1984

Nitrogen flows from several species and varieties of legume

John Hamblin Dr

ANNUAL REPORTS OF: DR. JOHN HAMBLIN,
GERALDTON REGIONAL OFFICE,
FOR THE SEASON 1984.

Trial 83C24: N flows from several species and varieties of legume.

Trial 83C27: The effect of seeding rate, planting date and variety on the residual value of lupins.

Trial 84C25: Small rotation trial for 1985.

Trial 84C34 Nitrogen response on large rotation plots at ECRS.

THESE TRIALS WERE CARRIED OUT IN COLLABORATION WITH:

MR. R. DELANE,

AND WITH ASSISTANCE FROM:

MR. T. WHITE
MS. A. BISHOP.

REPORT ON TRIAL 83C24

NITROGEN FLOWS FROM SEVERAL SPECIES AND VARIETIES OF LEGUME

This project has examined the value of the legume phase for several rotational options at 3 sites differing in rainfall. A wide range of grain and pasture legumes were grown in 1982, and the plots cropped to wheat at 5 rates of applied nitrogen in 1983. In 1984 the plots were cropped to barley, again at 5 rates of applied nitrogen (Table 1). Pasture regeneration was also measured.

Table 1

Relative yields of wheat (1983) and barley (1984) following various legumes grown in 1982 (means of 5 rates of applied N, see earlier reports for details) grown at 3 sites. The yield of wheat on wheat (1983) and barley on wheat (1984) are the standards used (equal to 100%).

		Relative cereal yield					
Site		Gills		E.C.R.S		Criddles	
Rainfall		High		Medium		Low	
Year		83	84	83	84	83	84
Legume (1982)	no of treatments						
Lupins	9	159	128	-	132	172	126
Peas	2	153	104	-	109	105	86
Vetch	1	169	108	-	107	122	98
Clover	4	143	117	-	122	120	95
Medics	8	131	117	-	124	127	108
Others	3	100	95	-	114	90	77
Wheat	5	100	100	-	100	100	100
Cereal yields t/ha		.49	.72	-	.85	.40	.58

The most interesting result from this data is that the residual value of lupins persisted into the second cropping cycle (barley 1984). Clovers and medics also provided a reasonable residual in most situations, although it was less marked at the dry site. This is probablly related to the lesser growth of pasture species at that site in 1982. The correlations of residual value for the different legume genera as estimated by cereal yields were all positive and were significant in several cases (see below table 2).

Table 2

Correlation coefficients for cereals yields related to 1982 rotational history 5 d.f.

		Gills 1984	E.C.R.S. 1984	Criddles 1983	Criddles 1984
Gills	1983	.61 ns	.33 ns	.63 ns	.40 ns
Gills	1984		.82 *	.93 **	.85 *
E.C.R.S.	1984			.75 *	.57 ns
Criddles	1983				.91 **

This consistency was unexpected as these correlations involved comparing legume residual values over sites, years and cereal species. This suggests that that there are real, consistent differences in residual value between genera of legumes. Total N fixed by the legume does not explain this result completely as at Gills the amount of nitrogen fixed did not differ greatly between genera.

The responses to applied nitrogen were similar to 1983 and showed the classic pattern of deminishing returns, the results for the dry site are illustrated in figure 1.

We are trying to partition out the residual value from legumes into its components: nitrogen fixation, disease cleaning and other effects. Last year's report noted that the residual value of lupins at the dry site could not be explained only in terms of nitrogen and disease cleaning effects. It was suggested that "factor X" may be due to biological deep ripping, however further analysis indicates that the result could be due to potassium cycling. These alternative explanations will be examined further in 1985.

Pasture regeneration after one year of cropping was assessed in the buffer areas in mid July. The results are given below Table 3).

Overall the medics regenerated better than the clovers. It is expected that these differences will increase after two years of cropping as the medics are more hard seeded than the clovers. This will be assessed in 1985. Both M tornata and M littoralis regenerated well. It has been shown (see report on DAW 59) that medics have considerable growth reductions due to soil compaction. This factor, together with the development of Medic rhizobia more suited to acid conditions suggest that it may be possible to increase the yield of pastures considerably by deep ripping and suitable innoculation. This possibility is being examined in a preliminary trial in 1985 and may result in medic pastures having improved residual values for following cereal crops.

