Evergreen FARMING

Sustainable "Green Farms All Year Round"

www.evergreen.asn.au

Newsletter of Evergreen Farming September 2007

Points of Innovation

Achieving a successful establishment of perennial pastures on highly non-wetting sand has been an elusive dream for farmers. That was until innovative people like Grant Bain put on their thinking caps and got out their welders and starting modifying machinery. Suddenly good germination didn't seem so elusive after all. All it needed was some "left field" solutions. Farmers, being farmers, are now trialing a whole host of machinery modifications being to overcome non-wetting. At two recent Evergreen / NACC Establishment field days, farmers were invited to bring along their modified points. The two photos at the bottom show just how imaginative our members are! New ideas welcome… Send in your photos.

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Australian Government Department of Agriculture, Fisheries and Forestry National Landcare Programme

Department of Agriculture and Food

Kikuyu poisoning on the South Coast

Danny Roberts & Paul Sanford, Department of Agriculture and Food, Phone: (08) 9892 8535.

Although kikuyu is usually grazed with no ill effects sporadic outbreaks of poisoning in cattle and to a much lesser extent in sheep have been reported in Australia, New Zealand and South Africa. Kikuyu poisoning is rare in Western Australia.

Poisoning consistently occurs in association with the grazing of rapid kikuyu growth in autumn initiated by rain following a protracted period of summer drought. The majority of offending pastures have been spelled for several weeks prior to a toxic episode and have accumulated substantial herbage.

During April 2007 the Department of Agriculture and Food received 16 reports from cattle producers of outbreaks of kikuyu poisoning on properties surrounding Albany.

Poisoning developed when cattle were re-introduced, after good autumn rains, to spelled kikuyu-dominant pastures that had been heavily grazed over the extended dry summer and exposed to summer locust invasions.

The clinical signs developed within 2 to 5 days of the cattle being reintroduced to the paddocks. Symptoms include profuse salivation, depression, a staggering gait, standing near or over water, kicking and scratching of the belly, green diarrhoea and some animals had difficulty standing and walking.

Not all cattle grazing toxic kikuyu pastures develop clinical signs of poisoning with 5% to 80% of animals showing evidence of one or more symptoms. Most of the clinical signs seen in affected cattle disappeared over the next 3-5 days but some animals took more than 5 days to recover.

Most of the reported kikuyu outbreaks had deaths in 1 to 6 cattle. The worst outbreak had deaths in 23 out of 45 cows grazing a 44 hectare kikuyu dominant pasture.

It is not known what causes the kikuyu to become toxic under these conditions but fungi may be implicated. Investigators in NSW believe the poisoning is caused by the toxins of *Fusarium torulosum*, an endophyte fungus of kikuyu. The Animal Health Laboratories of DAFWA have identified *Fusarium torulosum* endophyte in kikuyu leaves from 20 out of 21 samples collected from toxic and non toxic paddocks. Samples of kikuyu leaves collected from toxic paddocks were rated as moderate to severe for *F. torulosum* infection compared with low or very low from non toxic paddocks.

While the presence of the endophyte supports the case that *F. torulosum* is involved, further research is required to identify the causal toxin associated with kikuyu poisoning.

From the President

Erin Gorter (President) Kojonup, Phone: (08) 9833 7524

It's been another busy few months for Evergreen Farming and Evergreen farmers, with some much needed rain experienced by most in the agricultural regions of WA – finally.

Our Pastures for Profit events were a resounding success with interesting speakers at Mt Barker, Esperance and Dandaragan. These days are now becoming fixtures on calendars as everyone is realising this is an event not to be missed each year. We are always keen to hear from our members if they have any suggestions for improvements. The team at John Duff & Associates are to be congratulated on putting together such a professional program with the help of committee members.

Our first, major Australian Wool Innovation funded project is now complete after 3 years of excellent research, development and extension. This project has vastly expanded our knowledge of perennial pastures and also greatly contributed to Evergreen's growth and success over the last few years. The support from AWI was critical, so I'd personally like to thank them on behalf of all WA woolgrowers (and other farmers alike!).

In exciting news we have just received funding from the Federal Government's National Landcare Programme (NLP) to provide one-on-one advice for new growers of perennial pastures in both northern and southern areas of the state. We will be able to visit 90 growers over the next 12 months to provide advice on species selection, establishment, and ongoing management. A number of high priority catchments have been targeted, and we will work with local Landcare officers to identify interested growers. More details soon.

Our AGM will be held at Technology Park in Bentley on Thursday 27 September from 11:30am. Guest speaker will be Kevin Goss from the Future Farm CRC. See you all there!

PASTURES FOR PROFIT 2007

Over 300 people attended this years Pastures for Profit workshops. Key messages from the main speakers were:

* David Marsh gave an impassioned talk on how and why he changed from high input cropping to a relatively low input grazing system. His goal is to build natural capital (soils, water, biodiversity, people etc) by the use of planned (rotational) grazing, matching stocking rate to carrying capacity, and perennial pastures. He emphasised the need to set your own goals, and not be too swayed by others or traditions, and then use these to make your own decisions.

* Christine Jones discussed all things carbon. A key message was that exudates from plant roots are the major source of soil carbon, not plant residues. She said regardless of whether you receive soil carbon credits in the future, building soil carbon is highly profitable as it increases water holding capacity and nutrient retention leading to better plant growth.

* David Lee from Holmes Sackett & Associates emphasised the need for a farming family to generate at least $200,000 of profit each year to meet living expenses, child education, capital improvements, succession, etc. He said the key profit drivers were scale of operation and cost of production. To boost profits, low or zero cost changes such as switching lambing time and choosing the optimum stocking rate should be pursued first, before looking at more costly changes such as pasture renovation or increased fertiliser.

2007 EXECUTIVE COMMITTEE

President

Erin Gorter - Kojonup
Ph: (08) 9833 7524
eringorter@bigpond.com

Vice President

Bob Wilson - Lancelin
Ph: (08) 9655 1055
bobwilson@bordernet.com.au

Secretary/Treasurer

David Monks - Badgingarra
Ph: (08) 9652 9277
monks.d@bigpond.com

Committee

Bob Leeson - Lancelin
Ph: (08) 9655 1785
rleeson@bigpond.com

Craig Forsyth - Dongara
Ph: (08) 9927 5035
craigfor@midwest.com.au

Paul Omodei - Manjimup
Ph: (08) 9777 2980
paul@agrom.com.au

Charlie Hick - Narrikup
Ph: (08) 9845 3076
candmhick@bordernet.com.au

Executive Officer

John Duff
Ph: (08) 9475 0753
jd@consultag.com.au

Projects Manager

Philip Barrett-Lennard
Ph: (08) 9475 0753
pbl@consultag.com.au

Administration

John Duff & Associates
Suite 5/110 Robinson Ave
BELMONT WA 6104
Ph: (08) 9475 0753
Fax: (08) 9475 0322
adminjd@consultag.com.au

Building soil carbon with Yearlong Green Farming

Dr Christine Jones, Founder of Carbon For Life Inc. www.amazingcarbon.com

The capacity for appropriately managed soils to sequester atmospheric carbon is enormous. The world's soils hold around three times as much carbon as the atmosphere and over four times as much carbon as the vegetation. **Soil represents the largest carbon sink over which we have control.**

When atmospheric carbon is sequestered in topsoil as organic carbon, it brings with it a wealth of environmental, productivity and quality of life benefits. An understanding of the 'carbon cycle' and the role of carbon in soils, is essential to our understanding of life on earth.

