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IRRIGATED SUNFLOWER IN THE ORD RIVER VALLEY.

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ABSTRACT

The ord River Irrigation Area (O.R.I.A.) is the most tropical part of Australia where sunflower is grown. The area is characterised by clay soils, high temperatures, and an absence of rain in the winter months when sunflower is grown under furrow irrigation.

Experiments have been conducted on cultivars; sowing time; N, P and Zn nutrition; plant population; water management; and insect damage. Late maturing hybrid cultivars sown between mid-April and mid-June have consistently produced the highest yields and oil contents. Experiments have shown that N and P should be added as fertilizer, while insect, disease and bird pests have not caused significant damage.

Yields from both experiments (best 3.0 t ha^{-1}) and commercial sowings (best 2 t ha^{-1}, average 1.3 t ha^{-1}) have been disappointing compared with higher latitude sub-tropical and temperate areas of Australia. Environmental limitations of temperature and daylength are thought to be the main reasons for the relatively poor yields and these are discussed in relation to the long term potential of sunflower in tropical Australia.

INTRODUCTION

The O.R.I.A. in North-West Australia (lat. 15°39'S, long. 128°43'E) was initially developed for cotton growing during the mid-1960's. However declining prices and severe insect problems saw the demise of cotton by 1974. In the immediate post-cotton period a range of potential crops were tested. As a result of this research, sunflower has now become the major crop of the region, accounting for some 35% of the cultivated area in the 1980 dry season.

Research with open pollinated sunflower cultivars during the 1960's produced very low yields because of poor seed set. This was attributed to a lack of natural pollinators, partly induced by heavy insecticide use on cotton (D.F. Beech, pers. comm.). When the current sunflower research programme commenced in 1976 we had the advantage of greatly reduced insecticide usage, permitting honey bees to be successfully maintained, and the more self-compatible hybrid cultivars.

Environment, cultivar, sowing date.

The climate (Table 1) of the O.R.I.A. is typical dry monsoonal with well defined wet (November — April) and dry (May — October) seasons. Temperatures are high throughout the year.

Sunflower is a dry season (winter) grown crop best suited to sowing between mid-April and mid-June (Garside 1980) and harvesting in September — October. Yield response to sowing date is very similar to that found with other temperate oilseed crops — linseed, safflower, rapeseed — in the O.R.I.A. (Beech and Norman, 1963a and b, 1964) and is mainly a function of temperature at flowering. May sown sunflower flowers in July the coolest month of the year, and this facilitates good seed set.

The late maturing hybrid cultivars, e.g. Hysun 30, have proved the most successful in the area, however yields have never reached the levels recorded for summer grown sunflower in the higher latitudes. The highest small plot yields have been 3 t ha^{-1} while the best commercial yields have been 2 t ha^{-1}. The average commercial yield for the region is 1.3 t ha^{-1}.

Evidence exists (A.L. Garside, unpub. data) that photoperiod is playing a major part in the growth and development of cultivars in this area. Most cultivars appear to be showing a long day response which results in an extended vegetative period under the relatively short photoperiods during May — July. As temperature is still quite high during this period, excessive vegetative growth occurs (heights up to 2.5 m) at, we expect, the expense of reproductive growth. This is thought to be a major reason for the relatively poor yields.

Oil percentage (dry weight basis) has been consistently in the high forties and has responded to sowing time in a similar way to yield (Garside, 1980) but linoleic acid levels are low, as could be expected with the high temperatures throughout the growing season (Simpson and Radford, 1976; Harris *et al.*, 1978). In most seasons linoleic acid levels below 60% can be expected for all but April sowings (A.L. Garside, unpub. data).

Nutrition.

The main soil of the area is Cununurra clay which is a weakly self-mulching, alkaline clay. It is low in nitrogen and phosphorus but has adequate supplies of potassium. Of the trace elements, zinc is most likely to limit yields. Results of nitrogen and phosphate x zinc experiments are presented in Tables 2a and 2b.

Commercial farms use 50 — 100 kg ha^{-1}N, 20 — 30 kg ha^{-1}P, and 5 — 10 kg ha^{-1}Zn.

Plant population and water management.

As in other localities (Thomson and Fenton, 1977; Prunty, 1981) plant population has had little influence on yield and oil content of sunflower in the O.R.I.A. (Table 3). In the one experiment conducted there was compensation for fewer plants by larger seed.

Experiments on water management have produced inconclusive results but indicate that relatively stressed conditions (irrigation after 240 mm pan evaporation) can be applied during vegetative growth providing frequency is increased during reproductive growth (Table 4).

Insects, disease, pests.

Neither insects nor diseases have been major problems in the area and the main bird pest, the little corella *(Cacatua sanguinea)* has not caused economic damage.

The types of both beneficial and pest insects are similar to that in more temperate areas of sunflower cultivation in Australia. The cluster caterpillar *(Spodoptera litura)* is potentially a major threat, and the grain feeding bugs *Oxycarinus luctuosus* and *Nysius* sp. are known to occur in high numbers in some crops. Research into the latter's effect on yield and oil quality is needed.

