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Yield and nutrient content of chilli (*Capsicum annuum* L.) in response to sources of P and levels of P and N

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Abstract

The highest yield of chilli dry pods (2770 kg ha^{-1}) was obtained by the application of 120, 60 and 35 kg N, P_2O_5 and K_2O ha^{-1}. The response to N and P application was linear up to 120 and 60 kg ha^{-1} N and P_2O_5, respectively. The protein content of dry pod increased in the higher levels of N and the highest value (12.25%) was recorded at 120 kg ha^{-1}. N and P application increased protein and mineral contents of dry pods. Among the sources of P, rock phosphate registered maximum calcium content compared to single super phosphate. The efficiency of incubated rock phosphate was similar to that of single super phosphate. However, rock phosphate with phosphobacteria did not enhance yield. Farm yard manure incubated rock phosphate proved to be a cheaper source of phosphatic fertilizer for soils with higher pH (>8).

Key words: chilli, nutrient content, rock phosphate, phosphobacteria, single super phosphate, yield.

Introduction

Chillies are the green or dried ripe fruits of pungent forms of *Capsicum annuum* L. It forms an indispensable adjunct in every house of tropical countries. It is specially liked for its pungency, spicy taste, besides the appealing colour it imparts to the food. In India, chilli is grown practically all over the country. India is the largest producer and exporter of chilli with 8.1 lakh ha area and 7.5 lakh tonnes of production (Peter 1997). The importance of balanced fertilizer application in increasing the production of chillies is well known. But only little information is available on the use of cheaper source of P fertilizers. Hence, the present study was undertaken to get information on the efficacy of rock phosphate in different combinations in comparison with single super phosphate.

Materials and methods

The field experiment was conducted at Tamil Nadu Agricultural University, Coimbatore. The soil of the experimental site was clay loam containing 290, 10.5 and 840 kg ha^{-1} of available N, P_2O_5 and K_2O, respectively with a pH of 8.3 and E.C. of 0.33 m mhos cm^{-1}. The experiment was laid out in a split plot design (5 x 4 m plot size) with three replications. The popular chilli variety (Co-3) was planted with a spacing of 30 x 15 cm. The fruits were harvested 75 days after transplanting at weekly intervals. The pods were dried in an oven at 45° C for three days and the dry weight was expressed as kg ha^{-1}.

There were seven main plot and three sub plot treatments.

The main plot treatments were single super phosphate @ 30 kg P_2O_5 ha^{-1} (SSP P_1); single super phosphate @ 60 kg ha^{-1} (SSP P_2); rock phosphate incubated with FYM @ 30 kg ha^{-1} (IRP P_1); rock phosphate incubated with FYM @ 60 kg ha^{-1} (IRP P_2); rock phosphate with phosphobacteria @ 30 kg ha^{-1} (RPP P_1); rock phosphate with phosphobacteria @ 60 kg ha^{-1} (RPP P_2) and control. The three sub plot treatments were control (N_0); 60 kg N ha^{-1} (N_1) and 120 kg N ha^{-1} (N_2).

The N and K were applied in the form of urea and muriate of potash, respectively. Uniform quantity of potash @ 35 kg ha^{-1} was applied just before transplanting. The entire dose of P was applied basally as per treatment. Nitrogen was applied in three equal splits at 30, 60 and 90 days after transplanting. The IRP was prepared by using 40 kg FYM (0.84% N, 0.6% P_2O_5 and 0.80% K_2O), incubated under anaerobic condition for one month before it was applied. FYM was not applied in other treatments. The P_2O_5 content of RP in this study was 20.0%. Forty kg FYM was applied in each IRP plot and no FYM was given to other treatment plots. The nutrient content was estimated as per the standard procedures (AOAC 1977; Jacksons 1973). The yield and nutrient content were analysed statistically through ANOVA (Panse & Sukhatme 1985).

Results and discussion

Dry pod yield

The levels of P and N had increased the yield significantly which ranged from 917 to 2270 kg ha^{-1} (Table 1). Among the sources, SSP was superior to IRP, while the RPP recorded the lowest yield. In SSP the maximum mean dry pod yield of 2770 kg^{-1} was observed at 120 kg N ha^{-1} whereas 917 kg ha^{-1} was recorded in control. In IRP the highest yield of 2750 kg ha^{-1} was registered at 60 kg P_2O_5 ha^{-1} (P_2) combined with 120 kg N ha^{-1}. Application of 30 kg P_2O_5 ha^{-1}(P_1) as IRP and 120 kg N ha^{-1} recorded higher yield. Application of N at 120 kg ha^{-1} combined with 60 kg P_2O_5 ha^{-1} as RPP recorded lower yield compared to other sources. This was in confirmation with the findings of Elezabeth & Guertal (2000).

