GROWTH ANALYSIS OF IRRIGATED SUNFLOWER AT TWO PLANT POPULATIONS.

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ABSTRACT

Dry matter and leaf area of vegetative and reproductive organs of sunflower plants were measured through the life cycle. Parameters of growth analysis (NAR, LAR, RGR and LAI) were compared.

Irrigated plants were sown at two densities, 5.6 pl m^{-2} (LD) and 16.6 pl m^{-2} (HD) at the South of Buenos Aires Province (lat. 39°23' S; long. 62°37' W). A total of 7000 m^3 ha^{-1} of water was applied as rain plus irrigation.

At harvest, the yield of LD plants was 5600 kg ha^{-1} with 52.0% oil content and a HI of 39.0% while the yield for HD plants was 5200 kg ha^{-1} with 54.7% oil content and a HI of 37.8%.

Growth analysis measurements showed that the RGR of HD plants was similar to that of LD plants and it declined until the start of grain filling. The variations in this parameter were due to fluctuations in solar radiation. The maximum LAI value was similar in both densities; it was reached before anthesis in the HD plants and three weeks later in LD plants.

INTRODUCTION

The method of growth analysis has been widely used as a tool for the quantification and description of the behaviour of plants under different environment and management conditions (Watson, 1952; Warren Wilson, 1966).

This paper reports the results obtained in the growth study of two sunflower populations growing under controlled irrigation.

MATERIALS AND METHODS

Sunflower plants cv. Dekalb G-97 were grown at two densities 5.6 and 16.6 pl m^{-2}, sown on 23/11/1979 and harvested on 13/3/1980.

The leaf area of 20 plants for each density was measured. Approximately twice a week 10 plants were harvested and separated into their vegetative and reproductive organs, dried and weighed.

The growth analysis was made using the following methods outlined by Donald and Hamblin, (1976) and Horie, (1977). Definitions of the parameters are as follows:

Relative Growth Rate (RGR) = Net Assimilation Rate (NAR) x Leaf Area Rate (LAR)

Leaf Area Rate (LAR) = Leaf Weight Ratio (LWR) x Specific Leaf Area (SLA)

Leaf Area Index (LAI) = Leaf Area x Ground $Area^{-1}$

Harvest Index (HI) = Economic Yield x Biological $Yield^{-1}$

Daily temperature and solar radiation were recorded.

RESULTS

It can be seen in Figure 1 that RGR values constantly declined through the experimental period, even though there was a maximum in the initial phase of the growth.

The evolution of NAR (Figure 2) had the same pattern as RGR although it showed large fluctuations principally in the middle of the growth period when the maximum LAI values were reached (Figure 3).

