It is supposed that the P-32 additions in localized holes in the soil profile do not substantially modify the natural root system of the sunflower. In the first sampling of plants, 43 days after emergence the P-32 absorption at 30 and 60 cm was significantly higher than at other placements (Table 4). Seven days later there was a moderate rainfall of 18.5 mm, and in the second sampling 57 days after emergence the plants from plots with P-32 localized at 10 cm had a radioactivity as high as at 30 and 60 cm. It is believed that the reasons for this were that in the first sampling the absorption of P-32 at 10 cm depth was limited because the soil was harrowed four times (once before and three times after the treatment) and also because it became dry very soon. This data supports the idea that the sunflower at this stage has a very dynamic active root system, able to respond to variation in the water status of the soil. In the upland rice, Reyniers *et al.*, (1978) pointed out that there was a strong correlation between the P-32 uptake and the hydric potential in the soil. In the following samples (71, 85 and 100 days after emergence) the roots started to absorb P-32 from 90 cm in similar amounts to those taken up in the first 60 cm. In general, the more superficial placement (10 cm) was always more efficient and the deepest placement the least efficient.

Table 4. Uptake of P-32 by sunflower at different ages and depths.

Plant material	Depth cm.	Days after emergence 43	57	71	85	100
	10		1461	1419	1104	1660
	30		2520	1190	899	994
Heads	60		1562	484	828	1672
	90		1326	276	465	733
	120		1101	871	351	603
	10	444	1068	880	873	1239
	30	1593	730	639	808	921
Leaves	60	1270	1053	596	728	984
	90	81	126	308	487	745
	120	53	97	280	470	682
	10		862	679	782	1294
	30		510	439	610	878
Stems	60		453	397	764	800
	90		131	264	473	631
	120		87	221	492	544

Any two means not underscored by the same line are significantly different.

It is concluded that to improve the efficiency of the fertilizers in the sunflowers, when broadcasting, these must be ploughed or disked deep into the soil, if not localized near the seed. This is especially critical for the rather immobile nutrients such as phosphorus. For the most mobile nutrients earlier application could be advantageous.

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EFFECT OF DAYLENGTH ON THE TIME OF INFLORESCENCE INITIATION AND RATE OF POST-INITIATION DEVELOPMENT IN TWO EARLY SUNFLOWER CULTIVARS.

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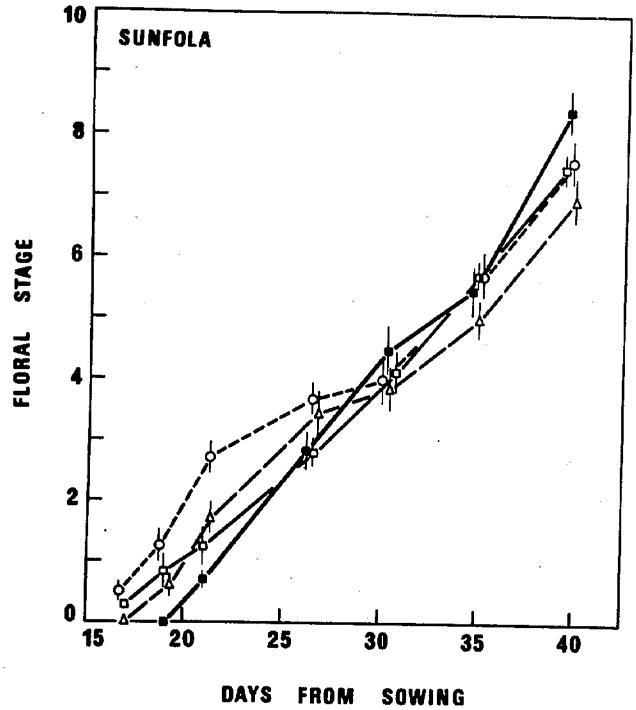
ABSTRACT

