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Response of plant growth regulators and trace elements on growth, flowering and yield of bottle gourd cv. GH 22

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Abstract

In the present experiment three levels each of plant growth regulators (NAA, GA_3, Ethrel) and trace elements ($ZnSO_4$, $MnSO_4$, Boric acid), respectively, were sprayed at second and fourth leaves stage along with control treatment on bottle gourd plants to find out their effect on fruit yield. The study was conducted at Research Farm of the Department of Vegetable Science, CCS, Haryana Agricultural University, Hisar during Spring summer season of 2017-18. The results of the study clearly indicated that application of Ethrel 200 ppm significantly increased the fruit yield and its related attributes over control treatment. The spraying of Ethrel 200 ppm significantly reduced the length of internodes (11.7 cm), node number to bear first female (7.3), number of staminate flowers per plant (104.3), length of internodes (11.7) as well as main vine length (357.2 cm) whereas it increases number of primary branches /vine (17.7), the numbers of pistillate flower per plant (17.0), longest fruit length & diameter (32.9; 7.5 cm), length of pedicel (15.9 cm), number of fruits per vine (7.7) and fruit yield per plot and per hectare (30.1 kg and 361.1 q), respectively. Whereas, the spray of GA_3 75 ppm delayed the node number to bear first female flower (15.3) and increased the number of staminate flowers per plant (145.7) and length of internodes & main vine length (16.7 and 487 cm) as well as it decreased the number of pistillate flowers per vine (9.3) and fruit yield per plot and per hectare (19.8 kg, 237.6 q). The highest node number to bear first male flower (13.3) and maximum number of days to opening of first male flower (54.7) were recorded in treatment NAA 300 ppm. From the study, it was concluded that bottle gourd plants of cv. GH-22 when sprayed with Ethrel 200 ppm produced the maximum fruit yield (361.1q/ha).

Keywords: Bottle gourd, trace elements, growth regulators, growth, flowering and fruit yield.

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Introduction

Bottle gourd (*Lagenaria siceraria*) commonly known as *ghia*, *dudhi*, or *lauki* in India belongs to family Cucurbitaceae. It is originated from Africa and thrives best in loamy soil. Total area for this viny vegetable in India during 2017-18 was 157000 hectare and the total production was 2683000 metric tonne (Anonymous 2017). It is a monoecious and annual plant with trailing/climbing vine. The fruit is a good source of glucose and fructose. It also contains vitamin B, ascorbic acid and minerals like potassium, calcium, phosphorus, magnesium, sodium, zinc, iron, manganese, copper and (USDA 2016). It is used to for the treatment of jaundice, diabetes, ulcer, insanity and hypertension. The fruits of bottle gourd are available throughout the year (Thakur *et al*. 2013). The important phase in the cucurbits is flowering, fruiting and yield. The staminate and pistillate flowers occurring in various arrangements and present separately on the same plant (Desai *et al.* 2011). *Hormone* is Greek word *hormao*, which means to stimulate. Presently, the plant growth regulators are used to control many physiological processes including flowering and fruiting. Although sex expression is a genetically controlled mechanism but application of growth regulators can modify it (Ying *et al*. 1994). Exogenous application of growth regulators at 2-4 leaf stage in bottle gourd resulted into expression of more female flowers by suppressing male flower (Hossain 2004).

Auxins, gibberellins, cytokinins, ethylene and abscisic acid are the commonly available hormones which are responsible for flowering in plant body (Hidayatullah *et al.* 2012). Ethrel is a versatile ethylene releasing agent which induces the female flowers and increases fruit yield in cucurbits. Gibberellins is responsible to increase the internodes spacing, induce and promote flowering and stimulates protein synthesis. Trace elements are important for better growth, yield and quality in plants.

Factors like intensive cultivation increase in salinity and soil pH resulted into their unavailability to plants (Ahmad *et al.* 2010). Soil as well as foliar application of micronutrients is essential for good growth and yield of crops. Their deficiency will lead to physiological disorders and ultimately leads to imbalanced growth and low yield. Zinc plays an important role in IAA formation to increase flower number and fruit set. Its deficiency will cause death of shoot tips, root stunted, leaves possess a thick coppery texture and curl and become brittle (Sharma and Gangaiah 2009). Manganese is also an essential plant nutrient and its deficiency will result into interveinal chlorotic and necrotic spots on leaves (Sharma and Gangaiah 2009).

