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Response of Rice (Oryza sativa L.) to Top Dressing of Phosphorus Through Complex Fertilizers

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ABSTRACT

A field experiment was conducted to study the effect of top dressing of phosphorus through complex fertilizers on rice during *kharif* 2009 on clayey soil at Agricultural College Farm, Bapatla. The experiment consisted of nine treatments *viz.,* application of 60 kg P_2O_5 ha^{-1} as basal through SSP (T_1), DAP (T_2) and 20:20:0 (T_3), two equal splits (½ as basal + ½ at maximum tillering stage) through DAP (T_4) and 20:20:0 (T_5), two equal splits (½ as basal + ½ at Panicle initiation (PI) stage) through DAP (T_6) and 20:20:0 (T_7), three equal splits (1/3 as basal + 1/3 at maximum tillering + 1/3 at PI stages) through DAP (T_8) and 20:20:0 (T_9). The results revealed that there was a significant increase in effective tillers m^{-2}, filled grains $panicle^{-1}$, grain yield and phosphorus uptake with s two splits of P_2O_5 half as basal and half at maximum tillering stage either through DAP or 20:20:0. No significant variation was recorded with regard to growth, total grains $panicle^{-1}$ and test weight due to sources of P at different times of application.

Key Words: Complex fertilizers, Rice, Top dressing.

The availability of Phosphorus (P) to rice grown on waterlogged soils depends on composition of fertilizers and time of fertilizer application. Normally, the entire dose of P is applied as basal for rice crop. But more often, due to various reasons, it is not always possible to apply the entire P at the time of transplanting as required. Under such circumstances, it is appropriate to know whether split applications of P or delayed application is permissible without any loss in grain yield.

Farmers are preferring complex fertilizers due to their several advantages over straight fertilizers and obtaining higher yields. It is to be proved that whether the higher yields are due to P alone in complex fertilizers or any other nutrient has to be ascertained. Hence, the present experiment was planned to study the efficiency of P from different complex fertilizers and their split application in increasing rice yields.

MATERIAL AND METHODS

The field experiment was conducted at the Agricultural College Farm, Bapatla during *kharif* 2009. The soil was clayey in texture with 7.6 pH, 0.72 dS m^{-1} E.C; 0.42 % organic carbon; 198 kg ha^{-1} available N; 18.0 kg P_2O_5 ha^{-1} available P and 384 kg K_2O ha^{-1} available K. The study comprised nine treatments *viz.,* T_1: SSP (basal); T_2: DAP (basal); T_3: 20:20:0 (basal); T_4: DAP (½ basal + ½ maximum tillering stage); T_5: 20:20:0 (½ basal + ½ maximum tillering stage); T_6: DAP (½ basal + ½ panicle initiation (PI) stage); T_7: 20:20:0 (½ basal + ½ PI stage); T_8: DAP (1/3 basal + 1/3 maximum tillering stage + 1/3 PI stage) T_9: DAP (1/3 basal + 1/3 maximum tillering + 1/3 PI stage). All the nine treatments were arranged in a randomized block design with three replications. Rice seedlings (twenty eight days old) were transplanted on 20-9-2009 by adopting a spacing of 20cm x 15cm. A recommended dose of 120-60-40 kg N-P_2O_5-K_2O ha^{-1} was applied uniformly to all plots. All the K and Zn in the form of $ZnSO_4$ @ 50 kg ha^{-1} were applied as basal. N was applied in three splits, 1/3 each at basal, maximum tillering and panicle initiation stages. Phosphorus was applied as per the treatments at different stages. The treatments which received straight fertilizer as SSP, entire dose of nitrogen was applied through urea. While applying DAP and 20:20:0, the nitrogen content was taken into account and remaining nitrogen was applied through urea. Recommended agronomic practices and plant protection measures were followed. The trial was harvested on 6-1-2010. The data was subjected to statistical analysis as prescribed by Panse and Sukhatme (1978).

Table 1: Growth of rice as influenced by sources and time of application of phosphorus

	Treatments	Plant height (cm)	Tillers (No. m^{-2})	Drymatter production (kg ha^{-1})	Days to 50 % flowering
T_1	SSP (basal)	88.6	436.7	10984	95
T_2	DAP (basal)	88.9	440.0	11073	95
T_3	20:20:0 (basal)	87.4	432.3	10914	97
T_4	DAP (½ basal + ½ max. tillering)	91.4	485.1	11544	95
T_5	20:20:0 (½ basal + ½ max. tillering)	90.7	481.8	11398	95
T_6	DAP (½ basal + ½ PI stage)	87.2	405.9	9998	97
T_7	20:20:0 (½ basal + ½ PI stage)	85.3	403.7	9981	97
T_8	DAP (1/3 basal + 1/3 max. tillering + 1/3 PI stage)	90.6	470.8	11161	96
T_9	20:20:0 (1/3 basal + 1/3max. tillering + 1/3 PI stage)	89.5	463.1	11152	96
	SEm (±)	1.8	26.9	722	0.60
	CD (P=0.05)	NS	NS	NS	NS
	CV (%)	3.5	10.4	11.5	1.09

Table 2. Yield attributes, Yield and Phosphorus uptake of rice as influenced by sources and time of application of phosphorus

