The Bioscan 8(1): 149-152, 2013
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
www.thebioscan.in

RESPONSE OF *KHARIF* GREENGRAM (*VIGNA RADITA* L. WILCZEK) TO SULPHUR AND PHOSPHORUS FERTILIZATION WITH AND WITHOUT BIOFERTILIZER APPLICATION

H. R. PATEL, H. F. PATEL*, V. D. MAHERIYA AND I. N. DODIA
Department of Agronomy, C.P. College of Agriculture,
S.D. Agricultural University, Sardarkrushinagar - 385 506 Gujarat, INDIA
e-mail: hfpatel108@gmail.com

KEYWORDS
Greengram
Gypsum
Phosphorus
Biofertilizer and
protein yield.

Received on :
18.07.2012

Accepted on :
20.12.2012

***Corresponding author**

ABSTRACT
The experiment was conducted with three levels of sulphur from gypsum (0, 20 and 40kg ha^{-1}), two levels of phosphorus (0, 20, 40kg ha^{-1}) and two levels of PSB inoculation (inoculation and uninoculation) was conducted to study the response of *kharif* greengram (*Vigna radita* L. Wilczek) to sulphur and phosphorus fertilization with and without biofertilizer application . 40 kg S ha^{-1} recorded significantly maximum number of branches plant^{-1}(4.48). plant spread (34.10), number of nodules plant^{-1}(16.46), dry matter plant^{-1}(9.27g), seed yield (1486.08 kg ha^{-1}), stalk yield (2161.79 kg ha^{-1}) and protein content (22.46%) as well as gave the highest net realization (Rs.28,440 ha^{-1}) with a net ICBR (1: 27.63). Similar trend was also observed in phosphorus application. 40 kg ha^{-1} phosphorus recorded significantly maximum number of branches plant^{-1}(4.48), plant spread (34.15), number of nodules plant^{-1}(16.66), dry matter plant^{-1} (8.74), seed yield (1435.95 kg ha^{-1}), stalk yield (2197.55 kg ha^{-1}) and protein content (21.34%) as well as gave the highest net realization (Rs.26,996 ha^{-1}) with a net ICBR (1:5.03). PSB inoculation significantly affected most of the growth parameters, yield attributes and yield, quality parameters. PSB inoculation recorded significantly the highest seed yield (1350.19 kg ha^{-1}) and stalk yield (2153.29) over uninoculation, also gave the highest net return (Rs. 25180 ha^{-1}) with net ICBR (1:111.27) as compared to uninoculation.

INTRODUCTION

Pulses production is very low and become challenging problem against the requirement of increasing population of our country. The pulses availability per capita was 69.9g in 1951, by increasing in 1971, it comes to 50g and in 1982 remained only 40g and in 2005, it was 27g. The availability of pulses is very negligible at present as against required 85g day^{-1} capita^{-1} for balanced diet. To recover this deficit of production. It is high time to cultivate pulses crops scientifically with increasing area. It plays an important role in maintaining and improving the fertility status of the soil, as they have ability to fix atmospheric N symbiotically in soil through root nodules.

Greengram commonly known as 'Moongbean' or 'moong'. It contains 24.3 per cent protein fairly rich in carbohydrates and also contains small amount of riboflavin and thiamine, also rich in phosphorus and iron. It generally grown as intercrop, mixed crop and sole crop in *kharif* as well as in summer season where adequate irrigation facilities are available. Among the various production factors, optimum fertilizer management and application either in the form of organic and inorganic is one of the well established techniques for increasing crop production.

Sulphur containing amino acids like cystine, cysteine and methionine and promotes nodulation in legumes, also helps in increasing protein per cent in legumes and oil per cent in oilseeds and involved in the formation of chlorophyll that permits photosynthesis.

