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Evaluation of System of Planting with Different Foliar application of Liquid Organic Formulation under Organic Rice [*Oryza sativa* (L.)] Production

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A B S T R A C T

A field experiment was conducted at Shiats Model Organic Farm (SMOF), SHUATS, Allahabad, during the *kharif* season of 2017 with 18 treatment replication thrice in Split Plot Design, to determine the effect of system of planting and different liquid organic formulation on growth and yield of organic rice (*Oryza sativa*). The result revealed that SRI system of planting was the best planting system for obtaining maximum number of tillers (10.71), dry weight (21.67 g), panicle length (27.13 cm), highest grain yield (2.88 t ha^{-1}), straw yield (4.11 t ha^{-1}). Along with foliar spray of sea weed extract.

Introduction

Rice (*Oryza sativa* L.) is the most important food crop of India and is a major energy source for about 60 % of the world population. Asia's food security largely depends on the irrigated rice which produces three quarter of total rice production. About 90 % rice is produced and consumed in Asia where the demand for rice is on the rise due to increasing population (Amudha *et al.*, 2009). Rice production under current inputs and technology is likely to fail to meet the projected demand, and there is an urgent need to increase rice productivity in the world. On an average, 2500 liter of water is applied, ranging from 800 to more than 5000 liter, to produce 1 kg of rough rice (Bouman, 2009). Recently rice cultivation under non-flooded conditions (aerobic) is being considered as an alternative to the conventional rice cultivation system in regions where rainfall and fresh water resources are limited. Under organic production the organic manures like farm yard manure (FYM) and compost are bulky in nature and very laborious to carry in the hilly terrain of north east reason. Availability of adequate quantity of organic manure in time and place is another constraint in crop production. Under such situation, seaweed extract and other liquid organic formulation like *panchagavya* and fish amino acid can be alternative, being an economic and low volume organic source of fertilizer. Use of

such organic fertilizers has gained popularity due to their potential use in organic and sustainable agriculture. These organic formulations contain all the trace elements and some essential plant growth hormones (Zhang and Ervin, 2008). Natural plant growth regulators (e.g. Auxin, Gibberellin and cytokinin) present in these liquid organic formulations give a major boost to crop yields by accelerating the plant's metabolic function (Zhang and Ervin 2008).

Materials and Methods

A field experiment was conducted at Shiats Model Organic Farm (SMOF), SHUATS, Allahabad, during the *kharif* season of 2017 with 18 treatments, replication thrice in Split Plot Design, under fully organic conditions to evaluate the effect of system of planting and different liquid organic formulation on growth and yield of rice (*Oryza sativa*).The experiment was laid out in split plot design with 3 planting methods (SRI, Direct Seeded Rice and Conventional Transplanted Rice) and 3 liquid organic formulation [*Panchagavya* (2 foliar spray at 20 and 40 DAT), *Panchagavya* (3 foliar spray at 20, 40 and 60 DAT), sea weed extract (2 foliar spray at 20 and 40 DAT), sea weed extract (3 foliar spray at 20, 40 and 60 DAT), fish amino acid (2 foliar spray at 20 and 40 DAT), fish amino acid (3 foliar spray at 20, 40 and 60 DAT)] as sub-plot treatments with 3 replications.

The recommended dose of fertilizer was taken as 120 kg N/ha, 60 kg P/ha, 40 kg K/ha. However in situ green manure and FYM was applied at the time of final land preparation of sub-plot.1 m^{-2} was harvested from every plot for the determination of result and statistical analysis was done using analysis of variance in split-plot design using software and statistical mean differences were found by Fisher´s protected least significant difference test.

Results and Discussion

Growth attributes

No. of tillers per hill

The result indicates that significant and maximum number of tillers per hill (10.71) at 75 DAS/DAT was observed under SRI system of planting. However, conventional transplanted rice was found to be statistically at par with SRI system of planting this might be due to planting in square method with wider spacing might have resulted in profused tillering under SRI cultivation which might have facilitated plants for better utilization of the resources. This advantage of SRI method in enhancing tiller numbers has been reported earlier by Udaykumar (2005). While among foliar application of 3% liquid organic formulation maximum (10.60) number of tillers $hill^{-1}$ was observed 2 foliar spray of fish amino acid (at 20 and 40 DAT/DAS).

Dry matter

Maximum dry weight (21.67g) was observed in SRI system of planting. Among foliar application treatments maximum value of dry weight (22.73 g) was found with 3 foliar spray of sea weed extract (at 20, 40 and 60 DAT/DAS).Planting under SRI might have facilitated plants for better utilization of the resources. Further, due to foliar application of sea weed extract, improvement in physiological function of nutrient mobilization and partitioning increased in the dry matter production Zodape *et al.,* (2009) (Table 1).

Leaf Area Index

Maximum leaf area Index (2.49) was found under conventional transplanted rice and among the foliar applications maximum leaf area (1.90) was found with 3 foliar spray of sea weed extract (at 20, 40 and 60 DAT/DAS).

