Original Research Article

Effect of Inter-cultivation and Physical Barriers on Growth, Yield and Disease occurrence in Zucchini (*Cucurbita pepo L.)*

ABSTRACT

The experiment entitled "Effect of Inter-cultivation and Physical Barriers on Growth, Yield and Disease occurrence in Zucchini (*Cucurbita pepo L*.)" was performed in the Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, during the month January-March, 2022. The trial was laid out in Randomized Block Design(RBD) replicated thrice with seven treatments. During the experiment, observations for plant height, number of leaves, number of nodes, days to initiation of first male flower and first female flower, total number of staminate and pistillate flowers, number of fruits per plant, weight of fruits,total yield etc were recorded. In addition to assess the profitability of treatments, cost of cultivation,net return, gross return and benefit-cost ratio was also worked out. The experimental findings revealed that the zucchini performance was significantly influenced by inter-cultivation and physical barriers. Among seven treatments, T4 Zucchini + Aluminium foil (On the ridge) was found to be the best with respect to growth, flowering characters, total yield (7.49 t ha^{-1}), net return (Rs 288,290) and benefit cost ratio (4.34).

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Keywords: *inter-cultivation, physical barriers, mulch, green net , zucchini, Cucurbita pepo, marigold, yield*

1. INTRODUCTION

Among the vegetables, cucurbits constitute one of the largest groups with their wide adaptation from arid climates to the humid tropics. Important genera of this family are *Lagenaria, Momordica, Luffa, Cucurbita pepo, Cucumis* and *Citrullus*. Zucchini is the earliest summer vegetable to appear in the vegetable market. Usually it is consumed at a young immature stage before skin becomes hard and tough. The flesh is grinded finely and is mild in flavour. Zucchini has its origin in America and is available in the market in yellow, light green or dark green colours. Zucchini is also called as "Courgette", fully grown courgette is known as "Marrow". Like other crops of cucurbits the production of zucchini is also hampered due to various abiotic and biotic stresses and thus posing a threat to its cultivation. Amongst different biotic stresses, viral infections are responsible for causing great losses to this crop(**Sharma *et.al*.,2013**).And since the use of insecticides is harmful for humans and the environment in the long run, the most effective and environment friendly management would be the adoption of inter-cultivation with the trap crops and physical barriers. Keeping in the view the present scenario of growing importance of this crop, the present study has been undertaken to workout suitable treatment for optimizing production of zucchini.

2. MATERIALS AND METHODS

The present investigation entitled "**Effect of Inter-cultivation and Physical barriers on growth, yield and disease occurrence in Zucchini**" was conducted at Vegetable Research Farm, Department of Horticulture, Naini Agriculture Institute, Sam Higgginbottom University of Agriculture, Technology & Sciences, Prayagraj (U.P.) during January-March 2022.The design of treatment was randomised block design (RBD) with seven different treatments and three rows. (T0) Zucchini (control), (T1) Zucchini + Marigold (1:2)(On the edges of the ridge , (T2) Zucchini + Marigold (1:3) (Around the zucchini plants) , (T3)Zucchini + Aluminium foil (Around the plant), (T4) Zucchini + Aluminium foil (On the ridge), (T5)- Zucchini + Green net, (T6) Zucchini + Application of neem oil. Data was collected on the basis of different parameters like number of leaves, height of plant (in cm), number of nodes, total number of staminate

flowers, total number of pistillate flowers, sex ratio(male:female ratio),number of fruits per plant, length of fruit (in cm), diameter of fruit (in mm), weight of fruits per plant (in kg), weight of fruits per plot(in kg) and total yield of fruits per hectare (t/ha). Statistical analysis of variance was performed on the data collected throughout the experiment. The significance of the treatments was determined using the 'F' test at a level of significance of 5%.

