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Effect of Morphactin on Growth and Geotropism of Peanut Gynophore Explants[1]

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Abstract. **The intercalary meristem (IM) of peanut (*Arachis hypogaea* L.), located 2.5 mm proximal to the ovules, showed a high sensitivity to morphactin (methyl-2-chloro-9-hydroxyfluorene-9-carboxylate) in response to unilateral gravity stimulus. All morphactin concentrations stimulated elongation, with optima at 0.1 and 10 ppm. Geotropic response diminished as concentration increased; at 50 ppm gynophores became ageotropic. Growth and the "anti-geotropic effect" seem to be coupled. The results imply a controlling role of auxin and favor the Cholodny-Went theory. Gynophores are physiologically root-like although anatomically stem-like in regard to morphactin effects.**

Following fertilization of the peanut flower, floral parts wither and within a few days, pegs (gynophores) which are the aerial phase of the peanut fruit (3, 13, 14) appear showing positive geotropism and elongating by an intercalary meristem (IM) (2, 4). The peanut gynophore was chosen for this study because its aerial gynophores exhibit geocarpy and fructify in soil (14, 15). The organ has a distinct intercalary meristem (IM) not complicated by appendages (4), its growth is strictly polarized, and, for young gynophores, the geotropic response is independent of the light regime (19). Although Brennan (2) hinted that studying the gynophore could be useful in elucidating basic problems of phytomorphogenesis, there is a paucity of such research on the more fundamental aspects of gynophore physiology. The effects of morphactins[3] on the gynophore were examined because its effects on plants include inhibition of longitudinal root and shoot elongation; inhibition of meristematic activity; altering polarity of cell division and copious disturbance of geo- and phototropism (11, 12).

Materials and Methods

Aerial gynophores were excised when they were about 4 cm long from Spanish-type peanut plants grown in pots in a growth chamber. They were immediately washed in distilled water to remove adhering debris and withered floral parts, surface sterilized in 1% Clorox (5.25% sodium hypochlorite) for 5 min and rinsed with distilled water. Five mm distal segments of the gynophores, including the ovary with the 2 ovules, were excised with a razor and placed horizontally on folded filter papers in Petri dishes so that half the length of each gynophore protruded beyond the supporting papers. Five ml of distilled water or solutions of 0.01, 0.1, 1, 10, 30, or 50 ppm morphactin were added to each Petri dish so that filter papers were saturated. No surfactant was used since morphactins penetrate the tissue quickly (17). The covered dishes containing 5 tissue segments were incubated at room temp in available light for 72 hr. The differential rate of elongation of cells of the IM region 2.5 mm proximal to the ovary resulted in curvature of the section. Incipient curvatures in the control were observed after 24 hr of incubation and curvatures were fully manifested (90° curvature for control) after 72 hr. No special light conditions were imposed. The experiment was repeated twice. Growth is reported as change in length to the nearest mm. The geotropic angle was determined by dipping each gynophore in ink and making imprints on lined paper. Curvature was measured by drawing a line on the imprint tangent to the growing point and determining the angle between this line and a line extended from the base of the gynophore.

Results

Excision of the ovary delayed but did not inhibit curvature (data not shown). Thus the IM is the region of stimulus perception and response, and also the region of maximum elongation according to Jacobs (7). Growth was enhanced by all concn of morphactin, with optima at 0.1 and 10 ppm (Fig. 1). Morphactin was very effective in altering geotropism, even at 0.1 to 1 ppm (Fig. 1). At 50 ppm morphactin, the gynophores were

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[3] Morphactin, (trade name: Maintain, common name: Chlorflurenol), a product of E. Merck Ag., Darmstadt, West Germany, was a gift from the Department of Environmental Horticulture, University of California, Davis.

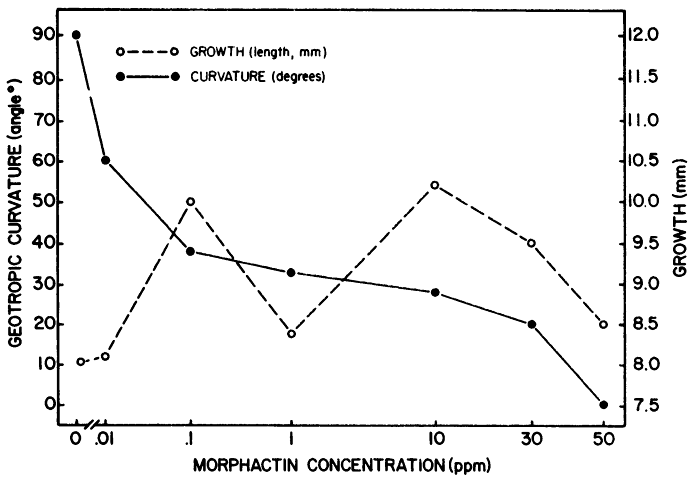

Fig. 1. Effect of morphactin concn on growth in length and geotropic curvature of peanut gynophore segments. 0 ppm is water control and each datum is the mean of 2 experiments. Abscissa in logarithmic scale (each increment represents a power of 10).

rendered completely insensitive to geotropic stimulus (ageotropic). There was an initial inverse relationship between the anti-geotropic effect and growth stimulation.

Discussion

Morphactins render roots and stems insensitive to geotropic stimulus (1, 17). Our results agree with previously published data on various plant organs (1, 6, 8, 18). The effect on peanut gynophore geotropism is striking at very low concn and parallels the reported effects on roots (11). Morphactins have been implicated in growth inhibition; however, our results show that they stimulate growth at low concn, which agrees with the work of Krelle and Libbert (8). The gynophore has a stem anatomy and stem-like auxin transport properties (2, 5) but is root-like in function and external morphology (8, 16). Smith (14) cautioned that it is a fruit by definition. However, its sensitivity to morphactin resembles that of roots.

Many studies (1, 7, 9, 10) indicate that morphactins inhibit auxin transport. According to the classical Cholodny-Went theory of geotropism and phototropism, gravity induces an asymmetrical distribution of auxin, more accumulating on the lower than the upper side of the organ. In view of the different sensitivities of roots and shoots to auxin, the negative and positive curvatures, respectively, in these organs, can be explained. Because gynophores are more root-like than stem-like in physiology, auxin may control geotropic response by acting differently on the IM. Yasuda (17) induced unilateral curvature on vertical gynophores by unilateral application of auxin. If curvature is affected by auxin, then morphactins could be used to test the Cholodny-Went hypothesis. Our studies show that growth of the gynophore is stimulated by morphactin while curvature is suppressed, so that "anti-geotropic effect" and growth regulating activity seem to be coupled.

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