Original Research Article

Effect of TA41 on growth, yield and fruit quality of Hybrid Cucumber (*Cucumis sativus* L.) under protected condition.

ABSTRACT

Protected cultivation involves growing crops under physical protection to reduce abiotic and biotic stresses even under adverse climates by using suitable protective devices and structures. A field experiment was carried out during March to May 2022 at Horticulture Research Field in the Department of Horticulture, Naini Agricultural Institutes, Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj (U.P.) India. The experiment was entitled as "Effect of TA41 on growth, yield and fruit quality of hybrid cucumber (*Cucumis sativus* L.) under protected condition" with randomized block design (RBD) with three replications and ten treatments. The experiment results revealed that hybrid cucumber performed extremely well under protected condition with respect to growth, earliness, yield and quality parameters. While taking the observation it was seen that in growth parameters, earliness and yield parameters, highest values were recorded significantly maximum in treatment T_8: Soil drenching of TA41 @ 25 ml/lt + Foliar spray of TA41 @ 45 ml/lt while comparing the qualitative parameters the highest values were recorded significantly maximum in treatment T_4: Soil drenching of TA41 @ 15 ml/lt + Foliar spray of TA41 @ 25 ml/lt. The benefit:cost ratio was obtained highest in treatment T_4 (3.53). Besides, this hybrid also proved to be the best in terms of disease resistance and profitability.

***Keywords*:** Benefit cost ratio, Earliness, Fruit quality, Growth, PGR (TA41), Yield.

INTRODUCTION

India grows a variety of vegetables including cucurbits like cucumber, pumpkin and gourds. These vegetables are commonly grown and play an important role in India's farming. They make up a big part of the vegetable production in India about 18%. In fact, India produces about 6.5 million tons of cucurbits which is the highest in South Asia. Though authentic statistical records of area, production and productivity of Cucumber are not available but in the year 2019 India produced approximately 20.3 million tons of cucumbers making it the second-highest producer of cucumbers globally just behind China (FAO, 2019).

The Cucumber (*Cucumis sativus* L.) belongs to the family Cucurbitaceae is an annual plant species and is found to be day neutral. Basically, it is monoecious, trailing or climbing vine with angled hirsute or rough stems. They contain 0.4% protein, 2.5% carbohydrates, 1.5mg iron and 2mg of vitamin C per 100g fresh weight. Cucumber had its origin as well as

domestication in India and spread to other parts of the world. Today it has become the fourth important vegetable in the world after tomato, cabbage and onion.

Trichoderma species use different mechanisms for pathogen inhibition, such as mycoparasitism via hydrolytic enzyme secretion, antibiosis via secondary metabolite production, competition for space and nutrients, promoting plant growth, and inducing plant systemic resistance mechanisms (*Chao et al., 2019*). Trichoderma spp. are effective biocontrol agents due to the rapid multiplication or the tolerance of harsh conditions (*Tapwal et al., 2016*). Trichoderma spp. have potent antagonism and mycoparasitic actions on plant pathogens, allowing them to reduce the incidence of plant diseases, and the main mechanism for Trichoderma species is hyper parasitism (*Kredics et al., 2018, Halifu et al., 2020*). The Trichoderma colonization of roots causes root hair growth and triggers defence activities, such as significant changes in a variety of metabolic pathways and the activation of genes involved in plant host defines, primarily through signalling pathways involving jasmonic acid and ethylene (*Contreras-Cornejo et al., 2015*).

Using plant growth regulators can be a great way to improve crop production and increase the number of crops grown. These regulators are substances that can be applied to plants to help them grow faster, stronger and produce more fruit or vegetables. Applying plant growth regulators on plants externally can alter the natural growth and development of plants. This means that farmers can use plant growth regulators to manipulate the physiological processes of plants which can potentially increase their crop yield and better crop quality.

Materials and Methods

The experiment was conducted in the Horticulture Research Field, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj (U.P.) during March to May 2022. The experiment was conducted on hybrid cucumber (*Cucumis sativus* L.) var. Gurka F1 under protected condition with ten treatments including control (Table 1) and three replications in randomized block design under protected condition. Five plants were randomly selected per treatment for recording the observations. Statistical analysis was done by using method of analysis of variance (ANOVA) by Fischer and Yates (1963).

Table – 1 TREATMENT DETAILS OF DIFFERENT CONCENTERATIONS & METHOD TO APPLY PGR (TA41) ON CUCUMBER.

Treatment	Treatment Combination
T_0 (control)	Without any treatment of TA41.
T_1	Soil drenching of TA41 @ 10 ml/lt.
T_2	Soil drenching of TA41 @ 10 ml/lt. + Foliar spray of TA41 @ 5 ml/lt.
T_3	Soil drenching of TA41 @ 15 ml/lt.
T_4	Soil drenching of TA41 @ 15 ml/lt. + Foliar spray of TA41 @ 25 ml/lt.
T_5	Soil drenching of TA41 @ 20 ml/lt.
T_6	Soil drenching of TA41 @ 20 ml/lt. + Foliar spray of TA41 @ 35 ml/lt.
T_7	Soil drenching of TA41 @ 25 ml/lt.
T_8	Soil drenching of TA41 @ 25 ml/lt. + Foliar spray of TA41 @ 45 ml/lt.
T_9	Foliar spray of TA41 @ 15 ml/lt.

