# "THE EFFECTS OF SEASONAL IRRIGATION WATER REGIMES IN SUNFLOWER CHARACTERS IN SOUTHERN ITALY".

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## INTRODUCTION

It is well known that sunflower seed yield, oil and protein content, as well as their quality, are complex characters strongly conditioned by genotype-environmental (soil, watr, fertilization etc.) (1), (4).

Consequently, for the sunflower breeder it is essential to understand the influence of the environment in formulating and advantageous breeding programme. The present investigation was carried out in Southern Italy sponsored and planned by "La Cassa del Mezzogiorno" to obtain information on the effects regarding water regimes on sunflower crops.

## MATERIALS AND METHODS

During the years 1976-1978 int the experimental field FORTORE (Apulia area, Italy), a trial of irrigation on c.v. Siponto sunflower was carried out. Six seasonal water regimes were compared. Their volumes were obtained by varying the irrigation turn in function of the ETE. They were calculated by "Class A" pan evaporimeter and not by specific sunflower crop coefficient. They were obtained by mean crop coefficients from other species on which the same investigation had been carried out in the same (field, (2), (3).

From the thime of sowing to when 50% of the ground was covered by vegetation, the crop coefficients were 0.66; from 50% to 100% they

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became 0.85 and from 100% to milk stage, they became 1.00 and 0.70 to the end of the irrigation season.

Except for the unirrigated control, water was distributed every 10, 20, 40, 80, 160 mm of ETE. The volumes of water used each time were varied during the irrigation season in function of the crop coefficients and they resulted equal to $m^3$/ha 400 x Kc.

The sowing was done on May 30, 1976, March 31, 1977 and March 16, 1978 using 5.5 plants/$m^2$.

A randomized block design replicated four times was used. At harvest each year the seed and oil yields were determined. The protein content was determined in the 1977 and 1978 trials.

The percentage of fatty acids was analyzed in the 1978 trial only. Oil content was determined from each of the four replications, it was extracted by a Soxhlet extraction apparatus. Protein content was determined by the Kjeldahl procedure on the defatted flour. Analyses for fatty acids were determined by Carlo Erba Fractovap 2450 gas-chromatographs equipped with flame ionization detectors. The columm was in steel 2 m Ø 6x5 with 10% of DEGS on Chromosorb W (60-80 mesh). Column and injector were held at 190° and 250°C respectively with a flow rate of 20 ml/min. of nitrogen gas.

In fig. 1 the thermopluviometric rate during the trial years is reported. In 1976 rainfall levels were higher than the average levels for the years 1963 to 1975; in 1977 there were heavy rainfalls (70 mm) only in June, while the other monthly levels were well below those of the 1963-1975 period.

In 1978 rainfall was abundant in the first 5 months thus being very helpful for the initial development of crops, but in the following months they were very scarce.

In the three trial years the average temperatures were inversely proportional to the rainfall; in 1976 and 1978 the average temperatures were usually lower than those of the previous 13 year period. While, in 1977 they were a bove the average temperatures had from 1963-1975, up to the month of July.

## RESULTS

In fig. 2 the achene production at 10% moisture are reported. It can be noted how in 1976 irrigation did not influence the yield; in fact, the unirrigated control produced 3.2 t/ha in equal measure as irrigation variants. In 1977 and 1978 instead, the achene production increased to a certain point with the increase of seasonal irrigation

and then became constant. The lower yield in 1977 compared to 1978 is due to the lower amount of water in the soil. This result could be justified by the different course of the two curves; in fact, in 1978 the higher yield (non significantly different from the others) is reached through the irrigation variant every 40 mm EA × Kc and with a seasonal volume of 4000 $m^3$/ha, while in 1976, the higher production, though inferior to the 1978 one, was reached with the irrigation variant every 20 mm of EA × Kc and with a seasonal volume equal to 7500 $m^3$/ha.

In fig. 3 the oil yield is reported: the course of the curves is similar to that of the achenes yield. In this case, however, it seems the irrigation is more important: in fact, if we observe fig. 4, we notice how higher percentages of oil correspond to higher volumes of irrigation water. The oil quality results regarding only 1978 are reported in fig. 5. In this case too, the best results are obtainable at seasonal volume 4000 $m^3$/ha; in fact, increasing the seasonal water volume, the unsaturated fatty acid content increases (particularly the linoleic acid one). Consequently, the saturated fatty acids decrease.

In fig. 6, the curves of the protein production (t/ha) reveal a similar behaviour to the one in achenes and oil. In regards to the protein percentage in the de-fatted flour, no significant difference resulted among treatments though values tend to decrease with the increase of seasonal volumes.

