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Narrow Leaf Mutant: A New Plant Type in Pearl Millet

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A spontaneous narrow leaf mutant in pearl millet [*Pennisetum glaucum* (L.) R. Br.], resembling a grass plant was recovered in a landrace accession IP 8443 from Niger. The mutant was characterized by narrow leaf blades that folded toward the dorsal side and produced five to 24 slender stems. It flowered earlier and produced smaller spikes and seeds than the normal broad leaf plants. In reciprocal crosses involving the mutant and normal leaf plants, the F_1 resembled the normal leaf parent. The F_2 segregation had a good fit for 3 normal leaf/1 narrow leaf ratio (P, 5–9), and BC_1 had a good fit to a 1 normal leaf/1 narrow leaf ratio (P, 3–7), indicating that a single recessive gene designated as *nl* governed the narrow leaf character. This novel mutant might be a useful marker to establish linkage groups and to develop a new plant type.

Leaf blade width in pearl millet [*Pennisetum glaucum* (L.) R. Br.] was found to vary between 14 and 80 mm in the world collection of 21,339 accessions that is being maintained at the ICRISAT Asia Center (IAC), Patancheru, India. In pearl millet, several spontaneously occurring and induced mutants were reported (Koduru and Krishna Rao 1983; Mengesha and Appa Rao 1989). Though a narrow leaf mutant has been reported in maize (Neuffer et al. 1968), no such mutant has yet been reported so far in pearl millet (Kumar and Andrews 1993). During rejuvenation and evaluation of pearl millet germplasm at IAC, we observed a new plant type designated as *narrow leaf* from IP 8443, a landrace collected from Niger. This article describes the morphology and mode of inheritance and possible use of this new mutant.

Materials and Methods

During germplasm evaluation in the 1986 rainy season at IAC, Patancheru, a pearl millet germplasm accession IP 8443 collected from Niger produced two narrow leaf mutant plants in a progeny of 78 plants. The inflorescences of narrow leaf plants were bagged to produce selfed seed. The narrow leaf mutant bred true in subsequent generations. Morphological characters were recorded on 30 random plants from four replicates for the mutant and also for 30 normal plants, using the descriptors for pearl millet (IBPGR/ICRISAT 1981). To study the mode of inheritance, reciprocal crosses were made between the normal and the mutant plants during the postrainy season of 1991 by taking advantage of protogyny (Burton 1979). Segregation in F_2 and BC_1 generations was studied for nine individual progenies in each case. As the segregation ratios were found to be homogeneous, pooled data were also used to calculate χ^2 to test goodness of fit of observed F_2 and BC_1 ratios to theoretical ratios.

Results and Discussion

The mutant was characterized by narrow leaf blades that tended to fold toward the abaxial side. The mutant plants produced five to 24 slender stems from the basal nodes, flowered early, grew shorter in height, and produced shorter spikes and smaller seeds than the normal (broad leaf) plants (Table 1). Leaf blade width of the mutant plants decreased gradually from the earlier developed leaves to the sub-

Table 1 Morphological differences between narrow leaf mutant and normal broad leaf plants of pearl millet

Character	Narrow leaf plants mean	SE	Normal plants mean	SE
Leaf blade width (mm)	13 6	0 81	40 5	6 84
Leaf blade length (cm)	46 4	1 03	68 8	9 46
Leaves on main culm (no)	8 0	0 2	9 5	0 83
Stem thickness (mm)	4 2	0 10	9 3	0 13
Tillers/plant (no)	11 7	8 08	3 8	1 53
Flowering (days)	61 0	0 71	75 0	5 21
Plant height (cm)	122 0	3 76	228 0	9 56
Spike length (cm)	21 4	0 22	56 5	7 83
Spike thickness (mm)	12 5	0 25	20 3	6 84
Flag leaf sheath length (cm)	27 5	1 79	22 4	3 24
Peduncle length (cm)	18 5	3 38	33 0	0 83
Grain mass (g 1 000 grains)	4 0	0 05	10 8	0 34

Data are based on 80 plants grown in the 1991 rainy season at IAC Patancheru India

Figure 1 Morphology of the narrow leaf mutant (right) in which the leaf blades are narrow and the stems are many and slender compared to broad leaves (left)

sequent leaves whereas the reverse was true in the normal broad leaf plant The narrow incurved leaf blades profuse tillering and reduced canopy height before flowering gave it a characteristic grass like appearance (Figure 1) The narrow leaf mutant in pearl millet resembles the *corn grass* mutant for vegetative characters Whereas the *corn grass* mutant was characterized by poorly developed ears and tassels (Neuffer et al 1968) the narrow leaf mutant in pearl millet produced well developed fertile spikes and produced viable seeds though the number and size of seeds were reduced

All F_1 plants from reciprocal crosses made between normal and mutant plants produced broad leaves indicating that the mutant trait is recessive to normal However leaf blade length and width plant height and stem thickness were greater in the F_1 plants than in the broad leaf parent which may be due to heterosis In the F generation it was easy to classify plants as narrow leaf or broad leaf plants indicating qualitative inheritance The heterogeneity χ^2 values were 0 38 and 0 97 for progenies in F generation and 0 13 and 0 56 in BC_1 generations indicating homogeneity for segregation Hence the segregation data of nine progenies were pooled to calculate χ^2 The F segregation ratio showed a good fit to a 3 broad leaf/1 narrow leaf (Table 2), indicating that the narrow leaf trait is inherited as monogenic recessive The narrow leaf F_2 plants bred true in the F_3 generation In progenies of 20 normal F_2 plants, 14 segregated like the F_2 while six bred true When the F_1 was backcrossed to narrow leaf plants, the backcross generation segregated as 1 normal/1 narrow leaf plant (Table 2) but when the F_1 was backcrossed to broad leaf plants all backcross plants had broad leaves confirming that the narrow leaf mutant was monogenic recessive Because such a mutant has not been reported earlier (Kumar and Andrews 1993) we propose that the mutant should be designated *narrow leaf* with the gene symbol *nl nl* The mutant differs from normal plants not only for leaf blade width but also for spike and grain characteristics We did not observe recombinants for spike and grain characters in the F or backcross generations suggesting pleiotropic effects of the mutant gene Pollen fertility of the narrow leaf mutant was normal and we did not find any meiotic abnormalities in the mutant in a total of 658 pollen mother cells from five spikes

As the narrow leaf plants can be identified at seedling stage it is a useful marker to establish linkage groups The narrow folded leaf blades might help reduce transpiration and hence it is desirable to study its response under drought conditions

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Table 2 Inheritance of narrow leaf mutant in pearl millet

Cross	Generation	No of plants: Normal leaf	Narrow leaf	Ratio	χ	P	Het
Narrow leaf × Normal leaf	F	53	—	—	—	—	
Narrow leaf × Normal leaf	F	591	201	3 1	0 06	0 8–0 9	0 97
F × Narrow leaf	BC	115	126	1 1	0 50	0 3–0 5	0 13
F_1 × Normal leaf	BC	426	—	1 0	—	—	—
Normal leaf × Narrow leaf	F	29	—	—	—	—	
Normal leaf × Narrow leaf	F	360	127	3 1	0 30	0 5–0 7	0 38
F × Narrow leaf	BC	240	228	1 1	0 31	0 5–0 7	0 56
F × Normal leaf	BC	302	—	1 0	—	—	—

Het heterogeneity χ^2 value

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