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Standardizing agro techniques of organic rice for ecofriendly production

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ABSTRACT

An experiment was conducted at College of Agriculture, Vellayani during the year 2012 to standardize the nutrient schedule and weed management techniques for organic rice with its economic feasibility. The experiment was laid out in split-plot design with four replications. The study revealed the superiority of closer spacing (15×15 cm) on grain and straw yield. The stale seed bed technique and hand weeding were at par with respect to grain yield. The grain and straw yield were the higher with one third RDN as FYM, one third as vermicompost and one third as vermicompost and one third as neem cake + 2 kg Azospirillum + 2 kg P solubilizing bacteria ha^{-1}, and statistically at par with soil test based application (half as vermicompost and half as neem cake). Stale seed bed technique and closer spacing effectively controlled the weeds. The weed biomass was lower with FYM 1 t + green leaf manure 1 t+ dual culture of Azolla + 2 kg Azospirillum + 2 kg P solubilizing bacteria + 1 kg PGPR (mix 1) ha^{-1} and FYM 5 t+ 800 kg oil cakes ha^{-1} (half basal + half top dressing at active tillering stage). The comparison between organic and conventional methods showed significant difference at all the crop growth stages with the least weed biomass in organic over conventional.

Keywords: Conventional farming, organic rice, stale seed bed, weed biomass

Paddy soil system favours fertility maintenance and buildup of organic matter in soils, and is the backbone of long-term sustainability of the wet land rice systems (Sahrawat, 2004). Nitrogen (N) status of soils was sustained by maintaining equilibrium between N-loss of crop harvest and nitrogen gain from biological N-fixation in primary rice farming of the pre- chemical period (Ladha and Peoples, 1995). However, in current intensive rice mono-cropping systems, this equilibrium has been disturbed with inputs of mineral fertilizers and playing a significant role (Ladha *et al*., 2000). The application of chemical fertilizers is costly and gradually lead to the environmental contamination. Organic residue recycling is becoming an increasingly important aspect of environmentally sound sustainable agriculture. Now-a-days, agricultural production based on organic applications is gaining importance and the demands for the resulting products are increasing. Therefore, effective use of organic materials in rice farming needs to be promoted. Keeping these views under consideration an investigation was carried out at College of Agriculture, Vellayani to standardize the nutrient schedule and weed management techniques for organic rice.

The experiment was conducted at the Instructional Farm (8.5°N latitude and 76.9ºE longitude and altitude 29m above MSL), College of Agriculture, Vellayani, Thiruvananthapuram, Kerala during *kharif* season of 2012. The experiment was laid out in split-plot design with four replications. The main plot treatments were two spacing (S) and two weed management practices (W) and sub-plot treatments included four nutrient schedules (N). The recommended package of practices of Kerala Agricultural University for raising organic rice was taken as a control (FYM 5 t ha^{-1} + 90:45:45 kg NPK ha^{-1}). Two spacing were S_1- 20×15cm and S_2- 15×15cm. The weed management practices used were W_1-stale seed bed and W_2-hand weeding. Four nutrient schedules were N_1- option 1 of the organic adhoc recommendation of KAU- FYM 5t + 800kg oil cakes ha^{-1} (1/2 basal +1/2 top dressing at active tillering stage), N_2- option 2 of the organic adhoc recommendation of KAU- FYM 1t + green leaf manure 1t + dual culture of *Azolla*+2 kg *Azospirillum*, 2 kg P solubilizing bacteria and 1kg PGPR (mix1) ha^{-1}, N_3- option 3 of the organic ad hoc recommendation of KAU-1/3rd RDN as FYM,1/3rd as vermicompost and 1/3rd as neem cake + *Azospirillum* (2 kg) and P solubilizing bacteria (2 kg) ha^{-1}, N_4-soil test based application-half as vermicompost and half as neem cake.

Biometric characters

All the treatments had significant influence on the bio-metric characters of the crop. The spacing of the crop significantly influenced crop height at later stages while nutrient schedule throughout the growth stages. The interaction effect of weed management techniques, spacing and nutrient schedule were significant throughout the growth stages except at harvest stage. The control plot recorded the higher plant height at all

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stages. Tiller production was significantly influenced by spacing and nutrient schedule (Table 1). The closely spaced plants produced higher number of tillers at all stages. Among the nutrient schedule N_3 recorded the higher tiller number and N_2 the lowest. The nutrient schedule only had significant influence on LAI with N_3 recoding the higher values. The dry matter production of the plant was significantly influenced by weed management techniques and spacing with stale seed bed and closer planting recording the highest dry matter production. Among the nutrient schedule N_3 recorded the maximum dry matter production but was *at par* with N_4.

