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Suppression of auxin stimulated growth of barley coleoptile sections by endosulfan

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Abstract. Endosulfan, a cyclic sulphurous acid ester commonly used as a broad spectrum insecticide, suppressed the elongation of barley coleoptiles. Indoleacetic acid at optimum concentration overcame the inhibition of growth of coleoptiles treated with 10 ppm endosulfan. However, perfusion of the coleoptile sections with endosulfan and subsequent treatment with indoleacetic acid could not stimulate cell elongation to the extent observed in the control.

Keywords. Endosulfan; indoleacetic acid; cell elongation *Hordeum vulgare*.

Introduction

Germination of *Cicer arietinum* has been shown earlier to be inhibited by prior exposure of the seeds to the pesticide endosulfan (Agarwal and Beg, 1979). Evidence is now presented suggesting interference by the pesticide with the function of indoleacetic acid (IAA).

Materials and methods

Barley (*Hordeum vulgare*Linn) grains were soaked for 10 min in 0.1 (w/v) aqueous hypochlorite solution and washed thoroughly with distilled water. The washed grains were allowed to imbibe water overnight in a refrigerator, spread over moist cotton and germinated at 28±2°C till the coleoptiles attained a length of 1.5 – 2.0 cm. The excised coleoptiles were placed on a glass plate and 1 cm long sections were cut after rejecting 3 mm of the tip portion.

A stock endosulfan solution was prepared in ethanol. Ten ml of either water alone or water containing a predetermined optimum concentration of IAA and 0.05 ml ethanol containing different amounts of endosulfan were taken in petridishes

Abbreviation used: IAA, indoleacetic acid.

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and coleoptile sections were placed for growth at 30°C for 24 h. In separate experiments, coleoptile sections were infiltrated with endosulfan (10 –50 ppm) in evacuated Thunberg tubes and incubated for 1 h at 30°C. Controls were taken without endosulfan but with equal volumes of ethanol. After washing thoroughly with distilled water the sections were kept for growth in petridishes containing optimum concentrations of IAA.

The length of the sections were measured using an overhead projector (AIML, India) which gave a seven fold magnification.

Results

The control coleoptile sections showed 40% elongation in 24 h. The endogenous IAA was nearly completely exhausted by incubation of the sections in water for 4 h, i.e. till 15% elongation was observed. The optimum IAA concentration determined was the sum of 1.0 ppm exogenous IAA plus an unknown endogenous level of IAA. This optimum IAA concentration (1.0 ppm) was used in subsequent experiments as IAA-control and the effect of endosulfan was determined at this level. Simultaneously, the effect of endosulfan was also studied against the control. The latter was included to see whether endosulfan alone possessed any auxin like activity.

The data presented in figure 1 show that relatively low level of endosulfan (0.1 – 1 ppm) had no adverse effect on the elongation of the sections. At 10 ppm,

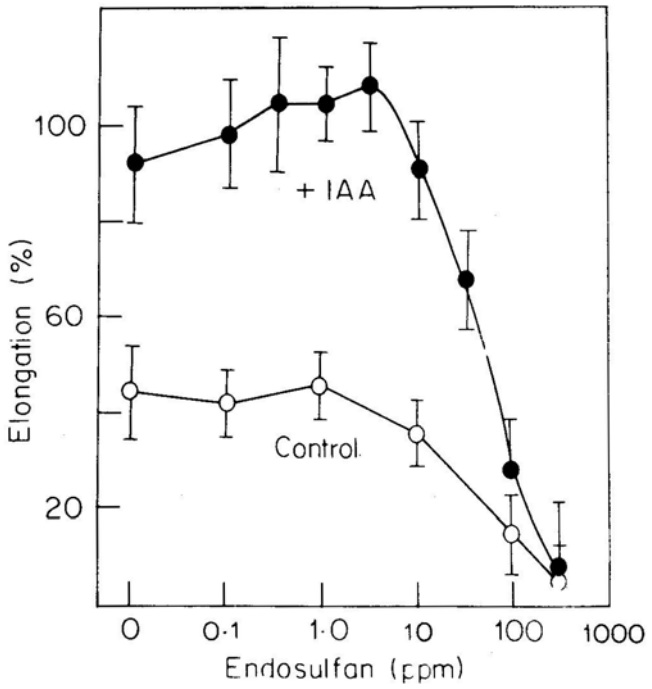

Figure 1. Effect of endosulfan on the elongation of barley coleoptile sections in the presence and in the absence of optimum (1.0 ppm) IAA concentration.

