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GROWTH, YIELD AND QUALITY PERFORMANCE, NUTRITIONAL COMPOSITION AND THERAPEUTIC POTENTIAL OF CUCUMBER (CUCUMIS SATIVUS L.) OFF-SEASON PRODUCTION IN PLASTIC TUNNEL

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ABSTRACT
The study was aimed at enhancing yield and quality in terms of growth parameters using different doses of nitrogen supplementing nutritional composition and therapeutic potential of off-season cultivation of cucumber in plastic tunnels as a routine practice in certain areas of Pakistan. In this regard, study focused on improving the off-season production of Monaliza cucumber in plastic tunnels in D.I.Khan division using different split doses of nitrogen (N_2) with a constant amount of potassium (K) and phosphorus (P) with a purpose to enhance the cucumber yield and quality with the applications of various doses of nitrogen complementing nutritional and medicinal value by efficient management of N_2 fertilizers. Cucumber seedlings were transferred to the plastic tunnel on the 6th day of their germination. A 150Kg/ha dose of N_2 in the form of 2, 3, 4, and 5 equal split doses were applied along with a constant dose of 75 kg/ha of both P and K. The least days to flowering, fruit setting and fruit maturity were found with the application of four equal split doses of N_2. Similarly, the maximum number of fruits per plant, maximum fruit length and fruit weight were obtained by using four equal split doses of N_2. Moreover the maximum yield was also obtained with application of four equal split doses of N_2. The findings revealed that appropriate amount of N_2 in four equal split doses in a combination of P and K had a significant effect on all the yield and quality parameters of Monaliza cucumber having nutritional and medicinal values.

Keywords: Cucumber, fertilizer, yield, quality, nutritional, medicinal, plastic tunnel.

INTRODUCTION
Cucumber (*Cucumis sativus* L.) is an annual vine that grows along the ground or climb by means of simple tendrils. It is regarded as one of the most valuable vegetable used by human being [1]. Although it has low nutritional and calorie values but still is the basic source of multivitamins and essential elements [2]. It provides a reasonable amount of vitamin A and C when aids in spices [1,3,4]. Besides, it also contains fair amounts of potassium, calcium and folate [5,6]. Because of having a large amount of water and very little amount of calories, it is the food of choice for those facing the problems of body weight. Some people are quite sensitive and suffer from mild stomach problems when they use cucumber in its raw form instead of not soaking in vinegar. Its daily use is very significant for those suffering from blood pressure problems as there is a high amount of potassium

of more than 75mg/100 [7,8]. According to the report of National Cancer Institute, cucumber is one of those vegetables that protects against certain types of cancer [8]. Each and every community and society uses it in accordance to their own taste and requirements [1,10]. Fresh cucumbers are cut in the form of thin slices and used as salad, used as appetizers in pickled form or used in different forms for adding colour to food items [1,10,11]. For cucumber to grow, it needs about 75°F to 77°F at daytime and about 70°F at night. In this regard, different techniques are in use to maintain ideal temperature for its growth. Thus, plastic tunnels are used for in different parts of the world including Pakistan for extending the season and producing important vegetables of the summer season in the winter or early in the spring. This is called off season vegetable production technology or Season extension. For this purpose, Low, high and walk in tunnels are the famous structures commonly used in majority of the cases in the Pakistan. Most of the vegetables, especially cucurbits when cultivated and grown in safe and protected land give maximum results in terms of both quality and quantity [11] and that impact of community activities on cucumber variety and the choice of cultivar has been the deciding factor to a large extent [12]. Air temperature, humid hot conditions and plants cultivated very close to each other are the main factors that negatively influence the yield of cucumber.

On the other hand, intensity of light, use of proper fertilizers and some other agents were quite effective in aspects on the part of yield of cucumber. What is important from financial point of view is the cost on the structuring of protected cultivation, the running cost and availability of market to sell the yield. Therefore, such protected structures should be made which are of low cost, like that of greenhouses which have natural ventilations or those of walk-in-tunnels and plastic low tunnels. These structures very much suitable for a country like Pakistan both from economic and market point of view for the off-season production of cucurbits.

The greenhouses having natural ventilation very much suit the parthenocarpic cucumber to cultivate, and the fact that, walk-in-tunnels suit cultivating off-season melons. Plastic low tunnels are ideal for off-season production of summer squash, certain types of gourd, and all types of melons [13]. Hence, avoiding the negative and enhancing the positive parameters can improve the yield to a maximum extent [14]. Thus, here the main objective of this research work dealing production of off□season cucumber was to optimize conditions for those who grow vegetable to get maximum income and invest least.