Results and Discussion

The present investigation entitled "Effect of TA41 on growth, yield and fruit quality of hybrid cucumber (*Cucumis sativus* L.) var. Gurka F1 under protected condition" was carried out during March to May 2022 at Horticulture Research Field in the Department of Horticulture, Naini Agricultural Institutes, Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj (U.P.) India.

Growth Parameters:

Growth parameters play a vital role in vegetable crops by providing insights into crop performance, developmental stages, environmental responses, comparative studies and modelling. By studying these parameters, researchers can enhance crop productivity, optimize cultivation practices and contribute to the development of sustainable and efficient vegetable production systems.

Growth parameters such as plant height and number of nodes were observed.

The application of TA41 shows significantly increased plant height and number of nodes in cucumber. These parameters were recorded maximum in treatment T_8: Soil drenching of TA41 @ 25 ml/lt. + Foliar spray of TA41 @ 45 ml/lt. which is 103.97 cm & 21.13 respectively while treatment T_0 (control) shows the minimum plant height and number of nodes which is 91.57 cm & 18.33 respectively.

This might be due to the fact that Soil drenching of TA41 @ 25 ml/lt. + Foliar spray of TA41 @ 45 ml/lt. act as a nutrilink to plants increasing hormonal concentration, nutritional condition, enzyme activation and these may have contributed to a considerable extent for better plant height and number of nodes. Similar results were also reported by ***Saptari RT et al., 2013*** who reported that TA41 can promote the activity of xyloglucan endotransglucosylase which cause loosening of cell wall and increases cell permeability.

Earliness Parameters:

Earliness parameters play a crucial role in vegetable crops as they directly affect the timing of crop development, maturity and harvest. These parameters are especially important in commercial vegetable production where timely and consistent harvests are essential for maximizing yields and meeting market demands.

Earliness Parameters such as days to first flowering, node number bearing first female flower, days to first fruit setting, days to first fruit picking were observed.

The application of TA41 have significantly reduced the days to first flowering, node number bearing first female flower, days to first fruit setting and days to first fruit picking. Above parameters were recorded maximum in treatment T_0 (control) which are 24.73, 1.67, 28.67 & 38.73 respectively while the minimum was found in treatment T_8: Soil drenching of TA41 @ 25 ml/lt. + Foliar spray of TA41 @ 45 ml/lt. which are 19.6, 1.13, 23.47 & 33.67 respectively.

This might be due to the fact that PGR can induce the plant to produce more endogenous components especially auxins and cytokinins. These hormones can promote cell division and elongation resulting in faster growth and earlier fruit production. They form symbiotic relationships with plant roots and can enhance nutrient uptake and transfer to the plant which can result in faster growth and earlier fruit production. Similar results were also reported by ***Glick BR. 2012.***

Yield Parameters

Yield Parameters such as number of fruits per plant, average fruit weight (gm), fruit length (cm), fruit girth (mm), fruit yield per plot (kg) and fruit yield per 250 m^2 (q) were observed.

Application of TA41 significantly increased the yield parameters such as number of fruits per plant, average fruit weight (gm), fruit length (cm), fruit girth (mm), fruit yield per plot (kg) and fruit yield per 250 m^2 (q). Here treatment T_8: Soil drenching of TA41 @ 25 ml/lt + Foliar spray of TA41 @ 45 ml/lt shows maximum number of fruits per plant, average fruit weight (gm), fruit length (cm), fruit girth (mm), fruit yield per plot (kg) and fruit yield per 250 m^2 (q) which was 26, 173.23 gm, 14.11 cm, 32.95 mm, 36 kg & 62.5 q respectively while least was observed in treatment T_0 (control) which is 20.33, 136.74 gm, 11.83 cm, 25.33 mm, 22.21 kg & 38.56 q respectively.

The increase in the number of fruits were associated with increased production of flower, coupled with the reduction in flower and fruit drop that ultimately increased the percentage of fruit set (***Prasad RN et al., 2013***). The possible reason for increased fruit yield might be associated to better inorganic nitrogen utilization in the presence of biofertilizers which enhanced biological nitrogen fixation, better development of root system and possible higher synthesis of plant growth hormones (***Gajbhiye et al., 2003*).** Fruit development is highly affected by auxin formation in the growing seeds and other parts of the fruit to supply food reserves in order to increase fruit development. Moreover, microorganisms that produce auxin are VAM and Azosprillium sp. As microbe, which attaches nitrogen and plays as growth regulator (***Sam RJ et al., 2019***). It was also due to the content level of nitrogen, phosphorus and potassium in TA41 have higher nutrients than other treatments. Similar results were reported by ***Kumaran SS et al., 2001***.

