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# CONTROL OF FLOWERING IN TEOSINTE

## Short-Day Treatment Brings Early Flowers

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**A**TTEMPTS to force teosinte into flower in mid-summer, in order to facilitate hybridizing it with maize, have afforded considerable information concerning the flowering time of teosinte under diverse conditions. The possibility that some of this information may be of use to others suggests its publication. The paper is, therefore, to be considered as a help in the technique of teosinte and maize hybridization rather than a contribution to the solution of the physiological problems involved.

### Early Observations

Some years ago the writer observed that teosinte that germinated in the greenhouse at Ithaca, New York, during December came into flower within a few months, while plants of the same stock started almost any time from March to June did not blossom until October. With the publication of the results of Garner and Allard with respect to the effects of length of day on the blossoming time of various plants, the reason for this behavior of teosinte became apparent.

The first few times that the writer attempted to force teosinte into flower in time to cross it with maize grown out-of-doors, he began the short-day treatment too early or too late for best results. It seemed worth while, therefore, to determine as nearly as possible when the treatment should be begun, how long it must be continued, the degree of darkness of the room into which the plants were placed to shorten the time of exposure to daylight, and kindred matters. The time and facilities available did not permit as elabor-

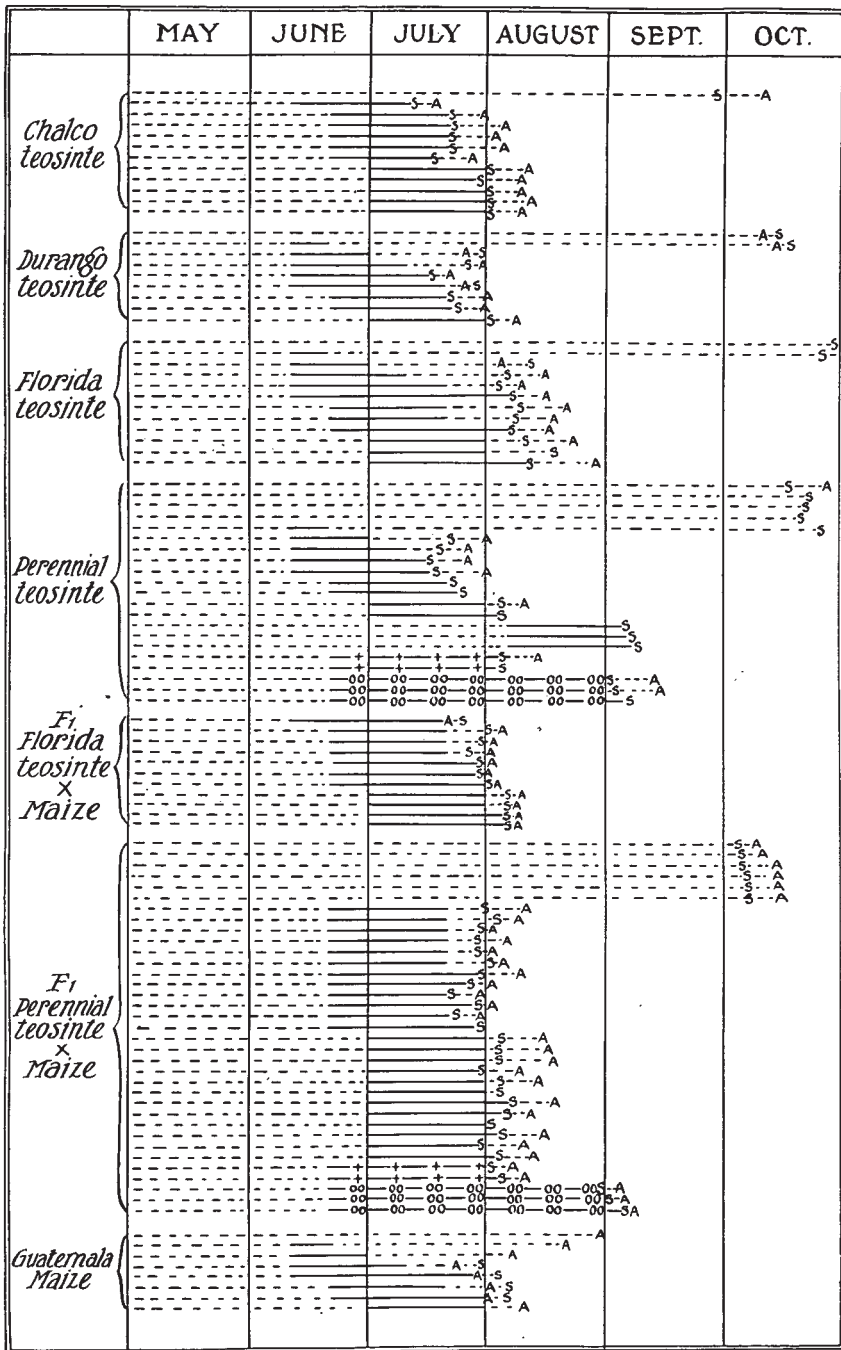
ate an experiment as desired, but the results, so far as they go, were fairly decisive, at least on certain points.

