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Fertilization and Chemical Elicitors Response on Nodulation, Yield and Quality of Mungbean Seed and Fodder

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ABSTRACT: A field trial was experimented at Agronomy farm, S.K.N. college of agriculture, Jobner, Jaipur (Rajasthan). Results revealed that fertilization of 75% recommended dose of fertilizer (RDF) (15-30 N-P_2O_5 kg/ha) obtained more number of total nodules (19.88) and effective number of nodules/plant (17.88), fresh (103.4 mg/plant) and dry weight (59.27 mg/plant) of nodules, number of branches/plant and yield as compared to water spray (control) and 10-20 N-P_2O_5 kg/ha (50% RDF) and it remained at par with 20-40 N-P_2O_5 kg/ha (100% RDF). Among elicitors, 500 ppm thiourea significantly increased number of total nodules (20.4) and effective nodules/plant (18.22), fresh (103.96 mg/plant) and dry weight (60.72 mg/plant) of nodules, branches/plant at 50 DAS (8.9) and harvest stage (9.30) and yield over sole application of salicylic acid and control while, remained at par with application of salicylic acid + 2% at flower initiation. Quality parameters *i.e.* phosphorus concentration (%) & uptake (kg/ha) and potassium uptake in grain and straw also significantly affected by 75% RDF and foliar spray of 500 ppm thiourea. However, application of 75% RDF along with 500 ppm thiourea proved superior to enhance growth and quality of mungbean under semiarid condition.

Keywords: Fertilization, Elicitors, Nodulation, Thiourea (TU).

INTRODCTION

Mungbean/Green gram [*Vigna radiata* (L.)] is a *kharif* as well as summer season crop belongs to family leguminosae. It contains of high quality protein (24.5%) (Ihsan *et al*., 2013). It sown under in arid and semi arid conditions where abiotic stress condition frequently occurs during crop season. India is its primary origin and is mainly cultivated in East Asia. Mungbean crop is the 3rd important crop in pulses grown in nearly 16 % of the total area for pulses in India. It is grown about area of 4.51 m ha and the production of 2.52 m t with a productivity of 548.0 kg/ha (Anonymous, 2020).

Starter dose of nitrogen required for starting growth pattern and further development of legume. Application of more dose of nitrogen (N) can decrease number and growth of nodule leads to harmfully affect the fixation capacity of nitrogen. Phosphorus helps in better nodulation, root growth and development. The various abiotic stresses mainly drought and high temperature affected mungbean production. Under this situation, applied fertilizer is no fully advantageous utilize. Both these stresses cause harmful impacts on the physiology, and reproduction process of plant (Traub *et al*., 2017) resulting decline a substantial crop yields. Application of elicitors (thiourea and salicylic acid) stimulate defense mechanisms in plants under abiotic stress conditions and modulate photosynthesis, nitrogen metabolism, proline metabolism, internally indicating to trigger plant siege in opposition of pathogens; an enhanced carbon dioxide assimilation, rate of photosynthetic and maximized mineral uptake and plant water relations during different plant developmental stages of the stressed plant (Waqas *et al*., 2019). Hence, agrochemicals might prove beneficial in crop tolerance and higher production.

MATERIALS AND METHODS

The trial was conducted at Agronomy farm, S.K.N. College of Agriculture, Jobner. Jobner is situated at 26°05' North latitude (N. Lat.), 75° 28' E. longitude and at an altitude of 428 meters (geographically) beyond mean sea level. The weather parameters obtained from the college meteorological observatory. The physic-chemicals properties of soil during experiment showed in Table 1. The applied treatments comprising of four

fertilization *i.e.* control, 50% recommended dose of fertilizer (10-20 N-P_2O_5 kg/ha), 75% RDF (15-30 N-P_2O_5 kg/ha), 100% RDF (20-40 N-P_2O_5 kg/ha) and elicitors *i.e.* control, salicylic acid (SA) at 75 ppm at flower initiation (FI) and 7 days after first spray, salicylic acid of 75 ppm with 2% urea at FI and thiourea of 500 ppm at FI. The mungbean was sown with seed rate of 18 kg ha^{-1} on 6th July of 2017 (plot size was 4 m × 3.6 m). Fertilizers (Nitrogen and phosphorus) were used as per recommended treatment through diammonium phosphate (DAP) and urea at the time of sowing. TU and SA treatments were applied as foliar spray with 500 liter water/ha. For observation on the number of nodules on root /plant at 40 DAS, 3 plants in each plot of experiment were randomly chosen and removed them meticulously after wetting the soil and pickings the soil upto depth of 30 cm. The sampled plants were isolate with soil and the clung soil was bathed with a fine jet of water. The nodules were extracted with the assist of forcep, numbered and the mean of 3 plant nodules was listed in number of nodules/plant. Other observations recorded as par standard methods.

