SUNFLOWER (HELIANTHUS ANNUUS L.) RESPONSE TO INCREASING IRRIGATION LEVELS IN SOUTHERN ITALY.

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INTRODUCTION

Sunflower as an oil crop is gaining importance in Italy; at present interested acreage is about 25-30.000 ha. It is grown mainly as a rainfed crop in Central Italy; in the drier Southern Regions it has not shown the diffusion that should be related to the request of edible fats. The reasons are the uncertain yields of rainfed crops and the lacking of knowledge on crop response to irrigation.

As a rule, sunflower has water requirements between 500 and 1000 mm, depending on growth period and climatic conditions. Data reported on ET max under irrigation are 706 mm in Chile (Tosso and Tondreau, 1976), 530-730 mm in France (Rollier, 1975), 438 mm in Bulgaria (Vitkov et al. 1974). Lisymetric values obtained in Southern Italy by Tedeschi and Zerbi (1975) are 584 mm as ET max, While values of 337 mm were associated with water stress that reached —1.5 MPa (—15 bar) in the period of maximum moisture need. Yields in this last case were significantly reduced, but remained at a consistent level. A number of Authors agrees on this subject: notwithstanding the relatively high weter needs of the crop, sunflower has the ability to resist short periods of water déficit without severe yield decrease (Muriel and Downes 1975, 1977; Nicolas et al. 1977). This behaviour can be explained with the uptaking of soil-water from deep soil layers due to a deep root system.

Results are here reported and discussed on a three yearly trial carried out with the aim to obtain data on the crop response to

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irrigation increasing levels in two Southern Italy areas having different soil and climatic characteristics.

MATERIALS AND METHODS

Tests have been carried out in Campania and Apulia Regions, respectively in the Vitulazio experimental farms of the Irrigation Institute and in the Rutigliano Farm of the Agronomic Institute. Soils were both clay-loams with good water retention capacity. Soils in the Apulia field has a limited deepness (about 40 cm) and lays on a cracked bedrock. Typical relations between soil moisture and soil water potential are represented in Fig. 1. Water table level in the Vitulazio fields decreases from 1.5 m to 4.0 m during the May-August period, While is very deep throughout the year in the Rutigliano farm. Data on climatic conditions of both areas in the three years are reported in fig. 2. In respect of the average climates 1976 has been a wetter year, 1977 and 1978 have been near the average.

In both fields the same irrigation schedule was followed: six irrigation treatments were set, irrigating with 50 mm of water whenever evaporation from an "A" class Pan reached respectively 30-60-90-120-150-180 mm. A control without irrigation, after the possible initial watering, was also included. Different requirements associated with growth stages have been considered: the abovesaid evaporation values have been corrected by the following coefficients.
initial stage - 8th leaf = 0.4;
vegetative stage - bud emergence = 0.7;
flowering - yield formation = 1.0;
ripening = 0.5

As an example, the watering intervention limit 90 was 225 mm during the first stage and respectively 129,90 and 180 during the following stages. A calendar of irrigations and of sowing and harvesting dates is reported in fig. 2. Two varieties have been tested: early Cernianka and medium-early Airelle.

RESULTS

A number of effects and interactions has been evidenced by analysis of the variance. Data are here illustrated as response curves to increasing dephts of irrigation water, independently from rains. Varie-

ties have not shown significant differences in respect to yield, so mean values are reported.

Plant density at harvesting was influenced by treatments only in 1978 at Rutigliano when about 40% of plants died by drought in the not-irrigated plots (fig. 3).

Curvilinear regressions of seed yields on irrigation depht show decreasing increments with increasing moisture regimen in the Rutigliano test; Vitulazio corresponding curves were flatter and in comparison yields were higher at lower regimens and lower when crop was frequently irrigated (fig. 4). In 1976 at Vitulazio the summer was so rainy that it has not been possible to differentiate all the treatments and yields were uniform and low.

Weight of 1000 seeds was correlated with irrigation level in the Apulia test (fig. 5); no differences were found in the other area.

Seed yield was analyzed for oil content in 1977 and 1978. In both years there was no significant response of oil percentage in Campania; in 1977 a curvilinear behaviour of fat content was found in the Apulia field with low values corresponding to drier plots (fig. 6).