### Methods Used

Teosinte plants of stocks originally obtained from Messrs. Collins and Kempton of the United States Department of Agriculture, and plants of maize collected in Guatemala by Dr. Knudson of Cornell University were started in pots in the greenhouse on May 1st, 1923. Germination was fairly prompt in most cases, but no records of the date of germination were made. For perennial teosinte, offsets rather than seeds were used. All plants were kept in the greenhouse, exposed to the full length of day of that season, until June 10th, about a month after germination.

Beginning on June 10th a part of the plants were placed on small trucks, run outdoors at 8:00 A. M. and returned to a darkened room at 6.00 P. M. They were, therefore, exposed to a ten-hour day. Of the remaining plants, some were left in the greenhouse and some kept constantly out-of-doors near the trucks of plants receiving the short-day treatment. At ten-day intervals for a time thereafter, some plants were removed from and others placed in the trucks. The different plants were thus subjected to the short-day treatment at various ages and for various lengths of time.

The room used in this test was darkened by means of several thicknesses of heavy brown paper placed over the glass of the doors and windows. While not perfectly dark, objects in the interior could be made out



**SHORT-DAY TREATMENT OF TEOSINTE AND MAIZE**

FIGURE 23. Effect of short-day treatment on flowering date of teosinte, teosinte-maize hybrids, and sub-tropical maize. The plants were started May 1 and grown in pots. Each line represents a single plant.

Explanation of symbols:

- Exposure to full length of day.
- Ten hours in full light and fourteen hours in a dark room.
- + - + - Ten hours in full light and fourteen hours in a partly darkened room.
- 0 0 — 0 0 Ten hours in full light and fourteen hours under canvas shade.
- S indicates date of appearance of silks.
- A indicates date of appearance of anthers.

with difficulty when the room was closed. To vary the test, some plants were placed, except for the ten hours of daylight, in a similar room that was partly darkened by green window shades, the glass in the doors not being covered. Still other plants were shaded by means of a heavy canvas enclosing them at the top and sides. The canvas was not securely fastened and often gaped a few inches admitting direct light. No determination of the intensity of light in the several darkened or shaded rooms was attempted. It was found, however, that the light under the canvas at 6:00 P. M. in mid-summer was sufficient to enable one to read fine print fairly readily.

### Results of the Tests

The result of the various short-day treatments are perhaps best seen in the diagrams and photographs reproduced here. It is strikingly apparent from the diagrams that in general, plants given only ten hours of daylight blossomed much earlier than those exposed for the full length of day. In case of teosinte and teosinte-maize hybrids the difference was usually more than two months, and for the sub-tropical maize practically one month.

Perhaps the next most striking feature of the diagrams is that ten days of short-day treatment, beginning when the plants were only about a month old, had no effect whatever in hastening the flowering period. It does not follow from this, however, that a ten-day treatment begun later would have been without effect. The experiment gives no information on that point. A twenty-day treatment, on the contrary, was almost as effective as treatment for thirty, forty, or even fifty days.

Of the annual teosintes, Chalco was earliest, Durango next, and Florida last in coming into flower when given no treatment. And the same order of flowering was observed in general for these three varieties when exposed to a ten-hour day. Untreated perennial teosinte plants were slightly later

than Durango plants and treated ones of approximately the same season as that annual variety. Hybrids of fairly early stocks of maize with both Florida teosinte and perennial teosinte blossomed, on the whole, somewhat earlier than pure Florida teosinte and slightly later than perennial teosinte.