Building soil carbon requires green plants and soil microbes.

There are 4 steps to 'turning air into soil'

i) Photosynthesis
ii) Resynthesis
iii) Exudation
iv) Humification

Photosynthesis is a two-step endothermic reaction (ie a **cooling process**) which takes place in the chloroplasts of green leaves. Incoming light energy (sunlight) is captured and stored as biochemical energy in the form of a simple sugar - glucose ($C_6H_{12}O_6$), using carbon dioxide (CO_2) from the air and water (H_2O) from the soil. Oxygen is released to the atmosphere.

Photosynthesis requires 15 MJ of sunlight energy for every kilogram of glucose produced. If the same 15 MJ of incoming light energy makes contact with a bare surface, such as bare ground, it is reflected, absorbed or radiated - as **heat**, usually accompanied by moisture. The respective area of the earth's surface covered by either actively growing crops and pastures, or bare ground, has a significant effect on global climate.

Resynthesis: Through a myriad of chemical reactions, the glucose formed during photosynthesis is resynthesised to a wide variety of carbon compounds, including carbohydrates, proteins, organic acids, waxes and oils. Carbon atoms can link together to form long chains, branched chains and rings, to which other elements, such as hydrogen and oxygen, can join.

The energy captured during photosynthesis and stored in carbon compounds serves as 'fuel' for life on earth. Carbohydrates such as cellulose provide energy for grazing animals, the starch in grains provides energy for livestock and people. The carbon stored in previous eras as 'fossil fuels' (hydrocarbons) such as coal, oil and gas provides energy for vehicles, machinery and industry.

Exudation: Around 30-40% of the carbon fixed by grass plants during photosynthesis is exuded into soil to form a microbial bridge (to feed the microbes that enhance the availability of essential plant nutrients). In this way, actively growing crops and pastures provide 'fuel' for the soil engine.

Figure 1. Root volume, rhizosphere surface area, exudation of carbon, microbial activity, humification and soil building are highly correlated with the perenniality and vigour of groundcover plants

Carbon compounds are essential to the creation of topsoil from the structureless, lifeless mineral soil produced by the weathering of rocks.

Organic carbon additions are governed by the volume of plant roots per unit of soil and their rate of growth. The more active green leaves there are, the more roots there are, the more carbon is added. It's as simple as that (Figure 1). The breakdown of fibrous roots pruned into soil through rest-rotation grazing is also an important source of carbon in soils.

Humification: Adding organic carbon to soil is one thing, keeping it there is another. Organic carbon moves between various 'pools' in the soil, some of which are short lived while others may persist for thousands of years. Carbon additions need to be combined with land management practices that foster the conversion of relatively transient forms of organic carbon to more stable complexes within the soil.

In the humification process, soil microbes resynthesise and polymerise labile carbon (exuded from plant roots) into high molecular weight stable humic substances. Humus, a gel-like substance that forms an integral component of the soil matrix, is the best known of the stable organic fractions.

Humification cannot proceed unless there is a continuous supply of 'fuel' for soil microbes. If humification does not occur, the carbon exuded from plant roots (or added to soil as plant residues or manure) simply oxidises and recycles back to the atmosphere as carbon dioxide.

Continued

Humic substances have significance beyond the relatively long-term sequestration of atmospheric carbon. They are extremely important in pH buffering, inactivation of pesticides and other pollutants, improved plant nutrition and increased soil-water-holding capacity. By chelating salts, humic substances can also effectively ameliorate the symptoms of dryland salinity. Increasing the rate of humification has highly significant effects on the health and productivity of agricultural land.

Importance of soil fungi

Most perennial grasses are excellent hosts for mycorrhizal fungi, with up to 100 metres of microscopic fungi forming per gram of soil under healthy grassland. Glomalin is a glycoprotein (contains both protein and carbohydrate) produced by arbuscular mycorrhizal fungi living on plant roots. Glomalin can persist for several decades and may account for one third of the stable organic carbon stored in agricultural soils.

Mycorrhizal fungi and glomalin production are inhibited by bare soil, intensive tillage, the application of phosphorus fertiliser and the presence of plants from the Brassica family such as canola, which do not form mycorrhizal associations.

Maintaining soil structure

'Aggregation' is part of the humification and soil carbon building process and is essential for maintaining soil structure. Glues and gums from fungal hyphae in the rhizosphere enable the formation of peds or lumps (which can be seen with the naked eye, often attached to plant roots). The presence of these aggregates creates macropores (spaces between the aggregates) which markedly improve the infiltration of water. After rain less water sits on the soil surface and waterlogging is reduced. As structure continues to improve, smaller and smaller aggregates are formed, along with soil mesopores and micropores, dramatically improving soil function, aeration, levels of biological activity and resilience.

Soil structure is not permanent. Aggregates made from microbial substances are continually breaking down and rebuilding. An ongoing supply of energy in the form of carbon from actively growing plant roots will maintain soil structure. If soils are left without green groundcover for long periods they can become compacted, blow or wash away.

Under conventional cropping or set-stocked annual pastures, the stimulatory exudates produced by short-lived species are negated by bare earth at other times of the year. The result is a decline in levels of soil carbon, soil structure and soil function.

Soil building requires green plants and soil cover for as much of the year as possible. In seasonal rainfall environments, a mix of perennial groundcover species enables response to rain at any time. In grazing enterprises, rest-rotation grazing is absolutely essential. For broadacre cropping, the presence of out-of-season groundcover ensures stability, long term productivity and soil building rather than soil destruction.

Any farming practice that improves soil structure is building soil carbon.

Water, energy, life, nutrients and profit will increase on-farm as soil organic carbon levels rise. The alternative is evaporation of water, energy, life, nutrients and profit if carbon is mismanaged and goes into the air.

