Research report
of the
Grootfontein Agricultural Development Institute
2005
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INTRODUCTION
Although the Grootfontein Agricultural Development Institute (GADI) is primarily known as an agricultural college, it is also today the leading institute in the RSA with regard to research and development on small stock production from natural veld. As a result of its previous and current research and development programs, it enjoys national and international recognition as a research institution. The development and evaluation of new farming technology is one of the strategic objectives of the institute. The two main focuses of the Research and Development (R&D) program of GADI is the development of technology to promote profitable and sustainable small stock production and to enhance sustainable natural resources management and use in the small stock producing areas.

CLIENTS AND CLIENT NEEDS
The primary beneficiaries of the GADI R&D program are land users in the extensive sheep and goat producing regions of South Africa. The interests of most land users are represented by:

- Departments of Agriculture (National and Provincial)
- Commodity organisations
- Agribusiness
- Breeders’ associations
- Organised agriculture.

The GADI R&D program consists of different R&D projects, which are based on the needs of clients. Different forums are used as the basis for the determination of client needs such as:

- Provincial departments of agriculture
- The needs framework of the Red Meat Research and Development Trust which reflects the needs of the red meat industry of South Africa
- National Wool Growers’ Association (NWGA) R&D Advisory Committee
- NWGA Production Advisory Committee
- Angora Goat Liaison Committee
- Mohair South Africa Research Advisory Committee.

Client needs identified at different forums can be grouped as follows:

- Implementation of current knowledge with regard to sheep and goat production to the benefit of communal and emerging producers
- Grazing capacity norms for different production areas – estimation at farm level
- Veld management systems for sustainable land use in the arid areas
- More efficient utilisation of available plant material for livestock production
- Management practices for more efficient survival and growth to reproduction age in sheep and goats
- More efficient methods of breeding for increased profitability and the introduction of marker assisted selection in sheep and goats in South Africa
- Investigation into the cause of specific animal diseases and practical animal health practices
- Evaluation of the financial impact of different management interventions on farming enterprises for emerging and existing producers
- Implications of different farm management practices on the quality of animal fibres and practical utilisation of fleece traits in ensuring maximum price
- Methods to reduce livestock losses due to problem animals and theft.

STAKEHOLDERS
As GADI’s R&D program is largely driven by client needs, different stakeholders financially support many of the research projects. The stakeholders provided approximately 70% of the operational cost of the GADI R&D program. Financial support were obtained from the following stakeholders during the reporting period:

- Cape Wools SA
- Mohair South Africa
- Red Meat Research and Development Trust
- Grootfontein Research Trust
Financial support from different stakeholders to the GADI R&D program is mediated through the Grootfontein Research Trust, which is registered with the Receiver of Revenue as a private, non-profitable trust fund. The trust has its own administrative officer who is responsible to procure research consumables, required for the different research projects.

Other stakeholders and research partners who contributed towards the GADI R&D program in the form of physical execution (manpower) of research projects are:

- Eastern Cape Department of Agriculture (Adelaide, Cradock and Jansenville Experimental Stations)
- Northern Cape Department of Agriculture and Land Reform (Carnarvon, Karakul and Koopmansfontein Experimental Stations)
- North West Department of Agriculture, Conservation, Environment and Tourism (Potchefstroom Livestock Centre)
- Mpumalanga Department of Agriculture and Land Administration (Nooitgedacht Agricultural Development Institute)
- Twenty-six communities in the Transkei and Ciskei areas of the Eastern Cape
- Seventy-eight farmers and their farm workers in seven provinces
- Agricultural Research Council
- University of Pretoria

**RESEARCH STAFF**

The research staff of GADI consists of seven scientists (Five animal scientists and two pasture scientists), five technicians and 21 support staff.

**PROGRESS REPORTS**

For monitoring and evaluation of progress with the R&D program, researchers are annually requested to submit comprehensive progress reports on each individual R&D project by the end of July. For this, data collected to date in each project are analysed and reported. For obvious reasons, the preliminary results reported in some progress reports cannot be released, as it might be misleading or may be misinterpreted. Therefore, this research report only contains abstracts from the comprehensive progress reports.
Abstracts from progress reports

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ESTABLISHMENT OF RAM BREEDING FLOCKS FOR DIFFERENT COMMUNAL FARMING AREAS OF THE EASTERN CAPE

B.R. King

AIM AND OBJECTIVES
The aim of this project is to establish ram breeding flocks for different communal farming areas.

The objectives of the project are:
• Improvement of woolled sheep flocks of rural communal farmers
• Establishment of a group-breeding nucleus in each community
• Community group-breeding flocks supply rams to neighbouring communities in the long term.

INTRODUCTION
This project forms part of the larger program for woolled sheep development in the communal areas of the Eastern Cape. This project started in August 2002 with the identification of 16 communities by the committee members of regions 20 to 24 of the NWGA, which represent the former Transkei and Ciskei areas. The layout of the woolled sheep development program consists of:
• The annual supply of 3000 rams to communal farmers – managed by the NWGA
• The evaluation of the impact of the rams that were introduced through the execution of progeny tests – performed by GADI
• The establishment of 16 ram breeding groups in the communal areas, which will eventually supply rams to neighbouring communities – managed by GADI.

This specific report deals with the latter of the abovementioned aspects.

Communities
The 16 communities, as well as their geographical location, are illustrated in Table 1 and Figure 1.

Table 1. The 16 communities in the Eastern Cape

<table>
<thead>
<tr>
<th>Region 20</th>
<th>Region 21</th>
<th>Region 23</th>
<th>Region 24</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dudumasha</td>
<td>Allen Water</td>
<td>Rockcliff</td>
<td>Luzi</td>
</tr>
<tr>
<td>Tabasa</td>
<td>Lushington</td>
<td>Manzimahla</td>
<td>Lephakoeng</td>
</tr>
<tr>
<td>Nyandeni</td>
<td>Roxeni</td>
<td>Qoqodala</td>
<td>Mahlake</td>
</tr>
<tr>
<td>Chizele</td>
<td>Beckles Farm</td>
<td>Camama</td>
<td>Ngwetheni</td>
</tr>
</tbody>
</table>

Figure 1. The 16 communities in the Eastern Cape
CONCLUSIONS

1. Good progress was made in most of the communities and the project is continuing.
2. The first own-bred rams will be evaluated during the next reporting period.
3. At all sixteen communities selection and mating took place, but at six of the communities lambing percentages was poor. A lack of sufficient rain was one of the major factors that contributed to the low reproduction rate at some of the communities. In the next year, a special effort will be made to address the problems experienced at these communities with regard to low lambing percentages. This will include more emphasis on general management aspects such as testing of rams for fertility, earlier identification of available ewes, health care, etc.
3. Due to the project intervention, improved general flock management resulted in increased sheep numbers, which lead to other problems such as overgrazing. In future, the marketing of old animals and castrated males needs to be promoted in the communities.
4. By the end of the next reporting period, progress in each community will be evaluated and a decision on the future of the project in each community will be taken.
EVALUATION OF THE GENETIC POTENTIAL FOR GROWTH AND WOOL PRODUCTION OF TYPICAL TRANSKEI EWES AND RAMS

P.G. Marais

AIM AND OBJECTIVES
The aim of the project is to determine the impact of the NWGA livestock improvement program in the communal areas of the Eastern Cape. The objectives of the project are:

- To evaluate the commercial rams, bred for the NWGA project vs the communal rams (Transkei) in the communal areas of the Eastern Cape through a progeny test.
- To evaluate the communal rams vs the commercial rams in the commercial areas of the Eastern Cape through a progeny test.

INTRODUCTION
This project forms part of the larger program for woolled sheep development in the communal areas of the Eastern Cape. The lay-out of the woolled sheep development program consists of:

- The annual supply of 3000 rams to communal farmers – managed by the NWGA
- The evaluation of the impact of the rams that were introduced through the execution of progeny tests – performed by GADI
- The establishment of 16 ram breeding groups in the communal areas, which will eventually supply rams to neighbouring communities – managed by GADI.

This specific project deals with the second of the aforementioned aspects. The project started in March 2004 at four localities in the Tarkastad and Cathcart districts. These farmers represent the commercial farming group in the project. The four participants are Erik Truter (Sterling Chase, Cathcart), John Miller (Winston, Cathcart), Dawid Wardle (Gladstone Farm, Thomas River) and Robby Wardle (Esher, Thomas River). With the exception of Erik Truter, the other farmers are all suppliers of rams to the NWGA ram breeding project. At the start of the project at each locality, a flock of 200 ewes of the farmer was randomly divided into two groups and each group was individually tagged and numbered with two different colour ear tags. One group of ewes was mated to six commercial rams and the other 100 ewes to six typical Transkei rams. The groups were placed in different camps, comparable in size and veld quality and quantity for the 6 weeks duration of mating. Mating started the first week in March 2004. After mating the groups were run together as one flock. Lambing took place during August 2004.

To establish the Transkei part of the project, four communal areas were selected on a basis that they must represent the average farming conditions of the Transkei region. The four participating communities are, Ncorga Inagatu Irrigation Scheme (Umgababa Community, Engcobo), Quatsa New Mines Community (Mbheku shearing shed, Tsomo) Sokapasa Community (Ngqamakhwe) and Singinquni Community (Kentani). A number of ewes were randomly chosen at each community, divided into two groups and each group was individually tagged and numbered with different colour ear tags. One group of ewes was designated to be mated to six rams originated from commercial farmers. The other group of ewes was put to six typical Transkei rams. During the week of 11 – 14 October 2004, the identified ewes were synchronised with sponges (See number of ewes at each community in Table 2). During the week of 25 – 28 October 2004 rams were put to the ewes in the specific groups for a 35-day mating period. Hired shepherds were responsible to keep the groups separate for the mating period. After the mating period the ewes were allowed to return to their respective owners. The ewes started lambing on the 15th March 2005. Tagging of lambs was done at each community on a weekly basis. During the week of 6 – 9 June 2005 the final recording of lambs, tagging, dosing of lambs and ewes, as well as the castrating of ram lambs, were done.

RESULTS AND DISCUSSION
Progeny tests on commercial ewes
The following data were collected from all four commercial farms: number of ewes mated, number of ewes lambed, number of lambs born, identification of sexes, weaning weight of lambs and 6-month weight of lambs. The number ewes lambed/ewes mated varied between 72% and 99% among farmers, while the weaning percentage (number of lambs weaned/number of ewes mated) varied between 64% and 109% among the groups mated with commercial rams and between 68% and 101% among the groups mated to Transkei rams.
Table 1. Weaning and 6-month weights of progeny of commercial and Transkei rams mated to commercial ewes (kg ± SE)

<table>
<thead>
<tr>
<th></th>
<th>Commercial progeny</th>
<th>Transkei progeny</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weaning weight (kg)</td>
<td>23.25 ± 0.21 a</td>
<td>21.91 ± 0.21 a</td>
</tr>
<tr>
<td>6 – month weight (kg)</td>
<td>30.23 ± 0.23 a</td>
<td>28.62 ± 0.25 a</td>
</tr>
</tbody>
</table>

Both weaning and 6–month weights of progeny born of commercial rams were significantly higher than those of the progeny of Transkei rams.

Progeny tests on communal ewes
The number of communal ewes used for the progeny tests in the communal areas of the Eastern Cape is presented in Table 2.

Table 2. Number of communal ewes mated in each community

<table>
<thead>
<tr>
<th>Communities</th>
<th>Mated to commercial rams (n)</th>
<th>Mated to Transkei rams (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ncorga</td>
<td>143</td>
<td>143</td>
</tr>
<tr>
<td>Quatsa</td>
<td>183</td>
<td>183</td>
</tr>
<tr>
<td>Sokapasa</td>
<td>117</td>
<td>117</td>
</tr>
<tr>
<td>Kentani</td>
<td>147</td>
<td>147</td>
</tr>
</tbody>
</table>

Data collection on the progeny born from the abovementioned matings will continue and will be reported during 2006.

CONCLUSION
From the reproduction data collected from the four commercial farms, it is evident that differences occurred between farms. The differences that were observed between the weaning and 6–month weights of lambs originating from commercial and Transkei rams are of significance. It is noteworthy that the weight advantage of lambs from the commercial versus Transkei rams increased from 1.34 kg at weaning to 1.61 kg at six months of age. These results demonstrated that by introducing commercial rams to Transkei ewes, a significant improvement in growth is possible and that the ram breeding project of the NWGA could be of great commercial use in terms of slaughter weight.
AIM AND OBJECTIVES
The aim of this project is to collect data, which will enable the government and other decision makers to know the production status of woolled sheep in communal areas of the Eastern Cape so that they can be able to plan certain interventions for the improvement of animal production in these areas.

The objectives of the project are:
- To encourage the farmers to keep stock records
- To train the farmers basic animal management and handling skills and
- To determine growth rate, reproduction rate, wool production and wool quality of Transkei and Ciskei sheep.

BACKGROUND
Six rural villages were identified, three in the Ciskei (Masele, Qoboqobo & Nxukhwebe) and Transkei area (Mqanduli, Idutywa & Sterkspruit ) respectively. Three farmers in each village were identified and thirty to forty ewes (2-4 tooth) from the flock of each farmer were selected, weighed and given ear tag numbers. The following data are recorded:
- Body weight (Every second month)
- Wool production
- Wool quality (Fibre diameter, staple length and clean yield)
- Lambing %
- Weaning %
- Fecundity

CONCLUSION
Sheep in Transkei, which are kept in the mountains day and night, are in good condition when compared to those that are kept in kraals during the night. Some of these traits have a direct relationship with veld condition status. Veld condition assessment in each grazing area should be incorporated in future.
BREEDING MERINO SHEEP FOR INCREASED PROFIT PER SMALL STOCK UNIT

W.J. Olivier

AIM AND OBJECTIVES
The aim of this study is to evaluate profit per small stock unit (SSU) as a selection criterion in woolled sheep.

The objectives of this study are:
- To evaluate profit per SSU as a selection criterion for woolled sheep
- To breed Merino sheep for increased income per SSU
- To supply the Eastern Cape Department of Agriculture Livestock Improvement Program with genetic material to improve the profit per SSU in the communal areas
- To make animals available for student and farmer training.

INTRODUCTION
To ensure continued success of both commercial and communal wool farmers, it is important that the animals with the highest profit per SSU can be identified, rather than the animals with the highest gross income per head. This will result in the selection of animals that will increase the profit per hectare of a wool farming enterprise. Furthermore, it will also ensure that the wool industry of South Africa produce wool and mutton at optimal levels without increasing the pressure on the natural resources.

Two flocks are used for this experiment. One flock is kept under intensive conditions on irrigated pastures at Cradock Experimental Station (Cradock), while the second flock is kept under extensive conditions on natural pastures at Grootfontein Agricultural Development Institute (Grootfontein). Both these flocks are selected for increased profit per SSU according to Herselman (2004).

The number of rams that have been supplied to communities in the rural areas of the Eastern Cape province is summarised in Table 1.

Table 1. The number of rams supplied to communities of the rural areas of the Eastern Cape province

<table>
<thead>
<tr>
<th>District</th>
<th>Community</th>
<th>No. of rams</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engcobo</td>
<td>Neorga Irrigation Scheme</td>
<td>2</td>
</tr>
<tr>
<td>Cofimbaba</td>
<td>Quitza New Mines</td>
<td>2</td>
</tr>
<tr>
<td>Nqamakwe</td>
<td>Sokkerpasa</td>
<td>2</td>
</tr>
<tr>
<td>Butterworth</td>
<td>Centemi</td>
<td>3</td>
</tr>
<tr>
<td>Butterworth</td>
<td>Teko Corner</td>
<td>2</td>
</tr>
<tr>
<td>Tsomo</td>
<td>Xume</td>
<td>7</td>
</tr>
<tr>
<td>Queenstown</td>
<td>Buleke</td>
<td>1</td>
</tr>
<tr>
<td>Maclaer / Mount Fletcher</td>
<td>Hlankomo</td>
<td>4</td>
</tr>
</tbody>
</table>

CONCLUSION
The first progeny of this project was born during the 2004 lambing season. The rams that were selected in 2004 for breeding purposes will have a positive effect on the breeding objective of both these flocks. The 2004 progeny will be performance tested at the end of 2005.

