

## Original Research Article

### **Effect of foliar nutrition on the population of plant parasitic nematodes, flower quality and yield of gerbera**

**Commented [D1]:** Add scientific name of gerbera flower plant

#### **ABSTRACT**

**Commented [D2]:** Very well written but specify plant nematode names on which effect of foliar nutrition studied

The study aimed to find out the effect of different concentration of foliar nutrition on soil nematode population, yield and quality of gerbera flowers. The experiment was conducted in naturally infested field with plant parasitic nematodes located at the Instructional cum Research Farm, Department of Horticulture, Biswanath College of Agriculture, AAU, Biswanath Chariali during *rabi* season 2022-23. The experiment was laid out in factorial Randomized Block Design (RBD) with three replications and twenty four treatment combinations viz., different concentration of foliar sprays T<sub>1</sub>: Control, T<sub>2</sub>: 3g/l NPK +20g/l micronutrient, T<sub>3</sub>: 4g/l NPK +20g/l micronutrient, T<sub>4</sub>: 5g/l NPK +20g/l micronutrient and six varieties V<sub>1</sub>: Pride of Sikkim, V<sub>2</sub>: Arka Krishika, V<sub>3</sub>: Pink Melody, V<sub>4</sub>: Orange Sun Brust, V<sub>5</sub>: Saffron, V<sub>6</sub>: Red Seven. Treatment wise suckers of different varieties of gerbera were planted at spacing of 30 cm from row to row and 30cm from plant to plant in each plot measuring 1sq.m. One month after planting treatment wise different concentration of foliar sprays were applied and same treatments were repeated at 15 days interval till six months from planting. Final nematode population in soil was recorded one month after the last application of foliar nutrients. Significant effect on different concentrations of foliar nutrition on the stalk length, flower diameter and number of flowers per plot was observed across all the varieties. The maximum stalk length, flower diameter and number of flowers per plot was observed in the treatment with 5 g/l NPK + 20 g/l micronutrient, in all the varieties, whereas the minimum was recorded in control. The highest number of flowers per plot was recorded in the plots with variety Pride of Sikkim. While the lowest number of flowers was recorded in plots with variety Red Seven. The variety Pride of Sikkim exhibited the maximum stalk length. The maximum flower diameter was observed in Orange Sunburst, while variety Red Seven recorded the minimum stalk length and flower diameter. The nematode population had shown a significant correlation with the varying concentrations of foliar nutrition. Among the different concentrations of foliar spray 5g/l NPK + 20 g/l micronutrient recorded minimum nematode population in soil, while maximum nematode population was recorded in control. The minimum nematode population in soil was recorded in the plots with variety Arka Krishika, while the maximum nematode population was recorded in plots with variety Red seven.

*Key words: Foliar nutrition, gerbera, plant parasitic nematodes, variety*

#### **1. INTRODUCTION**

**Commented [D3]:** Add recent references

Gerbera (*Gerbera jamesonii* Hook) belongs to the Asteraceae family, which is a perennial Mediterranean plant. Gerbera is widely recognized for its captivating flowers and is commonly referred to as Transvaal Daisy, Barberton Daisy, or African Daisy. It is one of the ten most popular commercial cut flowers in the world and according to the global trends in floriculture; it occupies the fourth place among cut flowers (Choudhary and Prasad, 2000). The tremendous variability in gerbera with reference to flower colour, shape and size makes it more useful for cut flowers, bouquet, decoration in marriages and landscaping in gardening

(Aswath and Survary, 2004). Gerbera is characterized by its captivating flower structures known as "heads" or capitulum. This herbaceous perennial plant displays a compact growth habit, forming clusters of flowers with solitary heads atop long and slender stalks that gracefully rise above the foliage. The leaves of Gerbera are typically petioled and can be either entire or pinnatilobate, exhibiting a coarse texture or occasionally featuring tubular shapes and two distinct lips.

