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EFFECT OF DIKEGULAC ON FLOWERING, FRUIT SETTING AND DEVELOPMENT OF *CUCUMIS SATIVUS* L.

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SUMMARY

Foliar application of dikegulac sodium (2,3:4-6-di-O-isopropylidene-α-L-xylo-2-hexalofuranosate) had promotive effect on flowering, fruit setting and fruit development of *Cucumis sativus*. It suppressed male flowering and promoted female flowers. Dikegulac at 50mgl^{-1} increased the length and girth of the fruits by 46.3% and 81.5% respectively. With the same concentration, the weight of the fruits was increased by 38.8%. Dikegulac (50mg l^{-1}) also improved the quality of the developing fruits by increasing the contents of insoluble carbohydrate and ascorbic acid in the fruits at 15 days of age.

Key words: **Dikegulac, flowering, fruit setting, fruit development, *Cucumis sativus***

INTRODUCTION

Bocion *et al*. (1975) first observed that dikegulac sodium (2,3:4-6-di-O-isopropylidene-α-L-xylo-2-hexalofuranosate), which is an intermediate product in the commercial synthesis of L-ascorbic acid, acted as a plant growth regulator. There are a number of reports showing its effect in modifying growth behaviour of plants. It quickly disrupted apical dominance and retarded plant growth (Arzee *et al*. 1977) leading to shortened plant height and deferred leaf senescence (Bhattacharjee and Gupta 1981).

Most of the informations, so far accumulated, described the effects of dikegulac on the vegetative phase of a plant. There are only a few reports on its effects on the reproductive phase. Foliar spray of dikegulac before flowering on *Chrysanthemum morifolium* (Arzee *et al.* 1977) and *Helianthus annuus* (Arzee *et al.* 1977, Purohit 1980) hastened flowering. Dikegulac increased setting of normal (Frost and Kretchman 1987) and parthenocarpic fruits (Bocion *et al*. 1975).

C. sativus is a monoecious cucurbit bearing male and female flowers on the same plant. This possesses four distinct phases in its life and grows throughout the year. The long vegetative phase (30-35 days) was followed by a male phase when only the male flowers are produced (10-15 days). Next is a long mixed phase where male and female flowers appear together (25-28 days). The last phase of growth is an abortive phase when most of the female flowers are abortive. Fruits are formed from female flowers in the mixed phase. In the present study, the effects of dikegulac on flowering behaviour, fruit set and fruit development of *Cucumis sativus* was therefore, examined.

MATERIALS AND METHODS

Seeds of *Cucumis sativus* (cv. Long green) were obtained from Bonpus Nursery, Burdwan. Though these plants grow throughout the year, the experiments were conducted from February to April having 12-13 h. of photoperiod with an average day temperature of 23 ± 4°C. Plants were cultivated in an experimental field for three successive years in natural conditions with a

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randomized block design following Ghosh and Basu (1984). Each experiment was repeated in three different plots. As there was no significant difference in the results obtained in three successive years, the data of the third year only are presented here. The study was carried out upto 90 days of age of the plants checking the data every third day. The count of flowers included the buds also and the data presented are of the main axis only, not of branches.

Solutions of dikegulac (25, 50 and 100 mg l^{-1}) (without surfactant) were sprayed at 5 days of age on the foliage for three alternate days. The solution was sprayed with a glass hand-sprayer to wet the leaves completely without dropping any solution on the ground. Distilled water was sprayed on the control plants. Extraction and estimation of soluble and insoluble carbohydrates in the fruits of different ages were done according to McCready *et al*. (1950). Extraction and estimation of ascorbic acid content of the fruits was done following Reddy *et al*. (1980). Statistical analyses were carried out following Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

Dikegulac affected reproductive phase of *Cucumis sativus*. Dikegulac treatment suppressed the male flowers leading to decrease in total flowering and decrease in the ratio of male to female flowers, though total number of female flowers was also increased (Table 1). Thus dikegulac promoted femaleness of the plant by decreasing the male flowers and increasing the female flowers (except at 100 mgl^{-1}). With dikegulac treatment, the mean node number (position) for the appearance of first male as well as female flower buds was much lower than control (Table 1) showing earliness of flowering and extension of the fruit-producing (productive) phase of the plant. The first appearance of both male and female flower buds became earlier with 50 mgl^{-1} dikegulac. The effects were decreased with higher concentrations (Table 1). Alteration of growth and flowering of Kalanchoe by dikegulac was reported by Nightingale *et al*. (1985). The results presented here are in accordance with the view of Bocion *et al*. (1975) that dikegulac causes promotion of flowering.

Exogenous application of dikegulac improved the fruit setting by 45% by increasing the number of female flowers (Table 2). 50 mgl^{-1} of dikegulac was most effective which also promoted the development of fruit leading to increase in the length (46.3%), girth (81.5%) and weight (38.8%) of the mature fruits (Table 2).