While among the major nutrients, phosphorus is key element in process of photosynthesis, root formation and development, growth and yield and enhancement of maturity of the crop. Phosphorus also reduces the harmful effect of excess nitrogen and imparts resistant to plants against disease. Supply of phosphorus to legume increase the number and size of root nodules and nitrogen fixing potentiality of *rhizobium*, so it essential for obtaining the higher yield of crop (Patil and Jadav, 1994).

The seed inoculation with proper strain of phosphorus solubilize bacteria is also a low cost input for enhancing yield, as it solubilize the unavailable phosphorus in to the available form, which reduce the high cost of inorganic phosphorus fertilizer (Parveen *et al*., 2002). Therefore, studies were undertaken to determine the effect of sulphur, phosphorus and inoculation of phosphorus solubilizing bacteria and its combination on greengram.

The experiment was envestigated to study the effect of sulphur, phosphorus and PSB inoculation and its interaction effect of different treatment on growth, yield and quality of greengram and to study the economics of different treatment.

MATERIALS AND METHODS

The experiment was conducted at Agronomy Instructional Farm, C. P. Collage of Agriculture, Sardarkrshinagar Dantiwada Agricultural University, Sardarkrshinagar, District: Banaskantha (North Gujarat) during *kharif* season of 2006. The climate of

Table 1: Effect of sulphur levels, phosphorus levels and bio-fertilizer application on growth parameters, yield parameters and quality parameters of greengram.

Treatments	Number of pods plant^{-1}	Length of pod (cm)	Number of seeds pod^{-1}	Seed yield plant^{-1}	Seedyield (kg ha^{-1})	Stalkyield (kg ha^{-1})	Protein content (%)
S_0 (0 kg S ha^{-1})	15.84	6.46	9.60	5.60	1136.80	1911.78	18.96
S_1 (20 kg S ha^{-1})	16.76	6.68	9.95	6.43	1314.43	2160.44	19.76
S_2 (40 kg S ha^{-1})	18.00	7.30	10.45	7.24	1486.08	2161.79	22.46
S.Em. ±	0.411	0.139	0.229	0.188	32.284	54.279	0.151
CD at 5 %	1.169	0.395	0.650	0.534	91.75	154.267	0.430
P_0 (0 kg S ha^{-1})	15.77	6.46	9.64	5.97	1229.33	2000.67	19.41
P_1 (20 kg S ha^{-1})	17.03	6.87	9.68	6.36	1272.02	2035.79	20.42
P_2 (40 kg S ha^{-1})	17.79	7.11	10.68	6.94	1435.95	2197.55	21.34
S.Em. ±	0.411	0.139	0.229	0.188	32.28	54.279	0.151
CD at 5 %	1.169	0.395	0.650	0.534	91.75	154.267	0.430
B_0 (Uninoculated)	16.34	6.60	9.65	6.14	1274.68	2000.72	20.22
B_1 (Inoculated)	17.39	7.03	10.35	6.66	1350.19	2153.29	20.57
S.Em. ±	0.336	0.114	0.187	0.154	26.359	44.318	0.124
CD at 5 %	0.954	0.322	0.531	0.436	74.917	125.959	0.351

Table 2: Economics of different treatments of sulphur levels x phosphorus levels x PSB inoculation on greengram crop

