# OCTOBER-SOWN LUPINUS ANGUSTIFOLIUS IN CANTERBURY

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## ABSTRACT

Late spring sown lupin crops in Canterbury suffer in dry seasons from low seed yields while wet seasons prolong flowering and harvest difficulties may be encountered in autumn.

Three experiments with mid October sown lupins are reported where treatments included a range of plant densities (12 to 156 plants/m$^2$), two varieties (Unicrop and Uniharvest), irrigation and weed control with atrazine (0 to 4 kg a.i./ha).

Yields ranged from less than 2 t/ha in a dry season (1974/75) from an unirrigated crop to a maximum of over 6 t/ha from the lowest density irrigated treatment in a cool moist season (1975/76).

Unicrop was higher yielding (1.9 t/ha) than Uniharvest (1.4 t/ha) in the dry season and was one month earlier maturing.

Atrazine applied pre-emergence at rates of 0.5 to 2.0 kg a.i./ha controlled annual weeds for the duration of the crop growth period in dry and wet seasons and in irrigated treatments. Weed competition reduced seed yields by 18% at 93 plants/m$^2$ (3.6 t/ha) and 33% at 40 plants/m$^2$ (2.8 t/ha) in untreated control plots compared with 1 kg a.i./ha of atrazine (4.5 and 4.2 t/ha respectively). The 4 kg a.i./ha rate of atrazine halved lupin plant densities and seed yields.

Maturity was delayed by irrigation for up to five weeks and by low plant densities for two weeks. High plant densities reduced the flowering period and the proportion of yield contributed by higher order pods.

## INTRODUCTION

Although it is generally recommended that lupins for seed production should be sown in autumn or early spring (White 1961, Withers 1975) later sowings are often unavoidable. The risk of reduced yields increases with later sowing dates. Withers **et al.** (1974) presented the results of a southern North Island survey where only 28 per cent of October sown crops yielded more than 2 t/ha of seed while 80 per cent of the earlier sown crops produced more than 2 t/ha. Late sown crops are likely to be low yielding in dry seasons because the shortened flowering period results in fewer higher order pods. Conversely, flowering in late sown crops in the presence of adequate soil moisture may be prolonged throughout summer and crop maturity delayed into autumn when harvesting conditions are less reliable.

Good seed yields have been obtained from October-sown lupins however, and studies of late sown crops should point to possible strategies for obtaining high yields in most seasons. Results from three October sown lupin experiments are presented in this paper. Experiments 1 and 2 provided agronomy experiments for Lincoln College Diploma in Field Technology class practical work. Experiment 3 was part of a postgraduate research programme, (SJH).

## EXPERIMENTAL

Experiment 1 was grown during the 1974-75 season which was warm and dry while Experiments 2 and 3 were grown during the cool 1975-76 season. A Stanhay Precision Seeder was used in all three experiments to sow inoculated seed into Wakanui Silt loam on the Lincoln College Research Farm. Fertiliser was not applied to Experiments 1 and 2 but Experiment 3 received a 200 kg/ha basal dressing of superphosphate.

### Experiment 1

Unicrop and Uniharvest varieties of **Lupinus angustifolius** were compared at six spacings (5, 10 and 25 cm within 30 cm rows and 4, 5 and 10 cm within 15 cm rows). A randomised block design with six replicates was used. Plots were 10 x 1.5 m.

The area was ploughed out of five year pasture in autumn 1974 and the trial was sown after spring cultivations on 15th October 1974. Atrazine (1.3 kg a.i./ha) and alachlor (2.5 l/ha) were applied before emergence on 17th October and subsequently gave satisfactory weed control. The experiment was not irrigated.

At harvest a one metre length of three rows was taken at random from the centre rows of each plot.

### Experiment 2

Six weed control treatments (atrazine at 0, 0.5, 1, 2, 4 kg a.i./ha and hand weeded) were applied to blue flowered Unicrop (WAU 11B) sown at two spacings (12.5 cm and 4.5 cm within 15 cm rows). A randomised block design was used with five replicates. Plot size was 10 m x 1.5 m.

The area was cultivated out of weeds which followed a 1974-75 very widely spaced lupin genetics experiment. Seed was sown on 16 October, 1975 and the atrazine treatments were applied on 17 October, using a sulky mounted precision sprayer. The trial was spray-irrigated on 10 December after hand weeding was completed.

Two harvest samples three rows wide and one metre long were taken at random from the centre rows of each plot.

