Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(3): 2279-2282
Received: 14-03-2019
Accepted: 16-04-2019

Nitesh Kumar Singh
Department of Soil Science and Agricultural Chemistry, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India

RP Singh
Department of Agricultural Chemistry and Soil Science, Udai Pratap Autonoumos College, Varanasi, Uttar Pradesh, India

Correspondence
Nitesh Kumar Singh
Department of Soil Science and Agricultural Chemistry, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, India

Effect of phosphatic fertilizer and PSB on growth and yield of mung bean (*Vigna radiate* L.) in inceptisol of Varanasi

Nitesh Kumar Singh and RP Singh

Abstract
A field experiment was conducted at research plot of Udai Pratap Autonomous College, Varanasi. (U.P.) to study the effect of Phosphatic Fertilizer and PSB on Growth and Yield of Mung Bean (*Vigna radiata* L.) and Fertility Status of Soil. The experiment entailed of three phosphorus levels (20, 30 and 40 kg P ha^{-1}), and two levels of seeds inoculation with PSB (un-inoculation and inoculation). Results shown that the increasing levels of phosphorus up to 40 kg P_2O_5 $ha^{-1}$and inoculation of seed with PSB increased the growth and yield attributes of the plant. On the basis of result shown by the current experiment we can say that the net return of the crop is increased with increasing the levels of phosphorus and inoculation of seeds with PSB.

Keywords: Fertility status, nutrient uptake, seed inoculation, PSB, growth and yield attributes, net returns

Introduction
Mung bean (*Vigna radiata* L.) is one of the important short duration pulse crop. Historically, India has been largest producer and consumer of Mung bean. However, its true yield potential has not achieved owing to several constraints (Singh *et al.*, 2010) [1]. It is cultivated on loamy sand soils in western Indo-Gangetic plains. It responds to both macro and micro nutrients. It is the third important pulse crop in India, covering an area of 2.86 million hectares, accounting for 12 percent of the total acreage, but constitutes only 8 percent of the total pulse production of the country. Inspite of its considerable genetic improvement, the yield potentials have not yet been exploited in totality as visualized by its average productivity as low as 4.68 q ha^{-1} in India (Yadav *et al.*, 2014) [2]. Declining trends in area, production and yield of pulses are recorded in the Indo-Gangatic plains popularly known as pulses basket of India. Rice-wheat and rice based cropping systems have replaced to a large extent the traditional pulse crop area, driving them out towards marginal / sub-marginal lands. Balanced supply of plant nutrients is essential for its high productivity. Nutrient requirement is one of the major abiotic constraints limiting productivity of mung bean. The inbuilt mechanism of biological nitrogen fixation enables mung bean crop to meet 80-90% of their nitrogen requirements. Balanced nutrition is indispensable for achieving higher productivity. At the same time, in view of increasing nutrients demand there is immense need to exploit the alternate source of nutrients *viz*. organic materials and biofertilizers to sustain the productivity with more environment friendly nutrient management systems. The environmental issues and other hazards emerging out of the imbalanced use of nutrients should also be addressed properly. Phosphorus is an integral part of plant body and the second major nutrient limiting plant growth is generally deficient in most of the soils due to its ready fixation (Schachtman *et al.*, 1998) [3]. The increasing prices of phosphatic fertilizers have raised an alarming situation for the country. Another issue is the reactivity of phosphate anions which are immobilized by forming a complex with Al or Fe in acidic soils (Norrish and Rosser, 1983) [4] or Ca in calcareous soils (Sample *et al.*, 1980) [5]. Hence, the amount available to plants is usually a small proportion of the total. Stevenson (1986) [6] reported that about 80% of added P fertilizers precipitated due to metal ion complexes. It has also been guessed that amount of P-fixed if solubilized might be sufficient for the next century (Goldstein *et al.*, 1993) [7]. The fundamental mechanism for mineral phosphate solubilization is the production of organic acids and chelating oxo acids from sugars (Antoun and Kloepper, 2001 and Peix *et al.*, 2001) [8, 9]. Production of organic acids results in acidification of the microbial cell and its surroundings. Gluconic acid seems to be the most common acids of mineral phosphate solubilization (Maliha *et al.*, 2004) [10]. Nodule forming Rhizobium has also been recognized as a P-solubilizer (Halder *et al.*, 1991) [11].

