The Pharma Innovation Journal 2021; 10(7): 1366-1370

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; 10(7): 1366-1370

www.thepharmajournal.com
Received: 18-05-2021
Accepted: 27-06-2021

Neelam Nama
Agriculture University, Kota, Rajasthan, India

MK Sharma
Agriculture University, Kota, Rajasthan, India

DS Meena
Agriculture University, Kota, Rajasthan, India

RK Yadav
Agriculture University, Kota, Rajasthan, India

Preeti Verma
Agriculture University, Kota, Rajasthan, India

Yash Narayan Sharma
Agriculture University, Kota, Rajasthan, India

Corresponding Author:
Neelam Nama
Agriculture University, Kota, Rajasthan, India

Consequence of liquid bio-fertilizers and drought mitigating chemicals on soil physico-chemical properties and nutrient availability of mungbean [*Vigna radiata* (L.) Wilczek] under SE-Rajasthan

Neelam Nama, MK Sharma, DS Meena, RK Yadav, Preeti Verma and Yash Narayan Sharma

Abstract

A field experiment was conducted at farm of agricultural research station Ummedganj, Agriculture University Kota during *Zaid*-2020 to find out the effect of liquid bio fertilizers and drought mitigating chemicals on soil physico-chemical properties and nutrient availability after harvesting mungbean crop. The experiment comprised of ten treatment combinations *viz.* T_1 - 100% RDF (Control), T_2 - 100% RDF + Rhizobium (10 ml/kg seed) + water spray, T_3 - 100% RDF + Rhizobium (10 ml kg^{-1} seed) + 2% KCl spray, T_4 - 100% RDF + Rhizobium (10 ml/kg seed) + 0.4% Sodium selenite spray, T_5 - 100% RDF + Rhizobium (10 ml/kg seed) + 2% KCl+ 0.4% Sodium selenite spray, T_6 - 100% RDF + P.S.B. (10 ml/kg seed) + Water spray, T_7 - 100% RDF + P.S.B. (10 ml/kg seed) + 2% KCl spray, T_8 - 100% RDF + P.S.B.(10 ml/kg seed) + 0.4% Sodium selenite spray, T_9 - 100% RDF + P.S.B.(10 ml/kg seed) + 2% KCl + 0.4% Sodium selenite spray, T_{10} - 100% RDF + Rhizobium (10 ml/kg seed)+ P.S.B. (10 ml/kg seed) + 2% KCl + 0.4% Sodium selenite spray. The experiment was laid out in randomize block design and replicated thrice with mungbean, variety IPM-02-03 grown as test crop. Results showed that application of 100% RDF + Rhizobium (10 ml/kg seed)+ P.S.B. (10 ml/kg seed) + 2% KCl + 0.4% Sodium selenite spray significantly improved the soil physico–chemical properties, increased the nutrient availability in soil after harvesting the mungbean crop *viz.*, organic carbon (0.53%), available nitrogen (244.61 kg ha^{-1}), available phosphorus (22.60 kg ha^{-1}), available potassium (436.61 kg ha^{-1}) Fe content (4.88 mg kg^{-1}), Mn content (3.68 mg kg^{-1}), Zn content (0.63 mg kg^{-1}) as compared to initial soil test values.

Keywords: Mungbean, *Rhizobium*, PSB, sodium selenite, KCl and physico-chemical properties

Introduction

Pulses, also known as grain legumes, are next to cereals in terms of agricultural importance. Pulses account 29.03 million hectare area with production of 24.42 million tonnes and productivity of 8.06 q/ha in the country (Annonymous 2020). Mungbean [*Vigna radiata* (L.) Wilczek], also known as greengram, stands third after chickpea and pigeonpea among pulses. It occupies 3.64 million hectare area and contributes 1.95 million tonnes in pulse production with productivity of 8.72 q/ha in the country (Anonymous, 2020) [2, 3]. The important greengram growing states are Rajasthan, Madhya Pradesh, Uttar Pradesh, Odisha, Maharashtra, Karnataka and Bihar.

