

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

ABSTRACT

Protected cultivation provides a means to mitigate abiotic and biotic stresses, enabling crop production even in adverse climates. A field experiment was carried out from March to May 2022 at the Horticulture Research Field in the Department of Horticulture, Naini Agricultural Institutes, Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj (U.P.) India, the effects of the treatment TA41 on hybrid cucumber were investigated. The experiment was entitled as “Effect of TA41 on growth, yield and fruit quality of hybrid cucumber (*Cucumis sativus* L.) under protected conditions” 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, the highest values were recorded significantly maximum in treatment T₈: Soil drenching of TA41 @25 ml/l + Foliar spray of TA41 @45 ml/l while comparing the qualitative parameters the highest values were recorded significantly maximum in treatment T₄: Soil drenching of TA41 @15 ml/l + Foliar spray of TA41 @25 ml/l. The benefit:cost ratio was obtained highest in treatment T₄ (3.53). Besides, this hybrid also proved to be the best in terms of disease resistance and profitability. This study contributes valuable insights into the benefits of protected cultivation and the potential of TA41 for improving cucumber production. The findings have practical implications for growers, providing them with evidence-based recommendations to enhance their crop yields, quality, disease resistance, and profitability.

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

INTRODUCTION

The commonly grown vegetables in India such as cucumber, pumpkin, and gourds are known to play an important role in India's farming contributing to 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, containing 0.4% protein, 2.5% carbohydrates, 1.5mg iron and 2mg of vitamin C per 100g fresh weight, and has eventually emerged as the fourth

important vegetable in the world. Basically, it is a monoecious, trailing or climbing vine with angled hirsute or rough stems. The cucumber had its origin as well as domestication in India and spread to other parts of the world.

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 their rapid multiplication or the tolerance of harsh conditions (Tapwal *et al.*, 2016). Trichoderma spp. have effective antagonism and mycoparasitic actions on plant pathogens, allowing them to reduce the incidence of plant diseases, and the key mechanism for Trichoderma species is hyperparasitism (Kredics *et al.*, 2018, Halifu *et al.*, 2020). The Trichoderma colonization of roots causes root hair growth and triggers defense activities, such as significant changes in a variety of metabolic pathways and the activation of genes involved in plant host defense, 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.) from 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 01) and three replications in randomized block design under protected condition. Five plants were randomly selected per treatment for recording the observations.

Table – 01 TREATMENT DETAILS OF DIFFERENT CONCENTRATIONS & 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 @ 10ml/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.

Statistical Analysis

The data recorded throughout the course of investigation was subjected to Statistical analysis by using analysis of variance (ANOVA) for randomized block design (RBD) by Fischer and Yates (1963). Whenever 'F' test was found significant for comparing the means of two treatments, a critical difference (C.D. at 5%) was worked out.

Results and Discussion

Growth Parameters:

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 T₈: Soil drenching of TA41 @ 25 ml/lt. + Foliar spray of TA41 @ 45 ml/lt. which is 103.97 cm & 21.13 respectively while treatment T₀(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/lit. + Foliar spray of TA41 @ 45 ml/lit. act as a nutrient link 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 endo-transglucosylase which cause loosening of cell wall and increases cell permeability.

Earliness Parameters:

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 T₀(control) which are 24.73, 1.67, 28.67 & 38.73 respectively while the minimum was found in treatment T₈: Soil drenching of TA41 @ 25 ml/lit. + Foliar spray of TA41 @ 45 ml/lit. 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 m² (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 m² (q). Here treatment T₈: Soil drenching of TA41 @ 25 ml/lit + Foliar spray of TA41 @ 45 ml/lit 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 m² (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 T₀ (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 information 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 Azospirillum sp. A microbe, which attaches nitrogen and plays as a 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 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 T₄: 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 T₀ (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*.

Treatment	Plant Height (cm)	Number of Nodes	Days to 1 st Flowering (Female)	Days to 1 st Fruit Setting	Days to 1 st Fruit Picking	Node Number Bearing 1 st 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
FTest	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

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 T₈ (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 T₄ (Soil drenching of TA41 @ 15ml/lt. + Foliar spray of TA41 @ 25ml/lt.) significantly enhances the quality traits of hybrid cucumber var. Gurka F1 under protected condition.

Competing Interests

Authors have declared that no competing interests exist.

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