Yield and yield attributing characters

The stale seed bed preparation as a technique of weed management recorded the highest number of productive tillers m^{-2}, grain weight panicle^{-1} and spikelet panicle^{-1}, while there was no significant difference between the two treatments of weed management techniques with respect to the other yield attributing characters and yield. The stale seed bed technique and hand weeding were at par with respect to grain yield. Both the techniques had similar influence on filled grains panicle^{-1} and thousand grain weight. The said parameters are the chief yield contributing characters and were not influenced significantly by the two weed management techniques. Similar results were reported by Sindhu *et al*. (2010).

Table 1: Effect of weed management techniques, spacing and nutrient schedule on dry matter production, yield attributes, yield and harvest index of organic rice

Treatments	DMP (kg ha^{-1})	Productive tillers m^{-2}	Grain weight panicle^{-1}(g)	Spikelet panicle^{-1}	Filled grains panicle^{-1}	Thousand grain weight (g)	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Harvest index
Weed management (W)									
W_1	1912.79	319.00	1.62	90.43	72.97	17.13	1912.79	3667.42	0.34
W_2	1847.61	299.32	1.47	88.47	71.63	16.63	1847.61	3537.92	0.34
SEm (±)	**41.38**	**4.10**	**0.01**	**0.56**	**0.77**	**0.23**	**41.38**	**10.03**	**7.68**
LSD (0.05)	**NS**	**13.11**	**0.05**	**1.82**	**NS**	**NS**	**NS**	**NS**	**NS**
Spacing (S)									
S_1	5200.83	267.30	1.56	88.92	71.44	16.75	1781.80	3429.03	0.34
S_2	5764.90	351.03	1.53	89.98	73.15	17.01	1978.60	3786.30	0.34
SEm (±)	**51.64**	**4.10**	**0.01**	**0.56**	**0.77**	**0.23**	**41.38**	**10.03**	**7.68**
LSD (0.05)	**165.21**	**13.11**	**NS**	**NS**	**NS**	**NS**	**132.38**	**181.65**	**NS**
Nutrient schedule (N)									
N_1	5192.8	283.69	1.45	88.34	71.59	16.65	1798.10	3394.60	0.34
N_2	5067.5	264.84	1.36	86.63	69.10	15.84	1694.10	3373.40	0.33
N_3	5957.0	365.00	1.72	93.12	75.35	17.91	2067.80	3889.30	0.34
N_4	5714.2	323.12	1.65	89.71	73.16	17.12	1960.80	3753.40	0.34
SEm (±)	**114.28**	**323.12**	**0.05**	**0.67**	**0.95**	**0.29**	**75.04**	**81.42**	**9.75**
LSD (0.05)	**327.79**	**6.11**	**0.14**	**1.93**	**2.72**	**0.84**	**215.25**	**233.55**	**NS**

Note: S_1- 20×15cm, S_2- 15×15cm, W_1-stale seed bed, W_2-hand weeding, N_1- option 1 of the organic adhoc recommendation of KAU- FYM 5 t + 800 kg oil cakes ha^{-1} (1/2 basal +1/2 top dressing at active tillering stage), N_2- option 2 of the organic ad hoc recommendation of KAU- FYM 1 t + green leaf manure 1 t + dual culture of Azolla +2 kg Azospirillum, 2 kg P solubilizing bacteria and 1 kg PGPR (mix1) ha^{-1}, N_3- option 3 of the organic ad hoc recommendation of KAU-1/3rd RDN as FYM,1/3rd as vermicompost and 1/3rd as neem cake + Azospirillum (2 kg) and P solubilizing bacteria (2 kg) ha^{-1}, N_4-soil test based application-half as vermicompost and half as neem cake.

Straw yield of a plant is contributed mainly by number of tillers and leaves, were not influenced significantly by both the weed management techniques.

Spacing had significant influence on number of productive tillers m^{-2}, grain and straw yield with closer spacing of plants recording higher values for these parameters. Spacing significantly influenced grain and straw yield with closer spacing recording the higher grain and straw yield. This might be due to more productive tillers m^{-2} produced by an increased plant population in closer spacing. This observation is in conformity with the earlier findings of Pandey and Tripathi (1995), Maske *et al*. (1997) and Omina EL-

Shayieb (2003). The higher straw yield could be attributed to the higher tiller number, height and LAI contributed by closer spacing. Closer spacing also accounted for shading of leaves of one plant to another which in turn accounted for more vegetative growth thus contributing to high straw yield. That was also reported by Maske *et al.* (1997).

