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AN EVALUATION OF LUPINS (*lupinus* spp.)
FOR SEED PROTEIN PRODUCTION

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ABSTRACT

Since 1972 there has been interest in the greater use of seed protein in grain-based meals for stock. Lupins were one of the crops proposed to fill this requirement. This study was initiated to provide information on the agronomic requirements of *Lupinus angustifolius*, *L. luteus* and *L. albus* for seed production with emphasis on the southern North Island of New Zealand. In addition, some more basic studies on carbon and nitrogen translocation and the response of lupins to water stress were also carried out to provide a better understanding of the lupin plant and its response to its environment.

Initially some field experiments were laid down to measure responses to sowing date, plant density, defoliation and cultivar. At wide spacing, *L. angustifolius* showed an approximately linear decrease in seed yield/plant as sowing date moved from April to October. At normal densities, however, sowing in late July gave the best seed yield. Autumn sowings were affected by disease. It was concluded that, in the absence of disease, seed yield was largely determined by the length of the period of favourable environmental conditions between the start of flowering and the finish of reproductive development. This period determined the number of lateral inflorescences produced which, in turn, determined the number of pods producing seed. Pod number was the main component influencing seed yield. Thus, early sowing and reliable summer rainfall or irrigation seem to be the factors determining high lupin seed yields.

Responses to density were variable. In one experiment there was no response in seed yield by four cultivars over these sowing times to densities ranging from 50-140 pl/m². In a further experiment, increases in seed yield were obtained as plant density increased from 25-100 pl/m².

Removal of the main stem growing point early in growth briefly stimulated lateral stem growth but the effect on lateral stem seed yield was insufficient to compensate for the loss of the main stem seeds.

There was little difference between the *L. angustifolius* cultivars Uniharvest, Uniwhite and Unicrop when sown early but, with late spring sowing, Unicrop flowered earlier which was an advantage under dry early summer conditions. In one experiment comparing a range of legume species, *L. albus* and *Pisum sativum* produced the highest seed yield but *L. albus* and *L. luteus* yielded the most protein per unit area. The peak rate of nitrogen accumulation in all species was similar and the main factor influencing protein yield appeared to be the duration of nitrogen accumulation. Provided each crop utilised similar durations of the growing period, the yield of seed protein/ha from various legume crops is likely to be similar; the main difference being the composition of the seed. It was suggested that, for maximum seed protein yield, indeterminate cultivars may have some advantage over more determinate cultivars provided appropriate management procedures are adopted.

Studies on water stress indicated that it plays an important role by influencing the distribution of assimilate between vegetative and reproductive growth. Mild water stress tended to stop vegetative growth and increase the rate of seed growth. When sufficiently severe, water stress appeared to initiate the senescence of the plant, the timing of which determined the potential seed yield for that situation. Water deficit had its main effect on seed yield by reducing pod number. Other yield components were relatively stable.

Day temperatures of 28°C, when imposed early in growth, reduced vegetative and seed yield in *L. albus*. As the plant developed, however, the adverse effects of high temperature decreased until

growth was stimulated during first order lateral flowering. No direct effect of high temperature on pod abscission was apparent and it was suggested that pod loss under high temperatures which have been reported occurred largely because of an associated water stress.

A ^{14}C translocation study indicated that most movement of photosynthate in *L. albus* was into the branch on which the labelled leaf was inserted, or into lower branch orders directly connected to it. Results suggest that, in *L. albus* cv. Ultra, lower order stems are a more important competitor with the inflorescence for photosynthate than the new, rapidly developing, higher order lateral branches.

A possible strategy for growing lupin in a commercially viable situation in the Southern North Island is discussed.