The yield of dry pod increased with the application of N and P. Nitrogen at 60 kg ha^{-1} recorded 80% higher pod yield over control and further increase of N level to 120 kg ha^{-1} had enhanced the pod yield to the tune of 40% over 60 kg ha^{-1}. Thus a linear trend of yield was observed for the increase in N level up to 120 kg ha^{-1}. Ramachandran & Subbiah (1981) reported similar response up to 120 kg N ha^{-1}. Response even up to 150 kg N ha^{-1} was recorded by Narasappa *et al.* (1988). Among the sources of P for chilli crop, application of SSP recorded higher yields of pod (2315 kg ha^{-1}). When P was applied as IRP the yield loss of 2% over SSP only was registered. On the other hand, P applied as RP inoculated with phosphobacteria resulted in 24% reduction in yield (1927 kg ha^{-1}) compared to SSP. In this investigation phosphorous solubilising bacteria was not effective in enhancing the yield.

Phosphorous content

Application of P increased phosphorous content in dry pod significantly and the lowest P content was recorded in control (0.190%) (Table 2). The concentration at the P_1 level (30 kg ha^{-1}) was significantly higher than control and further increase in P increased its content to 0.22%. Application of N had favourable effect in increasing the P content recording higher value of 0.216% in N_2 level, but the difference between N_0 and N_1 was not significant. Among the sources and levels of phosphorus, SSP @ 60 kg ha^{-1} recorded the highest P content. Incorporation of phosphorous increased the P content at each level of N and control. Higher P content was noticed at higher levels of P application. Since, soil of the experimental site is low in available P status, application of P fertilizer had resulted in more of P concentration in dry pods. This finding also corroborates with that of Singh & Srivastava (1988). Nitrogen application had favourable effect in increasing the phosphorous content, while source of P did

Table 1. Dry pod yield and protein content of chilli in response to different sources of P and levels of P and N

Source and level of P	Dry pod yield (kg ha^{-1})				Protein content (%)			
	N_0	N_1	N_2	Mean	N_0	N_1	N_2	Mean
SSP P_1	1478	2387	2643	2169	12.07	12.09	12.27	12.14
SSP P_2	1631	2546	2770	2315	12.12	12.09	12.22	12.14
Mean	1554	2466	2706	2242	12.09	12.09	12.24	12.14
IRP P_1	1424	2372	2548	2114	12.07	12.07	12.27	12.13
IRP P_2	1616	2475	2750	2280	12.07	12.07	12.27	12.13
Mean	1520	2423	2644	2197	12.07	12.07	12.27	12.13
RPP P_1	1305	2057	2178	1846	11.82	12.07	12.27	12.05
RPP P_2	1466	2274	2286	2008	12.07	12.07	12.23	12.12
Mean	1385	2165	2232	1927	11.94	12.07	12.25	12.08
P_0	917	1655	2043	1538	11.83	12.07	12.22	12.24
N levels (Mean)	1405	1655	2044		12.00	12.07	12.25	
P levels (Mean)	1385	2044	2202		11.83	12.10	12.13	
	SEd	CD			SEd	CD		
P	7.01	15.29			0.043	0.095		
N	17.98	36.83			0.067	0.138		
S	6.97	15.19			0.043	NS		
N at P	58.27	119.35			0.218	NS		
P at N	39.48	81.02			0.152	0.310		

not have any appreciable effect on the phosphorus content of the dry pod.

Potassium content

Phosphorous and N fertilization increased the K content significantly over the control but P_1 and P_2 as well as N_1 and N_2 were on par (Table 2). Among the forms of phosphatic fertilizers, SSP recorded the maximum content of potassium (1.70%) followed by IRP and RPP. However, the difference was not significant. At each level of N and P, higher K content was recorded than control. Application of N at 120 kg ha^{-1} failed to increase K content noticeably over 60 kg ha^{-1}. Application of P increased the K content and the crop showed a tendency to utilize more of K from the soil resulting in higher concentration of K in dry pods in the presence of SSP than RPP. Similar observation was also reported by Mathur & Lal (1989).

Calcium content

The calcium content of the dry pod increased with the application of phosphorus. Calcium content was 0.85% in control, which was higher than in the two levels of phosphorous (Table 2). There existed no significant difference between P_1 and P_2 levels. Application of N at three levels recorded lower Ca content than control. Regarding the source of P fertiliser, SSP recorded the lowest Ca content (0.66%) and maximum value was registered in IRP and RPP, but they were on par. At each level of N, addition of P had not influenced the Ca content significantly. Application of nitrogen and phosphorous increased the calcium content in dry pods.

