Annual technical report

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Project No: W.B.1

Title: Economic sustainability of short- and long-rotation crop/pasture production systems in the Southern Cape

Project leader: MB Hardy

Co-worker: W Langenhoven

Report compiled by MB Hardy and W Langenhoven
Institute for Plant Production, Tygerhoek Experimental Farm, PO Box 25, Riviersonderend 7250

Aim

The aim of this study is to determine the short- and long-term effects of a number of the most feasible short- and long-rotation, crop and crop/pasture rotation systems identified for the southern Cape region on: crop yields, weed control, disease suppression, soil production potential, sheep production and the economic sustainability of land-use in the southern Cape.

Introduction

The project was initiated during 2001 at the request of the GSA Winter Rainfall Region Research Committee and is strongly supported by this committee. There are three trial sites viz. Tygerhoek Experimental Farm, Swellendam (on the farm of Mr Joos Badenhorst in the Napky district) and Riversdale (on the farm of Mr Fanie Joubert in the "vlaktes" just south of Riversdale). The project was established during 2002. Funding for all production season's to date (2002 to 2006) was applied for and granted by the Winter Cereal Trust (WCT – 60% of working capital requirements) and the Protein Research Foundation (PNF – 40% of working capital requirements). The technical committees that were formed for each trial site met in three separate meetings during February 2006 to develop management protocols for the 2006 season based on the experimental design, production data from 2005 and the management inputs during 2005. The technical committees comprise Departmental, Agri Business (Co-Ops), ARC and University staff, as well as members in the grain production industry and co-operating farmers.

The management of each trial site and results obtained during 2006 (the 5th year of the trial) are presented separately below. For the "long-rotation" crop sequences at Riversdale and Swellendam, 2006 is the final year of the 5-year cropping phase being tested on those sites. All crops were undersown with lucerne in preparation for the next 5-year pasture phase. Since management and input procedures remain much the same from year to year the reader will note that the descriptions and discussions that follow are similar to those given in previous reports.

Riversdale (*long-rotation site*)

Crop rotation trial

The plot plan for the 2006 season is presented in Appendix 1. Note that 2006 was the final year in the 5-year cropping phase on the research site. The trial moves to a new site in 2007 where the next 5-year cropping phase, following 5 years of lucerne pasture, will start. Soil samples were collected from all camps in December 2005 and analysed to determine their nutrient status and carbon content.

<u>Crop management</u>

Glyphosate (360 a.i.) was used to spray weeds on two occasions (26/04/06 & 3/05/06) over the whole trial area before planting. The second herbicide application was done as it became evident that new weed seedlings had emerged subsequent to the first application date. The main management activities (inputs) are presented in Table 1. The crops (wheat & tritcale) were planted into undisturbed soil using an AUSPLOW at a depth of about 20mm. Lucerne was broadcast over the whole land directly after planting. Broadcasting the lucerne was unplanned as it was intended that the lucerne should be planted in the row together with the cereal seed. A seed delivery problem on the planter resulted in no lucerne seed being planted during the cereal planting process.

Fertilizer was applied in liquid form being sprayed in the planting furrow between the closing tool and the press-wheel. Cyperphos was applied during planting to prevent insect damage to emerging seedlings since insect densities were high in previous season's stubble that had remained until planting.

Post emergence crop protection measures were necessary with strategic applications of Bromoxynil (broad-leaf weeds), Duet (disease control) and mospilan and cyprfos (aphids and bollworm) during the season.

No nitrogen topdressings were considered necessary.

The wheat and triticale were harvested directly. Late rains delayed grain from maturing until late November

<u>Data collection</u>

Weed dynamics – Thirty composite soil samples were taken during March 2006 (two from each of the 15 plots – see detail in data files at Tygerhoek), placed into seedling trays and were monitored to determine weed seed banks for each plot in a shade cloth facility at Tygerhoek.

Yield and quality – As reported for the previous seasons the total harvest from each plot was weighed. Two grain-samples (each weighing approximately 3kg) were drawn from the yield of each plot. Wheat samples were sent to the SSK silo at Swellendam and Stellenbosch University (Agronomy Department) respectively for quality analyses.

Table 1. **Management of crops planted during 2006 at the Riversdale site**

Crop	Cultivar	Planting date	Seeding rate (kg/ha)	Fertilisation rate at planting (kg/ha)	Top dressing (kg/ha) (application date)	Crop protection Product (date)
Wheat	SST 027	05/06	50	22.5N + 12.5P + S + Cu	Nil	Glyphosate (26/04 & 03/05) Cyperphos (5/06) Bromoxynil (15/06) Duet+mospilan (24/08) Cyperfos (16/10)
Lucerne	SA Standard	06/06	10.0	Nil	Nil	Nil (but into previously sprayed area)
Triticale	Bacchus	05/06	50	22.5N + 12.5P + S + Cu	Nil	Glyphosate (26/04 & 03/05) Cyperphos (5/05) Bromoxynil (15/06) Duet+mospilan (24/08) Cyperfos (16/10)

Plant counts were done on all plots on 1/06/2006. Counting procedure was the same as presented in the 2005 report. Counts were done within plant rows at each of 20 randomly located 1.0m row lengths in each camp. Note that a systematic random sampling procedure was followed to ensure that the whole camp was sampled.

Daily rainfall was recorded at the homestead approximately 1km away from the trial site.

Seeding rate trial
A large-scale seeding rate trial was planted (05/05) using the AUSPLOW planter and the same fertilizer applications as reported for wheat in Table 1. Crop protection measures were also the same as reported in Table 1. Trial design was a randomised blocks with four blocks and five seeding rate treatments. Gross plot size of each of the twenty plots was approximately 200m x 13.2m. The wheat (Baviaans) was planted to provide a range in plant populations from < 50 to > 200 plants m^{-2} (seeding rates from 20 to 120 kg ha^{-1}). Plant populations (plants m^{-2}) were determined on 01/06/06 i.e. 27 days after planting. Plant populations were ultimately used in data analyses. Tiller and ear densities ($plant^{-1}$ and ha^{-1}), grain yield (kg ha^{-1}) and yield components (thousand kernel mass [TKM], kernels per ear) were determined.

Lucerne cultivar demonstration
A lucerne cultivar demonstration trial was also planted at the site (see location of the demonstration on the plot plan in Appendix 1). A plot plan for the trial is given in Appendix 2.

<u>Post harvest</u>
The whole area was grazed by sheep during the summer after harvesting. Two composite soil samples were taken from each experimental plot in January 2007 and sent for (macro- and micro-elemental) analysis to the Elsenburg soils lab. Note that

these were the last soil samples taken from the trial site since 2006 was the final year of the 5-year cropping phase.

Results

<u>Rainfall</u>

As was the case in most of the southern Cape in 2006 the summer months were relatively dry with few significant rainfall events. A number of evenly distribute rain showers, each less than 5mm occurred from January to the end of March. Regular rainfall events of between 5 and 15mm occurred from early April to end July (Figure 1). Rainfall during August was high (Figure 1) and this rainfall together with the already wet soils resulted in water-logging across much of the Riversdale "Vlaktes". The water-logging is likely to have had a negative effect on crop yield in some areas. Persistent small rainfall events delayed harvesting until the end of November. A total of 424mm of rain was recorded for the period April to end October 2006 and was the highest rainfall recorded for the 5-year research period.

Planting was not affected by wet soils. Insect and disease control measures were applied by spray aircraft as the lands were too wet for tractors to enter the fields when the disease and insect pests had to be controlled.

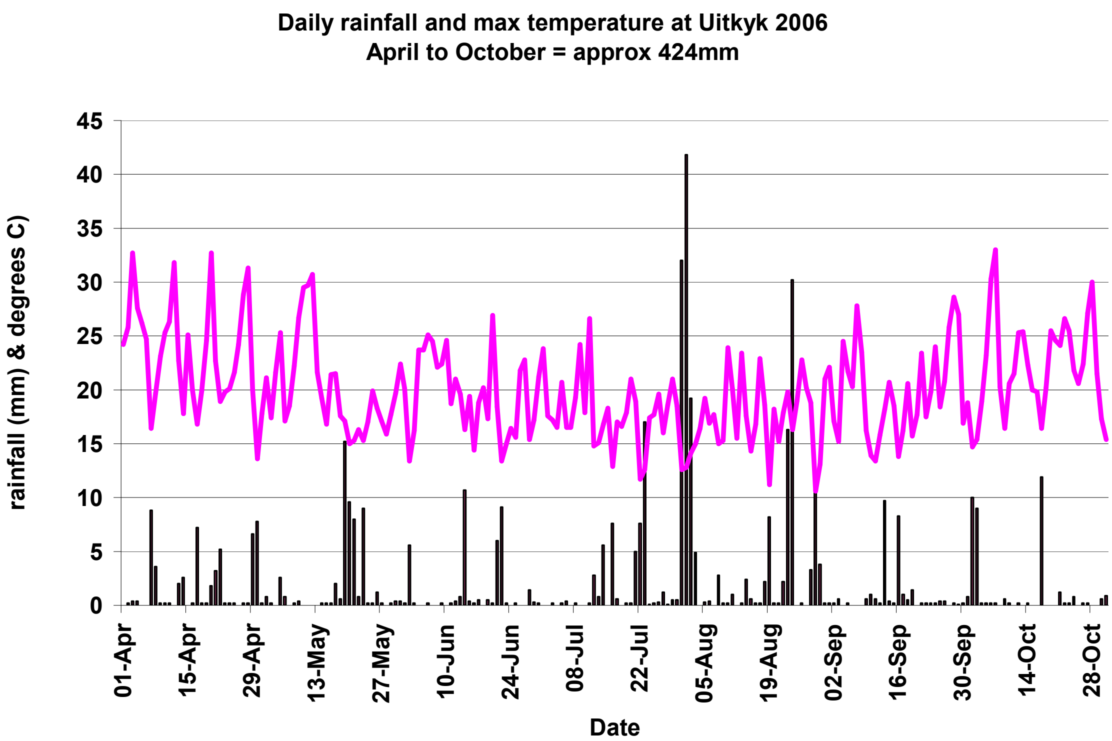


Figure 1 Daily rainfall recorded on Uitkyk during the 2006 growing season

<u>Plant counts</u>

Wheat - Estimated plant density ranged from 63 to 90 seedlings m^{-2} (Figure 2). Crop sequence appears to have no effect on density. For a seeding rate of 50kg/ha, TSW of 43g, germination of 98% and an expected 80 survival of germinating seeds a seedling density of 90 was expected.

Triticale - Estimated plant density ranged from 76 to 100 seedlings m^{-2} (Figure 2). As was the case for wheat crop sequence appears to have no effect on density. For a seeding rate of 50kg/ha, TSW of 39.7g, germination of 90% and an expected 80 survival of germinating seeds a seedling density of 90 was expected

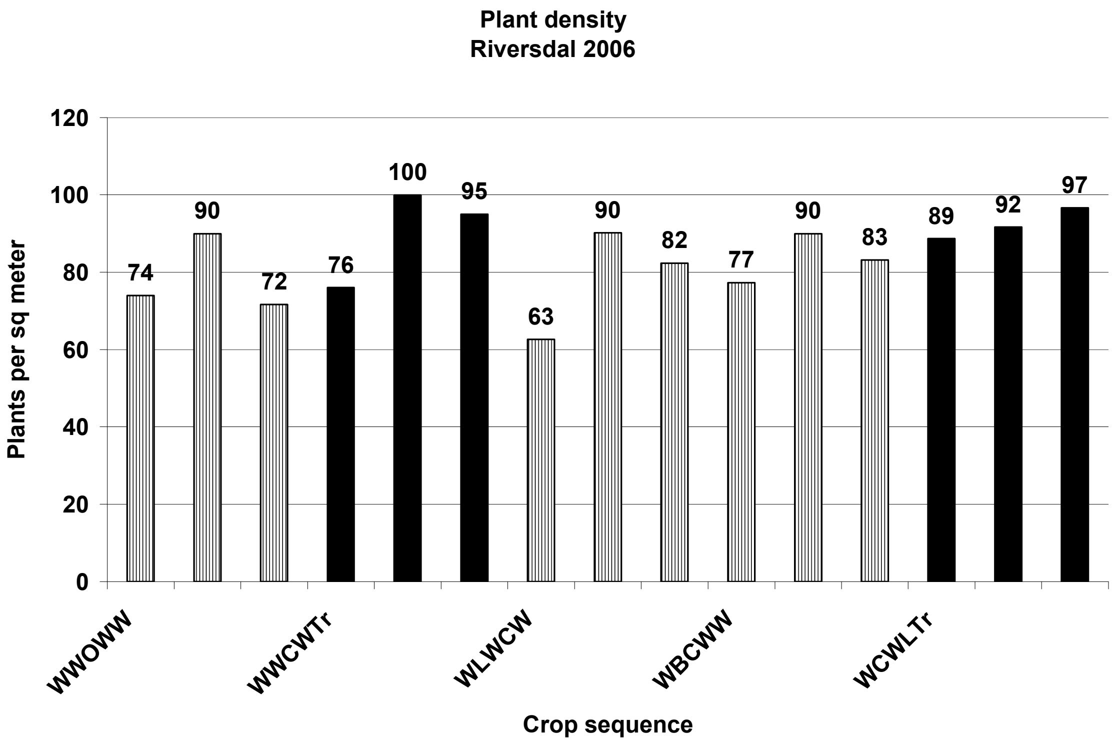


Figure 2 **Seedling densities for wheat and triticale in each replication of each system. Note that the crop is the 5th crop in the crop sequences. W=wheat, C=canola, L=lupin, Tr=triticale, B=barley, O=oats**

Crop yields

Crop yields are presented in Figure 3.

Wheat yields were similar to those recorded for similar sites on the farm. High soil moisture conditions at the site would have limited gas exchange in the soils and soil temperature is likely to have been lower than most seasons. These factors would have limited the potential of this cultivar (SST 027) which achieved yields in excess of 4000kg/ha on well drained soils in the region (see wheat yields in the Tygerhoek section of this report).

In contrast to previous seasons there is no distinct pattern indicating that the previous season's crop had any influence on wheat yields in 2006. Wheat after wheat in the WWOWW crop sequence had the lowest average production (2579 kg/ha) with wheat after wheat in the WBCWW crop sequence had the highest mean production (2959 kg/ha). In contrast to previous seasons the yield of wheat after canola (2724 kg/ha) was, on average, similar to the yield of wheat after wheat systems.

There is no clear correlation between crop yield and plant density (cf Figs 2 & 3). Thousand seed mass (TSM) were in the range 38 to 40g and were not affected by crop sequence.

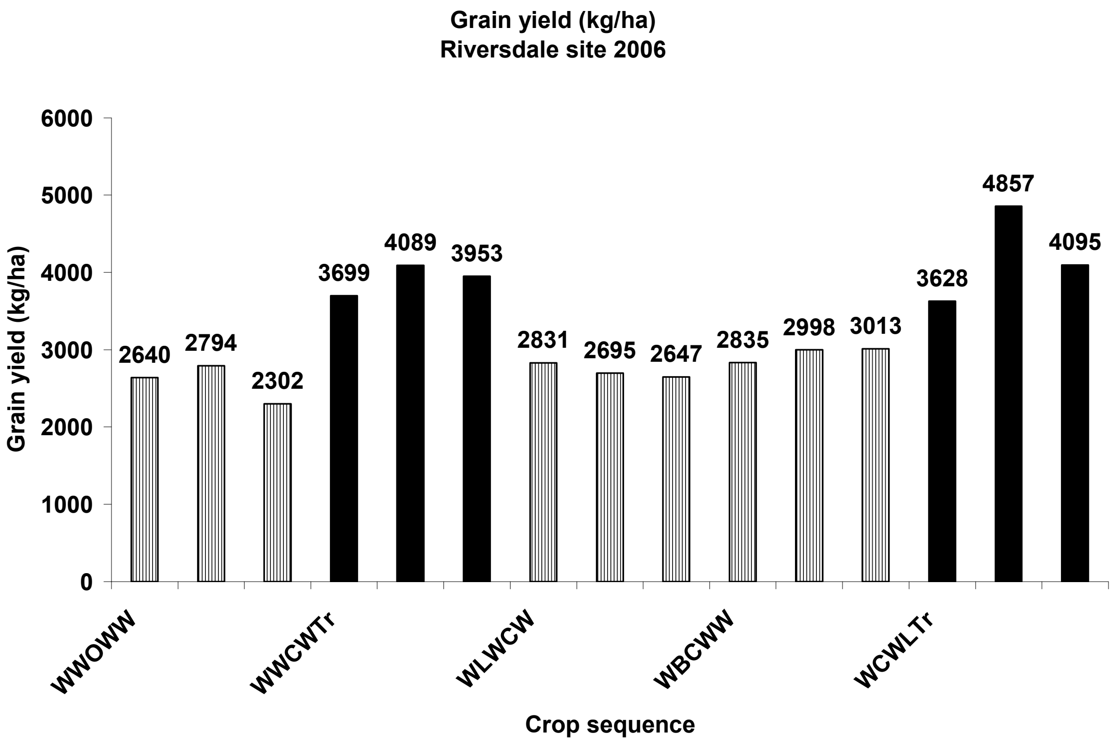


Figure 3 Crop yields for wheat and triticale in each replication of each crop sequence. Note that the crop is the 5th crop in the crop sequences. W=wheat, C=canola, L=lupin, Tr=triticale, B=barley, O=oats

Triticale (Bacchus) yields were excellent (Figure 3) despite the low plant densities (Figure 2) and far greater than expected. Yield was, on average, higher where lupins were planted in the previous season (4193kg/ha vs 3913kg/ha). High yields compensated for the relatively low market price of Triticale with little difference in estimated gross margins between sites for the 2006 season (Figure 4). Wheat @ R1285/ton to R1395/ton depending on grade, and Triticale @ R950/ton. The much lower gross margin realised for wheat in the WWHWW crop sequence is a function of lower yields and lower grading of the crop.

Crop quality

Results of the quality analyses conducted at the SSK silo at Swellendam are presented for **wheat** in Table 3. The quality parameters as determined by the Swellendam silo are used to determine the value of the crop for that particular season and are used in the COMBUD analyses of each production system. Quality of wheat data, as determined by the University of Stellenbosch, are provided in Appendix 3. %CP of wheat samples as determined at the Stell. Uni. labs is lower at the higher end of the range and higher at the lower end of the range than those determined for the same samples at the SSK silo lab (cf data in Appendix 3 with the data in Table 2). Regression analysis shows a high and significant correlation between the two measurements ($y = 1.599x – 6.48$; $r^2 = 0.932$: x = %CP @ SU & y = %CP @ Swell silo). “Falling number” is above minimum allowable levels before the grain could be downgraded due to this quality parameter (Appendix 3). Wheat grading was therefore influenced by the %CP content and HLM. %”Sifsels” were generally low and within minimum allowances.

