

# APPENDIX 1

## ANNUAL PROGRESS REPORT

**Farmer innovations in Conservation Agriculture  
(CA) systems for sustainable crop intensification  
in semi-arid, sandy soil conditions, North West  
Province**

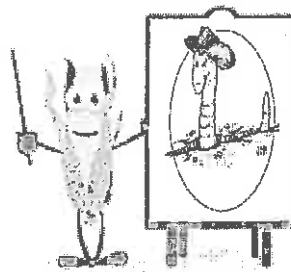
**For the period:**

**JULY 2014 TO SEPTEMBER 2015**

**Compiled by:**

**HJ Smith, JP Otto, G Trytsman, AA Nel, CJ Coetzee, A  
Dreyer and E Hugo**

**September 2015**



**Ottosdal No-till Club**

# EXECUTIVE SUMMARY

## OTTOSDAL ANNUAL PROGRESS REPORT

Farmer innovations in Conservation Agriculture (CA) systems for sustainable crop intensification in semi-arid, sandy soil conditions, North West Province

Compiled by: HJ Smith, JP Otto, G Trytsman, AA Nel, CJ Coetzee, A Dreyer and E Hugo  
For the period: July 2014 to September 2015

The Ottosdal Conservation Agriculture (CA) project, which is funded by The Maize Trust, implemented by the Ottosdal No-till Club in collaboration with various partners (i.e. ARC, SGS), and coordinated by the Grain SA CA programme, has been successfully running for the second year. During the 2014-2015 season frequent project meetings have taken place involving all the key partners (project team members) in the project. Those include farmers, researchers, input suppliers, Grain SA/MT and manufacturers. These meetings are instrumental in the running of the project, serving as a platform for collective and adaptive project management. Some of the key project events, such as the farmer-led trials and the conference, have been planned and coordinated from this platform. The annual reference meeting took place on 6 August 2015. The meeting was preceded by a planning meeting whereby the trials and other actions for the new season have been revisited; these adjustments have been reported below. The Ottosdal No-till Club in collaboration with Grain SA and The Maize trust had a very successful CA conference at Ottosdal on 11 and 12 March 2015. The conference was attended by 300 farmers and other interested people. The event also had an international flavour with the attendance of an Argentinean delegation, which is collaborating in the project through the Grain SA X Argentinean cooperation agreement.

**Soil classification, sampling and chemical analysis** were done for every trial and selected farms. Root evaluations and root development problems in different soil profiles have been done. The soil data and findings were presented at the CA conference from 11 to 12 March as well as at the Reference group meeting on 6 August 2015. A full annual report is attached.

For the **assessment of cover crop adaptability and suitability** an on-farm, farmer-led screening trial with seventeen different potential cover crops was established at the farm Humanskraal of Mr George Steyn. Cover crops offer many benefits for agriculture productivity and sustainability while reducing off farm environmental effects. The use of no-tillage systems greatly increases the benefits of cover crops and vice versa. Despite adverse weather conditions (e.g. drought, hail), winter annuals were planted late February and germination of crops were erratic due to the dry soil condition and less than favourable rainfall. Important activities that took place there after included the harvesting of the cover crops to determine the yield on the different treatments. Both the summer crops as well as the winter annuals were harvested, of which the results are presented and discussed in this report. Soil samples were taken from some cover crops trial treatments during the harvesting event in March to determine the soil health conditions. Samples were analysed using an array of methods to calculate soil health. The results of these tests are attached to this report as appendixes.

To optimise CA local **agronomic principles and practices** need to be refined for local conditions. A number of research objectives and trials were identified to address some of these practices. Objectives and trials for the 2014/15 season were:

- Finding suitable crop rotation systems for CA
- Comparing local and Argentinian row widths and plant population densities
- The use of tines versus coulter on planters on the performance of crops
- Cultivar evaluation in conservation agriculture systems

## 1. Coordination and management

Work Package title	<b>Coordination and management</b>
Work Package period	July 2014 to September 2015
Lead partner	Ottosdal No-till Club (Mr Hannes Otto) and Grain SA (Dr Hendrik Smith)
Involved partners	All
Objectives	Coordinate activities among all partners Ensure timely reporting to Grain SA / The Maize Trust Promote synergy among project activities
Justification	Project size, complexity and level of integration/interdependency among different project actions require strict delivery and adherence to project timelines as essential. Partners must often work together to achieve specific project outputs.
Description of work	<p><b>Activity 1: Project inception workshop.</b></p> <p><b>Progress and Results achieved:</b> A one-day project planning and inception workshop was held on 20 August 2013 (at the Ottosdal country club) at the beginning of the project to enable all project partners to define work packages and procedures to achieve the project outputs and objectives. These WP's are used for the financial control and payment of the project and for the monitoring of the agreed tasks and deliverables. Work package managers were identified at this meeting and will present/follow strategies and protocols which are frequently monitored by all partners.</p> <p><b>Activity 2: Frequent coordination meetings.</b></p> <p>The purpose of these monthly or bi-monthly meetings is to establish an Innovation platform for improved communication, integration and sharing. The essence or key action in these meetings will be social learning, characterised by feedback, reflection, planning and coordination between different work packages and stakeholders. A secondary activity is the creation of a wider network in support of communication, sharing, learning and scaling out.</p> <p><b>Progress and Results achieved:</b> Frequent project meetings has taken place involving all the key partners (project team members) in the project. Those include farmers, researchers, input suppliers, Grain SA/MT and manufacturers. These meetings are instrumental in the running of the project, serving as a platform for collective and adaptive project management. Some of the key project events, such as the farmer-led trials and the conference, have been planned and coordinated form this platform.</p>

Argentina and various CA farmers from the North West Province, who shared their successes and problems in relation with CA. Mr Wessel van Wyk then talked about soyabean cultivation, while Mrs Kobus Burger and Willie Pretorius both presented on Soil Health.

**Activity 5: Reporting.**

All partners participates in the preparation of a six-monthly progress report, as well as the annual progress report. The lead applicant and work package managers' report on results and work progress, as well as actions taken to minimise the effects of delays on other project activities.

**Progress and Results achieved:** Reporting has been done according to the standards and format required by The Maize Trust.

**Activity 6: Annual progress reports.**

The Annual report will be made following The Maize Trust / CA-FIP instructions. Work package managers will be responsible for collating information and making a single work page report. The lead applicant will be responsible for integrating these into a single full report. A similar approach will be used to prepare the final project report covering information from all project years.

**Progress and Results achieved:** See progress and results of other Work Packages below.

Deliverables • Project actions and reporting delivered on time

Risks The project study area is experiencing a major drought period and trial results might be affected.

**2. Assessment of soil quality**

Work Package title **Assessment of soil quality under Conservation Agriculture (CA) systems in the semi-arid cropping areas of the North-West Province**

Work Package period July 2014 to September 2015

Lead partner SGS (Mr Adriaan Dreyer)

Involved partners Ottosdal No-till Club, ARC-GCI, Grain SA,

## DELIVERABLES, PROGRESS AND RESULTS ACHIEVED PER ACTIVITY

Activities	Deliverables	Progress and Results achieved
1. Monitoring and Sampling	<p>Soil classification (types and depths)</p> <p>Detailed sampling of each trial site;</p> <p>Selected samples in surrounding landscape</p> <p>Root evaluations in soil profiles</p>	<p>Soil classification and analysis were done for every trial and selected farms.</p> <p>Root evaluations and root development problems in different soil profiles have been done.</p> <p>(See report attached below)</p>
2. Lab Analyses	<p>Organic C (%)</p> <p>Standard soil analysis:</p> <p>4 basic cations, P, pH, ratios, micro-elements</p> <p>Texture (once-off, top- and subsoil)</p>	<p>Soil chemical sampling was done for every trial.</p> <p>(results included in annual report attached in <b>Appendix 1.1</b>)</p>
3. Monthly meetings (project team) & Training	<p>Participate in monthly forum meetings, discussing problems and possible solutions to that.</p>	<p>Participated in two meetings that were held.</p>
4. Annual reference group meeting (advisory committee)	<p>Report progress and findings to advisory committee;</p> <p>Discussion and evaluation of data.</p> <p>Learning from each other.</p>	<p>Participated on 6 August and gave presentation.</p>
5. Annual reports and admin (technical data)	<p>Written technical report covering trial procedures, results and progress.</p>	<p>See annual report attached below</p>
6. Participate in Awareness events	<p>Trial visits with stakeholders;</p> <p>participate in awareness events, such as information day and/or cross-visits</p>	<p>Presented data and findings at the CA conference from 11 to 12 March as well as the Reference group meeting on 6 August 2015.</p>

Description of work	On-farm, farmer-led screening trials: around 10 potential cover crops
Activities	<ol style="list-style-type: none"> <li>1. Land preparation (finding a suitable location, sourcing materials)</li> <li>2. Purchase Materials &amp; Equipment</li> <li>3. Establishing and Planting of trials</li> <li>4. Seasonal management and maintenance of trials</li> <li>5. Monitoring and Sampling (including harvesting, biomass and yield determination, nutrient analysis)</li> <li>6. Lab Analyses</li> <li>7. Monthly meetings (project team) &amp; Training</li> <li>8. Annual reference group meeting (advisory committee)</li> <li>9. Harvesting, biomass and yield determination, nutrient analysis</li> <li>10. Annual report and admin (production &amp; technical data)</li> <li>11. Participate in Awareness events</li> </ol>
Risks	<p>Finding a suitable site for a trial of this magnitude</p> <p>Getting the right equipment and seed to do the job well</p> <p>Acts of God (drought, hail, etc.)</p> <p>Labour (weed control, harvesting, etc.)</p>

**Table 3.1: A summary of progress made during 2014 / 2015.**

Activities	Deliverables	Progress and Results achieved
7. Land preparation (finding a suitable location, sourcing materials, action planning)	<p>Description of natural resources. This will include positive and negative factors that can impact on plant growth. Selection of suitable site(s).</p> <p>Action plan that will include acquisition of seed, inoculum, stickers, implements, chemical inputs, monitoring and evaluation of trial, harvesting, collecting and interpretation of data.</p> <p>The action plan should clarify the roll of all parties involved.</p>	<p>Previous plots have been marked for identification. Cover crops were rolled with a knife roller. Plots with volunteer plants were sprayed with Round-up. Plots received the necessary fertilizers and pesticides.</p> <p>A complete report on progress was compiled for Grain SA during June 2014.</p> <p>The same action plan as the previous year is used.</p>
8. Purchase Materials & Equipment	Acquisition of seed, inoculum, stickers, implements, chemical inputs.	<p>Summer annuals were delivered to George Steyn on 19/11/2014 and winter annuals on 16/2/2015. Seed was delivered by myself after receiving it from Simon Hodgson of cover crop solutions.</p> <p>Seed was ordered for the next growing season in August 2015.</p>

		identify micro-organism were done in March 2015.
13. Monthly meetings (project team) & Training	Partake in monthly forum meetings, discussing problems and possible solutions to that.	Partake in meetings. Three visits to discuss and give feedback was undertaken.
14. Annual reference group meeting (advisory committee)	Report progress and findings to advisory committee; Discussion and evaluation of trials. Learning from previous mistakes.	Took part in meeting on 6 August 2015.
15. Annual report and admin (production & technical data)	Written technical report covering trial procedures, results and progress.	Technical report was submitted by 28/08/2015.
16. Participate in Awareness events	Trial visits with stakeholders; participate in awareness events, such as information day and/or cross-visits  Ottosdal conference	Article in "Landbouweekblad" 2014. Poster at the congress of LaRSSA. Monthly article in Grain SA.  During the Ottosdal CA conference held from 10-12 March 2015, delegates were made aware of cover crops and the use thereof at farm level.

