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Effect of single super phosphate and rock phosphate on growth & yield of rice

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Abstract
This experiment was conducted in order to evaluate effect of Single Super Phosphate (SSP) and Rock Phosphate (RP) on growth parameters of paddy (CAU-R1) in department of Soil Science and Agricultural Chemistry of College of Agriculture, Central Agricultural University, Imphal (Manipur) during kharif season of 2016. Results on pot experiment revealed that, comparing with the untreated control all phosphorus treated soil gave significantly (p=0.05) higher plant height, number of tillers and dry matter yield of paddy at different stages of crop growth. Plant height was significantly higher in T_5 (50% RD of P_2O_5 from SSP + 50% RD of P_2O_5 from RP, RD- Recommended Dose) which is at par with T_6 (25% RD of P_2O_5 from SSP + 75% RD of P_2O_5 from RP). Among the different treatments, comparatively more number of tillers was sawn in T_6 which is at par with T_3 (100% RD of P_2O_5 from RP). Dry matter accumulation was higher in paddy grown in T_6 added soil on 100th day and T_5 at harvest which are at par with T_5 and T_6, respectively. Significantly higher grain yield (g hill^{-1}) was observed in paddy grown in T_5 followed by T_6 and T_2 (100% RD of P_2O_5 from SSP).

Keywords: single super phosphate, rock phosphate, paddy

Introduction
Rice (*Oryzasativa* L.) is grown in all continents occupying 150 million ha, producing 575 million tonnes with an average productivity of 3.83 tonnes ha^{-1}. India is first in terms of area and second in production of rice but the average productivity is still low, mainly due to use of iow yielding varieties and incorrect fertilizer management practices. Phosphorus (P) is second most important plant nutrient after nitrogen. It is often necessary to apply phosphorus for rice production to meet our food security in future (Zhang *et al.* 2006). Since the recovery efficiency of P is low, there is a need to find right P source to increase fertilizer use efficiency. The cost of conventional water soluble P fertilizer is high in India because their manufacture requires high grade rock phosphate and sulphur. Thus an alternative use of indigenously available rock phosphate is gaining importance in India (Biswas and Narayanasamy, 2006) [4]. The combined application of soluble P fertilizer with local rock phosphate significantly enhanced plant growth (Kundu and Basak, 1999; Ravi and Siddaramappa, 2000 and Xiong *et al.*, 2002). Phosphate based fertilizers can be good alternative fertilizers for plants. Increase in rock phosphate level can significantly increase the dry matter yield of paddy (Poleshi *et al.* 2008) [11]. Application of rock phosphate can reduce cost of cultivation, which ultimately increase benefit-cost ratio.

Materials and Methods
Soil Sampling and pot experiment
A pot experiment was carried-out during kharif season 2016 in the Rice Research Farm of the College of Agriculture, Central Agricultural University, Iroisemba, Imphal to study the effect of single super phosphate and rock phosphate on growth parameters of paddy. The location of the field experimented is situated at 24^0 45‟ N latitude and 93^0 56‟ E longitude with an elevation of 790m above the mean sea level. Soil type was clay loam in texture and acidic reaction having pH value of 5.5 (Length of day 12 h, day average temperature 29 ^{0} C, night average temperature 16^0 C and humidity 77% in experiment duration). Recommended dose of fertilizers i.e. 60: 30: 30 N, P_2O_5, K_2O ha^{-1} were added before transplanting (15 days old seedling) to all the pots (4 kg soil pot^{-1}) equally. Each pot was kept in submerged condition throughout the period of experiment maintaining water level at 5-10 cm above the soil surface. Treatments included in the pot experiment were T_1= Control, T_2= 100% Recommended Dose (RD) of P_2O_5 from SSP, T_3= 100% RD of P_2O_5 from RP, T_4= 75% RD of P_2O_5 from SSP +

+ 25% RD of P_2O_5 from RP, T_5= 50% RD of P_2O_5 from SSP + 50% RD of P_2O_5 from RP, T_6= 25% RD of P_2O_5 from SSP + 75% RD of P_2O_5 from RP.

Statistical Analysis

The experiment was carried out under randomized block design (RBD). Altogether there were six treatment combinations replicated thrice. All the data pertaining to the investigation were statistically analysed through analysis of variance technique for comparing the treatments effects as described by Gomez and Gomez (1984) [6]. The significance of various effects was tested at 5% level of probability.

Results and Discussion

Plant height

Results revealed that irrespective of all treatments, plant height increased upto harvest (Table 1). Plant height of all phosphorus applied treatments was higher over untreated control. The increase in plant height with phosphorus fertilizer application was also reported earlier by Khan *et al.* (2007) [8]; Tabar (2013) and Noonari *et al.* (2016) [10]. Detailed study of the data revealed that plant height of paddy grown in soil fertilized with 50% SSP+50% RP showed comparatively higher which was at par with 25% SSP+75% RPand 100% SSP at different growth stages of paddy.