Yearlong Green Farming (YGF) is any practice turning bare soil into soil covered with green plants. YGF increases quality, quantity and perenniality of green groundcover in broadacre cropping, horticultural, forestry and grazing enterprises.

Many benefits of Pasture Cropping, for example, can be attributed to having perennial grasses and cereals together side by side in space and time. Ongoing carbon additions from the perennial grass component evolve into highly stable forms of soil carbon while the short-term, high sugar forms of carbon exuded by the cereal crop roots stimulate microbial activity.

As a bonus, regenerative farming practices such as Pasture Cropping result in the production of food much higher in vitamin and mineral content and lower in herbicide and pesticide residues than conventionally produced foods.

Rewarding farmers for Yearlong Green Farming practices that build new topsoil and raise levels of organic carbon would have a significant impact on the vitality and productivity of Australia's rural industries. YGF would also reduce evaporation and heat radiation from bare soil surfaces, reduce the incidence of dryland salinity and counteract soil acidity.

Under **regenerative** regimes, soil carbon and soil life are restored, conferring multiple ecological and production benefits in terms of nutrient cycling, soil water storage, soil structural integrity and disease suppression. Benefits extend well beyond the paddock gate. Improved soil and water quality are the 'key' to catchment health, while YGF represents the most potent mechanism available for mitigating climate change.

It's about turning carbon loss into carbon gain.

Getting started in lifeless, compacted soils where the soil engine has shut down is the hard part. The longer we delay, the more difficult it will be to re-sequester soil carbon and re-balance the greenhouse equation.

Evergreen FARMING

Quantity and Quality trials - Key results to date

Geoff Moore, Department of Agriculture and Food, Phone: (08) 9368 3293.

There is considerable interest in growing sub-tropical grasses but little information on which species are best suited to WA conditions and the level of production which can be expected.

To answer these and other questions a series of five trials were established in spring 2004 in a joint project between Evergreen Farming, DAFWA and farmer groups to measure the seasonal production of a range of sub-tropical grasses in terms of both quantity and quality. Lucerne and annual volunteer pasture were added as controls. An annual pasture trial was established alongside the perennial trial in the following autumn with a range of annual legumes plus annual ryegrass. The trials are at Mingenew, Buntine and Badgingarra in the northern agricultural region, south-west of Kojonup in the Great Southern and on the sandplain north of Esperance. The project is continuing until June '08, but as most of the perennial trials have been established for almost 3 years it is an opportune time to discuss some of the key findings to date:

• Outstanding production on the Esperance sandplain

The site on Esperance Downs Research Station was established in spring 2005 (12 months after the other sites). Conditions have been favourable since the trial was established, with good summer rainfall both years, resulting in very high production. In the 18 months from late '05 to May '07, the best sub-tropical grass treatments (Finecut and Callide rhodes grass and Narok and Splenda setaria) have produced total biomass of 26-28 T DM/ha, compared with 14.4 T DM/ha for the annual volunteer pasture. This data was collected from monthly cuts between January '06 and May '07. Gatton panic, green panic and whittet kikuyu also performed well, with total biomass over the same period of 24.5, 24.0 and 20.6 T DM/ha respectively.

• Sub-tropical grasses out-perform annual pastures in a tough year in the north

There is increasing evidence that sub-tropical grasses can improve the resilience of farming systems in the northern agricultural region. For example, the best sub-tropical grass treatments produced significantly more biomass at Badgingarra than the best annual pasture treatments during the growing season in 2006 (Table 1). This is without taking into account the production following the summer rain in January-February.

At Buntine (325 mm) in the north-eastern wheatbelt the sub-tropical grasses (Bambatsi panic, green panic, rhodes grass) are showing good persistence, but to date production has been moderate. Overall, the economics of sub-tropical grasses in low rainfall areas appears questionable without subsoil moisture.

• Well adapted species show good persistence under very tough seasonal conditions

In terms of dry conditions it cannot get much tougher than the extended dry period across most of the agricultural area from November '06 to June '07. With the very dry seasonal conditions production was minimal. By late autumn the perennial grasses at Buntine, Mingenew and Badgingarra in the northern agricultural region were highly moisture stressed. The question was how quickly the grasses would recover, if at all.

The response of the grasses following the light rainfall in June-July was encouraging. There was excellent survival (<10% plant deaths) of bunch grasses like panic grass (gatton, green) at the Buntine, Badgingarra and Mingenew sites and they responded rapidly to the rainfall with new growth (see photo). Bambatsi panic, signal grass and setaria also had good survival (<10% plant deaths) but the plots had a lower plant density to start with; while kikuyu maintained >90% groundcover.

Rhodes grass was the most affected by the extended dry conditions. Some rhodes grass plants died at all three sites in the northern agricultural region and the remaining plants were highly stressed and are recovering slowly. Up until this last summer rhodes grass had performed very well at all of these sites. Plant density in the rhodes grass plots was very high (because the plots are mowed rather than grazed) which may

Table 1. Seasonal production at Badgingarra in 2006 (sown species kg DM/ha)

	Harvest date and biomass sown species (kg DM/ha)					
Variety	**16/02/06**	**8/06/06**	**6/09/06**	**12/10/06**	**13/12/06**	**Total**
Annual volunteer	0	241	664	1354	0	2260
Katambora rhodes	1303	887	2008	2050	1112	7360
Gatton panic	2153	589	1618	1214	141	5715
Callide rhodes	722	976	1371	1406	707	5180
Green panic	2214	787	2154	1470	394	7020
Narok setaria	2156	1243	634	1084	683	5800
Veldt grass	123	193	1160	1861	668	4000

Continued

Green panic at Mingenew on 10 July 2007 showing excellent recovery from the extended dry

have contributed to the overall stress. However, rhodes grass has the ability to rapidly send out runners and form new plants when favourable conditions return, so it will be interesting to see whether they recover strongly.

• Summer growth and sub-tropical grasses

The widespread summer rain in January-February 2006 enabled us to measure the production of the sub-tropical grasses under ideal growing conditions at Buntine, Mingenew and Badgingarra. The finding that rain in summer promotes growth of sub-tropical grasses should not be surprising, given that they come from sub-tropical environments with summer dominant rainfall patterns. As the summer rain was preceded and followed by dry periods, it enabled us to develop the following rule of thumb for summer production. Sub-tropical grasses with a high plant density can be expected to produce in the order of 20 to 30 kg DM/ha per mm of rainfall over the summer – early autumn period (assuming useful rainfall which is defined as >20 mm over a 7 day period). For example, if the rainfall is 35 mm over 3 days, then production of 700-1050 kg/ha can be expected from sub-tropical grasses. This of course assumes a good plant density (~10-20 plants/m^2) to get these levels of out-of-season production.