Table 1: Physical and chemical properties of soil.

Textural class	Available N (kg/ha)	Available P_2O_5 (kg/ha)	Available K_2O (kg/ha)	Organic carbon (%)	pH (1 : 2 soil water suspension)
Loamy sand	128.3	16.23	154.26	0.18	8.2

RESULTS AND DISCUSSION

A. Effect on nodulation

The presented data indicate that supply of fertilizer levels influenced significantly in producing total, effective nodules/plant as well as fresh weight and dry weight of nodules (Table 2). The highest total (20.40) and effective (18.37) nodules per plant were obtained under 20 kg N + 40 kg P_2O_5/ha which was significantly superior to level of 50% RDF and water spray which was at par with 75% RDF. Highest fresh (104.80 mg/plant) and dry weight (60.47 mg/plant) of nodule/plant were obtained under 100% RDF (20-40 N-P_2O_5 kg/ha). These results are in obedience with data of Singh *et al.* (2017); Verma *et al.* (2017). It might be as-a-result-of phosphorus fertilizer application which enhanced healthy root initiation, growth and lateral fibrous root formation and also essential for nodulation as well as N_2 fixation. Among elicitors, highest total and effective nodules on root/plant was listed under TU@500ppm at flower initiation (20.4), respectively that was on par to joining spray of SA @ 75 ppm and 2% urea at FI (Table 2). Foliar spray of sole SA @ 75 ppm at FI and 7 days after first spray was at par with combination spray of SA @ 75 ppm along with 2% urea. Minimum number of nodules was obtained under control plot (water spray). Similarly, the dry (60.72 mg/plant) and fresh weight (103.96 mg/plant) of nodule recorded maximum in thiourea 500ppm at flower initiation. Results closely conformity with study of Singh (2007) who finds that seed drenching and foliar spray of 1000 ppm thiourea indicated significantly more growth in respect of number and dry weight of root nodules/plant of mothbean over control.

Table 2: Effect of fertilization and elicitors on nodulation in mungbean plant.

Treatments	Number of nodules		Weight of nodules (mg/plant)	
Fertilization	**Total number of nodules**	**Effective number of nodules**	**Fresh nodules**	**Dry nodules**
Control (no fertilization)	15.96	13.67	88.29	50.36
50% RDF	18.58	16.58	96.39	55.35
75% RDF	19.88	17.8	103.40	59.27
100% RDF	20.40	18.37	104.80	60.47
S Em±	0.411	0.36	2.18	1.23
CD (P = 0.05)	1.187	1.04	6.30	3.57
Elicitors				
Control (Water spray)	16.4	14.52	89.58	50.13
SA @ 75 ppm at FI and 7 days after first foliar spray	18.59	16.4	98.18	56.15
SA @ 75 ppm + 2% Urea at FI	19.46	17.28	101.17	58.45
Thiourea @ 500 ppm at FI	20.4	18.22	103.96	60.72
S Em±	0.41	0.36	2.18	1.23
CD (P = 0.05)	1.18	1.04	6.30	3.57

B. Effect on numbers of branches/plant and yield

The branches of mungbean were substantially affected due to levels fertilization. Application of 15-30 N-P_2O_5 kg/ha produced markedly higher branches (8.79 at 50 DAS and 9.05 at harvest stage) over 10-20 N-P_2O_5 kg/ha and control (water spray) with the % extent of 7.3 and 26.6 (50 DAS) & 7.5 and 29.1 (at harvest), respectively. Increased availability of nitrogen and phosphors, enhanced number and size of cell resulting to better growth. Nitrogen stimulates photosynthetic rate and by-which increase fulfill of carbohydrates to

