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Research Article

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Effect of Varying Phosphorus and Potassium Doses on Growth and Root-Knot Disease in Okra (*Abelmoschus Esculentus* L.)

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ABSTRACT
Okra (*Abelmoschus esculentus* L.) is a warm-season vegetable commonly cultivated for its edible green pods. Known for its high nutritional value, okra is rich in vitamins A and C, folate, and dietary fiber. Phosphorus and potassium are essential for the healthy growth and high yields of okra. However, farmers in Nepal do not apply these nutrients in sufficient amounts, leading to poor crop growth and reduced productivity. A field experiment was conducted at the Horticultural Farm of Agriculture and Forestry University in Chitwan, Nepal, from March to June 2024, to determine the effect of different doses of phosphorus and potassium on growth and the control of root-knot disease in okra. Seven treatments were arranged in a randomised complete block design (RCBD) with three replications: 70:37:24 kg NPK/ha (T_1), 70:37:0 kg NPK/ha (T_2), 70:37:48 kg NPK/ha (T_3), 70:37:72 kg NPK/ha (T_4), 70:0:24 kg NPK/ha (T_5), 70:52:24 kg NPK/ha (T_6), and 70:74:24 kg NPK/ha (T_7). The vegetative, yield, and disease parameters were recorded. The treatment with 70:74:24 kg NPK/ha (T_7) resulted in the highest plant height (75.16 cm) and the least number of days to 50% flowering (49.96 days). The number of fruits (15.26), fruit diameter (1.87 cm), fruit weight (22.37 g), and fruit yield per hectare (18.45 mt) were enhanced by 70:37:72 kg NPK/ha (T_4). The highest gall index (4.06) and the number of galls (75.53) were observed in the treatment with 70:0:24 kg NPK/ha (T_5). The treatments showed no significant difference in the incidence of root-knot disease. Therefore, higher doses of phosphorus and potassium were found to be effective for the growth and control of root-knot disease in okra.
Keywords: Gall index, *Meloidogyne incognita*, Phosphorus, Potassium, Root-knot

INTRODUCTION
Okra (*Abelmoschus esculentus* L.), also known as Lady's finger or Bhindi in Nepal, is a popular annual vegetable crop that is grown in many tropical, sub-tropical and warm temperate regions all over the world (Patil *et al*., 2015). Grown for its tender fruits (pods), it provides different nutrients like protein, fat, carbohydrates, fiber, minerals (sodium, potassium, zinc) and vitamins (A, B and C) (Shivaramegowda *et al*., 2016). In Nepal, okra is cultivated on an area of 9140 ha with the production of 107,641 mt (MoALD, 2024). In year 2077/078, the yield of okra was 13.20 mt/ha, but it has substantially reduced to 11.78 mt/ha in the year 2079/080 (MoALD, 2024). This could be due to pest infestation or incidence of diseases like root-knot disease. Root-knot disease is an important plant disease caused due to the plant-parasitic nematode, *Meloidogyne incognita*, affecting various vegetable crops like okra, tomato, chilli, eggplant, etc. worldwide (Perry *et al*., 2013). Root-knot nematode is estimated to cause the global crop loss of 5%, resulting in the loss of billions of dollars every year (Mukhtar *et al*., 2014). In many crops, including okra, the deficiency of phosphorus and potassium leads to the infection of different diseases, like root-knot disease. The plant deficient in phosphorus and potassium has a thin stem, shorter root and a weak stem, and as a result, increase the susceptibility of the plant to entry and infection by the pathogen.

