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Influence of plant growth retardant on seed yield and quality of Okra

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Abstract
A field experiment was conducted during kharif season of 2019-2020 at Instructional Farm, Department of Vegetable Science, Faculty of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola to study the "Effect of plant growth retardants on growth and quality of okra (*Abelmoschus es*culentus L.). The experiment was laid out in Randomized Block Design (RBD) with three replications and ten treatments. The treatments were Cycocel (CCC), Maleic Hydrazide (MH), Ethrel and control, sprayed at two different stages *viz*., 30 and 50 days after sowing. Spraying of CCC 500 ppm at 30 and 50 days after sowing significantly influenced on increase in numbers of fruit per plant length of fruit, diameter of fruit, Number of seeds per fruit and weight of seed per fruit. Significantly highest fruit yield per plant, fruit yield per plot and fruit yield per hectare as well as quality parameters like test weight, graded seed yield and germination percentage was noted at CCC 500 ppm. The minimum fruit yield was received in control.

Keywords: Abelmoschus esculentus, plant growth retardants, okra, Quality and seed yield

Introduction
(*Abelmoschus esculentus* L. Moench) the member of family Malvaceae is considered to have its origin in Tropical America. It is important vegetable crop in Indian diet. It is widely grown as an annual herbaceous vegetable crop. It is often cross-pollinated crop and having diploid chromosome number 2n=132 (Bassett, 1986). It also called as 'Lady's finger' or 'Bhendi'. Its tender green fruits are used as a vegetable and are generally marketed in the fresh state, but sometimes in canned or dehydrated form. Okra fruits can be cooked in a variety of ways. It can be fried in butter or butter oil and cooked with necessary ingredients. They can boil and served as salad or cut into pieces and served with soup. The roots and stems of okra are used for clearing the cane juice from *gur* or brown sugar is prepared (Chauhan, 1972) [4]. Okra fruits also have nutritional and medicinal values as the fruit contain 6.4 g carbohydrates, 1.9 g protein 0.2 g fat, 66 mg calcium, 56 mg phosphorus, 1.5 mg iron and 13 mg vitamin-C per 100 g edible portion (Bose, 1999) [2]. Similarly, okra fruit is excellent source of iodine which is necessary for the resistance against throat disease like goiter (Chauhan, 1972) [4]. In some places, the plants are soaked in water and the resulting solution is used as a clarifier in the manufacture of jiggery. Its ripe seeds are roasted, ground and used as a substitute for coffee in Turkey (Mehta, 1959) [7]. Matured fruits and stems containing crude fiber are used in the paper industry. Okra is rich in vitamins, calcium, potassium and other minerals matters.

Okra is an important fruit vegetable. Plant growth regulators prove beneficial for augmentation of physico-biochemicals processes. Yield potential of okra can be improved with the adoption of scientific cultivation technology including use of growth retardant. Growth retardants help in efficient utilization of metabolites play vital role in the regulation of plant system, formation of pods, seed, etc. in the plant. The crop is easy to cultivate and suited to regions with moderate rainfall. Okra is a warm season crop, requiring ample moisture for germination. Okra has high nutritional, medicinal and industrial value and high financial value. The seeds are also a good source of vitamins, minerals and medically important compounds mucilage occurs in most parts of the plant and is associated with other substances such as tannins. It usually occurs in the roots, bark and seeds, but is also found in the flowers, leaves and cell walls. The edible part of okra is the immature pod, which is harvested when tender. The leaves, buds and flowers are also edible. Dried okra can also be stored and used later for soup or stew. In West Africa, okra is utilized mainly because of its high mucilage content which is used in the thickening of soup.

Scientific seed production resembles an importance of quality seed to be used for raising of crop in order to get better and higher production of quality vegetables. Inadequate supply of good quality seed is one of the main constrain in getting the increased production of vegetable crops. Although, the seed production in vegetable is highly profitable, yet the growers are afraid to take up this venture because of lack of technical knowledge in production technologies. In recent years, a number of different and reliable approaches have been made to increase the quality seed production by use of various growth retardants. This technique has acquired response and is currently being exploited in the seed production unit especially in the vegetable crops.

