The Pharma Innovation Journal 2023; 12(10): 775-778

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(10): 775-778
© 2023 TPI
www.thepharmajournal.com
Received: 06-07-2023
Accepted: 11-08-2023

Rajendra Singh
Ph.D. Scholar, Jagannath University, Chaksu, Jaipur, Rajasthan, India

SL Sharma
Professor, Jagannath University, Chaksu, Jaipur, Rajasthan, India

AS Godara
Associate Professor, Swami Keshwanand Rajasthan Agricultural University, Bikaner, Rajasthan, India

Ashok Choudhary
Subject Matter Specialist, Rajasthan University of Veterinary and Animal Sciences, Bikaner, Rajasthan, India

Corresponding Author:
Ashok Choudhary
Subject Matter Specialist, Rajasthan University of Veterinary and Animal Sciences, Bikaner, Rajasthan, India

Effect of phosphorus and growth regulators on yield, nutrient uptake and quality of mungbean [*Vigna radiata* (L.) Wilczek] in arid region of Rajasthan

Rajendra Singh, SL Sharma, AS Godara and Ashok Choudhary

Abstract

An experiment was conducted during the *Kharif* seasons of 2021 and 2022 at Agricultural Research Station, Fatehpur, Sikar (Rajasthan) to evaluate the effect of phosphorus and salicylic acid on yield, nutrient uptake and quality of Mungbean. Five phosphorus levels [0, 15, 30, 45 and 60 kg ha^{-1}) in main-plots and four concentrations of growth regulators *viz.* no spray, salicylic acid 50 ppm, salicylic acid 75 ppm and salicylic acid 100 ppm, in subplots were studied in split-plot design with 3 replications. Application of 45 kg phosphorus produced significantly higher seed (1822 kg ha^{-1}) and straw yield (3145 kg ha^{-1}) over preceding graded lower levels and found at par with 60 kg phosphorus. Successive increase in phosphorus levels up to 45 kg ha^{-1} significantly increased nitrogen, phosphorus and potassium content in seed and straw. However, significantly highest uptake of nitrogen (73.0 & 42.5 kg), phosphorus (7.9 & 7.7 kg) and potassium (26.0 & 61.9 kg) by seed as well as straw was observed at 60 kg phosphorus ha^{-1} over lower levels, respectively. Significant increase in seed protein content (23.8%) as well as protein yield (316.9 kg ha^{-1}) was recorded with successive increase in phosphorus levels up to 45 kg ha^{-1} and beyond it increase was marginal. Foliar spray of salicylic acid 75 ppm resulted in significantly higher seed (1789 kg ha-1) and straw yield (3100 kg ha^{-1}) over lower concentrations and remained at par with 100 ppm salicylic acid. Salicylic acid @ 75 ppm increased nitrogen, phosphorus and potassium content of seed and straw over lower concentrations, while the highest uptake of these nutrients were observed with 100 ppm salicylic acid. Seed protein content (23.3%) and protein yield (307.5 kg) were significantly higher up to 75 ppm salicylic acid over lower concentrations of salicylic acid.

Keywords: Mungbean, salicylic acid, phosphorus levels, nutrient content and uptake, protein content

Introduction

Green gram or mungbean [*Vigna radiata* (L.) Wilczek] is a main source of dietary protein of majority of populace of arid and semi-arid regions of country due to its ecological suitability even under drought situations. It occupies 4.03 Mha areas and contributes 3.15 Million tonnes in pulse production in the country (Anonymous, 2022 a) [2], Rajasthan is chief contributor having 23.32 lakh hectares acreage with the production of 11.75 lakh tonnes and productivity of 504 kg ha^{-1} (Anonymous, 2022 b) [3]. There is huge yield gap between its attainable yield and actual productivity. Among many reasons of its low productivity the for most one is its cultivation on poor and marginal lands with low inputs *viz.*, use of inadequate nutrients and no use of growth regulators which are utmost essential for more carbon assimilation, dry matter partitioning and retention of flowers/ pods even under abiotic stresses.

Pulses are more responsive to phosphorus because it stimulate growth, initiate nodule formation as well as influence the efficiency of the *rhizobium*-legume symbiosis. It is required in large quantities in young cells such as shoot and root tips where metabolism is high and cell division is rapid. It also aids in flower initiation, seed and fruit development (Ndakemi and Dakora, 2007) [12]. Growth regulator, salicylic acid (SA), also participates in the signaling of abiotic stresses. Application of exogenous SA could provide against several type stresses such as high or low temp, heavy metals, and so on preliminary treatment to plants with low concentrations of SA might have an acclimation-like effect, causing enhanced tolerance toward most kinds of abiotic stresses due to primarily to enhance anti oxidative capacity. Since, growth regulators are strong antioxidant and also supply reactive sulfhydryl group for the functioning of sucrose transport protein, they can more effectively improve assimilate partitioning and yield of mungbean under arid environmental condition. Considering these aspects, a study was carried out to assess the impact of phosphorus levels, and growth regulators on yield, nutrient uptake and quality of mungbean.