Oil yield follows the pattern of seed production: flatter curves in Vitulazio with intermediate yields (about 1.2 tons per hectare when irrigation was about 300 mm); steeper curves in Rutigliano with higher yields corresponding to higher irrigation levels (fig. 7).

Head diameter at maturity has been investigated in the Apulia field: average diameter increases with logaritmic law when water availability is higher (fig. 8).

DISCUSSION AND CONCLUSIONS

The environment has notably conditioned the crop yield. In the less demanding area of Vitulazio, characterized by a relatively high water table, yield reaction to growing irrigation levels was not so marked as in Apulia. In this last area irrigation has proved necessary to obtain high yield and oil percentage. This agrees with the conclusions of many Authors: Karami (1977); Muriel et al. (1975, 1977); Kaliappa et al. (1974); Vasiliu (1968); Pacucci, Scarascia-Mugnozza (1972); Andriani and Gatto (1977); Osman and Talha (1975); Tarantino and Alba (1978).

Data on soil-water depletion (here not reported) measured throughout the growing season in the wetter Vitulazio area show that maximum uptake is in the 0-60 cm layer. Uptake from deeper layers was impossible to measure due to the presence of the water table

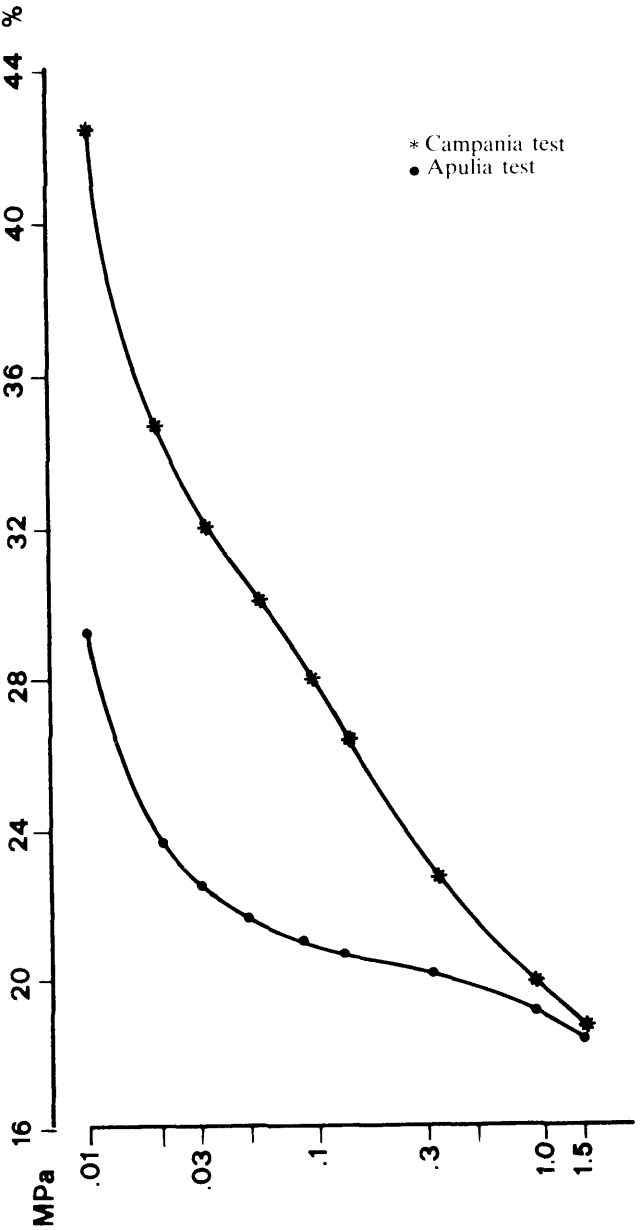

Fig. 1. Soil water potential curves

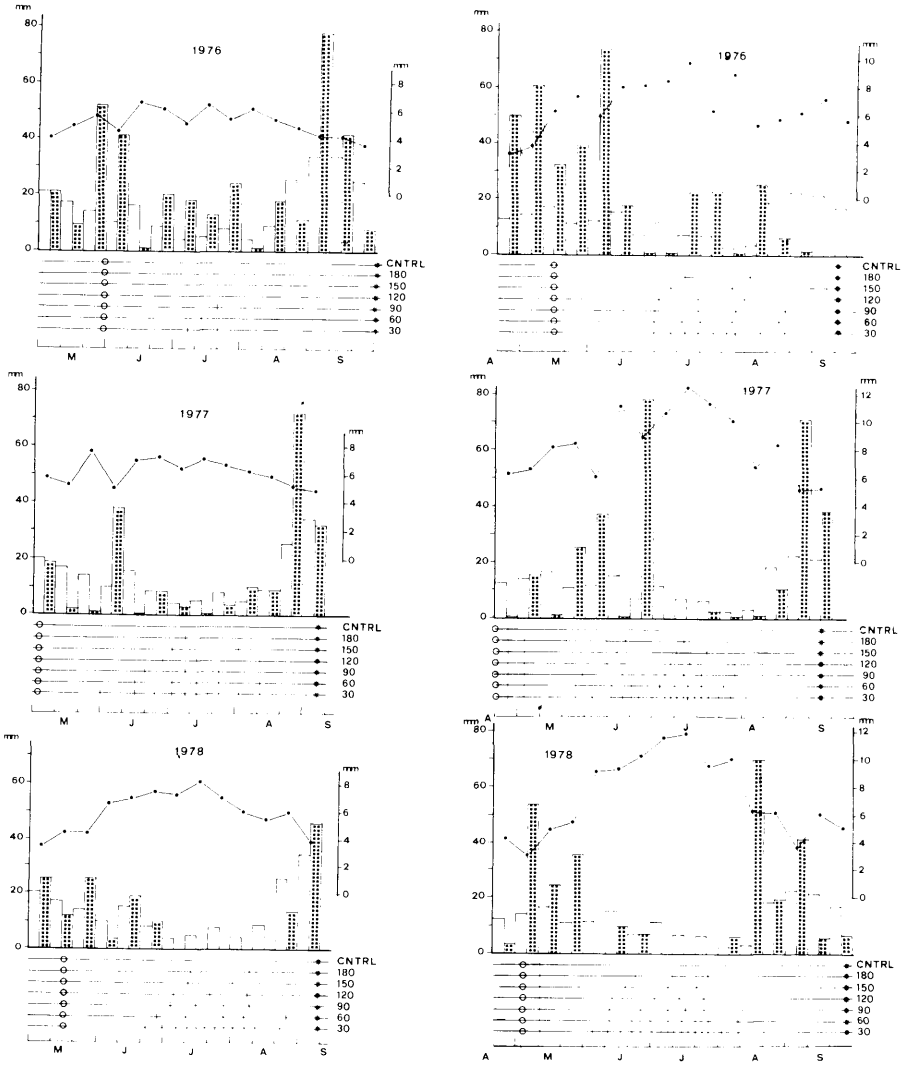

Fig. 2. Climatic conditions of test years: left, Campania test; right, Apulia test. Rain scale on the left evaporation from «A Class» pan scale on the right. Also represented are sowing dates (0), harvesting dates (*) and watering dates for different treatments (——).
(·——·) evaporation from «A» class pan.
Rain values
Average values of years 1958-78.

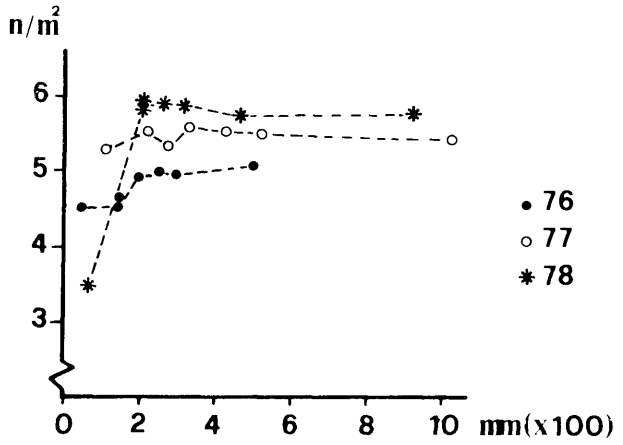

Fig. 3. Plant density at harvesting in the Apulia test as influenced by total irrigation depth.