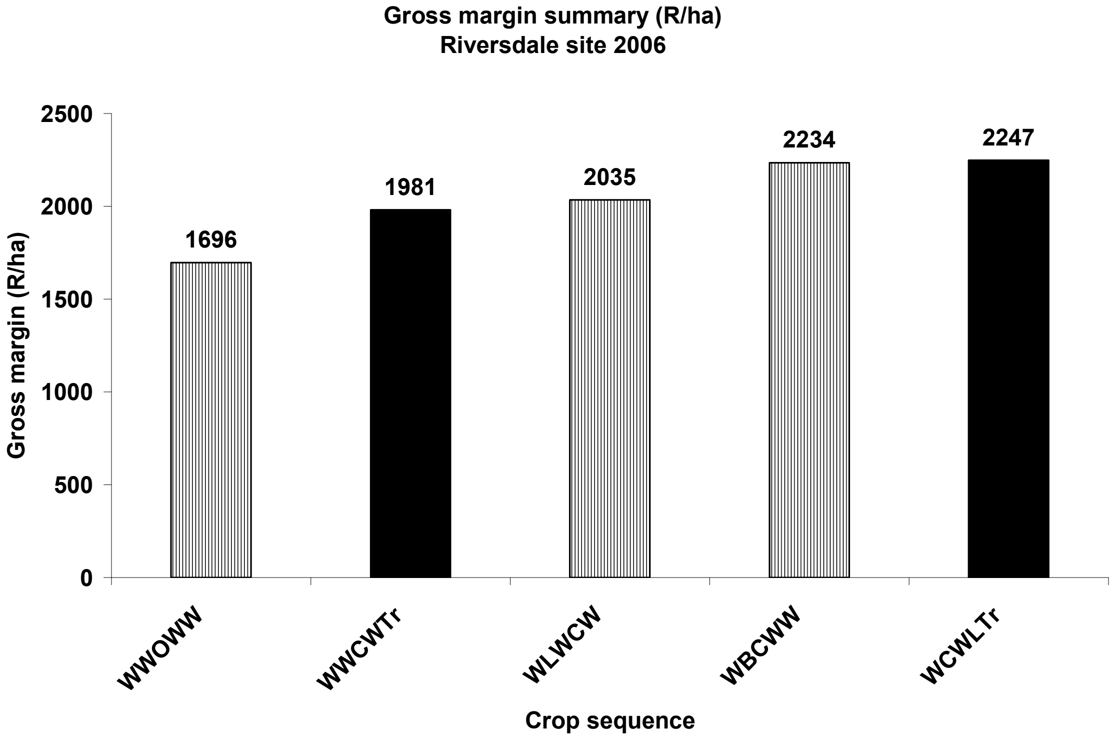


Figure 4 **Average gross margins for wheat and triticale in each crop sequence. Note that the crop is the 5th crop in the crop sequences. W=wheat, C=canola, L=lupin, Tr=triticale, B=barley, O=oats**

Wheat quality was lowest in the WWOWW crop sequence and highest in the WLWCW crop sequence (Table 3).

Table 2 **Hectolitre mass (HLM - kg), % crude protein (%CP), % "Sifsels" and grading for wheat samples as determined at the SSK silos, for the Riversdale site in the 2006 season**

Wheat				
Previous seasons crop	**HLM**	**% CP**	**% "Sifsels"**	**Grade**
WWOWW	76.4	10.58	1.30	B3
WWOWW	76.5	10.60	1.50	B3
WWOWW	74.0	9.87	0.90	B4
WLWCW	76.5	12.36	2.00	B2
WLWCW	75.2	12.20	1.90	B2
WLWCW	74.6	11.15	0.80	B3
WBCWW	76.5	10.60	2.10	B3
WBCWW	75.6	11.00	2.10	B2
WBCWW	75.1	9.60	1.60	B4

For Triticale %CP ranged between 8.4 & 10.1, and HLM ranged from 68.3 & 70.7.

<u>Seeding rate trial</u>
Similar results to those recorded for the 2005 season were recorded in 2006. A detailed statistical analyse of all data collected in these large-scale seeding rate trials since 2003 is being undertaken and will be reported on in full once completed. In summary results for the 2006 season showed that: plant density increased with

increased seeding rate. Ear density (ears m^{-2}) increased asymptotically while the number of ears $plant^{-1}$ decreased with increasing plant population. TKM and number of kernels ear^{-1} decreased with increasing ear density. Due to this negative correlation between ear density and both TKM and kernels ear^{-1}, grain yield was not affected by plant or ear density. Grain yield was also not related to the TKM or number of kernels ear^{-1}. Refer to summary figures in Appendix 4.

As stated in the report for the 2005 season, these results clearly show the wheat plant's physiological and phenological ability to adapt to decreased plant populations by increasing ear density, number of kernels per ear and TKM towards maximising grain yield if soil and climatic conditions are favourable.

Weed seed-bank study

The weed seed-bank study data will be discussed once a full data set is available after the 5th year of study on this site. Grass weeds have not become a problem on the site.

Soil analyses

Results of the soil analyses are presented in Appendix 5. These data were used when planning fertilisation requirements for each plot. No lime or P was applied to any plots besides maintenance P at planting (Table 1).

Lucerne cultivar demonstration

Dry matter yield was estimated on each plot once during 2006 (24/10/2006). Refer to Appendix 2 for detail of cultivars and trial layout. The plants had not been defoliated since planting in May 2006. Having been planted at the start of the winter the plants were only now beginning to tiller strongly. Statistical analyses (randomised block design with three replications) showed that PAN4546 had produced more dry matter than all the other cultivars (PAN4546 prod = 3372 kg/ha). WL414, SASTD and Aurora had similar production (2752, 2726 & 2568 kg/ha respectively) and WL357 the lowest production (2508 kg/ha). These are obviously preliminary data and must be treated within the context of planting date, season, not defoliated and time of season when DM was estimated.

Swellendam – Napky (*Long-rotation* site)
The plot plan for the 2006 season is presented in Appendix 6. Note that 2006 was the final year in the 5-year cropping phase on the research site. The trial moves to a new (adjacent) site in 2007 where the next 5-year cropping phase, following 5 years of lucerne pasture, will start.

<u>Site and crop management</u>
Dune snail infestations that had been developing over the past few years, and on treatment plots that had high levels of free lime in particular, had reached levels where it was necessary to control them before planting. It is important to note the observation that the snails first started to increase in numbers in plots planted to canola (2003). The snails creep up the plant stubble/residues, over-summering above the hot, dry soil surface. Options for control are limited. The most practical option (reported from Australia) was to flatten ("sleep") stubble by dragging a draw-bar ("sleepyster") behind a tractor on a hot day during summer, causing physical damage to snail shells and forcing the snails to remain on the hot soil surface where they desiccate and are unlikely to survive. This operation was done twice (January – on the whole trial area, and in March – on half of the trial area i.e. those plots located on the south western side of the site) with limited success.

Since no significant rainfall events occurred during the summer months it was not necessary to spray for weeds before the first autumn rains. A number of small but well spaced rain showers occurred from the end of March to end April, stimulating weed germination and allowing for a single, pre-sowing, broad-spectrum herbicide application before planting the site on 5 May 2006. All management activities for each crop planted in 2006 are summarised in Table 3.

Table 3. **Management of crops planted at the Swellendam site during 2006**

Crop	Cultivar	Planting date	Seeding rate (kg/ha)	Fertilisation rate at planting (kg/ha)	Top dressing (kg/ha) (application date)	Crop protection Product (date)
Wheat	SST 57	04/05	59.0	23.6 N + 8.8P + 2.0 S – all plots	nil	Glyphosate (03/05) Hoelon & Bromoxinal + Dimet (10/06) Opus + dimet (21/07)
Barley	Clipper	04/05	51.0	23.6 N + 8.8P + 2.0 S – all plots	nil	Glyphosate (03/05) Hoelon & Bromoxinal + Dimet (10/06) Opus + dimet (21/07) Opus (30/08)
Triticale (Korog)	Bacchus	05/05	55.0	23.6 N + 8.8P + 2.0 S – all plots	nil	Glyphosate (03/05) Hoelon & Bromoxinal + Dimet (10/06) Opus + dimet (21/07)

All seed was planted with the Tygerhoek "no-till" row planter built by the Engineering section at Elsenburg. The planting mechanism places all fertilizer with the seed at planting. The SSK research plots were scarified in early April (Refer to Appendix 6 - site plan) and then planted to wheat using the no-till planter on the same date as wheat was planted on the rest of the experimental plots.

All plots were inspected frequently to ensure that weed and insect control measures, swathing and harvesting were taken timeously.

Late and regular, small rainfall events resulted in slow maturation and ripening of the crops. Harvesting was therefore delayed by at least a month beyond the "normal" harvesting date. All the barley and triticale plots were swathed "platgesny" at the end of October and harvested ("opgetel") on 5 December. Wheat was harvested directly on 13 November.

Data collection

Yield and quality – Barley and triticale yields were estimated from 2x150m swathed windrows (6.4m wide), located off-centre to avoid the "wenakker", of each plot. Wheat yield was estimated by directly harvesting three sample strips (each 151m long by 1.5m wide) from each plot using the ARC-SGI small-plot harvester. Two grain-samples (each of 3 kg) were drawn from the yield of each plot for quality analyses.

Samples were sent for grading to the SSK silo at Swellendam. Wheat samples were also sent to Stellenbosch University (Agronomy Department) for quality analyses. The thousand seed weight (TSW) was determined for all samples.

Plant counts were done on all plots on 01/06/2006 using the procedure first used in the 2005 season i.e. counts were done within plant rows for each of 20 randomly located 1.0m row-lengths in each plot. Note that a systematic random sampling procedure was followed to ensure that the whole plot was sampled.

Daily rainfall was recorded at the ARC's automatic rainfall station situated at the homestead 0.5 km away from the trial site.

Weed dynamics – Thirty-eight composite soil samples were taken during March 2006 (two from each of the 19 plots – see detail in data files at Tygerhoek), placed into seedling trays and kept in a shade cloth facility at Tygerhoek. All seedlings that germinated in each tray were counted and identified. These data were used to estimate weed seed banks for each plot. The same procedure was followed in the previous two seasons.

Post harvest

Sheep grazed the whole area during the summer. Two composite soil samples were taken from each experimental plot in January 2007 and sent for (macro- and micro-elemental) analysis to the Elsenburg soils lab. Note that these were the last soil samples taken from the trial site since 2006 was the final year of the 5-year cropping phase.

Results

Rainfall

The summer and early autumn months were relatively dry with few significant rainfall events. A number of evenly distribute rain showers, each less than 10mm occurred during April and early May allowing for pre-planting herbicide control and an early May (5th) planting date (Figure 5). A dry period from late May to mid July appears to have resulted in greater stress for the wheat cultivar (SST 57) than occurred in the barley (clipper) and triticale (Bacchus) crops (refer to crop yield data). Good rains fell from 20 July through to the end of August and regular rain shower occurred through to end October and into November resulting in a late harvesting season. Temperatures remained cool which, together with the favourable moisture availability in the later part of the season (Figure 5), provided conditions for above average yield of barley and triticale. Total rain during for the period 1 April to 31 October was 256mm, which is relatively high for the farming district.

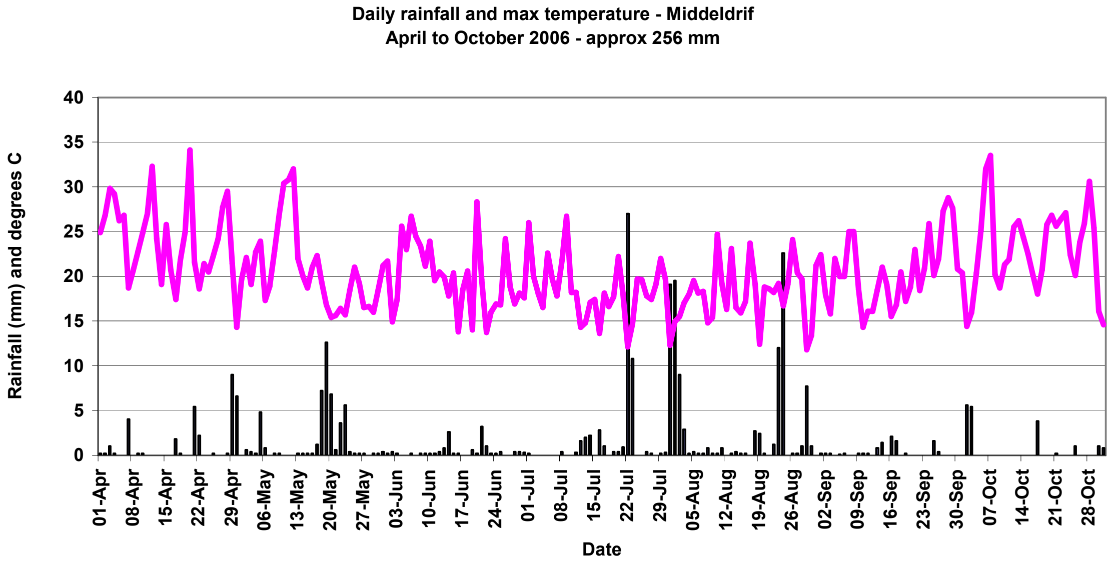


Figure 5 Daily rainfall for the 2006 season

<u>Plant counts</u>
Seeding rates were aimed at plant densities in the range 100 to 120 plants per sq meter for wheat, 80 to 90 for barley, and 100 for triticale.. This was done to limit competition between the sown crops and the under-sown lucerne thus providing the lucerne an opportunity to establish during this final year of the cropping phase. The tillering potential and growth pattern of the crops were also taken into consideration, hence the differing target plant densities for the different crops.

Wheat – Wheat was planted following canola in all crop sequences where wheat was planted. Average plant density per crop sequence ranged from 100 to 116 plants m^{-2} (Figure 6). These plant densities were in the expected range indicating favourable conditions for germination and seedling survival following planting (TSW of 43.4 x seeding rate of 67 kg/ha x germination % of 98% x expected 80% survival rate of seedlings).

Barley – Barley followed wheat in both crop sequences where barley was planted. Target plant densities were achieved again based on measured TSW, germination %, seeding rate and expected 80% seedling survival (Figure 6).

Triticale – As for the other two crops target densities were achieved (Figure 6).

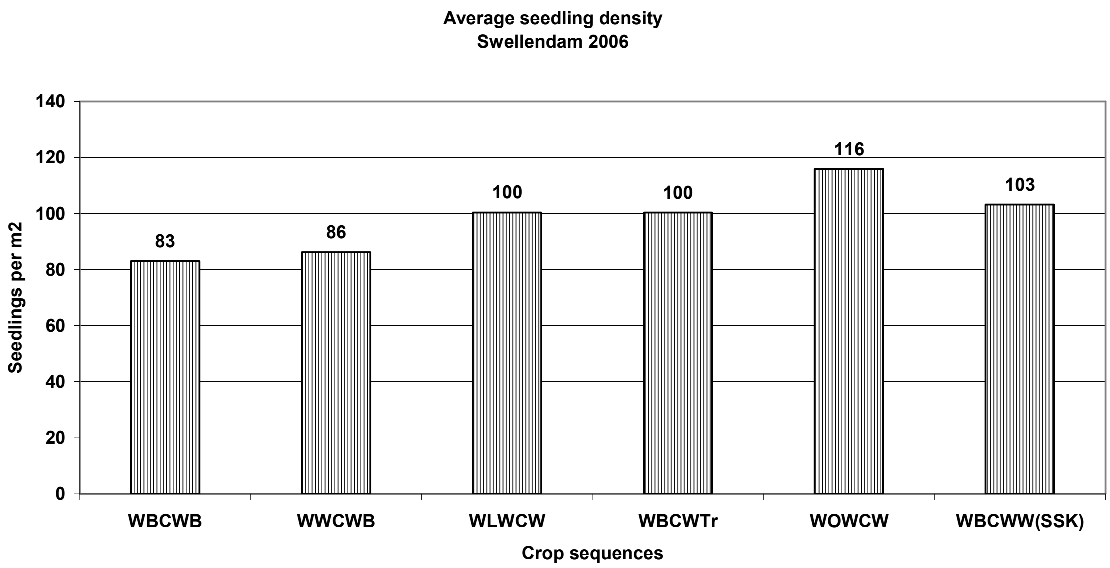


Figure 6 **Average seedling counts for each crop sequence 2006. W = wheat, C = canola, B = barley, Tr = triticale: SSK = SSK site**

Ear counts showed the inherent differences in tillering among the crops. Barley had the lowest plant densities but ear densities were twice those measured for the wheat and triticale i.e. 360 to 390 ears m^{-2} for barley versus 170 to 190 ears m^{-2} for wheat and 175 ears m^{-2} for triticale.

<u>Crop yields</u>
Crop yields are summarised in Table 4.

Table 4 **Average and range in yield of crops during the 2006 season (W=wheat; C=canola; B=barley; Tr=triticale)**

Crop in 2006 (crop sequence)	Average yield (kg/ha)	Range in yield (kg/ha)	Number of plots
Barley (WBCWB)	2686	2241 – 3039	3
Barley (WWCWB)	3340	2964 – 3768	3
Triticale (WBCWTr)	3273	2402 – 3773	3
Wheat (WLWCW)	1759	1297 – 2365	3
Wheat (WOWCW)	1930	1612 – 2203	3
Wheat (WBCWW)	1451	1359 – 1578	3

Crop yields reflected the favourable moisture conditions that were experienced during the 2006 season. These yields were by far the best recorded for the 5 year experimental period.

While these results were better than expected, wheat yields were generally lower than the average for the surrounding camps on the farm. It is difficult to speculate why the wheat yields should have been lower but it may have been due to the fact that the wheat was planted a week or two earlier than other wheat on the farm. The favourable soil moisture conditions at and just subsequent to planting would have resulted in rapid establishment of the seedlings but the extended period of soil moisture stress conditions that occurred from about two weeks after planting would have coincided with the period of the wheat plant's development when its production potential was being established (40 to 60 days after emergence). The lowest wheat yields were also obtained in plots that had either high levels of free-lime in the soils or had shallow soils on warmer aspects of the trial site.

Crop quality

Results of the quality analyses conducted at the SSK silo at Swellendam are presented for **wheat** in Figures 7 & 8. As reported for the 2005 season there is considerable variability in grade due to the variability in HLM (Fig. 8). Crude protein concentrations are surprisingly high considering the relatively high yields obtained and the low N application rate (Figure 7 & Tables 3 & 4). Another important point to consider is that these %CP figures were recorded for wheat that followed the previous season's canola. There is a perception among producers that the protein content of wheat following canola tends to be lower than wheat following other crops. This may well occur due to the relatively high N requirement of canola leading to lower residual N in the field following a canola crop. However, this data set and those collected from several sites in the southern Cape over the last 5 seasons have not supported the perception of lower protein in wheat following canola.

Wheat produced from all crop sequences was of an extremely poor quality (Figure 8). Grain quality was reduced due to very low HLM that could be ascribed to the moist conditions that occurred while the crop was drying. Furthermore, the moisture content of the grain delivered to the silo was in excess of 12%, mostly 14%+. It is noted that the UT and AKK grades would increase once the grain had dried below 12%. For the purposes of economic analysis all grain will therefore be upgraded to B4 and a drying cost will be included in the budgets.