While there are numerous exceptions to the statement, it can be said in general that the later the short-day treatment was begun the later the plants flowered. This is particularly true of Chalco teosinte, which showed silks in almost exactly thirty days from the time the treatment began, whether it started June 10th, 20th, or 30th. Perennial teosinte flowered in from thirty-five to forty days when treatment was begun June 10th, and in slightly over thirty days when begun June 30th and August 5th. Less pronounced and somewhat less consistent results from beginning treatment at different dates were obtained with Durango and Florida teosinte. In case of hybrids of maize with Florida and with perennial teosinte, silks appeared about five days later when the treatment was begun June 30th than when begun June 20th.

Perennial teosinte plants and perennial teosinte-maize hybrids were the only ones tested in different degrees of darkness. In case of both of these, plants kept in the partly darkened room, except for the ten hours of full daylight, flowered at about the same time as similar plants put in the almost totally dark room ten days later. In other words, they responded to the treatment somewhat less quickly. When treated with the canvas shade, similar plants of these two lots flowered in about seventy days as contrasted to an average of about thirty-five days for the dark-room plants whose treatment began at the same time. It is interesting to note, however, that even this canvas-shade treatment brought the plants into flower thirty-five to forty-five days earlier than no treatment.

From the information gained in this test, it should be possible, under similar conditions in the future, to start



**FLORIDA TEOSINTE AFTER SHORT-DAY TREATMENT**

FIGURE 24. The plant at the left was given full daylight throughout the summer except for the ten days from June 10 to 20 when it was subjected to the short-day treatment, ten hours in daylight and fourteen hours in a dark room. It began flowering October 27, fifty-one days after the photograph was taken. Evidently the short-day treatment for so brief a period in an early stage of development had no appreciable effect. The plant at the right was given the same short-day treatment from June 30 to July 30 and came into flower August 10, twenty-seven days before the photograph was taken. Photographs for Figures 24-27 were made September 6, 1923.





**PERENNIAL TEOSINTE AFTER SHORT-DAY TREATMENT**

FIGURE 25. The plant at the right received the full length of daylight throughout the summer and began flowering October 20, forty-five days after the photograph was taken. The plant at the left was ten hours in full daylight and fourteen hours in the shade of a canvas each day, from June 20 to September 1, when it began flowering, five days before the photograph was taken.



#### HYBRIDS OF MAIZE AND PERENNIAL TEOSINTE

FIGURE 26. The two plants at the right were in full daylight throughout the summer. The smaller plant grew in a very small pot under rather dry conditions out-of-doors and the larger one in a somewhat larger pot under moister conditions in the greenhouse. The former blossomed October 4 and the latter October 5, about four weeks after the photograph was taken. The plant at the left was given short-day treatment, by use of a dark room, from June 30 to July 30 and flowered August 4, or thirty-three days before the photograph was taken. The second plant from the left was given short-day treatment, by being kept under a canvas shade fourteen hours a day, from June 20 to August 31, when it flowered six days before the photograph was taken.





**CHALCO TEOSINTE FORCED INTO FLOWER BY SHORT-DAY TREATMENT**

FIGURE 27. The plant at the left was exposed to the full length of daylight of the summer. Its first flowers appeared September 28, or twenty-two days after the photograph was taken. The plant at the right was subjected to the short-day treatment, ten hours in full daylight and fourteen hours in a dark room each day, from June 30 to July 30, and began flowering August 1, or thirty-six days before the photograph was taken. Its tassel was broken off.



teosinte plants and to begin the short-day treatment at dates such that they will flower within perhaps five days, one way or the other, of any date in mid-summer that may be set for their flowering. It should be noted, however, that there is nothing in these tests to indicate how much effect, if any, differences in temperature may exert in determining the flowering time. Ordinarily the earliest of the writer's maize cultures, planted in the garden at Ithaca about May 15th, flower by July 10th to 15th. In the cool summer of 1923, they were ten days to two weeks later than that. Some seasons untreated Durango teosinte plants flower at Ithaca about the first of October. This year they were about two weeks later. Whether plants subjected to the short-day treatment would show similar differences in different seasons is not certainly known, but it seems likely

that differences in temperature might have some effect.

There is little in the writer's experience to suggest that differences in cultural conditions have any noticeable effect on season of flowering. During the summer of 1923 Guatemala maize flowered at practically the same time whether grown in the garden or in relatively small flower pots in the greenhouse. Peruvian maize and Durango teosinte failed to show either silks or anthers in the garden at the time of the first killing frost, but the plants had reached practically the same stage of development, tasselling, as had similar potted plants in the greenhouse. Large types of tropical corn are, however, apt to develop few or no ears when grown in small pots and perennial teosinte plants seem more likely to have aborted tassels when they have grown with little vigor.

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