

## CONTRIBUTIONS TO SUNFLOWER CROP TECHNOLOGY UNDER IRRIGATION IN DOBRUDJA

P. TOMOROGA and H. SIMOTA  
(Romania)

The recent development of the great irrigation systems in Dobrudja called for multilateral investigations at the Research Station Valul lui Traian in order to establish the adequate cultural technology for the main irrigated crops. The research results were partially published by Simota and Coronea (1968), Renea (1971), Tomoroga and Simota (1972) with reference to different specific aspects of sunflower culture.

In this paper we present some results concerning the performance of various sunflower varieties and hybrids under Dobrudja conditions in connection with plant population.

### MATERIAL AND METHODS

The hybrids and varieties examined were developed at the Research Institute for Cereals and Industrial Crops — Fundulea.

The experiments were carried out between 1970 and 1973 at the Valul lui Traian Research Station for Irrigated Crops, in Constantza district, on a chestnut carbonated chernozem, under irrigation conditions.

The square lattice was used in variety and hybrid trials and the subdivided block design for the investigations concerning the interaction variety x population x fertilizer, the experiment being carried out in 4 to 6 replications.

Granulated ammonium nitrate with 33% N, granulated single superphosphate with 18%  $P_2O_5$  and potash salt with 40%  $K_2O$  were utilized as fertilizers.

Yield results were statistically interpreted and expressed in q/ha at 12% moisture content.

According to the weather conditions of each experimental year, the insufficient rainfall amount in this part of the country was supplemented by irrigation with rates of water ranging from 1700 to 2800 cm. per hectare, distributed in 3—4 waterings.

## RESULTS

The varietal factor is one of the most important in obtaining high sunflower yields. The basic variety grown in the Carasu irrigated system from the very beginning of its exploitation was the variety Record. The single hybrids Romsun HS-52 and Romsun HS-53 have been recently released being tried out during several years at the Valul lui Traian Research Station for Irrigated Crops. The results are recorded in table 1.

In comparison with the variety Record the experimented hybrids have a shorter growing period (by 7—10 days) and a more reduced height (with up to 20 cm). At the same time the head diameter is by 2.3—2.7 cm larger while the 1000 kernel weight is by 8.6 g more reduced in Romsun HS-53 and by 6.7 g in Romsun HS-52, and the test weight is by 1.1 more reduced in both hybrids. The investigated hybrids have a higher husk percentage, by 0.9% in Romsun HS-52 and by 1.5% in Romsun HS-53. Oil percentage in kernels is by 0.5 to 2.3% higher. Seed yields were higher than those obtained with the variety Record. On the basis of the experimental data obtained by the State Commission for Varietal Testing, the single hybrid Romsun HS-53 was licensed for the Carasu zone. Among the new sunflower hybrids, Romsun HS-59 and Romsun HS-61 are the most promising exceeding the check hybrid Romsun HS-53 by 11—15%.

The high yielding potential of sunflower hybrids can be achieved only by ensuring the adequate plant population, which depends both on the moisture reserves of the soil and its fertility. The morphological and physiological features of the cultivated varieties and hybrids should also be taken into consideration. The plant population causes phenotypical variations in the main yield components, which finally influence the size and quality of the obtained yield.

In the undertaken experiments we tried to establish the optimal sunflower plant population under irrigation. The results are given in table 2. With respect to seed yield a significant increase of 15% and 25% in populations of 50,000 and 60,000 plants per hectare respectively was recorded in comparison with the check population of 40,000 plants per hectare. When the population was raised to 70,000 plants per hectare the yield decreased but still exceeded the check by 19%. The highest average yield of the 4 experimental years was 40.2 q/ha with 60,000 pl/ha. Head diameter, measured at complete anthesis decreases as plant population increases. As compared to the check, the highest plant population determined a reduction of the head diameter by 10%.

Leaf area size, determined during the same period, varies similarly to head diameter. The highest estimates per plant were obtained at low populations. Leaf area goes down parallelly with the population increase, a 36% decrease being recorded with the treatment of 70,000 plants per hectare. But if the results are reported to the unit of area, the process is reversed and a parallelism is found between plant population and leaf area increase. As compared to the check, leaf area increases by 13% in a plant population of 70,000 plants per hectare.

