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Effect of seed soaking and foliar sprays of plant growth regulators on germination, growth and yield of okra [*Abelmoschus esculentus* (L.) Moench] var. Parbhani Kranti

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ABSTRACT : A study was conducted to find out the effect of seed soaking and foliar sprays of plant growth regulators on germination, growth and yield of okra (*Abelmoschus esculentus* L.) var. Parbhani Kranti.The treatment comprised of the two concentrations *i.e.* seed soaking of GA3 (50 and 100 ppm) and cycocel (100 ppm and 150) and foliar spray of cycocel (250, 500, 750, 1000 ppm) at 30 and 45 days after sowing and control. The experiment was laid out in Randomized Block Design with two replications. Soaking of okra seeds with GA3 @ 100 ppm and foliar sprays cycocel @ 750 and 1000 ppm at 30 and 45 DAS ,respectively was found to be beneficial in early germination (2.75 days),highest germination percentage (99.5), reduction in height of plant (86.65 cm), length of internodes (5.10 cm),and increase number of leaves (43), number of internodes (15.90), number of branches (3.15),leaf area(1249.5cm^2),resulted in to induce early flowering (34 days), increase number of flowers (23.40), fruit set (87.54 %), number of fruits (20.46),and yield per plant (201.30 g/plant) of okra.

KEY WORDS : GA_3, Cycocel, Okra

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Okra [*Abelmoschus esculentus* (L.) Moench] is an annual vegetable crop and belongs to family Malvaceae. The primary centre of its origin is believed to be the tropical or subtropical Africa (Chauhan, 1972). It has been grown in the mediterranean as well as in the tropical and sub-tropical region of many countries.

Among fruit and vegetables, okra is an important vegetable having good demand throughout the year for its tender fruits. India is the largest producer of okra in the world. In recent years, scientists have given due 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 regulators in various ways.

Treatment of seed and foliar spray with plant growth regulator is one of the most popular methods and has been claimed as an effective tool by many workers for improving rate and amount of germination. Among the several growth substances, gibberellic acid (GA_3) and cycocel (CCC) are found very promising and these are being used in a fruit and vegetable crops. The role of GA_3 in cell elongation in plants has been well established which resulted in increasing the plant height. GA_3 also enhance, early flowering in many plant species. Contrary to GA_3, cycocel has been found to retard plant height by reducing internodes length and also simultaneously it induces the formation of lateral shoots thereby plant posses more number of fruits bearing shoots.

RESEARCH METHODS

The present investigation on effect of seed soaking and foliar spray of plant growth regulators on growth and yield of okra (*Abelmoschus esculentus* L.) var. Parbhani Kranti was undertaken at Instructional Cum Research Farm, Department of Horticulture, College of Agriculture Latur, during 2010-2011 under shade net condition. The experiment was laid out in Randomized Block Design with two

replications. There were 13 treatments of two concentrations of GA_3 @ 50 and 100 ppm, cycocel @ 100 and 150 ppm seeds soaking for 12 hours and foliar spray of cycocel @ 250, 500, 750 and 1000 ppm at 30 and 45 days after sowing and control. The treated seeds of okra were used for sowing. The seeds were dibbled manually with a recommended seed rate of 10 kg/ha, these seeds were dibbled at each hill 30 cm apart of row and 15 cm betweens plants. Thinning was done to keep only one healthy seedling at each hill by removing weak seedling after 15 days of sowing. Recommended cultural and plant protection measures were taken of uniformly in all plots as and when required.

RESEARCH FINDINGS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarised under following heads:

Effect on growth :

The data presented in Table 1 revealed that the lowest height of plant at 90 DAS was recorded in treatment T_{12} *i.e.* seed soaking of cycocel @ 150 ppm and foliar spray of cycocel @ 750 and 1000 ppm at 30 and 45 DAS (77.25 cm). The reason for reduction in height of plant might be that cycocel produced shorter stem length through inhibition of cell division.Cycocel interact with gibberellins or lower the levels of diffusible auxin and thereby suppress vegetative growth (Gowda and Gowda, 1983).