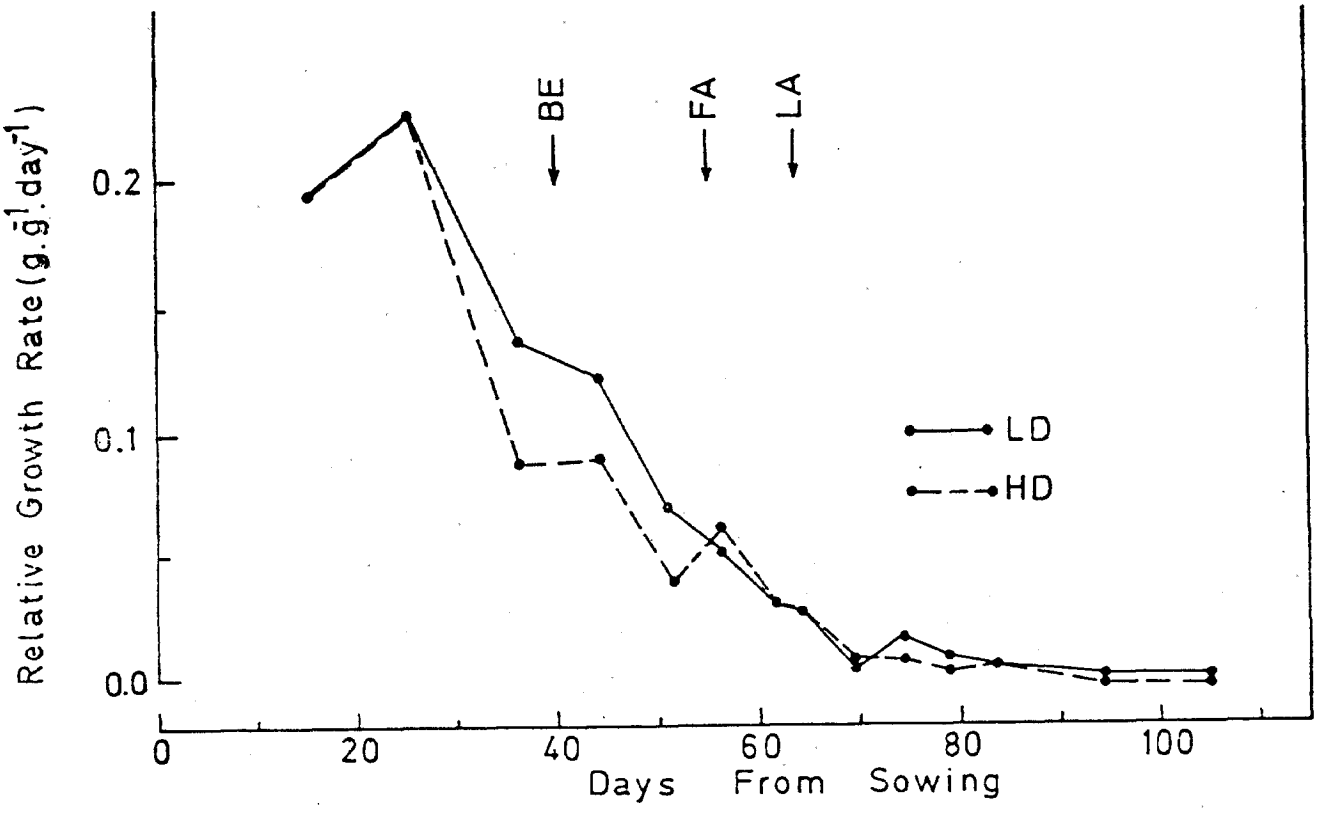

Figure 1. Changes in RGR values. LD: 5.6 pl m^{-2}; HD: 16.6 pl m^{-2}; BE: Bud Emergence; FA: First Anthesis; LA: Last Anthesis. (The same notation in all the figures).