The conception rate at both localities was very high, especially at Grootfontein, where the ewes are run on natural pastures. The conception rate, as well as the high fecundity resulted in an exceptionally good lambing percentage of above 140% at both localities. Furthermore, only a small percentage of lambs died before weaning. The advantage of the high weaning percentage of the 2004-born lambs will be visible through the selection intensity when these animals are classed at the end of 2005. This means that more young ewes can be kept in both flocks in order to increase the size of the adult ewe flock. The project is running according to the project proposal.
INVESTIGATION INTO PRODUCTION AND REPRODUCTION SELECTION CRITERIA IN AFRINO SHEEP

M.A. Snyman

AIM AND OBJECTIVES
The aim of this project is to identify effective selection methods and criteria to increase efficiency of mutton and wool production under extensive grazing conditions.

The objectives of this study are:
• To evaluate selection criteria to improve reproductive efficiency of dual purpose sheep breeds under extensive grazing conditions
• To evaluate selection criteria to improve mutton and wool production efficiency of dual purpose sheep breeds
• To maintain a comprehensive database for evaluation of selection criteria for mutton and woolled sheep in South Africa
• To provide research animals for other projects, such as the parasite project (AP2/2) and the project on maternal values (AP2/7).

BACKGROUND
This is a co-operative project between the Northern Cape Department of Agriculture and Grootfontein Agricultural Development Institute (GADI). The project is continuing as in the past. Researchers and technicians from GADI are still responsible for data collection and capturing, linear scoring of subjective traits and selection of breeding sires and dams. This is done in collaboration with the farm personnel at Carnarvon Experimental Station. Lambs of the flock are also part of the projects on parasite resistance (AP2/2) and ultrasound scanning of Longissimus dorsi area (AP2/5). Ewes of the flock are part of the project on maternal values in sheep (AP2/7).

RESULTS AND DISCUSSION
Selection strategy
Selection in the flock is aimed at increasing reproductive performance, increasing body weight, decreasing fibre diameter, keeping wool weight constant and improving wool quality traits.

Productive performance
The average productive performance of the ram and ewe lambs over the past 15 years and production of 2003-/ 2004-born ram and ewe lambs, are summarised in Table 1. Productive performance of the ewe flock is presented in Table 2.

<table>
<thead>
<tr>
<th>Trait</th>
<th>Ram lambs (15 year avg)</th>
<th>2004-born</th>
<th>Ewe lambs (15 year avg)</th>
<th>2004-born</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth weight (kg)</td>
<td>4.75 ± 0.02</td>
<td>4.51 ± 0.06</td>
<td>4.50 ± 0.02</td>
<td>4.25 ± 0.06</td>
</tr>
<tr>
<td>120-day weaning weight (kg)</td>
<td>31.0 ± 0.3</td>
<td>31.8 ± 0.4</td>
<td>28.5 ± 0.3</td>
<td>29.4 ± 0.4</td>
</tr>
<tr>
<td>9-month body weight (kg)</td>
<td>48.8 ± 0.4</td>
<td>45.9 ± 0.5</td>
<td>43.4 ± 0.4</td>
<td>43.6 ± 0.5</td>
</tr>
<tr>
<td>16-month body weight (kg)</td>
<td>63.3 ± 0.4</td>
<td>53.0 ± 0.6</td>
<td>52.2 ± 0.4</td>
<td>48.3 ± 0.5</td>
</tr>
<tr>
<td>Clean fleece weight (kg)</td>
<td>2.02 ± 0.03</td>
<td>1.87 ± 0.05</td>
<td>1.96 ± 0.03</td>
<td>1.96 ± 0.04</td>
</tr>
<tr>
<td>Fibre diameter (µm)</td>
<td>20.1 ± 0.1</td>
<td>18.8 ± 0.1</td>
<td>20.5 ± 0.1</td>
<td>19.1 ± 0.1</td>
</tr>
<tr>
<td>Crimp quality</td>
<td>29.7 ± 0.6</td>
<td>34.8 ± 0.8</td>
<td>30.9 ± 0.6</td>
<td>35.2 ± 0.7</td>
</tr>
<tr>
<td>Evenness of fleece</td>
<td>33.7 ± 0.4</td>
<td>35.8 ± 0.6</td>
<td>34.4 ± 0.4</td>
<td>36.7 ± 0.6</td>
</tr>
<tr>
<td>Creeping belly</td>
<td>38.0 ± 0.6</td>
<td>35.9 ± 0.8</td>
<td>40.3 ± 0.6</td>
<td>36.2 ± 0.8</td>
</tr>
</tbody>
</table>

During 2003 and 2004, abnormally low rainfall, with resultant poor grazing conditions was experienced at the experimental station. This poor grazing conditions is reflected in the lower 16-month body weights of the 2003-born ram and ewe lambs.
Table 2. Production of Afrino ewes over the past 15 years in the Carnarvon flock

<table>
<thead>
<tr>
<th>Trait</th>
<th>Average ± SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body weight (kg)</td>
<td>66.9 ± 6.1</td>
</tr>
<tr>
<td>Clean fleece weight (kg)</td>
<td>1.64 ± 0.42</td>
</tr>
<tr>
<td>Fibre diameter (µm)</td>
<td>21.1 ± 1.2</td>
</tr>
<tr>
<td>Clean yield (%)</td>
<td>65.2 ± 6.2</td>
</tr>
<tr>
<td>Staple length (mm)</td>
<td>74.1 ± 10.6</td>
</tr>
<tr>
<td>Number of lambing opportunities</td>
<td>3.28</td>
</tr>
<tr>
<td>Total weight of lamb weaned (kg)</td>
<td>127.0 ± 40.3</td>
</tr>
<tr>
<td>Number of lambs born</td>
<td>4.62 ± 1.37</td>
</tr>
<tr>
<td>Number of lambs weaned</td>
<td>4.18 ± 1.41</td>
</tr>
</tbody>
</table>

Genetic trends
Genetic trends for body weights, wool traits and reproduction indicated that the selection objectives with regard to reproductive performance, body weight and fibre diameter have been obtained. However, putting a lot of emphasis on reducing fibre diameter, without a large enough check on wool weight, lead to a slight reduction in clean fleece weight. Furthermore, the emphasis on crimp quality, together with the emphasis on fibre diameter, has also lead to a correlated increase in the appearance of creeping belly. It was therefore decided in 2001 that less emphasis would in future be put on fibre diameter, especially with the selection of young ewes, and more emphasis on wool weight.

CONCLUDING REMARKS
- The project is running according to the project protocol and progress has been satisfactory. As this is a long-term project, which involves the evaluation of selection criteria, it will continue in its current form.
- The data set collected on this research flock, is one of the most comprehensive data sets on productive and reproductive traits of woolled mutton sheep available worldwide.
- Results of the project on maternal values could probably be implemented in the selection program in four or five years time.
THE UPGRADING OF A GENETIC FINE WOOL MERINO STUD

W.J. Olivier

AIM AND OBJECTIVES
The aim of this project was to further decrease the fibre diameter in the already established Cradock fine wool Merino stud without sacrificing the other traits.

The objectives of this study were:
- To decrease the mean fibre diameter
- To maintain or increase body weight, clean fleece weight and staple length
- To make rams available to the wool industry through the annual ram sale of Grootfontein
- To supply rams to the communal areas of the Eastern Cape
- To use the animals from this study for the training of the students of the Grootfontein Agricultural College.

BACKGROUND
The original aim of this project was to establish a genetic fine wool Merino flock. The original selection objectives were to increase body weight, maintain or increase clean fleece weight and to maintain or decrease fibre diameter. The emphasis placed on body weight during the initial stages of this project was due to the fact that the original animals bought for this project was small and had a poor conformation. Due to the fact that the original aim, and subsequently the selection objectives of this project was achieved by 1996, as well as the demand for super fine wool and the price premium paid for fine wool during the 1990’s, it was decided to change the aim of the project in 1997. This resulted in the shift in emphasis in the selection objectives towards the decrease of fibre diameter.

Scientifically orientated performance testing through the use of BLUP of breeding values for the economically important traits, according to the Small Stock Improvement Scheme of the Agricultural Research Council, was used as the main selection tool in this stud. The evaluation of subjectively assessed wool and conformation traits were also done and used to cull animals with wool and conformation faults.

The data collected from this stud will be used to estimate genetic parameters for the different traits, as well as genetic and phenotypic correlations between all the production, reproduction and subjectively assessed traits. The most important correlations, in the context of this project, are between mean fibre diameter and the other traits, as the aim of this project was to establish a genetic fine wool Merino flock. The results from this study will be of importance for the industry with regard to the production of fine wool.

The genetic material that was bred through this project is evaluated through a separate project that is done on the farms of Merino farmers in different areas of South Africa. Furthermore, fine woolled rams are also sold on the Grootfontein ram sale in September each year.

RESULTS AND DISCUSSION
The genetic trends for body weight, clean fleece weight, fibre diameter and staple length are depicted in Figure 1. A within flock BLUP analyses was done to get a better picture of the changes in the trends of the economically important traits, which were also the selection objectives of this stud. It is evident from this figure that there was a positive trend in the body weight of the stud and an increase of almost 8 kg in body weight was achieved. There was also a genetic increase of 0.80 kg in clean fleece weight and more than 10 mm in staple length. Mean fibre diameter decreased genetically with more than 1 μm.

The selection objectives from the commencement until 1996 were to increase body weight, decrease or maintain mean fibre diameter and increase or maintain clean fleece weight. It is evident from this figure that most of the improvement in body weight (± 5 kg genetic improvement) was obtained between the commencement and 1996. During this period the mean fibre diameter decreased slightly, while clean fleece weight and staple length increased. The selection objectives of the first part of this study were therefore reached.
As a result of the progress made in body weight, it was decided to change the selection objectives of this stud with regard to body weight and mean fibre diameter in 1996. More emphasis was placed on decreasing the mean fibre diameter and body weight was to be maintained or increased. It is evident from Figure 1 that the mean fibre diameter decreased drastically from 1997 onwards. During this period there was still an increase in body weight, clean fleece weight and staple length.

CONCLUSION

It is evident from the results of this study that the body weight of the animals increased substantially over the experimental period. During the same time mean fibre diameter decreased, although not very much during the first eight years. It is also interesting to note that although mean fibre diameter decreased, there was an increase in the amount of wool produced, as well as an increase in the staple length.

These results were obtained despite the unfavourable genetic correlations between fibre diameter and the other traits. In other words, large fine wool animals that still produce a substantial amount of wool, with acceptable staple length, are bred.

The selection objectives were achieved with the aid of selection tools such as estimated breeding values and the Small Stock Improvement Scheme of the Agricultural Research Council.
EVALUATION OF GENETIC FINE WOOL ANIMALS UNDER NATURAL CONDITIONS IN THE NON-TRADITIONAL FINE WOOL PRODUCING AREAS OF THE RSA

W.J. Olivier

AIM AND OBJECTIVES
The aim of this project is to evaluate genetic fine wool animals under natural grazing conditions in the non-traditional fine wool producing areas of the RSA.

The objectives of this study are:
- To evaluate genetic fine wool animals in different environments
- To compare the reproduction, growth and wool characteristics of genetic fine wool animals with that of strong wool animals in the non-traditional fine wool producing areas.

BACKGROUND
The worldwide tendency towards finer wool has lead to the establishment of a project in 1988 by the Department of Agriculture to improve the production of finer wool. This project consisted out of three phases, namely:
- Phase 1: Establishment of a genetic fine wool flock
- Phase 2: To improve and enlarge this flock
- Phase 3: Evaluation of these fine wool animals under different environments.

Phase 1 was completed successfully in 1996 with the establishment of the fine wool flock at the Cradock Experimental Station. Phase 2 started in 1997 and was completed in 2003. The success of the improvement phase is reflected in the demand from farmers for rams from this flock.

Phase 3 was initiated in 1990 with the establishment of the fine and strong wool Merino flocks at Grootfontein Agricultural Development Institute. Due to the fact that neither the farming conditions nor the available grazing of Grootfontein is representative of the RSA, a conclusion could not been made about the viability and sustainability of fine wool production in the extensive sheep farming areas of the RSA. Therefore, in 1999 it was decided to initiate a project where animals from the Grootfontein fine wool flock would be compared to strong wool animals in four non-traditional fine wool areas of the RSA.

EXPERIMENTAL PROCEDURES
In August of 2000, the 200 ewes of the Grootfontein fine wool flock were randomly divided into four groups. These ewes were mated in May 2000 to rams from the Cradock fine wool Merino stud. The four participants were identified by the NWGA and they collected their respective groups during August and September of 2000. A group of the participants own ewes were also mated at approximately the same time as the fine woolled ewes. The first lambs were born during October / November of 2000. Grootfontein also supplied the replacement ewes (born in 1999 at Grootfontein) for the 2001 mating season. Rams from the Cradock fine wool Merino stud were used as sires in the respective fine wool lines. The ewes of the control line were mated to the rams of the respective participants.

RESULTS AND DISCUSSION
The profit per small stock unit (SSU) for the two groups at each locality is summarised in Table 1. This value for each individual animal was calculated by using the model of Herselman (2004).

Table 1. Profit per small stock unit (SSU)

<table>
<thead>
<tr>
<th></th>
<th>Fine wool</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gys van Wyk, Carnarvon</td>
<td>208.35 ± 2.49</td>
<td>190.10 ± 2.64</td>
</tr>
<tr>
<td>Sterrie Marais, De Aar</td>
<td>205.83 ± 2.62</td>
<td>193.14 ± 2.61</td>
</tr>
<tr>
<td>Hennie Coetzee, Steynsburg</td>
<td>243.38 ± 3.41</td>
<td>207.75 ± 3.71</td>
</tr>
<tr>
<td>Ben Uys, Wakkerstroom</td>
<td>221.21 ± 3.03</td>
<td>200.48 ± 3.10</td>
</tr>
</tbody>
</table>

a,b,c,d - Values with the same superscript differed significantly for the same participant

It is evident from this table that the fine wool groups at all four localities had a higher (P<0.05) profit per SSU compared to their counterparts. The body weight of the respective groups did not have a large influence on the difference in profitability, due to the fact that the differences in body weight were relatively small or non significant. Therefore, these differences were the effect of the difference in wool production. Due to the fact that the fine wool
animals produced less and shorter wool, it is can be deducted that the differences in profitability are probably due to
the differences in mean fibre diameter between the respective groups.

CONCLUSION
It is evident from the results of this project that the fine wool animals produced less and finer wool compared to the
control animals. This could be expected, as a decrease in fibre diameter would result in a decrease in the fleece weight,
as these traits are positively correlated. However, the most important conclusion thus far is that the fine wool animals’
reproduction and body weight is in the same range as that of the control animals. The differences in mutton production
between these groups were therefore relatively small and would not have a major effect on the profitability of fine
wool versus strong woolled sheep farming enterprises. Thus, it seems at this stage that fine wool can be produced
under extensive farming conditions in the RSA, where it was thought that fine wool animals would not be able to
produce or reproduce, without a negative effect on the profitability of a woolled sheep farming enterprise.
ESTABLISHMENT OF A GENETIC POOL OF DUAL PURPOSE SHEEP WITH PREMIUM QUALITY MEAT AND SUPER FINE WOOL UNDER EXTENSIVE CONDITIONS

M.J. Herselman

AIM AND OBJECTIVES
The aim of the study is to establish a genetic pool of dual-purpose sheep with premium quality meat and super fine wool under extensive conditions for future evaluation and distribution to the industry.

