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HONOLULU, HAWAII
University of Hawaii

Narrow Leaf 3 (nl3) on Chromosome 1.

----James L. Brewbaker

Narrow leaves occur in several maize mutants as pleiotropic effects (e.g., Corngrass, Ragged) but only two loci have been labeled “narrow leaf” and these are rather gross dwarfs. “Narrow leaf 3” is proposed here to designate near-isogenic lines we’ve developed that have a reduced leaf width compared to parent Hi27 but are otherwise quite normal.

Our Hawaii Foundation Seeds assemblage of near-isogenic lines (NILs) based on tropical inbred Hi27 currently includes about 150 genotypes (MNL81:15). These are now summarized on our website www.ctahr.hawaii.edu/hfs. All genes have been accessed from temperate-adapted inbreds or hybrids of the Maize Genetics Coop. Our initial crosses of the temperate lines with Colombian flint-derived Hi27 resulted in very impressive heterosis for all quantitative traits we measured. We’ve also encountered impressive heterosis among our own 6-BC NILs (MNL81:16). We have thus sought evidence for quantitative trait loci (QTLs) that are linked to the mapped mutant loci we’re transferring.

The narrow-leaf trait was observed in conversions of the pericarp and cob color locus P (Chrom. 1S-68.5). This locus is represented by allele *p-ww* in parent Hi27 which has no color in pericarp or cob. The conversion of Hi27 to *p-rw* (red pericarp, white cob) began in 1967 with MGC stock 63-2656-3/2655-5 (*a Dt et lg2*), a bronze-pericarp stock that was found also to carry *p-rw*. When selfing was initiated after 8 backcrosses (BCs) to produce homozygous red-pericarp lines, the narrow-leaf trait segregated as a simple recessive.

Two NILs are now maintained, *nl3*^{Hi27} and (*nl3 p-rw*)^{Hi27}, the latter a double mutant with the red pericarp allele. Each conversion represents the 8 BCs and many sibs or selfs over more than 30 cycles of breeding. The narrow-leaf NILs are otherwise indistinguishable from Hi27 in leaf length, plant height, maturity, ear traits or in yield. The *nl3* locus must be closely linked to the *P* locus. Also derived from this *P* locus stock were NILs of the double-cob mutant *dbcb* we reported last year in MNL83, all of which have normal leaf widths.

The *nl3* trait is quite distinct from those described in the literature. Emerson’s locus *nl1* on Chrom. 10S was a very weak mutant with linear leaf stripes resembling the gene *lineate*, also on 10. The *lineate* stripes in our stocks *li*^{Hi27} and (*g li*)^{Hi27} are in leaves of normal width, and stripes occur only along the veins, resembling symptoms of Maize Mosaic Virus. Neuffer’s *nl2* on 5S-62 was described also as weak and irregular (formerly called “ragged”), and the gene acted as a dominant. Similarly, the EMS-induced mutant *nl*-1517* was reported by Scanlon and Freeling (MNL70:15) to have shortened, narrow leaves with blades occasionally missing altogether and to be on Chrom. 3. Neuffer also reported *nld* (narrow-leaf dwarf), a small compact plant with narrow,

rolled, chlorotic leaves. Among the 120+ genes represented in Hi27 NILs only Cg (corngrass) and Rg (ragged) have consistently narrower leaves than the parent. The leaves on tillers are often quite narrow, of course, as in our NILs for *gt*, *tb* and *tlr* (cf. our photo in MNL81:15), and many diseases and abiotic stresses can affect leaf length and width. Most mutants with shortened leaves (*d1*, *na1*, *na2*, *py*) have either normal or somewhat wider leaves.

The nl3 phenotype was most obvious among young plants (30-45 days) that also have a somewhat erect habit, not unlike our NILs for *gs1* and *gs2*. The data in Table 1 were taken in the middle of first fully expanded leaves at 35 days after planting (about meiosis). Grand growth was just beginning (anthesis occurred 30 days later). The nl3 plants had leaves reduced in width by 9 mm without change in vein numbers on each side of the midrib. Hi27 was almost identical in these traits to Mark Zuber's classic inbred Mo17. Contrasting data are presented in the table for dwarf d1^Hi27 with its highly expanded leaf blades with 11 veins on each side.

Table 1. Seedling leaf widths (mm) of nl3 mutants vs. Hi27 and d1

Line	Width	CV	Veins
nl3	46.4	7.2%	8
Hi27	55.3	7.9%	8
d1	76.2	9.7%	11

Figure 1 shows Hi27 (center) and NILs nl3^Hi27 (left) and d1^Hi27 (right), a photo taken 43 days after planting and 23 days before anthesis.



Figure 1. Leaves of nl3^Hi27, Hi27 and d1^Hi27 (from left to right)

Complementary studies at anthesis included measurements over several years of the uppermost leaves and of leaves subtending the ear. These comparisons showed leaves of nl3 to average about 10% narrower than normal throughout their length without variation in vein number. The data are summarized in Table 2, again representing mid-leaf section. The data were also characterized by very low variances (CVs of 5.6% for ear leaf and 9.1% for uppermost).

Table 2. Mature leaf widths (mm) of nl3 mutants and inbred Hi27

<u>Line</u>	<u>Ear leaf</u>	<u>Uppermost leaf</u>
nl3	76.7	54.4
Hi27	86.0	65.3

Conversions of Hi27 from other sources to alleles *p-vv*, *p-wr* and *p-rr* did not segregate narrow leaf. There has been no evidence in our (nl3 p-rw)^Hi27 stock of mutability for the P locus. Both lines have always been characterized by reddish anthers, as contrasted with the bronze anthers of parent Hi27. Red anthers also occur in four of our NILs having red cobs due to allele *p-wr*. However, neither of the narrow-leaf NILs ever showed red cobs.

Variation in leaf length is a common pleiotropic trait with our dwarfing loci *d1*, *na1*, *na2* and *py*. However, only the d1 locus (3S-30) has especially wide leaves with high vein number throughout development (Table 1, Figure 1). Our d1^Hi27 NIL also has a closely-linked locus conferring high susceptibility to southern rust, unique among Hi27 NILs that are routinely highly tolerant.