### PROGRES REPORT ON COVER CROPS: Results for the 2014-2015 season:

#### Objectives:

- To establish and maintain on-farm screening trials
- Determining the biological productivity of different cover crops
- Measuring the production of crop residues of each cover crop system
- Measure the adaptability of cover crops in different agro-ecological regions in North West.

#### General:

In **Figure 3.1** the yield of all crops were calculated and divided by the number of treatments (crops) and are presented from high to low in terms of yield. In general the summer annuals at Humanskraal did well in terms of production. Four legumes *M. pruriens*, *G. max*, *V. unguiculata* and *L. purpureus* are ranked under the top six accessions while two grasses *P. glaucum* and *S. bicolor* respectively is second and fourth. From the summer annuals *H. annuus* did the worse. It also seems that winter annuals in such a dry season used up soil moisture and treatments planted on especially *R. sativus* performed poorly in terms of yield.

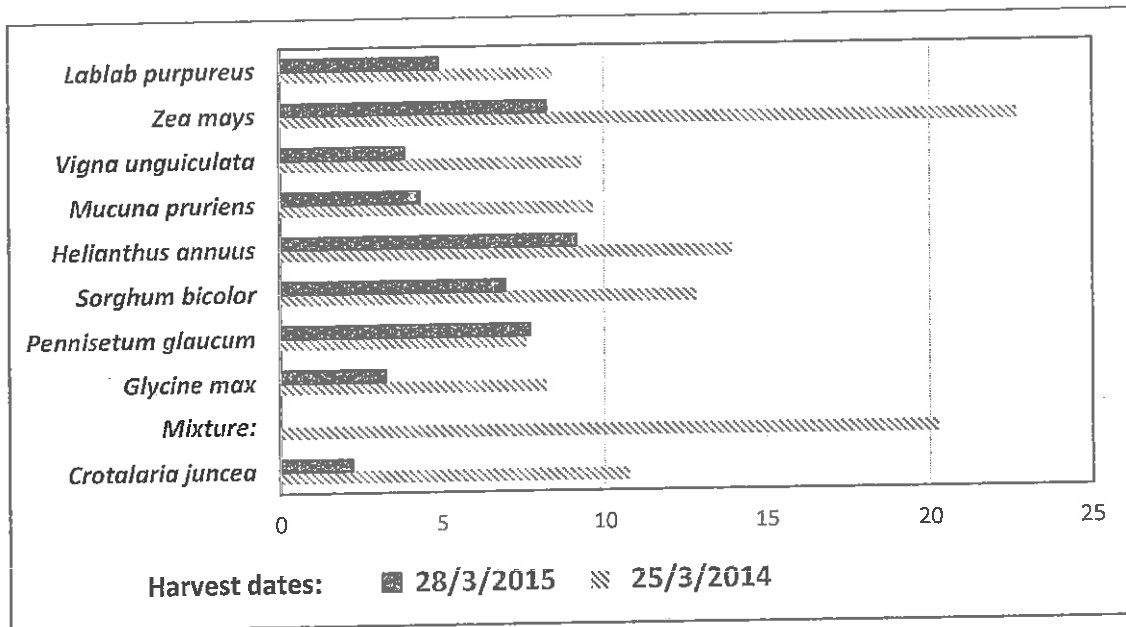


Figure 3.2: Summer annual yields (t/ha) for the 2014 (wet) and 2015 (dry) seasons at Humanskraal.

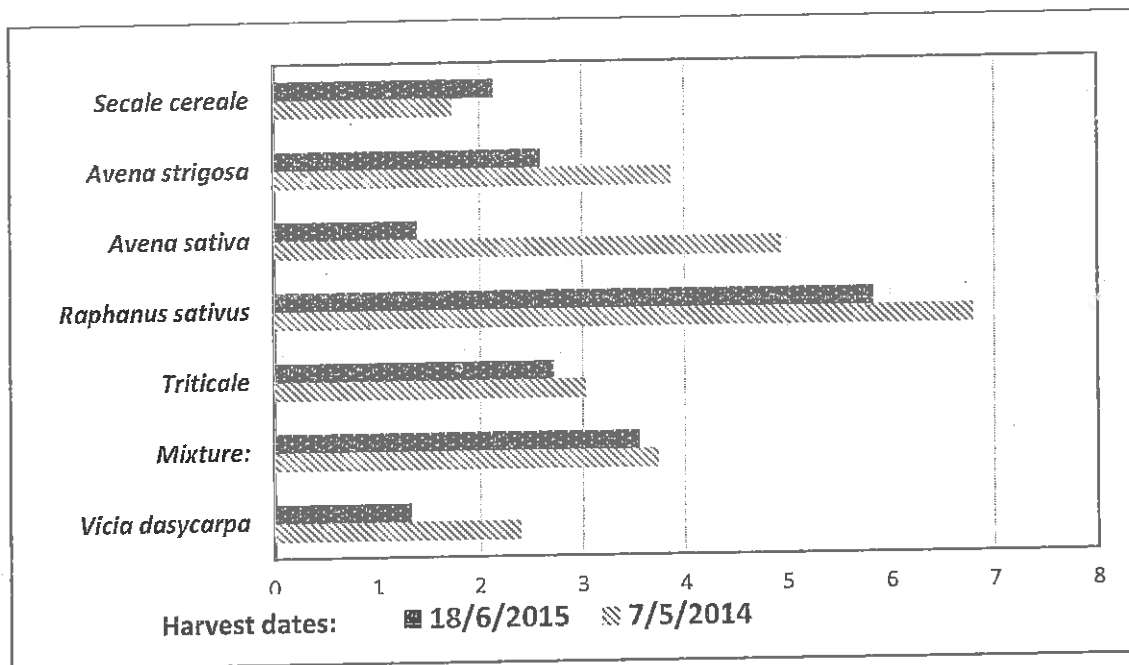
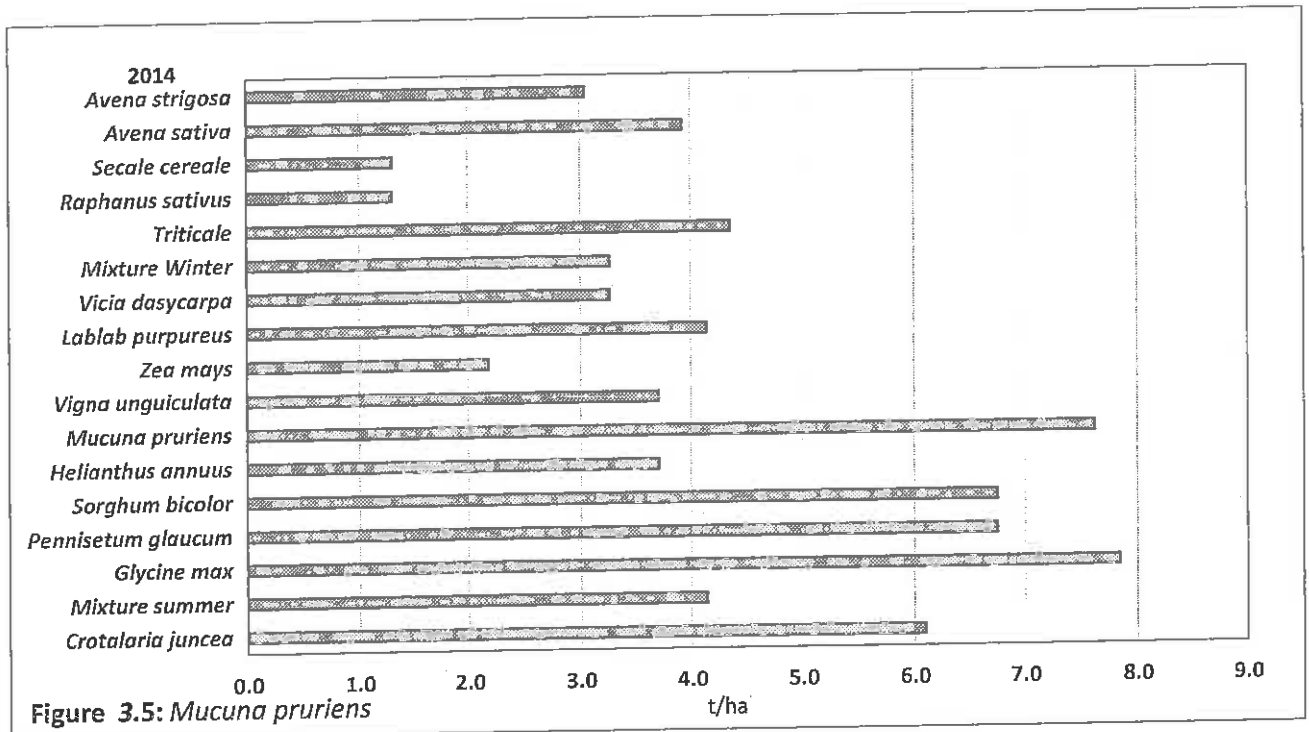


Figure 3.3: Yield difference (t/ha) between winter annuals for 2014 (wet) and 2015 (dry) season at Humanskraal.

Figure 3.4 – 3.20 represent the different treatments and their yield of the 2013/14 season crops. Interesting facts will be highlighted. A picture representing the different cover crops during 2015 season is also included on the page. This gives the reader an idea of the yield and the growth habit of the crops.

between livestock and crop systems however will be limited due to L-dopa toxicity if a cover crop is use as livestock feed.