## CONCLUSIONS

On the basis of these results, with reference to the environment considered, the following observations can be made.

— The achene production (t/ha) can increase 2 or 3 times in comparison to the one obtainable on dry cultures by administering adapt seasonal irrigation volumes.

— Identical results can be obtained for the protein yield and in oil, and also, for the quality of the latter.

— The best yields, both in quality and quantity, are obtained with seasonal volumes at 4000-5000 $m^3$/ha as already observed for many other species in the same environment.

— Finally, in agreement with our opinion, in a breeding programme before establishing an ideotype for further research it is necessary to consider the productivity potential of the cultivars available in function of the water and of the other environmental factors.

## ABSTRACT

The results of three trials carried out on sunflower (Apulia area) are reported.

The effects of six irrigation regimes (unirrigated control and water application to the threshold of 10, 20, 40, 80, 160 mm of evapotranspiration calculated by "Class A" pan evaporimeter and crop coefficient) are compared on sunflower (c.v. Siponto).

Best results are obtained using a water regime of about 4.000 to 5.000 $m^3$/ha.

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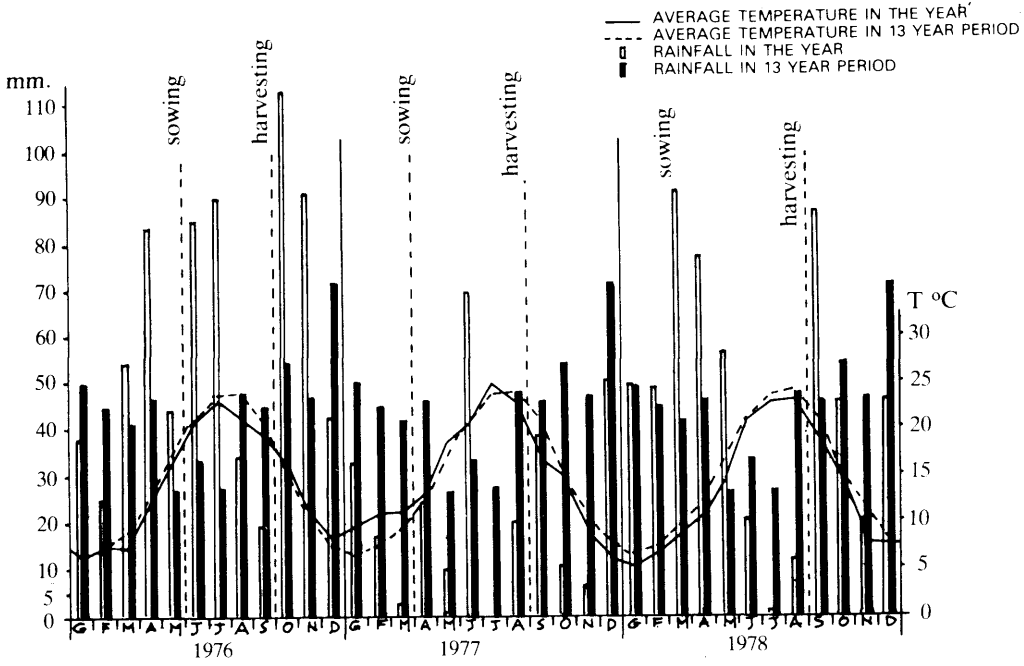
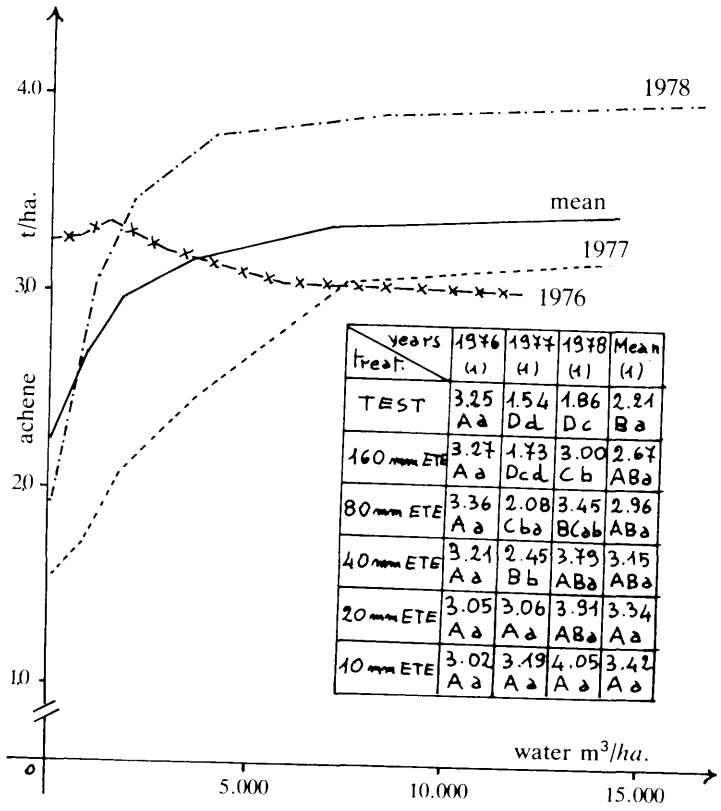
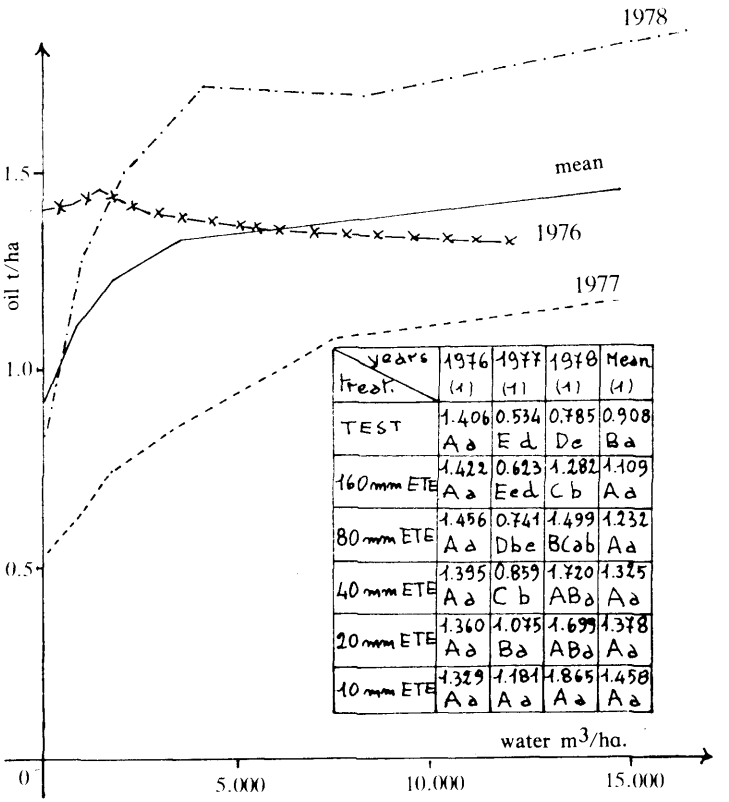



