

Effect of Phosphorus and Mulching on Moisture, Yield and Yield Attributes of Mungbean (*Vigna radiata* L.) under Rainfed Condition

Simranpreet Singh, Ramawatar Meena, Y.V. Singh and Raj Kumar Meena

Department of Soil Science and Agricultural Chemistry, Institute of Agricultural Science,
Banaras Hindu University, Varanasi (U.P.)
E-mail Id : rmeena78@gmail.com

Abstract

Field experiment was conducted in kharif season 2014 at the experimental farm of Rajiv Gandhi South Campus (R.G.S.C) of Banaras Hindu University, Mirzapur, Uttar Pradesh. The experiment was placed under factorial randomized block design with four levels of P_2O_5 viz., control, 20, 30, and 40 kg P_2O_5/ha and four levels of mulching with legume straw viz., No mulch (Control), 1.5, 2.0, 2.5 t ha^{-1} and replicated thrice. Increasing levels of phosphorus and mulching (Legume Straw) enhanced the plant height (55.25 cm), yield attributes like number of pods/plant (41.90), number of grains/pod (10.06), test weight (34.01 g), grain (10.78 q ha^{-1}) and straw (26.63 q ha^{-1}) yield was found maximum with the application of phosphorus and legume straw mulch @ 40 kg $P_2O_5 ha^{-1}$ and 2.5 t ha^{-1} , respectively.

Key Words: Mungbean, Phosphorus, Mulching, Yield and Yield attributes.

Introduction

Mungbean is capable of fixing atmospheric nitrogen through Rhizobium species living in root nodules, Rhizobium spp. Invades the root hairs of mungbean and results in the formation of nodules, where free air nitrogen is fixed. These bacteria, although present in most of the soils help to improve nodulation, N_2 -fixation solicit crop growth and yield of leguminous crops. It contains 1-3% fat, 50.4% carbohydrates, 3.5-4.5% fibers and 4.5- 5.5% ash, while calcium and phosphorus are 132 and 367 mg per 100 grams of seed, respectively. Phosphorus is necessary for the production of protein, phospholipids and phytin in mungbean grain^[4]. The green plants are used as animal feed and the residues as manure. Hence, on the nutritional point of view, mungbean is perhaps the best of all other pulses. As a whole, mungbean could be considered as an inevitable component of sustainable agriculture. It is one of the popular short duration grain legumes in India and occupies third place after the chickpea and pigeonpea.

Material and Methods

A Field experiment was conducted in kharif, 2014 at the experimental farm of Rajiv Gandhi South Campus (R.G.S.C) of Banaras Hindu University, Mirzapur, Uttar Pradesh. Geographically, experimental site falls under the sub-tropical zone and located on 25° 10' N latitude 82° 37' E longitudes and an altitude of approximately 147 meter above mean sea level. The experiment was conducted in factorial randomized block design with four levels of P_2O_5 viz., control, 20, 30, and 40 kg P_2O_5/ha and four levels of mulching viz., No mulch (Control), 1.5, 2.0, 2.5 t ha^{-1} and replicated thrice. The variety PDM 139 (Samrat) was selected for the cultivation of during kharif season. The sowing was done at the rate of 25 kg grains/ha and hand weeding was done at 25, 45 days after sowing. No irrigation was applied as the experiment is conducted under rainfed conditions. The crop was harvested at full maturity. Growth parameters i.e. number of nodules/plant, dry weight of nodules (g), number of pods per plant, number of grains per pod, 1000-weight of grain (g), grain and straw yield were recorded. The initial

soil of Agriculture Research Farm, I.Ag.Sc., BHU, was analyzed through standard methods.

Results and Discussion

Soil Moisture Content (%)

Soil moisture content (%) was significantly influenced by various moisture conservation practices at 25, 50 DAS and at harvest. At 25 DAS (days after sowing) significantly highest (10.70%) soil moisture content was recorded with application of legume straw mulch @ 2.5 t ha⁻¹. At 50 DAS (days after sowing) 8.96% soil moisture content was recorded with the same treatment, in continuation soil moisture content decreasing with the increasing of crop duration. Maximum soil moisture content (4.74%) was observed with the legume straw mulch @ 2.5 t ha⁻¹ while lowest moisture content recorded under control (2.21%) at harvesting stage. With the application of phosphorus @ 40 kg P₂O₅ ha⁻¹ highest (10.66%) of soil moisture content was seen at 25 DAS while decreasing the moisture content with the duration of crop at 50 DAS and at harvesting 8.81 and 4.25% moisture was found, respectively.

