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Nodulation, Yield Attributes and Yield of Mungbean [*Vigna radiata* (L.)] Influenced by Different Level of Potassium Humate and Fertility Levels

Yogesh Kumar[1], Rajhans Verma[1], Kuldeep Singh[2], Oma Shanker Bhukhar[2], Rajesh[2]

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Abstract

Background: Optimum crop growth and yield is result of interlinking of several factors. In semi- tropical soil in central plateau and hills zone are deficit in organic carbon and NPK content; therefore inadequate fertilization may leads to pure quality and also lower crop productive capacity of soil. For the maintenance of sustainable and productive production, maintaining soil health is a critical factor. Under low fertility levels, mungbean gives low seed yield. Potassium humate, nitrogen and phosphorus (RDF) application may be increase yield of mungbean in this zone.

Method: A field experiment was conducted to study, “Nodulation, yield attributes and yield of mungbean [*Vigna radiata* (L.)] influenced by different level of potassium humate and fertility. The experiment was carried out in factorial randomized block design with three replications and sixteen treatment combination.

Result: Result showed that total number of root nodules, effective nodules, fresh and dry weight of root nodules, leghaemoglobin, nodule index, no. of pods/plant, no. of seeds/pod, test weight, seed and straw yield were observed significantly higher with application of potassium humate @ 4.5 kg/ha. Among different fertility level, the application of 100% RDF significantly increased the total number of root nodules and effective nodules, fresh and dry weight of root nodules, leghaemoglobin, nodule index, no. of pods/plant, no. of seeds/pod and test weight, seed and straw yield. With combined application of potassium humate @ 3.0 Kg/ha + 75% RDF significantly higher no. effective nodules, dry weight of root nodules and seed yield were observed, as well as saving of 25% RDF and 1.5 kg potassium humate were also observed.

Key words: Leghaemoglobin, Mungbean, Nodulation, Nodule index, Potassium humate.

Introduction

Mungbean is a self-pollinated crop which comes under leguminaceae family. It is a hardy crop and can be grown on well drained sandy loam soils under rain fed conditions. Mungbean is the pulse crop which is extensively grown in subtropical regions of the world. It has high nutritive value containing 25% protein in which lysine and tryptophan amino acids are predominant (Kumar *et al.,* 2018). It is the main source of minerals and vitamins, *i.e.* vitamin E and vitamin K which is playing metabolic role in maintaining human great health. Different types of minerals found in pulses are particularly iron, zinc and magnesium. It is considered as dual purpose crop which can be used for seeds as well as for forage (Davies and Stewart, 1987).

Among cultivated pulses, mungbean is a leading pulse crop with an area of 3.64 million ha and an annual production of 2.34 million ton with productivity of 8.72 q/ha (Anonymous, 2019). Yield potential of mungbean mainly in arid and semiarid regions may be enhanced by mediating soil fertility and agronomic management practices. Addition of organic substance during the crop cultivation enhanced the soil microbial population and diversity (Dotaniya *et al.,* 2020). During the mineralization, different type of low molecular organic acid produced by the soil microbial population, which act as plant nutrient mobilizers (Dotaniya *et al.,* 2016). Humic substances are natural occurring ligands found in soils predominantly which played life sustaining multiple functions in the soil environment (Olaetxea *et al.,* 2018). Humic substances act as chelating agents in soil and enhanced the labile concentration of plant nutrients. The use of humic substances enhances the soil quality, nutrient availability and also promote crop yield. Potassium humate is the concentrated form of humus having composition of 50% humic and 12% potassium, which is a salt of potassium. It occurs naturally in the form of lignite from peat material which under low pressure converts into coal and eventually into a pure humic substance. Chemical composition of potassium

[1]Department of Soil Science, Sri Karan Narendra Agriculture University, Jobner-303 329, Rajasthan, India.
[2]Department of Agronomy, Sri Karan Narendra Agriculture University, Jobner-303 329, Rajasthan, India.