Materials and Methods

A field experiment was carried out during the *Kharif* seasons of 2021 and 2022 in sandy-loam soil at Agricultural Research Station, Fatehpur, Sikar, Rajasthan under Jagannath University, Jaipur. The experimental site is situated in Sikar district which falls in arid and semi-arid region of Rajasthan.

The location of the experiment is 324 m above mean sea-level on latitude 27^0 98' North latitude and longitude 74^0 95' East longitudes and is characterized by hot semi-arid climate. The annual rainfall is mainly confined to 3 months (July–September) and means precipitation is about375mm.The soil was sandy loam with a pH 8.1, having low organic carbon (0.21%), low available nitrogen (144kg/ha), low available phosphorus (24kg/ha) and medium available potassium (130 kg/ha). The experiment was laid out in split plot design, comprising 5 levels of phosphorus *i.e*. 0, 15, 30, 45 and 60 kg P_2O_5 ha^{-1} as main-plot and 4 concentrations of growth regulators, *i.e.* no spray, 50 ppm salicylic acid,75 ppm salicylic acid and 100 ppm salicylic acid as sub plot treatment replicated thrice. Sowing of mungbean variety 'IPM-02-3' using 16 kg seed/ha was done at 30 cm line-to-line spacing and plant-to-plant distance of 10 cm was maintained. The phosphorus was supplied through single super phosphate. Salicylic acid was sprayed at flower initiation stage.

Seed and straw yield were recorded to evaluate the effect of treatments. Seed and straw samples were analyzed using standard procedures for estimation of N, P and K content in seed as well as straw and their uptake and protein content and protein yield. The data were subjected to homogeneity test and upon finding the data homogenous pooling was done and the statistical analysis was done as per procedure suggested by Panse and Sukhatme (1985) [13].

Results and Discussion

Yield attributes and yield

A significant improvement in pods $plant^{-1}$, seeds pod^{-1}, seed weight pod^{-1}, pod length and 1,000-seed weight, seed yield and straw yield of mungbean were recorded with an increment in phosphorus level. All these yield attributes and yields were the maximum at 60 kg phosphorus ha^{-1}, however, found at par with 45 kg phosphorus (Table-1). Favourable effects of yield attributes resulted in significant yield increase at eachhigher level of phosphorus. The maximum seed (1886 kg ha^{-1}) and haulm yield (3228 kg ha^{-1}) were recorded at 60 kg phosphorus, however, remained at par with 45 kg phosphorus. The increment in seed yield was 543, 305, 177 and64 kg ha^{-1} over 0, 15, 30and 45 kg phosphorus respectively, the corresponding increase in haulm yield was 705, 389, 244 and 83 kg/ha. Physiological role of phosphorus in enhancing growth parameters might have led to increased yield attributes and there by yield of crop at higher levels of phosphorus *vis-to-vis* application of phosphorus might have resulted in increased carbohydrate accumulation and their remobilization to reproductive parts of the plants, being the closest sink and hence, resulted in increased flowering, fruiting and seed formation (Nadeem *et al*., 2004) [10], Sepat (2005) [15] and Kumawat (2006) [8].

Nutrient content & uptake and quality

The nitrogen, phosphorus and potassium contents of mung bean seed and haulm increased significantly with increase in the level of phosphorus up to 45 kg ha^{-1} and further increase failed to registered substantial enhancement in nutrient contents in seed as well as haulm (Table 2). However, significantly higher nitrogen, phosphorus and potassium uptake by seed and haulm were recorded under 60 kg phosphorus over lower doses. It was because the application of 45 kg phosphorus improved the overall nutritional environment in the rhizosphere as well as in the plant system, resulting in increased nodulation and dry weight of nodules, which might have increased the availability of N, P and K and of some other nutrients from deeper layers. Thus the favourable influence of 45 kg phosphorus on higher nutrient absorption and production of assimilates and their efficient partitioning into different sinks led to higher content of N, P and Kin seed and haulm and ultimately significantly highest uptake of N, P & K at 60 kg phosphorus was recorded due to cumulative effect of yield and corresponding nutrient content in seed and haulm. The significantly increased protein content and protein yield were also recorded up to 45 kg phosphorus. Protein concentration is essentially the manifestation of nitrogen concentration in seed. Hence, increased nitrogen concentration might have increased the protein concentration. These results are in close conformity with the findings of Ram and Dixit (2001) [14] in green gram, Nagar and Meena (2004) [11] in cluster bean, Sepat (2005) [15] and Gupta *et al.* (2006) [6] in urdbean. The N, P and K contents of seed and haulm of mungbean increased significantly with increase in concentration of salicylic acid upto75ppm.The response of salicylic acid with respect to N, P and K uptake by seed and haulm was observed up to the 100 ppm salicylic acid. The significantly increased protein content and protein yield were also recorded up to 75 ppm salicylic acid and enhanced concentration of salicylic acid (100 ppm) failed to register further improvement in protein content and yield. Hussain *et al*. (2010) [7] in pearl millet found increased nutrient uptake with salicylic acid application. Gunes *et al.* (2007) [5] and Grown (2012) [4] also demonstrated that salicylic acid improved the uptake of minerals.

