JOURNAL OF AGRICULTURE AND CROP SCIENCE
Journal homepage: www.jakraya.com/journal/jacs

ORIGINAL ARTICLE

Effectiveness of Various Growth Retardants on Growth and Yield of Okra

C.K. Pateliya, B.R. Parmar, H.L. Kacha and S.K. Patel

Krishi Vigyan Kendra, AAU, Dahod, Gujarat, India.

Correspondence Author:

Prof. H.L. Kacha,

Email: kacha.hitesh@yahoo.com

Received: 26/11/2014

Revised: 30/11/2014

Accepted: 01/12/2014

Abstract

The aim of the study was to evaluate the effectiveness of various growth retardants on growth and yield of okra. The experiment was laid out in a Randomized Block Design with ten treatments and three replications. The treatments were Cycocel (CCC), Maleic Hydrazide (MH), Ethrel and control, sprayed at two different stages viz., 25 and 50 days after sowing. The results revealed that CCC 300 ppm recorded the maximum retardation in plant height and induced the maximum number of branches and leaves per plant. The girth of the main stem and number of internodes was recorded highest at CCC 300 ppm. The Foliar application of CCC 300 ppm significantly reduced intermodal length as compared to control. Spraying of CCC 300 ppm at 25 and 50 days after sowing significantly influenced on increase in fruit length, fruit diameter and girth of fruit. Significantly highest fruit yield per plant, numbers of fruits per plant and fruit yield per hectare was noted at CCC 300 ppm. The minimum fruit yield was received in control.

Keywords: Growth retardants, okra, growth and yield.

1. Introduction

Okra (*Abelmoschus esculentus* (L.) Moench) is an annual vegetable crop belongs to family *Malvaceae*. The centre of origin is tropical and sub-tropical region of the world. Okra is known as 'Gumbo' in United States of America, 'Ladys Finger' in England, whereas 'Bhinda' or 'Bhindi' in India. Okra is the most profitable summer vegetable. It occupies a place of prominence amongst summer vegetables in our country. Its adaptability to a wide range of growing condition makes it popular among vegetable growers. It is widely grown for its immature tender fruits which are used as vegetable. It is used in curries, stewed with meat and cooked into soups. Fruits are also canned green or dried off season uses. The root and stem of okra plants are used for cleaning the cane juice in the manufacture of Jaggery and Sugar (Chauhan, 1972). Okra fruits also have nutritional and medicinal values as the fruit contain 6.4 g carbohydrates, 2.2 g protein 0.2 g fat, 66 mg calcium, 500 mg phosphorus, 15 mg iron and 13 mg vitamin-C per 100 g edible portion. Similarly, okra fruit is excellent source of iodine which is necessary for the resistance against throat disease like goiter (Chauhan, 1972). It is good for the people suffering from heart weakness (Yawalkar, 1969). Ripen seeds are roasted ground and used as substitute for coffee in turkey. Matured fruits and stem contain crude fibre are used in paper industry. Among fruit vegetable okra is an important fruit vegetable having good demand throughout the year for its tender fruits. India is the largest producer of okra in the world (Anon., 2013). Total area under okra cultivation in India is estimated to be 3.6 lakh hectares with an annual production of 35 lakh tones (Shanmagasundaram, 2004). The area under okra cultivation in Gujarat is 65.66 thousand hectares, with the production of 723.33 thousand MT (Anon., 2013). Okra crop requires long warm growing season and is susceptible to frost. The optimum day temperature for its better growth is between 25^{o}C to 40^{o}C and that of night is over 22^{o}C. It thrives in all kinds of soils but to well drained medium black and light clayey soils, rich in organic matter and favourable soil pH range form 6.0 to 6.8 is more suitable for okra cultivation.

The growth and yield of cultivated crop plants is mainly influenced by genetic and crop management factors. First factor involve in various breeding techniques while second factor involves cultural operation, plant protection and other agronomical practices, both these factors have been fully exploited by various research workers. In recent years, scientists have given attention to the idea of regulating plant growth as third most important factor in improving the growth, yield and quality with the application of plant growth substances in various ways (Cathey, 1964). It helps in efficient utilization of metabolites in certain

physiological process going in plant systems. The role of Cycocel has been found to retard the plant height by reducing inter nodal length and simultaneously induce the formation of lateral shoots thereby, plant possess more number of fruit bearing shoots. MH has been found to suppression of apical dominance thus, enhancing lateral shoots and increasing fruit yield. Ethrel is synthetic ethylene releaser, it induce flowering and act as growth inhibitor as well as promoter. Among several growth retardants CCC, MH and Ethrel are very promising and these are being used a large scale in vegetable crops. Considering the importance of okra by way of green fruits as vegetable the present study was conducted to determine the effect of different growth retardants on growth, yield and quality of okra at different concentration, supplied as foliar spray.

