Tropical Grassland Society of Australia Inc.

TGS news & views

about pasture development in the tropics and subtropics

Volume 23 No. 3
September 2007

Newsletter subscription: $50 per annum
Print Post approved : No. 424043–00007

Carbon storage under pastures

Carbon sequestration and carbon trading are becoming popular topics. The Queensland Country Life (20 September 2007) carried an article about how Resource Consulting Services is developing a Carbonlink program that might allow users of 'new grazing systems' to claim or sell carbon credits.

Carbon sequestration under pastures has been a topic under investigation for the last decade or more. Miles Fisher and other pasture workers in South America had a letter in the eminent science journal Nature in 1994 describing how introduced deep-rooted grasses could store more carbon than native savanna grasses. The grass that he favoured particularly was Gamba grass (*Androgon gayanus*) that has been concerning environmentalists in northern Australia recently (see last issue of News and Views and letter to the Editor in this issue).

They found that their native savanna pastures stored 186–197 tonnes C/ha whereas a Gamba/stylo pasture stored an extra 50 tons C/ha. In another region, a mixture of *Brachiaria humidicola* and creeping peanut (*Arachis pintoi*) stored 70 tonnes C/ha more than the native grass. But both sites received much more rainfall than that in our Australian savanna regions.

Their comments back then were that "The combinations of a deep-rooted grass with a nitrogen-fixing legume can increase nutrient cycling, greatly improve animal production and markedly increase soil biological activity. These effects occur mainly at the soil surface while carbon storage takes place below the plough layer. Thus far from being environmentally degrading, improved pastures can fill the restorative role in tropical systems that was recognised in pre-Roman times for Mediterranean systems, and may play a vital part in stabilising the global carbon cycle and minimising the greenhouse effect of atmospheric CO_2."

Grassland v. forest

Len 't Mannetje in his paper in the March issue of Tropical Grasslands on the role of grasslands and forests as carbon stores. (TG (2007) Vol 41, 50–54) says that grasslands are as important as forests for storing carbon. However, although grasslands store carbon there can be a negative effect on greenhouse gas emissions when they are grazed by ruminants that produce methane. (Termites eating dead wood and other vegetation also produce methane but this is not counted as human induced.) Extensive pastures produce little N_2O or NH_3 unlike the intensively managed and fertilised temperate grasslands of Western Europe. Grasslands give off CO_2 as they decompose or are burned or when fermented in livestock—but reincorporate it in the next growth.

continued on page 4 …

Newsletter editor:
Ian Partridge
Tel: (07) 4688 1375
Fax:(07) 4688 1477
ian.partridge@dpi.qld.gov.au

Published by the Tropical Grassland Society of Australia Inc
306 Carmody Road, St Lucia Qld 4067

Society News

Our Internet address — www.tropicalgrasslands.asn.au
Our Society e-mail address is tgs@csiro.au

The Pasture Picker is running again. The database was not searching for a couple of weeks in March when Microsoft changed their requirements and these changes were not enabled in Pasture Picker at the time. My thanks to Greg Pinington who keeps us going when things fall over, as they have again in August when I have lost ftp access to the site!

The journal archive is now more up-to-date; the latest volume available on the web site is now Volume 39 for 2005. There should always be an 18-month delay before the new issues are accessible so that our members get the science before the general public.

Your Executive for 2007

President
George Lambert
Condamine Alliance
PO Box 3477
Toowoomba Village Fair Qld 4350
Phone: 07 4620 0112
Fax: 07 4613 1657
e-mail: george.lambert@condaminealliance.com.au

Vice President
Tony Illing
David Illing Pastures Pty
57, Gipps Rd
Drayton, Toowoomba Qld 4350
Phone: 07 4630 2110
Fax: 07 4630 2188
e-mail: illingpastures@bigpond.com

Past President
Kevin Lowe
DPI&F Mutdapilly Research Station
MS 825, Peak Crossing
Ipswich, Qld 4306
Phone: 07 5464 8713
Fax: 07 5467 2124
e-mail: Kevin.Lowe@dpi.qld.gov.au

Secretary
Richard Moss
DPI&F Mutdapilly Research Station
MS 825, Peak Crossing, Ipswich, Qld 4306
Phone: 07 5464 8737
Fax: 07 5467 2124
e-mail: Richard.Moss@dpi.qld.gov.au

