
Effect of Potassium and Manganese on Yield, Quality, and Nutrient Uptake by Pea (*Pisum sativum* L.)

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Abstract

*A pot experiment was conducted to study the effect of potassium and manganese on yield, quality, and nutrient uptake by pea (*Pisum sativum* L.). The experiment was laid out in a randomized block design with four levels of potassium (0, 30, 60, and 90 kg K₂O ha⁻¹) and four levels of manganese (0, 0.5, 1.0, and 2.0 mg kg⁻¹) with three replications. The results revealed that increasing doses of potassium up to 90 kg ha⁻¹ significantly enhanced pea yield, while manganese application tended to decrease the yield. Protein content was improved by the application of both potassium and manganese. Potassium addition had a beneficial effect on the uptake of N, P, K, and Mn by the pea crop, while manganese addition had a significant but adverse effect on yield, quality, and nutrient uptake, except for Mn uptake.*

Key words: Potassium, manganese, yield, nutrient uptake, pea

Introduction

Pea is commonly grown in temperate areas of all continents. It has many uses: immature pods and seeds are used as green vegetables, either fresh or frozen; it is used as green forage for grazing animals, in situ or as hay or silage; and it is grown for its mature seed, which itself has many uses. If the crop is managed properly, green pods are produced continuously for several months. Application of balanced fertilizer increases vegetative growth and improves yield and quality of the produce. As a grain legume, field peas are capable of fixing most of the required nitrogen from environment. Among the mineral elements, potassium plays a major role on the plant growth. Potassium (K) is key element for crop productivity and soil fertility. Potassium (K) is the vital nutrient involved in many essential physiological processes in plants; it can increase crop productivity and quality, and capability of plants to survive adverse conditions. Potassium deficiency is a world-wide problem,

although cropping intensity and improved variety enhance K deficiency in soil. The crop is grown on such soil show potassium deficiency (Akter et al., 2020). Micronutrients like manganese play an important role in increasing crop yield through their effect of plant itself and also help in nitrogen fixing process. Manganese (Mn) plays an important role in Nitrogen metabolism and forms several compounds needed or plant metabolism. Mn also acts as co- factor for several plant enzymes, where it activates about 35 different enzymes. Manganese, one of the essential micronutrients though involved in respiratory process such as oxidation of carbohydrates to carbon dioxide and water, also participates in the metabolism of nitrogen. It activates the enzymes, directly involved in the synthesis of chlorophyll.

Materials and Methods

A pot experiment of this investigation was carried out at Agriculture experimental field were

undertaken in the (Department of Soil Science and Agricultural Chemistry), Nehru Mahavidyalaya, Lalitpur (U.P.) during winter season 2024-2025. Lalitpur district is a part of Bundelkhand plateau. Betwa River is the boundary between Jhansi and Lalitpur in the north. Most of the area is under the average elevation of 300m-450m from the Sea level. Its latitudinal extension is from 24°10' to 25°15' (north) and longitudinal extension is from 78°10' and 79°0' (East). The experimental station is situated at 44 km in the Southern of center of Lalitpur city on Sagar-Road. The soil had EC 0.21 dSm⁻¹, pH 7.8, organic carbon 4.7 g kg⁻¹, available N 80.5, P 6.0, K 95.0 kg ha⁻¹, and manganese 1.68 mg kg⁻¹. The experiment was laid out in randomized block design with four levels of potassium (control, 30, 60 and 90 kg K₂O ha⁻¹) and four levels of manganese (control, 0.5, 1.0 and 2.0 mg kg⁻¹) with three replications. The recommended doses of N and P @ 25 and 60 kg P₂O₅ ha⁻¹, respectively were applied as urea and single super phosphate. Potassium and manganese were supplied through MOP and MnSO₄ as per treatments. The pea was sown on November 13, 2024 and irrigated at the proper time as judged by the appearance of soil and crop. The weeds were eradicated time to time from the crop. The crop was

harvested on maturity. The grain and straw samples were analyzed for N content by Kjeldahl method (Jackson 1973). Grain and straw samples were digested in di-acid (HNO₃, HClO₄) and the digest were analyzed for phosphorus by vanado molybdo phosphoric acid yellow color method, K by flame photometer and Mn by atomic absorption spectrophotometer (Jackson 1973). The uptake of nutrients was calculated using the yield data in conjunction with their respective contents.

Results and discussion

Potassium application had a significant response on seed yield and straw yield of garden pea. All the higher doses of potassium significantly engaged the seed yield and straw yield. The percent enhancements were 1.27, 6.01, 11.4% in seed and 19.11, 28.0, 35.9% in stover over control due to the application of @ 30, 60, and 90 kg K/ha of pea, respectively (table-1). These results were reported by Hussain et al. (2011) and Ahmed et al. (2015). All the higher level of manganese tended to decreased 2.23, 4.48, 7.57% in seed and 3.85, 9.10, 14.69% in stover due to application of @ 0.5, 1.0, 2.0 ppm/ha. These results were reported Lal, et al. (2012) and Deep Chandra et al. (2024).