Fig. 1.—Thermopluviometric rate during the trial years




| years / treat. | 1976 (1) | 1977 (1) | 1978 (1) | Mean (1) |
|---|---|---|---|---|
| TEST | 3.25 Aa | 1.54 Dd | 1.86 Dc | 2.21 Ba |
| 160 mm ETE | 3.27 Aa | 1.73 Dcd | 3.00 Cb | 2.67 ABa |
| 80 mm ETE | 3.36 Aa | 2.08 Cba | 3.45 BCab | 2.96 ABa |
| 40 mm ETE | 3.21 Aa | 2.45 Bb | 3.79 ABa | 3.15 ABa |
| 20 mm ETE | 3.05 Aa | 3.06 Aa | 3.91 ABa | 3.34 Aa |
| 10 mm ETE | 3.02 Aa | 3.19 Aa | 4.05 Aa | 3.42 Aa |

Fig. 2. (1).— Volues in ony columm followed by the same letter are not significantly different: capital letter at the 5% level, small letter at 1% level (Duncan's MRT).




| years / treat. | 1976 (1) | 1977 (1) | 1978 (1) | Mean (1) |
|---|---|---|---|---|
| TEST | 1.406 Aa | 0.534 Ed | 0.785 De | 0.908 Ba |
| 160 mm ETE | 1.422 Aa | 0.623 Eed | 1.282 Cb | 1.109 Aa |
| 80 mm ETE | 1.456 Aa | 0.741 Dbe | 1.499 BCab | 1.232 Aa |
| 40 mm ETE | 1.395 Aa | 0.859 Cb | 1.720 ABa | 1.325 Aa |
| 20 mm ETE | 1.360 Aa | 1.075 Ba | 1.699 ABa | 1.378 Aa |
| 10 mm ETE | 1.329 Aa | 1.181 Aa | 1.865 Aa | 1.458 Aa |

Fig. 3.