The objectives of the study are:
- To establish a genetic pool of dual purpose sheep (150 breeding ewes) which is superior with regard to wool quality (fibre diameter)
- To increase the numbers of the pool to 400 breeding ewes
- To improve the wool and meat quality, while maintaining other production traits such as reproduction and growth.

INTRODUCTION
The project originated from a request by the wool industry for the establishment of a genetic pool of dual-purpose sheep with super fine wool. The wool industry supplied the funds for the initial purchasing of the ewes, as well as the running costs for the first two years. A memorandum of agreement between the Department of Agriculture: Grootfontein Agricultural Development Institute (GADI), the Agricultural Research Council and the Grootfontein Research Trust formalised co-operation between the parties involved in the project. The project started in January 2001 with the screening, identification and buying of ewes for the nucleus flocks at Grootfontein. During 2001 and 2002 a total of 217 ewes were bought from 25 Dohne Merino breeders, while 145 ewes were bought from 15 Letelle breeders. A third group of fine wool Merino sheep from the Cradock fine wool stud was also included and run together with the Dohne and Letelle flocks. The first mating took place during May 2001.

MATERIAL AND METHODS
All adult animals were shorn during the last week of July 2004. This data were not reported earlier as the analysis of wool samples was not completed in the previous reporting period. One week before the onset of lambing in September 2004, the ewes mated during April/May 2004 were brought in from the veld and placed in small pens (10 ewes/pen) and provided with a pelleted roughage diet. This was done to accommodate accurate parent-offspring identification. Ewes and their lambs were taken back to the veld within one week after lambing, except for triplets, which remained in the pens for approximately one month. Data collection on the 2004 progeny and the ewe flock was according to the project protocol. The 2004 lambs were weaned on 13 January 2005 and shorn on 24 January 2005.

The 2003 progeny was provisionally classed on 4 November 2004, shorn on 8 November 2004 and the 12-month wool production data collected. Final inspection by the relevant breeders’ societies was performed in March 2005.

This year’s breeding season started on 11 April 2005 and lasted until 17 May 2005. One hundred and fifty four Dohne ewes, 125 Letelle ewes and 98 Fine Wool Merino ewes were available. Dohne and Letelle ewes were group mated to own bred rams, while Merino ewes were mated to rams from the Cradock fine wool stud. Each ram was placed with his group of ewes in a separate camp during the mating period, which lasted for 35 days.

RESULTS
The production data of the adult ewes in the different flocks are shown in Table 1.

Table 1. Production data of adult ewes in the nucleus flocks (2004 Ewe flock)

<table>
<thead>
<tr>
<th></th>
<th>Dohne</th>
<th>Letelle</th>
<th>Merino</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of ewes mated</td>
<td>233</td>
<td>157</td>
<td>100</td>
</tr>
<tr>
<td>Lambs born per 100 ewes mated</td>
<td>134</td>
<td>142</td>
<td>148</td>
</tr>
<tr>
<td>Lambs weaned per 100 ewes mated</td>
<td>115</td>
<td>117</td>
<td>134</td>
</tr>
<tr>
<td>Body weight at mating (kg)</td>
<td>58.3 ± 0.4</td>
<td>52.8 ± 0.4</td>
<td>49.3 ± 0.9</td>
</tr>
<tr>
<td>Clean wool (kg)</td>
<td>2.73 ± 0.04</td>
<td>1.76 ± 0.04</td>
<td>3.12 ± 0.09</td>
</tr>
<tr>
<td>Fibre diameter (µm)</td>
<td>19.8 ± 0.1</td>
<td>18.6 ± 0.1</td>
<td>18.4 ± 0.2</td>
</tr>
<tr>
<td>Staple length (mm)</td>
<td>87.9 ± 0.9</td>
<td>78.2 ± 1.0</td>
<td>81.5 ± 2.3</td>
</tr>
<tr>
<td>Staple strength (N/kTex)</td>
<td>33.3 ± 0.5</td>
<td>32.4 ± 0.6</td>
<td>41.4 ± 1.3</td>
</tr>
</tbody>
</table>
SUMMARY
In general, good progress has been achieved with the project. Although the data of the Merino group are still incorporated, they are used for another research project, which has different objectives than this specific project. Ewe numbers in the nucleus flock at Grootfontein declined considerably during the year due to the fact that a large proportion of the ewes initially bought from breeders had to be culled on age. A request has been put forward to the Dohne Merino breeders for the purchasing of more stud ewes on estimated breeding values to increase the genetic pool. However, no finalisation on this matter has been achieved.
DEVELOPMENT OF A METHOD FOR THE ESTIMATION OF BREEDING VALUES FOR RESISTANCE/RESILIENCE OF SHEEP TO INTERNAL PARASITES, WHICH WILL BE APPLICABLE UNDER ANY ENVIRONMENTAL CONDITIONS

M.A. Snyman

AIM AND OBJECTIVES
The aim of this study is to develop a protocol for the evaluation of internal parasite resistance of breeding sires, bred in the extensive sheep grazing areas of South Africa where the natural infection of *H. contortus* is limited.

The objectives of this study are as follows:

- To identify effective selection methods for internal parasite resistance in small stock and to apply these methods in practice
- To compare the natural and artificial challenge methods under intensive as well as extensive conditions in order to evaluate the latter in practice
- To estimate genetic parameters for indicators of parasite resistance, and correlations of these indicators with production and reproduction traits under South African conditions.

BACKGROUND
Internal parasite infection plays an important role in the ability of animals to produce and reproduce to their full capability. Despite various control measures, internal parasites remain one of the largest animal health problems in the small stock industry. To make matters worse, resistance of parasites to available anthelmintics increased drastically during the last decade. During the last few years, the possibility of selection for animals resistant to internal parasites has been investigated and selection programs based on faecal egg counts (FEC) have been implemented in Australia and New Zealand. However, not all questions concerning the practical use of FEC in breeding programs have been answered. For example, repeatability of FEC under various conditions has been shown to be highly variable. Furthermore, many of the ram breeders in South Africa are located in the drier, western parts of the country, with a lower natural parasite infection. As no breeding program will have parasite resistance as its sole objective, the genetic relationship of resistance with other production and reproduction traits should also be considered.

The project started during March 1998. Since then, lambs in each of the following research flocks were infected with third stage *Haemonchus contortus* larvae at 6-8 months of age for the artificial challenge procedure:

- Afrino flock at the Carnarvon Experimental Station (1997 to 2004)
- Dorper flock at the Carnarvon Experimental Station (1998 to 2002)
- SA Mutton Merino flock at Potchefstroom Livestock Centre (2002)

It was decided to include the natural challenge method in the project from October 2000, in order to be able to compare results obtained with artificial challenge, with those obtained with natural parasite infections. This part is done on lambs from the Fine wool Merino stud at Cradock Experimental Station, and since 2002 on the Potchefstroom Mutton Merino flock.

CONCLUDING REMARKS
At this stage of the project, the following conclusions could be made:

1. For the purpose of developing a protocol to evaluate breeding values for resistance of sires born in the extensive sheep grazing areas, the natural challenge procedure will definitely not be an option. This is largely due to the low and unpredictable rainfall, with the resultant variable parasite challenge, which makes this procedure unreliable for use at a specific time each year.

2. Furthermore, using breeding values for parasite resistance based on the Famacha©-system, will also not be feasible for the evaluation of breeding sires in the extensive areas. The reason for this is that the recording period is too long before differences between animals are expressed. Furthermore, employing the Famacha©-system after natural challenge is unfeasible, as mentioned in (1). To employ the Famacha©-system after artificial challenge would be unpractical, as faecal egg counts can already be recorded on day 28 after infection, after which the test can be finished. The data collected during this study, however, confirm that the Famacha©-system (FAM) is an excellent management tool to identify animals that need anthelmintic treatment.
3. For the most important part of the study, where animals selected in a dry area (Carnarvon) are evaluated under a higher rainfall area (Potchefstroom), much more data still need to be recorded.

4. For the part of the study which involves data recording for estimation of genetic parameters for especially FAM, much more data also needs to be collected.

5. Although haematocrit (HEMA) has a high genetic correlation with FEC, it is more difficult and expensive to measure, while other factors could also influence the anaemic status of an animal. Therefore, HEMA as such, would not be a feasible selection criterion as indicator of resistance.

6. For the purpose of developing a protocol to evaluate sires born in the extensive sheep grazing areas, FEC after artificial challenge procedure seems the best option as selection criteria for resistance against internal parasites. The following should be taken into account:
   a) The availability of a viable, non-resistant strain of *H. contortus* is an important issue, which should be addressed as soon as possible.
   b) Animals should receive a pre-test dose of larvae to activate their immune response.
   c) The level of infection should be high enough to ensure that genetic differences can be expressed.

7. The project will continue in its current format for the next year (2006), after which it will be evaluated and a decision regarding its future be made.

**LIST OF PUBLICATIONS**

INVESTIGATION INTO THE SELECTION CRITERIA OF MERINO SHEEP

W.J. Olivier

AIM AND OBJECTIVES
The aim of this study is to evaluate the effect of two different breeding strategies on the wool production and wool characteristics of Merino sheep.

The objectives of this study are:
- To evaluate the effect of two different breeding strategies to decrease fibre diameter on the wool production and wool characteristics of Merino sheep
- To increase body weight and staple length
- To maintain or increase clean fleece weight
- To make rams available to the wool industry through the annual ram sale of Grootfontein
- To supply rams to the communal areas of the Eastern Cape
- To use the animals from this study for the training of the students of the Grootfontein Agricultural College.

INTRODUCTION
The increase in the demand for fine and super fine wool, as well as the price premium that was paid for fine wool during the 1990’s, has caused a shift towards the production of fine wool in an increased number of flocks in South Africa. Fibre diameter can be decreased either through within flock selection or through the purchase of genetic fine wool animals.

One of the perceptions with regard to fine wool production is that the use of genetic fine wool animals on strong wool animals will have a negative effect on the quality of the wool. It is assumed that the progeny of these animals will have under-crimped wool, as well as a large variation over the fleece.

It is therefore important for the Merino industry of South Africa to quantify what possible effects these two breeding strategies may have on wool production and characteristics of Merino sheep. Two selection lines, namely a fine wool and a control line, were therefore established within the Grootfontein Merino stud in 2001. The same selection objectives are used in both lines. The only difference between the two lines is that genetic fine woollen rams from the Cradock fine wool Merino stud are mated to the fine wool line ewes, while the control ewes are mated to rams selected for fineness from the control line.

RESULTS AND DISCUSSION
The genetic trends for body weight, clean fleece weight, fibre diameter, staple length and relative economic value are depicted in Figure 1. The progeny of the F-line produced finer (P<0.01) wool with shorter staples (P<0.05) than that of the C-line. The relative economic value of the F-line was also higher (P<0.01) than that of the C-line. There were no significant differences in body weight or clean fleece weight between the respective lines.

CONCLUSION
It is evident from the results of this study that the 2003 progeny of the F-line produced finer wool with shorter staples than that of the C-line, as expected. However, there were no significant differences in body weight or clean fleece weight between the respective lines. The fact that there is no difference in body weight and clean fleece weight between the two lines can contributed to the fact that the improvement of these two traits were of utmost importance in the Cradock fine wool Merino stud a few years back. The change in staple length from the 2002 progeny to the 2003 progeny might be the result of a ram used as sire from the Charmac Merino stud of Mr Henry McNaughton with an exceptional high value for staple length, as well as the fact that the other rams used in the C-line also had better staple lengths than the rams used in the F-line.

The relative economic value of the F-line was higher than that of the C-line, as a result of the difference in fibre diameter. At this stage it would appear that neither of the different breeding strategies with regard to decreasing fibre diameter would negatively affect the other economically important traits.
The rams that were selected in 2004 for breeding purposes will have a positive effect on the breeding objectives of this stud with regard to body weight (C-line), mean fibre diameter and staple length. These rams will also increase the relative economic value of both lines. One of the biggest problems when selecting rams to be used as sires, is the fact that these animals are subjected to a second round of visual appraisal. In order to select rams that will have a positive effect on all of the selection objectives, it is important that this problem must be addressed during the next mating season in 2006. To achieve this, more emphasis should be placed on the estimated breeding values for the traits specified in the selection objectives than on visual appraisal.
EVALUATION OF SELECTION CRITERIA FOR BOER GOATS UNDER EXTENSIVE CONDITIONS

W.J. Olivier

AIM AND OBJECTIVES
The aim of this study is to investigate and evaluate selection criteria currently used in the Small Stock Improvement Scheme (SSIS) of the Agricultural Research Council: Animal Improvement Institute (ARC:AII) for Boer goats under extensive conditions.

The objectives of this study are to:
- Determine whether selection based on the traits measured in the SSIS would result in increased lifetime production and reproduction efficiency in Boer goats
- Do a linear assessment of the subjective traits included in the breed standards and to estimate heritabilities and correlations of these traits with production and reproduction traits
- Do a linear assessment of the number of teats and to estimate heritability of and correlations of this trait with production and reproduction traits, in order to investigate the possible inclusion of number of teats as a selection criterion for ram selection
- Construct a viable breeding plan for Boer goats based on the results of this project
- Implement this breeding plan in the industry
- Establish a database for the estimation of accurate genetic parameters for Boer goats.

INTRODUCTION
Red meat is one of the most important sources of protein for the population of the RSA. Due to the limited natural resources in many of the small stock producing areas of the RSA, efficiency of meat production should be increased within the available resources, in order to utilise the existing resource optimally and also to simultaneously conserve it for future generations. In order to achieve this goal, selection should be aimed at increasing the efficiency of meat production and more specific goat meat production. The ARC:AII has established the SSIS in order to provide farmers with a selection tool with which the efficiency of goat meat production can be improved. The purpose of the SSIS is to improve the overall productivity of the breed through the identification of high producing animals and to select these animals as the parents of the next generation (SSIS: Boer goat performance testing plan, 1998). The SSIS incorporates the production traits, namely 100-day weaning weight and 270-day body weight, as well as reproduction traits. In other words, the producer will receive a growth and reproduction report from which he could make his selection on weaning weight, body weight and ewe productivity. One of the objectives of this study is therefore to investigate and evaluate selection criteria currently used in the SSIS for Boer goats under extensive conditions.

Furthermore, on several occasions the question was raised by breeders regarding the importance of number of teats when breeding rams are selected. The breed standards of the Boer Goat Breeders’ Society specify the different types of teat arrangements that are acceptable and not acceptable for both rams and ewes. It is therefore important to determine the heritability of the number of teats, as well as the correlation of this trait with production and reproduction traits in order to decide whether it should be included in the performance testing scheme.

Stud breeders are responsible for the genetic progress made in any breed, as superior genetic material is distributed down to the commercial and small-scale farmers. A broad spectrum of Boer goat farmers (stud, commercial and previously disadvantaged or small scale farmers) will therefore benefit from the results of this study.

