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Effect of Different Levels of Nitrogen, Phosphorus and Potassium Fertilizers on Yield of Cucumber (*Cucumis sativus L.*) Under The Climatic Conditions of Takhar Province

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ABSTRACT

The experiment was carried out in the research farm of Agriculture Faculty, Takhar University under the title of the effect of nitrogen fertilizer with different amounts of phosphorus and potassium fertilizers on cucumber yield under the climatic conditions of Takhar Province, Afghanistan. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications and four treatments. Treatments T_1 without of any fertilizer, T_2 nitrogen 80 kg ha^{-1}, phosphorus fertilizer 100 kg ha^{-1}, and potassium fertilizer 85 kg ha^{-1}. T_3 nitrogen fertilizer 80 kg ha^{-1}, phosphorus fertilizer 120 kg ha^{-1} and potassium fertilizer 95 kg ha^{-1}. T_4 nitrogen fertilizer 80 kg ha^{-1}, phosphorus fertilizer 140 kg ha^{-1} and potassium fertilizer 105 kg ha^{-1}. In the order of information related to fruit length, fruit diameter, weight per fruit, weight per plant, fruit yield per hectare in tons was registered. The maximum fruit length (19.39 cm), fruit diameter (4.80 cm), weight per fruit (184.87 gr), fruit weight per plant (2.86 kg) and performance per hectare (61.37 tons) in T_4 with nitrogen fertilizer 80 kg ha^{-1}, phosphorus fertilizer 140 kg ha^{-1} and potassium fertilizer 105 kg ha^{-1} were found, while the lowest recorded data was from T_1 i.e. control. From this experiment, it can be said that the use of NPK fertilizer with the use of 80 kg of nitrogen fertilizer ha^{-1}, 140 kg of phosphorus fertilizer ha^{-1} and 105 kg of potassium fertilizer ha^{-1} for cucumber cultivation caused better growth and performance in the field of Takhar University.

Keywords- Cucumber, NPK, Fruit, Yield, Takhar Province.

I. INTRODUCTION

Cucumber is an annual plant of the genus Cucumis, with the scientific name (*Cucumis sativus L.*). It is a popular vegetable of the cucurbitaceae family, of which about 30 species have been registered in Asia and Africa (Paywoast, 2008). This plant is native to tropical regions and is one of the oldest cultivated plant products. Cucumber is one of the fresh fruit vegetables that is commonly cultivated all over the world. Its production in the open space and greenhouses is gradually increasing due to its excellent nutritional benefits. During the last century, it has significantly improved the performance of the product. Cucumber needs large amounts of over-consumed and under-consumed nutrients for economic efficiency. Nitrogen, phosphorus and potassium are important nutrients for cucumber cultivation. Cucumber plants should be fertilized with a sufficient dose of nitrogen, phosphorus and potassium, which are the main elements and have a significant effect on plant growth. Nitrogen is understood as one of the main overused nutrients that are essential for plants. However, improper use of nitrogen fertilizers leads to major problems in both environmental health and human health (Ahmed *et al.*, 2017).

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Nitrogen is a component of chlorophyll, the green pigment of plants that stimulates photosynthesis. Nitrogen deficiency significantly reduces the growth and performance of cucumber. Phosphorus is essential for photosynthesis. A high level of available phosphorus throughout the root zone is essential for root growth and good use of water and other nutrients by plants (Schachtman *et al*., 1998). Potassium is more absorbed by plants than any other mineral element except nitrogen and in some cases calcium. Potassium helps some essential functions of plants such as protein production, photosynthesis, maintaining fruit quality and reducing diseases (Ramezani *et al.*, 2017). Cucumber plants require much more potassium than any other nutrient. It has been observed that potassium has the ability to improve the quality of cucumber fruits. Biological and non-biotic stress factors have a great effect on the production of this plant. In most parts of the country, farmers do not know about the appropriate levels of nitrogen, phosphorus and potassium fertilizers for cucumber cultivation. These facts show that there is a wide scope of increasing cucumber production with proper use of nitrogen, phosphorus and potassium fertilizers. The present experiment was conducted with the aim of investigating the effects of nitrogen, phosphorus and potassium on the growth and performance quality of cucumber in the Research Farm area of Takhar University.

II. MATERIALS AND METHODS

Experience site

The experiment was carried out in the research farm of Agriculture Faculty, Takhar University, during the period of March to May, 2024, under the title of the effect of different amounts of nitrogen, phosphorus and potassium chemical fertilizers on cucumber yield under the climatic conditions of Takhar province. The texture of the soil is sandy loam,with nitrogen is 0.082 percent, phosphorus available in the soil is 14.65 g/kg and potassium in the soil is 78.36 g/kg, the soil pH value is 8.2.