3. RESULTS AND DISCUSSION

3.1 Growth Parameters

The data on growth parameters in different treatment combinations was recorded (Table 1). The maximum plant height was recorded in T4 Zucchini + Aluminium foil (On the ridge) (38.33 cm at 30 DAS, 49.75 cm AT 45 DAS and 62.75 cm at 60 DAS) being significantly superior while minimum to the T0 control (25.75 cm at 30 DAS, 34.67 cm at 45 DAS an 49.75 cm at 60DAS). Noticeable height increases observed with aluminium foil mulch application was because of ability to retain moisture and keep soil wet which enhanced better water use efficiency by seedlings. Mulching in general has a positive effect on height, leaf numbers and size, shoot diameter and dry matter. Water is essential for plant development. The leaves help plants suck up water and dissolved nutrients from the soil to support the plant's growth. Such information on plant height was also available from the studies of Abd-El- Gaid, Parmer et al. (2013) and Dadeech et al.

The maximum number of nodes was observed in T4 Zucchini + Aluminium foil (On the ridge) (21.08) and the minimum number of nodes was in T0 control (14.75). Number of nodes are the contributors of yield as they bear the leaves, which fix the carbon dioxide through photosynthetic mechanism. As far as zucchini is concerned, the leaf production is an important phenomenon especially for all the developing fruits. The results were in concurrence with the earlier findings of Rodriguez et al. (2018) and Dadeech et al.

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The maximum number of leaves per plant was observed in treatment T4 Zucchini + Aluminium foil (On the ridge) i.e., (19.58) and the minimum was observed in T0 control (14.25). This may be attributed to the prevailing favourable climate which helped the plants in better utilization of solar radiation, nutrients and water for the synthesis of photosynthates and the prevailing temperature might have helped in faster multiplication of cells and cellular elongation resulting in better growth of roots and shoots, which helped better vegetative growth including number of leaves. Reflective mulches like aluminium foil utilize the entire light spectrum, thereby boosting the available amount of light and heat to plants resulting in vegetative growth and higher yields. The results were in concurrence with the earlier findings of Rodriguez et al. (2018) and Dadeech et al.

The minimum number of days taken to initiation of first staminate flower was observed in T4 Zucchini + Aluminium foil (On the ridge) (39.00) and the maximum number of days was taken by T5 Zucchini + Green net (43.25). And the maximum number of days taken to initiation of first pistillate flower was observed in T5 Zucchini + Green net (50.00) and the minimum number of days was taken by T4 (44.83). Days taken to initiation of first staminate and pistillate flowers is more in T5 Zucchini + Green net because 50% shading green net was used due to which light availability to the plants might have reduced. Whereas during flowering time more light is required. The above results are in close conformity with Patil and Patil (2000) in cucumber and Umamaheshrappa et al. (2005) in cucumber.

The maximum number of statminate flowers was observed in T4 Zucchini + Aluminium foil (On the ridge) (8.58) and the minimum number of staminate flowers was observed in T5 Zucchini + Green net (6.08). The maximum number of pistillate flowers was observed in T4 Zucchini + Aluminium foil (On the ridge) (13.00) and the minimum number of pistillate flowers was observed in T5 Zucchini + Green net (6.92). The total number of staminate and pistillate flowers were more might be because of the aluminium foil which acted as a mulch and might have reduced the leaching down of the nutrients thereby enhancing the proper nutrient availability to the plants which might have resulted in better vegetative growth, followed by early flowering and a greater number of flowers. The results are in concurrence with earlier findings of Hamid et al. (2002) and Umamaheshrappa et al. (2005).

3.2 Yield Parameters

The maximum number of fruits per plant was observed in T4 Zucchini + Aluminium foil (On the ridge) (5.33) and the minimum number of fruits per plant was observed in T5 Zucchini + Green net (2.58). The higher number of fruits observed in case of T4 Zucchini + Aluminium foil (On the ridge) might be due to pollination and reflective nature of aluminium foil mulch to reflect back the ultraviolet rays into the plant canopy, thereby providing sunlight for the shady underside of the leaves which in turn enhances the photosynthetic process. Less number of fruits were observed in T5 Zucchini + Green net might be because of the green net which acted as a barrier not only for harmful pests but also for beneficial insects such as honey bee, butterflies etc due to which pollination could not take place which may have resulted in less fruits with small shapes. This was an agreement to the findings of Resende and Floria (2003) in cucumber, Narke et al. (2015) in zucchini and Hem Lata et al. (2017) in Zucchini.

