SOME EFFECTS OF DATE, RATE AND METHOD OF SOWING ON LUPIN SEED YIELD

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ABSTRACT

Three trials are reported. For both Unicrop and Uniharvest, a range of 10 sowing dates from April until October resulted in a linear reduction in yield per plant as sowing became later. There was no significant differences in yield between Uniharvest and Unicrop. Yield was found to be related to the number of pods produced.

In experiment 2, the effect of 3 spacings (11cm, 8cm, and 4 cm) within a constant 18cm row width was studied using 4 varieties (Unicrop, Uniharvest, Uniwhite and Weiko III) at three sowing times (April, July and October). Within each sowing time there was no significant difference in seed yield per plot between the spacings used. There was no significant differences in seed yield per plot between varieties except for the October sowings. At that time, Unicrop had a significantly higher yield than the other varieties and Weiko III was significantly higher than Uniwhite or Uniharvest This superiority in yield of Unicrop and Weiko III is attributed to earlier flowering which was advantageous under the dry conditions prevailing at this site.

Uniwhite sown into cultivated and direct drilled seedbeds produced similar yields despite early differences in growth.

INTRODUCTION

The growing of sweet lupin for seed production has continued on a small scale throughout both the North and South Islands during 1973/74. A survey of 19 crops grown in the Southern North Island has shown a wide variation in yield ranging from 3360 to 670 kg/ha. However, 80% of those farmers who sowed the crop before the end of September achieved yields higher than 2,000 kg/ha but only 28% of those who planted during October achieved more than 2,000 kg/ha. This is in agreement with previous results (Withers 1973) which indicate that early spring sowings gave higher yields than late spring sowings.

In this paper, three trials are reported. They were designed to study a wider range of sowing dates than reported by Withers (1973) and to further evaluate the available varieties at a number of sowing dates and rates. It was decided also to investigate whether lupins could be successfully direct drilled into chemically-desiccated pasture; this technique could assist farmers to achieve the early sowings by eliminating the time required for cultivation, to permit sowing in soil conditions that would otherwise prevent cultivation.

MATERIALS AND METHODS

Three separate experiments are reported. All were conducted at Massey University during the 1973/74 season.

Experiment 1

This was a comparison of 10 sowing dates (see Table 1) ranging from April to October and included 2 varieties of **Lupinus angustifolius** (Uniharvest and Unicrop) in a randomised block design with 4 replications. Each plot consisted of 3 rows of plants spaced 30 cm apart. At harvest, plants were taken from the centre row and contribution to yield of the different sequences of inflorescences measured.

The equivalent of 24 kg P/ha and 112 kg K/ha as potassic superphosphate was broadcast prior to sowing and raked in. Three seeds per position were sown by hand and later thinned to one plant per position. Atrazine was applied pre-emergence at a rate of 1 kg/ha.a.i. The soil type was Manawatu silt loam, a recent alluvium.

Experiment 2

Four varieties (Uniwhite, Uniharvest, Unicrop, Weiko III) were compared at three spacings (11, 8 and 4 cm within the row and a constant row width of 18 cm.) The design was a split plot randomised block with sowing rates as the main plots and varieties as sub-plots with 4 replications. This was repeated for 3 sowing dates (16 April, 20 July and 2 October).

The desired populations were obtained by sowing at a higher rate with a Stanhay spacing drill and thinning after emergence. Fertiliser and weed control applications were the same as Experiment 1.

Each plot was 7m by 8 rows and at harvest a quadrat 5m by 4 rows was taken for measurement of the number of productive plants and the yield of each series of inflorescences.

The soil type was Manawatu fine sandy loam which has a gravel subsoil and tends to dry out rapidly in summer.

Experiment 3

Direct drilled plots were sprayed with 5 l/ha of paraquat plus 1.12 kg/ha of atrazine on 8 October and 6 l/ha paraquat on 10 October. Excessive rates of paraquat were used as the intention was simply to eliminate competition and no comparison with other spraying rate trials is inferred.

Cultivated treatments were mouldboard ploughed on 12/9/73 and subsequently prepared by rolling, disc harrowing, dutch harrowing and re-rolling.

The common sowing date of 12/10/73 meant that the cultivated seed-bed fallow period was minimal but adequate.