TABLE OF CONTENTS

		PAGE
INTRODUCTION:		1
SECTION A:	LITERATURE REVIEW	5
A.1	Seed Production in Annual Legumes	5
A.2	Background to Lupin Growing	6
A.2.1	Lupin Seed Quality	7
A.2.2	Lupin Species	8
A.2.2.1	<i>Lupinus angustifolius</i>	8
A.2.2.2	<i>Lupinus albus</i> (white lupin)	9
A.2.2.3	<i>Lupinus luteus</i> (yellow lupin)	10
A.3	The Development of Legume Seed Yield	11
A.3.1	Plant Structure and Development	11
A.3.2	Components of Legume Seed Yield	14
A.3.3	Flowering and Podset	16
A.3.4	Pod and Seed Development	19
A.4	The Carbon and Nitrogen Economy of Grain Legumes	20
A.4.1	The Carbon Economy	21
A.4.2	The Nitrogen Economy	23
A.4.2.1	Initial Assimilation	24
A.4.2.2	Utilisation of Nitrogen	26
A.4.3	The Importance of Senescence in Legume Seed Production	27
A.5	Some Effects of Environment on Seed Yield	32
A.5.1	Water Deficit and Yield	32
A.5.1.1	The Main Physiological Effects of Drought	33
A.5.1.2	Effect of Water Stress on Legume Seed Production	35
A.5.2	Relationship between Temperature and Seed Yield	37
A.5.3	Time of Sowing	39
A.5.4	Plant Density Effects on Seed Yield	41

		PAGE
SECTION B:	FIELD TRIALS	
B.1	Influence of Time of Sowing on Seed Yield	44
	B.1.1 Introduction	44
	B.1.2 Materials and Methods	44
	B.1.3 Results	46
	B.1.4 Discussion	51
B.2	The Effect of Sowing Time and Plant Population on Four Cultivars of Lupins	52
	B.2.1 Introduction	52
	B.2.2 Materials and Methods	53
	B.2.3 Results	54
	B.2.4 Discussion	56
B.3	A Spacing and Defoliation Study	59
	B.3.1 Introduction	59
	B.3.2 Materials and Methods	60
	B.3.3 Results	61
	B.3.4 Discussion	71
B.4	A Comparison of several grain legumes at two sowing times	73
	B.4.1 Seed Yield and Components	73
	B.4.1.1 Introduction	73
	B.4.1.2 Materials and Methods	75
	B.4.1.3 Results	76
	B.4.1.4 Discussion	
	B.4.2 Distribution of Nitrogen within above-ground components	83
	B.4.2.1 Introduction	83
	B.4.2.2 Materials and Methods	83
	B.4.2.3 Results	85
	B.4.2.4 Discussion	103

	PAGE
SECTION C:	WATER STRESS STUDIES ON <i>LUPINUS ALBUS</i>
C.1	General Introduction 108
C.2	Effect of water stress imposed during a single growth stage at two humidity levels 110
C.2.1	Introduction 110
C.2.2	Materials and Methods 111
C.2.3	Results 115
	C.2.3.1 Levels of water stress imposed 115
	C.2.3.2 Duration of growth stages 115
	C.2.3.3 Total plant growth 117
	C.2.3.4 Leaf growth 119
	C.2.3.5 Stem Growth 123
	C.2.3.6 Reproductive growth 125
C.2.4	Discussion 131
C.3	Effect of water stress imposed during two or three growth stages 136
C.3.1	Introduction 136
C.3.2	Materials and Methods 137
C.3.3	Results 140
	C.3.3.1 Vegetative growth 140
	C.3.3.2 Flower number 143
	C.3.3.3 Seed yield and components 144
	C.3.3.4 Effect of water stress on reproductive growth 148
	C.3.3.5 Source of nitrogen for seed growth 151
C.3.4	Discussion 154
	C.3.4.1 Seed Yield 154
	C.3.4.2 Effect of water stress on assimilate distribution 156
C.4	Effect of high temperature under conditions of adequate and restricted water supply 159
C.4.1	Introduction 159
C.4.2	Materials and Methods 160
C.4.3	Results 161
C.4.4	Discussion 166

