

# PRODUCTIVE ABILITIES OF SOME SUNFLOWER VARIETIES AND HYBRIDS

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## INTRODUCTION

Peredovik is the most widely spread sunflower variety in Bulgaria providing high and stable yields. In the last few years the new high-yielding Bulgarian hybrid Start was introduced into production too.

Vranceanu and Stoenscu (1972) compared the productive abilities of sunflower varieties Record and some single hybrids. The superiority of the hybrids is manifested in the seed yield, the uniformity of the sowing, resistance to drought and lodging. On the other hand they are of lower ecological plasticity. Later the same authors come to the conclusion that single hybrids, due to their narrower genetic basis are of a more limited ecological plasticity, if compared to the open pollinated varieties (1978). According to studies, carried out by Fick and Zimmer (1976) varieties Peredovik and Sputnik give lower yields but possess higher stability than single and three-way hybrids. In contrast to those results, Miller and Fick (1978), when following the response of Peredovik and of a specially selected group of hybrids to sowing density of 36000; 48000 and 72000 plants/ha do not detect any significant differences both in yield and quality of the seeds. The only difference between the variety and the hybrids is that while in hybrids stem height increases with higher density, in varieties it remains unchanged. Bounnit et al. (1978), on the other hand find that the heterosis effect with respect to seed yield and oil is approximately the same both in single, three-way and double-cross hybrids, but the adaptivity of the 2nd and 3rd group of hybrids is better.

In corn too 3-way and double-cross hybrids are superior to single hybrids in yield stability (Sprague and Federer, 1951; Eberhart et al. 1964).

Reviewing the breeding work in USA and having in mind the results obtained in FAO trials in 1976, Dr. Bochkarev (1979) draws the conclusion that with respect to oil-yield even the best hybrids are still on the level of varieties.

The present study is aimed at comparing those changes in the productive potentials of some varieties and hybrids that depend on the size of the nutritive area/plant at different sowing densities.

## MATERIAL AND METHOD

The material used was: the Bulgarian variety Dunav and the Romanian hybrid HS-305 in 1978, and the Russian variety Peredovik and the Bulgarian single hybrid Start, in 1979.

The trial was carried out in the conditions of non-irrigation by the method of the Latin rectangle, in 4 replications at a harvest area of 25 m<sup>2</sup>. Each of the varieties and hybrids were tested in 4 variants:

Variant	I	II	III	IV
Sowing density	70/23	70/35	70/70	70/105
Number plant per ha	61236	40816	20408	13605
Area in m <sup>2</sup> per single plant	0.163	0.245	0.490	0.735

The second variant is accepted for a check. It has been applied as a check in all comparative varietal trials at our Institute.

The characters that have been recorded are as follows: seed and kernel yield, % kernel and oil content in it, 1000 seed weight, head diameter and number of full seeds in the head. The terms that have been used are: integral yield, i.e. yield/ha and individual yield - yield/plant.

In order to give a more complete characteristics of the varieties and hybrids studied, and to follow better the changes of the structural elements in the separate variants, a new character is being offered to the attention of the breeder. That is the compactness - density (CD) of the head. It can be formulated in 2 ways.

- a) through the seed weight in g/cm<sup>2</sup> of the head
- b) through the number of full seeds/cm<sup>2</sup> of the head

The total rainfalls in vegetation period were 262.8 mm in 1978 and 436.1 mm in 1979.

