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Effects of TA41 on Growth, Yield and Quality of Brinjal

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

An experiment was conducted during 2021 to study the effect of TA41 on growth, yield and quality of brinjal cv. Kashi Sandesh at Vegetable farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj (UP). There were 10 treatments 9 are consisting of different attributes of TA41 and water was used as control. The treatment is spayed at 30 and 45 days after transplanting. All the treatments were replicated three times in a randomized block design keeping the plot size 1mx2m. The treatment T_6 (soil drenching of TA41 @ 20ml /L + foliar spray 40ml /L) found the best performances. The maximum Plant height (63.67), Number of leaves per plant (59.74), leaf length (36.76 cm), leaf width (26.76cm). days of first flowering (75.85), no of flowers per plant (20.81), fruit length (8.05cm), fruit width(39.74mm), no of fruits per plant (17.22), fruit yield per plant (1449.33g), average fresh weight of fruit (151.97g), yield per hectare (805.35q/ha), TSS (5.67 Brix), shelf life of fruits (4.11), fruit borer (8.67%)**,** leaf miner (1.00%), little leaf (1.00%), Phomopsis blight (8.33%). The significantly higher gross return (Rs 805350/ha), net profit (Rs 649760/ha) and B:C ratio (5.17) was recorded under T_6 (soil drenching of TA41 @ 20ml /L + foliar spray 40ml /L. Overall results revealed that the application of TA41as soil drenching of TA41 @ 20ml /L + foliar spray 40ml /L proved to be better for different growth, yield and quality traits in brinjal.

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1. INTRODUCTION

"Vegetables are the important components in the diet of Indian people as majority of the Indians are vegetarian. Vegetables are the rich source of carbohydrates, protein, vitamins, minerals, fat, crude fiber and elemental salts. Besides, vegetables also enhance the test, colour and texture of the diet" Choudhary [1]. "India occupies prime position in the world in production of vegetable crops ranking 2nd next to China and producing about 162.89 million tons from an area of 9.72 million hectares. However, it is not sufficient to meet the requirement of the present population. India will require about 200 million tons of vegetables annually by the year 2022 AD" Choudhary [1]. "Among vegetables, brinjal is one of the most common and principal vegetable grown in India and other parts of the world, however, higher altitudes are not suitable for its cultivation. There are a large number of cultivars which are being grown throughout the country depending upon yield and consumers preference. It belongs to the family Solanaceae and the scientific name is *Solanum melongena* L. some other names are Eggplant and Aubergine etc" [2]. "The brinjal is much more important in the warm areas, being grown extensively in India, Bangladesh, Pakistan, China, Philippines. Besides, France, Italy and United State are popular country for its cultivation" Anonymous [3]. "Brinjal is also famous as a poor man's crop because it finds the place among the vegetables, where higher production of vegetables is an important observation" [4]. "The brinjal is staple vegetable in almost all tropical countries in the world and liked by both poor and rich consumers. Since there is a common belief that brinjal is not much valuable vegetable for health. However, it is quite high in nutritive value and can be compared with tomato" [5].

"Generally, solanaceous vegetables require large quantity of major nutrients like nitrogen, phosphorus and potassium, in addition to secondary nutrients such as calcium and sulphur for better growth, fruit and seed yield. The cost of inorganic fertilizer has been enormously increasing to an extent that they are out of reach of the small and marginal farmers and also it is continuously harming the ecological niche. The use of TA41 in such situation is therefore a practically paying proposal" [6,7]. TA41 is a multifunctional organic growth promoter that takes care of viral, fungal, and sucking pests [8-12]. As a result of this, the quality of crop produce is highly improved and increases the growth and yield of crops by 50%. TA41 effectively controls and prevents soft-bodied sucking pests such as whiteflies, aphids, mites, scale insects, thrips, mealy bugs, and planthoppers. It is very effective & works quickly against sucking pests [13-18]. TA41 also helps in retaining soil moisture and prevent soil erosion and develops healthy soil for high yield [19-21].

