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

The M1 results show a higher recombination rate than the diallel results
and lead to nonadditivity. In fact wxBL-B recombines with wxC in the M1
generation but does not recombine in the diallel (Table 2). Nonadditivity
has been previously reported at the wx locus in maize. 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 M1 generation led to the conclusion that EMS induces in-
dependent mutations at sites within the wx locus in maize. Also the
occurrence of recombination in the M1 generation between mutant and tester
sites indicates that "point mutations" (gene mutations) have been induced
by this mutagen. The occurrence of recombination between EMS-induced
and spontaneous wx mutants crossed in all combinations confirms the earlier
report and is further indication that "point mutations," or at least minor
deletions, have been induced by this mutagen.

The author is grateful to Gary McGovern for assistance in performing this
research.

References:


Robert W. Briggs

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 radi-
ations 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 rela-
tive 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/ YG 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 subletal genetic effect (YG leaf sectors), to eventual
gamete lethality (pollen sterility and reduced seed set), to growth retarda-
tion due to somatic cell death (reduction in plant height, survival and
emergence), to complete cessation of cell division ("reversal" of emergence

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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

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Neutrons (K rads)</th>
<th>X-rays (K rads)</th>
<th>RBE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) 1 yr² sector per leaf 5</td>
<td>0.068</td>
<td>5.15</td>
<td>75.7</td>
</tr>
<tr>
<td>2) 2 yr² sectors per leaf 5</td>
<td>0.27</td>
<td>9.91</td>
<td>36.6</td>
</tr>
<tr>
<td>3) 50% seed set</td>
<td>0.63</td>
<td>21.06</td>
<td>33.4</td>
</tr>
<tr>
<td>4) 50% pollen fertility</td>
<td>1.73</td>
<td>37.50</td>
<td>21.7</td>
</tr>
<tr>
<td>5) 50% plant height</td>
<td>2.51</td>
<td>29.76</td>
<td>11.9</td>
</tr>
<tr>
<td>6) 50% survival</td>
<td>3.31</td>
<td>34.01</td>
<td>10.3</td>
</tr>
<tr>
<td>7) 50% emergence</td>
<td>6.77</td>
<td>66.70</td>
<td>9.9</td>
</tr>
<tr>
<td>8) Emergence reversal</td>
<td>18.65</td>
<td>93.10</td>
<td>5.0</td>
</tr>
<tr>
<td>9) Plant height reversal</td>
<td>24.04</td>
<td>84.96</td>
<td>3.5</td>
</tr>
</tbody>
</table>

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.

H. H. Smith