

## NEW RESULTS ON SUNFLOWER HYBRID DEVELOPMENT IN YUGOSLAVIA

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The creation of sunflower hybrids in the Institute of Agricultural Research — Novi Sad, on the basis of male sterility runs in two directions :

- a) on the basis of genetical type of male sterility with the gene linked to the seedling colour ;
- b) on the basis of cytoplasmic male sterility.

The Novi Sad source of male sterility NS-GMS-A9345 was used as genetical type. More than 500 hybrid combinations have been investigated annually on the basis of this source of male sterility. On this occasion the results of some prosperous combinations only will be presented. On the basis of the results obtained it can be concluded that there is a great number of hybrid combinations having the seed yield significantly higher than the standard varieties. In the individual hybrid combinations the seed yield exceeds 50 mtc/ha (table 1). Unfortunately these hybrid combinations have lower oil content in seed. Some of the hybrids have the oil content in seed somewhat higher than the standard varieties VNIIMK 8931 and Peredovik (table 2). The individual hybrids have simultaneously the seed yield and oil yield per hectare significantly higher than the standard varieties. Among these hybrids the outstanding are GMS x S<sub>905</sub> (table 1) as an early one and GMS x S<sub>7</sub> (table 2) with an oil yield ranging 1964 kg/ha.

The individual hybrids are genetically resistant to *Plasmopara helianthi* and tolerant to *Sclerotinia libertiana* — hybrid No. 3 in table 2.

Among the hybrids based on the genetic type of male sterility the best results are obtained by hybrid H-22. This hybrid with the inbred line of male parent from Majak variety has the highest value among all hybrids based on genetic type of male sterility concerning the most im-

Table 1

Value of some sunflower hybrids on GMS basis

No.	Hybrid (Variety)	Length of vegetation — days	Seed yield mtc/ha	Hybrid/ /V8931	Oil content in seed %	Oil yield kg/ha	Hybrid/ /V8931
1	GMS × S <sub>334</sub>	120	50.74*	123.0	41.70	1840	109.1
2	GMS × S <sub>393</sub>	120	45.23	109.6	41.59	1636	97.0
3	GMS × S <sub>424</sub>	120	48.64	117.9	44.65	1889	112.0
4	GMS × S <sub>431</sub>	130	50.36*	122.0	41.02	1796	106.5
5	GMS × S <sub>438</sub>	121	41.91	101.6	47.51	1732	102.7
6	GMS × S <sub>905</sub>	118	49.20*	119.2	45.96	1967*	116.6
7	GMS × S <sub>901</sub>	118	46.86	113.6	45.35	1849	109.5
8	GMS × S <sub>925</sub>	125	41.08	99.5	47.75	1706	101.1
9	GMS × S <sub>928</sub>	121	43.36	105.1	47.86	1805	107.0
10	CVH6IBC23-F	118	37.67	91.3	45.43	1490	88.3
11	CA4BC23-F	118	37.84	91.7	45.78	1506	89.3
12	BK-IV-G	121	39.72	96.2	36.00	1244	73.7
13	H-52-R	121	39.38	95.4	48.13	1648	97.7
14	H-53-R	120	42.38	102.7	45.75	1686	100.0
15	VNIIMK 8931 (Check)	125	41.25	100.0	46.99	1686	100.0
16	Peredovik	124	35.79	—	49.45	1539	—
17	NS-P-20	125	40.69	—	48.88	1730	—

For seed yield:

LSD 5% = 7.8 mtc/ha  
1% = 10.6 mtc/ha

For oil yield:

LSD 5% = 235 kg/ha  
1% = 293 kg/ha

Table 2

Value of some sunflower hybrids on GMS basis

No.	Hybrid (Variety)	Length of vegetation — days	Seed yield mtc/ha	Hybrid/ /V8931	Oil content in seed — %	Oil yield kg/ha	Hybrid/ /V8931
1	GMS × S <sub>4</sub>	125	41.62	103.9	51.98	1882	110.9
2	GMS × S <sub>7</sub>	124	46.46*	116.0	48.61	1964*	115.7
3	GMS × S <sub>23</sub>	114	44.43	111.0	48.86	1888	111.2
4	GMS × S <sub>76</sub>	120	42.68	106.6	51.43	1909	112.4
5	Peredovik	124	39.38	—	51.19	1753	—
6	VNIIMK 8931 (Check)	125	40.02	100.0	48.77	1697	100.0

For seed yield:

LSD 5% = 6.03 mtc/ha  
1% = 8.51 mtc/ha

For oil yield:

