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Histological Response Of Hypocotyl Of *Cucumis Sativus* To Growth Substances

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In response to different regimes of IAA, GA_3, KN, MH, Cou and CCC the seedlings of *Cucumis sativus* showed a definite change in hypocotyl length, vessel-element size, and other histological characters. MH and Cou decreased the length of hypocotyl, vessel-elements and crotical cells, but caused an appreciable increase in the width of vessel-elements, and radial diameter of cortical cells causing an increase in hypocotyl diameter. GA_3 and CCC increased length of hypocotyl, vessel-elements and cortical cells. IAA was inhibitory, while KN had insiginificant effect on these parameters.

Exogenous application of growth substances inducing histological changes is well-known (Sachs, 1965). One of the most common effects is the elongation of stem internodes due either to cell division or cell elongation (Kato, 1955, 1958; Sachs, 1965; Moore, 1979). We have studied the effect of some well known growth substances on the anatomical and histological changes in *Cucumis sativus*. L.

MATERIALS & METHODS The seeds of *C.sativus* cv. Japanese Long Green were procured from The National Seed Corporation, New Delhi. Healthy seeds were soaked in aqueous solution of indole-3 acetic acid (IAA), gibberellic acid (GA_3), maleic hydrazide (MH), coumarin (Cou) and chlorocholine chloride (CCC), in 100, 200 and 500 ppm and kinetin (KN) in 10,25 and 50ppm concentrations, for 6 h and then transferred to moist filter paper in 15 cm dia Petri-plates incubated in dark at 228± 28 C. Petriplates were watered equally on alternate days. The control set (untreated seeds soaked in distilled water) was run simultaneously. Germination started after two days of sowing; 10-day-old seedlings were collected fixed in formalin-acetic acid ethanol and subsequently, preserved in 70% ethanol. For histological studies, sections were cut at 12-14 µm thickness (Johansen, 1940). For separation of vessel elements, maceration technique was used (Johansen, 1940). Parameters like length of hypocotyl, cortical zone thickness, size of vessel elements, cortical cell size, vascular bundle size, and size of peg cells were evaluated.

RESULTS Hypocotyl length and vessel element size: The hypocotyl length and vessel element length increased in response to GA_3 and CCC treatments. However, in both the treatments, 200 ppm of GA_3 and CCC caused the maximum increase in hypocotyl length but vessel element length was not significantly influenced by concentration (Fig.1). But the vessel diameter was less compared to the untreated seeds. With KN, the hypocotyl length increased, but vessel element length decreased with increase in concentration. Corresponding to decrease in vessel element length, there was an increase in the diameter of vessels.

IAA, MH and Cou caused marked decrease in the length of hypocotyl and vessel elements (Fig.1). The degree of inhibition increased with increase in concentration. As for the width of vessel elements, in IAA it decreased with increase in concentration but, in MH and Cou, with the increase in concentration there was an in-

