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Effect of urea-DAP briquettes and zinc levels on nitrogen, phosphorus and potassium uptake and yield of hybrid rice

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ABSTRACT

A field experiment was conducted during *kharif* season of 2006 at Agronomy Farm, College of Agriculture, Dapoli, on clay lateritic loam soil. Results of the experiment revealed that the deep placement of urea-DAP briquettes (@ 114 kg N + 25.4 kg P) + 50 kg K_2O ha^{-1} recorded higher nitrogen, phosphorus and potassium uptake of 118, 29.0 and 95.58 kg ha^{-1}, respectively and grain yield (70.22 q ha^{-1}) which was significantly higher as compared to RDF (150:75:50 kg NPK ha^{-1}), deep placement of Urea-DAP briquettes (57 kg N + 12.7kg P) + 50 Kg K_2O ha^{-1} and control. Zinc levels also recorded significant effect on uptake of these nutrients and yield of hybrid rice. Soil application of $ZnSO_4$ @ 25 kg ha^{-1} produced significantly higher NPK uptake and yield of rice. Data also revealed that different levels of macronutrients and zinc levels interacted significantly in enhancing the grain yield of rice. Application of urea-DAP briquettes (@ 114 kg N + 25.4 kg P) + 50 kg K_2O ha^{-1} alongwith $ZnSO_4$ @ 25 kg ha^{-1} (F_3Z_2) recorded significantly higher grain yield as compared to all other treatment combinations except F_3Z_4 which was at par with F_3Z_2.

Key words : Hybrid rice, Urea-DAP briquettes, Zinc levels, NPK uptake, Yield

INTRODUCTION

Rice (*Oryza sativa L.*) is the most important food crop of India. Nearly three fourth of the people in the country subsist on it (Anonymous, 2000). The adoption of suitable fertilizer management within the reach of an ordinary farmer could be exploited to boost the yield. The important agronomic factor affecting the yield of paddy is fertilizer management practice. Nitrogen is major nutrient required for rice. Low recovery of applied nitrogen by rice has been attributed due to denitrification, ammonia volatilization, runoff and immobilization Thus it is necessary to increase N-use efficiency. Urea-DAP briquettes dissolve slowly and maintain higher level of NO_3 in soil upto the maximum period of crop growth and hence, were found beneficial in transplanted rice under anaerobic condition (Reddy and Reddy, 1986). Deep placement of briquettes is more efficient than conventionally applied prilled urea (Savant and Stangel, 1995). Now, it has been recognized that growing high yielding varieties of rice with repeated use of fertilizers, containing only major nutrients may necessitate the application of micronutrients for sustained crop production (Subbaiah and Mitra, 1997). Zinc, being third most important plant nutrient assumes significance in modern agriculture after N and P, limiting the growth and yield of rice. Zinc is essential for several enzymes that regulate various metabolic activities (Tandon, 1995). Therefore, present investigation was planned to study the effect of urea-DAP briquettes and zinc levels on the NPK uptake and yield of hybrid rice.

MATERIALS AND METHODS

A field experiment was carried out during *kharif* season of 2006 at Agronomy Farm, College of Agriculture, Dapoli, dist. Ratnagiri (M.S). Rice variety 'Sahyadri-2' was grown in clay loam soil with pH 6.10. The experiment was conducted in split plot design with three replications. The treatments included four levels of fertilizers (macronutrients) *i.e.*, F_1- RDF (150:75:50 kg NPK ha^{-1}), F_2- deep placement of urea-DAP briquettes (57 kg N + 12.7kg P) + 50 Kg K_2O ha^{-1}, F_3- deep placement of urea-DAP briquettes (114 kg N + 25.4kg P) + 50 Kg K_2O ha^{-1} and F_4- control in main plot and Z_1-control, Z_2- soil application of 25 kg $ZnSO_4$ ha^{-1}, Z_3 -spraying of 0.5 per cent $ZnSO_4$ solution at flag leaf stage, and Z_4 -dipping of rice seedling roots in 2 per cent $ZnSO_4$ solution at the time of transplanting in sub plots. The gross plot size was 4.0 × 3.0 m. The values of available nitrogen, phosphorus, potassium and zinc were 356.96, 15.78, 253.35 and 2.08 kg ha^{-1}, respectively. Fertilizers were applied as per the treatments. In case of F_1 first dose of 50 per cent nitrogen and full dose of phosphorus and potassium were applied at the time of transplanting. Remaining 50 per cent nitrogen was applied in two equal splits at one month after transplanting and at flag leaf stage. In case of F_2 placement of urea DAP briquettes (57 kg N + 12.7kg P) + 50 Kg K_2O ha^{-1} one briquette was placed in every alternate square of four hills by hand and two briquettes were placed at every alternate square of four hills, for the treatment of F_3. Zinc application was done as per the treatment. In case of dipping of seedling roots for two hours in two per cent zinc sulphate solution was done

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before transplanting. Sowing of hybrid rice variety Sahyadri-2 was done in nursery on 10th June 2006 and transplanting was carried out on 1st July 2006. Twenty one days old seedlings of hybrid rice were transplanted by recently developed two row transplanting method allowing for formation 15 x 15 cm hill square and 25 traffic lane in entire field as per the SIRA technology were transplanted @ 1 seedling per hill at 25 x 15 x 15 cm spacing. Hand weeding was done one month after transplanting to keep the plot weed free. Nitrogen content in grain and straw was estimated by Microjeldahls method whereas phosphorus and potassium content in grain and straw of rice was estimated by Calorimetric and Flame photometer methods, respectively. NPK uptake was calculated by multiplying grain and straw yield with respective percentage Fig.