In Rajasthan, total area under mungbean was 23.26 lakh hectares with the production of 13.04 lakh tonnes and productivity of 561 kg ha^{-1} (Anonymous, 2020) [2, 3]. It is mainly cultivated in arid and semi arid districts including Nagaur, Jaipur, Jodhpur, Sikar, Pali, Jhunjhunu and Ajmer. Despite of being such an important crop, the average productivity of greengram in the state is quite low compared to its production potential which is a matter of serious concern. Mungbean contains about 51.6% carbohydrate, 26-27% protein, 4-5% minerals, 3-4% vitamins (Kaul, 1982) [11]. Mungbean fodder contains an average about 17.5% crude protein, 22.5% crude fibre, 28.4% nutrient detergent fiber, 3.0% ether extract and 11.4% ash (Feedipedia, 2018) [7]. Liquid biofertilizer formulation is the promising and updated technology which inspite of many advantages over the agrochemicals left a considerable dispute among the farmer community in terms of several reasons, major being the viability of organism.

Shelf life is the first and foremost problem of the carrier based biofertilizer which is up to three months and its does not retain throughout the crop cycle. Liquid biofertilizer on the other hand facilitate the long survival of the microorganism by providing the suitable medium which is sufficient for the entire crop cycle (Maheswari and Elakkiya, 2014) [15]. *Rhizobium* and PSB inoculants as liquid biofertilizers helps to increase yield of legume crop by fixing atmospheric nitrogen in root nodules and by converting the insoluble phosphate in to soluble form respectively. *Rhizobium* inoculant is recommended to ensure adequate nodulation and nitrogen fixation offers an economically attractive and ecologically sound means of reducing external inputs and improving the quality and quantity of internal resource of nitrogen. In mungbean, nitrogen fixation takes place through symbiotic association between the bacteria of genus *Bradyrhizobium* and mungbean crop (Raja and Takankhar, 2017) [17]. It is estimated that the nitrogen fixed by mungbean crop is approximately 35kg N ha^{-1}. Liquid formulation of bio-fertilizer is the promising and updated technology over the conventional carrier based production technology which has many advantages surmounting the hurdles over the later, the liquid inoculants developed were known to have population of *Rhizobium* species and PSB up to the levels of 10^8 cells ml^{-1} (Velineni *et al*., 2011) [20].

Drought is one of the most common abiotic stresses for reducing the crop yield. Drought is a meteorological term and is commonly defined as period without significant rainfall. Drought stress changes the biochemical and physiological reaction, pigment composition and morphological characters of plants. In arid and semi-arid regions, water deficit is a major crop restraining factor. Limited amounts of water, low and irregular rainfall and hot summer promote drought stress which is the world leading intimidation that should be considered. Water scarcity and increasing demand create an urgent need for improved irrigation management to maximize the efficiency of available precious water resources (Ahmad *et al*., 2015) [1]. The reactions of plants to water stress differ significantly at various organizational levels depending upon intensity and duration of stress as well as plant species and its growth stage. Water stress imposed at any of the growth stages declined the crop growth and stress at flowering stage being most inhibitive (Grover *et al*., 2001) [9].

The application of stress mitigating chemicals might prove beneficial in crop tolerance to adverse conditions. Sodium selenite and potassium chloride spray was found significantly superior to mitigating the drought stresses (Devangan *et al*., 2015) [4]. However, the physiological and biochemical basis of plants to unfavourable conditions induced by the application of stress mitigating chemicals are yet to be clearly understood. Application of these stress mitigating chemicals in conjunction with fertilizer doses might provide a best management practice in order to understand the proven technology.

