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EFFECTS OF CLIMATE ON THE RESPONSE OF SUNFLOWER (HELIANTHUS ANNUUS L.) IN RELATION TO SOWING TIME IN A SOUTHERN ENVIRONMENT OF ITALY.

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SUMMARY - The climatic elements and their influence about the quality and productive parameters of sunflower were analysed in a southern environment of Italy, (the Sele valley), in relation to the sowing time (from 4 th March to 12 th May) in a dry growth.

The analysis of the multiple regressions allows to obtain same informations about the effects of main climatic parameters (insolation, heat unit sums and water deficit) on the length of phenological stages, and biological cycle; on the biometrical data, on the seed and oil yield.

The water deficit and the heat unit sums during the interval "S - R5" (Sowing-flowering) induce different effects on the length of this period of the cycle and on the seed and oil yield.

In our environment early sowing are necessary, for the sunflower, in observance of thermic limit as well as suitable water supply in the period from the "flower bud" stage to "setting" above all where the first part of the cycle has water shortage.

Key words: sunflower, climate, sowing time.

INTRODUCTION

The adaptability and productiveness of the sunflower in a farming environment are tied, above all, to happen of thermic and hydric conditions indispensable for an adequate development of the plants in the different phenological phases (Benvenuti and others, 1978; Monotti, 1980).

It is very important the knowledge of the climatic environment parameters to better employ the growing cycle, so as to find a suitable sowing time which consents a better exploitation of the hydric resources.

MATERIALS AND METHODS

For this study data were drew from an our two-year trial (1981-1982) carried out in the Sele valley, on unirrigated sunflower grown under different sowing times, in the Ministry of Agriculture and Forestry "Oil Plant Project".

A free impollinated cultivar, with late tendency and high size ("Argentario"), was adopted with a density of 4 plants/s.m.

For the manuring, at the sowing time 100 kg/ha of P_2O_5 and 50 kg/ha of K_2O were used; Nitrogen was distributed partially at sowing time (60 kg/ha of N_2) and partly in covering (40 kg/ha of N_2), on medium mixture soil, well rich in nitrogen and potassium and slightly rich in phosphorus and organic substance, with pH 7.5, Field Capacity of 24% and Permanent wilting point of 11.4%, in the dry soil weight.

The sowing times, taken into consideration, have occupied quite an ample length of time from March to the middle of May (4/3, 20/3, 7/4, 19/4, 21/4, 4/5, 12/5 and 19/5).

The dates of the principal phenological phases (here indicated according to the terminology of Schneiter and Miller, 1981), the length of the vegetative phase (from the sowing time "S" to the beginning of the flowering "R5" and of the reproductive phase (from "R5" to the physiological maturation "R9"), as well the length of the complete cycle, were recorded.

The cumulative insolation, the heat unit sums, the medium daily insolation, the medium temperatures for the following 10 days after the different sowings, during the flowering and the week preceding the physiological maturation, the values of the water deficit (ETP-P), were calculated (tables 1,2).

In order to define the heat unit sums the formula [(T+t)/2] - 8°C, were the value 8 is the biologic minimum for the sunflower (Giardini, 1974), was adopted.

The ETP values were determined along the basis of the evaporimetric method, using the daily data from evaporimetric bac class "A" Pan, corrected with the coefficient 0.8 (kp).

The climatic parameters were used like independent variables (xi) in the analysis of multiple regressions in which, like dependent variables (y), were taken into consideration biometric parameters (the plants height and the head diameter) and productive (the yield in seeds and oil), and also the length of the cycle and of the "S-R5" and "R5-R9" intervals (table 3).

CLIMATIC TREND

From the exam of figure 1, in which the climatic trend of two years is shown, it appears that the two years were differents, in particular in the rain.

The natural water availability (the rains) in the "S-R5" interval resulted, always higher when we showed earlier. With the first sowing time, the water deficit was of 191 mm in 1981 and of 209 mm in 1982, passing respectively to 295 mm and to 368 mm with the last sowing.

Referring to thermic values and insolation (table 2) we can point out that starting with the first dates of sowing (March), the medium temperatures recorded during the then days following the sowing were very close to the medium value (8-10°C) indicated optimal for the sunflower (Bonciarelli, 1972).

With the following sowing times (April and May), the temperatures appear higher, going from 14°C of the April to 18°C of the mid May.