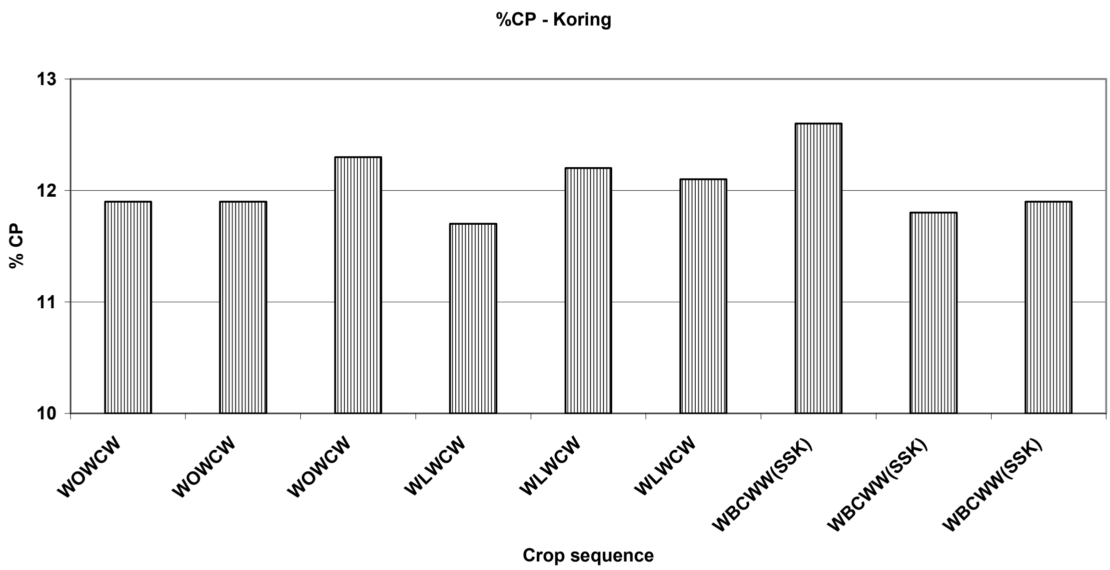


Figure 7 Quality (%CP) at the Swellendam site in 2006 for all plots planted to wheat. W = wheat, C = canola, B = barley, Tr = triticale

The other factor that resulted in a downgrading of the grain was contamination with snails. All plots where the grading was recorded as AKK ("class other wheat") were infested with snails. These plots were also those with high levels of free lime in the soil. The previous season's canola crop would have exacerbated the snail densities.

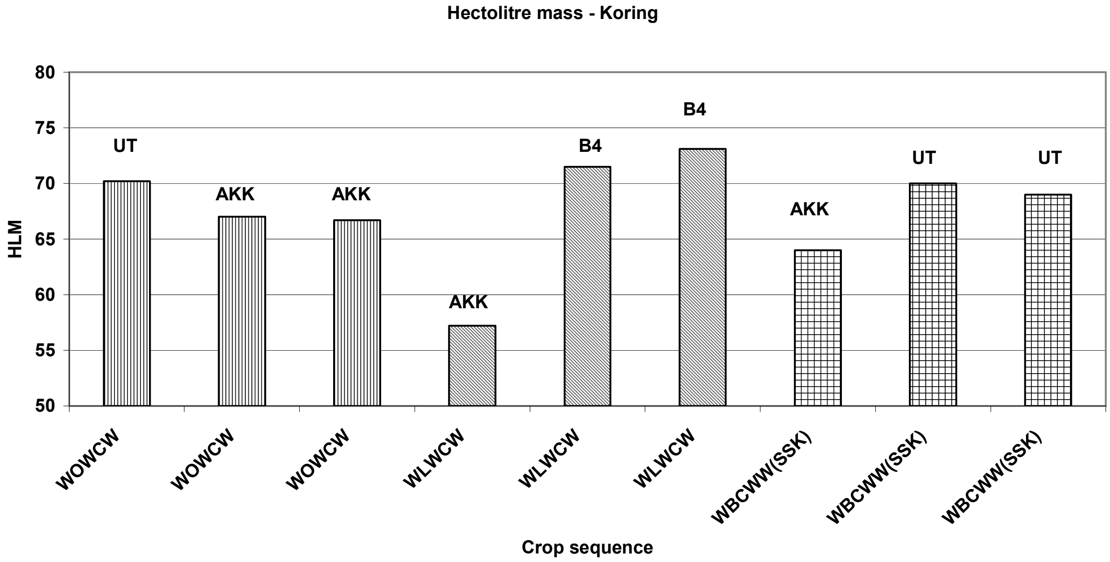


Figure 8 **Quality (HLM) and grade (AKK, UT & B4) for the Swellendam site in 2006 for all plots planted to wheat. W = wheat, C = canola, B = barley, Tr = triticale**

Quality of wheat data, as determined by the University of Stellenbosch, are provided in Appendix 7. The discussion on wheat quality for the Riversdale site applies here.

Weed seed-bank study

Ryegrass populations have increased in all crop sequences. Summarised trends in ryegrass populations from the 2002 to 2006 seasons are presented in Figure 9.

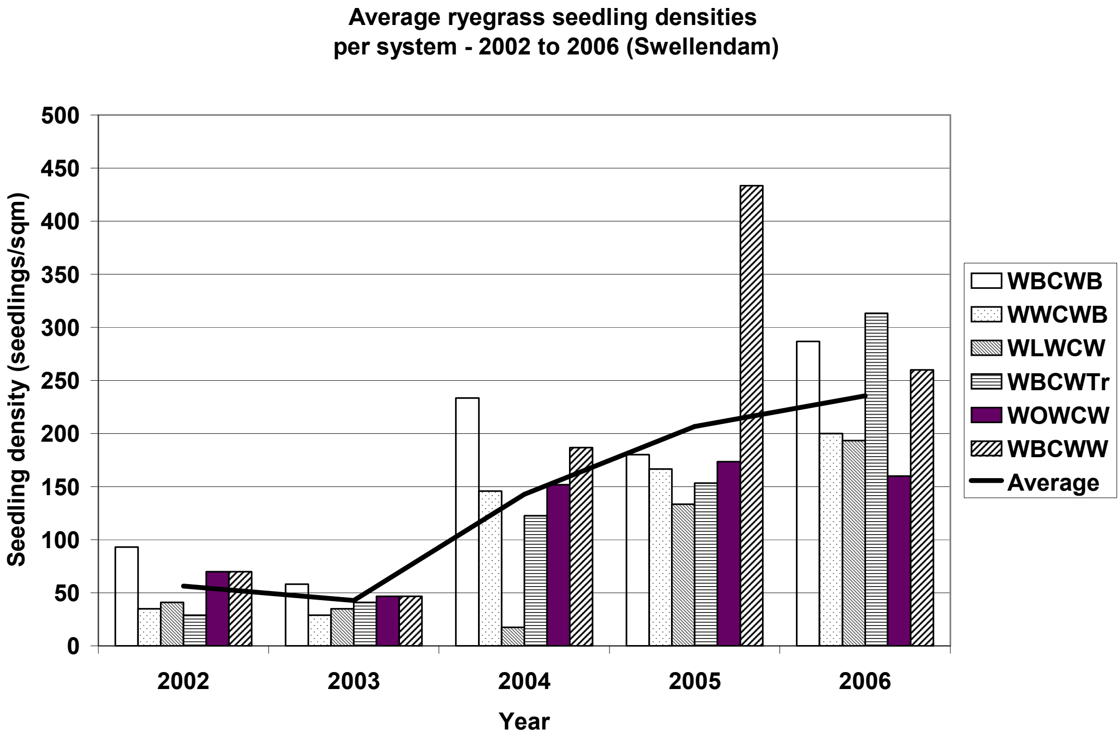


Figure 9 **Average ryegrass seedling density in each system from March 2002 to March 2006. W=wheat, C=canola, B=barley, L=lupin, Tr= triticale**

Soil samples used for soil seed-bank studies were collected during March each year so the data presented for each year represents the effects of the previous season's crop and crop management on soil weed seed banks (in 2002 all plots were sampled after 5 years of lucern).

There has been a steady trend of increasing ryegrass densities over all crop sequences. The ryegrass densities as estimated from soil seed-banks at the start of the 2006 season are unacceptable and would have had a great negative effect on crop yields if they had been allowed to persist (or could not be controlled) in all the crops. Fortunately ryegrass was relatively well controlled through the application of Bromoxinal. Soils samples taken in March 2007 will provide the final weed-seed-bank data for this site and provide an indication of the rate of increase of ryegrass for each treatment over the five-year trial period. At this stage it does not appear that any of the crop sequences that were tested provide adequate opportunity to control ryegrass in this dry region of the Napky.

<u>Soil analyses</u>

The results of soil analyses for each plot are presented in Appendix 8. These data were used when planning fertilisation requirements for each plot. Plots and portions of plots with free lime are clearly shown by the high pH (pH>7). These are: 5b, 9a&b, 10a&b, 11a, 17b, 18b & 19a where a & b refer to the top "half" and the bottom "half" of each plot respectively. If these figures are superimposed onto the plot map the area of high pH (free lime) over the research site is quite clear. This area is then the area where snail infestations first started and where high pH negatively influenced crop growth and development.

Tygerhoek – (Short-rotation experimental site)

The plot plan for the 2006 season is presented in Appendix 9.

Crop and pasture management

Wheat, barley, oats, canola, lupins and medic/clover pastures were sown in the report year. Detailed management inputs for each crop are available on file at Tygerhoek (hard copy and electronic). Note that the management inputs for each crop varied depending on the crop planted in the previous year and the specific requirements of each plot. A summary of management inputs follows.

All crops were planted with a knife-point DBS Auspow planter (13 knife-points each 300mm apart). Fertilizer (N & P) was placed below the seed at planting. Nitrogen top dressings were applied as Nitrosul (26%N + 5%S).

Wheat (SST 027) was planted at a seeding rate of 69 kg/ha together with 20 kgN/ha, 15 kgP/ha and 10 kgS/ha on 10 & 11 May 2006. Refer to details on file for weed, pest and disease control measures. Fertiliser top dressings were applied as required. Wheat was also planted in all of the VAR treatment camps viz. Sub-camps 1.3, 8.4, 15.2 and 17.3 since the weed problem had been greatly reduced in those sub-camps and potential returns were greater than for alternative crops such as canola and oats.

Barley (SSG 564) was planted at a seeding rate of 48 kg/ha together with 20 kgN/ha, 15 kgP/ha and 10 kgS/ha on 11 May 2006. Refer to details on file for weed, pest and disease control measures. Fertiliser top dressings were not applied to any of the barley plots. Note that the crop was sprayed only once to control diseases.

Oats (SSH405) was planted at a seeding rate of 39 kg/ha together with 20 kgN/ha, 15 kgP/ha and 10 kgS/ha on 1 May 2006. Refer to details on file for weed, pest and disease control measures. Fertiliser top dressings were applied as required. In contrast to previous seasons the oats was planted for seed production (hence SSH405) as grass weed densities had been greatly reduced in those plots. The decision was based on ease of marketing seed as apposed to hay or silage and high potential yields as shown from the Swellendam and Riversdale sites in previous seasons.

Canola (ATR Stubby) was planted at a seeding rate of 3.2 kg/ha together with 20 kgN/ha, 15 kgP/ha and 10 kgS/ha on 26 April 2006. Simazine was applied at planting onto wet soils. Only one N top dressing of 30kgN/ha was applied during the season (about 6 weeks after planting). Snail bait (Mesurol – 6kg/ha) was applied to all plots one week after planting. Refer to details on file for weed, pest and disease control measures.

Lupins (Tanjil) were planted at a seeding rate of 85 kg/ha together with 11.5 kgP/ha on 27 April 2006. Refer to details on file for weed, pest and disease control measures. Snail bait (Mesurol – 6kg/ha) was applied to all plots one week after planting. Fertiliser top dressings were applied as required.

Medic and clover seed were sown into the camps 6 (bottom end of sub plots 1 & 2) and 22 (all sub-plots). These were the pasture camps that were severely damaged by storm water early in 2005 (refer to the report for the 2005 season for more detail). The storm water removed a thin portion of the topsoil as well as caused water-logging in parts of those camps, both impacts resulting in a loss of pasture seed for successful regeneration of the pastures. The pastures were re-seeded on 25 May

2006 at 7.5kg per ha. The seed mix comprised Paraggio (1.5kg), Santiago (1.0kg), Caliph (1.5kg), Gosse (1.5kg), Nungarin (1.5kg) and Balanse (0.5kg).

Sheep remained in their respective treatments with access to both pasture and crop residues through the dry summer months. The sheep were moved to their respective pasture camps in early April. Dry matter production of the medic/clover pastures in the pasture/crop/pasture/crop system (system 3) was extremely poor as pasture regeneration was slow and the sheep prevented pasture seedlings from establishing which had a severe negative effect on sheep production (refer to the results section of this report for further detail). As in previous seasons a detailed record of how much feed was supplied to each group of animals was maintained. A record of sheep grazing days per treatment area was also maintained.

<u>Data collection</u>
Daily rainfall was recorded at a position that is centrally located on the site as well as on other locations on the farm.

Crops
Plant counts were done on all crops at the beginning of June. Counting procedure was the same as that used in 2005. In summary, counts were done within plant rows at each of 20 randomly located 1.0m row lengths in each camp. Note that a systematic random sampling procedure was followed to ensure that the whole camp was sampled.

The incidences of **root disease** and **crown rot** were **not** determined during the 2006 season

All crops were swathed prior to harvesting. The canola was swathed when between 40 and 60% of pod contained seeds that had begun to change colour and were firm enough not to be crushed when rolled between thumb and forefinger. Both the lupins and the canola were harvested in the evening before or when there was the least chance of seed losses due to pod shatter and of pods breaking from stalks during the harvesting process. The total area (adjusted for areas that had been removed to gain access to harvest the oats plots – see records on file) of each camp was harvested and weighed to determine yield per plot of each crop. Two x 3kg grain samples were drawn from the yield of each plot. Barley and wheat samples were sent to the Overberg Agri silos at Rietpoel and to Stellenbosch University (Agronomy Department) respectively for detailed quality analyses. Canola and lupin samples were analysed for % oil and %CP at Elsenburg.

Crop residues were estimated after harvesting. Samples were collected from 20 randomly place 0.25 m^2 quadrats per treatment plot in December 2006.

Pastures
Detailed records of sheep numbers and the duration of grazing were maintained for each camp (see records in 2006 data files at Tygerhoek). The animals were weighed at regular intervals without starvation to provide data for determining growth rates of lambs and mass change of ewes on pastures and crop residues.

Seasonal herbage mass production was monitored in alternate sub-camps of each replicate of the lucerne treatment. Estimates of herbage mass production were taken when the animals entered (“in”) a sub-camp and again when they left the sub-camp (“out”). Samples were collected from 20 randomly place 0.25 m^2 quadrats per sub-camp on each sampling occasion.

Five exclusion cages were allocated per ha and located in each of the medic/clover pasture camps. Herbage samples were cut within ("in" samples) and adjacent to ("out" samples) each cage (quadrat size = 1.0m x 0.25m). The exclusion cages were randomly re-located within the same camp after each harvest and the procedure was repeated. All samples were separated into medic, clover, grasses and broad-leaf weeds, which were then dried and weighed.

Post harvest

Grain stubble, in those camps that were part of a pasture/crop rotation, was grazed by sheep during the summer after harvesting. Pasture residues including medic pods were also used by sheep during summer. Mass of medic pods was monitored during February 2006 in each camp that had been grazed during 2005 (all pods in 40 randomly selected sampling positions per camp using a circular quadrat (110mm diameter) were collected and weighed. The mass of plant material (grain stubble) that remained on each of the cropped sub-camps after harvest was determined in early December 2006

Two composite **soil samples** were taken from each sub-camp in December 2005 and sent for (macro- and micro-elemental) analysis to the Elsenburg soils lab. The soils data were used when planning fertilisation requirements for each camp in 2006.

Potential **weed densities** (soil weed seed banks) were determined from 110 composite soil samples: one composite sample from each treatment camp and two from each of the lucerne treatment areas. Each sample was made up of a composite of 20 "cores" each 40mm in diameter. Soil "cores" were taken to a depth of 50mm. Seedling trays were filled to just over half their depth with weed-free, treated nursery bark. Each composite soil sample was placed into a separate seedling tray, on top of the bark and to a depth of 20mm. Seedling trays were kept moist under shade cloth. The number of seedlings to emerge in each tray was counted, by species, during the growing season. Once identified the seedling was removed from the tray. Data from each replicate were combined to give mean seedling numbers per treatment. Note that this is the same facility used for seed bank studies for the Riversdale and Swellendam sites. The same sampling procedure was applied at the Riversdale and Swellendam sites.

Results

Rainfall

Rainfall and temperature data (Figure 10) were recorded at the ARC-ICSW automatic weather station located close to the trial area. Temperature data were not available for the period 1 April to 28 April. Note that rainfall data are also available from a rain gauge located in the centre of the trial area. This rain gauge is read daily.

January and February were dry months excepting for one large rainfall event (68mm) in the first week of January. A total of approximately 35mm of rain fell during the first three weeks of March. Soils at the site were therefore moist at the start of April providing the potential for a better than average grain production season.

Total rainfall (approx 335mm) for the period 1 April to the end of October 2006 was lower than recorded for the same period in 2005. However two large rainfall events (totalling over 140mm) in April 2005 skews the data for that year. Due to the relatively high rainfall through April and May, and the fact that soils were moist at the beginning of April, the soils remained moist despite a dry period from the end of May to the first week of July 2006. This, together with continued good rains during July and August, and maximum daily temperatures below 30^{o}C provided ideal conditions for cereal grain production (Figure 10).

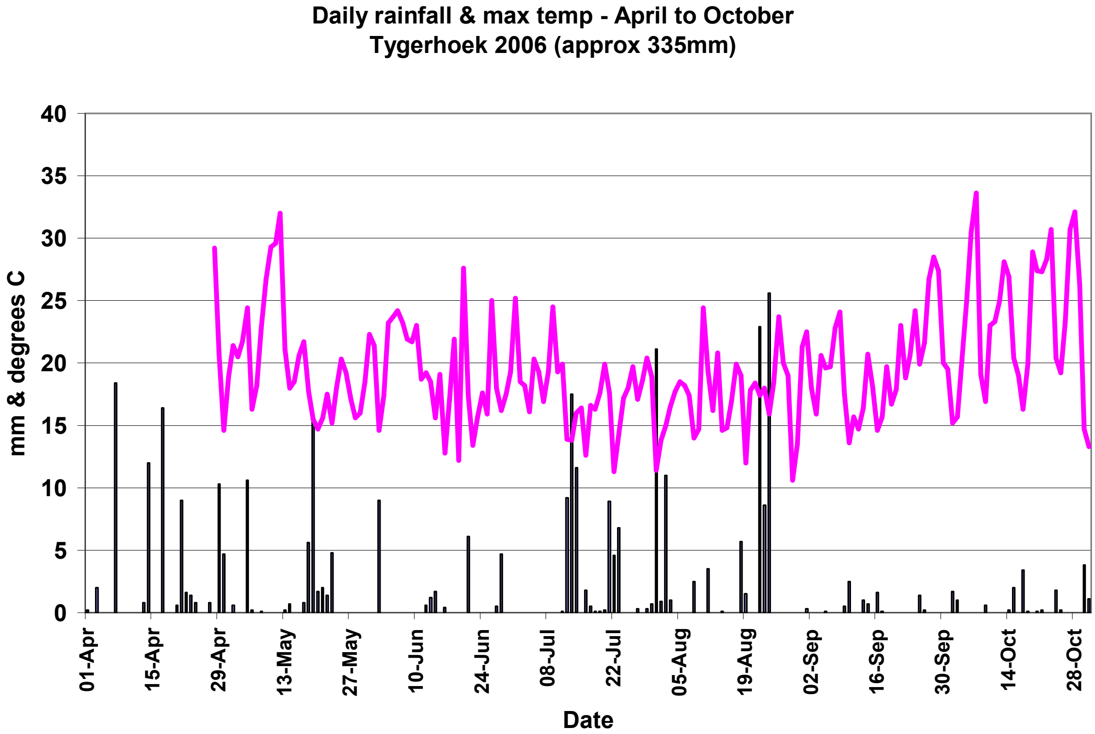


Figure 10. Daily rainfall and maximum daily temperature for Tygerhoek in the 2006 season.

