OBSERVATIONS ON THE EFFECTS OF MALEIC HYDRAZIDE ON FLOWERING OF TOBACCO, MAIZE AND COCKLEBUR*

BY AUBREY W. NAYLOR

OSBORN BOTANICAL LABORATORY, YALE UNIVERSITY, NEW HAVEN, CONNECTICUT

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In April, 1949, experiments were begun in this laboratory to determine effects of maleic hydrazide[1] on growth of a number of species of plants. Our first objective was to determine its effect upon growth and differentiation of Turkish tobacco plants which were just producing flower buds. Concentrations ranging from 0.05 to 0.8 per cent were used in treating five lots of ten plants each. The solutions were made up in distilled water to which one drop of Aerosol OT was added per 100 ml. to act as a spreading agent. All leaves of the plants were then sprayed on both upper and lower surfaces. Each plant received approximately 25 ml. of the proper solution. Height measurements were made and note taken of the number of flower buds visible without the aid of a hand lens. The plants were then placed on the greenhouse bench in such a manner that light and moisture conditions would be as uniform as possible.

TABLE 1

EFFECT OF FIVE CONCENTRATIONS OF MALEIC HYDRAZIDE ON GROWTH IN HEIGHT AND FLOWER EXPRESSION IN TURKISH TOBACCO

PER CENT MALEIC HYDRAZIDE USED	NO. OF PLANTS TREATED	AVERAGE HEIGHT, CM., APRIL 19	NO. OF PLANTS WITH FLOWER BUDS, APRIL 19	AVERAGE HEIGHT, CM., MAY 17	NO. OF PLANTS WITH LIVING FLOWERS, MAY 17	AVERAGE INCREMENT IN CENTIMETERS
0.8	10	34.6	2	48.2	None	13.6
0.4	10	36.4	3	49.5	None	13.1
0.2	10	38.1	5	57.4	None	19.3
0.1	10	39.4	6	65.0	5	25.6
0.05	10	39.7	4	91.6	10	51.9
Control	10	43.0	1	106.9	10	63.9

None of the plants treated with 0.2, 0.4 and 0.8 per cent maleic hydrazide had produced new flowers and all those initiated at the time of treatment were dead. Some of these abscissed. On the other hand, of the ten plants treated with 0.1 maleic hydrazide, only five produced flowers and these grew slowly. All of those plants receiving 0.05 per cent maleic hydrazide flowered, but again the rate of development of the inflorescences was slower than the controls. Figures obtained on height increment following treatment indicate nearly equal effectiveness of concentrations of 0.2, 0.4 and 0.8 per cent maleic hydrazide in suppressing terminal growth. Lower concentrations showed decreasing effectiveness in inhibiting over-all growth in height (table 1).

Maize is also very markedly inhibited in growth by maleic hydrazide. The effective concentration range for it is approximately the same as for tobacco. Wisconsin hybrid No. 525 maize was used in the tests reported here. Single plants were grown in soil in two-gallon crocks. Seeds were planted in July and the plants were approximately one meter tall with no visible staminate inflorescence (tassel) at the time of treatment. Crystalline maleic hydrazide was used in making the solutions, and Emulphor EL was employed as the spreading agent. All solutions were adjusted to