RESULTS AND DISCUSSION

Effect of urea-DAP briquettes:

Data presented in Table 1 revealed that, different levels of fertilizers (macronutrients) had significant effect on uptake of nutrients and yield of hybrid rice. Placement of urea-DAP briquettes (@ 114 kg N + 25.4 kg P) + 50 kg K_2O ha^{-1} produced significantly higher nitrogen, phosphorus and potassium uptake of 118.41, 29.0 and 95.58 kg ha^{-1}, respectively and grain yield (70.22 q ha^{-1}) of rice, which was significantly higher over all other fertilizer levels under study. Application of urea-DAP briquettes (@ 56 kg N + 12.7 kg P) + 50 kg K_2O ha^{-1} was the next best treatment which produced higher NPK uptake and yield than RDF and control. Higher NPK uptake and yield under placement of urea-DAP briquettes (@ 114 kg N + 25.4 kg P) + 50 kg K_2O ha^{-1} treatment was mainly due to the continuous, steady and more availability of nutrients through the deep placement of urea-DAP briquettes in the reduced zone. Similar results were also obtained by Rao and Ghai (1987) and Jena *et al*. (2003).

Table1 : Nitrogen, phosphorus and potassium uptake and Grain yield (q ha^{-1}) of hybrid rice as influenced by various treatments

Treatments	Nutrient uptake (kg ha^{-1})			Grain yield (q ha^{-1})
	Nitrogen	Phosphorus	Potassium	
Fertilizer levels (Macronutrients)				
F_1	91.68	22.14	73.00	53.04
F_2	83.19	21.75	71.68	56.67
F_3	118.41	29.00	95.58	70.22
F_4	46.46	12.26	40.41	38.44
S.E.±	1.23	0.35	0.64	0.77
C.D. (P=0.05)	4.25	1.22	2.23	2.66
Zinc levels				
Z_1	59.55	14.63	49.69	39.13
Z_2	105.65	25.93	86.35	65.40
Z_3	82.78	20.86	69.79	55.15
Z_4	91.77	23.74	74.83	58.71
S.E.±	0.96	0.25	0.84	0.57
C.D. (P=0.05)	3.33	0.86	2.90	1.98
Interaction effect				
Between levels zinc of at same level of fertilizers				
S.E.±	3.85	0.99	3.36	2.30
C.D. (P=0.05)	NS	NS	NS	7.35
Between levels of fertilizers at same level of zinc				
S.E.±	2.07	0.55	1.59	1.25
C.D. (P=0.05)	NS	NS	NS	4.15

NS- Non significant

Effect of zinc levels:

Uptake of nutrients and yield of rice was influenced significantly due to the different levels of zinc. Soil application of $ZnSO_4$ @ 25 kg ha^{-1} recorded significantly higher nitrogen phosphorus and potassium uptake of 105.65, 25.93 and 86.35 kg ha^{-1} and grain yield of 65.40q ha^{-1} than all other treatments. Similarly, the treatment of dipping of seedling roots in 2 per cent $ZnSO_4$ solution produced significantly higher NPK uptake and grain yield as compared to $ZnSO_4$ spray @ 0.5 per cent and control. Similar findings were also reported by Uddin *et al*. (1981) and Khanda and Dixit (1996).

Interaction effect:

Data on interactions presented in Table 2 revealed that different levels of macronutrients and zinc levels interacted significantly in enhancing the grain yield of rice. Application of urea-DAP briquettes (@ 114 kg N + 25.4 kg P) + 50 kg K_2O ha^{-1} alongwith $ZnSO_4$ @ 25 kg ha^{-1} (F_3Z_2) recorded significantly higher grain yield as

Table 2 : Grain yield (q ha^{-1}) of rice as influenced by interactions between the levels of fertilizers and zinc

Fertilizer levels (macronutrients)	Zinc levels			
	Z_1	Z_2	Z_3	Z_4
F_1	38.85	62.54	52.64	58.13
F_2	42.79	67.60	62.81	53.49
F_3	45.83	85.73	66.81	82.49
F_4	29.05	45.70	38.28	40.73
			S.E.±	C.D. (P=0.05)
Between the levels of zinc at the same level of fertilizers			2.3	7.35
Between the levels of fertilizers at the same level of zinc			1.25	4.15

compared to all other combinations except F_3Z_4 which was at par with F_3Z_2. All the macronutrients alongwith zinc either soil applied or seedling root deep treatment was found significantly superior in enhancing the grain yield as compared to control. Placement of urea-DAP briquettes (@ 114 kg N + 25.4 kg P) + 50 kg K_2O ha^{-1} and soil application of 25 kg $ZnSO_4$ ha^{-1} might have resulted into more and steady availability of nutrients throughout the growth period of crop resulting into higher yield attributes and yield of hybrid rice. Dixit and Patro (1994) and Bhowmic and Nayak (2000), also obtained significantly higher yield with combined application of higher levels of macronutrients and zinc sulphate.

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