Treasurer
Kevin Lowe
DPI&F Mutdapilly Research Station
MS 825, Peak Crossing, Ipswich, Qld 4306
Phone: 07 5464 8713
Fax: 07 5467 2124
e-mail: Kevin.Lowe@dpi.qld.gov.au

Journal Editor
Lyle Winks
44, McNeills Rd, MS 825,
Peak Crossing Qld 4306
Phone: 07 5467 2314
Fax: 07 5467 2314
e-mail: lwinks@gil.com.au

Newsletter Editor
Ian Partridge
DPI&F, PO Box 102
Toowoomba Qld 4350
Phone: 07 4688 1375
Fax: 07 4688 1199
e-mail: Ian.Partridge@dpi.qld.gov.au

44th Annual General Meeting and Field Day

The 44th Annual General Meeting will be held on Friday 23rd November 2007

at 3 p.m.

at CSIRO, 1st Floor, Queensland BioPrecinct, 306 Carmody Road, St Lucia

3 p.m. Arrival and smoko

3.30 p.m. Annual General Meeting

Agenda

1. Apologies
2. Minutes of the 43rd AGM held at Mutdapilly
3. Executive Committee Report
4. Treasurer's Report
5. Journal Editor's Report
6. Newsletter Editor's Report
7. Harry Stobbs Memorial Fund report
8. General Business
9. Award of TGS Fellowship
10. Election of Office Bearers
11. Presidential Address

Carparking is available at the University Car park in Fred Schonell Drive. The boom gate at the CSIRO car park in Carmody Road will close at 5 pm (unless you have an electronic swipe card).

We are planning to finish with a BBQ on the building roof. This will cost about $15 each person.

RSVP for catering purposes to Cam McDonald (3214 2289) or to Ian Partridge (see next opposite page).

Tour on eastern Darling Downs on 24th

The field trip on the eastern Darling Downs on Saturday 24th will start with a visit to the NAPCO Wainui feedlot near Bowenville and then move to various pasture paddocks.

Attendees can meet (in their own transport) at the DPI&F complex carpark in Tor Street, Toowoomba at 9.30 am or at the NAPCO Wainui carpark at Bowenville at 10.30.

We will board a 50-seater bus at Wainui for a tour around the feedlot complex and farm under the guidance of the Waimua manager, Mr Geoff Cornford.

Which pasture paddocks we will visit to the north of the Warrego Highway will be decided closer to the day when we are able to see the recovered pastures. At present, wild turnip seems to be the dominant species (see page 9) but it will soon set seed and die off. Some good rainfall last month has now been followed by some wild storms after heat wave conditions (and the leucaena is growing).

The bus for the tour of the feedlot will be costing $70 an hour so the cost per person should be minimal (but depends on the number coming). We will organise a cut lunch (away from the feedlot) for a cost of around $10, and will bring that from Toowoomba.

Please advise George Lambert or Ian Partridge (contact details on the opposite page) if you are coming – for catering purposes).

... continued from page 1

Many or most natural grasslands or savannas are burned fairly regularly; of course, this is generally why they remain grasslands. Burning releases CO_2 into the atmosphere instantaneously but, as unburned leaf litter would eventually decompose, the difference between burning and not burning is one of rate of release rather than quantity. Again, all that CO_2 would be incorporated in the grass growth in the next growing season.

Repeated burning of savanna woodlands may actually increase the C content of the soil because each year some of the wood is burned to charcoal—which is stable.

Charcoal

Television viewers may have seen the recent story on ABC Catalyst program about locking carbon in soil as charcoal—called Agrichar. Charcoal is highly stable in the soil and it can also increase soil fertility and waterholding capacity by its very fine porous nature. However, charcoal is made by controlled combustion of wood so that manufacturing charcoal will ultimately produce CO_2. What you gain on the round-about you lose on the swings.

But the incorporation of an equivalent amount of old CO_2 into new grass growth does depend on healthy and vigorous grass growth and this is where the RSC push for carbon trading comes in. Pastures that are consistently grazed too heavily decline, with the individual plants and their root systems becoming smaller. Thus to lock up more carbon, the grassland should be well managed, and cell and rotational grazing may have an important practice. However, changes in soil carbon under different grazing management are not easy to assess and may not be significant. This is in keeping with a range of other studies in Australia and overseas which have reported generally neutral, but variable, responses of soil carbon to grazing.

