 2004; Von Braun and Bos, 2004). Rice contains optimum nutritional value of 78% protein, 3% fiber and 3% fat (Kumar et al., 2017). Rice is the most important and extensively crop grown in India occupying an area of 395.39 lakh hectares (Agricultural Situation in India 2018) with the production of 111.5 million tonnes combined with the average productivity of 2.4 t ha -1 . In Tamil Nadu, total area under rice is 17.21 lakh hectares, with production of 61.31 lakh million tonnes and with a productivity of 3562kg ha-1 during 2018-19 (Salient statistics on Agriculture 2019).

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Manual transplanting is the most common practice being followed under lowland ecosystem. Good crop stand establishment is one of the key components for efficient use of resources, inputs and consequently for achieving desired level of productivity. Proper row arrangement and appropriate inter and intra row spacing are important for improving the crop growth, sink capacity and ultimately the yield of rice (Sridevi, 2011). Method of establishment is one of the cultural practices, which influences the rice crop through its effect on growth and development (Gopi et al., 2006).

Puddling practices benefits rice by reducing water percolation losses, facilitating easy seedling establishment and creating anaerobic conditions to enhance nutrient availability (Sanchez, 1973). But repeated puddling adversely affects soil physical properties by destroying soil aggregates, reducing permeability in subsurface layers and forming hard pans at shallow depths (Sharma and De Datta, 1985; Aggrawal et al., 1995; Sharma et al., 2003), all of which can negatively affect the following non-rice upland crop in rotation (Hobbs and Gupta, 2000; Tripathi et al., 2005). Moreover, puddling and transplanting require large amount of water and labor, both of which are becoming increasingly scarce and expensive thus making rice production less profitable. Also the drudgery involved in transplanting– a job largely done by women is of serious concern. To escape from drudgery in manual transplanting, mechanized rice transplanting is being practiced in many countries of the world but in India mechanized transplanting has not popularized as yet due to high cost of trans-planters and land leveling problems.

Crop geometry is a vital factor, which decides the effects of resource utilization in any type of paddy cultivation. Plant spacing decides number of plants per unit area, and this in turn, decides the amount of crop canopy created to help paddy to use the resources effectively. Increasing the spacing between or within rows increases light penetration into the crop canopy resulting in enhanced weed growth. Hand weeding or cono weeder is the only recommended practice for the control of weeds in the System of Rice Intensification (SRI). SRI is practiced under square planting of the order of 25 x 25 cm. Proponents of SRI claim high yield compared to conventional methods (Singh and Talati 2005; Vijayakumar et al., 2006) However, there are conflicting reports too regarding the success of SRI (Surridge 2004; Sheehy *et al*., 2004; Latif *et al*., 2005). SRI, which envisaged hand weeding or cono weeding have been suggested by many workers to make weeding economical and paddy production were profitable. From a study on SRI at Bangladesh, Islam and Molla (2001) found that wherever labour is available, two hand weeding or one hand weeding plus herbicides could be followed to make weeding economical and rice production profitable. In places where labour scarcity is a problem only herbicides should be used. De Datta (1981) had reported that mechanical weeding using inter row cultivators or rotary weeders is practical only in row seeded rice and does not remove weeds within or close to the rice hills, which can still cause marked reduction in yield.

Combination of pre and post emergence herbicides are needed to provide high economic return by reducing weed density with highly diversified weed flora (Chauhan, 2012). But all the herbicides cannot control the weeds effectively in rice. In developed countries intercropping of dhaincha with rice is generally practiced to control weeds (Singh et al., 2007). This situation stimulated the initiation of research for evaluating suitable herbicide usage on different establishing methods for controlling the complex weed flora of rice under puddled condition. In view of the above apprehensions related to weed control, the present experiment was undertaken to assess the influence of plant spacing and weeding on crop growth and yield in transplanted paddy.

