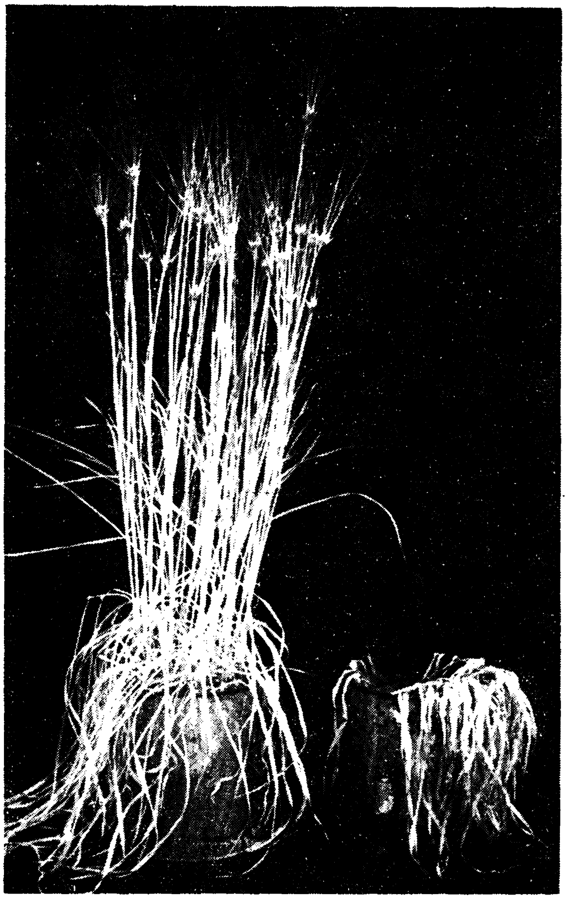

FIG. 1. Effect of maleic hydrazide on barley. Plants on the right treated; on the left untreated.

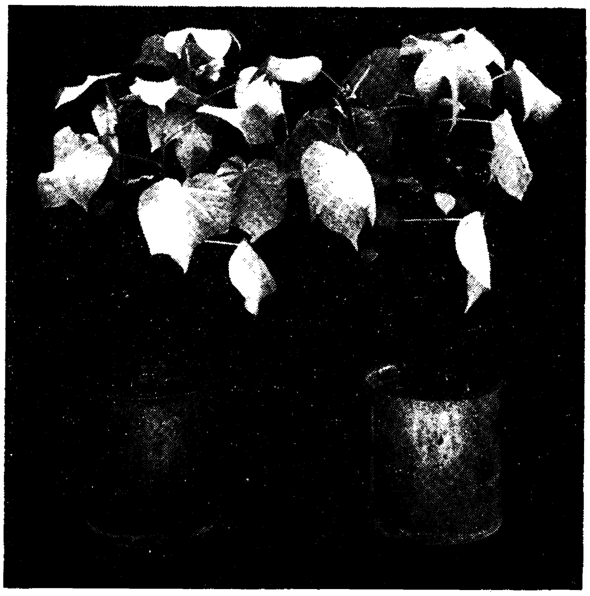

FIG. 2. Effect of maleic hydrazide on cotton. Plants on the right treated; on the left untreated.

unaffected. Even after 6 additional weeks, the treated cotton was in no way different from the control plants, both coming into flower at the same time. Addition of Vatsol caused more rapid killing of barley, but the end result otherwise was the same. No effect was discernible in cotton, with or without the spreader.

Subsequent tests have proved that various types of plants react quite differently to this new compound. Age of the plants is critical, in that young plants respond to a much greater extent. Cotton treated in the cotyledon stages was very severely inhibited, whereas plants 16 in. in height showed no apparent response. Age of grass plants is also critical. Young water grass (*Echinochloa Crus-galli*) and Johnson grass (*Holcus halepensis*) plants sprayed with 0.2% maleic hydrazide stopped growing, developed anthocyanin pigmentation, and finally died. Older plants showed some response but survived.

Control of grasses is essential to the mechanization of cotton harvesting in the West. Under field conditions, cotton can be kept relatively free of weeds until it is laid by. At this time young grass seedlings are able to grow so rapidly that the plants are tall enough by harvest time to be picked up by harvesters, producing grassy cotton. If this new chemical should provide a solution to this problem, it would prove to be an extremely valuable herbicide. For those who are studying chemical weed control, it presents a new and interesting selectivity. Results already obtained seem to justify very thorough testing of this compound.

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Effects of Irradiating Maize Pollen in a Nuclear Reactor on the F_1 Plants[1]

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The purpose of this paper is to report preliminary results in determining inherited changes induced by irradiating maize pollen in a nuclear reactor. The work was carried out by making crosses between untreated plants and plants with irradiated tassels, and subsequently studying the phenotypic effects on the F_1 plants. The irradiations were made in the heavy water pile of the Argonne National Laboratory.

