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EFFECT OF FYM, PHOSPHORUS AND SULPHUR ON YIELD OF SUMEER BLACKGRAM AND POST HARVEST NUTRIENT STATUS OF SOIL

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ABSTRACT
An experiment conducted to study the "effect of farm yard manure, phosphorus and sulphur on yield of summer blackgram and post harvest status of nutrients under South Gujarat condition at college farm, Navsari Agricultural University, Navsari during summer 2013." Plant height at 60 DAS and harvest, number of branches, seed (1149 kg/ha) and stover (2652 kg/ha) yields of blackgram were recorded significantly higher under the incorporation of 5 t FYM/ha over control. The protein content, protein yield, organic carbon content, available nitrogen and phosphorus status of soil were also found significantly higher under same treatment. Phosphorus applied @ 40 kg/ha was recorded significantly superior plant height at 60 DAS and harvest, number of branches, number of pods/ plant, number of seeds/ pod, length of pod, grain (1171 kg/ha) and stover (2667 kg/ha) yields as well as protein yield (232.10 kg/ha) of blackgram and available phosphorus in soil (41.97 kg/ha) over control. Significantly the higher plant height at 60 DAS and harvest, number of branches/plant, number of pods/ plant, seeds/ pod, grain (1153 kg/ha), stover (2548 kg/ha) as well as protein yield of blakcgram and available S (21.63 ppm) in soil were observed under 20 kg S/ha compared to control.

INTRODUCTION

Blackgram is third important pulse crops of India and Gujarat state in particular. Among all the pulses, blackgram (*Vignamungo* (L.) Hepper) is a highly prized pulse for its biological protein value and rich in phosphoric acid. Being, a leguminous crop, blackgram fulfills major part of nitrogen requirement by symbiotic nitrogen fixation with the help of bacterium called Rhizobia (Pareek *et al.*, 1978). Therefore, adequate supply of organic manure and other nutrients is essential for proper growth and development as well as nutritional quality of blackgram. FYM is known to play an important role in improving the fertility and productivity of soils through its positive effects on soil physical, chemical and biological properties and balanced plant nutrition (Kumar *et al.*, 2011). It improves the structure and water holding capacity of soil. Due to low and unstable production and increasing the population pressure, per capita availability of pulses decreasing from 69 g in 1961 to about 31.6 g in 2010-11, against the minimum requirement of 80 g per capita per day. To make up minimum 50 g pulses per capita per day and further demand from burgeoning population at least 23.88 m tonnes of pulses are required by 2015 which is expected to touch 29.30 million tonnes by 2020. To satisfy the demand of pulses requirement of ever increasing population, the production of pulses has to be increased only by increasing the yield/unit area/day.

Phosphorus is second most critical plant nutrient, but for pulses, it assumes primary importance, owing to its important role in root proliferation and thereby atmospheric nitrogen fixation. The yield and nutritional quality of pulses is greatly influenced by application of phosphorus. It plays a key role in various physiological processes like root growth and dry matter production, nodulation and nitrogen fixation and also in metabolic activities especially in protein synthesis. It also helps in establishing seedling quickly and also hastens maturity as well as improves the quality of crop produce.

Presently, sulphur is being recognized as fourth major essential plant nutrient after nitrogen, phosphorus and potassium. Sulphur plays an important role not only in boost up the productivity but also improve the quality of the blackgram (Saraf *et al.*, 1997). It can also play important role in synthesis of sulphur containing amino acids, i.e. cystine, cysteine and metheonine, besides glutathione.

On account of perennial availability of canal water from Ukai-Kakarapar irrigation project, there are possibilities of growing blackgram in summer season instead of summer paddy in South Gujarat region. But the information pertaining agronomic aspects like application of FYM, phosphorus and sulphur is not available for summer cultivation of blackgram. Keeping in view the above consideration, the present investigation is undertaken to study the effect of FYM, phosphorus and sulphur on yield of summer blackgram

(*Vignamungo* (L.) Hepper) and post harvest nutrient status of soil under South Gujarat condition.