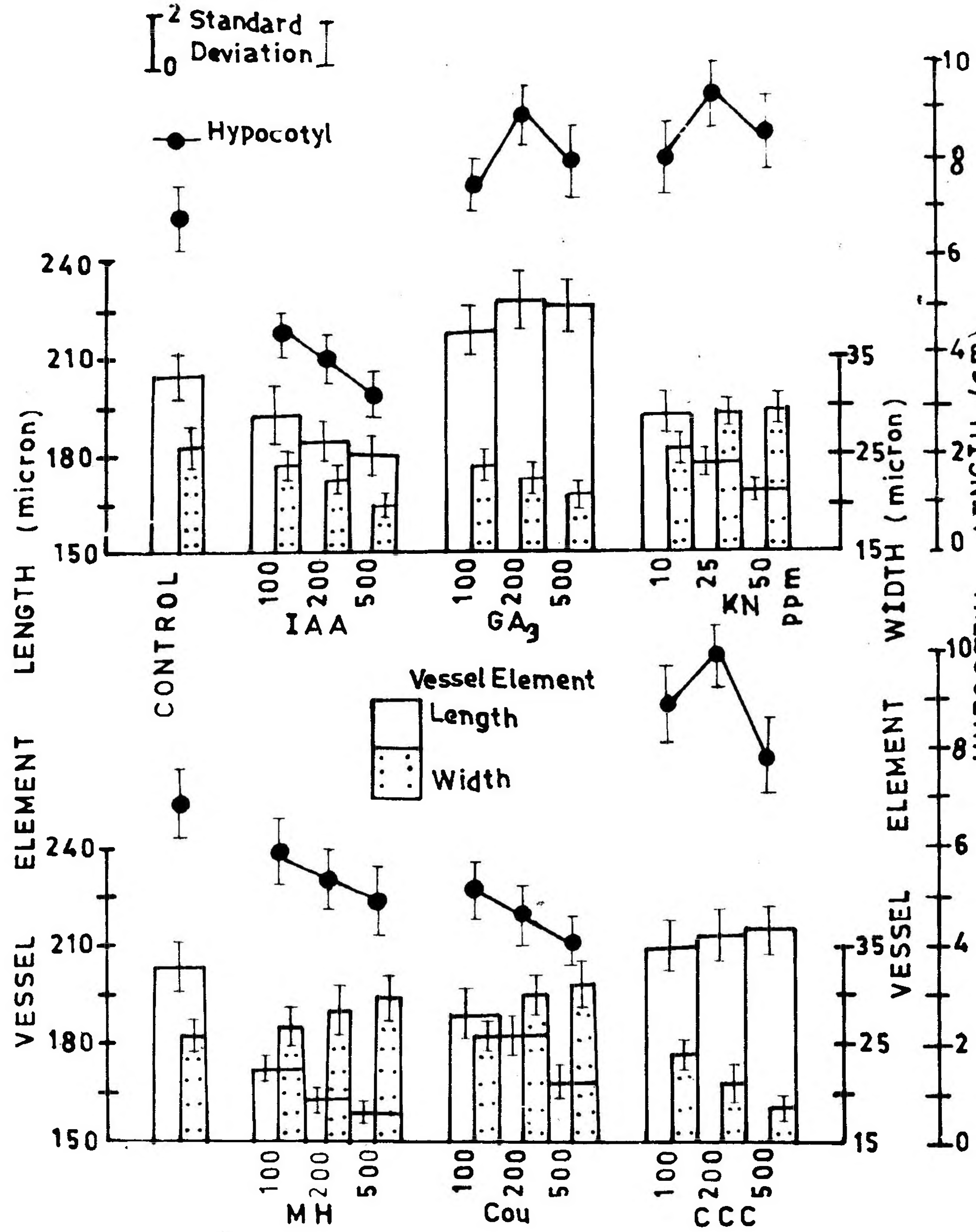

Fig. 1. Effect of treatment of growth substances on the elongation of hypocotyl, and size of vessel elements.

Table 1 Response of hypocotyl to soaking of seeds in different growth substances.

Treatment (ppm)	Thickness of Cortex µm	Cortical cell dimensions (µm)				Vascular bundle (µm)		Peg cell diameter (µm)	
		Longitudinal	Radial	Tangential	Volume (μm^3)	Length	Width	Radial	Tangential
Control	561	150	60	47	4.2×10^5	236	151	80	48
IAA 100	549	146	57	40	3.3×10^5	238	153	99	45
200	560	142	59	45	3.7×10^5	236	150	109	46
500	571	139	61	45	3.8×10^5	231	150	90	46
GA_3 100	562	147	58	47	4.1×10^5	212	140	71	47
200	573	156	60	49	4.5×10^5	211	139	73	47
500	583	154	62	52	49×10^5	210	139	75	47
KN 10	538	147	58	39	3.3×10^5	237	150	69	44
25	562	150	60	44	3.9×10^5	238	146	72	44
50	578	148	60	46	4.1×10^5	240	145	73	44
MH 100	548	90	67	51	3.0×10^5	251	152	81	46
200	560	86	69	55	3.2×10^5	251	152	81	46
500	578	82	76	57	3.6×10^5	253	153	81	48
Cou 100	540	108	60	43	2.8×10^5	248	170	79	38
200	559	107	62	45	2.9×10^5	246	170	79	39
500	574	98	64	47	2.9×10^5	243	169	79	42
CCC 100	663	155	58	43	3.8×10^5	251	164	77	37
200	699	156	63	46	4.4×10^5	244	159	77	43
500	742	156	64	47	4.7×10^5	238	153	80	46

Each value represents the mean of 30 readings.

crease in the width of vessels (Fig.1).

