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Response of Direct Seeded Rainfed Low Land Rice to Organics and Zinc Application

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ABSTRACT

A field experiment was conducted during *kharif*, 2014 at Agricultural College Farm, Bapatla. The experiment was laid out in RBD and replicated thrice. Treatment combinations include FYM and Urban Compost as organic sources and two methods of zinc application. The results showed that significantly higher growth parameters viz., plant height, no. of tillers m^{-2}, drymatter accumulation, yield attributes (no. of productive tillers m^{-2}, total grains panicle^{-1}, no. of filled grains panicle^{-1} and test weight) and yield of direct seeded rice were with RDF (120: 60: 40 kg NPK ha^{-1}) along with FYM @ 10 t ha^{-1} and $ZnSO_4$ @ 50 kg ha^{-1} basal soil application combination which was at par when zinc was applied as foliar spray @ 0.5% at 20 and 40 DAS with RDF + FYM @ 10 t ha^{-1}.

Key words : FYM, Urban Compost, Zinc and Direct Seeded Rice.

Rice (*Oryza sativa* L.) is relished as a staple food by more than one third of the world's population (Zhao *et al.*, 2011). Maintaining stable rice production is extremely important to feed the constantly growing population. For estimated population of 1.63 billion people by the year 20540 with a per capita rice consumption of 225 to 275 g day^{-1}. In the present scenario the rice productivity has reached to a plateau. In order to achieve the expected targets there is very need to adopt proper crop production practices.

Transplanting has been the traditional practice of establishment of rice for higher productivity, but looming water crisis, escalating labour costs and water-intensive nature of traditional rice cultivation ramble the search for an alternative management method for sustainable rice production. Direct seeding of rice seems not only a desirable alternative but also an economically viable approach in rescuing farmers. In Andhra Pradesh, an area of 47.52 lakh hectares is under rice cultivation of which, 4.0 lakh hectares is under direct seeding of rice (Commissioner and Director of Agriculture, 2013-14), which is gaining importance among the farmers of Krishna Agro Climatic Zone.

Combined use of organic manures and inorganic fertilizers help in maintaining yield stability through correction of marginal deficiencies of secondary and micronutrients, enhancing efficiency of applied nutrients and improves soil physical, chemical and biological properties. FYM is an important source of organic matter and has long been considered as a desirable soil amendment in sustaining soil health (Bala and Hossain, 2008). The end product of the degradable waste (compost) can be used in agriculture, since it contains sufficient amounts of plant nutrients, including most of the micronutrients.

Zinc deficiency is one of the important abiotic factors limiting rice productivity worldwide and also a wide spread nutritional disorder affecting human health. Zinc is involved in a number of physiological processes of plant growth and metabolism including enzyme activation, protein synthesis and metabolism of carbohydrates, lipids, auxins and nucleic acids, gene expression and regulation and reproductive development (Marschner, 1995).

MATERIAL AND METHODS

A field trial was conducted during *kharif,* 2014 at Agricultural College Farm, Bapatla on sandy clay loam soil with pH 8.3, organic carbon 0.3%, available N (210 kg ha^{-1}), available P (14 kg ha^{-1}), available K (324 kg ha^{-1}) and available Zn (0.4 ppm). The experiment was laid out in a randomized block design with three replications consisting of nine treatments viz., RDF (T_1), RDF + FYM @ 10 t ha^{-1} (T_2), RDF + Urban compost

@ 10 t ha^{-1} (T_3), RDF + $ZnSO_4$ @ 50 kg ha^{-1} as basal soil application (T_4), RDF + FYM @ 10 t ha^{-1} + $ZnSO_4$ @ 50 kg ha^{-1} as basal soil application (T_5), RDF + Urban compost @ 10 t ha^{-1} + $ZnSO_4$ @ 50 kg ha^{-1} as basal soil application (T_6), RDF + FYM @ 10 t ha^{-1} + Foliar application of $ZnSO_4$ @ 0.5% at 20 and 40 DAS (T_7), RDF + Urban compost @ 10 t ha^{-1} + Foliar application of $ZnSO_4$ @ 0.5% at 20 and 40 DAS (T_8) and RDF + $ZnSO_4$ @ 0.5% at 20 and 40 DAS (T_9). Recommended dose of fertilizer (120: 60: 40 kg NPK ka^{-1}) was commonly applied to all treatments. The variety BPT 5204 (Sambamahsuri) was sown on 1st August, 2014. Thinning and gap filling was done within a week days after sowing. A common dose of 60 kg P_2O_5 ha^{-1} and 40 kg K_2O ha^{-1} was applied in last ploughing through SSP and MOP, respectively by taking plot size into consideration. Nitrogen@ 120 kg ha^{-1} was applied through urea in three equal splits one each at sowing, active tillering and panicle initiation stages. Zinc @ 50 kg ha^{-1} was applied as basal application in respective treatment plots as zinc sulphate hepta hydrate ($ZnSO_{4.}$ 7 H_2O) and the same was applied as foliar spray @ 0.5% as per the treatments at 20 and 40 days after sowing. The field was irrigated immediately after sowing the dry seeds to achieve good germination. The plots were transformed into submerged condition from 40 days after sowing on receipt of canal water. The water was drained out from the field one week before harvest of the crop and field was maintained under saturation. Pre-emergence herbicide, Pretilachlor was applied @ 0.75 kg a.i ha^{-1} uniformly on second day after sowing. Weeding was done manually at 15 DAS and at 30 DAS to maintain weed free conditions during critical period of crop growth. Need based plant protection measures were taken during drop growth period. The data on plant height, drymatter accumulation, yield attributes, yield and net returns were recorded as per standard statistical procedures.

