Influence of foliar feeding of NPK(19:19:19) on growth, yield, and quality of Cucumber (*Cucumis sativus* L.) cv.Kalyanpur Green

Abstract

The present experiment entitled "Influence of foliar feeding of NPK(19:19:19) on growth, yield, and quality of Cucumber (*Cucumis sativus* L.) cv. Kalyanpur Green " was conducted during *Zaid* season of 2023-2024 at Department of vegetable science Kalyanpur, Kanpur. The trial was laid down in randomized complete block design (RCBD) with three replications and thirteen treatments *viz* .T_1- Control Plot water spray at 25,40 and 55 DAS, T_2- NPK (19:19:19:) @ 0.5% of foliar spray at 25 DAS, T_3- NPK (19:19:19:) @ 0.5% of foliar spray at 40 DAS, T_4- NPK (19:19:19:) @ 0.5% of foliar spray at 55 DAS, T_5- NPK (19:19:19:) @ 0.5% of foliar spray at 25 & 40 DAS, T_6- NPK (19:19:19:) @ 0.5% of foliar spray at 40 & 55 DAS, T_7- NPK (19:19:19:) @ 0.5% of foliar spray at 25,40 & 55 DAS, T_8- NPK (19:19:19:) @ 1.0% of foliar spray at 25 DAS, T_9- NPK (19:19:19:) @ 1.0% of foliar spray at 40 DAS, T_{10}- NPK (19:19:19:) @ 1.0% of foliar spray at 55 DAS, T_{11}- NPK (19:19:19:) @ 1.0% of foliar spray at 25 & 40 DAS ,T_{12}- NPK (19:19:9:) @ 1.0% of foliar spray at 40 & 55 DAS and T_{13}- NPK (19:19:19:) @ 1.0% of foliar spray at 25,40 & 55 DAS.Result of study revealed that maximum vine length in T_{13}(400.00 cm), first fruit harvest in T_{13}(53.927 DAS), fruit length in T_{13} (23.600cm), fruit width in T_{13}(4.00cm), internode length in T_{13}(18.900 cm), number of fruits per vine in T_{13} (14.700), yield per plant in T_{13}(2.60 kg), yield per plot in T_{13}(23.900 kg), yield per hectare T_{13}(98.200 quintal), Vitamin C in T_{13}(4.043 mg/100gm), TSS in T_{13}(3.693 %) whereas minimum days to first male flower in T_{13}(39.497 DAS), days to first female flower in T_{13} (39.800 DAS) and first fruit harvest in T_{13}(51.927).

Keywords: Cucumber, NPK, foliar feeding, growth and yield.

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The study revealed that the best treatment for vine length, days to first male flower ..... are found in treatment T13.

Introduction

Cucumber, scientifically known as (*Cucumis sativus* L.,) is a widely popular vegetable from the Cucurbitaceae family, characterized by a chromosome number of 2n=14. Originating in India, cucumber boasts numerous nutritional benefits, including being a good source of iodine and comprising approximately 95% water and 4-6% dry substances, which include about 2% sugars, 1% albuminous substances, 0.7% cellular tissues, and 0.1% fat (~~Sushmita, S., 2018~~). This versatile vegetable, ideal for summer cultivation, finds its place in various culinary applications, such as salads, pickles, desserts, and cooked dishes, owing to its edible tender fruits. It is a

Comment [MSB52]: Correct the reference Sushmita, 2018

widely cultivated vegetable crop known for its crisp texture and refreshing taste. Among the many factors influencing its growth and productivity, nutrient management plays a critical role. Cucumber cultivation in India and specifically in Uttar Pradesh spans approximately 116.62 thousand hectaresand 3.99thousand hectares, respectively, with annual productions of 1,651.92 thousand metric tons (MT) and 100.57 thousand metric tons (MT). (Horticultural Statistics at a Glance 2021).

