EFFECTS OF VARYING SOWING DATES ON SUNFLOWER CULTIVARS

J. Lammerink and D.A.C. Stewart

Crop Research Division, DSIR,
Private Bag,
Christchurch

ABSTRACT

Late and uneven ripening and excessive seed losses by birds have been the main problems of sunflower crops in Canterbury and North Otago.

A trial was conducted at Lincoln with four early-maturing CRD selections, four Fl hybrids and the standard cultivar Peredovik, sown on 26 September, 9 and 23 October, 1973. Flowering was delayed by approximately one week for two weeks delay in sowing time. Yields and oil percentages of all cultivars decreased from early to late sowing. Full flowering was approximately two weeks earlier for the CRD selections and two Fl hybrids than for Peredovik at each sowing date. The CRD selections were 17 percent shorter than Peredovik. Fl hybrids were less variable in height and flowering time than Peredovik and the CRD selections.

Early and uniform ripening should minimise seed losses by birds.

INTRODUCTION

Because of its high content of linoleic acid sunflower oil is one of the most desirable vegetable oils for human consumption. It is used as a cooking oil and for the production of polyunsaturated table margarine. After the oil is extracted from the seed, the residue is valuable as a high grade protein supplement (Earle **et al.** 1968). Sunflower seed is also used experimentally in specially prepared feed meals for the production of polyunsaturated meat and milk products (Cook **et al.** 1970; Scott **et al.** 1970).

There is a good potential demand for both sunflower oil and sunflower meal. It is estimated that by 1980 the New Zealand annual consumption of sunflower oil will be in the order of 8000 tonnes, requiring approximately 23,000 tonnes of seed. An additional 11,000 tonnes of seed will be required, if for health reasons the New Zealand population demands that 1% of the output of meat and milk products should be polyunsaturated.

Sunflowers grow well in New Zealand, but in the wetter parts of the country the crop suffers severe damage from the fungus diseases **Sclerotinia sclerotiorum, S. minor** and **Botrytis cinerea.** Sunflowers are quite drought resistant, although they may benefit from an occasional irrigation. For successful ripening they require warm, dry weather. The most suitable areas for commercial production would be Canterbury, North and Central Otago. Commercial attempts at promoting the crop have been disappointing however, despite efficient weed control and precision drilling. The main problems have been:

(a) Late, slow and variable ripening, which may induce late infection of **Sclerotinia** and **Botrytis** and necessitate premature harvesting and artificial drying.

(b) Heavy seed losses from birds, aggravated by the long ripening period. The seeds are particularly attractive to the greenfinch, **Carduelis chloris.**

Peredovik, of Russian origin, has been the main cultivar grown commercially in New Zealand for oil production (Currie 1972).

Most crops in the South Island have been sown in late October or November, although it is known that sunflowers will germinate and grow from earlier sowings.

Flowering time, height, yield and oil percentage were determined for different cultivars and sowing dates in a small plot trial at Lincoln in 1973/74.

MATERIAL AND METHODS

The trial was of a split-plot design with three sowing dates as main treatments and nine cultivars as sub-treatments.

The main treatments were replicated twice and the sub-treatments twice within each block.

The sowing dates were: 26 September (Sowing I), 9 October (Sowing II) and 23 October 1973 (Sowing III). The cultivars were four bulks of early maturing lines selected at Crop Research Division, Lincoln, four F1 hybrid cultivars and the standard cultivar Peredovik.

The four bulks were EEi, Ei and Y1 out of Peredovik and VI out of open pollinated cultivar trials. EEI and VI were bulked after three cycles of selection for earliness, and EI and YI after two cycles.

The four FI hybrid cultivars were H60, H232 and H234. The seed was produced at Lincoln from crosses of cytoplasmic male sterile inbreds (cms HA 60, 89, 232 and 234) and a fertility restorer genotype (RHA 266), obtained from Texas. The seed of Peredovik (P) was produced at Timaru by a commercial firm from seed imported from France.

Plots consisted of single rows, 6 m long. Row and within-row plant distances were 60 cm and 20-28 cm. Molybdate superphosphate at 250 kg/ha and urea at 125 kg/ha were applied on 24 September. Weed control was by trifluralin applied on the same day.

The percentages of plants at the preflowering, flowering and post-flowering stage in each plot were determined on 26 September, 3, 9, 16 and 30 January. In order to determine not only mean flowering time but also its variability, an analysis of variance was carried out on the within-plot variance of flowering score, defined as —

$$F = \frac{nl + 2n2}{nO + nl + n2}$$ in which nO, nl and n2 are the numbers of plants at pre-flowering, flowering and post-flowering.