The subject of hereditary effects of irradiations associated with the fission process has gained additional significance with the advent of the atomic bomb and the accompanying sharply intensified interest in nuclear energy. In this connection, studies have been made of hereditary changes in maize (*1, 2, 4*) and in cotton (*3*)

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following exposure at the atomic bomb explosion at Bikini in 1946. The radiations involved in the maize work were not designated in the reports, although Brown (*3*) indicated that the effects in cotton were due to gamma rays. Zirkle (*5*) has reported on the biological effects of slow neutrons from a nuclear reactor.

Security considerations make it impossible to report on all facts gained and problems encountered in carrying out the present studies. The information that can be reported follows.

The irradiations were made during the summer of 1947. Mature maize tassels were placed in the thermal neutron column of the heavy water pile as close to the pile proper as possible. The pile was operated at a power in the neighborhood of 300 kw. Tassels were irradiated at various lengths of time at this power. The exposures as reported do not include the time involved in bringing the reactor to the desired power, during which time the tassels were also exposed to the radiations.

TABLE 1

PERCENTAGES OF MAIZE PLANTS WITH ABNORMALITIES IN THE F_1 SPOROPHYTE GENERATION FROM CROSSES OF NORMAL BY NORMAL WITH MATURE TASSELS IRRADIATED IN A NUCLEAR REACTOR

			Percentage with specific abnormalities			
Exposure in nuclear reactor in min	Total no. F_1 plants examined	Percentage with one or more visible abnormalities	Height abnormal	Leaves narrow (grasslike)	Tassels or ear shoots lacking or incompletely developed	Chlorophyll content below normal
0	302	.3	.3	0.0	0.0	0.0
1	297	5.1	4.7	1.0	1.3	0.0
2	287	9.4	8.4	5.9	1.7	0.7
4	208	23.1	22.6	7.7	3.4	0.0
8	104	29.8	28.8	10.6	9.6	4.8
16	3	0.0	0.0	0.0	0.0	0.0

No attempt was made to get a pure source of any one type of radiation by shielding out other types. It is known that ionization at the position of the tassels was due, in a large part at least, to both slow neutrons and gamma rays. The relative ionizations of the two components are not known. The average flux of neutrons at the position of the tassels was 7×10^{10} neutrons/cm^2/sec.

The tassels were irradiated at periods of 0, 1, 2, 4, 8, and 16 min, respectively. Crosses were made by collecting pollen from the tassels within a period of 48 hr following treatment and placing it on untreated female plants. Seed of these crosses was planted in the field at Lincoln, Nebraska, on May 21 and June 8, 1948. Results from the two planting dates were not significantly different and hence have been combined for the purpose of reporting.

Percentage stands of F_1 plants based on number of kernels planted for the various treatment levels were as follows: control, 91.8%; 1-min radiation, 88.1%; 2-min, 82.4%; 4-min, 47.8%; 8-min, 30.8%; and 16-min, 5.3%.

The percentages of F_1 plants that were obviously different morphologically from normal plants, based on visible external characteristics at time of flowering, are reported in Table 1. Plants were classed as abnormal when there were marked, readily recognized deviations from normal with respect to height of plants, width of leaves, development of tassels or ear shoots, or development of chlorophyll. Examples of abnormalities were as follows: Some plants lacked ear shoots or produced shoots with very few or no externally visible silks. Some tassels were reduced in size, or had a reduced number of branches, or the anthers were lacking, empty, or failed to be exserted. The plant that appeared to be the most abnormal of any in the field was one that attained a height of 4 in. and developed only five leaves. It was yellow-green in color, developed no visible ear shoot or tassel, but remained alive throughout the summer. Another yellow-green plant attained a height of 6 in. It had a small tassel, but no ear shoot.

TABLE 2

PERCENTAGE OF F_1 MAIZE PLANTS WITH ABNORMAL POLLEN FROM CROSSES OF NORMAL BY NORMAL WITH MATURE TASSELS IRRADIATED IN A NUCLEAR REACTOR

Exposure in nuclear reactor in min	Total No. plants examined	Percentage of plants with abnormal pollen
0	286	3.5
1	292	22.3
2	268	47.8
4	169	87.0
8	80	91.3
16	3	100.0

There was an increase in percentage of abnormal plants with each increase in length of treatment, except for the 8-to-16-min increase. There were, however, only three plants in the 16-min treatment and hence little significance can be attached to this comparison. Although the percentage of abnormal plants increased with increase in length of treatment, the degree of abnormality in the affected plants did not vary for the different treatment levels.

The effects of the irradiation on pollen of the F_1 plants are reported in Table 2. The percentage of plants with abnormal pollen increased with each increase in length of time of tassel irradiation and equaled 100% at the 16-min exposure.

These results indicate that the irradiation of maize pollen was very effective in producing changes in the F_1 plants. With the longer exposures, the reduction in stands of F_1 plants was drastic. This, together with the fact that a high proportion of the surviving plants had abnormal pollen, may be indicative of the fact that many of the changes consisted of chromosomal aberrations.

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