	Treatments	Effective tillers m^{-2}	Total number of grains $panicle^{-1}$	Filled grains $panicle^{-1}$	Test weight (g)	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Phosphorus uptake (kg ha^{-1})	
								Grain	Straw
T_1	SSP (basal)	403.7	130	123	15.1	4946	6034	8.69	3.39
T_2	DAP (basal)	407.0	131	125	15.2	4976	6046	8.66	4.06
T_3	20:20:0 (basal)	399.3	126	119	15.1	4932	6028	7.74	3.27
T_4	DAP (½ basal + ½ max. tillering)	452.1	146	141	15.6	5249	6232	11.48	7.01
T_5	20:20:0 (½ basal + ½ max. tillering)	448.8	143	137	15.5	5141	6145	9.64	6.88
T_6	DAP (½ basal + ½ PI stage)	336.9	125	117	15.1	4455	5535	6.41	5.69
T_7	20:20:0 (½ basal + ½ PI stage)	333.0	123	115	15.0	4437	5510	6.36	4.57
T_8	DAP (1/3 basal + 1/3 max. tillering + 1/3 PI stage)	437.8	140	134	15.4	5008	6061	9.10	6.68
T_9	20:20:0 (1/3 basal + 1/3max. tillering + 1/3 PI stage)	430.1	137	131	15.2	4984	6054	9.02	5.73
	SEm (±)	26.8	3.4	3	0.2	170	284	0.56	0.34
	CD (P=0.05)	80.2	NS	10	NS	510	NS	1.68	1.02
	CV (%)	11.4	4.4	5	2.3	6.0	8.3	11.34	11.27

RESULTS AND DISCUSSION

The data (Table 1) on growth indicated that the plant height, number of tillers m^{-2}, drymatter production and days to 50% flowering was not significantly affected either by the sources or by time of application of phosphorus. Application of DAP in two equal splits (T_4) produced the maximum plant height (91.4 cm), number of tillers m^{-2} (485.1) and drymatter (11544 kg ha^{-1}). Application of 20:20:0 in two equal splits (T_7) recorded smallest plants (85.3 cm) and lowest number of tillers m^{-2} (403.7) and drymatter (9981 kg ha^{-1}). The better growth with two splits of DAP (T_4) might be due to availability of P at initial vegetative stages, which might have promoted more extensive root system through accelerating various metabolic processes such as cell division, cell development and cell enlargement in roots, which, inturn, improved the stature of the plant and have contributed to production of more number of tillers per hill. The results obtained in study are in conformity with Yogeswara Rao *et al*. (1973).

The number of effective tillers m^{-2} and filled grains per panicle were significantly influenced by sources of phosphorus and their different times of application. It is clear from table 2 that split application of DAP (T_4) produced the maximum number of effective tillers (452.1) and filled grains per panicle (141). Application of 20:20:0 in two equal splits (T_7) resulted in significantly the minimum number of effective tillers (333.0) and filled grains per panicle (115). The highest number of effective tillers m^{-2} and filled grains per panicle with split application of P either through DAP (T_4) or 20:20:0 (T_5) suggest that application of P is needed only during the early stages of crop growth. De Datta (1981) also opined that in general, P is applied to rice at planting, but later application can be made, provided it is not later than the time of active tillering.

Data on grain yield presented in (Table 2) revealed that application of two splits of DAP, ½ as basal and ½ at maximum tillering stage (T_4) produced significantly higher grain yield (5249 kg ha^{-1}) than that produced by T_6 i.e., DAP, ½ as basal and ½ at PI stage (4455 kg ha^{-1}) and T_7 i.e., 20:20:0 ½ as basal and ½ at PI stage (4437 kg ha^{-1}) and were at par with two splits of 20:20:0 and three splits of DAP and 20:20:0 and basal application of DAP, SSP and 20:20:0. The increase in grain yield with T_4 and T_5, over T_6 and T_7 was 17.8 and 18.3 per cent respectively. The favourable effect of split application of P at maximum tillering stage through DAP on filled grains $panicle^{-1}$ (Table 2) might have ultimately reflected in significant increase in grain yield. Pradan and Dixit (1989) and Singh and Verma (2006) also reported similar results.

Split application of DAP, ½ as basal and ½ at maximum tillering stage (T_4) recorded the highest straw yield (6232 kg ha^{-1}) over other treatments. The results are not however statistically significant. The highest straw yield might have been contributed by its plant height and maximum number of tillers.

Phosphorus uptake was significantly influenced due to sources of P at different times of application (Table 2). Application of P through DAP in two splits (T_4) registered significantly the highest (11.48 kg ha^{-1}) P uptake in grain (Table 2) followed by T_5, which were statistically at par with T_8 and T_9. The lowest (6.36 kg ha^{-1}) P uptake of grain was recorded with 20:20:0 in two splits (T_7), which was on a par with T_6 and T_3. The positive effect of split application at basal and maximum tillering on P uptake was also reported by Ramaiah (1979). The P uptake in straw, was significantly the highest (7.01 kg ha^{-1}) with DAP in two splits (T_4) and it was on a par with that of T_5 and T_8. The lowest (3.27 kg ha^{-1}) uptake was registered with basal application of 20:20:0 (T_3) which was on a par with that of T_1 and T_2. Sometimes delayed or split application of P is reflected in better P uptake rather than in higher yields, which was evident in the present study and is in agreement with the findings of Goswami and Kamath (1984).

Overall, it can be concluded that P is essential in the early stages of crop growth and the marginal increase in yield over basal application of P suggests that if at all P is to be applied in splits, it should be applied upto active tillering stage in the form of DAP.

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