A picture of velvetbean taken on the 26/3/2015

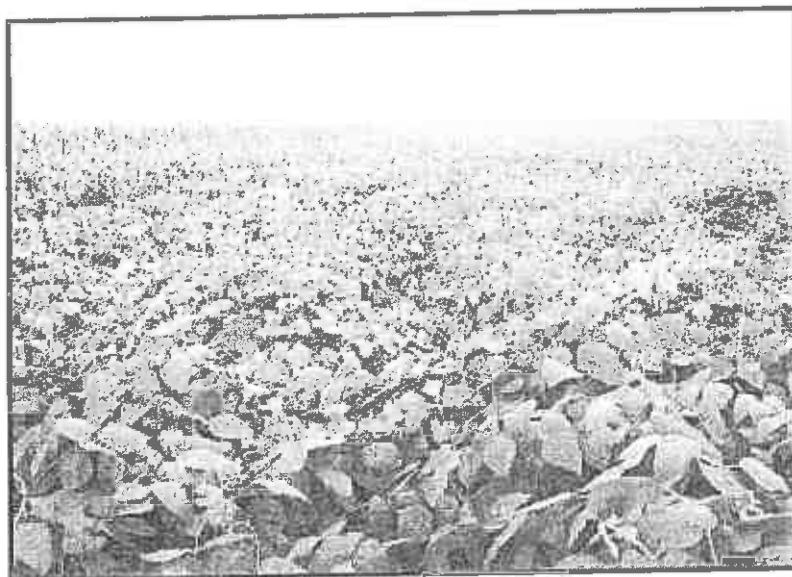
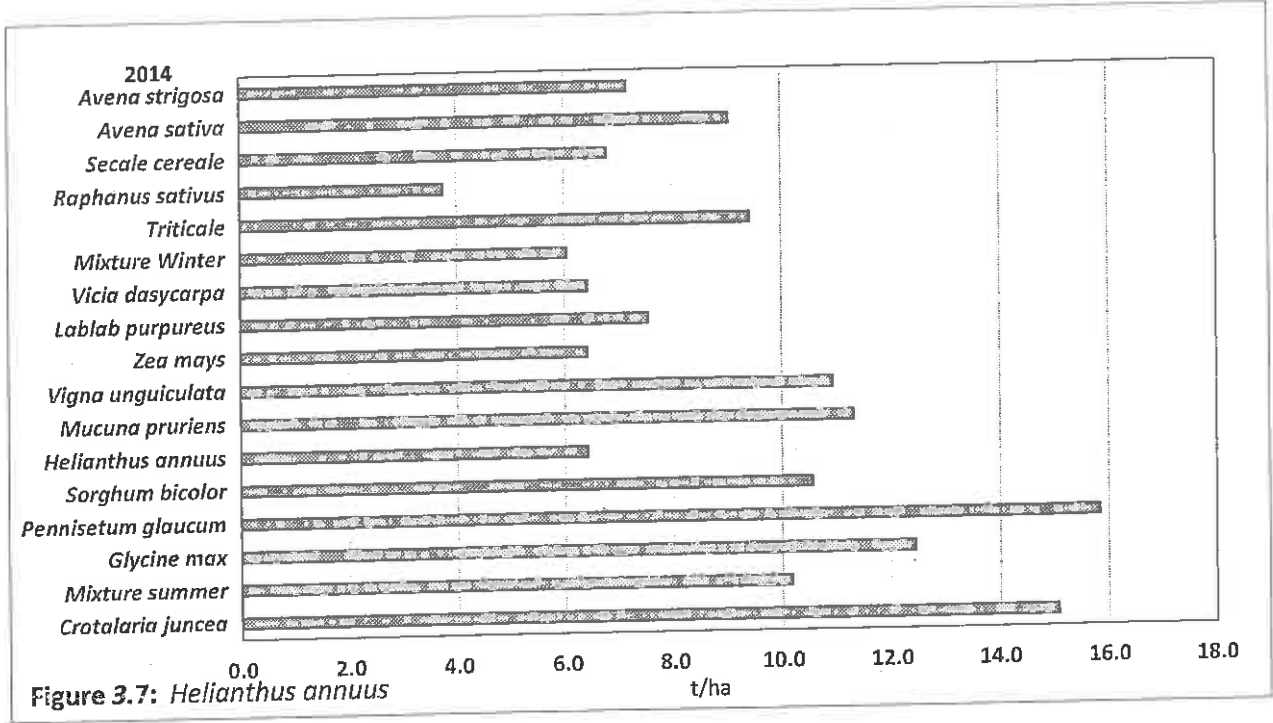


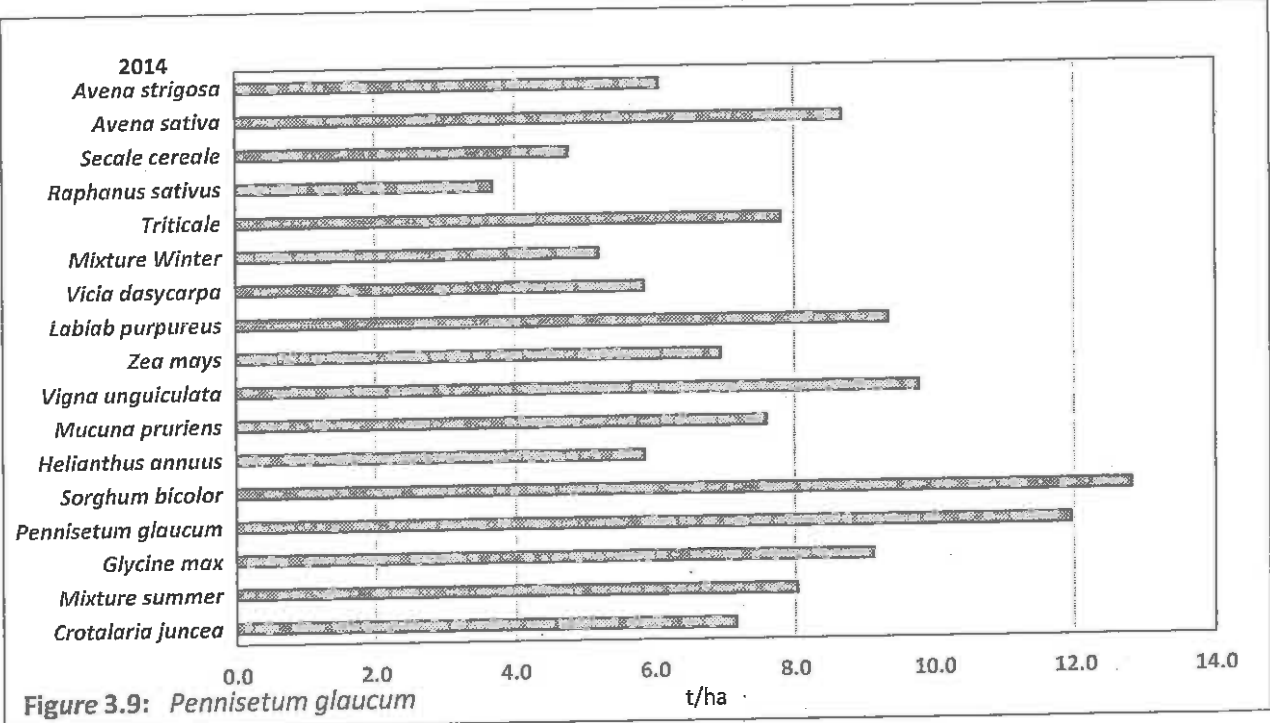
Figure 3.7 represents sunflower yield on the different treatments. Again, with the exception of millet, sunflower seems to do well after all treatments containing legumes. In the previous report we mentioned the fact that sunflower and soybean had the lowest crop residues at planting of all the crops, a mere 5% soil cover.



A picture of sunflower taken on the 26/3/2015



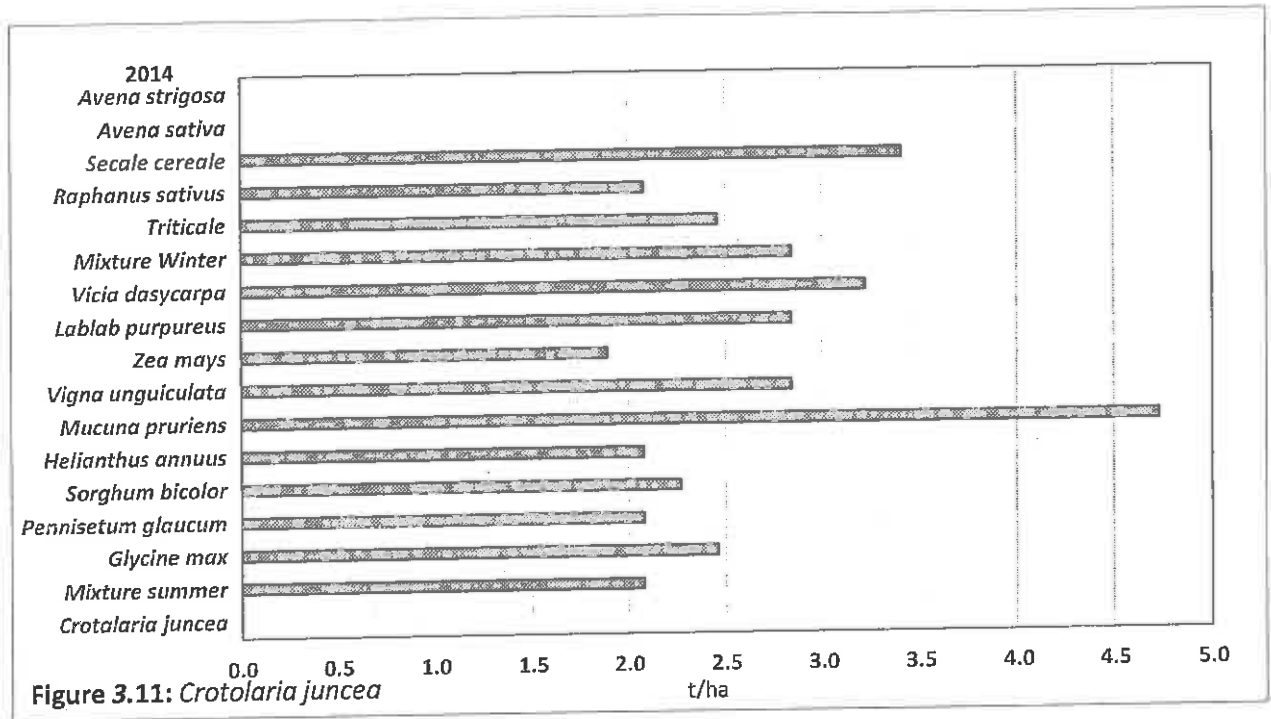
Figure 3.9 represents millet yield on the different treatments. In the previous season millet was planted too deep and did not yield to its full potential. Whether this had an effect on crop yield this season due to the fallow effect, is unknown. From Figure 3.1 though it is clear that crops yielded the highest on the millet treatment. As an ancient crop millet still provides farmers with a good alternative when integration with livestock is the objective.



A picture of millet taken on the 26/3/2015



Figure 3.11 represents *C. juncea* yield on the different treatments. *Crotalaria* (sunhennop) did not establish well after planting. It is also one of the crops noted for its yield reduction between the two seasons. Since it produces many yellow flowers it can attract beneficial insects such as pollinators and predators.