When foliar micronutrients are applied, then it also allows for post-planting multiple application timings. The growth regulators increase the yield by suppressing the number of male flowers on lateral branches and increase the female flower production on lateral branches (Mahida *et al.* 2015). To observe the effect of different micro nutrients and plant growth regulators on growth and yield of bottle gourd so the present study has been carried out with the objective to find out the best treatment for higher fruit yield in bottle gourd variety GH 22.

Materials and Methods

A field experiment was conducted at Research Farm of the Department of Vegetable Science, Chaudhary Charan Singh Haryana Agricultural University, Hisar during Spring-summer of 2017-18. Soil of the experimental plot was high in pH, medium in organic carbon and available nitrogen, medium in phosphorus and high in potash. The treatments comprising of three levels each of trace elements, *i.e.*, $ZnSO_4$ @ 0.25, 0.50 and 0.75%, $MnSO_4$ @ 0.30, 0.40 and 0.50% and Boric acid @ 0.2, 0.3 and 0.4% and three growth regulators (NAA @ 200, 250 & 300 ppm, GA_3 @ 25, 50 & 75 ppm and Ethrel @ 100, 150 & 200 ppm, respectively), along with control (water spray) treatment, were laid out in Randomized Block Design (factorial) with three replications. The small quantities of PGR's were first dissolved in little alcohol and then their final solutions were prepared. Ethrel/Ethephon was available in liquid form whereas the rest of the PGR and trace elements used were in powder form. Fresh solutions of each 18 treatment combinations were prepared separately by weighing the chemicals on electronic balance separately as per their treatment concentration in one litre bottle separately and the same process was repeated when the plants attain at fourth leaves stages also. The seeds of bottle gourd cv. GH 22 were sown at a spacing of 2.5 m ×60 cm. The FYM@ 12 tonnes/ha were mixed properly in the soil at the time of last ploughing. The recommended basal dose of fertilizers *i.e.*, NPK/ha (50:25:25) along-with half kg of FYM were applied at the time of sowing by spot placement method and the left-over nitrogen was applied at the time of flowering and fruiting stage. All the recommended cultural practices and plant protection measures were adopted to raise a healthy crop. The observations were recorded on fifteen quantitative characters *i.e.*, number of branches/vine, length of internodes (cm), main vine length (cm), node to first male flower, node to first female flower, staminate flowers per plant, pistillate flowers per plant, days to first male flower, fruit length (cm), fruit diameter (cm), length of pedicel (cm), fruiting period (days), fruit yield per plot (kg), fruit yield per hectare (q/ha). Experimental data of different parameters were analyzed in randomized block design with three replications for analysis of variance in OPSTAT (http://14.139.232.166/opstat/index.asp) statistical software developed by Chaudhry Charan Singh, Haryana Agriculture University, Hissar, Haryana, India (Sheoran 2010).

Results and Discussion

Growth Parameter: The application of trace elements and growth regulators had significant ($P<0.05$) effect on growth, flowering and fruit yield parameters in bottle gourd crop. A significant ($P<0.05$) increase in fruit yield (361.1 q/ha) was recorded when the bottle gourd plant were sprayed @ 200 ppm Ethrel at second and fourth true leaves stage twice, which produced 27.8% higher fruit yield than the fruit yield of control plot.

In the present experiment the different concentration of trace elements and plant growth regulators significantly increased the number of branches per vine, which increased with the increased concentration of Ethrel, whereas the same level of Ethrel reduced the main vine length and length of internodes in this crop, when applied at second and fourth true leaves stage. The maximum number of primary branches per plant (17.7) and length of pedicel (15.9) were observed in Ethrel 200 ppm foliar spray treatment followed by Ethrel (150 and 100 ppm) and NAA (300 and 250 ppm) for number of primary branches per plant and NAA (150 ppm and 300 ppm) for length of pedicel character. While, the minimum main vine length (357.2 cm) and intermodal length (11.7 cm) were recorded in crop plants sprayed with same dose of Ethrel 200 ppm. Whereas, the minimum number of primary branches per plant (9.7) and maximum intermodal length (16.7 cm) and main vine length (487.0 cm) were recorded in GA_3 75 ppm treatments (Table 1). This favorable effect of Ethrel on number of branches per vine, main vine and intermodal

length of bottle gourd might be due to its antagonistic effect on auxin, which enforces apical dominance and suppression of lateral buds to sprout. These results are in close conformity with the reports of Hilli et al. (2010) in ridge gourd, Mahida et al. (2015) in sponge gourd and Patel et al. (2017) who reported Ethrel 600 ppm reduced the vine length, number of nodes and internodal distance in bottle gourd.

