Indian Journal of Agronomy **70** (2): 240–244 (June 2025)
DOI: 10.59797/ija.v70.i2.5611

Research Communication

Impact of potassium fertilization and stress-mitigating chemicals on productivity and profitability of mungbean [*Vigna radiata* (L.) Wilczek]

MANISHA KUMAWAT[1], L.R. YADAV[2], M.R. YADAV[3], SNEHIL KUMAR WATSH[4], KIRAN DHAKA[5] AND RAHUL[6]

S.K.N. College of Agriculture, Sri Karan Narendra Agriculture University, Jobner, Rajasthan 303 328

Received: December 2024; Revised accepted: May 2025

ABSTRACT

A field experiment was conducted at the Agronomy Farm, S.K.N. College of Agriculture, Jobner, Rajasthan, during the *Kharif* 2022 to assess the impact of different levels of potassium and stress-mitigating chemicals on mungbean [*Vigna radiata* (L.) Wilczek]. The experiment was laid out in a factorial randomized block design with three replications. Treatments comprised of potassium doses of 20, 30 and 40 kg K_2O/ha with a control and stress-mitigating chemicals [KNO_3 @ 100 ppm, thioglycolic acid @ 100 ppm and kinetin @ 50 ppm and control]. Data showed that application of 40 kg K_2O/ha significantly increased plant height, dry matter accumulation and plant growth indices, *viz*. crop growth rate (CGR), relative growth rate (RGR), net assimilation rate (NAR) and leaf area index (LAI) over control and 20 kg K_2O/ha. However, it was at par to 30 kg K_2O/ha in terms of RGR and NAR. Further, foliar sprays of TGA @ 100 ppm at 30 and 45 days after sowing significantly improved plant height and dry matter accumulation at 50 DAS and maturity, CGR, RGR and NAR at 25–50 DAS and LAI at 50 DAS over control and KNO_3 @ 100 ppm while it remained on par with kinetin @ 50 ppm. The highest net returns (₹61,554 and 62,543) and B:C ratio (3.16 and 3.40) were also recorded by application of 40 kg K_2O/ha and foliar spray of TGA @ 100 ppm, respectively. Hence, application of 40 kg K_2O/ha and two foliar sprays of TGA @ 100 ppm at 30 and 45 days after sowing may be recommended to achieve higher growth and profitability of mungbean.

Key words: Kinetin, Mungbean, NAR, Potassium, Potassium nitrate, Thioglycolic acid

Pulses are second after cereals in their significance within agriculture, offering excellent opportunities for sustainable intensification and diversification. Among these, mungbean (*Vigna radiata* L.), commonly known as green gram, stands out as the most important crop in South-East Asia. It ranks as the third most important pulse crop in India, after chickpea and pigeon pea. In India, it is majorly grown in Rajasthan (48%) and Madhya Pradesh (13%). It covers 55.50 lakh ha and produces 31.65 lakh tonnes with a productivity of 570 kg/ha (GoI, 2021–22). Mungbean seed contains 24.2% protein, 1.3% fat, 60.4% carbohydrate, 10% moisture, 3% mineral and 3% vitamins (Hussain *et al*., 2011). Mungbean is also associated with soil fertility improvement as it has the ability to fix atmospheric nitrogen (Ehsan *et al*., 2017).

Mungbean lacks a specific K recommendation since it has been assumed that Indian soils have adequate K levels. However, due to intensive cropping and minimal or no K application, these soils have become deficient in K (Jat *et al*., 2022). The judicious use of fertilizers or soil fertility management is of prime importance to abridge the yield gaps at the farm level (Hussain *et al*., 2011). The use of K promotes the formation of photosynthates, activates >60 enzymes and improves plant's resilience to both abiotic and biotic stresses (Prasad *et al*., 2014). It assists in the opening and closing of stomata and maintains turgor pressure in the plants (Benerjee *et al*., 2023). A balanced potassium supply also enhances crop quality, leading to higher-value produce and increased returns for farmers. Thus, such a study will be useful for determining the optimal K dosage for balanced fertilization, thereby maximizing mungbean production.