Increase in sucrose and ascorbic acid content was taken as criteria of improvement of quality of fruit by Chen *et al*. (1990). Lingle and Dunlop (1987) had a view that content and compositions of sugar are the major criteria in judging the quality of the fruits of *Cucumis melo*. In addition to the promotion in size and weight of the fruit, dikegulac treatment also increased sugar content of the developing fruits of *C. sativus* showing improvement in the quality of the fruits. In this plant soluble carbohydrate content was maximum at 5 days old fruit, reduced at 15 days and increased again at 25 days of age (Fig. 1A). On the other hand, the insoluble sugar content of the fruits increased from 5 days to 15

Table 1. Effect of dikegulac on flowering of *C. sativus*

Concentration	First node to bear		Number of flowers			Ratio of male/
(mg l^{-1})	Male bud	Female bud	Total	Male	Female	female flowers
Control	14.00	24.66	82.00	74.66	7.33	10.18
25	6.00	8.00	74.66	62.66	12.00	5.22
50	2.33	4.33	74.33	60.33	14.00	4.30
100	4.33	12.33	73.53	66.33	7.20	9.21
CD at 5% P	0.61	1.32	1.50	1.23	0.81	––

Count of flowers included the buds also. The data presented are of the main axis only.

Table 2. Effects of dikegulac on fruit setting and fruit development of *C. sativus*

Concentration ($mg\ l^{-1}$)	Number of		Fruit setting (%)	Fruit size				Weight of fruit (g)	Increase in weight (%)
	Female flowers	Fruits		Length (cm)	Increase in length (%)	Girth (cm)	Increase in girth (%)		
Control	7.33	3.00	40.9	8.2	–	6.5	–	85.0	–
25	12.00	9.00	75.0	10.0	22.0	10.3	58.5	90.0	3.9
50	14.00	12.00	85.7	12.0	46.3	11.0	81.5	118.0	38.8
100	7.20	4.00	55.6	9.0	9.8	6.7	3.1	71.6	–
CD at 5% P	0.81	0.67	–	0.59	–	0.73	–	1.2	–

Count of flowers included the buds also. The data presented are of the main axis only.

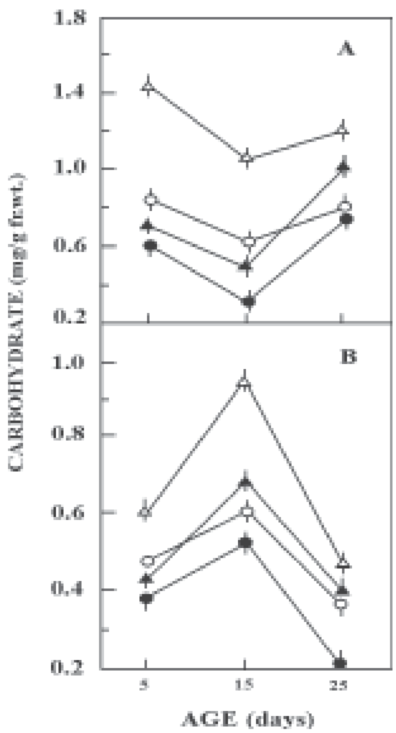

Fig. 1. Effects of dikegulac on soluble (1A) and insoluble (1B) carbohydrate content at different ages of cucumber (*C. sativus*) fruits. The concentrations of dikegulac were control (●), 25 mg l^{-1} (O), 50 mg l^{-1} (△) and 100 mg l^{-1} (▲). Bars at the points indicate standard deviations.

days of age then it declined at 25 days of age of the fruit (Fig. 1B). Purohit (1979, 1980) observed that the quantity of sugar in *Helianthus annuus* seedling decreased after dikegulac treatment, which was due to the inhibition of chlorophyll biosynthesis by dikegulac. In this plant increase in chlorophyll content of the leaves at the mixed phase (data not shown) leading to increased photosynthesis might be responsible for the increase in the sugar content of fruits. Ascorbic acid content of the developing fruits of the control plant decreased with increase in fruit age (Fig. 2). But with 100 mg 1^{-1} of dikegulac the ascorbic acid content of the fruits was increased. Increase in carbohydrate and ascorbic acid contents of the developing fruits after dikegulac treatment showed improvement in the quality of the fruits (Fig. 2). The amounts of carbohydrate in the developing fruits were much less due to the rapid metabolism during the fruit development. The amounts of ascorbic acid was