Flowering parameters: In case of flowering parameters all the parameters were significantly affected by spraying different level of trace elements and growth regulators on bottle gourd plant at two and four true leaves stage. The growth regulators Ethrel treatment action is of dual type *i.e*., such as it reduced the number of days required to open first female flower but it increased the total number of female flower per vine, wherever at the same time it delays the opening of male flower as well as increased the total number of staminate flowers per vine in bottle gourd crop. The minimum node number to bear first female flower (7.3) and number of staminate flowers per vine (104.3) as well as lower male to female sex ratio (6.1) was recorded when the crops were sprayed Ethrel 200 ppm treatment, which was closely followed by Ethrel 150 and NAA 300 ppm treatments except in the staminate flowers per vine character which was at par with only NAA (300 ppm). In addition to this the same treatment increased number of pistillate flowers per plant (17.0), fruiting duration (49.0 days) whereas the former traits were closely followed by Ethrel 150 and NAA 300 ppm. The second traits *i.e*., fruiting duration period (49.0 days), gave the similar results as obtained from the spray of (Ethrel 100, 150 ppm) and NAA (300 ppm). However, the maximum pedicel length (16.2 cm) was recorded in bottle gourd fruits, which was sprayed with NAA 300 ppm, which was closely followed by NAA 250 and Ethrel 200 and 150 ppm (Table 1). The sexual differentiation is governed by endogenous levels of auxin that develops flowering primordia and acts as anti-gibberellin substance during flowering, which suppresses staminate flowers and promotes more umber of pistillate flowers (Sulochanamma 2001). This might also be due to the buildup of high carbohydrate reserves in plants receiving various foliar application of Ethrel, resulting in early flowering as well as increased number of female flower and fruit set. The results of the present study are in line with the finding of Jadav et al. (2010) and Mehdi et al. (2012) found Ethrel 200 and 300 ppm most effective in increasing femaleness in cucumber, respectively and Mahida et al. (2015) who reported that Ethrel 250 ppm increased the number of female flowers per vine, while, reduced the days to first female flower appearance and lowered the male: female sex ratio in sponge gourd.

Whereas, the result obtained from gibberellins treatments were observed antagonistic to that of Ethrel treatments. The node number to bear first early male flower (6.7), number of days taken to bear first early male flower (46.7 days), less number of pistllate flowers per vine (9.3) and short fruiting duration period (38.0 days) were

Table 1: Effect of plant growth regulators and trace elements on growth and flowering parameters on bottle gourd variety GH22

Treatments	Number of branches/vine	Length of internodes (cm)	Main vine length (cm)	Node to first male flower	Node to first female flower	Staminate flowers per plant	Pistillate flowers per plant	Days to first male flower
T_1-$ZnSO_4$ 0.25%	11.3	15.0	384.8	7.7	12.7	126.7	12.3	51.7
T_2-$ZnSO_4$ 0.50%	12.0	14.7	380.8	8.7	12.3	119.3	13.1	53.3
T_3-$ZnSO_4$ 0.75%	12.3	14.0	374.5	9.3	10.7	112.3	13.6	54.0
T_4-$MnSO_4$ 0.3%	10.5	15.3	410.2	8.0	12.7	128.0	11.0	49.3
T_5-$MnSO_4$ 0.4%	11.3	14.7	406.5	8.3	13.3	133.3	11.7	51.7
T_6-$MnSO_4$ 0.5%	12.3	14.0	394.7	8.7	14.3	137.0	12.3	52.3
T_7-Boric acid 0.2%	11.0	15.0	403.5	9.1	12.0	128.7	13.7	50.7
T_8-Boric acid 0.3%	12.7	14.7	387.5	9.7	11.3	123.3	14.3	52.7
T_9-Boric acid 0.4%	13.7	13.6	378.8	10.3	10.0	116.7	15.0	53.3
T_{10}-NAA 200 ppm	13.3	14.7	426.4	11.0	10.3	119.3	14.3	51.7
T_{11}-NAA 250 ppm	14.7	14.0	414.9	12.3	9.7	114.7	15.3	53.3
T_{12}-NAA 300 ppm	15.7	12.7	385.7	13.3	8.7	107.7	16.7	54.7
T_{13}-GA_3 25 ppm	11.0	15.3	443.3	8.3	12.3	132.3	10.7	48.7
T_{14}-GA_3 50 ppm	10.7	16.0	468.9	7.7	13.7	138.7	10.0	47.3
T_{15}-GA_3 75 ppm	9.7	16.7	487.0	6.7	15.3	145.7	9.3	46.7
T_{16}-Ethrel 100 ppm	15.3	14.3	379.7	9.3	9.7	118.7	15.3	52.3
T_{17}-Ethrel 150 ppm	16.3	13.0	368.6	9.7	8.7	112.0	16.7	53.7
T_{18}-Ethrel 200 ppm	17.7	11.7	357.2	10.3	7.3	104.3	17.0	54.3
T_{19}-Control	10.3	15.0	396.3	8.7	12.3	129.2	11.7	51.7
General mean	**12.7**	**14.4**	**402.6**	**9.3**	**11.4**	**123.6**	**13.4**	**51.8**
CV (5%)	**6.8**	**8.4**	**1.8**	**11.4**	**12.5**	**3.2**	**2.9**	**3.3**
CD at 5%	**2.1**	**1.9**	**12.3**	**1.7**	**2.3**	**4.1**	**1.3**	**2.8**