Qualitative Parameters

Qualitative parameters in vegetable crops are of significant importance as they affect nutritional value, flavour, texture, appearance, shelf life, market value and consumer satisfaction. Paying attention to these parameters enables farmers to produce high-quality vegetables that meet consumer demands, promote healthy eating habits and enhance the economic value of their crops.

Qualitative Parameters such as TSS (°Brix), ascorbic acid (mg/100g) and juice percentage were observed.

Application of TA41 resulted in more total soluble solids, ascorbic acid and juice percentage in the cucumber. Maximum TSS, ascorbic acid and juice percentage was observed in the treatment T_4: Soil drenching of TA41 @ 15 ml/lt. + Foliar spray of TA41 @ 25 ml/lt. which is 4.72, 6.47 & 95.37 respectively while least was observed in treatment T_0 (control) which is 3.24, 5.4 & 88.3 respectively.

Adding bio-fertilizer and nutrients like nitrogen, phosphorus, and potassium can improve the quality of plants. This is because it boosts the plant's ability to make food (photosynthesis) and use nutrients (metabolism) resulting in more acids, compounds, and sugar being produced by the plant. Similar results were reported by ***Gajbhiye RP et al., 2003***.

Table 2: **Qualitative Parameters against different treatments**

Treatment	Plant Height (cm)	Number of Nodes	Days to 1st Flowering (Female)	Days to 1st Fruit Setting	Days to 1st Fruit Picking	Node Number Bearing 1st Female Flower	Number of Female Flowers/ Plant	Number of Fruits/Plant	Fruit Yield per Plant (kg)	Fruit Yield per Plot (kg)	Fruit yield per 250 sq. m (q)	Average Fruit Weight (gm)
T_0	91.57	18.33	24.73	28.67	38.73	1.67	21.67	20.33	2.78	22.21	38.56	136.74
T_1	98.13	19.83	20.53	24.13	34.2	1.4	23.67	22.67	3.66	29.31	50.87	161.75
T_2	100.4	20.27	20.27	24.27	34.4	1.4	23	22	3.64	29.09	50.5	166.48
T_3	100.53	20.07	20.6	24.47	34.73	1.33	22.67	21.33	3.34	26.75	46.43	157.15
T_4	102.5	20.33	19.8	23.67	33.87	1.2	26	24.67	4.23	33.84	58.74	171.83
T_5	100.97	19.9	20.13	24.2	34.13	1.27	24.67	23.33	3.55	28.37	49.26	152.79
T_6	101.9	20.13	20.2	23.93	33.8	1.47	25	24	3.77	30.13	52.31	157.17
T_7	102	19.97	19.87	24	34	1.27	22	20.67	3.45	27.6	47.91	167.2
T_8	103.97	21.13	19.6	23.47	33.67	1.13	27	26	4.5	36	62.5	173.23
T_9	101.23	19.87	20	24	34.67	1.53	23.67	22.67	3.54	28.35	49.21	156.67

F Test	S	S	S	S	S	NS	S	S	S	S	S	S
S. Ed. (±)	1.01	0.48	0.63	0.72	0.71	0.22	1.12	1	0.15	1.21	2.11	7.49
CD (5%)	2.11	1.02	1.31	1.5	1.49	0.46	2.35	2.09	0.32	2.55	4.43	15.73
CV	1.23	2.97	3.72	3.58	2.5	19.69	5.73	5.36	5.1	5.1	5.1	5.73

Table 3: Fruit Length, Fruit Girth, TSS, Vitamin C and Juice Percentage against different treatments

Treatment	Fruit Length (cm)	Fruit Girth (mm)	TSS (°Brix)	Vitamin C (mg/100g)	Juice Percentage
T_0	11.83	25.33	3.24	5.4	78.3
T_1	12.11	31.32	3.54	5.43	82.6
T_2	12.75	25.57	3.33	5.7	80.73
T_3	13.46	29.74	3.6	5.97	79.9
T_4	13.97	31.62	4.72	6.47	88.37
T_5	13.59	28.56	3.82	5.7	83.7
T_6	12.9	26.68	3.54	6.03	84.73
T_7	13.32	28.65	3.47	5.87	84.77
T_8	14.11	32.95	4.05	6.17	86.87
T_9	13.18	28.35	3.57	5.8	85.5
F Test	S	S	S	NS	S
S. Ed. (±)	0.35	0.36	0.27	0.31	0.64
CD (5%)	0.74	0.75	0.57	0.64	1.35
CV	3.27	1.51	9.03	6.41	0.95

Conclusion

On the basis of present investigation, it is concluded that the treatment T_8 (Soil drenching of TA41 @ 25 ml/lt. + Foliar spray of TA41 @ 45 ml/lt.) is proved as a best combination of TA41 for growth, earliness and yield traits, however, treatment T_4 (Soil drenching of TA41 @ 15 ml/lt. + Foliar spray of TA41 @ 25 ml/lt.) significantly enhances the quality traits of hybrid cucumber var. Gurka F1 under protected condition.

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