The highest number of leaves per plant were recorded in treatment T_{12} *i.e.* seed soaking of cycocel @ 150 ppm and foliar spray of cycocel @ 750 and 1000 ppm at 30 and 45 DAS (46.60), respectively, however, it was at par with treatment T_{11} *i.e.* seed soaking of cycocel 100 ppm and foliar spray of cycocel @ 750 and 1000 ppm at 30 and 45 DAS (44.10), respectively. The number of leaves was increased with increased in concentration of cycocel. It might be due to cycocel effective in suppressing apical dominance, there by promote the growth of lateral buds in to new shoots., (Arora and Dhankhar, 1992).which have effect on number of leaves higher in treatment of foliar spray of cycocel @ 750 and 1000 ppm. The highest number of internodes was recorded in treatment T_{10} *i.e.* seed soaking of GA_3 @ 100 ppm and foliar spray of cycocel @ 750 and 1000 ppm at 30 and 45 DAS (15.90), respectively, however, it was at par with treatment T_9 *i.e.* seed soaking of GA3 @ 50 ppm and foliar spray of cycocel @ 750 and1000 ppm at 30 and 45 DAS (14.70), respectively, T_{11} *i.e.* seed soaking of cycocel @ 100 ppm and foliar spray of cycocel @ 750 and 1000 ppm at 30 and 45 DAS (14.25), respectively. Cycocel reduced intermodal length by restricting the cell division hence, it increase the number of internodes (Tosh *et al.*, 1978). The lowest internodal length was recorded in treatment T_{10} *i.e.* seed soaking of GA_3 @ 100 ppm and foliar spray of cycocel @ 750 and 1000 ppm at 30 and 45 DAS (5.10 cm), respectively, however, it was at par with treatment T_{12} *i.e.* seed soaking of cycocel @ 150 ppm and foliar spray of cycocel @ 750 and 1000 ppm at 30 and 45 DAS (5.20 cm), respectively, T_{11} *i.e.* seed soaking of cycocel @ 100 ppm and foliar spray of cycocel @ 750 and1000 ppm at 30 and 45 DAS (5.30 cm), respectively, The length of intenodes was decreased with increased in concentration of cycocel, the growth of internodes was short mainly due to cycocel which restricted cell division and elongation in the apical meristem, hence, length of internodes was decreased (Patil *et al.*, 2008). Cycocel reduced intermodal length by restricting the cell division hence, it increased the number of internodes. The highest number of branches per plant was recorded in treatment T_{10} *i.e.* GA_3 @ 100 ppm seed soaking and foliar spray of cycocel @ 750 and 1000 ppm at 30 and 45 DAS (3.15), respectively, however, it was at par with treatment T_9 *i.e.* GA_3 @ 50 ppm seed soaking and foliar spray of cycocel @ 750 and 1000 ppm at 30 and 45 DAS (2.90), respectively, cycocel effective in suppressing apical dominance, there by promote the growth of axillary buds in to new shoots. Due to this reason number of branches was more with increase in concentration.

Effect on yield :

The data presented in Table 2 revealed that the significantly lowest number of days required for initiation of flowering was recorded in treatment T_{10} *i.e.* seed soaking of GA_3 @ 100 ppm and foliar spray of cycocel @ 750 and 1000 ppm at 30 and 45 DAS (34.00), respectively, however, it was at par with treatment T_9 *i.e.* seed soaking of GA_3 50 ppm and foliar spray of cycocel 750 and 1000 ppm at 30 and 45 DAS (34.60), respectively, It happened because of early germination.Similar results were reported by Suryanarayana and Arifuddin (1980) and Patil *et al*. (2008). Higher concentration of cycocel induced early flowering which might be due to suppression of vegetative growth and induction of early reproductive phase (Acharya, 2004). The highest number of flowers per plant was recorded in treatment T_{10} *i.e.* seed soaking of GA_3 @ 100 ppm and foliar spray of cycocel @ 750 and 1000 ppm at 30 and 45 DAS (23.40), respectively, however, it was at par with treatment T_9 *i.e.* seed soaking of GA_3 @ 100 ppm and foliar spray of cycocel @ 750 and 1000 ppm at 30 and 45 DAS (22.20), respectively,

Foliar spray of cycocel at higher concentration increase the number of flowers as compared to other treatment.These effect were perhaps, due to the fact that the treated plants were able to build up carbohydrate reserve favourable for more number of flowers (Vijayraghavan, 1999). Similar result were reported by Pal *et al.* (1970) and Arora and Dhankhar (1992). The highest fruit set percentage per plant was recorded in treatment T_{10} *i.e.* seed soaking of GA_3 @

100 ppm and foliar spray of cycocel @ 750 and 1000 ppm at 30 and 45 DAS (87.54%) respectively, however, it was at par with treatment T_9 *i.e.* seed soaking of GA_3 50 ppm and foliar spray of cycocel @ 750 and 1000 ppm at 30 and 45 DAS (86.63%), respectively,The increase in fruit set percentage was may be due to the presence of plant growth regulators (Gibberellins) essential for pollen tube germination and fertilization of the ovary and resulting growth of the ovary (Arora and Dhankhar, 1992). Similar result was reported by Pawar and Joshi (1977).