A picture of *C. juncea* taken on the 25/3/2014

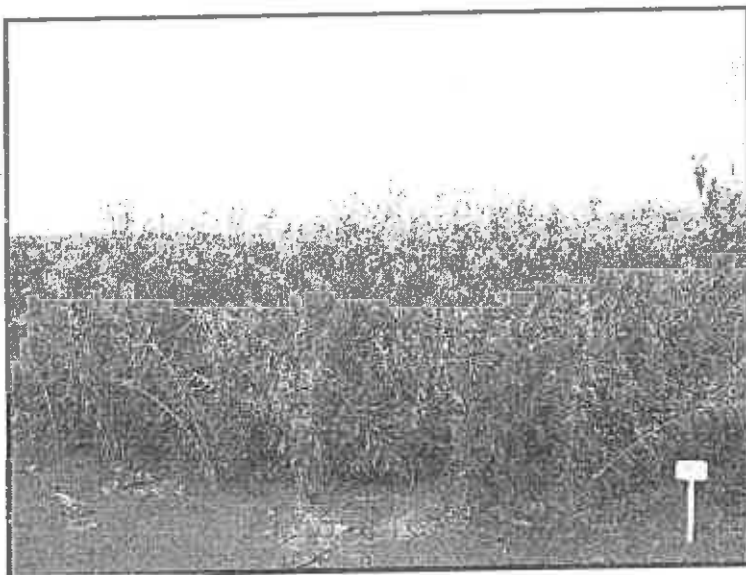
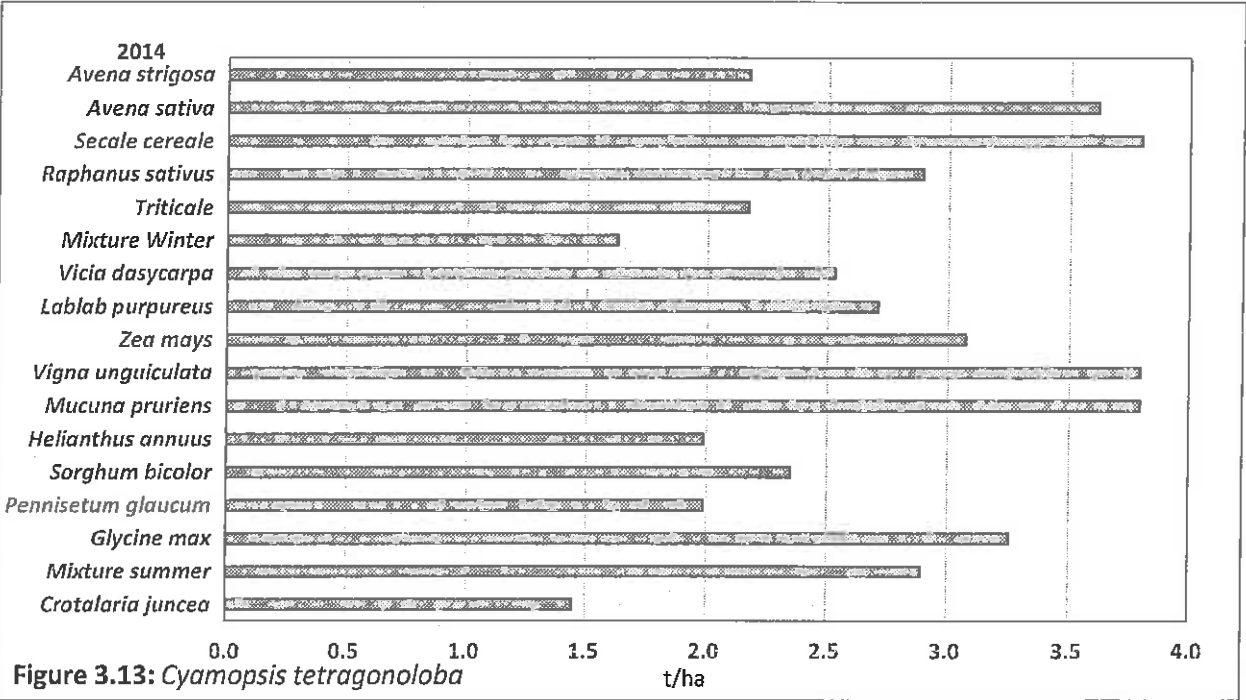


Figure 3.13 represents guarbean yield on the different treatments. Farmers decided to include guarbean in the trial. Mines use glue extracted from the plant seed and at the moment there is a demand for the product. Seed production during the drought season was low. Production was highest on oats and rye for the winter annuals whiles for the summer annuals it seems that it prefer to be planted after legumes such as cowpea and velvetbean.



A picture of guarbean taken on the 26/3/2015

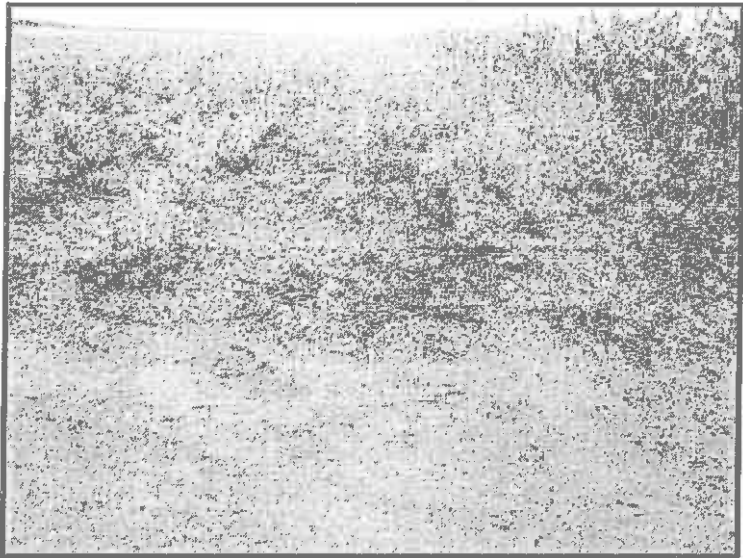
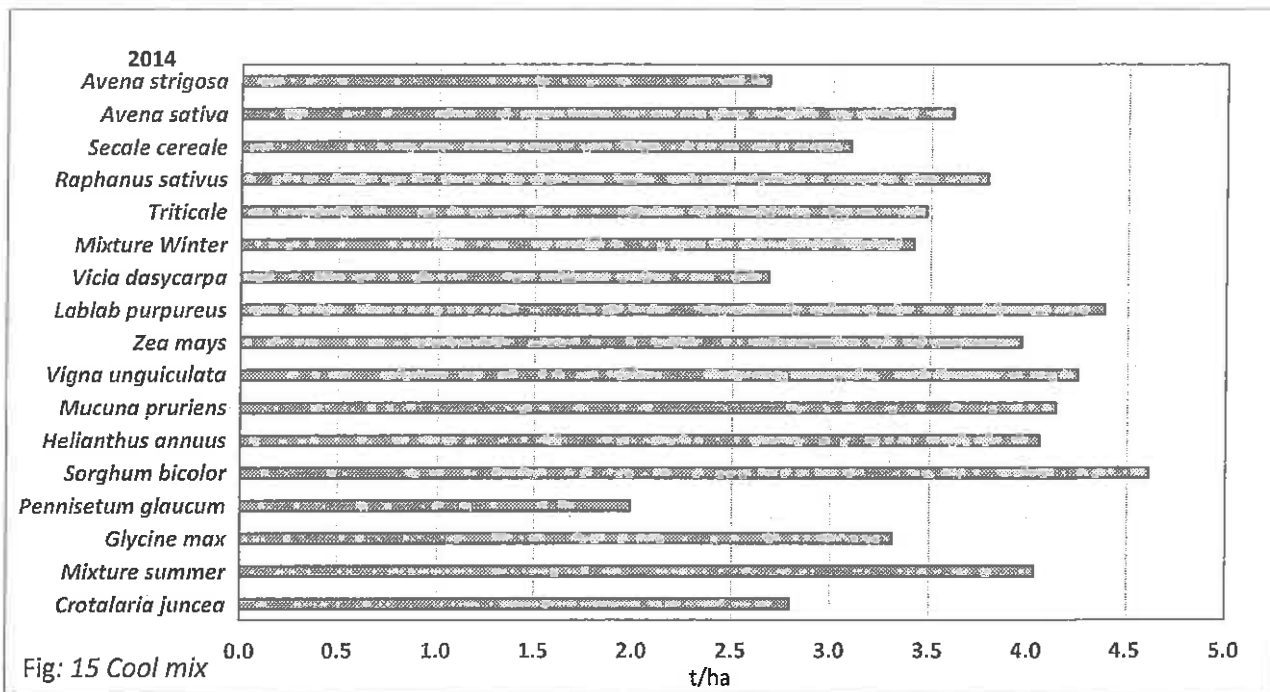


Figure 3.15: represents cool season mixture (radish, grazing vetch and black oats) yield on the different treatments. It is one of the better performing treatments when planted after sunflower. It could play a role when integration with livestock is the goal.



A picture of cool season mixture taken on the 18/6/2015

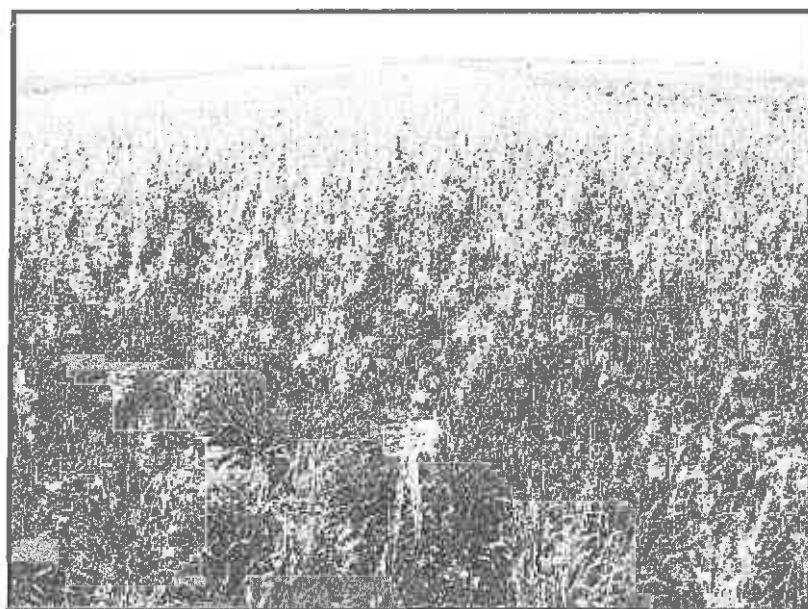
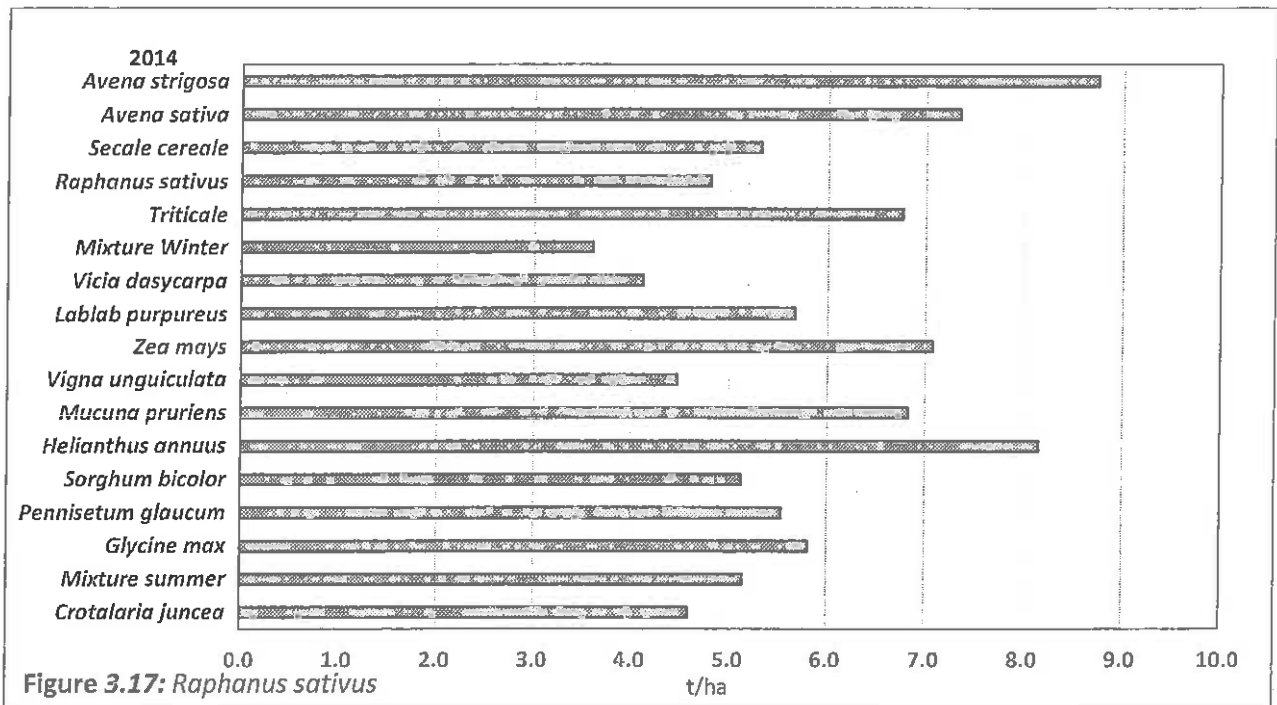