RESULTS AND DISCUSSION
The Boer Goat Breeders’ Society, through their inspectors meeting and the board member responsible for research, assisted with the identification of farmers who want to take part in this project and who will be able to do accurate data recording on their farms. These farmers are distributed throughout the Northern Cape, Eastern Cape, Western Cape, Free State and Limpopo Provinces of South Africa. The distribution of the participants are summarised and illustrated in Table 1 and Figure 1.
Table 1. Distribution of participants

<table>
<thead>
<tr>
<th>Participant</th>
<th>District</th>
<th>Province</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tobie Fourie</td>
<td>Louis Trichardt</td>
<td>Limpopo</td>
</tr>
<tr>
<td>Cornelius du Toit</td>
<td>Griekwastad</td>
<td>Northern Cape</td>
</tr>
<tr>
<td>Danie Lubbe</td>
<td>Oliefshoek</td>
<td>Northern Cape</td>
</tr>
<tr>
<td>Francois Maritz</td>
<td>Daniëlskui</td>
<td>Northern Cape</td>
</tr>
<tr>
<td>Lukas Burger</td>
<td>Griekwastad</td>
<td>Northern Cape</td>
</tr>
<tr>
<td>Louis van Rensburg</td>
<td>Prieska</td>
<td>Northern Cape</td>
</tr>
<tr>
<td>Nico Botha</td>
<td>Britstown</td>
<td>Northern Cape</td>
</tr>
<tr>
<td>Isak Vorster</td>
<td>Middelburg</td>
<td>Eastern Cape</td>
</tr>
<tr>
<td>Tolleie Jordaan</td>
<td>Adelaide</td>
<td>Eastern Cape</td>
</tr>
<tr>
<td>Stefaans Malan</td>
<td>Somerset East</td>
<td>Eastern Cape</td>
</tr>
<tr>
<td>Albert van Zyl</td>
<td>Hoopstad</td>
<td>Free State</td>
</tr>
<tr>
<td>Danie Schoeman</td>
<td>De Rust</td>
<td>Western Cape</td>
</tr>
<tr>
<td>Kobus Lötter</td>
<td>Willowmore</td>
<td>Western Cape</td>
</tr>
</tbody>
</table>

WAY FORWARD

Due to communication problems, as well as a lack of assistance from the participants, no data have been collected as yet. In order to solve these problems, a management program will be set up for each participant. This will assist with the scheduling of recording of the data. Data at the Koopmansfontein Experimental Station will be recorded from October 2005.

Mr Nico Botha has made data available that have been recorded with regard to production, reproduction and number of teats. The data will be evaluated for possible analyses.

The results obtained from this study will assist the Boer Goat Breeders’ Society in decision making with regard to the culling of certain teat types in both the rams and ewes. Furthermore, the correlations between the production, reproduction and type traits will also be of aid in constructing a breeding plan to improve the profit of Boer goat breeders and farmers.

Figure 1. Distribution of the participants
INVESTIGATION INTO THE RELATIONSHIP BETWEEN MILK PRODUCTION OF GRAZING EWES AND MATERNAL BREEDING VALUES FOR EARLY GROWTH TRAITS IN THREE SOUTH AFRICAN SHEEP FLOCKS

M.A. Snyman

AIM AND OBJECTIVES

The aim of this study is to evaluate the use of maternal breeding values for early growth traits as alternative or additional selection criterion for improved growth efficiency in slaughter lamb production enterprises.

The objectives of this study are as follows:

- To determine milk production potential of woolled sheep ewes under different grazing conditions
- To estimate genetic parameters for milk production of these ewes
- To determine the relationship between milk production of ewes and direct and maternal breeding values, as well as actual weaning weight of their lambs in three sheep flocks, under different grazing conditions
- To determine the relationship between maternal breeding values for early growth traits of sires and milk production of their daughters, as well as growth performance of the daughters’ lambs.

BACKGROUND

Body weight has always been one of the important traits considered during selection of both replacement ewes and rams in many wool and mutton sheep breeding enterprises. Using body weight as the sole selection criterion for improved early growth rate in lambs, could have the following detrimental effects:

Firstly, overall efficiency of pre-weaning growth could be negatively influenced due to a possible negative genetic relationship between additive direct and additive maternal components of traits affected by both direct and maternal effects. Early growth traits in sheep all fall within the latter category. Secondly, as body weight at all ages is highly genetically correlated, increasing body weight at an early age will also increase mature body weight. This will have a negative effect on overall profitability of the enterprise, if the increase in body weight is not accompanied by an increase in lambing percentage or a net increase in income from wool production.

It is therefore important that selection emphasis should be shifted from body weight to include some measure of maternal performance as well, be it direct maternal breeding values for early body weight, such as weaning weight, or milk production potential of the ewe.

During the first year of the study (2004), it was planned to do repeated milk recordings on a selected sample of the ewe flock, in order to obtain the average shape of the lactation curves for the ewes in each of the experimental flocks. As the ewes in the Cradock fine wool stud and the Merino ewes at Tygerhoek lambed earlier, this procedures will be done during 2005 in these two flocks. During 2004, ewes in the Carnarvon Afrino flock, as well as the Dohne Merino flock at GADI, were milked. Milk production of the ewes was determined at 7, 14, 21, 28, 35, 49, 63, 77 and 98 days after lambing, as well as at weaning, through the oxytocin technique.

PRELIMINARY CONCLUSIONS

1. Maternal breeding value for weaning weight of the dam has a positive correlation with milk production during Week 3 (0.49) and total milk production (0.31), but no correlation with milk production during Week 12 (-0.04).

2. Maternal breeding value for weaning weight of the sire of the dam has a positive correlation with milk production during Week 12 (0.40) and total milk production (0.22), and a lower positive correlation with milk production during Week 3 (0.06).

3. Maternal breeding value for weaning weight of the dam has a positive correlation with total weight of lamb weaned (0.22), but no correlation with individual weaning weight of her lambs (0.02). The opposite holds true for maternal breeding value for weaning weight of the sire of the dam, which has a positive correlation with individual weaning weight of the lambs of his daughter (0.32), but a negative correlation with total weight of lamb weaned by his daughter (-0.33). Insufficient corrections for twins could probably contributed to this discrepancy.

4. Direct and maternal breeding values for weaning weight of the lamb are positively correlated with maternal breeding value for weaning weight of its dam and maternal grandsire.

5. These are only preliminary correlations, as data from only 25 ewes and 39 lambs were used. However, most of these correlations are favourable considering the aim of the project.
ESTABLISHMENT OF A BIOLOGICAL BANK FOR THE ANGORA GOAT POPULATION IN SOUTH AFRICA

M.A. Snyman

AIM AND OBJECTIVES

The aim of the project is to establish a biological (DNA) bank for Angora goats in South Africa. A DNA bank is essential for the application of more recent techniques for studying genetic variation, identification of genetic disorders and the search for Quantitative Trait Loci.

The objectives of the project are:

- Identify 6 participating breeders
- Collect blood samples from all animals
- Collect production and reproduction data on all animals
- Store blood samples in Eppindorf tubes and on FTA Classic cards
- Extract DNA of all samples and store
- Create and keep up database with all relevant genetic, production and reproduction data.

BACKGROUND

This project is a combined initiative between Grootfontein ADI, the University of Pretoria and Angora goat producers. This project was implemented in January 2005.

The selection of most farm animal species is practiced according to quantitative theory. A relatively large and accurate system of performance records has been established over the years and proved to be essential for estimating breeding values. The development of molecular techniques and the mapping of the genomes of most farm animals have created new means for research regarding genetic diseases and disorders, as well as performance traits.

Advances in biotechnology, especially in the molecular field, have provided new opportunities for animal geneticists and breeders. Since the initiation of the Human Genome Project 13 years ago, projects have been established to map the genomes of most farm animal species, including the goat. At present, 262 genes, 694 loci and 1104 DNA markers are available on the goat map. Quantitative trait loci (QTL) are referred to as loci affecting quantitative traits. In farm animals most of the performance observed in traits of economic importance are the result of quantitative variation. In order to identify a QTL for a specific trait, many animals have to be genotyped for a large number of markers on different chromosomes. Phenotypic data (which has already been collected) and genotypic data (which will be obtained from DNA) are combined for locating the most likely location on the chromosome responsible for the specific trait.

The search for QTL’s is a long-term process and at least two to three generations of different families should be included. It is therefore essential to start collecting samples for DNA analyses. The goat genome map is under construction and as more markers become available, more opportunities arise for appropriate molecular research of the Angora goat.

CONCLUDING REMARKS

- The project will continue for the next six years.
- A database was constructed for this project as part of a M.Sc.-study on application and analyses of DNA-markers during 2004.
- All the relevant data of all the samples received has been entered into the database.
- DNA-markers are being tested on the half-sib families that comply with the prerequisites for a QTL-search.
FEED INTAKE AND DIGESTIBILITY OF SHEEP WITH VARYING ESTIMATED BREEDING VALUES FOR MATURE BODY WEIGHT

M.M. Kuselo

AIM AND OBJECTIVES
The aim of this trial was to determine the effect of selecting and breeding sheep for increased body weight on feed intake and digestibility.

The objectives of the study were to determine if the selection of sheep for increased body weight:

• is associated with a proportional increase in feed intake
• is associated with increased capacity to digest feed.

INTRODUCTION
Much of the research work with regard to sheep breeding in South Africa focussed on methods of genetic evaluation and the responses obtained through selection. Attempts to clearly define selection objectives do not seem to be adequate. The selection of breeding animals through the National Small Stock Improvement Scheme in South Africa is based on indices and estimated breeding values for different production traits. The net result of such selection is an increase in production or income per head and not necessarily per unit of available resource. The income from a sheep is directly related to the level of production of that animal, whereas the income from a sheep farming enterprise is determined by the efficiency of converting available grazing material into products. For the farm enterprise, the available grazing material is the primary limiting factor.

Herselman (2004) recently developed an alternative selection index, based on farm profit (R/Small Stock Unit), for incorporation in sheep performance testing. As this index takes the nutritional requirements of animals, based on the ARC (1980), into account, it implies that larger animals have higher nutritional requirements and therefore less of them can be kept on the same area of land when compared to smaller animals. Although the nutritional requirements of sheep as proposed by the ARC (1980) are scientifically based on vast numbers of research publications, two principles incorporated into the ARC formulas, needed confirmation as follows:

• that energy requirements of livestock are directly related to metabolic weight, also for animals specifically bred for increased body weight. Do genetically bigger animals eat proportionally more than genetically smaller animals?
• that digestion of feed is not influenced by the size of the animal, also for animals specifically bred for increased body weight.

EXPERIMENTAL PROCEDURES
Twelve mature ewes from the Cradock fine wool Merino stud were used to carry out the feed intake and digestibility trials at Grootfontein Agricultural Development Institute. A pelleted diet of lucerne hay mixed with 5% molasses was used to carry out the trial. Of these ewes, six had high estimated breeding values (EBVs; 1.04, 1.14, 2.30, 3.88, 4.93, 6.58) and the other six had low EBV’s (-6.46, -5.30, -5.06, -4.09, -4.08, -2.79) for mature body weights. Ewes were kraaled in individual pens. The experiment was performed in three phases.

During the first phase, a digestibility study was conducted at maintenance energy intake. For this, ewes were adapted over a 14-day period to the pelleted diet in individual pens, each receiving the amount of feed equal to its maintenance requirements (ARC, 1980). Subsequently, while feed was still provided at maintenance energy level, faeces were collected for a 10-day period. Faecal collection was done manually by collecting each sheep’s faeces daily and preserving it with toluene in an airtight plastic bag for the 10-day period. Dry matter determinations were performed for both the feed and faecal samples for calculation of dry matter digestibility percentages (DMD).

During the second phase, a digestibility study was conducted at ad libitum feed intake. For this ewes were adapted over a 14-day period to the pelleted diet in individual pens at ad libitum feed intake. Subsequently, feed intake was recorded over a 10-day period while faeces was also collected over a 10-day period, commencing two days after the start of the intake recording period. Dry matter determinations were performed for the feed leftovers and faecal samples for calculation of DMD.

During Phase 3, ad libitum feed intake was recorded over a period of five weeks. For this, ewes were once again adapted over a 14-day period to the pelleted diet in individual pens at ad libitum feed intake. Feed intake and body weight were recorded weekly over the five-week period.
STATISTICAL ANALYSES
The General Linear Model (GLM) of SAS was used to test differences in body weight, feed intake and DMD for significance (Littel et al., 1991).

RESULTS AND DISCUSSION

The average body weight, feed intake and DMD during Phase 1 for ewes with high versus low estimated breeding values for mature body weight are presented in Table 1. Body weights in the groups showed significant differences ($P<0.05$). This is not surprising as these animals were divided into the two groups according to their body weights. There was no significant difference in DMD between the groups. McDonald et al. (1995) reported that differences within the same species and even among ruminants are very small. Moreover, body weight was found elsewhere to have no influence on digestibility (Graham et al., 1997).

The average body weight, feed intake and DMD during Phase 2 for ewes with high versus low estimated breeding values for mature body weight are presented in Table 1. Although the average feed intake of the high EBV group was higher, the difference was not significant due to relative large variation among animals within the same group and the small number of animals per group. Furthermore, DMD did not differ between the groups.

Results obtained during Phase 3 are also presented in Table 1. The higher feed intake of the high EBV group was again not significant because of the large variation and small experimental groups. The variation in feed intake was associated with variation in body weight, as reflected by a correlation coefficient of 0.51 between body weight and feed intake. Moreover, feed intake per metabolic weight was the same (67.8 and 69.6 g/kg$^{0.75}$/day, respectively) for animals with high and low EBV’s for mature body weight.

Table 1.  Body weight, feed intake and DMD of sheep with varying estimated breeding values for mature body weights

<table>
<thead>
<tr>
<th>Phase 1</th>
<th>High EBV</th>
<th>Low EBV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body weight (kg)</td>
<td>70.1 ± 2.3 $^a$</td>
<td>61.1 ± 2.3 $^a$</td>
</tr>
<tr>
<td>Feed intake (kg/day)</td>
<td>1.1 ± 0.1</td>
<td>1.0 ± 0.1</td>
</tr>
<tr>
<td>Feed intake (g/kg$^{0.75}$/day)</td>
<td>55.8 ± 1.0</td>
<td>56.5 ± 1.0</td>
</tr>
<tr>
<td>Dry matter digestibility (%)</td>
<td>62.3 ± 2.5</td>
<td>57.5 ± 2.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Phase 2</th>
<th>High EBV</th>
<th>Low EBV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body weight (kg)</td>
<td>74.0 ± 2.3 $^a$</td>
<td>63.8 ± 2.3 $^a$</td>
</tr>
<tr>
<td>Feed intake (kg/day)</td>
<td>2.3 ± 0.1</td>
<td>1.8 ± 0.1</td>
</tr>
<tr>
<td>Feed intake (g/kg$^{0.75}$/day)</td>
<td>84.3 ± 7.4</td>
<td>87.1 ± 7.4</td>
</tr>
<tr>
<td>Dry matter digestibility (%)</td>
<td>55.4 ± 2.5</td>
<td>58.0 ± 2.5</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Phase 3</th>
<th>High EBV</th>
<th>Low EBV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body weight (kg)</td>
<td>76.6 ± 1.9 $^a$</td>
<td>63.5 ± 1.9 $^a$</td>
</tr>
<tr>
<td>Feed intake (kg/day)</td>
<td>1.8 ± 0.1</td>
<td>1.5 ± 0.1</td>
</tr>
<tr>
<td>Feed intake (g/kg$^{0.75}$/day)</td>
<td>67.8 ± 4.3</td>
<td>69.6 ± 4.3</td>
</tr>
</tbody>
</table>

CONCLUSIONS
The results of this study confirmed that:

- voluntary feed intake of sheep is directly related to metabolic weight, also for animals specifically bred for increased body weight - genetically bigger animals eat more than genetically smaller animals.
- digestion of feed is not influenced by the size of the animal, also for animals specifically bred for increased body weight - selection for increased body weight is not associated with increased capacity of animals to digest feed.
INVESTIGATION INTO REPRODUCTION AND KID MORTALITY OF SOUTH AFRICAN ANGORA GOATS

M.A. Snyman

AIM AND OBJECTIVES
The aim of this study is to identify the factors contributing to a low reproductive rate and high kid mortality in South African Angora goats.

