

Higher Yields and Greater Uniformity With Hybrid Sunflowers

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Although hybrid sunflowers have shown distinct yield advantages over open-pollinated varieties, hybrids have not been grown commercially in the United States because of high labor costs involved in producing the seed and difficulty in obtaining seed that would be 100 per cent hybrid. However, with the recent discoveries of cytoplasmic male sterility (2) and fertility restoration (1), it is now possible to produce hybrid sunflower seed much in the same way that hybrid corn and sorghum are produced. In this paper, yield and other performance data are presented for high-oil sunflower hybrids as compared to open-pollinated varieties grown in North Dakota.

Agronomic Performance

The North Dakota Agricultural Experiment Station has conducted sunflower variety trials since 1947. Hybrids have generally outyielded the open-pollinated varieties, often by as much as 30 per cent. Seed yields for 1969-1971 are shown in Table 1 for three of the better high-oil hybrids grown at Fargo. One hybrid was grown for three years at all



NDSU researchers are working on downy mildew resistant varieties of sunflowers. The mildew infected plant at right will not grow any larger.

of the Branch Stations. The high yield potential of these hybrids as compared to the best open-pollinated varieties presently being grown is indicated.

At Fargo in 1971, hybrids accounted for 20 of 21 entries which exceeded 2,000 pounds per acre. Data from a test to evaluate eight of the better experimental and/or commercial high-oil sunflower hybrids and open-pollinated varieties for agronomic

Table 1. Sunflower yields in North Dakota, 1966-1971.

Variety	Carrington					
	Fargo	Minot	Irrigated	Dryland	Langdon	Average
HA 64 x HA 60 ¹	2073	—	—	—	—	—
INRA 6501 ¹	1758	—	—	—	—	—
P-21 ms x HA 60 ¹	1750	1548	2279	952	1632	1632
VNIIMK 89.31 ²	1670	1379	1684	810	1421	1393
Peredovik ²	1548	1317	1868	808	1277	1364
Krasnodarets ²	1196	952	1285	635	850	984
Avg.	1666	1299	1779	801	1295	

¹Hybrid varieties.
²Open-pollinated varieties.

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July - August, 1972

characteristics, including yield and uniformity, are presented in Table 2. Average yield of the five hybrids represented an increase in yield of approximately 300 pounds per acre or 18 per cent more than the best open-pollinated variety, Peredovik. The highest yielding hybrid, P-21 ms x HA 60, yielded approximately 600 pounds more per acre or 35 per cent over Peredovik. Larger head size appears to account for at least part of the yield advantage of the hybrids.

The hybrids and open-pollinated varieties were similar for days to 50 per cent bloom and plant height. In general, the hybrids were lower in oil content than the open-pollinated varieties Peredovik and Record. However, low oil content is not expected to be inherent to hybrid varieties. Romania HS 52, for example was similar in oil content to Peredovik and Record and preliminary tests at Fargo involving F₁ hybrids of cytoplasmic male-sterility x restorer lines indicate that experimental hybrids which are as high or higher than Peredovik are available. With the exception of Romania HS 52, the hybrids were characterized by greater resistance to rust. Because resistance to rust is conditioned by a few dominant genes (3), incorporation of resistance into hybrid varieties has been rapid.

Greater Uniformity

Whereas individual plants in an open-pollinated field of sunflowers are genetically dissimilar, every plant in a hybrid field is of the same or closely related genotype. Consequently, hybrid varieties

are characterized by greater uniformity for most agronomic traits. Data illustrating the greater uniformity of the hybrids for flowering, height, head diameter, seed oil per cent and rust reaction are presented in Table 3. The number of days required from five and 95 per cent bloom for the single cross hybrids was reduced by two days when compared to Peredovik and Record. With few exceptions the hybrids were similarly more uniform for height, head size, oil percentage and rust reaction than the open-pollinated varieties.

Greater uniformity of hybrid varieties is generally considered advantageous. Fewer applications of insecticides for control of damaging insects, such as larvae of the sunflower head moth, are expected to be required for the uniformly flowering hybrids than are necessary for the more variable open-pollinated varieties. Greater uniformity in flowering and subsequent maturity also may be advantageous at the time of harvest. In commercial fields of open-pollinated varieties it is not uncommon to see many green heads when the majority of the heads are dry enough to combine. Similarly, greater uniformity in height and head diameter should provide easier harvest.

Greater uniformity of hybrids also may be disadvantageous. If flowering occurs coincident with a hot dry period, an early frost, or weather unfavorable for insect pollination, seed set in sunflowers is likely to be reduced. Because open-pollinated varieties flower over a longer period of time, they might escape part of the unfavorable period and

Table 2. Agronomic and oil data for eight sunflower varieties grown at Fargo, North Dakota in 1971.

