Effect of Halogenated Benzoic Acids on *Elodea densa*

A WIDE variety of plants have been treated with halogenated benzoic acids since the effect of these compounds as plant growth regulators was first reported by Zimmerman and Hitchcock[1]. A search of the literature has revealed no information on the effects of such compounds on aquatic plants. Accordingly, an experiment was set up to discover the effect of halogenated benzoic acids on *Elodea densa*.

Sprigs of *E. densa* were collected from a local pond. Terminal shoots 25 cm long were examined with a low-power (×40) dissecting microscope. All shoots showing buds or roots were discarded. Each remaining shoot was placed in a 3-l. glass jar containing a litre of tap water and 250 g of washed sand. The appropriate iodo-, bromo-, or chloro-benzoic acids substituted in the *ortho*-, *meta*-, or *para*-position were dissolved in 1 c.c. of ethanol and added to the jars containing *Elodea*. The final concentrations of the halogenated benzoic acids were 1×10^{-4}, 1×10^{-5}, and 1×10^{-6} M. One c.c. of ethanol was added to each control jar. All solutions were replaced every seven days. The experiment was conducted in a greenhouse and replicated three times over a four-month period. While the absolute responses to the acids varied from replication to replication, the relative responses to each acid were the same in each replication.

Data on total length and number of buds and roots were taken at weekly intervals for four weeks. Table 1 gives the total data for one replication. All shoots, regardless of treatment, had three or four buds. The chloro-substituted benzoic acids had little effect on number of roots. At the highest concentration iodo- and bromo-benzoic acids substituted in either the *ortho*- or *para*-positions inhibited the eruption of roots; at 1×10^{-5} M the same compounds had little effect on root number while at the lowest concentration they led to a greater number of roots. *m*-Iodobenzoic acid had little effect on the number of roots. The two highest concentrations of *m*-bromobenzoic acid had little effect on root number while the lowest concentration increased the number of roots.

The *m*-iodo- and *m*-bromo-substituted acids had little effect on shoot elongation. In general, increasing the concentrations of the *ortho*- and *para*-iodo- and bromo-benzoic acids and all chlorobenzoic acids led to inhibition of shoot elongation. There appeared to be little correlation between shoot elongation and root emergence. A compound, that is, *p*-chlorobenzoic acid, could affect elongation and not affect root emergence, or conversely, a compound, that is, *m*-bromobenzoic acid, could affect root emergence but have little effect on elongation. Where a compound did affect both root emergence and stem elongation, that is, *p*-bromobenzoic acid, the magnitude of the effects were quite different.

It would appear that halogenated benzoic acids can affect both stem elongation and differentiation in *E. densa*. Microscopic examination of sections through the nodal regions of shoots similar to those used in this experiment showed complete absence of bud and root primordia. It would seem, therefore, that in *Elodea* halogenated benzoic acids have no effect on initiation of bud primordia, enhance the differentiation of root primordia and in addition stimulate elongation of the stem. The effects of the acids on root primordia initiation and stem elongation appeared to be separate and not a result of an interaction. That is, the acids do not appear to affect elongation first and then elongation results in root differentiation and eruption. If shoots 10 or 15 cm long were treated with the acids, the results so far as elongation was concerned were identical to that of the 25 cm shoots. None of the two shorter shoot-lengths showed either buds or roots at the end of four weeks. Once again it would appear that the benzoic acids were affecting elongation without affecting primordia differentiation.

Table 1. EFFECT OF VARIOUS HALOGENATED BENZOIC ACIDS ON STEM ELONGATION AND NUMBER OF ROOTS IN *Elodea densa* AFTER FOUR WEEKS OF TREATMENT. PRIOR TO TREATMENT THERE WERE NO ROOTS AND STEM LENGTH WAS 25 CM

M Concentration	Iodo-substituted *Ortho* No. of roots	*Ortho* Length of stem	*Meta* No. of roots	*Meta* Length of stem	*Para* No. of roots	*Para* Length of stem
1×10^{-4}	0	21	5	29	0	25
1×10^{-5}	6	32	8	28	8	30
1×10^{-6}	15	35	5	28	17	37
	Bromo-substituted					
1×10^{-4}	1	25	7	28	1	25
1×10^{-5}	5	25	8	28	5	26
1×10^{-6}	12	35	13	28	12	35
	Chloro-substituted					
1×10^{-4}	7	28	6	29	6	28
1×10^{-5}	6	34	5	31	7	32
1×10^{-6}	7	36	7	46	7	37
	No. of roots				Length of stem (cm)	
Controls	6, 6, 7				28, 29, 29	

Van Overbeek[2] found 50γ equivalents of indolyl-3-acetic acid (IAA) per kilogram fresh weight of *Elodea*. This is a relatively high concentration. Niedergang-Kamien and Skoog[3] have reported that 2,3,5-triiodobenzoic acid interfered with the polar movement of IAA. It is possible, therefore, that the benzoic acids here were interfering with the IAA metabolism. It is interesting that the benzoic acids had no effect on the formation of bud primordia but had definite effects on the formation of root primordia and on stem elongation. In all three processes, IAA has been reported to play an important part. Since both treated and control shoots formed roots the benzoic acids did not initiate a new process but enhanced an already occurring process.

The *ortho*- and *para*-substituted halogenated benzoic acids show more reactivity in terrestrial plants than the *meta*-substituted compounds, which show little activity. The same position effects were seen in *Elodea*. The low activity of the chloro-substituted compounds on *Elodea* is at variance with the high activity of these compounds on terrestrial plants.

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Branched Lint Hairs in Cotton, *Gossypium hirsutum*

DURING investigations into the development of lint hairs in Upland cotton (*Gossypium hirsutum* L.) branched hairs were frequently observed in slides examined microscopically. Up to 9 per cent of the hairs on a slide were found to be branched and occasionally two or more branches were observed on a single hair. Branched hairs were found to occur in a wide range of cotton types within the species. The branches were blunt, tubular structures with a large