2. MATERIALS AND METHODS

The details of the various materials used and methods adopted to lay out the experiment are presented below:

2.1 Experimental Site

The experiment was carried out at Main Experimental Field, Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.) India. The area of Allahabad district comes under subtropical belt in the South East of Uttar Pradesh, which experience extremely hot summer and fairly cold winter. The maximum temperature of the location reaches up to 46℃ – 48℃ and seldom falls as low as 4℃ – 5℃. The relative humidity ranged between 20-94%. The average rainfall in this area is around 1013.4 mm annually. However, occasional precipitation is also not uncommon during winter months.

2.2 Experimental Details

The brinjal crop with Kashi Sandesh variety was grown in Randomized Block Design with 10 treatments and each replicated thrice. Treatment details were $T_{0(control)}$ without any treatment, T1 soil drenching of TA41 @10ml/L, T2 soil drenching of TA41 @ 10 ml/L +Foliar spray 20ml/L, T3 Soil drenching of TA41 @ 15ml/L, T4 Soil drenching of TA41@ 15ml/+Foliar spray 30ml/L,T5 Soil drenching of TA41@ 20ml/L, T6 Soil drenching of TA41 @ 20ml /L + foliar spray 40ml /L, T7 Soil drenching of TA41 @ 25ml /L, T8 Soil drenching of TA41 @ 25ml/l + foliar spray 50ml/L, T9 Foliar spray of TA41 @ 30 ml/L. Each plot comprised of $2m^2$ with a spacing 60 cm row to row and 30 cm plant to plant and each treatment carrying 9 plants per plot. The observations were recorded on vegetative growth, yield , quality and pest and disease incidence of brinjal as plant height (cm), number

of leaves per plant , leaf length (cm), leaf width (cm), fruit length (cm), fruit width (mm), no of fruits per plant , fruit yield per plant (g), days of first flowering , no of flowers per plant , average fresh weight of fruit (g), yield per hectare(g/ha), shelf life of fruits, total soluble solids (Brix) were recorded with the help of hand refractometer, fruit borer (%), Phomopsis blight (%). the data were collected from 9 plants of each treatment and analysis of variance technique was used to analyses the recorded data.

3. RESULTS AND DISCUSSION

The present investigation entitled “Effect of TA41 on growth yield and quality of brinjal *Solanum melongena* L. under prayagraj agroclimatic condition” cv. Kashi Sandesh was carried during November 2021 to April 2022 in research field. Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom university of Agriculture, Technology and Sciences, Prayagraj (U.P) India. The experiment was conducted in Randomized Block Design (RBD) with ten treatments and three replications. The mean data of all the traits were subjected to statistical analysis and salient features of experimental findings are mentioned below:

3.1 Growth Parameter

3.1.1 Plant height

At 150 days after transplanting the maximum plant height was recorded in T_6 (soil drenching of TA41 @ 20ml /L + foliar spray 40ml /L which is (63.67cm) followed by T8 and T7 which were at par to each other while the minimum plant height was recorded in the treatment T0 (without any treatment) is (54.63) as presented table 1. This might be due to fact that Soil drenching of TA41 @ 20ml /L + foliar spray 40ml /L act as a nutrilink to plants, increases hormonal, nutritional condition and contributed to a considerable extent for better plant height. Similar results were also reported by Saptari et al. [22] who reported that TA41 can promote the activity of xyloglucan endotransglucosylase which cause loosening of cell wall and increases cell permeability. Similar result was found in brinjal by Meena and Dhaka [23].

3.1.2 Number of leaves per plant

At 150 days after transplanting the maximum number of leaves per plant was recorded T_6 (Soil drenching of TA41 @ 20ml /L + foliar spray 40ml / 1L spray tank which is (59.74) followed by T8 and T7 which were at par to each other while the minimum was recorded in the treatment T0 (without any treatment) is (54.41) as presented Table 1. This might be due to fact that soil drenching of TA41 @ 20ml /L + foliar spray 40ml /L act as a nutrilink to plants, increases hormonal, nutritional condition and contributed to a considerable extent for better number of leaves per plant. The marked increase in growth characters might be due to the possible stimulation of meristematic tissues by auxin accelerating greater cell division and cell enlargement in growing portions. Findings are in accordance with the findings of Viradia (1982) and El-Soad et al. (1976).