• Poor persistence of bunch and rhodes grasses in the Great Southern

The sub-tropical grasses had good to excellent establishment at Kojonup and grew strongly in autumn '05. However, all the bunch grasses and most of the rhodes grass died over the first winter at this site. The notable exception was kikuyu, which was unaffected with almost 100% groundcover in late spring.

The sub-tropical grasses appear not to be dying from frosts alone. It is expected that frosts will burn the top-growth of sub-tropical grasses; however they usually re-grow when warm conditions return. In areas like northern NSW and south-east Queensland they persist in areas which receive ~40 frosts per year. In WA it appears the combination of occasional frosts plus cold, wet soils results in the grasses dying over winter.

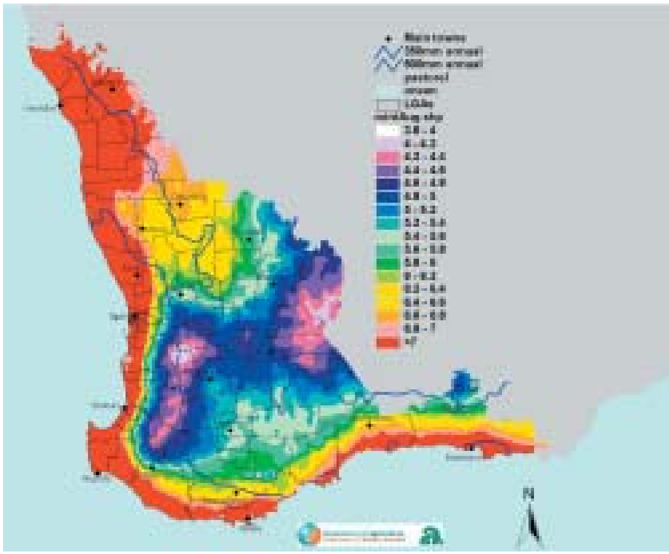
A 'cold zone' where the persistence of rhodes and bunch grasses is problematic has been spatially defined from maps of July-August mean minimum temperature (min. temperature <5.3°C) and frost frequency (see figure below). The cold zone appears to extend into the central and eastern wheatbelt.

• Kikuyu is extremely persistent

Kikuyu shows excellent persistence both in the Great Southern (where all of the bunch grasses died) but also at Mingenew and Badgingarra. It was unknown prior to the project whether kikuyu could persist on dryland sites in these environments. The answer is a resounding yes, with kikuyu having almost 100% groundcover at Badgingarra and Mingenew in June 2007 after the extended dry. It was the first species to respond to the light rainfall in late autumn. However, although kikuyu is very persistent at Mingenew and Badgingarra, production is considerably less than some of the other species.

These results suggest that kikuyu could be used for erosion control in the northern agricultural region on sandy rises. Most importantly, they should give growers on the south coast who have kikuyu or are contemplating sowing kikuyu a lot of confidence that established kikuyu pastures are highly likely to persist through any extended dry period that may occur on the south coast.

These trials are collaboratively funded by Australian Wool Innovation, Grain & Graze and Meat & Livestock Australia.



The mean minimum temperature showing the 'cold zone'.

Valuable lessons from extreme Esperance weather

Greg Warren, Quality Agronomics/Farm & General, Esperance, Phone: (08) 9072 0888.

When I took over the Esperance coordination of the "***Profit Driven Water Use with Sub Tropical Perennial Pastures***" Evergreen / ERF project I was aware of the range in seasonal conditions that Esperance is notorious for. However, I did not expect to experience such an extreme range of weather and rainfall patterns in the first 12 months.

The 2005 season was the first year of this project and experienced a cold and wet winter/spring which tested establishment under lower than ideal soil temperatures at sowing and massive weed and insect competition.

The spring of 2006 was the driest on record in some areas within the region, testing the establishment of sub tropical perennial grasses to the limit. Following this dry period was a 200 mm deluge in early January 2007!

The benefit of this variability is it has allowed agronomic packages to be developed that take into account seasonal extremes, something not often available with short-term projects.

Lessons learnt so far for successful establishment:

Which Species Where According to Rainfall and Soil Type

To date the standout sub tropical perennial grasses have been:

- Creeping Perennials – Kikuyu and Rhodes Grass
- Clumping / Tufting Plants – Setaria and Panic

Kikuyu has shown it will grow well in the 400^+ mm rainfall zone. It has also shown some promise in the 325 mm zone but production is limited without summer rainfall. It can grow well on deep gutless non-wetting sands and in transient waterlogged gravelly sands. Its success in high rainfall clay soils is dependent on good summer rainfall. It is providing major soil stabilization and carrying capacity benefits. In one trial area it has transformed poor deep sands that struggle to run 3 DSE through winter with no summer grazing into soils that can run >10 DSE all year round. This occurred within 8 months of sowing it down to kikuyu.

Rhodes grass (Topcut and Finecut are being trialed) is showing suitability to 450^+ mm rainfall zone and similar to kikuyu it is providing soil stabilization benefits. If mixed with Kikuyu, it is expected that kikuyu will dominate within 2-3 years due to its invasive underground stolons.

Setaria is showing reasonable adaptation and persistence in the transient water logging sand over gravel soils in the 400-500 mm region that have higher soil fertility. Trials at DAFWA's Esperance research station show consistent carrying capacity as long as it is not allowed to go rank.

Gatton panic is showing good adaptation to the sands and sand over gravel soils with good soil fertility in the 400^+ mm rainfall zone as long as they are well drained. A mixed planting of panic and lucerne will be grown in the 2007 trials.

Which Species Where According to Intended Grazing Use

Kikuyu is proving to be the best suited of the sub tropical grasses to the tight grazing patterns of sheep as its ability to spread via underground stolons prevents overgrazing. The surface growth of stolons with rhodes grass and the clumping nature of setaria and panic make them vulnerable to overgrazing by sheep, particularly when set stocked.

This clumping nature of panic and setaria and their grazing preference by livestock make them ideal species for cattle's softer grazing nature. Panic will be trialed in 2007 as "growing out" paddocks for cattle in a rotational grazing set up.

Kikuyu and rhodes grass are suited to cattle grazing and also work best when rotationally grazed.

Soil Temperature at Sowing is vital

The accepted measure of 15-18°C soil temperature for germination has proven to be the case on the South Coast and is extremely important in cold seasons. 2005 trials were planted in September when temperatures hovered around 13-14°C with limited germination until October when temperatures consistently reached 15°C. This 4-5 week lag period enabled annual weeds to germinate (particularly wireweed) and inhibit the sub tropical grass emergence.

