Foreword

What an exciting time to be involved in agriculture- especially on KI.

I hope everyone has had a chance to recharge their batteries over summer and are keen to continue their planning for the coming season. Much of the information found in this report will help us to fine-tune our farm management plans.

Similar to previous years, the booklet offers access to locally produced data and information which may help shape your soil, plant and animal management systems.

This year's trials booklet is again collated by Lyn Dohle (PIRSA) who contributes so much to the local agricultural industry. Thanks to all those who have written papers for this year's booklet and to Faye Stephenson and Jacquie Skinner (PIRSA) who once again have assisted with proofing and formatting the articles. The printing of this publication would not be possible without the significant sponsorship from PIRSA and we also thank NR-KI for their contribution.

Rick Morris

Chair - Agriculture Kangaroo Island Inc.

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Contents

An Update from Agriculture Kangaroo Island

Agriculture Kangaroo Island (AgKI) is the peak industry body representing primary producers and farmers on Kangaroo Island. Our membership base remains steady at approximately 150 members, being approximately half of the primary producers and farmers on the island.

We support our members by providing them with updated news, access to speakers and events and importantly, advocating for outcomes that support positive benefits for the agricultural sector.

In the past 12 months, we have worked on many issues, collaborating with a number of key organisations and agencies.

Projects and events for 2018 include:

- Crop trials
- Soil testing program
- Crop and pasture farm walks and field days
- Kikuyu trial work
- Oestrogenic clovers – identification & management
- Positive Ageing grant
- Production of the Ag Trials booklet
- Annual Ag Student award
- Ensuring the PIRSA Animal Health Officer position was filled expediently.

We have AgKI representation on many other boards and committees, including:

- Economic Growth on Kangaroo Island Local Advisory Board
- KI Bio-Security Advisory Committee
- KI Industry and Brand Alliance
- KI NRM Board
- KI Bushfire Prevention Committee
- Kangaroo Island Longer Term Water Plan review.

The AgKI board have also provided support, comment and discussion to other organisations including:

- Natural Resources – Kangaroo Island
- DEWNR – Native Vegetation Branch
- KI Council
- KI Natural Resources Management Board – KI NRM
- Office Commissioner Kangaroo Island
- Primary Industries and Regions SA
- Primary Producers SA.

The Board

None of these achievements would be possible without the support of our members and the dedication of the board members themselves. The current board members are:

- Rick Morris – Chairperson
- Jamie Heinrich – Deputy Chairperson
- Caleb Pratt
- Damian Florance
- Jenny Stanton
- Tim Buck
- Daniel Pledge
- Grant Flanagan
- Lyn Dohle - PIRSA Representative
- Andrew Boardman - KI Council representative
- Damon Cusack – KI NRM representative
- Darren Keenan – AgKI Executive Officer

Our Sponsors

Support from our valuable sponsors is vital for the organisation's ongoing future. We ask that where possible you support those businesses that support your organisation. AgKI's valued sponsors are:

Gold:

Rabobank

PIRSA

KI NRM Board

Silver:

Australian Wool Network

Elders

Landmark

Bronze:

Keilem Pty Ltd

Emmetts

The Islander

AGRICULTURE
KANGAROO ISLAND

Join now

If you would like to become a member of AgKI and gain the many member benefits, please fill in the slip below and post it along with your payment. For more information or if you would like a membership brochure emailed to you with the BSB details, email to admin@agki.com.au.

AgKI MEMBERSHIP FORM

Name: .....

Trading Name: .....

Postal Address: .....

.....

Phone number: .....

Email: .....

Enterprises (Please circle those you are involved in)

Wool | Prime lamb | Beef cattle | Cropping

Marron/aquaculture | Viticulture | Beekeeping

Other (please specify): .....

Payment: $99 GST incl.

Cheques or money orders should be made payable to 'Agriculture Kangaroo Island'

Please post this form and your payment to:

Agriculture Kangaroo Island
PO Box 794
KINGSCOTE, SA 5223

One Biosecurity

To assist livestock producers better manage, protect and promote their on-farm biosecurity, Primary Industries and Regions SA (PIRSA) in collaboration with Livestock SA have developed the new online One Biosecurity program at www.onebiosecurity.pir.sa.gov.au

This free, easy-to-use website was launched in August 2018. One Biosecurity will deliver the livestock sector greater market credibility and improved traceability, as well as making the industry less vulnerable to uncontrolled disease spread and encouraging better disease reporting and informed livestock purchasing.

One Biosecurity is voluntary but we want ALL of South Australia's sheep, beef and dairy cattle producers to register. The more producers who register with One Biosecurity, the stronger the program becomes and the greater protection it will offer to our livestock industries.

Who can register for One Biosecurity?

Producers who have a current Property Identification Code (PIC), can register and use the online program. Allied businesses, such as livestock agents, buyers, saleyards and abattoirs, will also be able to register and use components of the online One Biosecurity program.

How does One Biosecurity work?

Once registered, producers create an online profile containing details of their farming enterprises and biosecurity practices and status, which they can then choose to make public for other registered users to view.

It will also enable them to quickly generate a government and industry endorsed biosecurity plan for their property.

Registered producers will be self-guided through the program's two core online components:

- Biosecurity Practices Questionnaire
- Endemic Disease Risk Rating modules.

The online software uses a simple scoring system which generates two important factors: the Farm Biosecurity Rating (one to five stars) and, should the producer so choose, a Farm Disease Risk Rating for a series of selected diseases.

Diseases currently available for which the producer may wish to record a status are JD (cattle and sheep), pestivirus (cattle), sheep lice, ovine footrot and ovine brucellosis. A range of options are possible for each disease from "not currently classified" to "independently assessed" (low risk).

Validation

Verification is extremely important because it provides credibility to the system and confidence in the claims made. Desk top and on-farm audits by accredited auditors are part of the verification system.

Security

- With cyber security a constant concern, One Biosecurity has been developed with the highest security standards in mind to ensure producer data is secure.
- The only people with access to producer details are authorised Animal Health staff.
- Producers have control on which aspects of their enterprise profile they would like other people to view. The default setting is private; producers need to actively change their setting to public for information to be viewed by others.
- Users need to authenticate to the portal via the myPIRSA single sign-on portal which prevents unauthorised access to One Biosecurity.

What are the benefits?

One Biosecurity enables producers to benchmark their on-farm biosecurity practices thus providing a framework and record for wise decision making. The benefits will be realised at an individual farm level right through to the whole of industry level,

One Biosecurity (cont.)


Government of South Australia
Primary Industries and Regions SA

COMMERCIAL MERINOS

Sheep / Wool / Commercial (self-replacing) / Merino

DISEASE STATUS

Disease	Status	Assessed	Verified
Footrot	Self-Assessed Low Risk	30-Oct-2017	
Johne's Disease in Sheep	Independently Assessed Low Risk	09-Oct-2017	
Ovine Brucellosis	Self-Assessed Low Risk	27-Oct-2017	

1B

Assessed
30-Oct-2017

PREMIUM CLEAN ENVIRONMENT

One Biosecurity Enterprise ID: 1B-10076 PIC: SB263312
Search PIC or One Biosecurity Enterprise ID for more information.
Above description is as supplied by the vendor. No responsibility is held by the agent or PIRSA.

Example of disease status after completion of Endemic Disease Risk Rating modules.

impacting market access and ability to combat the constant threat of exotic disease. Some of the defined benefits include:

- An approved biosecurity plan in a simple, free, online process (all producers in Australia must now have a farm biosecurity plan on record for Livestock Production Assurance).
- The program generates an Animal Health Declaration (to accompany stock being transported)
- All records will be available on a single site and are easily updateable
- It will assist with purchasing decisions – a credible framework for risk-based trading.
- It will provide credible assurance to existing domestic and international markets and help us meet potential new market access requirements
- The livestock industry will have greater resilience and flexibility to meet the demands and challenges of changing markets and potential exotic disease threats like Foot and Mouth Disease.

How to register

1. Go to www.onebiosecurity.pir.sa.gov.au

Follow the link to 'Register Today on myPIRSA' on the left-hand side of the One Biosecurity home page. This will take you to a registration page.

Note: If you already have a myPIRSA account in the same name as your PIC registration, you must LOGIN to One Biosecurity using this account via the LOGIN button in the top corner of the One Biosecurity homepage.

2. Complete your details including your PIC registration. As you type in your property address it will display a list of possible matches. Click on the correct address. If your address is not listed or you wish to add a PO Box, click on 'My address is not listed – Allow me to supply my own'. Enter your address as prompted. Whatever contact details you provide in myPIRSA are what will be registered in One Biosecurity.

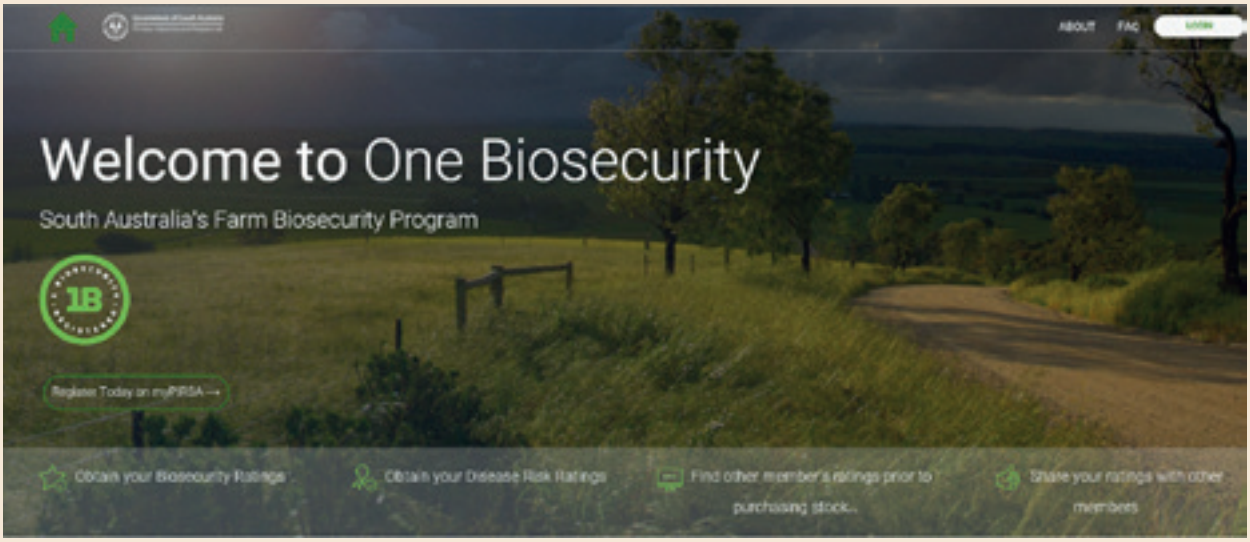
3. Press submit. A pop up box will appear to instruct you to verify your account via your email address within 2 hours.

4. Once you have verified your email address, your account will be activated. Please close this

page and return to the One Biosecurity tab to login, click on the link in the top corner of the OneBiosecurity homepage. Once logged in you will be ready to set up your profile.

5. If you are experiencing any technical difficulties please use the contacts below to have your concerns addressed.

Sample gate sign.



Home page of One Biosecurity website.

For Further information or help:

One Biosecurity:
Website: https://onebiosecurity.pir.sa.gov.au/home
Phone: (08) 8429 3300 Email: 1BSupport@sa.gov.au

Kate Buck, Animal Health Advisor:
Phone: 08 8553 4922, 0419 091 156 Email: kate.buck@sa.gov.au

Footrot Management Program Changes

Endemic sheep disease management programs

All PIRSA programs are reviewed regularly to ensure that the most effective and cost efficient solutions can be provided to industry. The changes to the program are occurring due to multiple factors, including:

- Long term trends which affect our operating environment such as new technology and the human resources available for program work. Programs that were effective historically will no longer be suited to the current situation
- Research and developments in science and ways of thinking i.e. increased emphasis on the role of biosecurity on livestock programs and vaccine developments
- Funding and costs of maintaining programs
- The ability to undertake cost effective detection of disease/infectious agent.

Overall, there is a change in the programs that are focused on increasing producer awareness and education and the role all producers must play in endemic disease management. These changes were phased in from July 2018. See individual program information for specific changes.

New changes to the State Footrot Management Program

The development of the modified South Australian Footrot Management Program reflects a change in focus from disease severity (visual foot scoring) to organism virulence.

Footrot is caused by a bacterium that has a spectrum of virulence ranging from virulent to benign, which may express a range of disease severity dependent on environment and host. It is no longer regarded as two different diseases (benign and virulent footrot). Good disease management must aim to prevent the spread of the whole spectrum in all hosts and environment, not just where conditions are ideal for severe lesions to occur.

The new program is also aimed at encouraging producers to proactively undertake footrot inspections and testing, and carry out effective management programs for all presentations of footrot, not waiting until disease levels are severe. The new program will consist of:

- Increased producer education on the role benign lesions play in the spread of more virulent strains of the bacterium.
- All forms of footrot will remain a notifiable disease and must be reported to PIRSA.
- When detected, all forms of footrot will be considered to potentially contain virulent strains of footrot until laboratory testing and on-farm inspection indicates bacterium at the benign end of the spectrum are present. Priority for follow up will be for the very virulent strains of the bacterium.
- Saleyard inspections, tracing and neighbour testing will all remain as part of the program.
- While movement restrictions remain in place for very virulent strains of the bacteria, there will be increased opportunity for trade with benign/intermediate strains of the disease.

What will be the movement restrictions for footrot infected properties?

