Inhibition of Flowering in Xanthium pensylvanicum Walln. by Ethylene

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Bonner and Thurlow (3) reported that indole-acetic acid (IAA) inhibited the formation of flowers in cockleburs (Xanthium pensylvanicum Walln.) when it was applied as a spray during the long inductive night. In this report, evidence is presented that ethylene also inhibits the flowering of cockleburr plants that have been exposed to a long inductive photoperiod and that the IAA effect is probably due to auxin stimulated ethylene production.

The 2 large apical beaks were cut from cockleburr fruits, (Chicago strain, generously supplied by F. B. Salisbury, Utah State University, Logan, Utah) washed in running water for 24 hours, planted in 4-inch pots containing soil, and seedlings grown for 3 weeks at 25° on a 16 hour light cycle (1500 ft-c) supplied by daylight fluorescent bulbs. The plants were induced to flower by exposure to 16 hours of darkness in 10 liter desiccators containing 0, 1, 10, or 100 ppm ethylene. After the induction period, the plants were returned to the growth chamber and the sizes of the inflorescences measured 8 weeks later. Ethylene evolution from the plants was measured by gas chromatography (2).

The inflorescences of the 2 controls receiving no ethylene were 5 and 8 mm in diameter and in anthesis. After 16 hours in the desiccator, the level of ethylene in the gas phase had risen to 0.025 ppm. One of the plants treated with 1 ppm ethylene remained vegetative and the other had an inflorescence 2 mm in diameter. The plants treated with 10 and 100 ppm ethylene remained vegetative. Except for an initial temporary leaf epinasty the ethylene treatment had no effect on the subsequent growth and vigor of the plants when compared to controls maintained on long days. This experiment was repeated on 3 other occasions and similar results obtained. Ethylene production from untreated cockleburr plants during the 16 hour dark period was 7 nl per hour per plant. After spraying with 0.1 and 1 mm IAA until runoff, the rate of gas production increased to 14 nl and 28 nl per hour respectively.

Some recent examples of auxin effects shown to be ethylene related include: the stimulation of abscission by auxin (2), the auxin-induced inhibition of growth of pea stem sections (4), and the induction of flowering of pineapples (5). Palmer (9) recently reported that high levels of IAA would inhibit the induction of invertase in aged beetroot (Beta vulgaris L.) tissue slices. Using the same species Scott (11) reported that 10 ppm ethylene would also inhibit invertase synthesis. Another example of auxin-ethylene effects may be the development of sex in monoecious species. In a recent review, Nitsch (8) pointed out that treatments with auxin and unsaturated gases such as ethylene, CO, and acetylene favor the formation of female flowers on cucumber (Cucumis sativus L.) plants. The results presented here suggest that the inhibition of flowering in the cockleburr by auxin may also be an ethylene effect.

The mechanism by which ethylene prevents the induction of floral primordia is unknown. However, it is known that RNA synthesis (6,10) and presumably protein synthesis (6,7) are an essential part of the induction process. It is known that ethylene can enhance RNA and protein synthesis in ethylene sensitive tissue (1), suggesting that ethylene may interfere in some way with the orderly production of RNA required for the flowering process.

Literature Cited