Materials and methods

The investigation was carried out at Instructional Farm, Department of Vegetable Science, Faculty of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during kharif season of 2019 - 2020. The experiment was laid out in randomized block design with three replications and ten treatments on medium black soil with uniform in texture, colour and having good drainage.

Two sprays of plant growth retardants were done at 30 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 dispray 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 400, 500 and 600 ppm of CCC, 200, 300 and 400 ppm of MH and 200, 300, 400 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) [8].

Result and Discussion

Seed yield characters

The results presented in Table 1 revealed that the response of different growth retardants on seed yield contributing characters of okra.

Number of fruit plant

The significantly highest (12.03) number of fruit plant was recorded in the treatment CCC 500 ppm (T2), which was followed by (11.46) found in treatment CCC 600 ppm (T3) and was statistically at par with the treatment MH 300 ppm (T5). However, significantly (9.73) lowest number of fruit plant was recorded in the treatment Control (T10). These findings are in accordance with Pateliya *et al.* (2010) [10] and Rajput *et al.* (2011) [12] in okra.

Length of fruit

Significantly lowest (10.12) length of fruit was recorded in treatment Control (T10).The maximum fruit length was noted with the treatment CCC 500 ppm as compared to other treatment. This might be due to cycocel triggers off the mobilization of metabolites, produced in other parts of the plants in to the fruit. Thus, fruit length can be promoted and stem growth inhibited. These findings are in accordance with Pateliya *et al*. (2010) [10] and Rajput *et al.* (2011) [12] in okra.

Diameter of fruit

Significantly lowest diameter of fruit (1.06) was recorded in the treatment Control (T10). Maximum diameter of fruit (2.47 cm) was recorded in treatment which received CCC 500 ppm. The reason for increased in fruit diameter was due to increased rate of respiration and photosynthesis of growth retardant treated plants than the plants in control treatment as explained by (Audus, 1960). This increase in fruit diameter due to CCC was reported by Barche *et al*. (2010) [1], Rajput *et al.* (2011) [12], Pateliya *et al*. (2014) [11].

Number of seed fruit

The significantly maximum (68.86) number of seeds fruit was recorded in the treatment CCC 500 ppm (T2) and significantly minimum (58.06) number of seeds fruit was recorded in the treatment Control (T10), similar findings was observed by Pateliya *et al*. (2014) [11] reported that number of seeds increases in okra with application of Cycocel.

Weight of seed fruit

The maximum weight of seed fruit (3.71) was recorded under T_2 treatment i.e. CCC 500 ppm, as compared to different treatment. This might be due to enhancement effect of cycocel for food materials translocation towards the site of new pod formation and pod development, ultimately increased the fruit weight. The results are in agreement with Patel *et al.* (2005) [9] and Kumawat *et al*. (2019) [6] in okra.

Seed yield plant

The maximum seed yield plant was recorded under foliar application of CCC 500 ppm (28.86 g), as compared to other treatments. The increasing seed yield in the treatment cycocel 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 in flowering and fruiting in okra. Similar trends were also observed by Pateliya *et al*. (2010) [10] and Rajput *et al.* (2011) [12] in okra.

Seed yield plot

The significantly maximum (1.48 kg) seed yield plot was recorded in the treatment CCC 500 ppm (T2), which was significantly superior over rest of all treatments. However, significantly minimum (0.94 kg) seed yield plot was recorded in treatment Control (T10).

Seed yield hectare

The significantly maximum (13.41 q) seed yield hectare^{-1} was recorded in the treatment CCC 500 ppm (T2), which was significantly superior to other treatments. However, significantly minimum (9.92 q) seed yield hectare was recorded in the treatment Control *i.e*. T10.