Bacillus sp. Increased grain yield of crops and lowered the P fertilizer requirements (Yuming *et al*., 2003) [12].

Materials and Methods

Experimental site

A field experiment was carried out in experimental area of the research plot of the Department of Agricultural Chemistry and Soil Science, Udai Pratap Autonomous College, Varanasi.

Selected crop

Mung bean (*Vigna radiata* L.) variety SML 668 was considered as a test crop for the experiment which are locally adopted and having high yield potential under adverse climatic condition. It completes life cycle within 80-90 days.

Treatment details

Field experiment was conducted to investigate the impact of three phosphorus levels (20, 30 and 40 kg P ha−1), and two PSB levels [(1) inoculated seed with PSB (+) and (2) seed not inoculated with PSB (− or control)] on solubilization and availability of phosphorus in an Inceptisol of Varanasi.

Seed treatment

For seed inoculation 10% solution of Jaggery (100 g gur in one litre of water) was prepared to serve as a sticker of PSB cells to seed. The gur solution was boiled and cooled. This solution was then sprinkled on seed duly spread on polythene sheet and mixed uniformly. The culture (@200g / 10 kg seed) was sprinkled uniformly over the sticker, coated the seeds and mixed simultaneously. After drying the seeds in shade for sometimes, it were used for sowing.

Experimental works

The total number of plot was 18 and these were randomly arranged. Healthy seeds of mung bean (var. SML 668) were sown by hand at the rate of 20 kg ha-1. Sowing was done in line with a spacing of 30 x 15 cm. Irrigation was given throughout the experiment period to keep the soil moist. At 30 and 60 days after sowing, plant height, number of leaves, number of branches, Number of nodules, Number of pods were recorded and the crop was harvested at maturity and allowed to dry in sun. Separate bundles were made for each plot and weighed then grain and Stover yield were recorded plot wise. After harvest, the soil from each pot was thoroughly mixed and approximately 100 g soil was sampled for laboratory analysis.

Soil pH

The pH of air dried, sieved soils was determined in a suspension of soil: distilled water: 1:2.5 (using 10 g soil and 25 ml water). The suspension was allowed to equilibrate for 4 hours. The pH was measured by using a combined glass and reference electrode saturated with KCl (Chopra and Kanwar, 1999) [13].

Soil EC

A soil water suspension was prepared in ratio of 1: 2.5 (10 g soil and 25 ml distilled water) and EC was recorded with glass electrode EC meter (Chopra and Kanwar, 1999) [13].

Organic carbon

Organic carbon was determined by Walkley and Black's rapid titration method. In this method one g of soil sample was oxidized with mixture of potassium dichromate and concentrated sulphuric acid. Unused potassium dichromate was backtitrated with ferrous ammonium sulphate in presence of diphenylamine indicator (Tandan 1999) [14].

Available nitrogen

Available nitrogen in soil sample was determined by Kjeldahl method with alkaline permanganate method as described by (Subbiah and Asija, 1956) [15].

Available phosphorus

Available phosphorus in soil samples was determined by Olsen's method where sodium bicarbonate (0.5 M NaHCO3) solution at pH 8.5 was used as extractant for neutral to alkaline soil and is designated to control ionic activity of Ca++ through solubility product CaCO3 thus extracting can be determine the most reacting forms of P from Al, Fe, and Ca phosphates. Phosphorus in the extract can be determined using a suitable method of colour development and measuring colour intensity and appropriate wave length (720 nm).

Statistical analysis

The calculated value of treatment and error of variance were compared with Fisher and Yates 'f' table of 5 % level of significance. When the value for treatment was found to be significant they were tested for significance by critical differences calculated from 't' value at 5% level of significance (Chandel, 2004) [16].

Results and discussion

It is evident from the results of present study that application of phosphorus at different levels through fertilizer or use of PSB alone or in combination increased the growth of crop (plants height, number of leaves and number of branches) as compared to control (without phosphorus). Growth attributes at 30 and 60 days after sowing significantly increased due to soil applied phosphorus through fertilizer or use of PSB alone or in combination.

