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Response of Nutrient and Weed Management Techniques on Semi Dry Rice Growth, Yield Parameters and Yield in Telangana

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ABSTRACT

At College Farm, Agricultural College, Aswaraopet, Bhadradri Kothagudem District, a field experiment was conducted on sandy clay loam soil in semi-dry rice during the kharif seasons of 2016 and 2017. The experiment was set up in a split plot design with three replications of each nutrient (chemical fertilizer alone and the combination of fertilizers with organic manures) and four weed management practices (Control, combination of pre/early post-emergence and post-emergence herbicides, along with hand weeding). Results of pooled analysis revealed that 75% RDF +25% N through vermicompost and Bispyribac sodium 10 SC@25 g ha-1 (PE) fb (Pyrazosulfuron ethy l10WP@25gha-1+2,4-D80WP@0.5kg a.i ha-1) + HW@ 50 DAS recorded significantly highest dry matter production, no. of panicles m-2, no. of filled grains panicle-1, test weight, grain and straw yield.

Key words: *Nutrient, Weed, Dry matter, Grain yield, Semi dry rice.*

Introduction

Statistics in the World revealed that an area of 162.06 M ha was cultivated with a production of 755.47 M t and 4661 kg ha^{-1} of productivity (FAOSTAT, 2019-20) India ranks second after China with production of 177.65 million metric tons. In India, rice was grown in an area of 43.66 M ha with production and productivity of 118.87 M t and 2723 kg ha^{-1} respectively, while in Telangana, it occupies an area of 3.19 M ha with production of 11.12 M t and productivity of 3483 kg ha^{-1} (CMIE, 2019-20).

Majority of rice is grown during *kharif* season. The high energy demand and escalated labor costs and huge water demand for puddling and continuous flooding for transplanted rice (Bhatt *et al*., 2016) inclined farmers towards semi-dry rice cultivation (Dry direct seeded or dry converted wet), when canal water is not released promptly and delayed transplanting.

Semidry rice is a system that connects upland conditions in the early phases of crop growth and low land conditions in the later stages, Rice is treated as a rainfed crop for 40 to 45 days and thereafter, water logged condition is maintained when sufficient water is available (Chatterjee *et al*., 1985).

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Both crop and weeds respond to soil fertility. Integrated nutrient management is regarded as a pivotal tool for small and marginal farmers to increase the crop productivity and economic feasibility on a long-term basis (Choudhary *et al*., 2014). In semi dry rice, due to the concurrent crop and weed growth, devoid of standing water in the initial crop establishment phase exacerbates weed insurgence. Success depends on effective weed control.

Materials and Methods

A field experiment conducted at College Farm, Agricultural College, Aswaraopet, Bhadradri Kothagudem District, Professor Jayashankar Telangana State Agricultural University in semi dry rice as influenced by nutrient and weed management practices during *kharif*, 2016 and 2017 in sandy clay loam soil with low nitrogen, medium in available phosphorus and potassium. Congenial weather conditions were prevailed during two years of the crop growth period. The experiment was laid out in split plot design with main plots as three levels of nutrient management (M_1 - 100% RDF, M_2 - 75% RDF + 25% N through vermicompost and M_3 - 75% RDF+ 25% N through FYM) while, subplots consisted of four weed management practices *i.e.* S_1 – Control, S_2- Bispyribac sodium 10 SC @25 g ha^{-1} (PE) *fb* Hand weeding @ 20, 40 DAS, S_3 - Bispyribac sodium 10 SC @25 g ha^{-1} (Early PoE) *fb* (Fenoxaprop-p-ethyl @62.5 g a.i ha^{-1} + 2,4 – D 80 WP @0.5 kg a.i ha^{-1}) at 35 - 40 DAS and S_4 - Bispyribac sodium 10 SC @25 g ha^{-1} (PE) *fb* (Pyrazosulfuron ethyl 10 WP @25 g ha^{-1} + 2, 4-D 80 WP @0.5 kg a.i ha^{-1}) + HW @50 DAS. KNM- 118 variety was sown with a spacing 20 cm x 15 cm in the 1st FN of July. The recommended dose of fertilizer (RDF) for the crop was 100: 50: 40 kg N, P_2O_5, K_2O kg ha^{-1} was applied through urea, SSP and muriate of potash. Zinc sulphate @ 5 kg ha^{-1} was sprayed to control *khaira* (Zn deficiency). To ameliorate iron deficiency, ferrous sulphate @ 5 g l^{-1} was sprayed with 1 g citric acid at 15 DAS.