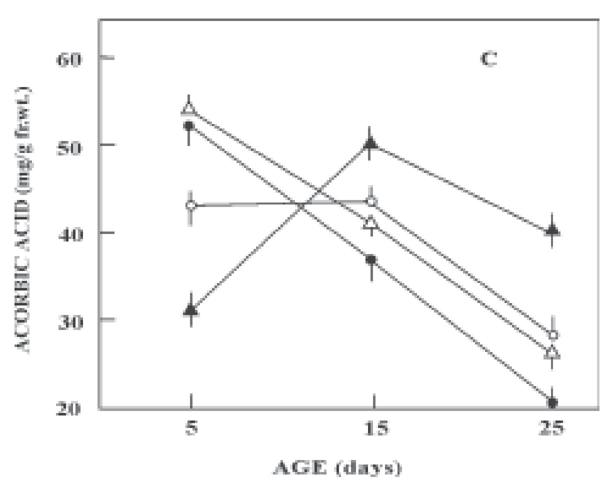

Fig. 2. Effect of dikegulac on ascorbic acid content in the developing fruits of *C. sativus*. The concentrations of dikegulac were control (●), 25 mg l^{-1} (O), 50 mg l^{-1} (△) and 100 mg l^{-1} (▲). Bars at the points indicate standard deviations.

much more than the carbohydrate in the developing fruits. Ascorbate is a precursor of oxalate in plants. In addition, in plants ascorbate is involved in the hydroxylation of pro-residues in cell wall proteins called extensins (Nelson and Cox 2005). During development of fruit, rapid cell division may require this high level. Such a high level of ascorbic acid was also shown in developing fruits of *Momordica charantia* (85 mg g^{-1}), and *Luffa acutangula* (7 mg g^{-1}) (Basu *et al.* 1994).

In many respect dikegulac acted as a plant retardant as it retarded plant growth (Arzee *et al.* 1977) and shortened the plant height (Bhattacharjee and Gupta 1981). But in the reproductive phase of this plant dikegulac had promotive effects as it increased female flowering and initiated early flowering by reducing the mean node for the appearance of both male and female buds. It also promoted fruit setting, increased size (length and girth) and weight of the fruits and improved their quality.

REFERENCES

Arzee, T., Langenauer, H. and Graessel, J. (1977). Effects of dikegulac, a new growth regulator, on apical growth and development of three compositae. *Bot. Gaz.* **138:** 18-28.

Basu, P.S., Banerjee, S. and Das, S. (1994). Hormonal regulation of flowering and fruit development: Effect of dikegulac on flowering, fruit setting and development of *Momordica charantia* L. and *Luffa acutangula* Roxb. *Indian J. Plant Physiol.* **37**: 282-285.

Bhattacharjee, A. and Gupta, K. (1981). Effect of dikegulac on growth and correlative biochemical changes in leaves of Sunflower (*Helianthus annuus* L. cv. EC 68414). *Biochem. Physiol. Pflanzen.* **175:** 305-313.

Bocion, P.F., De-Silva, W.H., Huppi, G.A. and Szkrybalo, W. (1975). Group of new chemicals with plant growth regulatory activity. *Nature* **258:** 142-144.

Chen, P., Yougin, L., Mingauan, D., Lihua, Z., Shike, W. and Yamin, Y. (1990). Studies on raising fruit yield improving quality of juice by rare earth element. *For. Res.* **3:** 178-181.

Frost, D.J. and Kretchman, D.W. (1987). Influence of Dikegulac on the growth of processing tomatos. *Hort. Sci.* **22:** 232-234.

Ghosh, S. and Basu, P.S. (1984). Hormonal regulation of sex expression and some physiological and biochemical changes in *Luffa acutangula* L. *Biochem. Physiol. Pflanzen.* **179:** 277-287.

Lingle, S.E. and Dunlop, J.R. (1987). Sucrose metabolism in netted muskmelon fruit during development. *Plant Physiol.* **14:** 386-389.

McCready, R.M., Guggloz, J., Silviora, V. and Owens, H.S. (1950). Determination of starch and amylase in vegetables. *Anal. Chem.* **22:** 1156-1158.

Nelson, D.L. and Cox, M.M. (2005). Lehninger Principles of Biochemistry (4th ed.). W.H. Freeman and Company, New York.

Nightingale, A.E., Susan, E.G. and Longnecker, M.T. (1985). Dikegulac alters growth and flowering of Kalanchoe. *Hort. Sci.* **20:** 722-724.

Panse, V.G. and Sukhatme, P.V. (1985). Statistical Methods for Agricultural Workers (4th ed.). ICAR Publication, New Delhi.

Purohit, S.S. (1979). Studies with a new growth regulator: Dikegulac I. Effect on seed germination, seedling growth and chlorophyll biosynthesis. *Comp. Physiol. Ecol.* **4:** 264-266.

Purohit, S.S (1980). Studies with a new growth regulator: Dikegulac sodium III. Effects on morphophysiology and biomass production of *Helianthus annuus*. *Comp. Physio. Ecol.* **6:** 261-267.

Reddy, S.M., Kumar, B.P. and Reddy, S.R. (1980). Vitamin C changes in infected fruits of tomato. *Indian Phytopath.* **33:** 511-512.