International Journal of Environment and Climate Change

Volume 13, Issue 9, Page 3194-3199, 2023; Article no.IJECC.104854
ISSN: 2581-8627
(Past name: British Journal of Environment & Climate Change, Past ISSN: 2231–4784)

Effect of Different Concentrations of Liquid N, P& K on Growth, Yield and Quality of Cucumber (*Cucumis sativus L.*) in Vertical Hydroponics under Shade Net

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJECC/2023/v13i92681

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/104854

Original Research Article

Received: 04/06/2023
Accepted: 07/08/2023
Published: 08/08/2023

ABSTRACT

The experiment was carried out to find out the effect of different concentrations of liquid NPK on growth, yield and quality of cucumber (*Cucumis sativus L.)*. The variety was "Ankita", which is F1 hybrid. The experiment was carried out during September, 2021 to December, 2021 in Shade net, Research Field, Department of Horticulture, SHUATS, Prayagraj. The experiment was conducted in

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Randomized Block Design (RBD), with eight treatments T_1(16.25ml NPK & micronutrients/Pl in total), T_2(18.75ml NPK & micronutrients/Pl in total), T_3(21.25ml NPK & micronutrients/Pl in total) T_4(23.75ml NPK & micronutrients/Pl in total) T_5(26.25ml NPK & micronutrients/Pl in total) T_6(28.75ml NPK & micronutrients/Pl in total) T_7(31.25ml NPK & micronutrients/Pl in total) with a control (T_0), replicated thrice in vertical hydroponics system. The NPK level increased by 5ml on every 15 days interval. The best result was shown by the treatment T_5(26.25ml NPK & micronutrients/Pl in total). The first fruit setting, picking, vine length, number of leaves, growth of plant, chlorophyll content all parameter were superior in T_5. The plants in control did not show any significant improvement as there were no nutrients given to them. The systems ran four hours daily during their vegetative growth and the timing was increased to six hours during their reproductive phase of development. Fruit formation occurs in almost all plants in each and every treatment except control there was no fruit formation.

Keywords: Cucumber; vertical; F1 hybrid; chlorophyll content; RBD; NPK.

1. INTRODUCTION

Cucumber (*Cucumis sativus L.),* belongs to the Cucurbitaceae family, one of the most important plant families in agriculture, The crop is the fourth most important vegetable after tomato, cabbage and onion in Asia [1], the second most important vegetable crop after tomato in Western Europe [2]. Cucumber grown during specific seasons [3] in northern India. It is one of the creeping vegetables with large consumer demand worldwide [4]. Soilless or hydroponics culture is one of the modern techniques. They are considered as important technologies for better water use efficiency as well as high good quality and quantity products [5-7]. Numbers of organic and inorganic materials such as gravel, sand, peat, sawdust, pumice, tuff, coir, vermiculite, perlite, and rock wool pure or in mixture are used as solid growing media in addition to hydroponics (Water), aeroponics and aquaponics as cropping systems [8-10]. The selection of a particular material as a substrate depends on its availability, cost and local experience on its use [11,12]. In hydroponic systems, the nutrient solution is delivered directly to the plant roots, allowing for precise control over the nutrients, water, and pH levels. This results in healthier and more productive plants that require less space, water, and fertilizers than traditional soil-based farming.

2. MATERIALS AND METHODS

An experiment entitled Effect of different concentrations of Liquid N, P and K on growth**,** yield and quality of cucumber in vertical hydroponics under Shade net was conducted at Shade net, Research Field, Department of Horticulture, Naini Agricultural Institute (NAI), Sam Higginbottom University of Agriculture, Technology and Sciences, during, September, 2021 to december,2021.

Statistical analysis was done by using method of analysis of variance (ANOVA) for completely randomized block design (CRBD) by [13]. The overall significance of difference among the treatment was tested, using critical difference at 5% level of significance. The result were statistically analyzed with the help of a window based computed package OPSTAT [14].