Traditional soil fertilization methods often face limitations due to nutrient leaching, volatilization, and poor soil nutrient availability. Foliar feeding, which involves applying nutrients directly to plant leaves, has emerged as an effective method to circumvent these issues. This technique ensures the rapid absorption of nutrients and can provide immediate supplementation during critical growth stages.~~Singh *et.al*. (2020)~~. Foliar feeding, a method of supplying nutrients directly to the leaves, has gained popularity due to its potential to enhance plant growth and yield. This study focuses on the influence of foliar application of a balanced NPK (19:19:19) fertilizer on the growth, yield, and quality of the cucumber cultivar Kalyanpur Green. Among various foliar fertilizers, the balanced NPK (19:19:19) formulation has garnered significant attention. This formulation supplies equal proportions of nitrogen (N), phosphorus (P), and potassium (K), each of which is essential for different physiological processes:Despite its potential, there is a paucity of research on the specific effects of foliar-applied NPK (19:19:19) on the growth, yield, and quality of cucumber cv. Kalyanpur Green. This study aims to fill this gap by systematically investigating these parameters.

To evaluate the effects of foliar feeding with NPK (19:19:19) on vegetative growth parameters of cucumber cv. Kalyanpur Green, to assess the impact on yield attributes and total yield, to analyze the influence on fruit quality parameters, including physical and biochemical characteristics, to determine the optimal concentration and frequency of foliar application for achieving the best growth, yield, and quality outcomes. Foliar applications were initiated at the four-leaf stage and continued at two-week intervals until the onset of fruiting. The nutrient solution was prepared by dissolving the appropriate concentration of NPK (19:19:19) in water and applied using a hand-held sprayer in the early morning to avoid evaporation losses. (~~Kumar *et al*., 2018~~).It is hypothesized that foliar feeding with NPK (19:19:19) will significantly enhance the vegetative growth, yield, and quality of cucumber cv. Kalyanpur Green. The expected outcomes include:Improved plant height, leaf number, and leaf area due to enhanced nutrient availability, increased fruit set and yield as a result of better nutrient absorption and utilization, enhanced fruit quality attributes, leading to higher marketability and consumer acceptance.

2. MATERIALS AND METHODS

The present investigation was conducted during *Zaid*season of 2023-24 at Department of vegetable science, Chandrashekhar Azad University of Agriculture and Technology, Kalyanpur, Kanpur. The experiments were analyzed at Randomized Block Design(RBD). The experiment laid down in 3 replication and consisted 13 treatments viz. T_1- Control Plot water spray at 25,40 and 55 DAS, T_2- NPK (19:19:19:) @ 0.5% of foliar spray at 25 DAS, T_3- NPK (19:19:19:) @ 0.5% of foliar spray at 40 DAS, T_4- NPK (19:19:19:) @ 0.5% of foliar spray at 55 DAS, T_5-

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Comment [MSB56]: Kumar and Sharma, 2018.

NPK (19:19:19:) @ 0.5% of foliar spray at 25 & 40 DAS, T_6- NPK (19:19:19:) @ 0.5% of foliar spray at 40 & 55 DAS, T_7- NPK (19:19:19:) @ 0.5% of foliar spray at 25,40 & 55 DAS, T_8- NPK (19:19:19:) @ 1.0% of foliar spray at 25 DAS, T_9- NPK (19:19:19:) @ 1.0% of foliar spray at 40 DAS, T_{10}- NPK (19:19:19:) @ 1.0% of foliar spray at 55 DAS, T_{11}- NPK (19:19:19:) @ 1.0% of foliar spray at 25 & 40 DAS ,T_{12}- NPK (19:19:19:) @ 1.0% of foliar spray at 40 & 55 DAS, T_{13}- NPK (19:19:19:) @ 1.0% of foliar spray at 25,40 & 55 DAS. The Gross plot size was ~~4.8 × 4.0 m~~and the spacing was kept 150× 50 cm between andwithin rows.Standard cultural practices recommended were followed uniformly in all experiments.

Comment [MSB57]: Plot size will be 4.5 x 4.0.

Biometrical Analysis

Experimental data was subjected to biometrical analysis as per the standard procedure given by Gomez and Gomez (1984).

