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Changes in Hypocotyl and Cotyledon of *Lagenaria siceraria* Induced by Growth Substances

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Different regimes of IAA, GA_3, MH and CCC influenced the elongation of hypocotyl, vessel-element size and other histological characters of hypocotyl and cotyledon of *Lagenaria siceraria*. MH markedly decreased the hypocotyl length, vessel-elements length and longitudinal dimension of cortical cells but caused maximum increase in width of vessel-elements, radial length of cortical cells thereby causing an increase in hypocotyl diameter at high concentration. GA_3 and CCC enhanced the length of hypocotyl and its vessel-element, and increased the longitudinal length of cortical cells. Thickness of cotyledonary v.s. (vertical section) was more in CCC and less in GA_3 and MH. Minor variations were recorded in size of vascular bundles and palisade cells. The response of IAA was in general inhibitory.

Key Words - Growth substances, Hypocotyl, Cotyledon, Length, Cortical cell, Vessel-element

Exogenously applied growth substances induce histological changes (sachs, 1965). One of the frequently noted effects is the elongation of internodes of stem either by cell division or by cell elongation (Moore, 1979). Literature on seed germination and seedling growth is impressive (Sircar, 1971; Katsumi & Kazma, 1978; Sharma & Govil 1987) but meagre information is available regarding changes in the histology of seedlings in response to growth substances. We studied the effect of growth regulators on histological changes in the hypocotyls and cotyledons of treated seedlings of *L. siceraria*.

MATERIALS & METHODS Seeds of *L. Siceraria* Mol. var. Pusa Summer Prolific Long (P.S.P.L.) were obtained from National Seed Corporation, New Delhi. Healthy and uniform seeds were soaked in aqueous solutions of indole-3-acetic acid (IAA), gibberellic acid (GA_3), maleic hydrazide (MH) and 2-chloroethyl-trimethyl ammonium chloride (CCC) at 100, 200, 500 ppm of each for 24 h and allowed to germinate on moist filter papers kept in petri plates in dark at 22± 1°C. Germination started 3 days after transferring the seeds to moist filter paper. 10 day-old seedlings were fixed in FAA and subsequently preserved in 70% alcohol. For histological studies, microtome sections were cut at 12-14 μ (Johanson, 1940). For separation of vessel-elements, maceration technique of Jeffery as described by Johanson (1940) was followed. Length of hypocotyl, vessel-element size, thickness of cortical zone, dimension of cortical cell, size of vascular bundle, size of peg cell, thickness of cotyledonary vertical section, size of palisade cell and size of vascular bundle were measured and analysed statistically.

RESULTS Hypocotyl Length and Vessel-Element Size The hypocotyl length and vessel-element length increased in response to GA_3 and CCC treatment. However, 200ppm was more effective in increasing the length of hypocotyl and 500 ppm increased the length of vessel-elements. GA_3 and CCC decreased the width of vessel-elements compared to the control.

IAA and MH inhibited the elongation of hypocotyl and its vessel-elements and high concentration was highly inhibitory. As far as the width of vessel-elements is concerned, IAA decreased it with increasing concentrations but MH reversed it (Fig. 1 A).

Table 1 Studies on Transverse and Longitudinal Sections of Hypocotyl in Response to Soaking of Seeds in Different Growth Substances

Treatment (ppm)		Thickness of cortex (μ)	Cortical cell dimensions (μ)				C.D.	Vascular bundle (μ)		Peg cell diameter (μ)	
			Longitudinal	Radial	Tangential	Volume		Length	Width	Radial	Tangential
Control		634	153	64	49	4.7×10^5		470	278	76	60
	100	600	149	60	43	3.8×10^5		478	281	99	49
IAA	200	634	140	63	46	4.0×10^5	0.26	466	270	114	50
	500	640	136	64	48	4.1×10^5		466	267	100	51
	100	636	155	63	48	4.6×10^5		436	261	71	50
GA_3	200	642	159	65	49	5.0×10^5	0.38	421	261	74	53
	500	656	156	65	52	5.3×10^5		421	261	74	55
	100	608	96	71	51	3.5×10^5		494	279	78	54
MH	200	629	88	77	56	3.8×10^5	0.33	496	280	78	57
	500	639	86	82	62	4.4×10^5		499	281	77	61
	100	640	154	64	45	4.4×10^5		493	289	64	49
CCC	200	652	158	64	47	4.8×10^5	0.19	482	281	75	55
	500	680	155	65	50	5.0×10^5		475	279	77	59

