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Thakor Bharvi K
N.M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat, India

Surve Vaishali
N.M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat, India

Singh Narendra
N.M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat, India

Deshmukh SP
N.M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat, India

Corresponding Author:
Thakor Bharvi K
N.M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat, India

Effect of summer green gram [*Vigna radiata* L.] varieties, sulphur levels and fertilizer levels on quality, nutrient content and uptake under south Gujarat condition

Thakor Bharvi K, Surve Vaishali, Singh Narendra and Deshmukh SP

Abstract
A field experiment was conducted during the summer season of 2019 at the College Farm, Navsari Agricultural University, Navsari, to study the "Effect of Summer Green gram (*Vigna radiata* L.) varieties Sulphur levels and Fertilizer levels on quality, nutrient content, and uptake under South Gujarat condition". The soil of the experimental field was clayey in texture having medium to poor drainage capacity, good water holding capacity, low in available nitrogen, low in available phosphorus, high in available potassium and low in available sulphur and slightly alkaline in reaction. Total twelve treatment combinations consisting of three levels of varieties (V1: GAM-5, V2: GM-6 and V 3: GM-7), two levels of sulphur (S1: without sulphur and S2: with sulphur @ 20 kg/ ha) and two levels of fertilizer treatment (F1:75% RDF and F2:100% RDF) were evaluated in factorial randomized block design with three replications. The results revealed that green gram variety GM-7 with sulphur application 20 kg/ ha along with a full recommended dose of fertilizer (20:40:00 NPK kg/ ha) improve the nutrient status of soil and it also maintains the fertility status of soil because green gram is considering a soil restoring crop.

Keywords: Green gram varieties, sulphur, RDF, nutrient content and uptake, RDF: Recommended dose of fertilizer

Introduction
Green gram is an excellent source of high-quality protein (25%) having high digestibility. Pulses can also be called as "mini fertilizer factory" as they fix atmospheric nitrogen 30 - 40 kg/ ha through symbiosis. It is tolerant of drought. It is consumed as whole grains as well as "Dal" in a variety of ways in our food. Sprouted green gram is used in the preparation of curry or a savory dish (South India). It is supposed to be easily digestible and hence the patients prefer it. It is also a good source of Riboflavin, Thiamine and Vit. C (Ascorbic acid). Green gram is also used as a green manure crop. I t also helps in preventing soil erosion. Being a short duration crop, it fits well in many intensive crop rotations. Green gram can be used as feed for cattle. It is grown in an area of 3.44 million ha with a total production of 1.4 million tonnes and productivity of 407 kg/ha (Anon., 2017 a) [2]. In Gujarat, it is cultivated in about 2.3 lakh hectares with an annual production of 1.21 lakh tonnes and average productivity of 526 kg/ha (Anon., 2017 b) [3].

The levels of N and P are high in green gram play an important role in its growth, development, high yield and significantly affect many green gram traits. Increasing the application of N fertilizer during the early growth period promotes vegetative growth and creates conditions favoring high yield. As the plant grows, the rhizobia increase and its ability to fix atmospheric nitrogen improve; however, during the late growth period, rhizobia activity inhibited if excess N fertilizer is applied Phosphorus is one of the major nutrients essential for the growth and development of plants. Being an energy bond compound plays an important role in the metabolism of a plant in the structural component of metabolically active compounds present in the plant. I t is needed by the leguminous crops for rapid and healthy root development. It hastens maturity and increases the rate of nodulation and pod development (Rani *et al.*, 2017) [13]. Phosphorus fertilizer promotes disease resistance, drought tolerance, and enhances nutrient and water absorption in the seedlings after they have depleted their endosperm reserves. Sulphur has a role in the growth and development of the crop in legumes. Sulphur increases crop yields and improve product quality. Both of which are important for determining the market price. Therefore, it becomes imperative to test the role of varieties, sulphur levels and fertilizer levels in green gram. With this background information, the present experiment was planned at the College Farm, Navsari Agricultural University, Navsari, Gujarat.