Abiotic stresses such as drought, salinity and high and low temperatures frequently hinder crop production, particularly for rainfed crops. Amongst the various abiotic stresses, drought is the most significant constraint in crop

Based on a part of M.Sc. Thesis of the first author submitted to S.K.N. College of Agriculture, S.K.N.A.U., Jobner, Rajasthan in 2022 (unpublished)

[1]**Corresponding author's Email:** manishakumawat21339@gmail.com
[1,4,5,6]M.Sc. Scholar, [2]Professor, Department of Agronomy, S.K.N. College of Agriculture, Sri Karan Narendra Agriculture University, Jobner, Rajasthan 303 328, [3]Assistant Professor, Department of Agronomy, Rajasthan Agricultural Research Institute (SKNAU), Durgapura, Jaipur 302 018

yield in arid and semi-arid regions (Araujo *et al*., 2015). The use of stress-mitigating chemicals might help to reduce the crop production losses caused by abiotic stresses. Potassium nitrate (KNO_3) serves as an effective plant growth enhancer improving photosynthetic pigments and reducing sodium (Na^+) absorption and oxidative stress in plants subjected to salt and water deficit stresses (Fayez and Baizaid, 2014). Thioglycolic acid (TGA) also called mercaptoacetic acid (MAA), enhances antioxidant enzymes activity, photosynthetic efficiency and improves the movement of photosynthates from source to sink *via* phloem loading in plants (Nathawat *et al*., 2018) which help plants resist stress conditions better. Kinetin, a synthetic cytokinin, acts as a potent natural antioxidant by influencing various physiological processes affected by drought stress (Werner *et al*., 2010) and protecting proteins and DNA from oxidative damage. Therefore, considering all these insights, the current study was contemplated to know the response of mungbean to rate of K application and foliar spray of stress-mitigating chemicals.

The field experiment was carried out during the *kharif* 2022 on Agronomy Farm, S.K.N. College of Agriculture, Jobner, Semi-arid Eastern Plain Zone of Rajasthan. The maximum and minimum temperatures during the crop season ranged between 30.2°C to 35.2°C and 20.3°C to 23.0°C, respectively. A total rainfall of 5.0 mm and 32.0 mm were recorded during the weeks of first and second foliar spray of stress mitigating chemicals, respectively. The soil of the experimental site was loamy sand in texture. Soil test results showed alkaline soil reaction (*p*H 8.2) with EC_e of 1.35 dS/m, poor in organic carbon (0.18 %), 127.5–17.2–160 kg N-P_2O_5-K_2O kg/ha. The experiment comprised of four levels of potassium (0, 20, 30 and 40 kg K_2O/ha) and four stress mitigating chemicals (control, KNO_3 @ 100 ppm, TGA @ 100 ppm and kinetin @ 50 ppm) in factorial randomized block design with three replications.

The state recommended dose of fertilizer for mungbean was 40–20 kg N-P_2O_5/ha applied at basal. Mungbean variety, 'IPM 02-03' was selected for the study sown on 8th July, 2022 at a seed rate of 20 kg/ha. Potassium was applied as per the treatments in the form of muriate of potash. Foliar spray of KNO_3, thioglycolic acid and kinetin with their respective concentrations was done at 30 and 45 DAS. In order to evaluate the effect of different treatments on growth, plant height and dry matter accumulation/plant were recorded using standard procedures.

The leaf area of three plants was measured for each treatment using portable leaf area meter and expressed as cm^2/plant. The net monetary returns (₹/ha) of each treatment were worked out by deducting the mean cost of cultivation (₹/ha) of each treatment from the gross monetary returns (₹/ha) gained from the respective treatment. The experimental data recorded were subjected to statistical analysis using *Analysis of Variance* technique. Significance of differences among treatment effects was tested by F-test and critical difference (CD) was worked out, wherever the difference was found significant at 5.0 % level of significance.