Table 1: Effect of phosphorus and growth regulator on yield attributes and yield of mungbean (pooled data of two years)

Treatments	No. of pods plant^{-1}	No. of seeds pod^{-1}	Pod length (cm)	Pod weight (g/plant)	Test weight (g)	Seed yield (kg/ha)	Straw yield (kg/ha)	Biological yield (kg/ha)	Harvest index (%)
Phosphorus									
P_0-Control	16.29	7.00	6.01	29.39	27.30	1343	2523	2523	34.55
P_1-15 kg/ha	17.40	7.71	6.84	34.80	29.19	1581	2839	2839	35.73
P_2-30 kg/ha	18.44	8.22	7.32	38.39	30.91	1709	2984	2984	36.39
P_3-45 kg/ha	19.61	8.63	7.90	44.18	32.53	1822	3145	3145	36.67
P_4-60 kg/ha	19.80	8.73	8.12	44.86	32.93	1886	3228	3228	36.82
SEm±	0.24	0.11	0.10	0.56	0.51	21.51	33.50	33.50	0.53
CD (P=0.05)	0.69	0.33	0.29	1.65	1.52	63.44	98.82	98.82	NS
	Growth regulators								
G_0-No spray (control)	16.61	7.18	6.29	30.49	27.80	1440	2633	2633	35.15
G_1-Salicylic acid 50 ppm	18.07	7.91	6.95	36.66	29.98	1603	2874	2874	35.73
G_2-Salicylic acid 75 ppm	19.20	8.54	7.79	42.85	31.92	1789	3100	3100	36.55
G_3-Salicylic acid 100 ppm	19.35	8.62	7.94	43.30	32.60	1841	3169	3169	36.70
SEm±	0.18	0.10	0.09	0.45	0.40	17.46	28.43	28.43	0.41
CD (P=0.05)	0.51	0.28	0.24	1.25	1.11	48.90	79.62	79.62	NS

Table 2: Effect of phosphorus and growth regulators on nutrient content and uptake, and quality of mungbean (Pooled data of two years)

Treatments	Nitrogen				Phosphorus				Potassium				Protein content (%)	Protein yield (kg/ha)
	Content (%)		Uptake (kg ha^{-1})		Content (%)		Uptake (kg ha^{-1})		Content (%)		Uptake (kg ha^{-1})			
	Seed	Straw	Seed	Straw	Seed	Straw	Seed	Straw	Seed	Straw	Seed	Straw		
Phosphorus														
P_0-Control	3.23	1.00	43.80	25.42	0.359	0.192	4.86	4.89	1.186	1.641	16.07	41.66	20.19	209.89
P_1-15 kg/ha	3.44	1.11	54.56	31.66	0.383	0.207	6.07	5.91	1.245	1.728	19.75	49.22	21.49	242.34
P_2-30 kg/ha	3.64	1.22	62.36	36.48	0.397	0.221	6.80	6.60	1.304	1.811	22.36	54.18	22.73	280.88
P_3-45 kg/ha	3.81	1.29	69.75	40.90	0.411	0.232	7.51	7.32	1.364	1.899	24.94	59.87	23.84	316.87
P_4-60 kg/ha	3.85	1.31	72.95	42.46	0.416	0.238	7.89	7.71	1.369	1.909	25.95	61.89	24.05	327.52
SEm±	0.04	0.01	0.75	0.33	0.004	0.002	0.08	0.05	0.014	0.019	0.27	0.43	0.24	4.55
CD (P=0.05)	0.12	0.03	2.23	0.98	0.011	0.007	0.22	0.14	0.042	0.057	0.80	1.28	0.69	13.41
Growth regulators														
G_0-No spray (control)	3.32	1.03	48.33	27.50	0.363	0.197	5.27	5.22	1.191	1.662	17.30	44.07	20.75	214.00
G_1-Salicylic acid 50 ppm	3.53	1.14	56.94	33.03	0.390	0.214	6.28	6.18	1.285	1.759	20.70	50.73	22.06	267.00
G_2-Salicylic acid 75 ppm	3.74	1.28	67.25	40.01	0.407	0.230	7.31	7.16	1.347	1.863	24.23	58.00	23.34	307.50
G_3-Salicylic acid 100 ppm	3.79	1.28	70.22	41.01	0.413	0.232	7.64	7.39	1.352	1.906	25.02	60.66	23.69	313.50
SEm±	0.03	0.01	0.60	0.30	0.002	0.001	0.07	0.05	0.013	0.015	0.22	0.41	0.21	3.87
CD (P=0.05)	0.08	0.02	1.68	0.85	0.007	0.004	0.19	0.14	0.035	0.042	0.62	1.15	0.59	10.84