| years / Treat. | 1976 (1) | 1977 (1) | 1978 (1) | Mean (1) |
|---|---|---|---|---|
| TEST | 43.4 Bb | 36.9 Ba | 42.1 Cc | 40.1 Ba |
| 160 mm ETE | 43.5 Bb | 36.0 ABa | 42.7 Cc | 40.7 Aa |
| 80 mm ETE | 43.4 Bb | 35.0 ABa | 43.5 BCbc | 40.8 Aa |
| 40 mm ETE | 43.4 Bb | 35.1 Bb | 45.5 Aab | 41.3 Aa |
| 20 mm ETE | 44.6 Aa | 35.3 ABa | 44.8 ABab | 41.5 Aa |
| 10 mm ETE | 44.1 Aa | 37.1 Aa | 46.1 Aa | 42.4 Aa |

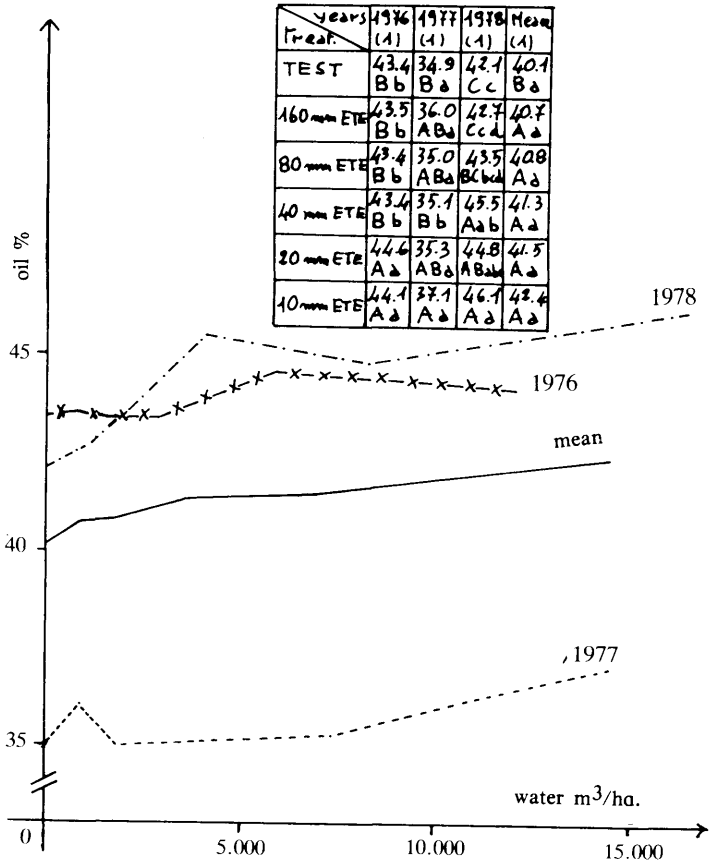



Fig. 4.