The soil of Nepal is naturally deficient in potassium and phosphorus. Unaware of this fact, farmers use the fertilizers in inappropriate amounts without a soil test regardless of the actual nutrient demand of the land. Farmers usually apply the fertilizers, irrespective of the dose recommended by MoALD but as per the level of the subsidy provided by the government of Nepal, viz. 50 per cent on urea, 40 per cent on DAP and 20 per cent on potassium (Jha, 2017). A good crop fertilization strategy helps to improve crop production while maintaining the quality of the environment at the same time (Devkota *et al*., 2019). Hence, the use of chemical fertilizer is one of the areas which needs utmost attention to reduce the losses in yield in farming. Optimizing the dose of fertilizer can result in improved plant health, increased resistance to diseases, and higher crop yields. The use of fertilizers improves the nutritional status and vigour of the plant, influencing the incidence and severity of disease infection and pest infestations in plants under field conditions (Agrios, 2005).

Using phosphorus-containing fertilizer mitigates the root-knot disease in plants by improving plant growth (Ferraz *et al*., 2010). Application of phosphorus in soil improves the protein synthesis, cell activity and production of polyphenol and peroxidase in plants, as a result of which the plant becomes resistant to the infection of root-knot disease (Santana-Gomes *et al*., 2013). Root-knot disease is a challenging disease to manage and can persist for several years in the soil, causing huge losses. As the newly developed resistant and tolerant varieties against root-knot disease are yet to be tested in Nepal, and the use of nematicides can raise environmental concerns, the use of fertilizer against root-knot nematodes can be a viable solution.

MATERIALS AND METHODS

Experimental site

The field experiment was conducted in the horticulture farm of Agriculture and Forestry University, Chitwan, Nepal, from March to June 2024 (Figure 1). It was located at an altitude of 256 MASL. The geographical coordinates of the research site were 27°38'52.8"N latitude and 84°20'51.7"E longitude. The mean temperature is 25 °C from October to February, and from March to June, the average temperature can rise as high as 43 °C.

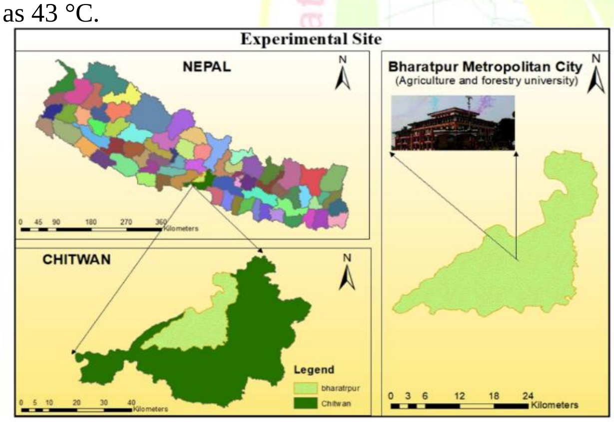

Figure 1. Map showing research location

Soil characteristics of the study site

The qualitative analysis of the soil sample from the research site was done using a soil test kit.

Experimental design

The research was conducted in a Randomized Complete Block Design (RCBD) with 7 treatments, and each treatment was replicated 3 times. The details of the experiment are given in Table 1. Each plot contained 5 rows, and each row accommodated 6 plants. The variety used was Arka Anamika. The spacing of 50 cm×30 cm (RR×PP) was maintained. There were altogether 21 plots, and the size of each plot was 4.5 m^2. The distance between each replication was 1m, the interplot distance was 0.5 m, and the total area of the experimental field was 202.4 m^2. From each plot, 5 plants were taken as a sample, excluding the border plants.

Table 1. Treatment details

Treatment	Treatment Details
T_1	70:37:24 kg NPK/ha (54 g Urea /plot, 36 g DAP/plot and 18 g MOP /plot) [dose recommended by MoALD]
T_2	70:37:0 kg NPK/ha (54 g Urea /plot and 36 g DAP/plot only)
T_3	70:37:48 kg NPK/ha (54 g Urea /plot, 36 g DAP/plot and 36 g MOP/plot)
T_4	70:37:72 kg NPK/ha (54 g Urea /plot, 36 g DAP/plot and 54 g MOP/ plot)
T_5	70:0:24 kg NPK/ha (68.08 g Urea /plot and 18 g MOP/plot only)
T_6	70:52:24 kg NPK/ha (48.52 g Urea/ plot, 18 g MOP/plot and 50 g DAP/ plot)
T_7	70:74:24 kg NPK/ha (41.04 g Urea/ plot, 18 g MOP/plot and 72 g DAP/plot)

