THE EFFECTS OF X-RADIATION ON COTTON

IN the summer of 1927, during the period when Dr. H. J. Muller was obtaining the first of his notable results on the extent of transgenation induced by X-rays in *Drosophila* and at his suggestion, a population of cotton plants was grown in the greenhouses at the University of Texas to provide material for parallel experiments in the case of a plant species of commercial importance. This original population was produced from seed of a single plant in a highly selected strain of "half and half" cotton supplied by the seed firm of Sumner and Company at Vernon, Texas. The experimental material was, thus, in as relatively homozygous condition as can be obtained in varieties of cotton grown under controlled breeding conditions.

Flowers of these greenhouse plants were emasculated the evening preceding anthesis, and the unopened anthers placed in gelatin capsules. The X-ray treatment was applied the next morning, and the pollen, which by this time had escaped from the anthers, was immediately placed on the stigmas of emasculated flowers. The control flowers were manipulated in the same manner in order to compare the setting of fruit in the two series. It was not considered necessary to keep the anthers of each flower separate for treatment since the individuals in the population were sister plants all having as their parent a single plant of highly inbred origin. The X-ray exposures used were 4, 8, 12, 16 and 25 minutes with a set-up of 50 kv., 5 ma., target distance of 10 cm and an aluminum filter. Seventeen mature fruits, yielding 311 seeds, were obtained from X-rayed pollen × untreated eggs and a larger number of fruits and seeds from the pollinations involving untreated pollen. In the spring of 1929 one half of the seeds from X-rayed pollen were planted in pots in the greenhouse at Berkeley, and from this number twenty-one plants were grown to maturity. The other half were planted in the open, but failed to reach the fruiting stage on account of unfavorable weather conditions. Plants from untreated pollen were grown as a control. It was originally noted that in the seventeen fruits obtained from treated pollen there was a decrease in number of seeds per fruit as the dosage became heavier. A further evidence that sterility was a by-product of the treatment is seen in the production of only twenty-one plants from over 150 seeds.

In external morphology many of these twenty-one plants were altered as compared with sister plants from untreated pollen. Among the more striking of these alterations in character expression was the presence of twisted and deformed stigmas, anastomosing leaf veins, peculiarities in leaf shape, fasciated and enlarged stems, incomplete flowers and dwarfness in habit. Only twelve of the twenty-one plants produced fertile fruits during the 1929 growing season, and seeds from two of these were empty. Three plants were obtained from seeds of the 25-minute dosage. One of these died before reaching maturity, and the other two failed to produce mature fruits.

An examination of the seeds of the ten fertile plants with perfect seeds shows a marked degree of variation as compared with seeds from the control plants. The uniform size of "half and half" seeds is one of the striking features of this variety of cotton, and in a quantity of seed it is hardly possible to select noticeably large or small seeds, so uniform is this character. Of the ten fertile plants mentioned above three produced seeds very much larger than the average size in the control. More striking, however, was the variation in the character which concerns the attachment of the lint in the mature seed. In "half and half" every fiber is attached to the seed at maturity, and must be pulled away in ginning. Two plants of the ten produced seeds from which the lint was entirely free at maturity, resulting in what might be termed "naked seeds." Three plants produced seeds which showed this character to a noticeable extent. In none of the control plants did this character appear.

Cytogenetic analysis of this X_1 generation is in progress and X_2 progenies are being grown. The information in hand suggests that quantitative and qualitative alterations in the hereditary material may readily be induced in cotton by treatment with X-rays. On the basis of these initial experiments it is anticipated that evidence may ultimately be forthcoming which will parallel the results obtained in this laboratory as to the deep-seated effects induced by high frequency radiation in tobacco, another species of economic importance.

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