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Influence of Organic Manures and Rock Phosphate Application on of Bengal Gram (*cicer arietinum* l.).

T.SARAVANAN* AND P.PANNEERSELVAM

Department of Crop Management,Vanavarayar Institute of Agriculture,
Manakkadavu, Pollachi, Tamil Nadu, India

Abstract : A field experiment was conducted on vertisols at Natural Resources protection and Development Society research station, Namakkal during *rabi* season of 2012-13 and 2013-14 to study the effect of organic manures and rock phosphate on growth and yield of Bengal gram (*Cicer arietinum* L.) in vertisols of Tamilnadu. Significantly higher grain yield was recorded with rock phosphate application @ 200 kg / ha (2140 kg/ha) over 50 kg and 100 kg of rock phosphate per hectare except rock phosphate @ 150 kg / ha (2069 kg/ha). Interaction effect of compost 5 t along with rock phosphate 200 kg / ha recorded significantly higher grain yield 2130 kg/ha) and haulm yield (3300 kg/ha) over other treatment combinations except either of organic manures FYM 5 t or compost 5 t along with 150 to 200 kg rock phosphate per ha. Significantly higher B:C ratio (3.32) was recorded with rock phosphate @ 200 kg / ha over other lower levels. Similarly, combination of compost @ 5 t/ ha with 150 kg rock phosphate resulted in higher B:C ratio (3.37).

Key words: Rock phosphate, organic manures, phosphate solubilising bacteria

Introduction

Bengal gram (*Cicer arietinum* L.) is a prime pulse crop in India next only to pigeonpea. Though it occupies an area to a greater extent, its productivity is low as compared to its potential yield in the experimental station (Kumar, 1997). Number of factors is responsible for its low productivity. Among them, imbalanced nutrition is an important factor affecting the yield of Bengal gram to a greater extent. To enhance the productivity of this crop, application of organic manures with rock phosphate, phosphorus solubilizing bacteria and seed treatment with rhizobium are of great importance.

Rhizobium inoculation enhances nodulation and N fixation in pulse crops. Bengal gram responded positively to P application with increased yield (Saraf *et al.*, 1997). Phosphate solubilising bacteria (PSB) plays an important role in making phosphorus available to crop plants (Gautam and Pant, 2002). Phosphorus is an important major nutrient which determines the productivity of Bengal gram in addition to N and K. The response of Bengal gram to organic mode of P nutrition is a primary concern in its cultivation. Many options are available for accomplishing the nutrition of the crop with major nutrients. Some of the organic sources of nutrients are not only supply nutrients but also water to sustain the steady demand of the crop.

Material and methods

A field experiment was conducted during *rabi* season of 2012-13 and 2013-14 at Natural Resources protection and Development Society research station Namakkal. The soil was clayey in texture with bulk density of 1.27 g per cc, pH of 7.90 with organic carbon content of 0.51%. The soils were low in available N (202 kg/ha) and available P (18.90 kg/ha) and medium in available K (347 kg/ha). The treatments consisted of two organic manures, FYM (5 t/ha) and compost (5 t/ha) with four levels of rock phosphate with PSB (50, 100, 150 and 200 kg/ha) and one absolute control. The nutrient composition of FYM(0.50%

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N, 0.20% P2O5, 0.5% K2O and organic carbon. 40.7%), compost(0.50% N, 0.30% P2O5, 0.5% K2O and organic carbon 41.2%) and rock phosphate(20% P2O5). The Phosphate Solubilising Bacteria (PSB) strain used was *Pseudomonas striata* @5kg/ha.

The experiment was laid out in factorial RCBD design with three replications. The seeds were treated with *rhizobium* in all the treatments. Bengal gram crop (var. JG-11) was sown in the first fort night of October in 30 cm x 10 cm spacing. The required quantity of organic manures and rock phosphate with PSB was incubated for 30 days before sowing of crop under shade by covering with gunny bags with regular water sprinkling and was applied at the time of sowing as per treatment. The crop duration was 110 to 120 days. The crop was grown under rainfed condition and plant protection measures were taken with spraying of neem oil, NPV and chilli +garlic extracts at 35, 45 and 75 days after sowing to control the infestation of pod borer.

