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EFFECT OF INTEGRATED PHOSPHORUS MANAGEMENT ON GROWTH, YIELD ATTRIBUTES AND YIELD OF SUMMER GREEN GRAM (*VIGNA RADIATA* L.)

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ABSTRACT

A field experiment was conducted during summer season of the year 2012. Result revealed that application of 40 kg P_2O_5 ha^{-1} from SSP significantly increased growth and yield attributes and seed yield (802 kg/ha)over control but remain at par with application 20 kg P_2O_5 ha^{-1} from SSP + PSB inoculation @ 5mL kg^{-1} seed. The highest nodule dry weight (35 mg/plant), protein content in seed (24.20%) and BCR value 3.31 was recorded with 20 kg P_2O_5 ha^{-1} from SSP + PSB followed by 40 kg P_2O_5 ha^{-1} from SSP. Which indicate that inoculation of PSB save 50 per cent inorganic phosphorus fertilizer.

INTRODUCTION

Phosphorus fertilization occupies an important place amongst the non-renewable inputs in modern agriculture. Crop recovery of added phosphorus seldom exceeds 20 per cent and it may be improve by the judicious management. As the concentration of available P in the soil solution is normally insufficient to support the plant growth, continual replacement of soluble P from inorganic and organic sources is necessary to meet the P requirements of crop (Tisdale *et al.*, 2010). Additional application of P is Increase nodule formation which increase nitrogen fixation and finally productivity of green gram (Prasad *et al.*, 2014). Organic manures play a vital role in increasing the productivity of pulses by several means. For example, FYM not only supplies all the major and micro nutrients, but also act as a soil conditioner and increase the productivity (Kamdi *et al.*, 2014). The use of PSB as biofertilizer may convert insoluble phosphorus to soluble phosphorus and make it available to the plant. *Bacillus* spp. are the most abundant P-solubilizers in the soil. Therefore, this study aiming to achieve higher efficiency of applied phosphatic fertilizers and effect of organic and inorganic sources with and without PSB inoculation. Keeping all this in view, present research problem was carried out.

MATERIALS AND METHODS

The present experiment was carried out during *summer* season 2012 on loamy sand soil of Anand Gujarat under irrigated condition with 12 treatments and 4 replications in a randomized block design. The soil of experimental plot was having 0.3 dSm^{-1} EC, 7.6 pH, 0.39 organic carbon, (Jackson, 1973) 183.4 kg available N, (Subbiah and Asija, 1956) 27.08 kg P_2O_5 (Chopra and Kanvar,1976) and 282.93 K_2O (Jackson,1973). The treatments tried were absolute control (T_1), 20 kg P_2O_5 ha^{-1} form SSP (T_2), 40 kg P_2O_5 ha^{-1} from SSP (T_3), 20 kg P_2O_5 ha^{-1} from DAP (T_4), 40 kg P_2O_5 ha^{-1} from DAP (T_5), 20 kg P_2O_5 ha^{-1} from DAP + 100 kg gypsum ha^{-1} (T_6), 40 kg P_2O_5 ha^{-1} from DAP + 200 kg gypsum ha^{-1} (T_7), 20 kg P_2O_5 ha^{-1} from DAP + 5 tonne ha^{-1} FYM (T_8), 20 kg P_2O_5 ha^{-1} from SSP + 5 tonne ha^{-1} FYM (T_9), 20 kg P_2O_5 ha^{-1} from DAP + PSB inoculation (T_{10}), 20 kg P_2O_5 ha^{-1} from SSP + PSB inoculation (T_{11}), 10 tonne ha^{-1} FYM + PSB inoculation (T_{12}). Starter dose of N @ 20 kg ha^{-1} was common for all treatments. PSB (*Bacillus coaglans*) having count of 10^8 CFU ml^{-1} were applied in in equal amount (5 ml kg^{-1} seed) in all the concerned treatments. SSP (16 % P_2O_5 and 12% sulphur), DAP (46% P_2O_5 and 18 % nitrogen) and gypsum (15% sulphur) were applied as per treatments. Green gram variety Meha was sown in 5.0 x 3.6 m plot having 30 cm row spacing.