Materials and Methods

The present investigation was conducted during the *Zaid*, 2020 at farm of agriculture research station Ummedganj, Agriculture University Kota. The Kota situated at 25.21° N latitude and 75.86° E longitudes at an altitude of 271 meters above mean sea level. The experimental area falls under Agro-climatic Zone V (Humid South Eastern Plains) of Rajasthan. Kota is characterized by sub-tropical conditions having hot and dry summer months (April to June) followed by hot and humid month from July to September and cold winter during December to January. The average annual rainfall 575mm, about three fourth contribute from south-west monsoon during July to September. Winter rain receive during the months of December, January and February are scanty and occasionally. The soil of the experimental site was medium black (*Vertisol*s) having clay loam texture, low in available nitrogen (220.5 kg ha^{-1}), medium in available phosphorus (17.5 kg ha^{-1}) and high in available potassium (421.8 kg ha^{-1}), pH (7.5), EC (0.36 dSm^{-1}) and low in organic carbon (0.43%). The experiment consisted of 10 treatments *viz.* T_1 - 100% RDF Control), T_2 - 100% RDF + Rhizobium (10 ml/kg seed) + water spray, T_3 - 100% RDF + Rhizobium (10 ml/kg seed) + 2% KCl spray, T_4 - 100% RDF + Rhizobium (10 ml/kg seed) + 0.4% Sodium selenite spray, T_5 - 100% RDF + Rhizobium (10 ml/kg seed) + 2% KCl + 0.4% Sodium selenite spray, T_6 - 100% RDF + P.S.B. (10 ml/kg seed) + Water spray, T_7 - 100% RDF + P.S.B. (10 ml/kg seed) + 2% KCl spray, T_8 - 100% RDF + P.S.B.(10 ml/kg seed) + 0.4% Sodium selenite spray, T_9 - 100% RDF + P.S.B.(10 ml/kg seed) + 2% KCl + 0.4% Sodium selenite spray, T_{10} - 100% RDF + Rhizobium (10 ml/kg seed)+ P.S.B. (10 ml/kg seed) + 2%KCl + 0.4% Sodium selenite spray. Mungbean crop sown using variety IPM 02-03 with 20kg ha^{-1} seed rate in *Zaid*, 2020.The experiment was laid out in randomised block design and was replicated thrice. Observations recorded for soil physico - chemical properties *viz*: pH, EC, bulk density and organic carbon and nutrient availability *viz*: available nitrogen, available phosphorus, available potassium, Fe, Mn, Zn, Cu content in soil, following standard procedures.

Results and Discussion

Soil Physico-chemical Properties after harvesting the mungbean

The results regarding residual effect of liquid biofertilizers (*Rhizobium* and PSB) and spray of drought mitigating chemicals on soil pH, EC, Bulk density and organic carbon was presented in Table 1. The data showed that pH, EC and bulk density of soil was not affected significantly due to individual seed treatment with *rhizobium* and PSB levels but the lower soil pH was recorded under the treatment T_{10} (100% RDF + *Rhizobium* (10 ml/kg seed) + P.S.B. (10 ml/kg seed) + 2% KCl + 0.4% Sodium selenite spray) (7.56) and T_6 (100% RDF + P.S.B. (10 ml/kg seed) + Water spray) (7.56%), similarly higher soil pH was observed with T_1 control (7.59). Singh *et al*. (2009) [19] revealed that the effect of various treatments on soil pH with addition of organic and inorganic fertilizer is not consistent. The slight decrease in soil pH with bio-inoculants treatments may be ascribed to the secretion of organic acids by PSB, *rhizobium* and azotobacter.

Electrical conductivity of the experimental soil ranged from 0.32 to 0.36 dS m^{-1} and it was maximum for T_1– Control and minimum for T_6 (100% RDF + P.S.B. (10 ml/kg seed + Water spray). Singh *et al*. (2007) reported that a change in EC values were very close margin due to combined application of bio-inoculants with chemical fertilizers. Further, Govindan and Thirumurugan (2003) [8] did not found any change in EC with the treatment of bio-inoculants. Similar results were also observed in bulk density which ranged from 1.30 to 1.34 Mg m^{-3} and data indicated that the difference in soil bulk density values were not reach up to the levels of significance due to seed treatment with *rhizobium* and PSB.

