

## EFFECTS OF ETHYLENE ANTAGONISTS ON RECOVERY FROM AUXIN-INDUCED INHIBITION OF ROOT ELONGATION

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**INTRODUCTION:** Since early reports on auxin-induced promotion of root elongation (7, 8), there have been numerous attempts to demonstrate promotion of root growth by indole acetic acid (IAA). A factor which complicates the study of auxin action is that auxin rapidly increases ethylene levels in plant tissues (1, 4). Several groups proposed that the potential ability of auxin to promote root growth was masked by auxin-induced production of inhibitory levels of ethylene (2).

The link between auxin and ethylene in the control of root elongation was examined by Mulkey *et al* (6). In these studies it was shown that pretreatment of maize roots with ethylene biosynthesis inhibitors allowed for suppression of ethylene biosynthesis and expression of auxin-induced elongation.

In this study we have examined the effects of ethylene antagonists on the recovery of root tissue from auxin-induced inhibition of elongation.

**MATERIALS AND METHODS:** Plant Material. Caryopses of corn were soaked overnight in running tap water and germinated between wet paper towels on opaque plastic trays placed in a vertical position (5). The seedlings were used after two days when the primary roots were about 1.5 cm long. Measurement of Elongation. Root elongation was measured using a computerized root auxanometer similar to ones previously described (3, 6). The voltage output from the auxanometer's transformer is directed both to a recorder, and after analog to digital conversion of the signal (Dash 8/EXP 16, MetraByte Corp. Taunton, MA), to an IBM-PC computer. Chemicals. Aminoethoxyvinylglycine (AVG) was obtained from Dr. G. Lee Benson, Maag Agrochemicals, Vero Beach, FL. Silver thiosulfate was prepared with silver nitrate and sodium thiosulfate. Sodium thiosulfate was dissolved in distilled water at eight times the concentration of silver nitrate. All other chemicals were obtained from Sigma (St. Louis, MO).

**DISCUSSION:** Fig. 1 (upper line) illustrates the growth kinetics associated with pretreatment of roots with AVG prior to exposure to IAA. After a steady growth rate is observed, roots were treated with  $10^{-6}$  M AVG. An increase in the rate of elongation resulted. This stimulation of growth suggests that "normal" auxin levels in root tissue are supraoptimal; thus suppression of ethylene biosynthesis resulting from the "normal" auxin levels allows for enhancement of root elongation. Addition of auxin ( $10^{-6}$  M), resulted in inhibition of root growth to about 10% of the original control rate. Fig. 1 (lower line) illustrates the effect of reversing the treatments described above. Roots were treated with  $10^{-6}$  M IAA which inhibited the roots by 90% within 30 min. AVG ( $10^{-6}$  M) was added 1 hr after IAA treatment. Root elongation recovered to approximately 60% of the original rate within 2 hrs.

Figure 2 illustrates the concentration dependence of IAA action on the elongation of roots treated with IAA (open circles), on roots pretreated with AVG for 1 hr prior to exposure to IAA (solid circles), on roots treated with IAA for 1 hr prior to AVG exposure (squares), and roots treated with IAA 1 hr prior to exposure to 0.1 mM silver ions (triangles). AVG or silver ion post-treatment of IAA-treated roots resulted in significant recovery from auxin inhibition when compared to recovery of control roots or to recovery observed in AVG-pretreated roots.

From this data the following conclusions can be made: 1) IAA-induced inhibition of root elongation results from auxin-induced ethylene biosynthesis. 2) Post-treatment of IAA-

inhibited roots with AVG or silver ions induces a recovery of elongation; thus inhibition of root growth by auxin is, at least in part, a reversible process.

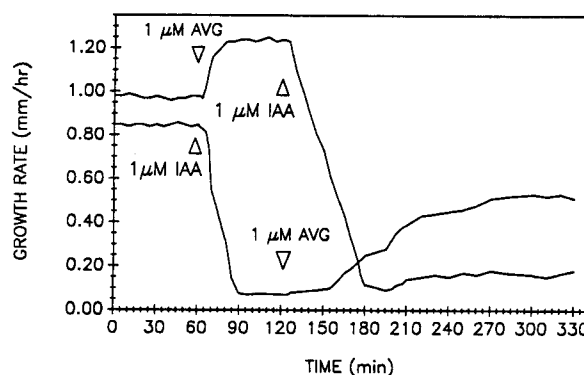


Figure 1. Kinetics of primary root elongation. Upper line illustrates the effect of treatment with  $1 \mu\text{M}$  AVG (first arrow) and subsequent exposure to  $1 \mu\text{M}$  IAA (second arrow) on root elongation. Lower line is the converse treatment. Note the recovery from IAA-induced inhibition after AVG treatment.

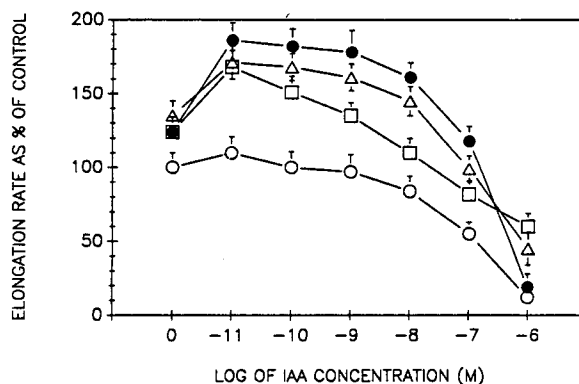


Figure 2. Concentration dependence of IAA action on the elongation of intact primary roots of maize. Open circles are rates 2 hours after IAA treatment. Closed circles are roots treated with AVG for 1 hr prior to IAA addition. Squares are roots exposed to IAA 1 hr prior to addition of AVG. Triangles are roots treated with IAA 1 hr prior to exposure to silver ions. Elongation rates were measured 2 hr after treatment with IAA.

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