Table 1: Effect of treatments on growth and yield components of mung bean

Treatments	Plant Height		Leaves plant-1		Branches plant-1		No. of nodule plant-1	Test weight	Pod	Dry pod	Grain	Stover yield
	30 DAS	60 DAS	30 DAS	60 DAS	30 DAS	60 DAS	45 DAS	(g)	plant-1	yield	yield	(q ha-1)
T0	28.43	29.16	20.14	21.58	4.33	5.5	2.12	28.31	8.22	5.33	3.35	8.8
T1	34.66	35.89	25.33	28.41	6.66	8.5	3.75	36.32	12.2	8.45	5.65	10.85
T2	45.16	48.58	27.75	32.41	7.91	11.1	7.16	46.2	18.42	15.13	12.35	15.63
T3	33.91	33.83	25.16	28.08	6.58	8.41	3.75	33.2	9.5	6.7	4.76	9.56
T4	35.12	38.82	25.33	29.5	6.83	9.08	4.43	38.2	13.26	10.5	8.81	13.21
T5	39.66	40.5	25.66	29.75	6.81	10.08	6.25	39.1	15.09	12.81	11.46	14.82
SEm+	8.58	6.455	3.71	5.3	1.5	2.14	0.75	2.75	1.22	0.6	0.06	0.04
CD (0.05)	N.S.	2.897	1.66	2.38	0.45	0.92	1.75	6.14	2.72	1.34	0.13	0.1

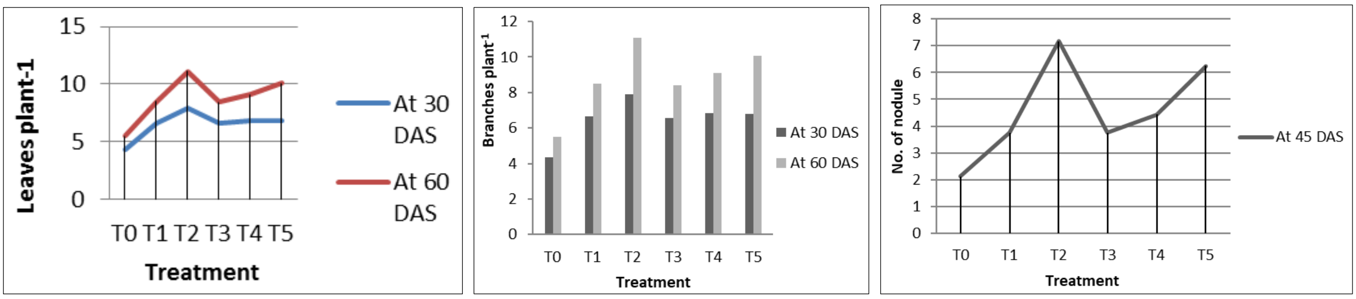

Fig 1: Effect of treatment on no. of leaves plant^{-1}, no. of branches plant^{-1} and no. of nodule at different growth stages