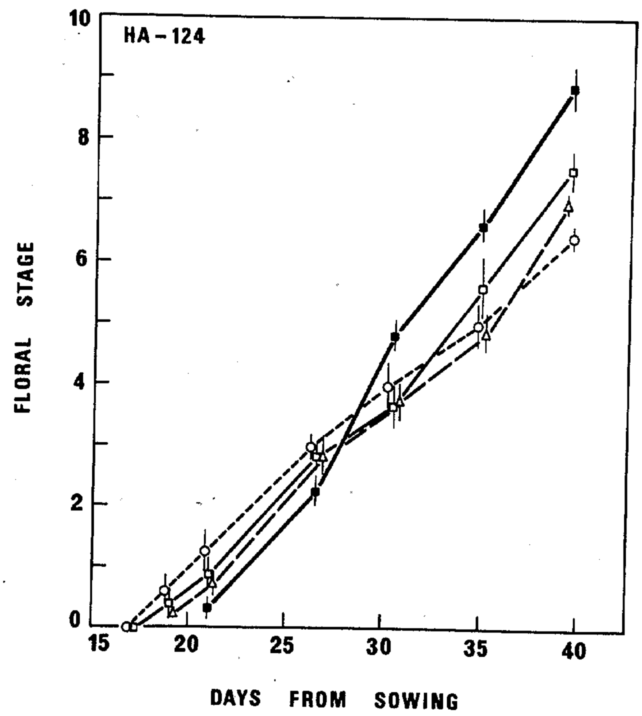
Early flowering cultivars Sunfola 68-2 and HA-124 were grown in controlled environments to assess their responses to long or short days. Three long-day regimes were examined; (A) 18 h high irradiance, (B) 18 h reduced irradiance, (C) 11 h high irradiance extended to 18 h by low intensity incandescent light. The one short-day regime comprised 11 h high irradiance, equivalent to the daily quantity of light supplied in (B) and (C). Apical buds were sampled at intervals to score the apex for the stage of flowering. Under the long-day regimes flower initiation occurred at about the same time, 18 to 21 days in Sunfola 68-2 and 20-22 days in HA-124. Initiation was delayed under short days, but only by about 2 days in each cultivar. By contrast, post-initiation development of the inflorescence was promoted by short days, accounting for the advancement of anthesis by 7 days in Sunfola 68-2 and by 10 days in HA-124. It is concluded that both cultivars are day-neutral for flower initiation and that photoperiodic effects aparently operate by influencing the rate of post-initiation development of the inflorescence.

INTRODUCTION

In the sunflower, photoperiodic studies have mainly been

Figure 1. Effect of daylength on time of flowering and post-initiation development of the flower in each cultivar. Long-day treatments: ○ (A), (B), □ (C); short-day treatment; ■ (D). For treatment details, see text. Values are means of four plants and two replicates. Vertical lines = ± S.E.





The earlier attainment of anthesis in short days (D) was not accompanied by a reduction in mean leaf number, but to the contrary, short days increased the number of leaves per plant (Table 1). We believe this is because the longer vegetative period allowed more leaves to form (Marc and Palmer, 1978b).

DISCUSSION

Although short days significantly advance the time of anthesis, this sensitivity to daylength is clearly not the result of earlier flower initiation. It may even be that initiation is slightly delayed by short days, although this was not significantly established in our experiments. In each cultivar, the earliest initiation occurred in long days under high irradiance (A) but the advancement was only 2.4 days in Sunfola 68-2 and 1.8 days in HA-124. This high irradiance effect may reflect enhanced photosynthesis under such conditions, giving an earlier attainment of a critical mass which may be necessary before the transition to flowering can occur. There is also the possibility that flowering was directly promoted, due to the properties of high intensity blue light (Sawhney, 1977; Mancinelli and Rabino, 1978). Although equal quantities of light were provided in treatments (B), (C) and (D) they may not have been equivalent in their effects on photosynthesis. Thus the restriction of photosynthesis to 11 h in the short-day treatment (D) may explain the slight delay in flower initiation. Since these daylength effects were all small in relation to the differences in age of the plants at the time of anthesis, the generalisation can be made that both cultivars changed to the flowering condition at about the same time in all the treatments, leading to the conclusion that they are day-neutral for flower initiation.

From Fig. 1 it can be seen that short days advanced anthesis by promoting the rate of development of the flower in the post-initiation phase. There is also an indication in Fig. 1 that post-initiation development in treatment (A) was delayed mainly after the attainment of floral stage 3 which marks the commencement of growth of the receptacle disc. The difference in anthesis times between treatments (A) and (D) of 7 days for Sunfola 68-2 and 10 days for HA-124 may therefore have two components; post-initiation development being accelerated under short days and delayed under high irradiance long days.