Figure 3.17 represents radish yield on the different treatments. Unlike cereal rye and other small grains whose residues decompose slowly and continue to immobilize N for an extended period, radish residues decompose and release N rapidly.



A picture of radish taken on the 10/5/2015

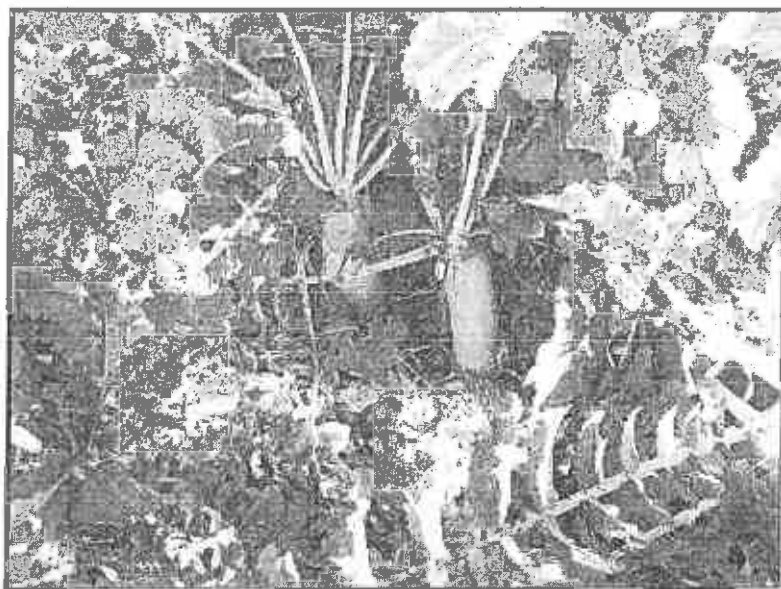
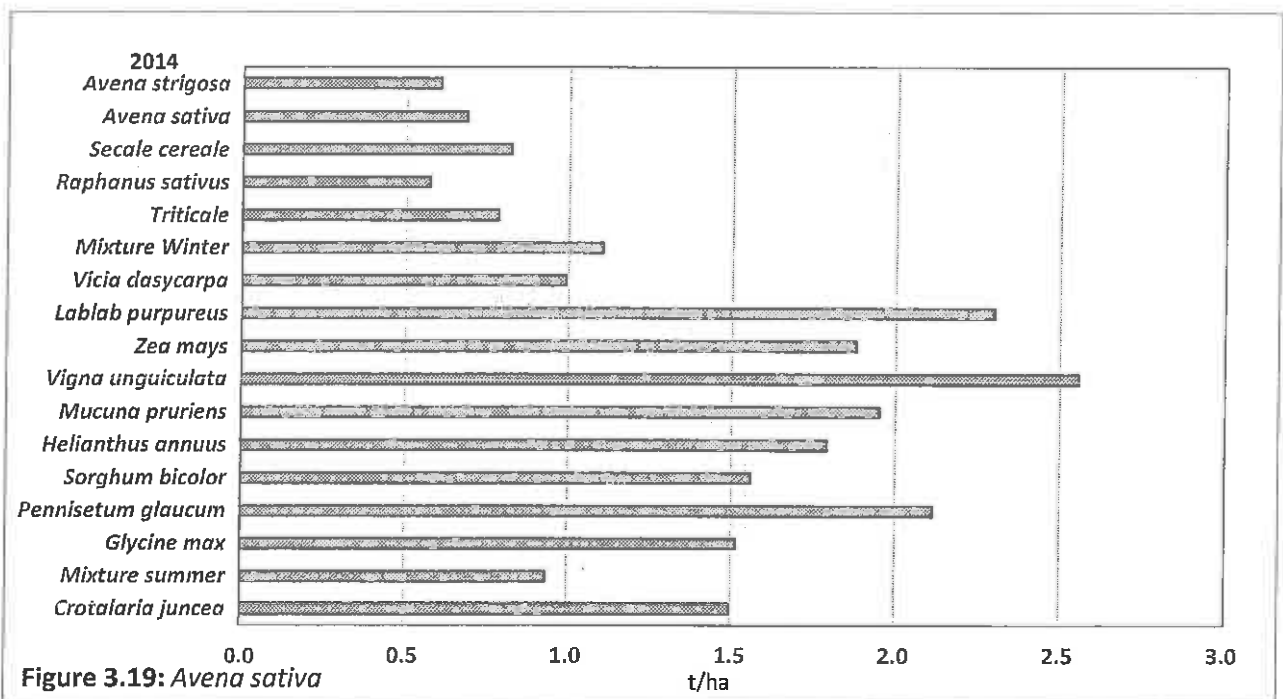
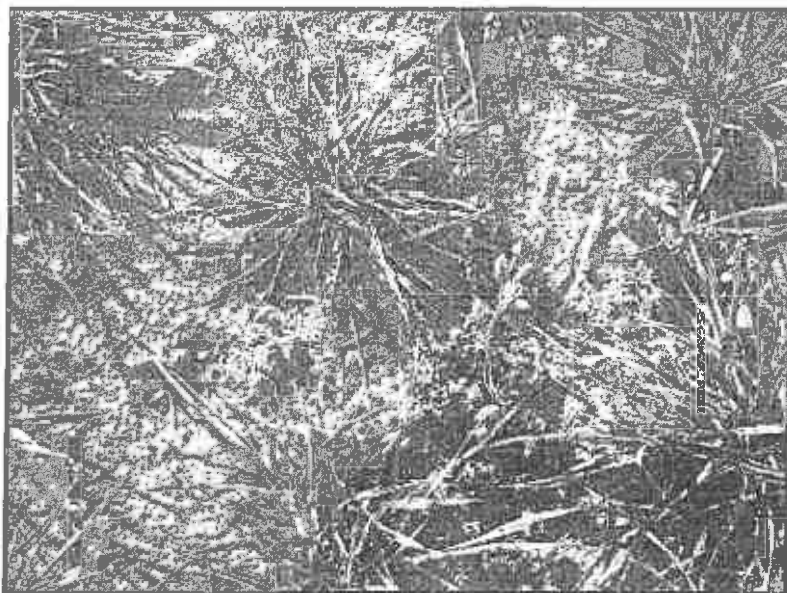


Figure 3.19 represents oats yield on the different treatments. The previous season oats was the only crop that did not die after applying Round-up. Also, regrowth after the winter season was observed. It grows well after annual summer legumes such as cowpeas. It did, however, not established well this season as shown in the picture below.



A picture of oats taken on the 10/5/2015



## Soil health assessment under selected treatments:

Soil samples were taken from some selected treatments to measure for soil biological indicators. At this stage, it is more a question of whether any differences between crops and or rotations between crops in soil health parameters can be detected. A decision was taken that we shall focus on pure stands and diverse rotation such as legumes on legumes, grass on grass, grass on legumes, legumes on grass, grass on broadleaves, legumes on broadleaves, veld and bare soil, where the latter will serve as a control.

Soil samples were taken at Humanskraal on 26/3/2015. Composite soil samples were taken on a depth of 20 cm using a spade; 5-6 core samples were taken close to the roots of the plants, were thoroughly mixed, where after a sub-sample was taken for analysis. Samples were placed in a cooler box with ice packs. This action was deemed necessary to keep micro-organism alive and restrict direct sunlight exposure.

After arriving in Pretoria samples were taken to the ARC - Plant Protection Research Institute (ARC-PPRI). Samples were split into equal amounts. Mr J. Habig received half of the sample for a range of soil microbial analyses (i.e. Biolog Ecoplate and enzymes), while the remaining half was couriered to Mr W. Pretorius at Crop Systems (Radicle Lab) for doing the Solvita and Haney Soil Health Test.

## SOIL ENZYME ANALYSES & COMMUNITY LEVEL PHYSIOLOGICAL PROFILING (BIOLOG ECOPLATE) – OTTOSDAL PROJECT: Prepared by J. Habig, ARC-PPRI

**Appendix 1.2**, Figure 1 and 2 show under which treatment the soil micro-organisms diversity are more or less the same. Bare soil and veld are the same; the microbes in the “maize monoculture”, “millet on winter mix” and “sunflower on maize” are the same and that microbes in the “lablab” treatments correlate. Within these treatments the microbial diversity are the same, but the diversity between the groups differ. This is an indicator of the plants ability to influence microbial diversity. It is clear from the report in Appendix 1.2 (Table 1) that lablab has the ability to significantly influence microbial diversity.

The figures at the microbial enzymes activities show how fast the microbes under different treatments can release elements and make it available in a form that can be used by plants. *B*-glucosidase gives an indication how fast carbon can be released; phosphates influence the release of P from organic matter and urease gives us an indicator of the release of N. Theoretically the faster C,P and N can be transferred from organic matter, the more active the microbial population is.