Observations on dry root nodules was recorded in five randomly uprooted plants from each plot at 45 DAS. Plant height, branches $plant^{-1}$, pods $plant^{-1}$, pod length, seeds pod^{-1} and seed weight $plant^{-1}$ were recorded by five randomly selected tagged plants before five days to harvesting. Seed and stover yield, test weight, net realization and BCR were recorded after harvest of the crop and Protein estimation was done at laboratory.

RESULTS AND DISCUSSION

Growth attributes

The plant height at harvest was significantly affected due to different organic, inorganic and PSB treatments (Table 1). Treatment T_{11} (20 kg P_2O_5 ha^{-1} from SSP + PSB inoculation) recorded higher plant at harvest (43.7 cm). Significantly lower plant height 36.1 cm was observed under treatment T_1 *i.e.* control than other treatments. Significantly higher number of branches $plant^{-1}$ (5.15) was observed under the treatment of T_3 (40 kg P_2O_5 ha^{-1} from SSP) and significantly the lowest number of branches $plant^{-1}$ (2.80) was recorded under the treatment T_1 (Table 1). Significantly higher number of root nodule $plant^{-1}$ (35.00) was recorded in treatment T_{11} (20 kg P_2O_5 ha^{-1} from SSP + PSB inoculation) and significantly the lowest number of root nodules $plant^{-1}$ (16.63) was recorded under the treatment T_1 (control). Treatment T_{11} recorded more than double (110%) root nodules number $plant^{-1}$.The increase in growth attributes under the treatment T_{11} (20 kg P_2O_5 ha^{-1} from SSP + PSB inoculation) and T_3 (40 kg P_2O_5 ha^{-1} from SSP) could be attributed to better proliferation of roots and increased nodulation due to increased phosphorus availability. Phosphorus encourage formation of new cells, promote plant vigour and hastens leaf development, which help in harvesting more solar energy and better utilization of nitrogen, which help towards higher growth attributes. The results are in conformity with those of Chovatia *et al.* (1993), Shrinivas and Mohammad (2002) and Shukla and Dixit (1996).

Yield attributes and yield

Different organic, inorganic and PSB treatments were significantly differ in yield attributes and yield of green gram *viz.*, number of pods $plants^{-1}$, length of pod, number of seed pod^{-1} , test weight, yield $plant^{-1}$, seed yield, stover yield.

Significantly higher number of pods $plant^{-1}$ (37.60), seeds pod^{-1} (8.53) as well as seed yield $plant^{-1}$ (9.13 g) were remarkably improved due to use of different organic, inorganic and PSB treatments were recorded in the treatment T_3 (40 kg P_2O_5 ha^{-1} from S.S.P). Significantly higher length of pods (6.48 cm) was recorded (Table 1) in the treatment T_5 (20 kg P_2O_5 ha^{-1} from DAP). These parameters were lowest in control (T_1). Phosphorus play a primary role in photosynthesis by way of energy transfer and thereby increase photosynthetic efficiency resulting in increased availability of photosynthetes. These all together resulted in overall increase in yield attributes. Similar findings were reported by Pal and Jana (1991), Rajkhowa *et al.* (1992).

Seed yield (802 kg ha^{-1}) and stover yield (1921 kg ha^{-1}) were observed under the treatment T_3 (40 kg P_2O_5 ha^{-1} from SSP) than treatment T_1 (control), but was found at par with treatment T_{11} (20 kg P_2O_5 ha^{-1} from SSP + PSB inoculation), T_7, T_5 and T_{10}. The treatments T_3, T_7, T_{11}, T_5 and T_{10} increases the seed yield by 38.1%, 35.3 %, 33.4%, 31.7% and 29.3% over control, respectively. The increment in seed yield by phosphorus application was due to increase in growth attributes and yield attributes over control, which is finally contributes in seed yield. The treatments T_3, T_7 and T_5 have 40 kg ha^{-1} chemical phosphorus, while treatments T_{11} and T_{10} have only 20 kg ha^{-1} chemical phosphorus and biofertilizer (PSB) thus, these treatments reduced 50% of dose of phosphorus and gave statistically same seed yield than treatments having 100% dose of phosphorus (T_3, T_7 and T_5).