The medium temperatures recorded during the flowering ranged between 21.1°C of the first date of sowing to the maximum of 25°C, recorded in some sowings of May: so the values are always superior to those optimal (18-20°C). The thermic values recorded in the week preceding the full physiological maturation resulted superior compared to those indicated by Vranceanu in 1974 (18-22°C) and in syntony with those indicated for a Central Italy environment (Pirani, 1981).

The values of cumulative insolation changed in relation to sowing time. More precisely, during the 10 days following the sowing, there was a rising with the delay of the sowing time (values comprised between 5 and 11.3 hours); during the flowering the values had a tendency of being higher, comprised between 8.4 and 10.1 hours a day, and still with a tendency of being lower for the earlier sowings.

In the phase preceding the physiological maturation, the daily length of insolation varied between 7.2 and 11 hours and appeared to decrease with the late sowing. In the cycle, a medium of 1159 hours of insolation were recorded, of which a large part was concentrated in the "S-R5" interval.

The heat unit sums for the whole cycle, on the average, resulted in 1600°C, corresponding to the optimal minimum limit (1600 to 2880°C) indicated by Vranceanu (1974).

For the pluriennal climatic data consult table 4.

RESULTS OF THE MULTIPLE REGRESSIONS

Bringing forward the data of sowing since the beginning of March, provided that the minimum thermic is respected, it is possible to employ the vegetative phase of the sunflower in a period that is characterized by values lower of the thermic unity and of the medium daily insolation, but with natural water supply higher than those encountered when we sowed later.

All that determines a more regular initial development of the plants, even if it is slower, with a longer "S-R5" interval (99 days, for the first sowing of March, 77 days for the sowing of April and 70 days in May) (equation y1 in table 3).

The sunflower being a photoindifferent plant (Pinthus, 1959), the shortening of period "S-R5" is bound, more to the thermic gradient than to the photoperiod (Robinson, 1971; Unger, 1980; Lanza and others, 1988).

The length of the interval since the reachment of the flowering until the physiologic maturation results, more or less, equal for the different sowing times, while the heat unit sums, which are relatively higher in the case of the first sowing, decrease for the later sowing.

By the bringing forward of the sowing time in March, even if it is registered a longer duration of "S-R5" interval, the stage "R5", anyway, is reached in advance (in the end of June, for the first sowing and from the middle to the end of July for the followings). This consents the plants to escape the higher values of temperatures and evapotranspiration.

The early sowing permits the sunflower plants to use, thanks to their deep roots, the water reserve supply, accumulated in the soil, due to the abundant winter rains in the environment in question, therefore to better resist the summer dryness.

The delay of the sowing time, to which correspond the elevated values of the heat unit sums in the period "S-R5" and lower in the period "R5-R9", allows a reduction of the growing cycle, as it results according to standardized coefficients of the equation y2 (table 3); in particular, bringing forward the sowing time to 4/3-20/3, the cycle took place in 150 days with the heat unit sums around 692°C in the period "S-R5" and 950°C in the period "R5-R9"; instead for the sowing time of 12-19/5, the duration is lowered to 122 days, with the heat unit sums of 891°C in the period "S-R5" and 769°C in the "R5-R9" interval.

The insolation has no effect in determining the duration of the biological cycle.

Bringing forward the date of sowing it is possible to obtain higher plants with bigger head diameter, at least in the absolute value. The height of the plants is first influenced, in order of importance, by sowing time, the

Tab. 3 - Dependent (y) and independent (xi) variables: significative equations and standardized coefficients of multiple regressions of the considered variables.

Dependent variables (y)		Significative equations and standardized coefficients of multiple regression
Days Sowing-Flowering (d)	Y1 =	+ 146 - 0.04 x6 - 2.4 x13 - 4.5 x15 b' x6 = - 0.08 ; b' x13 = - 0.49 ; b' x15 = - 0.39
Biological cycle (d)	Y2 =	+ 58.0 - 0.4 x6 + 0.04 x3 + 0.10 x4 b' x6 = - 0.68 ; b' x3 = + 0.34 ; b' x4 = + 0.70
Height of plants (cm)	Y3 =	+ 205 - 0.4 x6 - 0.02 x3 + 0.10 x5 b' x6 = - 0.45 ; b' x3 = - 0.12 ; b' x5 = + 0.46
Seed yield (t/ha)	Y4 =	+ 3.6 - 0.0006 x11 + 0.006 x5 b' x11 = - 0.06 ; b' x5 = - 0.93
Oil yield (t/ha)	Y4 =	+ 0.10 + 0.008 x2 + 0.00006 x3 - 0.0001 x4 + 0.002 x 5 + 0.58

x2 = lenght of cycle; x3 = heat unit sums "S-R5"; x 4 = heat unit sums "R5-R9"; x5 = water deficit (ETP-p) "S-R5" ; x6 = sowing time; x 11 = total insolation "S-R5" ; x13 = daily heat unit "S-R5" ; x14 = average daily insolation "S-R5".