The amount and timing of rainfall did not appear to result in soils becoming water-logged as occurred in the previous season.

<u>Plant counts</u>
Expected seedling densities were calculated for each crop planted in 2006 from the seeding rates, and TSW and germination percentages that had been determined for batch of seed.

Seedling densities for wheat ranged from 99 to 112 and 85 to 112 seedlings m^{-2}, for replicates one and two respectively. The expected seedling density was 125 seedlings m^{-2} indicating that 65% of the seed planted emerged as seedlings. This is considerably lower than the >80% establishment normally assumed for seed planted with the Ausplow planting mechanism but could perhaps be ascribed to the effect of Trifluralin treated soil falling back into the planting row causing a die-off of emerging wheat seedlings.

Seedling densities for barley and oats ranged between 88 to 106, and 91 to 102 seedlings m^{-2}, respectively. These densities were well within the expected seedling densities of 92 and 93 seedlings m^{-2}, for barley and oats respectively.

Seedling densities for canola and lupins ranged from 34 to 44, and 37 to 55 seedlings m^{-2}, respectively. Whilst densities were within the expected range for lupins they were somewhat lower than expected for canola.

<u>Grain yields</u>
Wheat
Wheat yield per plot ranged from 4.0 to 5.5 tons ha^{-1} and 4.4 to 5.6 tons ha^{-1} in replicates 1 and 2 respectively (Figures 11 & 12).

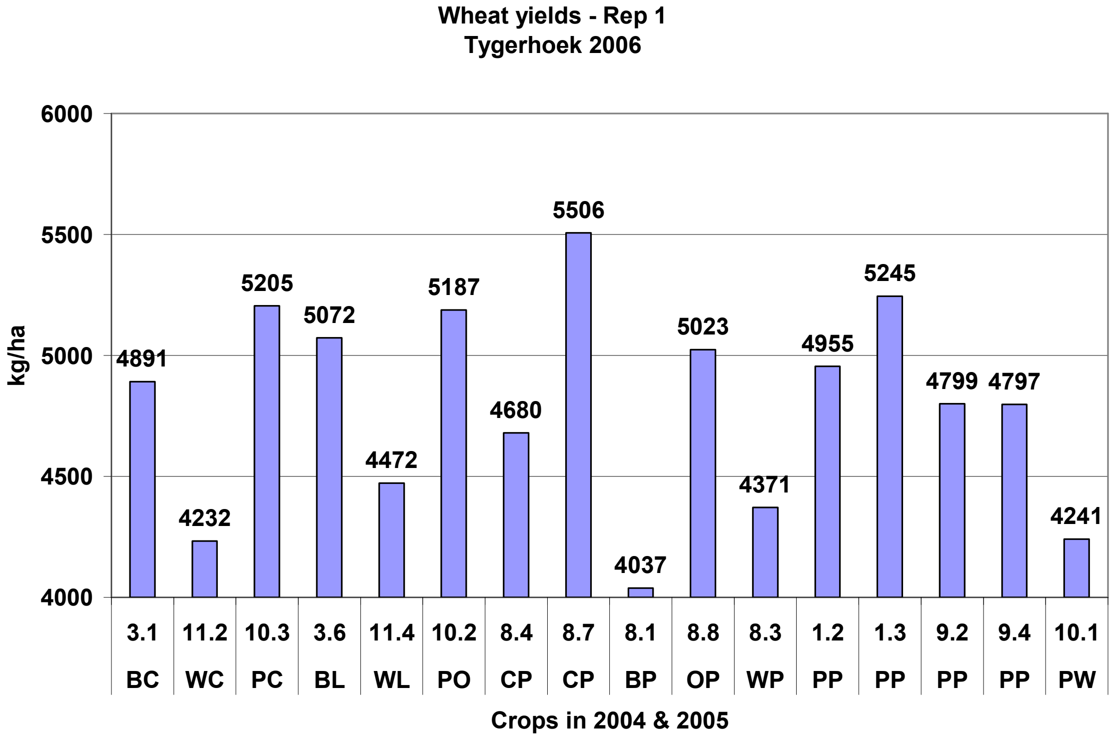


Figure 11 Wheat yields recorded in 2006 for rep 1 plots following different crops in 2004 and 2005 (P = Pasture, L= Lupin, C = Canola, W = Wheat, B = barley, O= Oats: e.g. WP = wheat in 2004 and pasture in 2005)

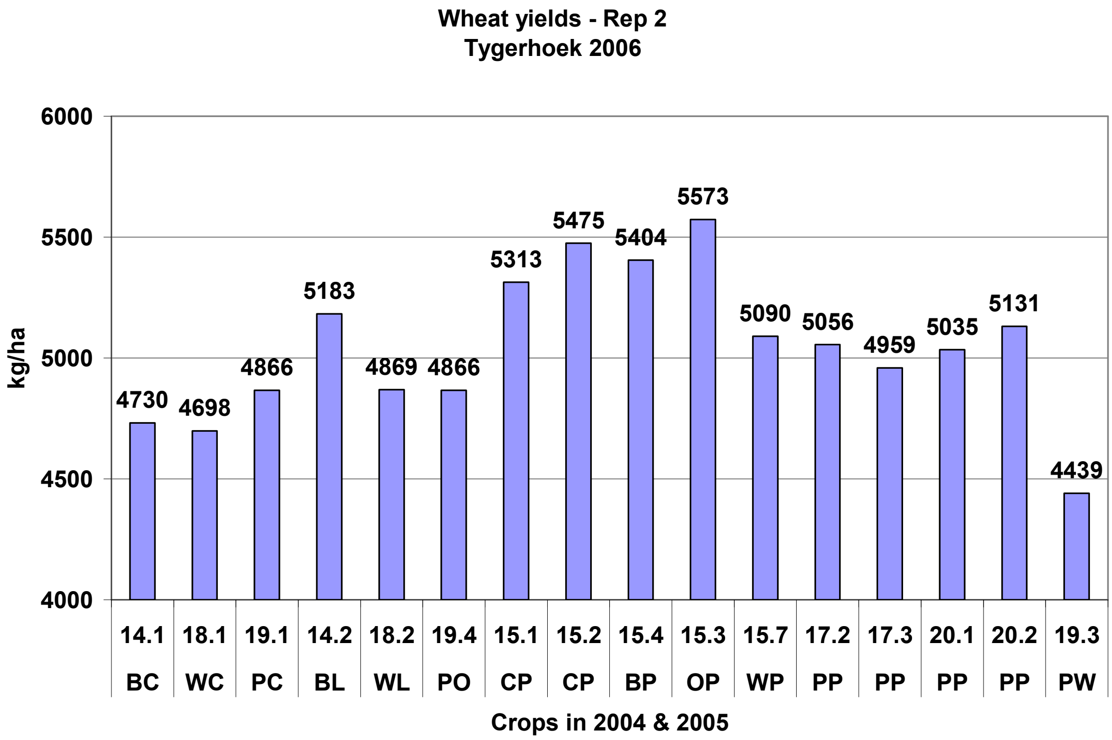


Figure 12 Wheat yields recorded in 2006 for rep 2 plots following different crops in 2004 and 2005 (P = Pasture, L= Lupin, C = Canola, W = Wheat, B = barley, O= Oats: e.g. WP = wheat in 2004 and pasture in 2005)

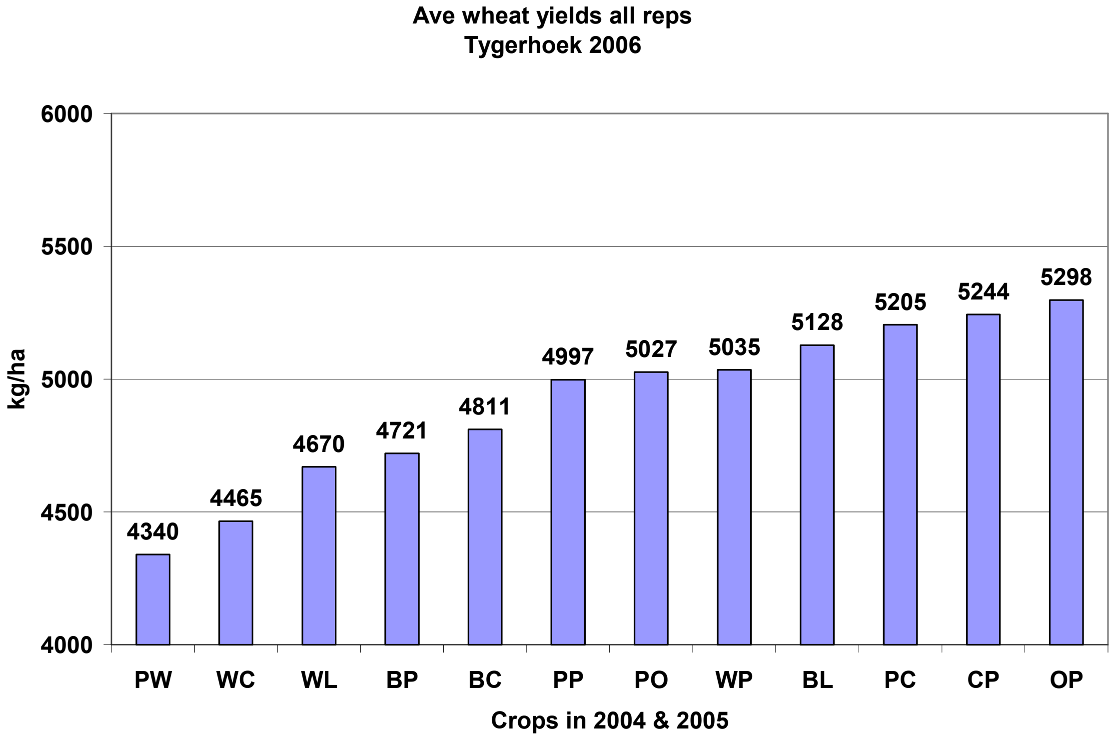


Figure 13 Average (all reps) wheat yields recorded for each wheat camp in 2006 following different crops in 2004 and 2005 (P = Pasture, L= Lupin, B = barley, C = Canola, W = Wheat, O= Oats: e.g. WP = wheat in 2004 and pasture in 2005

The average yield in replicate 2 was approximately 200kg/ha more than the average yield for replicate 1 (Figures 11 & 12). These differences are in contrast to previous results that suggested that yield potential of plots in replicate 1 was higher than for replicate 2 (refer to the 2005 and 2003 annual reports). Yields in the region of 4 to 5 tons are exceptional for the area and reflect the favourable rainfall (amount and distribution) discussed earlier in this report.

It is difficult to see any pattern of the effect of previous seasons' crops on wheat yield from inspection of the data presented in Figures 11 & 12. While data for replicate 2, presented in Figure 12, indicate that greater wheat yields appear to derive from plots where wheat follows pasture if the pasture was cropped in the previous year (2004), this apparent trend is not repeated in replicate 1 (Figure 11). There is, however, a clear trend in yield response to previous seasons' crop sequences when data for the different crop sequences are combined (Figure 13). It appears that where cash crops were planted in the previous two seasons, wheat yields tend to be lower than where a legume pasture (or legume crop – lupin) was planted in the previous season (Figure 13). These data provide some confirmation of the trends seen in replicate 2.

Wheat yields are high despite low plant populations again supporting research into seeding rates when using the Ausplow planter showing that grain yield is not affected by plant densities in the range 100 to 300 plants/sq m.

Barley
Yield of barley ranged from 3.2 to 4.0 tons ha^{-1} and are presented in Figure 14. There are no distinct patterns of yield response to previous seasons' crop sequences. Average yield over all plots was 3.6 tons ha^{-1} compared to an average

yield of 4.9 tons ha^{-1} for the wheat crop. It appears that cold weather during and subsequent to flowering negatively influenced pollination and development of grain. Inspection of barley ears showed that many of the florets were empty. Barley yield could therefore have been higher than recorded for the season.

The lowest barley yields (Figure 14) shown for plots 14.4 & 14.5 are a function of weed competition rather than previous season's crop. Field inspection showed that these plots had high densities of ryegrass and patches of *Bromus*. Grass weed problems were observed early in the development of the plants and test strips with various registered herbicides indicated a high degree of cross-resistance by ryegrass to available herbicides (both Sus and fops & dims) on those plots. At one stage it was thought prudent to make silage from all herbage from these plots (before weeds could produce mature seed). On consultation with advisors in the Agri Chemical industry and leading producers it was decided to harvest the grain as planned and combat the problem during the broad-leaf cropping phase of the rotation.

The relatively low seedling densities do not appear to have negatively affected yields.

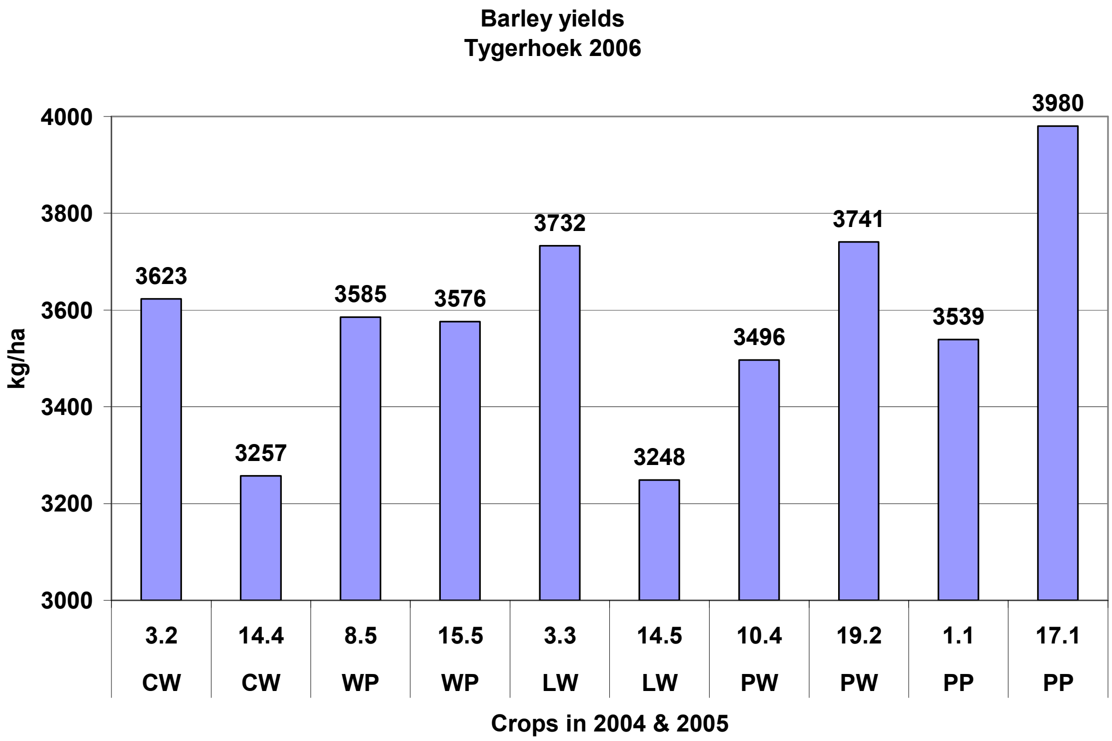


Figure 14 Barley yields recorded in 2006 for all plots following different crops in 2004 and 2005 (P = Pasture, L= Lupin, C = Canola, W = Wheat: e.g. WP = wheat in 2004 and pasture in 2005)

Oats

Grain yields varied from 1.27 to 1.70 tons/ha. These yields were far lower than expected for the season. It appears that the crop may have been too mature before swathing with ripe seed falling from the spikelets during wind and during the swathing process.

Canola

Actual (harvested) canola yields ranged from 1100 kg/ha to 1433 kg/ha (Figure 15). Average yield over all plots was 1270 kg/ha, which is similar to the average canola production for the region. These yields were, however, between 16 and 52% less than the estimated potential yields (Figure 15 & 16). Sampling for potential yield was done just before the crop was swathed. The lower actual yields are of concern in that the necessary care and attention were given when harvesting the crop. Losses are most likely to have occurred during swathing, while the crop was lying in its windrow or during the harvesting process. As recorded above, harvesting was done at a time of day and under climatic conditions when there was the least likelihood of losses due to pod shatter etc. The estimated average yield loss was 38%.