Corresponding Author: Kuldeep Singh, Department of Agronomy, SKN Agriculture University, Jobner-303 329, Rajasthan, India.
Email: kuldeeptamana4@gmail.com

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humate is N (3.71%), K (6.25%) and sulphur (0.55%). Potassium humate acts as an additive fertilizer which improves the efficiency of the fertilizers and provides favorable environment to the soil microbes. Organic matter is the inherent key of maintaining soil health which is responsible for improving the yield potential of crops. Indian soils are low in organic carbon content therefore mineralization rate of SOC and other nutrients are very low. Use of potassium humate as an amendment for improving soil health and soil properties in such Indian soils are a viable option in low organic C soils (Tripura *et al.,* 2017). It also reduced the losses and fixation of potassium in soil (Kumar *et al.,* 2013).

Soil fertility is the inherent capacity of soil which enriches the soil with nutrients which are directly affecting the crop yield and quality. It is the ability of soil to provide all essential plant nutrients in available form in a balance amount. For the maintenance of sustainable and productive production, maintaining soil health is a critical factor. Under low fertility levels, mungbean gives low seed yield (Nair, 2017). Optimum nitrogen fertilizer application enhanced the crop yield of mungbean. Application of optimum amount of nitrogen resulted higher dry matter production by increasing in vegetative growth and photosynthetic rate. There is significant increased in number of pods per plant, number of seeds per pod by the application of nitrogen fertilizer (Razzaque *et al.,* 2017). Phosphorus plays a vital role in flowering and seed formation in crop plants. It is performing as a nutrient limiting factor for the mungbean productivity. Application of recommended dose of phosphorus fertilizer had increased plant dry matter, phosphorus uptake and seed yield. Applied phosphorus in soil has great fate of immobilizing in soil which is the most limiting factor in phosphorus nutrition towards plants.

Potassium fertilizer application makes the mungbean crop tolerant to drought conditions by eliminating the adverse effects of drought. Even in water stress condition potassium increases the shoot growth of mungbean. Under drought conditions, the yield of mungbean decreases which can be increased with the application of potassium fertilizer (Sadaf and Tahir*,* 2017). Therefore, keeping mentioned facts in view, present study was undertaken to evaluate efficacy of potassium humate and RDF on summer mungbean for better nodulation and seed yield.

MATERIALS AND METHODS

This field experiment was conducted at the agronomy farm, S.K.N. College of Agriculture Jobner located at 26°05″ North latitude, 75° 28″ East longitude and altitude of 427 meters above mean sea level during the *kharif* season of 2019. The experiment was carried out in factorial randomized block design with three replications and 16 treatment combination. The experiment was comprised of four treatments of potassium humate (control, 1.5 kg/ha, 3.0 kg/ha, 4.5 kg/ha) and four treatments of fertility dose (control, 50% RDF, 75% RDF and 100% RDF) were applied to the mungbean. Treatment comprises: T_1- K_0F_0 (Control), T_2- K_1F_0 (potassium humate @ 1.5kg/ha and fertilizer level zero), T_3- K_2F_0 (potassium humate @ 3 kg/ha) and fertilizer level zero), T_4- K_3F_0 (potassium humate @ 4.5kg/ha) and fertilizer level zero), T_5- K_0F_1 (potassium humate level zero and 50% RDF), T_6- K_1F_1 (potassium humate @ 1.5 kg/ha and 50% RDF), T_7- K_2F_1 (potassium humate @ 3 kg/ha and 50% RDF), T_8- K_3F_1 (potassium humate @ 4.5 kg/ha and 50% RDF), T_9- K_0F_2 (potassium humate level zero and 75% RDF),T_{10}- K_1F_2 (potassium humate @ 1.5 kg/ha and 75% RDF), T_{11}- K_2F_2 (potassium humate @ 3 kg/ha and 75% RDF), T_{12}- K_3F_2 (potassium humate @ 4.5 kg/ha and 75% RDF), T_{13}- K_0F_3 (potassium humate level zero and 100% RDF), T_{14}- K_1F_3 (potassium humate @ 1.5 kg/ha and 100% RDF), T_{15}- K_2F_3 (potassium humate @ 3 kg/ha and 100% RDF), T_{16}- K_3F_3 (potassium humate @ 4.5 kg/ha and 100% RDF). The soil of experiment field was loamy sand in texture having alkaline ph (8.11), low in organic carbon (0.20%), available nitrogen (127.23 kg/ha), medium in available phosphorus (18.21 kg/ ha) and potassium (142.15 kg/ha). Fertilizer were applied as per treatment through diammonium phosphate (DAP) containing 46% P_2O_5 and 18% N, urea containing 46% N and K_2O through murate of potash at the time of sowing as per treatment and entire dose of potassium humate was thoroughly mixed in soil before sowing of the crop. The required quantity of seeds (25 kg/ha) was treated with rhizobium culture and phosphorus solubilising bacterial (PSB) before sowing @ 20 g/kg of seed. The seeds were sown in row drawn 30 cm apart. Plant to plant spacing was maintained at 10cm with 5cm deep of variety RMG-492. Irrigation applied in field only one time at 34 DAS.