Northern Australia findings

No changes in organic carbon in savanna lands of north-eastern Australia resulted from moderate increases in grazing pressure over a period of 6 to 8 years, although there was a significant decline in microbial biomass. Woodlands in north Queensland under various grazing regimes showed no change in soil carbon to a depth of 7.5 cm between ungrazed areas and areas grazed at 25% pasture utilisation although grazing at a utilization rate of 75% did reduce soil carbon by about 30%—with little recovery after 34 years of light grazing.

Destocking grasslands completely is unlikely to be a useful practice. The mature grass leaf will decompose slowly, accidental fires would probably negate any intended practice and ungrazed grass plants tend to become moribund.

Lighter stocking rates are likely to extremely beneficial in other ways on much of our country. The grass plants are larger, soil cover is better, soil structure and soil fauna activity are improved, animal growth rates are higher and risk from our variable climate is reduced.

In the USA, researchers found that fertilising, grassland improvement and good grazing management could result in the sequestration of 10–35 Mt of C annually with half this from the improved management of rangelands.

Plant trees or leucaena?

Mature forests in both tropical and temperate regions actually do little to reduce CO_2 levels because they have little net growth. They assimilate only as much CO_2 as they respire.

This is different in new tree plantations that are actively accumulating carbon in their wood, so one way of improving carbon storage is through agroforstry. But we also know that farmers or graziers are not going to plant large areas of trees unless it generates sufficient income or they receive recompense—the trees have to be worth money. It is highly unlikely that graziers will replant brigalow to replace those trees cleared under the brigalow development schemes but many are interested in leucaena. Leucaena is not going to be allowed to grow into large trees for forage production, but the stems and roots are woody.

Leucaena hedgerows are estimated to sequester 600 kg of C/ha/yr in the above-ground stems for the first 5 years after establishment with an additional 30% stored in the root systems. Thus an estimated total of 780 kg of C/ha/yr would be sequestered in leucaena biomass for the first 5 years after establishment giving a total of 3.9 t C/ha. Once fully established, it is assumed that the pastures are in a steady state where C sequestration in leucaena plants equals C release via respiration and the decomposition and decay of leucaena biomass.

continued on opposite page ...

Similar amounts of C are incorporated in soil organic matter beneath leucaena pastures. Soil organic C in the top 15 cm layer of soil increased by 0.12–0.22% of soil DM under old leucaena growing at Gayndah in south-east Queensland compared to adjacent grazed native grass pastures. Changes in the top 15 cm are mostly due to leaf drop and soil fauna; buffel grass roots will reach to 2 metres and leucaena roots to 6 m into the soil profile.

Added to this sequestration is the reduction in methane produced by ruminants eating leucaena because of more efficient fermentation Planting and grazing leucaena could help Queensland meet its emission targets, more effectively than through grazing management alone.

NSW research project

The NSW Department of Primary Industries has a project to help understand the positive role of pastures in sequestering carbon as part of a wider $2.5 million climate research program to help that state cut greenhouse emissions by 60% by 2050. Their researchers want to compare paddocks for example under cropping versus