recorded in minimum when the crop plants were sprayed with GA_3 75 ppm. Whereas, the GA_3 75 ppm treatment delayed the node number to bear first female flower (15.3) and increased the number of staminate flowers per vine (145.7) as well as widen the male to female sex ratio (15.7) when it was sprayed at two to four true leaves stage. The same GA_3 75 ppm treatment reduced the fruiting duration days (38.0 days) among all the total treatment sprayed. Also the highest number of node bearing first male flower (13.3) as well as maximum number of days taken to first male flower (54.7 days) were recorded in treatment NAA 300 ppm. The increasing concentration of GA_3 up to 75 ppm sprayed at second and fourth leaf stage caused a significant increase in main vine and intermodal length of bottle gourd. This might be due to stimulatory action of GA_3 on vine and intermodal length. According to Nath and Rao (1981) the ratio of male and female flowers is determined by a balance of auxin and gibberellins, the balance in favor of auxin resulting in the formation of female and the latter of male flowers. Gibberllic acid being growth promoter increased the length of main vine and suppressed the secondary branches. More vine growth lower down the carbohydrates to nitrogen ratio, which promotes maleness in bottle gourd. These results confirmed the findings of Sarkar et al. (1989) who recorded the longest vines and intermodal length in pointed gourd with the application of GA_3 at 200 ppm at second to fourth leaf stage. Sure et al. (2012) in pumpkin and Nagamani et al. (2015) who found that application of GA_3 @ 50 ppm significantly enhanced the vine length in bitter gourd over control. The results of the present study are in contrary to the finding of Hidayatullah et al. (2009) who reported that GA_3 significantly increased total number of pistillate flowers in cucumber. Further, Nagamani et al. (2015) stated that application of GA_3 significantly enhanced nodes number per vine in bitter gourd.

Fruiting parameters: The various growth substances and trace elements influenced the fruit parameters of bottle gourd fruit significantly. The fruits having maximum length and breadth of bottle gourd fruits (32.9; 7.5 cm), number of fruits per vine (7.7) and fruit yield per plot (24.4 kg) and per hectare (361.1 q/ha) was harvested from the crop spayed with Ethrel 200ppm the effect of which was equal to the effect of Ethrel 150 ppm (Table 2). The increasing concentration of Ethrel significantly increased the fruit yield and yield attributing characters such as number of fruits per vine, fruit length and fruit diameter (cm). The best results with maximum numbers fruit yield contributing traits were obtained when the crop was sprayed with Ethrel 200 ppm, which might be due to higher number of female flowers, higher number of fruits and higher fruit yield per vine which might be due to an increased rate of photosynthetic activity to build-up sufficient food stock, accelerated transport, efficient utilization photosynthetic products for developing female flowers, fruits and more fruit weight, ultimately leading to higher yield. These results corroborate the finding of Belhekar et al. (2006) and Kumar et al. (2006) found that Ethephon

Table 2: Effect of plant growth regulators and trace elements on fruiting parameters on bottle gourd variety GH 22