Treatment combination	Yield (kg ha^{-1})		Cost of cultivation (Rs ha^{-1})	Realization (Rs ha^{-1})		Incremental gross benefit (Rs ha^{-1})	Incremental cost(Rs ha^{-1})	ICBR	
	Seed	Stalk		Gross	Net			Gross	Net
$S_0P_0B_0$	970.40	1714.55	10178	25974	15796	-	-	-	-
$S_0P_0B_1$	1145.59	1796.99	10196	30435	20239	4443	18	246.83	245.83
$S_0P_1B_0$	1259.22	2100.00	10558	33580	23022	7226	380	19.01	18.01
$S_0P_1B_1$	1076.34	1820.00	10577	28728	18151	2355	399	5.90	4.90
$S_0P_2B_0$	1169.28	1867.64	10939	31099	20160	4364	761	5.73	4.73
$S_0P_2B_1$	1200.00	2171.50	10958	32171	21232	5436	780	6.96	5.96
$S_1P_0B_0$	1210.00	2005.00	10329	32255	21926	6130	151	40.59	3959
$S_1P_0B_1$	1350.00	2062.50	10348	35812	25464	9668	170	56.87	55.87
$S_1P_1B_0$	1199.26	1813.14	10710	31794	21084	5288	532	9.39	8.93
$S_1P_1B_1$	1370.85	2436.08	10729	36707	25978	10182	551	18.47	17.47
$S_1P_2B_0$	1357.51	2213.91	11091	36150	25059	9263	913	10.14	9.14
$S_1P_2B_1$	1398.94	2432.00	11110	36369	25259	9463	932	10.15	9.15
$S_2P_0B_0$	1280.00	2200.00	10480	34200	23720	7924	302	26.23	25.23
$S_2P_0B_1$	1420.00	2225.00	10500	37726	27226	11430	322	35.49	34.49
$S_2P_1B_0$	1326.45	2010.00	10862	35171	24309	8513	684	12.44	11.44
$S_2P_1B_1$	1400.00	2035.50	10881	37035	26154	10358	703	14.73	13.73
$S_2P_2B_0$	1700.00	2100.00	11242	44600	33358	17562	1064	16.50	15.50
$S_2P_2B_1$	1790.00	2400.06	11261	47150	35889	20093	1083	18.55	17.55

Selling price: Greengram seed = Rs. 25 kg^{-1}; Straw = Rs. 1kg^{-1}

this area is sb-tropical monsoon type. The weather condition is quite favourable for normal growth and development of the greengramcrop. In general, monsoon is warm and moderately humid; winter is fairly cold and dry, while, summer is quite hot and dry. The monsoon commences by the middle of June and retreats by the middle of September with an average rainfall of 550mm in 21 rainy days. During the experiment year, the total rainfall was received 1089 mm in 37 rainy days. The monsoon was set in 27th standard week and last up to 37th standard week. It was noticed that weather condition except rainfall was more or less normal and favourable for satisfactory growth and development of *Kharif* greengram. The rainfall during July to September months was exceptionally doubled during the investigation period.

The soil of experimental plot was loamy sand with pH (1: 2.5) 7.80, EC (dSm-1) 0.08, Organic Carbon 0.17%, available nitrogen 149kg ha^{-1}, available P_2O_5 26.31kg ha^{-1}, K_2O 287kg ha^{-1} and available S 8.0ppm. The experiment was laid out in randomized block design with four replications, having three levels of sulphur (S_0- Control, S_1- 20kg ha^{-1} and S_2- 40kg ha^{-1}), three levels of phosphorus (P_0- Control, P_1- 20kg ha^{-1} and P_2- 40kg ha^{-1}) and two levels PSB inoculation (with and without PSB inoculation). There were total 18 treatment combinations in all. Before sowing, one half quantity of seeds were treated uniformly with PSB culture having the microbial count of 108 and remaining half quantity of seed was not treated with PSB culture then greengram seeds were dried in the shade. Common dose and sulphur (Gypsum S – 18.5 %) were applied 15 days before sowing as per S receiving treatments and at the time of sowing entire quantity of phosphorus (DAP) was applied as per P_2O_5 receiving treatments. The crop was uniformly fertilized with 20kg N ha^{-1} in the form of urea as basal dose to each treatment. Seed of cv. 'GM-4' were sown at 3 to 4cm depth with 45cm spacing at 1st week of July, 2006. All the recommended cultural and plant protection measures were followed throughout the experimentation. The data on growth and yield parameters and seed, stalk yield and Protein content (%) were recorded and economics was also worked out.