3.1.3 Leaf length

At 150 days after transplanting the maximum leaf length (cm) was recorded in T_6 (soil drenching of TA41 @ 20ml /L + foliar spray 40ml /L which is (36.76) followed by T8 and T7 which were at par to each other while the minimum was recorded in the treatment T0 (without any treatment) is (27.69) as presented table 2. This might be due to fact that Soil drenching of TA41 @ 20ml /L + foliar spray 40ml / 1L spray tank act as a nutrilink to plants, increases hormonal, nutritional condition and contributed to a considerable extent for better leaf length. The marked increase in growth characters might be due to the possible stimulation of meristematic tissues by auxin accelerating greater cell division and cell enlargement in growing portions.

3.1.4 Leaf width

At 150 days after transplanting the maximum leaf width (mm) was recorded in T_6 (soil drenching of TA41 @ 20ml /L + foliar spray 40ml /L which is (26.76) followed by T8 and T7 which were at par to each other while the minimum was recorded in the treatment T0 (without any treatment) is (21.79) as presented table 1. This might be due to fact that Soil drenching of soil drenching of TA41 @ 20ml /L + foliar spray 40ml /L act as a neutralino to plants, increases hormonal, nutritional condition and contributed to a considerable extent for better leaf width. Contreras-Cornejo et al. [24] revealed that the secretion of IAA by *Trichoderma* spp. can significantly improve plant and lateral root growth. Trichoderma spp. can produce volatile and non-volatile secondary metabolites including 6-n-pentyl-6H-pyran-2-one (6PP), viridin, gliotoxin, harziandione, harzianopyridone, and

peptaibols which, as plant-growth promoters, have a significant effect.

3.1.5 Days to first flowering

The data mentioned in table 1 showed that Days to first flowering is recorded maximum in Treatment T0 without any treatment with (81.04 days) followed by T1 and T2 while the minimum is found in T_6 (soil drenching of TA41 @ 20ml /L + foliar spray 40ml /L which is (75.84days). More intensive flower setting was elicited either by improved plant growth through seaweed extract application or by endogenous components, especially cytokinins, which enhance nutrient partitioning in vegetative plant organ and increase in the transport to assimilates to the growing fruits. A similar effect was observed for eggplant treated with seaweed extract by Abd El-Gawad and Osman [25].

3.1.6 No. of flowers/plant

The number of flowers per plant with maximum is recorded (20.81) at T_6 (soil drenching of TA41 @ 20ml /L + foliar spray 40ml /L followed by T8 and T7 which is at par to each other While the minimum at control T0 (without any treatment) (12.41) This might be due to fact that soil drenching of TA41 @ 20ml /L + foliar spray 40ml /L act as a nutrilink to plants and increases hormonal, nutritional condition and contribute considerable extent for earliness in flowering and fruiting. Under the condition of presented experiment, bio stimulant application also increased the number of pollen tubes on the plants resulted in better reproductive effectiveness and increased fruit yield and quality, described in detail by Gomez Cadenas et al. [26] and Pohl et al. [27] Investigated the effect of the bio stimulant product containing macronutrients on citrus fruit set abscission. The beneficial effect of the bio stimulant resulted from an increase in the photosynthetic efficiency which led to better transport of carbohydrates from leaves of fruit sets [28-30].

3.2 Yield Parameters

3.2.1 Fruit length

The fruit length (cm) with maximum is recorded (8.05) at T_6 (soil drenching of TA41 @ 20ml /L + foliar spray 40ml /L followed by treatment T8 and T7 which is significantly superior over all the treatments. While the minimum at T2 (6.34). 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 Azospirillum sp. as microbe, which attaches nitrogen and plays as growth regulator [31-34].