The total no. of nodules and effective nodule/plant was counted on flowering stage at 40 days. Five plants randomly selected. Healthy pink colored nodules were counted and mean value was recorded as effective no. of nodules/plant. Effective root nodules were weighed with the help of an electronic balance and average was worked out and recorded as fresh weight of effective root nodules/plant than subjected to oven dry at 70°C till a constant weight was obtained and then average was worked out. Leghaemoglobin content of root nodule was estimated as hemochrome as described by Bergerson (1982).

$$\text{LB (mg/g)} = \text{A556 - A539} \times \frac{2D}{23.4}$$

Where, D is initial dilution.

The number of nodules was counted from randomly selected five plants from each plot at the time of flowering stage and nodule index was computed by formula.

$$\text{Nodule index} = \frac{\text{No. of nodules/ plant}}{\text{Length (cm) of tap root}}$$

Experimental data were analyzed using analysis of variance (ANOVA) as per factorial randomized block design (Gomez and Gomez, 1984). Significance of the treatments were tested using F test with 5% level of significance ($P<0.05$) and means were compared using the least significant difference (LSD) test at α = 0.05.

RESULTS AND DISCUSSION

Nodulation

Potassium humate

A perusal of data in Table 1 revealed that the application of potassium humate significantly increased nodulation parameters up to the treatment 4.5 kg/ha over control. Significantly maximum number of total nodules/plant, effective nodules/plant, fresh and dry weight of nodule (mg/plant), nodule index and leghaemoglobin content in nodule (mg/g) (37.89, 29.22, 137.60, 72.23, 1.27 and 2.02, respectively) were observed with the application of potassium humate @ 4.5 kg/ha followed by potassium humate @ 3 kg/ha over control. The lowest value of above parameters recorded under control. This effect might be due to presence of fulvic and humic acid in potassium humate. Humic acid supplies essential nutrients and minerals for plant growth, whereas the major function of fulvic acid is transport of nutrients. Potassium humate increased the availability of P in root zone, which in turn in better growth of root and shoot and also help in better nodulation (Tripura *et al.,* 2017). These findings were also supported by Abdelhamid *et al.* (2011), Patil *et al.* (2011) and Sarwar *et al.* (2014).

Fertility level

Significantly maximum number of nodules/plant, effective nodules/plant, fresh and dry weight of nodule (mg/plant), nodule index and leghaemoglobin content in nodule (mg/g) (37.83, 29.07, 139.35, 72.89, 1.27 and 1.97, respectively) were observed with application of 100% RDF followed by application of 75% RDF over control. This effect might be due to positive effects of nitrogen and phosphorus; Nitrogen provides favorable nutritional environment in the root zone for better growth of nodules. Phosphorus plays a major role in root development, improves root nodules and nitrogen fixation by roots. Plants receiving moderately high or high P had intermediate root length system and plant receiving high N concentration stimulated root growth and resulted in the longest root systems and nodulation (Gentili *et al.,* 2006). The present investigation is also conformity with Suman *et al.* (2007), Singh and Sharma. (2011).