## RESULTS AND DISCUSSION

The increasing of the plants' number/ha is accompanied by an increase of the average yields. (Table 1). That relationship is manifested better in 1979 when the rainfalls during vegetation were 173.3 mm more than the previous year. That helped to weaken the competition between the plants in the dense sowing. An exception presents HS-305 yielding highest at a density of 20408 plants/ha. That hybrid

TABLE 1  
*Seed and kernel yield per hectar, percent of  
kernel and oil in it*

Variant number of plant ha	seed yield		percent of kernel	percent of oil inthe Kernel	kernel yield	
	kg/ha	%			kg/ha	%
<u>DUNAV - 1978</u>						
61236	4000 <sup>+</sup>	111.1	83.1	65.5	3326 <sup>+</sup>	112.5
40816	3600	100.0	82.1	66.2	2955	100.0
20408	3620	100.6	81.6	63.3	2953	100.0
13605	3423	95.2	80.4	59.1	2751	93.1
<u>HS - 305 - 1978</u>						
61236	3697	104.3	79.2	62.2	2928	104.8
40816	3544	100.0	78.9	61.9	2795	100.0
20408	4037 <sup>+</sup>	113.9	77.1	59.5	3112 <sup>+</sup>	111.3
13605	3212 <sup>+</sup>	90.6	75.2	59.3	2417 <sup>+</sup>	86.5
<u>START - 1979</u>						
61236	4610 <sup>+</sup>	120.2	77.5	65.9	3573 <sup>+</sup>	121.2
40816	3836	100.0	76.8	65.9	2949	100.0
20408	3535 <sup>+</sup>	92.2	76.4	64.3	2702 <sup>+</sup>	91.6
13605	3060 <sup>+</sup>	79.7	75.0	61.6	2300 <sup>+</sup>	78.0
<u>PEREDOVIK - 1979</u>						
61236	3875 <sup>+</sup>	122.5	82.2	68.6	3183 <sup>+</sup>	123.0
40816	3164	100.0	81.8	67.2	2587	100.0
20408	3245	102.6	79.6	65.3	2583	99.8
13605	2904 <sup>+</sup>	91.8	80.1	62.1	2325 <sup>+</sup>	89.9

+ - Differences are statistically significant at the .05 percent level

is distinguished for its mightly developed vegetative mass. Most probably that would be the factor that determines the more unfavourable effect of competition between the individual plants of the hybrid at higher sowing densities. The same effect is much weaker in hybrid Start and the two varieties, of high productive potential is only Start, yielding over 4000 kg/ha.

The average seed yield manifests lower variability in varieties than in hybrids. For example, in 1978 the limits of variability is 15.9% for the variety, against 23.3% for the hybrid. In 1979 the same value for Peredovik is 30.7% and reaches 40.5% - for Start. Stability of the varietal integral yield is respectively 46.5% and 31.9% for 2<sup>nd</sup> year higher than the hybrid one.

The kernel percent between the 1<sup>st</sup> and the IV<sup>th</sup> variants varies from 2.1 to 4.0%. The value of that character is only very slightly variable and depends on the size of the nutritive area and on the changes in the other characters. Oil content in the kernel is distinguished for its low modification variability too. In more favourable conditions the relative share of the protein and the non-nitric extracts increases. The same process is manifested much better in varieties.

The variation of the kernel percent in the variants leads to a still stronger variation both of the absolute and relative kernel yield and oil yield/ha.

Yield stability is dependent on the plasticity of the variety or the hybrid and on the wider variation limits of the individual productivity. Varieties Dunay and Peredovik are almost of the same yield in the 2<sup>nd</sup> and 3<sup>rd</sup> variants. (Table 2).

The double increase of the nutritive area/plant is respectively followed by a doubling of the individual yields. At a nutritive area of 0.735 m<sup>2</sup> the relative yield of variety Dunav reaches the maximum of 277.8% against 100% for the check variant. One can assume that the utilization of this nutritive area is beyond the plant's potentialities. The relation between individual yield of the end variants is about 1.0:3.5. An exception presents hybrid Start, that is of lower individual variability.

Data in table 2 show that the variation limits of the individual yield are about 10g wider in varieties than in hybrids in both the years.

When comparing the individual and the integral yields of varieties and hybrids, one can see that the higher homozygosis rate in sunflower is connected with a certain narrowing of the ecological plasticity.