The objectives of the project are:
- Identify participants
- Collect data on body weight and reproduction of ewes
- Collect data on growth performance and hair production of kids
- Collect data on causes of kid mortalities
- Collect data on fertility of rams
- Collect data on all management aspects, such as management during mating and kidding, supplementary feeding practices, animal health practices and weather conditions
- Analyse data and identify important factors contributing to a low reproductive rate and high kid mortality in South African Angora goats.

BACKGROUND
Reproduction and lamb survival rate are the most important traits influencing income in all small stock breeds, including woolled sheep and Angora goats. Kids and young goats produce the most expensive mohair and a high weaning percentage will ensure a large proportion of kid and young goat mohair. High reproductive and kid survival rates also contribute to higher selection intensity, i.e. when more young goats are available at selection age, selection could be stricter and genetic progress could be quicker.

The poor reproductive performance and high kid mortality rate of Angora goats are well documented. There are numerous factors that contribute to the actual number of kids born per ewe that was put to the rams. Factors influencing the number of kids weaned or the survival rate of kids, include birth weight of the kid, genetic influences, mothering ability and milk production of the dam, adverse environmental or feeding conditions, disease and predators.

Various surveys had been done in the South African Angora goat industry, which assessed different aspects of Angora goat farming (Van Rensburg, 1962; Terblanche, 1988; Geyer, 1996). While some of these studies dealt with possible reasons for kid mortality, they did not cover the possible causes of reproductive failure. The purpose of this study is to identify the factors contributing to a low reproductive rate and high kid mortalities in Angora goats. In order to determine the factors responsible for the unsatisfactory reproductive performance, it is essential that all possible contributing influences be investigated. Therefore, in order to assess the problem, an intensive study of Angora flocks varying in reproductive rate and management practices, is done.

CONCLUSIONS
- The project is running according to schedule.
- Participating breeders are positive about the project and give excellent co-operation.
- Data recorded during this study on the retarded growth of kids after weaning, has led to an additional project on the investigation of different weaning practices of Angora kids.
- From the data collected over the past 5 years, it is clear that pre-weaning mortality rate in the Angora studs included in this study is not exceptionally high (average 11.5%). In fact, it compares favourable with that recorded for other sheep breeds.
- The most important single cause of kid mortalities was vermin (36.0%), while a combination of small, unthrifty kids who needed help suckling, ewes having little or no milk, thick teats and udder problems and ewes discarding their kids, was responsible for 36.7% of pre-weaning mortalities.
- Nearly 20% of the ewes did not reproduce. This aspect is usually not taken into account when the relatively poor weaning percentage of Angora goats is under discussion. High kid mortalities are usually blamed for the low weaning percentage.
- The low reproductive rate of especially young ewes is an aspect that needs further investigation.
- The project will be completed after the 2004-born young ewes have been shorn for the third time during January / February 2006.
LIST OF PUBLICATIONS


BYPASS PROTEIN SUPPLEMENTATION OF LATE PREGNANT AND LACTATING SHEEP AND ANGORA GOATS IN THE DIFFERENT GRAZING AREAS OF SOUTH AFRICA

J.H. Hoon

AIM AND OBJECTIVES
The aim of the project was to evaluate the effect and economic viability of strategic protein supplementation of small stock in the different grazing areas of South Africa.

The objectives of this study were:
- To determine the effect of supplementation of late pregnant and lactating ewes with different protein sources on the production (body weight at 42-day lamb age, fleece weight) and reproduction (conception percentage, weaning percentage) of ewes and the growth rate (42-day weight, weaning weight) of lambs/kids
- To use the available data to establish guidelines with regard to the supplementation of bypass protein sources to reproducing ewes in the different small stock grazing areas of South Africa for day-to-day advice to producers.

BACKGROUND
The project was carried out at 16 different localities (13 sheep and 3 Angora goat), representative of the different small stock grazing areas of South Africa.

Table 1. Participants of the protein supplementation project

<table>
<thead>
<tr>
<th>Name</th>
<th>District</th>
<th>Pastures</th>
<th>Animals</th>
<th>Treatments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nico Uys</td>
<td>Heidelberg (WC)</td>
<td>Lucerne pastures</td>
<td>Woolled sheep</td>
<td>Control</td>
</tr>
<tr>
<td>Caledon-Napier Co-op</td>
<td>Caledon</td>
<td>Lucerne pastures</td>
<td>Woolled sheep</td>
<td>X</td>
</tr>
<tr>
<td>WG Treurnicht</td>
<td>Porterville</td>
<td>Wheat stubble</td>
<td>Woolled sheep</td>
<td>X</td>
</tr>
<tr>
<td>Peter Steyn</td>
<td>Malmesbury</td>
<td>Wheat stubble</td>
<td>Woolled sheep</td>
<td>X</td>
</tr>
<tr>
<td>Llewelyn Louw</td>
<td>Malmesbury</td>
<td>Wheat stubble</td>
<td>Woolled sheep</td>
<td>X</td>
</tr>
<tr>
<td>Brian Davison</td>
<td>Caledon</td>
<td>Cynodon sp.</td>
<td>Woolled sheep</td>
<td>X</td>
</tr>
<tr>
<td>CP van der Merwe</td>
<td>Fraserburg</td>
<td>Karoo shrub veld</td>
<td>Woolled sheep</td>
<td>X</td>
</tr>
<tr>
<td>Abrie Marais</td>
<td>Philippolis</td>
<td>Mixed grass/shrub</td>
<td>Woolled sheep</td>
<td>X</td>
</tr>
<tr>
<td>Jurie Lessing</td>
<td>Noupooit</td>
<td>Sour grass veld</td>
<td>Woolled sheep</td>
<td>X</td>
</tr>
<tr>
<td>Andries Bester</td>
<td>Cedarville</td>
<td>Sour grass veld</td>
<td>Woolled sheep</td>
<td>X</td>
</tr>
<tr>
<td>Nooitgedacht Experimental Station</td>
<td>Ermelo</td>
<td>Sour grass veld</td>
<td>Woolled sheep</td>
<td>X</td>
</tr>
<tr>
<td>Disrie Compion</td>
<td>Pofadder</td>
<td>Stipagrostis grass veld</td>
<td>Mutton sheep</td>
<td>X</td>
</tr>
<tr>
<td>Koopmansfontein Experimental Station</td>
<td>Barkly West</td>
<td>Tarchonanthus shrub veld</td>
<td>Mutton sheep</td>
<td>X</td>
</tr>
<tr>
<td>Gappie de Klerk</td>
<td>Graaff-Reinet</td>
<td>Mixed shrub/grass veld</td>
<td>Angora goats</td>
<td>X</td>
</tr>
<tr>
<td>Fransie Fourie</td>
<td>Jansenville</td>
<td>Mixed shrub/grass veld</td>
<td>Angora goats</td>
<td>X</td>
</tr>
<tr>
<td>George Stegmann</td>
<td>Willowmore</td>
<td>Karoo shrub veld</td>
<td>Angora goats</td>
<td>X</td>
</tr>
</tbody>
</table>
At the start of the project at each locality, a flock of the farmer’s own ewes was mated as one group and randomly divided into three equal groups four weeks prior to lambing. The groups were then placed in different camps, comparable in size and veld quality and quantity, for the 12-week supplementation period. The animals remained in their respective groups for the duration of the study. Where the grazing conditions allowed it, a control group was kept (no supplementation), while the two treatment groups received supplementation with a low and high rumen undegradable/bypass protein content, respectively. The two supplementary diets were supplied at 300g/animal/day for four weeks prior to lambing and 400g/animal/day for eight weeks after lambing. The supplement intake of both groups was kept at the same level for the duration of the supplementation period. The following data were recorded at all the localities: body weight of lambs at 42-day age and at weaning, body weight of ewes at 42-day lamb age and weaning percentage. Ewes were also scanned for pregnancy by means of ultrasound scanning, where possible. Fleece weights of the individual ewes were recorded at two Angora goat localities (Willowmore, Graaff-Reinet) in 2002 and at two sheep localities (Cedarville and Ermelo) in 2003, while the total clip weights for ewes and for kids (1st shearing) were recorded in 2001, 2002 and 2003 at Jansenville for Angora goats. A sample of each fleece, collected in 2002 from Angora ewes at Willowmore and Graaff-Reinet, was also analysed by means of the OFDA2000 for different fleece characteristics. An economic analysis was done on the combined data of each locality, using the SM2004 computer simulation model, to determine the economic viability of supplementation of ewes during late pregnancy and lactation.

CONCLUSION
The results in general indicated a positive response with supplementation of ewes during late pregnancy and lactation on body weight of ewes, growth rate of lambs and weaning percentages. It would, however, appear that this response is only substantial when grazing conditions are relatively poor, in quality and/or quantity. It would, furthermore, appear that under less favourable grazing conditions during the supplementation period, supplementation, especially with a high bypass protein diet, had a positive effect on certain traits, specifically the number of lambs weaned/ewes mated. This is supported by the economic analysis that indicated a positive response in gross margin/ewe on sour grass veld, stubble lands and other poor quality grazing. It would also appear that supplementation with a high bypass diet is more profitable than a low bypass diet on these poor quality grazing.

The results indicated a specific pattern in the performance of the different groups of animals in direct relation to the type and quality of the veld/pasture. Under good grazing conditions, differences in production and reproduction data were small. However, under less favourable grazing conditions, animals receiving supplementation seem to perform better, especially with high bypass protein supplements. The prevailing grazing conditions (i.e. type, quantity and quality of vegetation) will therefore determine the type, period and amount of supplementation required to ensure that the implementation of a supplementary program during late pregnancy and lactation is an economically viable option. As weaning percentage is a very important factor in determining the economic viability of supplementation, it is important to focus more attention on the high producers in the flock (ewes with twins). It can therefore be concluded that the results indicated that different levels of bypass protein should be supplemented under different veld types and conditions to late pregnant and lactating ewes, thereby creating considerable savings in supplementation costs.

A major implication of the findings of this study is that a lot of assumptions and misconceptions with regard to supplementation of late pregnant and lactating ewes in general, and with different protein sources in particular, have been addressed. As small stock producers are becoming more aware of the results of this project, they are using it in the planning of their feed supplementation programs. In the process they are potentially saving money by using less expensive or even no supplementation under their specific farming circumstances and conditions.
AN INVESTIGATION INTO THE EFFECT OF SUPPLEMENTATION OF SHEEP AND ANGORA GOATS WITH A COMMERCIAL TRACE MINERAL SUPPLEMENT ON REPRODUCTION AND PRODUCTION

J.H. Hoon

AIM AND OBJECTIVES
The aim of the study was to determine the effect of supplementation of sheep and Angora goats with a commercial trace mineral supplement on reproduction rate of ewes and growth rate of lambs/kids in order to establish guidelines and make recommendations that will benefit producers financially.

The objectives of this study were:
- To record reproduction data (conception percentage, weaning percentage) of the ewes
- To record growth data (42-day weight, weaning weight) of the lambs/kids
- To analyse blood samples for trace element concentrations
- To use the available data to establish guidelines for day-to-day advice to producers.

BACKGROUND
The participants in the project are given in Table 1.

Table 1. Participants of the trace mineral supplementation project

<table>
<thead>
<tr>
<th>Name</th>
<th>District</th>
<th>Breed</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jannie Moolman</td>
<td>Middelburg</td>
<td>Angora goats</td>
<td>1, 2, 3</td>
</tr>
<tr>
<td>Syd Fitzhenry</td>
<td>Jansenville</td>
<td>Angora goats</td>
<td>1</td>
</tr>
<tr>
<td>John Kirkman</td>
<td>Steytleriville</td>
<td>Angora goats</td>
<td>1</td>
</tr>
<tr>
<td>Gert Smith</td>
<td>Willowmore</td>
<td>Angora goats</td>
<td>1</td>
</tr>
<tr>
<td>Theron vd Merwe</td>
<td>Murraysburg</td>
<td>Angora goats</td>
<td>1, 2</td>
</tr>
<tr>
<td>Hendrik Opperman</td>
<td>Cradock</td>
<td>Angora goats</td>
<td>1, 2, 3</td>
</tr>
<tr>
<td>Grant Middleton</td>
<td>Beaufort West</td>
<td>Angora goats</td>
<td>2</td>
</tr>
<tr>
<td>Gielo du Toit</td>
<td>Fraserburg</td>
<td>Woolled sheep</td>
<td>1, 2, 3</td>
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<tr>
<td>Brian Miles</td>
<td>Adelaide</td>
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<td>1, 2</td>
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<tr>
<td>Gerhard Strauss</td>
<td>Britstown</td>
<td>Mutton sheep</td>
<td>1, 2</td>
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<td>Hercu du Plessis</td>
<td>Kareedouw</td>
<td>Woolled sheep</td>
<td>1, 2</td>
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<td>Henry du Plessis</td>
<td>Kareedouw</td>
<td>Woolled sheep</td>
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<td>Albertus Roux</td>
<td>Springbok</td>
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<td>2</td>
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<td>Charles van Tonder</td>
<td>Dewetsdorp</td>
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<td>Koompansfontein</td>
<td>Barkly West</td>
<td>Mutton sheep</td>
<td>2</td>
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<tr>
<td>Jan Becker</td>
<td>Upington</td>
<td>Mutton sheep</td>
<td>2</td>
</tr>
<tr>
<td>Douglas Caldo</td>
<td>Laingsburg</td>
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<td>2</td>
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<td>Nico van Loggerenberg</td>
<td>Moorreesburg</td>
<td>Woolled sheep</td>
<td>2</td>
</tr>
<tr>
<td>Frikkie Jackson</td>
<td>Riversdale</td>
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<td>2</td>
</tr>
<tr>
<td>Jozua Roux</td>
<td>Cradock</td>
<td>Woolled sheep</td>
<td>1, 2, 3</td>
</tr>
</tbody>
</table>

At each locality, a flock of the farmer’s own ewes was mated as one group. The flock was randomly divided into two groups (control and treatment) and the groups were individually tagged and numbered with two different colour ear tags. The ewes of the treatment group received a 1 ml subcutaneous injection of a commercial trace mineral supplement (Multimin® - Virbac) 4-6 weeks prior to mating and again 4-6 weeks before lambing/kidding. A minimum of 70 ewes per group was used and all the ewes were managed as one group for the duration of the study.

The following data were collected at all the localities: body weight of lambs/kids at 42-day age, body weight of lambs/kids at weaning and weaning percentages of ewes. Where possible, ewes were also scanned for pregnancy to determine conception and/or scanning percentages. Blood samples of 10 animals per group were collected approximately four weeks after the first supplementation and the full blood samples were analysed for selenium (Se). An economic analysis, using the SM2004 computer simulation model, was done on the combined data of all the localities over the three year period to determine the economic viability of trace mineral supplementation of Angora goats and sheep.
The project was scaled down when it became known that the formulation of the commercial product used in this study, was to be changed by the manufacturer. The study ended after the 2003/2004 kidding season when the changed/new product became commercially available to all producers.

CONCLUSION
From the results it appeared that supplementation of Zn, Mn and Se by means of a commercial product (Multimin® - Virbac) in general had a positive effect on the measured reproduction traits of sheep and Angora ewes and the production of lambs/kids, although differences were relatively small at most localities. In areas known for possible mineral deficiencies such as Kareedouw, a large increase in the reproductive rate of the ewes, as well as the growth rate of the lambs, were observed. At some localities, however, no differences in production and reproduction traits could be observed and some of the results were even in favour of the control groups. Good grazing conditions were probably one of the reasons for the small differences observed between the control and treatment groups at most of the localities.