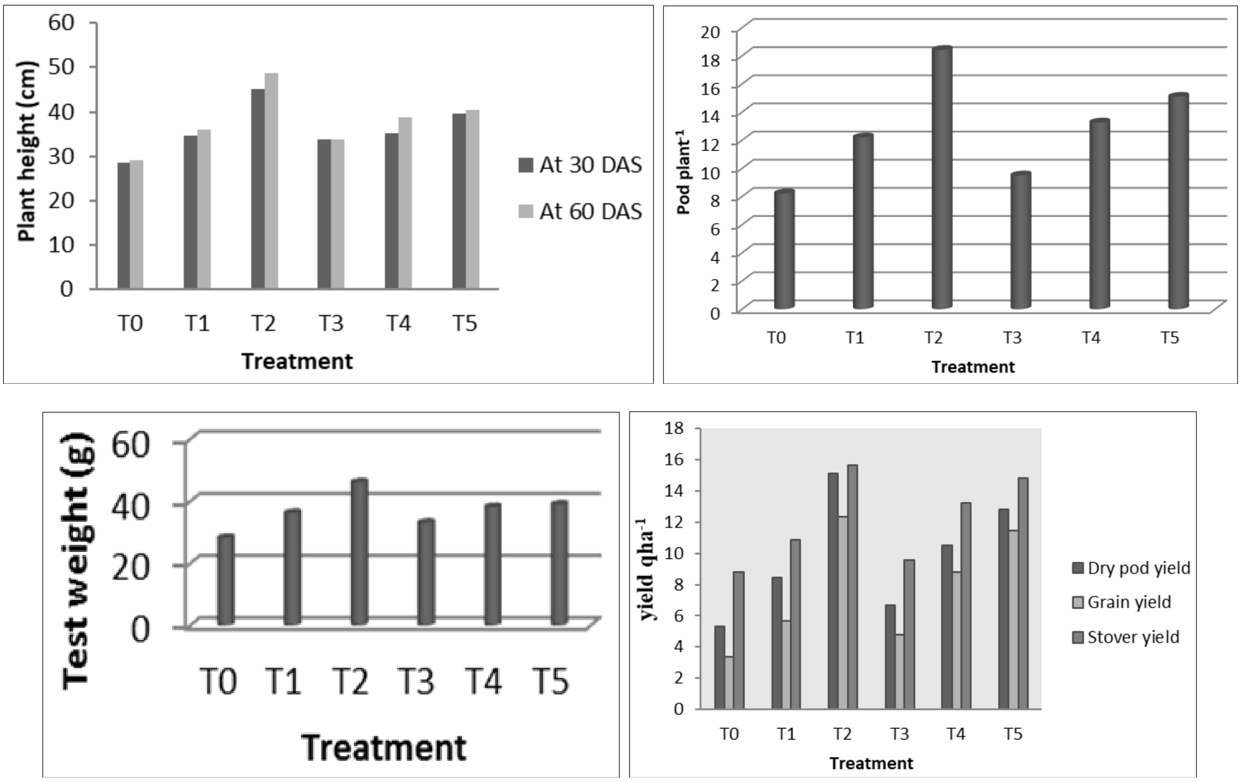

Fig 2: Effect of treatment on plant height (cm), pod plan $^{-1}$, test weight (g) and different yield component of plant at different growth stages

Growth attributes

Plant height

Data on mean number of plant height was recorded at two different stages of growth (30 and 60 days after sowing) which are presented in Table 1. The highest plant height was observed in treatment T_2 followed by other treatments in decreasing order as $T_5 > T_4 > T_1 > T_3 > T_0$.

Number of leaves

The maximum plant leaves was recorded in case of treatment T_2 and minimum was in the treatment T_0. The Effect of T_2 was statistically significant as compared to treatment T_0 (control). It is clear from the results that application of phosphatic fertilizer or PSB alone or in combination significantly increased the plant leaves as compared to without phosphorus (control).

Number of branches

It is clear from the data presented in table no. 1 that the maximum no. of branches found in treatment T_2 and minimum was in the treatment T_0 (control).

Number of nodule

The maximum number of nodules plant^{-1} were recorded in case of treatment T_2 followed by T_5, T_4, T_1, T_3 and T_0. T_2 was found significantly superior over all the treatments.

Yield attributes

Number of pods plant^{-1} and pod yield

Application of phosphorus through fertilizer or PSB treatment alone or in combination significantly increased the number of pods plant^{-1} and pod yield as compared to control. Treatment T_2 registered maximum number of pods plant^{-1} and pod yield and was found to be significantly superior over other treatments.

Grain yield, Stover yield and test weight

Results clearly indicate from the table 1 that grain yield, test weight and stover yield were significantly affected by application of phosphorus through fertilizer or use of PSB alone or in combination. Grain yield, test weight, and stover yields significantly increased due to soil applied phosphorus through fertilizer or use of PSB alone or in their combination. Increasing levels of phosphorus significantly registered higher yield and treatment T_2 was found to be the best treatment.