The result regarding residual effect of liquid biofertilizers and drought mitigating chemicals on organic carbon was presented in Table 1. It is evident from the results that the organic carbon content in soil was influenced significantly due to individual seed treatment with Rhizobium and PSB. The treatment T_{10} (100% RDF + *Rhizobium* (10 ml/kg seed) + P.S.B. (10 ml/kg seed) + 2% KCl + 0.4% Sodium selenite spray) recorded significantly higher (0.53%) content of organic carbon over all other treatments. The increase in organic carbon might be due to seed treatment with *rhizobium* and PSB increased the activity of microbes and support better root penetration and mungbean shedder leaves. Iraj *et al.* (2009) [10] also reported significant increase in organic carbon content with *rhizobium* or PSB as compared with control.

Availability of Nutrients in Soil after harvesting the mungbean

A critical examination of data showed that the application of different treatments of liquid biofertilizers with drought mitigating chemicals significantly increased the availability of major nutrients (N, P, & K) in Table 2 & Figure 1 and micronutrients (Fe, Mn and Zn), however effect on Cu content is non-significant in Table 3 & Figure 2 in soil after harvesting the crop. The application of T_{10} (100% RDF + *Rhizobium* (10 ml/kg seed) + P.S.B. (10 ml/kg seed) + 2% KCl + 0.4% Sodium selenite spray) attained maximum value of these nutrients. Results showed that application of 100% RDF + Rhizobium (10 ml/kg seed)+ P.S.B. (10 ml/kg seed) + 2% KCl + 0.4% Sodium selenite spray significantly improved the nutrient availability in soil after harvesting the mungbean crop *viz.*, available nitrogen (244.61 kg ha^{-1}), available phosphorus (22.60 kg ha^{-1}), available potassium (436.61 kg ha^{-1}) Fe content (4.88 mg kg^{-1}), Mn content (3.68 mg kg^{-1}), Zn content (0.63 mg kg^{-1}) as compared to initial soil test values. These results were in close conformity to Sarawgi *et al.* (1999) [18], who reported that the application of microbial culture along with phosphorus enhances the N and P content in chickpea. The accumulation of organic carbon with combined inoculation might have also contributed in augment available soil nitrogen at upper horizon as suggested by Dubey (2001) [5]. Kumar *et al.*, (2010) [13] reported that the PSB are known to have ability to solubilize P from insoluble source. The PSB secretes the different organic acids which act on insoluble phosphate to convert them in to soluble phosphate near the root of the plant and hence availability of P is increased. Konthoujam *et al.* (2013) [12] who had indicated that the judicious integration of organic and inorganic sources of nutrition significantly improved the soil available N, P, K, and micronutrient and numerically change in soil pH, electrical conductivity and organic carbon content in soil. Foliar spray of 2% KCl + 0.4% Sodium selenite resulted in increased nutrient availability, this might be due to good roots development and availability of adequate soil moisture because of higher moisture use efficiency which resulted into more binding of nutrients to the *rhizosphere* (Pettigrew, 2008) [16].