Interaction

The interaction effect of potassium humate and fertility levels on the total no. of effective nodules/plant and dry weight of nodule was significantly observed (Table 2 and 3). The treatment combination, potassium humate @ 4.5 kg/ha with 100% RDF (K_3F_3) recorded the maximum effective nodules/plant and dry weight of nodule (mg/plant) (33.98 and 84.02) which was remained at par on potassium humate @ 4.5 kg/ha with 75% RDF (K_3F_2) (32.28 and 80.26), potassium humate @ 3.0 kg/ha with 100% RDF (K_2F_3) (31.65 and 79.85), potassium humate @ 3.0 kg/ha with 75% RDF (K_2F_2) (31.43 and 78.57) over control (17.55 and 42.35). The significant increase in nodulation parameters under the application of potassium humate and fertility levels was largely function of improved root anatomy and soil health (Idress *et al.,* 2012). A synergistic interaction occurs between potassium humate and fertility levels (Kumar *et al*., 2014) and resulted in increase in the fresh and dry weight of nodules. This finding was in agreement with Abdelhamid *et al.* (2011), Ali *et al.* (2016).

Yield attributes and yield

Potassium humate

The data pertaining to the effect of potassium humate and fertility levels on yield attributes and yield of mungbean have

Table 1: Effect of potassium humate and fertility levels on no. of total nodule, effective nodule, weight of fresh and dry nodule (mg/plant), nodule index and leghaemoglobin content (mg/g) in nodule of mungbean at flowering.

Treatments	Total nodules /plant	Effective nodules /plant	Weight of total nodule		Nodule index	Leghaemoglobin content in nodules
			Fresh	Dry		
Potassium humate						
K_0 (control)	29.07	20.48	97.19	51.38	0.93	1.21
K_1 (1.5 kg/ha)	31.29	24.25	114.74	59.97	1.09	1.62
K_2 (3.0 kg/ha)	35.82	27.53	130.62	68.12	1.18	1.91
K_3 (4.5 kg/ha)	37.89	29.22	137.60	72.23	1.27	2.02
SEm±	0.67	0.44	2.39	1.15	0.02	0.03
CD (P=0.05)	1.93	1.28	6.91	3.31	0.08	0.08
Fertility levels						
F_0 (Control)	28.80	20.58	94.25	49.11	0.92	1.24
F_1 (50% RDF)	31.83	24.05	114.13	60.16	1.09	1.67
F_2 (75% RDF)	35.61	27.77	132.43	69.56	1.18	1.87
F_3 (100% RDF)	37.83	29.07	139.35	72.89	1.27	1.97
SEm±	0.67	0.44	2.39	1.15	0.028	0.03
CD (P=0.05)	1.93	1.28	6.91	3.31	0.081	0.08

been summarized in Table 4. Significantly maximum no. of pods/plant, no. of seeds/pod, test weight (g), seed and straw yield (kg/ha) (21.56, 8.95, 33.80, 1193 and 2617, respectively) was obtained with application of potassium humate @ 4.5 kg/ha followed by application of potassium humate @ 3 kg/ha over control. Humic acid improved plant net photosynthesis *via* increasing chlorophyll and electron transport flux in plants, this leads to more transport of photosynthetic products from leaves and stem to grain indicating that higher the biomass at anthesis (Aparicio *et al*., 2002). The results corroborated with the findings of Sarwar *et al.* (2014), Taha and Osman (2018) and Elkin *et al.* (2019).

Table 2: Interactive effect of potassium humate and fertility levels on effective no. of nodules/plant of mungbean at flowering.