LSD 5% = 245 kg/ha  
1% = 314 kg/ha

portant characters. According to the results presented in table 3, where the hybrid H-22 (NS-GMS-A9345 x M-6/4) is under No. 12, — it is evident that this hybrid for two years of investigations gave significantly higher seed yield. Its two-year average seed yield is significantly

Table 3

## Seed yield in parent lines and hybrids between MS-lines and self-pollinated lines of Armavirski and Majak

No.	Combination	Seed yield mtc/ha					
		F <sub>1</sub>			♂		
		1972	1973	$\bar{X}$	1972	1973	$\bar{X}$
1	NS—GMS—A9345×A3497—2/6—S <sub>10g.</sub>	35.90	37.93	36.91*	30.14	30.69	30.41
2	" × A3497—7/1—S <sub>10g.</sub>	34.87	35.82	35.34**	21.68	28.47	25.07
3	" × A9343—5/5—S <sub>9g.</sub>	35.53	35.53	35.53*	26.84	31.08	28.96
4	" × A9343—1/3—S <sub>9g.</sub>	33.17	27.71	30.44*	15.34	15.52	15.43
5	" × A9343—3/2—S <sub>9g.</sub>	38.97	42.02	40.49**	4.72	5.75	5.23
6	" × A9343—1/8—S <sub>9g.</sub>	35.35	32.57	33.96**	21.28	23.87	22.57
7	" × A3497—4/2—S <sub>6g.</sub>	37.91	48.52	43.21**	27.28	25.85	26.56
8	" × M—1/6—S <sub>9g.</sub>	38.97	36.80	37.88	30.46	33.22	31.84
9	" × M—3/3—1—S <sub>6g.</sub>	34.93	35.35	35.64**	17.63	16.47	17.05
10	" × M—4/4—3—S <sub>6g.</sub>	34.75	35.61	35.18**	24.97	20.18	22.57
11	" × M—7/3—1—S <sub>6g.</sub>	38.33	36.94	37.63**	29.67	26.75	28.21
12	" × M—6/4—S <sub>6g.</sub> (H—22)	46.43	49.48	47.95**	21.15	22.06	21.60
$\bar{X}$		37.09	37.94	37.51**	22.59	23.32	22.95
13	NS—GMS—A9345—♀	24.42	23.93	24.17			
14	VNIIMK 8931—Check	38.78	39.51	39.14			
15	Peredovik—Check	36.87	38.81	37.84			
16	VNIIMK 8883—Check	32.15	31.34	31.74			

LSD 5% = 6,5 mtc/ha  
1% = 8,6 mtc/ha

higher than the yield of the standard varieties and it ranges to 47,95 mtc/ha. In the same table there are presented the seed yields of parental lines of this hybrid.

The oil content in seed of the hybrid H-22 during the investigated years was higher than the standard variety VNIIMK 8931. The two-year average oil content of this hybrid (NS-GMS-A9345 x M-6/4) is 49,01% (table 4).

According to the results presented in table 5 it can be seen that the hybrid NS-GMS-A9345 x M-6/4 has significantly higher oil yield per hectare than the standard varieties VNIIMK 8931 and Peredovik. The two-year average oil yield of this hybrid is 2044 kg/ha and of the variety VNIIMK 8931 — 1639 kg/ha.

The hybrid H-22 (NS-GMS-A9345 x M-6/4) is in the process of reproduction and extension together with several more hybrids based on genetic type of male sterility.

In the breeding programme there are 450 inbred lines which are being converted into CMS-form. With a certain number of inbred lines this conversion into CMS-form has been completed. Several restorer lines have been found up to now. It is particularly very interesting that among