2. Materials and Methods

The present experiment on "Effectiveness of various growth retardants on growth and yield of okra was undertaken during the summer season of the year 2005 at the College farm, N.M. College of Agriculture, Navsari Agricultural University, Navsari. Navsari is situated at 20.95^0N latitude, 75.90^0E longitude and 10 meters above the mean sea level (MSL). An experiment in which, ten treatments involving three levels of each growth regulators viz.; CCC (100, 200 and 300 ppm), MH (150, 200 and 250 ppm) and Ethrel (100, 200 and 300 ppm) and control (water spray) were embedded in Randomized Block Design (RBD) with three replications. All the plants selected were uniform in growth and size at the distance of 45 cm x 30 cm. The climate of South Gujarat is typically tropical and characterized by fairly hot summer, moderately cool winter and warm humid monsoon. Generally, the monsoon in this region commences in the third week of June and retreats by end of September. Pre-monsoon rains in the last week of may or in the first week of June are not uncommon. Most of the precipitation is received from South-West monsoon, concentrating in the months of July and August. Average annual rainfall of this region approximates about 1501.73 mm (Average of last ten years of 1994 to 2003). The winter sets in usually towards the end of October. The temperature starts dropping from the beginning of November and lowest minimum temperature of the season is recorded either in December or January and hence these two months are the coldest months of the season. From February onwards the temperature starts rising and reaching the maximum in the months of May-June. However, during experimental period from February to May, monthly maximum temperature varied from 31.2^oC to 37.4^oC, minimum temperature 21.1^oC to 29.3^oC and humidity 17 to 90 per cent was recorded. The soil of experimental field is well drained fairly leveled, medium black with medium fertility and soil depth of more than two meters. Soil samples from site were drawn from depth of 0-30 cm and analyzed for physical and chemical properties. The physical properties of soil were 14.18, 19.35 and 64.78 per cent of sand, silt and clay, respectively. The values of available nitrogen, phosphorus and potash in the experimental soil were 243.01, 54.09 and 419.00 kg/hectare, respectively. The organic carbon 0.69 percent, soil pH 7.46 and electric conductivity 0.38 dS per meter were observed in the soil. The okra variety 'GO-2' was selected for the present study because the fruits of this variety are green, tender and attractive which will fetch the higher price in market. It is also highly resistant to yellow vein mosaic virus (YVMV) and suitable for both summer and *Kharif* season. Two sprays of plant growth regulators were done at 25 and 50 days after sowing. For the preparation of foliar spray solution, the required quantity of CCC (Chloromequat), MH (Maleic Hydrazide) and Ethrel weighted separately. CCC and Ethrel were dissolved in distilled water, while MH were dissolved in hot water and final volume made up to 1.0 liter by adding distilled water, subsequently solution of 100, 200 and 300 ppm of CCC, 150, 200 and 250 ppm of MH and 100, 200, 300 ppm of Ethrel were prepared by addition of distilled water just before spraying. The data pertaining to all the characters studied were subjected to the statistical analysis of variance techniques as described by Panse and Sukhatme (1967). The treatment differences were tested by "F" test of significance on the basis of null hypothesis. The appropriate standard error (SEm.±) was calculated in each case. The critical difference (C.D.) at 5 per cent level of probability was worked out, whenever the treatment effects were significant to compare the two treatments means. All the plants were subjected to uniform application of manures and fertilizers, plant protection measures and other cultural practices.