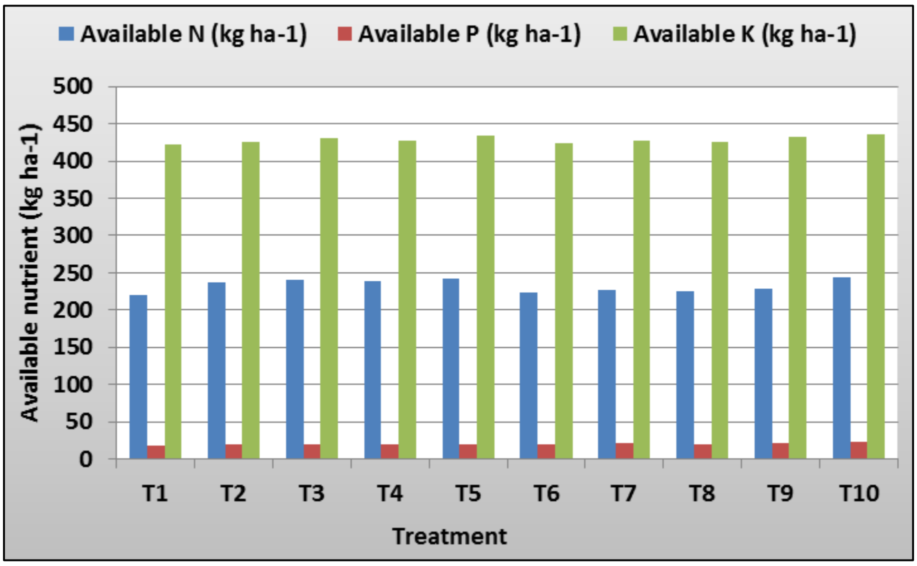

Fig 1: Effect of liquid bio-fertilizers and drought mitigating chemicals on available nutrient content in soil after harvesting of mungbean crop

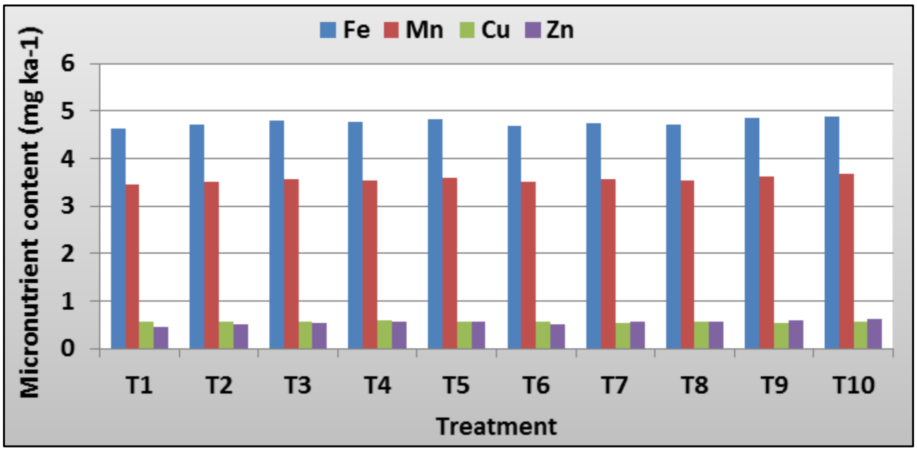

Fig 2: Effect of liquid bio-fertilizers and drought mitigating chemicals on micronutrient content in soil after harvesting of mungbean crop

Table 1: Effect of liquid bio-fertilizers and drought mitigating chemicals on physico-chemical properties of soil after harvesting the mungbean crop

	Treatment	pH	EC (dS m^{-1})	Organic carbon (%)	Bulk density (mg M^{-3})
T_1	100% RDF (Control)	7.59	0.36	0.43	1.34
T_2	100% RDF + Rhizobium (10 ml/kg seed) + water spray	7.59	0.35	0.48	1.34
T_3	100% RDF + Rhizobium (10 ml/kg seed) + 2% KCl spray	7.58	0.34	0.49	1.33
T_4	100% RDF + Rhizobium (10 ml/kg seed) + 0.4% Sodium selenite spray	7.57	0.34	0.49	1.33
T_5	100% RDF + Rhizobium (10 ml/kg seed) + 2% KCl + 0.4% Sodium selenite spray	7.57	0.34	0.51	1.30
T_6	100% RDF + P.S.B. (10 ml/kg seed) + Water spray	7.56	0.32	0.47	1.33
T_7	100% RDF + P.S.B. (10 ml/kg seed) + 2% KCl spray	7.58	0.33	0.48	1.32
T_8	100% RDF + P.S.B.(10 ml/kg seed) + 0.4% Sodium selenite spray	7.59	0.33	0.48	1.33
T_9	100% RDF + P.S.B.(10 ml/kg seed) + 2% KCl + 0.4% Sodium selenite spray	7.57	0.33	0.49	1.32
T_{10}	100% RDF + Rhizobium (10 ml/kg seed) + P.S.B. (10 ml/kg seed) + 2% KCl + 0.4% Sodium selenite spray	7.56	0.34	0.53	1.31
	SEm ±	0.02	0.01	0.01	0.03
	CD at 0.05%	NS	NS	0.03	NS