Figure 1. Example of pastures on deep sand soils on the South Coast with limited carrying capacity and high erosion risk

Continued

In 2006 soil temperatures were already at 15°C by mid August and plantings at this stage germinated quickly without weed competition. Topsoil moisture had disappeared by early September (the traditional sowing time) so plantings at this stage suffered from patchy emergence due to these dry soil conditions.

These 2 examples highlight that altering sowing time to suit seasonal conditions is critical. A robust thermometer is a valuable tool to have on hand.

Weed control prior to sowing is paramount

The 2005 sites were sprayed out 4-6 weeks before sowing and again just prior to sowing but the wet and cold spring resulted in massive weed germination by the time the perennial grasses germinated. Wireweed germinated in large numbers in spring in a number of the trial sites. It proved to be extremely vigorous and choked out the perennial grasses and consequently 6 trial sites were written off.

Early post emergent wire weed control is an option with a chemical such as Dicamba which the major sub-tropical grasses such as kikuyu, rhodes grass, setaria and panic have shown tolerance to. However it cannot be relied upon particularly if the site is prone to water logging. Further trial work into post emergent herbicide options is needed.

In 2006 early weed control prior to sowing proved vital for preserving valuable surface soil moisture. One non wetting soil site had no emergence of kikuyu and rhodes grass when the 1st knockdown spray was only 2 weeks prior to sowing. In contrast, a non wetting site with a knockdown 6 weeks prior resulted in kikuyu emergence of 5-20 plants/m². The main difference was adequate soil moisture close to the surface.

Figure 2. Paddock next door with same soils with an 8 month old stand of kikuyu. Note the regeneration of serradella

Insect control cannot be neglected

Insects such as Rutherglen bugs and Red Legged Earth Mite proved very damaging to germinating sub tropical grasses in 2005. The addition of an appropriate insecticide (such as Alpha-Cypermethrin) with the knockdown proved effective for RLEM and African Black beetle when used at high rates. Rutherglen bugs need monitoring post emergent and can be easily controlled with an organophosphate insecticide.

Legumes are still needed for pasture composition

Experience to date shows good regeneration of annual legumes under the perennial grasses with serradella on the deeper sands and sub-clover on the shallower soils. Nitrogen drives the growth of sub tropical grasses, so the legume component of the pasture must be maintained to provide a low cost source of Nitrogen.

It appears kikuyu and rhodes grass allow better legume regeneration in autumn compared with setaria and panic. Regardless of the species, the trick is to graze down the perennials tight enough before the break of season to allow space for the legume regeneration.

It may be possible to include some hard seeded serradella pod when sowing sub tropical grasses in spring. However it proved competitive for moisture in a 2006 trial resulting in poor rhodes grass establishment. It would only work if soil moisture conditions were ideal at sowing and further rainfall expected.

Discs or tines for seeding

Discs provide more accurate seed placement, important for the shallow seed depth required. They are also a safer option for the fragile deep sands (less erosion risk) as long as there is still a mat of dead plant material on the surface.

Tines with knife points, closing plates and press wheels work reasonably well in sandy soils, as long as moisture is close to the surface. Banding soil wetting agent in the press wheel furrow will be trialled this year.

An Evergreen, Esperance Regional Forum, Fitzgerald Biosphere Group and WA Lucerne Growers project funded by National Landcare Programme (NLP)

- southcoastnrm.com.au -

SOUTHCOAST NATURAL RESOURCE MANAGEMENT

Government of Western Australia

Australian Government

Chicory - A high quality perennial pasture

Paul Sanford & Geoff Moore, Department of Agriculture and Food and Geoff Saul, PSA Services, Hamilton, Victoria.

Chicory is a summer active perennial herb suited to areas of southern Australia where summer rainfall occurs. It provides high quality herbage for livestock during summer and autumn when many temperate species have lower nutritive value. Due to its deep tap root, chicory can access soil moisture at depth and so dry out the soil profile and reduce the risk of salinity.

The potential of chicory in WA is still being investigated. However in high rainfall districts chicory looks promising for soils too acidic to grow lucerne, as a specialist pasture for finishing stock, or as a high quality component of a mixed pasture.

Chicory is best suited to deep soils in the >500 mm rainfall zone (>400 mm south coast). Chicory grows from early spring until early summer, responds to summer rain and grows in autumn depending on soil moisture. Winter growth is poor. Plants flower in late spring to early summer.

High animal growth rates, eg 290 g/head/day for lambs and 900 g/head/day in calves have been measured on chicory. Chicory provides a good balance between crude protein, energy and minerals. Results from the EverGraze site in Wellstead have shown chicory to be consistently higher in dry matter digestibility (and therefore energy) than lucerne, tall fescue and sub-tropical grasses.

There also appears to be potential to use chicory pastures to 'flush' ewes and stimulate higher conception rates. Preliminary data from an EverGraze trial at Wagga NSW has shown ewes grazing chicory for 14 days pre-mating had higher conception rates than ewes grazing dry phalaris pastures.

Chicory has a tap root that can access moisture from 2-3 m deep. Soil moisture measurements as part of the EverGraze project indicate that chicory dries the soil out more than sub clover, cocksfoot, phalaris and tall fescue, and is comparable to lucerne.

Time of sowing is flexible as chicory can be sown in autumn or early spring. Seed should be sown into a weed free seed bed at a depth of 10 mm with a seeding rate of 3 kg/ha when sown alone or 0.5–1 kg/ha when sown in a mixture. Insect control is essential as chicory is susceptible to Red Legged Earth Mites. Chicory has good seedling vigour when sown under favourable conditions. A good stand will have 45–60 plants/m^2 at the start of the first summer. The first grazing of a new chicory stand should occur when the plants are 15-20cm high and stock should be removed when plants are about 10cm high. Grazing must be for a short period with high stocking rates, ie 3-5 days, 100 DSE/ha.

Chicory requires rotational grazing to persist and can die out within 12 months if set stocked. To maintain production and quality the key is to maximise leaf growth and minimise stem growth. A three to four week rotation is suggested. Chicory can tolerate grazing to ground level providing it is a short intense grazing followed by a rest. Hard grazing in late autumn will reduce the persistence of the stand over winter as insufficient leaf growth remains to replenish the root carbohydrate reserves. Grazing of the annual component of the pasture over winter should be controlled so that stock do not chew the crowns of the chicory as this can increase the potential for crown infection from fungal diseases.

Chicory tends to thin out over time, with 20-30% of plants dying per year. However, there is potential to reinvigorate stands by allowing seed set and then encouraging recruitment of new seedlings. This is best achieved by spelling the chicory from grazing for 4 weeks when seedheads appear then heavy grazing once the seed has matured to remove excess stemmy material. Given good initial establishment, natural reseeding should only be required in the 3rd /4th season after sowing.