Gerbera plant is very much prone to attack by several pests and diseases. Among them plant parasitic nematodes are presently considered as one of the important production constraints of gerbera cultivation. Although a large numbers of plant parasitic nematodes are found to be associated with carnation and gerbera elsewhere in the world (Lamberti *et al.*, 1987), root knot nematodes belonging to *Meloidogyne* spp. are predominant in India (Nagesh and Reddy, 2001). Exotic varieties of these plants from Europe suffered 40-60% mortality due to root knot nematode infection and its interaction with other soil-borne pathogens (Nagesh and Reddy, 1996). In India, yield losses due to root-knot nematode, *M. incognita* in carnation and gerbera were estimated to the tune of 26.6 and 31.1 per cent, respectively (Nagesh and Reddy, 2000). Yield reduction caused by plant parasitic nematodes can be overcome by managing the nematode pests with the application of chemical nematicides, but indiscriminate use of pesticides has caused immense damages to the entire ecosystems. Therefore, at present more emphasis has been taken on eco-friendly approaches for management of pests and diseases. Further, it has been reported that fertilizer application has been observed to boost the tolerance of the plants against diseases and also causes the mortality of nematodes (Huber, 1980). Keeping these facts in view the present investigation was under taken to evaluate the effect of different concentration of foliar nutrition on soil nematode population, yield and quality of flowers of different gerbera varieties.

## 2. MATERIALS AND METHODS

Commented [D4]: Very well written and elaborate nicely

The experiment was conducted in naturally infested field with plant parasitic nematodes during *rabi* season 2022-23 at the Instructional cum Research Farm, Department of Horticulture, Biswanath College of Agriculture, AAU, Biswanath Chariali to evaluate the effect of different concentrations of foliar nutrition on population of plant parasitic nematodes, yield and flower quality gerbera flowers. The experimental field was thoroughly ploughed followed by harrowing and levelling to bring the soil to fine tilth. The experiment was laid out in factorial Randomized Block Design (RBD) with three replications and twenty four treatment combinations viz., different concentration of foliar sprays T<sub>1</sub>: Control, T<sub>2</sub>: 3g/l NPK +20g/l micronutrient, T<sub>3</sub>: 4g/l NPK +20g/l micronutrient, T<sub>4</sub>: 5g/l NPK +20g/l

micronutrient and six varieties V1: Pride of Sikkim, V2: Arka Krishika, V3: Pink Melody, V4: Orange Sun Brust, V5: Saffron, V6: Red Seven. A total of 72 plots were made, each with the dimensions of 1m × 1m, and keeping a distance of 0.5m between two alternative plots. Treatment wise suckers of different varieties of gerbera were planted at spacing of 30 cm from row to row and 30cm from plant to plant. One month after planting treatment wise different concentration of foliar sprays were applied and same treatments were repeated at 15 days interval till six months from planting.

Prior to the commencement of the planting process initial plant parasitic nematode population in the field was recorded, For recording initial nematode population soil sample was collected in a random manner from the designated experimental plot. Extraction of nematodes from collected soil samples was done by modified Cobb's sieving and decanting technique followed by Baerman's funnel technique (Christie and Perry, 1951). The plant parasitic nematodes present in the suspension were identified up to generic level using taxonomic key and nematode population in each sample was counted three times in a multi chambered counting dish under a stereoscopic binocular microscope and mean was taken. Laboratory works were conducted at the Department of Nematology, B. N. College of Agriculture, AAU, Biswanath Chariali, Assam. The extracted plant parasitic nematodes from soil were identified as *Melodogyne*, *Helicotylenchus*, *Hoplolemus* and *Tylenchorhynchus*. Among these *Melodogyne* was found to be more predominant. For recording the final nematode population, soil samples were collected at 30 days after the last application of foliar spray. To determine the population of nematodes in a specific plant variety and treatment for each replication, three plants were chosen at random. Soil samples from the root zone of these selected plants were collected and thoroughly mixed to ensure uniformity. After that extraction counting was done. This process was repeated for each variety across all treatments and replications.