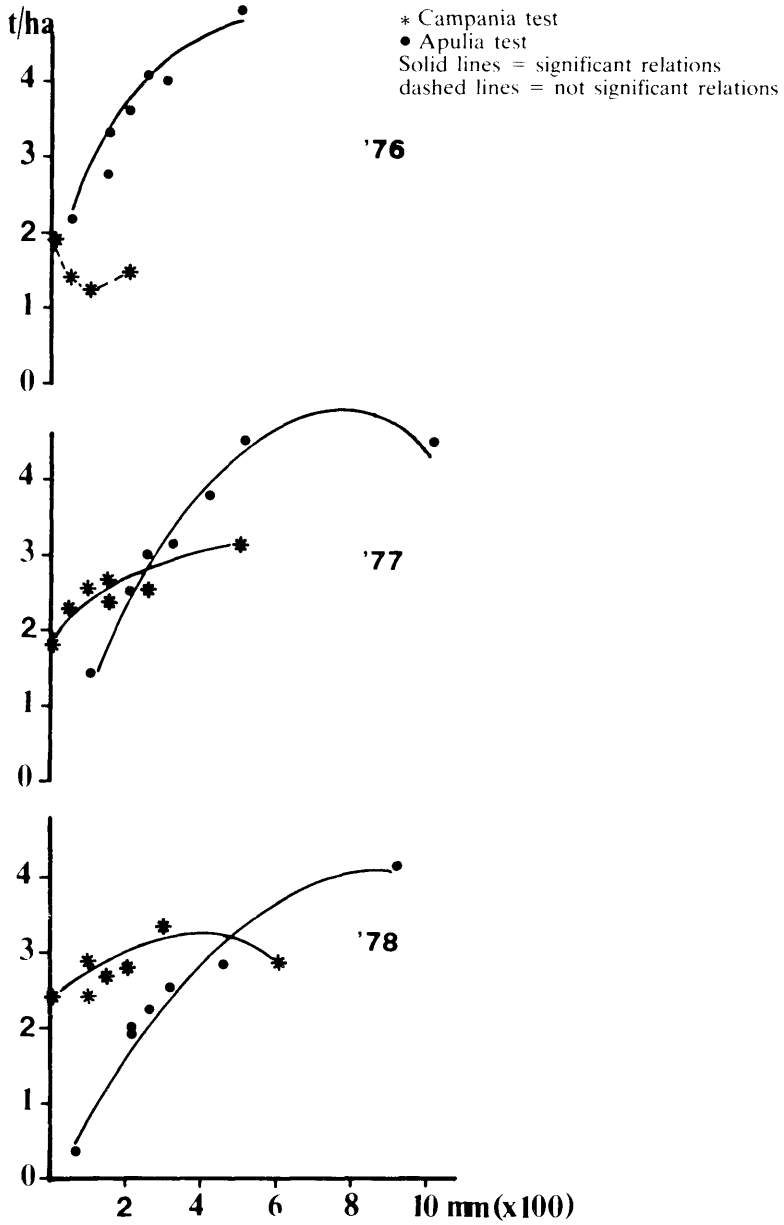

Fig. 4. Yield of seeds as influenced by total irrigation depth.

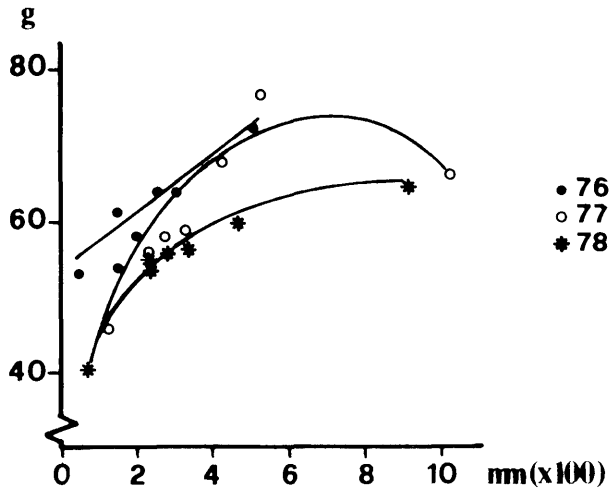

Fig. 5. Weight of 1.000 seeds a influenced by total irrigation depth in the Apulia test.