The heights of ten plants per plot were measured on 4 February, when all plants had completed growing.

Shortly after completion of flowering 10-15 adjacent seed heads per plot were covered with "Netlon" bags. The bagged seed heads of Sowings I and II were harvested on 13-14 February, those of Sowing III on 26 February. After three weeks of air drying the seed heads were threshed.

Oil percentages were determined by Nuclear Magnetic Resonance.

RESULTS

Time of flowering

In all cultivars flowering was delayed by approximately one week for each two weeks delay in sowing (Table 1).

The CRD selections and Hybrids 232 and 234 were approximately one week earlier in reaching full flowering than Hybrid 60 and two weeks earlier than Peredovik and Hybrid 89 for each sowing date.

The F1 hybrid cultivars were more uniform in flowering than the CRD selections and Peredovik as indicated by differences in variance of flowering score. Number of days from first to last plant in commencement of flowering was approximately 1-2 weeks for the hybrids and 2-3 weeks for the open pollinated cultivars.

TABLE 1: Percentages of plants at flowering and post-flowering.

	Sowing I		Sowing II		Sowing III	
Cultivar	Flower % 26 Dec	Post fl. % 9 Jan	Flower %* 3 Jan	Post fl.% 9 Jan	Flower % 9 Jan	Post fl.% 30 Jan
EE1	97 aA **	98ab A	86 ab AB	58 ab A	69a A	100a A
E1	80bc AB	96ab A	82bc AB	50ab A	35b B	99ab AB
Y1	79bc AB	93b AB	82bc AB	42b AB	36b B	95c C
V1	93ab A	94b AB	84bc AB	62a A	44b B	100a A
H60	43d C	73 c B	54 d C	8d CD	13c C	82d D
H89	Of D	O e C	O f E	Oe D	Od D	20f F
H232	89ab AB	100 a A	92a A	49ab A	43b B	100a A
H234	63cd BC	97ab A	76c B	23c B	11c C	96bc BC
P	7e D	8d C	16e D	2de CD	Od D	46e E

* including Post-flower %, EEL: 6%, El: 2%, Y1: 2%, V1: 2%.

** Analysis of variance after arcsin transformation.

Plant height (Table 2)

In all cultivars a small to moderate decrease in plant height occured from early to late sowing, but there were no differences in variability between sowings.

The CRD selections were considerably shorter than all other cultivars, but the F1 hybrids were the least vâriable. Hybrid 89 was the tallest and most uniform cultivar.

TABLE 2: Plant heights (cm) on 4 February

Cultivar	Sowing I	Sowing II	Sowing III	Within-plot variance Sowing I + II + III
EE1	111deCD	100 eE	101efE	124 ab A*
E1	109eCD	108 cdDE	102efE	109 ab AB
Y1	111deCD	108cdDE	107deDE	108 ab AB
V1	108 e D	104deDE	100f E	155 a A
H60	118 cdBC	111cCD	111cdCD	69 cd BC
H89	141 a A	131aA	125 aA	32 e D
H232	124 bcB	119bBC	116bcBC	62 d C
H234	123	123bB	117b ABC	66 d BC
P	126 b B	123bB	121abAB	102 bc ABC

* Analysis of variance after transformation to logarithms.

Seed yields (Table 3)

Seed losses by birds were severe on most plots of the hybrid cultivars, despite the use of "Netlon" bags. H232 in Sowing I and H60 in Sowing III gave the only reliable yield estimates of the hybrid cultivars.

Only in Sowing III were differences in seed yield significant, with H60 outyielding E1, and H60, V1, EE1 and Y1 outyielding Peredovik and H89.

TABLE 3: Seed Yields (g/m²)

Cultivar	Sowing I	Sowing II	Sowing III	Mean I+II+III
EE1	196a	176a	173a AB	182 b
E1	219a	205a	145bc BC	189 ab
Y1	205a	209a	166ab AB	193 ab
V1	234a	218a	177a AB	210a
H60	*	*	187 a A	-
H89	*	*	84dD	-
H232	209a	*	*	-
H234	*	*	*	-
P	207a	192a	121c C	173 b

* severe seed losses

Oil percentages (Table 4)

There was a reduction in oil percentages from early to late sowing. In Sowings I and II Hybrid 89 had the highest oil percentage followed by the CRD selections. In Sowing III Y1, EE1 and E1 were superior in oil percentage.