Until laboratory testing is undertaken to support an accurate diagnosis, some interim movement restrictions may need to be in place and your local animal health officer will discuss these with you. Once a diagnosis has been made, movement restrictions will depend on strain virulence – see the table overleaf for some general guidelines.

Note: All movements will require a declaration of status on the National Sheep Health Declaration.

General movement restrictions for footrot cases				
Diagnosis: Strain Virulence	**Sale to slaughter or via feedlot**	**Sale direct to other producers**	**Sale via saleyards**	**Required to declare virulent footrot on NSHD**
VERY VIRULENT TO VIRULENT Elastase result: 4 to 8 days	**YES**	**NO**	**NO**	**YES**
VIRULENT TO INTERMEDIATE Elastase result: 12 days	**YES**	**YES**	**NO**	**YES**
INTERMEDIATE TO BENIGN Elastase result: 16 TO 20+ days	**YES**	**YES**	**YES***	**NO**

** Please note that each saleyard will have their own entry requirements, at their discretion, and it is best to seek advice directly from them before sending infected sheep.*

Where to get help if you suspect footrot

Producers can still access disease investigations for flock problems via private veterinarians or report suspicion of footrot directly to PIRSA Animal Health staff. To minimise the economic impact of endemic diseases, thorough disease investigations are recommended to ensure an accurate diagnosis and correct treatment/preventative actions are undertaken.

Disease trace-back and trace-forward

Once a laboratory diagnosis has been completed and footrot is confirmed, then PIRSA will work with the producer to notify neighbours and people whom they have sold animals too. PIRSA's priority will always be to manage the virulent end of the spectrum first and those with benign strains may not be notified. It is our preference that producers proactively work together to manage footrot within their community. This requires producers to voluntarily disclose their status to their neighbours for all forms of footrot. PIRSA will provide assistance to local footrot action groups to enable good community management of the disease.

When walking sheep down a road you should still notify your neighbours. As with any infectious or notifiable disease, it is part of acting in a responsible way to meet your biosecurity obligations to minimise disease risk to your neighbours. Animals should be moved as quickly as possible and not left to graze on the roadside. In general, a period of seven days is required to decontaminate the land and minimise risk of transmission.

Saleyards

Current surveillance will continue, however more emphasis will be placed on testing and placarding of any suspect lesions. Higher levels of saleyard entry requirements are at the discretion of each saleyard.

Footrot Management (cont.)

It is an offence under the Livestock Act to move animals with a notifiable disease or bring animals into the state with a notifiable disease and appropriate compliance action will be undertaken. You should not send diseased, lame or sick animals to the saleyard. Contact a PIRSA Animal Health Officer if you are unsure.

Most quarantine orders will be released

We are changing the way that we undertake the regulated component of the program. Instead of individual orders we will be using the automatic restrictions under the Livestock Act that relate to notifiable diseases. Footrot is a notifiable disease under the Livestock Act 1997; note that is an offence to move animals affected with a notifiable disease under Section 30 (1) of this Act.

While it is likely that most properties will be released from order, there are still some movement restrictions that these producers will have to abide by. Should producers fail to undertake reasonable measures to manage footrot on their property, then an individual order under the Livestock Act may be issued. It is recommended that you continue with your current Property Disease Management Plan.

Purchasing infected sheep

If you purchase stock from an infected or suspect flock, you will most likely introduce the causative bacterium with them. You need to ensure that you manage the biosecurity risk by managing the disease and ensure the animals' welfare is not compromised, such as they are not suffering severe clinical disease, starving, emaciated or dying etc.

If it is likely that animals you introduce will have the bacterium, **your property inherits the same or suspect disease status and must be declared on the NSHD** in any future trading from your property. You have a biosecurity obligation to act responsibly to minimise the risk of spreading disease.

Score 5 footrot: left hoof

Trimmed and healed.
Photos by Wayne Mossop

Trading sheep to and from other states.

Other states have restrictions relating to virulent footrot and the definitions do differ in each state. Therefore, you must check the entry requirements for each state's requirements for trading stock. There will be no changes to what can enter SA in relation to footrot – it remains a notifiable disease and as such, sheep affected with footrot cannot be brought into SA.

How to be sure that properties are FREE from footrot infection before buying sheep?

Unfortunately, there is a lot of confusion when it comes to properties being free of footrot or virulent strains of footrot and producer declarations may not be accurate. Many producers would not be aware that virulent strains of footrot may be found in benign lesions. It is safest to buy from properties that are free from all forms of footrot. Ask for evidence such as laboratory and inspection results by accredited inspectors.

It's even safer to assume that all sheep entering your property may come from a footrot infected property and keep them in an isolation paddock until you can undertake a spring inspection. For animals that cannot be kept isolated i.e. rams, you should inspect every foot and not introduce anything with foot lesions.

Other than the NSHD how else can I know if I am purchasing "low risk" sheep?

There is very little information regarding footrot on the current NSHD. You will need to make direct contact with the producer to gather more information. Without undertaking testing there is no way to reliably determine if virulent strains of footrot may be present in benign lesions. The environment (rainfall and treatments), will also influence the disease severity that is expressed and a clinical presentation may not be reliable.

It is best to try and source sheep from properties that do not have any form of footrot and where the property regularly undertakes spring inspections to ensure disease does not occur. If you are buying from a property that has any form of footrot, enquire as to what form of testing they have undertaken to ensure virulent strains are not present. Buying sheep from an environment that is conducive to the expression of footrot i.e. high rainfall, may be lower risk than buying from a low rainfall area, as the disease is more likely to express to its full potential and be detectable.

Scald is footrot!

Footrot and scald are the same thing – interdigital inflammation – caused by the bacterium Dichelobacter nodosus. The term scald is used to describe the benign end of the spectrum. Benign strains have similar survival and transmission features to those of virulent strains of the same organism.Benign strains will present exactly the same as virulent strains early in the disease process, where the environment is not ideal for development of lesions or treatments have been undertaken. Even producers claiming to only have scald, could have virulent strains of the bacterium present on the property.

The only reliable way to determine whether D. nodosus is present and how virulent the strain may be, is to undertake testing.

What support is industry offering?

The SA Footrot Management Program is funded from the Sheep Industry Fund under the recommendations made by South Australian Sheep Advisory Group (SASAG).

This program is providing assistance to affected producers to undertake testing and best practice management programs, to achieve a low risk status, while considering individual business needs. The whole sheep industry can access information and advice to minimise the risks that footrot will pose to their business and industry. Providing education and awareness on footrot is a key component of the new program and available to the whole industry.

Footrot Management (cont.)

The current National Vendor Declaration (NVD) & National Sheep Health Declaration (NSHD) are still valid.

We are not aware of any reviews due to take place on the NVD, however, the NSHD will be reviewed shortly, and when it is published there will be a requirement to use the latest version.

Footrot on Kangaroo Island – situation for 2018

- At the end of 2018 there were 14 properties under quarantine order for virulent footrot present in their flocks (most orders will be released early 2019 as part of the new program and will have trade restrictions)
- 6 properties went under eradication programs, were successful and their orders were released.
- 6 new footrot detections; 2 x virulent, 3 x intermediate to virulent strains present and 1 x suspicion of virulent strain being present.

Take home messages

- All forms of footrot remain a notifiable disease and must be reported to PIRSA.
- Quarantine orders are no longer being issued (unless producers fail to undertake reasonable measures to manage footrot) and automatic restrictions under the Livestock Act 2007 that relate to notifiable diseases; it is an offence to move animals affected with a notifiable disease under Section 30 (1) of this Act.
- Virulence is no longer solely based on visual assessment, it is now determined through laboratory testing.
- While movement restrictions remain in place for virulent strains of the bacteria, there will be increased opportunity for trade with benign/ intermediate strains of the disease.
- It's important to seek professional advice on controlling and eradicating footrot.

For Further information:
Visit PIRSA website:
http://www.pir.sa.gov.au/biosecurity/animal_health/sheep
Kate Buck, Animal Health Advisor:
Phone: 08 8553 4922, 0419 091 156 Email: kate.buck@sa.gov.au

Ovine Johne's Disease Update

Changes to the management of Johne's disease (JD) in sheep in South Australia have been phased in since July 2018.

The SA Ovine Johne's Disease (OJD) Control program was regularly reviewed to ensure the best outcomes for the South Australian Sheep Industry. Factors that contributed to the change were:

- difficulties in accurately detecting infected properties at low levels of disease
- vaccine being very effective but not guaranteed of achieving eradication of the bacterium
- Thomas Foods International following the national trend to a voluntary, abattoir monitoring program.

Thus it was no longer possible to continue with the previous SA OJD control program. The new OJD management program aims to minimise the economic impact of JD for the South Australian Sheep Industry. The focus is for producers to understand the disease, declare known status, incorporate sound biosecurity practices and make decisions based on risk assessment. The new One Biosecurity Program provides the best framework for managing disease, production and trading.

Features of the program that producers should note:

- JD in sheep remains a notifiable disease and must be reported to PIRSA Animal Health.
- National Vendor Declarations (NVDs) and National Sheep Health Declarations (NSHDs) are still compulsory.
- There will be increased ability for infected producers to trade sheep. Buyer beware means you need to check the status of animals BEFORE you purchase – check the NVD and NSHD.
- Movement restrictions into SA remain in place. The only change to SA entry requirements is the acceptance of 'approved vaccinates' for the OJD program.
- The major components of the new OJD management program are:
  - Removal of orders and change in the notifiable disease status: properties known to be infected with JD will no longer be under movement restrictions and are able to trade animals.
  - Voluntary detection of disease: All on-farm investigations and abattoir monitoring will only be conducted when requested by the producer. PIRSA will no longer be undertaking routine testing of trace or neighbouring properties.
  - Greater focus on producer education and how to source low-risk stock (using the One Biosecurity website portal).
  - Continued support to assist producers undertake effective disease management.

Voluntary JD Investigations and management

If producers notice sheep that have symptoms consistent with JD (wasting, increased mortality, tail end in the mob) they should contact their private veterinarians or PIRSA for a disease investigation. Subsidies may be available to assist producers with costs and laboratory testing. Producers can choose to investigate or monitor for JD in two ways: voluntary abattoir inspections (producer requested) and voluntary on-farm testing by private veterinarians or PIRSA Animal Health Officers (producer requested).

Producers may request that their sheep be inspected for JD when sending sheep through Thomas Foods International abattoirs. Prior arrangement (preferably one week) will need to be made by producers filling in an 'abattoir surveillance application' form which can be found on the PIRSA website: http://www.pir.sa.gov.au/biosecurity/animal_health/sheep/health/ojd/voluntary_abattoir_surveillance.

OJD Update (cont.)

The completed application form must be emailed to: PIRSA.OJDAbattoirSurveillance@sa.gov.au.

If my sheep consignment tests positive on my requested JD abattoir surveillance, what will happen?

The property is considered infected or suspect. PIRSA will work with affected producers to formulate a property management plan to assist producers to reach a low-risk status. There will be no quarantine orders or movement restrictions placed on the property but producers will be required to declare their status when trading. Should producers fail to meet reasonable biosecurity measures to manage JD, orders may be placed on the property under the Livestock Act 1997.

Declaration of OJD Risk – Buyer beware

The National Sheep Health Declaration is required for all sheep movements between properties in South Australia. This document contains information on the history of the flock, OJD testing, abattoir monitoring and vaccination. BEFORE you buy sheep, it is YOUR responsibility to review this information and decide whether the animals are suitable to introduce to your property. Your livestock agent can assist you in gaining access to this information.

Sheep Market Assurance Program – SheepMAP

The Sheep Market Assurance Program is part of the National Johne's Disease Control Program and will not be affected by the SA OJD program. SheepMAP, is a classification scheme to assure sheep breeders and their clients that participating flocks have been objectively assessed as having low-risk of being infected with JD. Producers are encouraged to buy sheep from flocks participating in the SheepMAP program.

'Approved Vaccinate' Status

To be eligible for 'approved vaccinate' status on the National Sheep Health Declaration:

- sheep must be vaccinated by an approved Ovine Johne's disease vaccine before 16 weeks of age and marked with a 'V' National Livestock Identification System tag.
- sheep vaccinated after 16 weeks must be from a flock that meets one of the following criteria: registered to SheepMAP flock, or has returned a negative Pooled Faecal Culture 350 or High Throughput Johne's 350 in the 2 years before being vaccinated or has a current Abattoir 500 status.

Can I access stock from a flock that has JD? How does this affect my disease status and what does it mean if I then get the disease?

If you access stock from an infected or suspect flock, you will most likely introduce the causative bacterium with them. You need to ensure that you manage the biosecurity risk those animals pose by managing the disease. The best way to manage the disease is by vaccination using Gudair®. It is imperative that animal welfare is not compromised. Animals must not suffer severe clinical disease, starving, emaciated or dying. Due to the likelihood that animals you introduce will have the bacterium, your property inherits the same infected or suspect disease status and must be declared on the NSHD in any future trading from your property.

How can I be sure that properties are free from JD infection before buying sheep?

Properties that have a Sheep MAP accreditation, have undertaken a level of testing and maintain high standards of biosecurity. This is the best source of sheep as they have a low risk of being infected with JD. The longer they have been in the program and the more testing they have undertaken the greater the level of assurance. It should be noted that many producers may not

be aware that they have certain diseases and declaration of infection status on the NSHD may not be reliable. You should always determine the level of assurance you desire to ensure that animals are not affected with a disease. For instance, what proof does the farmer have they are low-risk? Do they have evidence of negative test results?