	PAGE
SECTION D: TRANSLOCATION STUDY	169
D.1 Translocation of ¹⁴ C in <i>Lupinus albus</i>	169
D.1.1 Introduction	169
D.1.2 Materials and Methods	170
D.1.3 Results	172
D.1.4 Discussion	181
SECTION E: CONCLUDING DISCUSSION	185
E.1 Basic considerations	185
E.2 Sowing time	189
E.3 Lupin species	191
E.4 Plant density	192
E.5 Potential for Lupin in the North Island	193
REFERENCES	196

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LIST OF TABLES

TABLE		PAGE
B.1.1	Sowing and flowering dates, days to flowering and degree-days to flowering for Unicrop and Uniharvest	45
B.1.2	Results of linear regression analysis of seed weight per plant, pod number per plant and time from sowing.	49
B.2.1	Seed weight per m ² and per plant; percentage of sown plants which produced seed for three sowing dates.	55
B.2.2	Seed weight per m ² and per plant; percentage of sown plants which produced seed for each cultivar at each sowing.	55
B.3.1	Effect of plant spacing on the dry weight of lateral stems per plant from early harvests.	61
B.3.2	Effect of spacing on the number of lateral stems per plant from early harvests	62
B.3.3	Effect of spacing on the number of fertile inflorescences per plant for each branch order - final harvest.	63
B.3.4	Effect of spacing on yield per plant and components of yield - final harvest	64

TABLE	PAGE	
B.3.5	Yield of oven dried seed (g/m^2) - final harvest	65
B.3.6	Seed yield (g) for each branch order at each spacing and sowing, and number of pods on main stem and first order laterals of the undefoliated autumn-sown plants on 18 October.	66
B.3.7	Effect of defoliation treatments on the number of lateral stems per plant - early harvests.	67
B.3.8	Effect of the defoliation treatments on the dry weight (g) of lateral stems per plant - early harvests	68
B.3.9	Effect of the defoliation treatments on the total leaf area per plant (cm^2) and leaf area of lateral stems - early harvests	69
B.3.10	Effect of the defoliation treatments on the number of flower sites and pods for each branch order - early harvests	70
B.3.11	Effect of defoliation on yield per plant and yield components	71
B.4.1	Total seed yield (g/m^2) and the number of plants contributing to yield	77
B.4.2	Number of pods per plant	78
B.4.3	Number of seeds per pod	78

TABLE	PAGE
B.4.4. Hundred seed weight (g)	79
B.4.5 Nitrogen percentage of seed	79
B.4.6 Yield of protein (N x 6.25) (g/m ²)	80
B.4.7 Path coefficients of components on yield	80
B.4.8 Relative water content of upper canopy leaves sampled 12-2 pm. Results in parenthesis sampled 8-9 am.	88
B.4.9 Regression coefficient b for regression equations total nitrogen and non-seed nitrogen during the decline phase with days from sowing.	92
B.4.10 Ratio of non-seed nitrogen to non-seed dry weight (mg/g) at the final sampling of each cultivar	94
B.4.11 Regression coefficient b for regression equations leaf and stem nitrogen with days from sowing and coefficient c for quadratic logistic equations stem nitrogen with days from late sowing.	96
B.4.12 Regression coefficient b for regression equations pod nitrogen and seed nitrogen with days from sowing.	100
B.4.13 Estimated contribution of nitrogen to seed from plant parts and that supplied direct from assimilation	102

TABLE		PAGE
C.2.1	Schedule of treatments	113
C.2.2	Schedule of harvests	114
C.2.3	Dry weight of main stem and first order leaf and dry weight per leaf at the end of first order lateral flowering.	121
C.2.4	Dry weight, nitrogen percentage and nitrogen yield of main stem leaf and stem at two humidity levels	122
C.2.5	Number of seeds per main stem pod	127
C.2.6	Number of productive first order lateral stems and pods per productive stem at final harvest	128
C.2.7	Weight of main stem seed per plant at harvest 4 (end of 1st order lateral flowering) and at final harvest	128
C.2.8	Number of incompletely filled seed in first order lateral pods - final harvest	129
C.2.9	Percentage of nitrogen in seed - final harvest	
C.2.10	Number of flowers per plant	130
C.3.1	Schedule of treatments	138
C.3.2	Schedule of harvests	139