3.2.2 Fruit width

The fruit width (mm) with maximum is recorded (39.74) at T_6 (soil drenching of TA41 @ 20ml /L + foliar spray 40ml /L followed by T5 and T7 which is significantly superior over all the treatments. While the minimum at T3 (25.00). 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.

3.2.3 Number of fruits per plant

The number of fruits per plant with maximum is recorded (17.22) at T_6 (soil drenching of TA41 @ 20ml /L + foliar spray 40ml /L followed by T8 andT6 and T7 which is significantly superior over all the treatments. While the minimum control at T0 (4.70). The number of fruits per plant is an important determination of yield in brinjal due to providing efficiency part and hormonal balance in the plant system [35].

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 [36]. Similar results were reported by Choudhury et al. [37] and Akand et al. [38] in tomato.

3.2.4 Fruit yield per plant

The fruit yield per plant (g) with maximum is recorded (1449.33) at T_6 (soil drenching of TA41 @ 20ml /L + foliar spray 40ml /L followed by T8 and T7 (Table 2), which is significantly superior over all the treatments. While the minimum control at T0 (668.15). The increase in fruit yield might have been due to the better performance of the yield attributes. It may be due to better assimilation of plant nutrients through bio fertilizers [39].

Table 1. Effect of TA41 on plant height (cm) and no of leaves per plant, leaf length (cm), leaf width (cm), days of first flowering, number of flowers per plant, fruit length (cm), fruit width (mm). no of fruits/plant on brinjal

Treatment no	Treatment details	Plant height	No of leaves/ plant	Leaf length	Leaf width	Days to first flower ring	No of flowers/ plant	Fruit Length	Fruit Width	No of fruits/ plant
		150 days	150 days	150 days	150 days					
T_0	Without any treatment of TA41	54.63	54.41	27.69	21.79	81.04	12.41	6.57	30.93	4.70
T_1	soil drenching of TA41 @10ml/L	55.26	54.15	28.06	22.89	80.67	13.04	7.03	38.96	5.85
T_2	soil drenching of TA41 @ 10 ml/L +Foliar spray 20ml/L	55.43	53.30	30.76	24.11	80.11	14.07	6.34	27.89	7.70
T_3	Soil drenching of TA41 @ 15ml/L	56.89	54.44	28.00	22.63	80.04	14.85	6.75	25.00	8.70
T_4	Soil drenching of TA41@ 15ml/+Foliar spray 30ml/L	58.78	53.78	31.29	23.37	78.67	16.81	6.92	27.26	10.52
T_5	Soil drenching of TA41@ 20ml/L	59.18	55.26	31.33	23.96	78.41	17.26	6.23	38.04	11.67
T_6	Soil drenching of TA41 @ 20ml /L + foliar spray 40ml /L	63.67	59.74	36.76	26.76	75.85	20.81	8.05	39.74	17.22
T_7	Soil drenching of TA41 @ 25ml /L	59.30	59.30	31.75	23.07	77.30	17.81	7.60	38.15	15.30
T_8	Soil drenching of TA41 @ 25ml/l + foliar spray 50ml/L	59.74	56.78	32.53	25.81	78.59	18.41	7.70	37.15	16.59
T_9	Foliar spray of TA41 @ 30 ml/L	57.67	56.56	32.20	25.19	79.26	17.37	7.64	37.11	14.70
F-Test		S	S	S	S	S	S	S	S	S
SEm±		0.43	0.74	1.09	0.67	0.85	0.75	0.16	2.24	0.45
C.D. at 0.5		0.90	2.46	2.28	1.41	1.78	1.58	0.34	4.70	0.94
CV		0.91	1.63	4.30	3.45	1.32	5.64	2.78	8.05	4.86

Table 2. Effect of TA41 on fruit yield/plant, average fresh weight of fruit(g), yield per hectare (q/ha), TSS(Brix), shelf life if fruits, fruit borer (%), leaf miner (%), little leaf (%), Phomopsis blight (%) on brinjal