A Mark II version of a recently developed chisel

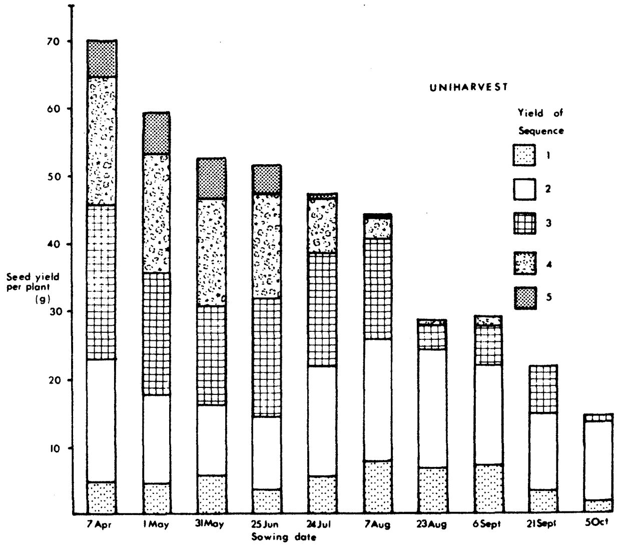

FIGURE 1: Total yield and yield of Inflorescence Sequences. Experiment 1.

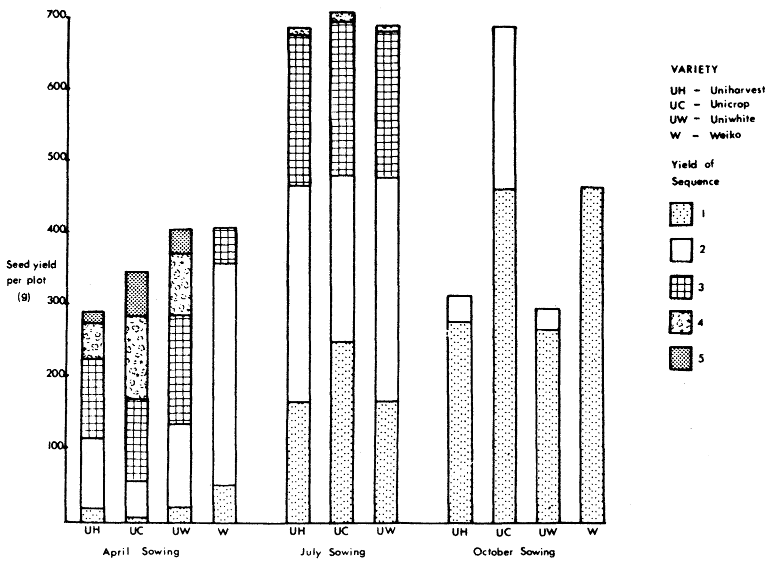

FIGURE 2: Total yield and yield of Inflorescence Sèquences — Experiment 2.

coulter and a bar harrow (Baker 1973) were used in the direct-drilled treatments to sow the seed. These coulters were also used in the cultivated seed-bed and covering was by light chain harrows.

Sowing rate for both treatments was 153 kg/ha of Uniwhite. No fertiliser was applied. The drill treatments were randomised in 4 replicates.

The fate of the seeds sown was assessed by utilising a special semi-cylindrical scoop which is inserted for 300 m horizontally into the soil bounding the sown row. Careful picking and counting established the fate of individual seeds at any point in time. Quadrats or row counts were used to establish plant numbers.

RESULTS

Experiment 1

The flowering dates, days from sowing to flowering and the differences between varieties are shown in Table 1. There was a steady decline in time from sowing to flowering in both varieties as sowing became later.

The degree-days using a base temperature of 5 deg. C from sowing to flowering were calculated and are also shown in Table 1. For unicrop, the degree-days were those for each sequence are shown in Figure 1 for uniharvest only. There was a steady decline in yield as sowing dates became later. Using the data for each replicate of both varieties, a regression analysis was performed and the results are shown in Table 2. As in the 1972/73 experiments (Withers 1973) the decline in yield with later sowings was due to a reduction in the number of pods produced caused by a reduction in the number of inflorescence sequences (Figure 1).

TABLE 1: Sowing and flowering dates, days to flowering and degree-days to flowering — Experiment 1.