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Materials and Methods

Field experiment was conducted in the Farmers field of Coimbatore, Tamil Nadu. To find out the effect of planting methods and weed management practices on the productivity and economics of paddy cultivation. The experiment was replicated twice in split plot design with three planting methods viz., SRI method (Square planting) with a spacing of 25 x 25 cm (SRI- (M1)), Machine planting(M2) with a spacing of 30 x 20 cm and Conventional planting (M3) with a spacing of 30 x 10 cm; and seven weed management practices viz., S1 –Pre E. Butachlor 2.5 lit per ha + Hand weeding on 45 DAT, S2- Pre.E (Metsulfuron Methyl 10 % - Chlorimuron Ethyl 10 %) @ 20g per ha + HW on 45 DAT, S3- Four mechanized weeding (15,25,35 and 45 DAT), S4- Pre E. Butachlor 2.5 lit per ha + three mechanized weeding (25,35 and 45 DAT), S5 - Pre.E (Metsulfuron Methyl 10 % - Chlorimuron Ethyl 10 %) @ 20g per ha + three mechanized weeding (25,35 and, 45 DAT), S6- Hand Weeding on 20 and 40 DAT and S7 – Un weeded. The variety CO (R) 50 was used in both the seasons of the study. The experimental field soil was clay loam in texture with low available nitrogen, medium level phosphorus and high potassium. SRI involved 14 days old single seedlings/ hill, machine planting and conventional method of transplanting (M3) of 21 days old 2-3 seedlings/hill. The seed requirement in SRI and machine planting was 8 and 10 kg ha^{-1} , respectively and 40 kg ha^{-1} for conventional method of transplanting. Raised bed nursery for SRI planting (Baskar, 2009), tray type nursery for SRI mechanical transplanting (Bell et al., 2003) and conventional nursery for conventional transplanting (CPG, 2015) were prepared. Other cultural practices and plant protection measures were followed as per recommendations of CPG, 2015. The herbicide was dissolved in 500 litres of water and sprayed with knapsack sprayer using deflector nozzle. The pre emergence herbicide was sprayed 3 days after transplanting. Data on plant height, leaf area index and dry matter production were observed. Total weed dry weight was recorded on active tillering stage by using 0.25 m quadrate at four places at random and paddy yield was recorded and analysed statistically.

Results and Discussion

Plant Height

The plant height is one of the important morphological parameters of crop as influenced by environment and management factors. Plant height variations at different growth stages due to the treatment effect are presented in Table 1. The crop establishment techniques had significant influence on plant height at vegetative, panicle initiation, flowering and maturity stages of crop.

Method of establishment and weed management practices significantly influenced the plant height at all the stages in both the seasons.

Among the three plant spacing, system of rice intensification (M1) Square planting 25 x 25 cm recorded significantly taller plants (44.34, 76.73, 100.16 and 101.64 cm in kharif and 44.34, 76.73, 120.20 and 121.97 cm in rabi. Distinctly lower 35.47, 61.36, 80.11 and 76.14 cm and 35.47, 61.36, 96.13 and 91.36 cm) plant height was recorded in 30 x 10 cm (manual method of transplanting system (M3)) in all the stages of observation in both the seasons. Establishment methods did not have any significant influence on plant height at harvest in kharif.

With respect to weed management practices, weeding with pre emergence (Metsulfuron Methyl 10 % - Chlorimuron Ethyl 10 %) 20g per ha + three mechanized weeding at 25, 35 and 45 DAT (S5) recorded significantly taller plants (51.66, 75.99, 95.49 and 95.78 cm and 61.99, 91.19, 114.58 and 114.94 cm) in all stages of the crop in both the seasons and shorter plants was observed in un weeded control (S7).

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There was no significant interaction between different weed management practices on plant height at all plant growth stages of rice during kharif and rabi of 2017 and 2018.

Leaf Area Index (LAI)

Leaf area index of rice at tillering and flowering stages were significantly influenced by establishment methods and weed management practices during kharif and rabi. Data on leaf area index of rice recorded at active tillering, panicle initiation and flowering stages as influenced by the treatments are furnished in Table 2.

Leaf Area Index (LAI) of rice at all the growth stages varied significantly for the different crop establishment techniques and weed management practices. In general, the LAI had increased with the advancement of crop growth and it reached the maximum at flowering stage of the crop. All the establishment methods differed significantly with each other at tillering stage to flowering stage in both the season. Distinctly lower LAI observed of 2.75 and 3.72 in manual method of transplanting during kharif and rabi seasons respectively.

At active tillering stage, square planting (SRI) with single seedling (M1) registered higher LAI of 6.71. At panicle initiation stage, square planting (SRI) with single seedling (M1) registered higher LAI of 10.81 and 11.89 in kharif and rabi season. At flowering stage higher LAI (11.68) and 12.85 in kharif and rabi season registered in square planting (SRI) with single seedling (M1) and comparable with conventional transplanting (M3).