All values are ±SE of 10 observations. Sections were incubated at 30°C for 24 h.

however, a visible inhibition was observed which further increased with increase in endosulfan concentration (figure 1).

The infiltration of excised coleoptile sections with endosulfan at 10-50 ppm caused inhibition of elongation both in water and on supplementation with optimum concentration of IAA (figure 2).

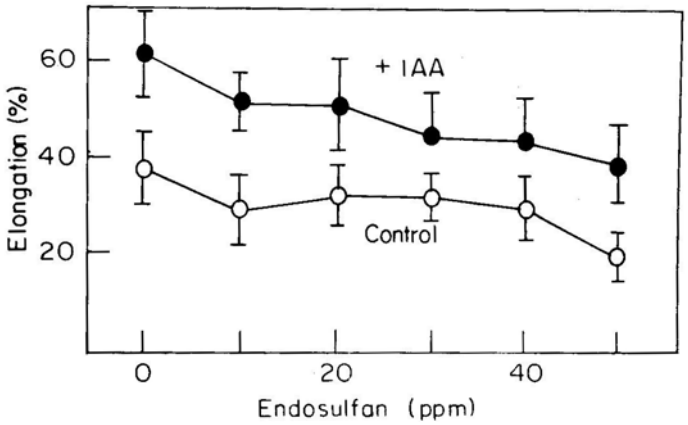

Figure 2. Elongation of endosulfan infiltrated coleoptile sections in the presence and absence of optimum IAA concentration (1.0 ppm).

All values are ±S.E. of 10 observations. Sections were incubated at 30°C for 1 h.

Discussion

The coleoptile growth test is used as a bioassay for IAA activity. Generally, the auxin antagonism or inhibitory properties of xenobiotics are measured at different concentrations against IAA content at maximum growth stimulation. The growth that occurred in the controls is probably due to low level of endogenous IAA remaining in coleoptile sections when the tips (natural source of IAA) were removed. It was evident that all the auxin was not probably depleted and that endosulfan possessed no auxin-like activity within the range 0.1– 1 ppm. However, the effect of auxin was enhanced insignificantly at this level of endosulfan when IAA and endosulfan were present together.

In the infiltrated barley sections, inhibition of elongation caused by endosulfan was concentration dependent. Barley straight growth test suggests that endosulfan at lower concentrations exerts a competitive inhibition which can be reversed by IAA whereas, at higher concentrations, endosulfan gets irreversibly bound to some site which is needed for the full expression of IAA activity (Hans and Gardner, 1976), Yung and Mann (1967); Lee (1977) and Lau and Yung (1978) demonstrated that metabolites of carbofuran and phenyl carbamate herbicides altered the expression of gibberellic acid and IAA in plants.

The present experimental design gives no evidence for the absence of IAA in coleoptile sectons. The basis for endosulfan inhibition of coleoptile elongation is

likely to be the same in the control and in IAA-treated coleoptiles. The data presented indicate that growth inhibition occurs by a similar mechanism, i.e. by auxin antagonism. Our preliminary results indicate that endosulfan antagonizes auxin-stimulated growth which is in agreement with the inhibited growth of *C. arietinum* seedlings on exposure to endosulfan (Agarwal, 1982). Thus, endosulfan exerts its inhibitory effects on seedling growth either by lowering the endogenous level of IAA (Agarwal and Beg, 1982) or by direct interaction with the hormone at its site of action, hampering the hormonal expression.

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References

Agarwal, S. (1982) *Biochemical studies in germinating seeds in relation to pesticide toxicity,* Ph. D.Thesis, Lucknow University, Lucknow.
Agarwal, S. and Beg, M. U. (1979) *Indian J. Biochem. Biophys.,* **16,** 57.
Agarwal, S. and Beg, M. U. (1982) *Indian J.Exp. Biol.,* **20,** 319.
Hans, K. and Gardner, G. (1976) *Ann. Rev. Plant Physiol.,* **27,** 267.
Lau, O. L. and Yung, K. H. (1978) *Plant Cell Physiol.,* **14,** 379.
Lee, T. T. (1977) *Can. J. Bot.,* **55,** 574.
Yung, K. H. and Mann, J. D. (1967) *Plant Physiol.,* **42,** 195.