

Influence of potassium management and stress mitigating chemicals on yield, nutrient uptake and quality of mungbean [*Vigna radiata* (L.) Wilczek]

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ABSTRACT

In the *kharif* season of 2022, a field experiment was carried out at S.K.N. College of Agriculture, Jobner, Rajasthan, using a factorial randomized block design to examine the impact of varying potassium levels and stress mitigating chemicals on yield attributes and nutrient uptake by mungbean cultivated in loamy sand soil. The study involved sixteen treatment combinations, each replicated three times, with four potassium levels (control, 20, 30 and 40 kg K₂O/ha) and four stress mitigating chemicals (control, KNO₃ @ 100 ppm, Thioglycolic acid @ 100 ppm and Kinetin @ 50 ppm). The application of 40 kg K₂O/ha significantly increased number of pods/plant, number of seeds/pod, test weight and concentration of nitrogen in both seed and straw showing significant superiority to control and other preceding levels of potassium. The application of 40 kg K₂O/ha remaining at par with 30 kg K₂O/ha led to higher phosphorus and potassium concentration in seed and straw over control. Among stress mitigating chemicals tested, foliar application of TGA @ 100 ppm, applied at 30 and 45 days after sowing, reported significantly greater yield attributes and concentration of nitrogen and phosphorus in both seed and straw compared to control and KNO₃, though it showed similar results to Kinetin @ 50 ppm. All stress mitigating chemicals did not have an impact on the potassium content in seed and straw but increased the total potassium uptake compared to the control while remaining comparable to one another.

Key words: Kinetin, nutrient uptake, potassium, potassium nitrate, thioglycolic acid, yield.

INTRODUCTION

Mungbean is a significant pulse crop of India grown in all three seasons (*Rabi*, *Kharif* and *Zaid*). The fertility management is one of the important factors that greatly affect the growth, development and yield of mungbean (Asaduzzaman *et*

al., 2008; Omran *et al.*, 2020). Potassium is the third most crucial macronutrient, after nitrogen and phosphorus, that is necessary for plant growth. Potassium plays vital role in maintenance of osmotic pressure and cell turgor and it also activates enzymes, regulates water uptake and controls stomatal closure, which enhances resilience to water stress. Additionally, potassium is essential for the movement of photosynthates and root development (Romheld and Kirkby, 2010).

Water deficit is the primary limiting factor for crop production under arid and semi-arid conditions. Water stress at any growth stage can reduce

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crop growth, with stress during the flowering stage being particularly detrimental (Grover *et al.*, 2001; Dass and Bhattacharyya, 2007). The application of stress-mitigating chemicals may help minimize crop production losses caused by abiotic stresses, which negatively impact plant growth and productivity worldwide. Thioglycolic acid (TGA) is a sulphhydryl compound and sulphhydryl compounds play a special role in photosynthesis and facilitate the movement of photosynthates through the phloem by improving dry matter partitioning, thereby enhancing the plant's ability to resist drought better. Kinetin stimulates cell division and promotes the development of lateral buds, leading to the formation of reproductive buds and improved vegetative growth as well. Taking all these insights into consideration, an experiment was carried out to evaluate the response of mungbean to application of potassium along with foliar spray of stress mitigating chemicals.

MATERIALS AND METHODS

The field experiment was conducted at S.K.N. College of Agriculture, Jobner, falling under agroclimatic zone III A (Semi-arid Eastern Plain Zone) of Rajasthan during *khariif*, 2022. A total of 371.5 mm of rainfall was recorded and the relative humidity fluctuated between 41 and 70 per cent during the crop season. The maximum temperature ranged between 30.2°C and 35.2°C, while the minimum ranged between 20.3°C and 23.0°C during the season. The soil of the experimental area was loamy sand in texture with alkaline soil reaction (pH 8.2) and EC_e of 1.35 dS/m. The value of organic carbon, available nitrogen (N), available phosphorus (P_2O_5) and potassium (K_2O) of the experimental soil were 0.18 %, 127.5 kg/ha, 17.20 kg/ha and 159.98 kg/ha, respectively. The experiment comprised sixteen treatment combinations having four levels of potassium (control, 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) replicated thrice in Factorial Randomized Block Design. The recommended dose of nitrogen (40 kg N/ha) and phosphorus (20 kg P_2O_5 /ha) for mungbean was applied prior to sowing. Seeds of the mungbean variety,

