ND266: A New Parental Line for Improved Corn Hybrids

H.Z. Cross and D.W. Wanner

Corn (*Zea mays* L.) is the most important crop in the United States and is one of the five major crops in the world. Corn grown on about 75 million U.S. acres is worth more than $20 billion annually. Troyer (1990) has stated, "Hybrid corn represents an extraordinary research success." He estimates that since 1960, average U.S. corn yields have increased almost 2 bushels per acre per year, worth about $330 million annually, with virtually no additional input by growers. Single-cross hybrids, which arose after 40 years of hybrid research, are more productive than open-pollinated or synthetic varieties. Modern hybrids exploit current cultural practices, such as higher plant densities, to increase yields.

While corn is relatively less important in North Dakota than the U.S. as a whole, it has been grown on nearly one million acres annually and has been worth in excess of $100 million annually to North Dakota producers in recent years. Cross (1981) estimated that annual corn grain yields in North Dakota were increasing about 2.3 percent (1.9 bushels per acre) per year due to genetic improvements, rates similar to Troyer's estimates for the U.S. At 2.3 percent of $100 million per year, these genetic improvements due to breeding are putting an additional $2.3 million annually into the pockets of North Dakota corn producers and require no additional inputs.

Future genetic improvement in corn hybrids for North Dakota depends on the continued availability of improved parental inbred lines for use in hybrid production. One of the objectives of the corn breeding program at North Dakota State University is to produce parental inbreds for use in producing these improved hybrids adapted to North Dakota. ND266 is the latest inbred line developed in this program.

BREEDING HISTORY

ND266 (tested as ND83-64) was selected from NDSD (FS)C1 (see Cross, 1984). NDSD(FS)C1 was produced by one cycle of reciprocal full-sib selection from NDSD, a synthetic developed at NDSU as a potential source of inbreds with improved stalk lodging resistance (see Cross, 1982). ND266 was self-pollinated for eight generations with selection for desired plant and ear traits.

AGRONOMIC DESCRIPTION

ND266 typically produces medium short plants with ears above the midpoint of the stalk (Table 1). Plants have medium short, wide leaves and large tassels. Ears with 14 to 16 rows of small kernels are borne on medium long shanks. ND266 is late AES200 maturity in terms of the North Central Corn Breeding Research Committee (NCR-2) classification system.

INBRED PERFORMANCE

ND266 was evaluated for yield and agronomic characters in 1984 at Fargo (Tables 2 and 3). ND266 had average grain yield and ear moisture at harvest, near average root and stalk lodging, and above average test weight.

HYBRID PERFORMANCE

ND266 was tested at eight hybrid combinations at two environments in 1987 and in six hybrid combinations at five environments in 1989. Estimates of general combining ability (GCA) across five environments in 1989 indicated that ND266 had the highest GCA effects for grain yield, and tended to hve intermediate GCA effects for grain moisture, root lodging, and performance index of the five inbreds tested (Table 4). It produced high yields in crosses with all eight tester lines in 1987 and with CM105, ND264, A554, ND246, and ND262 in 1989 tests (Table 5). Most hybrids with ND266 had low levels of stalk breakage and root lodging.

REFERENCES

Cross, H.Z. 1981. ND247 and ND248--Two early corn inbred lines. North Dakota Farm Research 40(1):8-11.

Cross, H.Z. 1982. Registration of maize germplasm (Reg. No. GP117 and GP118). Crop Sci. 22:1270.

Cross, H.Z. 1984. Registration of NDSG(MS)C5, NDSC(FS)C1, and NDSD(FS)C1 maize germplasm. Crop Sci. 24:1217.

Troyer, A.F. 1990. A retrospective view of corn genetic resources. Journal of Heredity 81:17-24.

Cross is professor and Wanner is research technician, Department of Crop and Weed Sciences.

Table 1. Summary of plant characteristics of ND266 and 12 standard inbreds grown at Fargo and Casselton in 1984.

