ND265: A New Parental Line of Early Corn

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Plant germplasm is the raw material which plant breeders use to construct new crop cultivars. When plant breeders depend on limited germplasm sources, the genetic base narrows, making the crop more vulnerable to insects, diseases, or environmental hazards. This happened to the U.S. corn (*Zea mays* L.) industry in 1970 when the southern corn leaf blight epiphytotic caused serious corn losses in much of the U.S. Corn Belt. This epiphytotic resulted from corn breeders' dependence on a single germplasm source for male sterility to produce hybrid corn for much of the U.S. market. This germplasm source was susceptible to *Helminthosporium maydis* which allowed the fungus to attack almost all corn hybrids across the U.S. Corn Belt.

To avoid these potential problems, hybrid corn breeders need genetic diversity at two levels. One, diversity of the hybrid may be increased by selecting parental inbred lines developed from different source populations. Corn breeders from companies without inbred development programs can control only this element of genetic diversity in their hybrids. Two, other breeders involved in developing inbred lines can diversify by choosing broad genetic-based source material for use in parental line development. Open-pollinated varieties, synthetic varieties, or other populations containing genes from many sources provide a broader genetic base than germplasm derived from narrow sources such as hybrid varieties.

Darrah and Zuber (1986) surveyed commercial seed corn producers and found that single cross hybrids were the most commonly reported germplasm source used to develop new inbred lines. The survey also revealed that 88 percent of the hybrid corn seed produced in 1984 included germplasm derived from a single original source, 'Reid'. These findings are evidence that corn breeders need to broaden the genetic base for future hybrid development.

Corn breeders in the central U.S. Corn Belt have an abundance of alternative parental lines to use in developing new hybrids, and many of these lines are more diverse than those currently being used to produce hybrids. Because hybrids produced from some of these inbreds have slightly lower performance than the best hybrids, these lines are not being used extensively, but could be quickly incorporated into hybrids if needed. However, only a small fraction of these inbreds mature early enough to produce hybrids for the extreme northern Great Plains.

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Breeders in the northern areas have fewer alternative parental lines to use in producing new hybrids. They have even smaller choice of genetic backgrounds in the available inbreds.

In order to provide more genetic diversity for developing very early inbreds, the North Dakota Agricultural Experiment Station has developed and released a number of new synthetic corn varieties for use by corn breeders in areas requiring early maturing corns. Since 1975 the NDSU corn breeding program has developed and released 26 inbred lines. Of these, 15 lines were developed from synthetic varieties. A total of seven different synthetics were used as germplasm sources for these 15 inbreds.

ND265 is a new inbred line released by the North Dakota Agricultural Experiment Station. It was developed from a synthetic variety which has not been used as a germplasm source for previously released inbreds.

BREEDING HISTORY

ND265 (tested as ND85-18) was selected from NDSA(FS)C2, an improved version of NDSA. NDSA was developed by intercrossing eight elite inbreds that had been selected for good general combining ability and early maturity and intermating for two generations (Cross, 1980). NDSA(FS)C2 was developed by two cycles of reciprocal full-sib selection with NDSB as the reciprocal tester population (for a description of NDSB see Cross, 1980). The S1 parent of ND265 was selected on the basis of its full-sib family performance. It was self-pollinated for eight generations with selection for desired plant and ear traits.

AGRONOMIC DESCRIPTION

ND265 produces medium tall plants with ears slightly below the midpoint of the stalk (Table 1). Plants have medium-long, narrow leaves and moderately good extrusion of the tassel above the flag leaf. Long slender ears with 10 to 14 rows of small kernels are borne on short shanks. ND265 is in the AES200 maturity group in terms of the North Central Corn Breeding Research Committee (NCR-2) classification system.

INBRED PERFORMANCE

ND265 was evaluated for yield and agronomic characters in 1988 at Fargo (Table 2). ND265 had below average grain yields, and much below average ear moisture at harvest. ND265 had low tillering, and no smut or stalk lodging.

Table 1. Summary of plant characteristics of ND265 and 16 standard inbreds grown at Fargo in 1988.