Treatment no	Treatment details	Fruit yield/ Plant (g)	Average fresh weight of fruits(g)	Yield/ Hectare (q/ha)	TSS(Brix)	Shelf life of fruits	Fruit borer (%)	Leaf miner (%)	Little leaf (%)	Phomopsis blight (%)
T_0	Without any treatment of TA41	668.15	84.94	371.26	5.13	3.33	13.00	2.00	2.00	11.33
T_1	soil drenching of TA41 @10ml/L	732.22	84.86	406.84	5.39	3.81	12.67	3.00	3.00	11.83
T_2	soil drenching of TA41 @ 10 ml/L +Foliar spray 20ml/L	856.96	84.94	476.19	5.37	3.67	12.33	2.00	2.00	1.83
T_3	Soil drenching of TA41 @ 15ml/L	948.44	95.10	527.02	5.61	3.67	11.67	2.67	2.67	10.33
T_4	Soil drenching of TA41@ 15ml/+Foliar spray 30ml/L	1027.81	95.10	571.12	5.44	3.70	12.33	2.00	2.00	10.00
T_5	Soil drenching of TA41@ 20ml/L	1017.74	91.70	565.59	5.71	3.63	9.67	2.00	2.00	9.67
T_6	Soil drenching of TA41 @ 20ml /L + foliar spray 40ml /L	1449.33	151.97	805.35	5.67	4.11	8.67	1.00	1.00	8.33
T_7	Soil drenching of TA41 @ 25ml /L	1283.00	151.97	734.10	5.57	4.07	9.67	2.00	2.00	9.00
T_8	Soil drenching of TA41 @ 25ml/l + foliar spray 50ml/L	1426.70	134.65	792.78	5.48	4.07	9.00	2.00	2.00	8.67
T_9	Foliar spray of TA41 @ 30 ml/L	1223.89	111.41	680.08	5.55	3.07	9.33	3.00	3.00	9.00
F-Test		S	S	S	S	S	S	S	S	S
SEm±		22.28	7.29	8.68	0.03	0.11	0.63	0.15	0.15	0.37
C.D. at 0.5		46.81	15.31	18.23	0.07	0.23	1.33	0.31	0.31	0.78
CV		2.57	8.21	1.79	0.73	3.60	7.17	8.43	8.43	4.54

3.2.5 Average fresh weight of fruit

The average fresh weight of fruit (g) with maximum is recorded (151.97) at T_6 (soil drenching of TA41 @ 20ml /L + foliar spray 40ml /L and T followed by T8 which is significantly superior over all the treatments. While the minimum control at T0 (84.94). The application of biofertilizer may increase fresh weight of eggplant 50.32%. It was due to the content level of nitrogen, phosphorus, and potassium in TA41 have higher nutrients than other treatments. Similar results were reported by Kumaran et al. [40], Suryanto and Solanki [2].

3.2.6 Yield per hectare

The yield per hectare (qq/ha) are shown in Table 2 with maximum is recorded (805.35) at T_6 (soil drenching of TA41 @ 20ml /L + foliar spray 40ml /L followed by T8 and T7 which is significantly superior over all the treatments. while the minimum control T0 (371.26) The possible reason for increased fruit yield might be associated to better inorganic nitrogen utilization in the presence of bio fertilizers, which enhanced biological nitrogen fixation, better development of root system and possible higher synthesis of plant growth hormones Gajbhiye et al. [41]. Similar trend of work has been noted by Anburani and Manivannan [35], Devi et al. [42], Devi et al. [43] and Wange and Kale [44] in brinjal.

3.2.7 Quality parameter

Total soluble solids: In terms of Total Soluble Solids (Brix) was recorded maximum in treatments T_6 (soil drenching of TA41 @ 20ml /L + foliar spray 40ml /L) with (5.67Brix) which is statistically at par with treatment T7 and T8 which is significantly superior over the other treatment. The lowest TSS of fruit was observed in the treatment T0 (without any treatment of TA41) which is (5.13 brix) as shown in Table 2. Total soluble solids (T.S.S.), quality of solids, dissolved in the liquid part of brinjal were observed to be increased after treatment with TA41. Total soluble solids (T.S.S.), quality of solids, dissolved in the liquid part of brinjal were observed to be increased after treatment with Azospirillum. The increased in quality due to application of bio-fertilizer and nitrogen, phosphorus and potassium could be attributed to the enhanced photosynthetic and metabolic activities, which resulted in the synthesis of higher number of acids, metabolites and glucose. These reserves ultimately contributed synthesis of TSS in tomato [40]. These results are in conformity with Kamili et al. [45] in brinjal.

