now verified and can be designated TB-10c; the breakpoint is on the short arm proximal to nl and oy.

J. B. Beckett

2. Location of new mutants by the A-B translocation method.

Following the procedure outlined earlier (MNL 45:144), 161 mutants were tested this year with a slightly modified and improved set of A-B translocations. The collection included 113 selected new mutants from EMS and NG treatments as well as 48 old cases that had received an inadequate test last year. The translocations used were the same as last year except that TB-1a was substituted for TB-1c, and TB-2L, $3L_{7285}$ and TB-6a were omitted. Translocation 10S has also been verified and designated TB-10c (see Beckett, above).

Fifty-nine of the 161 mutants tested have been tentatively located to chromosome. They have been added to those found last year and placed on a revised chromosome map (figure 1). Temporary symbols are used on the map as follows: w (white), wl (yellowish white), l (yellow), v (virescent), pg (pale green), pgs (pale green spotted), yg (yellow green), cb (crossbanded), pb (piebald), str (striped), gs (green stripe), ys (yellow stripe), wlb (white leaf blade), alb (albescent), spk (speckled), nl (narrow leaf), ad (adherent), d (dwarf), nec (necrotic), gl (glossy), bf (blue fluorescent), et (etched endosperm), sh (shrunken endosperm).

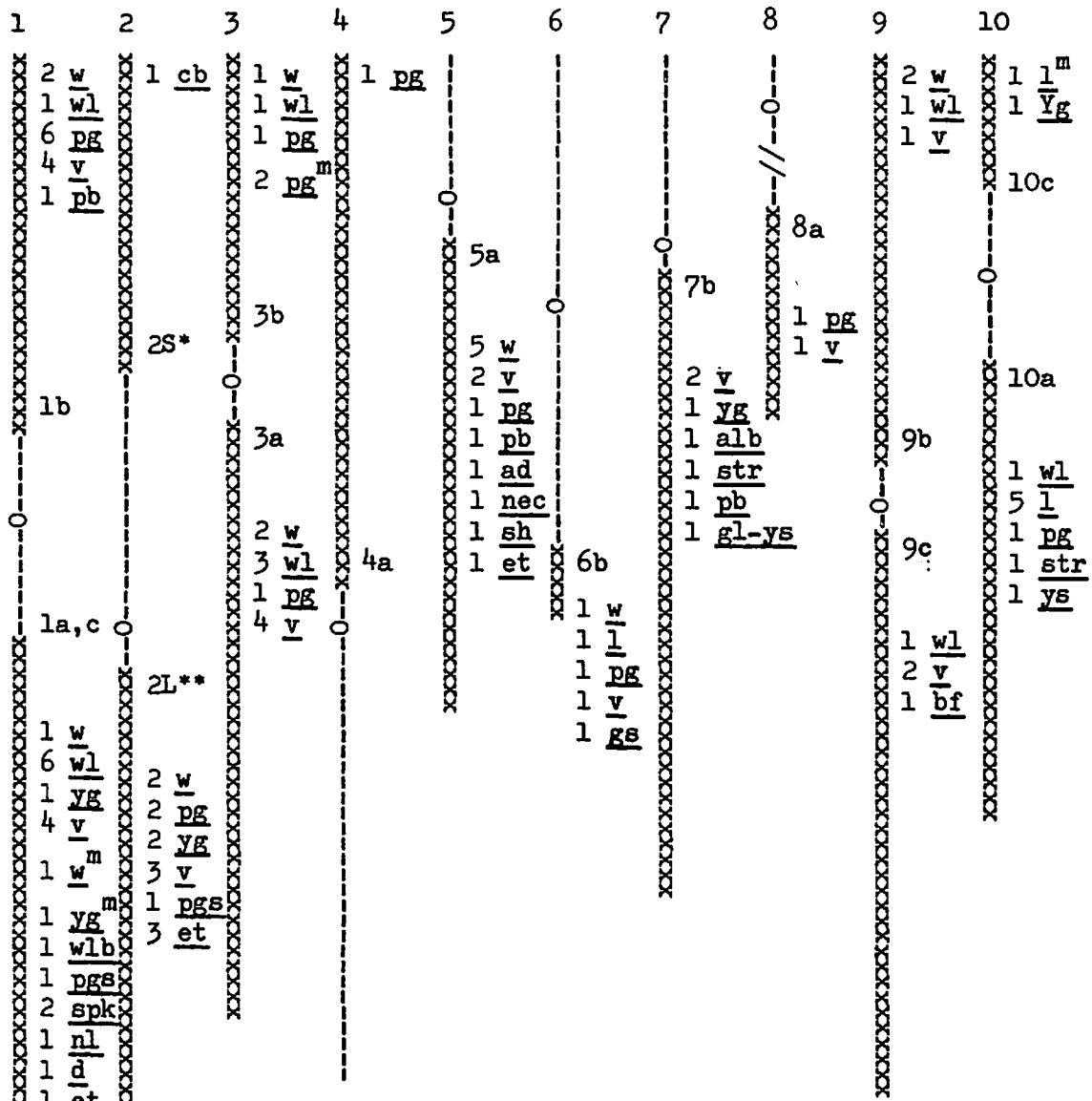
M. G. Neuffer
J. B. Beckett

3. New mutants induced by ethylmethanesulfonate and nitrosoguanidine.

Following procedures outlined in MNL 45:146, ears of vigorous genetic stocks were crossed by similar pollen treated with ethylmethanesulfonate (EMS) or nitrosoguanidine (NG). The resulting kernels were planted, the seedlings were noted for mutants, and the mature plants noted and selfed. The selfed ears were observed for segregation of endosperm texture and morphology mutants (not for aleurone color, as r and c were segregating in the initial parents), and a sample was planted in sand benches to test for seedling mutants. Excluding mature plant

Figure 1

Linkage map with A-B translocations and tentatively located mutants.



A-B translocations indicated by originator's symbol at the estimated proximal end of the uncovered portion (xxxx). The numbers and types of mutants uncovered are listed beside each region.

* TB 2S, $3L_{6270}$

** TB 2L, $1S_{4464}$ or TB 2L, $3L_{7285}$

characters, a total of 1208 new mutants was found. The results of this experiment are summarized in Table 1.

Table 1. Summary of results from progeny tests of kernels produced from pollen treated with ethylmethanesulfonate (EMS) or nitrosoguanidine (NG) in paraffin oil. Frequency x 10^{-3} in parentheses.

	kernels planted	surviving plants*	selfed ears tested	endosperm mutants		seedling mutants	
Control	587	523	414	0	(0)	3	(0.7)
EMS	7645	6007	4277	259	(61)	860	(201)
NG	1130	493	160	13	(81)	73	(456)

*These figures are low because of poor field conditions.

