ANATOMICAL AND PHYSIOLOGICAL STUDIES ON SOME CUCURBITACEOUS PLANTS AS AFFECTED BY GIBBERELLIN AND CYCOCEL

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external and internal morphology (anatomy) of such plants is often encountered. Such situation necessitates the immediate study in this field which is normally known recently as physiological anatomy. Our department has the previlage to overtake serious steps in this regard. This present investigation is not more than a humble effort in this direction.

The main objectives of this investigation is to study the growth and differentiation of two economically important cucurbit vegetable crops in response to the use of growth substances as an attempt to spot morphological and anatomical changes induced exogenously as a result of growth substances application. Spotting such early physiological differentiation at the morphological and anatomical levels would be considered of extreme importance to the scientific community from the academic and applicable points of view. Some of these physiological changes that might be of high applicable values are female/male sex ratio in flowering (i.e. high yield production upon increasing such ratio). Also, the production of tendrils number and length (a character which is extremely important for application of wire-growing techniques in plastic-houses). Another important aspect, is to try to understand the natural hormonal balance in plants in relation to vegetative growth and flowering.

height and dry matter production. Peter (1972) found that treating spring wheat with GA under different light regimes resulted in increasing plant height. Takahashi *et al*.(1973) found that in rice cv. Sasomishke both plant height and leaf length were markedly increased by foliar sprays of 0.1% GA but leaf breadth and total leaf area were decreased. Shoot dry weight also decreased after GA treatment. Farrag (1976) found that the growth length of wheat plants was generally stimulated with GA application. He also reported that the application of GA did not show consistent trends with regard to the response of dry matter production in wheat shoots in most cases.

2. Effect of cycocel:

Kazim and Khaliel (1983) found that CCC (chlormequat) at 100-1000 ppm had no appreciable effect on germination of cucumber (*Cucumis sativus* cv. Beta Alpha) but slightly increased seedling growth. Literature, unfortunately is very lacking on CCC-treated cucurbit plants.

Regarding the effect of CCC on other plant types, Humphries (1963) found that the application of CCC on mustard plants increased the total leaf area. The increase was due to the production of more lateral leaves. Halevy and Wittwer (1965) reported that there was a pronounced stimulation of the dry matter production in snapdragon plants treated with CCC. Heide (1969) found that soil

Sandonzev et al. (1970) stated that grain treatment with 10% chlormequat to winter wheat increased the dry matter production between emergence and the end of growth period. Smirnitskaya (1970) and Shpagin and Shaposhnikov (1970) stated that the application of CCC to wheat plants resulted in decreasing the stem height. Wünsche (1970) studied the effect of chlormequat on winter wheat and spring wheat. He found that in some instances, chlormequat reduced leaf area. This was often significant. In 1971, the same author declared that the application of 10^{-2}M CCC to spring wheat reduced the total dry matter production. Andrascik and Huska (1972) and Rowland and Cackett (1972) pointed out that the application of CCC to wheat plants resulted in decreasing the stem height. Singh et al. (1972) grew wheat plants cv. Gabo in nutrient solution and supplied CCC in the rooting medium one week after germination. They found that CCC reduced plant dry weight, apex elongation, and shoot extension. Farrag (1976) found that height growth of wheat plants was retarded with CCC application. He found also that CCC appeared in most instances to retard the dry matter accumulation in wheat shoots.

Hassan and Agina (1980) found that the mean fresh weight of stalks and florets increased by spraying or drench application of CCC in 3000 ppm to tuberose plants.

by 113.9 percent (with regard to control plants) was registered with concentration 10 ppm.

2. Effect of cycocel:

Saimbhi and Thakur (1973) studied the effect of CCC on sex expression of squash melo (*Citrullus vulgaris* var. fistulosus). They found that the staminate flower production was not affected by CCC but pistillate flower production increased when the monoecious variety Round Green was sprayed with CCC at the two- to three-leaf stage. El-Kholy and Hafez (1982) found that the application of CCC at 100 mg/L to snake cucumber (*Cucumis melo* var. pubescens) induced formation of the first female flower at lower nodes than in water-treated controls and suppressed the production of male flowers significantly.

C. Effect of gibberellin and cycocel on the anatomy of plants:

1. Effect of gibberellin:

Sircar and Chakraverty (1960) stated that in jute, (*Corchorus capsularis* L.) treated with GA increased the amount and percentage of fibers per plant. Atal (1961) and Stant (1963) found that hemp and jute plants treated with GA, were considerably longer, wider and more thick walled. Bostrack and Struckmeyer (1964) found that foliar applications of a 50 mg/L aqueous solution of GA to soybean plants resulted in:

(a) Chlorosis of leaves and reduction in size of leaflets.

(b) Terminal leaflets had slightly thinner lamina, smaller cells in the palisade layer and a greater amount of intercellular space.