Sowing Number	Sowing Date	50% Flowering Date		Sowing to Flowering (days)			Degree-days	
		Unicrop	Uniharvest	Unicrop	Uniharvest	Difference	Unicrop	Uniharvest
1	7 Apr	30 Jul	17 Sep	115	164	49	650	865
2	1 May	6 Sep	27 Sep	128	153	25	594	723
3	31 May	1 Oct	8 Oct	123	130	7	544	600
4	25 Jun	12 Oct	18 Oct	109	115	6	512	561
5	24 Jul	23 Oct	27 Oct	91	95	4	516	553
6	7 Aug	29 Oct	4 Nov	83	89	6	517	590
7	23 Aug	5 Nov	14 Nov	74	83	9	526	634
8	6 Sep	12 Nov	24 Nov	67	79	12	535	639
9	21 Sep	22 Nov	14 Dec	62	82	20	530	764
10	5 Oct	3 Dec	23 Dec	59	79	20	532	781

Table 2: Linear Regression Equations for Data from Experiment 1.

X	Y	Regression	r	S.E. of Estimate
Date	Pods	y = -0.47 + 122	-0.877	15.2
Date	Seedweight	y = -0.28 + 73	-0.886	8.7
Pods	Seedweight	y = -0.57 + 1.4	0.967	4.8

Date = sowing date in number of days from 1 April
Pods = number of pods/plant
Seedweight = weight of dried seed/plant (grams)

Experiment 2

Because of poor emergence, the populations in the 8 cm spacing in the April sowing and the Weiko III variety in the July sowing were too low or too variable so had to be deleted from the experiment. The desired populations were attained in all other treatments.

There were no significant differences in seed yield per plot between sowing rates (Table 3). The July sowing had the highest yield per plot. The higher sowing rates used caused a marked decline in the proportion of productive plants particularly in the April sowing.

From Table 4 it can be seen that there was no difference between the yield per plot for the varieties in the April and July sowings. In the October sowing however, Unicrop was superior in yield to the others with Weiko III yielding significantly more than Uniwhite or Uniharvest.

As with experiment 1, the early sowings produced seed from a greater number of sequences (Fig. 2).

TABLE 3: Results of Experiment 2 by sowing rate.

Sowing Time	Spacing	Seed yield/ plot (g) *	Percentage of sown plants producing seed (%)	Seed yield/ plant (g) *
April	11 cm	407 a	34 aA	7.1 aA
	8 cm	-	-	-
	4 cm	332 a	13 bB	4.2 bA
July	11 cm	673 a	94 aA	4.3 aA
	8 cm	713 a	89 bB	3.1 bB
	4 cm	700 a	74 cC	2.4 cC
October	11 cm	449a	93 aA	2.7 aA
	8 cm	501a	81 bB	2.4 aA
	4 cm	370a	55 cC	1.2 bA

* Oven dried weight

TABLE 4: Results of experiment 2 by variety.

Sowing Time	Variety	Seed Yield/ plot* (g)	Seed Weight/ plant * (g)	Percentage of sown plants producing seed (%)
April	Uniharvest	290 a	5.2 a	21 a
	Unicrop	355 a	5.9 a	22 a
	Uniwhite	420 a	6.0 a	24 a
	Weiko III	413 a	5.6 a	29 a
July	Uniharvest	689 a	3.1 a	88 aA
	Unicrop	704 a	3.5 a	81 bB
	Uniwhite	692 a	3.2 a	87 aA
October	Uniharvest	318 cC	1.5 cC	73 bB
	Unicrop	685 aA	2.9 aA	89 aA
	Uniwhite	294 cC	1.5 cC	70 bB
	Weiko III	466 bB	2.4 bB	75 bB

* Oven Dried Weight

Experiment 3

The rate of emergence of seedlings from the direct-drilled treatment was slightly higher (Table 5) but the plant density after 7 weeks was similar for the two treatments. At this time however the cultivated seed-bed plants had a higher dry weight and were looking more vigorous. As the plants flowered and approached maturity the visual difference largely disappeared and the direct drilled plants produced a similar seed yield per plant although the seed yield/metre row was slightly (but not significantly) lower due to a small reduction in the number of plants/metre row.

TABLE 5: Data from direct drilled and cultivated treatments Experiment 3.