Without undertaking testing, there is no way to reliably determine if sheep are not infected with JD. If you wish to purchase untested sheep that have a low risk status, then there are some basic factors you can consider:

- The environment will influence disease occurrence in animals.
  - o Those that have been born and raised their entire life in low rainfall areas with low stocking rates are less likely to develop disease even if infection is present.
- Sheep purchased from properties where all animals are approved vaccinates will have a lower risk of developing disease.
  - o Just remember if you are purchasing unvaccinated sheep and introducing them to a high rainfall/stocking density property, you should consider vaccinating them on arrival.

OJD on Kangaroo Island

CONGRATULATIONS! Due to the effort of the KI farmers through continuing to vaccinate against OJD and taking control measures, we have reduced the clinical disease of OJD on the island considerably.

By the end of 2018:

- 5 properties passed clearance tests.
- Of the10 KI properties known to be infected with clinical disease, 7 are eligible for clearance testing. If undetectable levels are reported through laboratory results, these properties will have their 'Infected' status removed.
- There was only 1 new detection in 2018.
- No properties on KI are under quarantine order for OJD and are able to trade sheep.

KEEP VACCINATING!

Vaccinating sheep with Gudair is highly recommended in high rainfall climates such as KI. This is especially important given the history of the disease on KI. Vaccinating does not eradicate the disease and the bacterium can stay in the soil for many months, so if vaccinating discontinues clinical signs are likely to increase.

Vaccination must be complemented with sound biosecurity practises. The new One Biosecurity program provides a credible framework for risk base trading. It also places biosecurity as a key factor for decision making in your livestock enterprise. All sheep and cattle producers in SA should be registered on the One Biosecurity web portal.

In 2001, there were a total of 55 properties known to be infected and impacted with clinical disease from OJD. If you don't want to get back to those levels again then keep vaccinating and sign up to One Biosecurity.

For Further information:
Visit PIRSA website:
http://www.pir.sa.gov.au/biosecurity/animal_health/sheep
Kate Buck, Animal Health Advisor:
Phone: 08 8553 4922, 0419 091 156 Email: kate.buck@sa.gov.au

Keeping Goats on Kangaroo Island

Permit required for Keeping Goats on KI

The eradication of feral goats from Kangaroo Island was announced by the Kangaroo Island NRM Board in 2018. More than 1200 goats were destroyed during the 12-year eradication program, at a cost of $1.3 million. A new feral population developing from poorly managed domestic goats is the greatest threat to this successful eradication.

Feral goats damage the natural environment, pasture and crops, and they can also harbour and spread exotic animal diseases. They will be just as difficult to remove a second time!

On the other hand, properly managed domestic goats can be a profitable business diversification. Goats produce meat, mohair, cashmere, leather and milk. Properly confined goats pose no problems to the environment or other enterprises.

Do you have the right set up to keep goats?

Good management practices are essential when keeping goats. Goats bred and raised in captivity are less likely to escape. The Kangaroo Island NRM Board recommends that owners do not take on any goats of feral origin as they can be difficult to domesticate.

Good fencing is the most critical element for reducing the risk of escape. More than one fence between your goats and the 'outside world' gives better protection. Fences should be well constructed and maintained, with enough wire to contain the goats. When planning the goat enclosure, avoid creek crossings, gutters or floodways and site fences away from trees where branches could fall and damage them.

Orlando and friends show due respect for an electrified fence.

Get the set up and your fences right in the first place before buying goats. Inspect fences frequently to ensure that any damage is detected early. Goats are more inclined to go under a fence than jump it so check for wallaby tracks under fences. A hot wire at the bottom will prevent goats going under.

Goat permits under the Natural Resources Management Act

Since 2016, goats have been 'declared' on Kangaroo Island under Section 174 of the NRM Act. This means that goat owners must obtain a permit from the KI NRM Board if they wish to keep goats as pets, for milking or as livestock. The Board has the authority under the NRM Act, to issue permits to allow landholders to keep goats, subject to conditions specified in its Declared Goat Policy. This policy clearly states the conditions under which a permit is issued to move, possess or sell goats on Kangaroo Island. Permits are only issued after a property inspection and risk assessment have been undertaken and the goat enterprise has been assessed as having a Low or Medium risk rating.

Permits are issued for up to three years, after which they may be renewed subject to the outcome of a property inspection and evidence that permit conditions are being met.

Under the National Livestock Identification System (NLIS) and also the KI NRM Board's Declared Goat Policy, a Property Identification Code (PIC) is mandatory for any property that has one or more goats.

The KI NRM Board's policy now requires that all permitted goats must be tagged with the property's PIC number.

If you are thinking of buying or keeping goats, please read the KI Declared Goat Policy, which can be found on the KI Natural Resources website:

https://www.naturalresources.sa.gov.au/kangarooisland/plants-and-animals/pest-animals

Further enquiries:

If you have any questions about the KI goat permit system, please contact Natural Resources KI staff:

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Good Clover Bad Clover

Background

Four oestrogenic sub clover varieties (Yarloop, Dinninup, Geraldton and Dwalganup) can be responsible for reduced ewe fertility, difficult births, prolapse of the uterus, urethral blockages in wethers and udder development in maiden ewes and wethers.

The 'Good Clover, Bad Clover' project commenced in April 2017 with the aim of increasing producer awareness of the potential issues and management strategies to deal with oestrogenic clover. The project involves coaching producers from 10 focus farms (on Kangaroo Island and the South East of SA), in the identification of the clovers and the development of management plans for their properties.

What was done

Pasture assessment across the medium to high rainfall zones of South Australia and Western Victoria, have found oestrogenic clovers in many pastures. The four main cultivars are widespread with Dinninup and Yarloop in the slightly higher rainfall areas (>500mm), while Dwalganup and in particular Geraldton were found to be more prolific in the drier areas. Dinninup is very widely distributed and in some areas at relatively high densities.

Two focus farms were selected on Kangaroo Island (Hd MacGillivray), for mapping of pasture composition and clover cultivars (good clovers and bad clovers) across a number of paddocks. This mapping has provided local information on the severity and extent of the bad clovers in pastures. Refer to **Table 1** for pasture composition on Farm 1 and **Table 2** for pasture composition on Farm 2.

Pasture composition will vary depending on both management (i.e. pasture renovation, grazing pressures, fertilizer and liming history and pest and weed control) and seasonal conditions (i.e. timing and the amount of rain at the break of season) as well as soil type.

The use of orange and red shading to indicate paddocks with high levels of bad clovers, highlights the number of paddocks that are affected and the level across the farms.

These measurements can be used by landholders to develop management plans for their pastures and ewe flocks. As ewes graze oestrogenic clovers, the oestrogens accumulate over time. The management option is then to reduce the intake of oestrogens over time by putting ewe weaners on the safest pasture.

Results

The Oestrogenic Clover % indicates the proportion of clover in the pasture that is oestrogenic.

The Pasture Oestrogenic Score indicates how safe the pasture is for grazing ewes.

In **Table 1**, Paddock MacGillivray 2–18, the Oestrogenic clover score is 58% and thus marked red, however the paddock only has 29% clover and is grass dominant (at 59%). This 'dilution factor' will reduce the overall intake of oestrogens by the stock, so the overall Pasture Oestrogenic Score is LOW. Manipulating the pasture through grazing management, can keep the pasture grassy and this reduces the intake of oestrogens. Young to mid aged group ewes could safely be grazed in MacGillivray 2–18. Paddocks MacGillivray 4–18 and 8–18, have a low oestrogen clover of 16% and LOW Pasture Oestrogen score and could be kept for ewe weaners. Paddock MacGillivray 7–18 with a POTENT Pasture Oestrogen score could be targeted for renovation, sale stock or the oldest age group of ewes or wethers.

On Farm 2 there are a higher number of paddocks with high oestrogenic clover % and POTENT Pasture Oestrogenic Scores. These could be renovated over time and in the short term, only grazed with older aged group ewes or sale stock. Paddock 29–2017 has recently been renovated and has a low Oestrogen Clover % so could be used for ewe weaners.

Many of the pastures had high levels of Dinninup clover, with the range of Dinninup clover within the total clover portion of the pasture ranging from 7% to 92% with a large proportion of the paddocks above 50%.

Table 1: Pasture Composition, Percentage of Oestrogenic clovers and ranking on Farm 1

Paddock	Grass %	Broadleaf %	Clover %	Oestrogenic Clover %	Pasture Oestrogen Score
MacGillivray 1-18	Cut for hay 2018				
MacGillivray 2-18	59	12	29	58	17 - Low
MacGillivray 3-18	50	17	33	62	12 - Low
MacGillivray 4-18	51	33	8	16	1 - Low
MacGillivray 5-18	47	9	45	56	25 - Moderate
MacGillivray 6-18	59	10	31	82	25 - Moderate
MacGillivray 7-18	29	18	53	93	49 - Potent
MacGillivray 8-18	65	6	29	16	5 - Low
MacGillivray 9-18	46	4	50	63	32 - Moderate
MacGillivray 10-18	57	6	37	90	33 - Moderate
MacGillivray 11-18	35	13	52	67	35 - Moderate
MacGillivray 12-18	31	28	41	92	38 - Moderate
MacGillivray 13-18	64	13	23	94	22 - Moderate
MacGillivray 14-18: Saline	69	10	21	39	8 - Low

Table 2: Pasture Composition, Percentage of Oestrogenic clovers and ranking on Farm 2

Paddock	Grass %	Broadleaf %	Clover %	Oestrogenic Clover %	Pasture Oestrogen Score
MacGillivray 15-18	20	29	51	78	40 - Potent
MacGillivray 16-18	21	14	65	61	40 - Potent
MacGillivray 17-18	19	48	33	42	14 - Low
MacGillivray 18-18	32	8	60	69	41 - Potent
MacGillivray 19-18	35	33	32	70	22 - Moderate
MacGillivray 20-18	38	34	28	71	20 - Low
MacGillivray 21-18	20	9	71	34	24 - Moderate
MacGillivray 22-18	4	60	36	86	31 - Moderate
MacGillivray 23-18	44	9	47	89	42 - Potent
MacGillivray 24-18	22	23	55	83	46 - Potent
MacGillivray 25-18	42	13	45	52	23 - Moderate
MacGillivray 26-18	49	8	43	67	29 - Moderate
MacGillivray 27-18	34	45	21	70	15 - Low
MacGillivray 28-18	18	17	65	42	27 - Moderate
MacGillivray 29-2017	18	18	64	18	12 - Low
MacGillivray 30-2017	58	32	10	90	9 - Low
MacGillivray 31-2016	16	21	63	53	33 - Moderate
MacGillivray 32-2016	72	8	20	53	11 - Low
MacGillivray 33-2016	43	4	53	61	32 - Moderate
MacGillivray 34-2016	6	30	64	49	31 - Moderate
MacGillivray 35-2016	17	41	42	58	24 - Moderate

Take home messages

Pastures with greater than 20% oestrogenic clovers are considered problematic.

Paddocks that have been identified as having greater than 20% oestrogenic clover should not be grazed with ewes whilst the clover is green. These paddocks can be grazed with older age group of ewes, wethers or terminal lambs. Drilling in winter-feed to dilute the clover content and avoiding grass cleaning of highly oestrogenic pastures is also recommended.

There is no cure for the permanent infertility in ewes that have had repeated exposure to large amounts of oestrogenic clovers over a long period of time. This cumulative effect may occur over a two to three year period of exposure. These ewes should be culled.

Renovation of pastures with low oestrogenic cultivars will improve productivity. Seed reserves in the soil often mean that renovation does not completely remove the oestrogenic clovers from a pasture. Ensuring new varieties can dominate through adequate soil nutrition, weed and insect control is important. In the years prior to renovation, reducing seed set of oestrogenic cultivars should be considered. In paddocks which can be cropped, encouraging germination via shallow tillage helps maximise germination and effectiveness of herbicide applications to reduce seed banks. Cutting clover hay or silage in the year prior to renovation can help reduce seed set, which in turn helps to reduce the seed bank and reduce competition for the establishment of new cultivars.

Funding/Sponsors:
MacKillop Farm Management Group in Partnership with AgKI through:
Meat & Livestock Australia
Sheep Connect SA
Natural Resources South East

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Oestrogenic Clover - A Case Study

The first indication that there was a problem on the Robert Hams' Kangaroo Island farm was that lambing percentages dropped to around 25%. The ewes were in good condition and while the pastures looked fine, the problem was soon identified as being oestrogenic clovers. That was 38 years ago.

At the time, PIRSA researchers David Little and David Woodard were working on a research project on renovating oestrogenic pastures on Kangaroo Island. They identified the problem and mapped the oestrogenic clovers on the Hams' farm.

"The percentages were pretty ugly," David Woodard said. "The paddocks ranged from 4% to 59% oestrogenic clovers. We work on anything above about 20% as posing a risk. Back then on the Hams' place, we found that nine out of 13 paddocks were high or very high and only two were totally safe."

David returned to the Hams' farm in October this year to conduct a field walk organised by Agriculture Kangaroo Island (AgKI), MacKillop Farm Management Group (MFMG) and Meat & Livestock Australia (MLA), who have partnered together on a new project called Good Clover, Bad Clover. The project will work closely with local producers to determine what constitutes good and bad clover and how to implement effective management of clovers.

Oestrogenic clovers – the bad clovers – are Dinninup, Dwalganup, Yarloop and Geraldton. These older varieties contain high levels of the isoflavone formononetin, which leads to fertility problems in ewes. The effect is cumulative so lambing percentages will continue to drop from one year to the next.

"Wethers may also experience problems on oestrogenic clovers over time, due to enlarged bulbo-urethral glands which may lead to death." David said. "Wethers raised for prime lamb can be run on the oestrogenic clovers because they aren't on the pasture for long enough to have any problems."

"Ewes may fail to conceive or abort before full term. Conception rates will vary and a wide spread of lambing time may occur within the flock. Rams are the only sheep not affected by the bad clovers. Pastures can be renovated and Rob Hams is doing a good job renovating his," David continued.