Fertilizer application

Urea, DAP and MOP were calculated for different experimental plots as per different treatments. The recommended dose of Urea, DAP and MOP was 6:4:2 kg/ ropani (MoALD, 2024). 1/3rd of Urea and full doses of DAP and MOP were applied at the time of planting, making a deep, narrow furrow on one side of the sowing ridge. Then, 1/3rd of urea was applied 30 days after sowing and the remaining 1/3rd was applied after flowering as top dressing.

Parameters recorded

Vegetative parameters

Plant height: Plant height was taken as the distance from the soil surface to the topmost growth point of the plant, and the average was calculated.

Number of leaves: The number of leaves per plant was recorded by counting the leaves arising from the main stem and other branches, and the average number of leaves per plant was calculated.

Stem diameter: Stem diameter was measured 5 cm above the base of the plant using Vernier caliper.

Canopy diameter: The canopy diameter of the plant was recorded by taking two diagonal measurements of the canopy coverage of the plant with the help of a measuring tape.

Fresh root weight: The plant was uprooted at 90 DAS, and the root was separated from the top, weighed, and the average was calculated for each treatment.

Dry root weight: The plant roots were sun-dried for a day and placed in a hot air oven for 2 days at 60 °C, weighed, and the average was calculated.

Yield parameters

Days to 50% flowering: It was determined by recording number of days from sowing until 50% of the plants in the plot had at least one open flower.

Fruit length: Five mature fruits were randomly selected from five tagged plants of each plot, and fruit length was measured from the base of the fruit to the tip, excluding the fruit stalk.

Fruit diameter: The same fruits taken to measure fruit length were used to record the diameter at the middle point with the help of a Vernier calliper.

Number of fruits per plant: The number of fruits per plant was recorded as the average of the cumulative number of fruits in all pickings of selected plants at a marketable stage.

Fruit weight: The average weight of fruit was measured with the help of a weighing balance.

Fruit Yield per hectare: Total fruit yield was determined by multiplying the total weight of fruits per plant by and plant population in hectares.

Fruit Yield = Fruit weight per plant × Plant population in hectares

Disease parameters

Disease incidence: The number of plants that are diseased in relation to the total number of plants was calculated.

$$\text{Disease incidence} = \frac{\text{Number of diseased plants}}{\text{Total number of Plants}}$$

Gall index: Galling index per plant was rated according to the following scale: 0 = no galls; 1 = 1 to 2 galls; 2 = 3 to 10 galls; 3 = 11 to 30 galls; 4 = 31 to 100 galls; 5 = >100 galls per root system (Taylor and Sasser, 1978).

Number of galls/plants: The number of galls present in the root sample of different treatments was counted, and the average was calculated.

Statistical analysis

The recorded data were tabulated using MS Excel and subjected to analysis of variance (ANOVA) using software R-Studio version 4.4.1. Duncan's multiple range test (DMRT) was performed for mean separation at 5% level of significance.

RESULTS AND DISCUSSION

Soil Characteristics

The qualitative analysis of the soil sample from the research site revealed that the level of Nitrogen was medium, Phosphorus was low, and Potassium was medium. The pH of the soil was around 7.

