important evidence to indicate that the wx mutants are homoallelic for the EMS-induced site is that the EMS-induced mutant wx^{BL-A} recombines with wx^{C} (Table 2), but wx^{BL-B} does not. However, wx^{BL-B}, unlike wx^{C}, does not recombine with wx^{90}; also wx^{BL-B} and wx^{BL-A} recombine with each other.

The M_1 results show a higher recombination rate than the diallel results and lead to nonadditivity. In fact wx^{BL-B} recombines with wx^{C} in the M_1 generation but does not recombine in the diallel (Table 2). Nonadditivity has been previously reported at the wx locus in maize.[3] More important than obtaining additivity of the data is the fact that recombination occurs among both the spontaneous and induced mutants in the diallel.

The frequency of intracistron recombination of various EMS-induced wx mutants in the M_1 generation led to the conclusion that EMS induces independent mutations at sites within the wx locus in maize. Also the occurrence of recombination in the M_1 generation between mutant and tester sites indicates that "point mutations" (gene mutations) have been induced by this mutagen.[2] The occurrence of recombination between EMS-induced and spontaneous wx mutants crossed in all combinations confirms the earlier report[2] and is further indication that "point mutations," or at least minor deletions, have been induced by this mutagen.

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2. Relative response of maize to X-rays vs. neutrons over a wide range of doses.

A problem of continuing interest in radiobiology is to determine why radiations which give different patterns of energy distribution in exposed tissues produce different degrees of response for equal amounts of total energy absorbed. A commonly used measure of this difference is the relative biological effectiveness (RBE), computed as the ratio of doses for two radiations of different quality required to produce the same effect. RBE values characteristically change with dose levels of X-rays (X) vs. neutrons (N); that is, no single ratio of X/N for equal effects holds throughout a range of absorbed doses.

Maize plants, grown from Yg_2/yg_2 seeds that had received various absorbed doses of fission neutrons or of 250 kVp X-rays, were scored for radiation damage on the basis of 9 criteria (Table 1). The responses ranged from those caused by a sublethal genetic effect (yg_2 leaf sectors), to eventual gamete lethality (pollen sterility and reduced seed set), to growth retardation due to somatic cell death (reduction in plant height, survival and emergence), to complete cessation of cell division ("reversal" of emergence