Table 2: Effect of liquid bio-fertilizers and drought mitigating chemicals on available nutrient content in soil after harvesting the mungbean crop

	Treatment	Available N (kg ha^{-1})	Available P (kg ha^{-1})	Available K (kg ha^{-1})
T_1	100% RDF (Control)	220.52	17.57	421.88
T_2	100% RDF + Rhizobium (10 ml/kg seed) + water spray	236.40	18.77	425.59
T_3	100% RDF + Rhizobium (10 ml/kg seed) + 2% KCl spray	239.91	19.22	430.47
T_4	100% RDF + Rhizobium (10 ml/kg seed) + 0.4% Sodium selenite spray	238.47	19.01	427.14
T_5	100% RDF + Rhizobium (10 ml/kg seed) + 2% KCl + 0.4% Sodium selenite spray	242.73	19.56	434.04
T_6	100% RDF + P.S.B. (10 ml/kg seed) + Water spray	223.68	19.87	424.40
T_7	100% RDF + P.S.B. (10 ml/kg seed) + 2% KCl spray	227.16	20.90	428.19
T_8	100% RDF + P.S.B.(10 ml/kg seed) + 0.4% Sodium selenite spray	225.14	20.28	425.28
T_9	100% RDF + P.S.B.(10 ml/kg seed) + 2% KCl + 0.4% Sodium selenite spray	228.22	21.50	431.98
T_{10}	100% RDF + Rhizobium (10 ml/kg seed) + P.S.B. (10 ml/kg seed) + 2% KCl + 0.4% Sodium selenite spray	244.61	22.60	436.61
	SEm ±	3.00	0.59	1.05
	CD at 0.05%	8.90	1.71	3.11

Table 3: Effect of liquid bio-fertilizers and drought mitigating chemicals on micronutrient content (mg kg^{-1}) in soil after harvesting of mungbean crop

	Treatment	Micronutrient content (mg kg^{-1})			
		Fe	Mn	Cu	Zn
T_1	100% RDF (Control)	4.63	3.46	0.58	0.46
T_2	100% RDF + Rhizobium (10 ml/kg seed) + water spray	4.73	3.52	0.58	0.52
T_3	100% RDF + Rhizobium (10 ml/kg seed) + 2% KCl spray	4.79	3.57	0.57	0.54
T_4	100% RDF + Rhizobium (10 ml/kg seed) + 0.4% Sodium selenite spray	4.77	3.53	0.59	0.56
T_5	100% RDF + Rhizobium (10 ml/kg seed) + 2% KCl + 0.4% Sodium selenite spray	4.82	3.61	0.58	0.57
T_6	100% RDF + P.S.B. (10 ml/kg seed) + Water spray	4.70	3.50	0.56	0.51
T_7	100% RDF + P.S.B. (10 ml/kg seed) + 2% KCl spray	4.74	3.58	0.55	0.56
T_8	100% RDF + P.S.B.(10 ml/kg seed) + 0.4% Sodium selenite spray	4.71	3.55	0.58	0.57
T_9	100% RDF + P.S.B.(10 ml/kg seed) + 2% KCl + 0.4% Sodium selenite spray	4.85	3.63	0.55	0.59
T_{10}	100% RDF + Rhizobium (10 ml/kg seed) + P.S.B. (10 ml/kg seed) + 2% KCl + 0.4% Sodium selenite spray	4.88	3.68	0.57	0.63
	SEm ±	0.02	0.01	0.02	0.01
	CD at 0.05%	0.07	0.03	NS	0.04