Five destructive samples were collected from the third row of each plot at harvest. Plant roots were removed, initially sun dried and then dried in hot air oven at 60 ^{o}C till a constant dry weight was obtained for dry weight and converted to kg ha^{-1}.

The number of panicles m^{-2} were recorded from each plot at harvesting within the net plot in 1 m area. Five panicles were collected randomly from the net plot and filled grains from each panicle were counted separately and averaged filled grains panicle^{-1}. A random sample of dried seed was taken from each treatment plot and recorded weight of 1000 grains in grams.

Grain yield was recorded separately from each treatment's net plot area and converted to per hectare yield, after which the grain was sun-dried to moisture content of 12%, later, cleaned and weighed. After separating the grains, left over straw harvested from each net plot treatment was sun dried and yield per plot was recorded. The grain and straw yield from the net plot area of each treatment was computed and expressed in kg ha^{-1}.

Results and Discussion

Dry matter production (kg ha^{-1})

Pooled data of dry matter production was statistically significant in relation to nutrient and weed management practices. Dry matter output was significant across nutrient and weed management practices (Table 1). The M_2 treatment *i.e.* 75% RDF + 25% N through vermicompost accumulated maximum dry matter at harvest which was on par with M_3 [75% RDF + 25% N through FYM]. Out of the four sub plots, S_4, *i.e.* Bispyribac sodium 10 SC @25 g ha^{-1} (PE) *fb* (Pyrazosulfuron ethyl 10 WP @25 g ha^{-1} + 2, 4-D 80 WP @0.5 kg a.i ha^{-1}) + HW @50 DAS generated the maximum dry matter followed by S_2 *i.e.* Bispyribac sodium 10 SC @25 g ha^{-1} (PE) *fb* Hand weeding @ 20, 40 DAS.

The availability of continuous, slow and adequate nutrients especially nitrogen throughout the crop growth period synchronizing with assimilation and absorption pattern by crop contributed to the highest dry matter accumulation which indicated the superior effect of organic manures compared to inorganics alone. The findings agree with Shalini *et al*. (2017) and Ajmal (2020).

Effective weed management combined with chemical and physical approaches, according to Priyanka *et al*. (2019) and Soujanya (2020), removed weeds and made better use of available resources during critical period of crop weed competition, favoring increased dry matter production.

No. of panicles (m^{-2})

Pooling the average data (Table 1) of nutrient treatments revealed that, M_2 produced considerably more panicles m^{-2} than M_3 and was statistically simi-

lar to each other.

Data pertinent to weed practices explained that S_4 [Bispyribac sodium 10 SC @25 g ha^{-1} (PE) *fb* (Pyrazosulfuron ethyl 10 WP @25 g ha^{-1} + 2, 4-D 80 WP @0.5 kg a.i ha^{-1}] had resulted in highest no. of panicles m^{-2}, followed by S_2 *i.e.* Bispyribac sodium 10 SC @25 g ha^{-1} (Pre-Emg.) *fb* Hand weeding @20, 40 DAS. In S_1 [Control], however, the no. of panicles m^{-2} were lower.

Better performance of combined inorganic fertilizes and organic manures was due to continuous and adequate supply of nutrients at every phenophase, improving photosynthetic efficiency, better translocation of photosynthates from source to sink leading to higher no. of panicles m^{-2} as reported by Anusha (2016) and Siddaram *et al*. (2017).