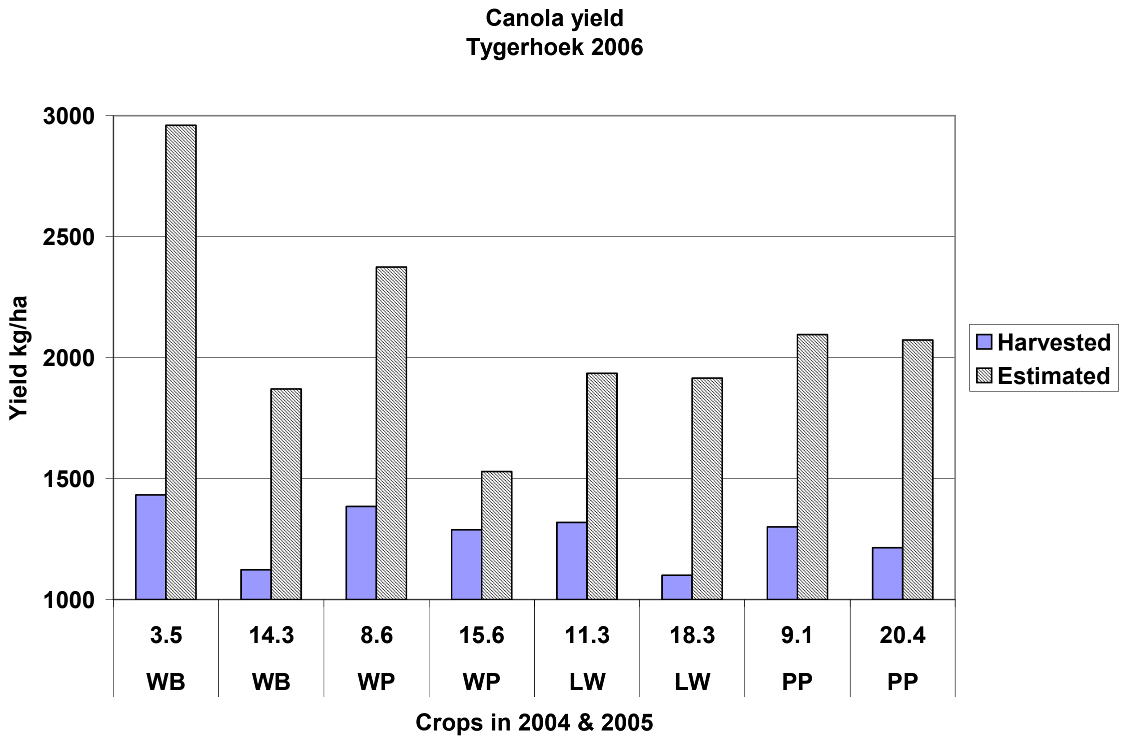


Figure 15 **Harvested and estimated canola yields recorded in 2006 for all plots following different crops in 2004 and 2005 (P = Pasture, L= Lupin, B = Barley, W = Wheat: e.g. WP = wheat in 2004 and pasture in 2005)**

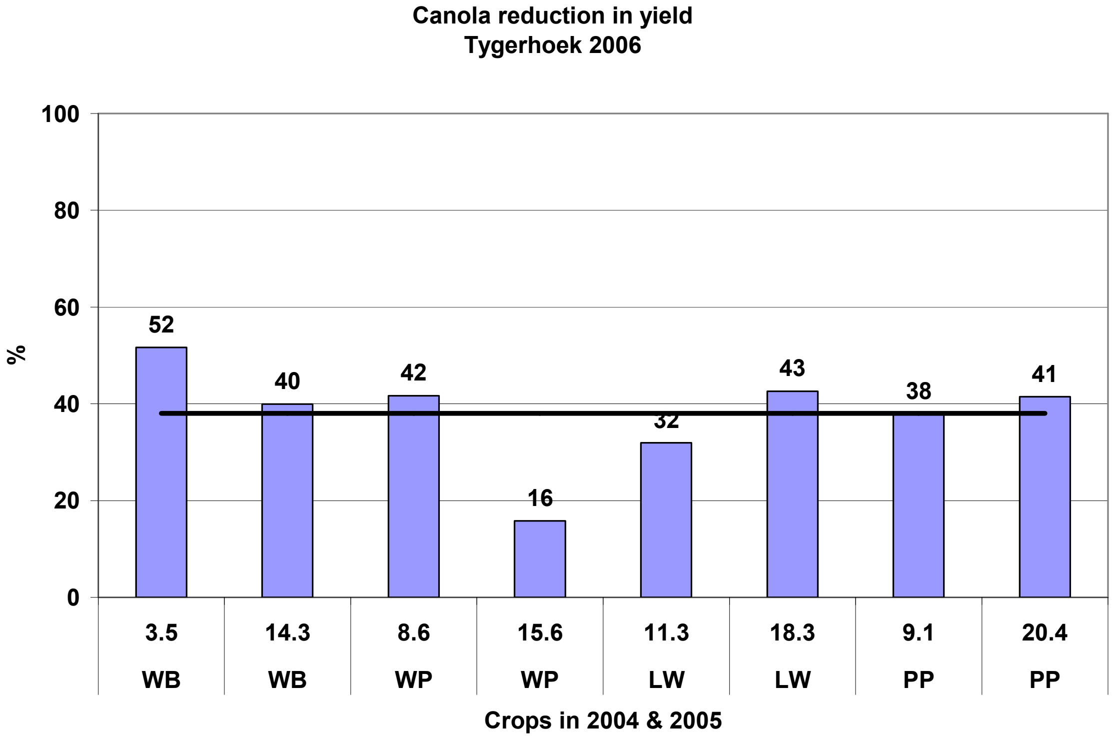


Figure 16 **Estimated canola yield reduction recorded in 2006 for all plots following different crops in 2004 and 2005 (P = Pasture, L= Lupin, B = Barley, W = Wheat: e.g. WP = wheat in 2004 and pasture in 2005)**

The average estimated yield was approximately 2000 kg/ha. So even if there had not been any yield losses the potential canola yield would have only been approximately 40% of the average wheat harvest for the site. Canola is expected to produce approximately 67% of the wheat yield for a given season. As discussed in the previous report the reason for this low proportion could be due to the cultivar used (ATR Stubby).

Lupins

Lupin yields were much lower than anticipated with less than half the yields recorded for the 2005 season (Figure 17). Plant growth was vigorous during the season. There appeared to be sufficient branching and flowers per branch. Flowers and newly formed pods could have been aborted due to the long cold and wet periods experienced during flowering and early pod development. The average production over all four sub-camps was 780 kg/ha. This is approximately half the yield required to cover total production costs for lupins. Negative net margins would therefore be recorded for this cash crop within its rotation system. It is important to note that these data should be seen in conjunction with all production data within and between rotations before conclusions can be made about the effects of lupin production on the economic viability of a particular rotation system on the farm.

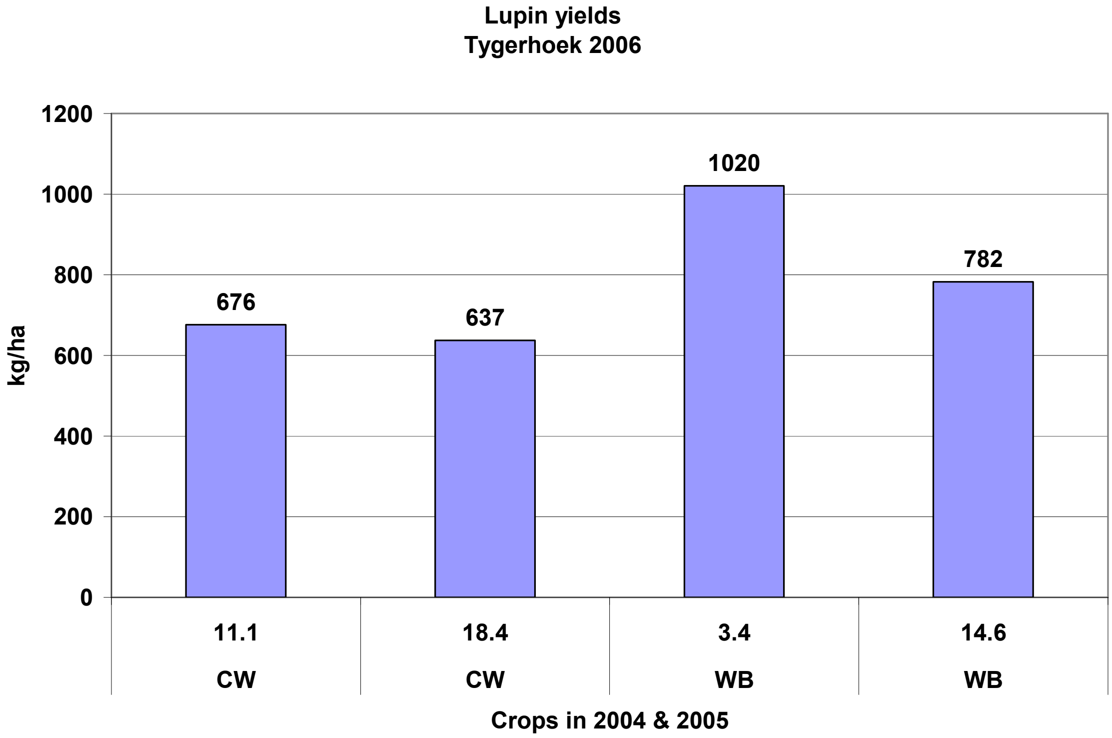


Figure 17 Lupin yields recorded in 2006 for all plots following different crops in 2004 and 2005 (C = Canola, B = Barley, W = Wheat: e.g. WB = wheat in 2004 and barley in 2005)

<u>Crop quality measures</u>
Wheat
Results of the quality analyses conducted at the Rietpoel silo are presented for wheat in Figures 18 and 19. These quality parameters are used to determine the value of the crop for that particular season and are used in the COMBUD analyses of each production system. Quality parameters of wheat samples, as determined by the University of Stellenbosch, are provided in Appendix 10.

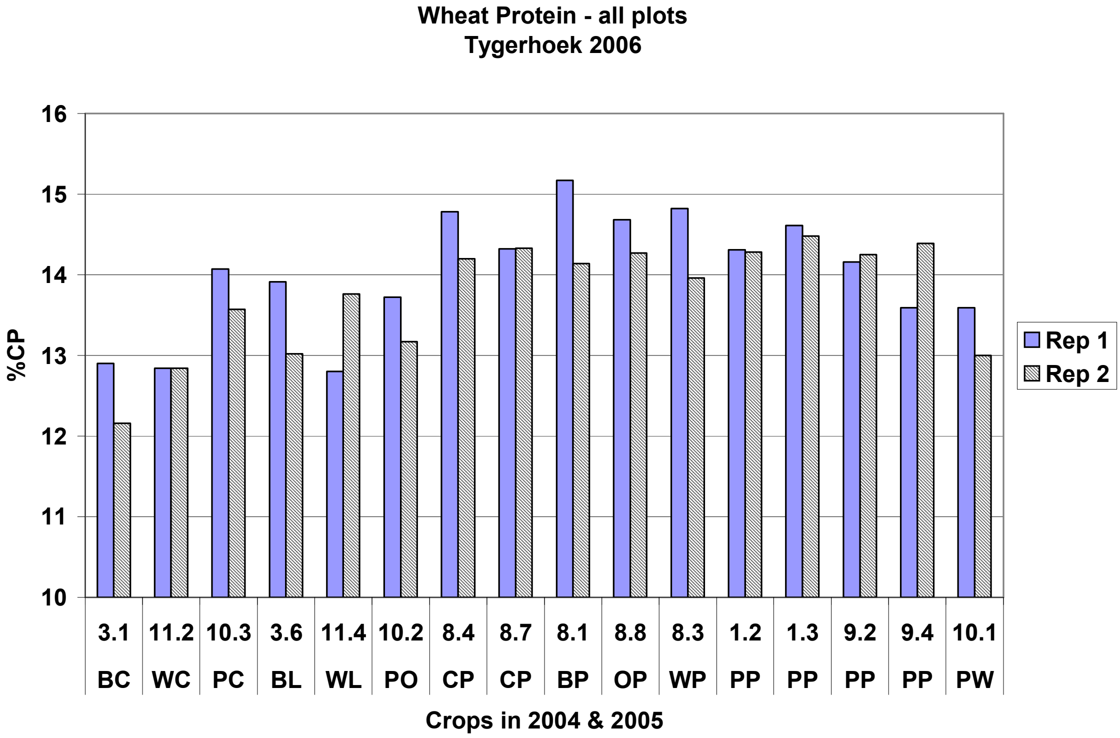


Figure 18 %CP of grain recorded for each wheat camp in 2006 following different crops in 2004 and 2005 (P = Pasture, L= Lupin, B = barley, C = Canola, W = Wheat, O= Oats: e.g. WP = wheat in 2004 and pasture in 2005)

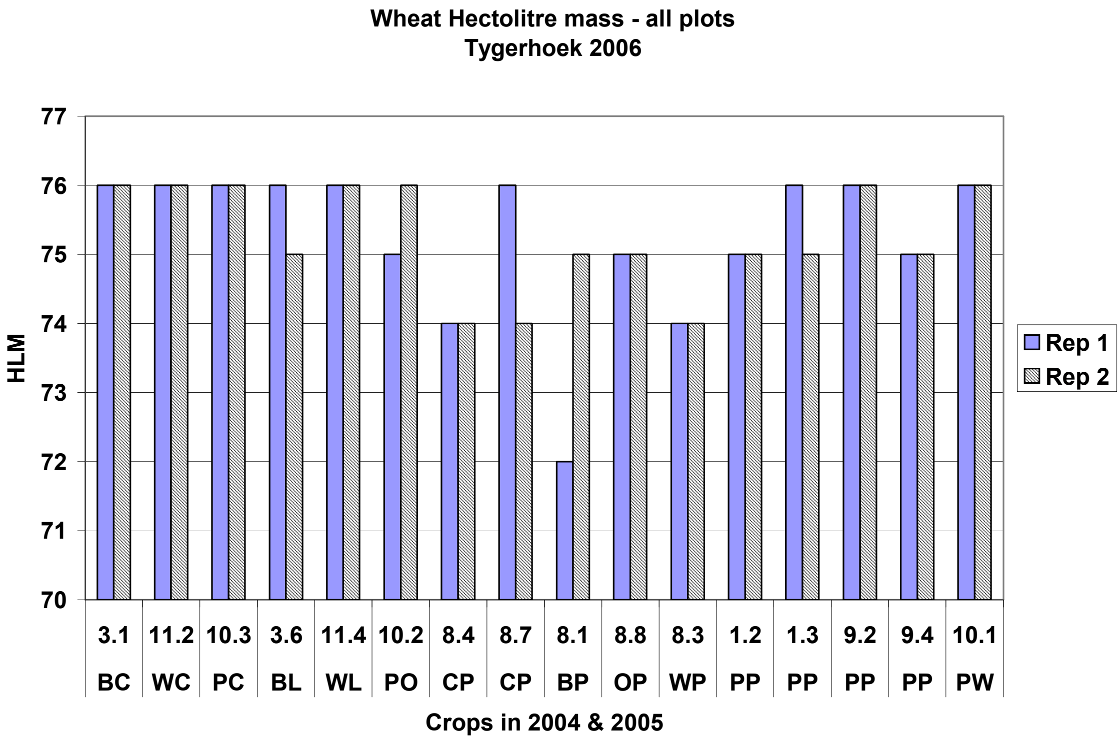


Figure 19 HLM of grain recorded for each wheat camp in 2006 following different crops in 2004 and 2005 (P = Pasture, L= Lupin, B = barley, C = Canola, W = Wheat, O= Oats: e.g. WP = wheat in 2004 and pasture in 2005)

Crude protein (%CP) content of grain was in excess of 12% in all samples despite the high yields recorded (Figure 18). Crude protein levels were therefore more than adequate to provide for prime quality material for the baking industry. However, most grain was classed as either B2 or B3 due to the low hectolitre mass (HLM) values recorded (Figure 19). There appears to be a tendency for wheat after pasture to have had lower HLM than wheat after canola, lupins, oats or wheat. Falling number estimates for all samples (Appendix 10) were above 250sec.

Barley

Barley was planted with 20kgN/ha. No N top dressings were applied during the season. Despite this and the relatively high yields (Figure 14) and rainfall (Figure. 10) recorded during the season the nitrogen content of kernels (Figure 20) was higher than the maximum allowed for brewing quality grain in all plots where barley followed pasture crops in the previous season. Furthermore, this trend persisted (Figure 20) where a pasture was grown two seasons before (in 2004) the report year. Malting quality barley grain was recorded in all plots were a non-legume crop was produced in the two seasons prior to 2006.

Kernel plumpness was above the minimum levels required for delivery as malting barley (Figure 21). Grain that showed the highest “plumpness” also had lower %N concentrations. Kernel plumpness varied widely within and among treatments.

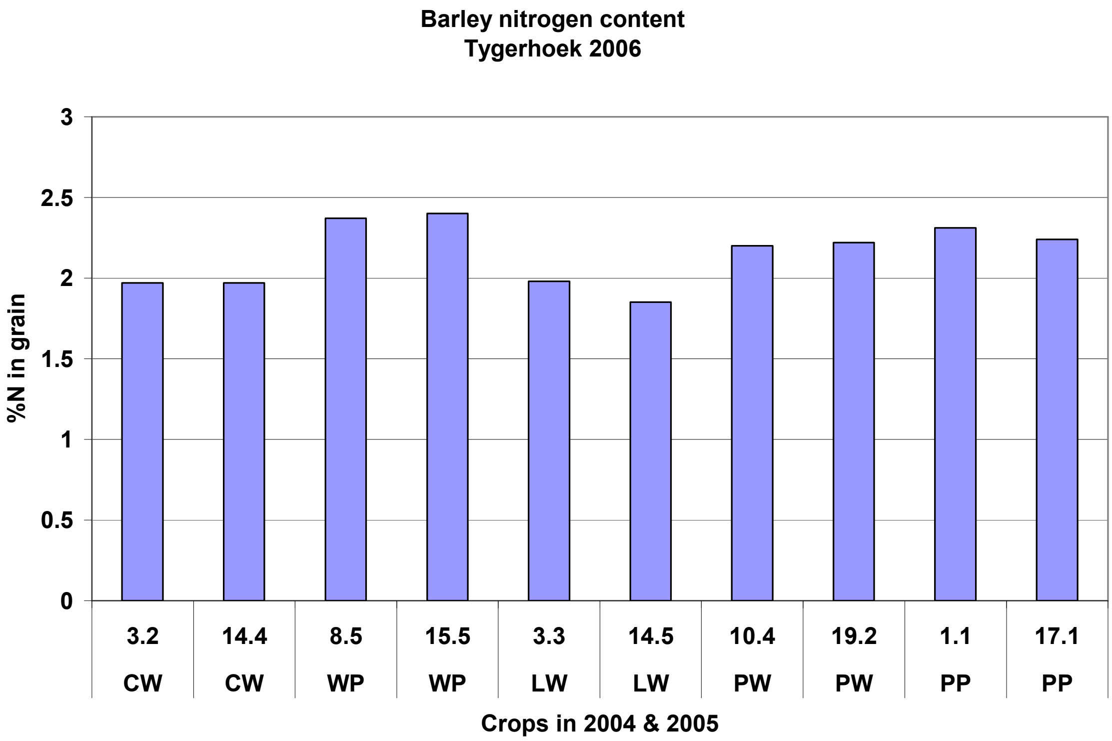


Figure 20 **%N in barley grain (2006) for all plots following different crops in 2004 and 2005 (P = Pasture, L= Lupin, C = Canola, W = Wheat: e.g. WP = wheat in 2004 and pasture in 2005)**

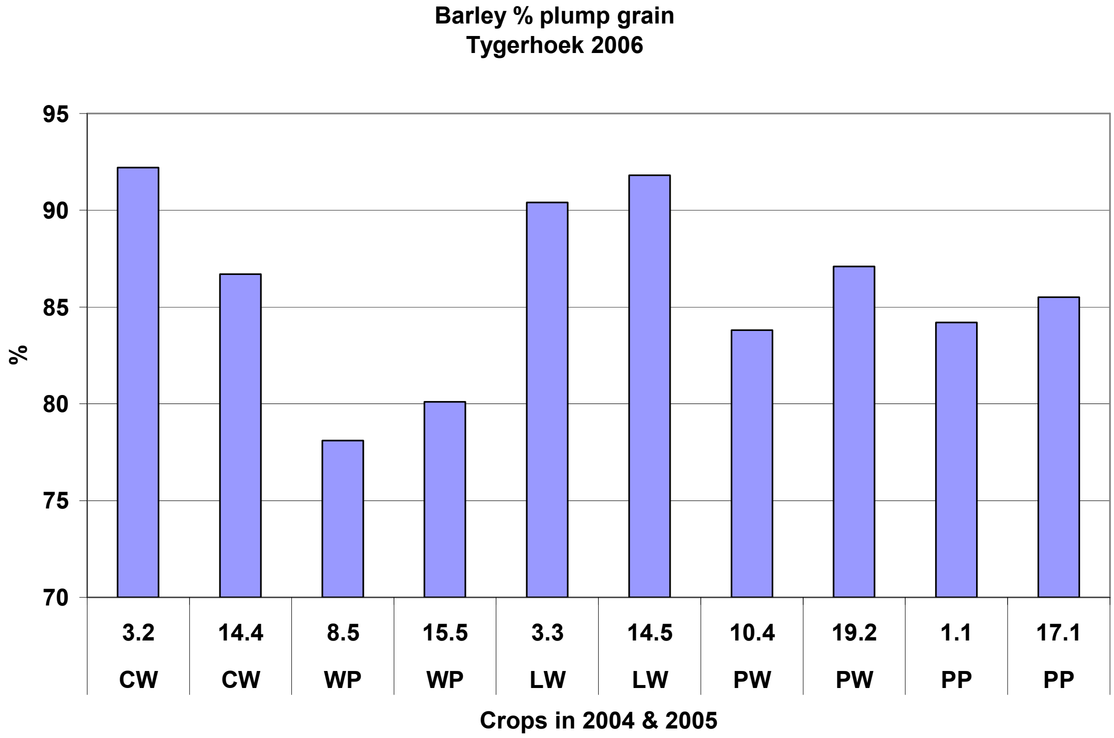


Figure 21 Barley "plumpness" (2006) for all plots following different crops in 2004 and 2005 (P = Pasture, L= Lupin, C = Canola, W = Wheat: e.g. WP = wheat in 2004 and pasture in 2005)

Canola
Quality data for canola are presented in Figures 22 & 23.