In spite of poor field conditions and problems of handling that are reflected in the data, there are distinct differences in survival and ear production between treatments. The NG treatment caused a striking reduction in germination and viability of surviving plants, while the EMS treatment did not. This difference was clearly seen when comparing the growing plants. Plants of the control and EMS progenies were vigorous and uniform, while those of the NG progenies were slow and extremely variable. Many did not survive till flowering, and only a few of those that did approached normal vigor and appearance.

Examination of F_1 seedlings and growing plants for probable dominant mutants yielded 24 pale green (pg), eight pale or yellow green sectored, one narrow leaf (nl) and one yellow green (yg) in the EMS-treated families, and three pg and one sectored in the NG-treated material. None was found in the control families. All of these cases (except one) either failed to produce ears or were not transmitted. The single exception was the yellow green case, which proved to be an excellent dominant yellow green mutant. This mutant will be described later.

The selfed ears included many that were segregating for various types of endosperm texture and morphology mutants, the analysis of which is presently being deferred.

A sample of thirty kernels from each selfed ear was planted in the sand bench, and the seedlings were examined for mutant types. The yield of seedling cases was much higher than expected when compared to the frequency of endosperm cases. The mutants included many of the known types as well as some that had not been seen before. A breakdown of seedling mutants into broad categories is presented in Table 2. Each category includes a wide range of variant types.

The white (w) seedlings include types with narrow stiff leaves, some with broad leaves, some that die quickly and others that grow normally to the 3-4 leaf stage. Some are chalky white, some almost translucent; some are bluish white, and some have patches of cells that become transparent. The yellowish white (wl) mutants have similar variations but also have varying amounts of yellow pigment; the narrow stiff-leaf type is rarely seen. The yellow (l) seedling types are more uniform and mostly normal in early development. Some are bright yellow, some faintly green and some a dull deep yellow. Some bleach to white rather quickly, and others remain yellow until the endosperm nutritional source is depleted. All the w, wl and l mutants are seedling lethals.

The virescent (v) class is highly variable in terms of chlorophyll expression but not for leaf texture and morphology. In all cases the mutant seedlings emerge with either reduced, defective or absent chlorophyll. After emergence they change at various speeds and in various patterns to something like normal appearance. The background or initial color differs from case to case including white, yellow, pale green and yellow green. Some turn green from leaf tip toward the base, others in the reverse order. Some turn green uniformly over the leaf, and others do so in small streaks, giving the leaf a grainy appearance; still others turn green in large irregular streaks and stripes. Many show indications of being sensitive to variations in light and temperature.