The total number of flowers produced in each plot was recorded from the first flowering with an interval of 3 days, for all three replications. Then the average flower number per plot was calculated. For recording flower diameter fully bloomed flowers were selected from the three representative plants and the diameter of the flowers was recorded, by using a meter scale, for all the replications. The average was calculated for each replication. The length of the flower stalk was measured from the point just below the flower head up to the point of origin of the stem. It was recorded from the three representative plants which were tagged, for all the replications. Average stalk length of each treatment was worked out and expressed in centimeters.

Commented [D5]: Check spelling and correct

Commented [D6]: Check spell and correct

Commented [D7]: Check spell and correct

All the data pertaining to the present investigation were subjected to the statistical analysis of variance (ANOVA) by Factorial Randomized Block Design by calculating the respective "F" value in accordance with Panse and Sukhatme (1985). The significance of difference between mean values of the character of the treatment was tested by computing critical difference (CD) estimates.

### 3. RESULTS AND DISCUSSION

Data presented in Table 1 revealed that the varieties significantly differed in terms of the number of flowers produced per plot. The highest number of flowers per plot was recorded in the plots with variety Pride of Sikkim. While the lowest number of flowers was recorded in plots with variety Red Seven. The number of flowers per plot was increased gradually with an increase in the concentration of foliar sprays. Significant difference was observed among the different concentrations of foliar sprays, influencing the number of flowers per plot. The maximum number of flowers per plot was recorded in treatment with 5 g/l NPK + 20 g/l micronutrient. Whereas, the minimum number of flowers per plot was observed in control. The interaction between the different concentrations of foliar nutrition and the varieties significantly affected the number of flowers produced by per plot. Among all the combinations, the highest number of flowers per plot was observed in the cultivar Pride of Sikkim with 5 g/l NPK + 20 g/l micronutrient treatment. Taya *et al.* (2004) observed that in *Heterodera avenae* (cereal cyst nematode) infected wheat plants, a comparatively higher yield were obtained in the treatments where combinations of NPK or PK were applied at optimum dose or at a higher dose.

Results presented in Table 2 indicated a significant effect on different concentrations of foliar nutrition on the stalk length of flowers and flower diameter across all the varieties. The variety Pride of Sikkim exhibited the maximum stalk length. The maximum flower diameter was observed in Orange Sunburst, while variety Red Seven recorded the minimum stalk length and flower diameter. A significant impact was noted among the various concentrations of foliar spray on the stalk length of flowers. The maximum stalk length and flower diameter was observed in the treatment with 5 g/l NPK + 20 g/l micronutrient, whereas the minimum stalk length and flower diameter was recorded in control. The interaction effects between different varieties and different concentrations of foliar nutrition had shown significant variations within the values of the diameter of flowers. Significantly, the maximum diameter was observed in Orange Sun Burst with 5 g/l NPK + 20 g/l micronutrient treatment. However, no significant interaction effect on stalk length was observed between the varieties and the different concentrations of foliar sprays. The maximum stalk length was observed in the cultivar Pride of Sikkim with 5 g/l NPK + 20 g/l micronutrient treatment. Yadav and

**Commented [D8]:** Here also add some recent references in discussion part

Kanwar (2018) reported that foliar spray of urea, zinc and kinetin has significant impact on plant growth parameters of wheat and also compensates the damage cause by cereal cyst nematode as compared to that of untreated control.



Fig 1. General view of the experiment

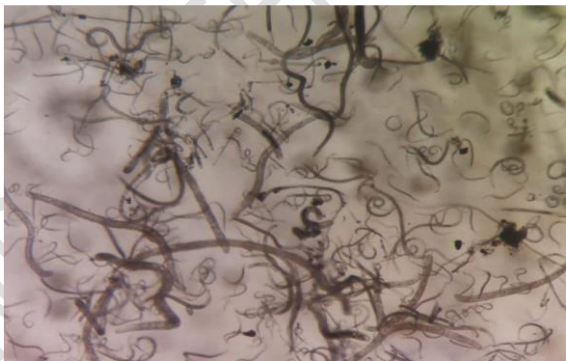


Fig.2 Different genera of plant parasitic nematodes extracted from experimental plots