Variety	Rust reading ¹	Days to 50% bloom	Height, inches	Head diameter, inches	Test weight, lb/bu	Seed yield, lb/A	Seed oil, percent
3 single cross hybrids							
P-21 ms x HA 60	1.3	72	76	6.1	29.5	2289	34.8
HA 258 x HA 61	1.3	75	80	5.6	32.0	1792	38.0
Romania HS 52	2.1	77	77	6.5	29.1	1894	42.2
Avg.	1.6	75	78	6.1	30.2	1992	38.3
2 3-way hybrids							
HA 64 x HA 258) x HA 61	1.2	75	82	6.1	34.3	1954	39.3
HA 65 x HA 258) x HA 61	1.1	76	80	5.9	34.2	2026	39.1
Avg.	1.2	76	81	6.0	34.2	1990	39.2
3 open-pollinated varieties							
Peredovik	1.8	76	80	5.9	30.1	1691	42.4
Record	2.0	81	83	5.8	30.1	1651	42.2
Tchernianka	1.9	68	58	5.6	28.2	1239	36.2
Avg.	1.9	75	74	5.8	29.5	1527	40.3

¹Rust reading - 0, rust free; 1, trace; to 5, highly susceptible.

Table 3. Variability in agronomic and oil characteristics for eight sunflower varieties.¹

Variety	Rust reading		Days from 5 to 95% bloom		Height, inches		Head diameter, inches		Seed oil, per cent	
	Range	Diff.	Range	Diff.	Range	Diff.	Range	Diff.	Range	Diff.
3 single cross hybrids										
P-21 ms x HA 60	1.0-2.0	1.0	68-79	11	64-84	20	3.2-8.5	5.3	29.2-39.8	10.6
HA 258 x HA 61	1.0-2.3	1.3	70.82	12	69-89	20	3.2-7.8	4.6	33.5-42.6	9.1
Romania HS 52	1.7-2.3	0.6	71-83	12	67-85	18	4.0-9.2	5.2	36.8-46.3	9.5
Avg.	1.2-2.2	1.0	69-81	12	67-86	19	3.5-8.5	5.0	33.2-42.9	9.7
2 3-way hybrids										
(HA 64 x HA 258) x HA 61	1.0-2.0	1.0	69-83	14	73-91	18	4.0-8.0	4.0	33.2-44.1	10.9
(HA 64 x HA 258) x HA 61	1.0-2.0	1.0	69-83	14	69-92	23	3.2-8.0	4.8	34.1-44.2	10.1
Avg.	1.0-2.0	1.0	69-83	14	71-91	20	3.6-8.0	4.4	33.7-44.2	10.5
3 open-pollinated varieties										
Peredovik	1.0-2.7	1.7	69-83	14	69-89	21	2.5-8.2	5.7	36.9-47.6	10.7
Record	1.0-3.0	2.0	74.88	14	69-93	24	2.8-9.2	6.4	35.7-47.4	11.7
Tchernianka	1.0-2.3	1.3	64.76	12	47-70	23	2.8-8.0	5.2	30.3-40.9	10.6
Avg.	1.0-2.7	1.7	69.82	13	61-84	23	2.7-8.5	5.8	34.3-45.3	11.0

¹Values used to express the range in variability for rust, height, head diameter, and oil percentage are the means of the high and low value from 15 random plants in each of 3 replications.

set more seed than the hybrids. Investigations relative to the performance of highly uniform hybrids under adverse conditions are needed.

Plant Population

Corn hybrids are generally planted at higher plant populations than open-pollinated varieties because they make more efficient use of additional quantities of fertilizer (4). Preliminary results from a study initiated at Fargo in 1971 indicated that the sunflower hybrids in Table 3 responded similarly to the open-pollinated varieties to plant populations of 12,500, 25,000 and 37,500 plants per acre. Additional trials under a wide range of growing conditions are necessary to determine if hybrid varieties might produce higher yields at plant populations different from those currently recommended for open-pollinated varieties.

Effects of increased plant populations (Table 4) were to delay flowering and produce taller plants

with smaller heads and seed of a lower test weight and higher oil content. Seed yields and susceptibility to rust were not significantly affected by plant population in this study.

Summary

Hybrid sunflower varieties had significantly higher yields and greater uniformity for rust reaction, flowering, height, head size and per cent seed oil than open-pollinated varieties. As a result of improved methods of seed production, hybrids can now be produced for commercial production.

References

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Table 4. Agronomic and oil data for 8 sunflower varieties grown at three different plant populations at Fargo, North Dakota in 1971.

Plant population, plants/acre	Rust reading	Days to 50% bloom	Height, inches	Head diameter, inches	Test weight, lb/bu	Seed yield, lb/A	Seed oil, percent
12,500	1.5	74	75	7.1	31.4	1807	38.5
25,000	1.6	75	77	5.5	31.0	1883	39.3
37,500	1.6	76	79	5.2	30.4	1761	40.0

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