Each value represents the mean of 30 readings; C.D. critical difference at 5% Probability level

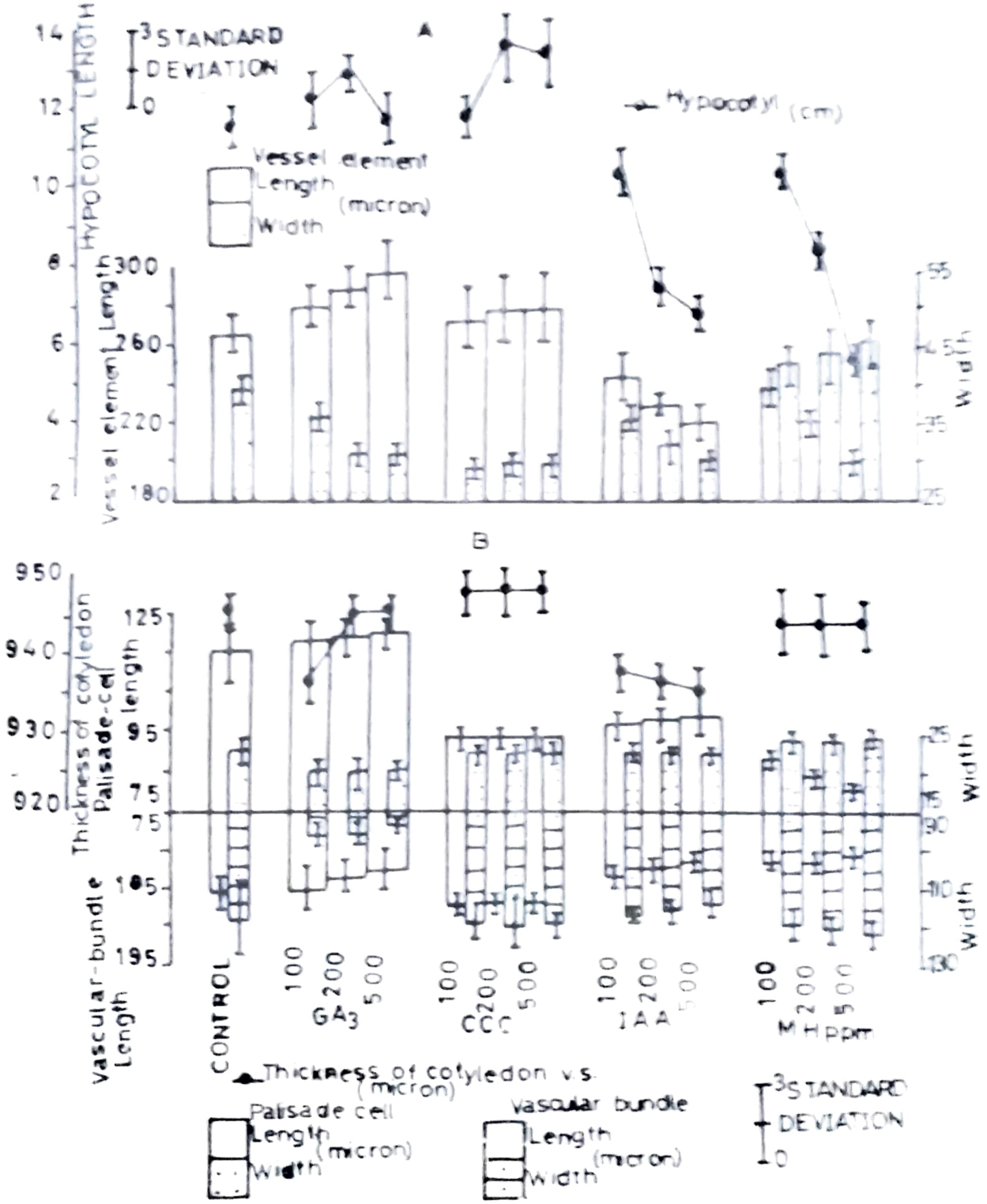

Fig. 1. A. Hypocotyl length and size of vessel-elements in different treatments. B. Thickness of cotyledon at vertical section, size of palisade cells and size of vascular bundles in different treatments.

ffect on Cortical Zone and Cortical Cell The thickness of cortical zone increased with increase in concentration of growth substances (Table 1) but it increased with high concentrations except in case of CCC where all the concentrations increased the thickness of cortical zone

Cortical cell dimensions responded differently to different treatments The longitudinal dimension of cortical cells of hypocotyls treated with GA_3 and CCC exhibited significant increase as compared to control. But treatment with MH and IAA inhibited the longitudinal elongation of cortical cells. With increase in concentration, there was a concomitant decrease in length. MH at 500 ppm caused maximum reduction. Low concentrations of growth substances exerted little response on the radial diameter of cortical cells. But higher concentrations affected slight increase. Similar trend was recorded in tangential length of cortical cells. While the volume of cortical cells was more in hypocotyls treated with 200 and 500 ppm of GA_3 and CCC, it was low in other treatments compared to the control (Table 1).

Vascular Bundle Size IAA and GA_3 did not affect the size of vascular bundles. However, IAA at 100 ppm slightly increased the size of vascular bundle. Both MH and CCC increased the size of vascular bundles (Table 1).

Size of Peg Cell IAA promoted radial elongation of peg cells to the maximum extent. Though GA_3 and CCC enhanced the radial length of peg cells, the maximum increase occurred in samples treated with 500 ppm of CCC. The tangential length declined in all the treatments, compared with the control (Table 1).