Inbred	Leaf no.	Leaf angle	Plant height	Ear height	Leaf length	Tassel brches	Shank length	Rust[1] rating	Leaf width
			..... inches				inches		inches
ND101	7.75	67.80	31.29	6.30	18.91	5.25	5.21	8.65	2.52
ND203	10.50	48.60	40.55	15.90	23.70	12.50	4.96	8.75	3.11
ND240	9.25	52.50	46.00	19.30	17.74	13.50	5.84	8.25	3.35
ND246	9.25	69.60	47.21	18.60	21.24	13.50	5.47	7.35	3.27
ND253	10.50	47.10	47.70	21.90	22.80	18.00	0.30	8.95	2.68
ND246	9.49	70.10	44.34	18.00	22.23	13.50	4.78	6.75	3.11
ND408	12.50	60.80	66.67	35.80	18.83	11.75	5.11	8.40	2.87
ND257	9.01	61.40	45.19	16.00	20.46	10.75	5.53	8.10	3.66
ND258	8.51	37.00	44.47	15.00	26.45	11.75	5.54	9.00	3.58
ND259	10.25	65.50	53.86	26.70	25.70	14.25	5.89	7.90	3.19
ND260	9.24	57.00	44.74	18.90	25.11	8.75	4.94	8.85	2.17
ND261	9.49	50.90	45.01	16.90	21.69	12.50	8.14	6.90	3.15
ND266	9.75	48.50	40.24	21.20	19.62	17.75	5.84	8.35	3.58
LSD(0.10)[2]	1.44	11.44	7.93	4.79	3.35	8.26	1.32	1.28	0.59

[1] The scale was 1 to 9 with 9 assigned when no rust pustules were found and 1 when the leaves were completely covered with pustules.

[2] Inbred differences larger than this value would be expected due to random environmental effects only once in 10 repetitions of this experiment.

Table 2. Summary of plant characteristics of ND266 and 12 standard inbreds grown at Fargo and Casselton in 1984.

Inbred	General appear.[1]	Uniformity[1]	Tillers	Aphid resist[1]	Root lodg.	Stalk lodg.	Tassel emergence[1]
			--- % ---		..... %		
ND101	3.24	7.08	64.00	8.50	0.00	3.55	4.98
ND203	6.01	7.82	59.25	7.90	3.50	0.00	2.76
ND240	6.58	6.58	4.00	7.70	0.00	41.50	4.01
ND246	6.54	6.74	2.75	8.20	0.00	2.15	3.52
ND252	5.04	0.45	0.00	6.80	0.00	0.00	3.02
ND253	7.99	7.75	20.45	7.90	2.80	0.00	3.51
ND256	6.25	5.14	14.12	9.00	0.00	0.00	2.25
ND408	6.99	6.27	5.05	8.90	16.60	30.50	5.48
ND257	6.23	7.63	28.15	8.50	0.00	0.00	4.24
ND258	5.98	6.63	45.50	9.00	6.20	0.00	2.97
ND259	6.21	4.22	29.00	8.20	0.00	0.00	3.02
ND260	6.23	7.34	30.50	9.00	4.70	15.00	3.47
ND261	5.99	6.65	51.00	9.00	0.00	0.00	4.00
ND266	6.77	6.06	10.75	8.50	7.80	6.05	2.99
LSD (0.10)[2]	2.04	3.11	29.48	3.36	13.29	24.22	1.18

1 The scale used was 1 to 9 with 9 assigned for the most desirable expression of the trait and for the least desirable expression.

[2] Inbred differences larger than this value would be expected due to random environment effects only once in 10 repetitions of this experiment.

Table 3. Summary of yield performance and agronomic characteristics of ND266 and 12 standard inbreds grown at Fargo in 1984.