Inbred	Plant ht.	Ear ht.	Leaf no.	Leaf length	Leaf wid.	Tassel emer.[1]	Shank len.	Ear len.	Ear wid.	Kernel rows	Kernel wt.	Kernel dpth.
	---- Inches ----			---- Inches ----			---------- Inches ----------				g	in
A654	36.8	14.5	8.2	17.9	3.14	3.5	6.6	4.12	1.36	13.3	0.245	0.25
CM105	39.2	15.9	9.4	20.1	2.97	5.0	6.6	4.67	1.24	12.4	0.198	0.16
ND240	32.0	15.7	9.6	17.4	3.34	3.5	11.4	3.60	1.33	14.7	0.279	0.21
ND246	36.7	14.7	9.6	18.1	2.76	3.0	6.8	3.92	1.03	12.0	0.174	0.14
ND247	40.0	21.0	9.5	19.7	2.54	4.5	7.2	4.83	1.19	13.0	0.223	0.18
ND248	35.2	15.2	9.5	19.6	3.34	2.5	9.0	4.60	1.33	13.2	0.207	0.24
ND253	41.6	17.3	11.9	21.7	2.88	2.8	7.4	4.26	1.27	13.7	0.224	0.21
ND254	20.1	9.3	8.1	15.4	3.37	3.8	6.7	4.46	1.38	15.2	0.184	0.25
ND256	37.4	16.2	9.3	20.2	3.36	2.5	6.9	4.11	1.32	15.1	0.229	0.19
ND257	39.2	15.1	9.6	17.6	3.65	4.2	12.7	4.89	1.30	16.4	0.168	0.18
ND259	33.0	16.5	8.6	20.2	3.06	5.2	5.4	4.62	1.04	9.9	0.230	0.09
ND260	44.6	15.2	10.3	21.3	3.05	4.0	10.1	6.73	1.57	14.1	0.234	0.33
ND262	30.0	13.6	9.9	16.1	3.05	3.2	8.2	3.74	1.39	15.0	0.234	0.25
ND264	35.2	16.5	8.2	23.2	3.44	3.8	7.6	4.54	1.26	12.5	0.228	0.18
ND301	44.6	16.6	10.1	20.3	2.74	3.5	7.4	4.20	1.10	13.0	0.234	0.14
ND474	43.0	19.9	10.1	19.5	2.76	5.0	5.9	4.73	1.41	14.6	0.238	0.24
ND265	39.7	18.2	10.5	20.5	2.66	3.8	7.2	4.72	1.09	11.5	0.208	0.13
MEAN	37.0	16.9	9.6	19.3	3.06	3.8	7.8	4.51	1.27	13.5	0.220	0.20
LSD[2]	7.3	4.6	2.1	7.7	1.38	1.4	4.4	0.95	0.17	1.8	0.016	0.08

[1]The scale was 0 to 9 with 9 assigned for the most desirable expression of trait.

[2]Inbred differences larger than this value would be expected due to random environmental effects only once in 20 repetitions of this experiment.

Table 2. Summary of yield and agronomic characteristics of ND265 and 16 standard inbreds grown at Fargo in 1988.

Inbred	Grain yld.	Ear moist.	Stalk ldg.	Root ldg.	Shell ratio	Gen. app.[1]	Uniformity[1]	Tillers	Smut	Ears /plt.	Plant pop.
	bu/A	--------------- % ---------------						-------- % --------			plt/A
A654	8.0	24.1	0.0	4.0	69.9	4.9	7.2	39.2	1.6	0.43	15460
CM105	2.7	38.6	0.0	4.8	35.1	7.2	5.9	2.8	0.0	0.66	20468
ND240	10.4	24.9	0.0	22.2	67.9	5.6	6.6	5.7	1.1	0.60	18291
ND246	5.2	19.6	0.0	12.5	60.3	6.7	8.2	9.2	23.0	0.40	20904
ND247	19.3	10.8	3.2	14.4	66.5	5.6	6.4	5.3	6.0	0.96	18944
ND248	26.2	15.3	3.5	5.0	71.7	5.9	7.3	24.5	12.8	0.84	20251
ND253	15.2	15.8	0.0	0.2	73.4	7.7	5.8	9.6	2.9	0.54	21557
ND254	25.0	10.1	0.0	15.3	79.8	5.2	6.1	9.4	1.3	0.94	14589
ND256	10.4	31.6	0.0	9.8	53.1	6.6	7.5	14.0	5.9	0.71	14372
ND257	13.9	9.5	0.0	0.0	49.4	7.0	6.5	21.0	32.1	0.96	18073
ND259	3.4	32.6	0.0	27.8	65.0	5.7	7.1	43.7	8.0	0.80	6097
ND260	73.3	12.6	0.0	6.3	81.3	6.8	7.2	32.4	5.5	1.10	18291
ND262	30.7	16.2	0.0	2.0	64.9	5.1	7.9	10.3	5.8	1.07	22210
ND264	6.1	17.0	0.0	0.9	75.8	3.9	6.3	4.6	4.7	0.31	20033
ND301	6.6	23.1	7.1	14.2	45.0	5.4	5.0	16.3	9.6	0.82	17420
ND474	21.0	11.0	7.1	15.3	65.8	5.4	6.9	25.4	0.0	1.03	11323
ND265	12.1	10.3	0.0	28.5	62.2	6.1	5.5	11.0	0.0	0.91	19162
MEAN	17.0	18.9	1.2	10.8	63.9	5.9	6.7	16.7	8.6	0.77	17496
LSC[2]	8.7	7.6	NS	19.0	10.8	1.4	1.8	20.1	11.9	0.54	4040

[1]The scale was 0 to 9 with 9 assigned for the most desirable expression of the trait.