These finding raise the possibility that reports of daylength sensitivity of anthesis time, for other cultivars of hybrids, may also be largely due to daylength affecting the rate of post-initiation development of the flower, rather than the time of flower initiation, as is often assumed.

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YIELD AND HARVEST INDEX OF SUNFLOWER CULTIVARS: INFLUENCE OF DURATION AND WATER STRESS.

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ABSTRACT
The yield and harvest index of 10 recent commercial Australian sunflower cultivars and 21 other lines and cultivars varying widely in maturity were measured with and without supplemental irrigation during a dry summer in Canberra, Australia. The harvest indices among the 10 commercial cultivars varied from 35 to 43% in the irrigated plots and from 33 to 38% in the unirrigated plots. The variation in the other 21 lines was greater, varying from 26 to 50% in the irrigated plants and from 16 to 43% in the unirrigated plants. The harvest indices were lower in the later lines than in the early lines in both the wet and dry plants, whereas seed yield increased linearly with time from sowing to anthesis in the irrigated sunflowers. Crop duration had no influence on yield in the unirrigated plants. A subsequent experiment with five of the cultivars showed that provision of water from just prior to anthesis increased the harvest index over that in the unirrigated and fully irrigated plots.

INTRODUCTION
The grain yield of a crop growing with a limited water supply can be conveniently considered as the product of three factors (Passioura, 1977), namely (i) the amount of usable water, (ii) the amount of dry matter produced per unit of water transpired, i.e. the water use efficiency, and (iii) the grain produced per unit of dry matter, i.e. the harvest index. Provided there are no negative interactions among these factors, improvement in any one will benefit yield. Donald and Hamblin (1976), working with cereals, suggested that selection for high harvest index rather than high yield may be desirable, particularly in early generation selections when single, spaced-plant yields will likely have little correlation with crop yield. The influence of water stress on harvest index has not been widely studied in sunflower. The present paper reports experiments in which the influence of water stress on the yield and harvest index of sunflowers was studied in a range of cultivars differing in duration.

MATERIALS AND METHODS
Ten recent commercial Australian sunflower cultivars — Rocket, Sunking, Sunace, Sungold, VNIIMK, Hysun 30, Hysun 31, Suncross 51, Suncross 52, Suncross 150 — were grown in a brown solodic soil (Sleeman, 1979) at the Ginninderra Experiment Station, near Canberra, Australian Capital Territory, during the 1979/80 growing season. Four rows, 0.75 m apart and 80 m long, of each cultivar were sown on 12 December 1979 with a pneumatic seeder to give a final plant population of 50,000 plants/ha. On an adjacent site 21 further sunflower lines and cultivars, containing four American-Indian lines (Arikara, Havasupai, Hopi, Seneca), seven early European and North American cultivars (Issanka, Majak, Manchurian, Polestar, Sunrise VNIIMK 6540, Yugor) and ten Queensland breeding lines (Q12349, Q12531, Q12353, Q12369, Q12463, Q12472, Q12721, A60 x R265, A60 x R226, A99 x R266), were planted in 42 plots, each 5 rows wide (0.75m between rows) and 3m long, to give a plant population of 50,000 per ha. The plants were sown into potting soil in 3.8 x 7.5 cm paper pots (Lannen Tehtaat, Finland) in the glasshouse on 27 November 1979. After emergence they were placed outdoors to harden and then were transplanted into the field on 12 December 1979. All plots were limed and given adequate fertilizer, and half the plots were irrigated regularly by overhead sprinkler to maintain the soil near field capacity. On 15 December 1980, five — Suncross 150, Polestar, Seneca, Havasupai and Manchurian — of the 21 cultivars were sown on an adjacent site in 30 plots; each plot was 4 rows wide (0.60 m between rows) and 4 m long with plants spaced to give the same population as previously. These plots were given one of four water treatments: WET, flood irrigated frequently throughout the season; DRY provided only with stored soil water by automatically covering the plot with a rain-out shelter whenever rain fell; REC 1, maintained as the DRY plots until 44 days after sowing and thereafter as the WET plots; REC 2, maintained as the DRY plots until 54 days after sowing and thereafter as the WET plots. Further details of the 1980/81 experiment are given in Rawson and Turner (1982a,b). The meteorologial conditions during the two seasons are given in Table 1.