Among the different three plant spacing, LAI was least in the treatment Hand Weeding on 20 and 40 DAT (S6) with values of 4.37 and 4.81 in kharif and rabi season at active tillering, and application of Pre E. Butachlor 2.5 lit per ha + Hand weeding on 45 DAT (S1) with values of 5.42, 5.44 and 5.96, 5.98 at panicle initiation and flowering stages of the crop in kharif and rabi . It was comparable with un weeded check

Regarding weed management practices, application of Metsulfuron Methyl 10 % - Chlorimuron Ethyl 10 % @ 20g per ha + three mechanized weeding (25,35 and 45 DAT) (S5) recorded significantly higher LAI of 6.64 14.87, 19.64 and 7.30, 16.36 , 21.60 at tillering , panicle initiation and flowering stage during kharif and rabi seasons.

The interaction effects between establishment methods and weed management practices were significant in all stages of the crop except vegetative stage in both the seasons.

Dry Matter Production

Dry matter production (DMP) was greatly influenced by the plant spacing and weed management practices during both the seasons. Dry matter production of rice increased with crop age (Table 3). Plant spacing under puddled condition significantly influenced the dry matter accumulation throughout the crop period.

Among the three plant spacing , Square planting (SRI method of transplanting (M1)) recorded significantly higher DMP at vegetative stage (5543 and 5433 kg ha^1 during kharif and rabi respectively) and it was comparable with 30 x 20 cm (machine method of transplanting (M2)) (4435 and 4346 kg ha^1 during kharif and rabi respectively). At panicle initiation stage square planting (SRI method of transplanting (M1)) recorded significantly higher DMP and was comparable with 30 x 20 cm spacing (machine method of transplanting (M2)) and conventional method of planting system (M3) in both the season.

At flowering stage, square planting (SRI) with single seedling (M1) recorded significantly higher dry matter production (19429 and 19040 kg/ha) than other crop establishment methods in kharif and rabi season.

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The lesser dry matter accumulation (7771 and 5627 kg/ha) was registered in conventional method of transplanting (M3) in kharif and rabi.

Similarly at maturity stage square planting (SRI) with single seedling (M1) recorded significantly higher dry matter production (19258 and 18872 kg/ha) than other crop establishment methods in kharif and rabi. The lesser dry matter accumulation (7758 and 7603 kg/ha) was registered in conventional method of transplanting (M3) in kharif and rabi.

Among the weed management practices, weeding with application of Metsulfuron Methyl 10 % - Chlorimuron Ethyl 10 % @ 20g per ha + three mechanized weeding (25,35 and 45 DAT) (S5) recorded significantly higher DMP (6051, 11701, 22059 and 25125 kg/ha and 5930, 11467, 11791 and 24622 kg/ha^{1}) at all stages of crop in both the seasons . Un-weeded control produced significantly lower DMP at all the stages in both the seasons.

Total weed dry weight

Crop establishment methods exerted significant influence on the total weed dry weight recorded on 60 DAT. In SRI machine transplanting total weed dry weight was significantly lower, which was on par with machine transplanting. Conventional transplanting recorded higher weed dry weight (Table 5). This might be due to early suppression of weeds on one hand and better crop stand on the other hand thereby reducing weed population and dry weight of weeds. The results are in agreement with the findings of Mohapatra et al. (2012). Weeds under conventional planting had better conditions for their early emergence, survival and growth resulting in higher weed population thereby reduced crop growth. This result is in agreement with Balasubramanian et al. (2003), who reported that occurrence of more number of weed species, higher density unit area favoured better growing conditions turning the competition in favour of weeds, thus resulted in increased weed dry weight. Among the weed management practices, considerable reduction in total weed dry weight was recorded with conoweeding three times at 10 days interval and application of Pre.E (Metsulfuron Methyl 10 % - Chlorimuron Ethyl 10 %) @ 20g per ha. This might be attributed to the minimum number of total weeds with less biomass during the cropping period (Table 5). Conoweeding three times at 10 days interval recorded lesser weed dry weight due to the incorporation of weeds into soil due to frequent conoweeding. This finding is in line with the findings of Anitha and Chellappan (2011). Crop establishment methods and weed management practices had significant interaction at all the stages of crop. SRI transplanting with conoweeding three times at 10 days interval significantly lowered the weed dry weight followed by application of Pre.E (Metsulfuron Methyl 10 % - Chlorimuron Ethyl 10 %) @ 20g per ha. This is in conformity with the findings of Uprety (2010), who revealed that machine planting with frequent conoweeding had encouraged frequent loosening of soil stimulating aerobic conditions with concomitant reduction in the density of weeds, dry matter. Also incorporation of weeds used as manure to the crop.