Table 3.

Pasture regeneration ratings, 0 none, 5 = excellent, at each site after one year of cropping.

Species and Variety	Site Gills	E.C.R.S.	Criddles	Mean
Trifolium subterraneum				
Nungarin	1.7	0.8	0.5	1.0
Seaton Park	2.6	0.8	0.2	1.2
T. hirtum				
Hykon	3.2	1.2	1.2	1.9
Kondinin	3.3	0.8	1.2	1.8
Medicago polymorpha				
Serena	2.5	1.5	1.5	1.8
Circle Valley	3.5	1.7	2.5	2.6
M. truncatula				
Cyprus	3.2	4.7	1.3	3.1
Jemalong	3.5	2.8	2.3	2.9
M. tornata				
Swani	5.0	3.2	3.8	4.0
Tornafield	4.7	4.2	4.2	4.4
M. littoralis				
Harbinger	4.7	5.0	4.2	4.6
M. scuttelata				
Snail	0.7	0.5	1.5	0.9

With hindsight it is apparent that many of the legume species would have grown better if the sites had been deep ripped before the trials commenced. However because of the complexity of the trials, it is not proposed to examine the effect of ripping by legume interactions in detail, but rather, future work will examine the effect of ripping on legume residuals, using a limited set of genotypes.

In conclusion this project has shown:

1. The prime importance of lupins in crop rotations in the Geraldton region. Lupins consistently had larger residualsfor a following cereal crop than any of the other legumes tested.

2. Lupins also provided a substantial residual value for a second year of cropping.

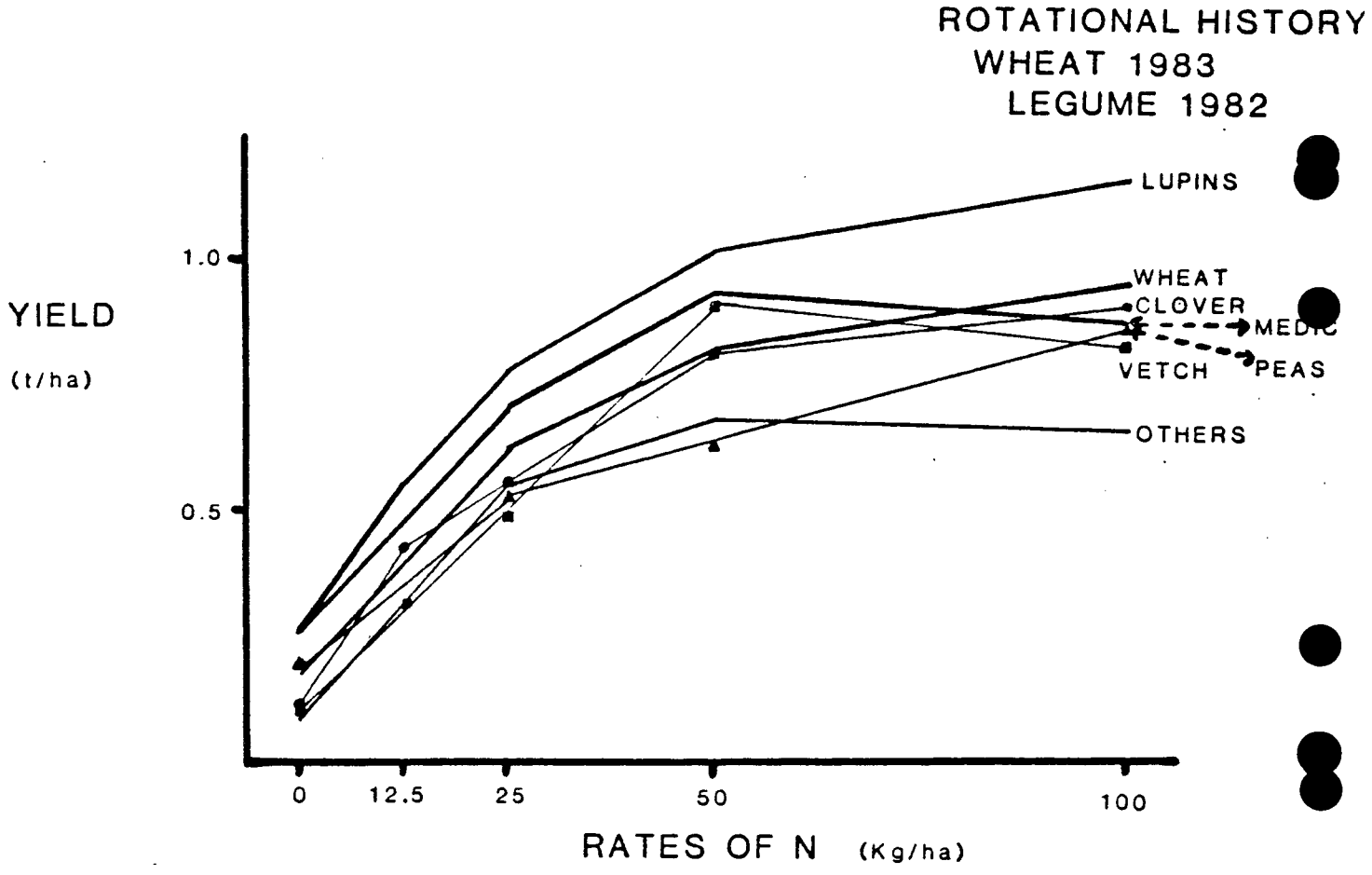
3. This project has attempted to partition the lupin residual value into its components. This has been partially successful. However further work is required to determine what all the components may be and also their relative magnitiude. It is not yet possible to say how these components vary over time and space. Further work will determine this.