Shelf life of fruits: In Table 2 is shown the shelf life of fruits. It was recorded maximum in treatment (4.11) T_6 (soil drenching of TA41 @ 20ml /L + foliar spray 40ml /L followed by T8 and T7 which is superior over the other treatments. The low shelf life of fruits was recorded in T0 (without any treatment of TA41) is (3.33).

3.3 Pest and Disease Incidence

Fruit borer: The minimum fruit borer (%) attack (8.67%) was recorded on T_6 (soil drenching of TA41 @ 20ml /L + foliar spray 40ml /L. While the maximum (13.00%) recorded in Absolute Control. Only four unrecorded post harvested diseases of fruits and vegetables were described by Dhingra and Mehrotra in 1980. Soft rot of eggplant fruit was caused by *Chrysoporium pruinosum* for controlling Continuous cropping of brinjal on the same piece of land should be avoided. As soon as the insect is detected, the affected parts should be clipped along with the insect and destroyed. Fruits showing any boring should be picked and destroyed. Whole of fruit surface become soft and pulpy, later on fruits emitted foul smell [46-49]. White coloured spore masses were also seen on the rotten fruit surface [50,51].

Leaf miner: The minimum leaf miner (%) attack (1.00%) was recorded on T_6 (soil drenching of TA41 @ 20ml /L + foliar spray 40ml /L. While the maximum (0.03) recorded in T1 and T9. it could be deduced that the T. *asperelloides* TA41 can modulate the response of the plant, increase resistance, and prevent the suppression of defense genes caused by *R. solani.*

Little leaf: The minimum little leaf (1.00%) was recorded on T_6 (soil drenching of TA41 @ 20ml /L + foliar spray 40ml /L. While the maximum (0.03) recorded in T1 and T9. Mitra and Majumdar [52] described that little leaf is an important disease of Brinjal caused by Mycoplasma. Investigations were carried out to study the uptake of 32P by healthy as well as little leaf infected tissue. Data revealed that no considerable difference in the uptake of 32P was higher in TMV infected leaf tissue than in healthy ones

Phomopsis blight: The minimum *Phomopsis* blight (%) (8.33%) was recorded on T_6 (soil

drenching of TA41 @ 20ml /L + foliar spray 40ml /L. While the maximum (11.83) recorded in T1 and T2. Singh and Chakrabarti [53] found that *Phomopsis* rot / blight caused by *Phomosis vexans*, is a serious disease of Brinjal particularly of the seed crop. The losses caused to the seed crop are much more than that reported on the vegetable crops.

Economics: Maximum gross returns, Net Return and Cost Benefit Ratio Rs. 805350/ha, Rs. 649760/ha and (1: 5.17) respectively was recorded in treatment T_6 (soil drenching of TA41 @ 20ml /L + foliar spray 40ml /L and the minimum Gross Return, Net Return and Cost Benefit Ratio (Rs. 371260/ha, Rs. 251450/ha and 1:3.09) respectively was recorded in treatment T0 (Control) as presented in table. As the economics is the need of the farmers while taking decision regarding the adoption of the techniques and scientific knowledge Hence, T_6 (soil drenching of TA41 @ 20ml /L + foliar spray 40ml /L gave the highest gross return, net return, and cost benefit is due to higher productivity and enhanced fruit quality, which increase the market value of the fruit.

4. CONCLUSION

On the basis of present investigation, it is concluded that the treatment T_6 (soil drenching of TA41 @ 20ml /L + foliar spray 40ml /L is proved as a best combination of TA41 for growth,yeild and quality. where treatment T_6 significantly enhances the growth, yield and quality traits of brinjal and also gave maximum return/ha.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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