Table-1 Influence of foliar feeding of N.P.K. (19:19:19) on growth, yield, and quality

Treatment	Vine length (cm)	Days to first male flower	Days to first female flower	First Fruit harvest (DAS)	Fruit length (cm)	Fruit width (cm)	Internode length (cm)	Number of fruits per vine	Yield per plant (Kg)	Yield per plot (Kg)	Yield per hectare (Quintal)	Vitamin C mg/100gm	TSS (°Brix)
T_1- Control Plot (water spray at 25,40 and 55 DAS	325.300	41.897	45.600	54.600	16.203	2.000	11.997	11.000	1.100	15.200	80.000	3.693	2.637
T_2- NPK (19:19:19:) @ 0.5% of foliar spray at 25 DAS	350.100	41.100	45.100	52.100	16.797	2.003	12.200	11.200	1.400	15.300	80.500	3.727	2.580
T_3- NPK (19:19:19:) @ 0.5% of foliar spray at 40 DAS	352.800	39.900	44.700	53.007	17.200	2.000	12.300	11.300	1.400	15.700	86.000	3.673	2.717
T_4- NPK (19:19:19:) @ 0.5% of foliar spray at 55 DAS	360.000	39.800	44.497	53.230	17.700	2.097	13.000	11.500	1.400	16.100	87.200	3.667	2.893
T_5- NPK (19:19:19:) @ 0.5% of foliar spray at 25 & 40 DAS	365.200	39.100	44.403	53.877	18.200	2.300	13.503	11.800	1.400	16.200	89.700	3.780	2.917
T_6- NPK (19:19:19:) @ 0.5% of foliar spray at 40 & 55 DAS	370.300	39.100	44.303	53.770	18.397	2.400	13.500	11.900	1.500	16.600	89.800	3.800	3.007
T_7- NPK (19:19:19:) @ 0.5% of foliar spray at 25,40 & 55 DAS	372.200	38.200	43.297	53.590	19.903	3.003	14.100	12.500	1.900	17.700	90.300	3.907	2.993
T_8- NPK (19:19:19:) @ 1.0% of foliar spray at 25 DAS	380.000	37.900	43.103	53.863	21.100	3.200	15.000	12.600	2.100	17.700	91.000	3.870	3.117
T_9- NPK (19:19:19:) @ 1.0% of foliar spray at 40 DAS .	383.300	37.403	42.100	53.943	21.500	3.000	16.200	12.900	2.200	18.200	91.300	3.933	3.200
T_{10}- NPK (19:19:19:) @ 1.0% of foliar spray at 55 DAS	390.100	41.903	40.400	52.930	21.700	3.400	17.097	13.100	2.300	18.700	92.800	4.003	3.300
T_{11}- NPK (19:19:19:) @ 1.0% of foliar spray at 25 & 40 DAS	392.000	41.100	40.000	53.337	21.700	3.500	18.603	13.600	2.400	21.100	96.700	4.010	3.490
T_{12}- NPK (19:19:19:) @ 1.0% of foliar spray at 40 & 55 DAS	395.800	39.900	39.497	53.037	23.603	4.000	18.800	13.700	2.500	22.300	97.100	4.023	3.483

T_{13}- NPK (19:19:19:) @ 1.0% of foliar spray at 25,40 & 55 DAS	400.00	39.800	39.497	51.927	23.600	4.20	18.900	14.700	2.600	23.900	98.200	4.043	3.6
C.D.	**14.255**	**1.740**	**2.022**	**NS**	**0.960**	**0.116**	**0.662**	**0.335**	**0.086**	**0.777**	**2.866**	**0.123**	**0.117**
SE(m)	**4.855**	**0.593**	**0.689**	**2.365**	**0.327**	**0.040**	**0.225**	**0.114**	**0.029**	**0.265**	**0.976**	**0.042**	**0.040**
SE(d)	**6.866**	**0.838**	**0.974**	**3.345**	**0.462**	**0.056**	**0.319**	**0.161**	**0.042**	**0.374**	**1.380**	**0.059**	**0.0**