plant. Similarly, optimum supply of phosphorus acts an important role in the keeping and transfer of energy in the biochemical reactions of alive cells including biological energy conversions. The results are conformity report made by Raof *et al*. (2015); Singh *et al.* (2017); Dongare *et al.* (2016); Rahman *et al.* (2016). Application of 60 kg P_2O_5/ha along with basal dose of 20 kg N + 30 kg K_2O/ha recorded significantly branches per plant in green gram (Luikham *et al.*, 2005). Each graded level of fertilization up to 75% RDF enhanced the grain yield of mungbean which was higher by 3.34 qtl/kg as compared to control. Fertilizing the crop with 75% RDF recorded the mungbean straw yield of 22.79 qtl/ha which was markedly higher than control (18.67 qtl/ha) and 50% RDF (21.25 qtl/ha) and remained on par to 20-40 N-P_2O_5 kg/ha (23.41 qtl/ha). Application of 20-40 N-P_2O_5 kg/ha recorded the maximum biological yield (34.74 qtl/ha) closely followed by 75% RDF (3356 kg/ha) and both these treatments were found statistically on par to each other but substantially higher over 10-20 N-P_2O_5 kg/ha and control. The magnitude increase in biological yield (Grain and straw yield) due to 15-30 N-P_2O_5 kg/ha was 7.5 and 2.9 qtl/ha over control and 50% RDF, respectively. Dongare *et al.* (2016); Rahman *et al.* (2016); Manoj *et al.* (2014) also notified the results of this study.

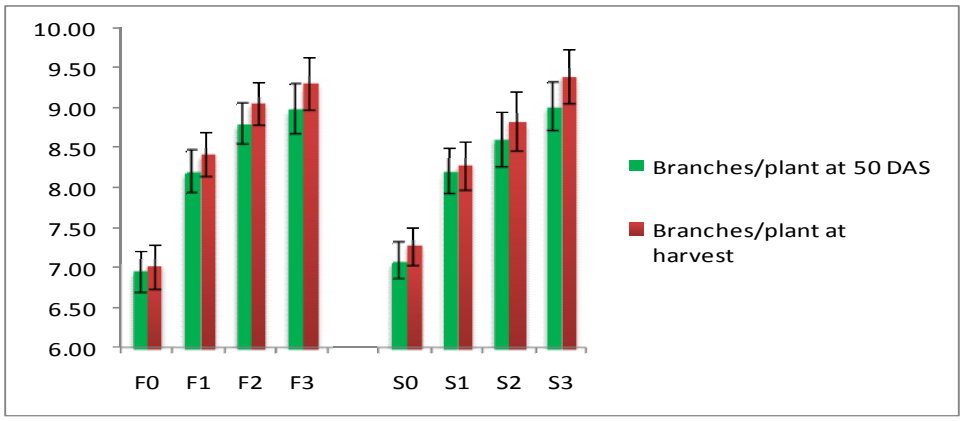

Fig. 1. Effect of fertilization and elicitors on number of branches/plant. The vertical bars indicate standard errors. Treatments indicated by F_0 = control, F_1 = 50% RDF, F_2 = 75% RDF, F_3 = 100% RDF and elicitors *i.e*. S_0 = control, S_1 = SA @ 75 ppm at FI and 7 days after first spray, S_2 = 75 ppm SA + 2% urea at FI and S_3 = 500 ppm thiourea at FI.

The difference in branches/plant was found substantial due to foliar shower of elicitors over control (water spray). Spray of TU @ 500ppm give significantly more branches/plant over control but remained on par to salicylic acid along with 2% Urea. The % enhancement due to TU and SA along with 2% Urea than control plot was 27.4 and 21.8 % (50 DAS) and 29.5 & 21.8 (at harvest), respectively. The beneficial role of 'thiols' in elicitors (TU and SA+ 2% urea), sulfuryl compounds in increasing the translocation of photosynthates which has potential for increasing productivity of crop under environmental stresses due of changing climate and global warming. Similar results of study were observed by Ghanshyam and Pareek (2009); Singh (2007); Ali and Mahmoud (2013); Satodiya *et al*. (2011).

Foliar spray of elicitors brought about significant enhancement in yield of mungbean. The highest seed yield (10.48 qtl/ha) was recorded with TU which significantly higher by 22.14 per cent over control (8.58 qtl/ha) while it remained at par with SA+ 2% Urea (10.08 qtl/ha). The maximum both straw and biological yield were recorded under the application of TU (22.76 and 33.24qtl/kg) which remaining at par with salicylic acid + 2% Urea (22.03 and 32.11kg/ha) proved superior to salicylic acid alone (9.79 and 21.62qtl/ha) and water spray (8.58.and 19.71qtl/kg). Devi *et al*. (2015); Choudhary *et al.* (2017) reported similar results.