Table 1: Effect of plant growth retardants on seed yield contributing characters in okra

Treatments	Number of fruit plant	Length of fruit (cm)	Diameter of fruit (cm)	Number of seeds fruit	Weight of seed fruit	Seed yield plant (g)	Seed yield plot (kg)	Seed yield hectare (q)
T_1: CCC 400 ppm	11.06	13.18	1.68	65.20	3.34	24.53	1.22	12.02
T_2: CCC 500 ppm	12.03	15.24	2.47	68.86	3.71	28.86	1.48	13.41
T_3: CCC 600 ppm	11.46	13.21	1.96	67.20	3.38	25.20	1.38	12.37
T_4: MH 200 ppm	11.03	12.31	1.70	63.33	3.18	24.03	1.21	11.23
T_5: MH 300 ppm	11.30	13.02	1.91	65.60	3.36	24.66	1.23	11.55
T_6: MH 400 ppm	11.00	12.07	1.69	63.26	3.17	24.06	1.20	11.27
T_7: Ethrel 200 ppm	10.06	11.86	1.59	61.06	3.11	23.80	1.16	10.98
T_8: Ethrel 300 ppm	10.26	11.92	1.64	61.60	3.13	23.93	1.17	11.00
T_9: Ethrel 400 ppm	10.86	12.42	1.66	63.13	3.16	24.00	1.19	11.25
T_{10}: Control	9.73	10.12	1.02	58.06	2.77	18.60	0.94	09.92
S. Em. +	0.29	0.59	0.18	1.61	0.12	1.21	0.06	0.34
C.D. at 5%	0.86	1.76	0.54	4.80	0.36	3.61	0.19	1.01

Quality parameters

The results presented in Table 2 revealed that the response of different growth retardants on seed quality of okra.

Test weight

The significantly highest (63.78g) test weight was recorded in the treatment CCC 500 ppm *i.e.* T2, which was followed by (60.07 g), found in treatment CCC 600 ppm (T3). However, significantly lowest (53.52 g) test weight was recorded in the treatment Control (T10) which was followed by treatment T7 & T8 *i.e.* treatments Ethrel 200 ppm and Ethrel 300 ppm, respectively.

Graded seed yield

The significantly highest (71.95%) graded seed yield was recorded in the treatment CCC 500 ppm (T2), which was significantly superior over other rest of the treatments. However, significantly lowest (57.15%) graded seed yield percentage was recorded in treatment Control (T10).

Germination percentage

The significantly highest (79.43%) germination percentage was recorded in the treatment CCC 500 ppm *i.e.* T2, which was significantly superior over rest of the other treatments. However, significantly lowest (70.38%) germination percentage was recorded with the control treatment (T10).

Table 2: Effect of plant growth retardants on seed quality parameters in okra

Treatments	Test weight (g)	Graded seed yield (%)	Germination percentage (%)
T_1: CCC 400 ppm	59.33	70.30	76.91
T_2: CCC 500 ppm	63.78	71.95	79.43
T_3: CCC 600 ppm	60.07	70.39	77.12
T_4: MH 200 ppm	58.11	69.08	75.29
T_5: MH 300 ppm	59.38	69.12	76.75
T_6: MH 400 ppm	58.40	64.09	75.10
T_7: Ethrel 200 ppm	57.39	58.53	73.35
T_8: Ethrel 300 ppm	57.75	59.36	73.45
T_9: Ethrel 400 ppm	58.09	59.74	74.98
T_{10}: Control	53.52	57.15	70.38
S. Em. +	1.21	0.43	0.75
C.D. at 5%	3.62	1.30	2.24

Conclusion

From the findings of the present investigation it can be concluded that application of plant growth retardants significantly improves the growth, seed yield and quality of okra. According to the data it is observed and concluded that, the foliar application of 500 ppm CCC i.e. treatment T_2 was found better and number of fruit plant, length of fruit, diameter of fruit, number of seeds fruit, weight of seeds fruit, seed yield plant, seed yield plot, seed yield hectare as well as test weight of seed, graded seed yield and germination percentage of okra seed as compared to control treatment.

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