The pale green (pg) mutants have a reduced amount of chlorophyll, which remains uniform during the life of the plant. Some are faintly

Table 2. Breakdown of seedling mutants obtained in F_2 from crosses involving pollen treated with the chemical mutagens ethylmethanesulfonate (EMS) and nitrosoguanidine in oil

	EMS	freq. x 10^{-3}	NG	freq. x 10^{-3}	control oil	freq. x 10^{-3}
F_2 ears tested	4277		160		414	
white (w)	53	12	6	38	0	0
yellow white (wl)	60	14	8	50	0	0
luteus (l)	32	7	5	31	2	0.5
virescent (v)	99	23	9	56	0	0
yellow green (yg)	14	3	1	6	0	0
pale green (pg)*	131	31	17	106	0	0
Zebra stripe (zb)-piebald (pb)	28	6	1	6	0	0
necrotic (nec)	81	19	1	6	0	0
lethal (ll)	21	5	0	0	0	0
dwarf (d)-small*	181	42	17	106	1	0.2
adherent (ad)	21	5	0	0	0	0
streaked and speckled	46	11	3	19	0	0
striped (str)	15	4	1	6	0	0
yellow stripe (ys)	15	4	2	13	0	0
glossy (gl)	13	3	1	6	0	0
other	50	12	1	6	0	0
Total	860	201	73	455	3	0.7

*These classes are inflated because of difficulties of classification and the frequent occurrence of phenocopies.

green and die after endosperm depletion; others are darker green and live longer; some survive to maturity. Leaf texture and morphology is generally nearly normal. The yellow green (yg) mutants resemble the pg mutants but have varying amounts of yellow pigment. This class varies

in viability, but in most cases the mutants survive to maturity. Included are some which grow more vigorously than normal seedlings under winter greenhouse conditions. There are some mutants in this class that develop necrotic patches that cause withering of parts of the leaves but no lethal damage. There is also one dominant yellow green mutant.

The zebra stripe (zb)-piebald (pb) class includes those green and pale green seedlings that have diurnal crossbands or patches of lighter tissue. In some cases, the bands are regular, with sequences of two or more shades of green, yellow or white; in others, the banding is irregular and occurs in patches along the midrib or on the leaf blade. Also included here are a group of seedlings called white tip (wt), which are of two types: (1) those which emerge as a green seedling with white leaf tips, and (2) those which are initially observed as a white seedling with a faintly green leaf base, with subsequent development of chlorophyll in the direction of the leaf tip.

The necrotic (nec) class includes those that have an abrupt wilting or browning of the leaf tips which advances down the leaf, usually causing death of the seedling. Sometimes these areas are localized on the terminal third of each leaf or in zebra-like stripes, in which case the mutant is not lethal. In some the necrotic tissue gives off a brown exudate; in others the tissue wilts dry and turns white.

The lethal (ll) class includes all those that die abruptly from various unclassified causes; closer observation may move many of these into the necrotic class.

The dwarf (d)-small class includes all the small seedling mutants seen. A large number are typical broad leaf andromonoecious dwarfs which respond to gibberellic acid; others have stiff narrow leaves, some with pale green flecking; some are dark green. Some are intermediate in growth; others are extremely small, being only three cm tall after two months growth. Some have large leaves with shortened internodes. Others have miniature parts and can be described as tiny or pigmy.

The adherent (ad) class includes a wide range of types that have the common characteristic of having some leaf or coleoptile tissue adhering together. In some cases this is extreme, and the seedling bunches

up in a knot. In other cases only the first two leaves are stuck together, and the plant grows normally. In some cases the leaves are all rolled tightly, forming a smooth tube; in others, the leaves are bunched up and crinkled.

The streaked and speckled class includes wide variations of green with small streaks or specks of lighter (including white and yellow) tissue or lighter green leaves with streaks and specks of darker green tissue. In some cases the leaves are narrow and stiff. In others they have normal shape and texture.

The striped (str) class includes all variations of white, yellow and pale green striping, ranging from an occasional stripe to those as extreme as striate (sr_2). Some are associated with morphological differences, and others are not.

The yellow stripe (ys) class is quite narrow, including only individuals which resemble the known ys mutants. The phenotype is that of normal green leaf veins and light yellow green tissues between the veins.

The glossy (gl) class includes all those which have a glossy phenotype at the 1-4 leaf stage. Some are associated with changes in leaf morphology, and others are not.

The "other" class includes a miscellaneous lot of interesting cases which were hard to classify in terms of known mutants.

M. G. Neuffer

4. Dominant yellow green.

A single yellow green seedling appeared among 56 normal seedlings in the F_1 following EMS treatment. The plant, which remained yellow green till maturity, was selfed. Sixty kernels planted from the selfed ear produced ten normal green, 33 bright yellow green and eight pale yellow seedlings. The yellow seedlings died as soon as the endosperm reserves were depleted. The yellow green seedlings grew more rapidly than the green and produced normal tassels and ears. (This rapid growth occurs only in the winter greenhouse; in the field, the yellow green plants are much smaller than normal.) Yellow green plants were crossed on normal sibs and other genetic testers. In all cases, seedling tests of the sib