C. Effect on quality parameters

(i) Phosphorus content and their uptake. The present investigated data showed that increasing dose of fertilizer significantly enhanced the phosphorus content in grain and mungbean straw. Application of 75% RDF (15-30 N-P_2O_5 kg/ha) being on par to 100% RDF (20-40 N-P_2O_5 kg/ha) recorded markedly higher phosphorus content in seed and straw, respectively. Fertilizer at 75% RDF increase phosphorus concentration of 74.8 and 9.7 % in seed and 98.1 & 10.4 % in straw over control (water spray) and 10-20 N-P_2O_5 kg/ha recommended dose of fertilizer, respectively.

The phosphorus uptake by grain and straw was found to be substantially higher under 15-30 N-P_2O_5 kg/ha (9.9 and 4.8 kg/ha) over 50% RDF (8.09 and 4.0 kg/ha) and control, it also remained on par to application of 20-40 N-P_2O_5 kg/ha. The less P uptake under control plot in terms of kg/ha was 3.9 and in grain and 2.0 kg/ha in straw. Reason behind that improved nutritional environment around root in the rhizosphere as well as in the plant system leading to enhanced translocation of

nitrogen, phosphorus and potassium in grain and straw. Since the nutrient uptake (nitrogen, phosphorus and potassium) is a function of its content in seed and straw yield of the crop. The improvement in these parameters due to nitrogen and phosphors fertilization led to an increased uptake of nutrients in the present study. These results are closely conformity with findings of Singh *et al.* (2017) in mungbean. Choudhary *et al.* (2017) also found that application of P_2O_5 at 40 kg/ha and thiourea 500 ppm spray at branching and flowering significantly increased P, K concentration in seed and straw of mungbean and their total uptake over control.

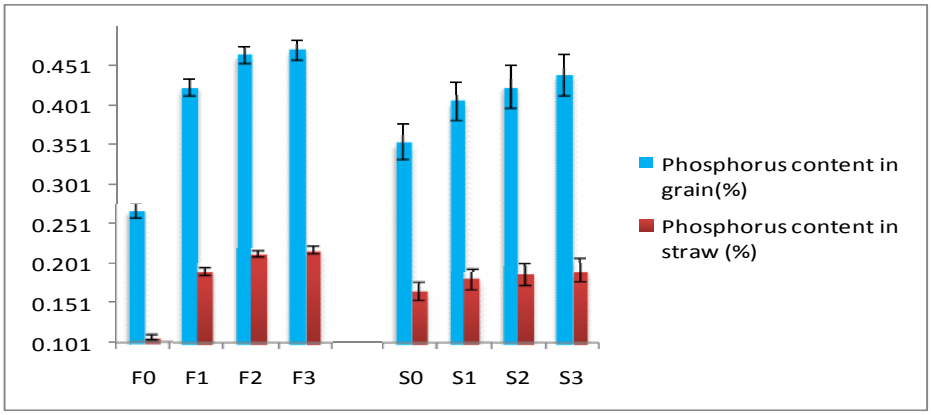

Fig. 2. Effect of fertility levels and elicitors on phosphors content in grain and straw. The vertical bars indicate standard errors. Treatments indicated by F_0 = control, F_1 = 50% RDF, F_2 = 75% RDF, F_3 = 100% RDF and elicitors *i.e.* S_0 = control, S_1 = SA @ 75 ppm at FI and 7 days after first spray, S_2 = 75 ppm SA + 2% urea at FI and S_3 = 500 ppm thiourea at FI.