Tab. 4 - Decadic climatic data of Sele valley. Average values of twenty years (1971-1990) for rain and temperatures; 12 years (1979-1980) for humidity, wind and insolation.

Month	Dec.	Rains mm	Temperatures Max °C	min °C	Thermic excursion °C	Water deficif mm	Heat unit sums °C	Humidity Mean %	Humidity Min	Wind m/s	Insolation n *	n/N
	I	26. 1	15. 0	6. 2	8. 8	+52. 0	22					
Mar	II	33. 2	15. 4	6. 3	9. 1	+13. 3	26	77	53	8. 0	4. 7	0. 40
	III	33. 7	18. 6	7. 6	11. 0	+ 8. 8	36					
	I	22. 4	18. 0	8. 5	9. 5	- 5. 4	53					
Apr	II	32. 3	17. 6	8. 2	9. 4	- 4. 4	52	69	50	1. 5	6. 0	0. 45
	III	20. 0	18. 9	8. 8	10. 1	-11. 6	58					
	I	19. 4	21. 2	10. 7	10. 5	-15. 7	78					
May	II	13. 7	23. 0	12. 4	10. 6	-24. 5	95	69	46	1. 5	7. 6	0. 53
	III	7. 6	24. 2	13. 3	10. 9	-42. 5	178					
	I	12. 8	25. 0	14. 0	11. 0	-32. 4	117					
Jun	II	3. 7	26. 0	15. 1	10. 9	-45. 7	126	69	53	1. 4	9. 4	0. 55
	III	3. 6	27. 3	16. 4	11. 0	-47. 9	139					
	I	1. 4	28. 5	17. 3	11. 2	-54. 9	153					
Jul	II	3. 3	28. 6	18. 3	10. 3	-52. 6	160	67	44	1. 5	10. 3	0. 69
	III	2. 5	29. 7	18. 5	11. 2	-61. 6	192					
	I	5. 4	30. 2	18. 9	11. 3	-52. 1	171					
Ago	II	8. 4	29. 4	18. 3	11. 1	-43. 4	166	62	45	1. 5	9. 9	0. 73
	III	17. 2	27. 9	17. 5	10. 4	-34. 8	168					
	I	14. 0	27. 4	16. 5	10. 9	-30. 1	142					
Sep	II	21. 5	26. 9	16. 1	10. 8	-15. 7	182	69	47	1. 5	8. 1	0. 65

* n = mean daily real duration of sunshine hourse for the Latitudes.
N = mean daily duration of maximum possible sunshine hourse for the Latitudes.

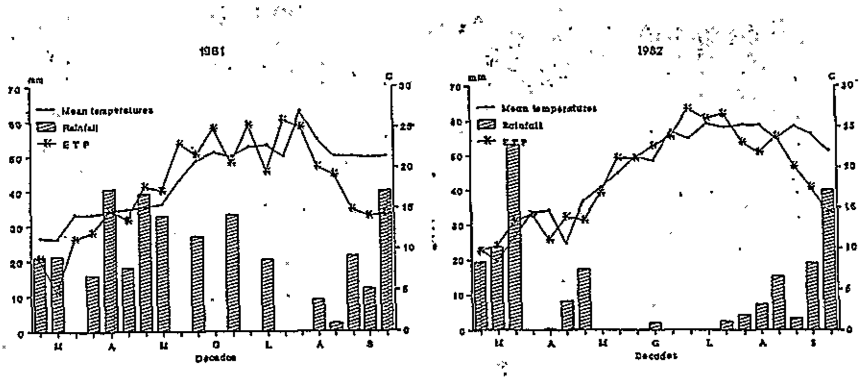

Fig. 1 - Trend of decadic climatic parameters. Sele valley, Battipaglia (1981-82)

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