'IPM 02-03' were sown on 8th July, 2022 in rows spaced at 30 cm apart, at a depth of 4-5 cm using a seed rate of 20 kg/ha. Potassium was applied according to the treatment specifications in the form of muriate of potash (60% K_2O) at the time of sowing. The stress mitigating chemicals were applied as foliar sprays at 30 and 45 days after sowing (DAS) at their respective concentrations. Number of pods/plant, number of seeds/pod and test weight were recorded from each plot using standard procedures. Estimation of nitrogen in seed and straw was done using "colorimetric method" given by Snell and Snell. Phosphorus concentration in seed and straw was determined by "Vanadomolybdo phosphoric acid" yellow colour method and intensity of the colour was measured by Spectrophotometer. Potassium concentration in the samples was estimated by "flame photometric method" using K filter. The experimental data observed, were analyzed statistically using the Analysis of Variance (ANOVA) technique as suggested by Fisher. Correlation and regression coefficients for seed yield and its contributing traits were calculated following the

$$\text{Nutrient uptake (kg/ha)} = \frac{\text{Nutrient conc. in seed (kg/ha)} \times \text{Seed yield (kg/ha)} + \text{Nutrient conc. in straw (kg/ha)} \times \text{Straw yield (kg/ha)}}{100}$$

method described by Snedecor and Cochran (1968).

RESULTS AND DISCUSSION

Yield attributes and yield

Results (Table 1) showed that varying levels of potassium significantly affected yield attributing characters over control. Application of potassium @ 40 kg K_2O /ha recorded the highest number of pods/plant (21.24), number of seeds/pod (10.77) and test weight (34.79 g). The application of 40 kg K_2O /ha resulted in 30.8% higher number of pods/plant, 34.1% higher number of seeds/pod and 27.6% higher test weight of mungbean compared to the control. Furthermore, application of 40 kg K_2O /ha produced significantly higher seed yield (1009 kg/ha) and straw yield (2398 kg/ha) relative to control, as well as to the 20 and 30 kg K_2O /ha. An adequate amount of potassium during the early stages of crop development encour-

age vegetative growth and branching by affecting cell division and elongation and consequently increase flowering and seed set. The enhanced filling of grains, attributed to improved enzyme activity and the effective movement of photosynthates from source to sink, results in larger seed sizes (Das, 1999), which could be the probable reason of an increase in test weight due to a higher level of potassium. The increased seed yield of mungbean may be a result of the cumulative effect of improved yield attributes. These results are consistent with the findings of Hussain *et al.* (2011), Hamim and Choudhary (2019) and Amanullah *et al.* (2021) in mungbean.

Foliar application of TGA @ 100 ppm at 30 and 45 DAS, improved the number of pods/plant by 16.0% and 6.65%, number of seeds/pod by 23.6% and 7.79% and test weight by 13.4% and 6.49% compared to the control and KNO₃, respectively. The highest yield attributes *viz.*, number of pods/plant (20.20), number of seeds/pod (10.38) and test weight (33.16g) were recorded with TGA @ 100 ppm and these results were statistically at par with kinetin @ 50 ppm. Foliar spray of TGA also produced the highest seed yield (963 kg/ha) and straw yield of mungbean (2297 kg/ha), primarily due to improvements in yield components. The presence of a sulphhydryl (thiol) group in TGA plays a key role in photosynthesis and dry matter partitioning, which may enhance drought tolerance in plants. TGA, containing a thiol group, has been

reported to improve the translocation of photosynthates from source to sink through phloem loading, thereby supporting yield formation (Srivastava *et al.*, 2008). Similar findings were reported by Dhikwal *et al.* (2013) and Nathawat *et al.* (2016) in barley and clusterbean, respectively.