Table 1. Effect of different concentration of foliar nutrition on number of flowers per plant and per plot

Varieties	Number of flowers/plant					Number of flowers/plot				
	Treatments					Treatments				
	Control	3g/l (NPK) + 20g/l micro nutrient	4g/l (NPK) + 20g/l micro nutrient	5g/l (NPK) + 20g/l micro nutrient	Mean	Control	3g/l (NPK) + 20g/l micro nutrient	4g/l (NPK) + 20g/l micro nutrient	5g/l (NPK) + 20g/l micro nutrient	Mean
Pride of	10.57	11.65	13.65	15.33	12.80	93.80	106.29	122.69	135.50	114.5

Sikkim										7
Arka Krishika	7.04	8.65	10.80	13.32	9.95	63.80	77.21	97.85	117.24	89.02
Pink Melody	5.68	7.03	8.29	10.17	7.79	51.06	62.08	73.96	91.09	69.55
Orange Sunburst	9.46	10.58	12.64	14.66	11.84	85.05	94.94	113.92	131.65	106.39
Saffron	7.35	8.82	10.27	14.46	10.23	66.05	79.88	98.39	129.87	93.55
Red seven	5.76	6.80	8.35	9.42	7.59	51.63	61.80	74.85	85.50	68.45
Mean	7.64	8.92	10.67	12.89		68.57	80.36	96.94	115.14	
S.E(d)	V: 0.26	T: 0.21		V x T: 0.53		V:2.85	T:2.33	VxT:5.71		
CD(P=0.05)	V:0.54	T: 0.44		V x T: 1.08		V: 5.76	T:4.70	V x T: NS		

\* SE (d): Standard error deviation \* CD: Critical difference  
 \*g: Gram \*: Nitrogen \*P: Phosphorus \*K: Potassium

Table 2. Effect of different concentration of foliar nutrition on stalk length and flower diameter of gerbera

Varieties	Stalk length of flower (cm)					Diameter of flower (cm)				
	Treatments					Treatments				
	Control	3g/l (NPK) + 20g/l micro nutrient	4g/l (NPK) + 20g/l micro nutrient	5g/l (NPK) + 20g/l micro nutrient	Mean	Control	3g/l (NPK) + 20g/l micro nutrient	4g/l (NPK) + 20g/l micro nutrient	5g/l (NPK) + 20g/l micro nutrient	Mean
Pride of Sikkim	43.61	45.46	47.10	50.13	46.57	7.83	8.33	8.60	9.03	8.45
Arka Krishika	34.54	35.76	37.46	38.76	36.62	7.06	7.83	8.83	9.50	8.30
Pink Melody	33.33	34.80	36.20	38.13	35.97	7.07	7.70	8.16	8.56	7.87
Orange Sunburst	37.28	38.13	40.30	42.43	39.53	9.55	10.30	10.73	11.60	10.54
Saffron	38.60	40.36	42.13	44.0	41.30	8.54	8.83	9.06	9.53	8.99
Red seven	34.28	35.20	36.16	38.03	35.61	5.36	5.77	6.03	6.33	5.87
Mean	36.93	38.28	39.92	41.93		7.57	8.12	8.57	9.09	
S.E(d)	V: 0.29	T: 0.24		V x T: 0.59		V:0.13	T:0.11	VxT:0.27		
CD(P=0.05)	V:0.59	T: 0.48		V x T: NS		V: 0.27	T:0.22	VxT: 0.54		

\* SE (d): Standard error deviation \* CD: Critical difference \*cm: Centimeter  
 \*g: Gram \* l: Litre \* N: Nitrogen \*P: Phosphorus \*K: Potassium

Table 3. Effect of different concentration of foliar nutrition on final nematode population in soil