3. RESULTS AND DISCUSSSION

Effect of different concentration of liquid NPK and micronutrients on growth parameters at cucumber: The data on vegetative growth at cucumber as influenced by various treatments one given in Table 1. It is clearly evident that maximum attributes observed in T5 such as length of main vine plant was 190.02 cm followed by T4 with 179.74 cm, and minimum in control with 55.50 cm, number of Primary and Secondary branches of cucumber plant with 3.03 and 9.10, followed by T_4 (23.75ml/plant) with 2.50 and 6.50. While lowest number of primary and secondary branches per plant was recorded in control with 1.77 and 2.12, Maximum numbers of leaves/plant were recorded in T_5 (26.25ml NPK/Pl) with 14.33 followed by T_4 (23.75ml NPK/Pl) with 13.70, whereas minimum 4.10 leaves/plant was recorded in T_0(Control) were significantly affected by the application of

Table 1. Effect of different concentrations of liquid NPK on growth and flowering behaviour of cucumber in vertical hydroponics

	Vegetative parameters				Flowering parameters		
Treatments	**Vine length (cm)**	**Number of leaves**	**Number of primary branches**	**Number of secondary branches**	**Number of female flower /plant**	**Number male flower /plant**	**Sex ratio (Male: Female)**
T_1(16.25ml NPK/plant) in total	151.30	11.90	2.30	4.14	19.33	37.67	1.92
T_2(18.75ml NPK/plant) in total	160.86	12.30	2.37	4.97	20.33	40.33	1.94
T_3(21.25ml NPK/plant) in total	170.74	13.27	2.40	5.52	21.00	42.00	2.03
T_4(23.75ml NPK/plant) in total	179.74	13.70	2.50	6.50	22.33	45.00	2.10
T_5(26.25ml NPK/plant) in total	190.02	14.33	3.03	9.10	23.67	51.67	2.23
T_6(28.75ml NPK/plant) in total	178.71	13.17	2.57	6.16	21.67	43.67	2.14
T_7(31.25ml NPK/plant) in total	176.51	12.57	2.40	5.35	19.00	39.67	2.09
T_0(Control)	55.50	4.10	1.77	2.12	3.67	6.33	1.74
F-TEST	S	S	S	S	S	S	S
S.E.(d)	0.63	0.20	0.17	0.36	0.87	1.63	0.099
C.D @ 5%	0.49	0.43	0.37	0.78	1.88	3.53	0.214
C.V.	1.36	2.02	8.54	8.07	5.62	5.22	5.985

Table 2. Effect of different concentrations of liquid NPK on yield and yield attributing parameters in cucumber in vertical hydroponics

Treatments	**Number of fruits/plant**	**Fruit length (cm)**	**Fruit diameter(cm)**	**Average fruit weight**	**Fruit yield/ plant**	**Fruit yield/ structure**
T_1(16.25ml NPK/plant) in total	18.00	7.94	3.27	64.90	3.70	14.80
T_2(18.75ml NPK/plant) in total	19.00	8.32	3.43	66.33	3.85	15.40
T_3(21.25ml NPK/plant) in total	19.67	8.92	4.13	69.33	4.28	17.10
T_4(23.75ml NPK/plant) in total	20.67	9.68	4.53	72.40	4.68	18.73
T_5(26.25ml NPK/plant) in total	22.00	10.07	4.63	75.30	4.79	19.17
T_6(28.75ml NPK/plant) in total	20.67	9.13	4.07	71.27	4.23	16.93
T_7(31.25ml NPK/plant) in total	17.67	8.53	3.80	70.17	3.93	15.73
T_0(Control)	0.00	0.00	0.00	0.00	0.00	0.00
F-TEST	S	S	S	S	S	S
S.E.(d)	0.766	0.14	0.13	0.763	0.08	0.33
C.D @ 5%	1.66	0.29	0.29	1.651	0.18	0.70
C.V.	5.454	2.12	4.73	1.526	2.70	2.70

different concentrations of liquid NPK with micronutrients. The experimental results revealed that all the growth parameters were significantly improved by using lower to higher concentration of liquid NPK and micronutrients. It's important to note that the optimal nutrient levels for cucumber growth can vary depending on a number of factors, including the specific cultivar, growing conditions, and the growth stage of the plant. However, in general, higher levels of nitrogen, phosphorus, and potassium can contribute to increase all attributes of growth parameters. The result matches the result of Çalişkan, B and Caliskan, A.C. (2019), Yan *et al.,* (2012).