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~~RESEALT~~ AND DISCUSSION

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Vine length(cm)

Among the various treatments T_{13} had maximum vine length (348.100 cm) followed by T_{12} (338.800cm) and T_{11} (334.00). Whereas minimum vine length was noticed in control (325.300) Since,the foliar spray of NPK 19:19:19 can lead to maximum vine growth in cucumbers by ensuring a balanced and readily available supply of essential nutrients, enhancing overall plant health, and promoting efficient and rapid nutrient uptake directly through the leaves. Similar findings were noticed by Patil *et al.*,(1998).; (Table 1.)

Days to first male flowering

Among the various treatments T_{13} produced male flower in minimum days (39.800 days after sowing) followed by T_{12} (39.900 days after sowing) and T_{11} (41.100 Days after sowing). Whereas maximum days for male flower initiation was noticed in control (41.897 days after sowing). Since the foliar application of NPK 19:19:19 helps by balanced nutrient supply, improved nutrient absorption, and enhanced photosynthesis and growth promoting early and healthy development of male flowers. Similar findings were noticed by Thriveni *et al.,* (2015).; (Table 1.)

Days to first female flower

Among the various treatments T_{13} produced female flower in minimum days (39.497 days after sowing) followed by T_{12} (39.497) days after sowing) and T_{11} (40.000 Days after sowing). Whereas maximum days for female flower initiation was noticed in control (45.600 days after sowing). Since the earlier appearance of female flowers in cucumber plants treated with an NPK 19-19-19 foliar spray is due to the balanced and immediate nutrient availability that supports optimal plant growth, flowering, and hormonal balance Similar findings were noticed by Prasad *et al.,* (2016).;(Table 1.)

First Fruit harvest (DAS)

Among the various treatments T_{13} produced first fruit harvest in minimum days (53.927 days after sowing) followed by T_{12} (53.037 days after sowing) and T_{11} (53.337 days after sowing).

Whereas maximum days for first fruit harvest was noticed in control (52.600 days after sowing) Since the early first fruit harvest in cucumbers following foliar spray with NPK 19:19:19 is likely due to enhanced nutrient availability, improved plant health, and optimized flowering and fruit setting processes facilitated by the balanced nutrient composition of the spray Similar findings were noticed by Akinrinde, A. A, 2006.;(Table 1.)

Fruit length (cm)

Among the various treatments T_{13} fruit length (23.600 cm) followed by T_{12} (23.603 cm) and T_{11} (21.700 cm). Whereas minimum fruit length was noticed in. control (16.203 cm) Since the foliar application of NPK 19:19:19 it helped by balanced nutrient supply, improved nutrient uptake**,** enhanced photosynthesis and metabolism and improved flowering and fruit set Similar findings were noticed by Jagraj Singh *et al.,* (2020).;(Table 1.)

Fruit width (cm)

Among the various treatments T_{13} had highest fruit width (4.20 cm) followed by T12 (4.00 cm) and T11 (3.50 cm). Whereas minimum fruit width was noticed in control (2.00 C.M) since the use of NPK 19-19-19 as a foliar spray provides a balanced supply of essential nutrients, leading to better vegetative growth, enhanced photosynthesis, improved metabolic functions, and overall plant health. These factors collectively contribute to an increase in the width of cucumber fruits Similar findings were noticed by Gao Z, Zhang H, Cao C, *et al.,*;(Table 1.)

Internode length (cm)

Among the various treatments T_{13} internode length (18.900 cm) followed by T12 (18.800 cm) and T11 (18.603 cm). Whereas minimum fruit width was noticed in control (11.997 cm). since the balanced nutrients provided by NPK 19-19-19 foliar spray directly contribute to better internode length in cucumbers by supporting essential physiological and biochemical processes that promote overall plant growth and health Similar findings were noticed by Alekar *et al.,* (2015**).;** (Table 1.)