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The maximum fruit weight per plant (in kg)was recorded in treatment T4 Zucchini + Aluminium foil (On the ridge) (0.749 kg) whereas, the minimum fruit weight per plant (in kg) was recorded in T5 Zucchini + Green net (0.454 kg). The maximum fruit weight per plant might be due to the increased growth and flower attributes which in turn lead to the increased photosynthetic activity and accumulation of photosynthates and dry matter production. The results are in close conformity with the findings of Resende and Floria (2003) in cucumber and Rodriguez et al. (2007).

The maximum weight of fruits per plot (in kg) was recorded in treatment T4 Zucchini + Aluminium foil (On the ridge) (1.99 kg) whereas, the minimum weight of fruits per plot (in kg) was recorded in treatment T5 Zucchini + Green net (0.34 kg). The maximum weight of fruits per plot (in kg) in T4 Zucchini + Aluminium foil (On the ridge) might be due to increased yield per plant (in kg).The results are in close conformity with the findings of Czinsky et al. (2001), Brown et al. (2001), Yoltas et al. (2003), Resende and Floria (2003) in cucumber and Rodriguez et al. (2007).

The maximum yield per hectare was recorded in T4 Zucchini + Aluminium foil (On the ridge) (7.49 t/ha) which was significantly superior whereas, the minimum yield per hectare was recorded in T5 Zucchini + Green net (4.54 t/ha). This might be due to the plant population, maximum number of fruits per plant, fruit weight, environmental factors and congenial microclimate in T4 Zucchini + Aluminium foil (On the ridge) as compared to other treatments. These findings are in close conformity with Kanawar *et at.* (1993) in squash melon, Eifediyi and Remison (2010) in cucumber, Kolekar *et al.* (2013) in watermelon, Ngetich *et al.* (2013) and Karde (2014) in zucchini, Maluki *et al.* (2016) in watermelon Narke *et al.* (2015) in zucchini, and Lata *et. al.* (2017) in zucchini.

The maximum length of fruits was recorded in T4 Zucchini + Aluminium foil (On the ridge) (17.88 cm) whereas, the minimum length of fruits was recorded in T5 Zucchini + Green net (9.83 cm). The maximum fruit length in treatment T4 Zucchini + Aluminium foil (On the ridge) was might due to the availability of higher levels of nitrogen. The minimum fruit length in treatment T5 Zucchini + Green net was might be due to poor pollination caused by the green net which acted as a barrier for the pollinators and which resulted in small and oddly shapes of the fruits. Similar results were reported by Resende and Floria (2003) in cucumber, Narke et al. (2015) in cucumber and Lata et al. (2017) in Zucchini.

The maximum diamter of fruit was recorded in T4 Zucchini + Aluminium foil (On the ridge) (71.50 mm) whereas, the minimum diamter of fruit was recorded in T5 Zucchini + Green net (43.00 mm). The maximum fruit diameter in treatment T4 Zucchini + Aluminium foil (On the ridge) was might due to the light intensity which might have affected the cell division and cell expansion of the fruits. The results were in concurrence with the findings of Resende et al. (2002).

The disease incidence (%) was maximum in T0 (30.08) and minimum in T4 Zucchini + Aluminium foil (On the ridge) (18.33). The maximum disease incidence in treatment T0 might due to absence of trap crops such as marigold and physical barriers. The minimum disease incidence in treatment T4 Zucchini + Aluminium foil (On the ridge) might be due to the aluminium foil mulch which was placed on the ridges. Alumninum foil being reflective in nature is great at keeping leaf sucking and chewing insects like aphids, whiteflies etc away from the main crop by confusing insects' ability to locate their hosts.Similar results were reported by Moura et al. (2001), Boyhan and Brown (2002), Gungoosingh (2002), Walters et al. (2003) and Smith (2009).