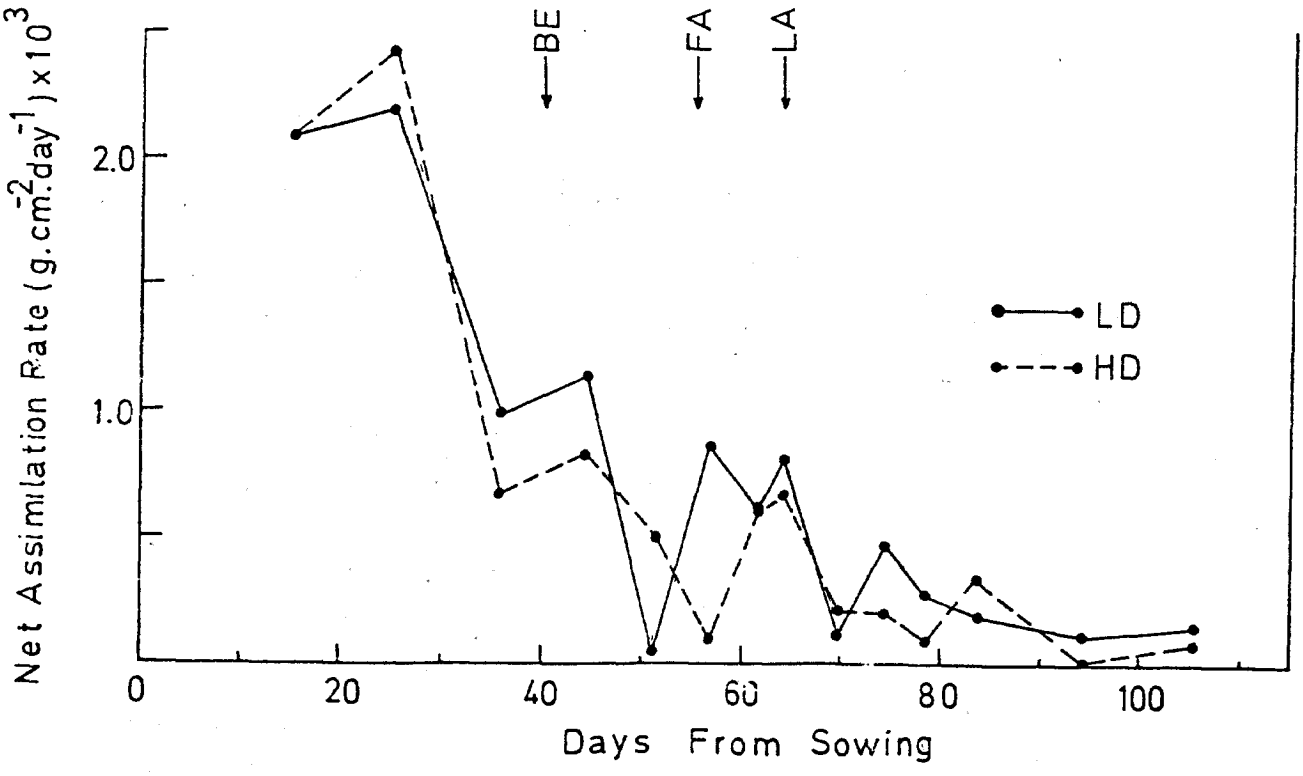

Figure 2. Changes in NAR values during the growth period.