Plant height and number of leaves

There was a significant (P<0.01) difference in plant height at 60 and 75 DAS among different treatments (Table 2). However, at 60 and 75 DAS, significant differences (p < 0.01) were observed. The highest plant height at 75 DAS was recorded in T_7 (75.16 cm) and T_6 (74.86 cm), while the lowest was in T_2 (54.31 cm). There are no significant differences among treatments for the number of leaves at any growth stage. Higher phosphorus levels (T_4, T_6 and T_7) result in significantly greater plant height at 60 and 75 DAS. Similarly, treatments without phosphorus (T_2 and T_5) generally result in lower plant height and fewer leaves at 75 DAS. Similar findings were reported by Murugan *et al*. (2001), who observed higher plant height with increasing levels of phosphorus and potassium due to better cell division resulting in vigorous vegetative growth.

Table 2. Effect of different doses of phosphorus and potassium on plant height and number of leaves of okra at different DAS, Chitwan, 2024

Treatment	Plant height (cm)				Number of Leaves			
	30 DAS	45 DAS	60 DAS	75 DAS	30 DAS	45 DAS	60 DAS	75 DAS
T_1	15.02	40.52	52.40^b	60.93^b	5.23	15.20	20.66	19.33
T_2	13.20	40.12	47.20^b	54.31^b	4.60	13.26	19.13	16.33
T_3	14.36	40.78	55.53^b	61.66^b	5.06	15.90	21.06	20.00
T_4	14.22	41.47	66.46^a	74.33^a	5.66	16.73	25.06	24.33
T_5	14.33	39.82	50.33^b	57.06^b	5.20	14.93	20.60	18.66
T_6	14.52	42.77	66.60^a	74.86^a	5.16	15.73	20.93	23.66
T_7	14.67	42.20	68.26^a	75.16^a	5.26	15.80	21.56	22.33
F value	0.510^{ns}	0.279^{ns}	0.001**	0.004**	0.252^{ns}	0.177^{ns}	0.628^{ns}	0.560^{ns}
$SE_m\pm$	0.22	0.37	0.30	0.41	0.09	0.30	0.80	1.19
LSD $_{(0.05)}$	1.81	0.28	9.75	11.40	0.78	2.48	6.54	9.70
CV %	7.1	13.8	9.4	9.7	8.5	9.08	17.2	26.4
Grand mean	14.33	41.09	58.11	65.47	5.17	15.36	21.29	20.66

Note: ns; non-significant, **P<0.01, LSD; Least Significant Difference, SE_m; Standard Error of Means, CV, Coefficient of Variation. The same letter(s) indicate the non-significant difference between treatments at the 5% level of significance by DMRT. Figures in parentheses represent square root transformed values.

Canopy diameter, stem diameter and days to 50% flowering

These parameters were not significantly affected by different doses of phosphorus and potassium (Table 3). However, the highest canopy diameter as well as stem diameter was observed in T_4 at every DAS. At the same time, T_2 showed the minimum canopy diameter and stem diameter at every DAS. Though the differences were not statistically significant, higher phosphorus levels (T4) tend to result in larger canopy and stem diameters, and a lack of phosphorus (T2) generally leads to the smallest canopy and stem diameters. However, the number of days to 50% flowering differed significantly among the different doses of phosphorus and potassium. It was recorded the earliest at 49.96 days in T_7, which was at par with T_6 (51.18 days). The number of days to 50% flowering was observed at last at 54.62 days in T_5.

Table 3. Effect of different doses of phosphorus and potassium on canopy diameter and stem diameter of okra at different DAS, Chitwan, 2024