Grain Yield

The grain yield of rice was greatly influenced by methods of establishment and weed management practices during both seasons. For the given establishment methods, significantly higher grain yield was obtained (5903 and 5726 kg ha^{1} during kharif and rabi respectively) with system of rice intensification (M1). Grain yield of 5228 and 5071 kg ha^{1} was recorded in machine transplanting (M2) during kharif and rabi which was comparable with conventional method of transplanting (M3) 4203 kg/ha and 4077 kg/ha of yield were obtained during kharif and rabi respectively Table.4.

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As far as weed management practices are concerned, weeding with application of Metsulfuron Methyl 10 % - Chlorimuron Ethyl 10 % @ 20g per ha + three mechanized weeding (25, 35 and 45 DAT) (S5) enhanced the higher grain yield to 5759 and 5587 kg ha^1 during kharif and rabi respectively and it was on par with application of Pre E. Butachlor 2.5 lit per ha + three mechanized weeding (25, 35 and 45 DAT) (S4) during kharif and rabi respectively. Among weed management practices, un-weeded control (S7) recorded significantly lower grain yield during both the seasons.

The interaction effects between method of establishment and weed management practices were significant in both the seasons. Application of Metsulfuron Methyl 10 % - Chlorimuron Ethyl 10 % @ 20g per ha + three mechanized weeding (25,35 and 45 DAT) (S5) enhanced the higher grain yield to 5759 kg/ha and 5587 kg ha^1 and on par with application of Pre E. Butachlor 2.5 lit per ha + three mechanized weeding (25,35 and 45 DAT) (S4).

Table.1 Effect of spacing and weed management practices on plant height (cm) of paddy

Treatment	Plant Height (cm)							
	2017				2018			
	Vegetative	Panicle initiation	Flowering	Harvest	Vegetative	Panicle initiation	Flowering	Harvest
M1(SRI 25 x 25 cm)	44.34	76.73	100.16	101.50	44.34	76.73	120.20	121.83
M2 (Machine 30 x 20 cm)	42.56	73.63	96.08	97.55	42.56	73.63	115.29	116.93
M3 (Conventional 20 x 10 cm)	35.47	61.36	80.11	80.21	35.47	61.36	96.13	91.22
SEd	0.22	0.01	0.05	0.10	0.27	0.01	0.04	0.12
CD (P=0.05)	0.95	0.04	0.20	0.43	1.15	0.05	0.18	0.51
Subplot								
S1	42.82	72.89	89.72	90.11	51.38	87.47	107.66	108.13
S2	39.12	68.69	93.31	92.15	46.94	82.43	111.97	110.58
S3	40.78	69.60	92.61	94.94	48.94	83.52	111.14	113.92
S4	40.76	73.33	93.20	95.62	48.91	87.99	111.84	114.57
S5	51.66	75.99	95.49	95.78	61.99	91.19	114.58	114.94
S6	37.64	68.77	93.08	95.02	45.16	82.53	111.70	114.03
S7	32.75	64.73	87.41	78.14	39.30	77.68	104.89	93.76
SEd	1.71	0.42	0.31	1.44	2.05	0.50	0.28	1.73
CD (P=0.05)	3.59	0.88	0.65	3.03	4.31	1.06	0.58	3.64
Interactions								
SEd (MxS)	2.75	0.67	0.50	2.32	3.30	0.81	0.45	2.78
CD (P=0.05)	5.81	1.42	1.06	4.88	6.98	1.70	0.95	5.85
SEd (SxM)	2.96	0.73	0.54	2.50	3.55	0.87	0.48	3.00
CD (P=0.05)	6.22	1.53	1.13	5.25	7.46	1.84	1.01	6.30

Main Plot – Planting Methods.