[2]Inbred differences larger than this value would be expected due to randon environmental effects only once in 20 repetitions of this experiment.

HYBRID PERFORMANCE

ND265 was tested in four hybrid combinations at two locations in 1986 and eight hybrid combinations in five environments in 1988 (Table 3). ND265 produced high yields in crosses with ND301 and ND240 in 1986 and with ND474 and A654 in 1987. ND265 produced good overall performance in hybrids with ND246 and CM105.

Estimates of general combining ability (GCA) over five environments in 1988 indicated that only ND257 had significantly better GCA effects for low harvest moisture than ND265, and only ND250 had better GCA effects for grain yield.

REFERENCES

Cross, H.Z. 1980. Registration of maize germplasm (Reg. No. GP84 and GP85). Crop Sci. 20:418.

Darrah, L.R. and M.S. Zuber. 1986. 1985 United States farm maize germplasm base and commercial breeding strategies. Crop Sci. 26:1109-1113.

Table 4. Average general combining ability effects for ND265 compared to various sets of standard inbreds.[1]

Inbred	Grain moist.	Grain yield	Root lodg.	Stalk lodg.	Pop.	P.I.
	%	bu/A	-------- %	--------	plts/A	
Design II analysis (four testers) over 2 locations in 1986						
CG10	-0.02	20.72	-0.15	-0.75	1066	28.38
ND474	-0.45	0.45	-1.21	4.13	684	2.52
ND300	1.05	-7.31	0.31	2.05	843	-12.60
ND265	-0.72	1.41	-0.37	1.47	919	4.40
LSD (0.05)[2]	2.59	21.10	4.16	8.14	2634	
Diallel analysis over 5 locations in 1988						
CM105	0.74	0.33	-2.97	-1.98	114	-5.71
ND240	0.43	0.67	-2.31	1.39	-556	-2.40
ND246	0.26	-1.66	-2.22	-2.04	713	-5.98
ND250	-0.43	4.55	7.19	0.55	776	14.86
ND257	-2.14	-2.66	-0.37	0.52	-18	17.30
ND256	0.55	-0.87	-0.73	-0.71	-958	-6.74
ND474	1.02	0.38	1.59	-0.55	-419	-7.86
ND265	-0.43	-0.75	-0.19	2.83	347	2.37
LSD (0.05)[2]	1.62	4.69	4.64	2.78	983	

[1]General combining ability effects are differences between the mean of all hybrids in the test and all hybrids produced from a particular inbred. Negative values indicate that inbred's hybrids were below average while positive values indicate above average performance.

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

Table 3. Average performance of selected single cross hybrids with ND265 and check hybrids tested at two environments in 1986 and five environments in 1988.

Pedigree	Hybrid	Grain moist.	Grain yield	Root lodg.	Stalk lodg.	Pop.	P.I.[1]
		%	bu/A	-------- %	--------	plts/A	
Means of 2 locations in 1986							
ND265 x ND240	NDG566	27.19	82.1	1.27	18.13	16561	113.86
CM105 x ND265	NDG538	30.59	73.2	0.00	5.52	14166	90.26
ND246 x ND265	NDG549	25.49	53.0	4.46	7.88	15531	78.34
ND265 x ND301	NDG583	27.79	99.6	0.00	18.37	15426	135.12
PIONEER BRAND	3978	29.77	103.4	4.70	4.89	17273	130.94
TOP FARM BRAND	TFSX87	28.62	102.5	2.04	5.27	15584	134.98
LSD (0.05)[2]		4.91	42.2	8.33	16.28	5267	
Means of 5 locations in 1988							
A654 x ND265	NDG790	12.65	47.1	15.70	5.61	18117	97.37
CM105 x ND265	NDG538	9.88	41.6	9.33	2.70	16725	102.45
ND240 x ND265	NDG566	12.78	39.9	13.27	8.80	17272	75.96
ND246 x ND265	NDG549	9.01	43.4	4.62	4.20	17046	117.26
ND250 x ND265	NDG772	9.77	44.4	18.54	7.20	17810	110.53
ND256 x ND265	NDG796	11.65	42.9	6.58	3.50	16070	89.49
ND474 x ND265	NDG762	11.82	52.1	17.49	7.60	17470	107.27
ND257 x ND265	NDG780	7.36	39.8	19.80	13.20	18000	131.46
PIONEER BRAND	3978	13.11	58.9	9.05	1.90	19661	109.27
TOP FARM BRAND	TFSX87	12.94	51.8	8.65	3.10	16719	97.34
LSD (0.05)[2]		3.96	11.5	11.37	6.82	2409	

[1]P.I. = Performance Index = (Yield/test mean)/(Moisture/test mean) x 100.

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