MATERIAL AND METHODS

Experimental Site

All the experimental work and field study was done the onsite base of Agricultural Research Farm Dera Ismail Khan. The climate at the station is quite warm and humid with average annual rainfall of 316 mm. The soil is loom, not sandy and is frost-free.

Materials and designing

Monaliza hybrid variety of cucumber was used throughout the study. Cucumber seeds were grown and were then transferred to the plastic tunnel on 6^{th} days of their germination. The subplot consisted of total of 26 plants per row

Use of different doses of N_2

Plant to plant and bed-to-bed distance of 30 cm and 200 cm was maintained. Different N_2 doses were applied (Table-1) in equal splits along with a constant doze of P and K (75 kg/ha each). P and K were applied at the time of seedbed preparation. A negative control was also used where no N_2 was applied (Table-1). Proper watering, removing weeds and ploughing etc. were done throughout growth period cucumber.

Table 1: Use of different doses of N_2

Treatments	N_2 Application	N_2 Kg/ha
T1□Control	00	00
T2	2 equal split dozes	75:75
T3	3 equal split dozes	50:50:50
T4	4 equal split dozes	37.5:37.5:37.5:37.5
T5	5 equal split dozes	30:30:30:30:30

Growth Parameters

How many days the cucumber takes to make flowers, how many days it takes to set fruit, how many fruits are in a single plant, what is the weight of a fruit, how long a fruit is and how long a vine is, are the parameters considered for this study.

Fruit Yield and Quality:

Harvesting of cucumber fruit was done 2 times per week. Accordingly, numbers of flowers and fruits in one plant were noted. Moreover, how long a fruit is, how many grams is a fruit and what is the diameter of a fruit, were also noted.

Chemical Content:

To avoid any damage to fruit, a net of white colour was used on both side of the tunnel and Irrigation was done with trickle- irrigation technique [14]. The cost was compared with benefit, and many are invested in the beginning was also noted. Moreover, fixed costs and variable costs for producing cucumber were taken into consideration.

RESULTS:

The study addressed the issue of off□season production of cucumber in plastic tunnel in D.I.Khan division. The goal was to enhance the production of Monaliza cucumber variety by using the different doses of nitrogen with a fixed amount of P and K. In this respect, attempt was made to improve the cucumber yield and quality by efficient management of N_2 fertilizers, nutrient management of cucumber production under tunnels and in finding out efficient methods of nitrogen application.

Growth Parameters:

Days taken to flowering: The maximum days taken to flowering were found in T1, which was 46.33 and 45.67 days in 1st and 2nd Year respectively as reflected in Table 2, where no essential nutrients were provided. In contrast, the least 35.67 and 35.33 days in 1st and 2nd Year respectively taken to flowering were observed in T4□four split doses (Table 2). Almost the same results (Table 2) were found with treatments of N_2 in the form of 150kg/ha applied in the 2nd year of trials. These results showed that either no provision or inappropriate use of essential elements retarded the growth of the plant and hence resulted in quite longer days to flowering.

Table 2. Effect of different doses of N_2 on days taken to flowering, fruit setting, fruit maturity, No. of fruits/plant, fruit length, fruit weight, vine length and yield kg/ha

Treatment	N_2 kg/ ha	Days to flowering	Days to fruit setting	Days to fruit maturity	No. of fruit/ Plant	Fruit length	Fruit weight	Vine length	Yield
1st Year									
T1□control	0	46.33a	63.00a	76.33a	9.67d	12.17c	108.57e	151.33d	44567e
T2□two split doses	75□75	43.00ab	54.00b	63.67b	11.00c	16.33b	131.33c	229.67c	47840d
T3□three split doses	50□50□50	41.00bc	51.00bc	64.33b	11.33bc	16.47b	136.23b	275.00b	60825b

