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ASPECTS AND PROBLEMS OF SUNFLOWER CULTURE IN SOUTHERN ITALY

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Sunflower is a crop of potential economic importance in numerous areas of Central and Southern Italy in consequence of the present price levels in the E.E.C. - It is foreseen (IRVAM, 1971) that about 200 000 hectars could be advantageously cropped in Italy with sunflower.

Therefore the Institutes of Plant Breeding and Agronomy of University of Bary (Italy) are carrying out research programmes with the purpose of studying the possible spreading of this crop in Southern Italy. In this report we refer on agronomic researches carried out as preliminary to the development of a breeding programme.

The agronomic studies carried out in 1970 and 1971 were performed for ascertaining the influence of watering time and volumes, of row spacing and spacings in the row, and of rates of N, P and K in sunflower.

Another set of research is concerning the evaluation and adaptation of several sunflower varieties and strains.

The most significant achievements are summarized in this paper ; among the numerous characters taken into consideration reference will be made only for grain yield, fat content and oil yield.

INFLUENCE OF WATERING TIME AND VOLUMES

The aim of this experiment was to search the most suitable watering time and volume. The non-irrigated control has been compared with three watering volumes (300, 600 and 900 m^3/ha) and four watering time in correspondence of P.E.T. values of 147.4 - 73.7 - 49.1 and 36.9 mm. These P.E.T. values have been calculated with TURC formula and have been used as criteria when to irrigate. The total number of treatments has been of 13. The experiment was carried out for 2 years at Policoro (Matera). The sunflower varieties used in 1970 and 1971 have been : Peredovik and Wniimk 8931, respectively. The results obtained are reported in Table 1 as two-year averages since no substantial differences were observed in each year.

The watering time correspondent to each PET value was greater in the second year, while the

number of irrigations varied very little only at PET values of 147.4 and 73.7 mm. Irrigation influenced positively both grain and oil yields, while the fat content of seeds do not change.

The grain yield of non-irrigated control has been of 25.7 q/ha ; increasing the number of irrigations from 1-2 (PET = 147.4 mm, with watering time of 34-40 days) to 5 (PET = 36.9 mm, with watering time of 8-10 days), the grain hield - as average of different watering volumes -increased from 5 % (27.1 q/ha) to 36 % (35.0 q/ha). As regards the influence of watering volumes, we observed that the grain yield increases increasing the watering volume grom 300 m^3/ha to 600 m^3/ha and decreases with 900 m^3/ha. This trend is not the same at each PET value for the presence of watering time-watering volumes interaction. In general we should irrigate when the PET is equal to 36.9 (watering time = 8-10 day ; number of irrigation during the crop vegetation = 5) with a watering volume of 600 m^3/ha ; i.e. frequent irrigations with normal watering volumes.

Since the irrigation doesn't influence the seed fat content (43,6 % in non-irrigated control and about 43 % with irrigation), the considerations made for the grain yield are also valid for the oil yield.

INFLUENCE OF ROW SPACINGS AND SPACINGS IN THE ROW

Two experiments have been carried out for this study. In the first experiment, the influence of three row spacings (60-70-80 cm) and three spacings between plants in the row (30-30-40 cm) combined factorially (3 x 3 = 9 treatments)was studied in tall and short sunflower varieties. The 9 treatments provided populations ranging from 3.1 to 8.3 plants per m^2. The trial has been repeated for 2 years (1970 and 1971) at Policoro (Matera) in irrigated condition. The tall varieties were Peredovik in 1970 and Wniimk 8931 in 1971 ; as short varieties we used the strains P-4/68 in 1970 and P-3/68 in 1971. Being the same the influence of treatments in the 2 years, in table 2 the 2-year mean values are indicated.

In the tall varieties the row spacings and the spacing between plants in the row do not influence the grain yield (39.6 q/ha), the fat content (43.4 %) and the oil yield (17.2 q/ha). However, there is an interaction between these two factors that influence the grain and oil yield : the highest yield has been achieved with densities of 3.6 - 4.2 plants/m^2 corresponding to rows 70 cm apart and plants 30 cm apart in the rows, and rows 60-80 cm apart and plants 40 cm apart in the rows.

In short varieties, the grain yield, the fat content and the oil yield decrease, as row spacings and spacings in the row increase. The best population densities are in the range of 7.1-8.3 plants/m^2, corresponding to rows 70-60 cm apart and plants 20 cm apart in the rows.