References

1. Ahmad F, Iqbal S, Khan MR, Abbas MW, Ahmad A, Nawaz H, *et al*. Influence of seed priming with salicylic acid on germination and early growth of sesame. Pure Applied Biology 2019;8(2):1206-1213.
2. Anonymous. Economic Survey.2019-20. Government of India, India 2020.
3. Anonymous. Agricultural Statistics At a Glance, Government of India, Ministry of Agriculture Cooperation and Farmers Welfare, Director of Economics and Statistics 2020.
4. Devangan S, Singh RP, Singh MK, Singh S. Effect of integrated nutrient management and drought mitigating practices on performance of rainfed chickpea (*Cicerarietinum*). Indian Journal of Agricultural Sciences 2017;87(3):301-305.
5. Dubey. Balance sheet of N and P as influenced by phosphate solubilizing bacteria and phosphate fertilization in rainfed soybean (*Glycine max*.) grown on vertisols. Annals Agricultural Research 2001;22(1):162-164.
6. Egilla JN, Davies FTJ, Boutton TW. Drought stress influences leaf water content, photosynthesis, and water use efficiency of Hibiscus rosa- sinensis at three potassium concentrations. Photosynthetica 2005;43:135-40.
7. Feedipedia. Animal Feed Resources Information System 2018.
8. Govindan K, Thirumurugan V. Effect of Rhizobium and PSM's in soybean- A review of Journal Maharashtra Agricultural university 2003;28(1):054-060.
9. Grover A, Kapoor A, Satyalakshmi O, Agarwal S, Sahi C, Agarwal SK, *et al*. Understanding molecular alphabet of the plant abiotic stress responses. Current Science 2001;80:206-216.
10. Iraj A, Tajik M, Iran-nejad H, Armandpisheh O. The effect of biofertilizers on soybean seed vigor and field emergence. Journal of Food Agricultural and Environment 2009;7(3-4):420-426.
11. Kaul AK. Pulses in Bangladesh. Agricultural Research

Farmgat, Dhaka. Council 1982, 27.
12. Konthoujam ND, Tensubam BS, Athokpam HS, Naorem BS, Shamurailatpam D. Influence of inorganic, biological and organic on nodulation and yield of soybean (*Glycine max* L. Merrill) and manures soil properties. Australian Journal of Crop Science 2013;7(9):1407-1415.
13. Kumar S, Reager ML, Pareek BL. Effect of phosphorus and biofertilizers on nutrient content and its uptake by moth bean. Journal of Progressive Agriculture 2010, 1.
14. Kumawat N, Kumar R, Sharma OP. Nutrient uptake and yield attributes of mungbean (*Vigna radiata* L.) influenced by organic manure PSB and phosphorus fertilization. Environment and Ecology 2009;28(1):332-335
15. Maheswari NU, Elakkiya T. Effect of liquid bio fertilizers on growth and yield of urdbean (*Vignamungo* L.). International Journal Pharmaceutical Sciences Review Research 2014;29(2):42-45.
16. Pettigrew WT. Potassium influences on yield and quality production for maize, wheat, soybean and cotton. Physiologia Plantarum 2008;133:670-681.
17. Raja D, Takankhar VG. Effect of liquid bio-fertilizers (*Bradyrhizobium* and PSB) on growth and yield of soyabean (*Glycine max* L.). International Journal Pure Applied Biosciences 2017;5(5):88-96.
18. Sarawagi SK, Tiwati SK, Tripathi RS. Uptake and balance sheet of nitrogen and phosphorus in gram (*Cicer aritenium*) as influenced by phosphorus, biofertilizers and micronutrients under rainfed condition. Indian Journal of Agronomy 1999;44(4):768-772.
19. Singh H, Kumar SC, Chandra R. Effect of combined inoculation on nodulation, nutrient uptake yields and quality of chick pea in Vertisol. Journal of Indian Society of Soil Science 2009;54:251-254.
20. Velineni S, Brahmaprakash GP. Survival and phosphate solubilizing ability of Bacillus Megaterium in liquid inoculants under high temperature and desiccation stress. Journal of Agricultural science and Technology 2011;13(5).