RESULTS AND DISCUSSION

Growth Characters

At 30 DAS, plant height (18.1 cm) showed significant increase with RDF + FYM @ 10 t ha^{-1} + $ZnSO_4$ @ 50 kg ha^{-1} as basal soil application (T_5). However, it was comparable with T_6, T_7, T_9, T_4 and T_8. At all other stages (60, 90 DAS and harvest), T_5 was significantly higher in plant height (61.3, 82.8 and 84.9 cm, respectively at 60, 90 DAS and at harvest) to rest of the treatments and the lowest plant height was recorded with RDF (T_1). The increase in plant height is due to higher nutrient uptake by the crop through organics application and zinc increased auxin production, an important growth promoter regulating the stem elongation and cell enlargement. These findings are in line with those of Yadav *et al*. (2011) and Gill and Walia (2013).

At 30 DAS, the treatments T_5 and T_7 recorded significantly higher no. of tillers m^{-2} (293) over rest of the treatments. Next to T_5 and T_7, the treatments T_6, T_4, T_8 and T_9 resulted in higher no. of tillers m^{-2}, and differed significantly with T_2, T_3 and T1 which recorded less no. of tillers m^{-2}. At 60 DAS, the T_5 recorded significantly higher no. of tillers m^{-2} (577) and closely followed by T_7, T_6 and T_8. The plots that received T_4, T_9, T_2 and T_3, however were inferior to T_5 but superior to T_1. AT 90 DAS, T_5 continued to record the highest number of tillers m^{-2} (611) though it was on a par with T_7 and T_6. The treatments that received T_8, T_4, $T_{9,}$ T_2 and T_3 were comparable with each other, whereas, application T_1 recorded the least number of tillers m^{-2}. The trends in no. of tillers m^{-2} noticed at harvest was similar to that observed at 90 DAS, except T_8 which was found on a par with T_7 at harvest. This enhancement in tiller production is due to incorporation of organic sources which lead to continuous availability of nutrients in available form to the plant at different stages and high zinc availability in the rhizosphere when $ZnSO_4$ applied as basal soil application, whereas foliar feeding of zinc corrected the negative effects of Zn deficiency in plant growth when it is applied at optimal range compared to control. These results are in complete agreement with those reported by Aruna *et al*. (2012).

Maximum drymatter accumulation of 488 kg ha^{-1} at 30 DAS, was recorded with T_5 which was significantly superior to that of rest of the treatments except T_7 and T_6. Next in order, the treatments which received T_8, T_4 and T_9 recorded higher drymatter accumulation than rest of the treatments in the study. At 60 DAS, the significantly highest drymatter accumulation (2511 kg ha^{-1}) was recorded with T_5 but it was on a par with T_7. The treatments, T_6, T_4, T_8 and T_9 remained at par among themselves. The treatments T_2 and T_3 were found comparable to each other. The trends in drymatter accumulation noticed at 90 DAS and at harvest

Table 1. Plant height (cm), no. of tillers m^{-2} and drymatter accumulation (kg ha^{-1}) of direct seeded rice as influenced by organics and zinc treatments.