"The process of renovating the affected pastures takes several years. We began renovating them by cropping the paddocks two years in a row," Rob said. "We sprayed out the clover at seeding and then sprayed again over the top of the crop; then in the third year, we knocked the paddock again before reseeding it with two sub-clovers and balansa. It seems to be going alright but we had to reduce stock to be able to do it."

"The new cultivars that we have sown are producing better quality and quantity of feed, but we have only had stock running on it for a year because we had to let the seed bank establish," he continued. "In the early days, we just managed the oestrogenic pastures we had by running cattle or wethers on them, rather than trying to renovate them. We've also run our older ewes on them and accepted lower lambing percentages in that mob. The oestrogenic clovers can also be grazed safely by ewes when the grass is completely dry."

"Renovating the pastures requires investment," Rob said. "There's the cost of destocking and then the cost of renovating the paddocks – buying in seed and so on. You can't do it unless you can do it economically. Now that there's money in sheep, it's easier."

The Hams' lambing percentages are now back up to around 80%.

Lessons Learned

- Understand the issue – assess each paddock for prevalence of oestrogenic clovers
- Graze strategically:
  - Avoid grazing ewes on oestrogenic clovers before or during mating to avoid temporary infertility
  - Avoid long term exposure of ewes to high oestrogenic clover paddocks as this can cause permanent infertility
  - Reserve high oestrogenic clovers to finish terminal lambs which are not affected
  - Graze weaners and young ewes on the least oestrogenic clover pastures available
  - When oestrogenic clovers are completely dried off, they may be grazed by ewes
  - Avoid cutting hay or silage from oestrogenic clover paddocks as the hay or silage can still be affected.
- Manage pastures:
  - Dilute clover based pastures with newer non-oestrogenic clovers or other pasture species
  - Develop a long term strategic spraying and grazing program to prevent oestrogenic clover seed set and reduce the seed bank
  - Buy certified clover seed to ensure it does not contain the older oestrogenic varieties
  - Be aware that purchased hay or silage may contain high oestrogenic clovers.

On-farm snapshot

Operators: ***Robert Hams; Ron & Yvonne Hams***

Location: ***Vivonne Bay, Kangaroo Island, South Australia***

Area: ***900ha Cleared***

Enterprise: ***Merino, self-replacing flock (older ewes mated to terminal sires); Angus cattle***

Livestock: ***4000 Merino Sheep***

Pastures: ***Sub-clovers***

Soils: ***Ironstone rubble over clay***

Rainfall: ***550mm***

Ron Hams in newly renovated pasture

Getting More from our Kikuyu Pastures

Background

There has been widespread adoption of kikuyu by many farmers on Kangaroo Island and in many ways, it's a perfect fit. Kikuyu is tough, robust and responds well to any summer rainfall events. It stands up well to hard grazing and grows on most soil types. However, like most things, they are never quite as good as the advertising promises, and kikuyu's failure may be that it grows too well and can cause a lack of pasture feed during the winter months.

Many KI farmers have noticed a 'kikuyu induced winter drought' when clovers struggle to perform. This can occur if there is a weak break of the season. The kikuyu outcompetes the clover seedlings and an excess of standing kikuyu biomass prevents light and moisture from reaching the soil surface.

Even with increased fertiliser applications and red-legged earth mite (RLEM) control, producers can still struggle to maintain legume content in kikuyu.

Management Options

1. Increasing clover content

The best legume option for kikuyu is sub clover and can significantly increase gross margins, but how do we increase its growth during winter? One option is to supress (but not kill) kikuyu growth at the break of the season to allow the clover to dominate. Spray 0.5 to 1.0 L/ha of Clethodim when clover cotyledons are present, about 2 -4 weeks after the break. Don't forget to add an insecticide for RLEM control.

In WA, they heavily graze the kikuyu stand and then drill in the clover seed in late May/June. This works well in the west as they have cold nights (6-8 degrees) and frosts that help to supress kikuyu growth. It may be an option for some parts of KI.

If you didn't have a seed bank of sub clover then direct drill in clover seed (ensure it's been inoculated). The secret to success is direct drilling (90% success rate) as opposed to broadcasting with a 10% success rate. Use discs or knife points with double disc openers, to cut through the kikuyu stolons and rhizomes and use press wheels. Take care not too seed to deeply.

However, you can only use these techniques if you have good weed control. Supressing kikuyu growth to allow the clover through also allows weeds such as silver grass, capeweed and chick weed to explode in numbers. Be aware of the weeds that are present and have a plan to control them beforehand or a plan to control following suppression. Alternatively, you may simply be able

Table 1: Silver Grass control options

TREATMENT	COMMENTS
Simazine	Incorporate with moisture. For best results use as a pre-emergent
Propyzamide	For best results use as a pre-emergent
Imazapic	Will reduce clover populations, so only use if legume content is already low
Clethodim	Will suppress but not kill silver grass
Spray top (sub lethal doses Glyphosate or Paraquat)	Spray before hay off (seed in the soft dough stage). If in doubt spray earlier and use stock to nip off any fresh tillers. If grazing fails to control regrowth a respray will be required. Or use a wick whipper to knock down silver grass late in the season before seed set. Note: silver grass seed dormancy is about 2 years, thus if populations are high it will be necessary to spray top for 2 years.

to add an additional herbicide to the mix during suppression. It's critical to control silver grass even if it's only present in low numbers (refer to **Table 1**).

2. Increase pasture productivity.

Most pasture legumes are not as tolerant of acidic soils as kikuyu (pHCaCl2) >5.2). Clover also has a higher requirement for potassium (ensure soil is >100 ppm Colwell K) and phosphorus (35-45 ppm Colwell P in ironstone soils) than kikuyu. Soil test and apply fertiliser and or lime as required.

Use Gibberellic acid and nitrogen (N) to boost kikuyu grow through the winter. Application of N to ryegrass (which has a higher cold tolerance than kikuyu) will produce more winter feed. The most efficient rate of N to boost growth of kikuyu in summer and autumn is 25 kg N/ha.

3. Other pasture mix

Annual ryegrass or forage oats can be sown for additional winter/spring feed. Seed rye grass at 20-40kg/ha. Drill seed in at the break of season either with or without suppressing kikuyu. This option is best in high rainfall zones >600mm, but it does require re-sowing of rye grass every few years and needs fertilising with nitrogen to maximise growth rates (unless you have an excellent clover stand). Use a disc seeder or knife points with double disc openers and press wheels to cut through the kikuyu.

4. Grazing management

Set stocking at high stocking rates will encourage clover but rotational grazing will favour the grass component, which increases production/ha. Refer to **Table 2** and **Table 3** for recommended grazing pressures.

What's next?

Agriculture Kangaroo Island (AGKI) has received Landcare funding to trial some of the above options to see what will work best for KI soils and climate.

Take home messages

- Clover content in kikuyu can be increased by hard grazing of the kikuyu stand prior to the opening rains (insure RLEM are controlled, lime if soil is pHCaCl<5).
- Sowing legumes can increase legume content. If grass suppression is used, weeds may also increase unless control measures are taken.
- Legume content can be increased after the break by using a grass selective herbicide to suppress the kikuyu, if you have an adequate clover seedbank.
- If clover needs to be added, drill seed in, don't broadcast.

Kikuyu Pastures (cont.)

Table 2: Recommended grazing pressures for kikuyu (set stocking)

SEASON	TARGETED DM kg/ha	COMMENTS
Summer	800 (1cm or less)	This maintains pasture quality and minimises build-up of rank material that inhibits germination of winter active grasses in autumn.
Break of Season	800 -1000	Maintain grazing pressure to open up the sward allowing moisture and light to reach the ground and space for emerging clover seeds to develop. RLEM control is crucial to prevent seedling loss through predation.
Autumn	800 - 1400	Grazing from 5 cm forms a more upright pasture, this maximises pasture quality and allows light penetration for good establishment of annual clover's and winter active annual grasses.
Winter	1400 - 3000	
Spring	1000 - 1400 (2-5cm)	
Late spring/ early summer	3000 or less	Graze to prevent rank material from accumulating.

Table 3: Recommended Food on Offer (FOO) targets for kikuyu (rotational grazing)

SEASON	PRE-GRAZING FOO DM kg/ha	RESIDUAL FOO DM kg/ha	REST PERIOD BETWEEN GRAZINGS (days)
Winter	2600	1400	60
Spring	3800	1400	30

Funding/Sponsors:
Agriculture Kangaroo Island through the National Landcare Program
Information sourced from *Improving Subtropical Grass Pastures on the South Coast of Western Australia* by Paul Sanford, Ron Masters and Eric Dobbe. Bulletin 4892 (MLA and Dept. Primary Industries & Regional Development).

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The AgKI Potential Trial - The Final Wash Up

Background

At the 2013 Agriculture KI AGM and Conference, Western Australian agronomist, Wayne Smith, promoted the concept that Kangaroo Island had the potential to sustainably double its cropping production and achieve stocking rates in the order of 40 DSE. Early in 2014, a group of four farm businesses, local agronomy and industry organizations, the Kangaroo Island Futures Authority and the Kangaroo Island Natural Resources Management Board established the Agriculture Kangaroo Island (AgKI) Potential project, to trial the methodologies proposed to achieve these outcomes.

What was done?

The project established three grazing trial sites and two cropping trial sites on four properties. The sites chosen reflected the soils and rainfall most KI farming enterprises typically experience.

In the grazing trial, the sites were treated to improve soil pH, macro and micronutrient levels, perennial pastures and a seven cell rotational grazing system was established to maximize water use and improve soil structure and health. During the trial, nitrogen fertilisers were applied following late spring, summer and autumn rainfall events, to drive stock feed rather than use supplementary feeding.

The cropping systems sites were also treated, to improve soil pH, macro and micronutrient levels. A continuous cropping system was introduced utilising summer cover crops with the aim of adding plant diversity, driving down the water table to reduce winter waterlogging, and improving soil organic matter, nutrients, structure and biota.

Pasture composition and ground cover were monitored at each grazing site. Participants provided information on stocking rates and production figures were analysed at both cropping and grazing sites. Soil pH and nutrients were also measured, at the start and end of the trial.

Table 1: Trial Site Descriptions.

PROPERTY	OWNERS	LOCATION	TRIAL SITE (ha)	SOILS	RAIN-FALL (mm)	ENTERPRISE
ELLA MATTA	Heinrich Family	Central Plateau	14.3	Ironstone	650	Merino Wethers
BUNSIL	Steve & Lucy Morgan	South Coast	113	Shallow non-wetting sands	525	Self-replacing merino 1st cross ewes
BELLEVISTA	Bell Family	Lower Cygnet River	67	Clay-loam	500	Self-replacing merino 1st cross ewes
DALMORE	Stanton Family	North Coast	34.9	Shallow non-wetting sands	480	Wheat/Canola/Bean No-till cropping
BELLE-VISTA*	Bell Family	Lower Cygnet River	34.3	Clay-loam	500	Wheat/Canola/Bean No-till cropping

* This site also had a 16.3 ha summer cash crop trial site.

AgKI Potential Trial (cont.)

Results

Grazing Sites

The perennial grass based, rotational grazing systems can boost production on a range of soil types in the region whilst maintaining pasture cover. This trial was able to achieve increases of 30% to 100% in stocking rates with no negative impacts on pasture condition, soil health or increased erosion risks **under average seasonal conditions.**

A well-established perennial pasture base is critical for boosting production, reducing input costs and improving resilience to unseasonal conditions. As these systems are driven closer to their theoretical maximums, the risk of pasture degradation and soil health decline increases significantly, and strategies for rapidly decreasing stock numbers are required.

The boost in production increases returns, however costs increase as grazing intensity increases and rates of return decrease. The ability to apply fertiliser in conjunction with summer rain to reduce supplementary feeding has a significant impact on profit. It is likely that the return on expenditure versus the risk of degradation will determine what grazing intensity a given landholder will be comfortable with.

Soil acidity was lower and organic carbon higher under the perennial grasses and this could provide savings on input costs over the long term. Increasing pasture diversity, particularly summer active species, may further increase these benefits. In addition, it would enable the system to cope with unseasonable conditions and have further production benefits in average seasons.

Most participants found the demands of moving stock on a regular basis a significant disruption to other work and questioned whether it would be possible to adapt this to largescale enterprises particularly, across a number of properties. In addition, the requirement to have stores of fertiliser on hand to take advantage of spring/summer rainfall was also an issue, and again fertilising opportunistically was a disruption to normal farm operations. The long dry summer of 2017-18 required a significant increase in supplementary feeding at one site and destocking at another. Even so, ground cover declined significantly at both sites, demonstrating the risk involved in pushing the system close to its theoretical maximum and the system clearly requires a mechanism such as confinement feeding areas or reserve paddocks to enable rapid destocking.

Cropping Sites

The success of the high-input, continuous cropping system varied with soil condition. When applied to soils with reasonable nutrient levels and structure, the inputs required were lower making them affordable and more effective. Record wheat tonnages of 7.1t/ha were recorded at one site. On the poorer soils, the cost of these techniques was prohibitive and ultimately, convinced the participants to seek other more cost-effective, if longer-term, avenues to improve soil health.

This cropping system is particularly resource hungry, producing declines in organic carbon, phosphorous and sulphur at the sites. Integrating cover cropping into the system was designed to or at least offset, if not reverse, this decline. However, neither site consistently established healthy cover crops.