M1 – SRI Method of planting

M2 – Machine Planting

M3- Conventional line planting

Sub Plot

S1 –Pre E. Butachlor 2.5 lit per ha + Hand weeding on 45 DAT

S2- Pre.E Almix @ 20g per ha + HW on 45 DAT

S3- Four mechanized weeding (15,25,35 and 45 DAT)

S4- Pre E. Butachlor 2.5 lit per ha + three mechanized weeding (25,35 and 45 DAT)

S5 - Pre.E Almix @ 20g per ha + three mechanized weeding (25,35 and 45 DAT)

S6- Hand Weeding on 20 and 40 DAT and S7- Un Weeded Control

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Table.2 Effect of spacing and weed management practices on leaf area index of paddy

Treatment	Leaf Area Index					
	2017			2018		
	Vegetative	Panicle initiation	Flowering	Vegetative	Panicle initiation	Flowering
M1(SRI 25 x 25 cm)	6.71	10.81	11.68	7.38	11.89	12.85
M2 (Machine 30 x 20 cm)	5.37	8.93	11.26	5.90	9.83	12.38
M3 (Conventional 20 x 10 cm)	2.75	5.63	6.08	3.02	6.19	6.69
SEd	0.09	0.23	0.22	0.10	0.25	0.24
CD (P=0.05)	0.40	1.00	0.93	0.44	1.10	1.02
Subplot						
S1	4.78	5.42	5.44	5.26	5.96	5.98
S2	5.34	6.75	6.89	5.87	7.42	7.58
S3	5.00	8.88	9.76	5.50	9.77	10.74
S4	5.82	12.08	14.79	6.40	13.28	16.27
S5	6.64	14.87	19.64	7.30	16.36	21.60
S6	4.37	6.19	6.25	4.81	6.80	6.88
S7	2.63	5.01	4.94	2.89	5.51	5.43
SEd	0.50	0.46	0.47	0.55	0.51	0.52
CD (P=0.05)	1.05	0.97	0.99	1.16	1.07	1.09
Interactions						
SEd (MxS)	0.81	0.78	0.79	0.89	0.85	0.86
CD (P=0.05)	1.73	1.78	1.78	1.90	1.96	1.96
SEd (SxM)	0.87	0.80	0.82	0.96	0.88	0.90
CD (P=0.05)	1.83	1.68	1.71	2.01	1.85	1.88

Table.3 Effect of spacing and weed management practices on dry matter production (kg/ha) of paddy

Treatment	Dry Matter Production							
	2017				2018			
	Vegetative	Panicle initiation	Flowering	Harvest	Vegetative	Panicle initiation	Flowering	Harvest
M1(SRI 25 x 25 cm)	5543.43	13325.71	19428.57	19257.53	5432.56	13059.20	19040.00	18872.38
M2 (Machine 30 x 20 cm)	4434.74	10660.57	15542.86	15383.20	4346.05	10447.36	15232.00	15075.53
M3 (Conventional 20 x 10 cm)	2217.37	5741.71	7771.43	7757.97	2173.02	5626.88	7616.00	7602.81
SEd	13.58	335.93	14.81	169.64	13.31	329.21	14.52	166.25
CD (P=0.05)	58.43	1445.42	63.74	729.93	57.26	1416.51	62.46	715.33
Subplot								
S1	4268.00	10410.67	11968.00	10814.15	4182.64	10202.45	11728.64	10597.87
S2	4376.53	10885.33	10442.67	8832.39	4289.00	10667.63	10233.81	8655.74
S3	4092.00	7440.00	15517.33	16035.04	4010.16	7291.20	15206.99	15714.34
S4	5130.40	10906.67	19008.00	19590.80	5027.79	10688.53	18627.84	19198.98
S5	6051.47	11701.33	22058.67	25124.83	5930.44	11467.31	21617.49	24622.34

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S6	2329.07	10736.00	10530.67	9445.52	2282.49	10521.28	10320.05	9256.61
S7	2208.80	7285.33	10208.00	9087.55	2164.62	7139.63	10003.84	8905.80
SEd	626.55	351.53	1507.91	243.83	614.02	344.50	1477.75	238.95
CD (P=0.05)	1316.36	738.56	3168.05	512.27	1290.03	723.79	3104.69	502.03
Interactions								
SEd (MxS)	1004.81	656.21	2418.08	426.21	984.72	643.09	2369.72	417.69
CD (P=0.05)	2111.46	1757.31	5080.48	1044.12	2069.24	1722.17	4978.87	1023.24
SEd (SxM)	1085.22	608.87	2611.78	422.32	1063.52	596.70	2559.54	413.88
CD (P=0.05)	2280.00	1279.22	5487.22	887.28	2234.40	1253.63	5377.48	869.54