Treatments	K_0	K_1	K_2	K_3
F_0	17.55	20.16	21.55	23.07
F_1	19.65	23.52	25.51	27.54
F_2	21.60	25.76	31.43	32.28
F_3	23.11	27.55	31.65	33.98
SEm±	0.89			
CD (p=0.05)	2.56			

Table 3: Interactive effect of potassium humate and fertility levels on dry weight of total nodules of mungbean at flowering.

Treatments	K_0	K_1	K_2	K_3
F_0	42.35	48.89	50.87	54.33
F_1	48.77	58.34	63.20	70.31
F_2	54.46	64.94	78.57	80.26
F_3	59.95	67.72	79.85	84.02
SEm±	2.29			
CD (p=0.05)	6.62			

Fertility levels

Significantly maximum no. of pods/plant, no. of seeds/pod, test weight (g), seed and straw yield (kg/ha) (22.07, 8.86, 34.47, 1197 and 2604, respectively) with application of 100% RDF followed by application of 75% RDF over control. Application of nitrogen in the early stage of mungbean is very important in promoting vegetative growth and biomass production. Hence, application of nitrogen stimulated seed setting and rapidly increased the yields attribute of mungbean (Razzaque *et al.,* 2017). Phosphorus plays an important role in energy transfer and conservation. During certain stage of development more assimilates are produced than used in development and growth of plant and excess assimilates are diverted in storage compounds. At later stage the storage compound remobilize and move to sink which increased the number of pods and seeds per pod (Hernandez *et al*., 1983). These results were in recognizance with the findings of Yakadri *et al.* (2002), Karwasra *et al*. (2006), Kumar (2015).

Interaction

The interaction effect of potassium humate and fertility levels on seed yield was significantly observed (Table 5). The treatment combination, potassium humate @ 4.5 kg/ha with 100 % RDF (K_3F_3) was recorded the maximum seed yield (1412.06 kg/ha) but it was found *at par* with combined application of potassium humate @ 4.5 kg/ha and 75 % RDF (K_3F_2) (1347.84 kg/ha), application of potassium humate @ 3.0 kg/ha and 100% RDF (K_2F_3) (1343.32 kg/ha) and application of potassium humate @ 3.0 kg/ha and 75 % RDF (K_2F_2) (1310.25 kg/ha) over control. The significant increment in yields under the application of potassium humate and fertility levels was function of better growth and subsequent increment in yields. The synergistic interaction occurs between potassium humate and fertility levels had resulted in enhancement of number of pods per

Table 4: Effect of potassium humate and fertility levels on no. of pods/plant, no. of seeds/pod, test weight (g), seed and straw yield (kg/ha) of mungbean at harvest.

Treatments	No. of pods/ plant	No. of seeds/ pod	Test weight	Seed yield	Straw yield
Potassium humate					
K_0 (control)	15.65	6.86	25.80	767	1946
K_1 (1.5 kg/ha)	18.15	7.71	29.61	983	2222
K_2 (3.0 kg/ha)	20.30	8.32	32.32	1139	2472
K_3 (4.5 kg/ha)	21.56	8.95	33.80	1193	2617
SEm±	0.40	0.13	0.50	18	38
CD (P=0.05)	1.17	0.37	1.46	52	111
Fertility levels					
F_0 (Control)	14.80	6.84	25.44	760	1942
F_1 (50% RDF)	18.07	7.74	28.72	987	2221
F_2 (75% RDF)	20.72	8.40	32.89	1139	2490
F_3 (100 % RDF)	22.07	8.86	34.47	1197	2604
SEm±	0.40	0.13	0.50	18	38
CD (P=0.05)	1.17	0.37	1.46	52	111

Table 5: Interactive effect of potassium humate and fertility levels on seed yield (kg/ha) of mungbean at harvest.