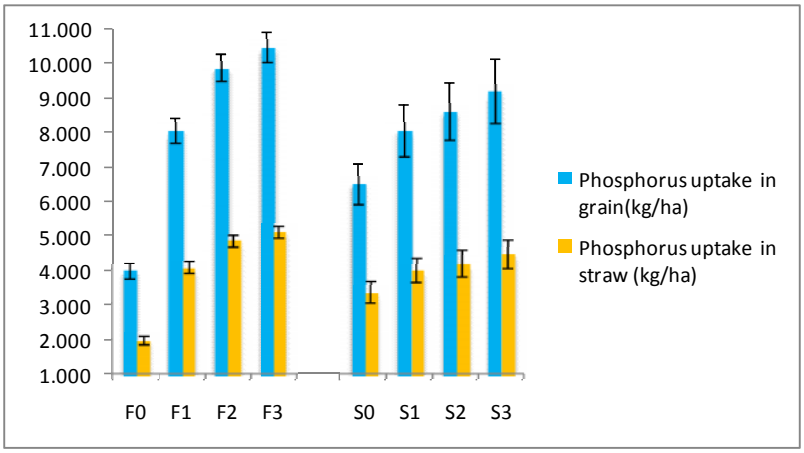

Fig. 3. Effect of fertility levels and elicitors on phosphors uptake in grain and straw. The vertical bars indicate standard errors. Treatments indicated by F_0 = control, F_1 = 50% RDF, F_2 = 75% RDF, F_3 = 100% RDF and elicitors *i.e.* S_0 = control, S_1 = SA @ 75 ppm at FI and 7 days after first spray, S_2 = 75 ppm SA + 2% urea at FI and S_3 = 500 ppm thiourea at FI.

Foliar spray of TU increased the P content in seed over control by 23.3 %, respectively. The corresponding enhancement in straw was to the extent of 15.6 per cent. Further, sole foliar spray of SA enhanced P content with 13.8% in seed and 8.4% in straw than control. However, it remained statistically on par to SA+ 2% Urea. Elicitor chemicals brought about substantial improvement in P uptake by seed and straw as compared to control. Maximum P uptake was recorded with 500 ppm TU (9.22 in grain and 4.48 kg/ha in straw, respectively). It might be due to thiourea helped in enhancement of metabolic processes in plants and better development, resulting to more absorption of nutrients from environment of rhizosphere. Kuttimani and Velayutham (2011); Kumawat *et al.* (2014) found that ntrients uptake of mungbean were significantly increased with the foliar spray of elicitors over control. Surendra *et al* (2013) observed that the basal supply of N at 25 kg/ha with foliar spray of 2% urea and 0.1 ppm brassinolide substantially increased the P content of leaf in plant blackgram.

(ii) Potassium content and their uptake. A presented data showed that fertility levels from 0% RDF (control) to 100% RDF did not cause any substantial influence in K content of seed and straw. While, the highest content of K in both seed (0.83%) and straw (1.68%) was

observed with fertilizer application at 100% RDF. Different elicitors also did not bring markedly influence in K content in seed and straw. The fertility levels, 75% and 100% RDF remained equally effective with respect to K uptake. These findings are closely similar with results of Singh *et al.* (2017); Choudhary *et al.* (2017). The elicitors brought about substantially improvement in K uptake by mungbean. The maximum K uptake in seed (0.83%) and straw (1.7%) was recorded with 500 ppm TU spray being at par with 75 ppm SA+ 2% urea. Choudhary *et al.* (2017); Kuttimani and Velayutham (2011); Bochaliya *et al.* (2011); Surendra *et al.* (2013) were also reported similar results.

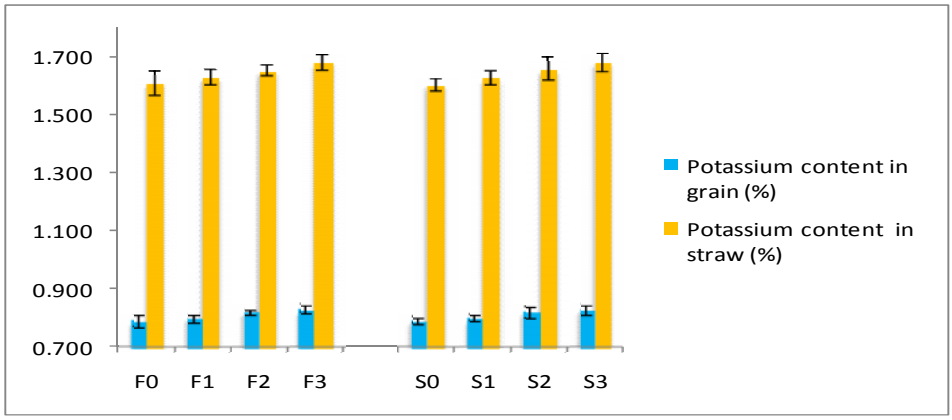

Fig. 4. Effect of fertility levels and elicitors on potassium content in grain and straw. The vertical bars indicate standard errors. Treatments indicated by F_0 = control, F_1 = 50% RDF, F_2 = 75% RDF, F_3 = 100% RDF and elicitors *i.e.* S_0 = control, S_1 = SA @ 75 ppm at FI and 7 days after first spray, S_2 = 75 ppm SA + 2% urea at FI and S_3 = 500 ppm thiourea at FI.