Results and discussion

Application of compost @ 5 t per ha recorded significantly higher plant height (35.36 cm) over FYM @ 5 t per ha (33.40 cm). However, other growth parameters like number of branches per plant, Leaf Area Index (LAI) at 90 DAS and Total Dry Matter (TDM) production at harvest were not significant due to application of organic manures (Table 1)

Among various levels of rock phosphate with PSB application, rock phosphate @ 200 kg / ha being recorded at par with 150kg/ha recorded significantly higher number of branches (7.42), LAI (1.22) and TDM production (20.54 g/plant) over other levels (Table 1). Dubey (1996) also reported that seed yield and TDMP were increased with the use of *Pseudomonas striata* alone and in conjunction with rock phosphate

Interaction effect of compost 5 t along with rock phosphate 200 kg with PSB recorded significantly higher plant height (35.47 cm), number of branches (7.68), LAI (1.24) and TDMP (20.66 g/ plant) over compost and FYM applied with 50 kg per ha rock phosphate and absolute ontrol (Table 1). Application of crop residues and organic manures with PSB was reported to improve the efficacy of rock phosphate due to release of organic acids and CO2 from crop residues facilitating the build up of P in soil with such a treatment (Prasad, 2009). Higher dose of rock phosphate with PSB applied along with compost might have resulted in higher availability of P due to better mineralization of nutrients. This better availability and uptake of P by Bengal gram increased growth parameters. It also enhanced plant vigour in terms of increased leaf area and greater accumulation of photosynthates in the plants. These results are in conformity with the findings of Shivakumar *et al.* (2004) who reported that the increasing levels of phosphorus in the form of rock phosphate inoculation with phosphate solubilizing bacteria (PSB) and *rhizobium* seed treatment significantly increased the plant height, number of branches per plant, grain and stover yield during both the years indicating that application of higher levels of phosphorus under low moisture condition is necessary for getting higher yields in chick pea. Similarly Shaktawat *et al.* (2006) reported that, higher phosphorus dose through rock phosphate either alone or in combination with acidulants were better than the lower one. Under residual studies after soya bean crop, the maximum seed yield of mustard (18.83 q/ha) was recorded by rock phosphate+ PSB+FYM at 90 kg P205/ha which was found at par with the same treatment combination at 60 kg P2O5 per ha over absolute control. Application of varied levels of rock phosphate with PSB and their interaction with organic manures had significant influence on number of pods per plant, 100-seed weight, grain yield and haulm yield (Table 2).

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Among various levels of rock phosphate, significantly higher number of pods per plant (66.22), 100-seed weight (20.48 g) and grain yield (2104 kg/ha) were recorded at rock phosphate 200 kg/ha over all other levels except with 150 kg/ha rock phosphate. Interaction effect of compost @5 t along with rock phosphate 200 kg / ha has resulted in significantly higher number of pods (67.76), 100-seed weight (20.71 g), grain yield (2130 kg/ha) and haulm yield (3300 kg/ha) over application of rock phosphate at lower levels with organic manures and absolute control.

The increased yield attributing characters and yield in higher levels of rock phosphate with PSB and their interaction with organic manures were attributed to the increased availability of phosphorus which also favoured the symbiotic N2 fixation and higher growth of plants, thereby had positive effect on yield attributes (Kushwaha, 2007). These results are also in accordance with the findings of Alagawadi and Gaur (1988) who studied that nodulating nitrogenase activity, dry matter production, nutrient uptake, protein content and grain yield of Bengal gram as well as available P content in the soil due to inoculation of *Pseudomonas striata* increasedcompared to uninoculated control. All the above parameters further, augmented in the presence of MRP. Similarly Thiyageshwari and Raniperumal (2002) stated that the grain yield of urdbean ranged from 530 to 998 kg per ha, maximum per cent increase over control of 88 was recorded with the tri-combination of Tunis rock phosphate (100%) with vermicompost and phosphobacteria which was significantly higher over control with respect to number of pods per plant and 100 grain weight, the impressive effect of TRP (100%) with VC and PSB were recorded with a value of 23 and 42.3 g, respectively. The control without the application of P2O5 registered the lowest value in all the parameters.

Significantly higher gross returns (` 58568/ha) and net returns (` 40945/ha) were recorded with application of 200 kg / ha rock phosphate over 50 and 100 kg rock phosphate/ha except 150 kg/ha (Table 3). The highest B:C ratio was observed in application of 200 kg rock phosphate per ha (3.33) followed by 150 kg rock phosphate per ha (3.30). Among interaction effects, significantly higher B:C ratio was recorded with compost 5 t/ha along with rock phosphate 150 kg/ha (3.37) followed by compost 5 t/ha along with rock phosphate 200 kg/ha.