Treatments	Fruit length (cm)	Fruit diameter (cm)	Length of pedicel (cm)	Fruiting period (days)	Number of fruits per vine	Fruit yield per plot (kg)	Fruit yield per hectare (q)
T_1-$ZnSO_4$ 0.25%	26.7	6.6	10.4	42.3	5.3	23.6	282.6
T_2-$ZnSO_4$ 0.50%	27.0	6.7	10.9	43.7	5.7	24.2	289.8
T_3-$ZnSO_4$ 0.75%	27.6	6.9	11.8	45.3	6.0	24.9	298.4
T_4-$MnSO_4$ 0.3%	26.7	6.3	10.6	39.3	4.7	23.8	285.6
T_5-$MnSO_4$ 0.4%	26.4	6.4	10.9	40.7	4.3	22.7	272.4
T_6-$MnSO_4$ 0.5%	26.9	6.6	11.2	42.3	4.0	22.3	268.0
T_7-Boric acid 0.2%	26.2	6.1	13.7	42.3	5.3	23.2	278.6
T_8-Boric acid 0.3%	27.2	6.5	14.8	43.7	5.7	24.1	285.4
T_9-Boric acid 0.4%	27.5	6.4	15.1	44.0	6.0	25.7	296.4
T_{10}-NAA 200 ppm	26.2	6.8	15.2	44.3	6.3	24.8	297.0
T_{11}-NAA 250 ppm	27.2	6.9	15.7	45.7	6.7	25.6	301.8
T_{12}-NAA 300 ppm	29.5	7.1	16.2	46.3	7.3	26.8	321.8
T_{13}-GA_3 25 ppm	25.5	6.5	12.7	41.0	4.7	22.6	271.6
T_{14}-GA_3 50 ppm	24.4	6.4	12.0	38.7	4.3	21.7	260.6
T_{15}-GA_3 75 ppm	23.8	5.9	11.6	38.0	3.7	19.8	237.6
T_{16}-Ethrel 100 ppm	28.4	7.0	14.3	46.7	6.3	26.0	312.5
T_{17}-Ethrel 150 ppm	31.7	7.2	15.4	47.3	7.0	28.5	342.0
T_{18}-Ethrel 200 ppm	32.9	7.5	15.9	49.0	7.7	30.1	361.1
T_{19}-Control	26.2	6.1	13.1	39.0	5.0	23.1	273.4
General mean	**27.2**	**6.6**	**13.3**	**43.1**	**5.6**	**24.4**	**291.4**
CV (5%)	**2.9**	**2.5**	**3.9**	**3.8**	**1.6**	**10.6**	**10.6**
CD at 5%	**1.3**	**0.3**	**0.9**	**2.7**	**0.8**	**3.1**	**46.7**

250 and 300 ppm increased the average fruit length, breadth, fruit weight, number of fruits per plant, fruit yield and narrow the sex ratio in bottle gourd. Mahala et al. (2014) and Nanaware et al. (2014) in bottle gourd, Mahida *et al*. (2015) reported that Ethrel 250 ppm increased the number of fruits per vine, fruit yield per vine and fruit yield per hectare in Sponge gourd.

Whereas, the shortest fruits in length and breadth (23.9; 5.9 cm), number of fruits per vine (3.7) and fruit yield per plot (19.8 kg) and per hectare (237.6 q/ha) were harvested from the crop sprayed with GA_3 75 ppm. Whereas, the minimum length of pedicel 10.4 cm was recorded when the crop was sprayed with $ZnSO_4$ 0.25%, which was statistically at par with $ZnSO_4$ 0.50%, $MnSO_4$ 0.3, 0.4 and 0.5%. Reverse trend was observed with GA_3 75 ppm foliar application, which significantly decreased the number of fruits per vine (3.7), length and breadth of fruits (23.8 , 5.9 cm) and fruit yield per plot (19.8 kg) and per hectare (237.6 q). Gibberllic acid being growth promoter increases the vine length but suppresses the secondary branches. More vine growth reduces the carbohydrates to nitrogen ratio, which increases maleness in bottle gourd. The results of the present study are contrary to the finding of Mahala et al. (2014) reported that Ethrel 100 ppm was most effective in increasing fruit diameter, number of fruits per vine, fruit weight and fruit yield in bottle gourd. Patel et al. (2017) reported that Ethrel@600 ppm profoundly increased the number of female flower and fruit yield, while minimum male flowers and lowest sex ratio were recorded in Ethrel 600 ppm.