Nutrient content, uptake and quality parameters

Application of 40 kg K₂O/ha, 30 kg K₂O/ha and 20 kg K₂O/ha significantly improved the N concentration in both seed and straw over control. The corresponding increase due to application of 40 kg K₂O/ha in the N concentration in seed and straw was 22.9% and 28.4%, respectively as compared to control. The N uptake due to 40 kg K₂O/ha, 30 kg K₂O/ha, 20 kg K₂O/ha were 71.54, 62.91 and 54.74 kg/ha, respectively, which were significantly higher than that of control. Phosphorus concentration in both seed and straw increased significantly over control only with the application of 40 kg K₂O/ha, showing an increase of 6.78% in seed and 7.69% in straw. A significant increase in phosphorus uptake was also observed with 40 kg K₂O/ha, 30 kg K₂O/ha and 20 kg K₂O/ha compared to control, with the highest uptake (8.91 kg/ha) recorded under 40 kg K₂O/ha. Application of 40 kg K₂O/ha significantly enhanced potassium concentration in both seed and straw, with increase of 13.8% and 6.16% in seed and 14.9% and 5.79% in straw over the control and 20 kg K₂O/ha, respectively. However, these results were statisti-

Table 1. Effect of potassium and stress mitigating chemicals on yield attributes and yield of mungbean

Treatments	Pods/ plant	Seeds/ pod	Test weight (g)	Seed yield (kg/ha)	Straw yield (kg/ha)	Biological yield (kg/ha)
Potassium (kg K ₂ O/ha)						
Control	16.24	8.03	27.26	757	1927	2684
20	18.84	9.55	31.08	872	2091	2963
30	20.06	10.17	32.94	941	2242	3183
40	21.24	10.77	34.79	1009	2398	3407
SEm±	0.39	0.21	0.64	22	52	62
CD (P = 0.05)	1.12	0.59	1.85	63	151	178
Stress mitigating chemicals						
Control	17.42	8.40	29.25	800	1972	2772
KNO ₃ @ 100 ppm	18.94	9.63	31.14	886	2142	3028
TGA @ 100 ppm	20.20	10.38	33.16	963	2297	3260
Kinetin @ 50 ppm	19.82	10.11	32.53	930	2247	3177
SEm±	0.39	0.21	0.64	22	52	62
CD (P = 0.05)	1.12	0.59	1.85	63	151	178
CV (%)	7.01	7.40	7.04	8.48	8.37	6.99

cally at par with 30 kg K₂O/ha. The highest potassium uptake (56.29 kg/ha) was recorded due to 40 kg K₂O/ha representing a 44.2% increase over the control. Potassium application promotes biological nitrogen fixation through improved nodulation, leading to higher N content in both seed and straw. The overall improvement in crop growth due to balanced fertilization contributed to increased N, P, and K content in the seed. Similar findings of enhanced nutrient uptake in mungbean with potassium application were reported by Biswash *et al.* (2014) and Quddus *et al.* (2019).

The results (Table 2) indicate that among stress mitigating chemicals, the highest nitrogen concentration in seed (3.62%) and straw (1.36%) was observed with TGA application. TGA also resulted in the highest nitrogen uptake (66.59 kg/ha), although it remained statistically at par with kinetin. The maximum phosphorus concentration was also recorded with TGA, which was significantly greater than the control and KNO₃ by 15.8% and 6.89% in seed and 21.9% and 5.85% in straw, respectively. TGA and kinetin were found to be equally effective for this parameter. Phosphorus uptake under TGA (8.77 kg/ha) increased by 41.2% and 14.6%, compared to control and KNO₃, respectively. Stress mitigating chemicals did not have a significant effect on potassium concentration in either seed or straw. However, KNO₃, ki-

netin, and TGA resulted in higher total potassium uptake than the control, although they remained statistically at par with each other. Foliar application of stress mitigating chemicals likely promoted better root growth, enabling deeper soil penetration and improved nutrient extraction, which may explain the increased nitrogen and phosphorus concentrations in seed and straw. Similar results were recorded by Meena *et al.*

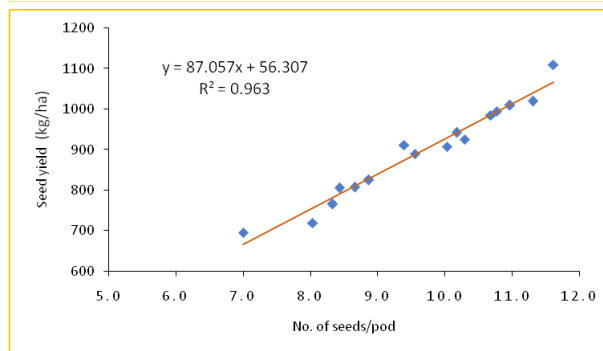
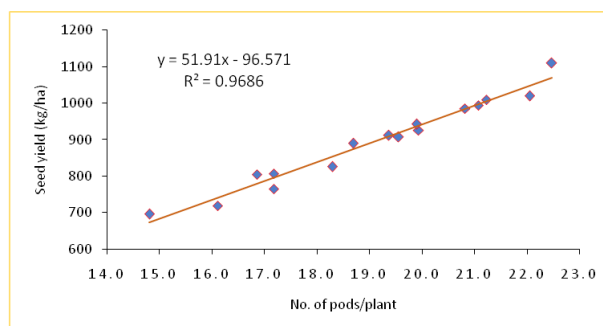