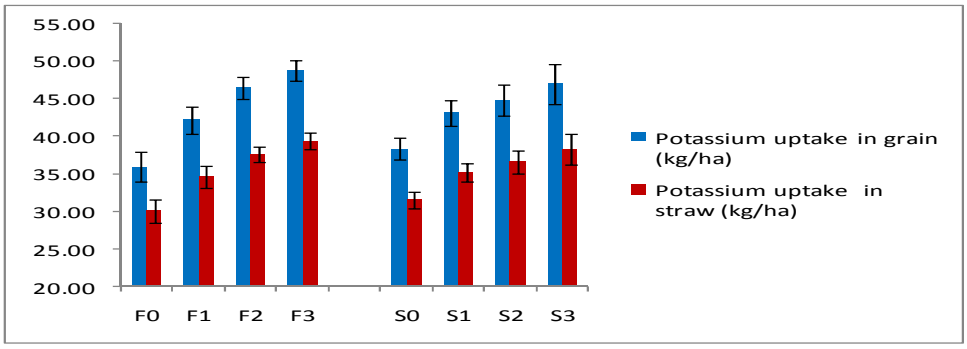

Fig. 5. Effect of fertility levels and elicitors on phosphors uptake (kg/ha) in grain and straw. The vertical bars indicate standard errors. Treatments indicated by F_0 = control, F_1 = 50% RDF, F_2 = 75% RDF, F_3 = 100% RDF and elicitors *i.e.* S_0 = control, S_1 = SA @ 75 ppm at FI and 7 days after first spray, S_2 = 75 ppm SA + 2% urea at FI and S_3 = 500 ppm thiourea at FI.

Table 3: Effect of fertility levels and elicitors on yield of mungbean.

Treatments	Yield (quintal/ha)		
	Seed	Straw	Biological
Fertilization			
Control (no fertilization)	7.43	18.67	26.10
50% RDF	9.40	21.25	30.65
75% RDF	10.77	22.79	33.56
100% RDF	11.33	23.41	34.74
S Em±	2.3	4.0	6.3
CD (P = 0.05)	6.8	11.4	18.3
Elicitors			
Control (Water spray)	8.58	19.71	28.29
SA @ 75 ppm at FI and 7 days after first foliar spray	9.79	21.62	31.41
SA @ 75 ppm + 2% Urea at FI	10.08	22.03	32.11
Thiourea @ 500 ppm at FI	10.48	22.76	33.24
S Em±	2.3	4.0	6.3
CD (P = 0.05)	6.8	11.4	18.3

CONCLUSION

It may be concluded that better root nodulation, good quality of seed and fodder and yield of mungbean can be enhanced by application of fertilizer at 100% RDF (20-40 N-P_2O_5 kg/ha) and foliar spray of thiourea @ 500pm at flower initiation.

REFERENCES

Ali, E. A. and Mahmoud A. M. (2013). Effect of foliar spray by different salicylic acid and zinc concentrations on seed yield and yield components of mungbean in sandy soil. *Asian Journal of Crop Science*, *5*(1): 33-40.

Anonymous, (2020). Annual report, ICAR-Indian Institute of Pulse research, Kanpur.

Bochaliya, G. S., Tiwari, R. C., Ran, B., Kantwa, S. R. and Choudhari, A. (2011). Response of fenugreek (*Trigonella foenum-graecum)* genotypes to planting geometry, agro-chemicals and sulphur levels. *Indian Journal of Agronomy*, *56*(3): 273-279.

Choudhary, S., Sharma, O. P., Choudhary G. L. and Jat, L. (2017). Response of urdbean [*vigna mungo* (l.) hepper] to phosphorus fertilization and thiourea on yield, quality, nutrient content and uptake. *International Journal of Current Microbiology and Applied Sciences*, *6*(10): 2841-2847.

Devi, S., Patel, P. T. and Choudhary, K. M. (2015). Effect of SH- compounds on yield, protein and economics of summer greengram [*Vigna radiata* (L.) Wilczek] under moisture stress in north Gujarat conditions. *Legume Research*, *38*(4): 542-545.

Dongare, D. M., Pawar, G. R., Murumkar, S. B. and Chavan, D. A. (2016). To study the effect of different fertilizer and biofertizer levels on growth and yield of summer green gram. *International Journal of Agricultural Sciences*, *12*(2): 151-157.