Table 1

Yield results, observations and determinations made on sunflower hybrids and varieties examined under irrigation conditions (Valul lui Traian Research Station, 1971—1973)

Hybrid or variety	Length of the growing stages in days from emergence to		Plant height, cm	Head diameter cm	Test weight (kg/hi)	1000 seed weight (g)	Husk %	Oil percentage in		Seed yield		Oil yield	
	Anthesis	Maturity						Kernels	Achenes	g/ha	%	kg/ha	%
Record	74	137	191	21.1	38.4	75.8	21.7	61.9	49.1	35.8	100	1757	100
Ronsun HS-52	71	130	170	23.4	37.3	69.1	22.6	64.2	50.5	37.6	105	1900	107
Ronsun HS-53	71	128	178	23.8	37.2	84.4	23.2	62.4	48.5	37.7	105	1828	104

LSD 5% = 3.6 q/ha 1% = 4.8 q/ha 0.1% = 6.2 q/ha

Table 2

The influence of plant population on sunflower yield under irrigation conditions (Valul lui Traian Research Station, 1970—1973)

Plant population (thousand p/ha)	Leaf area at anthesis				Head diameter		Yield		Difference	Sig-nificance
	By plant		By hectare		cm	%	q/ha	%		
	sq.m	%	sq.m	%						
40	1.103	100	44.120	100	19.9	100	32.0	100	—	***
50	0.911	82	45.550	103	19.1	95	36.8	115	4.8	***
60	0.809	73	48.540	110	18.7	93	40.2	125	8.2	***
70	0.716	64	50.120	113	17.9	90	38.1	119	6.1	***

LSD 5% = 2.0 q/ha 1% = 2.6 q/ha 0.1% = 3.5 q/ha

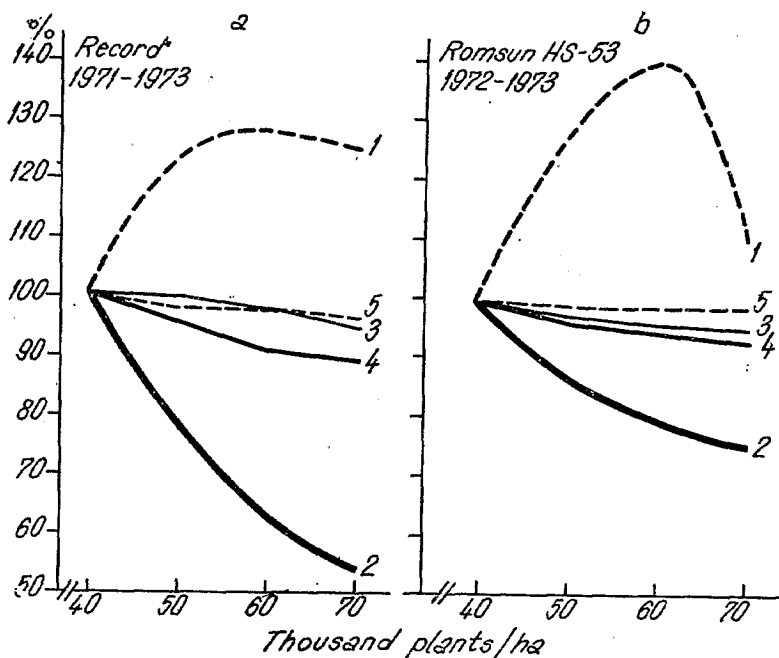


Fig. 1 — Plant population influence on yield (1), leaf area (2), head diameter (3), 1000 seed weight (4) and test weight (5) in sunflower variety Record and single hybrid Romsun HS-53 (in per cent as compared to 40.000 plants per hectare).

The results indicate as a maximum limit the population of 60,000 plants per hectare.

Investigations were made to establish the variation of the optimum plant population in accordance with the morpho-physiological characteristics of the cultivated hybrids and varieties. The results of these experiments are presented in table 3 and figure 1. The performance of the variety Record as well as of the single hybrids Romsun HS-52, Romsun HS-53, Romsun HS-301 and Rumson HS-90 was investigated and it was found that in all cases the highest yields were obtained with the population of 60,000 plants per hectare.

The variety Record shows small yield differences when the plant population varies between 50,000 and 70,000 plants per hectare. Romsun HS-52 is similar to Record variety in this respect while the other hybrids, especially Romsun HS-53 and Romsun HS-90 show great yield decreases when population exceeds 60,000 plants per hectare.

Differences were also observed in leaf area size. The highest leaf area reduction caused by population increase, was found in Record variety, while in hybrids this reduction was less severe, the lowest being recorded in Romsun HS-90 and Romsun HS-53.

Table 3

The influence of plant population on different sunflower varieties and hybrids under irrigation conditions  
(Valul lui Traian Research Station)