Treatment	Canopy diameter (cm)				Stem diameter (cm)			Days to 50% flowering
	30 DAS	45 DAS	60 DAS	75 DAS	45 DAS	60 DAS	75 DAS	
T_1	13.48	41.63	47.27	44.73	1.11	1.27	1.32	53.54[ab]
T_2	13.01	36.06	44.03	41.03	1.05	1.22	1.25	54.11[ab]
T_3	16.15	43.65	50.80	45.33	1.21	1.35	1.39	53.30[ab]
T_4	17.80	46.43	56.70	48.26	1.38	1.52	1.55	52.05[abc]
T_5	13.08	39.16	46.83	42.58	1.09	1.22	1.27	54.62[a]
T_6	13.35	41.67	49.67	44.73	1.01	1.32	1.36	51.18[bc]
T_7	15.21	43.33	51.36	46.30	1.07	1.26	1.34	49.96[c]
F value	0.08[ns]	0.15[ns]	0.12[ns]	0.74[ns]	0.16[ns]	0.34[ns]	0.31[ns]	0.02*
SE_m±	0.44	1.03	1.04	1.18	0.03	0.03	0.03	0.33
LSD $_{(0.05)}$	3.59	8.42	8.54	9.62	0.28	0.28	0.25	2.72
CV %	13.8	11.5	9.6	12.09	14.05	12.2	10.6	2.7
Grand mean	14.58	41.04	49.52	44.71	1.13	1.31	1.35	52.68

Note: ns; non-significant, LSD; Least Significant Difference, SE_m; Standard Error of Means, CV; Coefficient of Variation.

Number of fruits, fruit length, fruit diameter, fruit weight and fruit yield

The number of fruits per plant and fruit diameter differed significantly among different treatments, as shown in Table 4. The maximum number of fruits (15.26) and fruit diameter (1.87 cm) were recorded in T_4. The minimum number of fruits (11.70), fruit diameter (1.46 cm) was observed in T_5, followed by T_2, which lacks potassium. The effect of different treatments on fruit length was found to be insignificant. According to Nakro *et al*. (2022) with the application of potassium, chlorophyll content of the foliage increases, which in turn increases the rate of photosynthesis, carbohydrate synthesis and as a result increases fruit production and the number of fruits per plant. The increase in fruit diameter was reported by Amjad *et al*. (2014).

There was a significant (P<0.05) difference in fruit weight and fruit yield among different treatments. Maximum fruit weight (22.27 g) and fruit yield (18.12 mt/ha) were recorded in T_4. The lowest yield was observed in T2 (14.16 mt/ha), which lacks potassium. Higher phosphorus application (T4 and T3) lead to more fruits, larger fruit size, heavier fruit weight, and higher yield. Similarly, the absence of potassium (T2) results in lower fruit weight and yield. However, fruit length remained unaffected by NPK variations, while fruit diameter and weight significantly improved with phosphorus addition. The results are in agreement with Yagmur *et al*. (2004) who reported positive correlation with the application of potassium and fruit weight and yield in tomato. Use of potassium fertilizer positively influences leaf area development, chlorophyll content and reproductive parameters and increases fruit yield of plants (Kaya *et al*., 2002).

Table 4. Effect of different doses of phosphorus and potassium on the number of fruits, fruit length, fruit diameter, fruit weight and fruit yield of okra, Chitwan, 2024

Treatment	Number of Fruits	Fruit length (cm)	Fruit diameter (cm)	Fruit weight (g)	Fruit yield (mt/ha)
T_1	12.83[abc]	14.33	1.62[ab]	17.95[bc]	16.92[ab]
T_2	12.40[bc]	13.89	1.50[b]	17.69[c]	14.16[b]
T_3	14.70[ab]	15.91	1.76[ab]	21.34[ab]	17.86[a]
T_4	15.26[a]	15.84	1.87[a]	22.37[a]	18.45[a]
T_5	11.70[c]	14.03	1.46[b]	17.70[c]	14.43[b]
T_6	14.03[abc]	14.60	1.69[ab]	19.52[abc]	16.98[ab]
T_7	15.13[a]	14.44	1.68[ab]	18.35[bc]	17.49[a]
F value	0.03*	0.62[ns]	0.03*	0.03*	0.04*
SE_m±	0.29	0.36	0.03	0.39	0.35
LSD $_{(0.05)}$	2.41	2.94	0.31	3.22	0.90
CV %	9.9	11.2	10.64	9.3	9.8
Grand mean	13.72	14.72	1.65	19.27	16.61

Note: ns; non-significant, *P<0.05 LSD; Least Significant Difference, SE_m; Standard Error of Means, CV; Coefficient of Variation. The same letter(s) indicate the non-significant difference between treatments at 5% level of significance by DMRT.