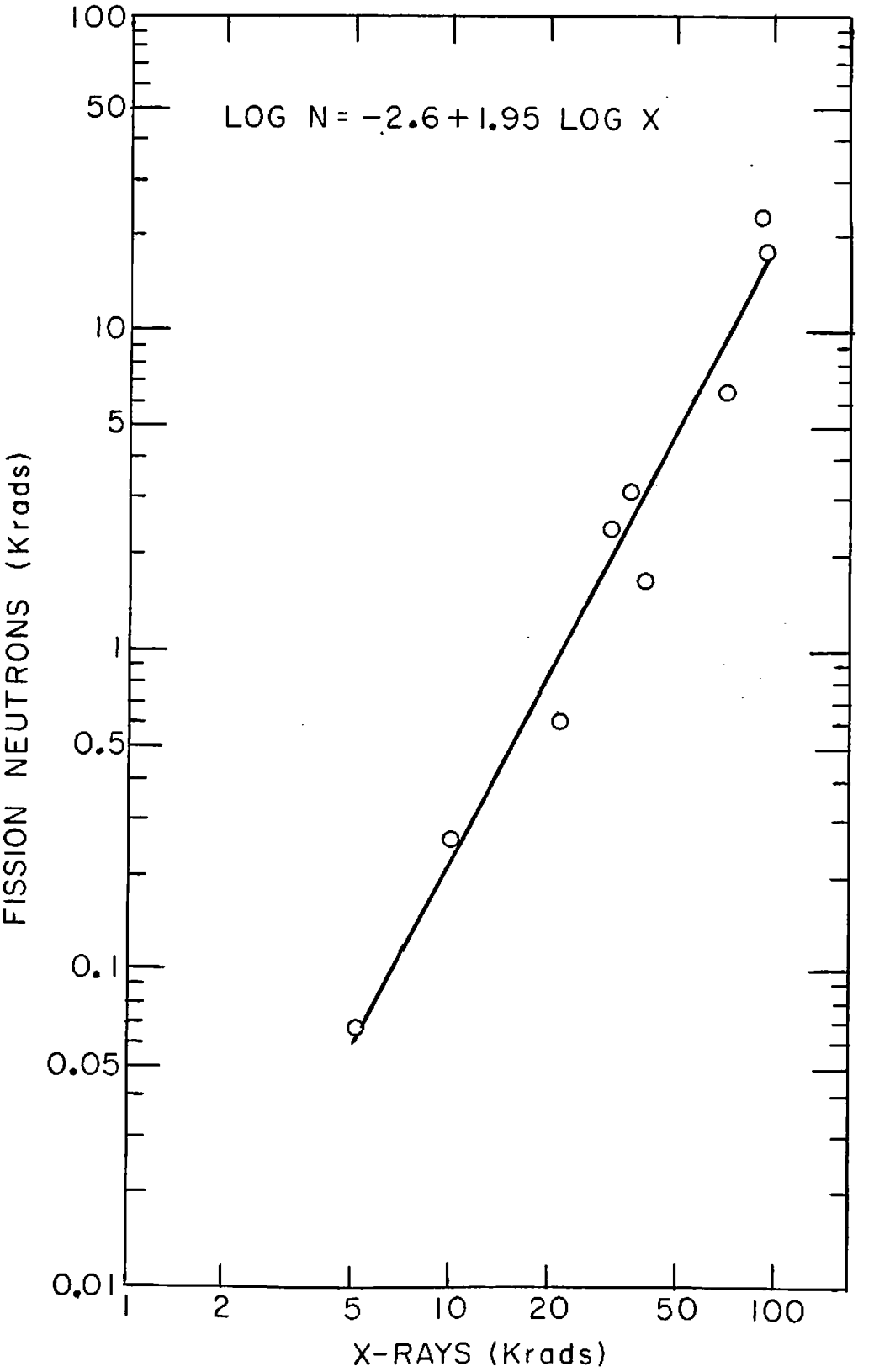

Fig. 1. Logarithmic plot of 9 criteria of equal effect (see Table 1) in maize plants grown from seeds which had received a wide range of absorbed doses of fission neutrons or of 250 kVp x rays.

and plant height). The steadily decreasing RBE with increasing doses results from the proportionally larger increments of neutron dose (N), relative to X-ray dose (X), that are required to give the equal effects measured.

Table 1
Criteria of response, doses, and RBE values for maize irradiated with fission neutrons and 250 kVp X-rays

Criteria	Neutrons (K rads)	X-rays (K rads)	RBE
1) 1 $\underline{yg}_2$ sector per leaf 5	0.068	5.15	75.7
2) 2 $\underline{yg}_2$ sectors per leaf 5	0.27	9.91	36.6
3) 50% seed set	0.63	21.06	33.4
4) 50% pollen fertility	1.73	37.50	21.7
5) 50% plant height	2.51	29.76	11.9
6) 50% survival	3.31	34.01	10.3
7) 50% emergence	6.77	66.70	9.9
8) Emergence reversal	18.65	93.10	5.0
9) Plant height reversal	24.04	84.96	3.5

Figure 1 shows a logarithmic plot of X vs. N for each of the 9 criteria. These points can be fitted to a straight line, for which the least square equation is:

$$\log N = -2.6 + 1.95 \log X$$

This simple power function, which spans 4 orders of magnitude of neutron doses, is amenable to the following straightforward explanation: (1) the responses measured have a common cause which is chromosome breakage and genetic loss; (2) increasing somatic growth inhibition and gamete lethality are attributable directly to quantitatively more genetic damage; (3) neutron-induced damage increases linearly with dose and X-ray-induced damage with the approximate square (slope = 1.95) of the dose; (4) this relationship remains uncomplicated from irradiated seed through the development of the maize plant.

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