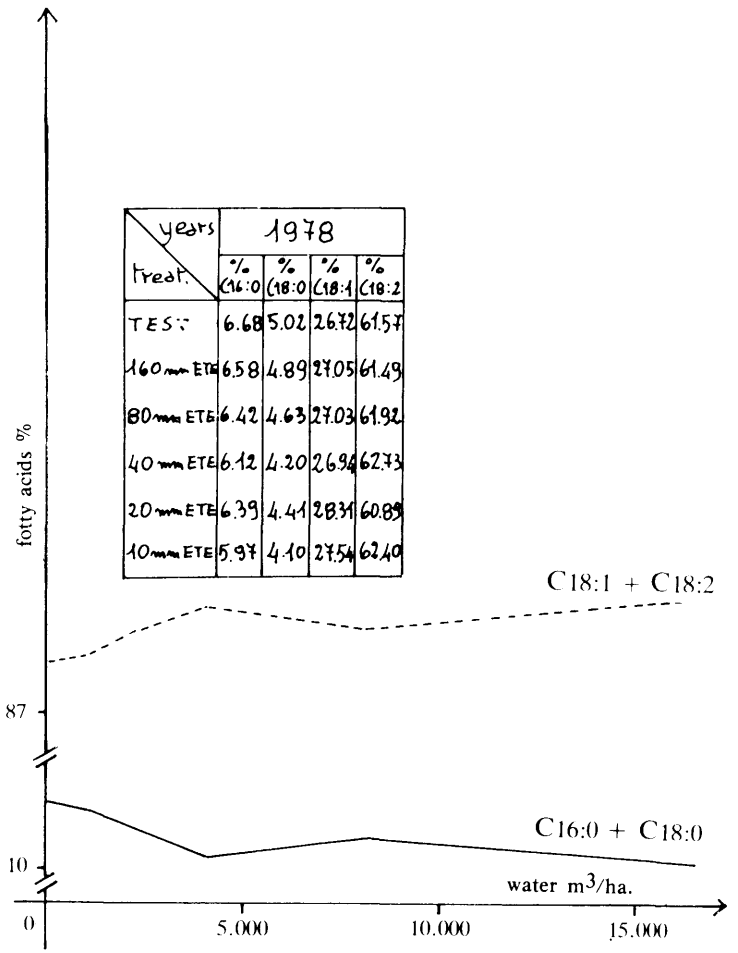
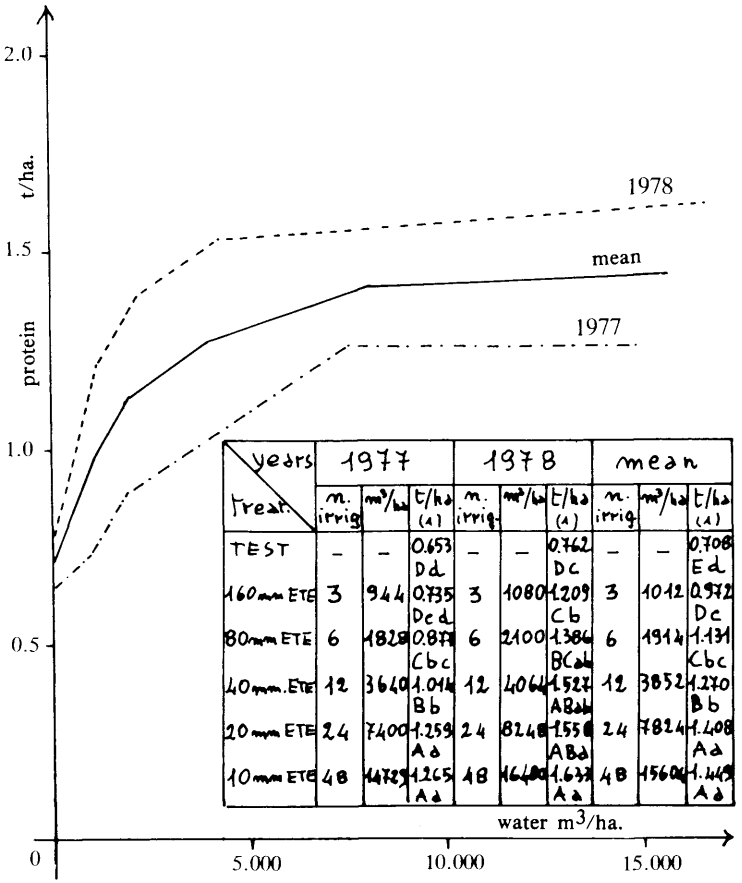

years
Treat.
1978
% C16:0
% C18:0
% C18:1
% C18:2
TEST 6.68 5.02 26.72 61.57
160 mm ETE 6.58 4.89 27.05 61.49
80 mm ETE 6.42 4.63 27.03 61.92
40 mm ETE 6.12 4.20 26.94 62.73
20 mm ETE 6.39 4.41 28.31 60.89
10 mm ETE 5.97 4.10 27.54 62.40
fotty acids %
C18:1 + C18:2
87
C16:0 + C18:0
10
water m3/ha.
0
5.000
10.000
15.000

Fig. 5.




| years / Treat. | 1977 n. irrig | 1977 m³/ha | 1977 t/ha (1) | 1978 n. irrig | 1978 m³/ha | 1978 t/ha (1) | mean n. irrig | mean m³/ha | mean t/ha (1) |
|---|---|---|---|---|---|---|---|---|---|
| TEST | – | – | 0.653 Dd | – | – | 0.762 Dc | – | – | 0.708 Ed |
| 160 mm ETE | 3 | 944 | 0.735 Dcd | 3 | 1080 | 1.209 Cb | 3 | 1012 | 0.972 Dc |
| 80 mm ETE | 6 | 1828 | 0.877 Cbc | 6 | 2100 | 1.386 BCab | 6 | 1914 | 1.131 Cbc |
| 40 mm ETE | 12 | 3640 | 1.014 Bb | 12 | 4064 | 1.527 ABab | 12 | 3852 | 1.270 Bb |
| 20 mm ETE | 24 | 7400 | 1.259 Aa | 24 | 8248 | 1.556 ABa | 24 | 7824 | 1.408 Aa |
| 10 mm ETE | 48 | 14725 | 1.265 Aa | 48 | 16400 | 1.633 Aa | 48 | 15604 | 1.449 Aa |

Fig. 6. (1).— Valves in any column followed by the same letter are not significantly different: capital letter at the 5% level, small letter at 1% level - (Dunean's MRT).