Conclusion

Based on two years experiment, it was concluded that application of 45 kg phosphorus along with foliar sprays of salicylic acid 75ppm appeared to be the best nutrition option in getting higher yield, nutrient uptake and quality in mungbean.

References

1. Akhtar J, Ahmad R, Ashraf M, Tanveer A, Ahmad E, Oraby O. Influence of exogenous application of salicylic acid on salt stress Mungbean (*Vigna radiata*) growth and nitrogen metabolism. Pakistan Journal of Botany, 2013;45:119-125.
2. Anonymous. Posted Economics, Generic Crop India II PR English Production and Productivity, Pulse Development Scheme, ZPD Kanpur; c2022a.
3. Anonymous. Rajasthan Economic review. Commisionerate of Agriculture, Rajasthan; c2022b.
4. Grown B. Physiological role of salicylic acid in improving performance, yield and some biochemical aspects of sunflower plant grown under newly reclaimed sandy soil. Australian Journal of Basic and Applied Sciences. 2012;6(4):82-89.
5. Gunes A, Inal A, Alpaslan MF, Eraslan EG, Bagci, Cicek N. Salicylic acid induced changes on some physiological parameters symptomatic for oxidative stress and mineral nutrition in maize (*Zea mays* L.) grown under salinity. J Plant Phsiol. 2007;164:728-736.
6. Gupta A, Sharma GD, Chopra P. Effect of biofertilizer and phosphorus levels on yield attributes, yield and quality of urdbean (*Vigna mungo*). Indian Journal of Agronomy. 2006;51(2):142-144.
7. Hussain K, Khalid N, Majeed A, Khan F, Lin Feng, Ghani A, *et al*. Alleviation of salinity effects by exogenous applications of salicylic acid in pearl millet [*Pennisetum glaucum* (L.)] seedlings. African Journal of Biotechnology. 2010;9(50):8602-8607.
8. Kumawat S. Response of mothbean [*Vigna aconitifolia* (Jacq.) Marechal] to phosphorus and molybdenum. M.Sc. (Ag.) Thesis, Rajasthan Agricultural University, Bikaner; c2006.
9. Luikham E, Lhungdim J, Singh AI. Influence of sources and levels of phosphorus on growth and yield of green gram [*Vigna radiata* (L.) Wikzek]. Legume Research, 2005;28(1):59-61.
10. Nadeem MA, Ahmad R, Ahmad MS. Effect of seed inoculation and different fertilizer levels on growth and yield of mungbean (*Vigna radiata*). Journal of

Agronomy, 2004;3(1):40-42.
11. Nagar KC, Meena NL. Effect of phosphorus, sulphur and phosphate solublizing bacteria on yield components, yield and quality of cluster bean [*Cymopsis tetragonoloba* (L.) Taub.]. Legume Research, 2004;27(1):27-31.
12. Ndakidemi PA, Dakora FD. Yield components of nodulated cowpea (*Vigna unguiculata* (L.) Walp) and maize (*Zea mays*) plants grown with exogenous phosphorus in different cropping systems. Aust. J. Exp. Agric. 2007;47:587-590.
13. Panse VG, Sukhatme PV. Statistical Methods for Agricultural Workers. Indian Council of Agricultural Research, New Delhi; c1985.
14. Ram SN, Dixit RS. Growth, yield attributing parameters and quality of summer green gram (*Vigna radiata* (L.) Wilezek) as influenced by dates of sowing and phosphorus. Indian Journal of Agricultural Research, 2001;35:275 -277.
15. Sepat S. Response of mothbean [*Vigna aconitifolia* (Jacq.) Marechal] to phosphorus and sulphur fertilization under rainfed conditions. M.Sc. (Ag.) Thesis, Rajasthan Agricultural University, Bikaner; c2005.