Table 2. Effect of potassium and stress mitigating chemicals on quality parameters of mungbean

Treatments	N concentration (%)		Total N uptake (kg/ha)	P concentration (%)		Total P uptake (kg/ha)	K concentration (%)		Total K uptake (kg/ha)	Protein content (%)
	Seed	Straw		Seed	Straw		Seed	Straw		
Potassium (kg K ₂ O/ha)										
Control	3.02	1.09	44.08	0.354	0.195	6.46	0.712	1.75	39.04	18.88
20	3.30	1.23	54.74	0.363	0.201	7.40	0.763	1.90	46.36	20.63
30	3.51	1.32	62.91	0.370	0.205	8.12	0.804	2.00	52.37	21.94
40	3.71	1.40	71.54	0.378	0.210	8.91	0.810	2.01	56.29	23.19
SEm±	0.04	0.02	1.57	0.006	0.004	0.24	0.014	0.03	1.17	0.27
CD (P = 0.05)	0.12	0.06	4.52	0.017	0.011	0.69	0.041	0.10	3.36	0.77
Stress mitigating chemicals										
Control	2.99	1.10	45.84	0.335	0.178	6.21	0.763	1.87	43.17	18.70
KNO ₃ @ 100 ppm	3.41	1.28	58.19	0.363	0.205	7.65	0.778	1.94	48.73	21.33
TGA @ 100 ppm	3.62	1.36	66.59	0.388	0.217	8.77	0.777	1.93	51.97	22.59
Kinetin @ 50 ppm	3.52	1.31	62.65	0.378	0.210	8.27	0.771	1.91	50.18	22.00
SEm±	0.04	0.02	1.57	0.006	0.004	0.24	0.014	0.03	1.17	0.27
CD (P = 0.05)	0.12	0.06	4.52	0.017	0.011	0.69	NS	NS	3.36	0.77
CV (%)	4.36	5.51	9.30	5.45	6.25	10.67	6.31	6.25	8.32	4.36

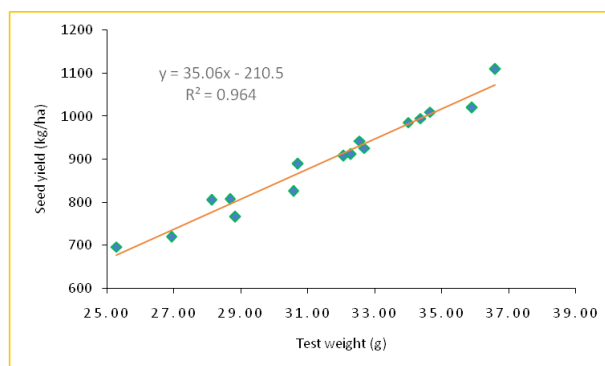


Fig. 1. Correlation of mungbean seed yield with number of pods/plant, no. of seeds/pod and test weight

(2016) and Panwar and Yadav (2018) in clusterbean.

In terms of protein content, basal application of 40 kg K₂O/ha proved superior to control, 20 kg K₂O/ha and 30 kg K₂O/ha, primarily due to the increased N concentration in the seed. Among

stress mitigating chemicals, foliar spray of TGA @ 100 ppm recorded the maximum protein content (22.59 %). However, its effect was statistically comparable to kinetin but produced a significantly higher protein content than KNO₃ and control.

CONCLUSION

The present study revealed that application of potassium and stress mitigating chemicals brought significant improvement in yield attributes, nutrient uptake and protein content of mungbean. Application of potassium @ 40 kg K₂O/ha and foliar spray of TGA @ 100 ppm showed superiority in terms of the above parameters compared to other treatments. Therefore, application of potassium @ 40 kg K₂O/ha along with foliar spray of TGA @ 100 ppm at 30 and 45 DAS may be recommended for higher yield and quality of mungbean.