Table.1 Effect of system of planting and foliar application of liquid organic formulation on growth attributes of rice at 75 DAS/DAT

Factors and Treatment	Growth attributes of Rice (at 75 DAS/DAT)		
	No. of tillers	Plant dry weight (g hill^{-1})	Leaf area index
System of Planting			
SRI	10.71	21.67	1.49
DSR	9.57	20.03	1.44
CTR	10.32	21.02	2.49
F test	S	S	S
SEm±	0.16	0.22	0.03
CD (P=0.05)	0.64	0.88	0.11
Foliar Application of 3% Liquid Organic formulation			
Panchagavya **(2 Foliar spray at 20 and 40 DAT/DAS)**	9.87	19.35	1.74
Panchagavya **(3 Foliar spray at 20, 40 and 60 DAT/DAS)**	9.93	19.76	1.76
Sea weed extract (2 Foliar spray at 20 and 40 DAT/DAS)	10.47	21.34	1.70
Sea weed extract (3 Foliarspray at 20, 40 and 60 DAT/DAS)	9.89	22.73	1.90
Fish amino acid (2 Foliar spray at 20 and 40 DAT/DAS)	10.60	20.97	1.79
Fish amino acid (3 Foliar spray at 20, 40 and 60 DAT/DAS)	10.44	21.28	1.69
F test	NS	S	NS
SEm±	0.26	0.33	0.08
CD (P=0.05)	-	0.97	-

SRI: System of Rice Intensification, CTR: Conventional Transplanted rice, DSP: Direct Seeded Rice

Table.2 Effect of system of planting and foliar application of liquid organic formulation on yield attributes of rice

Factors and Treatment	Yield and yield attributes of rice			
	Panicle Length	Grains Panicle^{-1}	Grain Yield (t ha^{-1})	Straw Yield (t ha^{-1})
System of Planting				
SRI	27.13	142.83	2.88	4.11
DSR	24.77	131.68	1.93	3.25
CTR	25.81	136.87	2.30	3.86
F test	S	S	S	S
SEm±	0.21	1.22	0.07	0.07
CD (P=0.05)	0.82	4.77	0.27	0.28
Foliar Application of 3% Liquid Organic formulation				
***Panchagavya* (2 Foliar spray at 20 and 40 DAT/DAS)**	24.89	145.15	2.18	3.36
***Panchagavya* (3 Foliar spray at 20, 40 and 60 DAT/DAS)**	25.63	132.27	2.26	3.41
Sea weed extract (2 Foliar spray at 20 and 40 DAT/DAS)	25.96	132.94	2.36	3.88
Sea weed extract (3 Foliarspray at 20, 40 and 60 DAT/DAS)	26.78	133.10	2.67	4.19
Fish amino acid (2 Foliar spray at 20 and 40 DAT/DAS)	25.76	131.42	2.26	3.69
Fish amino acid (3 Foliar spray at 20, 40 and 60 DAT/DAS)	26.41	147.88	2.52	3.93
F test	NS	S	NS	NS
SEm±	0.40	2.44	0.12	0.13
CD (P=0.05)	-	7.05	-	0.36

SRI: System of Rice Intensification, CTR: Conventional Transplanted rice, DSP: Direct Seeded Rice

Thiyagarajan *et al.,* (2002) reported that use of younger seedling do not necessary result in higher leaf area index. Similar tread also found by Anitha and Chellapan (2011). Another reason of maximum LAI due to foliar spray of seaweed extract found by Sivasankari *et al.,* (2006) which might be due to spraying of seaweed extract which was effectively utilized by the crop and expressed in higher LAI.

Yield and yield attributes

Length of Panicle

Maximum length of panicle (27.13 cm) was observed with SRI system of planting. Across foliar applications maximum length of panicle 26.78 cm was observed with 3 foliar spray of sea weed extract (at 20, 40 and 60 DAT/DAS). Longer panicle in SRI system may be due to the lower rate of leaf senescence in plants that have larger amounts of cytokinins transported into their canopies from the roots (Soejima *et al.,* 1995).

Grains per panicle

Significant and highest number of grains panicle^{-1} (142.83) was observed in SRI system of planting. Across foliar application maximum number of grains panicle^{-1} (147.88) was found with 3 foliar spray of fish amino acid (at 20, 40 and 60 DAT/DAS). Under SRI cultivation biomass-portioning efficiency increases distinctively, through higher translocation of assimilates, *viz.,* dry matter, carbohydrates, nitrogen, and their conversion rates enhances the grain filling and spike weight in SRI rice (Hugar *et al.,* 2009).

Grain and straw yield

Maximum grain yield (2.88 t ha^{-1}) and straw yield (4.11 t ha^{-1}) were found under SRI system of planting (Table 2). And among the foliar application of liquid organic formulation 3 foliar spray of sea weed extract (at 20, 40 and 60 DAT/DAS) was recorded maximum values of grain yield (2.67 t ha^{-1}) and straw yield (4.19 t ha^{-}). Higher grain yield in SRI may have attributed to large root volume, profuse and strong tillers with big panicles, more and well filled spikelets with higher grain weight (Satyanarayana and Babu, 2004) another reason might be due to the fact that seaweed extract is a biostimulant, which provide the rice plant with micro, macro nutrients and significant amounts of cytokinins, auxins and betaines, ultimately increasing the chlorophyll production by boosting the photosynthetic process, thereby stimulating vegetative growth. Thus, an overall plant performance would have been enhanced. Similar findings were observed by *Pramnnick et al.,* (2014).

Based on the current study, it may be concluded that SRI system of planting with 3 foliar spray of sea weed extract (at 20, 40 and 60 DAT/DAS)produce highest number of tillers (10.71), highest dry weight (21.67), length of panicle (27.13 cm), grain per panicle (142.83)grain (2.88 t ha^{-1}), straw yield (4.11 t ha^{-1}). These findings are based on 1 season, further trials may be required for considering it for recommendation.

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