Effect of different concentrations of liquid NPK on flowering parameter: Data articulated in Table 1 showed that the flowering behaviour in cucumber were influenced by the different concentrations of liquid NPK and micronutrients. The significant effect was noted in the terms of the total number of female and male flowers per vine differed significantly. Maximum number of female flower per vine in T_5(26.25ml/plant) was 23.67, followed by T_4(23.75ml/plant) was 22.33. Minimum number of female flowers per vine was found in T_0 (Control) was 3.67. Similarly Maximum number of male flower in T_5(26.67ml/plant) was 51.67, followed by T_4(23.75ml/plant) was 45. T_0(control) shown less number of male flowers with 6.33. The number of female and male flowers is an important character for earliness or lateness of crop in general. And in terms of sex ratio the results showed that the maximum sex ratio were found in T_5 (26.25ml/plant) with 2.23, followed by T_4(23.75ml/plant) with 2.10. The lowest sex ratio was recorded in T_0 with 1.74 male flowers, A careful analysis of the data reveals significant differences among the treatments regarding the Flowering Parameter of Cucumber plant. These findings suggest that the NPK concentrations in the hydroponic solution play a crucial role in determining the number of female and male flowers in Cucumber plants. Further investigation into the optimal NPK levels for number of female and male flower and it could lead to improved production and yield in Cucumber cultivation. The variation in number of female and male flower might also have been due to their genetic nature, environmental factor, hormonal factor and vigour of crop. Similar results have been reported by Martin M. Maboko *et al*., (2017), Md. Sabuj Ali *et al.,* (2022). The narrower sex ratio by the different concentrations of macronutrients (NPK) is possibly due to the fact that these substances are reported to increase functional female organs and compatibility besides reducing the embryo abortion in plants. Similar results were obtained earlier by Jennifer and Carol (2007) and Gill et al. (2012) in cucumber.

Effect of different concentrations of liquid NPK on Yield and yield attributing parameters: Data pertaining from the Table 2 showed that the different concentrations of liquid NPK were gave a significant influence in terms of yield and yield attributing parameters as compared to control during experimentation. The maximum number of fruits plant per plant were found in T_5(26.25 NPK ml/plant) 22.00, followed by T_4(23.75 NPK ml/plants). The lowest number of fruits were recorded in T_7(31.25 NPK ml/plant). The number of fruits per plant is one of the major factors for deciding the yield of the crop. In terms of fruit length. The maximum fruit length was found with T_5(26.25ml/plant) with 10.07 cm, followed by T_4(23.75ml/plant) with 9.6 cm. The minimum fruit length was recorded with T_1(16.25ml/plant) with 7.94 cm. Similarly, the maximum fruit diameter was found in T_5 (26.25ml NPK/plant) with 4.63cm, followed by T_4(23.75ml NPK /plant) with 4.53cm. The minimum fruit diameter was found in T_1(16.25ml NPK/plant) with 3.27cm, and the highest fruit weight was recorded in T_5(26.25 NPK ml/plant) with 75.30g, followed by T_4(23.75 NPK ml/plant) with 72.40g. The lowest fruit weight was found in T_1(16.25NPK ml/plant) with 64.90g. The maximum fruit yield per plant (kg) was recorded in T_5 (26.25ml NPK/plant) with 4.79kg followed by T_4 (23.75ml NPK/plant) with 4.68. The lowest fruit yield per plant was found in T_1 (16.25ml NPK/plant) with 3.70kg. The maximum yield/structure(kg) was recorded in T_5 with 19.17, followed by T_4 with 18.73kg. The lowest fruit yield/structure(kg) was found in T_1 with 14.80kg. Fruit yield is also depended on fruit length and fruit diameter, increasing fruit length and fruit diameter will increase fruit yield, The variation of fruit yield might have been due to Potassium is the key driver for fruit size and alongside Nitrogen is required in large quantities throughout fruit development and growth but too much nitrogen at a late growth stage can restrict fruit size; therefore, after increasement of NPK concentration from T_6, it shows adverse effect fruit size decreases. Significant differences were recorded with reference to fruit weight amongst, In this experiment it was found that on increasing the NPK concentration the Yield increases up to T_5 and it again decreases in T_6 which had higher

concentration than T_5 and minimum yield was obtained in T_1 with minimum NPK concentration. This optimum concentration of nutrients could have provided the plants with sufficient nutrients for their growth and development, resulting in better plant health and higher yields. the higher nutrient concentration may have led to greater nutrient uptake and assimilation by the plants, which would have contributed to increased biomass production and male and female flower formation; This finding correlates with the findings of Olubanjo and Adaramola [15], Janapriya and Palanisamy [26].

4. CONCLUSION

On the basis of results obtained from the present study concluded that the effect of the different concentrations of liquid NPK on growth, flowering and yield in cucumber variety Ankita were gave significant effect as compared to control and other treatments. Among all the treatments, T_5 (26.25 ml NPK& micronutrients/Pl. in total) was found best in terms of growth and yield parameters of Cucumber in vertical of hydroponic system.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/104854