Growth parameters

Potassium application: Application of potassium at increasing levels significantly improved growth parameters, *viz.* plant height, dry matter accumulation, CGR, RGR, NAR and LAI over control (Table 1). Application of K_2O @ 40 kg/ha significantly increased plant height and dry matter accumulation at 25 DAS, 50 DAS and maturity over 0, 20 and 30 kg K_2O/ha. It also showed significant improvement in CGR at 25-50 DAS and 50 DAS-maturity and LAI at 25 DAS and 50 DAS. While in the case of RGR at both stages (25-50 DAS and 50 DAS-harvest) and NAR at 25-50 DAS, application of 40 kg K_2O/ha was comparable with application of 30 kg K_2O/ha. Potassium application @ 40 kg K_2O/ha obtained the highest seed yield (1.01 t/ha) and registered an increase of 33.3, 15.7 and 7.23% over control, 20 kg K_2O/ha and 30 kg K_2O/ha, respectively (Table 2). Sufficient quantity of K in the soil and plant roots made K readily available to plants, which might have produced higher levels of enzymatic and metabolic activity and improved photosynthesis. It also increases the availability of N and P which in turn improves plant growth. Amanullah *et al.* (2021) also reported that increasing levels of potassium increased plant growth and yield and plots fertilized with 60 kg K/ha produced the taller plants and highest grain yield of mungbean.

Stress mitigating chemicals: Plant growth parameters were significantly affected over control by foliar spray of stress-mitigating compounds at 30 and 45 DAS. Foliar spray of TGA @ 100 ppm recorded taller plants and greater dry matter accumulation at 50 DAS and at maturity. Foliar spray of TGA @ 100 ppm being comparable to kinetin @ 50 ppm, registered significantly higher CGR at both the stages, RGR and NAR at 25-50 DAS and LAI at 50 DAS over control and KNO_3 @ 100 ppm. In terms of RGR at 50 DAS to maturity, foliar spray of TGA @ 100 ppm remained comparable with KNO_3 @ 100 ppm and kinetin @ 50 ppm. Furthermore, foliar spray of TGA @ 100 ppm significantly recorded 20.4 and 8.69% higher seed yield over control and KNO_3 while remaining at par with kinetin @ 50 ppm. Application of thioglycolic acid (TGA) maintains cell turgor and improves photosynthesis and partitioning of photosynthates under moisture stress conditions (Nathawat *et al*., 2018) which may have increased dry matter accumulation. A higher CGR, RGR and NAR compared to control

Table 1. Effect of potassium and stress mitigating chemicals on growth parameters of mungbean