Rahman, M. M., Bhuiyan, M. M. H., Sutradhar, G. N. C., Rahman, M. M. and Paul, A. K. (2016). Effect of phosphorus, molybdenum and rhizobium inoculation on yield and yield attributes of mungbean. *International Journal of Sustainable Crop Production*, *3*(6): 26-33.

Raof, Z. K., Mehraban, A. and Moghaddam, H. (2015). Influence of Water Stress and Phosphate Fertile 2 on some characteristics of Mungbean. *Biological Forum – An International Journal*, *7*(2): 545-548.

Luikham, E., Lhungdim, J. and Singh, A. I. (2005). Influence of sources and levels of phosphorus on growth and yield of green gram [*Vigna radiata* (L.) Wilczek]. *Legume Research*, *28*(1): 59-61.

Ghanshyam and Pareek B. L. (2009). Effect of sulphur and thiourea on growth and yield of mothbean [*Vigna aconitifolia* Jacq. Marchal] in arid western Rajasthan. *Annals of Biology*, *25*(1): 17-19.

Ihsan, M. Z., Shahzad, N., Kanwal, S., Naeem, M., Khaliq, A., and El-Nakhlawy, F. S. (2013). Potassium as foliar supplementation mitigates moisture induced stresses in mung bean (*Vigna radiata* L.) as revealed by growth, photosynthesis, gas exchange capacity and Zn analysis of shoot. *International Journal of Agronomy. Plant Production*, *4*: 3828–3835.

Singh, B. R. (2007). Effect of thiourea and molybdenum on productivity of moth bean [*Vigna aconitifolia* (Jacq.) Marechal.]. M.Sc. (Ag.) Thesis, Rajasthan Agricultural University, Bikaner.

Kumawat, K., Shivran A.C. and Kumawat, P. (2014). Effect of bioregulators and phosphorus on yield, economics, nutrient uptake and quality of mothbean [*Vigna aconitifolia* (jacq.) Marechal]. *Annals of Biology*, *30*(1): 98-101.

Kuttimani, R. and Velayutham, A. (2011). Foliar application of nutrients and growth regulators on yield and economics of greengram. *Madras Agricultural Journal*, *98*(4): 141-143.

Manoj, Singh, R. K., Singh, A. N., Hardev, R. and Prasad, S. R. (2014). Growth, yield attributes and quality of summer green gram (*Vigna radiata* L.) as influenced by nitrogen and irrigation levels. *Annals of Agricultural Research* New Series, *35*(1): 47-53.

Satodiya, B. N., Patel, H. C., Patel, A.D., Saiyad, M. Y. and Leua, H. N. (2011). Effect of dicapitations and PGR's on seed yield and it's attributes in clusterbean cv. Pusa Navbahar. *The Asian Journal of Horticulture*, *6*: 38-40.

Singh, B. R. (2007). Effect of thiourea and molybdenum on productivity of moth bean [*Vigna aconitifolia* (Jacq.) Marechal.]. M.Sc. (Ag.) Thesis, Rajasthan Agricultural University, Bikaner.

Singh, M. , Deokaran, Mishra, J. S. and Bhatt, B. P. (2017). Effect of Integrated Nutrient Management on Production Potential and Quality of Summer Mungbean (*Vigna radiata* L.). *Journal Krishi Vigyan*, *5*(2): 39-45.

Surendar, K., Vincent, S., Vanagamudi, M., and Vijayaraghavan, H. (2013). Physiology of pgr's and nitrogen on crop growth rate, net assimilation rate, nitrate reductase activity and indole acetic acid oxidase activity of black gram (*Vigna mungo* L.). *Genomics and Applied Biology*, *4*(3): 15-21.

Traub, J., Kelly, J., Loescher, W. (2017). Early metabolic and photosynthetic responses to drought stress in common and tepary bean. *Crop Science*, *57*:1670-1686.

Verma, G., Kumawat, N. and Morya, J. (2017). Nutrient Management in Mungbean [*Vigna radiata* (L.) Wilczek] for Higher Production and Productivity under Semi-arid Tract of Central India. *International Journal of Current Microbiology and Applied Sciences* *6*(7): 488-493.

Waqas, M.A., Kaya, C., Riaz, A., Farooq, M., Nawaz, I., Wilkes, A., and Li, Y. (2019). Potential mechanisms of abiotic stress tolerance in crop plants induced by thiourea. *Frontiers in Plant Science*, *10*: 1336.

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