WATER REQUIREMENTS FOR DRYLAND SUNFLOWERS

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INTRODUCTION

Sunflower production in Australia has increased rapidly in the last ten years; in Victoria alone sunflowers have emerged from being an unknown crop to one covering 10,000 hectares in 1975/76. Whilst most of the total grain production comes from irrigated sunflowers, half of the area sown is grown under dryland conditions. Dryland sunflowers are sown after short fallows which store winter rainfall; the crops are planted in spring (October/November) and then have to survive a hot dry summer (Mediterranean climate) to mature in autumn (April). Dry winters may store insufficient soil water to assure good yields. The present experiment was performed to determine the effects of a range of stored water levels at sowing on grain yield and oil content. Such data, together wih an individual seasonal knowledge of stored water levels, should allow yield predictions in regions of predominantly winter rainfall.

EXPERIMENTAL METHODS

The experiment was sown on 15th November, 1976, and the 10th November, 1977, on a calcareous grey clay (Stace *et al.*, 1968) at the Wheat Research Institute, Horsham, Victoria, Australia. A range of stored soil moisture levels were achieved by covering plots (four *dry* plots) during winter, allowing normal winter rainfall to partially wet the soil (*medium* water status, four plots) or irrigating to field capacity (four *wet* plots).

The experiment consisted of 12 five metre square plots which were

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arranged in three blocks of four plots corresponding to each of the main water treatments. The open-pollinated variety, Sunfola 68-2 (sown at 50,000 plants/ha), was used in both years.

Sampling for soil water was performed at sowing and maturity. Four 120 cm cores (4.2 cm diameter) were taken from the central area of each plot and the total water usage for each period was calculated using the differences in soil moisture plus rainfall. The experiments were harvested on 4th April, 1977, and 10 th April, 1978. Grain yields and oil contents were determined from at least 15 randomly selected heads in the central area of each plot. Each head had to be covered by a paper bag after flowering to prevent bird damage; this protection was not completely effective and resulted in one missing plot.

RESULTS

Growing Season Conditions

Growing season rainfall was highest in 1976/1977 (243 mm); 1977/78 was a much drier season (162 mm) compared to the long-term average rainfall for the October to April period of 213 mm. Mid-summer temperatures were considerably lower in the 1977/78 experiment; the mean monthly maximum temperature was 18.3°C in February 1978, compared to 21.4°C in February 1977, with a long-term average 18.9°C.

Grain Yield

In both years, crop water supply had a major effect on grain yields (Figure 1). The influence of water supply was least in 1977/78, probably as a result of the cooler late summer conditions. The equations for the relationship between grain yield and Total Water Use (mm) were:

1. 1976/77 Grain Yield (t/ha) = 0.0039 TWU - 0.3410 (r = 0.87)
2. 1977*78 Grain Yield (t/ha) = 0.0044 TWU - 0.4050 (r = 0.86)

Oil Content

The range of water levels caused no effect on oil contents in 1976/77. In 1977/78 there was a suggestion that increasing water availabi-

lity also increased oil content. At the two extremes of total water usage in 1977/78 (155 and 352 mm) the oil levels in the seed were 42.0 and 54.2 per cent, respectively.

Water Use Efficiency (Table 1)

Water use efficiencies for both years are shown in Table 1.

TABLE 1

Water use efficiences

(kg grain/ha/cm water used; mean data for main water status groups)

Water Level	*1976/77*	*1977/78*
Dry	11.2	22.8
Medium	25.8	22.6
Wet	31.5	26.4

Soil water status had little effect on the efficiency of water use for grain yield in 1977/78, but lack of water in 1976/77 decreased water use efficiency.

RESULTS AND DISCUSSION

Sunflower grain yields in these experiments were strongly related to water supply, especially soil water at sowing. These findings agree closely with data from Texas (Jones, 1978). In the Wimmera region of Victoria, sunflower production, using currently available varieties, will depend upon:

(a) heavy winter rains to bring stored water reserves close to field capacity. This should provide 150 to 200 mm of crop available water, but is only likely one year in every four or five.