Yield and yield attributes

Plant Height

Plant height is an important component for grain and straw yield. Plant height increased continuously and significantly with increasing levels of phosphorus up to 40 kg P₂O₅ ha⁻¹ at all stages of crop growth (Table 1). Maximum height was recorded at level of 40 kg P₂O₅ ha⁻¹ is 55.25 cm while 53.32cm was observed with application of 2.5 t legume straw mulch at harvesting stage. The difference between 30 and 40 kg P₂O₅ ha⁻¹ was significant and higher over control. Minimum plant height was recorded at control 50.82 cm. Plant height also increased continuously and significantly with increasing levels of mulching up to 2.5 t ha⁻¹, at all the stages of crop growth (Table 1). The plant height was increased with increasing levels of phosphorus might be due to effect of mulching in metabolism of growing plants^[2]. It is directly related with cell division, enlargement and elongation.

Number of trifoliolate leaf plant⁻¹

Maximum number of trifoliolate leaves (7.29) recorded with the application of 40 kg P₂O₅ ha⁻¹ at harvesting as compared to 50 DAS (4.75). Number of trifoliolate leaf per plant was significantly influenced by various moisture conservation practices treatments at 25, 50 DAS and at harvest. Maximum number of trifoliolate leaf (7.78) at 50 DAS (days after sowing) was observed with application of 2.5 t ha⁻¹ legume straw mulch. Minimum number of trifoliolate leaf per plant was found at control (6.13 and 4.09) under both the levels respectively.

Pod length plant⁻¹ (cm)

Highest pod length plant⁻¹ was recorded (7.43 cm) with application of nutrient @ 40 kg P₂O₅ ha⁻¹ while lowest pod length plant⁻¹ (5.54 cm) was observed under 0 kg P₂O₅ ha⁻¹ (control) application. Due to mulching treatments, pod length plant⁻¹ (cm) significantly improved and highest pod length plant⁻¹ (7.65 cm) was recorded with the application of legume straw mulching @ 2.5 t ha⁻¹.

Number of pods plant⁻¹

Maximum numbers of pods / plant were found 41.9 and 41.13 with application of 40 kg P₂O₅ and legume straw mulch 2.5t ha⁻¹, respectively. An increasing in number of pods with increasing levels of P₂O₅ and the difference among the treatments were significant. Minimum pods 34.25 and 35.52 were recorded at control under both the levels^[1].

Number of seed pod⁻¹

Maximum value of grains per pod (10.06) with the application of 40 kg P₂O₅ ha⁻¹ and 10.03 with 2.5 t legume straw mulch were observed while 7.27 and 6.98 seeds per pod were found under control, respectively.

Harvest index

The data pertaining to harvest index (Table 2) showed that change was significant with application of inorganic sources of plant nutrients with mulching. It is evident from the table that harvest index varied from 22.26 to 25.44 %. The maximum (25.44 %) harvest index value was observed with 2.5 t legume straw mulch ha⁻¹ followed by 40 kg P₂O₅ ha⁻¹ (25.12 %), in case of phosphorus and mulching levels, respectively. The minimum harvest index (22.26

% & 23.45%) was recorded under control of both the levels.

Test weight

The Data pertaining to the test weight of mungbean grains are given in table 2. From the data, it is evident that the test weight of wheat ranged from 31.65 to 34.01 per 1000grains. The maximum test weight (34.01 g) and (33.74 g) was recorded with application of 40 kg P₂O₅ ha⁻¹ and 2.5 t legume straw mulch ha⁻¹, respectively. Minimum test weight (31.65 g) and (32.44 g) was recorded in control of both levels.

Grain and straw yield

Maximum value of grain yield (10.78 q ha⁻¹) was recorded at level of 40 kg P₂O₅ ha⁻¹ and minimum value of grain yield (7.32 q ha⁻¹)

was recorded at 0 kg P₂O₅ ha⁻¹(control). The effect of treatments was significant among the phosphorus levels. In case of mulching maximum grain yield (9.64 q ha⁻¹) was found with application of legume straw @ 2.5 t ha⁻¹. The straw yield (Table 2) of ranged from 18.01 to 26.63 q ha⁻¹. The lowest straw yield (18.01 q ha⁻¹) was recorded with control and maximum (26.63 q ha⁻¹) was recorded with application of phosphorus @ 40 kg P₂O₅ ha⁻¹ which was about 48 % increased over control. Similarly mulching was also increased of straw yield ranged between 20.77 - 23.81 q ha⁻¹ which was under control and legume straw @ 2.5 t ha⁻¹. The results are in line with the findings of many others^[2, 3].