Treatment	Plant height (cm)			Dry-matter accumulation (g/plant)			CGR ($g/m^2/day$)		RGR (mg/g/day)		NAR (g/m^2 leaf area/day)	LAI	
	25 DAS	50 DAS	At harvest	25 DAS	50 DAS	At harvest	25-50 DAS	50 DAS-Harvest	25-50 DAS	50 DAS-Harvest	25-50 DAS	25 DAS	50 DAS
Potassium (kg K_2O/ha)													
Control	17.0	34.8	41.1	1.22	6.40	9.31	6.91	8.09	66.2	31.1	3.41	1.22	3.11
20	18.5	39.6	46.9	1.32	7.52	11.20	8.27	10.22	69.5	33.1	3.76	1.32	3.40
30	19.7	42.4	50.6	1.40	8.63	13.00	9.64	12.14	72.6	34.0	4.07	1.41	3.66
40	20.9	45.1	53.6	1.48	9.34	14.18	10.48	13.44	73.6	34.7	4.15	1.51	3.92
SEm±	0.40	0.95	1.02	0.03	0.17	0.27	0.23	0.35	1.09	0.62	0.07	0.03	0.07
CD (P=0.05)	1.15	2.75	2.93	0.08	0.50	0.77	0.66	1.02	3.14	1.79	0.21	0.09	0.22
Stress mitigating chemicals													
Control	18.5	36.1	43.0	1.34	7.05	10.26	7.61	8.91	66.1	31.1	3.57	1.33	3.18
KNO_3 @ 100 ppm	18.8	40.1	47.8	1.36	7.87	11.81	8.68	10.94	70.0	33.6	3.82	1.37	3.48
TGA @ 100 ppm	19.5	43.0	51.0	1.37	8.64	13.06	9.69	12.28	73.3	34.2	4.04	1.38	3.78
Kinetin @ 50 ppm	19.2	42.6	50.3	1.36	8.33	12.57	9.30	11.77	72.4	34.1	3.96	1.38	3.66
SEm±	0.40	0.95	1.02	0.03	0.17	0.27	0.23	0.35	1.09	0.62	0.07	0.03	0.07
CD (P=0.05)	NS	2.75	2.93	NS	0.50	0.77	0.66	1.02	3.14	1.79	0.21	NS	0.22
CV (%)	7.23	8.14	7.32	7.31	7.51	7.72	8.99	11.19	5.34	6.47	6.39	8.18	7.37

Table 2. Effect of potassium and stress mitigating chemicals on yield and economics of mungbean

Treatment	Seed yield (t/ha)	Gross returns (₹)	Net returns (₹)	Benefit: cost ratio
Potassium (kg K_2O/ha)				
Control	0.76	70183	40093	2.48
20	0.87	80219	49596	2.78
30	0.94	86472	55582	2.97
40	1.01	92710	61554	3.16
SEm±	0.02	1838	1838	0.06
CD (P = 0.05)	0.06	5308	5308	0.19
Stress mitigating chemicals				
Control	0.80	73831	48808	2.95
KNO_3 @ 100 ppm	0.89	81628	55994	3.18
TGA @ 100 ppm	0.96	88522	62543	3.40
Kinetin @ 50 ppm	0.93	85602	39479	1.85
SEm±	0.02	1838	1838	0.06
CD (P = 0.05)	0.06	5308	5308	0.19

may be described by the improvement in dry matter production due to the application of TGA. Lakhran *et al.* (2021) and Athnere *et al*. (2021) also confirmed similar results in wheat and green gram, respectively.

Economics

Successive levels of potassium significantly resulted in a higher net returns over control. Higher net returns were obtained on account of 40 kg K_2O/ha (₹61,554) over control, 20 kg K_2O/ha and 30 kg K_2O/ha showing an increase of ₹21,461, ₹11,958 and ₹5,972, respectively. Application of 40 kg K_2O/ha recorded higher B:C ratio (3.16) over control, 20 kg K_2O/ha and 30 kg K_2O/ha. It can be attributed to a significantly higher yield due to this potassium level.

Results also revealed that significantly higher net returns were obtained due to the chemicals applied to mitigate stress over control except kinetin. TGA recorded maximum net returns (₹62543/ha) which was higher than control and KNO_3 showing an increase of ₹13735 and ₹6549, respectively. The B:C ratio of TGA (3.40) was also higher over control and KNO_3 which can be attributed to increased yield and its low cost.

The present one-year study revealed that application of potassium and stress mitigating chemicals brought significant improvement in growth parameters and yield over control. Application of potassium @ 40 kg K_2O/ha and foliar sprays of TGA @ 100 ppm could be a better option for obtaining higher yield and net returns for mungbean in Semi-arid Eastern Plain Zone of Rajasthan.

REFERENCES

Amanullah, Yar, M., Khalid, S., Elshikh, M.S., Akram, H.M., Imran, Al-Tawaha, A.R.M., Ahmad, M., Muhammada, A., Ullah, S., Ali, A., Fahad, S., Adnan, M. and Ali, A. 2021. Phenology, growth, productivity, and profitability of mungbean as affected by potassium and organic matter under water stress vs. no water stress conditions. *Journal of Plant Nutrition* **45**(5): 629–650.