Travis Bell and Grant Flanagan inspecting cereal

Take home messages

- The AGKI Potential trial has shown that current production limits in both cropping and grazing enterprises are higher than previously considered under average seasonal conditions.
- Perennial grass based rotational grazing systems seem to be widely applicable even on poorer soil types.
- The grazing system is vulnerable to prolonged dry conditions and rapid adaptation is required to prevent a decline in pasture cover and increased erosion risk.
- The boost in production increases returns, however costs increase as grazing intensity increases and rates of return decrease. It is likely that the return on expenditure versus the risk of degradation is what will determine what grazing intensity a given landholder will be comfortable with.
- The continuous cropping system is likely to be successful in a more restricted set of "better" soil types and improving the success of cover cropping will be key to enabling the system to achieve better results.
- A more proactive approach to plant nutrition and having materials on hand to plant early, based on available soil moisture rather than relying on break of season rains, was critical to cropping success.
- Identifying a suite of plants suitable for summer cover cropping on KI is necessary for successful continuous cropping.

Funding/Sponsors:

Kangaroo Island Natural Resources Board (through the Australian Government National Landcare Programme)

Office of the Commissioner for Kangaroo Island

Kangaroo Island Pure Grain

Elders Pty Ltd

Agronomic Acumen

Primary Industry and Regions South Australia

Andrew, Tracie and Jamie Heinrich; Steve and Lucy Morgan; Travis and Lachie Bell; Will and Jenny Stanton

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See the NRKI or Agriculture Kangaroo Island websites for a full copy of the report.

Cropping: Using Legumes to Improve Nitrogen Efficiency

Background

This was the third and final year of a trial funded by the South Australian Grains Industry Trust (SAGIT), to evaluate the nitrogen fixation capabilities of various legume species grown on Kangaroo Island.

In 2016 four legume species – Samira faba beans, PBA Coogee field peas, Jennabillup lupins and Monti + Gosse sub clover and one non-legume species – linseed, were sown in a completely randomized design with four replicates. Each legume was inoculated with its appropriate rhizobia according to label directions. The non-legume linseed was included in the trial as a control.

In the second year (2017) the trial was sown to Clearfield canola - 46Y83 and in 2018 Kowari oats were sown. The trial was designed to answer the following questions:

- Which of the four legume species had fixed the most nitrogen (N) in the 2016 season?
- How much N did these legume crops fix?
- How much of the N fixed by the legume was utilised by the first and second subsequent crops? Concurrently, how much N was lost through leaching or denitrification?

What was done

The trial site was located for the 3 years on the Stanton's property Caledonia, 989 Timber Creek Road in MacGillivray. The soil was typical of those used for cropping on the plateau - sandy loam over clay. The site was limed in April 2016 and a soil test (0-10cm) immediately before sowing in May revealed a pHCaCl2 6.1, Colwell P 27mg/kg, PBI 195, Colwell K 176mg/kg, Sulphur 26mg/kg and Organic Carbon 2.6%.

In 2016, two paired 80cm soil moisture probes, (SMP's) were installed in a faba bean and linseed plot connected to a weather station. Accompanying these SMP's, was a Hydra Probe installed at 80cm, which measured ion content, soil temperature and soil moisture. These Hydra Probes tracked and logged the nitrate movement through the 80cm profile.

In order to monitor the nitrate released into the soil water by the various crop species, ceramic water collecting tubes Sentek SoluSAMPLERs, were installed to a depth of 30cm in 2017. These were removed at the end of the 2017 growing season.

Weather data was also recorded at the site using a rain gauge, air temperature & humidity and wind speed & direction sensor. These sensors were logged and the data uploaded every 15 minutes.

The site received 812mm of rain in 2016 (Decile 10), 515mm in 2017 (Decile 2-3) and 518mm (Decile 2-3) in 2018 compared to the long-term average of 530mm.

Measurements taken during the project included: nodule scores, dry matter, starting deep soil nitrogen, soil water nitrate, biomass nitrogen uptake and grain yield and quality.

Results

Table 1: 2016 Measurements

2016 Crop	Nodule Score	Dry Matter (t/ha)	Grain Yield (t/ha)
Linseed	0	1.98 c	0.7
Faba Beans	2.5 b	2.74 bc	3.27
Peas	3.3 a	6.53 a	3.18
Lupins	3 ab	3.81 b	NA
Sub Clover	3.4 a	2.58 bc	NA

2016 Results

The peas, lupins and sub clover shared similar nodulation scores (**Table 1**). A score over 3 is deemed adequate. The nodulation score of the faba beans although not statistically different from

the lupins, fell shy of the adequate threshold of 3. It was likely that the pHCaCl2 4.8 at the 4-8cm sowing depth was the reason behind the lower nodulation score.

Due to the wet conditions, linseed was unable to compete against the tirade of waterweeds that overtook the plots. Consequently it gave the lowest biomass yield of 1.98t DM/ha and grain yield of 700kg/ha.

The PBA Coogee field peas had significantly higher biomass than the other legume species (**Table 1**). This variety and its associated Group E rhizobia, were well suited to the soil at the trial site as its nodulation score was above adequate.

Due to wildlife eating the 4 lupin plots before harvest, a lupin yield was not obtained.

Table 2: Starting Deep Soil N

2016 Crop	2017 N (kg/ha)	2018 N (kg/ha)
Linseed	16.8b	23.2a
Faba Beans	43.8a	32.4a
Peas	39.4a	25.8a
Lupins	38.8a	39.0a
Sub Clover	37.7a	35.0a

Table 3: Grain Yield, N Uptake & Quality

2016 Crop	2017 Canola (t/ha)	2018 Biomass N (kg/ha)	2018 Oat Grain Protein (%)
Linseed	2.16b	92a	11.15a
Faba Beans	3.13a	104a	11.85a
Peas	3.63a	100a	11.70a
Lupins	3.13a	108a	12.05a
Sub Clover	3.04a	108a	11.80a

2017 Results

All the legumes sown in 2016 shared similar starting soil nitrogen levels to 35cm depth compared to the linseed control (**Table 2**), inferring that they all fixed a similar amount of N in 2016. The average starting N of the four legumes was ~40kg/ha being ~23kg/ha higher than the linseed control. (Soil was sampled to 35cm due to constraints of manpower versus B horizon heavy clay).

Similarly, the canola grain yield at the end of the season from the plots of the four legume species was statistically different from the linseed control (**Table 3**). There are two likely reasons for this outcome. Obviously, the linseed being a non-legume did not fix any N in 2016 and thus the 2017 canola crop had less available N. Secondly, the 2016 linseed plots had a higher ryegrass burden attributable to the poorly competitive nature of linseed which consequently allowed numbers to build up. In high numbers ryegrass is a strong competitor and therefore stole nutrients, moisture and sunlight from the canola crop, reducing yield.

Based on the canola grain yields in **Table 3**, it could be concluded that growing any of the four legumes conferred, ~1t/ha canola yield advantage over the linseed control.

The site received 106kg N/ha as in-crop fertiliser, which assuming a 50% efficiency meant the crop took in 53kg N. Typically 80kg N is required to grow 1 tonne of canola. The average yield of the canola grown on the legume stubbles was ~3.23t/ha, which meant 258kg of N was utilised by the canola. If 53kg N was supplied from the bag, the remaining 205kg came from the soil N pool.

Likewise, the canola grown on the 2016 linseed stubble yielded ~2.16t meaning it required a total of 172.8kg N with 53kg applied from the bag = 119.8kg N came from the soil N pool.

Therefore, it could be deduced that the difference between the linseed and the legume soil N pool was the amount of N fixed by the legumes (205.4kg – 119.8kg) = 85.6kg N [= 186kg urea],

which happens to be approximately the amount of N required to grow 1 tonne of canola. Isn't it great when the numbers align!

2018 Results

The starting deep N tests taken two years after the legumes were sown, showed large variability amongst the different legume plots but no statistically significant differences (**Table 2**). This was also reflected in the in-crop biomass nitrogen uptake measurement taken in August (**Table 3**). Unfortunately, strong wind in December laid the oat crop flat in a westerly direction, making it impossible to harvest with the host organisations plot harvester to produce a reliable grain yield. Instead, grain was collected from each plot and analysed for protein (**Table 3**), but once again no statistical differences could be found.

Soil Water Nitrate Readings

Soil water nitrate readings were taken fortnightly from each plot from June 1st 2017 ceasing on October 2nd 2017.

The soil water nitrate (NO3) levels decreased throughout the season for all crop types (**Figure 1**). In agreement with the results of the starting deep soil N in 2017, (**Table 2**) linseed had statistically lower soil water NO3 readings, than the other crops until the second to last reading on 19th September.

With the exception of the first soil water nitrate reading taken on 1st June, the remainder of the season nitrate readings for the lupins, sub clover, peas and faba beans were statistically similar.

Soil Moisture Probes

2016

Linseed used significantly more moisture from a greater depth, than the faba bean plots. Linseed roots reached 60cm, whilst the faba beans only reached 40cm at most. Saturation of the profile occurred for many weeks of the season, and the lower layers in the faba bean plots were still near on saturation in December 2016. Despite 2016 being a Decile 10 rainfall year, by years end, linseed had essentially dried out the profile.

2017

More moisture was extracted from the 2016 faba bean plot, compared to the linseed plot. This was likely due to the fact there was more moisture available in the faba bean profile residual from 2016. Interestingly, at the time of the deep N soil sampling, the faba bean plots appeared to have the wettest soil samples whilst the linseed had the driest soil.

At the end of the growing season there was more total moisture still left in the faba bean plots compared to the linseed, i.e. the canola did not extract all the residual moisture left from 2016, so there was in effect, still residual moisture left for crop in 2018.

The ion sensors showed there was more net extraction of ions from the 2016 faba bean plots compared to the 2016 linseed plots.

2018

The oats drew both the linseed and faba bean sites, back to a level playing field. There appeared to be no increased soil moisture or ion content in either plot. During August however, there was a saturation event that saw the highest levels of soil moisture since the project began. Since that point, a dry spring saw the moisture extraction in both plots, draw down to a similar level. Interestingly, the oats did not extract as much moisture out of the profile as the linseed did at the end of 2016.

In regards to the ion content, it is a similar story with the levels being the same in either plots throughout 2018; in effect showing that there was no residual elevated ion content left over from the 2016 faba bean plots.

Soil Probes Summary

There were differences between the faba bean and linseed in regards to both soil moisture and ion content. Looking at the summed graph from the start of 2018 (**Figure 2**), it appears that there were slightly elevated levels of moisture still residual from the faba beans in 2016, even after the canola in 2017. This goes in line with the thinking that faba beans are not as deep rooted as linseed and thus the faba beans left behind soil moisture. The canola crop of 2017 had a good growing season with enough winter precipitation to allow it to reach maturity without extracting all of the deep soil moisture reserves. It takes the second season's crop of oats following the faba bean plots to see the moisture levels even out when compared to the linseed plots.

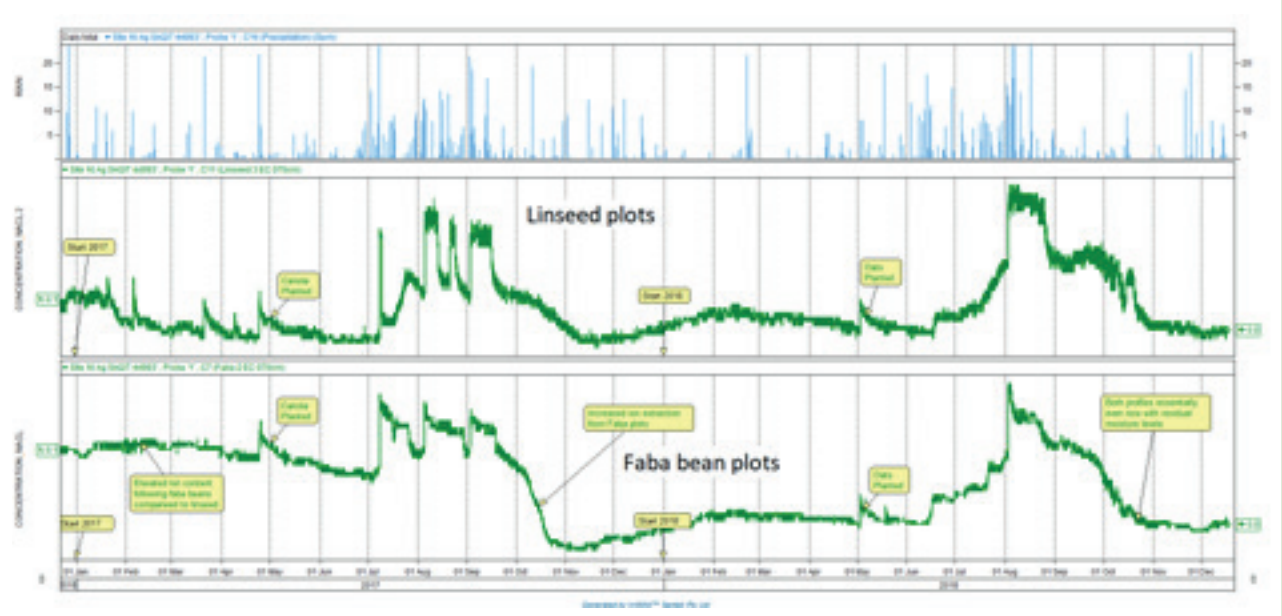
In regards to the ion content, the sensors showed a slightly elevated ion content following the faba bean plots towards the end of 2016 (**Figure 3**). The coarseness of these readings, makes it a bit hard to confidently assess the differences, but there was an apparent increase in ion reduction of the faba bean plots (extraction of nitrates?) from the canola crop from mid-September to early November 2017. At the start of 2018 the ion levels were very similar, and then mirrored each other during the 2018 season.