The highest number of fruit per plant was recorded in treatment T_{10} *i.e.* seed soaking of GA_3 @ 100 ppm seed soaking and foliar spray of cycocel @ 750 and 1000 ppm at 30 and 45 DAS (20.46), respectively, however, it was at par with treatment T_9 *i.e.* seed soaking of GA_3 @ 50 ppm and foliar spray of cycocel @ 750 and 1000 ppm at 30 and 45 DAS (19.30), respectively. Significantly higher number of fruits per plant, was obtained with increase in concentration of foliar spray of cycocel. The highest yield per plant was recorded in treatment T_{10} *i.e.* seed soaking of GA_3 @ 100 ppm and foliar spray of cycocel @ 750 and 1000 ppm at 30 and 45 DAS (201.30 g), respectively, however, it was at par with treatment T_9 *i.e.* seed soaking of GA_3 @ 50 ppm and foliar spray of cycocel @ 750 and 1000 ppm at 30 and 45

Table 1 : Effect of seed soaking and foliar sprays of plant growth regulators on germination and growth of okra

Treatments	Germination (%)	Height of plants (cm)	Number of leaves	Length of internode (cm)	Number of internodes (cm)	Number of branches	Leaf area (cm^2)
T_1	98	97.10	27.10	7.12	10.30	1.60	1225.5
T_2	99.5	98.40	29	7.30	11	1.80	1249.5
T_3	92	93.40	31.80	6.95	11.10	1.95	1187.5
T_4	92.50	91.50	33.95	6.75	11.30	2.05	1167.0
T_5	98.50	85.90	36.45	6.65	11.80	2.30	1153
T_6	99.50	84.15	37.30	6.40	11.90	2.40	1155.5
T_7	93	82.35	39.70	6.20	12.50	2.50	1138.5
T_8	93	81.55	40.50	6.15	12.90	2.60	1137.6
T_9	97	89.10	41.40	5.90	14.70	2.90	1130.2
T_{10}	99.50	86.65	43.00	5.10	15.90	3.15	1134.6
T_{11}	94	79.45	44.10	5.30	14.25	2.70	1124.2
T_{12}	92.50	77.25	46.60	5.20	13.70	2.70	1113.7
Control	83	102.00	22.90	8.25	9.70	1.40	1075.7
S.E.±	1.45	1.53	2.40	0.46	1.10	0.17	26.16
C.D. (P=0.05)	4.46	4.72	6.59	1.44	3.39	0.54	80.50
C.V	8.16	6.45	8.31	10.35	12.58	10.85	8.20

Table 2 : Effect of seed soaking and foliar spray of plant growth regulators on yield of okra

Treatments	Days to flowering	Number of flowers	Fruit set (%)	Number of fruits per plant	Yield/plant (g)
T_1	35.60	18.40	81.12	15.40	172.25
T_2	35.10	18.60	81.52	14.90	166.20
T_3	36.60	17.30	78.60	14.20	143.80
T_4	36.50	17.35	80.61	13.60	155.8
T_5	34.90	21.30	84.09	16.40	178.2
T_6	34.70	20.60	85.70	17.40	181.0
T_7	35.30	19.50	83.99	17.20	182.40
T_8	35.80	20.30	85.39	18.30	185.00
T_9	34.60	22.20	86.63	19.30	195.30
T_{10}	34.00	23.40	87.54	20.46	201.30
T_{11}	34.80	21.70	86.54	18.80	194.50
T_{12}	34.80	21.80	86.24	18.65	190.55
Control	39.60	12.60	75.20	10.15	134.10
S.E.±	0.79	1.07	1.21	0.81	10.66
C.D. (P=0.05)	2.44	3.30	3.73	2.49	32.59
C.V.	7.16	7.73	6.06	6.95	8.59

DAS (195.30 g), respectively. Higher concentration treated plants had higher number of internodes *i.e.* short internodal length,which resulted to produce more number of fruits. Significant improvement in yield may be due to cycocel reduced height of plant and increased branching resulting in diversion of food material for the improvement of flowering and fruiting.It might be also the result of decrease in level of auxin,this is resulted in increase in level of cytokinins that resulted in more flowering and fruiting (Mehrotra *et al.*, 1973), similar results were reported by Patel (1998) and Prasad and Shrihari (2008).

Conclusion:

On the basis of different characteristics it could be concluded that soaking of okra seeds with GA_3 @ 100 ppm and foliar sprays of cycocel @ 750 and 1000 ppm at 30 and 45 DAS found to be beneficial in early germination (2.75 days), highest germination percentage (99.5), reduction in height of plant (86.65 cm), length of internodes (5.10 cm), and increase number of leaves (43), number of internodes (15.90), number of branches (3.15), leaf area (1249.5 cm^2), resulted to induce early flowering (34 days), increase number of flowers (23.40), fruit set (87.54 %), number of fruits (20.46), and yield per plant (201.30 g/plant) of okra.

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