The increase of seed yield may be due to increase in P availability through solubilization of phosphate rich compound. The PSB secrete a number of organic acids which may form chalets resulting in effective solubilization of phosphate, favoured higher nitrogen fixation, dry matter accumulation, rapid growth, higher absorption and utilization of P and other plant nutrients and ultimately positive resultant effect on growth and finely yield attributes,. Similar result with half dose of chemical phosphorus through SSP with PSB were also reported by Chesti and Ali (2007).

Protein content

Protein content (24.20%) was significantly higher in the treatment T_{11} (20 kg P_2O_5 ha^{-1} from SSP + PSB inoculation) than other treatments except treatments T_3, T_7, T_5, T_4 and T_9. The lowest protein content (20.25%) was recorded in treatment T_1 (control). significant role of these treatments in root enlargement, better microbial activities resulted in more availability and uptake of nitrogen and thereby increased protein content in seed. The results are in agreement with those of Patel *et al.* (2013), Jat *et al.* (2012) and Shukla and

Table 1: Effect of different treatments on growth and yield attributes of summer green gram

Treatment	Plant height at harvest (cm)	Branch $plant^{-1}$	Pods $plant^{-1}$	Pod length (cm)	Seeds pod^{-1}	Seed weight $plant^{-1}$ (g)	Test weight (g)
T_1	36.1	2.80	14.5	5.95	6.64	3.55	32.30
T_2	39.5	3.95	23.6	6.12	7.48	5.78	34.85
T_3	41.8	5.15	37.6	6.29	8.53	9.13	36.63
T_4	41.0	3.60	22.9	6.01	6.91	5.60	35.73
T_5	41.4	5.13	32.6	6.48	7.96	8.00	36.23
T_6	41.7	3.60	27.2	6.33	7.45	6.65	34.68
T_7	42.3	4.68	33.0	6.37	8.23	8.15	36.18
T_8	40.9	3.50	21.6	5.81	6.75	5.35	33.88
T_9	40.6	3.85	23.2	5.81	6.98	5.70	34.60
T_{10}	41.5	3.85	27.1	6.43	7.13	6.70	35.20
T_{11}	43.7	4.35	29.0	6.41	7.74	7.20	36.20
T_{12}	40.2	2.95	24.5	6.00	6.85	6.05	35.25
S.Em. ±	0.89	0.20	2.01	0.12	0.12	0.49	0.69
C.D. at 5%	2.56	0.58	5.78	0.34	0.34	1.40	2.00
C.V. %	4.35	10.25	15.22	3.81	3.81	15.00	3.95

Table 2: Effect of different treatments on yield, protein content and economics of green gram

Treatment	Seed yield (kg/ha)	Stover yield (kg/ha)	Protein content (%)	Dry root nodules weight (gm)	Net return	BCR
T_1	581	1493	20.25	16.63	23659	2.67
T_2	703	1651	23.30	23.83	30385	3.01
T_3	802	1921	24.16	31.38	35955	3.25
T_4	698	1626	23.66	20.75	29922	2.97
T_5	765	1810	23.97	30.03	33287	3.05
T_6	703	1621	23.28	22.25	30220	2.99
T_7	786	1863	24.09	31.88	34231	3.06
T_8	730	1732	23.31	27.00	26776	2.31
T_9	741	1706	23.66	29.50	27497	2.35
T_{10}	751	1768	23.73	30.50	33281	3.18
T_{11}	775	1892	24.20	35.00	35082	3.31
T_{12}	705	1720	23.23	23.65	20896	1.85
S.Em. ±	21.1	53.4	0.30	1.87		
C.D. at 5%	60.7	153.6	0.85	5.38		
C.V. %	5.79	6.16	2.53	13.93		

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