In short, faba beans left behind more moisture and ions (nitrates), compared to linseed. This was of apparent benefit to the following canola crop and in the case of the soil moisture, may have been of benefit in the second year crop.

Figure 1: Soil water nitrate readings

Figure 2: Three years of Soil Moisture Graphs. Top Linseed. Bottom Faba Beans

Figure 3: Three years of Soil Moisture Graphs. Top Linseed. Bottom Faba Beans.



Take home messages

- All the legumes sown - peas, lupins, sub clover and faba beans - were equal in terms of their nitrogen fixing capabilities, reflecting the importance of having well nodulated legumes.
- The average amount of N fixed by the legumes was calculated at ~86kg/ha (~187kg urea).
- In year 2, this residual N gave rise to a ~1t/ha canola yield advantage.
- In year 3, no differences in residual nitrogen from the legumes was measured.
- Linseed extracted more moisture, from a greater depth, than the faba beans in the same year and all subsequent crops – canola and oats.
- The linseed was able to dry the soil profile in a decile 10 year (812mm rainfall). This is a potential solution for farmers wanting to dry out their soil profile.
- Two years after growing linseed, soil moisture levels were even.

Funding/Sponsors:

South Australia Grains Industry Trust (SAGIT) funding administered by AgKI

Stantons for providing trial site, seed and spraying

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Soil pH and Nutrient Mapping in the Potato Industry

Background

Precision mapping of soil pH and nutrients can help guide more cost effective applications of lime and fertiliser. The aim of this project was to assess the benefits of adopting precision systems technology in the potato industry. Phosphorous availability is known to decline in acidic soils and lime applications are recommended to combat the deleterious effects of low pH. Standard applications of 2.5 t/ha of lime are commonplace in agricultural and horticultural systems, but recent research and demonstration has shown lime cost savings of up to 40% when the soil pH is mapped in a precise way.

What was done

Two pivot sites on Peter Cooper's property, Timber Creek Rd, were mapped by PrecisionAg for both pH and nutrients in September 2017. A variable lime application rate map was then developed to raise pH to 5.5 across the site. Lime was applied in Feb 2018. The 'lime zones' were resampled by hand in November 2018, in increments down to 20cm pre-incorporation of the lime. Potatoes were planted in the pivot in October 2018. Normalised Difference Vegetation Index (NDVI) maps were used to ascertain any differences in growth rates due to soil pH or nutrients.

Results

The pH ranged from 5-6.2 across the 25 ha pivot site. Lime was applied at 3 different rates – 3t/ha to maintain the pH (the red zone), 4t/h to increase the pH by 0.1 unit (yellow zone) and 5t/ha to increase soil pH by 0.2 unit (Blue zone) (**Figure 1**).

The site was re-monitored in December (10 months post lime application) and the red zone (3t/ha) had maintained the pH, the yellow (4t/ha) had led to a slight increase in pH of between 0-0.4 units and the blue zone (5t/ha) had increased pH by between 0.5 to 2 units.

The deeper soil sampling undertaken in November, showed the greatest pH change was in the top 5cm, showing limited movement of lime down the profile. The majority of nutrients (both macro and traces) were concentrated in the top 0-5 cm and decreased with depth.

The soil phosphorus map (**Figure 2**) shows considerable variability across the site.

The growth rates across the site were monitored remotely using NDVI (Decipher) maps (**Figure 3**). No visual differences were observed that correlated to soil pH or nutrient status, with growth differences attributed to varietal differences.

Figure 1: Range in soil pH pre-liming and recommended lime application rates

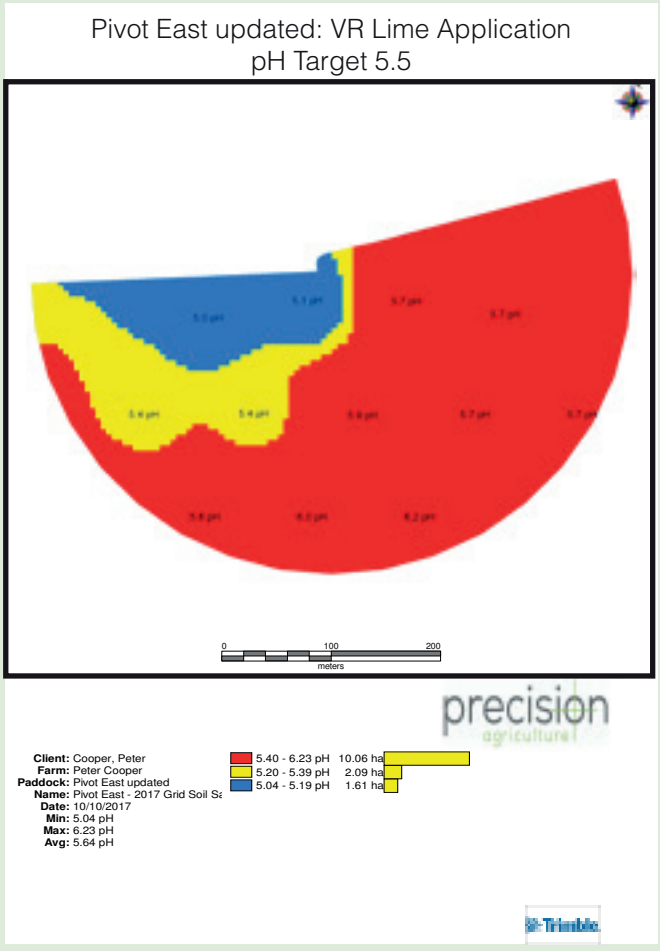


Figure 2: Soil phosphorus map, pre fertiliser application

Pivot East: Phosphorus (P) (Colwell)

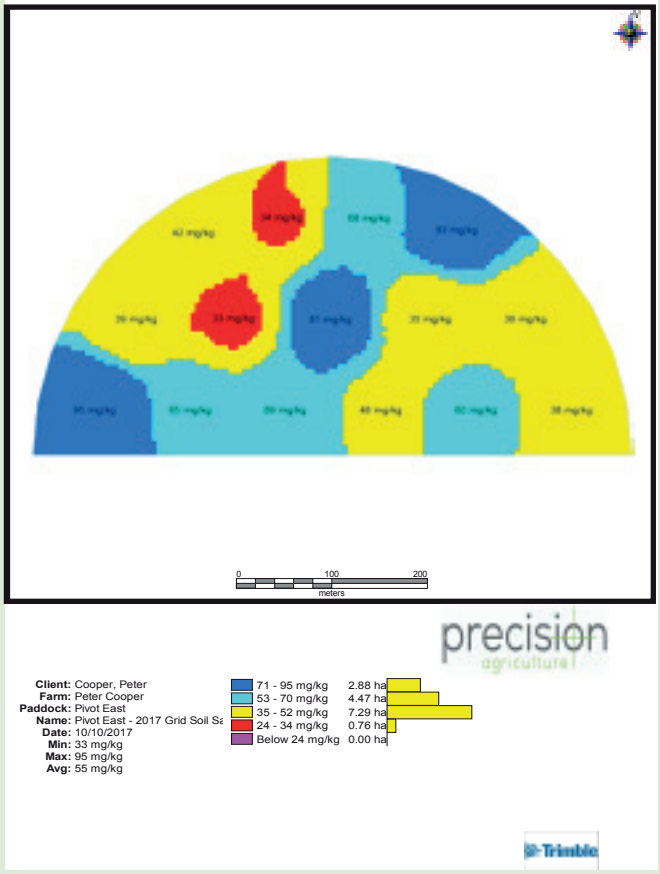
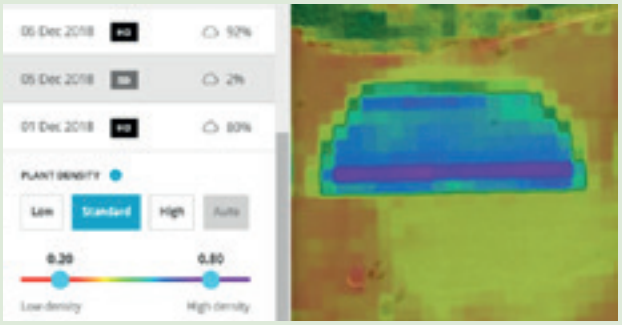


Figure 3: NVDI map



Take home messages

- Precision mapping clearly highlights the variability on soil pH and nutrients across a site
- Variable application of lime is more cost effective than a blanket application rate and enables a more targeted approach

Funding/Sponsors:

Peter Cooper

South Australia Potato Industry Trust (SAPIT) Fund

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Kangaroo Island Soil Health Report

Results from 2017-2018 Soil Tests

Background

In 2017/18, Agriculture Kangaroo Island (AgKI) received funding and support from the Australian Government National Landcare Program and PIRSA, to assist landholders to undertake soil testing on their properties and provide interpretation of soil test results. Soil test kits are available to all producers from the Kingscote PIRSA Office and soil augers are available for loan. In the 2017-2018 season, 21 KI farmers submitted 93 soil samples for testing.

Results

Soil pH

Soil pH is important as it drastically alters the availability of plant nutrients and the activity of many soil microorganisms (refer to **Table 1** for minimum pH targets).

Table 1: Target for minimum Acidic pH.

Land Use	pH ($CaCl_2$)
Extensive Grazing	5.0 – 5.5
Intensive cropping/grazing	5.5
Most horticultural crops	5.5 – 6.5

Most soil samples taken during the 2017-2018 season were below critical pH levels. **Figure 1** shows that the average pH in all hundreds (except Dudley, Newland and Menzies) were below 5.5 (pH $CaCl_2$), the majority showing an average pH of 5.0 or below. At these levels, pH will be limiting farm productivity and liming should become a financial priority.

Salinity

Saline soils are defined as soils that contain a high enough level of soluble salts in the root zone that plant growth is adversely affected. Ideally, soils should have a salinity level of less than 2 dS/m (for salt sensitive plant species). Of the soil samples taken, almost all samples were below 2 dS/m.

Organic Carbon

The organic carbon test is a useful indicator of organic matter status, therefore of overall fertility, microbial activity, and the structural stability of the soil. The ideal target level of organic carbon varies with soil type i.e. sandy soils greater than 1% is desired, through to greater than 2% in clay soils. Of the soils tested, all were well above critical values.

Soil Nutrients

Maintaining an adequate nutrient status in the soil is paramount to determining the productivity of the soil. Phosphorus, potassium and sulphur are essential nutrients for plant biomass and yield production (see **Table 2** for target levels).

Table 2: Target levels for essential nutrients

Soil Nutrients	Target levels	
	Ironstone Soils	Sandy Soils
Phosphorous (Colwell)	35-45 mg/kg	>20 mg/kg
Potassium (Colwell)	>120 mg/kg	>120 mg/kg
Sulphur	6-8 mg/kg	>10 mg/kg

Figure 1: Average soil pH($CaCl_2$) results for each hundred during the 2017-18 season. The black line indicates the target pH level of 5.5($CaCl_2$)

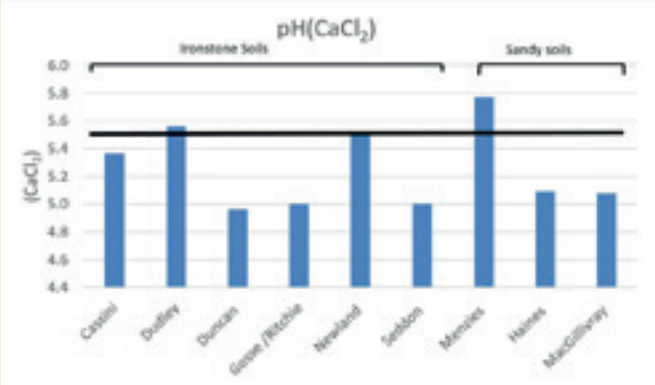

Figure 2: Average soil phosphorus levels for each hundred during the 2017-18 growing season. The black lines indicate the target soil phosphorus levels for both sandy soils and ironstone soils.

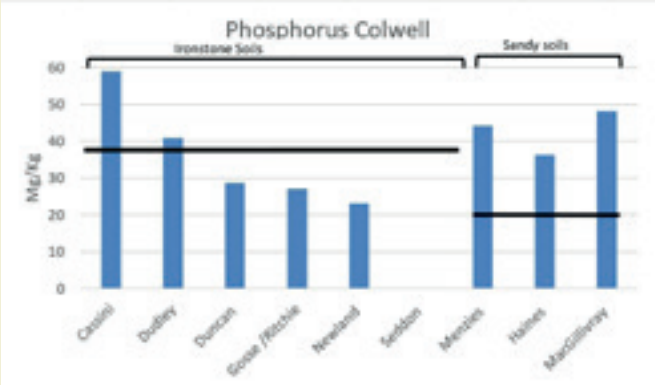

Figure 3: Average soil potassium levels for each hundred during the 2017-18 season. The black line indicates the target soil potassium level of 120mg/kg.

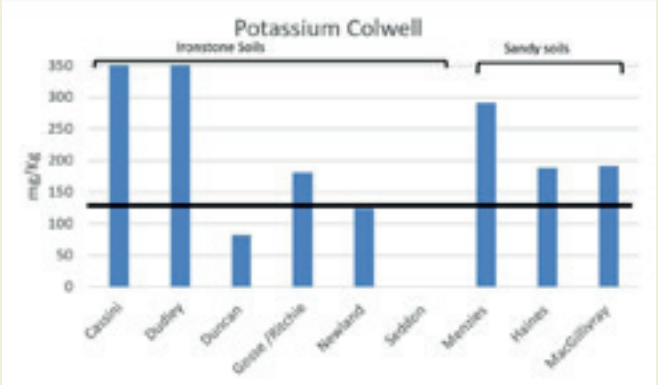

Figure 4: Average soil sulphur levels for each hundred during the 2017-18 season. The black line indicates the target soil sulphur levels.