Materials and methods

The field experiment was conducted during the summer season of the year 2019 at College Farm, N.M.College of Agriculture, Navsari Agricultural University, Navsari, Gujarat. The experimental soil was clay in texture, low in available nitrogen (227.64 kg/ha), low in available phosphorus (20.47 kg/ha), high in available potassium (282.28 kg/ha), low in available sulphur (8.96 kg/ha) and slightly alkaline in reaction (pH 7.50). Total twelve treatment combinations consisting of three levels of varieties (V1: GAM-5, V2: GM-6 and V3: GM-7), two levels of sulphur (S1: without sulphur and S2: with sulphur @ 20 kg/ha) and two levels of fertilizer treatment (F1: 75 % RDF and F2: 100 % RDF) were evaluated in factorial randomized block design with three replications. Greengram varieties were sown with the spacing of 45 cm x 15 cm on 16th February and harvested on 14th May 2019. Other cultural practices and plant protection measures were taken as per recommendations. The data on seed and stover yield was recorded from the net plot and converted on a hectare basis. The nitrogen content in green gram seed was estimated by micro Kjeldahl's method as described by Jackson (1973) [8]. The protein content of the seed was computed by multiplying the nitrogen percentage with 6.25 for each treatment. Chemical studies about nitrogen, phosphorus, potassium and sulphur content and their uptake by seed and stover and available nitrogen, phosphorus, potassium and sulphur status in the soil after harvest of the crop were determined as per different methods viz., Alkaline $KMnO_4$ method (For N), Wet digestion (Diacid) Vanado molybdo phosphoric acid yellow colour method (for P), Flame photometric method (for K) and Turbidiometric method (for S). The data were analyzed statistically by adopting the standard procedures described by Panse and Sukhatme (1985) [9]. The purpose of the analysis of variance was to determine the significant effect of treatments on green gram.

Results and discussion

Effect of varieties

Protein content in seed, as well as N, P, K and S contents in seed and stover were not differed significantly due to different varieties. However, significantly higher protein yield (231. 00 kg/ha) as well as significantly highest uptake of N, P, K and S by seed (36. 69, 7.47, 9.35 and 7.22 kg/ha, respectively. While significantly highest N, K and S uptake by stover (14.10, 38.69 and 5.10 kg/ha, respectively) were recorded under variety GM-7 (V3) (Tables 1 and 2). Similar results were also observed by Ahmad *et al*. (2003) [1] in mungbean reported a similar trend of variety.

Effect of Sulphur level

Protein content in seed, as well as N, P, K and S contents in seed and stover were not differed significantly due to sulphur levels. However, significantly higher protein yield (202.02 kg/ha) as well as significantly highest uptake of N, P, K and S by seed (32.32, 6.30, 8.05 and 6.26 kg/ha) respectively. While significantly highest N and S uptake by stover (13.08 and 4.94 kg/ha, respectively) were recorded under with application of sulphur @ 20 kg/ha (S2) as compared to without sulphur (S_1). Nowadays, sulphur is the most important 4th major essential nutrient after N, P and K. Sulphur is essential for protein synthesis. The quality of grain increase with protein percentage. Sulphur also promotes nodulation in legumes by fixing atmospheric nitrogen (Singh *et al*., 2017) [14] (Tables 1 and 2). These results supported the observations made by Patel *et al.* (2010) [11], Patel *et al.* (2013) [12], Banik and Sengupta (2014) [6] and Bairwa *et al*. (2014) [5] in green gram.

Effect of Fertilizer levels

Protein content in seed, as well as N, P, K and S contents in seed and stover, were not differed significantly due to fertilizer levels. However, significantly higher protein yield (201.89 kg/ha) as well as significantly highest uptake of N and P by seed (32.33 and 6. 22 kg/ha) respectively. While significantly highest N, P, K and S uptake by stover (13.13, 6.12, 36.08 and 5.12 kg/ha, respectively) were recorded under 100 % RDF (F2) as compared to 75 % RDF (F1) (Tables 1 and 2). Nitrogen application to mungbean crop improves grain protein percentage. These results supported the observations made by Banik *et al.* (2014) [6], Gorade *et al.* (2014) [7], Bahadur and Tiwari (2014) [4], Patel *et al*. (2016) [10] and Varma *et al*. (2017) [15] in green gram.

Interaction Effect

All quality parameters, nutrient content and uptake by seed and stover were found non-significant. Similar findings obtained by Patel *et al*. (2013) [12] in green gram and Banik and Sengupta (2012) in green gram and Varma *et al*. (2017) [15] in green gram.