Treatments	K_0	K_1	K_2	K_3
F_0	585.80	753.39	829.43	872.62
F_1	758.50	975.50	1073.96	1141.04
F_2	830.07	1067.55	1310.25	1347.84
F_3	895.63	1137.56	1343.32	1412.06
SEm±	36.15			
CD (p=0.05)	104.40			

plant and seed per pods, ultimate the seed yield. This finding was in agreement with Ali *et al*. (2016) and Ranpariya *et al.* (2017).

CONCLUSION

Based on above findings, experimental results was concluded that the yield and nodulation obtained under treatment combination K_2F_2 (potassium humate 3.0 kg/ha + 75% RDF) was significantly higher than other treatments combinations and found statistically equal to treatment combination K_3F_2 (potassium humate 4.5 kg/ha + 75% RDF), K_3F_3 (potassium humate 4.5 kg/ha + 100% RDF) and K_2F_3 (potassium humate 3.0 kg/ha + 100% RDF), which indicate the saving of 25% RDF and 1.5 kg potassium humate.

REFERENCES

Abdelhamid, M.T., Selim, E.M. and El-Ghamry, A.M. (2011). Integrated effects of bio and mineral fertilizers and humic substances on growth, yield and nutrient contents of fertigated cowpea (*Vigna unguiculata* L.) grown on sandy soils. Journal of Agronomy. 10: 34-39.

Ali, K. (2016). Effect of humic acid doses on yield and quality parameters of cowpea [*Vigna unguiculata* (L.)]. Legume Research. 40: 155-159.

Anonymous, (2019). 3rd Advance Estimate, Ministry of Agriculture and Farmers Welfare.

Aparicio, N., Villegas, D., Araus, J.L., Casadesús, J. and Royo, C. (2002). Relationship between growth traits and spectral vegetation indices in durum wheat. Crop Science. 42: 1547-1555.

Bergersen, F.J. (1982). Root Nodules of Legumes: Structure and Functions. The University of Michigan Research Studies Press, 164 pages.

Davies, S. and Stewart, A. (1987). Nutritional Medicine, Richard Clay Ltd., Bungay, Suffolk.

Dotaniya, M., Aparna, K., Choudhary, J., Dotaniya, C.K., Solanki, P., Narwal, E., Kumar, K., Doutaniya, R.K., Lal, R., Meena, B.L., Lata, M., Singh, M. and Singh, U. (2020). Effect of soil pollution on soil microbial diversity. Frontiers in Soil and Environmental Microbiology. 10: 255-272.

Dotaniya, M., Datta, S., Biswas, D., Dotaniya, C., Meena, B., Rajendiran, S., Regar, K. and Lata, M. (2016). Use of sugarcane industrial by-products for improving sugarcane productivity and soil health. International Journal of Recycling of Organic Waste in Agriculture. 5: 185-193.

Elkin, Z. (2019). Integrated use of humic acid and plant growth promoting rhizobacteria to ensure higher potato productivity in sustainable agriculture. Sustainability. 11: 3417.

Gentili, F., Wall, L.G. and Huss-Danell, K. (2006). Effects of phosphorus and nitrogen on nodulation are seen already at the stage of early cortical cell divisions in *Alnus incana*. Annals of Botany, 98: 309-315.

Gomez, K.A. and Gomaz, A.A. (1984). Statistical Procedures for Agricultural Research. J. Wiley and Sons, Singapore.

Hernández-Nistal, J., Aldasoro, J., Rodriguez, D., Matilla, A., Nicolás G. (1983). Effect of thiourea on the ionic content and dark fixation of CO_2 in embryonic axes of Cicer arietinum seeds. 57: 273-278.

Idrees, M., Anjum, M. and Mirza, J. (2012). Potassium humate and NPK application rates influence yield and economic performance of potato crops grown in clayey loam soils. Soil and Environment. 37: 53-61.

Karwasra, R.S., Kumar, Y. and Yadav, A.S. (2006). Effect of phosphorus and sulphur on green gram (*Phaseolus radiatus*). Haryana Journal of Agronomy. 22: 164-165.