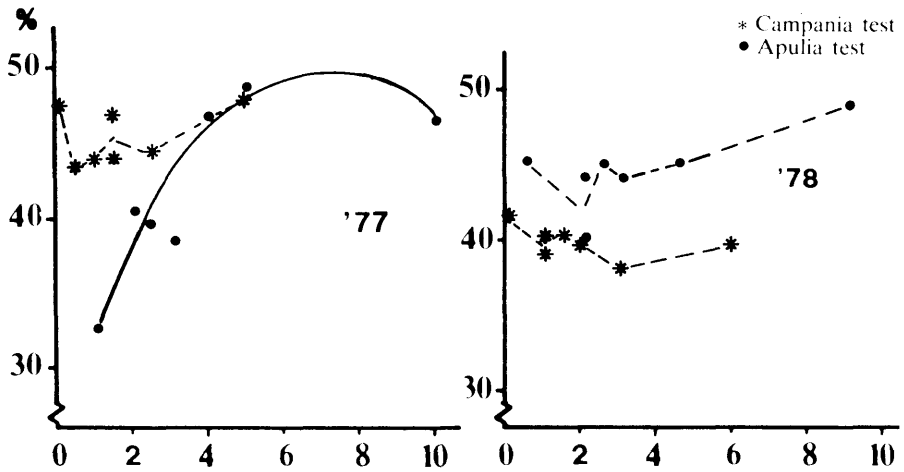

Fig. 6. Oil percentage as influenced by total irrigation depth.

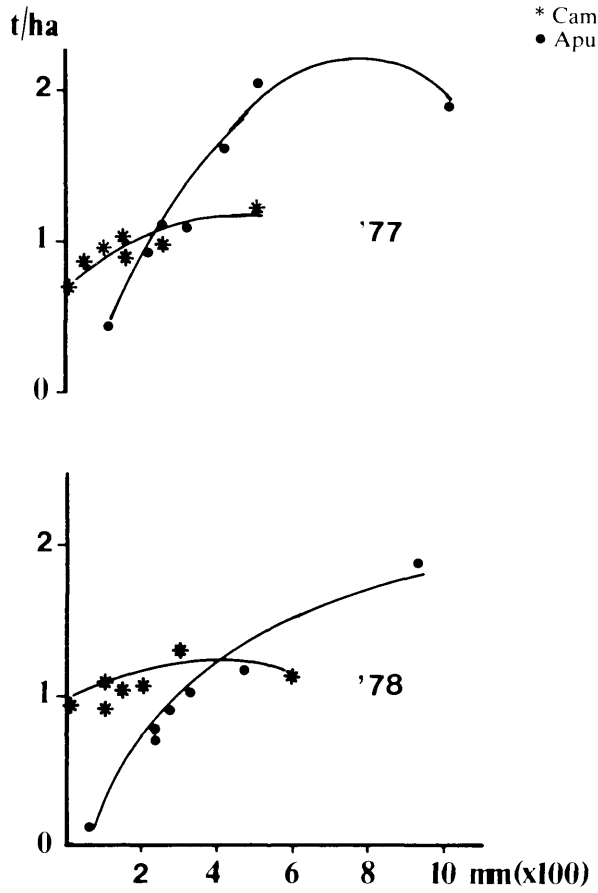

Fig. 7. Oil yield as influenced by total irrigation depth.

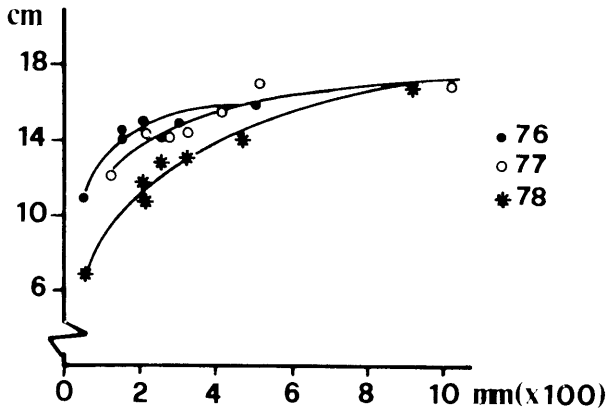

Fig. 8. Head diameter as influenced by total irrigation depth in the Apulia test.