(c) Elongation of internodes caused by increasing of cell elongation.

(d) Reduction of cell diameter resulted in a reduction in diameter of stems.

(e) More lignified xylem parenchyma and partial collapse of relatively thin-walled vessel elements and tracheids.

De Maggio (1966) suggested that the effect of GA was on cambial division, the actual differentiation of sieve elements being controlled by IAA. Digby and Wareing (1966a) studied the effect of applied growth hormones on cambial division and the differentiation of cambial derivatives in woody shoots. They found that when GA is applied, cambial division occurs but the resultant derivatives on the xylem side of the cambium remain undifferentiated. High IAA/low GA concentrations favour xylem formation, whereas low IAA/high GA concentrations favour phloem production. The new phloem tissue produced as a result of hormone treatment is fully differentiated, containing sieve elements and sieve plates. They also found that IAA is important in promoting the elongation of cambial derivatives to produce xylem vessel and fiber elements, though in the case of fibers applied GA caused further elongations. The same authors (1966b) suggested that in *Alianthus altissima*, phloem production continued because high endogenous gibberellin level were present after the auxin level had been reduced by short-day treatment. Hess and Sachs (1972) found that auxin induced xylem differentiation, whereas GA together with auxin led to increase the cambial activity and differentiation of xylem poor in vessels and rich in fibers. GA alone had little effect. Peterson and Yeung (1972), in histological studies of shoot apices on *Hieracium spp*. plants treated with GA and GA_7, found that the induction of mitosis and cell elongation particularly in cells of the sub-apical region contributed to stem elongation. El-Shaarawi and Megahed (1978) studied the effect of GA on some morphological and histological responses in *Phaseolus vulgaris* cv. Siminol. They found that GA increased stem length due to greater cell elongation in the internodes. Longitudinal divisions were retarded. Harrison and Klein (1979) stated that GA or BAP (benzyl amino purine) each could partly replace the stem apex for xylem cell formation, and GA partly replaced the stem apex for phloem cell initiation. Mixture of auxin and BAP were less effective than auxin alone in xylogenesis, but a mixture of auxin and GA synergistically stimulated phloem cell initiation. Roni (1979) studied the role of auxin and gibberellin in differentiation of primary phloem fibers in *Coleus blumei* Benth. He found that IAA alone sufficed to cause the differentiation of whereas GA is more involved with phloem.

Concerning monocots, Shimizu (1965) applied GA at 100 and 500 ppm to rice plants as foliar sprays or soil treatments at different stages of growth. He found that GA is responsible not only for cell multiplication and accelerated meristematic activity, but it is also thought to have some effects on the differentiation of vascular bundles in the panicle, leading to an increase in the number of both branches and spikelets. Finally, it was suggested that GA may cause degenerated organs and tissue to re-appear. El-Shaarawi (1976) found that the transverse cell division of wheat stem was stimulated by the application of GA , whereas the longitudinal cell division was retarded. So GA affected the length of individual cells. It was concluded in this experiment that growth promotion induced by GA involved only cell division and not cell elongation.

2. Effect of Cycocel:

El-Shaarawi and Megahed (1978) found that the application of CCC to *Phaseolus vulgaris* L. retarded transverse cell division in stem while the longitudinal division, particularly in the stelar cambium, was stimulated thus producing more conducting elements.

On monocots, however, Tolbert (1960), Kozarev (1969), Lyaskovskii and Kalinin (1969), Mekhtisade *et al*. (1969), Bergmann *et al*. (1970), and Smirnitskaya (1970) found that the application of CCC to wheat plants increased the stem diameter and wall thickness. Zaher et al. (1973) indicated that the application of CCC to wheat plants increased the stem wall thickness by increasing the number of cell rows in the mechanical fibrous tissue and colourless ground parenchyma. The number of vascular bundles was also increased. El-Shaarawi (1976) found that the transverse cell division of wheat stem was retarded by the application of CCC, at the same time longitudinal cell division was enhanced. Subsequently treated plants had shorter and thicker stems. It is concluded that (in this experiment) growth retardation induced by CCC involved only cell division and not cell elongation. Firgany et al. (1979) studied the effect of CCC in concentrations ranging from 0-2500 ppm on anatomical characters in wheat plants (Giza 155). They found that stem shortening was due to shortening of cells accompanied by an increase in stem tissues. More number of bundles was also noticeable. CCC had no effect on the anatomy of flag leaf and its following one.