Variety or hybrid	Plant population (thousand pl/ha)	Leaf area at anthesis						Head diameter		Yield		Difference	Sig- nificance
		By plant		By hectare		cm	%	q/ha	%				
		sq.m	%	sq.m	%								
		sq.m	%	sq.m	%								
Record (1971—1973)	40	1.524	100	60,960	100	18.0	100	28.8	100	—	***		
	50	1.278	83	63,900	104	17.4	96	35.4	123	6.6	***		
	60	0.941	61	56,460	92	17.7	98	36.5	126	7.7	***		
	70	0.833	54	58,310	95	17.2	95	36.0	125	7.2	***		
Romsun HS-52 (1971—1973)	40	0.900	100	36,000	100	19.5	100	30.8	100	—	***		
	50	0.765	85	38,250	106	18.7	95	36.0	117	5.2	***		
	60	0.750	83	45,000	125	17.8	91	37.6	122	6.8	***		
	70	0.631	70	44,170	122	18.2	93	34.7	112	3.9	***		
Romsun HS-53 (1972—1973)	40	0.947	100	37,880	100	18.7	100	28.0	100	—	**		
	50	0.823	86	41,150	108	18.3	97	32.4	115	4.4	***		
	60	0.765	80	45,900	121	18.4	98	39.6	141	11.6	***		
	70	0.714	75	49,980	132	17.6	94	30.2	107	2.2	***		
Romsun HS-301 (1972—1973)	40	1.000	100	40,000	100	19.7	100	28.0	100	—	**		
	50	0.875	87	43,750	109	19.4	98	32.4	115	4.4	***		
	60	0.812	81	48,720	121	19.1	96	37.4	133	9.4	***		
	70	0.666	66	46,620	116	17.8	90	34.0	121	6.0	***		

The head size is less affected in Record and Romsun HS-53 but very pronounced in Romsun HS-301.

Except yield, another important factor contributing to the correct determination of the optimum density is 1000 seed weight. In sunflower, the population increase leads to a decrease in 1000 kernel weight; if this decrease exceeds a certain limit, a qualitative seed depreciation results.

The experimental results indicate that the Record variety registers a 1000 seed weight decrease of 7.0 g when the population rises from 50,000 to 60,000 plants per hectare therefore a 50,000 plant population is recommended for this variety. The same happens with Romsun HS-52 in which the decrease in 1000 seed weight is of 4.1 g.

In Romsun HS-301, the reduction of 1000 seed weight is smaller (2.2 g), which allows to recommend a density of 55,000 plants per hectare for this hybrid.

In Romsun HS-53 and Romsun HS-90 the reduction of 1000 seed weight is quite small in 50,000 and 60,000 plant populations. Correlated to the obtained yields, the best density for these hybrids is 60,000 plants per hectare.

Another aspect is related to the effect of chemical fertilizers, particularly of those with nitrogen, on plant density. The results of table 4 show that, within the same plant population an increase of the nitrogen rate from 70 to 140 kg/ha a.s. brings about 8 to 14% yield increase. At

Table 4

The influence of nitrogen rates on sunflower yield, in different plant populations under irrigation conditions (Valul lui Traian Research Station, 1971—1972)

Plant population (thousand pl/ha)	Fertilizer rates	Yield		Difference	Significance
		q/ha	%		
40	N <sub>70</sub> P <sub>70</sub> K <sub>80</sub>	28.9	100	—	
	N <sub>105</sub> P <sub>70</sub> K <sub>80</sub>	30.9	105	2.0	***
	N <sub>140</sub> P <sub>70</sub> K <sub>80</sub>	33.0	114	4.1	***
50	N <sub>70</sub> P <sub>70</sub> K <sub>80</sub>	33.9	100	—	
	N <sub>105</sub> P <sub>70</sub> K <sub>80</sub>	36.1	106	2.2	***
	N <sub>140</sub> P <sub>70</sub> K <sub>80</sub>	37.3	110	3.4	***
60	N <sub>70</sub> P <sub>70</sub> K <sub>80</sub>	36.1	100	—	
	N <sub>105</sub> P <sub>70</sub> K <sub>80</sub>	37.7	104	1.6	**
	N <sub>140</sub> P <sub>70</sub> K <sub>80</sub>	39.2	108	3.1	***

LSD 5% = 1.2 q/ha    1% = 1.6 q/ha    0.1% = 2.0 q/ha

the same time it is evident that applying the same fertilizer rate the yield gains obtained by increasing the plant population are similar. At higher plant populations the yield gains due to nitrogen fertilizer

application tend to decrease, being of only 8% in a population of 60,000 plants per hectare, as compared to 10% in a 50,000 and 14% in a 40,000 plant population.

### CONCLUSIONS

1. Among the present hybrids, Romsun HS-52 and especially Romsun HS-53 are the best, exceeding the variety Record both in seed and oil yield.

2. Among the prospective hybrids, Romsun HS-59 and Romsun HS-61, that exceed Romsun HS-53 by 11—15% with respect to seed yield, appear outstanding.

3. The optimum plant population depends on the morphological and physiological characters of sunflower varieties and hybrids.

4. The recommended plant populations per hectare are as follows: 50,000 for Record and Romsun HS-52, 55,000 for Romsun HS-301 and 60,000 for Romsun HS-53 and Romsun HS-90.

5. By applying increased nitrogen fertilizer rates, no differentiation of the optimum plant population, specific for different sunflower varieties and hybrids, is obtained.

### BIBLIOGRAPHY

1. Simota, H., Cornea, C., 1968. *Lucrări științifice ale Stațiunii Experimentale Dobrogea*, vol. II, 147—170.
2. Tomoroga, P., Simota, H., 1972, *Probleme Agricole*, 4, 14—24.