Table 1 Effect of phosphorus and mulching on soil moisture (%) and plant growth at different stages

Treatments	Soil moisture content (%)			Plant Height (cm)			No. of trifoliolate leaf plant ⁻¹		
	25 DAS	50 DAS	At Harvesting	25 DAS	50 DAS	At Harvesting	25 DAS	50 DAS	At Harvesting
P₂O₅ level									
0 Kg P ₂ O ₅ ha ⁻¹ (Control)	7.72	6.95	2.21	27.89	42.07	50.82	1.25	4.21	6.13
20 Kg P ₂ O ₅ ha ⁻¹	9.00	7.42	3.5	29.42	43.53	52.6	1.73	4.43	6.81
30 Kg P ₂ O ₅ ha ⁻¹	9.35	8.06	3.77	31.18	44.05	53.72	2.28	4.56	7.01
40 Kg P ₂ O ₅ ha ⁻¹	10.66	8.81	4.25	33.76	45.37	55.25	2.42	4.75	7.29
SEm±	0.12	0.08	0.08	0.27	0.16	0.17	0.03	0.02	0.01
CD (P=0.05)	0.4	0.31	0.33	0.56	0.32	0.36	0.12	0.07	0.04
Legume Straw Mulch									
No mulch	7.78	7.21	2.25	29.77	43.25	52.62	1.51	5.44	4.09
1.5 t ha ⁻¹ mulch	9.96	8.26	3.93	30.11	43.43	52.85	2.16	7.31	4.56
2 t ha ⁻¹ mulch	10.27	8.43	4.28	30.55	43.71	53.12	2.41	7.52	4.71
2.5 t ha ⁻¹ mulch	10.70	8.96	4.74	31.07	44.12	53.32	2.74	7.78	5.22
SEm±	0.07	0.09	0.06	0.27	0.16	0.17	0.09	0.03	0.04
CD (P=0.05)	0.21	0.28	0.16	0.56	0.32	0.36	0.26	0.08	0.14

Table 2 Effect of phosphorus and legume straw mulching on yield and yield attributes of mungbean

Treatments	Yield and yield attributes						
	No. pod plant ⁻¹	Pod length plant ⁻¹ (cm)	No. of seeds/pod	Grain yield (q/ha)	Straw yield (q/ha)	Test weight (g)	Harvest Index (%)
P₂O₅ level							
0 Kg P ₂ O ₅ ha ⁻¹ (Control)	34.25	5.54	7.27	7.32	18.01	31.65	22.26
20 Kg P ₂ O ₅ ha ⁻¹	38.07	6.98	8.34	8.83	21.79	32.83	23.99
30 Kg P ₂ O ₅ ha ⁻¹	40.58	7.26	9.41	9.46	23.35	33.94	24.28
40 Kg P ₂ O ₅ ha ⁻¹	41.9	7.43	10.06	10.78	26.63	34.01	25.12
SEm±	0.84	0.05	0.13	0.2	0.51	0.72	0.16
CD (P=0.05)	1.71	0.21	0.25	0.42	1.03	1.47	0.64
Legume Straw Mulch							
No mulch	35.52	6.51	6.98	8.41	20.77	32.44	23.45
1.5 t ha ⁻¹ mulch	38.24	7.31	8.57	8.99	22.21	32.78	24.32
2 t ha ⁻¹ mulch	39.9	7.47	9.49	9.34	23.06	33.47	25.00
2.5 t ha ⁻¹ mulch	41.13	7.65	10.03	9.64	23.81	33.74	25.44
SEm±	0.84	0.05	0.13	0.20	0.51	0.72	0.10
CD (P=0.05)	1.71	0.21	0.25	0.42	1.03	1.47	0.29

Conclusion

On the basis of the results summarized above in the present investigation, it can be concluded that the 40 kg P₂O₅ ha⁻¹ with legume

straw mulch at 2.5 tons ha⁻¹ was found most suitable under rainfed condition for green gram crop.

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