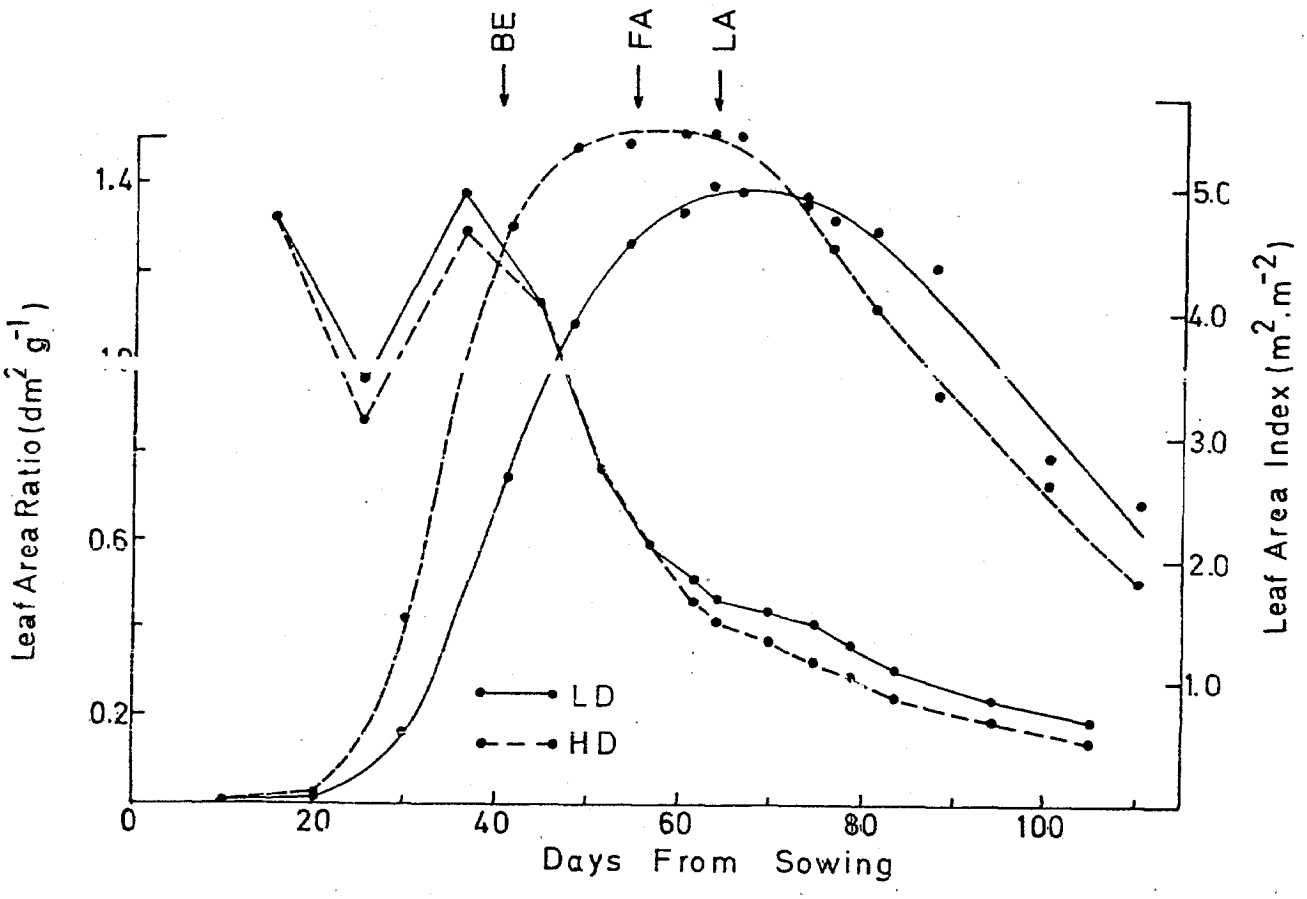

Figure 3. Changes in LAR and LAI values during the growth period. The LAI curves were hand fitted.

LAI values were independent of plant density but maximum LAI was reached approximately three weeks earlier in HD plants than in LD plants. The Leaf Area Duration was also greater in HD plants than in LD plants.

LAR (Figure 3) showed an abrupt decrease in the initial phase followed by a recovery. This decline was similar to values of SLA which are described in Table 1.

Daily temperatures and solar radiation data are shown in Figures 4 and 5. Results of HI and yield can be seed in Table 2.

Table 1. Specific Leaf Area (SLA) values during the growth period for the two plant densities.

	Days from sowing									
	10	20	30	41	48	60	66	76	89	110
SLA HD	1.80	1.48	2.74	3.02	2.68	2.37	2.33	2.21	2.01	1.93
SLA LD	1.80	1.67	2.65	2.44	2.26	2.40	2.40	2.31	2.50	2.40

HD: 16.6 pl m^{-2}; LD: 5.6 pl m^{-2}

Table 2. Yield values for the two plant densities.

	Whole Plant Weight (gr)	Seed Yield per plant (gr)	Crop Yield Seed (kg/ha^{-1})	Total Oil %	Harvest Index %
HD	92.89	35.15	5200	54.7	37.84
LD	253.48	99.08	5600	52.0	39.08