As discussed in previous reports oil content of TT canola cultivars is expected to be lower than for conventional cultivars. Oil content ranged from 28 to 32% over all treatment camps (Figure 22). These oil contents are considerably lower than the average oil content of canola delivered to processors. While all canola plots received the same amount of N at planting and as a top dressing (total N applied to all plots was 50 kgN/ha), %oil content of canola on those plots where legume pastures grew in the previous season was lower than where a cereal crop had been planted in the previous season. These data indicate a higher availability of N to the maturing canola plant in canola after legume pasture, than in canola after cereal, crop sequences. Canola samples with higher oil content had correspondingly lower %CP content than the remaining samples (Figure 23).

Crude protein contents of seed samples varied among treatments with clear indications that canola following annual legume pasture provided a higher %CP content than canola after a cereal crop (Figure 23).

Note that the quality analyses for the seed sample from plot 18.3 had not been completed at the time of preparing this report.

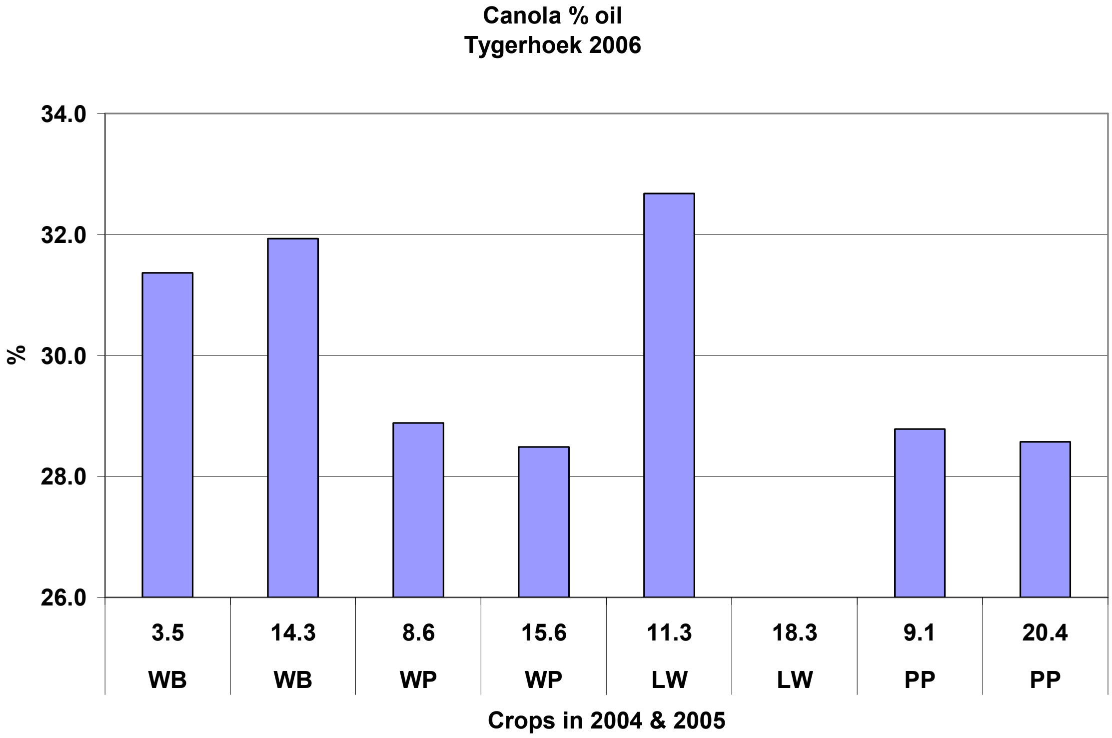


Figure 22 **% Oil of canola recorded in 2006 for all plots following different crops in 2004 and 2005 (P = Pasture, L= Lupin, B = Barley, W = Wheat: e.g. WP = wheat in 2004 and pasture in 2005)**

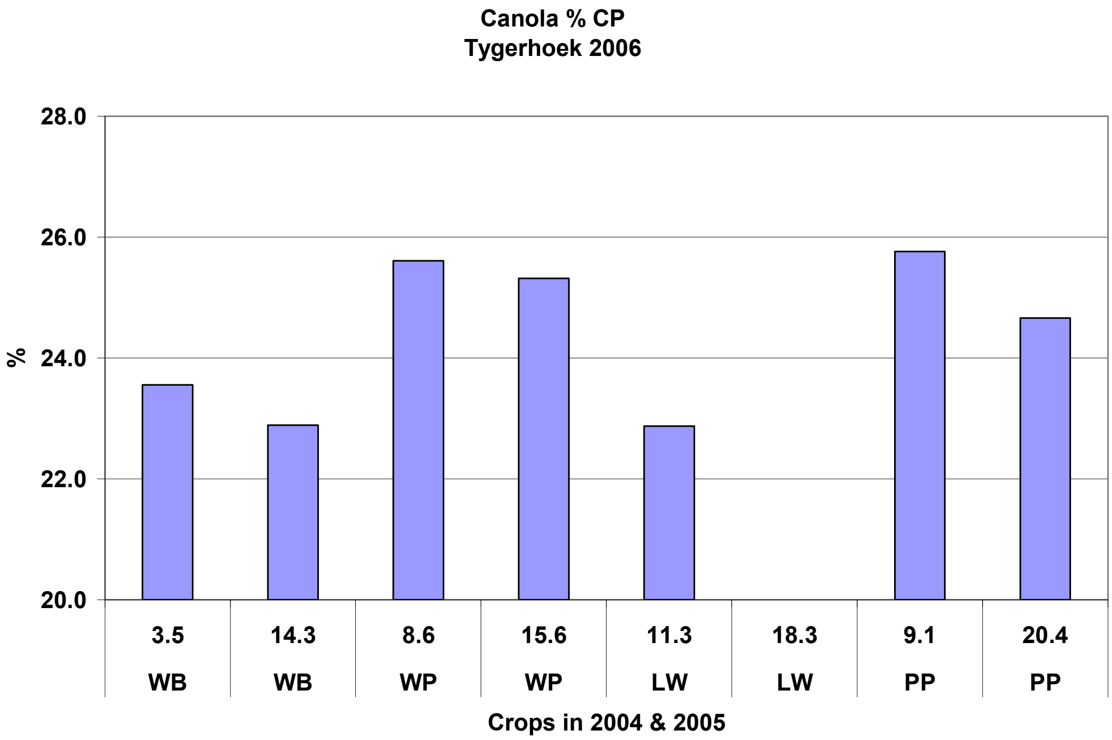


Figure 23 **% CP of canola recorded in 2006 for all plots following different crops in 2004 and 2005 (P = Pasture, L= Lupin, B = Barley, W = Wheat: e.g. WP = wheat in 2004 and pasture in 2005)**

Lupins
Crude protein content of lupin sample did not vary between plots indicating that crop sequence in the previous season had no effect on this quality parameter (Figure 24). The %CP content of the lupins is much the same as has been recorded in previous seasons.

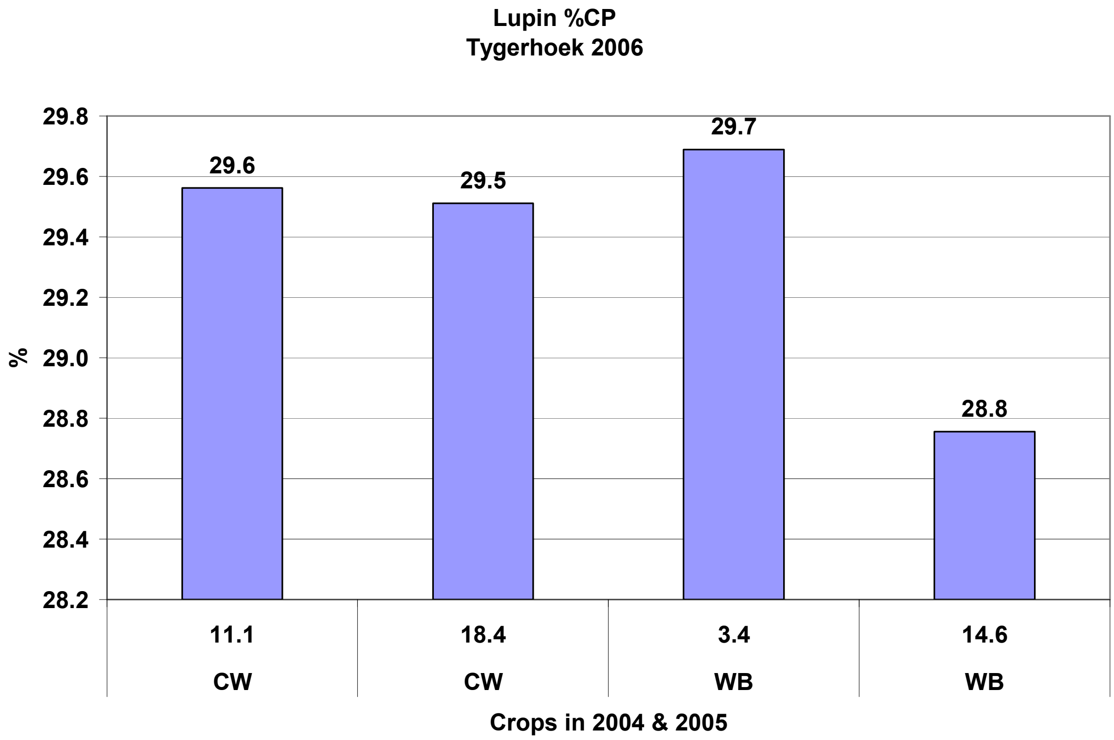


Figure 24 Lupin yields recorded in 2006 for all plots following different crops in 2004 and 2005 (C = Canola, B = Barley, W = Wheat: e.g. WB = wheat in 2004 and barley in 2005

<u>Pasture production data</u>
Lucerne
Herbage availability was estimated in every alternate sub-camp of each lucerne replicate, when the animals entered a sub-camp and again when they left that sub-camp. Summary data presented in Figure 25 illustrate the kind of data collected for sub-camps 2 in each of the lucerne replicate. The data represent a full year of grazing where the animals entered a sub-camp after 35 days (5 weeks) after the last grazing i.e. the grazing cycle for the sub-camp, and the other 5 sub-camps available to the group of sheep, was 7 days grazing ("in") and 35 days of rest ("out"). Data from each of the sub-camps monitored during the season must still be analysed in detail.

Herbage availability (kgDM/ha) declines through the summer months and was at its lowest in March/April of 2006. Herbage availability rapidly improved after the beginning of April (Figure 25).

As noted in the 2005 report the lucerne pastures remain productive and do not appear to have reduced carrying capacity when compared to previous seasons. This is despite that the animals remain on the pasture year round at a stocking rate equivalent to 5.5 ewes/ha (including lambs for approximately five months). A further observation is that the ewes and their lambs require minimal additional feed when compared to the ewes and lambs that graze on the medic/clover pastures. No additional feed (besides the supplement 6 week before and at lambing) was supplied to the ewes for the period September 2005 to August 2006.

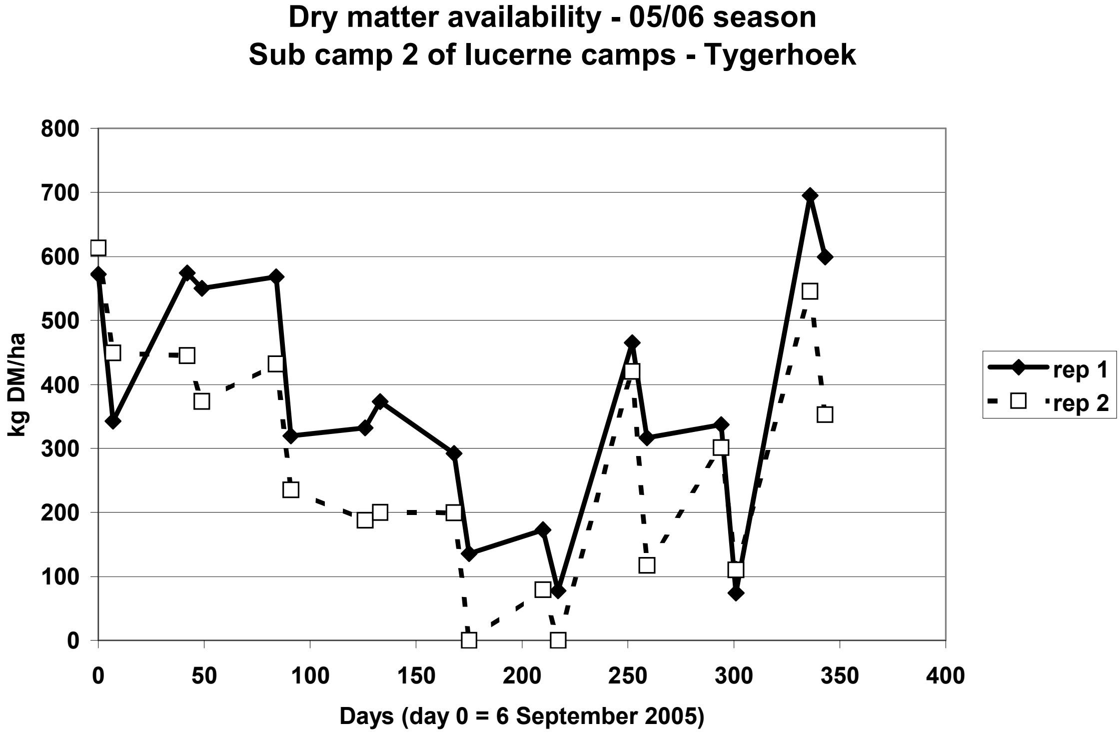


Figure 25 Lucerne pastures – trends in herbage availability – Sept 2005 to August 2006 for sub-camp 2 in each replicate

Medic/clover

There was a problem with estimating medic and clover availability (kgDM/ha) during 2006. Due to practical problems the exclusion cages were only placed in the camps in late June. The exclusion cages were left in their positions until 4 September when estimates were made of the total herbage that had accumulated in the camp since the exclusion cages were placed.

Dry matter production (kgDM/ha) among medic/clover pastures was extremely variable (Figure 26). Production not only varied in amount but also in composition with DM production in many of the pastures dominated by weeds (grasses and broadleaf). Of greatest concern were the CPCP pastures (i.e. alternate years of cash crops and pastures). Pasture growth started late in the season and pasture growth was slow. Since only one pasture camp is available to a group of animals in the CPCP pasture systems and pasture growth was slow, the ewes grazed all emerging seedlings at the start of the season preventing their establishment. The effects of this, artificially high grazing pressure in one of these camps (Camp 2) was so high that it never recovered. Animals had to be fed throughout the season (refer to the additional feed supplied to animals on file) and lamb performance was so poor that the ewes and lambs had to eventually be removed from the pasture (refer to the animal performance data presented below). It was decided that those camps should be divided into two so that a degree of grazing management could be implemented as occurs in the other pasture treatments.

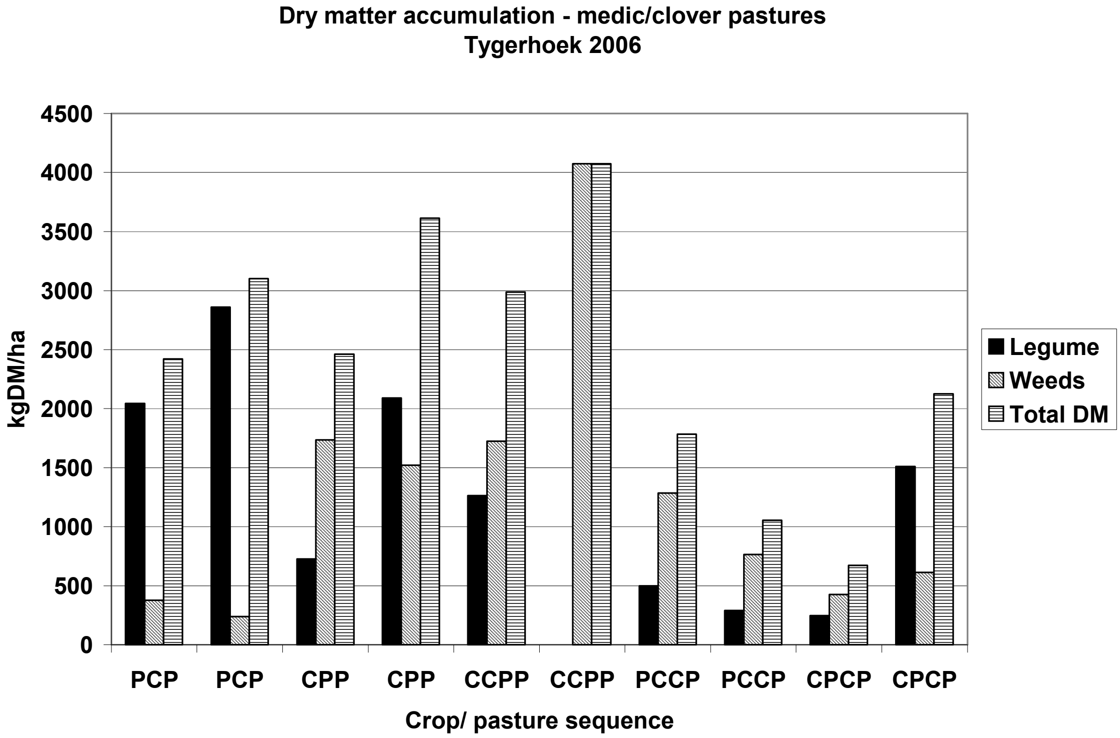


Figure 26 Medic/clover pastures – trends in herbage availability – Sept 2006

Animal performance

Mass change of ewes and lambs are shown for each treatment camp in Appendix 11. Ewes allocated to the lucerne camps tended to maintain high body mass than ewes in the medic/clover camps throughout the season. This is to be expected given the high summer rainfall and resultant availability of high quality feed in the lucerne camps throughout the summer and autumn. Lamb growth from the lucern pastures was, however, similar to that recorded for lambs on the medic/clover pastures. Detailed economic analyses are being conducted on these data.