Inbred	Grain yield	Ear moist.	Shelling	Test weight	Ears/ plant	Plant pop.
	bu/A	%	%	lb/bu		
ND101	14.8	15.7	67.6	60.8	1.25	12194
ND203	13.2	18.9	59.3	60.0	1.09	10452
ND240	43.4	18.4	83.6	53.9	1.38	15242
ND246	42.7	14.3	77.6	63.3	0.95	19162
ND253	30.0	19.5	85.8	55.3	0.72	17420
ND256	39.0	19.2	77.2	54.3	0.98	17856
ND408	52.5	26.1	76.2	58.5	1.43	16984
ND257	28.3	16.5	67.3	53.9	1.24	13936
ND258	10.5	22.5	59.9	57.1	0.88	14807
ND259	54.0	33.1	68.7	54.9	1.10	16984
ND260	30.3	16.0	79.5	56.0	1.18	13065
ND261	25.8	12.7	74.5	58.6	1.61	10888
ND266	33.7	16.1	81.3	62.4	1.15	14807
LSD(0.10)[1]	19.0	12.9	12.0	2.5	NS	4660

[1] Inbred differences larger than this value would be expected due to random environmental effects only once in 10 repetitions of this experiment.

Table 4. Average general combining ability effects for ND266 compared to four standard inbreds at five environments in 1989.[1]

Inbred	Grain moist.	Grain yield	Root lodg.	Stalk lodg.	Pop.	P.I.[2]
	%	bu/A	%	%	plts/A	
A554	-1.30	-0.77	6.31	-0.61	-1601	10.84
ND262	1.14	-3.91	3.43	-0.48	-1804	-11.72
CM105	1.07	-2.42	-7.31	-0.52	-1376	-7.22
ND246	-1.86	0.47	-0.94	0.64	2638	10.88
ND266	0.96	6.62	-1.49	0.98	2143	-2.78
LSD (0.10)[3]	1.91	10.20	8.64	NS	1751	

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

[3] Average differences among hybrids of this amount could be explained by random environmental effects only once in 10 repetitions of this experiment.

Table 5. Average performance of selected single cross hybrids with ND266 and check hybrids tested at two environments in 1987 and five environments in 1989.

Pedigree	Hybrid	Grain moist.	Grain yield	Root lodg.	Stalk lodg.	Pop.	P.I.[1]
		%	bu/A	%	%	plts/A	
1987							
ND266 x ND81-16	NDH001	30.30	113.53	7.6	0.8	23641	94.4
ND266 x NDB8	NDH002	25.45	110.50	25.0	7.4	22897	109.4
ND266 x CM105	NDG164	26.00	110.98	18.0	8.7	23906	107.6
ND266 x ND408	NDH003	29.65	109.23	12.8	14.8	23906	92.8
ND266 x ND485	NDH004	25.90	104.62	12.2	18.4	23397	101.8
ND266 x ND81-17	NDH005	25.35	96.15	18.4	12.3	22405	95.6
ND266 x ND80-10	NDH006	24.95	106.53	24.5	2.6	23673	107.6
ND266 x ND81-10	NDH007	27.65	97.79	22.6	4.5	23634	89.1
Pioneer Brand	3953	21.15	98.74	15.2	12.9	23653	117.7
LSD (0.10)[2]		2.28	16.97	11.9	9.1	2255	
1989							
ND266 x A554	NDG964	15.49	73.20	16.8	1.3	19391	118.9
ND266 x ND246	NDG958	13.02	72.80	1.3	0.3	20126	140.7
ND266 x ND261	NDG949	18.77	48.86	0.1	1.9	20568	65.5
ND266 x ND262	NDG971	18.77	72.55	9.9	1.4	14745	97.3
ND266 x ND264	NDG974	19.38	76.10	4.8	0.6	18579	98.9
CM105 x ND266	NDG164	20.98	78.08	1.3	3.1	18671	93.7
CM105 x ND261	NDG491	16.41	71.56	2.8	2.5	15621	109.8
CM105 x ND257	NDG068	11.88	96.90	0.3	0.1	19083	205.4
CM105 x ND246	NDG052	15.06	75.69	1.3	0.1	22146	126.6
Pioneer Brand	3954	13.57	87.70	17.4	1.1	20189	162.7
Pioneer Brand	3963	12.62	87.87	10.6	0.0	21540	175.3
LSD (0.10)[2]		3.31	17.67	15.0	NS	3032	

[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 10 repetitions of this experiment.