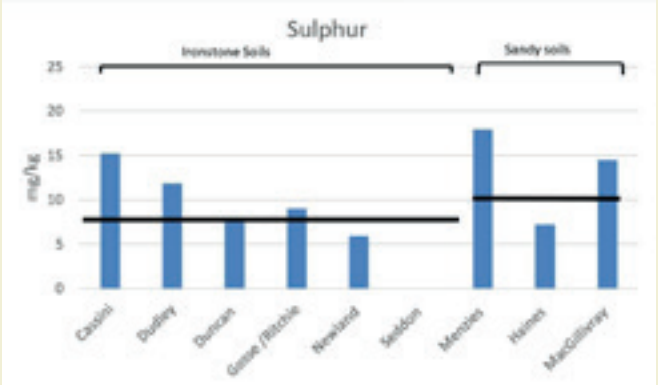

Table 3: Summary of Results for Sandy Soils

	pH level ($CaCl_2$)	Phosphorus (mg/kg)	Potassium (mg/kg)	Sulphur (mg/kg)	Conductivity (dS/m)	Organic Carbon (%)
	Target Levels of Sandy Soils					
	>5.5	>20 mg/kg	>120 mg/kg	>10 mg/kg	0-2 dS/m	>1.0%
HUNDRED (no. samples)	Average (range)	Average (range)	Average (range)	Average (range)	Average (range)	Average (range)
Haines (24)	5.1 (4.4 – 5.7)	39 (11 – 67)	196 (67 – 460)	7 (3.2 – 18.6)	0.10 (0.21 – 0.04)	3 (1.8 – 3.9)
MacGillivray (14)	5.1 (4.5 – 5.6)	48 (33 – 66)	191 (83 – 284)	14 (5.6 – 23.8)	0.10 (0.05 – 0.15)	3 (2.63 – 4.34)
Menzies (14)	5.8 (4.8 – 7.1)	44 (13 – 96)	209 (129 – 651)	18 (8 – 61.9)	0.19 (0.07 – 0.73)	2 (1.51 – 3.98)

Table 4: Summary of Results for Ironstone Soils

	pH level ($CaCl_2$)	Phosphorus (mg/kg)	Potassium (mg/kg)	Sulphur (mg/kg)	Conductivity (dS/m)	Organic Carbon (%)
	Target Levels of Ironstone Soils					
	>5.5	>35-45 mg/kg	>120 mg/kg	6-8 mg/kg	0-2 dS/m	>2.0%
HUNDRED (no. samples)	Average (range)	Average (range)	Average (range)	Average (range)	Average (range)	Average (range)
Dudley (16)	5.6 (4.5 – 7.4)	41 (23 – 85)	384 (134 – 862)	12 (7.4 – 19.9)	0.16 (0.08 – 0.26)	3 (2.2 – 4.9)
Duncan (8)	5.0 (4.7 – 5.5)	29 (18 – 51)	83 (36 – 162)	6.4 (2.7 – 23.8)	0.09 (0.04 – 0.16)	3 (2.35 – 4.89)
Ritchie (15)	5 (4.3 – 5.1)	27 (12 – 65)	181 (69 – 361)	9 (5.8 – 14.6)	0.12 (0.07 – 0.15)	2 (2.8 – 4.8)

During 2017-2018, almost all of the samples collected from hundreds with predominantly sandy soils had phosphorus levels greater than 20 mg/kg. Of the hundreds with predominantly ironstone soils, about half of the samples had phosphorus levels lower than the recommended level of 35-45 mg/kg (**Figure 2**).

The majority of soil samples in all hundreds had potassium levels above 120 mg/kg (**Figure 3**).

Of the hundreds with predominantly ironstone soils, the majority of samples had sulphur levels greater than 6-8 mg/kg (**Figure 4**). Of the hundreds with predominantly sandy soils, the majority of samples from the hundred of Haines were below the critical value of 10 mg/kg.

Summary

The 2017-2018 soil tests carried out by Kangaroo Island farmers indicate that overall, soils in the area are on target or above for organic carbon and potassium and low in salinity.

Soil phosphorus levels were low in the predominantly ironstone soil hundreds and sulphur levels were also low on some properties with sandy soils. Across the Island, soil pH ($CaCl_2$) levels were below critical values. Areas where the coupling of low phosphorus and low pH is occurring, would result in limiting overall farm productivity.

Soil types vary within each hundred, so care must be taken in the broader interpretation. In addition, the data only reflects the number of samples taken in each Hundred, which may represent only a few properties. The data and resultant graphs can only be interpreted to the point of identifying trends over time.

Take home messages

- Soil testing is essential for monitoring soil fertility levels
- Of all the soil samples taken the majority were below critical levels for pH
- Phosphorus levels were low on some properties with ironstone soils
- Sulphur levels were low on some properties with sandy soils.

Funding/Sponsors:

Agriculture Kangaroo Island through the National Landcare Program

PIRSA

Note: The information used was sourced from individual Kangaroo Island Farmer soil tests and analysed using CSBP Analytical Laboratory.

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Soil Testing - Making the Best Use of Technology

Background

Precision Agriculture has now been mapping paddocks on KI since 2013. But are we making the best use of this technology? It's one thing to have the 'pretty maps' and a spreader that will apply lime and fertiliser to match paddock variability, but how does that relate to grazing pressure and other sub soil constraints? AgKI received funding through the National Landcare Program, to set up two demonstration sites to investigate the use of pH and nutrient mapping (using PrecisionAg, in the top soil (0-10cm)) with pasture growth monitoring (using Decipher) and sub soil constraint mapping (using the EM38).

What was done?

The two demonstration sites are located on Rick and Annie Morris' property, Mt Taylor Rd and Bolto Partners, Woods Rd. Both sites were mapped by PrecisionAg in November 2017 for pH, PBI, phosphorus, potassium and sulphur on a 1.5 ha grid. In addition, an EM38 survey was also undertaken at both sites, mapping at two depths 0 - 0.75m and 0 - 1.5m.

EM38, or electromagnetic mapping, sends an electromagnetic signal into the soil which generates a secondary magnetic field which is then measured. The strength of the signal received can be used to measure subsoil characteristics including moisture, texture and salinity, as well as identifying potential constraints. EM38 maps correlate well with yield, particularly in dry years.

In addition at the Bolto site, each 1.5 ha grid was mapped twice, with one transect running N-S and one E-W to check the repeatability of the mapping. At the Morris site, PBI was measured at each 1.5 ha grid to ascertain how variable PBI is across a paddock. The usual practice is to test one or two composite samples per paddock.

The next step in the project will be to correlate the soil data to pasture growth rates using NDVI maps. NDVI (Normalised Difference Vegetation Index), is basically an index of greenness. Changes in NDVI are strongly correlated to the variation of green herbage during the season and can be used as a means of monitoring density and vigour of green vegetation growth.

Results

1) Nutrient mapping, EM38 and NDVI.

Nutrient and EM38 mapping has been completed on both sites. Work will be undertaken this year to correlate the soil and NDVI results and to further investigate soil limitations. Stay tuned for next year's write up for the results. Refer to **Figure 1** for an EM38 map of the Bolto demonstration site highlighting the variation across the site.

2) Mapping reliability

At the Bolto site, the paddock was divided into 12 x 1.5 ha grids and each grid was mapped twice (one transect running N-S and one E-W).

The pH ranged from 5.3 to 6.2 across the paddock. The pH mapping was reasonably robust, with 75% of all the readings the same or within 0.2 units difference. This is consistent with the natural variation we would expect to see within replicated soil transects.

Two grids had a 0.3 unit difference and one with 0.6 unit difference. If the pH target for the paddock was 5.5, these variations would have resulted in an under/ over lime application of approximately 0.5t/ ha on those 4.5 ha, or the potential for an extra 2.25t of limesand application on a 18 ha paddock.

The phosphorus ranged from 15 to 67 ppm and Sulphur ranged from 8 to 15ppm across the paddock. Again this is consistent with the natural variation we see across paddocks. The phosphorus and sulphur maps were also reasonably robust with 80% of all readings having less than 25% variation. Two grids had phosphorus results that were different enough to have caused an under/over application of up to 1 kgP/DSE/ha. The sulphur readings in the two grids varied by 3 units, but this variation would not have warranted a change in the fertiliser recommendations.

Figure 1: Map of Bolto demonstration site, showing the variation in the 0-1.5m depth EM38 readings

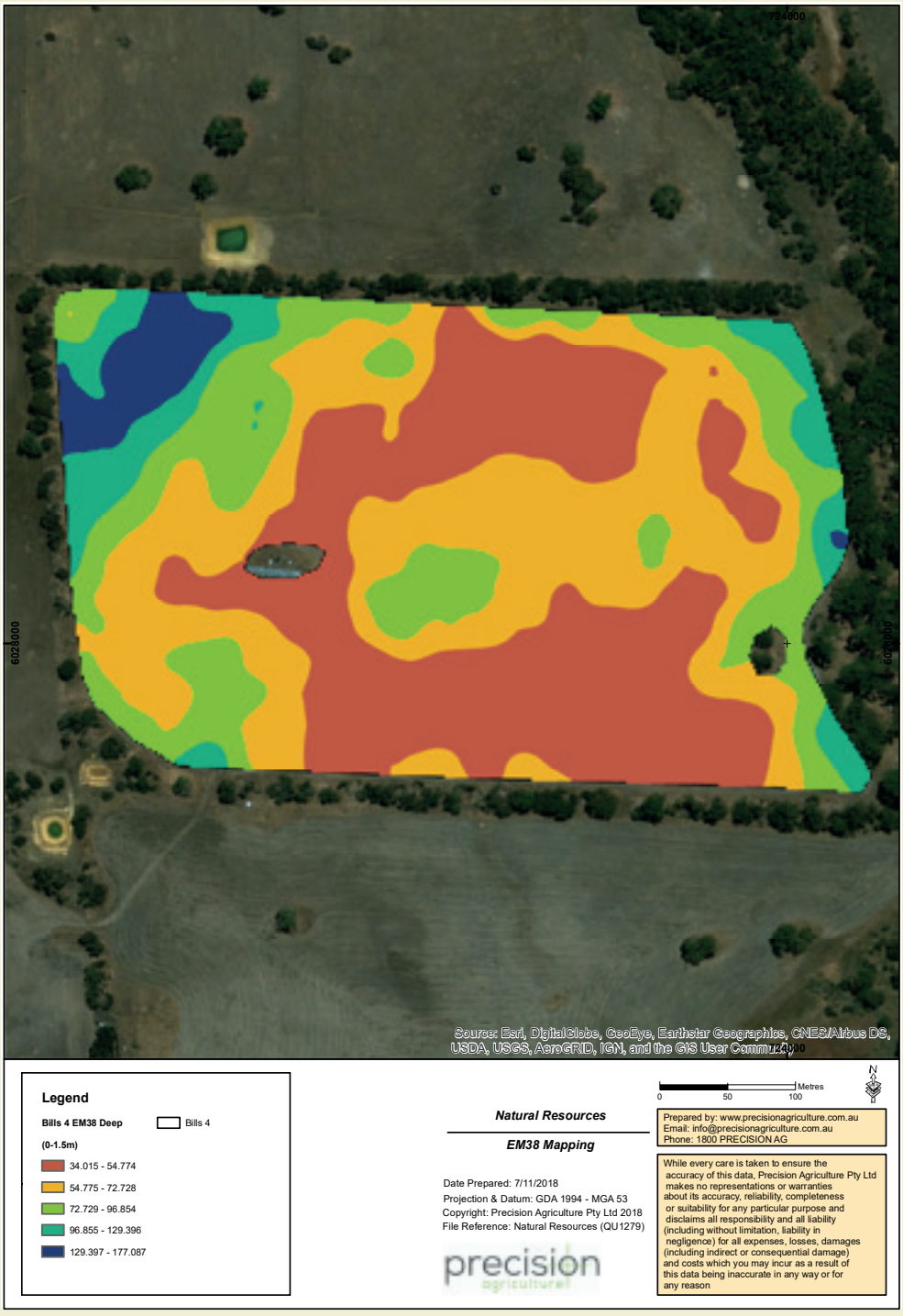

Figure 2

Bunkers North Phosphorous (P)

precision agriculture

THE FUTURE OF FARMING IS HERE

Client: Morris, Rick
Farm: Rick Morris
Paddock: Bunkers North
Name: Bunkers North - Soil Tests 2(
Date: 19/11/2018
Min: 18 mg/kg
Max: 57 mg/kg
Avg: 39 mg/kg

Above 70 mg/kg	0.00 ha
53 - 70 mg/kg	2.80 ha
35 - 52 mg/kg	11.30 ha
24 - 34 mg/kg	5.54 ha
18 - 23 mg/kg	4.25 ha

Trimble

The potassium was the most variable with only 67% of the readings having less than 25% variability. Although, at this site there were only two grids of readings below the critical value of 120 ppm, meaning; only 2 sites that may have required potassium could have been missed.

Overall, the N-S and E-W transects for the grid sampling were generally consistent with the few exceptions outlined above. This provides confidence in the grid soil mapping being used whilst highlighting the soils are variable and this variability can affect the results within an individual grid.

Only two PBI readings were taken at the Bolto site, with only 3 points difference between the two readings. On Morris property, the PBI was mapped on a 1.5 ha grid. Usually the PBI is calculated from a single composite sample per site. PBI's are critical for calculating phosphorus application rates i.e. a site with a phosphorus reading of 25ppm in a soil with a PBI of 30, would require a maintenance application of 1kgP/DSE whereas, the same phosphorus reading in a soil with a PBI of 140, would be considered phosphorus deficient and would require an application of 1.5-2.0kg P/DSE. On the Morris site the PBI varied from 45 to 146.