This trial involved some 300 plots in 1982, and 1500 in both 1983

and 1984. The full data is available on disk to anybody who would like to use it from the Geraldton Regional Office.

FIGURE 1

BARLEY YIELDS 1984



REPORT ON TRIAL 83C27.

THE EFFECT OF SEEDING RATE, PLANTING DATE AND VARIETY ON THE RESIDUAL VALUE OF LUPINS.

The importance of lupins to light land farming systems is well known . Recently Dr. J.S.Gladstones has developed lupin varieites which branch much less than current types. They are also higher yielding in the Geraldton Region (see report on this trial for the 1983 season). Averaged over 6 trials, involving sites, years, seeding rates, planting dates and fertilizer rates the reduced branching types yielded 121% of Illyarrie, the standard veriety for the region. As the yield potential of reduced branching types looks so promising it is important to assess whether increased yield leads to a significantly reduced residual value. This year we examined whether reduced branching lupins have a reduced residual value compared to conventional, branched types.

As an initial approximation the N fixed can be considered as proportional to BY and the N carried off as proportional to grain yield (GY). Therefore the residual value in terms of nitrogen will be proportional to BY-GY. It is apparent that if BY remains constant and GY is increased then less residual nitrogen may be available for cereal crops from reduced branching lupins.

Trail 83C27 was one of the initial trials on reduced branching types and involved 3 species of lupin (Lupinus angustifolius, L.albus and L.cosentinii) and 10 varieites. Three varieties were normal branching L.angustifolius and 4 were reduced branching types. These were sown at 4 densities and at 4 planting dates. These treatments generated a wide range of grain yields (GY, 253 to 3152 kg/ha) and of biological yields (BY, 900 to 11027 kg/ha). The treatments varied greatly in both the amount of N fixed and in the amount of nitrogen carried off. This trial therefore provided an ideal site to obtain an initial assessment of the effect of the plant type of the previous lupin crop on its residual value for a following cereal crop.

In 1984 these plots were sown to wheat (cv Eradu) and nonitrogen was applied. All the nitrogen for the crop was supplied by the previous lupin crop. It is therefore possible to assess the residual value of the lupin crops both in terms of lupin growth and yield in 1983 (Lupin BY -GY) and in terms of wheat yields in 1984 and to see whether these two measures are related and whether the various treatments imposed on the lupins (Plant type, species, maturity, variety, hard seededness) affected their residual value both in terms of 1983 BY -GY and in terms of 1984 wheat GY.