## SOLVITA 24 HOUR CO<sub>2</sub> BURST TEST: Prepared by W Pretorius, Crop Systems and Radicle Lab

Soil health is the key to improved productivity and better yields and Solvita® soil tests give you the ability to measure soil biology and evaluate your soil management practices. With Solvita soil tests, soil labs, producers and crop consultants have the capability to easily measure soil CO<sub>2</sub> respiration and reserve organic nitrogen, important indicators of soil fertility. Being able to evaluate the turnover of organic matter via CO<sub>2</sub> respiration is important for a number of reasons:

- **Indicator of soil health** – The rates of CO<sub>2</sub> release is generally regarded as an indicator of Soil Health and is favourably improved with practices such as cover cropping, where the quality of

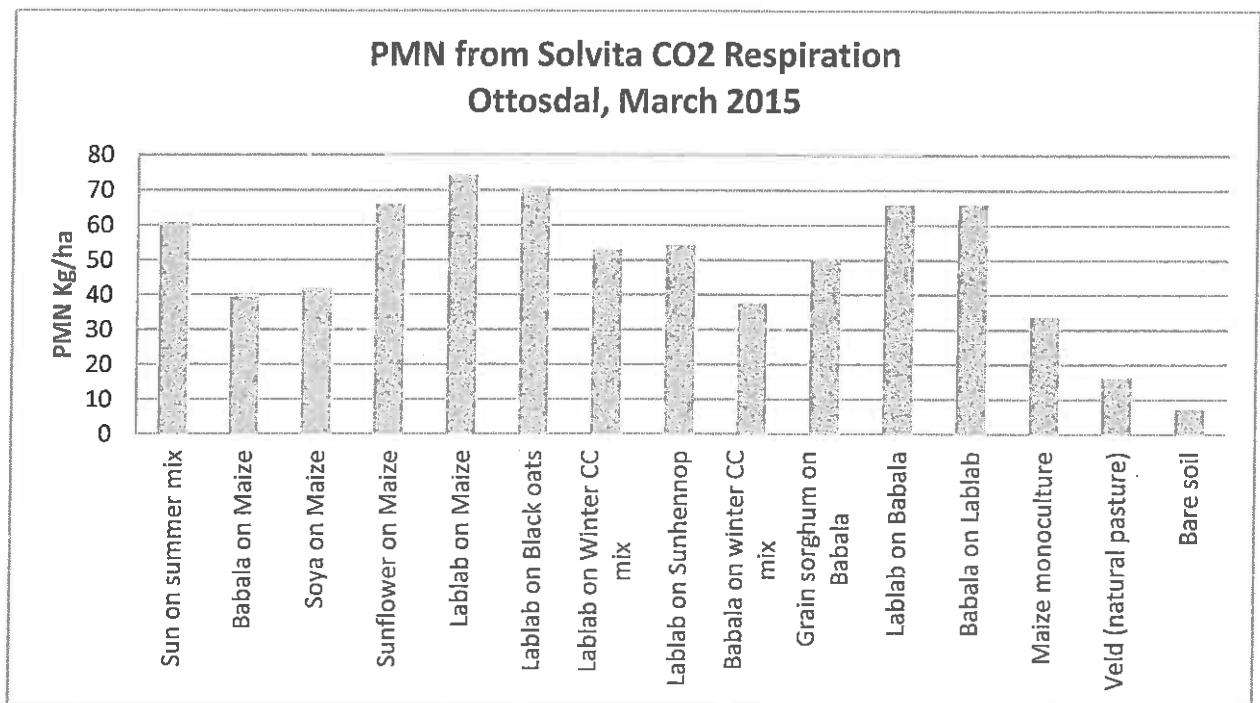


Figure 3.22: PMN from Solvita CO2 respiration at Ottosdal, March 2015

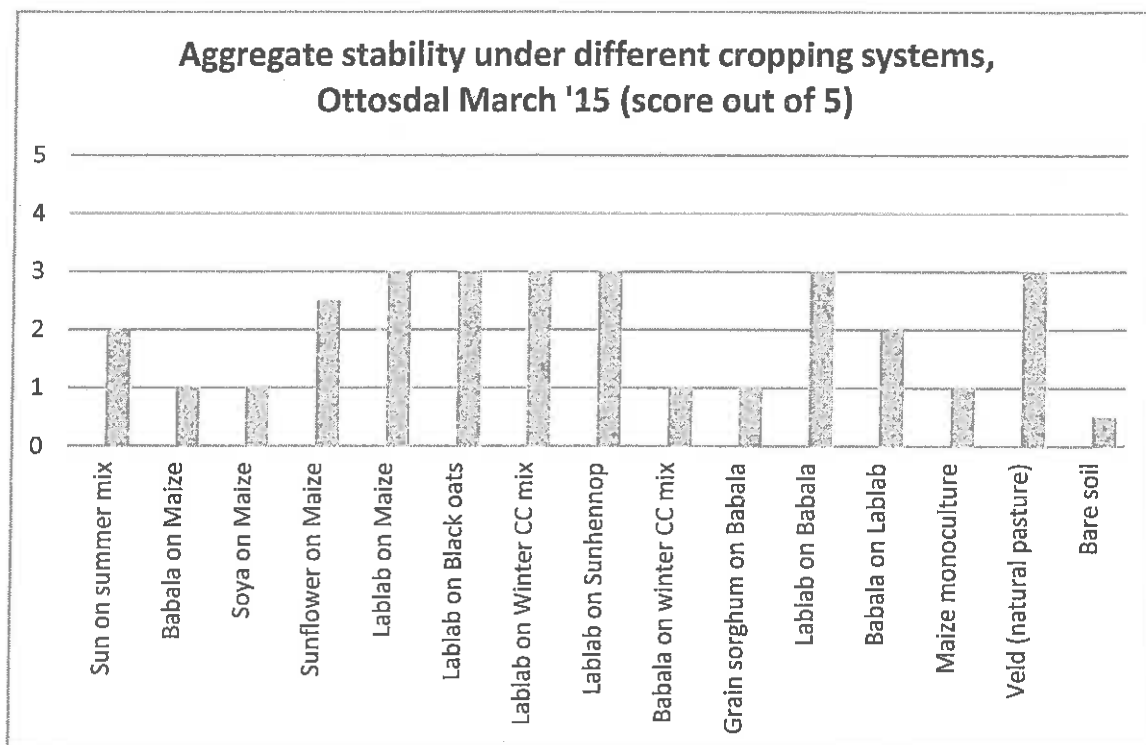


Figure 3.23: Aggregate stability under different cropping systems at Ottosdal, March 2015

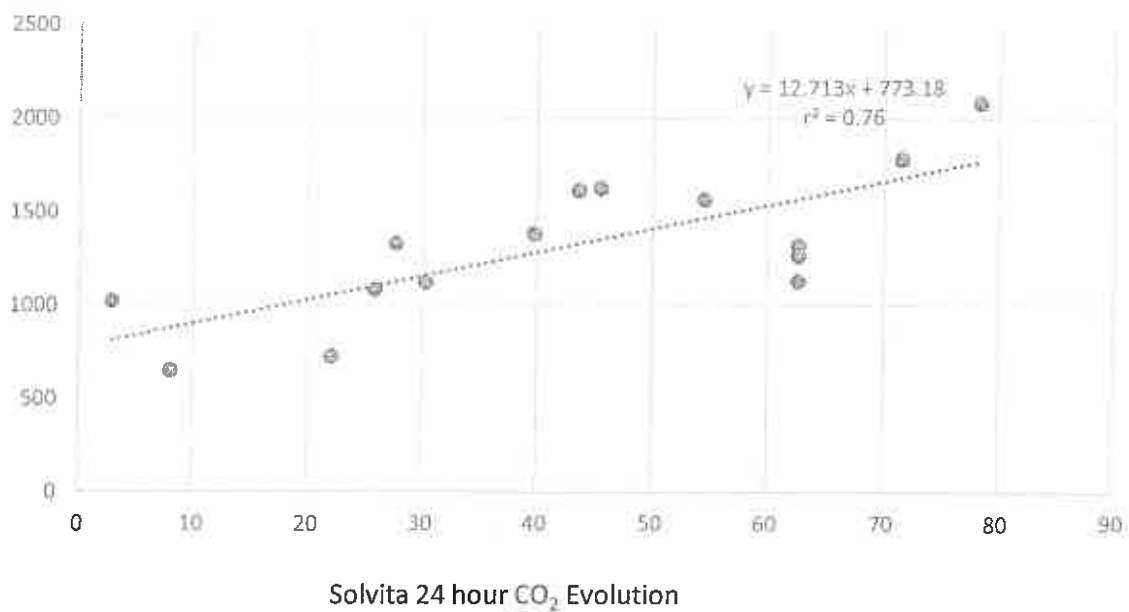


Figure 3.26: Relationship between Solvita 24 hour CO<sub>2</sub> emission and glucosidase enzyme activity.

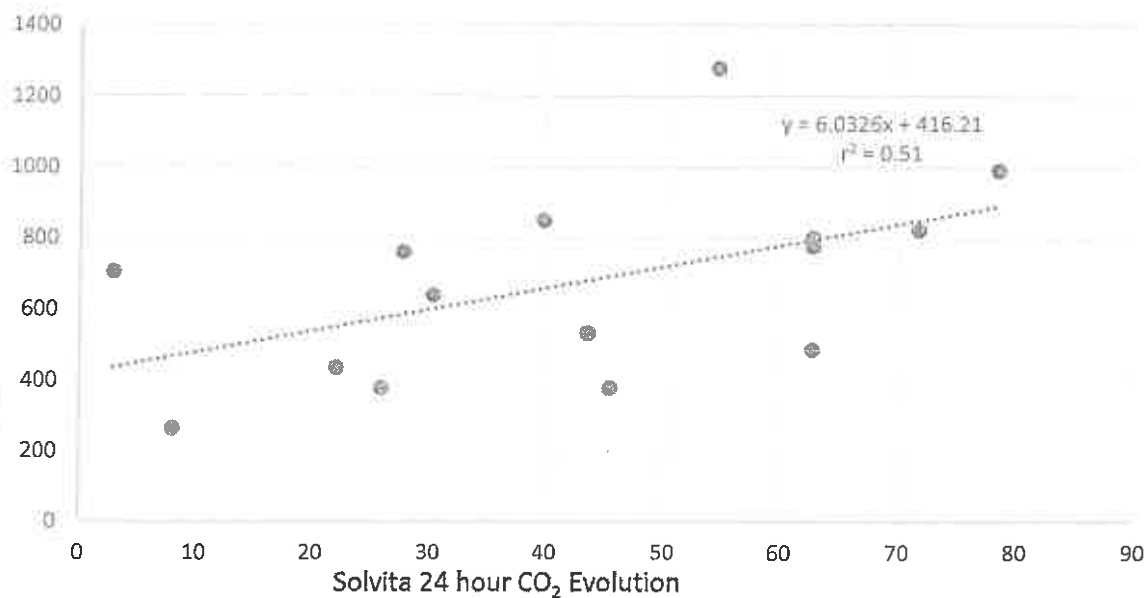


Figure 3.27: Relationship between Solvita 24 hour CO<sub>2</sub> emission and Alkaline Phosphatase enzyme activity.