MATERIALS AND METHODS

A field experiment was conducted during summer season of 2013 at the college farm, Navsari Agricultural University, Navsari to study the "Response of summer blackgram (*Vignamungo* (L.) Hepper) to farm yard manure, phosphorus and sulphur under South Gujarat condition". The soil of the experimental field was clayey in texture having medium to poor drainage, low in available nitrogen, medium in organic carbon, available phosphorus and sulphur. Total twelve treatment combinations comprising of all possible treatments of two levels of farm yard manure viz., F_0 (0 t/ha) and F_1 (5 t/ha), three levels of phosphorus viz., P_0 (0 kg P_2O_5/ha), P_1 (20 kg P_2O_5/ha) and P_2 (40 kg P_2O_5/ha) and two levels of sulphur viz., S_0 (0 kg S/ha) and S_1 (20 kg S/ha) were tested in factorial randomized block design with four replications. Blackgram variety Gujarat Urad-1 was sown by opening of furrow at a distance of 45 x 10 cm. The full dose of fertilizers was applied according to the treatments manually before sowing the seeds. The sources of nitrogen, phosphorus and sulphur were urea, DAP and gypsum, respectively. All the recommended cultural practices and plant protection measures were followed throughout the experimental periods.

RESULTS AND DISCUSSION

Effect of FYM

An application of FYM @ 5 t/ha was recorded significantly higher plant height at 60 DAS (32.35 cm) and at harvest (36.73 cm) and number of branches per plant (5.02) as compared to control (Table 1). The increase in plant height and number of branches might be due to addition of FYM in to soil improved physical, chemical and biological properties of soil and this leads to improve the root growth and development and thereby uptake of nutrients and water from greater soil volume resulting in to better plant growth. The present findings are in close agreement with Ghanshyam and Jat (2010), Jat *et al.* (2012a) and Tomar *et al.* (2013).The yield attributing characters such as number of pods per plant, seeds per pod, length of pod and test weight were found to be non significant due to the application of farm yard manure. In general, higher values of all the yield attributing characters were recorded under the 5 t FYM/ha.

Mahetele and Kushwaha (2011) were also found same types of result.

Seed and stover yield of blackgramwere significantly increased due to application of farm yard manure. FYM applied @ 5 t/ha was produced significantly higher seed (1149 kg/ha) and stover yields (2652 kg/ha), which was to the tune of 10.16 and 19.08 per cent higher as compared to control. The marked increased in grain and stover yield due to beneficial effect of FYM on various growths and yield attributes like plant height and number of branches and finally their cumulative effect on yield. The above finding is in complete agreement with Ghanshyam and Jat (2010), Sharma and Abraham (2010),Shete *et al.* (2011) and Tomar *et al.* (2013).

Application of farm yard manure significantly influenced the organic carbon, available nitrogen and phosphorus status of soils but, soil pH, EC and available S were not differed significantly by farm yard manure (Table 2). Significantly higher organic carbon (0.54 %) was found due to FYM applied @5 t/ha as compared to control (0.50 %) was. It might be due to addition of FYM which directly adds organic carbon and helps to stimulate the growth and activity of micro-organisms. Jat *et al.* (2012 b) also supported these findings.

Similarly, available N (237.47 kg/ha) and P_2O_5 (40.84 kg/ha) were also recorded significantly higher under the same treatments. This may be attributed to the fact that FYM application is able to uptake only partial amount of nutrient from FYM due to slow release of nutrient from FYM besides, FYM might have led to adsorption of mineral nutrient on organic 'micelles' thereby reducing their leaching from the soil. Similar results were also reported by Raju *et al.* (1991) and Jat *et al.*(2012 a)

Table 1: Effect of FYM, phosphorus and sulphur on growth and yield attributes, yield and economics of summer blackgram

