NDSB(MS)C8 and NDSG(MS)C8: Improved Synthetic Sources for Early Corn

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American Indians, the original corn (*Zea mays* L.) breeders, developed corn varieties to suit their cultural practices. Will and Hyde (1964) have described many corn strains adapted to the northern Great Plains which were grown by several tribes including the Mandans of North Dakota. Will and Hyde (quoting from journals of Bradbury, a botanist who traveled through the Upper Missouri area in 1811) stated that Indian corn grew to a height of about three feet and resembled a small bush. Corn was usually planted in widely spaced hills and cultivated with wood, antler, and bone tools by the women of the tribe. These varieties were well suited to the cultural practices of the Mandans, such as very low planting densities and hand harvesting. In fact, Will and Hyde (1964) stated that crop failures on the Upper Missouri were rare and "the only complete crop failures mentioned on the Upper Missouri in early times appear to have been caused by the grasshoppers which descended in dense clouds and in a few hours stripped the corn patches bare."

Although Indian corn varieties were well suited to cultural practices prior to agricultural mechanization, they possessed traits such as numerous tillers, ears placed very low on the stalk, multi-colored kernels, and very weak stalks. Such traits are not suitable for the high planting densities, high fertilizer rates, mechanical cultivation, mechanical harvesting, and grain grading standards of modern agriculture. Early corn breeding efforts by the North Dakota Agricultural Experiment Station sought to improve the land race varieties brought in by immigrants or derived from the Indian corns. Open-pollinated varieties such as 'Rainbow Flint' were widely grown until hybrids became popular in the 1940s and 1950s. The advent of mechanical harvesting at about this time changed the objectives of the corn improvement project at NDSU toward developing varieties with ears borne higher on the stalk. The direction of the corn improvement program again changed toward parental inbred line development when it was demonstrated that hybrid varieties outyielded open-pollinated varieties. Although varieties grown by the Indians of the Upper Missouri River contributed to development of open-pollinated varieties such as Rainbow Flint, they have had little impact on breeding of modern corn hybrids, according to Hallauer and Miranda (1981).

Troyer and Rosenbrook (1983) have pointed out that planting densities for corn production have been increasing about as long as records have been kept of corn growing practices, and have advocated the testing of new corn germplasm at high planting densities. Cross et al. (1987) reported that yields averaged over four North Dakota environments were highest at the highest planting density tested (30,000 plants per acre). As corn growers continue to increase planting densities to increase grain yields, new corn hybrids will be needed with increased tolerance to high planting densities. New source populations of inbred parents tolerant to high planting densities are needed to produce these hybrids. Initially, inbreds were developed from old open-pollinated varieties, but these old varieties usually have very low frequencies of plants with traits desired in modern hybrids. Synthetics are open-pollinated varieties created by combining several corn strains with desirable characteristics. Because synthetics can be created with high frequencies of plants having desired traits, they are becoming common source populations for new parental inbred lines for use in Corn Belt hybrids.

NDSB(MS)C8 and NDSG(MS)C8 are improved versions of yellow dent synthetics developed in the corn improvement project at North Dakota State University for use in early maturity corn breeding programs.

BREEDING HISTORY

NDSB(MS)C8 was developed by eight cycles of mass selection for yield and standability at high planting densities from NDSB (see Cross, 1980 and 1986). Seed was bulked from approximately 100 ears (half-sib families) selected from approximately 10,000 plants (selection intensity = 1 percent) each cycle to give an improved population. Selection was from among competitive plants grown at approximate planting densities of 75,000 plants per acre. Selection was based on ear size and resistance to lodging. NDSG(MS)C8 wàs produced by eight cycles of mass selection for yield and standability at low planting densities from NDSG (see Cross, 1984). Equal numbers of seeds from 30 ears (half-sib families) were composited to give an improved population each cycle. Selection intensity was approximately 1 percent and was based on dried grain yield per unlodged plant. To reduce environmental effects on selection, each isolated selection plot was divided into a number of small grids and ears from the best plants were selected within each grid. NDSG was derived from the open pollinated variety 'Minnesota 13'.

AGRONOMIC DESCRIPTION AND PERFORMANCE

In tests at normal planting densities (23,000 plants per acre), NDSB(MS)C8 averaged significantly higher (12.1

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percent) grain yield over 12 environments than NDSB(MS)C6, the previously released version of NDSB (Table 1). NDSG(MS)C8 tested in eight environments at 23,000 plants per acre produced significantly higher yields (17.9 percent) than NDSG(MS)C5 which was the previously released version of NDSG. Both new synthetics have averaged slightly higher yields than NDSAB which has been the highest yielding synthetic in previous tests. NDSB(MS)C8 is more resistant to stalk lodging than NDSG(MS)C8. When averaged over all environments, ear moisture at harvest and stalk lodging percentages were not significantly changed by selection, but NDSB(MS)C8 appeared to be more susceptible to root lodging than the earlier released version. Both of these synthetics are AES200 maturity.

References

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Table 1. Agronomic performance of NDSG(MS)C8 and NDSB(MS)C8, grown over three years in North Dakota.

Entry	Ear moist.	Grain yield	Root lodg.	Stalk lodg.
	%	bu/A	--------- %	---------
1984 - 4 locations				
NDSB(MS)C6	24.33	89.51	0.94	10.29
NDSB(MS)C8	28.27	102.88	4.44	9.90
NDSAB	23.42	91.64	2.32	8.37
Pioneer Brand 3978	25.66	110.54	1.95	6.61
LSD(0.05)[1]	4.17	27.33	NS	NS
1986 - 4 locations				
NDSG(MS)C5	38.95	107.40	1.52	8.07
NDSG(MS)C8	42.01	122.71	3.34	8.95
NDSB(MS)C6	38.42	121.08	1.38	4.55
NDSB(MS)C8	39.31	129.98	0.51	1.63
NDSAB	38.00	123.63	1.96	5.38
Pioneer Brand 3978	38.12	149.12	0.00	3.35
LSD(0.05)[1]	2.25	17.18	4.90	5.61
1987 - 4 locations				
NDSG(MS)C5	40.90	97.03	10.79	7.44
NDSG(MS)C8	42.57	118.39	7.59	5.61
NDSB(MS)C6	40.04	95.77	2.87	3.61
NDSB(MS)C8	40.35	110.42	7.40	4.62
NDSAB	39.19	108.86	4.77	5.69
Pioneer Brand 3978	38.12	140.42	0.72	1.78
LSD(0.05)[1]	5.27	17.45	6.74	4.47
1986, 1987 - 8 environments				
NDSG(MS)C5	39.93	102.22	6.16	7.76
NDSG(MS)C8	42.29	120.55	5.47	7.28
NDSB(MS)C6	39.23	108.43	2.13	4.08
NDSB(MS)C8	39.83	120.20	3.96	3.13
NDSAB	38.60	116.25	3.37	5.54
Pioneer Brand 3978	38.12	144.77	0.36	2.57
LSD(0.05)[1]	2.73	12.23	2.54	3.36
1984, 1986, 1987 - 12 environments				
NDSB(MS)C6	34.26	102.12	1.73	6.15
NDSB(MS)C8	35.98	114.43	4.12	5.38
NDSAB	33.54	108.04	3.02	6.48
Pioneer Brand 3978	33.97	133.36	0.89	3.91
LSD(0.05)[1]	2.35	11.65	2.20	3.35

[1] Average differences among hybrids of this amount could be explained by random environmental effects only once in 20 repetitions of this experiment.