#### 4. Weed survey of field trials: planning and analyses

Work Package title	<b>Weed survey of field trials: planning and analyses</b>
Work Package period	July 2014 to September 2015
Lead partner	ARC-GCI (Dr E Hugo)
Involved partners	Ottosdal No-till club members, SGS
Objectives	<ul style="list-style-type: none"> <li>• To plan the on-farm maize weed survey trials</li> <li>• To analyse and report the results of the weed survey trials</li> <li>• Determine challenges in weed control of no-till practices</li> </ul>
Justification	<p>Knowledge of the long-term effect of tillage or reduced-tillage practices on weed diversity and species composition will provide information necessary for improving weed management in agro-ecosystems. The constant use of certain active ingredients of herbicides such as glyphosate in a monoculture-maize production system also raises a concern for development of resistant weed populations. Most research to date on weed control in reduced tillage practices have shown clearly that tillage has a profound effect on the species composition and subsequent shift in the weed spectrum.</p> <p>The absence of soil disturbance and presence of crop residue cover in CA systems will generally lead to an increase over seasons in organic matter content of the soil, soil moisture, temperature and microbial activity. These factors may have a direct or indirect effect on weed control efficacy, including weed species present, time of weed seed germination and emergence, weed-crop interference, competition between weed species, effective herbicide application and residual efficacy of herbicides as well as waiting period of herbicides on follow-up crops.</p>
Description of work	<b>Planning of trials in collaboration with participating farmers. Analyses of farmer collected results and reporting of findings.</b>
Activities	Planning of trials through the attendance of the frequent coordination meetings where aims and procedures will be discussed with farmers. Planning of trial layout and compiling of data sheets to be completed by participating farmers. Collection of data from farmers at the after harvest of the trials. Statistical analyses, interpretation, discussion and drawing of conclusions from the results. Presentation and reporting of the results to participants and MT as required.
Deliverables	<ul style="list-style-type: none"> <li>• Annual trial plans report</li> <li>• Regular attendance of meetings</li> <li>• Reporting as required</li> <li>• Popular article once enough results have been acquired.</li> </ul>
Risks	Adequate involvement and participation of farmers

## 5. Agronomic field trial planning and analyses

Work Package title	Agronomic field trial planning and analyses
Work Package period	July 2014 to September 2015
Lead partner	ARC-GCI (Dr. A. A. Nel)
Involved partners	Ottosdal No-till club members, SGS
Objectives	<ul style="list-style-type: none"> <li>To plan the various on-farm maize CA related field trials</li> <li>To analyse and report the results of these trials</li> </ul>
Justification	<p>Plant population density is one of relatively few variables that farmers can manage easily. Current recommendations for maize plant population were derived from trials under conventional tillage. Physically, the soil is very different in no-till than in tilled soil. This might require an adjustment in the plant population density of crops. Recommendations from elsewhere in the world is that plant population densities should be increased and row width should be decreased for no-till cropping.</p> <p>Crop rotation, another easily manageable variable, is one of the principles of conservation agriculture. No information on how crops respond to rotation in conservation agriculture systems in this semi-arid environment is available. Unknown variables are what cultivars are the best adapted for CA, should Argentinian guidelines on row width and plant population density be followed, should planters be fitted with coulters rather than tines?</p> <p>Crop responses to changes in management and the environment is usually complex interactions resulting in variation of the results, which might lead to wrong conclusions and recommendations. In order to generate scientifically sound recommendations on these two agronomical variables, proper planning and analyses of the results is needed.</p>
Description of work	Planning of trials in collaboration with participating farmers. Analyses of collected results and reporting of findings.
Activities	Planning of trials through the attendance of the frequent coordination meetings where aims and procedures will be discussed with farmers. Planning of and compiling of data sheets to be completed by participating farmers. Analyses, interpretation, discussion and drawing of conclusions from the data. Presentation and reporting of the results to participants and MT
Deliverables	<ul style="list-style-type: none"> <li>Annual trial plans report</li> <li>Regular attendance of meetings</li> <li>Reporting as required</li> <li>Popular article once enough results have been acquired.</li> </ul>
Risks	Adequate involvement and participation of farmers

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Involved partners	Ottosdal No-till club members, SGS
Objectives	<ul style="list-style-type: none"> <li>To plan the various on-farm maize CA related field trials</li> <li>To analyse and report the results of these trials</li> </ul>
Justification	<p>Plant population density is one of relatively few variables that farmers can manage easily. Current recommendations for maize plant population were derived from trials under conventional tillage. Physically, the soil is very different in no-tillage than in tilled soil. This might require an adjustment in the plant population density of crops. Recommendations from elsewhere in the world is that plant population densities should be increased and row width should be decreased for no-till cropping.</p> <p>Crop rotation, another easily manageable variable, is one of the principles of conservation agriculture. No information on how crops respond to rotation in conservation agriculture systems in this semi-arid environment is available. Other unknown variables are what cultivars are the best adapted for CA, should the Argentinian guidelines on row width and plant population density be followed and should planters be fitted with coulters rather than tines?</p> <p>Crop responses to changes in management and the environment is usually liable to interactions resulting in variation of the results, which might lead to wrong conclusions and recommendations. In order to generate scientifically sound recommendations on these two agronomical variables, proper planning and analyses of the results is needed.</p>
Description of work	Planning of trials in collaboration with participating farmers. Analyses of farmer collected results and reporting of findings.
Activities	Planning of trials through the attendance of the frequent coordination meetings where aims and procedures will be discussed with farmers. Planning of trial layout and compiling of data sheets to be completed by participating farmers. Statistical analyses, interpretation, discussion and drawing of conclusions from the collected data. Presentation and reporting of the results to participants and MT as required.
Deliverables	<ul style="list-style-type: none"> <li>Annual trial plans report</li> <li>Regular attendance of meetings</li> <li>Reporting as required</li> <li>Popular article once enough results have been acquired.</li> </ul>
Risks	Adequate involvement and participation of farmers

## 5.1 Introduction

No-till in the Ottosdal area commenced in 2005 by a few farmers, after visiting local farmers and institutions abroad. They realised that soil erosion and soil degradation undermined the sustainability and future of grain production on their land and that no-till is the only measure against this retrogression.

Experience from elsewhere in the world has shown sustainability and efficient resource utilisation are reached when no-till is combined with other agronomical practices. These principles are crop rotation, the creation of a permanent or semi-permanent soil cover of crop residues, and on some soils, the adaption of controlled traffic. When these principles are combined and applied in crop production, it is called Conservation Agriculture (CA). On its own and in combination, these principles reduce soil erosion, lessen the risk of diseases, enhance soil quality or health and limit soil compaction.

To optimise CA in Southern Africa, agronomic principles and practices need to be refined for local conditions. These agronomic principles and practices include, the optimum row width, optimum plant population densities, best performing cultivars, most suitable crop rotations and planting practices, and comparing successful agronomic principles from abroad such as Argentina, with what are considered suitable for local conditions.

The aim of this project is to optimise several agronomical practices for CA in the Ottosdal and surrounding area, and to use these field trials for the promotion of CA among fellow farmers.

## 5.2 Objectives

Objectives for the 2014/2015 season were:

- Finding suitable crop rotation systems for CA
- Comparison between local and Argentinian row widths and plant population densities
- The use of tines versus coulters on planters on the performance of crops
- Cultivar evaluation in conservation agriculture systems

## 5.3 Trials and Procedures

Trials were done on various farms of the No-till Club members. For the crop rotation objective, field trials were done on different farms, each representing one replicate to make statistical analyses of the results possible. A six-row Jumil JM2670-SH-EX planter, with 0.52 m row spacing, was used on all trials except the trial comparing the Argentina system, where a Pierobon planter was used; all other inputs were similar on the different farms. The procedures followed for each objective follows.

## Results

The first season in crop rotation served to create a “rotational effect” in the soil. Yields recorded in two of the four trials planted in 2013/14 are shown in Table 1. Yield results of the 2014/15 season are shown in Table 2.

**Table 5.1** Grain yield of the crops planted in the crop rotation trial in 2013/14

Farm	Maize (t ha <sup>-1</sup> )	Sorghum (t ha <sup>-1</sup> )	Soybean (t ha <sup>-1</sup> )	Sunflower (t ha <sup>-1</sup> )
Humanskraal	8.92	2.85	2.05	2.85
Noodshulp	6.08	3.73	2.67	2.92

The yield of both maize and grain sorghum was affected by the previous crop, although all yields were low. The yield of maize preceded by forage sorghum was 60% or 0.84 t ha<sup>-1</sup> higher than the mean yield of maize preceded by cowpea, maize, soybean and sunflower. The grain yield of grain sorghum preceded by maize and soybean was 127% or 0.78 t ha<sup>-1</sup> higher than that of grain sorghum preceded by sunflower. Compared with the other rotational crops, sunflower was the only crop that had a suppressive effect on the yield of both maize and grain sorghum. Due to a lack of replicates, no conclusion can be made about the soybean yield response.

**Table 5.2** Mean grain yields (t ha<sup>-1</sup>) in 2014/15 as affected by the previous crop grown in 2013/14.

Crop	Previous crop					
	Cowpea	Forage sorghum	Grain sorghum	Maize	Soybean	Sunflower
Maize	1.11 <sup>B*</sup>	2.23 <sup>A</sup>	1.72 <sup>AB</sup>	1.51 <sup>B</sup>	1.45 <sup>B</sup>	1.51 <sup>B</sup>
Grain sorghum	1.08 <sup>AB</sup>	1.08 <sup>AB</sup>	1.03 <sup>AB</sup>	1.24 <sup>A</sup>	1.53 <sup>A</sup>	0.61 <sup>B</sup>
Soybean <sup>**</sup>	0.75	0.95	0.80	0.63	0.93	0.56

\*Means followed by different letters in a row are significantly different at P = 0.05. \*\*Means of only two replicates

### 5.3.3 The use of tines versus coulters on planters on the performance of crops

#### Introduction

Different planter options are available, with either a coulters or a tine fitted to the fertiliser unit. Coulters usually disturb the soil less than tines, which is an advantage. Deeper placement of fertiliser, and a larger or deeper seedbed can be created with tines to benefit seed emergence and seedling growth. It is unclear whether coulters or tines are best suited for crop growth and yield in local conditions.

#### Aim

To determine the influence of tines and coulters on the growth and yield of different crops on a number of farms.

#### Procedures

Two trials were done in 2014/15 on the farm Humanskraal. In the first trial, strips of maize were planted with coulters and adjacent to it, with tines fitted to the Jumi! JM2670-SH-EX planter as treatments in 0.5 m rows. A statistical analysis was not possible as only two replicates were planted.

Three tine configurations were also compared in two replicated field trials.

- Long tine, working depth 240 mm
- Short tine, working depth 150 mm
- Diamond point depth 150 mm

#### Results

Maize planted with tines and coulters had about similar yields, as the difference was only 5%. This is in accordance with the results from 2013/14.

The effect of tine type and working depth on the yield of maize is shown in Figure 4. The yield of maize, planted with a tine with a working depth of 240 mm, was 18% higher than the mean yield obtained with the short and diamond type tines.

### **5.3.4 Cultivar evaluation in conservation agriculture systems**

#### **Introduction**

Cultivar selection is an important aspect in the optimisation of maize production, which is controlled by the farmer. Currently, cultivar trials are not done in no-till as part of conservation agricultural systems. It is thus unknown how cultivars will perform in no-till, under both the local and altered plant population densities and row widths of CA.