	Cultivated Seed-bed	Direct Drilled
Ungerminated seed at day 13	0.0%	0.0%
Germinated but not emerged at day 13	10.7%	3.2%
Emerged at day 13	89.3%	96.8%
Plants/0.2m^2 at 7 weeks	12.3	12.5
D.W./plant at 7 weeks	1.40g	0.87g
Seed yield/metre of row (terminal)	28.4g	24.8g
No. plants/metre of row (terminal)	10.23	9.2
Seed yield/plant (terminal)	2.8g	2.7g

DISCUSSION

From both Experiments 1 and 2 it is apparent that the potential yields per plant are highest from Autumn sown plants. Experiment 2 has shown that this may not necessarily be reflected in yields per unit area if the sowing rate is high. The reason for the higher yield per plant is the production of more lateral inflorescences formed over a longer flowering period. However, this also results in a much larger plant causing severe competition amongst closely sown plants as indicated by the low proportion of productive plants in the April sowing in Experiment 2. The indications from this low productivity is that spacings greater than 11cm are required, perhaps as high as 15-20 cm (6-7 plants/metre row). As the proportion of productive plants in the 11 cm spacings for the July and October spacings is over 90% of those sown, it is likely that this spacing is resulting in minimal inter-plant competition. The 8 cm spacing results in significantly fewer productive plants and lower yields per plant but the seed yield per plot is increased although this is not significant statistically. Therefore the optimum rate for spring sowings is possibly about 9-12 established plants/metre row which is equivalent to 76-104 kg/ha of live seed sown with 100% establishment. This would be comparable with the 100-120 kg/ha sowing rate commonly used by farmers.

Experiments 1 and 2 indicate that there is generally little difference in yield between the Uni-varieties. The main exception is the October sowing in Experiment 2 where Unicrop flowered 3 weeks earlier than the other two. The increased yield resulted probably because the early flowering enabled pod setting to be further advanced before this light soil became too dry. In a wetter year or on a heavier soil this difference in yield may not occur. It should be noted that the October-January rainfall this season was 45% below the 10 year average. On the heavier soil in Experiment 1; the yield per plant for the 5 October sowing were not significantly different between Unicrop and Uniharvest. Therefore Unicrop may have an advantage over Uniharvest only when it is sown in late spring under conditions where an early moisture stress can be expected or where the maturity of Unicrop is significantly earlier under warm conditions. In the latter situation, Uniharvest does not become fully vernalised and develops into a large plant with much delayed flowering.

The reduction in yield with later sowings may have been accentuated by the dry season. In years with higher rainfall at the critical spring/summer period, the drop in yield may not be so severe. The main effect of moisture stress appears to be on the production of new lateral inflorescences. (Fig. 1). Gates (1968) has shown in **L. albus** and other plants that the apex is sensitive to moisture stress even at low levels of stress. The effect is to slow or stop the production of leaf (and presumably floral) primordia. It could be this effect which is reducing the production of new infloresences in later sowings. Gates also found that on rewatering, initiation recommenced at a rate similar to controls. For this reason it is possible that inflorescence development would restart if sufficient moisture was supplied. However more work is required to resolve this question.

Weiko III produces fewer inflorescences than the **L. angustifolius** cultivars although the yield from each inflorescence can be high (Fig. 2). The good yield from this variety in Experiment 2 is surprising considering the general tendency for it to be lower in yield than the Uni-varieties (Gladstones 1972; Withers, Unpublished Data) and more work is needed with this variety. Its tendency to lodge may be a disadvantage but it ripens quickly and evenly. Its seed is higher in protein than **L. angustifolius** cultivars (Gladstones 1972) which makes it more desirable for livestock feeding.

The data in Table 1 shows similar trends to the work by Gladstones and Hill (1969) and Rahman and Gladstones (1972, 1974) although the time from sowing to flowering was longer than in these trials compared with most of the Western Australian sites used by Gladstones and Hill (1969).

It is apparent from the degree-day figure that temperature is influencing flowering dates of Unicrop except for the April-May sowing times when the significant period under short and reducing photoperiod is probably delaying initiation. Uniharvest also shows this trend initially but then probably becomes influenced by its vernalisation requirement by needing an increase in degree days to flowering as the vernalisation requirement becomes less satisfied.

Experiment 3 was an initial trial only and there is insufficient evidence to draw detailed conclusions. It appears that the direct drilled seeds established more quickly but soon fell behind in vigour. However, there was no difference in seed yield per plant and the small, but non-significantly lower yield of the direct drilled treatment was apparently caused by slightly lower plant numbers. On the evidence of experiments 1 and 2 the sowing date of 12 October is considered late for this crop. Further work is therefore warranted and planning to investigate the possibility of using direct-drilling techniques to bring the sowing date sufficiently forward to a time when the likelihood of obtaining a cultivated seedbed is slight because of high soil moisture at that time.

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