Table 1: Quality parameters and nutrient content of summer green gram as influenced by varieties, sulphur levels and fertilizer levels

Treatments	Protein content (%)	Protein yield (kg/ha)	N content %		P content %		K content %		S content %	
			Seed	Stover	Seed	Stover	Seed	Stover	Seed	Stover
A)Varieties										
V_1: GAM-5	21.08	151.66	3.37	0.63	0.66	0.31	0.86	1.78	0.65	0.21
V_2: GM-6	20.67	187.37	3.31	0.63	0.65	0.31	0.85	1.77	0.64	0.23
V_3: GM-7	21.94	231.00	3.51	0.68	0.71	0.32	0.89	1.89	0.69	0.25
S.Em±	0.66	6.58	0.11	0.02	0.01	0.006	0.02	0.05	0.02	0.013
CD at 5 %	NS	19.31	NS	NS	NS	NS	NS	NS	NS	NS
B) Sulphur levels										
S_1:Without sulphur	20.59	178.00	3.36	0.63	0.66	0.30	0.85	1.80	0.64	0.24
S2: With sulphur (20 kg/ha)	21.87	202.02	3.50	0.66	0.68	0.31	0.87	1.81	0.68	0.25
S.Em±	0.54	5.38	0.09	0.02	0.01	0.005	0.02	0.04	0.01	0.010
CD at 5 %	NS	15.77	NS	NS	NS	NS	NS	NS	NS	NS
C)Fertilizer levels										
F_1: 75 % RDF	20.02	178.13	3.27	0.63	0.67	0.31	0.86	1.78	0.65	0.23
F_2: 100 % RDF	20.44	201.89	3.52	0.65	0.68	0.31	0.87	1.83	0.66	0.26
S.Em±	0.54	5.38	0.09	0.02	0.01	0.005	0.02	0.04	0.01	0.010
CD at 5 %	NS	15.77	NS	NS	NS	NS	NS	NS	NS	NS

Interaction	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CV %	10.82	11.98	9.95	10.05	7.78	8.57	7.79	9.16	7.97	9.86

Table 2: Nutrient uptake of summer green gram as influenced by varieties, sulphur levels and fertilizer levels

Treatments	N uptake (kg/ha)		P uptake (kg/ha)		K uptake (kg/ha)		S uptake (kg/ha)	
	Seed	Stover	Seed	Stover	Seed	Stover	Seed	Stover
A)Varieties								
V_1: GAM-5	24.26	11.71	4.75	5.82	6.18	33.44	4.67	4.30
V_2: GM-6	30.02	11.70	5.90	5.80	7.70	33.13	5.84	3.94
V_3: GM-7	36.69	14.10	7.47	6.56	9.35	38.69	7.22	5.10
S.Em±	1.05	0.41	0.18	0.46	0.46	1.05	0.19	0.21
CD at 5 %	3.09	1.21	0.50	NS	0.72	3.06	0.55	0.55
B) Sulphur levels								
S_1:Without sulphur	28.50	11.93	5.73	5.76	7.31	33.97	5.56	4.52
S_2: With sulphur (20 kg/ha)	32.32	13.08	6.30	6.13	8.05	35.79	6.26	4.94
S.Em±	0.86	0.33	0.15	0.38	0.21	0.85	0.15	0.23
CD at 5 %	2.52	0.99	0.41	NS	0.59	NS	0.45	0.48
C)Fertilizer levels								
F_1: 75 %RDF	28.52	11.87	5.83	5.86	7.47	33.70	5.80	4.35
F_2: 100 % RDF	32.33	13.13	6.22	6.12	8.00	36.08	6.03	5.12
S.Em±	0.86	0.33	0.15	0.38	0.21	0.85	0.15	0.23
CD at 5 %	2.52	0.99	0.41	1.058	NS	2.47	NS	0.38
Interaction	NS	NS	NS	NS	NS	NS	NS	NS
CV %	12.00	13.45	9.81	13.59	11.25	11.25	11.01	12.68

Conclusion

From the experimental results, it can be learned that green gram variety GM-7 with sulphur application 20 kg/ha along with a full recommended dose of fertilizer (20:40:00 NPK kg/ha) improve the nutrient status of soil and it also maintains the fertility status of soil because green gram is considering a soil restoring crop.

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