There is little specific information on the response of chicory to applied nutrients. Chicory is very responsive to N and companion species should aim to have a high legume content to fix nitrogen for use by the chicory. In addition, urea can be applied in August/September at 100 kg/ha to maximise chicory growth in spring. If the spring rains continue into October/ November, a second application of N could be considered.

Overall chicory looks promising for high rainfall areas of WA particularly as a specialist pasture for livestock requiring a diet high in energy and protein in late spring and summer eg prime lambs.

Evergraze - Prime lamb production system update

Paul Sanford, Department of Agriculture and Food, Albany, Phone: (08) 9892 8475.

EverGraze is a national research project with the aim of developing perennial based systems that increase livestock profit while addressing natural resource management goals such as decreasing groundwater recharge. In WA the main EverGraze site is demonstrating a 60ha prime lamb production system based entirely on perennials. The following is an update of the progress at the Wellstead research site.

Last year turned out to be one of the driest years on record with the site receiving only 290 mm. Based on historical records only one year since 1900 has been drier, 2002 which recorded just 264 mm. In the last 107 years Wellstead has only recorded an annual rainfall of less than 350 mm on 9 occasions which is approximately every 1 in 12 years. The dry conditions continued into the first half of 2007, however fortunately recent winter rainfall has been more typical. The site has only received 174 mm from January 1 until July 31, compared to the long term average for this period of 294 mm.

While the drought has meant we have not been able to explore the potential of the livestock system it has been a test of perennial persistence. As expected kikuyu, setaria, panic and lucerne survived the drought with little or no plant loss. Most surprising however was the excellent drought tolerance of chicory (variety Puna), not only did it maintain plant density but remained green throughout summer, only falling below 75% dry matter digestibility once in January. In contrast virtually all the tall fescue (variety Quantum Max P) plants died in summer. Given that the tall fescue swards had not been grazed since October 2006 the most likely cause of death is moisture stress. Quantum is a summer active tall fescue and is therefore less drought tolerant than the winter active, summer dormant types.

In response to the loss of tall fescue and poor annual seed set in spring 2006, we re-sowed six of the eight tall fescue plots to annual ryegrass and subclover and the remaining two plots to a winter active tall fescue (variety Resolute) and a mixture of tall fescue (varieties Resolute and Quantum Max P) this autumn. In addition forage oats were sown into a plot of lucerne and subclover into a plot of chicory. All seed sown has established well. If we get sufficient late winter and spring rainfall we will sow further tall fescue, some tall wheat grass and a small area to kikuyu in spring.

The demonstration was initially stocked at 6.6 Merino ewes/ha however due to the drought the stocking rate was reduced to 4.7 ewes/ha in February and further to 3.8 ewes/ha (approx 8 dse/ha) in June. The bulk of the ewes remained in a feedlot from December until early July due to the need to accumulate sufficient FOO for lambing and pasture growth. A small mob of ewes that were doing poorly in the feedlot were put back onto green perennial pasture in autumn and as a consequence improved in both liveweight and condition score.

Joining commenced on February 19 and the Poll Dorset rams were removed on March 21. Ewes were scanned in May and recorded a potential lambing percentage of 146%. Ewes in separate twin and singles mobs were placed on kikuyu and annual pasture with just under 1000 kg DM/ha on July 4. Lambing commenced on July 19 and to date lamb losses have been low.

The 2006 lamb drop were weaned in early November at an average liveweight of 25 kg and agisted to the Esperance Downs Research Station due to insufficient feed on the site. The lambs grazed perennial and annual pastures on the station and were then placed in a feedlot once feed ran out. They were turned off in June, the single lambs recorded an average carcass weight of 21.8 kg with a value of $74 per head and the twins a carcass weight of 20.6 kg with a value of $67.

A crude preliminary analysis suggests a loss of $60/ha in 2006 as a consequence of supplementary feed costs and high fertiliser rates. If lambs had been sold at weaning, losses would have been higher at around $200/ha. However if lambs had been finished on pasture at the site the profit would have been $165/ha which compares well with the original target of $104/ha.

The goal in 2007 is to do exactly that, finish as many lambs as possible on perennial pastures. If adequate rainfall and substantial amounts of green feed continue into early summer it may be possible. The analyses suggest this is one major benefit of a perennial based system for meat production.

EverGraze is funded by the Future Farm Industries CRC, Meat and Livestock Australia and Australian Wool Innovation.

The lambing ewes in a sheltered "nursery" paddock of Setaria and Gatton Panic. Photo 1 Aug 07.

Sustainable Control of Pasture Pests

Peter Mangano, Department of Agriculture and Food, Phone: (08) 9368 3753.

The French anystis mite (right), an effective predator of redlegged earth mites (left), blue oat mite and lucerne flea.

Redlegged earth mites, lucerne flea, aphids, caterpillar pests and other insects damage pasture at all stages of plant growth, reducing seedling density, biomass production, seed yield and legume component. Redlegged earth mites are without doubt the most damaging of these pests.

Insecticides have provided a cheap and effective means of easily controlling the mites; however the discovery of chemical resistance in a population of redlegged earth mites near Esperance is a warning that repeated applications of insecticides may be a recipe for disaster.

Resistance to Chemicals

In 2006 an Esperance farmer was unable to control redlegged earth mites (RLEM) in his seedling canola crop. Four applications at registered rates of synthetic pyrethroids failed to control the RLEM. Subsequently the crop suffered extensive mite feeding damage and considerable yield loss.

Samples of the mites were analysed for resistance by Dr Paul Umina at Melbourne University and compared with mites from susceptible 'control' populations. Very high levels of resistance to 2 synthetic pyrethroids, bifenthrin and alpha-cypermethrin, were found in the Esperance RLEM population.

Resistance levels are determined by the dose required to kill half the mites (LD50). When the Esperance RLEM were tested against bifenthrin LD50 numbers showed an increase in resistance of greater than 240,000 fold. Resistance to alpha-cypermethrin was almost 60,000 fold compared to those of the susceptible mites. Importantly this strong resistance was shown to have a genetic basis. This means it could persist in the field indefinitely.

Currently, chemicals are the major management option used for the control of RLEM. Unfortunately, pesticides are often applied in an ad hoc fashion with little concern for the longer-term implications. This is worrying because the continued application of pesticides places enormous selection pressure on a species to develop resistance.

It is quite probable that resistant RLEM populations are present elsewhere and the Esperance farmer is simply the first to report the problem. The farmer says his paddock had a history of repeated chemical applications with synthetic pyrethroids to control RLEM and other insect pests.