Treatment	Plant height (cm) 60 DAS	At harvest	Number of branches /plant	Number of pods /Plant	Number of seed/ pod	Length of pod (cm)	Test weight (g)	Seed yield (kg/ha)	Stover yield (kg/ha)
Farm yard manure (t/ha)									
F_0 – 0	29.04	34.37	4.77	19.83	6.03	4.51	44.63	1043	2227
F_1 – 5	32.35	36.73	5.02	20.61	6.18	4.60	45.08	1149	2652
S.Em.±	0.44	0.46	0.08	0.28	0.07	0.06	0.52	21.63	46.65
C.D. (P=0.05)	1.27	1.33	0.24	NS	NS	NS	NS	62.28	134.31
Phosphorus (kg/ha)									
P_0 – 0	28.90	33.96	4.66	19.40	5.84	4.44	44.63	1029	2182
P_1 – 20	30.73	35.30	4.84	20.59	6.23	4.49	44.94	1087	2471
P_2 – 40	32.47	37.38	5.18	20.68	6.26	4.74	45.00	1171	2667
S.Em.±	0.54	1.63	0.10	0.34	0.08	0.07	0.64	26.49	57.13
C.D. (P=0.05)	1.56	0.57	0.30	0.99	0.23	0.21	NS	76.28	164.49
Sulphur (kg/ha)									
S_0 – 0	29.58	34.03	4.62	19.51	5.92	4.47	44.29	1039	2332
S_1 – 20	31.82	37.07	5.17	20.93	6.30	4.64	45.42	1153	2548
S.Em.±	0.44	0.46	0.08	0.28	0.07	0.06	0.52	21.63	46.65
C.D. (P=0.05)	1.27	1.33	0.24	0.81	0.19	NS	NS	62.28	134.31

Table 2: Post harvest nutrient status of soil as influenced by various treatments

Treatments	EC (dS/m)	pH	Organic carbon (%)	Available N(kg/ha)	Available P_2O_5 (kg/ha)	Available S(ppm)
Farm yard manure (t/ha)						
F_0 – 0	0.41	7.7	0.50	221.36	38.54	19.60
F_1 – 5	0.42	7.8	0.54	237.47	40.84	20.93
S.Em.±	0.01	0.08	0.01	3.03	0.66	0.53
C.D. (P=0.05)	NS	NS	0.02	8.73	1.91	NS
Phosphorus (kg/ha)						
P_0 – 0	0.39	7.7	0.51	224.70	37.62	19.65
P_1 – 20	0.41	7.8	0.52	231.07	39.47	19.90
P_2 – 40	0.42	7.9	0.54	233.25	41.97	21.25
S.Em.±	0.01	0.10	0.01	3.71	0.81	0.65
C.D. (P=0.05)	NS	NS	NS	NS	2.33	NS
Sulphur (kg/ha)						
S_0 – 0	0.40	7.7	0.51	225.54	38.97	18.90
S_1 – 20	0.42	7.8	0.53	233.80	40.40	21.63
S.Em.±	0.01	0.08	0.01	3.03	0.66	0.53
C.D. (P=0.05)	NS	NS	NS	NS	NS	1.53
Interaction	NS	NS	NS	NS	NS	NS
CV %	8.56	5.17	8.05	6.46	8.17	12.80
Initial value	0.39	7.6	0.48	219.52	38.93	17.97

Effect of phosphorus

Growth, yield attributes as well as seed and stover yields were significantly influenced by various levels of phosphorus. Significantly the taller plant height was registered with the application of 40 kg P_2O_5/ha at 60 DAS (32.47 cm) and at harvest (37.38 cm) over 20 kg P_2O_5/ha and control (Table 1). The lowest plant height at 60 DAS (28.90 cm) and at harvest (33.96 cm) was recorded under control. It might be due to application of phosphorus increased photosynthesis activity of plant and helps to develop a more extensive root system and thus enables the plant to extract more water and nutrient from soil depth, resulting in better development of plant growth. The difference in number of branches per plant with respect to two lower levels of phosphorus application (P_0 and P_1) was non-significant. But, it was significantly highest with the higher levels (40 kg P_2O_5/ha) over both the treatments.The variation in the yield attributing parameters like number of pods per plant, seeds per pod and length of the pod were remarkably differed by different levels of phosphorus. Both the parameters *viz.,* number of pods per plant and seeds per pod were found significantly superior under 40 kg and 20 kg P_2O_5/ha over control. Significantly the highest length of pod (4.74 cm) was registered with the 40 kg P_2O_5/ha as compared to other treatments. In general, overall improvement in growth and yield attributing character because of phosphorus increased the photosynthesis activity of plant and helps to develop a more extensive root system and thus enables the plant to extract more water and nutrients from soil depth, resulting in better development of plant growth and yield attributes. Positive responses in terms of yield attributes due to application of phosphorus have also been reported by Vikrant *et al.* (2005), Gupta *et al.* (2006), Sharma and Rana (2006), Singh *et al.* (2006), Parmar and Thanki (2007), Thenua and Kumar (2007), Mahetele and Kushwaha (2011), Patil *et al.* (2011),Kumawat *et al.* (2013), Patel *et al.* (2013a) and Tomar *et al.* (2013).