Araujo, S.S., Beebe, S., Crespi, M., Delbreil, B., Gonzalez, E.M., Gruber, V., Lejeune-Henaut, I., Link, W., Monteros, M.J., Prats, E., Rao, I., Vadez, V. and Patto, M.C.V. 2015. Abiotic stress responses in legumes: strategies used to cope with environmental challenges. *Critical Reviews in Plant Sciences* **34**(1–3): 237–280.

Athnere, S., Kolage, A., Gagare, Y. and Gadakh, M. 2021. Effect of irrigation regimes and foliar sprays of potassium on growth and economics of summer greengram (*Vigna radiata*). *Indian Journal of Agronomy* **66**(3): 373–377.

Banerjee, P., Kumari, V.V. and Nath, R. 2023. Nutrient management of spring-summer blackgram (*Vigna mungo*) with cobalt, potassium and boron under different dates of sowing in Eastern India. *Indian Journal of Agronomy* **68**(1): 44–47.

Ehsan, Q., Rana, D.S. and Choudhary A.K. 2017. Influence of crop establishment methods and phosphorus fertilization on production efficiency, profitability and resource-use efficiency of mungbean (*Vigna radiata* L. Wilczek) in southern Afghanistan. *Indian Journal of Agronomy* **62**(3): 367–370.

Fayez, K.A. and Bazaid, S.A. 2014. Improving drought and salinity tolerance in barley by application of salicylic acid and potassium nitrate. *Journal of the Saudi Society of Agricultural Sciences* **13**(1): 45–55.

Government of India. 2021–2022. Fourth Advance Estimates of Production of Foodgrains. Directorate of Economics and

Statistics, Department of Agriculture and Farmers Welfare, Ministry of Agriculture and Farmers Welfare, Government of India, New Delhi.

Hussain, F., Malik, A.U., Haji, M.A. and Malghani, A.L. 2011. Growth and yield response of two cultivars of mungbean (*Vigna radiata* L.) to different potassium levels. *The Journal of Animal and Plant Sciences* **21**(3): 622–625.

Jat, M.K., Yadav, P.K., Tikkoo, A. and Yadav, S.S. 2022. Effect of potassium application on yield and quality of green gram (*Vigna radiata* L.) on coarse textured soils of Southern Haryana. *Indian Journal of Experimental Biology* **60**: 59–63.

Lakhran, H., Sharma, O.P., Bajiya, R., Verma, H. P., Gupta, A. and Kanwar, S. 2021. Effect of thermal environment and bioregulators on productivity, profitability and nutrient uptake of wheat (*Triticum aestivum*) under semi-arid conditions of Rajasthan. *Indian Journal of Agronomy* **66**(1): 19–24.

Nathawat, N.S., Rathore, V.S., Meel, B., Bhardwaj, S. and Bhargava, R. 2018. Exogenous sulphydryl improves membrane stabilization, photosynthesis and antioxidant defense systems in *Vigna aconitifolia* L. under water stress. (In): *Proceedings of the National Academy of Sciences, India, Section B: Biological Sciences* **88**(3): 875–885.

Prasad, R., Kumar, D., Rana, D.S., Shivay, Y.S. and Tewatia, R.K. 2014. *Potassium Management*. Textbook of Plant Nutrient Management, *Indian Society of Agronomy*, New Delhi, pp. 122–123.

Werner, T., Nehnevajova, E., Kollmer, I., Novak, O., Strnad, M., Kramer, U. and Schmulling, T. 2010. Root-specific reduction of cytokinin causes enhanced root growth, drought tolerance, and leaf mineral enrichment in Arabidopsis and tobacco. *The Plant Cell* **22**(12): 3,905–3,920.