Higher no. of panicles m^{-2} produced was due to efficient weed control through critical period of crop weed competition during reproductive phase led to fertilization and produced less sterile spikelet. These results are corroborated by Chakraborti *et al*. (2017) and Goswami *et al*. (2018).

No. of filled grains panicle^{-1}

M_2 treatment *i.e.* 75% RDF + 25% N through vermicompost recorded maximum number of filled grains panicle^{-1}, comparable to M_3 [75% RDF + 25% N through FYM] based on pooled mean data.

Among weed practices, highest number of filled grains panicle^{-1} was attained with Bispyribac sodium 10 SC @25 g ha^{-1} (PE) *fb* (Pyrazosulfuron ethyl 10 WP @25 g ha^{-1} + 2, 4-D 80 WP @0.5 kg a.i ha^{-1}) +

Table 1. Dry matter, yield parameters and yield of semi dry rice as influenced by nutrient and weed management practices during *kharif*, 2016 & 2017.

Treatments	Dry matter production (kg ha^{-1})	Number of Panicles (m^{-2})	No. of filled grains panicle^{-1}	Test weight (g)	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})
Main plots: Nutrient Management (M)						
M_1	7067	184.8	78.0	22.4	3332	4238
M_2	8826	217.4	88.7	21.0	4248	5042
M_3	8237	210.7	86.5	21.0	3986	4837
SEm±	197	5.33	1.97	0.5	97	129
CD (*P=0.05*)	773	20.9	7.7	NS	382	508
Sub plots: Weed Management (S)						
S_1	4501	150.7	67.2	18.8	1905	
S_2	9737	234.9	93.2	22.3	4876	5554
S_3	7637	192.3	82.1	22.3	3518	4663
S_4	10299	239.2	95.2	22.5	5122	5691
SEm±	212	3.72	2.36	0.49	88	102
CD (*P=0.05*)	630	11	7	1.4	2916	304
Interaction						
M × S						
SEm±	367	6.44	4.08	0.84	153	177
CD (*P=0.05*)	1091	19.1	NS	NS	455	NS
S × M						
SEm±	432	8.90	4.67	1.02	190	232
CD (*P=0.05*)	1211	26.4	NS	NS	543	NS

PE – Pre-Emergence, PoE – Post-emergence, DAS – Days After Sowing, FYM – Farm Yard Manure, *fb* – Followed by

Nutrient Management

M_1 – 100% RDF

M_2 – 75% RDF + 25% N through Vermicompost

M_3 - 75% RDF + 25% N through FYM

Weed Management

S_1 - Control

S_2 - Bispyribac sodium 10 SC @25 g ha^{-1} (PE) *fb* Hand weeding @20, 40 DAS

S_3 - Bispyribac sodium 10 SC @25 g ha^{-1} (Early PoE) *fb* (Fenoxaprop-p-ethyl 62.5 g a.i ha^{-1} + 2,4 – D 80 WP 0.5 kg a.i ha^{-1}) at 35-40 DAS

S_4 - Bispyribac sodium 10 SC @25 g ha^{-1} (PE) *fb* (Pyrazosulfuron ethyl 10 WP @25 g ha^{-1} + 2, 4 – D 80 WP @0.5 kg a.i ha^{-1}) + HW at 50 DAS

HW @50 DAS *i.e.* S_4 which was statistically comparable with Bispyribac sodium 10 SC @25 g ha^{-1} (PE) *fb* Hand weeding @20, 40 DAS and both of them were significantly better than rest of the treatments. S_1 [Control] produced lowest number of filled grains $panicle^{-1}$.

Increased chlorophyll concentration in leaves and optimal nutrient balance between source and sink, enhanced photosynthates transfer to grain development resulted highest no. of filled grains $panicle^{-1}$. The results are in conformity with Pandit *et al*. (2020).

There were more filled grains due to adequate availability of growth resources as a result of decreased weed competition and higher photosynthetic efficiency of translocation from source to sink. Same findings were observed by Lokesh *et al*. (2021).