The average carcass mass of lambs varied from 16kg to 21kg and 14kg to 19kg in the medic/clover and lucerne camps respectively. Average greasy wool production per ewe ranged from 4.9kg to 5.7kg.

Economic data

As for the previous seasons' data sets each treatment camp (Riversdale and Swellendam) and sub-camp (Tygerhoek) was treated as a separate economic entity. All data, required to develop income and expenditure budgets, has been captured using MICRO-COMBUD package, for each of the 15 camps at Riversdale, 19 camps at Swellendam, and 110 sub-camps at Tygerhoek. The economist responsible for this component of the project is busy verifying input data and is working on compiling results for the 2002, 2003, 2004 and 2005 seasons.

Concluding remarks

The experiment is proceeding according to the experimental protocols. The trial sites continue to be used in support of the cropping industry in the southern Cape. Many farmers and advisors have visited the trial sites over the past season (see list of presentation below). It should be noted that the Riversdale site was again the focus point of an extremely well attended information day that was organised by the

TuinRoute Agri "Graanbedryfskommittee" under the chairmanship of Mr Bassie Malherbe. Approximately 150 people attended the day. Many farmers also brought their farm workers as part of their "in-service" training program.

A detailed economic analysis of the gross margins associated with each of the crop sequences being tested at the Riversdale site from 2002 to 2004, showed quite clearly the advantages of including crops such as canola and lupins in the cropping system. As noted in the previous report the lack of up-to-date economic data is one of the most serious problems being experienced with the trial. As indicated above we continue to work closely with the Economics section at Elsenburg to rectify this matter.

The MSc student (from the Agronomy Department: University of Stellenbosch) who is working on the effect of rotation on the physiognomy of wheat at the Tygerhoek trial site has completed a second season of data collection and intends submitting his results (Thesis) by the end of 2006.

The additional large-scale seeding rate study that we have been doing in collaboration with our co-worker at Riversdale has yielded valuable information that is of direct practical value to local wheat producers.

PRESENTATIONS AND PUBLICATIONS

The following section summarizes the presentations made and articles published during 2006. These publications and presentations were based on the crop rotation trials being conducted in both the Swartland and the southern Cape.

Scientific and semi-scientific articles

One scientific article and one semi-scientific article, both based on information gained from these trials, were published during the report period.

Lampbrecht SC, Marasas FO, Hardy MB & Calitz FJ 2006. Effect of crop rotation on crown rot and the incidence of *Fusarium pseudograminearum* in wheat in the Western Cape, South Africa. Australsian Plant Pathology, 2006, 35, 419 - 426

Hardy MB 2007. The Southern Cape crop rotation project: progress 2002 to 2005. Elsenburg Journal Vol 4 No. 1. 2-4.

Popular articles

Six popular articles, based on the trial data and experiences or that make reference to the trials, were published during the report period.

Hardy M, Langenhoven W, Badenhorst J & Joubert F 2006. Southern Cape crop rotation research in progress 2002 – 2005. Proceedings of Information day Outeniqua Experimental Farm 3 October 2006.

Hardy M, Langenhoven W, Joubert F & Badenhorst J 2006. Narrow leaf sweet lupins show their potential in Southern Cape crop rotation trials: seed yield. SA Grain 8 (7) pp 39 – 41

Hardy MB & Laubscher S 2006. Die langtermyn wisselbouproef te Langgewens: Produksiedata vir 2005 en gewasbestuursinsette vir 2006. Skog saamdragids 6 September 2006

Anon 2006. Graanprodusent van die jaar: En die finaliste is … Hendrik Willem de Waal. SA Grain 8 (9) pp 28

Malherbe B 2006. Boere maak 'n plan. SA Grain 8 (12) pp 14 - 15

Genis Amelia 2006. Boere bring navorsing plaas toe. Landbouweekblad No 1480. 8 December 2006. pp 8 – 19

Presentations

As in previous seasons several successful information days were held on the various trial sites during the report period. We were also invited to present and discuss the results of our trials on occasions such as: Study Group and Farmer Association meetings.

Talks/presentations at Farmer's days etc 2006

Hardy, M., Agenbag, A., Langenhoven, W. & Joubert,F., 2006. Seeding rates for wheat in the Western Cape: do we need to adjust our recommendations? Platform presentation. Combined Congress 2006 of the South African Society for Crop Production and the Soil Science Society of South Africa. 23 – 26 January, Durban.

Hardy,. M., 2006. Address 5 technical committees (Langgewens, Tygerhoek, Swellendam, Riversdale & Bredasdorp) on results of 2005 crop rotation research in the Western Cape. 13 to 28 Feb 2006. (35 people)

Hardy,.M. & Laubscher, S., 2006. Address Piketberg Farmer's Association on production dynamics and economy of crop and crop/pasture rotations in the Swartland. 14 February 2006. (14 people)

Hardy,. M., 2006. Address Riversdale "Bedryfskommittee" on results of the crop rotation research and seeding rate trials at the Riversdale site. 23 February 2006. (7 people)

Hardy,. M., 2006. Address Riversdale "vlaktes" farmer's Association meeting on results of the crop rotation research and seeding rate trials at the Riversdale site. 23 February 2006. (45 people)

Hardy, M., 2006. Basal fertilization requirements of kikuyu, perennial ryegrass and clover pastures. Outeniqua dairy study group meeting. George. 2 March 2006. (20 people)

Hardy, M.,. 2006. Seeding rates for wheat in the Riversdale "vlaktes". Overberg Agri Voorsaai dag. 7 March 2006. (70 people)

Hardy M & Langenhoven W 2006. Host New Zealand farmer on a "Walk & Talk" at the Tygerhoek trial site. 3 August 2006.

Hardy, M. 2006. Ekonomiese ontleding van wisselbouproewe by Swellendam. Swellendam Kleingraanstudiegroep 16 Augustus 2006. (15 people)

Hardy, M. 2006. Crop rotation for profit. In "Steek R100 000 ekstra in jou sak" – 'n werkswinkel vir landbou produsente. Agri Megaweek 30 Augustus 2006 (50 people) X 2 lectures

Laubscher S 2006. Walk & talk on Langgewens site for PNS tour group. 31 August 2006 (15 people)

Hardy, M. & Langenhoven W., 2006. Tygerhoek short rotation cropping systems – weed control walk and talk. Southern Cape crop rotation technical committee meeting 5 September 2006. (20 people)

Hardy M, Laubscher S & Hugo H 2006. Produksie en ekonomiese ontledings van langtermyn wisselbouproewe to Langgewens. SKOG Boeredag 6 September 2006 (130 people)

Hardy M & Laubscher S 2006. Crop management in Langgewens crop rotation trial (2006). SKOG Boeredag 6 September 2006 (130 people)

Hardy, M. & Laubscher S 2006. Langgewens crop rotation trial – weed control walk and talk. Swartland crop rotation technical committee meeting 9 September 2006. (18 people)

Hardy M 2006. Crop rotation systems in the Swartland. Report back to Trustees of the Winter Cereal Trust and "continuation of funding application" meeting. CSIR 11 September 2006.

Hardy M 2006. Crop rotation systems in the Southern Cape. Report back to Trustees of the Winter Cereal Trust and "continuation of funding application" meeting. CSIR 11 September 2006.

Hardy M 2006. The establishment and development of an on-farm cropping systems research site in the Protem area. New project funding application to Trustees of the Winter Cereal Trust. CSIR 11 September 2006.

Hardy M 2006. Sustainable crop production on shale soils. Report back to Trustees of the Winter Cereal Trust and "continuation of funding application" meeting. CSIR 11 September 2006.

Hardy M & Lombard P 2006. Cultivar evaluation of wheat in the Winter Rainfall Region. Report back to Trustees of the Winter Cereal Trust and "continuation of funding application" meeting. CSIR 11 September 2006.

Hardy M, Langenhoven W & Hugo H. Economic evaluation of the Riversdale crop rotation trial: 2002 to 2005. Riversdale Farmers Day – Uitkyk. 13 September 2006 (130 people)

Hardy M & Langenhoven W 2006. Management of crops in the Riversdale crop rotation trials – walk & talk. Riversdale Farmers Day – Uitkyk. 13 September 2006 (130 people)

Hardy M 2006. Crop rotation systems in the Swartland. Report back to Trustees of the Protein Research Trust and "continuation of funding application" meeting. Spier 14 September 2006.

Hardy M 2006. Crop rotation systems in the Southern Cape. Report back to Trustees of the Protein Research Trust and "continuation of funding application" meeting. Spier 14 September 2006.

Hardy M 2006. The establishment and development of an on-farm cropping systems research site in the Protem area. New project funding application to Trustees of the Protein Research Trust and "continuation of funding application" meeting. Spier 14 September 2006.

Hardy M 2006. Report back to Trustees of the Western Cape Animal Production Research Trust on projects funded through the Trust and managed by the Institute for Plant Production i.e Crop rotation, Cultivar evaluation, Shale soils, weed research. Knorhoek 21 September 2006.

Hardy M 2006. Produksie en ekonomie van wisselbou-stelselproewe in die Suid Kaap. Outeniqua Inligtingsdag 3 October 2006 (150 people)

Hardy M 2006. A re-evaluation of the "Sustainable crop production from shale soils" trial. Elsenburg 16 November 2006 (15 people)

Appendix 1

Proefplan --- RIVERSDAL 2006

NB: All camps undersown with Lucerne

Lucerne cultivar trial (planted May 2006)	LNR Cultivar x Rywydte x saaidigtheid en Stikstof- en P- plasing proewe

185m

Camp				
1	a	Stelsel 2	KOROG	b
2	a	Stelsel 3	KORING	b
3	a	Stelsel 5	KOROG	b
4	a	Stelsel 1	KORING	b
5	a	Stelsel 4	KORING	b
6	a	Stelsel 5	KOROG	b
7	a	Stelsel 1	KORING	b
8	a	Stelsel 4	KORING	b
9	a	Stelsel 2	KOROG	b
10	a	Stelsel 3	KORING	b
11	a	Stelsel 2	KOROG	b
12	a	Stelsel 4	KORING	b
13	a	Stelsel 3	KORING	b
14	a	Stelsel 5	KOROG	b
	a	Stelsel 1	KORING	b

Pad

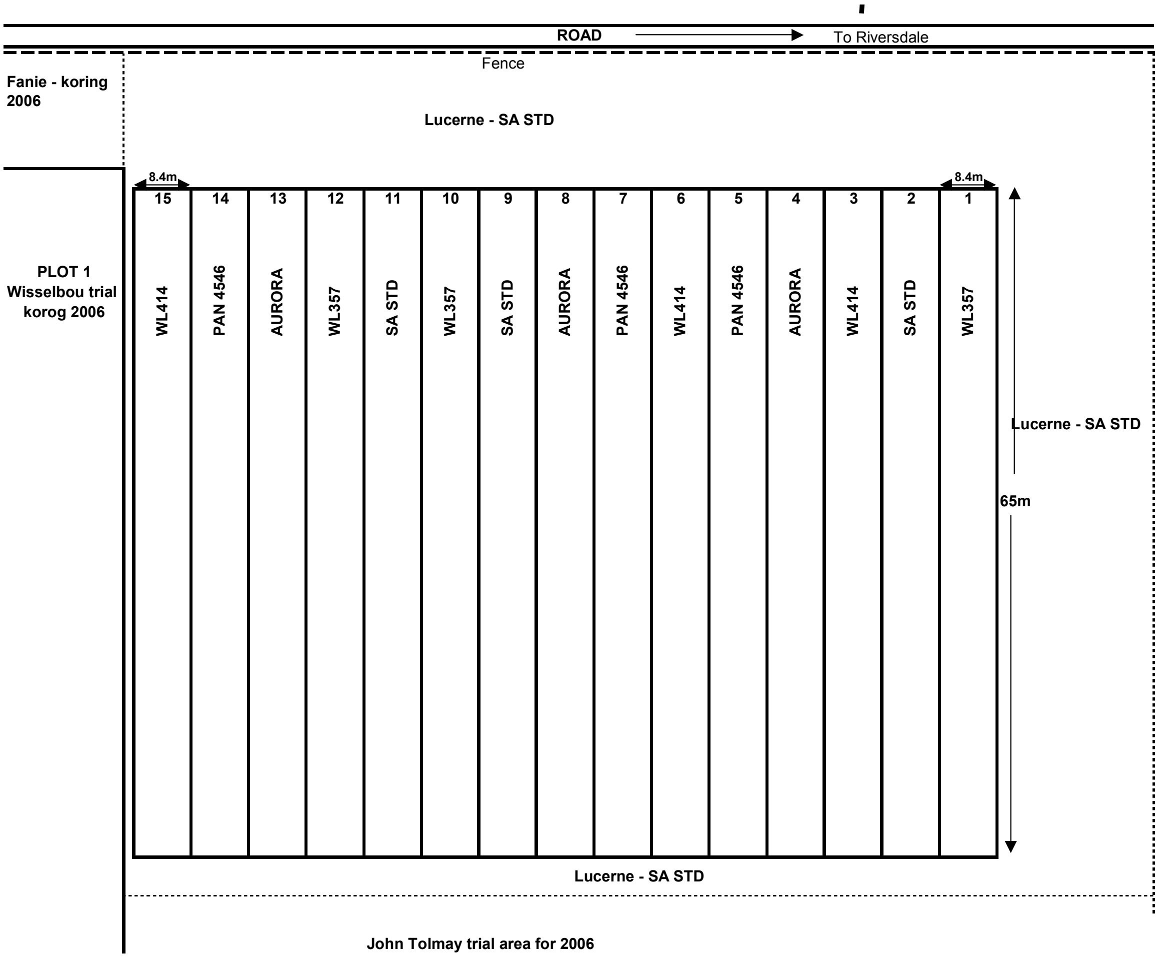
Stelsels

1	**K K H K K**
2	**K K C K Tr**
3	**K L K C K**
4	**K G C K K**
5	**K C K L Tr**

G - Gars
K - Koring
H - Hawer
C - Canola
Tr - Korog
L - Lupien

Appendix 2

Plot plan for lucern demonstration trial planted in May 2006



APPENDIX 3

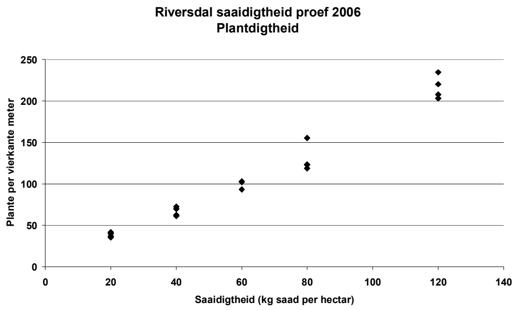
Stellenbosch University lab: Quality measures for wheat samples taken from the Riversdale trial plots during 2006.

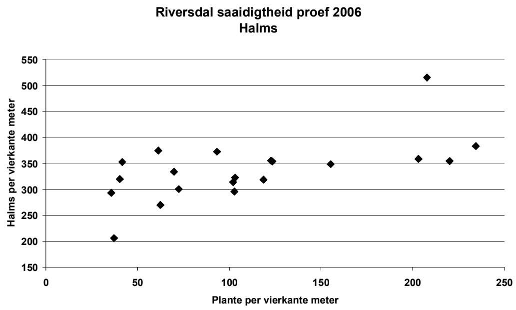
RIVERSDAL: (KORING)

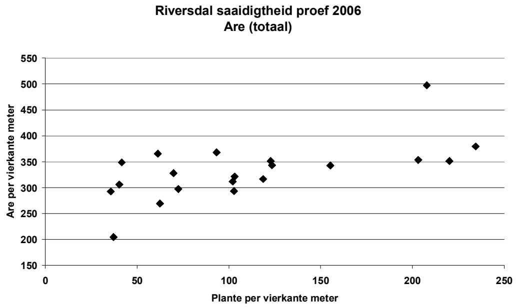
MONSTER	SKOON g	HLM g	DKM g	KPROT %	VALGETAL sek
2	2.560	77.6	36	11.8	313
4	2.606	78.2	38	11.0	285
5	2.222	78.8	38	10.6	305
7	2.553	79.0	38	10.6	298
8	2.178	78.4	40	11.0	279
10	2.600	77.2	40	11.5	289
12	2.500	78.2	40	10.0	314
13	2.345	77.6	40	10.9	286
15	2.371	77.4	40	10.3	317

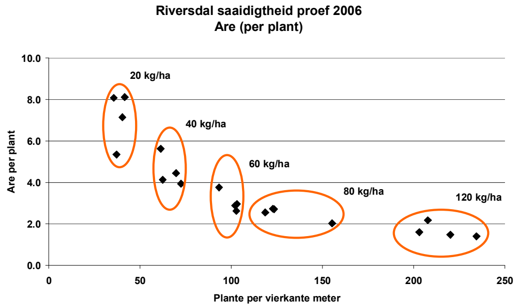
Appendix 4

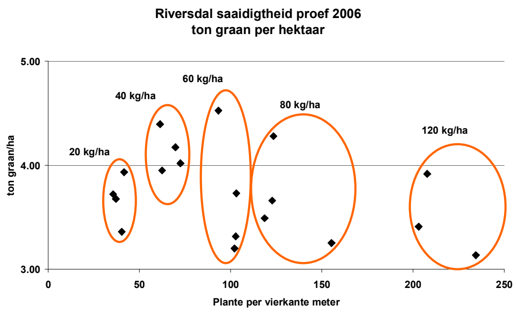
Summary data for the 2006 seeding rate trial at the Riversdale site











Appendix 5

Lab Reference: RS-2005.12.011 **Report Date:** December 2005
Client Reference: Riversdal December 2005