Table.4 Effect of spacing and weed management practices on grain yield (kg/ha) of paddy

Treatments	**Grain Yield kg/ha**				**Treatments**	**Grain Yield kg/ha**			
	2017					**2018**			
	M1	**M2**	**M3**	**Mean**		**M1**	**M2**	**M3**	**Mean**
S1	5937.2	5306.2	4416.0	**5219.78**	**S1**	5759.04	5147.01	4283.52	**5063.19**
S2	6056.1	4678.2	3792.7	**4842.30**	**S2**	5874.37	4537.85	3678.87	**4697.03**
S3	5824.1	5008.7	4044.6	**4959.12**	**S3**	5649.33	4858.44	3923.26	**4810.34**
S4	6381.0	5929.2	4619.0	**5643.03**	**S4**	6189.52	5751.32	4480.38	**5473.74**
S5	6282.4	6041.8	4953.8	**5759.33**	**S5**	6093.93	5860.55	4805.19	**5586.55**
S6	5363.1	5088.3	3916.1	**4789.12**	**S6**	5202.16	4935.60	3798.57	**4645.44**
S7	5478.1	4548.6	3683.7	**4570.12**	**S7**	5313.76	4412.14	3573.14	**4433.01**
Mean	**5903.11**	**5228.71**	**4203.67**		**Mean**	**5726.01**	**5071.85**	**4077.56**	
	SEd CD (P=0.05)					**SEd CD (P=0.05)**			
	M	31.31	134.71				M	30.37	130.67
	S	83.50	175.43				S	81.00	170.17
	M at S	137.51	304.60				M at S	133.39	295.46
	S at M	144.63	303.86				S at M	140.29	294.74

Table.5 Effect of spacing and weed management practices on total weed dry weight kg/ha of paddy

Treatment	2017				2018			
	Vegetative	Panicle initiation	Flowering	Harvest	Vegetative	Panicle initiation	Flowering	Harvest
M1(SRI 25 x 25 cm)	25.46	20.56	24.42	29.24	22.91	18.51	21.98	26.32
M2 (Machine 30 x 20 cm)	25.89	20.59	24.67	29.52	23.30	18.53	22.20	26.56
M3 (Conventional 20 x 10 cm)	25.66	20.76	24.88	29.98	23.09	18.68	22.39	26.98
SEd	0.13	0.18	0.33	0.34	0.12	0.16	0.29	0.31
CD (P=0.05)	0.55	0.76	1.41	1.47	0.50	0.69	1.26	1.32
Subplot								
S1	25.78	20.76	24.77	29.69	23.20	18.69	22.29	26.72
S2	24.95	20.08	24.17	29.07	22.46	18.07	21.75	26.17
S3	25.65	20.58	24.70	29.69	23.09	18.52	22.23	26.72
S4	23.56	18.98	22.85	26.96	21.20	17.08	20.56	24.26
S5	20.30	16.20	19.33	23.28	18.27	14.58	17.40	20.95
S6	25.05	19.87	23.81	28.59	22.55	17.89	21.44	25.73

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S7	34.39	27.98	32.97	39.77	30.95	25.18	29.68	35.79
SEd	0.40	0.30	0.29	0.50	0.36	0.27	0.26	0.45
CD (P=0.05)	0.83	0.63	0.61	1.05	0.75	0.57	0.55	0.94
Interactions								
SEd (MxS)	0.65	0.52	0.57	0.87	0.58	0.46	0.51	0.78
CD (P=0.05)	1.42	1.22	1.61	2.12	1.28	1.10	1.45	1.91
SEd (SxM)	0.69	0.52	0.51	0.86	0.62	0.47	0.45	0.78
CD (P=0.05)	1.44	1.10	1.06	1.81	1.30	0.99	0.96	1.63

Conclusion

From the present study, it could be concluded that square planting with conoweeding three times at 10 days interval starting from 25 DAT of rice will be producing more tillers and promising practice to increase the rice productivity and profitability. Square planting 25 x 25 cm and weeding with Pre.E (Metsulfuron Methyl 10 % - Chlorimuron Ethyl 10 %) @ 20g per ha produced higher grain yield.

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