Figure 1 shows the relationship between 1983 BY - GY and 1984 wheat yields for planting date and seeding rate. Planting date (Fig 1a) changes the residual as measured by 1983 BY - GY. However there was only a large reduction in 1984 GY when the 1983 BY - GY was reduced below 2.8 t/ha. Above that the relationship

appears to be essentially flat or possibly curvi-linear. Seeding rate (Fig 1b) has less effect on both 1983 BY - GY and on 1984 wheat GY, although there may be a slight increase with increasing density. From a practical view point seeding rate does not appear important as most farmers are using seeding rates of 100 kg/ha and there is little increase in the 1984 residual above that rate.

The correlation between 1983 BY - GY residual and 1984 GY over varieties was low and not significant (0.22 ns). However it is possible to examine the effect of several lupin factors. Thisis shown in Table 1.

Table 1.
Effect of species, plant type, maturity and hard seededness of lupins in 1983 on grain yield of wheat in 1984, t/ha.

Species				
L.angustifolius				
Main effect	1.84			
		Branching		
		Normal	v	Reduced
		1.85		1.83
		Flowering		
		Early	v Mid v	Late
		1.83	1.73	1.90
L.albus				
Main effect	1.64			
L.cosentinii				
Main effect	1.62			
		Hard seed	v	Soft seed
		1.48		1.77

It is seen that the main effect of L.angustifolius is greater than the main effect of L.albuus and L.cosentinii. In the case of L.albus this is probably due to its lower BY, only 2.63 t/ha compared with 4.72 t/ha for L.angustiolius. In the case of L.cosentinii the lower main effect is caused by the poor residual of the hard seeded line. It is likely that much less seed of this variety germinated on the opening rains, than for all the other varieties which were soft seeded. The nitrogen from the killed lupin seedlings is therefore likely to be less for this genotype than from all the others.

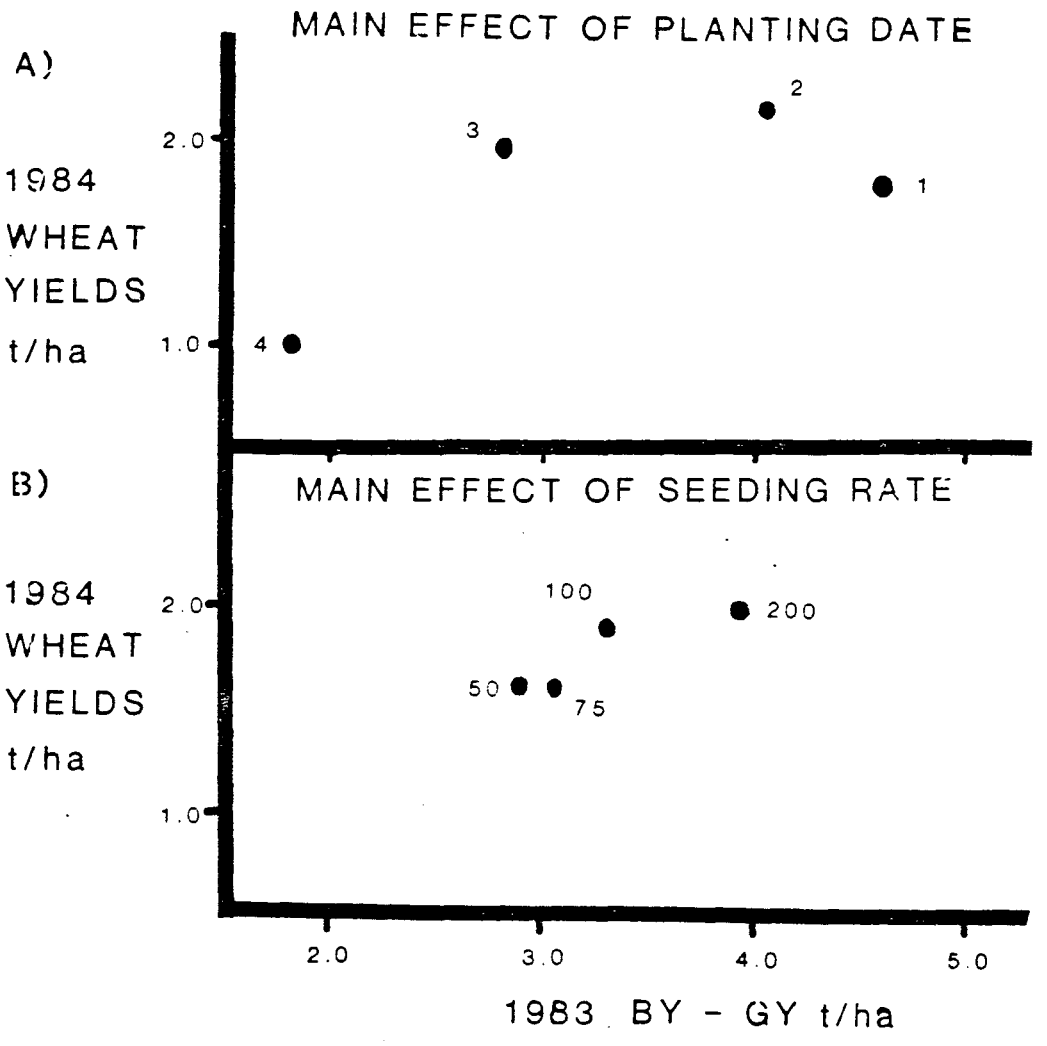
Reduced branching had little effect on the 1984 wheat yields and a similar result was obtain for the effect of flowering time. This initial result is encouraging as it suggests that reduced branching genotypes will not have a reduced residual value for following cereal crops. However this result was obtained from