Experience Method

Cucumber cultivar Green crystal no-3 type of was used as the test variety. The experiment was conducted in the form of a Randomized complete block design (RCBD) including three replications with four treatments. The T_1 without fertilizer. The amount of nitrogen in this experiment was constant in all treatments except the control, 80 kg ha^{-1}. That is, treatment T_2 nitrogen fertilizer 80 kg ha^{-1}, phosphorus fertilizer 100 kg ha^{-1} and potassium fertilizer 85 kg ha^{-1}. T_3 nitrogen fertilizer 80 kg ha^{-1}, phosphorus fertilizer 120 kg ha^{-1} and potassium fertilizer 95 kg ha^{-1}. T_4 80 kg of nitrogen fertilizer ha^{-1}, 140 kg of phosphorus fertilizer ha^{-1} and 105 kg of potassium fertilizer ha^{-1}. The plot was 2 meters long and 1.5 meters wide. The land of the experiment was first plowed with a tractor and later it was smoothed and broken with a shovel.

Cucumber seedlings prepared in special seedling bags or Seed try, 30 days after seedlings were transferred to the main bed at sunset and planted with a distance between two plants of 50 cm and a distance between two rows of 60 cm. The number of plots in each plot was 11 and the gaps were filled again five days later. Fertilizer was added according to the recommended amounts in the ground, nitrogen fertilizer was divided into three parts, one part of which was mixed with all amount of phosphorus and potassium fertilizers before planting seedlings in the soil, the second dose of nitrogen one month after seedlings and the third dose it was applied in the yield stage. The first irrigation was done before planting seedlings and the second irrigation was done simultaneously after planting seedlings. Subsequent watering were done according to the needs of the plant and the heat of the day. Weed control was done three times by hand and spade. Super top was used to control insects and tiram was used to control fungal diseases on two occasions.

Data Collection

Information about fruit per plant, fruit length, fruit diameter, fruit weight, performance per plant and performance per hectare were recorded from 3 plants randomly selected from each plot. The cucumber plant produced fruit 48 days after planting seedlings, which was harvested every seven days.

Statistical Analysis

All the collected data were statistically analyzed using the statistical analysis system software package (SPSS version 22). Treatment means that had a significant difference were compared using Duncan's multiple range test (DMRT) at the 5% level.

III. RESULTS AND DISCUSSION

Fruit Length

Significant changes in cucumber fruit length were recorded for different levels of NPK fertilizer management practices. Table 1. The longest cucumber fruit was 19.39 cm in T_4 and the shortest fruit was 10.45 cm in T_1. T_3 16.81 cm and T_2 13.14 cm respectively. Jilani *et al.*, (2009) observed the maximum length of fruit with the use of 100 kg of nitrogen, 50 kg of phosphorus and 50 kg of potassium per hectare.

Table 1. Effect of different level of NPK on fruit Length (cm).

Treatments	50 DAS	57 DAS	64 DAS	71 DAS	78 DAS	85 DAS
T_1	9.41 d	10.78 d	10.38 d	10.35 d	10.95 d	10.86 d
T_2	11. 85 c	12.74 c	13.62 c	13.42 c	13.61 c	13.61 c

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T_3	15.97 b	16.30 b	17.06 b	17.46 b	17.10 b	16.98 b
T_4	18.02 a	18.78 a	20.22 a	20.11 a	19.69 a	19.55 a

Fruit Diameter

The diameter of cucumber fruit in cm was recorded from all treatments. The diameter of cucumber fruit was significantly affected by the application of different levels of NPK fertilizer. Table 2: The maximum diameter of cucumber fruit was 4.80 cm in T_4 with 80 kg of nitrogen fertilizer, 140 kg of phosphorus fertilizer and 105 kg of potassium fertilizer per hectare and then from that T_3 3.58 cm; T_2 was observed to be 2.76 cm. T_1 without using fertilizer was recorded with the smallest size, i.e. 2.01 cm. Zahid *et al*., (2021) observed the average diameter of cucumber fruit with nitrogen application of 55 kg ha_{-1}.

Table 2. Effect of different level of NPK on fruit diameter (cm).

Treatments	50 DAS	57 DAS	64 DAS	71 DAS	78 DAS	85 DAS
T_1	1.45 d	2.01 d	2.05 d	2.15 d	2.21 d	2.22 d
T_2	2.13 c	2.50 c	2.86 c	3.03 c	3.04 c	3.02 b
T_3	2.97 b	3.09 b	3.51 b	3.95 b	4.01 b	3.99 c
T_4	3.86 a	4.84 a	4.99 a	5.06 a	5.06 a	5.02 a

Fruit Weight

The weight of each cucumber fruit was significantly different with the application of different levels of NPK fertilizer. Table 3, the maximum fruit weight is 184.89 gr, in the T_4, nitrogen fertilizer is 80 kg ha^{-1}, phosphorus fertilizer is 140 kg ha^{-1}, and potassium fertilizer is 105 kg ha^{-1} and then T_3 162.41 gr; T_2 was observed 149.91 gr. The lowest weight of each fruit was 132.93 grams from T_1 (without fertilizer). Similar results were also reported by Mohammad *et al.*, (2021) on the average weight of cucumber fruit using 150 kg of nitrogen, 120 kg of phosphorus and 120 kg of potassium ha^{-1}.

