Effects of Naphthaleneacetic Acid on Field-Grown Soybeans

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The auxin (9) naphthaleneacetic acid (NAA) or its amide has been used as a floral thinner and to inhibit the abscission of fruit in the fall, particularly with apples (1, 7); and NAA has been used to promote uniform flowering of pineapple plants (3). Large amounts of these auxins inhibited both vegetative and reproductive growth of cotton (8). Spraying flowers of soybean plants with NAA failed to increase floral set (10). Another auxin, 2,4-D, has been reported to cause brittleness of stems of corn plants (2) and of soybean plants (4).

The present study was a part of a study to determine the effect of growth regulatory compounds on field-grown soybeans (2, 5).

MATERIALS AND METHODS

Experiments were conducted near Ames, Iowa, on Colo silt loam. Before planting, 250 pounds per acre of 0-20-20 (0-9-16, elemental) fertilizer was disked into the seed bed. Plots were irrigated during July to bring soil moisture up to field capacity. Soybeans (Glycine max (L.) Merrill) were planted in rows 40 inches apart, with a stand of approximately 10 plants per foot. A 16-foot section of row was harvested for determination of seed yield after removing approximately 1 foot from each end of an 18-foot row. Some specific experimental procedures are given in Table 1. Four-foot sections of row were taken for determination of dry matter of some component parts of plants as affected by NAA during the season (Table 6).

Stages of growth were as described by Kalton et al. (6). In brief, the stages were as follows: stage 1, 1 trifoliate leaf expanded; stage 2, 3 trifoliate leaves; stage 3, 5 to 6 trifoliate leaves with 1–5% of the plants flowering; stage 4, 30% of the plants flowering; stage 5, flowers at the apical portion of the stem; stage 6, pods in the lower 1/2 of the plant; stage 7, pods at the apical portion of the stem; and stage 8, pods in top of plant full length.

Except in experiment 3, a mixture of 3/8 alpha-NAA and 1/8 of its amide (w/w) was used. This mixture will be referred to as NAA. In Experiment 3 only the amide was used. Desired amounts of the mixture were weighed into flasks and brought into solution with 95% ethanol. In the field, the solution was poured into low-pressure hand sprayers containing a measured volume of water with 0.05% Tween 20. Foliage was sprayed to the point of run-off. The plants in control rows were not sprayed.

RESULTS

The first visible effect of spraying plants with NAA was epinasty of the upper part of the stem and of some of the petioles. This effect could be seen 1 hour after spraying and lasted for approximately 24 hours. With subsequent sprayings, the epinasty caused by NAA became less noticeable. Application of NAA at a prefloral stage decreased branching and delayed flowering. In Experiment 3, the effect of NAA applied at this stage was almost completely reversed by a later application of auxin.

Some effects of stage at which NAA was applied to the plants are shown in Table 2. As compared with control plants, the treated plants were shorter, smaller, and the width of the plants smaller. Later in the season, treated plants were shorter than control plants (Tables 4, 7). The varieties listed in order of expected decreasing susceptibility to lodging. NAA decreased lodging in all the varieties, but the most striking improvement was for varieties more prone to lodge. Application of NAA at stage 2 increased the average height above the soil surface and pod present at the time of harvest. The effect was greater for those varieties which set pods close to the soil surface. Application at stage 2 did not affect maturity, seed size, or seed yield.

Some effects of stage at which NAA was applied to Lincoln soybeans are shown in Table 3. Maturity was delayed if NAA was applied at a stage greater than 3. Height of the lowest pod increased with stage of application up to a maximum at stage 4 and thereafter decreased. Plants were flowering closer to the lower nodes at stage 4. At stage 6, plants failed to develop in the lower nodes, and this effect was lost as readily as flowers at stage 4. Pods at stages 1, 2, and 3 did not appreciably affect seed size. NAA applied at stage 4 increased seed size and decreased seed yield.

The effects of the amide of NAA stages are shown in Table 4. Application of chemicals at stage 6, 7, or 8 delayed the vegetative parts of the plants. Leaves and leaf and petiole abscission was decreased. Pods matured on green plants. During stages 1 and 2 setting pods. The vigor of those stages of the plants treated with NAA at an abortion of half of the seeds which were set. By the beginning of stage 5, approximately half of their normal complement of large-sized seeds at stage 8 had sufficient auxin; collectively, were able to compete with the aborted seeds at stage 7. NAA was applied later than stage 6. The effect of auxin on seed abortion was at stage 6 or 7. The chemical applied at stage did not decrease seed yield as much as it decreased seed size.