Table 4

**Oil content in seed in parent lines and hybrids between MS-lines and self-pollinated lines of Armavirski and Majak**

No.	Combination	Oil content in seed — %					
		F <sub>1</sub>			♂		
		1972	1973	$\bar{X}$	1972	1973	$\bar{X}$
1	NS—GMS—A9435×A3497—2/6—S <sub>10</sub> g.	42.70	43.33	43.01	41.01	44.06	42.53
2	” × A3497—7/1—S <sub>10</sub> g.	38.01	38.04	38.02	30.07	42.26	36.16
3	” × A9343—5/5—S <sub>9</sub> g.	45.92	44.46	45.19**	36.33	36.40	36.36
4	” × A9343—1/3—S <sub>9</sub> g.	44.65	45.26	44.95	43.21	46.02	44.61
5	” × A9343—3/2—S <sub>9</sub> g.	40.50	42.14	41.32	35.71	41.31	38.51
6	” × A9343—1/8—S <sub>6</sub> g.	46.50	46.31	46.40	46.32	43.56	44.94
7	” × A3497—4/2—S <sub>6</sub> g.	44.46	44.14	44.30	44.94	44.26	44.60
8	” × M—1/6—S <sub>9</sub> g.	46.33	47.17	46.75	47.26	48.28	47.77
9	” × M—3/3—1—S <sub>6</sub> g.	45.94	45.63	45.79	44.92	50.21	47.56
10	” × M—4/4—3—S <sub>6</sub> g.	44.69	45.72	45.20	45.68	46.95	46.31
11	” × M—7/3—1—S <sub>6</sub> g.	44.49	40.37	42.43	43.35	42.55	42.95
12	” × M—6/4—S <sub>6</sub> g. (H—22)	49.13	48.90	49.01**	43.49	46.47	44.98
$\bar{X}$		44.44	44.28	44.36	41.85	44.36	43.10
13	NS—GMS—A9345 — ♀	39.99	39.03	39.51			
14	VNIIMK 8931 — check	48.60	47.71	48.15			
15	Peredovik — check	48.12	49.58	48.85			
16	VNIIMK 8883 — check	44.51	45.54	45.02			

LSD 5% = 2,5%  
1% = 3,4%

Table 5

**Oil yield in parent lines and hybrids between MS-lines and self-pollinated lines of Armavirski and Majak**

No.	Combination	Oil Yield — kg/ha					
		F <sub>1</sub>			♂		
		1972	1973	$\bar{X}$	1972	1973	$\bar{X}$
1	NS—GMS—A9345×A3497—2/6—S <sub>10</sub> g.	1333	1429	1381*	1075	1176	1125
2	” × A3497—7/1—S <sub>10</sub> g.	1152	1185	1168*	567	1046	806
3	” × A9343—5/5—S <sub>9</sub> g.	1419	1374	1396**	848	983	915
4	” × A9343—1/3—S <sub>9</sub> g.	1288	1090	1189**	576	270	423
5	” × A9343—3/2—S <sub>9</sub> g.	1372	1540	1456**	146	206	176
6	” × A9343—1/8—S <sub>6</sub> g.	1429	1311	1370**	857	904	880
7	” × A3497—4/2—S <sub>6</sub> g.	1466	1863	1664**	1066	995	1030
8	” × M—1/6—S <sub>9</sub> g.	1570	1509	1539	1252	1395	1323
9	” × M—3/3—1—S <sub>6</sub> g.	1396	1442	1419**	688	719	703
10	” × M—4/4—3—S <sub>6</sub> g.	1351	1414	1382**	992	824	908
11	” × M—7/3—1—S <sub>6</sub> g.	1483	1297	1390*	1118	990	1054
12	” × M—6/4—S <sub>6</sub> g. (H—22)	1984	2104	2044*	800	891	845
$\bar{X}$		1436	1463	1447**	832	866	849
13	NS—GMS—A9345 — ♀	849	812	830			
14	VNIIMK 8931 — check	1639	1639	1639			
15	Peredovik — check	1543	1675	1609			
16	VNIIMK 8883 — check	1244	1241	1242			

LSD 5% = 256,2 kg/ha  
7% = 339,8 kg/ha

inbred lines of Majak variety there are lines having restorer genes in themselves. These restorer lines have high oil content in seed. Among the restorers used three of them are resistant to *Plasmopara helianthi* and one of them is the male parent of the hybrid No. 1 in table 6.

Table 6:

Value of some sunflower hybrids on CMS basis

No.	Hybrid (Variety)	Lenght of vegetation days		Seed yield kg/ha		Oil content in seeds %		Oil yield kg/ha	
			F <sub>1</sub> /V8931		F <sub>1</sub> /V8931		F <sub>1</sub> /V8931		F <sub>1</sub> /V8931
1	cms <sub>1</sub> × RHA—NS—1	121	96.8	4683	120.9	48.75	100.7	1986**	121.6
2	cms CF × RHA—M—6/1—3	122	97.6	4577	118.2	47.46	98.0	1954**	119.6
3	VNIIMK 8931 — Check	125	—	3871	—	48.40	—	1633	—
For seed yield				For oil yield					
LSD 5% = 574 kg/ha				LSD 5% = 197 kg/ha					
1% = 763 kg/ha				1% = 262 kg/ha					

Beside the local restorer lines in the breeding programme there are used also the restorer lines from USA, Canada and Argentina.

A great number of hybrids based on cytoplasmic male sterility were investigated in 1973. Few of them are significantly better than the standard varieties concerning the seed yield and oil yield per hectare. Two prosperous hybrids based on cytoplasmic male sterility are presented in table 6.

In 1974 the reproduction of several hybrids based on cytoplasmic male sterility has started.