Successive increased in phosphorus levels had significant differences on seed and stover yields of blackgram over their preceding levels. An application of 40 kg P_2O_5/ha was produced significantly higher seed (1171 kg/ha) and stover yields (2667 kg/ha) as compared to 20 kg P_2O_5/ha and control. The increase in the seed and stover yield of blackgram with increase in the levels of phosphorus may be attributed to better vegetative growth as observed by taller plant height, more number of branches and increased in yield attributes like number of pods per plant, seeds per pod and length of pod resulted in higher seed and stover yield. The results were supported by the findings Vikrant *et al.* (2005), Singh *et al.* (2006), Parmar and Thanki (2007), Thenua and Kumar (2007), Mahetele and Kushwaha (2011), Patil *et al.* (2011), Kumawat *et al.* (2013), Patel *et al.* (2013a) and Tomar *et al.* (2013).

The various levels of phosphorus application did not manifest their significant influence on post harvest nutrient status of soil (Table 2), except available phosphorus in soil. Significantly higher values of available phosphorus (41.97 kg/ha) was recorded with the application of 40 kg P_2O_5/ha as compared to 20 kg P_2O_5/ha and control. The lowest available phosphorus was recorded under control (37.62 kg/ha), which was at par with 20 kg P_2O_5/ha. The available P status of the soil after harvest of blackgram was improved might be due to residual effect of phosphatic fertilizer. Almost similar findings were also reported by Raju *et al.* (1991), Sharma and Rana (2006), Thenua and Kumar (2007), Ghanshyam *et al.* (2010) and Singh and Singh (2012).

Effect of sulphur

Application of sulphur was manifest their significant differences on growth and yield attributes. Significantly taller plant height of 31.82 cm at 60 DAS and 37.07 cm at harvest and maximum number of branches per plant (5.17) were recorded by sulphur applied @ 20 kg/ha over control. The increase in the plant height at 60 DAS, at harvest and number of branches per plant were up to the tune of 7.57, 8.90 and 11.90 per cent, respectively due to 20 kg S/ha over control. This might be as a

sulphur, being a fourth major nutrient, might have play an important physiological role by enhancing the cell division and multiplication, elongation and chlorophyll biosynthesis, which in turn to better plant height and branches per plant. Almost similar findings were also reported by Marko *et al.* (2013) and Ramawtar *et al.* (2013). An application of 20 kg S/ ha was registered significantly higher number of pods per plant (20.93) and number of seeds per pod (6.30) than control. Statistically non significant, but numerically higher values of length of pod and test weight of blackgram were reported under same treatment. The increase in yield attributes under sulphur fertilization is obvious that sulphur improve overall nutritional environment of the rhizosphere as well as in the plant system, which in turn enhanced the plant metabolism and photosynthetic activity resulting in to better growth and yield attributes of plant. Seed (1153 kg/ha) and stover (2548 kg/ha) yield of blackgram were produced significantly higher with 20 kg S/ha over control (Table 2). Improvement in the yield might have resulted from significant and progressive effect of sulphur on growth and yield attributes and efficient and grater partitioning of metabolites and adequate translocation of nutrient to developing structure. The present results closely resembled with those Prajapat *et al.* (2011), Tripathi *et al.* (2011), Bairwa *et al.* (2012), Marko *et al.* (2013), Patel *et al.* (2013a), Patel *et al.* (2013b) and Ramawtar *et al.* (2013).

Nutrients status (Table 2) of soil after harvest of summer blackgram was not significantly influenced by sulphur, except the available S. However, numerical higher value of soil pH, EC, organic carbon content, available nitrogen and phosphorus were registered due to application of 20 kg S/ha. Available sulphur in soil was significantly increased with the application of 20 kg S/ha over control. This could be due to higher mobilization S. This indicates that crop might not have been utilized the available sulphur native to the soil. These findings lend support to the report of Venkatesh *et al.* (2006).

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