D. Effect of gibberellin and cycocel on certain metabolic aspects:

1. Effect of gibberellin and cycocel on soluble carbohydrates:

a. Effect of gibberellin:

Regarding the effect of GA on soluble carbohydrates in Dicots, Burton and Sciuchetti (1961), reported that the leaves of wheat seedlings cv. Victor. Zakova and Adamkova (1965) found that the application of GA markedly increased the total sugar content of maize roots. Zakova (1966) treated maize plants with 0.1 mg GA/plant at earing. He found that GA increased sugar content in all parts of the plant. Katsumi (1970) demonstrated that the amount of reducing sugars was less in GA-treated seedling of dwarf maize. Radley (1970) found that GA at 10 μg/ml resulted in increasing the total sugar content. Copalakrishnan and Sircar (1974) grew rice plants cv. Bhasamanik in nutrient solution to which GA at 10^{-2} mg/L was added. They found that GA increased sugar content in the plants.

b. Effect of cycocel;

The picture regarding the effect of CCC on soluble sugars (in cucurbit plants) is not clear enough, and needs more confirmation, since the available literature are very contradicting to the extent that one might suggest that different effects noticed among different plants could be attributed to non-specific effects on diverse plant systems.

Concerning the dicots, Helaly et al. (1985) found that sugars concentrations in potato leaves decreased as a result of CCC treatment. However, literature dealing with other dicot plants are rather rare.

Regarding monocot plants, Lyaskovskii and Kalinin (1969) revealed that the application of 4-8 kg chlormequat/ha to wheat plants at 5 to 6 leaf stage resulted in increasing the accumulation of soluble carbohydrates. Narang et al. (1971) applied chlormequat to wheat plants as a foliar application of 4 kg/ha. They found that reducing sugars content in the grain was decreased by this treatment.

2. Effect of gibberellin and cycocel on amino acids:

a. Effect of gibberellin:

Mahmoud (1980) found that mint plants at the 1st cut showed a pronounced increase in total free amino acids in response to treatments with GA in comparison with the control, whereas the reverse was true at the 2nd cut. Moreover GA showed no qualitative differences in total free amino acids between treated and untreated plants. He found also that GA decrease total free amino acids in geranium shoots in both cuts.

Regarding monocot plants, Dabrowska et al. (1967) germinated barley and oat seeds in the presence of 5 mg GA/L. They found that the seeds contained more amino acids on the 2nd day after treatment. On the 5th day, the increase in amino acid concentrations was proportional to the level of applied GA within the range 1-10 mg/L. Farrag (1976) found that the application of GA did not show consistent trends with regard to nitrogen fractions.

b. Effect of cycocel:

Stefl et al. (1975) found that the application with chlormequat to winter rape (*Brassica napus* L. var. arvensis) resulted in an increment of free amino acids content and thus increased winter hardiness.

Regarding monocot plants, Arundzhyan and Shirakyan (1970) stated that when seeds of winter wheat cv. Artashali 42 were soaked in CCC solutions, 15 day-old seedlings grown from them contained large amounts of free amino acids in the tops than in seedlings grown from seeds soaked in water. Sadeghian and Kühn (1970) applied chlormequat to the soil at 10, 50 or 150 mg/pot about 10 days after emergence of spring wheat seeds, or on the leaves at 25 mg/pot at tillering and at stem elongation. They found that chlormequat had no significant effect on the pool of free amino acids, although there were increases in contents of lysine, arginine, glutamic acid and alanine. Krishchenko _et al_. (1974) treated spring and winter wheat with 4 kg chlormequat/ha as a foliar application. They found that chlormequat increased the content of lysine, histidine, proline, methionine, isoleucine, lucine and tyrosine and decreased those of glutamic acid and serine in extractable protein in the grain. Farrag (1976) found that the application of CCC to wheat plants did not show regular responses regarding to the nitrogen fractions.

E. Effect of gibberellin and cycocel on endogenous plant hormones:

1. Effect of gibberellin and cycocel on endogenous auxin levels:

The influence exerted due to the application of either

GA or CCC to plants, upon endogenous auxin levels has been reported by a number of investigators.

a. Effect of gibberellin:

With regard to dicot plants, Nitsch (1957) indicated that the beneficial effect of gibberellins on some woody plants was due to an increase in their auxin content. In the same regard the apical treatment of intact plants with gibberellic acid (GA) was shown to increase the yield of extractable auxins (Phillips et al. (1959) with Alaska pea). To interpret the formentioned results, Housley and Deverall (1961) reported (in pea plants) that GA treatment might lead to the production of an inhibitor which retarded auxin destroy in the IAA-oxidation system. Also, Kuraishi and Muir (1962, 1964) found an increment in the diffusible auxins from excised apices. Andersen and Muir (1969) examined diffusates from apices of young plants of Savoy Cabbage treated with GA , the direct assay of agar blocks containing diffusates showed that, four days after treatment with GA, there was an increase in stem elongation. They also did not find any effect of GA on the enzymatic conversion of tryptophan to tryptamine to IAA.

The studies of Bouillenne and Leyh (1962) revealed further analogous picture on monocot plants. According to their results, the dwarf maize var. Segregation 5N and Dominant Dwarf grown in controlled environment and treated