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Table 1. Effect of organic manures and rock phosphate with PSB on growth parameters of Bengal gram (Pooled data)

Treatment	Plant Height (cm)	No of branches/Plant	LAI 90 DAS	TDMP at harvest g/plant
Organic manures (OM)				
OM1: Compost @ 5 t ha-1	33.4	6.38	1.19	19.77
OM2: FYM @ 5 t ha-1	35.36	5.99	1.17	19.32
S.Em±	.66	.16	.02	.31
C.D. at 5%	1.92	NS	NS	NS
Levels of rock phosphate (RP) with PSB				
RP1: 50 kg rock phosphate ha-1	3.30	5.37	1.10	18.29
RP2: 100 kg rock phosphate ha-1	34.02	5.92	1.17	19.12
RP3: 150 kg rock phosphate ha-1	34.09	6.05	1.21	20.23
RP4: 200 kg rock phosphate ha-1	36.1	7.42	1.22	20.54
S.Em±	0.94	0.23	.03	0.44
C.D. at 5%	NS	0.64	.09	1.27
Interaction				
OM1RP1	32.90	5.57	1.10	18.61
OM1RP2	33.70	6.08	1.18	19.40
OM1RP3	33.52	6.20	1.23	20.39
OM1RP4	35.47	7.68	1.24	20.66
OM2RP1	34.70	5.17	1.09	17.97
OM2RP2	35.33	5.75	1.16	18.83
OM2RP3	34.67	5.90	1.20	20.07
OM2RP4	36.73	7.15	1.21	20.42
Absolute control	28.40	4.65	.98	15.80
S.Em±	1.31	.31	.04	.59
C.D. at 5%	3.75	.88	.12	1.71

FYM – Farm yard manure RP – Rock phosphate with PSB DAS – Days after sowing
NS – Non-significant PSB – Phosphorous solibilizing bacteria
LAI- Leaf Area Index TDMP- Total dry matter production

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Table 2. Effect of organic manures and rock phosphate with PSB on yield and yield attributes of Bengal gram (Pooled data)

Treatment	No of pods/plant	100 grain weight	Grain yield/ ha	Haulm yield/ha
Organic manures (OM)				
OM1: Compost @ 5 t ha-1	63.86	19.98	1991	3163
OM2: FYM @ 5 t ha-1	60.65	19.61	1923	3079
S.Em±	1.37	.17	42	73
C.D. at 5%	NS	NS	NS	NS
Levels of rock phosphate (RP) with PSB				
RP1: 50 kg rock phosphate ha-1	57.72	19.05	1775	2930
RP2: 100 kg rock phosphate ha-1	61.29	19.27	1880	3047
RP3: 150 kg rock phosphate ha-1	63.77	20.39	2069	3254
RP4: 200 kg rock phosphate ha-1	66.22	20.48	2104	3255
S.Em±	1.94	.24	60	104
C.D. at 5%	5.59	.70	172	NS
Interaction				
OM1RP1	58.95	19.21	1803	2969
OM1RP2	63.00	19.42	1911	3091
OM1RP3	65.71	20.60	2120	3292
OM1RP4	67.76	20.71	2130	3300
OM2RP1	56.49	18.89	1747	2890
OM2RP2	59.58	19.12	1849	3003
OM2RP3	61.83	20.18	2017	3215
OM2RP4	64.68	20.25	2079	3210
Absolute control	48.97	18.92	1450	2597
S.Em±	2.62	.32	80	138
C.D. at 5%	7.52	.93	229	398

FYM – Farm yard manure RP – Rock phosphate with PSB DAS – Days after sowing
NS – Non-significant PSB – Phosphorous solibilizing bacteria
LAI- Leaf Area Index TDMP- Total dry matter production

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Table 3. Effect of organic manures and rock phosphate with PSB on gross returns, net returns and B:C ratio of Bengal gram (Pooled data)

Treatment	Gross return	Net return	B: C Ratio
Organic manures (OM)			
OM1: Compost @ 5 t ha-1	55544	38108	3.18
OM2: FYM @ 5 t ha-1	53678	36242	3.08
S.Em±	1085	1085	.06
C.D. at 5%	NS	NS	NS
Levels of rock phosphate (RP) with PSB			
RP1: 50 kg rock phosphate ha-1	49673	32425	2.88
RP2: 100 kg rock phosphate ha-1	52531	35158	3.02
RP3: 150 kg rock phosphate ha-1	57671	40173	3.30
RP4: 200 kg rock phosphate ha-1	58568	40945	3.32
S.Em±	1534	1534	.09
C.D. at 5%	4430	4430	.25
Interaction			
OM1RP1	50454	33206	2.93
OM1RP2	53395	36022	3.07
OM1RP3	59030	41532	3.37
OM1RP4	59297	41674	3.36
OM2RP1	48892	31644	2.83
OM2RP2	51666	34293	2.97
OM2RP3	51666	34293	2.97
OM2RP4	56313	38815	3.22
Absolute control	40880	26257	2.80
S.Em±	2047	2047	012
C.D. at 5%	5884	5884	.34

FYM – Farm yard manure RP – Rock phosphate with PSB DAS – Days after sowing
NS – Non-significant PSB – Phosphorous solibilizing bacteria
LAI- Leaf Area Index TDMP- Total dry matter production