Kumar, D., Singh, A.P., Raha, P., Rakshit, A., Singh, C.M. and Kishor, P. (2013). Potassium humate a potential soil conditioner and plant growth promoter. International Journal of Agriculture, Environment and Biotechnology. 6: 441-446.

Kumar, D., Singh, A.P., Raha, P. and Singh, C. (2014). Effects of potassium humate and chemical fertilizers on growth, yield and quality of rice (*Oryza sativa* L.). Bangladesh Journal of Botany. 43(2): 183-189.

Kumar, S. (2015). Effect of phosphorus fertilization and bio-organic on growth and yield of mungbean. M.sc. (Ag.) thesis S.K.N. Agriculture University, Jobner.

Nair, R.M., Gotz, M., Winter, S., Giri, R.R., Boddepalli, V.N. and Sirari, A. (2017). Identification of mungbean lines with tolerance or resistance to yellow mosaic in fields in India where different begomovirus species and different *Bemisia tabaci* cryptic species predominate. European Journal of Plant Pathology. 149: 349-365.

Olaetxea, M., Hita, D., Garcia, A., Fuentes, M., Baigorri, R., Mora, V., Garica, M., Urrutia, O., Erro, J., Zamarreno, A.M., Berbara, R.L. and Garcia-Mina, J.M. (2018). Hypothetical framework integrating the main mechanisms involved in the promoting action of rhizospheric humic substances on plant root- and shoot growth. Applied Soil Ecology. 123: 521-537.

Patil, R.B., Kadam, A.S. and Wadje, S.S. (2011). Role of potassium humate on growth and yield of soybean and black gram. International Journal of Pharma and Bio Sciences. 2: 242-246.

Ranpariya, V.S., Polara, K.B., Hirpara, D.V. and Bodar, K.H. (2017). Effect of potassium, zinc and FYM on content and uptake of nutrients in seed of summer green gram (*Vigna radiata* L.) and post harvest soil fertility under medium black calcareous soil. International Journal of Chemical Studies. 5(5): 1055-1058.

Razzaque, M.A., Haque, M.D. and Karim, M.D. (2017). Effect of nitrogen on growth and yield on mungbean in low nutrient soil. Bangladesh Journal of Agricultural Research. 42: 77.

Sadaf, A. and Tahir, M. (2017). Effect of Potassium on Growth, Yield and Quality of Mungbean under Different Irrigation Regimes. Bulletin of Biology and Allied Science Research. 2: 4.

Sarwar, M., Hyder, S.I., Ehsan, A.M., Tauseef, T. and Shahid R.M. (2014). Integrated effects of humic acid and bio fertilizer on yield and phosphorus use efficiency in mungbean under rainfed condition. World Journal of Agricultural Sciences. 2: 40-46.

Singh, Y.P. and Sharma, A. (2011). Effect of sources of phosphorus and microbial inoculation on productivity, nutrient availability in soil and uptake of nutrients by chickpea (*Cicer arietunum* L.) grown on sandy loam soil. Indian Journal of Agriculture Sciences. 81: 834-837.

Suman, Dahama, A.K. and Poonia, B.L. (2007). Effect of blanced fertilization on growth and yield of green gram. Haryana Journal of Agronomy. 23: 118-119.

Taha, S. and Osman, A. (2018). Influence of potassium humate on biochemical and agronomic attributes of bean plants grown on saline soil. Journal of Horticultural Science and Biotechnology. 93: 545-554.

Tripura, P., Kumar, S. and Verma, R. (2017). Effect of potassium humate and bioinoculants on nutrient content, uptake and quality of cowpea. International Journal of Current Microbiology and Applied Sciences. 6: 1735-1741.

Yakadri, M., Ramesh, T. and Rao, L.M. (2002). Effect of nitrogen and phosphorus on growth and yield of green gram [*Vigna radiata* (L.) Wilczek]. Legume Research. 25: 139-14.