Histology of Cotyledon The effect of growth substances varied on different parameters of cotyledon. The thickness of cotyledonary (v.s.) vertical section was less in all treatments except CCC where it was more than the control. The size of palisade cells and vascular bundles also varied slightly in different treatments. In samples treated with GA_3, the length of palisade cells was more and width was less, whereas in samples treated with MH, a reverse trend was recorded (Fig. 1 B).

DISCUSSION The role of growth substances in inducing histological changes is well documented (Sachs, 1965; Moore, 1979). IAA and GA_3 are considered as growth promoters, whereas MH and CCC are regarded as growth inhibitors. The effect of growth regulators is profoundly influenced by their endogenous level, type of plant species, conditions under which the plant is grown and the exogenous concentration (Thimann, 1977; Moore, 1979). GA_3 and CCC enhanced the hypocotyl length whereas IAA and MH affected it adversely. The extent of inhibition was more pronounced in samples treated with MH. Maximum inhibition was observed in hypocotyls treated with MH at 500 ppm. Our results with GA_3 agree with the findings of Liu & Loy (1976) in water-melon and Katsumi & Kazma (1978) in cucumber. Struckmayer (1953)and Choudhary & Rajgopal (1957) noted that MH inhibited seedling growth. CCC is a well-known inhibitor of the growth of several plant species (Cathey, 1964).

The effect of different growth substances on vessel-element length and width could be related to their corresponding effect on hypocotyl length. GA_3 and CCC besides increasing the length of hypocotyl also increased the length of vessel-elements at the cost of width. MH and IAA reduced the length of vessel-elements compared to control. The effect of IAA and MH varied on vessel-element width. With increase in concentration, IAA decreased the width.

Sachs (1965) and Kigel (1981) recorded enhanced plant growth by exogenous application of GA.

Further increase in plant growth is due to increase in cell division and cell length (Sircar, 1971; Moore, 1979).

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