Test Weight (g)

Results of pooled analysis explained non-significant variation of test weight with nutrient management whereas significant effect was found with weed management. S_4 *i.e.* Bispyribac sodium 10 SC @25 g ha^{-1} (PE) *fb* (Pyrazosulfuron ethyl 10 WP @25 g ha^{-1} + 2, 4-D 80 WP@ 0.5 kg a.i ha^{-1}) + HW @50 DAS recorded highest test weight followed by Bispyribac sodium 10 SC @25 g ha^{-1} (PE) *fb* Hand weeding @20, 40 DAS {S_2}. However, S_4 was statistically equal with S_3 and S_2. Lowest test weight was observed with control *i.e.* S_1 (Table 1).

Test weight improvement was noticed in weed free treatment that enabled genetic potential of rice plants with better control of weeds and weed control efficiency through out crop growth period as suggested by Sylvestre *et al*. (2019) and Srinivasa *et al*. (2019).

Grain yield (kg ha^{-1})

Grain yield was significantly influenced with nutrient treatments. M_2 treatment [75% RDF + 25% N through vermicompost] accrued higher grain yield of 4248 kg ha^{-1} which was statistically at par with M_3 (3986 kg ha^{-1}). However, lower grain yield was obtained with M_1 *i.e.* 100% RDF, evident from the pooled mean data.

Weed management practices exerted a significant variation on grain yield. Bispyribac sodium 10 SC @25 g ha^{-1} (PE) *fb* (Pyrazosulfuron ethyl 10 WP @25 g ha^{-1} + 2, 4-D 80 WP @0.5 kg a.i ha^{-1}) + HW @50 DAS yielded 5122 kg ha^{-1} and was at par with yield of 4876 kg ha^{-1} with S_2 [Bispyribac sodium 10 SC @25 g ha^{-1} (PE) *fb* Hand weeding @20, 40 DAS].

Combination with 75% RDF and 25% N through vermicompost or FYM provided slow, continuous release and greater availability and uptake of macro and micro-nutrients and active participation in carbon assimilation, photosynthesis, starch formation, sugar and protein translocation, water entry to the root of plants, etc. resulting in increased dry matter, source and sink capacity and ultimately yield. The findings agreed with those of Gayatree *et al*. (2017) and Rishikesh *et al*. (2020).

Sequential application of pre-and post-emergence, broad spectrum and tank mixture herbicides with different mode of actions as well as hand weeding ensured to combat weed menaces and prevent changes in weed community structure throughout the crop growth period might have improved source and sink capacity *viz.*, yield attributes which expedited higher yield as stated by Singh and Pandey (2019).

Straw Yield (Kg ha^{-1})

As per pooled mean data on nutrient management practices, 75% RDF + 25% N through vermicompost, *i.e.* M_2 recorded highest straw yield which was at par with 75% RDF + 25% N through FYM followed by 100% RDF.

Bispyribac sodium 10 SC @25 g ha^{-1} (PE) *fb* (Pyrazosulfuron ethyl 10 WP @25 g ha^{-1} + 2, 4-D 80 WP @0.5 kg a.i ha^{-1}) + HW @50 DAS *i.e.* S_4 produced the highest straw yield followed by S_2, S_3 and S_1 (Table 1).

An increase in straw output emphasizes the differentiation process from the somatic to the reproductive phase. Direct influence on dry matter production of vegetative parts *viz.*, such as plant height, leaf area and number of tillers etc. while indirectly through enhanced morphological growth parameters. Goswami *et al*., (2018) found similar results.

Application of herbicide mixtures produced season long weed free condition that linked to luxuriant crop growth with higher dry matter production enhanced straw yield. Least straw yield was due to intense weed competition for growth resources. The results of this study agree with those of Neha *et al*. (2021).

Conclusion

Application of integrated nutrient and weed management recorded significantly superior growth

and yield parameters and yield compared to sole application of herbicides or control. Enhanced nutrient supply had improved metabolic activity and cell division, leading to increased growth traits such as higher dry matter production, resulting in higher rice straw output.

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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