Fresh root weight, dry root weight, Disease incidence, gall index and number of galls per plant

The different doses of phosphorus and potassium had no significant influence on the fresh and dry root weight (Table 5). However, T_5 had the highest fresh root weight (23.04 g) and dry root weight (4.27 g) due to increased gall formation.

Disease incidence was not significantly affected by different doses of phosphorus and potassium in okra, but the highest disease incidence (70.67%) was recorded in T_2 (70:37:0 kg NPK/ha) with no potassium application and least incidence (52.33%) was seen in T_6, amended with potassium (Table 5).

Different doses of phosphorus and potassium had a significant impact on gall index and the number of galls. The highest gall index was recorded in T_5 (4.06), indicating more severe gall formation. Similarly, the lowest gall index was in T_7 (3.53), suggesting reduced nematode damage. The lowest number of galls (41.40) was found in T_4, and the highest number of galls (75.53) was found in T_5. The results indicated that the increase in the doses of potassium and phosphorus application could lead to reduction in galling and gall index in okra. The current findings are consistent with those of Hemmati and Saeedizadeh (2019), who claimed that the application of potassium fertilizer resulted in the decreased activity (number of galls and egg masses, and reproduction factor) of *M. javanica* in the rhizosphere and on the roots of tomato seedlings. Zhao *et al*. (2014) observed that potassium could increase the activity of enzymes like peroxidase (POD), catalase (CAT) and superoxide dismutase (SOD) in the plants that makes it less susceptible to the infection of root-knot nematode. The findings were coherent with Zhao *et al*. (2016), who reported a significant reduction in the disease index of root knot disease compared to control after application of higher levels of potassium.

Table 5. Effect of different doses of phosphorus and potassium on fresh root weight, dry root weight, disease incidence, gall index and number of galls of okra, Chitwan, 2024

Treatment	Fresh root weight (g)	Dry root weight (g)	Disease incidence (%)	Gall index	Number of galls per plant
T_1	18.87	3.32	66.67	3.86^{abc}	53.26^{b} (7.05)
T_2	20.53	3.33	70.67	3.93^{ab}	54.00^{b} (7.11)
T_3	17.45	3.15	65.67	3.67^{bc}	44.26^{b} (6.56)
T_4	16.83	2.28	54.67	3.67^{bc}	41.40^{b} (5.45)
T_5	23.04	4.27	68.33	4.06^{a}	75.53^{a} (8.65)
T_6	18.48	3.33	52.33	3.86^{abc}	45.06^{b} (6.62)
T_7	17.59	2.91	57.67	3.53^{c}	44.13^{b} (6.31)
F value	0.57^{ns}	0.30^{ns}	0.37^{ns}	0.04*	0.0004 ***
$SE_m\pm$	0.89	0.19	2.51	0.10	4.63
LSD $_{(0.05)}$	7.32	1.57	20.51	0.34	2.80
CV %	21.7	27.3	18.5	12.48	41.55
Grand mean	18.97	3.32	62.28	3.8	51.09

ns; non-significant, *P<0.05, ***P<0.001, LSD; Least Significant Difference, SE_m; Standard Error of Means, CV; Coefficient of Variation. The same letter(s) indicate the non- significant difference between treatments at 5% level of significance by DMRT. Figures in parentheses represent square root transformed values