Number of tillers

Results showed that irrespective of all different treatments number of tillers per hill increased up to 75th day and then no more new tiller appears (Table 1). All phosphorus applied treatments showed significantly higher number of tiller appearance comparing with control at all growth stages of paddy which is at par with the findings of Khan *et al.* (2007) [8]; Tabar (2013) and Noonari *et al.* (2016) [10]. Among the different treatments, paddy grown in 25% SSP+75% RP and 100% RP treated soil showed comparatively higher number of tillers per hill followed by 50% SSP+50% RP treatment on 75th day.

Dry matter yield

Results showed that irrespective of different treatments, there was an increasing trend of dry matter of paddy up to harvest (Table 1). The rise of the rice dry matter with crop growth was also reported by Liu and Zhu (1996) [9]. Comparing with the untreated control all phosphorus treated soil gave significantly higher dry matter yield of paddy at different stages of crop growth. This is at par with the findings of Poleshi *et al*. (2008) [11] and Banerjee and Pramanik (2009) [2]. Among the different treatments, significantly (p= 0.05) higher dry matter of paddy was recorded in soil applied with 50% SSP+50% RP on 50th day followed by 25% SSP+75% RP. Critical study of the data revealed more dry matter accumulation in paddy grown in 25% SSP+75% RP added soil on 100th day and 50% SSP+50% RP at harvest which are at par with 50% SSP+50% RP and 25% SSP+75% RP, respectively.

Grain yield

Irrespective of different treatments, all SSP and RP applied soil produced significantly more grain yield over check treatment (Table 1). Khalil *et al*. (2002) [7]; Khan *et al.* (2007) [8]; Banerjee and Pramanik (2009) [2]; Tang *et al*. (2011) [12]; Fageria *et al*. (2014) [5] and Noonari *et al.* (2016) [10] also reported that paddy yield was increased significantly by P application over control. Detailed study of the yield data pointed out that soil applied with 50% SSP+50% RP shows significantly higher yield followed by25% SSP+75% RP and 100% SSP. Supportive findings on higher grain yield of paddy grown in soil fertilized with mixture of SSP and RP than single application of RP was presented by Balasubramaniyan (1989) [1]; Bhardwaj *et al.* (1996) [3] and Ravi and Siddaramappa (2000).

Table 1: Plant height (cm), Number of tillers per hill, Dry matter yield (g hill^{-1}) and Grain yield (g hill^{-1}) of paddy grown in soil fertilized with single super phosphate and rock phosphate

Treatments	Plant height (cm)					Number of tillers per hill					Dry matter yield (g hill^{-1})					Grain yield (g hill^{-1})
	25 DAT	50 DAT	75 DAT	100 DAT	Harvest	25 DAT	50 DAT	75 DAT	100 DAT	Harvest	25 DAT	50 DAT	75 DAT	100 DAT	Harvest	
T_1	34	61.7	88.7	92.7	94.3	2	4	7	7	7	6.17	10.47	16.13	23.27	26.83	21.33
T_2	47.7	79.3	99.7	104.3	104.7	3	5	8	8	8	7.17	12.20	19.57	26.40	29.87	33.33
T_3	43.7	73.0	96.7	100.0	101.7	3	6	10	10	10	7.60	13.63	20.37	28.17	32.40	25.67
T_4	44.3	76.3	97.3	101.0	102.3	3	5	8	8	8	8.03	12.80	19.67	27.10	30.53	28.00
T_5	50	84	105.6	107.2	110.7	4	6	9	9	9	8.17	13.73	19.87	28.23	33.67	36.33
T_6	48.3	82.0	103.3	105.1	106.9	4	6	10	10	10	7.73	12.83	20.40	28.33	32.57	34.67
S.E.d(±)	0.82	1.41	1.83	1.89	1.92	0.42	0.29	0.39	0.39	0.39	0.14	0.23	0.36	0.50	0.57	0.53
CD(p=0.05)	1.82	3.13	4.07	4.22	4.28	0.94	0.64	0.88	0.88	0.88	0.32	0.52	0.80	1.11	1.27	1.19

T_1= Control, T_2= 100% Recommended Dose (RD) of P_2O_5 from SSP, T_3= 100% RD of P_2O_5 from RP, T_4= 75% RD of P_2O_5 from SSP + 25% RD of P_2O_5 from RP, T_5= 50% RD of P_2O_5 from SSP + 50% RD of P_2O_5 from RP, T_6= 25% RD of P_2O_5 from SSP + 75% RD of P_2O_5 from RP, DAT= Days after transplanting

Conclusion

All phosphorus fertilized soil gave significantly higher plant height, number of tillers, dry matter yield of paddy than the untreated control at different stages of crop growth. Plant height was significantly higher in T_5 which is at par with T_6. Among the different treatments, comparatively more number of tillers was shown in T_6 which is at par with T_3. Grain yield was significantly higher in paddy grown in T_5 followed by T_6 and T_2. With the combined application of SSP and RP at 50:50, it may be possible to get better agronomic effectiveness. Effectiveness of RP can be increase by combining with SSP, even though it is a poor source of P. The results of the investigation are far from adequate to explain or to throw enough light to the adoption of definite management practices, thus more studies needed to be taken up under different management practices on number of soils.

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