In the second experiment (tab. 3), we have studied the influence of two plant densities (4.2 and 8.4 plants/m^2, achieved with rows 60 cm apart and plants 40 and 20 cm apart in the rows) in tall varieties (Peredovik and Wniimk 8931) and short varieties (Jenisey and P-3/68 strain), in irrigated and non irrigated conditions. The non irrigated trials have been carried out at Santeramo (Bari), Brindisi and Policoro (Matera) ; the irrigated trials have been carried out at Brindisi, Policoro (Matera) and Gaudiano (Potenza).

In non-irrigated conditions, the plant density doesn't influence the three characters examined, while under irrigation the results of the former experiment are confirmed, i.e. for tall varieties the best plant density is 4.2 plants/m^2, and for short varieties is equal to 8.3 plants/m^2. Moreover, under irrigation the seed oil content decreases significantly in respect to non irrigated crop.

INFLUENCE OF RATES OF N, P AND K

Two trials have been carried out for this purpose. In the first (1970 at Foggia), three rates of N (0 - 60 - 120 kg/ha), three rates of P (0 - 60 - 120 kg/ha) and two rates of K (0 - 100 kg/ha) have been combined factorially for a total of 18 treatments ; in the second (1971 at Santeramo), the total treatment number has been 36, obtained from factorial combination of four rates of N (0 - 40 - 80 - 120 kg/ha), three rates of P (0 - 80 - 160 kg/ha) and three rates of K (0 - 75 - 150 kg/ha). The sunflower varieties used in this experiment were : Peredovik in 1970 and Wniimk 8931 in 1971.

The different rates of nitrogen, phosphorus and potassium fertilizers don't influence the grain yield, while increasing nitrogen fertilization decreases the seed fat content, and consequently the oil yield. This nitrogen effect has been more evident in 1970 trial (table 4).

Although the evident interest of the above mentioned data, we think that further experimentation is necessary to establish the optimum fertilizer combination for sunflower crop in Southern Italy.

EVALUATION AND ADAPTATION

This part of our program aims to investigate the evaluation and adaptation of sunflower in Southern Italy in irrigated and non irrigated conditions. This work has been carried out at seven farms located in key areas of possible sunflower spreading and 18 varieties have been examined. In table 5 are reported the mean values of grain yield, fat content and oil yield, and the number of trials in which the varieties were tested. Only 7 varieties have been tested in all 12 trials. The mean values of varieties tested in less than 6 trials have been corrected with Patterson method for the purpose of comparison with the other varieties.

In general, the grain and oil yields are greater in irrigated crop while the seed fat content decreases with irrigation. The increments of grain and oil yields ranged from 35-40 % (Saratovskj, Stepniak, etc) to 100-110 % (Wniimk élite, Armarviskj, Peredovik, etc) ; the seed fat content decreases, with irrigation, from 1 - 2 % (Wniimk 6540 and 8883, Jenisej, etc) to 6 - 9 % (Record, Saratovskj, etc.).

The grain yield mean values of non irrigated crop varied from 10.8 q/ha (P-7/68 strain) to 22.6 q/ha (Wniimk 8931) ; those of irrigated crop ranged from 13.1 q/ha (P-4/68 strain) to 38.8 q/ha (Wniimk 8931).

The seed fat content of non irrigated crop varied from 24.1 % (P-3/68 strain) to 43.9 % (Wniimk 6540) ; with irrigation the extreme values have been 25.8 % (P-4/68 strain) and 43.2 % (Wniimk 6540).

In table 6 are reported the number of varieties tested in each trial and the extreme values for each character in each trial. In non irrigated conditions the grain yield variability ranged from a high or over 22-24 q/ha in some locations in the two years to a low of less than 10 ; with irrigation the higher yield value has been over 40-45 q/ha and the lower less than 10-15 q/ha. As regards the seed fat content, the variability ranged from a high over 43-45 % to a low of less than 30 % in non irrigated and irrigated conditions.

Finally, the oil yield, ranged from a high over 10 q/ha in non irrigated condition and 15-20 q/ha with irrigation to a low of less than 5 q/ha in both irrigated and non irrigated conditions.