Among the sources of P carriers, Ca concentration in the dry pod of RPP and IRP treated plot was much higher than that of SSP. This was due to the capacity of RP to supply more of Ca than SSP. This finding was in agreement with that of Mathur & Lal (1989) who reported superiority of RPP over SSP in supplying Ca to the plants.

Table 2. Influence of P and N on phosphorous, potassium, calcium and magnesium contents in dry pods of chilli

Source and level of P	Phosphorous (%)				Potassium (%)				Calcium (%)				Magnesium (%)			
	N_0	N_1	N_2	Mean	N_0	N_1	N_2	Mean	N_0	N_1	N_2	Mean	N_0	N_1	N_2	Mean
SP P_1	0.213	0.213	0.216	0.214	1.66	1.73	1.73	1.70	0.74	0.64	0.61	0.66	0.192	0.288	0.288	0.256
SSP P_2	0.226	0.226	0.233	0.228	1.66	1.73	1.73	1.70	0.74	0.64	0.61	0.66	0.192	0.230	0.320	0.277
Mean	0.219	0.219	0.224	0.227	1.66	1.73	1.73	1.70	0.74	0.64	0.61	0.66	0.192	0.304	0.304	0.266
IRP P_1	0.213	0.213	0.216	0.214	1.70	1.70	1.70	1.70	0.74	0.74	0.74	0.74	0.192	0.288	0.288	0.256
IRP P_2	0.213	0.220	0.220	0.217	1.65	1.66	1.68	1.66	0.80	0.74	0.74	0.76	0.192	0.256	0.288	0.245
Mean	0.213	0.216	0.218	0.215	1.67	1.68	1.69	1.66	0.77	0.74	0.74	0.75	0.192	0.272	0.288	0.250
RPP P_1	0.210	0.210	0.210	0.210	1.65	1.66	1.70	1.67	0.80	0.74	0.66	0.73	0.160	0.288	0.256	0.234
RPP P_2	0.216	0.216	0.220	0.217	1.65	1.61	1.66	1.64	0.80	0.74	0.74	0.76	0.192	0.224	0.288	0.234
Mean	0.213	0.213	0.215	0.213	1.65	1.63	1.68	1.65	0.80	0.74	0.70	0.74	0.176	0.256	0.269	0.234
P_0	0.190	0.193	0.196	0.193	1.56	1.60	1.60	1.58	0.85	0.74	0.69	0.76	0.128	0.224	0.256	0.202
N levels (Mean)	0.211	0.213	0.216		1.56	1.69	1.66		0.78	0.71	0.68		0.178	0.269	0.283	
P levels (Mean)	0.190	0.212	0.220		1.56	1.69	1.66		0.85	0.71	0.70		0.128	0.248	0.252	

	SEd	CD	SEd	CD	SEd	CD	SEd	CD
P	0.0026	0.005	0.040	0.08	0.04	0.09	0.028	0.062
N	0.0023	0.004	0.010	0.22	0.05	0.10	0.027	0.057
S	0.0001	NS	0.040	NS	0.04	0.90	0.029	NS
N at P	0.007	0.015	0.034	0.07	0.16	NS	0.090	NS
P at N	0.005	NS	0.046	NS	0.11	NS	0.066	NS

Magnesium content

Application of phosphorous and nitrogen had increased the Mg content significantly over the control, but the concentration between P_1 and P_2 and N_1 and N_2 did not differ significantly (Table 2). Among the sources of P, SSP registered maximum Mg content (0.266%) followed by IRP and the lowest value was recorded in the RPP (0.233%). The favourable effect of N and P application on Mg content was observed. No appreciable variation in the Mg content was observed due to sources of P.

Protein content

The mean protein content in treatments devoid of N was 12%. It increased to 12.07 % in 60 kg N ha^{-1} (N_1) and further increased to 12.25% when N was applied at the rate of 120 kg ha^{-1}. Application of phosphorous increased the protein content at both levels of P (Table 1). The source of P did not influence the protein content of dry pod. When no phosphorous was added, increasing levels of N appreciably increased the protein content from 11.83% to 12.22%. In this study, protein content of dry pod was found to increase with the application of N. The higher concentration of protein in dry pod was attributed to the increased levels of N application (protein content was arrived by multiplying the nitrogen content with factor 6.25). The beneficial effect of N application in increasing the protein content was observed in this investigation. Phosphorous application had only marginal effect in increasing the protein content. In all the sources of phosphorous, the protein content did not change appreciably.

From the experiment a linear trend in yield was noticed with the increase of N upto 120 kg ha^{-1}. Among the sources of phosphate fertilisers, SSP had registered the highest yield. When P was applied at the rate of 60 kg ha^{-1} as IRP, the yield loss of 2% only was registered. The yield reduction was 24% when P was applied as RPP. Significant variation in nutrient content was not noticed due to the source of phosphatic fertilizers.

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