(b) a reasonably wet coll spring/summer, assuming a wet winter has supplied adequate stored water at sowing, to provide the remaining 150 mm of rain required for a 0.8 to 1 t/ha sunflower crop.

Long-term rainfall data suggest that average yields will be in the range of 0.3 to 0.5 t/ha. Unless water use efficiency can be improved with variety changes or improved cultivation practices, sunflowers will remain as an opportunity crop in wet years.

REFERENCES

(1) JONES, O. R., 1978. Management practices for dryland sunflower in the U. S. Southern Great Plains. Proc. 8th International Sunflower Conference, Minneapolis, 1978, p. 89.

(2) STACE, H. C. T., HUBBLE, G. D., BREWER, R., NORTHCOTE, K. H., SLEEMAN, J. R., MULCAHY, M. J. and HALLSWORTH, E. G., 1968. A Handbook of Australian Soils. Glenside: Rellim Technical Publications, p. 93.

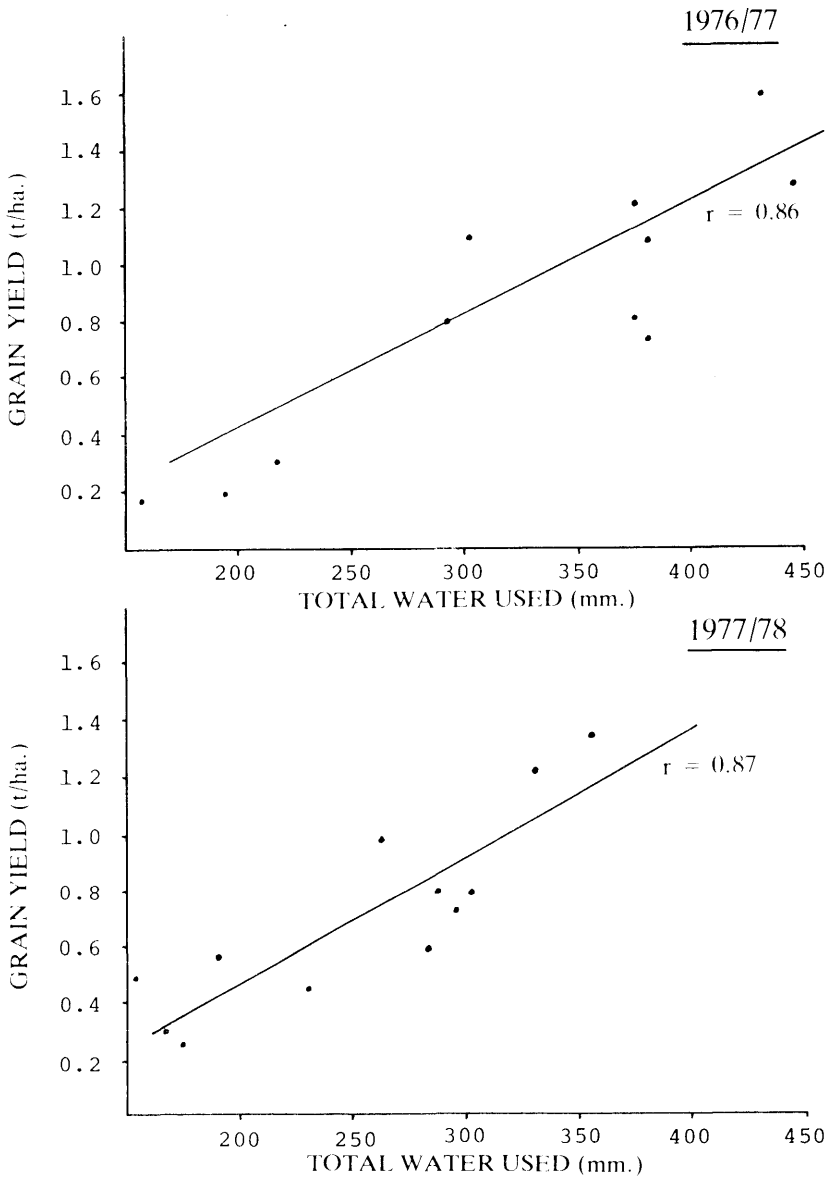

Figure 1.— Grain yield and water use relationships.