Hybrid 60 had the lowest oil percentage in all three sowings.

TABLE 4: Oil percentages of sunflower seed (moisture free basis)

Cultivar	Sowing I	Sowing II	Sowing III
EE1	48.0 bc AB	45.6 bAB	44.3 a AB
E1	48.1 bc AB	45.2 b B	44.2 a AB
Y1	49.0 ab AB	45.3 b B	44.6 a A
V1	47.1bcd BC	44.5 b B	42.9 ab AB
H60	41.6 e D	41.5 c C	37.7 c D
H 89	50.5 a A	47.9 a A	41.9 b B
H232	45.3 d C	44.2 b B	42.2 b AB
H234	45.2 d C	44.8 bB	41.7 b BC
P	46.5 cd BC	44.6 b B	39.2 c CD

DISCUSSION

Early flowering sunflowers mature during the warmer time of the season, thereby requiring a shorter ripening period than later flowering ones. They would also have an advantage in being less prone to attack by **Sclerotina** sps. and **B. cinerea,** although these fungal diseases did not occur in the present trial.

It is obvious that flowering and hence ripening can be advanced by: (a) growing early cultivars, such as the CRD selections and Hybrids 232 and 234 (b) early sowing.

The CRD selections were shorter than the other cultivars and this would facilitate harvesting. On the other hand the F1 hybrid cultivars were more uniform both in flowering and height.

Flowering was delayed by approximately one week for every two weeks delay in sowing.

Because of bird attack plots were not all harvested at the same maturity and yield data for hybrid cultivars were incomplete. In this trial both yield and oil content as well as height decreased from early to late sowing.

As voracious consumers of ripening sunflower seeds, greenfinches are the most important pest of sunflowers in the South Island.

It is reasonable to assume that by shortening the ripening period the amount of seed lost to birds would decrease, provided enough sunflowers are grown in a certain district.

At Lincoln the average flowering time of an individual plant, i.e. the period from first to last another dehiscence, is approximately 9 days and bird damage has been observed as early as 15 days after flower commencement. Under favourable ripening conditions a plant would be ready for harvest approximately 30 days after flower commencement, but it would take another 10-15 days of summer weather before the seed would be sufficiently dry to obviate artificial drying.

Assuming similar ripening conditions Peredovik and the CRD selections would be prone to bird attack for four to five weeks before harvesting for artificial drying, and six to seven weeks without artificial drying. For the F1 hybrid cultivars these bird-prone periods would be approximately one week shorter.

It was interesting to note that greenfinches showed a preference for the F1 hybrid cultivars but this is unlikely to be of practical significance in commercial sunflower crops.

No research into the ecology and feeding habits of greenfinches has been conducted in New Zealand. However it has been observed that as summer progresses, feeding flocks become larger and more itinerant.

It is concluded that the best way to minimise seed losses by birds would be to grow large areas of an early-maturing F1 hybrid, sown early.

Producing F1 hybrid seed on a continuing basis does not only require isolated fields in which the cytoplasmic male sterile inbred line and the parent line carrying the fertility restorer gene are grown together, but also the maintenance of the male sterile inbred. This is achieved in an isolation field where it is grown in combination with a line of the same genotype but with a normal fertile cytoplasm. Because of the extra handling and risks F1 hybrid seed would be more costly than open pollinated seed.

ACKNOWLEDGEMENTS

Miss Elizabeth Stevenson, Applied Mathematics Division, DSIR, Lincoln, for statistical analyses.

Dr M.L. Kinman, Texas Agricultural Experiment Station, College Station, Texas, for supplying seed of the inbred parents, used for the production of F1 hybrid seed.

REFERENCES

Cook, L.J., and Scott, T.W., Fertuson, K.A., and McDonald, I.W. 1970. Production of polyunsaturated ruminant body fats. Nature **228:** 178-9.

Currie, J.D. 1972. Sunflowers in North Otago. New Zealand Journal of Agriculture **125** [**4**]: 33-7.

Earle, F.R., Vanetten, C.H., Clark, T.F., and Wolff, I.A. 1968. Compositional data on sunflower seed. Journal of the American Oil Chemists Society **45:** 876-9.

Scott, T.W., Cook, L.J., Ferguson, K.A., and McDonald, I.W., Buchanan, R.A., and Loftus Hills, G. 1970. Production of polyunsaturated milk fat in domestic ruminants. Australian Journal of Science **32:** 291-3.