### Experiment 3

Seven seed rates of blue flowered Unicrop (WAU 11B) were sown on 10 October 1975. Established populations with a row width of 15 cm were 27, 44, 64, 92, 113, 132 and 156 plants/m$^2$. A split plot design was used where main plot treatments were:

(i) natural rainfall only,

(ii) natural rainfall plus three irrigations (trickle) after flowering had commenced.

A high yielding crop of seed peas had been grown on the trial area during the previous season. Atrazine at 1.5 kg a.i./ha applied on 13 October controlled weeds until the crop was harvested.

Plots were 11.5 m x 3 m. At maturity three samples one metre long from the centre three rows of each plot were taken for yield estimation.

## RESULTS

A summary of Lincoln College meteorological data contrasting the 1974-75 and 1975-76 seasons is presented in Table 1. A feature of the 1974-75 season was the very low rainfall in November and December. The 1975-76 season was generally wetter and cooler than average but March was drier and warmer than usual.

TABLE 1: Rainfall and Temperatures at Lincoln College 1974-75, 1975-76 and long term averages.

| | Rainfall mm | | | Mean-Temperature °C | | |
|---|---|---|---|---|---|---|
| Month | 74-75 | 75-76 | Average | 74-75 | 75-76 | Average |
| Sept | 77 | 34 | 46 | 8.9 | 9.7 | 8.5 |
| Oct | 66 | 71 | 48 | 10.5 | 11.1 | 10.9 |
| Nov | 8 | 62 | 52 | 13.8 | 12.2 | 12.8 |
| Dec | 16 | 35 | 58 | 16.8 | 13.8 | 14.8 |
| Jan | 88 | 70 | 56 | 18.5 | 15.2 | 16.0 |
| Feb | 76 | 42 | 47 | 16.9 | 13.4 | 15.8 |
| Mar | 72 | 19 | 57 | 15.8 | 15.3 | 14.1 |
| Apr | 55 | 40 | 53 | 13.2 | 10.8 | 11.4 |

### Experiment 1

Results from the 1974-75 experiment are presented in Figure 1. Yields were moderate because of the dry season and ranged from 83 g/m$^2$ to 237 g/m$^2$ from the lowest Uniharvest and highest Unicrop densities respectively.

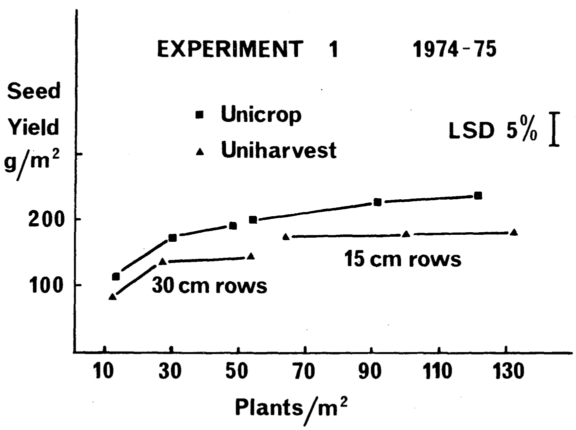


FIGURE 1: Effect of plant population on yield in **L. angustifolius** cv. Unicrop and Uniharvest.

Unicrop outyielded Uniharvest at all spacings. Unicrop had significantly higher ($P < 0.001$) 1000 seed weight (171 g vers. 138 g) and more seeds per pod ($P < 0.001$) (3.6 vers. 3.2) than Uniharvest.

Seed yield/m$^2$ increased with increasing plant populations. Higher crop densities resulted in significant increases in the number of mainstem pods/m$^2$ ($P < 0.001$) but higher order pods/m$^2$, seeds/pod and 1000 seed weights did not differ.

There were considerable differences in the rate of crop development between varieties and among plant populations. Unicrop started flowering about 10 December and Uniharvest three weeks later. Densely spaced Unicrop plots were ready for machine harvesting in late January while widely spaced plots were not ripe until two weeks later in mid-February. Uniharvest plots ripened up to four weeks later than similar populations of Unicrop.

### Experiment 2

Results from the 1975-76 weed control x spacing experiment are summarised in Figure 2. The highest yield in Experiment 2 of 450 g/m$^2$ was almost twice that of the best from Experiment 1, but the Experiment 2 crop was not ready for harvest until mid to late March which represented a difference in maturity date of at least seven weeks.

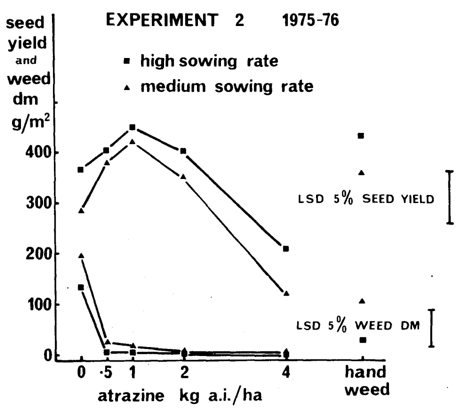


FIGURE 2: Effect of rate of atrazine application and hand weeding on seed yield of **L. angustifolius** (at medium and high populations) and weed dry matter production.

