ABERRATIONS IN SHOOT MORPHOGENESIS OF PEA SEEDLNGS AFTER TREATMENT WITH MICROTUBULE DISORGANIZERS AND 2.4-D

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Microtubules are known to be involved in morphogenetic activities on the cellular level and it can be assumed that genes that influence the organization of microtubules may also influence the plant's morphology. On the other hand, auxins are known to influence plant morphology on the intercellular level, the auxin-herbicide 2,4-dichlorophenoxyacetic acid (2,4-D) being especially noted for causing abnormal growth (1). In a comparative study we treated young pea seedlings with microtubule disorganizers and 2,4-D to determine their morphogenetic effects on shoot development.

One-week-old etiolated pea seedlings were treated with the following compounds: colchicine (5×10^{-3} M), vinblastine (100 ug/ml) and 2,4-D (10^{-4} M) dissolved in water. From 5-10 ul of each solution were applied between the primary leaves of the apical hook. The seedlings were further cultivated under a light/dark regime of 16/8 hours on moist vermiculite to induce light-dependent morphogenesis. Under these conditions the MT-disorganizers (colchicine, vinblastine) and the auxin-herbicide 2,4-D, produced different morphological changes in the shoot. Within one week after treatment the colchicine-treated population exhibited aberrations ranging from strong swelling in the apical tissue of clearly inhibited seedlings to abnormal leaf formation in slightly furtner developed seedlings (Fig. 1a). Deviations in leaf shape were common in this population. For example, one of the stipules was often a sent, reduced in size, or altered in shape. The leaflet blades also differed in size, shape, and conformation. The stems were thickened or broadened toward the tip similar to fasciated structures. Nevertheless leaves and stems were green and growth was not at all inhibited.

The vinblastine-treated seedlings showed similar but less striking aberrations in shoot development, and shoot morphogenesis in general was only slightly inhibited (Fig. 1b).

The 2,4-D-treated seedlings were not so drastically Inhibited, but several morphological aberrations were evident (Fig. 1c). Again, the leaf blades were abnormal in size and shape, but not in color. Apical leaves often showed extremely disturbed morphogenesis, e.g. blade curvature and stem broadening. The stipules were not affected so strongly, but they did show changes in size and shape similar to seedlings treated with colchicine.

These preliminary investigations demonstrate that the light-dependent morphogenesis of young pea seedlings is affected substantially by MT-disorganizers and by 2,4-D. Both compounds induced similar abnormalities in leaflet, stipule, or stem formation, thus supporting the view that microtubule organization within the plant cells may be directed by auxins.

1. Audus, L. J. (ed.) 1964. Physiology and Biochemistry of Herbicides. Academic Press, London.

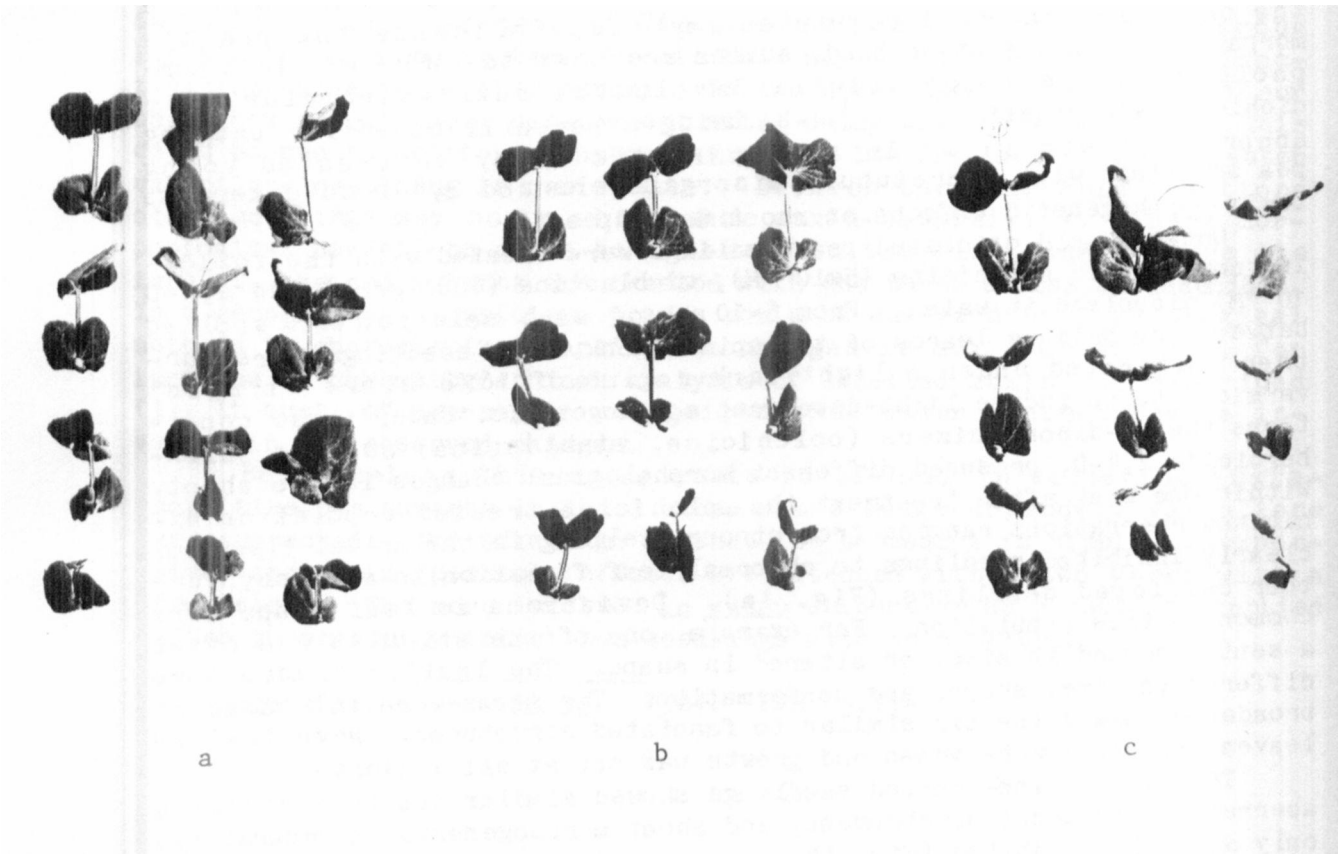

Fig. 1. Leaf aberrations resulting from treating one-week-old pea seedlings with: (a) colchicine, (b) vinblastine, or (c) 2,4-D.