Treatments	Plant height (cm)				No. of tillers m^{-2}				Drymatter accumulation (kg ha^{-1})			
	30 DAS	60 DAS	90 DAS	Harvest	30 DAS	60 DAS	90 DAS	Harvest	30 DAS	60 DAS	90 DAS	Harvest
T_1	15.2	52.9	67.4	72.7	217	406	438	339	230	1720	4703	9976
T_2	15.7	54.7	70.6	75.9	226	447	484	369	267	1818	4911	10197
T_3	16.3	53.2	68.3	74.0	249	429	468	354	296	1808	4857	10111
T_4	17.1	56.5	73.4	76.1	258	486	511	405	384	2123	5071	10479
T_5	18.1	61.3	82.8	84.9	293	577	611	478	488	2511	5679	12182
T_6	17.5	59.6	75.4	77.8	259	535	555	447	426	2211	5305	10922
T_7	17.2	60.5	78.2	81.8	285	542	598	466	449	2392	5457	11710
T_8	16.6	57.7	74.0	68.9	251	516	525	427	409	2008	5264	10711
T_9	15.9	55.9	71.5	75.2	233	469	505	392	361	1946	4969	10286
SEm±	0.7	1.9	2.6	2.9	8	22	26	23	22	93	202	539
CD(P=0.05)	2.1	5.6	7.8	8.7	24	67	79	68	65	278	604	1615
CV (%)	7.3	5.7	6.1	6.6	6	8	9	10	10	8	7	9

Table 2. Yield attributes and yield of direct seeded rice as influenced by organics and zinc application.

Treatments	Productive tillers m^{-2} at harvest	Total No. of grains panicle^{-1}	Number of filled grains panicle^{-1}	1000grain weight(g)	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})
T_1	274	140	125	15.1	3935	4913
T_2	295	146	135	15.5	4267	5285
T_3	283	144	129	15.3	4039	5014
T_4	312	153	141	16.0	4438	5466
T_5	363	174	155	17.2	5477	6441
T_6	334	166	150	16.4	4709	5665
T_7	338	169	153	16.7	5203	6209
T_8	328	160	147	16.2	4635	5508
T_9	309	151	131	15.9	4306	5307
SEm±	14	7	5	0.3	234	231
CD (P=0.05)	41	20	14	1.0	701	692
CV (%)	7	7	6	3.8	9	7

were similar to that observed at 60 DAS. At every stage maximum drymatter accumulation was recorded only with application of FYM and Urban Compost in combination with zinc either as soil application or foliar nutrition along with RDF showing the need for supplementation of zinc when organics were applied alone. Increase in drymatter with organics and zinc might be due to increased growth measured in these treatments in terms of plant height and tiller number. These results are in accordance with the findings of Chaudhary and Sinha (2007) and Siddaram *et al.* (2010).

Yield Attributes

Among the various treatments, T_5 resulted in the highest number of productive tillers m^{-2} (363). However, the treatments, T_7, T_6 and T_8 remained on a par, but all these treatments proved significantly superior to the rest of the treatments. Remaining treatments i.e. T_4, T_9, T_2, T_3 and T_1 were found statistically at par and the lowest number of productive tillers m^{-2} (274) was observed with T_1 which was due to lower uptake of zinc in this treatment, which became a limiting factor and no supplementation of other nutrients either by FYM (or) by Urban Compost. These results are in close conformity with the findings of Yadav *et al*. (2011) and Kandali *et al.* (2015).

The maximum number of total grains panicle^{-1} (174) and filled grains panicle^{-1} (155) was registered with T_5 which was on a par with the treatments T_7, T_6 and T_8, but all these treatments proved significantly superior to rest of the treatments. Continuous supply of the nutrients due to application of these organics might have supported longer panicles with more spikelets. The contribution of carbohydrates formed from increased photosynthetic activity due to zinc application might have resulted in efficient translocation of food material into the sink (grain) thereby increased the number of filled grains panicle^{-1}. Such an increase in number of filled grains panicle^{-1} with the application of organics and zinc was also noticed elsewhere Gill and Walia (2013) and Esfahani *et al*. (2014).

Significantly higher test weight of 17.2 g was observed with T_5 which was on a par with the treatments T_7, T_6 and T_8. Rest of the treatments, T_4, T_9, T_2, T_3 and T_1 were remained at par with each other.

Yield : Grain yield and straw yield also followed the trend noticed with that of yield attributing characters. Significantly higher grain and straw yield of rice, 5477 kg ha^{-1} and 6441 kg ha^{-1}, respectively, was recorded with T_5 which was comparable with that of application of T_7. These results are in complete agreement with Chaudhary and Sinha (2007), Siddaram *et al*. (2010), Sagarika *et al.* (2012) and Esafahani *et al*. (2014).

Conclusion:

Overall, the study indicated that combined application of FYM @ 10 t ha^{-1} and zinc as basal soil application @ 50 kg ha^{-1} along with RDF (120: 60: 40 kg NPK ha^{-1}) is more beneficial for realizing higher growth characters, yield attributes and yields direct seeded rice.

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