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Factors Influencing Variation in RBE in
Irradiation of Maize Seeds*

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Dormant maize seeds, heterozygous for the yellow-green alleles, Yg_2/yg_2 , were exposed to 250 kVp x rays and to reactor-generated fast neutrons in order to determine RBE values on the basis of seven different criteria: frequency of yg_2 sectors per rad, seed set, pollen fertility, plant height, seedling survival, seedling emergence, and plant height reversal effect. Semi-log survival curves were plotted from the data. RBE's for the first and last criteria, yg_2 sector frequency and plant height reversal effect, were computed as the ratio of the dose of x rays to fast neutrons which produces a comparable response. With the other criteria, RBE's were computed as the ratio of dosages that cause a 50% reduction from control values.

When the criteria of response are arranged in series according to the increasing dosage required to produce them (Table 1), it is evident that there is a corresponding decrease (from 67 to 3) in RBE. That is, the efficiency of neutron irradiation relative to x rays depends on the criteria used and decreases with the dosage required to produce the measured response.

In a second series of experiments the hydration time of seeds was varied prior to subjecting them to irradiation. The presoaking periods were: 0, 6, 12, 18, 20, 22, 24, 26, 30, 32, 36, 40 and 42 hours. The irradiations were 380 rads of x rays and 30 rads of fast neutrons. The criterion used was the frequency of yg_2 sectors (chromosome breakage and loss of Yg_2) in seedling leaves 4 and 5. The data, plotted in Figure 1, show that the RBE decreases from 67 in dry seeds (6.7% water content in embryos) to 5 in seeds hydrated for 36 or more hours. This change in RBE is due to

the relatively greater increase in sensitivity to x irradiation (mainly during the 18-30 hour presoaking period) than to fast neutrons.

In summary, the two series of seed irradiations, reported briefly here, show that the RBE of reactor-generated fast neutrons compared to 250 kVp x rays is markedly influenced by the criteria used for comparison and the physiological condition of the seeds.

Table 1

RBE IN MAIZE

Criteria of effect	Dosage		RBE
	X rays	Fast neutrons	
1.0 yg_2 sect/leaf 5	5,000	75	67
2.5 yg_2 sect/leaf 5	12,200	400	30.5
Seed set	28,750	1,000	28.75
Pollen fertility	35,000	2,250	15.55
Plant height	35,000	3,000	11.67
Seedling survival	39,000	4,000	9.75
Seedling emergence	72,500	11,000	6.59
Plant height reversal effect	80,000	30,000	2.66

FIGURE 1