only one site and season and needs to be treated with caution.

There is probablly room for further increase in the nitrogen harvest index and grain yield without reducing the residual. This is because it was only when the BY was drastically reduced by late planting that a reduction in residual was found (Fig. 1), suggesting that there is still room for an increase in the amount of N carried off in grain before residual is affected. Further work will clarify this point.

The full data from this trial, 160 treatments x 2 replicates is available on disk to anyone who would like the full data.

FIGURE 1


A)
MAIN EFFECT OF PLANTING DATE
1984 WHEAT YIELDS t/ha
2.0
1.0
2
3
1
4
B)
MAIN EFFECT OF SEEDING RATE
1984 WHEAT YIELDS t/ha
2.0
1.0
100
200
50
75
2.0
3.0
4.0
5.0
1983 BY - GY t/ha

REPORT ON TRIAL 84C25

SMALL ROTATION TRIAL FOR 1985

This trial was set up to provide different rotational histories for plots in 1985. The paddock history was:

1981	Wheat
1982	Lupins
1983	Wheat

In 1984 the following treatments were planted:

Crop	Variety
Rapeseed;	Wesbrook
Oats;	Mortlock
Barley;	Stirling
Wheat;	Eradu
Lupins	Illyarrie
	Chittick
	Marri
	75A39-113 *
	Erragulla **
Wheat/Lupins mixture;	Illyarrie/Eradu
Medic pasture;	Harbinger

There were six replications. These treatments will allow further study of the residual value of reduced branching lupins compared with conventionasl types and also provide a better estimate of the components of the residual value of lupins. In 1985 the whole area will be grown to wheat at 5 levels of applied nitrogen.

* reduced branching early flowering line.
** soft seeded type.

REPORT ON TRIAL 84C34

NITROGEN RESPONSE ON LARGE ROTATION PLOTS AT ECRS

Each year small nitrogen response trials are grown on the large rotation plots at ECRS that are sown to wheat.

The rates of nitrogen used were:

0, 12.5, 25, 50, and 100 kg N / ha, N source 34:0.

The wheat variety used was Eradu.

The rotation treatmens were:

Wheat on Illyarrie lupins,
Wheat on hard seeded Erragulla lupins,
Wheat on Harbinger medic,
Continuous wheat, conventional,
Continuous wheat, minimum tillage,
Continuous wheat, stubble mulch.

The results (Figure 1), show typical response patterns, wheat on lupins being much better than wheat on wheat, with wheat on medic being intermediate. The wheat on Erragulla lupins had a lower mean yield than the wheat on Illyarrie lupins. Of the continuous wheat treatments, stubble mulching had the lowest yield. On the continuous wheat plots and the wheat/medic plots grass weeds, particularly brome grass, are a major problem. This will reduce yields either by direct competitin, or by delaying planting to get weed control. Nonetheless the rotational responses are dramatic.

FIGURE 1

WHEAT ON LARGE ROTATION PLOTS E.C.R.S.