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EFFECT OF COATED AND SPLIT APPLICATION OF SINGLE SUPERPHOSPHATE ON YIELD AND NUTRIENT USE EFFICIENCY IN TRANSPLANTED RICE

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Indian soils are generally deficient in available phosphorus. Phosphorus is a major component in ATP, the molecule that provides "energy" to the plant for such processes as photosynthesis, protein synthesis, nutrient translocation, nutrient uptake and respiration. Application of phosphorus creates favorable environment, precursor to increase uptake of nutrients from soil for better growth and development. Efficiency of P fertilizer as single super phosphate is quite low (15-20%) due to fixation of P. The best management strategy with P is to build up it up to satisfactory level in soil, where a maintenance dose is needed not to mine the soil reserve but to reduce the extent of fixation. Single superphosphate is one of the most commonly used as well as the cheapest fertilizer in India. Splitting and coating of phosphatic fertilizers are important techniques for enhancing its use efficiency. The present investigation was under taken to evaluate the effect of coated and split application of SSP on yield and quality of rice as well as uptake and use efficiency of phosphorus.

The field experiment was conducted at Instructional Farm of Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad (U.P.) during *Kharif* 2010 and 2011. The experiment was laid out with three replications in a randomized block design with nine treatment combinations viz. T_1 control, T_2 100% RDPF (60 kg P_2O_5 ha^{-1}), T_3 50% basal + 50% top dressing in one split at tillering stage, T_4 50% basal + 25% at tillering stage + 25% at PI stage, T_5 Mahua oil coated SSP, T_6)Neem oil coated SSP T_7 Gypsum coated SSP, T_8 cow dung coated SSP, T_9 Poultry manure coated SSP. The rice variety NDR-359 was taken as test crop. The experimental soil had pH (1:2.5) 8.8, EC 0.41dSm^{-1}, organic carbon 2.7g kg^{-1}, available N 188, P_2O_5 16 and K_2O 254 kg ha^{-1}. Half of the nitrogen and entire doses of potassium were applied as basal in the form of urea, and muriate of potash, respectively and the remaining N was applied equally at tillering and panicle initiation stages. The recommended dose of phosphorus was applied as per treatments. The plants were analyzed for N and P content following the standard procedures (Jackson, 1973). The protein content in grain was computed by nitrogen content in grain multiplied by 6.25. Apparent recovery and phosphorus use efficiency were calculated by using formula as given below.

$$\text{Apparent recovery (\%)} = \frac{\text{P uptake under treatment} - \text{P uptake under control}}{\text{Quantity of P added in treatment}} \times 100$$

$$\text{P use efficiency (kg produce/kg P applied)} = \frac{\text{Grain yield under treatment} - \text{Grain yield under control}}{\text{Quantity of P added in treatment}}$$

The grain and straw yield of rice (Table 1) revealed that the yield was influenced significantly due to coated and split application of single superphosphate over control. The highest grain and straw yields (49.50 and 69.50 q ha^{-1}) were recorded in gypsum coated SSP which were 44.4 and 28.2 % higher over control, respectively. Gypsum coated SSP was at par with neem oil coated SSP as well as split application of SSP (50% basal + 50% top dressing applied in two splits) was significantly superior over rest of the treatments in respect of grain and straw production. This might be due to fewer fixations and more availability of phosphorus because of its slow release and minimum contact with soil. The result corroborates with the findings of Yadav *et al.* (2009) and Bhattacharya *et al.,* (2011).

The modified and split application of SSP increased the uptake of phosphorus over the control (Table 1). The maximum total phosphorus uptake (35.2 kg ha^{-1}) was recorded with the application of gypsum coated SSP followed by neem oil coated SSP (31.5 kg ha $^{-1)}$ and minimum with control (12.7 kg ha^{-1}). Among the basal and splits application of SSP, the highest uptake was recorded with 50% basal + 50% top dressing in two splits ($T_{4)}$ and minimum with 100% basal application of SSP (T_2). The total phosphorus uptake showed positive and significant association with gypsum coated SSP. This might be due to availability of phosphorus and its optimum absorption by plant roots, which helped the plants to produce maximum grain yield of rice (Pandey *et al.,* 2007).

Table1: Effect of coated and split application of SSP on yield, protein content and P uptake and use efficiency in transplanted rice

Treatment	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Protein Content (%)	Total P uptake (kg ha^{-1})	Apparent recovery (%)	Phosphorus use efficiency (kg produce / kg P applied)
T_1: Control	34.20	54.20	7.31	12.75	-	-
T_2 : 100% RDPF (60kg P_2O_5 ha^{-1})	36.30	56.30	8.06	18.45	9.50	3.5
T_3: 50% Basal +50% one split at tillering stage	44.00	64.00	8.31	27.52	24.61	16.33
T_4: 50% Basal+ Split 25% at tillering + 25% at PI stage	44.70	64.70	8.56	28.98	27.05	17.50
T_5: Mahua oil coated SSP (1:20)	42.50	62.50	8.31	25.25	20.83	13.83
T_6 : Neem oil coated SSP (1:20)	46.40	66.40	8.75	31.51	31.26	20.33
T_7 : Gypsum coated SSP (1:10)	49.50	69.50	8.81	35.20	37.41	25.50
T_8: Cow dung coated SSP (1:5)	38.80	58.80	8.19	21.06	13.85	7.67
T_9: Poultry manure coated SSP (1:10)	40.60	60.60	8.25	23.28	17.55	10.67
SEm±	1.69	1.80	0.35	-	-	-
C D at 5%	4.96	5.26	1.03	-	-	-

The protein content in rice grain was influenced significantly with coated and split application of SSP over control. The maximum protein content (8.81%) was recorded with gypsum coated SSP which was significantly superior over control and at par with rest of the treatments. Among the coated material, neem oil coated (8.75%) was found second best coating materials in enhancing the protein content followed by mahua coated (8.31%). This might be attributed in release pattern of P from superphosphate coated materials and splitting might have provided the adequate supply of phosphorus which accelerated the synthesis of nitrogen and enhanced the protein content in rice. Similar findings were also reported by Tarafdar (2013) and Pattanayak *et al.,* (2009).

The highest P recovery was obtained with gypsum coated SSP (37.41) followed by neem oil coated SSP (31.26 %), Application of SSP as 50% basal + 50% in two splits was at third place as regards the apparent recovery of P(27.05%) . This might be attributed to the increase in availability of P in soil by reducing the P fixation. The similar findings were also of Sharma *et al. (*2009) and Garg *et al.* (2010).

The maximum phosphorus use efficiency (25.50 kg produce/kg P) was received with the application of gypsum coated SSP followed by neem oil coated SSP (20.33 kg produce/kg P). The minimum phosphorus use efficiency (3.5 kg produce/kg P) was received with applied entire dose of phosphorus as basal. The higher phosphorus use efficiency with coating and split applications might be due to better utilization of phosphorus by the crop which reduce P fixation and increase its availability. The findings were also corroborated by Pattnayak *et al.,* (2009). The different types of coatings affected dissolution rate of superphosphate which in turn influenced efficiencies of coated SSP fertilizers. The moisture absorption and SSP fertilizer dissolution rates decreased by coatings compared to uncoated fertilizer with increase in time which in turn increased the availability of phosphorus. Similar results were also reported by Garcia *et al.,* (1995).

From the results, it may be concluded that application of gypsum and neem oil coated SSP proved most effective in increasing yield, P uptake, protein content, apparent recovery and P use efficiency over rest of the coatings and splitting of single superphosphate.

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