T4□four split doses	37.5□37.5□37.5□37.5	35.67d	43.33d	55.00c	13.33a	19.10a	141.1a	350.00a	63332a
T5□five split doses	30□30□30□30□30	38.00cd	48.67c	61.00bc	12.33ab	16.97b	127d	255.00b	58680c
LSD (P≤0.05)		4.30	3.02	7.15	1.06	1.689	4.12	20.27	1458.4
2nd Year									
T1□control	0	45.67a	66.00a	78.00a	9.67c	11.40c	109.67e	135.00d	30020b
T2□two split doses	75□75	41.00b	54.33b	65.67b	11.67b	13.67b	127.22d	187.00c	45367ab
T3□three split doses	50□50□50	39.00b	51.67c	92.00c	12.00ab	15.00ab	139.00b	259.00b	56620a
T4□four split doses	37.5□37.5□37.5□37.5	35.33c	47.33d	56.33d	13.00a	16.83a	141.77a	316.67a	59973a
T5□five split doses	30□30□30□30□30	35.33c	53.67bc	61.33c	11.00b	14.77b	131.87c	173.33c	56325a
LSD (P≤0.05)		3.31	2.29	2.85	1.19	1.84	1.87	30.44	18937

Days to fruit setting: A strong positive correlation was found between use of appropriate nutrients and the days took to fruit setting. Maximum days to fruit setting were observed 63 and 66 days during 1st and 2nd years of trial respectively in control, while, least number of days to fruit set was found by providing 150kg N_2/ha in four equal split doses (43.33 and 47.33 days) in 1st and 2nd years trials respectively as reflected in Table-2. This revealed the significant of appropriate and organized use of essential nutrients to Monaliza cucumber variety.

Days to fruit maturity: Least numbers of days (55 and 56.33 days) in 1st and 2nd years trials respectively noticed in Treatment T4 having 150 kg/ha in four equal split doses, while the highest numbers of days (76.33 and 78 days) during 1st and 2nd year trials respectively were taken by control, where no N_2 was applied. This again showed a positive correlation between days to maturity and use of N_2, indicating that proper use of N_2 fertilizer had a significant effect in bringing quickly organized fruit maturity to flowering and fruiting.

Likewise, close results to T4 were observed with the use of N_2 fertilizer in the form of 150kg/ha in 5 doses. Same treatments of N_2, P and K were applied with same other requirements for the 2nd year but no significant difference was found between the results of two years as reflected in Table-2.

Number of fruits per plant: To see the effect of different doses of N_2 on the number of fruits per plant, different doses of N_2, we found that the highest numbers of fruits/plants (13.33 and 13.0) in 1st and 2nd years of trials respectively, were obtained by using 150kg/ha of N_2 in four equal split doses, while the least number of fruits/plant (9.67 and 9.67) in 1st and 2nd years of trials respectively were obtained with control as reflected in Table-2.

Fruit length (cm)

Five different treatments of N_2 in two consecutive years were applied to see the effects of N_2 on the length of Monaliza fruit, with fixed amounts of both P and K of 150kg/ha. Maximum fruit length of 19.1cm and 16.83cm in 1st and 2nd years of trials respectively was found with 150kg/ha of N_2 in four equal split doses, while least fruit length was found with control as reflected in Table-2.

Although, the fruit lengths of the 2nd year were slightly less than its corresponding fruit lengths of the 1st year these were negligible.

Fruit Weight (g)

To what extent, nitrogen was positively affecting the fruit weight, different doses of N_2 were applied

in two equal doses for two consecutive years. We found that maximum fruit weight (141.1 and 141.77g) in 1st and 2nd years of trials respectively was obtained with 150kg/ha of N_2 in four equal split doses T4, while least fruit length was found with control as reflected in Table-2.

Vine length (m)

To know about the possible effects of varied amounts of N_2 utilization on the length of the vine of Monaliza cucumber variety, different doses N_2 were applied. Maximum vine length of 350 and 316.67 m in 1st and 2nd years of trials respectively was obtained with 150kg/ha of N_2 in four equal split doses T4, while least fruit length was found with control as reflected in Table-2.

Yield (kg ha^{-1})

Maximum yield of fruit of Monaliza cucumber (63332 and 59973 kg/ha) in 1st and 2nd years of trials respectively was obtained with 150kg/ha of N_2 in four equal split doses T4 in was obtained with application of 150kg/ha of N_2 in four equal split doses of treatment T4**.** The control produced the least amount of fruit both in the 1st and 2nd year of trials as reflected in Table-2.

Table-3: Nutritional Compositions of Cucumber

Nutrients	**Composition (%)**
Copper	4%
Vitamin C	4%
Biotin	3%
Vitamin B1	3%
Potassium	3%
Magnesium	3%
Vitamin K	19%
Molybdenum	12%
Manganese	3%
Pantothenic acid	5%

Perusal of Table-3 revealed the nutritional compositions i.e Copper (4%), Vitamin C (4%), Biotin (3%), Vitamin B1 (3%), Potassium (3%), Magnesium (3%), Vitamin K (19), Molybdenum (12%), Manganese (3%) and Pantothenic acid (5%).