Varieties	Nematode population in soil (250cm <sup>3</sup> )				
	Treatments				
	Control	3g/l (NPK) + 20g/l micronutrient	4g/l (NPK) + 20g/l micronutrient	5g/l (NPK) + 20g/l micronutrient	Mean
Pride of Sikkim	751.67	643.33	513.33	410.05	579.58
Arka Krishika	716.67	650.67	481.67	400.08	562.25
Pink Melody	815.08	749.33	563.33	465.02	648.17
Orange Sunburst	755.23	690.68	530.35	450.68	606.73
Saffron	710.20	640.33	542.67	430.13	580.75
Red seven	821.67	728.33	630.67	505.06	671.42
Mean	761.70	587.11	543.67	443.44	
S.E(d)	V: 12.09	T: 9.87		V x T: 24.19	
CD(P=0.05)	V: 24.42	T: 19.94		V x T: NS	

\* SE (d): Standard error deviation \* CD: Critical difference \*cm<sup>3</sup>: Cubic centimeter

\* N: Nitrogen \*P: Phosphorus \*K: Potassium \*g: Gram \* l: Litre

Final population of plant parasitic nematodes in soil was highly influenced by the different concentrations of foliar nutrition across all the varieties. The minimum nematode population in soil was recorded in the plots with variety Arka Krishika, which was statistically at par in plots with variety Pride of Sikkim. While the maximum nematode population in soil was recorded in plots with variety Red seven (Table3). The variation in the population of plant parasitic nematodes in soil across the different cultivars may be due to the inherent genetic makeup of the particular variety resulting in varied resistance to plant parasitic nematode infestation. The nematode population had shown a significant correlation with the varying concentrations of foliar nutrition. Among the different concentrations of foliar spray 5g/l NPK + 20 g/l micronutrient recorded minimum nematode population in soil, while maximum nematode population was recorded in control. The interaction between the varieties and the different concentrations regarding the nematode population was found to be non-significant.

The findings from the present study demonstrated a progressive decrease in the plant parasitic nematode population in soil with an increase in foliar nutrient concentrations. The reduction in the population of plant parasitic nematode across the different concentrations of

foliar nutrition might be due to the fact when the plants are supplied with sufficient quantities of fertilizers especially phosphorus, which results in the increase in the protein synthesis, cell activity and production of polyphenol, peroxidase and ammonia which causes the plant to become more resistant against plant diseases. (Zambolim *et al.*, (2005). Farhat *et al.* (2018) also observed that several agrochemical products viz., NemaKill, Indole-3- butyric acid, Gibberellic acid, Indole acetic acid, Salicylic acid, Citric acid and Glutamic acid when applied as foliar spray reduced reniform nematode (*Rotylenchulus reniformis*) population and reproduction. Similarly, Oka *et al.* (2007) reported that application of potassium phosphate to the aerial part was effective in controlling cereal cyst nematode (*H. avenae*) and root-knot nematode (*Melodogyne marylandi*) in wheat and oats. Perrenoud (1990) also reported that adequate plant nutrition with potassium helps in reducing the incidence of diseases due to increased resistance to the penetration and development of pathogens. The present finding is also in conformity with the findings made by Sharma and Khan (1995), who reported that minimum infestation of root-knot nematode, *M. incognita* was recorded with the application of all three fertilizers (N, P and K) in combination on tomato seedlings.

#### 4. CONCLUSION

The result derived from the present study revealed that foliar nutrition of water soluble NPK along with micronutrient exhibited better performance concerning floral parameter, flower yield and reduction of plant parasitic nematode population in different varieties of gerbera. However, out of six varieties, Pride of Sikkim, Arka Krishika, Orange Sunburst and Pink Melody were found to perform better in terms of number of flowers, diameter and stalk length. Foliar nutrition at 5 g/l NPK + 20 g/l micronutrient was found best in terms of floral character along with flower quality and highest reduction of nematode population. Thus, for growing gerbera in open field condition few of the variety may be recommended with foliar application of NPK along with micronutrient for better yield and quality of gerbera flowers.