Good weed control was achieved at all rates of altrazine but the 4 kg rate was, as expected, excessive and seed yields were inferior to all other treatments. Weeds were kept in check reasonably well in the hand weeded plots until mid-December when species such as fathen established after the 10 December irrigation. These weeds were left to develop under the lupin canopy and although their dry matter yield was significantly greater than from the atrazine treated plots there was no significant reduction in lupin seed yield from weed competition during the later stages of crop development. Competition from weeds did, however, reduce seed yield significantly in the control plots ($P < 0.001$). Lupin plant numbers and mainstem pod number were not affected by weeds but the number of higher order pods was significantly less in control treatments (P<0.01).

The high sowing rate yielded significantly more seed than the medium sowing rate largely because more mainstem pods/$m^2$ were produced. High lupin populations of over 90 plants/$m^2$ suppressed weeds in both hand weeded and control treatments better than medium lupin populations of about 40 plants/$m^2$. This was reflected in the seed yield of the medium density control treatment which was reduced much more than yields from the high density control treatment.

**Experiment 3**

Experiment 3 yields which were generally high are shown in Figure 3. The mean yield of the seven non-irrigated populations (27 to 156 plants/$m^2$) was 475 g/$m^2$ while the yields of irrigated populations ranged from 472 to 630 g/$m^2$. Contrary to expectations there were no significant differences among yields of the non-irrigated populations. The lowest density gave the highest seed yields in the irrigated treatment.

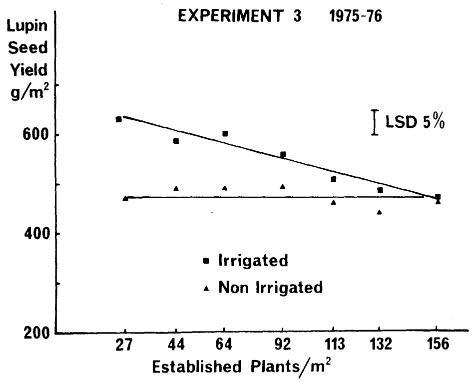


FIGURE 3: Effect of plant population and irrigation on seed yield of **L. angustifolius** (WAU 11B).

Irrigation delayed maturity by up to five weeks and the low density plots were not ready for harvest until early April. High density non-irrigated plots were ready for header harvesting on 24 February while low density plots took an extra two weeks to reach the same maturity stage.

## DISCUSSION

Farmer experience in Canterbury and the results presented in this paper emphasise the conflict between the need to irrigate late sown lupin seed crops and the importance of heading the crop by early March to avoid harvesting difficulties, seed drying costs and disruption to crop rotations.

As Unicrop is clearly the earliest maturing, sweet, non-shattering **Lupinus angustifolius** variety available it is the preferred variety for mid to late spring sowings.

Good weed control not only gives increased lupin seed yields but it also reduces trash problems at harvest. Atrazine at all rates between 0.5 and 2.0 kg a.i./ha gave good control of annual weeds for the duration of the lupin crops in all three experiments. The 1 kg a.i./ha of atrazine treatment gave highest yields of seed in Experiment 2 and seed yields were reduced by up to 18 per cent at 93 plants/$m^2$ and 33 per cent at 40 plants/$m^2$ when no atrazine was used.

Further work on time and rates of irrigation is continuing but present evidence suggests that one irrigation in mid-December at the time of Unicrop main stem flowering should provide a satisfactory compromise between obtaining maximum yields and avoiding the risk of prolonged flowering of successive orders of inflorescences which occurs when soils remain moist throughout January and February.

The earlier maturity of closely spaced lupin plots in all experiments indicates that medium (40-70 plants/$m^2$) to high densities (about 120 plants/$m^2$) should be used for late sown lupin crops. Low densities encourage the production of higher order inflorescences and may yield more seed than higher density crops under favourable conditions. However the hazards associated with the inevitable late harvests are too great for low densities to be recommended.


## ACKNOWLEDGEMENTS

Experiment 3 was funded in party by a D.S.I.R. Research Contract. The authors wish to thank Messrs M. Betts, G. Meijer, M. Mobley, N.H. Mountier, Miss Tracy Williams and members of 1975 and 1976 Diploma in Field Technology course for statistical advice and technical assistance.


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