Conclusion

Accordingly, the field experiment was conducted adopting randomized block design with six treatments and three, replications. Treatments comprising; T_0 (Control, N: K @ 30 kg ha^{-1}), T_1 (T_0+ P@ 20 kg ha^{-1}), T_2 (T_0 + P @ 40 kg ha^{-1}+PSB), T_3 (T_0 + PSB), T_4 (T_0 + P @ 20 kg ha^{-1} + PSB) and T_5 (T_0 + P @ 30 kg ha^{-1} + PSB). To observe the effect, growth attributes (plant height, number of leaves, number of branches and number of nodules) and yield attributes (number of pods plant^{-1}, pod yield, test weight, grain and Stover yield) were recorded. Therefore, it is concluded from the study that mung bean favorably responded to soil applied phosphorus through fertilizer or seed inoculation with PSB alone or in combination. A dose of phosphorus @ 40 kg ha^{-1} in combination of PSB inoculation was found to be the best treatment in respect of growth and yield of mung bean.

References

1. Singh Guriqbal, Aggrawal Navneet, Khanna Veena. Integrated Nutrient management in lintil with organic manures, chemical fertilizers and bio fertilizers. Journal of Food Legumes. 2010; 23:149-151.
2. Yadav RDS, Chaudhary RK, Kushwaha GD. Effect of sowing time, spacing and seed treatments with Rhizobium and phosphate solubilizing bacteria on seed yield, its contributing traits and seed quality parameters in mung bean (*Vigna radiate* L.) Wilczek. Journal of Research in Agriculture and Animal Science. 2014; 2:01-05.
3. Schachtman DP, Reid RJ, Ayling SM. Phosphorus uptake by plants from soil to cell. Plant Physiology. 1998; 116:447-453.
4. Norrish K, Rosser H. Mineral phosphate, in: soils, an Australian Viewpoint. Academic press, Melbourne, CSIRO/London, UK, Australia, 1983, 335-361.
5. Sample EC, Soper RJ, Raez GJ. Reactions of phosphate fertilizers in soils. In: The Role of phosphate in Agriculture, (Eds.) F.E., Khasawneh, Sample, E.C. and Kamprath, E.J., Madison, WI: American Society of Agronomy, 1980, 263-310.
6. Stevenson FJ. Cycles of soil carbon, nitrogen, phosphorus, sulpher micro nutrients, Wiley, New York, 1986.
7. Goldstein AH, Rogers RD, Mead G. Mining by microbe. Bio technol. 1993; 11:1250-1254.
8. Antoun H, Kloepper JW. Plant growth promoting rhizobacteria. Encyclopedia of Genetics. Brenner, S. and Miller, J.F. (Eds in chief), 2001, 1477-1480.
9. Peix A, Boyero Rivas AA, Mateos, Barrueco, Rodriguez C, Molina *et al*. Growth promotion of chickpea and barley by a phosphate solubilizing strain of Mesorhizobium Mediterranean under growth chamber conditions. Soil Biology and Biochemistry. 2001; 33:103-110.
10. Maliha R, Samina K, Najma A, Sadia A, Farook L. Organic acids production and phosphate solubilization by phosphate solubilizing microorganism under in vitro conditions. Pakistan Journal of Biological Science. 2004; 7:187-196.
11. Halder AK, Misra AK, Chakrabarty PK. Solubilization of inorganic phosphates by *Bradyrhizobium*. Indian Journal of Experimental Biology. 1991; 29:28-31.
12. Yuming B, Xiaomin Z, Smith DL. Enhanced soybean plant growth resulting from co-inoculation of Bacillus strains with *Bradyrhizobium* japonicum. Crop Science. 2003; 43:1774-1778.
13. Chopra SL, Kanwar JS. Analytical Agricultural Chemistry, Kalyani Publications, New Delhi, 1999.
14. Tandon HLS. Methods of analysis of soil, plants, waters and fertilizer, Fertilizer Development and Consultation Organization New Delhi, 1999.
15. Subbiah BV, Asija GL. A rapid procedure for determination of available nitrogen in soil. Current Science. 1956; 25:259-260.
16. Chandel SRS. A Hand Book of Agricultural Statistics. Achal Prakashan Mandir 117 / 574, Pandu Nagar Kanpur, 2004, 17-35.