#### 5. FUTURE SCOPE

In future further research is necessary that foliar nutrition to be combined with soil application of NPK fertilizers, micronutrients and other organic amendments for huge reduction of nematode population, increasing flower yield and boosting crop growth. Soil application of fertilizers and organic amendments directly affects nematode population as majority of plant parasitic nematodes dwell in soil.

Commented [D9]: Very well written



## DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (Chat GPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

## COMPETING INTERESTS

Author has declared that no competing interests exist.

## REFERENCES

- Aswath, C. and Survy Nazneen, (2004). An improved method for in vitro propagation of gerbera. *J. Orna.Horti.*, 7(2), 141-146.
- Choudhary, M.L & Prasad, K.V. (2000). Protected cultivation of ornamental crops-An insight. *Indian Journal of Horticulture*, 45, 49-53.
- Christie, J. R., & Perry, V. G. (1951). Removing nematodes from soil. *Proceedings of the Helminthological Society of Washington*, 18, 106-108.
- Farhat, A.A., Al- Sayed, A.A., Adam, M. and Diab, Shaimma F. (2018). Comparative efficacy of biotic and abiotic agro chemical products against *Rotylenchulus reniformis* under field condition. *Egypt J. Agronematol.*, 17(1), 77-93.
- Huber, D. M. (1980). The role of mineral nutrition in defense. In: Plant disease: An advance Treatise, vol. 5, Horsfall, J. G and E.B. Cowling (Eds), Academic Press, New York, pp: 381- 406.
- Lamberti F, Tacconi R, Marinari A, Derrico FP, Basile M.(1987). Major plant parasitic nematodes associated with flower crops in Italy and their control. *Difesa delta Pinate.10*, 77-84.
- Nagesh, M. & Reddy, P. P (1996). Management of *Meloidogyne incognita* on carnation and gerbera in commercial polyhouses. In: Crop productivity and sustainability-sharpping the future, 2<sup>nd</sup> International Crop Science Congress, NAAS, New Delhi, India.p.249.
- Nagesh, M. & Reddy, P. P (2000).. Crop loss estimation in carnation and gerbera due to the root-knot nematode, *Meloidogyne incognita* (Kofoid and White) Chitwood. *Pest Management in Horticultural Ecosystems*. 6, 158-159.
- Nagesh, M. & Reddy, P. P.(2001). Pathogenicity of selected antagonistic soil fungi egg masses under in vitro and in vivo conditions. *J. Bio Control.15*, 63-68. .
- Oka, Y., Tkachi, N. & Mor, M. (2007). Phosphite inhibits development of the nematodes

*Heterodera avenae* and *Meloidogyne marylandi* in cereals. *Phytopathology*, 97(4), 396-404.

Panse, V.G. & Sukhatme, P.V. (1985). Statistical Method for Agricultural workers. Indian Council of Agricultural Research, New Delhi

Perrenoud, S. (1990). Potassium and plant health. 2nd Edn., International Potash Institute, Bern, Switzerland, page: 368.

Sharma, G. C. & Khan, M. L. (1995). Effect of NPK fertilizers on *Meloidogyne incognita* infestation and plant growth in tomato. *Indian Journal of Nematology*, 25(2), 147-149.

Taya, A. S., Dalal, M. R. & Naagar, K. C. (2004). Influence of inorganic fertilizers on cereal cyst (*Heterodera avenae* Woll). *Agric. Sci. Dig.*, 24(2), 109-111.

Yadav, S & Kanwar, R.S. (2018). Effect of higher doses of fertilizers and spray of urea, Zn and kinetin on damage potential of *Heterodera avenae* in wheat. *Plant Pathology Journal*, 17, 33-38.

Zambolim, L., Rodrigues, F.A. & Capucho, A.S. (2005). Resistance to Plant Diseases Induced by Mineral Nutrition. In: Alternative Pest and Disease Control, Venzon, M., T.J.P. Pallani, Jr. and A. Pallini (Eds.), EPAMIG., Vicoso, Brazil, pp: 185-219.