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.
- Asaduzzaman, M.D., Karim, M.F., Ullah, M.J. and Hasanuzzaman, M. 2008. Response of mungbean (*Vigna radiata* L.) to nitrogen and irrigation management. *American-Eurasian Journal of Scientific Research*, **3**(1): 40-43.
- Biswash, M.R., Rahman, M.W., Haque, M.M., Sharmin, M. and Barua, R. 2014. Effect of potassium and vermicompost on the growth, yield and nutrient contents of mungbean (BARI Mung 5). *Open Science Journal of Bioscience and Bioengineering*, **1**(3): 33-39.
- Dass, Anchal and Bhattacharyya, R. 2017. Wheat residue mulch and anti-transpirants improve productivity and quality of rainfed soybean in semi-arid north-Indian plains. *Field Crops Research*, **2010**: 9-19.
- Das, P.C. 1999. Plant Nutrients. (In): *Manures and Fertilizers* (2nd Edition). Kalyani Publishers, New Delhi, India, pp. 5-10.
- Dhikwal, S.R., Kumawat, S.M., Das, S. and Jat, B.L. 2013. Effect of bio-regulators application on productivity of barley (*Hordeum vulgare* L.) in arid conditions of western Rajasthan. *Forage Research*, **38**(2): 106-111.
- Grover, A., Kapoor, A., Lakshmi, O.S., Agarwal, S., Sahi, C., Katiyar-Agarwal, S., Agarwal, M. and Dubey, H. 2001. Understanding molecular alphabets of the plant abiotic stress responses. *Current Science*, **80**(2): 206-216.
- Hamim, H. and Choudhary, A.K. 2019. Influence of varying potassium levels on yield, water productivity, profitability and resource-use efficiency in *kharif* mungbean (*Vigna radiata*) under semi-arid conditions of Afghanistan. *Indian Journal of Agricultural Sciences*, **89**(3): 551-555.
- 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. *Journal of Animal and Plant Sciences*, **21**(3): 622-625.
- Meena, V.K., Kaushik, M.K., Kumar, R., Singh, M., Meena, B.L., Meena, B.P., Meena, R.K., Kumar, U. and Kumar, S. 2016. Influence of growth regulators on nutrient concentrations, nutrient uptake and quality parameters of cluster bean

- varieties. *Legume Research*, **39**(5): 797-801.
- Nathawat, N.S., Rathore, V.S., Meel, B., Bhardwaj, S. and Yadava, N.D. 2016. Enhancing yield of clusterbean (*Cyamopsis tetragonoloba* L. Taub) with foliar application of sulphhydryl compounds under hot arid conditions. *Experimental Agriculture*, **52**(3): 418-433.
- Omran, A.H., Dass, A., Rajanna, G.A., Dhar, S., Choudhary, Anil K., Meena, S.L. and Rathore, S.S. 2020. Root-shoot characteristics, yield and economics of mungbean [*Vigna radiata* L.] under variable rates of phosphorus and nitrogen in Kandahar region of Afghanistan. *Bangladesh Journal of Botany*, **49**(1): 13-19.
- Panwar, D. and Yadav, L.R. 2018. Effect of stress mitigating chemicals on nodulation, total nutrient uptake and protein content of clusterbean [*Cyamopsis tetragonoloba* (L.) Taub] varieties. *International Journal of Current Microbiology and Applied Sciences*, **7**(11): 2923-2928.
- Quddus, M., Hossain, M., Naser, H.M., Anwar, B., Siddiky, M. and Ali, M. 2019. Influence of potassium addition on productivity, quality and nutrient uptake of mungbean (*Vigna radiata* L.). *Journal of Agricultural Studies*, **7**(1): 21-40.
- Romheld, V. and Kirkby, E.A. 2010. Research on potassium in agriculture: needs and prospects. *Plant and Soil*, **335**(1): 155-180.
- Srivastava, A.K., Nathawat, N.S., Ramaswamy, N.K., Sahu, M.P., Singh, G., Nair, J.S., Paladi, R.K. and D'souza, S.F. 2008. Evidence for thiol induced enhanced in situ translocation of 14-C sucrose from source to sink in *Brassica juncea*. *Environmental and Experimental Botany*, **64** (3): 250-255.