Nutrient schedule had significant influence on most of the yield attributing characters and yield. Treatment N_3 recorded the higher number of productive tillers m^{-2}, spikelet $panicle^{-1}$ and filled grains $panicle^{-1}$, while maximum grain weight per panicle, thousand grain weight, grain yield and straw yield *on par* with N_4 for all these parameters. The beneficial effect of organic manures on the yield attributes like number of productive tillers could be attributed to the supply of plant nutrients in an available form through the proper decomposition and mineralization of organic manure and also on the solubilizing effects of organic manure on the fixed forms of nutrients (Sinha *et al*., 1981). Choudhari and Thakuria (1996) observed more number of productive tillers under integrated nutrient management due to the greater survival of tillers with organic manures owing to continuous and controlled supply of nutrients throughout the crop growth period.

Organic manures in general have been reported to maintain a better nutrient status in the soil. This in turn might have improved the photosynthetic efficiency of the plant and thereby increased the number of filled grains as observed by Nehra *et al.* (2001). Application of Farm yard manure (FYM) improved the physical and chemical properties of soil and gave enough time to its decomposition and increased the availability of different nutrients which was reflected in growth of plants and increased yield and its components. Plant growth promoting (PGP) microorganisms enhance the capacity of plants to absorb nutrients like N and P efficiently, resulting in stronger growth and higher crop yields. Increase in thousand grain weight might be due to continuous supply of nutrients through organic manure which resulted in more number of normal and filled grains. Enhanced grain weight due to high organic manure was previously reported by Babu (1996).

Application of neem cake as fertilizer and pesticide is a traditional practice. Apart from the major nutrients neem cake also contains calcium, magnesium, and sulphur compounds which favour the growth and yield. Further neem cake, which has been shown to inhibit nitrification, might have resulted in a desirable slow release of nitrogen to the plants. Thus it might have helped in spreading the effect of fertilizer over a longer period of time by reducing losses through denitrification and leaching. The increased yield in N_3 and N_4 is mainly due to better mineralization, increased nutrient uptake and the enhanced microbial population.

Organic manures might have also increased the absorptive power of the soil for cations and anions, phosphates and nitrates and released them slowly for the

Table 2: Effect of weed management techniques, spacing and nutrient schedule on weed biomass

Treatments	Weed biomass (g m^{-2})			
	20 DAT	40 DAT	60 DAT	Harvest
Weed management (W)				
W_1	47.60	54.92	67.03	106.13
W_2	50.44	59.59	71.20	111.98
SEm (±)	**0.44**	**0.73**	**1.32**	**1.68**
LSD (0.05)	**2.14**	**3.18**	**3.52**	**5.12**
Spacing (S)				
S_1	50.75	61.33	71.07	113.26
S_2	47.29	53.18	67.17	104.85
SEm (±)	**0.44**	**0.73**	**1.32**	**1.68**
LSD (0.05)	**2.14**	**3.18**	**3.52**	**5.12**
Nutrient schedule (N)				
N_1	47.60	54.50	67.09	107.73
N_2	46.36	55.06	65.60	106.18
N_3	52.29	59.76	72.05	112.31
N_4	49.8	59.70	71.73	110.01
SEm (±)	**0.94**	**1.40**	**1.55**	**2.26**
LSD (0.05)	**1.82**	**2.98**	**5.38**	**NS**

benefit of the crop during the entire crop growth period and leading to higher yield as reported by Sinha *et al*. (1981). Application of FYM and vermicompost had favorable effect on grain yield. Increase in grain yield might be due to increase in ammoniac and nitrate nitrogen, and enhanced availability of major and micro micronutrients due to FYM addition (Mondal and Chettri, 1998). All the growth parameters were found to be responding well to vermicompost. This might be due to increased availability of nutrients to plants. Worm casts were rich in available nutrients for plant growth (Tomati *et al*., 1998) and had all the qualities of a fertilizer (Bano *et al*., 1987). The combination of FYM, vermicompost and neem cake was better in improving the grain yield. Bastia *et al.* (2014) reported that organic manures helped in enhancing the fertility and productivity of soil as a whole.

The weed biomass was found the lowest in stale seed bed technique and closer spacing at all stages. Among the nutrient schedule N_2 recorded the lower weed biomass at 20 and 60 days after transplanting (DAT) which was *at par* with N_1. At 40 DAT, N_1 recorded the lower weed biomass which was on par with N_2 (Table 2).

The comparison between organic and conventional showed that there was significant difference at all the crop growth stages with organic recording the lower weed biomass than conventional.

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