The paddock mapping shows the inherent variability in all paddocks (refer to **Figure 2**). If traditional soil sampling had been undertaken (where samples are taken in a single transect to get one result for the whole paddock), a transect running E-W would have given an entirely different reading than one running N-S, resulting in over 50% of the paddock being either over or under fertilised. This highlights the variability in P and PBI across the paddock and the value of more intensive soil sampling to inform fertiliser decisions.

Take home messages

- Precision mapping of soil provides a more accurate understanding of pH and nutrient status than traditional sampling
- Soils are highly variable, so even replicate samples of the same transect will vary and there is no 'perfect result' so just be aware of this in the interpretation of the maps.
- If your paddock varies in soil type ensure extra samples are analysed for PBI.

Funding/Sponsors:

Agriculture Kangaroo Island through the National Landcare Program

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Soil pH Micro-variation Mapping

Background

Farmers usually collect top-soil (0-10cm) samples when determining if they need to lime, but soil pH can be quite variable down the soil profile. Will a single sampling depth show up this inherent variability? To then further complicate the issue, most farmers usually broadcast lime as the paddock is either in permanent pasture or under minimum tillage in crop. However, we know that lime moves slowly through the soil profile and KI data indicates limited movement below 5-10cm.

This raises many questions:

- Are our soils acidifying at depth, and if so will this impact on crop and pasture growth?
- What happens when we just apply lime to the top soil?
- Do we need to be re-thinking our liming program?

The widespread adoption of minimum tillage will have impacts on how we manage soil acidity. The current standard industry practice of spreading lime, with no incorporation under minimum till systems, confines the lime benefits to the surface layers. There is a range of options to get lime to depth under minimum or no-till operations that farmers may need to now consider:

- Applying high rates of surface applied lime to drive the leaching of lime down the soil profile.
- Incorporating lime into sub-surface or sub-soil using specialised machinery.
- Delving or spading to help move lime or help mix less acidic soil horizons.
- Use of strategic tillage to more thoroughly incorporate the lime.

What was done

Two cropping sites were selected on R & K Stanton and Sons “Caledonia” property on Timber Creek Rd, Hundred of Seddon. Both sites were sampled on the 4th June 2018. At each site, four mini (soil) pits were dug approximately 50 cm apart. In each mini pit, five 4 cm wide cores were taken, two under each seeding row and three cores between the seeding rows. Each core was subsampled into 2.5 cm increments down to 15 cm, bulked and analysed for soil pH.

Site 1:

- Canola stubble 8” spacings
- Limed 2009 and 2016 @ 2.5t/ha
- Continuously cropped since 2006
- Zero till since 2010
- Soil – loamy ironstone over clay. Clay at about 30 cm (below sampling depth)

Site 2:

- Canola stubble 8” spacings
- Limed 2009 @ 2.5t/ha
- Continuously cropped since 2006, except in 2016 when it was sown to Balansa clover
- Zero tillage since 2010
- Soil – loamy ironstone over clay. Clay at about 30 cm (below sampling depth)

Results

At Site 1 the results show limited lime movement below 5 cm, even after 2 lime applications (refer to **Table 1**). This correlates with other monitoring work on Kangaroo Island and the mainland, which indicates that broadcast lime does not move much below about 5 cm at normal application rates of 2.5t/ha. Only the top 2.5 cm of top soil has pH readings considered adequate for crop growth, with some lime movement into the 2.5 to 5 cm layer but still below desirable levels.

The results indicate a distinct “acid throttle” between 5-10cm. An acid throttle occurs when there is a layer of soil with low pH that would be

sufficient to restrict root growth, thus limiting the crop's access to water and nutrients.

Site 2 (**Table 2**) was limed over nine years ago and the results are showing that re-acidification has now occurred in the top soil. In essence, the acid throttle is now the full top 10cm of soil.

These results indicate the need for regular liming to increase and then maintain soil pH. Site 2 had completely re-acidified in nine years. The results also highlighted the limited movement of lime down the profile. Traditional 0 -10 cm soil sampling post liming may give a false result by indicating a pH increase through the top soil when in fact, it's only the top 2.5 cm that has increased in pH. Farmers need to be aware of this and sample pH at greater depths. A quick check may be to dig a quick a hole (just with a shovel will be fine) down to 20 cm and test the pH with a garden soil pH kit. This will quickly highlight the soil pH to depth and the potential for any acid throttles.

If an acid throttle is detected i.e. a zone of soil with a pH of less than 5 in the top 20 cm of soil, other liming strategies will need to be considered. This may involve an increase in rate and/or frequency of lime application, but be aware of the risk of over-liming and inducing nutrient deficiencies, especially Manganese. Otherwise, you may need to consider a once off strategic tillage to fully incorporate the lime.

Table 1: Soil pH results from site 1.
Note column headings are the distance from the first seeding row.

Depth/Width (cm)	Seeding Row	3-7cm	8-12cm	3-17cm	Seeding row	Mean down
0-2.5	5.61	5.52	5.62	5.62	5.74	5.6
2.5-5	4.65	4.76	4.81	4.81	4.74	4.8
5-7.5	4.38	4.38	4.51	4.51	4.13	4.4
7.5-10	4.45	4.43	4.42	4.42	4.32	4.4
10-12.5	4.67	4.61	4.61	4.61	4.59	4.6
12.5-15	4.79	4.81	4.74	4.74	4.74	4.8
Mean across	4.8	4.8	4.8	4.8	4.7	

pH	
>6	
5.5-5.9	
5.0-5.4	
4.5-4.9	
4.0-4.4	

Soil pH Micro-variation Mapping (cont.)

Table 2: Soil pH results from site 2.

Depth/Width (cm)	Seeding Row	3-7cm	8-12cm	3-17cm	Seeding row	Mean down
0-2.5	4.49	4.13	4.29	4.51	4.35	4.4
2.5-5	4.58	4.08	4.05	4.1	4.05	4.2
5-7.5	4.14	4.16	4.14	4.18	4.07	4.1
7.5-10	4.32	4.37	4.43	4.46	4.28	4.4
10-12.5	4.67	4.73	4.74	4.69	4.55	4.7
12.5-15	4.9	4.92	4.93	4.82	4.8	4.9
Mean across	4.5	4.4	4.4	4.5	4.4	

Take home messages

- Monitor pH to depth by using a shovel and cheap pH test kit
- Don't assume just because you once limed that the problem is solved – monitor, monitor, monitor
- Consider options to get lime to depth by increasing the rate and/or frequency of liming or using strategic tillage

Funding/Sponsors:

DEW

Stanton family

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Kangaroo Island Biodiverse Carbon Pilot Project

Background

Coastal riverine and areas of high rainfall in South Australia, have been identified as having potential for successful carbon farming projects and are considered priority areas for further investigation. As such, in 2018 the Department for Environment and Water (DEW) has identified Kangaroo Island as a primary location to launch the first biodiverse carbon offset pilot project, due to its climate, location, and potential brand marketing opportunities for local farms and businesses.

This Pilot project will use the Environmental or Mallee Planting Carbon Farming Methodology, to establish native mallee vegetation that can capture and store carbon as it grows. Projects can undertake revegetation by planting (environmental planting) or natural regeneration.

The project aims to add income diversification to the other benefits that native vegetation can bring to a property such as improving biodiversity, providing shelter for stock and beneficial insects for crops, protecting eroded or degrading land, protection of watercourses and improving water quality. A key principle of the project is to maximise on-farm benefits while minimising the impact on good quality agricultural land.

What is carbon farming?

Carbon farming is basically the capturing and long-term storing of carbon. This can be an engineering solution such as the capturing of methane produced in the breakdown of waste at municipal waste sites, capturing carbon in soil, reducing methane produced by stock or, in this case, by capturing carbon in vegetation.

An Australian Carbon Credit Unit (ACCU) is issued for every tonne of carbon captured. The credits are then sold through carbon markets. The income from a project depends on the growth rate of the trees and the price of carbon which fluctuates depending on supply of and demand for ACCU's. In much the same way as in the stock market, credits can be retained and sold when the owner thinks the price is right. Credits can also be sold directly to a voluntary buyer.

Carbon farming projects must follow specified carbon farming "methodologies" and other requirements under the Commonwealth Government's Emissions Reduction Fund. These methodologies describe how the method is applied and how the carbon is calculated.

Results

Following a call for expressions of interest and site inspections last November, 64 ha of revegetation on 11 properties and one site of 416 ha of natural regeneration have been approved. The revegetation sites are windbreak/shelterbelts, protecting creek lines or smaller patches on non-agricultural land.

The next step is to engage a Carbon Farming service provider, to work with the proponents to prepare a submission to register both a revegetation project and a natural regeneration project, with the Emissions Reduction Fund. If successful, these projects can serve as "anchor projects" that future works using the same methodology can be added to. Once the projects are registered, preparation for planting such as seed collection, growing tubestock, fencing and site preparation can commence.

Funding/Sponsors:

The Biodiverse Carbon Credit Pilot Project is a South Australian State Government funded project.

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Or go to the NRKI website at:
https://www.naturalresources.sa.gov.au/kangarooisland/land-and-water/KI_Biodiverse_Carbon_Credit_Pilot_Project

Biosecurity Update

Natural Resources Kangaroo Island (NR-KI) is working with PIRSA Biosecurity SA, on vehicle checks at the Cape Jervis ferry terminal performing front line biosecurity inspections, which include:

- checking new and used agricultural equipment for contaminants such as soil and seeds
- verification checks of National Vendor Declaration documentation for consignments of livestock
- vehicle checks of the traveling public, ensuring prohibited items such as honey and seed potatoes are not brought to Kangaroo Island.

NR-KI encourages the agricultural sector to incorporate biosecurity activities into their operations.

To date, 302 ferry services have been checked carrying 10,777 vehicles and 33,540 passengers. A significant increase in biosecurity awareness has been noted from the positive interactions with passengers and the decline in honey intercepted - from almost one in ten vehicles to less than one in every fifty vehicles.

NRKI have also worked closely with contractors visiting the Island, including tree trimming companies and utility providers, to ensure they are aware of biosecurity requirements and that their biosecurity procedures are in place when visiting rural areas. These procedures include cleaning and disinfecting equipment and

Inspecting a newly arrived potato cleaner for contaminants.

vehicles to reduce the likelihood of spreading weeds and disease through fieldwork activities.

SA Power Networks now have their own arrangements placing their warning signage at entrances to rural properties to direct contractors to contact the landholder prior to entry. This allows landholders to ensure that farming activities such as lambing or cropping, are not compromised by the entry of the contractors. Landholders are encouraged to liaise with utility providers, to ensure their biosecurity concerns are addressed when the contractors need to access the utility infrastructure on their land.

NR-KI have had presence at field days, agricultural shows and rams sales, to demonstrate the use of biosecurity tools such as, footbaths and boot scrubbers & use of biosecurity signs. They were also there to raise awareness of biosecurity concerns and encourage farmers to partake in the One Biosecurity scheme.

Response plans for high-risk agricultural pests including: rabbits, foxes and European wasps are in place to assess and act on reports received. The plans outline how NRKI will react to potential incursions, the resources and expertise available to assist in managing the risk and how the community will be involved in the response effort. Landholders are encouraged to be vigilant and report any unusual sightings of animals, insects or weeds in order to ensure new incursions of invasive species are investigated and dealt with. The need for vigilance is encouraged throughout the community and visitors alike.

A number of reports from the agricultural sector have resulted in significant biosecurity risks being averted for example; the detection of an unusual prickle seeds in feed lupins from the mainland was found to be the declared weed caltrop. This would have had a very high impact on agricultural production if it established on Kangaroo Island. The early detection allowed for compliance action to be taken to minimise the risk. The action against the supplier is still to be finalised but may result in a significant fine or other sanction.

In the meantime, the properties who received the contaminated lupins have undergone extensive surveillance and monitoring in an effort to detect any caltrop establishment. No plants have been detected and the monitoring will continue for at least another year.

Similarly, a report of a live rabbit being held on a rural property was acted on and the rabbit seized and compliance proceedings initiated. The absence of rabbits on Kangaroo Island is highly beneficial for agricultural production as well as for the environment.

The Biosecurity Strategy for Kangaroo Island 2017- 27 was developed following consultation with the community and the agricultural sector. It outlines the approach to managing biosecurity on the island. Biosecurity is a shared responsibility and we all benefit from the outcomes of maintaining a good biosecurity system.

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Wind-proof your farm: Increasing farm productivity with shelterbelts

FACT SHEET 2019

The benefits of shelterbelts

Research has shown the beneficial effects of shelterbelts on farm productivity.

The main benefits for landholders in southern Australia are:

1. **Young lambs with shelter have a greater survival rate than those without.**
   - » Shelterbelts can increase survival of young lambs in their first 48 hours from 84% to 93% for single lambs (Bird et al, 1984).
   - » The increase in survival is even larger for twins, where shelterbelts have been shown to increase survival from 56% to 78% (Bird et al, 1984).
   - » The bottom line $: For a flock of 2,000 ewes where half have a single lamb and half have twins, these percentages mean an extra 530 lambs surviving per year!
2. **Shelterbelts can reduce water loss in pasture plants particularly in spring and summer, which extends growing conditions.**
   - » Although there can be a loss of productivity close to a shelterbelt, gains in productivity have been shown in plant production at a distance of 2-18 times the height of the shelterbelt into the paddock.
   - » This positive effect is due to wind speed reduction and temperature modification resulting from the shelterbelt.

Natural Resources Kangaroo Island

Government of South Australia