#### **Aim**

The aim is to identify the best performing maize cultivars at a relatively high plant population for this region.

#### **Procedures**

Four cultivar trials were done, each on a different farm in 2014/15. Various available cultivars were included which also differed among farms. The trial layout consisted of six rows of the chosen cultivars at 52 cm row widths. A control cultivar was included between every two adjacent cultivars tested. The cultivars included are shown with the results in Fig. 5 to 8

Plots of 62.4 m<sup>2</sup> were harvested by hand and the grain threshed for yield determination. Cultivar yields were normalised through the following steps: The mean yield of the control was first calculated as  $X_c$ . A factor was calculated for each control strip as  $X_c$  divided by the yield of the control strip. Individual measured cultivar yields were then adjusted by multiplying it with 0.66 times the control strip factor next to it plus 0.33 times the control strip factor, which are one cultivar strip away from it.

#### **Results**

The adjusted cultivar yield results of the four trials are shown in Fig. 5 to 8.

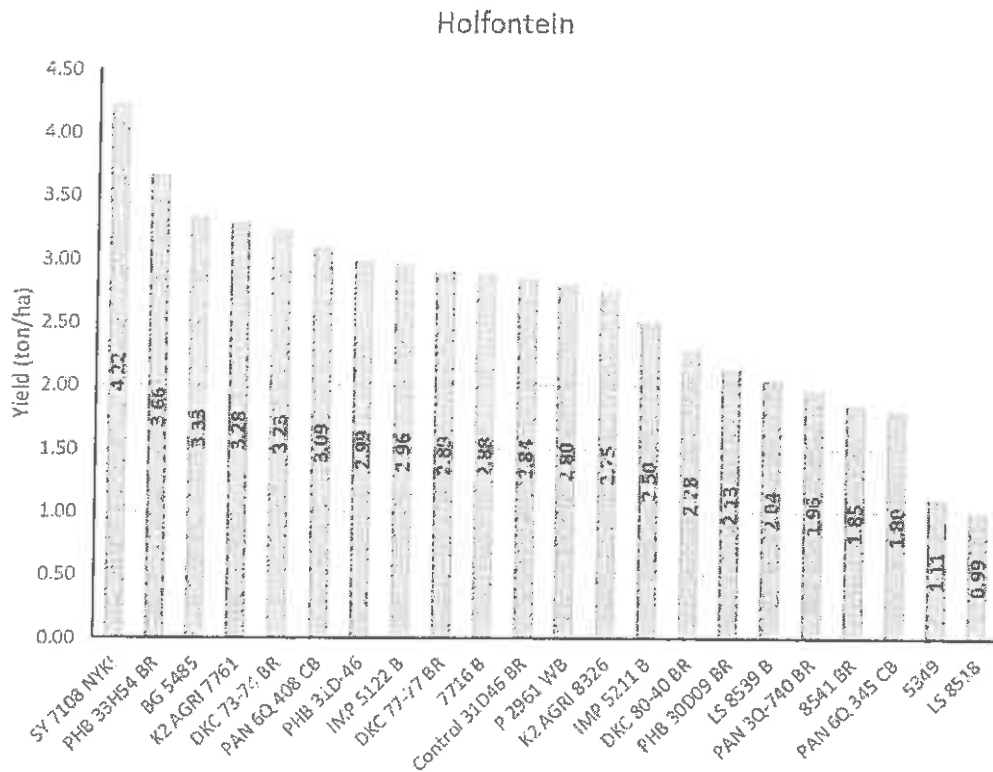


Fig. 5.7 Adjusted cultivar yields at Dirk Laas (rainfall = 431 mm).

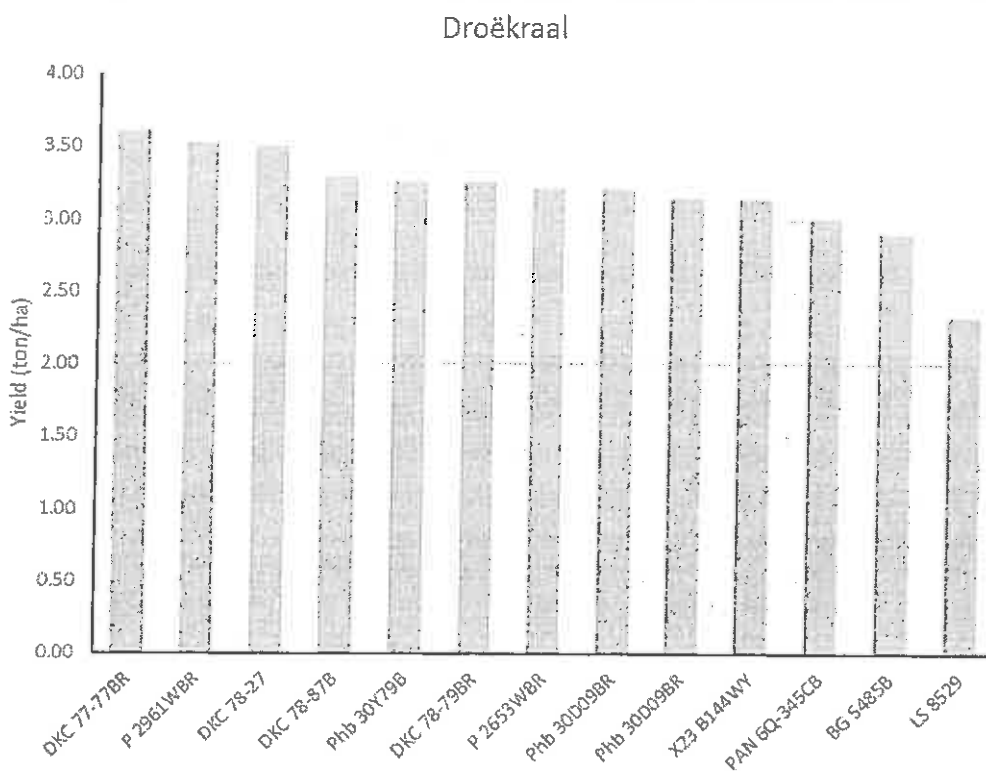


Fig. 5.8 Maize cultivar yields at Droëkraal (rainfall = 454 mm).

2014/15 season strips of these crops were planted transverse to the direction of the 2013/14 season creating a series of plots where each crop is grown in rotation with the other crops and in monoculture. In 2015/16, the 2013/14 layout will be used.

### **3. A comparison of local row widths and plant population densities of maize in CA systems with Argentinian recommendations**

The objective is to compare the yield performance of CA grown maize over a number of seasons and farms between currently used practices of 0.9 m row widths and plant populations of below 24 000 plants ha<sup>-1</sup> with the Argentinian recommendations of widths of 0.52 m spaced rows and plant population densities of more than 40 000 ha<sup>-1</sup>. The available Jumil planter will be used for this trial.

### **4. The effect of tines versus coulters for planting on the performance of different crops**

The objective is to compare the yield performance of crops planted in adjacent strips when a tine is fitted to the no-till planter with that of a coulters. Trials on different farms serve as replications.

### **5. Investigating the performance of maize cultivars in CA systems**

The objective is to compare the performance of a number of maize cultivars grown in a CA system at the increased plant population density of about 40 000 ha<sup>-1</sup> on different farms. A "check row" trial layout will be used where a control cultivar will be planted in every third six-row-strip. Cultivar yields are adjusted according to the adjacent control yields and compared.

### **6. Comparing local conventional cropping practices with Argentinian CA practices.**

The objective is to compare the performance of crops grown with local conventional practices such as rip-on-row with the Argentinian system of no-till, 0.52 m row widths and increased plant population densities using the Pierobon planter. At least three farms where conventional systems are still in use will be identified and the farmers approached for participation. Farms will serve as replicates and a selected field will be assigned to a trial. Part of the selected field will be allocated to the Argentinian CA practice while the crop on rest of the field will be conventionally grown by the farmer using his own equipment.

2. Planting
3. Seasonal management
4. Monitoring and Sampling
5. Lab Analyses
6. Monthly meetings (project team)
7. Annual reference group meeting (advisory committee)
8. Annual report and admin
9. Participate in Awareness events

Risks	<ul style="list-style-type: none"> <li>• Being a dryland experiment, low and erratic rainfall may compromise crop yields;</li> <li>• Wild animals and birds may jeopardise crop performance and yields;</li> <li>• Instrumental and logistical failure can result in incomplete activities and results</li> </ul>
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#### DELIVERABLES, PROGRESS AND RESULTS ACHIEVED PER ACTIVITY

Activities	Deliverables	Progress and Results achieved
1. Land preparation (10 visits)	Assist farmers to lay out their trial plots Prepare (calibrate and train) farmers on the trial treatments Make sure land preparation (e.g. weeding) is done according to specifications Make sure the correct type and quantity of production inputs are ready	Assisted to prepare land on 18 trials at 7 farmers' fields
2. Planting (10 visits)	Prepare planter for planting Move planter between farmers for timely planting Make sure farmers plant according to standard treatment specifications	Assisted to establish trials on 18 trials at 7 farmers' fields See list of trials in Table 6.1 below.
3. Seasonal management (30 visits)	Assist farmers in weeding and pest/disease management	Has completed seasonal activities for 2014-2015
4. Monitoring and Sampling (Done with activity 3 above)	Assist farmers to complete field forms Assist to collect soil samples Monitor the farmer-led actions	Has completed seasonal activities for 2014-2015
5. Lab Analyses	Assist with soil sampling	NA
6. Monthly meetings (project team) & Training (9 meetings)	Participate in monthly forum meetings, discussing problems and possible solutions to that.	Participated in 3 project meetings
7. Annual reference	Report progress and findings to advisory	Participated in meeting on 6

## 7. Summary of expenses on July 2015

Project Description	Total Actual YTD Jul15	Total Budget YTD Jun15	Total Budget YTD Jul15 - Sep15	Total budget Jul14 - Sep15	Available to use to Sep 2015
Ottosdal: Soil	74 681	87 200	9 240	96 440	21 760
Ottosdal: Cover crop	113 747	114 920	24 880	139 800	26 053
Ottosdal: Weeds	25 763	25 980	11 520	37 500	11 738
Ottosdal: Agronomy	59 160	59 160	11 520	70 680	11 520
Ottosdal: Grain SA	124 856	122 404	40 000	162 404	37 548
Ottosdal: Farmer facilitator	86 170	90 480	34 824	125 304	39 134
<b>Total</b>	<b>484 377</b>	<b>500 144</b>	<b>131 984</b>	<b>632 128</b>	<b>147 751</b>
<b>Plus: Management fee (5%)</b>	<b>24 219</b>	<b>25 007</b>	<b>6 599</b>	<b>31 606</b>	<b>7 388</b>
<b>Grand Total</b>	<b>508 596</b>	<b>525 151</b>	<b>138 583</b>	<b>663 734</b>	<b>155 139</b>

\* Expenses and invoices still expected which will affect the final amount until 30 September.