TABLE	PAGE	
C.3.3	Total plant weight	141
C.3.4	Total plant nitrogen content	141
C.3.5	Relative growth rates during 3 flowering periods for total plant weight and for vegetative parts only.	142
C.3.6	Number of flower sites per plant	142
C.3.7	Number of main stem pods at final harvest and first order lateral pods at harvest 4 and final harvest	146
C.3.8	Number of seeds per pod and hundred seed weight at final harvest	147
C.3.9	Estimated increase or decrease of nitrogen in plant parts, loss of nitrogen in senescing leaf and total net nitrogen accumulation rate during second order lateral flowering.	152
C.3.10	Estimated translocation of nitrogen between plant parts for the period between harvest 4 and final harvest	153
C.4.1	Dry weight of the total plant, vegetative and reproductive tissues at the end of main stem flowering and end of 1st order lateral flowering.	162
C.4.2	Mean duration of growth periods	162

TABLE		PAGE
C.4.3	Relative growth rates during 1st order lateral flowering	163
C.4.4	Number of flowers	163
C.4.5	Weight of seed per plant	164
C.4.6	Number of pods per plant at final harvest.	164
C.4.7	Number of seeds per pod at final harvest	165
D.1.1	Total activity in plant components from Experiment 1	173
D.1.2	Total activity in plant components from Experiment 2	175
D.1.3	Total activity in plant components from Experiment 3	177
D.1.4	Total activity in plant components 2 days after labelling for Experiments 4-6 and the proportion of total activity in each component for Experiments 4-7,	178

LIST OF FIGURES

FIGURE		PAGE
A.3.1	Schematic layout of a lupin plant showing the position and numbering of the branch orders.	13
A.3.2	Diagrammatic representation of direct paths of influence of several structural components of the plant upon yield.	14
A.4.1	Outline of the model given by Sinclair and de Wit (1976)	29
B.1.1	Period, for each inflorescence and sowing date, when > 50% of plants were flowering	47
B.1.2	Accumulated net water availability, number of frosts per week, and mean weekly air temperatures for the 1973/4 season	48
B.1.3	Seed yield per plant for each branch order	50
B.2.1	Total yield and yield of branch orders	57
B.4.1	Accumulated water availability, and mean weekly air temperature for the 1974/5 season.	86
B.4.2	Dry weight per plant of components for early and late sowings	89

FIGURE		PAGE
B.4.3	Total nitrogen per plant and non-seed nitrogen per plant during the decline phase for early and late sowing	91
B.4.4	Nitrogen content of leaf, stem, pod and seed per plant for early-sown plants	97
B.4.5	Nitrogen content of leaf, stem, pods and seed per plant for late sowing	99
C.2.1	Results of relative leaf water content (RWC) measurements. Each point is a mean of 8 plants	116
C.2.2	Total plant dry weight and proportion which was seed	118
C.2.3	Total plant nitrogen and proportion which was seed	118
C.2.4	Rate of change in leaf and stem dry weight and nitrogen for the main stem over three growth stages and for the first order lateral stems over one growth stage	120
C.2.5	Dry weight of stems at final harvest	124
C.2.6	Weight of seed and number of pods per plant	126
C.3.1	Seed weight per plant at H ₃ , H ₄ and at final harvest	145

FIGURE		PAGE
C.3.2	Changes in dry weight of components between harvests for control plants	149
C.3.3	Changes in dry weight of components between harvests for treatment PF1	149
C.3.4	Changes in dry weight of components between harvests for treatment F13	150
C.3.5	Changes in dry weight of components between harvests for treatment F23	150