Number of fruits per vine

Among the various treatments T_{13} had highest number fruit per vine (14.700) followed by T_{12} (13.700) and T_{11} (13.600). Whereas minimum number of fruit was noticed in control (11.00)

since the improved number of fruits per vine in cucumber plants treated with foliar spray NPK 19-19-19 can be attributed to the balanced supply of essential nutrients (N, P, K) supporting overall plant health, reproductive processes, and stress tolerance, ultimately enhancing fruit set and development Similar findings were noticed by Thriveni *et al.*, (2015).; (Table 1.)

Yield per plant (Kg)

Among the various treatments T_{13} yield per plant (2.600 kg) followed by T_{12} (2.500 kg) and T_{11} (2.400 kg). Whereas minimum yield per plant (kg) was noticed in control (1.100 kg) since the foliar spray of NPK 19-19-19 provides cucumbers with readily available and balanced nutrition, which supports optimal growth, development, and stress tolerance. This ultimately leads to better yields per plant compared to plants that might rely solely on soil-applied nutrients or those facing nutrient deficiencies Similar findings were noticed by ~~Mostafa, H. and Mohammad .M.M~~2012. (Table 1.)

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Yield per plot (Kg)

Among the various treatments T_{13} had produced maximum yield per plot (23.900 kg) followed by T_{12} (22.300 kg) and T_{11} (21.100 kg). Whereas minimum yield per plot was noticed in control (15.200 kg) since the use of NPK 19-19-19 as a foliar spray on cucumber plants enhances nutrient availability, uptake efficiency, and supports robust growth and productivity, leading to better yields per plot in cucumber cultivation Similar findings were noticed by Arshad*et al.*, (2014) conducted.;(Table 1.)

Comment [MSB513]: Reference missing

Yield per hectare (q)

Among the various treatments ~~T13~~ yield per hectare (quintal) (98.200 q) followed by T_{12} (97.100 q) and T_{11} (96.700 q). Whereas minimum yield per hectare was noticed in control (80.00 q) since the better yield per hectare in cucumbers with NPK 19-19-19 foliar spray is due to its balanced nutrient composition, quick absorption by the plant, and targeted support for essential growth stages and physiological processes. These factors collectively contribute to healthier plants, improved fruit production, and ultimately, higher yields Similar findings were noticed by Arun and Kumar (2014).,;(Table 1.)

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Vitamin C (mg/100gm)

Among the various treatments T_{13} had highest content vitamin C (4.043mg/100gm) followed by T_{12} (4.023 mg/100gm) and T_{11} (4.010 mg/100gm). Whereas minimum vitamin C content was noticed in control (3.693 mg/100gm) Since the foliar application of NPK 19:19:19 it helped the enhances photosynthetic efficiency, stress resistance, overall plant health, and specific biochemical pathways involved in vitamin C synthesis, leading to higher vitamin C content in the fruits Similar findings were noticed by ~~Sharma, M.K. 2009,;(~~Table 1.)

Total soluble solid (TSS) of edible fruit (°Brix)

Among the various treatments T_{13} had content highest Total soluble solid (TSS) of edible fruit (3.693%) followed by ~~T12~~ (3.483%) and T11 (3.490%). Whereas minimum Total soluble solid (TSS) of edible fruit content was noticed in control (2.637 %) it helped the application of a balanced NPK 19-19-19 foliar spray enhances the TSS in cucumbers by providing essential nutrients that improve photosynthesis, carbohydrate synthesis, stress resistance, and overall fruit quality Similar findings were noticed by ~~Pandey, V., Ahmed, Z, *et al.*,2005. ;(~~Table 1.)

Conclusion

The study on the influence of foliar feeding with NPK (19:19:19) on various growth, yield, and quality parameters of cucumber (*Cucumis sativus* L.) cv. Kalyanpur Green has Overall, the foliar application of NPK 19:19:19 significantly enhances cucumber plant growth, flowering, fruiting, and yield, providing balanced and readily available nutrients, improving photosynthesis, and promoting overall plant health.

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Comment [MSB519]: write all reference to standard format of journal.