RESULTS AND DISCUSSION

The yield attributes like number of pods plant^{-1}, length of pod and number of seeds pod^{-1} were progressively enhanced due to application of sulphur. An application of 40kg ha^{-1} sulphur level recorded significantly highest number of pods plant^{-1} (18.00), length of pod (7.30cm) and number of seeds pod^{-1} (10.45) followed by 40kg ha^{-1} sulphur level and control. The increase in these yield attributing characters might be due to the important role in sulphur in energy transformation, activation of number of enzymes and also in carbohydrate metabolism. Supply of sulphur in adequate and appropriate amount helps in flower primordial initiation for its reproductive part, which govern number of pods plant^{-1}, length of pod, number of seeds pod^{-1} (Dey and Basu, 2004; Singh and Yadav, 2007). Similarly, seed yield plant^{-1}, seed yield and straw yield were found significant. 40kg ha^{-1} sulphur level recorded significantly highest seed yield plant^{-1} and seed yield (1435.95 kg ha^{-1}) over 40kg ha^{-1} sulphur level and control, as well as observed significantly higher straw yield (2161.79kg ha^{-1}) over control but it is at par with 20kg ha^{-1} sulphur. The application of S and Ca through Gypsum might have encouraged yield attributes, total biomass and pod development, as a resultant effect there was increase in yield, similar results are reported by Bapat *et al*. (1986).

Protein content was found significant at different level of sulphur. As sulphur level increased, there was significant progressive increase in protein content (%). 20kg ha^{-1} and 40kg ha^{-1} sulphur levels increased protein content by 4.21 and 18.45 per cent respectively over control. It is due to increased availability of sulphur and thus nitrogen availability was increased. Sulphur also synthesized some sulphur containing amino acids like cystine, cysteine and methionine, thus resulting in increase in the synthesis of protein (Shahi, 2002; Srinivasan *et al*. 2001).

The phosphorus application had shown marked influence on yield attributes like number of pods plant^{-1}, length of pod and number of seeds pod^{-1}. The 40kg P_2O_5 ha^{-1} level of phosphorus recorded significantly higher number of pods (17.79) plant^{-1} and length of pod (7.11) over the control, but it was at par with 20kg P_2O_5 ha^{-1}. Similarly, 40kg P_2O_5 ha^{-1} level produced significantly the higher number of seeds (10.68) pod^{-1} as compared to rest of the levels. The favorable effect of phosphorus application on above characters was mainly due to its primary role in photosynthesis by way of rapid energy transfer and thereby increased photosynthetic efficiency and thus increased the availability of photosynthesis. These resulting increased in total biomass production and there translocation in plant parts. These altogether resulted in to overall increase in above three characters (Yadav, 2004; Singh and Pareekh, 2007). Similarly, 40kg P_2O_5 ha^{-1} level of phosphorus produced significantly the highest seed yield (6.94g) plant^{-1}, seed yield (1435.95kg ha^{-1}) over rest of the phosphorus levels, which were 20kg P_2O_5 ha^{-1} and control levels found at par with each other. While in case of straw yield, 20kg P_2O_5 ha^{-1} recorded significantly highest (2197.95kg ha^{-1}). The average increase in seed yield plant-1 under 20kg P_2O_5 ha^{-1} and 40kg P_2O_5 ha^{-1} levels was 6.53and 16.24 per cent, in case of seed yield was 3.43 and 16.80 per cent and increase in straw yield 9.84 and 8.08 per cent over control.

Protein content was found significant at different level of phosphorus in similar trend like sulphur. 40kg ha^{-1} phosphorus application observed significantly highest protein content (21.34 %) then 20kg ha^{-1} and control. The differences were significant at each level. This might be due to phosphorus promotes root growth and thus increase the uptake of nitrogen, which resulted in increased protein content. This result found similar with Jain *et al*. (1987); Patel and Patel (2006).

