Technical Papers

A Correlation of Severity of 2,4-D Injury with Stage of Ontogeny in Monocot Stems[1]

Arthur J. Eames

Department of Botany,
Cornell University, Ithaca, New York

Experiments with 2,4-D treatment of millet, *Setaria italica* (L.) Beauv., and green foxtail grass, *S. viridis* (L.) Beauv., show that the degree of injury to the stems is correlated with stage of maturity of the nodal parts. The modifications of the nodal parts form a series in degree of injury very much like that occurring in bean leaves after treatment with 2,4-D (*1*) and seen also in the leaves of many other plants, woody and herbaceous.

Seedlings of millet and foxtail grown in a greenhouse were treated 45 days after the seeds were planted by painting the upper surface of 2 leaves of each plant with a solution of 250 ppm of 2,4-D in water with 2% Tween. After a few days, swelling appeared in the bases of the internodes that were elongating at time of treatment. (The swellings involve the nodal level of the stem and are conveniently called nodal.) Since the effect of 2,4-D is upon immature tissues, it appears in monocot stems in these regions. The nodal swellings were larger in the millet than in the foxtail, which is much less sensitive to 2,4-D treatment.

As the swellings developed, a size series became evident. The most prominent enlargement was that at the second node (above the embryonic nodes), numbered 2 in Fig. 1. The swelling at the next older node, that below this, numbered 1, was much less prominent; No. 3 was the next most prominent, with Nos. 4 and 5 showing less and less evidence of injury. As the swellings increased in size, they became platelike expansions, most extensive on the side opposite the median point of leaf attachment (Fig. 1 *B*, node 3). (In the figure the inequality is partly concealed at some nodes because the widest part of the swelling lies behind the stem.) The zigzag form that develops in the stem at this time is apparently due to the one-sided swelling in the nodal regions.

When the platelike stage is well established, adventitious root tips appear in large numbers over the distal part of the swellings, and roots develop rapidly. The time of appearance of these roots, and the extent of their development at any one time, are parallel to the size of the swellings and supply additional evidence of the series in the effect of the treatment. Root length may not always fit into the series because the roots close to and at the ground level may become established in the soil and continue to grow, whereas those higher on the stem die and begin to rot away as the plant becomes moribund.

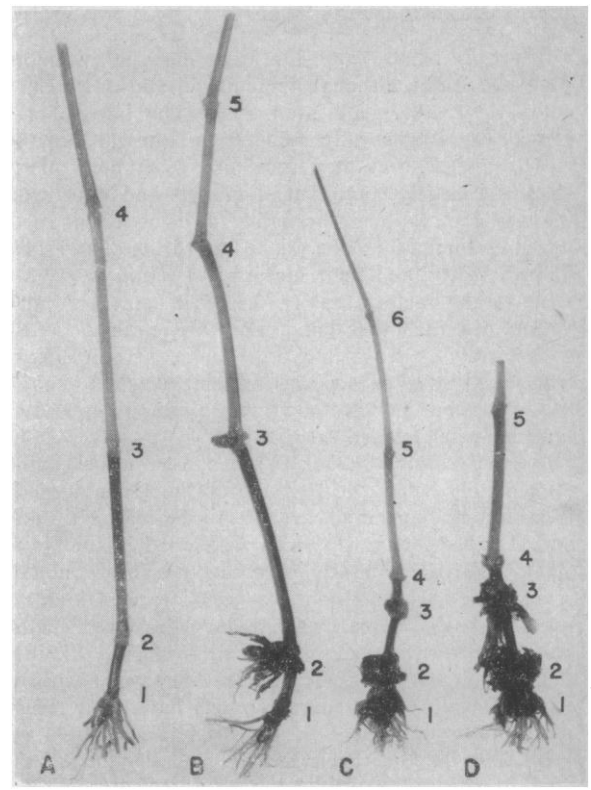

FIG. 1. Seedlings of millet with leaves removed. *A*, normal; *B–D*, treated, *B* and *C* 21 days, *D* 35 days, after treatment. *B–D* show platelike swellings of nodal regions forming a series in size related to stage of internodal development at treatment. Greatest enlargement at node 2, with decrease upward and downward. Adventitious roots (just appearing at node 3 in *B*, *C*) at greatest length at node 2 (in *C* and *D* dead and decaying). (Length of internodes varies greatly with individual plants and is not significant.) × 75.

Fig. 1 shows the stems of normal and treated millet seedlings with leaves removed. The swellings of the lower nodes are concealed by the roots, but the approximate development can be judged. The lowest node (above the nodes of the embryo), No. 1, shows rather slight enlargement; the next node above (2) shows the greatest enlargement; those above show progressively less and less swelling toward the apex. The series is thus similar to that seen in dicot leaves. Stems therefore demonstrate, as do leaves, that the effect of 2,4-D is upon the maturing tissues—the injury becoming evident as the tissues continue development; that the extent of injury is dependent upon stage of development when treated; and that the effect is brief. If the effect were not brief, but continuing, the modifications would be the same in successive internodes.

[1] This paper is based upon work done for the Biological Department, Chemical Corps, Camp Detrick, Frederick, Md., under Contract No. W-18-035-CM-237.

Reference

1. WATSON, D. P. *Am. J. Botany*, **35**, 543 (1948).