3. Results and Discussion

3.1 Morphological Characters

The mean data on morphological characters was recorded at the final stage of growth as affected by foliar spray of growth retardants along with statistical inference are presented in Table 1. The results showed that lowest plant height (61.20 cm) and inter nodal length (4.64 cm) was recorded with CCC 300 ppm and significantly superior over control followed by the CCC 200 ppm and CCC 100 ppm (64.30 and 68.35 cm, respectively) and MH 250 ppm (70.50 cm), which was statistically at par with each other. The foliar application of 300 ppm CCC at 25 and 50 days after sowing was recorded highest number of functional leaves per plant (41.71), stem girth (2.77 cm), internodes per main stem (11.65) and number of -

Table 1: Effect of growth retardants on morphological characters of okra Cv. GO-2

Treatments	Plant height (cm)	No. of leaves/ plant	Girth of the main stem (cm)	No. internodes/ main stem	Internodal length (cm)	No. of branches/ plant
T_1 : CCC 100 ppm	68.35	36.18	2.46	10.33	4.98	2.55
T_2 : CCC 200 ppm	64.30	39.19	2.61	10.97	4.77	3.25
T_3 : CCC 300 ppm	61.20	41.71	2.77	11.65	4.64	3.70
T_4 : MH 150 ppm	76.28	36.20	2.43	10.20	5.30	2.07
T_5 : MH 200 ppm	74.27	36.33	2.46	10.32	5.20	2.57
T_6 : MH 250 ppm	70.50	39.81	2.63	11.05	4.67	3.70
T_7 : Ethrel 100 ppm	81.72	33.68	2.15	9.05	5.28	1.65
T_8 : Ethrel 200 ppm	80.45	34.34	2.26	9.50	5.17	1.82
T_9 : Ethrel 300 ppm	79.12	34.77	2.30	9.64	4.73	2.10
T_{10} : Control	84.25	32.96	2.00	8.40	5.73	1.60
S. Em. $\pm$	4.83	2.53	0.14	0.62	0.22	0.14
C.D. at 5%	10.14	5.33	0.31	1.31	0.46	0.30
C.V. %	7.98	8.51	7.60	7.60	5.41	7.02

Table 2: Effect of growth retardants on yield attributing characters of okra Cv. GO-2

Treatment	Fruit length (cm)	Fruit diameter (cm)	Number of green fruits per plant	Fresh weight of fruit (g)	Fruit yield per plant (g)	Fruit yield (t/ha)
T_1 : CCC 100 ppm	11.56	1.78	14.00	12.89	221.89	13.45
T_2 : CCC 200 ppm	11.72	1.85	14.33	13.54	235.49	14.28
T_3 : CCC 300 ppm	12.86	1.93	16.44	13.84	250.24	15.17
T_4 : MH 150 ppm	11.34	1.50	14.33	12.69	219.03	13.28
T_5 : MH 200 ppm	11.43	1.58	14.45	12.96	221.53	13.43
T_6 : MH 250 ppm	12.17	1.90	15.16	13.18	237.28	14.39
T_7 : Ethrel 100 ppm	10.08	1.08	12.74	11.68	194.33	11.78
T_8 : Ethrel 200 ppm	10.41	1.19	13.16	12.34	204.00	12.37
T_9 : Ethrel 300 ppm	10.66	1.27	13.47	12.64	207.00	12.55
T_{10} : Control	9.82	1.00	11.67	10.60	180.38	10.94
S. Em. $\pm$	0.49	0.10	1.09	0.53	13.47	0.81
C.D. at 5%	1.03	0.21	2.29	1.12	28.31	1.71
C.V. %	5.40	8.27	3.57	5.17	7.60	7.60

branches per plant (3.70), which was statistically at par with MH 250 ppm with each other. The effect of growth retardant on morphological characters of okra might be due to suppression of vegetative growth which leads to less demand for food materials synthesized by growth retardant treated plants. Thus, the excessive carbohydrate reserves might have accelerated the reproductive characters of okra is also supported by the findings of Tosh *et al.* (1978), Patel and Singh (1991) and Sajjan *et al.* (2003) in okra.