HD: 16.6 pl m^{-2}; LD: 5.6 pl m^{-2}

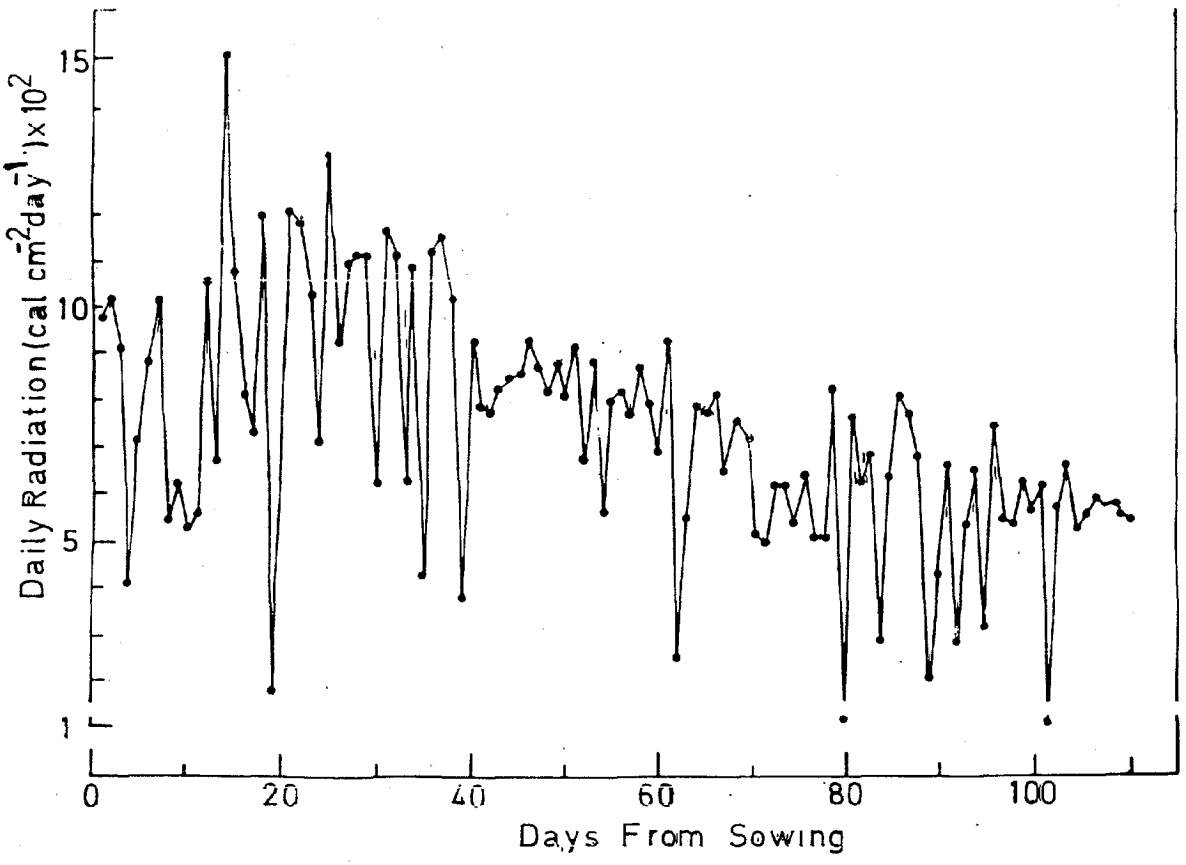

Figure 4. Daily solar radiation registered during the growth period.