We need to reconsider standard industry practices for controlling RLEM. Chemicals have been the main method of controlling this pest for over 50 years, so it's surprising we haven't encountered resistant RLEM before now. In recent years the increased usage and reliance on low cost insecticides has accelerated the selection pressure for resistant pests.

How much damage are the mites causing?

In Department of Agriculture and Food trials, a reduction of up to 4 tonnes per hectare of dry matter occurred in one season in lax grazed pastures as a result of a large build-up of redlegged earth mites on annual pastures. Contrastingly in adjoining pastures grazed to a "feed on offer" of 1400 kg/ha mite populations were kept very low and were comparable to levels achieved by spraying.

The trials demonstrated that pests become more damaging as grazing pressure is reduced. In "good seasons" set stocked spring pastures will rapidly out grow the animals and result in pest mite numbers exceeding 50,000 per m^2. This results in a reduction in dry matter production, legume component and seed set unless spraying is undertaken. Uncontrolled spring mite infestations have the added disadvantage of providing a basis for large carryover of populations (via over-summering eggs) to the following autumn.

However, the production benefits from controlling pests in spring can largely be wasted unless the extra feed is utilised by strategic grazing management or fodder conservation.

Integrated approach to managing pest problems

In order to preserve the benefits of current inexpensive insecticides, lessons can be learnt from horticulture where pest resistance has occurred. These involve an integrated approach where natural and cultural factors, which limit pest populations, are used and only supplemented where necessary

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with insecticides as a final option. To successfully carry out integrated pest management the following issues need to be understood and taken into consideration:

Correct identification of pests

Along with RLEM and Lucerne flea there are several other pest earth mites that can easily be misidentified due to their small size. Bryobia (Clover) mite, balaustium mite and blue oat mite are commonly found in pastures and mis-identification can easily occur unless they are closely examined under a magnifying glass.

The biology of the earth mites differ and importantly they respond differently to various insecticides and rates. Failure to control mites may be assumed to be from insecticide resistance but could in fact be a misidentification of the pest.

Monitoring

Estimating mite numbers can be very difficult. During some parts of the day they are more content to crawl over the ground, where they are more difficult to see.

Key times for monitoring pests are:

- prior to intended sowing of new pasture paddocks
- during seedling emergence and early plant establishment
- during spring when numbers could be increasing and before they commence laying over-summering eggs

Plant species and varietal resistance against pests

Most annual and perennial pasture grasses have a high level of tolerance to pests and spraying of established pastures is rarely required. Contrastingly, legumes are generally much more susceptible to earth mite and lucerne flea damage.

Cultural control options

As mentioned above, intensive grazing of pastures to FOO levels (generally below 2 t/ha) in spring will greatly reduce pest numbers and their carry-over potential between seasons.

Herbicide (or full cultivation) fallow periods where no green material exists in paddocks for at least a week prior to sowing crops will greatly assist in starving out mites and dramatically reducing their impact.

The risk of earth mite or lucerne flea damage can depend on previous crop rotations. Risk is generally highest if paddocks have been in long term pasture (with high levels of broad-leafed weeds) where mite populations have been uncontrolled. Lower risk paddocks often follow a (weed free) cereal crop where conditions are less favourable for mite increase.

Insecticide options

The practice of spraying all pasture paddocks in spring using “Timerite” dates to prevent mite buildup is likely to lead to future problems. It is recommended that farmers instead select paddocks for spring spraying based on FOO levels, future grazing management options, seed production requirements and intended paddock use next autumn.

Where spraying is required the use of “soft” chemical options should be considered. For example, when spraying for aphids, the use of pirimicarb will provide good control of aphids without affecting beneficial predators and parasites.

Rotating chemical groups where possible, for example between synthetic pyrethroid and organophosphates, between and within seasons will help to reduce resistance build-up.

Use of insecticide seed treatments for new pastures is preferable to spraying as it directs smaller quantities of pesticide to where it is needed and away from beneficial predatory insects.

Biological control

There are effective predators present in Australia which specifically target Lucerne flea, RLEM and blue oat mite. The pasture snout mite is now widespread in many WA pastures and helps to suppress lucerne flea numbers. The orange coloured mite has a pointy head and mouthparts which it uses to pierce and feed on the lucerne flea.

Two other predators were deliberately introduced from overseas. The spiny snout mite is a more effective predator of lucerne flea but is not as widespread. The French anystis mite is an effective predator of RLEM, blue oat mite and lucerne flea but is also limited in its distribution.

The predators are unable to provide the same level of control as chemicals, but they do reduce pest numbers and subsequently increase pasture legume survival and production.

Fortunately the predators are not greatly affected by use of the commonly used pesticides but their numbers are significantly reduced by grazing pastures to low FOO levels and repeated crop rotations. Because the predators spread very slowly (about 70 metres per year) they can only become effective when they are collected and re-distributed on farms and allowed to increase over a number of years.

The discovery of RLEM resistance has been greatly assisted by collaborative networks established under the National Invertebrate Pest Initiative (NIPI), supported by GRDC.

Perennials for "Dandaragan Organic Beef"

David & Joan Cook, Dandaragan, Ph: (08) 9651 4022.

David and Joan Cook of "Noondel", Dandaragan, are Western Australia's largest producers of certified organic beef. Their "Dandaragan Organic Beef" brand supplies grass fed organic beef year round to a select group of up-market butcher shops in Perth. They believe that perennial pastures are crucial to the success of their business and the health of their land.

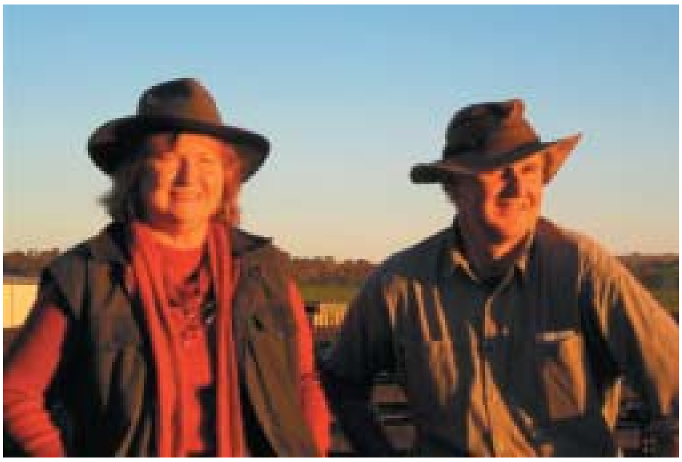
"Noondel" comprises 2,900 hectares of rolling red gum country in and around Dandaragan.