The average gross margin per ewe, as calculated with the SM2004 model, indicated an economic advantage in the use of trace mineral supplementation for sheep and Angora goats. As the cost of trace mineral supplementation is relatively low, an increase of less than 1% in the weaning percentages of the ewes as a result of the supplement was sufficient to make this practice economically viable. It is, however, important to keep in mind that in this study many other on-farm factors could have influenced certain traits such as weaning percentage, e.g losses due to problem animals, etc. According to the mean blood Se values, it would appear that supplementation of sheep and Angora goats specifically with Se at all the localities, will not be of economic value to the producer.
INVESTIGATION INTO THE EFFECT OF VITAMIN A SUPPLEMENTATION ON THE REPRODUCTION OF SHEEP AND GOATS

P.G. Marais

AIM AND OBJECTIVES
The aim of this project was to investigate the effect of vitamin A supplementation on the reproductive performance of sheep and goats at four Experimental Stations.

The objectives of this study were:
- To identify the effect of vitamin A supplementation via intramuscular injections, on the reproductive and productive performance of sheep and goats
- To obtain information to enable better advice to sheep and goat farmers.

MOTIVATION
In South Africa vitamin A supplementation is recommended widely and used extensively in practice, both by farmers and by the feed industry. This situation prevails despite the fact that it appears that no conclusive evidence, indicating that such supplements hold any benefit in terms of animal performance, exists. A study was therefore conducted under different environmental conditions to determine the effect of vitamin A supplementation on reproduction and production of sheep and goats.

EXPERIMENTAL PROCEDURES
The project started in 2001 with Merino and Dorper sheep, Boer goats and Angora goats and was repeated over four years. The four localities that have been used, were as follow:
- Grootfontein Agricultural Development Institute  Merino
- Grootfontein Agricultural Development Institute  Angora
- Adelaide Experimental Station    Boer goat
- Karakul Experimental Station    Dorper
- Koopmansfontein Experimental Station   Dorper

At the start of the project, a flock of ewes at each locality was randomly divided into two groups (control and treatment) and each group was individually tagged and numbered with two different colour ear tags. At each locality, the ewes were mated as one group. The ewes of the treatment group received a 0.25 ml (125 000 i.u.) subcutaneous injection of a commercial vitamin A product (Provit A, Virbac) 4 - 6 weeks prior to mating and again 4 - 6 weeks before lambing. A minimum of 50 ewes per treatment group was used and all the ewes were managed as one group for the duration of the study.

The following data were collected: number of ewes mated, number of ewes lambed, number of lambs born, number of lambs weaned, birth weight and weaning weight.

RESULTS AND DISCUSSION
The results of the study are summarised in Table 1.

Table 1. Effect of vitamin A on reproductive and productive performance of sheep and goats

<table>
<thead>
<tr>
<th>Localities</th>
<th>Vitamin A</th>
<th>Experimental groups</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fertility (%)</td>
<td>Lambing (%)</td>
<td>Birth weight (kg)</td>
</tr>
<tr>
<td>Grootfontein Merino</td>
<td>86.0</td>
<td>132.1</td>
<td>4.27</td>
</tr>
<tr>
<td>Grootfontein Angoras</td>
<td>78.7</td>
<td>90.7</td>
<td>3.34</td>
</tr>
<tr>
<td>Koopmansfontein Dorpers</td>
<td>75.8</td>
<td>87.2</td>
<td>4.03</td>
</tr>
<tr>
<td>Karakul Exp. Station Dorpers</td>
<td>97.8</td>
<td>107.3</td>
<td>3.96</td>
</tr>
<tr>
<td>Adelaide Boer goats</td>
<td>94.1</td>
<td>207.7</td>
<td>3.88</td>
</tr>
<tr>
<td>Overall</td>
<td>86.48</td>
<td>125.0</td>
<td>3.89</td>
</tr>
</tbody>
</table>
The results indicate that differences in reproduction (lambing % and fertility %) and body weight at birth and weaning occurred between years at the same locality. These differences can be attributed to differences in environmental and grazing conditions. From the results it is evident that vitamin A supplementation had no effect on reproduction and production traits measured in this study.

**CONCLUSION**

Vitamin A supplementation had no effect on reproduction and growth of sheep and goats at any of the localities. It would appear that the practice of farmers to supplement sheep and goats with one-quarter dose of the prescription vitamin A for cattle might only be an additional cost factor. However, most of the flocks in which vitamin A was tested in this study already had high reproduction rates. In the Koopmansfontein flock, in which reproduction is relatively low, lambing percentage increased by 3.2% over the four-year period. Therefore, it might be necessary to also evaluate the use of vitamin A in selected flocks, especially Angora goats, with known low reproduction rates.
A SURVEY ON THE EFFECTIVENESS OF DIFFERENT PROBLEM ANIMAL CONTROL METHODS IN THE SMALL STOCK PRODUCING AREAS OF SOUTH AFRICA

M.J. Herselman

AIM AND OBJECTIVES
The aim of this project is to investigate the extent of livestock losses due to problem animals and the effectiveness of the control methods of problem animals in the small stock producing areas of South Africa and to investigate the use and effectiveness of livestock guarding dogs (LGD’s), as a method of problem animal control.

The objectives of the study are:
- To record sheep and goat mortalities under farming conditions in South Africa
- To determine factors that contribute towards losses of sheep and goats to problem animals
- To determine the effectiveness of control methods of problem animals
- To determine the impact of introducing livestock guarding dogs on the predation problem.

BACKGROUND
Loss of livestock to predation remains one of the major problems experienced by sheep and goat farmers. Many ways of dealing with the problem are practiced by farmers and new techniques are introduced on a regular basis. The effect of these methods used by farmers differs from region to region and even from farm to farm. The farmers also use their own methods for which there are no records available. The use of livestock guarding dogs (LGD’s) is a proven technique in other parts of the world and is now also gaining popularity in South Africa.

This project, to obtain reliable information on the extent of livestock losses from individual producers and for the evaluation of the impact of different problem animal control methods, started in 2003. In addition, Anatolian Shepherd dogs are also introduced into the project as they become available from the Grootfontein Research Trust breeding program. Farmers buy these dogs at a subsidised price and integrate them into their flocks as prescribed. The data on the effect of these dogs on stock losses are then integrated into the database. In this way it is possible to study the effectiveness of these dogs. Fourteen Anatolian Guarding dogs were already placed with participants during the previous reporting period. During the reporting period, eight more puppies (6 weeks of age) were placed with participating farmers.

EXPERIMENTAL PROCEDURES
Currently the survey covers 51 farms throughout South Africa (See Figure 1). For the purpose of this report, data collected during the second year of the survey (2004) are reported. Each farmer completed an annual questionnaire in which particulars of his farming enterprise, neighbouring farms as well as livestock numbers were requested. Losses of livestock and predators killed were reported by means of completing the monthly questionnaire. During the first year and a half, participants were phoned monthly to obtain the required data. However, due to the high telephone cost, it was decided to change the format of data collection from July 2004. Since then, the monthly questionnaires were sent in advance to each participant together with franked envelopes. Farmers then send each month’s questionnaire back to Grootfontein.

Figure 1. Problem animal survey participants during 2004
RESULTS
A summary of the survey results is presented in Table 1. A total of 208 lynx and 324 black-backed jackal were killed on the 51 survey farms.

Table 1. Summary of survey results

<table>
<thead>
<tr>
<th></th>
<th>Sheep</th>
<th>Goats</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lambs in survey</td>
<td>49770</td>
<td>14197</td>
<td>63967</td>
</tr>
<tr>
<td>Adults in survey</td>
<td>65245</td>
<td>24746</td>
<td>89991</td>
</tr>
<tr>
<td>Total animals in survey</td>
<td>115015</td>
<td>38943</td>
<td>153958</td>
</tr>
<tr>
<td>Lambs caught by predators</td>
<td>2250</td>
<td>894</td>
<td>3144</td>
</tr>
<tr>
<td>Adults caught by predators</td>
<td>156</td>
<td>76</td>
<td>232</td>
</tr>
<tr>
<td>Total animals caught</td>
<td>2406</td>
<td>970</td>
<td>3376</td>
</tr>
<tr>
<td>% of lambs caught</td>
<td>4.5</td>
<td>6.3</td>
<td>4.9</td>
</tr>
<tr>
<td>% of adults caught</td>
<td>0.2</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>% of animals caught</td>
<td>2.1</td>
<td>2.5</td>
<td>2.2</td>
</tr>
</tbody>
</table>

SUMMARY
Much too little data are currently available to make any reliable conclusions. However, the following preliminary conclusions can be made:
1. Although individual cases of extremely high livestock losses occur, the extent of the predator problem appears not to be a general threat to small stock production in South Africa. Data collected so far indicate that predators kill approximately 5% of all lambs. Nonetheless, extrapolating the data collected in this study indicate that approximately 685 000 sheep and goats to the value of R300 million are annually killed by predators.
2. With data collected so far in the project, it was not possible to relate the extent of the predation problem to topography, utilisation of neighbouring farms or problem animal control measures.
3. The stock theft problem appears to be much lower than the predator problem with less than 0.2% of small stock been recorded as stolen.
4. Extrapolation of data collected in this study suggests that approximately 66 000 black-backed jackal and 42 000 lynx are annually killed by farmers, with the largest proportion being caught in traps.
INVESTIGATION INTO THE CAUSE, PREDISPOSING FACTORS AND EFFECTIVE TREATMENT OF SWELLING DISEASE IN SOUTH AFRICAN ANGORA GOATS

M.A. Snyman

AIM AND OBJECTIVES OF THE PROJECT

The aim of this study is to identify the causative agent(s) responsible for swelling disease in South African Angora goats.

The objectives of this study are:

• To carry out trials to investigate and identify the predisposing factors as well as the causative agent(s) responsible for swelling disease
• To identify the most effective treatment for swelling disease.

BACKGROUND

During the early 1970’s, Angora goat farmers reported a condition in their goats, characterised by the sudden onset of severe subcutaneous oedema of the lower body parts. Some goats died of the condition, while others seemed to recuperate spontaneously. According to various internal reports of the Regional Veterinary Laboratory at Middelburg (EC), numerous trials were conducted to investigate the cause of this disease. However, no conclusive evidence was found as far as the cause of the disease is concerned. Therefore, results of these trails were not published.

Outbreaks of swelling disease still occur periodically and some losses are still experienced by Angora goat producers. No definite cure is known; various farmers practice different treatments, not all of which are always successful. As a result, delegates at the 60th Annual General Congress of the Mohair Growers’ Association of South Africa unanimously accepted a resolution that purposeful research should be carried out on the cause, treatment and prevention of swelling disease in various areas among all age groups of Angora goats in South Africa.

CONCLUSIONS

• From all the information available on swelling disease in Angora goats, it is obvious that it is a complex condition, of which little is known regarding the mechanisms involved in the initiation and course of the disease.
• Although *O. circumcincta* infection has been listed as one of the predisposing factors for the disease, the present study, as well as some previous work, indicated that *O. circumcincta* infection alone does not cause swelling disease.
• No definite conclusions can be drawn with regard to the role of coccidial infection in the etiology of swelling disease, but this relationship needs further investigation.
• The results of this study further indicated that higher dietary protein levels could possibly aid in the prevention of swelling disease.
• The additional stress due to the adverse weather conditions during the experimental period, played a definite role in precipitating the disease in the goats already predisposed as a result of the other factors.
• The possibility that there are different clinical forms of the disease should also be kept in mind, as reported cases differed considerably in the extent of oedema, as well as with regard to other associated parameters and the duration and outcome of the disease.
AN INVESTIGATION INTO THE EFFECT OF DIFFERENT WEANING PRACTICES ON THE POST-WEANING GROWTH OF ANGORA KIDS

J.H. Hoon

AIM AND OBJECTIVES
The aim of the project is to find practical solutions for the problems generally associated with post-weaning stress in Angora goats.

The objective of the study is to determine the effect of different weaning methods on:
- the post-weaning growth of Angora kids,
- the body weight change of ewes from weaning until mating,
- the milk production of the ewes and
- the conception rate of the ewes in the next breeding season.

INTRODUCTION
The project was initiated on the farm of Mr Jannie Moolman (Rusoord) in the Middelburg district during the 2003/2004 kidding season. During the 2004/2005 kidding season, the study was repeated at the same locality. The farmer’s own animals were used and the animals grazed on natural veld. At the onset of lambing in September 2004, a flock of Angora ewes (± 450) and their kids were randomly tagged with three different colour ear tags, namely red, orange and yellow and were also numbered individually. The nucleus of ewes in each group consisted of ewes that were also used in the pilot study in 2003/2004. Ten ewes from each group that kidded in the same week and had single kids, were identified and marked. Milk production of these 30 ewes (10 ewes per group) was recorded on a weekly basis from 3 weeks after kidding (04/10/2004) until 11/11/2004 and on a two-weekly basis thereafter until 31/03/2005, when the mating season started. The oxytocin method was used to determine the 4-hour milk production of the 10 ewes in each group. The body weights of the 30 kids of the respective ewes were also recorded on a weekly basis, on the same day when the milk production of the ewes was recorded.

At weaning (22/02/2005) the three treatments commenced as follow: Treatment 1 (Weaned) – Kids and ewes were separated, i.e. normal weaning took place; Treatment 2 (Swopped) – Kids were separated from their mothers, but were put with other mature ewes, i.e. normal weaning but weaned kids stayed with other ewes; Treatment 3 (Not weaned) – Kids and ewes remained together, i.e. no weaning took place. The on-farm layout was as follows: The ewes and kids of Treatment 3 (Not weaned) were kept with the ewes of Treatment 2 (Swopped); The ewes of Treatment 1 (Weaned) were kept with the kids of Treatment 2 (Swopped); The kids of Treatment 1 (Weaned) were kept separately.

Body weights of ewes were recorded at weaning (22/02/2005) and before mating (31/03/2005). The mating season started on 01/04/2005 for a six week period. Body weights of the kids of all three groups were recorded at weaning (22/02/2005) and approximately every four weeks thereafter until 05/07/2005. The conception and scanning percentages of all the ewes of the three groups were determined on 20/06/2005 by means of ultrasound scanning. The animals stayed in their respective groups from weaning (22/02/2005) until the final body weights of kids were recorded on 05/07/2005. All the animals were subjected to the same management practices throughout the experimental period.

CONCLUSION
The results from the 2004/2005 kidding season concurred to a large extent with the results obtained during the 2003/2004 kidding season at the same locality. Promising results were obtained with regard to the effect of the different treatments on the post-weaning growth of Angora kids, especially where kids were swopped (Treatment 2) and not weaned (Treatment 3). The non-weaning of kids also did not have any negative effect on the conception and scanning percentages of the ewes, despite a slightly lower body weight at mating compared to ewes where normal weaning took place.

In the forthcoming kidding season (Sep/Oct 2005), the project will also start at two localities in the Jansenville/Steytlerville and Grahamstown/Adelaide districts. The project will be repeated for three kidding seasons at each locality in order to minimise year effects and to obtain sufficient data to make sound recommendations to producers with regard to different weaning practices for Angora goats.
ACCURATE CLIP CLASSING OF MOHAIR FOR FINENESS THROUGH THE TECHNIQUE OF EGT (EVERY GOAT TESTED)

M.A. Snyman

AIM AND OBJECTIVES
The aim of the project is to evaluate the technique of EGT (Every Goat Tested) in terms of accurate clip classing of mohair for fineness and clip realisation.

The objectives of the project are:
- To establish the variation in mean fibre diameter (MFD) and its associated traits within South African Angora goat flocks and within various age groups. These results will greatly assist in establishing a general and fairly accurate prediction of the percentages of animals in flocks (or fibre volume) falling in the various micron categories and would be essential for the general prediction of what typical advantages would be possible through using the technique of EGT at specific micron:price relationships at any particular moment.
- To estimate the repeatability of MFD. Not only will these findings address the necessity of subsequent individual MFD measurement, but also improve the accuracy of the calculated predicted income premiums obtainable through EGT.
- To accurately measure what is practically achievable (theoretically vs. actual findings) through EGT in classing into finer mohair lines and to establish the financial benefits (if any) of such an action for the different age categories of mohair in the market place.