Effect on Cortical Zone and Cortical Cells: Except in CCC treatment, the cortical zone thickness increased in high concentrations, but in lower concentrations it remained less than in the control (Table 1). In CCC, the cortical zone thickness increased with increase in concentration.

Cortical cell dimensions differed in response to treatments. In GA_3 and CCC, the longitudinal dimensions of cortical cells increased compared to the control, but different concentrations of solutions had no significant effect. In KN, MH and Cou, the longitudinal dimension of cortical cells decreased. The radial dimensions of cortical cells did not show any significant influence in presence of low concentrations but at high concentrations, there was some increase except with MH where the increase was significant. A similar trend on the effect on tangential dimension was noted in all the treated seeds (Table 1). Total volume of cortical cell was significantly more in GA_3 and CCC-treated seeds, while in all other cases it was less than the control. In Cou-treated seeds, it was significantly less in all concentrations (Table 1).

Vascular Bundle Size:- Vascular bundles in hypocotyl region showed increase in radial dimension when treated with KN, MH, Cou and CCC but with IAA the increase was insignificant. It decreased significantly with GA_3. The tangential dimension increased with IAA, MH, Cou and CCC, and decreased with GA_3 and KN (Table 1).

Peg Cell Size:- The growth substances caused significant effect on peg cells. IAA produced considerable increase in radial dimension with a concomitant decrease in tangential dimension (Table 1). With all other treatments, both radial and tangential diameters decreased. No significant change in cell size occurred with MH.

DISCUSSION Phytohormones and other growth substances have diverse effects on different organs of plants and or different species. In *C. sativus*, GA_3 and CCC enhanced hypocotyl length, while IAA, MH, KN and Cou reduced growth. Anatomical studies indicate that the increase in length is due to increase in cell divisions, and longitudinal elongation in the region of cortex. Liu & Loy (1976) also concluded that GA_3 enhanced hypocotyl length in water melon due to cell elongation and cell divisions. IAA and KN did not increase the length of hypocotyl either through increase in cell length or cell divisions. The inhibitory effect may be due to an increase in the endogenous hormonal level which may be higher than the optimal concentration. Chadwick & Burg (1967) and Loy (1980) also reported inhibitory effect of IAA and GA_3. MH and Cou retard hypocotyl growth, mainly due to the effect on cell elongation and cell divison. However, both the substances increased the radial elongation of cortical cells thereby increasing the diameter of hypocotyl. Choudhri & Rajgopal (1957) and Masaki *et al.*(1973) also reported the inhibitory effect of MH and Cou.

While generalizing the effect of IAA, Hanson & Trewavas (1982) emphasized that it induced cell expansion in excised system, but Thimann (1977) concluded that it is inhibitory in intact plants.

REFERENCES

CHADWICK A V & BURG P S 1967 An explanation of the inhibition of root growth caused by IAA *Plant Physiol.* **42** 415-420.

CHOUDHRI R S & RAJGOPAL R 1957 In *Modern developments in plant physiology* - A Seminar. Delhi Univ, Delhi.pp 134-137.

HANSON J B & Trewavas A J 1982 Regulation of plant cell growth. The changing perspective *New Phytol* **90** 1-18.

JOHANSEN D A 1940 *Plant Microtechnique* McGraw-Hill, New York.

KATO J 1955 Responses of plant cells to gibberellins *Bot Gaz.* **117** 16-24.

KATO J 1958 Studies on the physiological effect of gibberellin with auxins and growth inhibitors *Physiol Plantarum* **11** 10-15.

LIU P B W & LOY J B 1976 Action of gibberellic acid on cell proliferation in the subapical shoot meristem of watermelon seedling *Am J Bot* **63** 700-704.

LOY J B 1980 Promotion of hypocotyl elongation in watermelon seedling by 6 Benzyladenine *J Exp Bot.* **31** 743- 750.

MASAKI H, N UMETSU, C MIJOMOTI & TAMORI K 1973 Inhibition of the biosynthesis of plant cell wall materials, especially cellulose biosynthesis by coumarin *Plant Cell Physiol* **14** 11-23.

MOORE J C 1979 *Biochemistry and Physiology of plant hormones* Springer -Verlag, New York.

SACHS R M 1965 Stem elongation *Ann Rev Plant Physiol* **66** 75-96.

THIMANN K V 1977 *Hormone action in the whole life of plants Univ Mass Amherst.*