3.2 Yield Attributing Characters

The data indicated that effectiveness of various levels of growth retardants on yield attributing characters were found significant among all the treatments (Table 2). The foliar application of CCC 300 ppm at 25 and 50 days after sowing produced significantly maximum fruit length (12.86 cm), fruit diameter (1.93 cm), number of green fruits per plant (16.44), average fruit weight (13.84 g), fruit yield per plant (250.24 g) and fruit yield (15.17 t/ha) which was at par with MH 250 ppm followed by MH 200 ppm and CCC 200 ppm in most of the characters. Whereas, the lowest yield attributing characters was noted in control treatments. The increasing fruit yield in the treatment CCC might be due to decreased in the plant height and increased the number of branches as a resulting in diversion of flow of food materials for increasing the flowering and fruiting of okra. Same trends was observed by Tosh *et al.* (1978), Chudasma (1991) and Sanjjan *et al.* (2003) in okra and Patel *et al.* (2005) and Desai *et al.* (2005) in bottle guard.

4. Conclusion

It is concluded that the foliar application of CCC 300 ppm at 25 and 50 days after sowing is most

effective treatment for producing maximum number of branches, maximum number of fruits per plant, fruit yield per plant, fruit weight and yield per hectare in okra Cv. GO-2 under South Gujarat conditions.

References

Anonymous (2013). District wise area and production of Horticultural Crops. *Department of Horticulture, Gandhinagar, Gujarat.*

Cathey HG (1964). Physiology of growth retarding chemicals. *Annual Review of Plant Physiology,* 15: 271-302.

Chauhan DVS (1972). Vegetable production in India (3rd Ed.). *Publication by Ram Prasad and Sons, Agra.*

Chudasma VN (1991). Effect of plant growth substances on growth and growth attributing characters in okra. *M.Sc. (Agri.) Thesis Submitted to GAU, S.K. Nagar, India.*

Desai MM, Naik JR and Intwala CG (2005). Effect of growth retardants on sex behaviour and yield of bottle gourd. *Paper presented in National Seminar on Plant Physiology, Navsari (Gujarat),* pp: 126.

Hunge RV, Vyakaranahal BS, Kulkarni GN and Shashidhara SK (1991). Effect of growth regulators on seed quality of vegetable cowpea. *Current Research,* 20(11): 236-237.

Jackson MC (1967). "Soil chemical analysis" *Prentice Hall of India Pvt. Ltd., New Delhi,* pp. 183-192.

Mangal JL, Lal S and Arora SK (1988). Studies on the effect of chlorocholine chloride and naphthalene acetic acid application on salt resistance and productivity of okra. *Haryana Agricultural, University Journal of Research,* 18(3): 191-197.

Panse VG and Sukhatme PV (1967). Statistical methods for agricultural workers. *ICAR Pub., New Delhi,* pp. 369.

Patel AM, Desai JR, Patel SR and Patel GL (2005). Comparative study of apical nipping and CCC with different spacing in okra Cv. GO-2. *National Seminar on Plant Physiology,* pp. 122.

Patel KD (1989). Studies into the effect of CCC and plant density on plant growth and yield components in okra (*Abelmoschus esculentus* (L.) Moench). Cv. Pusa Sawani. *M.Sc. (Agri.) Thesis Submitted to GAU, S.K. Nagar, India.*

Patel KD and Singh SP (1991). Effect of CCC and plant density on plant height and yield components in okra. *Orissa Journal of Horticulture,* 19(1-2): 14-21.

Patel KM (1988). Efficiency of growth regulators and urea on growth, yield and yield component in okra (*Abelmoschus esculentus* (L.) Moench). Cv. Pusa Sawani. *M.Sc. (Agri.) thesis submitted to GAU, S.K. Nagar, India.*

Sajjan AS, Shekharagouda M, Pawar KN and Vyakarnahal BS (2003). Effect of regulatory chemical on growth, yield attributes and seed yield in okra (*Abelmoschus esculentus* (L.) Moench). *Orissa Journal of Horticulture,* 31(2): 37-41.

Shanmagasundaram S (2004). The Hindu Survey of Indian Agriculture. *Publication by Kasturi and Sons Ltd. Chennai*, pp.126-127.

Singh AK and Mishra EM (1977). Effect of Ethrel and CCC on growth and yield of okra (*Abelmoschus esculentus* (L.) Moench). *Indian Journal of Horticulture*, 34(4): 435-436.

Tosh C, Choudhary MA and Chatterjee SK (1978). Effect of growth regulators on growth, development and yield of okra (*Abelmoschus esculentus* (L.) Moench). *Science and Culture Journal,* 44(12): 544-547.

Yawalkar KS (1969). Vegetable crops of India. *Agriculture of Horticulture Publication House, Nagpur.*