BACKGROUND
The use and economic benefits of EST (Every Sheep Tested) in the wool industry, locally and abroad, is well-proven and found general application in order to add on-farm value to wool clips by exploiting wool’s non-linear price: micron relationship. This practice is especially favoured in times when finer wools fetch substantial price premiums above stronger wools.

The potential of this exact concept for mohair is obvious and it is thus not surprising that the EGT-concept (Every Goat Tested) recently found general application amongst the more progressive South African Angora goat farmers in improving their clip realisation. However, various issues with regard to the specific nature of mohair (in comparison with wool) need to be investigated before accurate predictions on the economic feasibility of this technique or concept for mohair is possible.

CONCLUSIONS
The following can be concluded:
- There are large differences in MFD as well as the other fibre diameter traits measured among the various producers. Differences between producers accounted for more variation in the traits than season.
- The MFD frequency distribution (variation among individual animals in the flock) also varied considerably among the different producers.
- There is a large overlap in MFD of adults, young goats and kids, which warrants the application of EGT.
- Generally, winter adult mohair had a higher MFD, higher SD_MFD, higher CV_MFD and variable SD_ALONG compared to summer adult mohair. Theoretically it can be expected that, even at similar micron, the processing performance of winter adult will be somewhat inferior to that of summer adult mohair.
- The MFD frequency distribution of winter adult mohair was also wider than the corresponding summer mohair.
- Winter young goat mohair also had a higher MFD, higher SD_MFD, variable CV_MFD and variable SD_ALONG compared to summer young goat mohair. On top of the seasonal effect, an age effect also contributed to differences in fibre diameter profile.
• Generally, the frequency distribution of winter young goat mohair was also wider than the corresponding summer mohair.
• Summer kid mohair had a lower MFD, lower SD_MFD, higher CV_MFD and higher SD_ALONG than winter kids. This could mainly be ascribed to an age effect.
• Variation among individual kids was less for summer than for winter kid mohair.
• The frequency distribution of CV_MFD for summer and winter adult as well as young goat mohair differed very little, while there was a considerable difference between summer and winter kid mohair.
• The frequency distribution of SD_MFD for summer and winter mohair of all age groups differed very little.
• Relatively high repeatability estimates were obtained for MFD, SD_MFD and CV_MFD.
• Analysed data indicated that ewes would not remain in the same shearing group for consecutive seasons. It is therefore essential that all goats be micron tested before each shearing when accurate clip classing based on EGT is employed.
BREEDING PROGRAM FOR LIVESTOCK GUARDING DOGS

C.G. Stannard

AIM AND OBJECTIVES
The aim of this project is to breed livestock guarding dogs (LGD’s) for evaluation under South African conditions.

The objectives of this project are:
- to obtain a breeding group of Anatolian Shepherd dogs
- to supply puppies to be placed with farmers
- to evaluate the puppies under working conditions.

BACKGROUND
Livestock losses as a result of predators, stray dogs and stock theft is a major problem facing small stock farmers throughout South Africa. Losses in the small stock industry in South Africa due to predators amounts to approximately 1 million sheep per year (Bekker, 2001). For the past few decades, this problem has been a discussion point on every forum in the small stock industry. The National Problem Animal Policy Committee was established with the aim to guide the control of predators and to ensure that the control methods employed are correctly applied. Through the years, different methods of control have been used, such as poisoning, traps, hunting dogs and electric fences. From practice it is also evident that professional predator hunters and hunting clubs have limited success in the control of problem animals.

An additional method for predator control is the LGD’s. LGD’s are being used with great success against predators in the USA, Britain, Australia and Namibia, as well as the countries of origin of these dogs. There are eight different breeds of dogs that can be used as LGD’s. Of these breeds, the Anatolian Shepherd dog is widely considered to be the best, owing to its size, aggressiveness, loyalty, braveness and working ability. The dogs protect the herd by the following methods: patrolling, barking, urine marking, chasing and attacking the predator if it threatens the herd.

At present the breeding group consists of six females and two males. Fourteen puppies born from the breeding program have already been placed with farmers during previous reporting periods for evaluation. During this reporting period, these dogs at farms have been evaluated and most were successfully raised as guarding dogs. The efficiency of these dogs to prevent livestock losses will be monitored during following years.

Only nine of the twenty puppies born during the reporting period survived until placement due to deaths caused by the parvo virus. This has resulted in a management change in order to prevent infection of future litters. The females that have to pup will be moved to cages with cement floors, which can be sterilized after the birth of puppies. The females will be kept in these cages for the whole six-week period, from birth until weaning.

CONCLUSION
Due to the fact that not enough data are available, it is not possible to make any conclusive remarks on the evaluation of the puppies already been placed with farmers. It is evident from the results that participants should take care that the dogs be handled in accordance with the guidelines of the project. Furthermore, bloodlines that consistently bred dogs with a poor working ability or behavioural problems, should be identified and eliminated. The project is running to satisfaction and the results are used to establish working knowledge of these dogs under South African conditions.
VELD REGENERATION AFTER FIRE IN THE KALAHARI THORNVELD

P.C.V. du Toit

AIM AND OBJECTIVES
The aim of the study is to monitor the rate of regeneration of the vegetation of the Kalahari Thornveld following fire in this tall grassveld, which is normally reserved for grazing by cattle.

The objectives of the study are:
- To follow the rate of recovery of the most palatable grasses
- To conduct two types of botanical surveys, namely line-point surveys and ten square metre quadrat harvesting
- To estimate the number of years following the fire, before full use can again be made of the veld by grazing.

BACKGROUND
The vegetation of the Kalahari Thornveld varies tremendously over very short distances, on account of soil type and soil depth and the reaction of the vegetation to the annual rainfall. There are flat plains with mainly *Acacia erioloba* trees dominating and rocky hills with a variety of different, very palatable (*Grewia spp & Diospyros spp*) to unpalatable shrubs (*Rhus spp, Euclea spp & Tarchonanthus camphoratus*). In between the tall thorn trees occurs a variety of tall grasses which differ in palatability throughout the season, which makes the rotational grazing of this veld very difficult. Due to irregular and sparse rainfall, the forage supply is not constant year after year, which still further aggravates the problem of rationing out the forage in such a way that the resources are not over-utilised during years of below-normal rainfall. By trying to overcome this problem, a realistically low stocking rate is usually applied to these farms. However, during periods of above normal rainfall, the grass growth is fast and as a result, not very nutritious. Animals then graze very selectively, which in turn means that the production of plant material is very high, but not very nutritional. This material builds up and suppresses the growth of the palatable grasses during the following year. Burning off these grasses aids in the recovery of the vegetation, and it is usually found that the following growth is very nutritious and the animal production very high. This trial was carried out on Vaalharts Research Station, following a devastating veld fire, which occurred during 1997.

CONCLUSIONS
Burning of the vegetation should be considered in the Kalahari Thornveld when the grass growth has become too rank for the animals to graze in order to produce satisfactorily. However, too frequently burning can be very damaging to the veld, leading to a poor species composition, which impacts negatively on animal production. In this particular type of Kalahari Thornveld, the vegetation recovered almost fully after seven years, however, the period may be shorter in areas where the soil is deeper.
DEVELOPING GRAZING INDEX VALUES

P.C.V. du Toit

AIM AND OBJECTIVES
The aim of this study is to develop a method for the estimation of grazing capacity index values for most of the plant species in the Karroid extensive grazing areas of South Africa in order to estimate realistic grazing capacities for the veld grazing areas.

The objectives of the study are:
• To develop grazing index values for different plant species
• To develop the formula for the calculation of grazing capacity from grazing index values and other information
• To verify the accuracy of the method in the different vegetation types
• To verify the new grazing capacity map for South Africa.

BACKGROUND
In order to estimate reasonably realistic grazing capacities for the different areas included in the Nama-Karoo, several different plant species are measured and harvested to calculate their productivity. This material is then analysed chemically to determine its nutritive value. When plant surveys are undertaken, it is then a reasonably simple procedure to estimate the current grazing capacity of the area where the survey was conducted, by simply multiplying the various species’ frequency values by the appropriate grazing index value. The sum of all these values gives a veld condition index, which was determined logically, and the sum of the different species’ frequencies provide a value of the cover on the veld, which prevents soil loss by either rain drop splash and rill formation or by wind erosion. By appropriate computation, the veld condition index value is expressed as the current grazing capacity of the specific sample of veld where the survey was undertaken. The model which is used to estimate the current grazing capacity is as follows: \((500 \div \text{the veld condition index value}) \times 7.14\). This calculation expresses the grazing capacity in ha/LSU.

A number of farmers in the different ecological areas in the Nama-Karoo made their farms available for this type of research. After the initial measurement of their size and subsequent harvesting of fifty individuals of a species, these species are monitored on a regular basis, every three months, in order to estimate their forage value, which influences the grazing capacity allocated to that specific area.

Vegetation on the following farms are being monitored:
• Goegab Nature Reserve, Cape Nature Conservation in the Namaqualand Broken Veld to Succulent Karoo variation;
• Tweefontein, Mr Stoffel Lombard in the Succulent Karoo;
• Schansklip, Mr Jikkie Burger in the Panne & Vloere Veld of the Arid Karoo and Desert Grassveld, red kalahari sand and loam;
• Nanibees, Mr Francis Visagie in the Panne & Vloere Veld of the Arid Karoo and Desert Grassveld, shale and doleritic soils;
• Vraweer, Mr Pietie van Jaarsveld in the Bushmanland Bulte- and Kaaingveld of the Arid Karoo and Desert Grassveld;
• Gnous, Mr Koos Brink in the Western Kalahari Thornveld, red kalahari duneveld sands;
• Massakloutjie, Mr Francois Page in the Northern Kalahari Thornveld in South Africa almost on the border of Botswana, in red kalahari duneveld sands and,
• New Holme, Mr Piet Ferreira in the False Upper Karoo.

The model which is used to estimate grazing index values, is as follows:

**Grasses:** \(\frac{[(\text{the mean canopy spread cover} + \text{the mean animal-available dry matter production} + \text{the mean TDN value} + [K + (Ca + Mg)]) \times \text{the ether extract content value}}{100} (\text{TDN = total digestible nutrients})\)

**Karoo sub-shrubs:** \(\frac{[(\text{the mean canopy spread cover} + \text{the mean animal-available dry matter production} + \text{the mean TDN value} + [K + (Ca + Mg)]) + \text{the ether extract content value}}{100}\).

The ether extract content of grasses consists mainly of vitamins which are essential for an animal’s well-being, while the ether extract content of the Karoo sub-shrubs consists mainly of resins and aromatic oils, which causes the loss of the building blocks of proteins in the animal’s body through the urine of the animal.
CONCLUSIONS

It is possible to estimate reasonably accurate grazing index values for these plants, which are used together with the line-point method of botanical survey to estimate realistic current grazing capacities for the different areas. These surveys are now also used by the Land Use unit in Pretoria to verify the new grazing capacity map, which is in preparation. Lately, this method has also been tested in the Limpopo Province where promising results were obtained to verify the satellite images. On account of the drought of the last two years that is still continuing in places such as the Bushmanland, fieldwork was curtailed in order not to bother these farmers unnecessarily.
DETERMINING THE CATTLE AND SHEEP GRAZING IMPACT IN THE EASTERN MIXED KAROO

P.C.V. du Toit

AIM AND OBJECTIVES
This project aims at determining the influence that cattle and sheep, grazing the veld at the same time, have on the optimal but sustainable use of the veld, while the animals still produce at a high level and the vegetation is still afforded time to regenerate and improve over time.

The objectives of the study are:
- To utilise veld with different combinations of sheep and cattle
- To measure the impact on the veld
- To measure the production of the livestock
- To determine the sustainability and profitability of different veld management systems.

BACKGROUND
Various authors have hinted at the possibility of improving the profitability of a stock-farming venture by running more than one species of animal on the veld, citing as evidence the fact that different species graze differently and that they do not utilise the same species. This was, however, refuted on more than one occasion. It is also claimed that sheep produce more profitably where they are allowed to follow cattle in a grazing system. This is true, however, very detrimental to the vegetation due to the selective grazing habit of sheep and their ability to select the most palatable parts of the different plants. This was refuted on the grounds that sheep, by grazing so selectively, will damage the plants after the cattle have removed the rough growth and that this will in fact detrimentally affect the plant species. The stocking rate starts off at a realistic but below grazing capacity norm, and as the animals grow the applied stocking rate in fact tend to approach the grazing capacity norm. In the project, the cattle to sheep ratio is one-to-one on a large stock unit basis, grazing the veld as one herd, occupying a paddock for fourteen days and moving between paddocks on a regular basis.

This trial is being carried out on the portion of the Grootfontein Experimental Farm known as Boesmanskop. This portion of the farm is typical of veld found in the Nama-Karoo, approximately one-third plains, one-third pediment and one-third hill. The current grazing capacity as estimated by the line-point method of vegetation survey is 28.93 ha/LSU (hectares per large stock unit), that is against the background of the grazing capacity norm for this area of 16 ha/LSU.

CONCLUSIONS
Sheep that are allowed to graze a paddock at the same time as cattle with the grazing period per paddock no longer than two weeks, produce better than any other system where sheep graze alone. The animal product produced per hectare is in such a system is considerably higher than in any of the formerly prescribed systems with grazing periods varying from two to four months per paddock. This system also aims at utilising the natural resources on a sustainable basis.
CHEMICAL CONTROL OF RHIGOZUM TRICHOTOMUM (DRIEDORING)

P.C.V. du Toit

AIM AND OBJECTIVES
The aim of this project is to evaluate the effect of controlling Rhigozum trichotomum (driedoring) with the herbicide containing tebuthiuron as active ingredient, in the dune veld of the Kalahari.

The objectives of the study are:
• To determine the efficacy of the herbicide in combating driedoring
• To measure the medium to long-term effect of the treatment on the regeneration of the veld
• To evaluate the financial viability of the treatment.

BACKGROUND
Large areas of the Northern Cape have suffered from this scourge. Not only does driedoring prevent other vegetation preferred by stock from establishing, but it contributes very little to the forage base, making stock farming virtually impossible in areas invaded by this unpalatable plant. Driedoring forms such dense stands that no other vegetation is able to establish in their vicinity. This happens because driedoring with its extensive root system completely dries out the soil, thereby making it impossible for any other vegetation to keep on growing or for seedlings of preferred plant species to establish.

A herbicide spreader, designed to put down the exact dosage per hectare, was applied on the farm Gnous, in the western Kalahari duneveld. Driedoring was immediately killed, especially in the areas between the dunes (streets) and with good follow-up rains. In addition, it was found the driedoring was immediately replaced by the climax plants that are normally found in the area such as Stipagrostis ciliaris, S. obtusa and Eragrostis lehmanniana and some Centropodia glauca, the most palatable grass in this part of the Kalahari. This observation is in direct contrast with the normal course of plant succession from pioneer plants, through the sub climax stage before it reaches the climax stage. On deep sand, the grazing capacity improved from 260 ha/LSU to 23 ha/LSU within two years after treatment. On sand overlying calcrete the grazing capacity improved from 260 ha/LSU to 55 ha/LSU within one year after treatment. After two years it improved further to 26 ha/LSU and later to 22 ha/LSU. Experienced farmers and researchers set the grazing capacity norm for the area at 22 ha/LSU.

CONCLUSION
It makes good economic sense to treat encroached areas with a herbicide, because the capital outlay can be recouped within two years.
THE CAMP 6 GRAZING EXPERIMENT

P.C.V. du Toit

AIM AND OBJECTIVES
The aim of this project is to demonstrate the disadvantages of fixed season grazing on mixed Karoo veld.

