IMPROVING THE CUCUMBER (CUCUMIS SATIVUS L.) OFF-SEASON PRODUCTION USING SPLIT DOSES OF NITROGEN IN PLASTIC TUNNEL

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ABSTRACT*: Off-season cultivation of cucumber in plastic tunnels is now a routine practice in certain areas of Pakistan. We here focussed on enhancing 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). We wanted to improve the cucumber yield and quality 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 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 to maturity were found with the application of 4 equal split doses of N_2. Similarly, the maximum number of fruits per plant, maximum fruit length and fruit weight were obtained by using 4 equal split doses of N_2. Moreover the maximum yield was also obtained with application of 4 equal split doses of N_2. We showed that appropriate amount of N_2 in 4 equal split doses in a combination of P and K had a significant effect on all the parameters of Monaliza cucumber.*

Keywords: Cucumber, Fertilizer, Plastic tunnel. Yield

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 6th 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 N2 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	N2 Application	N_2 Kg/ha
T1−control	00	00
T2	2 split dozes	75:75
T3	3 split dozes	50:50:50
T4	4 split dozes	38:38:38:38
T5	5 split dozes	30:30:30:30:30

Research 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

We address the issue of off−season production of cucumber in plastic tunnel in D.I.Khan division. Our 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. We were interested in improving 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.

Days taken to flowering: The maximum days taken to flowering were found in T1, the control (48.20 days) (Table 2) where no essential nutrients were provided. In contrast, the least (35.35) days 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 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, maturity, No. of fruits/plant, fruit length, fruit weight, vine length and yield/ha

Treatment	N2 kg/ ha	Days to flowering	Days to fruit setting	Days to maturity	No. of fruit/ lant	Fruit length	Fruit weight	Vine length	Yield
1st Year									
T1−control	0	48.20	18	46.38	22	12.00	105.6	1.60	44.0
T2−two split doses	75−75	44.40	12.80	43.0	32	16.50	129.0	2.4	49.2
T3−three split doses	50−50−50	40.46	11.70	42.15	33	17.50	136.7	3.5	62.1
T4−four split doses	38−38−38−38	35.35	10. 30	37.51	42	19.00	141.5	3.8	64.3
T5−five split doses	30−30−30−30−30	40.15	10.80	39.75	38	18.00	135.2	2.6	60.3
2nd Year									
T6−control	0	47.5	18	46.2	21	11.7	106.4	1.50	43.5
T7−two split doses	75−75	44.0	12.20	42.3	34	15.2	127.7	2.60	47.6
T8−three split doses	50−50−50	39.50	11.00	39.00	40	16.7	138.3	3.0	58.0
T9−four split doses	38−38−38−38	34.70	10.0	37.30	43	18.5	142.6	3.90	63.5
T10−five split doses	30−30−30−30−30	38.60	10.40	40.50	42	16.4	136.2	3.50	57.6

Days to fruit setting: A strong positive correlation was found between use of appropriate nutrients and the days took to fruit setting (**Table 2**). Maximum days to fruit setting were observed in control with 18 days, while, least number of days to fruit set was found by providing 38kg N_2/ha in 4 doses (10.30 days) that proved to be ideal in our case (**Table 2**). The same treatments were applied for the 2nd year with the same conditions that were set for the 1st year (**Table 2**). Again, the use of 38kg N_2/ha in 4 split doses was most suitable treatment.

***Days to maturity*:** We found that least numbers of days (37.51) were taken by using of 38kg N_2/ha in 4 doses (**Table 2**), while the highest numbers of days (46.38 days) 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 maturity to flowering and fruiting. Likewise, close results to T4 were

observed with the use of N2 fertilizer in the form of 30kg/ha in 5 doses (**Table 2**). 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 (**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 (**Table 2**), we found that the highest numbers of fruits (42 fruits/plant) were obtained by using 38kg/ha of N_2 in 4 doses, followed by 30kg/ha in 5 doses (38fruits/plant), while the least number of fruits were obtained with control (**Table 2**). Almost similar results were obtained in the 2nd year of trials (**Table 2**).

Fruit length (cm)

Five different treatments of N_2 (**Table 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 75kg/ha. Maximum fruit length of 19cm was found with 38kg/ha of N_2 in 4 doses, while least fruit length was found with control (**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 (**Table 2**). We found that maximum fruit weight was obtained with 38kg/ha of N_2 in 4 doses both in the 1st year (141.5g) and in the 2nd year (142.6g) (**Table 2**). The nearest results to the maximum were obtained with 30kg/ha of N_2 in 5doses, showing the importance and significance of N_2 for the healthy fruit weight to produce.

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 (**Table 2**) were applied. Maximum vine length of 3.9cm (**Table 2**) was produced by applying 38kg/ha of N_2 in 4 doses both in the 1st and 2nd year, followed by 30kg/ha in 5 doses. The least vine length was found in control (**Table 2**) where no N_2 was applied.

Yield (tons ha-1)

Maximum yield of fruit in Monaliza cucumber was obtained with application of 38kg/ha of N_2 in 4 doses (**Table 2**), followed by 50kg/ha in 3 doses. The control produced the least amount of fruit both in the 1st and 2nd year of trials.

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 (38kg/ha of N_2 in 4 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, we showed that proper use of N2 fertilizer 38kg/ha of N_2 in 4 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]. We comparatively found that application of 38kg/ha of N_2 in 4 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 38kg/ha of N_2 in 4 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]. We found that maximum fruit weight was obtained with 38kg/ha of N_2 in 4 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 38kg/ha of N_2 in 4 doses. Similarly, the maximum yield of fruit in Monaliza cucumber was obtained with application of 38kg/ha of N_2 in 4 doses.

CONCLUSION

Application of 38kg/ha of N_2 in 4 doses with the application of constant doses of 75kg/ha of both P and K produced the maximum yield of Monaliza cucumber variety in terms of a number of fruits, fruit weight, fruit length, and least number days to maturity and fruit setting.

CONFLICT OF INTEREST

All the authors do not have any conflict of interest

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