Nutritional Value and Therapeutic Potential of Cucumbers

Cucumbers are a highly nutritious food that contains many bioactive substances [25]. They are used in various ways, including for medicinal purposes, beauty care, and insect control. Cucumbers are popular for their many biotic activities, such as free-radical scavenging, antitumor, anti-swelling, and germicidal effects, as well as their capability to regulate glucose levels in the blood, promote dieresis, and provide pain relief [24]. Fermented cucumbers, on the other hand, are a great source of fiber and pro-biotic. Cucumber exhibits various medicinal properties like antimicrobial activity, glycemic lowering ability, antioxidant ability, etc., and is traditionally used in various treatments. This vegetable is very high in water content and very low in calories. It has potential of antibacterial, anti-diabetic, lipid lowering and antioxidant activity [26]. Cucumber has a cleansing action within the body by removing accumulated pockets of old waste materials and chemical toxins. Fresh fruit juice is used for nourishing the skin. It gives a soothing effect against skin irritations and reduces swelling. Cucumber also has the power to relax and alleviate the sunburn's pain. The fruit is refrigerant, haemostatic, tonic and useful in hyperdipsia, thermoplegia etc.

DISCUSSION

Uses of low cost low tunnels are now routinely used in Pakistan to grow off-season vegetables [15,16]. We here were interested in enhancing the production of Monaliza cucumber variety by using

the different doses of N_2 with a fixed amount of P and K. We also were interested in improving the cucumber yield and quality by efficient management of N_2 fertilizers, nutrient management of cucumber production under tunnels and to find out the efficient methods of nitrogen application. The amount of fertilizer to be used is of great significance for days taken to flowering [17]. We also showed that appropriate level and amount of fertilizer was the key for days taken to flowering. Improper use of principal nutrients adversely affected the plant growth and thus resulted in taking a large number of days to flowering.

We also found a strong positive correlation between use of appropriate nutrients (150kg/ha of N_2 in four equal split doses with constant 75kg/ha of both P & K) and the days taken to fruit set, showing the significance and importance of the appropriate and organized use of essential nutrients to Monaliza cucumber variety. Moreover, study showed that proper use of N_2 fertilizer 150kg/ha of N_2 in four equal split doses with constant 75kg/ha of both P & K had a significant effect in bringing quickly organized maturity to flowering and fruiting. Stunting of growth of plants occurred because of the insufficient provision of nutrients that resulted in prolonging the duration of fruit setting.

To get the mature fruit of cucumber soon, the smallest number of taken to fruit maturity are very important [18]. Nutrients in balanced mode are necessary for growing cucumber in a speedy fashion and thus result in increasing the number of fruits per plant [19]. It was comparatively found that application of 150kg/ha of N_2 in four equal doses with constant 75kg/ha of both P & K gave the maximum number of fruits. Increasing the NPK fertilizer application to a certain level increased the fruit length but beyond that level, it started decreasing, which revealed that the excess of fertilizer application had an adverse effect on fruit length [6, 20, 21].

We observed that maximum fruit length was obtained with 150kg/ha of N_2 in four equal doses and the application of N beyond that level, did not affect the fruit length to much extent.

An increase in N level the fruit weight also started increasing gradually [21, 22, 23]. Results revealed that maximum fruit weight was obtained with 150kg/ha of N_2 in four equal split doses alongwith application of both P and K in a constant amount of 75kg/ha. Regarding the possible effects of varied amounts of nitrogen utilization on the length of the vine of Monaliza cucumber variety, we found that the maximum vine length was produced by using 150kg/ha of N_2 in four equal split doses. Similarly, the maximum yield of fruit in Monaliza cucumber was obtained with application of 150kg/ha of N_2 in four equal split doses.

It is believed that regular intake or application on skin helps in reducing the ageing effect, boosting metabolism, and improving immunity. Cucumber is found a popular vegetable crop used in traditional medicine since ancient times. Cucumbers can help prevent diabetes and hypertension, treat Alzheimer's disease, prevent cancer, and helps in slowing down the aging process.

CONCLUSION

Application of 150kg/ha of N_2 in four equal split doses of treatment T4 with the application of constant doses of 75kg/ha of both P and K produced the maximum yield and improved quality of Monaliza cucumber variety in terms of a number of fruits, fruit weight, fruit length, and least number days to maturity and fruit setting. The study complements the nutritional composition and therapeutic potential of cucumber.

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