Conclusion

From the present study, it is concluded that bottle gourd crop variety GH 22 produced the maximum number of fruits, length & breadth and fruit yield when the crop was sprayed with Ethrel @ 200 ppm followed by Ethrel @ 150 ppm.

सारांश

वर्तमान प्रयोग में लौकी की किस्म जी.एच.–22 में तीन पादप वृद्धि नियंत्रकों (नैफ्थलिक एसिटिक एसिड 200, 250 व 300 पीपीएम जिब्रेलिक एसिड 25, 50 व 75 पीपीएम एवं इथ्रेल 100, 150 व 200 पीपीएम) और तीन सूक्ष्म पोषक तत्वों– जिंक सल्फेट 0.25, 0.50 व 0.75 प्रतिशत, मैंगनीज सल्फेट 0.30, 0.40 व 0.50 प्रतिशत और बोरिक एसिड 0.2, 0.3 व 0.4 प्रतिशत) के तीन स्तरों को क्रमशः दूसरे और चौथे पत्तियों की अवस्था में लौकी पर छिड़काव किया गया था। इन विभिन्न सूक्ष्म पोषक तत्वों और पादप वृद्धि नियंत्रकों का प्रभाव ग्रीष्म लौकी के पौधों की फल उपज पर अध्ययन 2017–18 के दौरान सब्जी विज्ञान विभाग के अनुसंधान फार्म, हरियाणा कृषि विश्वविद्यालय, हिसार में किया गया इस प्रयोग में सीमित सभी 19 उपचार संयोजन तीन प्रतिकृति के साथ यादृच्छिक प्रखंड आकार विधि से लगाए गये। अध्ययन के परिणामों से स्पष्ट हुआ कि जब इथ्रेल 200 पीपीएम पादप वृद्धि रसायन का छिड़काव लौकी के पौधों में दूसरे और चौथे सत्य पत्तियों की अवस्था में किया गया, तब फल की पैदावार और इसक संबंधित गुणों में काफी वृद्धि हुयी। प्रति लौकी प्रति गाँठ की संख्या पर मादा फूल लगने की अवस्था में कमी (7.3), लता की लम्बाई में कमी (357.2 से.मी.) प्रति लता नर फूल लगने की अवस्था में कमी (104.3), तने पर मौजूद प्रति गांठों के बीच की लम्बाई में कमी (11.7 से.मी.), फल की लम्बाई और व्यास में वृद्धि (329, 7.5 से.मी.), पुष्पवृन्त की लम्बाई में वृद्धि (15.9 से.मी.), प्रति पौध मादा फूल (17.0), प्रति पौध फलों की संख्या (7.7) और फलों की उपज प्रति हेक्टेयर (361.1 कुन्तल/हेक्टेयर) पायी गयी जबकि, जिब्रेलिक एसिड 75 पीपीएम के छिड़काव से पार्श्व संख्या की पहली मादा फूल लगने की अवस्था में देरी की (15.3) और प्रति पौधे नर फलों की संख्या में वृद्धि (145.7), तने पर मौजूद प्रति गांठों के बीच की लम्बाई और मुख्य लता की लम्बाई में वृद्धि हुयी (16.7 और 487 से.मी.) जबकि यह प्रति गाँठ पर नर फूल लगने की अवस्था (6.7) पहले नर फूल लगने के दिनों (46.7) में कमी पायी गयी। साथ ही साथ प्रति पौध मादा फूलों की संख्या (9.0) फल की लम्बाई और व्यास (23.8, 5.9 से.मी.) पुष्पवृन्त की लम्बाई में वृद्धि (11.6 से.मी.) और फल लगने की अवधि के दिनों (38 दिन), प्रति प्रखण्ड और प्रति हेक्टेयर फल की उपज (19.8 किलोग्राम 287.6 कुन्तल) न्यूनतम संख्या पायी गयी जबकि प्रति गांठ बाद में नर फूल लगने की अवस्था (13.3) नैफ्थलिक एसिटिक एसिड 300 पीपीएम में पायी गयी। अध्ययन से स्पष्ट हुआ कि लौकी की किस्म जीएच–22 में जब इथ्रेल की 200 पीपीएम के साथ छिड़काव किया गया तो फल की अधिकतम उपज (361.1 कुन्तल/हेक्टेयर) प्राप्त होती है।

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