Table 3. Effect of different level of NPK on fruit Weight (gr).

Treatments	50 DAS	57 DAS	64 DAS	71 DAS	78 DAS	85 DAS
T_1	130.54 c	135.84 d	130.5 c	140.45 d	132.58 d	127.67 d
T_2	145.59 bc	150.20 c	154.63 b	152.35 c	149.46 c	147.26 c
T_3	154.43 b	163.85 b	163.32 b	164.81 b	165.39 b	162.71 b
T_4	182.09 a	183.85 a	186.40 a	187.34 a	185.92 a	183.77 a

Fruit Weight per Plant

The use of different levels of NPK fertilizer showed a significant difference in the weight of the fruit per plant. The maximum fruit weight per plant was 2.86 kg in T_4 using 80 kg of nitrogen fertilizer per hectare, 140 kg of phosphorus fertilizer per hectare and 105 kg of potassium fertilizer per hectare, followed by T_3 2.22 kg, T_2 1.19 kg, that the lowest fruit weight per plant (1.0 kg) was obtained from the T_1 (without fertilizer) (Table 4). The significant response of the evaluated parameters was the number of fruits per plant, fruit weight per plant, fruit length and fruit diameter, and action. The applied NPK fertilizer may be a sign that the nutrients absorbed by the plant are well used. The synthesis of amino acids and the formation of energy are increased as a result of photosynthesis. Then the products of photosynthesis are transferred to the sink, because nitrogen is a component of chlorophyll, the green pigment of plants, which stimulates photosynthesis. Nitrogen deficiency significantly reduces the growth and performance of cucumber. El-Badawi (1994) and Lawal AB (2000). They reported the weight of cucumber fruit in the plant and the total performance of the chemical fertilizer used.

Table 4. Effect of different level of NPK on fruit Weight per plant (kg).

Treatments	50 DAS	57 DAS	64 DAS	71 DAS	78 DAS	85 DAS
T_1	0.99 c	1.04 c	1.01 c	1.06 c	1.01 c	0.91 c
T_2	1.08 c	1.24 c	1.21 c	1.33 c	1.24 c	1.06 c
T_3	1.73 b	2.11 b	2.36 b	2.52 b	2.52 b	2.1 b
T_4	2.37 a	2.56 a	2.94 a	3.14 a	3.24 a	2.94 a

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Fruit Yield per Hectare

The application of different levels of NPK fertilizer showed a significant difference in performance per hectare. Table 5: The highest performance per hectare was 61.37 tons in T_4 with nitrogen fertilizer 80 kg ha^{-1}, phosphorus fertilizer 140 kg ha^{-1} and potassium 105 kg ha^{-1}, followed by T_3 52.71 tons, T_2 46.55 tons. The lowest yield of 17.56 tons was obtained from T_1 (without fertilizer). Mohammad *et al.,* (2021) observed an average performance of 56.76 tons per hectare. Cucumber product with NPK ratio of 105: 140: 80 kg ha^{-1} had the highest performance. Jassal *et al.,* (1970) reported that increased performance of melons was beneficial due to higher levels of NPK application as they are primary plant nutrients. Arora and Siyag (1988) reported that in both seasons, N and P showed maximum fruit yield per hectare due to high nutritional power for plants.

Table 5. Effect of different level of NPK on yield per hectare (tons).

Treatments	50 DAS	57 DAS	64 DAS	71 DAS	78 DAS	85 DAS
T_1	16.31 c	17.24 c	17.69 c	18.23 c	18.03 c	17.87
T_2	34.67 b	43.75 b	48.51 b	50.89 b	51.73 b	49.77 b
T_3	46.11 a	52.04 a	56.12 a	55.77b	54.12 b	52.14 b
T_4	55.88 a	58.94 a	62.24 a	63.93 a	65.15 a	62.08 a

IV. CONCLUSION

The results showed that doses of nitrogen, phosphorus and potassium fertilizers had a positive effect on cucumber yield parameters such as fruit diameter, fruit length, weight per fruit, fruit weight per plant and yield per hectare. The results of the comparison of different parameters studied in this research showed that the best fruit weight per plant with the highest (2.86 kg) and the highest yield (61.37 tons per hectare) was observed in the treatment T_4. In this treatment, the amount of nitrogen was 80 kg ha^{-1}, phosphorus 140 kg ha^{-1} and potassium 105 kg ha^{-1}). Therefore, treatment T_4 (80 kg of nitrogen + 140 kg of phosphorus + 105 kg of potassium ha^{-1}) can be ordered as a suitable dose for farmers.

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