In 1970 studies have been carried out on stability of grain yield, fat content and oil yield of 11 varieties (Pacucci, 1971 ; Pacucci, Scarascia Mugnozza, Patruno, 1971) calculating the stability parameters via the method of Eberhart and Russel (1966). The more stable varieties were : Wniimk selections and Armarviskj.

In conclusion, the most interesting varieties for Southern Italy conditions, in non irrigated or irrigated conditions, are at present : Wniimk 8931, Record, Armarviskj and Smena élite.

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Table 4 - Effect of N fertilization on grain yield, fat content and oil yield of sunflower in 1970 and 1971

N - rate (kg/ha)	Grain yield (q/ha)	Fat content (%)	Oil yield (q/ha)
	VAR. PEREDOVIK (1970)		
0	18.7	38.9	7.3
60	17.4	36.0	6.3
120	18.2	32.7	5.9
	VAR. WNIIMK 8931 (1971)		
0	18.3	44.1	8.1
40	17.4	43.6	7.6
80	18.6	42.5	7.9
120	19.4	41.9	8.1

Table 5 - Mean values of grain yield, fat content and oil yield of sunflower varieties tested in Southern Italy in 1970 and 1971 (1)

Variety	Number of trials	Grain yield (q/ha)		Fat content (%)		Oil yield (q/ha)	
		non irrig.	irrig.	non irrig.	irrig.	non irrig.	irrig.
Wniimk 8931	6	22.6	38.8	42.5	40.8	9.5	16.5
Record	6	21.6	35.0	42.6	40.1	9.4	14.3
Wniimk 6540	3	21.3	31.0	43.9	43.2	9.1	13.4
Armarviskj	6	20.7	33.4	42.1	40.4	8.6	17.7
Saratovskj	3	19.8	27.5	41.5	38.9	8.3	11.6
Stepniak	2	20.1	32.1	39.4	35.8	8.3	11.5
Peredovik	6	19.3	30.6	42.5	40.9	8.2	17.7
Smena L.	2	19.3	32.4	40.2	30.7	8.1	13.7
Smena élite	6	19.1	31.7	42.6	41.1	8.1	13.3
Wniimk élite	3	17.3	35.8	43.5	41.9	7.5	15.0
Voronezskj	2	14.2	25.1	39.1	38.2	7.1	10.0
P - 3/68	6	18.4	28.0	24.1	29.9	6.2	8.6
Jenisej	6	16.6	25.8	36.3	35.9	6.1	9.9
Wniimk 8883	2	15.6	27.2	39.6	39.4	5.5	11.0
P - 4/68	3	11.2	13.1	27.6	25.8	3.6	3.3
P - 7/68	3	10.8	28.6	27.1	27.2	3.5	7.9
Zelenka 368	1	-	38.0	-	42.2	-	15.7
Yugorostonys	1	-	17.9	-	37.7	-	7.4

(1) The mean values of varieties tested in less than 6 trials have been corrected with Patterson method.

Table 6 - Number of varieties tested and extreme values of grain yield, fat content and oil yield observed in each trial in 1970 and 1971.

Character	1970		1971	
	Number of varieties	extreme values	Number of varieties	extreme values
	Non irrigated culture			
Grain yield (q/ha)	11	13.2 - 38.2	12	15.2 - 23.1
	11	5.1 - 17.7	8	18.1 - 24.5
	11	5.5 - 24.8	8	14.8 - 22.6
Fat content (%)	11	27.3 - 44.6	12	33.1 - 42.1
	11	28.9 - 45.3	8	37.8 - 47.9
	11	21.4 - 42.7	8	33.6 - 42.6
Oil yield (q/ha)	11	3.8 - 17.0	12	5.3 - 9.6
	11	1.5 - 6.6	8	8.5 - 11.5
	11	1.2 - 10.6	8	5.0 - 9.6
	Irrigated culture			
Grain yield (q/ha)	11	16.7 - 47.3	12	33.1 - 42.2
	11	11.9 - 52.6	8	28.4 - 38.1
	18	5.8 - 49.0	8	16.0 - 30.2
Fat content (%)	11	24.2 - 44.7	12	31.8 - 45.5
	11	25.7 - 48.3	8	32.8 - 43.5
	18	15.0 - 38.8	8	22.4 - 34.4
Oil yield (q/ha)	11	4.0 - 21.1	12	11.8 - 18.6
	11	3.1 - 24.5	8	10.9 - 16.4
	18	1.7 - 12.6	8	3.6 - 9.7