Qi *et al*. (2023) showed that the addition of phosphorus fertilizer drastically reduced the number of individual soil nematodes. The plants rich in phosphorus are reported to release less root exudate, making it less desirable for the nematodes (Marschner, 1997). Low galling and nematode multiplication were seen in the nematode-inoculated tomato plants due to the application of phosphorus and potassium (Akhtar *et al*., 1998). Use of the phosphorus and potassium containing fertilizers, DAP and MOP, resulted in the inhibition of hatching of cereal cyst nematode *Heterodera avenae* in lab and pot conditions (Yadav and Kanwar, 2010). Different concentrations of potassium were reported to significantly affect the number of cysts pot-1, eggs cyst-1, females, and cysts per root system as well as the reproductive factor of soybean cyst nematode (Pinheiro *et al*., 2009). Barbosa *et al*. (2010) speculated that the application of potassium improves the cell membrane's ability to receive signals, decreasing the number of giant cells, the number of female nematodes and the reproduction factor in plants infected with *Heterodera glycine*. Gao *et al*. (2018) found that the severity of soybean cyst nematode and cyst counts was significantly lowered by the application of appropriate potassium fertilizers during their study. The research showed that potassium fertilization can boost the plant's natural defences against soybean cyst nematode by enhancing root exudation of phenolic acids and gene expression related to plant pathogens.

CONCLUSION

The present study concluded that Phosphorus and potassium application significantly improve plant growth, fruit yield, and nematode resistance. Higher phosphorus and potassium levels lead to greater plant height, higher fruit yield, and reduced root-knot nematode infestation. Phosphorus-deficient treatment had the lowest yield and the highest nematode infestation, highlighting phosphorus as a key nutrient for plant health and disease management. Optimal NPK application at the rate of 70:37:72 kg/ha provides the best balance of yield improvement and disease resistance.

CONFLICT OF INTEREST

The author here declares that there is no conflict of interest in the publication of this article.

REFERENCES

Agrios, G.N. 2005. Plant Pathology. Fifth ed. London: Elsevier Academic Press. P. 922.

Akhtar, M., Siddiqui, Z. A., and Mahmood, I. 1998. Management of *Meloidogyne incognita* in tomato by some inorganic fertilizers. *Nematologia Mediterranea,* **26**: 23-25.

Amjad, M., Akhtar, J., Anwar-Ul-Haq, M., Imran, S., and Jacobsen, S. 2014. Soil and foliar application of potassium enhances fruit yield and quality of tomato under salinity. *Turkish Journal of Biology,* **38**: 208-218.

Barbosa, K. A. G., Garcia, R. A., Santos, L. C., Teixeira, R. A., Araújo, F. G., Rocha, M. R., and Lima, F. S. O. 2010. Evaluation of potassium fertilization on populations of *Heterodera glycines* in resistant and susceptible soybean cultivars. *Nematologia Brasileira,* **34**: 150-157.

Devkota, S., Kumar, J., Silas, V. J., Nivas, R., Khanal, P., and Dahal, M. 2022. Effect of organic sources of nutrients on growth and yield of okra (*Abelmoschus esculentus* L. var. Pusa Makhamali) under the agro-climatic condition of Kanpur. *The Pharma Innovation Journal,* **11**(7): 1757-1760.

Ferraz, S., Freitas, L. G., Lopes, E. A., and Dias-Arieira, C. R. 2010. Sustainable management of plant-parasitic nematodes. Viçosa: UFV Press. p. 306.

Gao, X., Zhang, S., Zhao, X., and Wu, Q. 2018. Potassium-induced plant resistance against soybean cyst nematode via root exudation of phenolic acids and plant pathogen-related genes. *PLoS One,* 13,7 (2018): *e0200903.*

Hemmati, S., and Saeedizadeh, A. 2019. Root-knot nematode, *Meloidogyne javanica,* in response to soil fertilization. *Brazilian Journal of Biology,* 80(3): 621-630.

Jha, N. 2017. Efficient fertilizer use. *The Kathmandu Post.* https://kathmandupost.com/opinion/2017/04/02/efficient-fertiliser-use

Kaya, C., Higgs, D., Saltali, K., and Gezerel, O. 2002. Response of strawberry grown at high salinity and alkalinity to supplementary potassium. *Journal of Plant Nutrition,* 25: 1415-1427.