Lab No	Sample ID	Texture	pH	Resistance	Acidity		Ca		Mg		Na		K		T-value	P	Cu	Carbon
			(KCl)	(ohm)	(cmol/kg)	(%)	(cmol/kg)	(%)	(cmol/kg)	(%)	(mg/kg)	(%)	(mg/kg)	(%)	(cmol/kg)	(mg/kg)	(mg/kg)	(%)
RS/05/01240	R 1a	Loam / Leem	6.2	650	-	-	17.09	-	1.57	-	22	-	288	-	19.5	104	0.9	1.48
RS/05/01241	R 1b	Loam / Leem	5.2	1030	0.88	-	4.59	-	0.77	-	21	-	193	-	6.82	66	0.61	-
RS/05/01242	R 2a	Loam / Leem	5.4	820	0.74	-	4.23	-	0.77	-	27	-	210	-	6.39	47	0.65	1.09
RS/05/01243	R 2b	Loam / Leem	6.5	620	-	-	9.04	-	1.5	-	31	-	290	-	11.43	76	0.74	-
RS/05/01244	R 3a	Loam / Leem	5	640	0.98	-	4.46	-	0.77	-	27	-	195	-	6.83	46	0.6	1.44
RS/05/01245	R 3b	Loam / Leem	5.4	510	0.81	-	5.51	-	1.03	-	28	-	311	-	8.27	104	0.74	-
RS/05/01246	R 4a	Loam / Leem	5.1	1000	0.93	-	3.82	-	0.72	-	27	-	206	-	6.11	54	0.53	1.58
RS/05/01247	R 4b	Loam / Leem	5.2	850	0.96	-	5.12	-	0.9	-	24	-	252	-	7.73	77	0.67	-
RS/05/01248	R 5a	Loam / Leem	5.4	790	0.63	-	3.23	-	0.52	-	21	-	184	-	4.94	67	0.55	1.03
RS/05/01249	R 5b	Loam / Leem	5.3	430	0.68	-	3.78	-	0.78	-	91	-	180	-	6.1	75	0.66	-
RS/05/01250	R 6a	Loam / Leem	5.9	480	-	-	6.61	-	1.4	-	49	-	344	-	9.11	100	0.76	1.38
RS/05/01251	R 6b	Loam / Leem	5.1	740	1.03	-	4.61	-	1.08	-	30	-	192	-	7.34	50	0.52	-
RS/05/01252	R 7a	Loam / Leem	5.7	790	-	-	6.06	-	0.91	-	31	-	243	-	7.74	73	0.64	1.13
RS/05/01253	R 7b	Loam / Leem	5.6	740	-	-	4.73	-	0.97	-	41	-	241	-	6.5	50	0.49	-
RS/05/01254	R 8a	Loam / Leem	5.7	600	-	-	5.74	-	1.03	-	40	-	235	-	7.55	59	0.74	1.11
RS/05/01255	R 8b	Loam / Leem	5.2	830	0.87	-	4.08	-	1.02	-	40	-	194	-	6.64	55	0.5	-
RS/05/01256	R 9a	Loam / Leem	6.1	710	-	-	6.7	-	1.07	-	24	-	222	-	8.45	93	0.71	1.13
RS/05/01257	R 9b	Loam / Leem	5.7	610	-	-	6.11	-	1.24	-	49	-	218	-	8.13	78	0.52	-
RS/05/01258	R 10a	Loam / Leem	6	580	-	-	6.37	-	1.19	-	49	-	207	-	8.31	46	0.52	1.38
RS/05/01259	R 10b	Loam / Leem	5.2	730	0.85	-	4.64	-	1.17	-	49	-	164	-	7.29	50	0.53	-
RS/05/01260	R 11a	Loam / Leem	5.7	510	-	-	4.87	-	1.12	-	45	-	198	-	6.7	48	0.58	1.15
RS/05/01261	R 11b	Loam / Leem	5.7	490	-	-	5.17	-	0.95	-	60	-	188	-	6.87	54	0.51	-
RS/05/01262	R 12a	Loam / Leem	6.1	510	-	-	6.09	-	0.97	-	48	-	222	-	7.85	57	0.57	1.17
RS/05/01263	R 12b	Loam / Leem	5.6	310	-	-	5.33	-	1.36	-	90	-	231	-	7.68	44	0.49	-
RS/05/01264	R 13a	Loam / Leem	5.6	600	-	-	4.28	-	0.95	-	42	-	224	-	6	51	0.57	1.05
RS/05/01265	R 13b	Loam / Leem	5.9	320	-	-	5.29	-	1.14	-	96	-	175	-	7.3	58	0.53	-
RS/05/01266	R 14a	Loam / Leem	5.6	290	-	-	4.77	-	1.11	-	51	-	261	-	6.78	53	0.59	1.35
RS/05/01267	R 14b	Loam / Leem	5.7	310	-	-	5.64	-	1.16	-	53	-	213	-	7.59	60	0.61	-
RS/05/01268	R 15a	Loam / Leem	5.4	670	0.77	-	3.96	-	1.02	-	35	-	201	-	6.42	57	0.63	1.42
RS/05/01269	R 15b	Loam / Leem	5.6	760	-	-	4.08	-	0.81	-	33	-	220	-	5.61	61	0.67	-

Appendix 6

Plot plan for the Swellendam site in 2006

2006

Proefplan - SWELLENDAM

a	a	a	a	a	a	a	a	a
KORING BEWERK	GARS	GARS	KOROG	KORING	KORING	KOROG	KORING	GARS
16	8	7	6	5	4	3	2	1
SSK	Stelsel 1	Stelsel 2	Stelsel 4	Stelsel 3	Stelsel 5	Stelsel 4	Stelsel 5	Stelsel 2
b	b	b	b	b	b	b	b	b

a	a	a	a	a	a	a
KORING	KOROG	GARS	GARS	KORING	GARS	KORING BEWERK
14	13	12	11	10	9	17
Stelsel 3	Stelsel 4	Stelsel 2	Stelsel 1	Stelsel 3	Stelsel 1	SSK
b	b	b	b	b	b	b

Remainder of camp = JB samples

2006 ARC Cultivar x Rywydte x Saaidigteheid en Stikstof en Phosphaat plasing proewe	a	a	
	KORING	KORING BEWERK	KORING
	15	18	19
	Stelsel 5	SSK	SSK NIE BEWEI = NB samples
	b	b	

Stelsels

1 : **K G C K G**
2 : **K K C K G**
3 : **K L K C K**
4 : **K G C K Tr**
5 : **K H K C K**
SSK : **K G C K K**

K : Koring
G : Gars
C : Canola
L : Lupien
Tr : Korog
H : Hawer

Appendix 7

Stellenbosch University lab: Quality measures of wheat samples taken from the Swellendam trial plots during 2006 Note that the %crude protein (KPROT) data should be viewed with caution

SWELLENDAM: (KORING)

MONSTER	SKOON g	HLM g	DKM g	KPROT %	VALGETAL sek
2	2.813	76.4	36	11.5	375
4	2.125	75.6	36	11.9	370
5	2.245	76.2	34	11.9	379
10	1.980	74.2	34	11.3	355
14	2.500	75.0	32	11.8	369
15	2.504	75.6	32	11.7	386
16	2.240	73.0	30	12.2	370
17	2.400	74.6	32	11.9	350
18	2.485	74.6	32	11.7	370
19	2.517	74.8	32	11.9	363

Appendix 8

Soil analysis data for the Swellendam site sampled December 2005

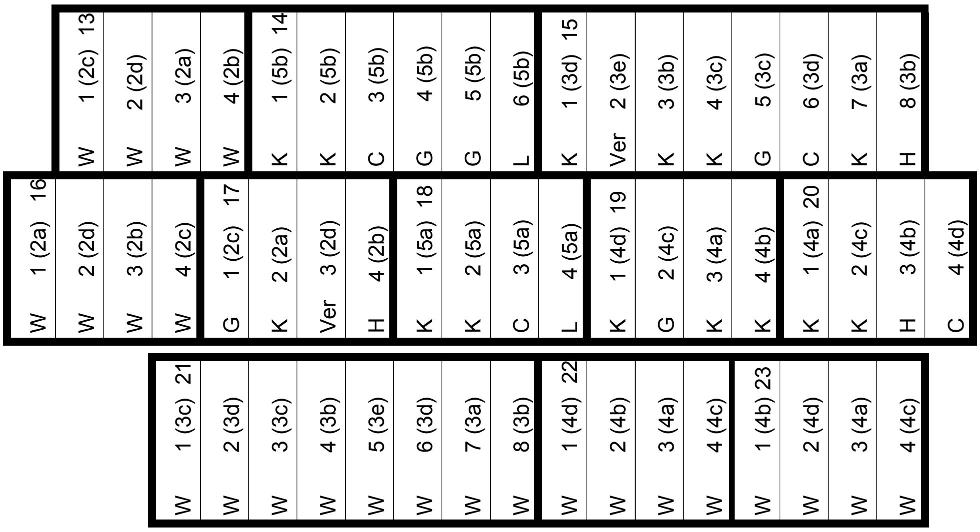
	Lab Reference:	RS-2005.12.012					Report D	Dec 2005						
	Client Reference:	Swellendam December 2005												
Lab No	Sample ID	Texture	pH	Resistance	Acidity		Ca	Mg	Na	K	T-value	P	Cu	Carbon
			(KCl)	(ohm)	(cmol/kg)	(%)	(cmol/kg)	(cmol/kg)	(mg/kg)	(mg/kg)	(cmol/kg)	(mg/kg)	(mg/kg)	(%)
RS/05/01270	S 1a	Loam / Leem	5.7	510	-	-	4.37	2.14	121	220	7.61	94	1.86	1.33
RS/05/01271	S 1b	Loam / Leem	5.9	330	-	-	3.8	2.44	201	207	7.65	61	1.32	-
RS/05/01272	S 2a	Loam / Leem	6.5	280	-	-	5.96	2.88	238	521	11.22	97	4.77	1.44
RS/05/01273	S 2b	Loam / Leem	5.5	480	-	-	3.54	2.22	159	127	6.79	61	1.71	-
RS/05/01274	S 3a	Loam / Leem	6.5	240	-	-	9.02	2.58	136	455	13.36	107	2.23	1.38
RS/05/01275	S 3b	Loam / Leem	5.6	440	-	-	4.41	1.95	119	155	7.28	60	1.18	-
RS/05/01276	S 4a	Loam / Leem	6.1	560	-	-	4.56	2.3	147	574	8.98	65	1.14	1.72
RS/05/01277	S 4b	Loam / Leem	6.6	470	-	-	7.54	2.3	139	213	11	44	1.66	-
RS/05/01278	S 5a	Loam / Leem	5.8	350	-	-	4.66	2.32	214	571	9.38	79	1.6	1.89
RS/05/01279	S 5b	Loam / Leem	7.1	400	-	-	12.21	2.72	127	313	16.29	52	2.27	-
RS/05/01280	S 6a	Loam / Leem	5.5	320	-	-	4.44	2.2	114	350	8.04	77	1.1	1.64
RS/05/01281	S 6b	Loam / Leem	5.4	440	0.82	-	4.16	2.1	148	197	8.23	49	1.34	-
RS/05/01282	S 7a	Loam / Leem	5.2	470	0.95	-	3.03	1.79	94	178	6.63	48	0.96	1.15
RS/05/01283	S 7b	Loam / Leem	5.9	350	-	-	4.42	2.07	126	176	7.5	67	1.03	-
RS/05/01284	S 8a	Loam / Leem	6.5	280	-	-	6.76	2.85	230	215	11.17	84	1.22	1.42
RS/05/01285	S 8b	Loam / Leem	6	400	-	-	4.64	1.92	139	212	7.72	52	1.24	-
RS/05/01286	S 9a	Loam / Leem	7.6	270	-	-	43.28	5.59	232	281	50.61	85	2.21	1.93
RS/05/01287	S 9b	Loam / Leem	7.7	220	-	-	65.6	5.28	414	214	73.24	74	2.08	-
RS/05/01288	S 10a	Loam / Leem	7.8	330	-	-	26.17	4.56	245	263	32.48	30	1.18	2.07
RS/05/01289	S 10b	Loam / Leem	7.5	340	-	-	37.37	4.41	300	350	43.99	103	2.93	-
RS/05/01290	S 11a	Loam / Leem	7.5	300	-	-	33.74	3.84	194	259	39.1	93	2.32	1.6
RS/05/01291	S 11b	Loam / Leem	5.3	470	0.9	-	3.15	1.6	122	171	6.62	54	1.07	-
RS/05/01292	S 12a	Loam / Leem	5.9	310	-	-	4.65	2.13	224	155	8.16	40	1.06	1.77
RS/05/01293	S 12b	Loam / Leem	5.3	320	1.08	-	4.4	2.63	153	286	9.51	83	0.86	-
RS/05/01294	S 13a	Loam / Leem	6.4	290	-	-	6.61	2.5	171	314	10.67	101	1.58	1.38
RS/05/01295	S 13b	Loam / Leem	5.8	600	-	-	3.95	1.97	131	129	6.83	72	1.59	-
RS/05/01296	S 14a	Loam / Leem	5.1	300	0.94	-	2.74	1.95	166	116	6.65	46	0.88	1.23
RS/05/01297	S 14b	Loam / Leem	5.8	410	-	-	4.75	1.71	123	166	7.43	45	1.57	-
RS/05/01298	S 15a	Loam / Leem	5.1	520	0.82	-	3.03	1.74	102	124	6.35	56	1.04	1.13
RS/05/01299	S 15b	Loam / Leem	5.3	640	0.81	-	3.44	2.16	94	114	7.11	58	1.26	-
RS/05/01300	S 16a	Loam / Leem	5.1	360	0.84	-	2.7	2.24	144	109	6.68	59	0.64	1.29
RS/05/01301	S 16b	Loam / Leem	6.1	410	-	-	6.23	2.53	136	205	9.89	85	2.18	-
RS/05/01302	S 17a	Loam / Leem	5.9	700	-	-	4.62	2.13	122	176	7.74	35	1.89	1.5
RS/05/01303	S 17b	Loam / Leem	7.9	400	-	-	60.7	5.27	183	169	67.21	68	1.14	-
RS/05/01304	S 18a	Loam / Leem	5.6	540	-	-	4.26	2.03	130	206	7.39	42	1.84	1.33
RS/05/01305	S 18b	Loam / Leem	7.3	180	-	-	10.48	3.61	426	319	16.77	79	3.65	-
RS/05/01306	S 19a	Loam / Leem	7.7	330	-	-	67.5	4.25	209	423	73.75	100	3.26	1.99
RS/05/01307	S 19b	Loam / Leem	6.1	470	-	-	6.85	1.95	68	521	10.44	130	3.77	-

Appendix 9

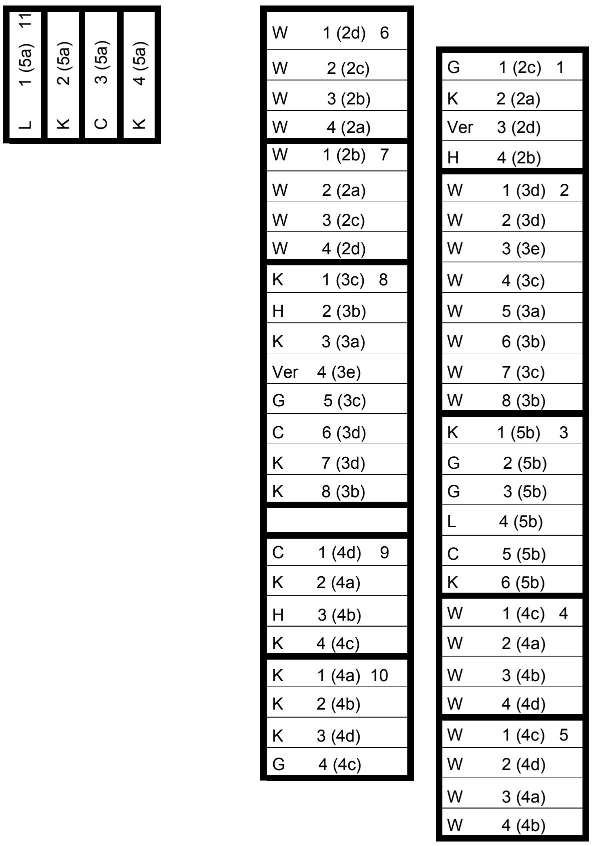
Plot plan for Tygerhoek site - 2006

Rep 2

Jaar 5 - 2006



Rep 1



Stelsel

1	**Permanent lusern**	
2a	**WWK**	**W - weiding**
2b	**WWH**	**K - koring**
2c	**WWG**	**H - hawer**
2d	**WWVer**	**G - gars**
3a	**WKWK**	**C - canola**
3b	**WKWH**	**Ver - veranderlike**
3c	**WKWG**	**L - lupien**
3d	**WKWC**	
3e	**WVerWVer**	
4a	**WWKK**	
4b	**WWHK**	
4c	**WWKG**	
4d	**WWCK**	
5a	**KCKL**	
5b	**KGCKGL**	

Appendix 10

Wheat, barley and oats grain sample analyses - Tygerhoek 2006
Analyses by Stellenbosch University (Agronomy Department)

KORING: 2006

MONSTER	SKOON g	HLM g	DKM g	KPROT %	VALGETAL sek
1.2	2.711	76.6	36	13.9	295
1.3	2.388	77.0	34	14.0	298
3.1	2.663	77.8	40	12.8	331
3.6	2.219	78.0	38	13.2	353
8.1	2.230	74.4	32	14.4	255
8.3	2.384	75.4	34	13.9	309
8.4	2.130	75.6	32	13.8	262
8.7	2.483	78.0	38	13.5	279
8.8	2.233	77.2	32	13.9	324
9.2	2.404	77.2	36	13.2	318
9.4	2.374	77.2	34	13.2	333
10.1	2.470	77.6	36	12.8	331
10.2	2.032	77.6	36	13.2	311
10.3	2.217	77.6	36	13.6	319
11.2	2.520	77.2	38	12.5	341
11.4	2.416	77.2	36	12.4	325
14.1	2.826	77.4	38	12.4	320
14.2	2.513	78.0	38	12.9	319
15.1	2.060	76.6	38	13.5	275
15.2	2.061	77.0	38	13.3	344
15.3	2.125	76.8	38	13.5	356
15.4	2.500	77.2	36	13.4	301
15.7	2.164	76.4	36	13.2	336
17.2	2.340	76.8	38	13.8	295
17.3	2.280	76.8	36	12.9	357
18.1	2.405	77.6	38	12.4	361
18.2	2.400	78.4	38	12.8	307
19.1	2.500	77.8	36	13.0	354
19.3	2.310	77.2	34	11.9	351
19.4	2.376	77.8	36	12.6	326
20.1	2.400	76.8	36	12.9	314
20.2	2.366	77.0	38	13.3	327

GARS: 2006

MONSTER	VETKORREL %			SKOON
	KAF	> 2.0	> 2.5	g
1.1	8.32	11.60	80.08	2.531
3.2	4.78	14.78	87.98	2.124
3.3	6.22	8.42	85.36	2.357
8.5	10.68	15.92	73.40	2.312
10.4	9.20	9.88	80.92	2.060
14.4	6.22	11.38	82.40	2.311
14.5	4.28	7.28	88.44	2.085
15.5	11.24	12.48	76.28	2.672
17.1	8.36	10.62	81.02	2.282
19.2	6.40	9.62	83.98	2.512

HAWER: 2006

MONSTER	SKOON g	HLM g	HLM g
1.4	1.620	38	38
8.2	1.561	40.2	40.2
9.3	1.559	40	40
15.8	1.821	44	44
17.4	1.823	41.6	41.6
20.3	1.782	42	42

Appendix 11

Ewe and lamb performance on medic/clover pastures at Tygerhoek = 2006