

## EFFECTS OF X-RAYS ON SEEDS

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In a recent paper (1) the author has shown that seeds subjected to various doses of x-rays show peculiarities at certain stages of the growth which are not necessarily maintained throughout the period of growth, and cannot be used as a criterion for the determination of the best dosage for yield at maturity.

In order to obtain some information concerning the effects of x-rays on seeds, by examination of mature plants from x-ray treated seeds, experiments were made on seeds of radishes, lettuce, and beans. The x-ray tube was operated at about 100,000 volts and 5 milliamperes. The rays were filtered through 1 mm. of aluminum, and the seeds were placed at a distance of 30 cm. from the target. They were subjected to the radiation for various lengths of time. The growth of the seeds was recorded every week, and showed phenomena similar to those exhibited by corn in the paper mentioned above and in agreement with the work of JOHNSON (2) and will not be discussed here.

According to SHULL and MITCHELL (3) the effects due to the x-rays are more pronounced when the seeds are subjected to the radiation in sprouted condition. In order to test this hypothesis two sets of experiments were conducted; one set of seeds was exposed to x-rays when dry, while the other set was exposed when the seeds were sprouted. For the latter set the seeds were allowed to remain in trays on sterilized cotton padding saturated with distilled water until definite sprouts appeared and then subjected to x-ray treatment. The results of the treatment are shown in table I.

The results show that the x-ray treatment did not produce significant changes in the case of radishes. The improvements in weight of the plants from treated seeds as compared with those from untreated is not very large, and may therefore be attributed to accident. Moreover there is no significant difference between the weight per pod of the seeds exposed when sprouted and those exposed when dry. The increase on the average is only about 10 per cent. which cannot be considered to be very important.

In the case of beans, plants from seeds treated dry have shown no significant changes over the untreated. However, plants from the irradiated sprouted seeds have shown increases of some 25 per cent. over the controls, which is probably too large to be considered accidental.

The results were more interesting in the case of lettuce. While the increase in weight was not significant in the case of most of the plants produced from seeds treated in the dry state, the five-minute dose produced an increase in growth of about 60 per cent. over the controls. Because of this large increase, the experiments were repeated a year later. The results indicated

TABLE I

PLANT	TIME OF EXPOSURE	EXPOSED DRY		EXPOSED SPROUTED		REMARKS
		WEIGHT PER PLANT		WEIGHT PER PLANT		
	<i>min.</i>	<i>gm.</i>	<i>gm.</i>	<i>gm.</i>	<i>gm.</i>	
Radishes, (Cincinnati Market)	0	3.3		4.0		In all 250 plants; about 20 plants in each set
	$\frac{1}{4}$	4.3		5.3		
	$\frac{1}{2}$	2.0		2.4		
	$\frac{3}{4}$	5.3		4.8		
	1	3.5		4.5		
	2	4.8		5.7		
	3	2.7				
	4	4.5		4.4		
Beans (Bountiful)	0	6.2		5.3		300 pods; about 25 in each set
	$\frac{1}{4}$	4.8		3.8		
	$\frac{1}{2}$	5.1		8.2		
	1	6.4		6.9		
	2	6.2		5.3*		
	4			7.3		
	6			5.5*		
Lettuce (White Boston)		1936	1937	1936	1937	300 plants; about 10 in each set
	0	4.3	4.0	4.3	5.0	
	$\frac{1}{4}$	4.7		6.0		
	$\frac{1}{2}$	3.7		3.8*		
	$\frac{3}{4}$	3.9		2.0*		
	1	4.7	4.0	5.1	6.9	
	2	4.0	6.65	5.8	5.7	
	3	3.6	4.5	4.7		
	4		6.0		8.6	
	5	7.0	6.1		7.7	
	6		4.9	5.0	6.1	
7	3.4	4.7		8.1		

\* Poorly sprouted.

that for the 4- and 5-minute exposures the increase is well over 25 per cent. In the case of the seeds irradiated when in sprouted condition, the increase in weight of plants grown from the treated seed over the controls was on the average about 50 per cent. for the larger doses used.

In addition to the differences in weight the x-rays seem to have also caused a noticeable difference in taste. About half of the people who have tasted the lettuce in 1936 have been able to detect this difference. The lettuce seemed to have a stronger, "tangier" taste, the "tanginess" increasing with the dose. In 1937 eight people out of twelve who tasted the lettuce have observed this difference. Considering the fact that the sense of taste varies a great deal with different individuals, the difference introduced by x-rays is probably real.

In addition to these greenhouse experiments, x-rayed seeds of corn were planted in the field. For these experiments, an inbred variety developed

in the Florida Agricultural Experiment Station was used. The seeds were planted in the field and so staggered as to minimize the effects of possible soil variation. The inbred variety, while possessing the advantage of small individual variation, possessed the great disadvantage of lower resistance to diseases and to the ravages of the corn borer. In place of the two hundred ears of corn expected for each batch, only about 40 per cent. of the normal crop was obtained. The results are presented in tabulated form.

TIME OF EXPOSURE IN MINUTES (EXPOSED DRY)	WEIGHT IN GRAMS PER EAR
0	204
1	213
2	198
4	213
8	212

It appears that for two or three doses, there is a small increase in weight of the ears grown from the x-rayed seeds over the controls. The result cannot be considered very significant.

The results of these experiments may be summarized briefly as follows: within the limits of the x-ray doses used in these experiments, significant effects of x-ray on the yield at maturity have been found only for lettuce and for beans. The response to the x-ray treatment was greater when the seeds were in sprouted condition. No significant changes have been observed in the case of radishes, exposed sprouted as well as dry, and of corn exposed dry.

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