



LUPINO

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Lupin production exceeds all expectations in the southern Cape Crop Rotation trials during 2003

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INTRODUCTION

Lupins play an integral role in various rotations that are being tested in the southern Cape crop rotation trials. Reasons for including lupins into the rotation are to provide the opportunity to break disease cycles in the cereal crop and to control grass weeds, to promote the development of healthy micro-organism populations in the soil and, perhaps most importantly, to increase soil organic nitrogen levels. All these factors, particularly increases in soil organic nitrogen, work together towards increasing cereal crop production and reducing cereal production costs.

There are three experimental sites in the southern Cape. At Riversdale, lupins are included in two rotations following 5 years of lucerne i.e. (a) wheat, lupin, wheat, canola, wheat and (b) wheat, canola, wheat, lupin, triticale. At Swellendam, lupins are included in one rotation following 5 years of lucerne i.e. wheat, lupin, wheat, canola, wheat. At Tygerhoek, lupins are included in two continuous cropping rotations i.e. (a) wheat, barley, canola, wheat, barley, lupin, and (b) wheat, canola, wheat, lupin. The trials started in 2002 and lupins were produced at all three experimental sites in 2003. Plot size ranges from 0.25 ha to 1.0 ha and normal farm implements are used to produce each crop. There is also a minimum of three plots per experimental site from which production data were recorded. In this report the management inputs and production data for the 2003 season are discussed together.

CROP MANAGEMENT

All management activities are presented in Table 1. Glyphosate was used to spray weeds over the whole trial area before planting. Simazine was applied to all plots on the morning before planting at Riversdale and four days before planting at Swellendam. At Tygerhoek the simazine was applied directly after planting. In all cases the soils were moist at the time of application and good rainfall (>10mm) occurred within a few days of planting. Under these conditions excellent weed control was obtained at all sites.

At Riversdale and Swellendam the lupin seed (Tanjil – a narrow-leaf (*Lupinus angustifolius*), sweet lupin cultivar) was planted into undisturbed soil using an

AUSPLOUGH. The same cultivar was planted at Tygerhoek and a modified no-till, Tine seeder with inverted T-boots and press-wheels was used to plant the seed. Seeds were planted at a depth of 15 to 20mm. At planting the P was applied either all with the seed (Tygerhoek) or one quarter with the seed and three quarters below the seed (Riversdale and Swellendam).

Table 1. Management of crops planted during 2003

Experimental site	Planting date	Seeding rate (kg/ha)	Fertilization rate at planting (kg/ha)	Top dressing (kg/ha) (application date)	Crop protection Product (date)
Riversdale	15/04	89	24 P	N/A	Simazol (15/4)
Swellendam	12/05	100	10.5 P	N/A	Simazol (08/5) Opus (13/8)
Tygerhoek	24/04	110	10.5 P	N/A	Simazol & Gramoxone (24/4) Opus + Rogor (08/9)

It should be emphasised that besides having good soil moisture and chemical weed control, other management decisions also played an important role in controlling weeds and ensuring that the crop had the potential to produce high yields. From Table 1 the reader will see that relatively high seeding rates were used at all sites. This was done to ensure a plant density of approximately 45 plants m⁻². An aspect of seed quality that has not been highlighted in the past is that besides ensuring that the seed has a good germination percentage and that the seed-coat is not damaged, the thousand seed weight (TSW) should be greater than 150g. This means that the individual seeds are heavier and have more energy for producing the first roots and shoots, thus ensuring rapid establishment and a high seedling survival rate, than smaller, lighter seeds. The seed used at the experimental sites had a TSW of 160g and a germination rate of >90%. Rapid plant development and canopy cover therefore also contributed to suppressing weeds.

While powdery mildew had to be controlled at the Swellendam and Tygerhoek sites there were no disease problems at the Riversdale site (Table 1).

HARVESTING

At Riversdale the lupins were harvested directly on 29 October while the crop was swathed (“platgesny”) into windrows, before harvesting at the Swellendam and Tygerhoek sites. Climatic conditions at harvesting are extremely important. Harvesting at the Riversdale and Tygerhoek sites was done during the early morning when the moisture content of the plants prevented pods from breaking off the stalks or shattering during the harvesting process. Practical problems experienced at the Swellendam site, however, led to the swathed windrows being harvested closer to mid-day when the plants were considerably drier. This resulted in considerable seed losses during harvesting.

DATA COLLECTION

Plant counts were done after all plants had emerged and the harvest from each plot was weighed. Grain samples were drawn from the yield of each plot and were sent to the Elsenburg feed lab for oil and protein analyses. The thousand seed weight (TSW) was also determined for each sample.

RESULTS

Rainfall

Good early-season rains were experienced at all sites in 2003. Good soil moisture provided the opportunity to plant all crops relatively early (refer to Table 1). Total rainfall for 1st April to 30th September (the growing period) was 187mm for Riversdale, 154mm for Swellendam and 254mm for Tygerhoek. The unusually high rainfall experienced at the end of March ensured good soil moisture at the start of the season. There was, however, a long dry period from the latter part of May to the beginning of August. The effect of the dry period was more severe at the Swellendam site due to the poor water holding capacity of the soils and the fact that the site is located on a warm north to northwesterly aspect. The Riversdale site has soils with a higher water holding capacity and that are cooler than the Swellendam soils. Good soil moisture at the start of the season would have ensured good seedling establishment and initial plant growth, and ameliorated the negative effects of the extended post-planting dry period. Regular rainfall events subsequent to the beginning of August provided excellent conditions for optimal plant growth and production.