Marschner, H. 1997. *Mineral nutrition of higher plants* (p. 889). London: Academic Press.

Ministry of Agriculture and Livestock Development (MoALD). 2024. Statistical information on Nepalese agriculture 2079/80 (2022/23). Singhadurbar, Kathmandu: MoALD.

Mukhtar, T., Hussain, M. A., Kayani, M. Z., and Aslam, M. N. 2014. Evaluation of resistance to root-knot nematode (*Meloidogyne incognita*) in okra cultivars. *World Vegetable Center.*

Murugan, M. 2001. Quality of chilli (*Capsicum annuum* L.) variety Co-3 as influenced by levels and sources of phosphorus and levels of nitrogen. *Journal of Spices and Aromatic Crops,* **10**(1): 1-5.

Nakro, A., Bamouh, A., Khatib, O. E., and Ghaouti, L. 2022. Effect of potassium source and dose on yield and quality of strawberry fruit. *American Journal of Plant Sciences,* **13**(9): 1196-1280.

Patil, P., Sutar, S., Joseph, J. K., Malik, S., Rao, S., Yadav, S., *et al*. 2015. A systematic review of the genus *Abelmoschus* (Malvaceae). *Rheedea,* 1: 14–30.

Perry, R. N., and Moens, M. 2013. Plant nematology. Centre for Agriculture and Bioscience International (CABI).

Pinheiro, J. B., Pozza, E. A., Pozza, A. A. A., Moreira, A. S., and Campos, V. P. 2009. Study of the influence of potassium and calcium on the reproduction of the soybean cyst nematode. *Nematologia Brasileira,* **33**: 17-27.

Qi, Y., Sun, X., Peng, S., Tan, X., and Zhou, X. 2023. Effects of fertilization on soil nematode communities in an alpine meadow of Qinghai-Tibet Plateau. *Frontiers in Ecology and Evolution,***11**: 1122505.

Santana-Gomes, S. M., Dias-Arieira, C. R., Roldi, M., Dadazio, T. S., Marini, P. M., and Barizao, D. A. O. 2013. Mineral nutrition in the control of nematodes. *African Journal of Agricultural Research,* **8**: 2413-2420.

Shivaramegowda, K. D., Krishnan, A., Jayaramu, Y. K., Kumar, V., Yashoda, and Koh, H. J. 2016. Genotypic variation among okra (*Abelmoschus esculentus* (L.) Moench) germplasms in South India. *Plant Breeding and Biotechnology,* **4**: 234-241.

Taylor, A. L., and Sasser, J. N. 1978. *Biology, identification and control of root-knot nematodes (Meloidogyne spp.).* North Carolina State University and U.S. Agency for International Development, Raleigh, N.C.

Yadav, S., and Kanwar, R. S. 2021. Effect of some fertilizers on hatching of cereal cyst nematode, *Heterodera avenae. Saudi Journal of Biological Sciences,* **1**: 4442-4445.

Yagmur, B., Okur, B., and Ongun, B. 2004. Effects of enhanced potassium doses on yield, quality, and nutrient uptake of tomato. *IPI Regional Workshop on Potassium and Fertigation Development in West Asia and North Africa*, Rabat, November 2004: 24-28.

Zhao, J., Wang, F., Li, J., Zou, B., Wang, X., Li, Z., and Fu, S. 2014. Effects of experimental nitrogen and/or phosphorus additions on soil nematode communities in a secondary tropical forest. *Soil Biology and Biochemistry,* **75**: 1-10.

Zhao, X., Hu, W., Zhang, S., Zhao, Q., and Wang, Q. 2016. Effect of potassium levels on suppressing root-knot nematode (*Meloidogyne incognita*) and resistance enzymes and compounds activities for tomato (*Solanum lycopersicum* L.). *Academia Journal of Agricultural Research,* **4**(5): 306-314.

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