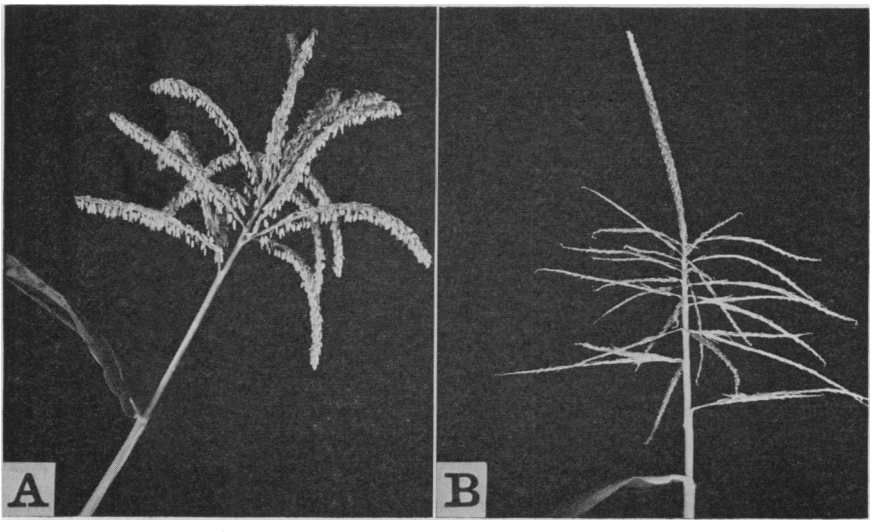

FIGURE 1

Appearance of the staminate inflorescence of maze 45 days after treatment with maleic hydrazide. *A*. Control. *B*. Leaves sprayed with 0.025% maleic hydrazide solution when the plant was 35 days old. Note the lack of anthers in the flowers of the treated plant.

pH 6.0. Concentrations ranging from 0.025 to 0.2 per cent were used. Each one exerted a marked effect.

The highest concentration prevented flower expression completely. The corn plants receiving the lowest concentration grew almost as rapidly as the controls but produced sterile tassels. The number of staminate flowers was approximately the same as in the controls but no anthers were formed (Fig. 1, B). The pistillate inflorescences on these plants, however, were composed of fertile flowers. Seed was set at the base of the ears and more would have probably been set toward the apex had the amount of fertile pollen in the greenhouse been higher.

Because of the striking effects of maleic hydrazide on flower development in tobacco and corn, it seemed desirable to determine if this substance would prevent flowering in a photoperiodically sensitive plant. *Xanthium saccharatum* Wallr.[2] was selected for this purpose because of the large body of information available about light and dark requirements for flowering. Normally Xanthium changes from the vegetative to reproductive condition when provided with cycles of 8.5 hours of dark—15.5 hours of light.[3] Spraying the leaves with as little as 10 ml. of a 0.025 per cent maleic hydrazide solution at the time photoinduction was begun shifted the critical daylength by thirty minutes. Controls which did not receive maleic hydrazide shifted very rapidly from the vegetative to reproductive condition. On the other hand, those receiving this substance changed slowly from the vegetative condition and this held true even when the dark period given was $10^1/_2$ hours long.

Maleic hydrazide thus appears to be a good inhibitor of flower buds as well as vegetative buds.[5, 6] It also causes loss of apical dominance. While it suppresses lateral buds as well as terminals much higher concentrations are required for this than for inhibition of the terminal bud alone. Although some of the leaves produced subsequent to treatment with high concentrations of maleic hydrazide show malformation, concentrations effective in inhibiting flower bud development which do not affect leaf development can be employed. This substance may possibly find application where it is necessary to delay or completely inhibit flowering as in tobacco, and possibly celery and lettuce production. Since there appears to be a difference in sensitivity of terminal and axillary flowers to this substance new possibilities in the production of hybrid seed are opened up. It is often desirable, for example, to have, in hybrid seed corn production, a pollen sterile parent, and preliminary experiments indicate this condition can be induced with the aid of maleic hydrazide.

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[1] Supplied through the courtesy of Naugatuck Chemical Company, Naugatuck, Connecticut, as a 30 per cent solution in diethanol amine.

[2] This is the species Hamner and Bonner refer to as *Xanthium pennsylvanicum*. According to Parker, *et al.*,[4] this species has been identified by Dr. S. F. Blake as *X. saccharatum*.

[3] Hamner, K. C., and Bonner, J., *Botan. Gaz.*, **100**, 388–431 (1938).

[4] Parker, M. W., Hendricks S. B., Borthwick, H. A., and Scully, N. J., *Ibid.*, **108**, 1–26 (1946) (see p. 3).

[5] Schoene, D. L., and Hoffmann, O. L., *Science*, **109**, 588–590 (1949).

[6] Naylor, A. W., and Davis, E. (in preparation).