Plant densities

Estimated plant densities ranged from 41 to 44 plants m⁻² at Riversdale, 47 to 66 plants m⁻² at Swellendam and 38 to 48 plants m⁻² at Tygerhoek (Table 2). The 66 plants m⁻² in one camp at Swellendam was higher than expected but plant densities in all other camps are considered ideal.

Crop yields

Crop yields are presented for each experimental camp at each site in Table 2. Note that two average yield values are given for the Swellendam camps. The higher value (in brackets) is the adjusted yield taking into consideration estimated losses resulting from the harvesting process (pods breaking off plants at harvesting due to the extremely dry and hot weather conditions at harvesting).

While yields recorded at the Swellendam site were considerably lower than those recorded for Riversdale and Tygerhoek they were exceptionally good and far better than expected for the climatic and soil conditions that are experienced in the area. In fact the yields were higher than those recorded for wheat and similar to those recorded for barley in adjacent camps in the same experimental area!

The yields recorded at Riversdale and Tygerhoek were also exceptional and show the potential for narrow-leaf lupins in the southern Cape. At Riversdale the lupin yields were approximately 85% of the yields recorded for barley at the same site. Wheat yields at the site were, however, far lower due to cold damage to the wheat during

pollination. The yield of wheat that was not exposed to cold damage was approximately 20% higher than that recorded for the lupins. Wheat yields at Tygerhoek were, on average, 50% higher than the yields recorded for lupins at the same site. The excellent yields recorded at all three sites were despite the long dry period experienced from the end of May to the beginning of August.

Table 2 Lupin plant counts and yields in each camp at each experimental site during the 2003 season

Experimental site	Crop in 2002	Crop in 2003	Plant counts (m ⁻²)	Average yield (kg/ha)
Riverdale	Wheat	Lupin	44	2401
Riverdale	Wheat	Lupin	42	2529
Riverdale	Wheat	Lupin	41	2414
Swellendam	Wheat	Lupin	47	1289 (1704)
Swellendam	Wheat	Lupin	66	1075 (1407)
Swellendam	Wheat	Lupin	58	1003 (1422)
Tygerhoek	Wheat	Lupin	48	2584
Tygerhoek	Wheat	Lupin	38	3028
Tygerhoek	Barley	Lupin	38	2828
Tygerhoek	Barley	Lupin	44	3058

At aspect of lupin production that must be highlighted is the effect of high pH due to the presence of free lime. Free lime outcrops occur quite commonly in various areas of the southern Cape and such areas are totally unsuitable for lupin production. One of the main negative effects is on the availability of trace elements. Approximately half of one of the lupin camps at the Swellendam site comprised a free lime outcrop with pH in excess of 7.5 and manganese (Mn) of 14ppm (an Mn level > 25ppm is required). Lupins in that half of the camp were severely stunted, had poor nodulation, developed secondary diseases and ultimately had very low production. In fact the plants were too stunted to harvest. Production in the remaining half of the camp, where the pH was <6.5 and the Mn level was >60, was not affected. It is strongly recommended that soils with a pH in excess of 6.5 and where free-lime occurs should not be planted to lupins.

Crop quality

Quality results are presented in Table 3. Per cent crude protein was lower than the required minimum of 31% for narrow-leaf, sweet-lupin cultivars while the % oil are in the ranges expected. Given that the lupin seed planted at all sites came from the same source it is interesting that the %CP content of the seed recorded for the Swellendam site is consistently lower than the %CP recorded for the other two sites. This is perhaps a function of the more stressful climatic and soil conditions at the Swellendam site as well as poor nodulation when compared to the other two sites.

The TSW of seed from the Swellendam site also tends to be lower than the TSW from the Riversdale site and two of the camps at Tygerhoek (Table 3). The two camps at Tygerhoek with low TSW (TSW = 134g & 135g) are camps with soils that have a lower water holding capacity and are warmer (northwesterly aspect) than the other

two camps at the same site. This again indicates that climate and soil affects not only affects crop yields but also seed quality.

Table 3 Total crude protein (%CP), oil (%oil) content and thousand seed weight (TSW - g) of lupin samples for the 2003 season from each camp at all three experimental sites

Experimental site	Crop in 2002	Crop in 2003	%CP	%oil	TSW (g)
Riversdale	Wheat	Lupin	28.3	4.7	148
Riversdale	Wheat	Lupin	26.8	5.3	157
Riversdale	Wheat	Lupin	27.1	4.0	155
Swellendam	Wheat	Lupin	22.9	5.8	130
Swellendam	Wheat	Lupin	24.3	5.4	138
Swellendam	Wheat	Lupin	25.9	5.6	144
Tygerhoek	Wheat	Lupin	26.8	4.9	146
Tygerhoek	Wheat	Lupin	27.2	4.7	135
Tygerhoek	Barley	Lupin	27.9	4.5	145
Tygerhoek	Barley	Lupin	28.0	4.5	134

CONCLUSIONS

Lupin production exceeded expectation. At the start of the trial there was considerable doubt about the value of including lupins in the project among members of the various technical committees. The lupin yields indicate that there certainly is potential to include them in cropping systems in the southern Cape. Producers must, however, ensure that firstly, the soils are suitable for lupin production, secondly that they plant only good quality seed at the correct seeding rate, thirdly that appropriate agronomic practices are followed for the control of weeds and disease, and finally that appropriate harvesting procedures are followed. Other management factors such as marketing of the crop must also be taken into consideration.

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