TABLE 2

*Productivity per single plant*

Variant nutrient area m <sup>2</sup>	seed weight per plant		1000 seed	diameter of head	density of the head		number of seed perplant
	gr	%			seed weight/cm <sup>2</sup> gr	seed number cm <sup>2</sup>	
<u>DUNAV - 1978</u>							
0.163	70.0	77.8	67.6	20.0	0.223	3.299	1036
0.245	90.0	100.0	67.0	23.5	0.207	2.094	1343
0.490	177.5	197.2	85.8	31.4	0.229	2.673	2069
0.735	251.7	277.8	112.0	37.7	0.249	2.015	2247
<u>HS - 305 - 1978</u>							
0.163	64.7	73.0	64.4	19.8	0.210	3.263	1005
0.245	88.6	100.0	71.0	22.8	0.217	3.056	1247
0.490	197.8	223.2	87.8	33.5	0.224	2.557	2253
0.735	236.2	266.2	266.6	105.1	40.4	0.184	1.756
<u>START - 1979</u>							
10.163	85.2	89.5	49.2	18.7	0.274	5.566	1528
0.245	95.9	100.0	51.4	21.4	0.267	5.190	1866
0.490	173.2	180.6	72.6	28.3	0.275	3.795	2386
0.735	225.0	234.6	82.9	33.4	0.257	3.099	2714
<u>PEREDOVIK - 1979</u>							
0.163	63.2	79.9	60.4	18.0	0.248	4.113	1046
0.245	79.1	100.0	62.6	19.7	0.260	4.150	1246
0.490	159.0	201.0	87.3	26.8	0.282	3.230	1821
0.735	213.5	269.9	90.4	30.6	0.290	3.214	2362

Seed yield/plant presents a composition of 2 elements: number of seeds and 1000 seed weight. More dynamic of the 2 proves to be the seed number, where the variation for Dunav, HS-305 and Peredovik is from 216.9% to 225.8%. The relative increase in the seed number of Start is only 177.6%, but the absolute difference between the end variants is, like in varieties and hybrid HS-305, about 1200 seeds. In

the 2<sup>nd</sup> variant due to the greater number of seeds (500 seeds more or about 42%) the percent of increasing for Start is lower.

The second element, e.i. 1000 seed weight varies too, but here the limits are narrower —from 149.7 to 168.5%. Seeds of hybrid Start are smaller. The rate of increasing the seed number and 1000 seed weight is practically the same.

The CD of the head is closely related to yield and depends. both on the number of seeds and 1000 seed weight and on the head diameter. Peredovik and Start differ from each other by the individual, the integral yield and 1000 seed weight, but because of differences in the head diameter, the head CD is almost the same in both of them —0.260 g/cm<sup>2</sup> and 0.267 g/cm<sup>2</sup>. By increasing the nutritive area/plant up to 0.490 m<sup>2</sup> the CD increases too. Head CD at 0.735 m<sup>2</sup> of nutritive area/plant goes on increasing only in varieties while in hybrids a decrease is recorded. It is most probably that in hybrid the breaking of proportionality in the increase of inflorescence sizes and seed weight is bigger. Cohesive forces between the separate seeds decrease. The CD expressed by seed weight/cm<sup>2</sup> is considerably effected by the environmental conditions too, but present data do not allow a more precise evaluation of that interaction.

In 1978 the head diameter reached 37.7 cm for Dunav and 40.4 cm for HS-305. In 1979 the same values are of considerably lower maximum — 30.6 cm for Peredovik and 33.4 cm for Start, where the highest head CD comes to 5.566 seeds/cm<sup>2</sup>.

## CONCLUSIONS

1. The better plasticity and the stability of the integral yield is conditioned by the wider variation limits of productivity (seed yield/plant/ of varieties Dunav and Peredovik.

2. Kernel percent is a character of an exceptionally low non-inherent variability.

3. In the conditions of the trial the seed number has wider limits of variation than their 1000 seed weight.

4. The head CD, expressed by the weight and number of seeds/cm<sup>2</sup> is a varietal character, but is considerably dependent of the conditions too.

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