There were number of pods (17.39) plant^{-1}, length of pod (7.03cm), number of seeds (10.35) pod^{-1}, seed yield (6.66g) plant^{-1}, seed yield (1350.19kg ha^{-1}) and straw yield (2153.29kg ha^{-1}) recorded significant with PSB inoculation over un-inoculation. The increase in values of above yield attributes and yield was 6.42, 5.51, 7.25, 7.76, 5.92, 7.51 and 3.60 per cent under PSB inoculation over un-inoculation significantly. This was might be due to inoculation with PSB, increased availability of P and favored 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 yield attributes, which led to increase the value of yield attributes and yield. This result was similar with Mitra *et al*. (1999); Rusal (2007).

PSB inoculation did not exert any significant effect on protein content. PSB inoculation increases 1.73 per cent protein content over un-inoculation.

Data in Table 2 indicate that the 40kg ha^{-1} sulphur with 40kg ha^{-1} phosphorus and PSB inoculation recorded highest seed yield (1790.00kg ha^{-1}) and straw yield (2400.06kg ha^{-1}) with highest net return of Rs. 35889, along with net ICBR 1:17.55, followed by 40kg ha^{-1} sulphur with 40kg ha^{-1} phosphorus and uninoculation. The lowest figure of seed yield (970.40), straw yield (1714.55), net-returns (15796) was recorded under $S_0P_0B_0$ (40kg S ha^{-1} + 40kg P ha^{-1} + uninoculation).

REFERENCES

Bapat, P. N., Sinha, S. B. and Sindhe, D. A. 1986. Effect of sulphur and phosphorus on yield and nutrient content of blackgram. *J. Indian Soc. Soil Science.* **34:** 82-86.

Dey, J. and Basu, T. K. 2004. Rsponce of greengram to different levels of potassium and sulphur with regards to growth, nodulation, field and quality. *Indian Agriculturist*. **48(3/4):** 161-165.

Jain, P. C., Jain, V. K., Chauhan, V. S. and Sharma, P. 1987. Effect of different levels of phosphorus and potash on growth and development of greengram. *Indian J. Agri. Res.* **21(4):** 225-229.

Mitra, S., Singh, H. G. and Dhar, R. 1999. Effect of roc phosphate and PSB on growth and yield of greengram in acid soils of Tripura. *Environment and Ecology*. **17(4):** 926-930.

Parveen, S., Mohammad Sagir, K. and Almas, Z. 2002. Effect of rhizospheric microorganisms on growth and yield of greengram. *Indian J. Agri. Sci.* **72(7):** 421-423.

Patel, F. M. and Patel, L. R. 2006. Response of greengram variety to phosphorus and rhizobium inoculation. *J.Farming System Res. and Develop*. **8(1):** 29- 32.

Patil, B. P. and Jadav, M. S. 1994. Effect of fertilization and rhizobium on yield of greengram on medium black soil of Konkan. *J. Indian Soc. of Coastal Agri. Res.* **12(1):**17-22.

Rusal, P. H. 2007. Effect of phosphomicrobials and rhizobium on greengram. *Madras Agri. J.* **93(6):** 399-404.

Shahi, D. K. 2002. Efeect of fertilization and seed inoculation on yield and quality of green (*Vigna radiate* (L.) Wilezek). *B. H. Agri. Univ. Res. J.* **14(1):** 21-24.

Singh, B. and Pareek, R. G. 2007. Effect of phosphorus and biofertilizers on growth and yield of moongbean. *Indian J. Pulse Res.* **22(1):** 31-33.

Singh, U. and Yadav, D. S. 2007. Studies on sulphur and zinc nutrition on greengram. *Legume Research*. **31(3/4):** 224 -226.

Srinivasan, K., Sankran, N. and Prabhakaran, J. 2001. Influence of sulphur application on nodulation and protein content of blackgram. *Madras Agri. J.* **87(7/9):** 456-458.

Yadav, S. S. 2004. Effect of sulphur and phosphorus on growth and yield of greengram. *Haryana Agri. Univ. Res. J.* **20(1/2):**10-12.