Table 1: Effect of potassium and manganese on seed and stover yield (gram/pot) and protein content (%) of pea crop

Treatments	Seed yield	Stover yield	Protein (%) in seed	Protein (%) in stover
Potassium (kg ha ⁻¹)				
K ₀	36.08	21.61	17.84	3.98
K ₁	36.54	25.74	18.42	4.33
K ₂	38.25	27.66	18.79	4.41
K ₃	40.21	29.37	18.84	4.44
SEm±	0.28	0.25	0.07	0.001
CD @ 5%	0.61	0.50	0.16	0.002
Manganese (mg kg ⁻¹)				
Mn ₀	36.16	28.03	18.72	4.53
Mn ₁	38.29	26.95	18.58	4.18
Mn ₂	37.41	25.48	18.38	4.30
Mn ₃	36.2	23.91	18.20	4.16
SEm±	0.28	0.25	0.07	0.001
CD @ 5%	0.61	0.50	0.16	0.002

Protein content

Application of potassium increased the protein content in seed and also in stover of pea and this effect was significant with each level of potassium. The increase protein content with K applied @ 30 kg ha⁻¹, 60 kg ha⁻¹ and 90 kg ha⁻¹ level of potassium over control was tone of extent 3.29, 5.37, 5.62% in seed and 8.76, 10.56, 11.37% in stover of pea respectively as compared to control (Table 1). Application of manganese has a non-significant effect on the protein content in seed and stover yield of pea crop. Application of manganese caused a significant decrease in protein content 0.71, 1.76, 2.75% in seed and 7.82, 5.19, 8.28% in stover due to 0.5, 1.0 and 2.0 ppm Mn/ha. All the higher doses of manganese @ 0.5, 1.0 and 2.0 ppm Mn/ha application were found non-significant on the protein content of seed and stover of pea. The similar result also found by Tiwari et al. (2012) and Farhad et al. (2010).

Nutrients uptake studies**Nitrogen uptake**

The data given in table 2 clearly indicate that potassium application have a significant effect on nitrogen uptake by pea. The percent enhancement

was 4.61, 12.45, 17.73% in seed and 21.10, 33.17, 42.37% in stover by the pea due to @ 30, 60 and 90 kg K/ha over control respectively. These findings were similar to those Mali et al. (2000) and Gupta, et al. (2020). Application of manganese had a significant response on N uptake in seed and stover yield by pea. The percent decreases were 3.54, 6.77, 10.67% in seed and 6.19, 13.81, 21.79% in stover yield over control due to @ 0.5, 1.0 and 2.0 ppm Mn/ha. A similar effect of manganese application on pea and other pulses crop production has also been reported by Lal, et al. (2012), Gupta, et al. (2020) and Deep Chandra et al. (2024).

Phosphorus uptake

The data given in table 2 clearly indicate that potassium application have a significant effect on phosphorus uptake in seed and stover yield by pea. The percent enhancement of phosphorus was 15.51, 39.98, 63.08% in seed and 41.54, 76.18, 100.09% in stover by pea with the application of @ 30, 60 and 90 kg K/ha over control respectively. Application of manganese has a significant effect on P uptake in seed and stover yield of pea

Potassium uptake

The data given in table 2 reveals that the

Table 2: Effect of potassium and manganese on N, P, K, and Mn uptake (mg/pot) by seed and stover of pea crop

Treatments	N uptake in seed	N uptake in stover	P uptake in seed	P uptake in stover	K uptake in seed	K uptake in stover	Mn uptake in seed	Mn uptake in stover
Potassium (kg ha⁻¹)								
K ₀	103.00	14.68	9.30	2.29	25.81	31.46	529.31	155.53
K ₁	107.75	17.89	10.75	3.24	29.65	41.62	572.00	205.02
K ₂	115.83	19.54	13.02	4.03	33.92	47.92	638.24	242.58
K ₃	121.27	20.89	15.17	4.75	37.12	53.24	679.92	285.27
SEm±	0.92	0.23	0.20	0.05	0.35	0.52	7.31	2.86
CD @ 5%	1.86	0.47	0.41	0.12	0.71	1.08	14.93	5.85
Manganese (mg kg⁻¹)								
Mn ₀	118.16	20.38	13.62	4.19	33.95	48.25	581.56	222.97
Mn ₁	113.98	19.13	12.61	3.76	32.42	45.36	599.56	225.96
Mn ₂	110.16	17.56	11.53	3.30	30.84	42.01	616.61	222.73
Mn ₃	105.55	15.93	10.48	2.86	29.28	38.61	621.74	216.73
SEm±	0.92	0.23	0.20	0.05	0.35	0.52	7.31	2.86
CD @ 5%	1.86	0.47	0.41	0.12	0.71	1.08	14.93	5.85

application of potassium increased the K utilization in seed and stover by pea and this effect was significant with each level of potassium. The percent enhancement of K uptake was 14.91, 31.42, 43.83% in seed and 32.31, 52.35, 69.25% in stover by pea with the application of @ 30, 60 and 90 kg K/ha over control, respectively. Application of manganese had a significant response on K utilization by pea. The percent decreases of K uptake were 4.50, 9.15, 13.76% in seed and 5.99, 12.94, 19.97% in stover by pea over control due to the application of @ 0.5, 1.0 and 2.0 ppm Mn/ha of pea, respectively Gupta, et al. (2020) Lal, et al. (2012) and Gupta, et al. (2020).

Manganese uptake

The data given in table 2 clearly indicate that the potassium application have a significant effect on manganese uptake by pea. The percent enhancement of manganese uptake was 8.06, 20.58, 28.45% in seed and 31.82, 55.96, 83.41% in stover by pea due to the application of 30, 60 and 90 kg K/ha over control, respectively. Application of manganese had a significant response on its uptake by pea. The percent enhancement of manganese uptake was 3.10, 6.03, 6.91% in seed and 1.34, 0.11, 2.80% in stover by pea over control due to the application of manganese @ 0.5, 1.0 and 2.0 ppm Mn/ha, respectively. The same resulted by Gupta, et al. (2020) and Lal, et al. (2012).

Conclusion

The study revealed that potassium application up to 90 kg ha⁻¹ significantly improved pea yield, quality, and nutrient uptake, while manganese application had a negative impact on most of the parameters studied.

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