Table 1. Effect of Inter-cultivation and Physical barriers on growth traits in Zucchini

Treatments	Treatment combinations	Plant height (cm)			No of nodes	No of leaves per plant	Days to initiation of first staminate flower	Days to initiation of first pistillate flower	Total number of staminate flowers	Total number of pistillate flowers
		30 DAS	45 DAS	60 DAS						
T_0	Control	25.75	34.67	49.75	14.75	14.25	42.42	49.08	7.67	9.17
T_1	Zucchini + Marigold (1:2)	30.08	45.58	53.17	18.67	17.58	38.50	45.90	7.83	11.83
T_2	Zucchini + Marigold (1:3)	37.50	48.92	54.83	18.83	18.17	39.33	48.75	7.92	12.58
T_3	Zucchini + Aluminium foil (Around the plant only)	32.42	46.00	54.42	17.92	14.92	39.50	45.92	7.83	12.42
T_4	Zucchini + Aluminium foil (On the ridge)	38.33	49.75	62.75	21.08	19.58	39.00	44.83	8.58	13.00
T_5	Zucchini + Green net	28.58	38.17	57.92	18.00	16.00	43.25	50.00	6.08	6.92
T_6	Zucchini + neem oil	35.08	41.00	50.33	17.75	16.83	42.40	46.17	6.25	10.08
F- test		NS	S	S	S	S	S	S	S	S
S. Ed. (±)		25.279	2.378	2.161	0.797	0.797	1.242	0.948	0.309	1.523
C. D. (P = 0.05)		52.176	4.908	4.460	1.645	1.645	2.563	1.957	0.637	3.143

Table 2. Effect of Inter-cultivation and Physical barriers on yield traits in Zucchini

Treatments	Treatment combinations	Number of fruits per plant	Weight of fruits per plant (kg)	Weight of fruits per plot (kg)	Total fruit yield (t/ha)	Fruit length (cm)	Fruit diameter (cm)
T_0	Control	2.91	0.507	0.91	5.07	14.73	48.25
T_1	Zucchini + Marigold (1:2)	3.66	0.574	1.31	5.74	14.06	45.25
T_2	Zucchini + Marigold (1:3)	5.16	0.585	1.83	5.85	16.05	66.53
T_3	Zucchini + Aluminium foil (Around the plant only)	3.99	0.509	1.29	5.09	11.80	57.75
T_4	Zucchini + Aluminium foil (On the ridge)	5.33	0.749	1.99	7.49	17.88	71.50
T_5	Zucchini + Green net	2.58	0.454	0.34	4.54	9.83	43.00
T_6	Zucchini + neem oil	3.08	0.527	0.86	5.27	11.15	62.75
F- test		S	S	S	S	S	S
S. Ed. (±)		0.725	0.064	0.312	0.642	1.469	1.877
C. D. (P = 0.05)		1.497	0.133	0.643	1.326	3.033	3.875

Table 3. Disease Incidence in Zucchini

Treatments		**Disease Incidence (%) At 60 DAS**
T_0	Control	30.08

T_1	Zucchini + Marigold (1:2)	23.26
T_2	Zucchini + Marigold (1:3)	21.05
T_3	Zucchini + Aluminium foil (Around the plant only)	20.12
T_4	Zucchini + Aluminium foil (On the ridge)	18.33
T_5	Zucchini + Green net	24.66
T_6	Zucchini + Neem oil	28.41
F- test		S
S. Ed. (±)		0.792
C. D. (P = 0.05)		1.645

CONCLUSION

From the present investigation it was concluded that T4 Zucchini + Aluminium foil (On the ridge) was found to be superior in terms of plant height, number of nodes, number of leaves, days to initiation of first staminate flower and pistillate flower, total number of staminate and pistillate flowers, number of fruits per plant, fruit weight, fruit length and fruit diameter.Among all the treatments, T4 Zucchini + Aluminium foil (On the ridge) was found to be suitable for controlling pest and disease attack. In this overall investigation from all the 7 treatments the treatment T4 Zucchini + Aluminium foil (On the ridge) was found suitable for cultivation for better yield per hectare (t/ha).

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