Diseases have been conspicuous by their absence. *Alternaria helianthi*, white blister (*Albugo tragopogonis)* and *Sclerotinia* sp. have not been recorded. *Macrophomina phaseoli* is always present but whether it is having an adverse effect in the irrigated situation is questionable. Sunflower rust *(Puccinia helianthii)* was recorded on open pollinated cultivars in one season only, when humid, moist conditions occurred in July.

CONCLUSIONS

Sunflower has filled an important gap in the agricultural development of this low latitude tropical area of Northern Australia. However its future must be precarious. The adaptive capacity of present sunflower cultivars, which have been developed for summer production, in sub-tropical areas, is extended to its limits in the environment of Northern Australia's winter months.

We are concerned, from a large number of wide-ranging agronomic experiments, that management practices are unlikely to raise yields above the 2 t ha^{-1} achieved occasionally by the best farmers. The only avenue to yield increase would appear to be the breeding of cultivars better adapted to the short day, high temperature environment of this area. Additionally, if sunflower seed from Northern Australia is to

Table 1. Long term means for selected climatic factors, Kimberley Research Station, Ord River Valley.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	YEAR
Rainfall (mm)	186.41	180.10	128.50	16.50	5.60	4.60	1.80	0.80	2.00	19.80	68.10	126.50	740.7
Mean Max (°C)	36.45	35.34	36.39	34.89	33.06	30.39	30.61	32.78	35.78	39.00	38.73	37.50	
Mean Min (°C)	23.78	23.84	22.89	23.72	17.11	15.72	14.33	15.50	19.00	22.39	24.45	24.45	
Evaporation (mm)	210.10	181.10	207.00	200.40	200.70	182.60	189.50	209.30	254.00	287.00	242.30	128.60	2592.60
Total Radiation (cal cm^{-2} day^{-1})	574	530	620	543	507	457	502	539	564	621	606	622	

Table 2. Yield (kg dry seed/ha) obtained from fertiliser applications on sunflower grown in the Ord River irrigation area.

(a) Response to Nitrogen applied as Urea to two varieties in 1977 Dry Season.

Variety	Nitrogen rate (kg N ha^{-1})			
	0	50	100	200
Hysun 10	1628	1959	1957	1909
Hysun 30	1028	1492	1316	1579
Mean	1328	1725	1634	1744

LSD 5% Nitrogen = 200

(b) Response to phosphate and zinc applied as double super and zinc oxide in 1978 dry season.

		Phosphate rate (kg P ha^{-1})		
		0	20	40
Zinc Rate kg Zn ha^{-1}	0	1268	2328	2618
	10	1550	2220	2280
	20	1812	2315	2795

LSD 5% (Zinc/Phosphate Combinations) = 208

Table 3. The yield and seed weight of two varieties of sunflower sown in the Ord River irrigation rrea in the dry season of 1977 at 4 different plant populations.

Variety	Character	Sown plant population (number/ha)			
		50 000	75 000	100 000	150 000
Hysun 10	Yield (kg ha^{-1})	1950	1956	1907	1903
	Seed Weight (g/100)	5.66	4.85	4.21	3.96
Hysun 30	Yield (kg ha^{-1})	1868	2099	1996	2034
	Seed Weight (g/100)	4.97	4.50	4.30	3.72

LSD 5% (populations) for Yield No significant Difference
LSD 5% (populations) for Seed Size 0.65

Table 4. The effect of irrigation frequency.

Seed Yield (Dry t ha^{-1}) of sunflowers sown in the dry season of 1980 in the Ord River irrigation area and subject to irrigation after specified amounts of pan evaporation E°. Data followed by different letters are significantly different at P = 0.05.

	240 mm E° P to PM	240 mm E° P to FF 60 mm E° FF to PM	240 mm E° P to BV 60 mm E° BV to PM	240 mm E° P to FF 30 mm E° FF to PM	240 mm E° P to BV 30 mm E° BV to PM	60 mm E° P to PM	60 mm E° P to FF 30 mm E° FF to PM	60 mm E° P to BV 30 mm E° BV to PM
Seed yield t ha^{-1}	1.8 ab	2.5 c	2.5 c	2.2 bc	2.6 c	2.2 bc	1.8 ab	1.6 a

P = planting BV = Bud Visible FF = First Flower PM = Physiological Maturity be readily marketed for edible oil, cultivars that will produce high levels of linoleic acid, independent of temperature, will be required.

The economic viability of a sunflower industry in this region is questionable, given the current yield levels. Certainly, it will only be in seasons when prices are high that the crop will produce economic returns in a single crop a year situation. However, it is likely to find a place, in the long term, in rotation with wet season crops such as soybeans and mungbeans. It is only in this context that we see sunflower remaining a commercial crop in the O.R.I.A.

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