The objectives of the study are:
- To graze certain paddocks at certain times of the year, year-after-year
- To monitor impact on veld condition
- To monitor animal production on this veld
- To use the demonstration plot to train farmers in the concept of rotational grazing systems.

BACKGROUND
This trial was laid out on Grootfontein by the late Dr CE M Tidmarsh in 1934, after consultations with small stock farmers and a review of farming practices in the Karroid areas which revealed a disquieting tendency. This was the fact that certain paddocks on every farm were reserved year-after-year for specific purposes at the same time of the year, such as mating, lambing and weaning. This trial was then laid out in order to demonstrate to the farming community the disadvantages, especially veld deterioration, of grazing the same paddock at the same time of year, year-after-year. This demonstration trial is therefore aimed at showing small stock farmers the negative effects that they can expect when they follow these practices. In short, this experiment shows small stock farmers how not to farm.

Treatments include the following:
- Paddock 1a is grazed during summer from the 15th of August until the 15th of February. As this paddock is grazed exclusively during the growing period of the grasses, the result is veld that is largely covered in Karoo sub-shrubs.
- Paddock 1b is grazed during winter from the 15th of February until the 15th of August. Paddocks 1a and 1b are laid out on pediment. As this paddock is grazed exclusively during the “dormant” period of the grasses, but during the normal growing period of the Karoo sub-shrubs, it results in the vegetation consisting mainly of grasses.
- Paddock 2a consists of two-thirds pediment and one-third plain and is grazed continuously at one sheep above the norm. This results in a very low seral stage veld, consisting mainly of Aristida congesta, A. barbicollis and A. adscensionis subsp. curvata.
- Paddock 2b also consists of two-thirds pediment and one-third plain and is grazed continuously at one sheep below the norm. This veld is also dominated by the annual Aristida species.
- Paddock 3a is grazed from the 15th of August until the 15th of December. As there is a period when the grasses can grow in response to the rain, the vegetation consists mainly of sub-climax species, with Eragrostis lehmanniana dominating.
- Paddock 3b is grazed from the 15th of December until the 15th of April, which is the main growing period of the grasses. The result is a low seral stage, dominated by Aristida species.
- Paddock 3c is grazed from the 15th of April until the 15th of August, which is the dormant season of the grasses. As a result, a healthy stand of climax grasses, namely Cymbopogon plurinodis, Digitaria eriantha, Sporobolus fimbriatus and Themeda triandra, developed. Paddocks 3a, 3b and 3c are all situated on pediment.
- Paddock 4a is grazed continuously for one year from the 15th of August until the 15th of August the following year while paddock 4b is rested for that period. The following year, the grazing is rotated, with 4a being rested and 4b being grazed. These paddocks are situated on pediment. All the climax grass species, as in paddock 3c, are found in these two paddocks.
- Paddock 5 upper is situated on pediment and is grazed continuously for one year from the 15th of August until the 15th of August the following year. This grazing practice is very detrimental as is reflected by the poor species composition as well in the extremely poor animal production.
- Paddock 5 lower is situated on plains and is grazed continuously for one year from the 15th of August until the 15th of August the following year. The grazing of this paddock is usually evaluated alongside paddocks 2a, 2b and 5 upper.
On account of the deeper soil found on the plains, a better species composition is maintained and the animal performance is likewise much better than those of the other three paddocks, being fairly closely followed by the animals in paddock 2b.

Paddock 6, situated on pediment, has never been grazed.

Table 1. Current grazing capacities for the different treatments in the Camp number 6 grazing experiment

<table>
<thead>
<tr>
<th>Paddock</th>
<th>Grazing capacity determined from 200 point observations (ha/LSU)</th>
<th>Grazing capacity determined from 500 point observations (ha/LSU)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>37.72</td>
<td></td>
</tr>
<tr>
<td>1b</td>
<td>26.85</td>
<td></td>
</tr>
<tr>
<td>2a</td>
<td>31.54</td>
<td></td>
</tr>
<tr>
<td>2b</td>
<td>27.54</td>
<td></td>
</tr>
<tr>
<td>3a</td>
<td>21.12</td>
<td>19.71</td>
</tr>
<tr>
<td>3b</td>
<td>31.55</td>
<td>28.08</td>
</tr>
<tr>
<td>3c</td>
<td>19.39</td>
<td>15.35</td>
</tr>
<tr>
<td>4a</td>
<td>28.42</td>
<td></td>
</tr>
<tr>
<td>4b</td>
<td>26.73</td>
<td></td>
</tr>
<tr>
<td>5 upper</td>
<td>23.77</td>
<td></td>
</tr>
<tr>
<td>5 lower</td>
<td>17.15</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>18.95</td>
<td></td>
</tr>
</tbody>
</table>

CONCLUSION
It has been proved that the practice of grazing specific paddocks at the same time of year, year-after-year is detrimental to the farming practice due to the fact that the stock graze out the palatable plants and that after a number of years only unpalatable plants, low in nutritive value, remains. Under such conditions, low animal production can be expected, which impacts severely on net farm income.
THE MOUNTAIN PADDOCK GRAZING EXPERIMENT

P.C.V. du Toit

AIM AND OBJECTIVES
The aim of this project is to demonstrate the disadvantages of fixed season grazing on hilly Karoo veld.

The objectives of the study are:
- To graze certain paddocks at certain times of the year, year-after-year
- To monitor impact on veld condition
- To use the demonstration plot to train farmers in the concept of rotational grazing systems.

BACKGROUND
This trial was also laid out by Dr Tidmarsh on the hilly areas of Grootfontein in 1943 for the same reasons used for initiating the Camp 6 grazing experiment. The experiment consists of six different paddocks, each being grazed differently as indicated in Table 1.

Table 1. Experimental layout

<table>
<thead>
<tr>
<th>Grazed between 15 February and 15 April</th>
<th>Grazed between 15 April and 15 August</th>
<th>Grazed between 15 October and 15 February</th>
<th>Grazed between 15 August and 15 October</th>
<th>Continuous grazing</th>
<th>Never been grazed</th>
</tr>
</thead>
</table>

This layout of the different paddocks means that the summer and the winter grazed paddocks are next to each other and the difference obtained over the sixty-two years are obvious. Similarly, the detrimental effect of continuous grazing is clearly visible. This is a trial worth visiting, if only to view the detrimental effect of fixed season grazing.

CONCLUSION
It has been proved that the practice of grazing specific paddocks at the same time of year, year-after-year is detrimental to the farming practice due to the fact that the stock graze out the palatable plants and that after a number of years only unpalatable plants, low in nutritive value, remain. Where this condition obtains, low animal production can be expected, which, over time, impacts severely on the net farm income. Due to the negative species changes, the cover is very low and the soil gets washed away during rainstorms and the wind blows out the dry dust, thereby aggravating the effects of incorrect grazing management practices. The remaining soil cannot support a vigorous stand of vegetation. Seeing the striking effects of grazing every summer versus grazing every winter, convinces many a farmer to change his particular type of grazing management.
DETERMINING THE OPTIMUM GRAZING CAPACITY IN THE EASTERN MIXED KAROO

P.C.V. du Toit

AIM AND OBJECTIVES
The aim of this project is to determine the optimum stocking rate for the eastern mixed Karoo veld.

The objectives of the study are:
- To stock veld at different rates with different small stock types
- To monitor impact on veld condition
- To monitor the production of livestock at different stocking rates
- To determine the optimum grazing capacity.

BACKGROUND
During the 1970’s to mid 1980’s it became evident that much uncertainty existed amongst pasture researchers and the farming community about the stocking rates that can be applied in different veld types. The grazing capacity strategy was launched by the then minister of agriculture, Mr Sarel Hayward but the department was severely criticised by the farming community when the first grazing capacity map for South Africa was released during early 1981. This necessitated drastic measures to be undertaken and the so-called stocking rate trials came into being all over South Africa in all the provinces. One trial was initiated at Grootfontein, known as the Hereford/Afrikaner stocking rate trial. Here, Angora goats and Merino and Dorper sheep were stocked at three stocking rates. The middle-stocking rate was at the recommended grazing capacity, one stocking rate was slightly higher and one was slightly lower.

Almost from the start the Angora goats did not produce well. However, good production was obtained from the Merinos and Dorphers. These stock grazed in a two paddock system with a period of grazing of four months, one of the systems that farmers were advised to follow. However, the middle stocking rate of the Merino sheep, which were stocked at the grazing capacity norm, was duplicated. In this system the paddock for the four months were sub-divided into four even sized paddocks and the sheep was moved between paddocks on a two-weekly basis. As can be expected, the low stocking rate sheep produced well, the medium stocking rate grazing the paddock continuously for four months faired less well and the high stocking rate did not produce well. The medium-stocking rate, which was allowed to change paddocks every fourteen days, outperformed any of the other stocking rates. However, production of animals in this trial was still poorer than that of the sheep in the sheep : cattle ratio trial.

This experiment is being carried out on two blocks of veld at Grootfontein known as Afrikaner camp and Hereford camp. The grazing period of four months results in the staggering of the grazing period, so that no paddock is grazed at the same time for two years running.

CONCLUSION
From this trial it can be concluded that both the low and the high stocking rates cannot be recommended. The low stocking rate because it is uneconomical and the high stocking rate because the sheep did not produce well. For this type of veld, the Dorper sheep produced better than the Merino as Dorper sheep are hardier and can withstand the extreme temperature conditions and this type of vegetation better than the Merino and seem to be better adapted to this area, which is prone to droughty periods.
EVALUATION OF FESCUE CULTIVARS

T.P. Nengwenani & P.C.V. du Toit

AIM AND OBJECTIVES
The evaluate the production potential and longevity of different tall fescue cultivars in the Karoo.

The objectives of the study are:
• To evaluate the production potential of different tall fescue cultivars in the Karoo
• To evaluate the longevity of different tall fescue cultivars
• To use data obtained through the study to formulate relevant recommendations to farmers in the Karoo.

BACKGROUND
Since the mid-1990’s, a number of seed breeders and seed producers wanted their seed tested as to its adaptability in the different climatic zones of South Africa. Different ryegrass cultivars, lucerne cultivars and tall fescue cultivars were planted and their production potential measured. The ryegrass cultivar and the specific lucerne cultivar trials were terminated after about six years. However, the tall fescue trial continued.

When the national cultivar trials came to an end, it was decided that the fescue cultivar trial must continue to evaluate its longevity and its potential to remain highly productive during subsequent years. This particular planting is now in its sixteenth year of production. No cultivar has died out yet and the individual plants grows more vigorously every year. The production potential of the sixteen cultivars planted remains on a high level and the cultivars that showed the most promise under cultivation in the Karoo were selected. Au Triumph had the highest production, followed by Falcon, Ondine, Phyter, Fuego, Grasslands Roa, Cajun and Junior. The other cultivars produced much less, although different results might be obtained under different conditions.

Table 1. Dry matter production of different tall fescue cultivars

<table>
<thead>
<tr>
<th>Cultivars</th>
<th>Dry matter production (Ton/ha/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arola</td>
<td>10.64</td>
</tr>
<tr>
<td>Au Triumph</td>
<td>13.01</td>
</tr>
<tr>
<td>Barcel</td>
<td>11.61</td>
</tr>
<tr>
<td>Cajun</td>
<td>10.85</td>
</tr>
<tr>
<td>Demeter</td>
<td>9.98</td>
</tr>
<tr>
<td>Doye</td>
<td>10.75</td>
</tr>
<tr>
<td>Falcon</td>
<td>11.85</td>
</tr>
<tr>
<td>Festal</td>
<td>10.34</td>
</tr>
<tr>
<td>Florine</td>
<td>11.08</td>
</tr>
<tr>
<td>Fuego</td>
<td>11.42</td>
</tr>
<tr>
<td>Grasslands Roa</td>
<td>11.30</td>
</tr>
<tr>
<td>Johnstone</td>
<td>10.89</td>
</tr>
<tr>
<td>Junior</td>
<td>10.83</td>
</tr>
<tr>
<td>Kentucky 31</td>
<td>8.89</td>
</tr>
<tr>
<td>Ondine</td>
<td>11.91</td>
</tr>
<tr>
<td>Phyter</td>
<td>11.81</td>
</tr>
</tbody>
</table>

CONCLUSION
Planting of certain areas to a suitable tall fescue cultivar, can relieve the grazing pressure on the veld and place the farming enterprise on a more stable footing, ensuring the sustainable use of the natural resources. This trial has been planted in 1990 and after almost sixteen years, all the cultivars are still growing very well.
EVALUATING TALL FESCUE UNDER GRAZING

T.P. Nengwenani & P.C.V. du Toit

AIM AND OBJECTIVES
The aim of the project is to evaluate tall fescue as a planted pasture under irrigation in the Karoo.

The objectives of the study are:
• To evaluate the production of tall fescue under grazing conditions in the Karoo
• To evaluate the production of livestock grazing tall fescue pastures under irrigation.

BACKGROUND
The need to use the natural resources on a sustainable basis has never been more acute than at the moment. We need to find pastures to complement the veld and to be used during critical periods. Ryegrass/clover pastures have already been proven to perform excellently under grazing during winter. The need is therefore to find a species which will complement the gap left when ryegrass dies off during summer. Theoretically, the perfect match will be a tall fescue cultivar. During 2003 a trial was initiated where the fescue cultivar, Au Triumph, was planted in association with a suitable clover cultivar, to be grazed by sheep. The first year of grazing was during the 2003/2004 season and the second cycle, 2004/2005, has just been completed. Grootfontein has two major problems, as does the rest of the Karoo, namely not enough land with soil suitable for cultivation and not enough water for optimal irrigation. The results of this trial therefore not only address the problems at Grootfontein, but it can also be extrapolated to the rest of the Karoo.

Table 1. Growth performance of sheep on tall fescue pastures

<table>
<thead>
<tr>
<th></th>
<th>Stocking rate</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Heavy (25 animals)</td>
<td>Medium (20 animals)</td>
<td>Light (15 animals)</td>
</tr>
<tr>
<td>2003/2004 season</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gain per hectare (kg/ha/238 days)</td>
<td>434.9</td>
<td>348.1</td>
<td>333.2</td>
</tr>
<tr>
<td>Gain per day (kg/ha/day)</td>
<td>1.83</td>
<td>1.46</td>
<td>1.4</td>
</tr>
<tr>
<td>Gain per animal (kg/animal/238 days)</td>
<td>17.40</td>
<td>17.41</td>
<td>22.21</td>
</tr>
<tr>
<td>2004/2005 season</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gain per hectare (kg/ha/208 days)</td>
<td>189.95</td>
<td>173.15</td>
<td>207.5</td>
</tr>
<tr>
<td>Gain per day (kg/ha/day)</td>
<td>0.91</td>
<td>0.83</td>
<td>1.00</td>
</tr>
<tr>
<td>Gain per animal (kg/animal/208 days)</td>
<td>7.60</td>
<td>8.66</td>
<td>13.83</td>
</tr>
</tbody>
</table>

CONCLUSION
There is overwhelming evidence that farming ventures can be made more profitable by the incorporation of suitable cultivated pastures. This will indeed lead to the sustainable use of our country’s natural resources. With the results of only two years of this trial, a complete fodder flow program can be worked out for most farms in the Karoo. Due to the late planting of the clover and the irregularity of the water supply, every paddock was only irrigated once per month, where-as the pasture needs to be irrigated every fourteen days. Therefore, the tall fescue pasture in this trial did not produce as would have been expected under favourable conditions. From the results it is evident that the high stocking rate is not yet high enough. The layout of these types of experiments ideally attempts to achieve a decline in production from the highest stocking rate group, whereas all the values of gain per hectare lie on the ascending arm of the quadratic function.