The Cooks planted their first perennials in the spring of 2001 after David and son Daniel went to Queensland on an Evergreen Study Tour. It was a small start given so little was known, with three small trial plots sown. They were successful and the area sown has expanded every year since, with a total of 280 hectares. But this area will rapidly increase with a further 200 hectares being sown in 2007.

Boundaries, lighter soil types and finishing paddocks will be the priorities for even greater perennial pasture establishment over the next few years. They have observed that invasive weeds such as Patterson's Curse and Doublegee are choked out by perennial grasses so planting them along boundary lines will restrict weed incursion from neighbouring farms. Lighter soil types give the fastest return on investment as the perennials grow best on these deep well drained soils and the existing annual pasture is relatively unproductive. The planting of perennials in their finishing paddocks will greatly assist the year round supply of quality beef. Tough seasonal conditions restrict their ability to supply through the late autumn and early winter. With a more perennial feed base this will be much less of an issue.

David thinks the new perennial based grazing system could be up to twice as productive as the existing system, although this comes from a combination of factors, not just the perennials. Major changes to grazing management and soil management are also having big impacts.

Cell grazing is used with big mobs of cattle rotating through a large number of paddocks. David is aiming to have 20 paddocks available to each mob, with cattle only spending 2 to 4 days in each paddock at a time. He provides the pastures 40 days rest in winter when they are growing quickly and 80 days rest in summer when they are growing slowly or not at all. This gives the plants sufficient time to recover from grazing. Perennial paddocks may be rested for longer than 80 days in summer if it is extremely dry, and conversely, rested for less than 80 days if there is significant summer rain. The Cooks are considering increasing the number of paddocks per mob to 40



Joan and David Cook

but this would involve moving stock daily in winter.

Portable water troughs on wheels have been built that move with the mob, towed behind a vehicle, reducing the water infrastructure requirements of cell grazing. Fencing is all low cost electric with 4'6" galvanised steel posts placed 20 m apart and one hot wire 900mm above ground level. Weaner cattle require an additional earth return wire located 700mm above ground level to keep them in.

Fertiliser is still applied but organic fertilisers such as Guano and Rock Phosphate and natural soil amendments such as Lime, Dolomite and Gypsum are used instead of Superphosphate. Trace elements are also applied.

Establishing perennial pastures without the use of herbicides might sound all but impossible, but David has developed a reliable way to control weeds prior to sowing that still fits with their organic principles. Offset discs are initially used to plough in the existing annual pasture, before a chain is dragged to level the paddock. Historically, David broadcast the seed from a fertiliser spreader before compacting the seedbed with a rock roller.

More recently an old combine has been converted to furrow sow perennial seed. This will replace the super spreader and rock roller and hopefully produce a much better germination. Large old fashioned scarifier points have been set up on a 28" spacing, each with a following press wheel. Steel plate has been welded to the top of each point to improve soil throw and ensure that a decent furrow is created.

With this new machine, David plans to halve his traditional sowing rate of 6 kg/ha to 3 kg/ha, knowing that the combination of furrow sowing and press wheels will have a big impact on establishment. The wide row spacing will allow

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operation at reasonably high speeds without worry of soil throwing from one furrow in to another.

David has narrowed his choice of perennial species down to three main species – Gatton Panic, Rhodes grass and Lucerne. He uses approximately a third of each in his seed mix. He says Gatton Panic is particularly suited to the deeper sandy soils while the Rhodes grass is more versatile and with its runners is great at filling in gaps in the pasture and providing ground cover. Lucerne is handy with its high feed quality and very deep roots. Chicory and Signal grass are also used but as more minor components of a mix.

Blue lupins grow over much of "Noondel" and since the establishment of perennial pastures they are now considered a "friend not foe". Their ability to fix large amounts of

Prolific perennial grass growth following a good start to the season. Photo 21 May 2005.

atmospheric nitrogen is vital to the productivity of the perennial grasses, and the dry residues are very useful livestock feed over summer. David also suspects they are very efficient at extracting P and K from the soil, which is handy in his organic system. When grown in conjunction with perennial grasses, the lupins never get too thick in spring (a common problem when on their own).

The Cooks noticed their cattle stopped scouring when they changed from a total annual pasture to a mixed annual / perennial pasture during winter in 2004. They did some feed testing and found that the annuals had excess levels of crude protein (25 to 35%) which probably caused the scouring. The perennials had a more optimum crude protein level of 18%. They also found that the perennials had significantly

Gatton Panic and Rhodes Grass still growing despite the dry conditions. Photo 23 November 2006.

higher levels of trace elements – twice as much cobalt and 3 times as much selenium as the annuals. They are convinced that perennials provide livestock with a more even plane of nutrition year round, which must benefit animal health and productivity.

The Cooks are quick to point out that there is also a whole host of environmental benefits of using perennial pastures. As David says "they eliminate erosion, recycle nutrients from deep in the soil, improve infiltration rate, and build-up soil organic matter. We will get as many perennials in the ground as soon as possible, and granted we will lose some production during the establishment phase, but we will soon make up for that".

Gatton Panic still slowly growing in the middle of winter. Photo 13 July 2006.

Statewide Snap Shots - Winter 2007

Perennials under Centre Pivot

Two pastoralists in the Carnarvon region have recently installed centre pivots to irrigate perennial pastures. They will be used to quickly finish large numbers of young cattle. A wide mix of perennial species has been sown under one pivot while sorghum has been sown under the other. Innovative electric fencing that the centre pivot can "roll" over will allow the pastures to be rotationally grazed. Photo 8 Aug 07 courtesy Janette Drew.

Pasture Cropping

This perennial pasture trial site on heavy soil near Greenough has been over sown to wheat this year. The aim is to test the Pasture Cropping concept from NSW where annual crops are sown over summer active native perennial grasses. Grain yields and perennial regeneration will be monitored. As you can see, some perennials have bounced back already. Photo 20 July 07 courtesy Tim Wiley.

Winter Active Tall Fescue

This 4 year old trial site at Kojonup is showing just how persistent Winter Active Tall Fescues can be. Most of the other temperate species have declined in density over the last 2 very dry years whereas the winter active tall fescues (left) appear to be as dense as ever. The adjacent plot of Summer Active Tall Fescue (right) has all but disappeared. Photo 27 June 2007.

Sowing Time

Andrew Kuss of Esperance sowed Kikuyu in late August last year and got an excellent strike despite the dry spring conditions. Yellow serradella is thriving amongst the kikuyu this year given the good start (and historic seed bank). The kikuyu is now starting to jump given some recent warmer weather. In the background is the paddock to be sown this year. It is sprayed off and ready to sow next week. Soil temperatures are now averaging over 14.5 degrees so conditions look ideal for sowing. Photo 22 Aug 07 courtesy Greg Warren.