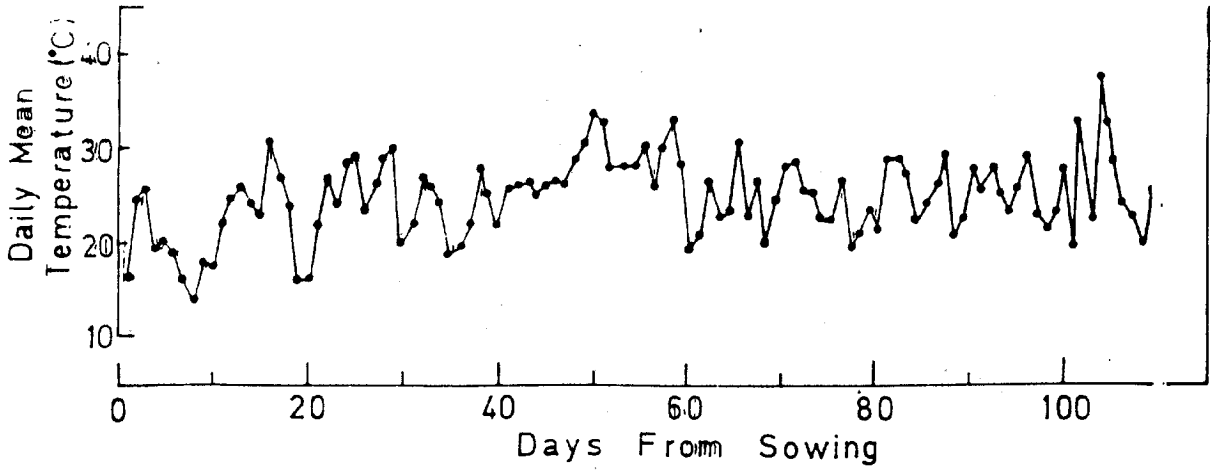

Figure 5. Daily mean temperature registered during the growth period.

DISCUSSION

Variations in RGR during the growth period are the result of the interaction NAR x LAR. That is the reason why they show the same pattern of decline through the growth period (Figures 1, 2 and 3).

However, as the NAR values are more variable, it can be said that RGR depends more on LAR than on NAR. The variations of NAR were due to the sensitivity of this parameter to changes in solar radiation (Horie, 1977). Temperature and soil water content were always near the optimal values, whereas solar radiation showed large fluctuations (Figures 4 and 5).

The results show a decline of the LAR values due to variations in SLA during the growth period (Table 1) since LWR values are fairly constant. This probably was a result of assymetrical distribution of the assimilates between leaves and other organs.

The HI of the two populations did not differ substantially even though the grain yield per plant was significantly lower for HD plants than for LD plants (Table 2).

It is concluded that under irrigation and high solar radiation the growth indexes studied at both densities were not different. However, as the HD plots have great ability to cover the soil earlier than the LD plots (showed by the evolution of LAI), yields per unit area were similar indicating that in the HD treatment low yields per plant were compensated by high plant populations.

ACKNOWLEDGEMENTS

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LITERATURE CITED

DONALD, C.M. and HAMBLIN, J. 1976. The biological yield and harvest index of cereals as agronomic and plant breeding criteria. *Advances in Agronomy,* 28:301 — 359.

HORIE, T. 1977. Simulation of sunflower growth. I. Formulation and parametrization of dry matter production, leaf photosynthesis, respiration and partitioning of photosynthates. *Bulletin of the National Institute of Agricultural Sciences.* Series A. No. 24 pp 45 — 69 (Japan).

WARREN WILSON, J. 1966. High net assimilation rates of sunflower plants in an arid climate. *Annals of Botany,* N.S. vol 30, No. 120:745 — 751.

WARREN WILSON, J. 1966. Effect of temperature on net assimilation rate. *Annals of Botany,* N.S. vol 30, No. 120:753 — 761.

WATSON, D.J. 1952. The physiological basis of variation in yield. *Advances in Agronomy,* 4:101 — 144.

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ESTIMATION OF LEAF AREA ON SUNFLOWER PLANTS.

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ABSTRACT

Correlation between leaf area, maximum width and length of individual leaves has been studied in sunflower plants. The results obtained by multiplying width times length gave a good estimation of leaf area but the width alone was considered the best with a r^2 of 0.97.

No significant differences exist between both estimates (L x W or W alone) and it is concluded that a field scale can be built for leaf area determinations using only the width value. This method diminishes the work by eight times.

INTRODUCTION

Foliar area is a valuable indicator of plant growth, because it is intimately related to dry matter accumulation, transpiration, yield and, especially, the photosynthetic capacity of the plant.

In many trials, it would be important to have some data on foliar area; however, there is no information on this value due to the amount of time needed for its determination, or to the fact that it is necessary to destroy the plant material when certain methods are applied.

Actually, there are rapid methods for obtaining the foliar