Carbon in cropping land

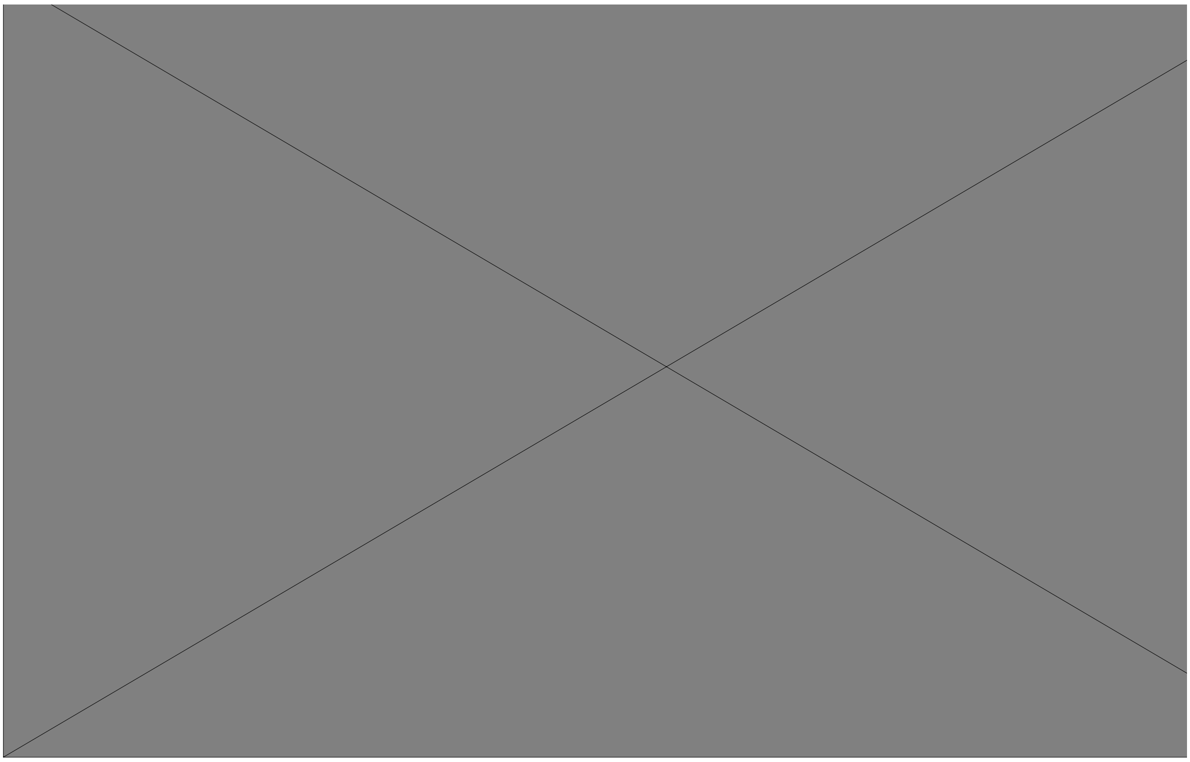
Adding a ley pasture will restore soil carbon levels in land that has been cropped for decades, but its effect will not last long when the soil is cultivated again. Similarly, zero-till will gradually build up soil carbon from the crop resides but the gains can be quickly lost but reverting to cultivation.

The masses of fine roots of a grass in intimate contact with the soil particles are the key to incorporation of organic matter in a soil—far more than ploughed in crop residues. Forage legumes with their taproots tend to increase nitrogen levels in soil through their leaf fall or defoliation and this improves the above and below ground growth of grass plants. Grain legumes, such as soybean do little for soil nitrogen; nearly all the fixed nitrogen is removed when the high-protein grain is harvested and removed. Even soybean straw has little protein.

Editor's note. I thank John Carter and Scott Dalzell and Max Shelton for providing information on carbon sequestration under grazing lands and under leucaena.

Thinking outside the square?

Since overall tree growth in our north Australian woodlands is limited by moisture, would the best way to lock up carbon be to kill the mature trees in situ by stem injection and to leave the standing trunks. This will allow new woody growth from the suppressed suckers and seedlings.



Kill mature trees, allow regrowth, then tordon again to lock up carbon?

Letter to editor

Gamba grass

As a member of the Tropical Grassland Society, an advocate of tropical pasture development, and someone who has been professionally involved in Gamba grass management for several years, I am compelled to comment on the blinkered and myopic viewpoint in the last issue of *TGS News & Views*. I certainly agree with the Society's policy on providing information, not recommendations, and the TGS website provides a generally accurate and balanced portrayal of the cultivar Kent. However, it is no longer adequate to describe Gamba grass as a "potential" environmental weed in the Northern Territory; it already is a very serious environmental problem that doesn't recognise state borders – and the evidence is very clear to those who look.

There are vast areas surrounding Darwin – rural residential blocks, vacant crown land and national parks – where frequent and intense fires fuelled by unmanaged Gamba grass are eliminating native grasses, shrubs and trees. Within this area can also be found well managed paddocks of Gamba grass where the commercial benefits of this productive, palatable and persistent cultivar are being realised. But it is quite absurd and misleading to simply contrast Gamba grass as "unlikely to become a dangerous fire hazard in commercial grazed paddocks" while "it is a potential hazard" on "ungrazed rural residential blocks ... and ungrazed and unmown roadsides". Many of the areas in which it is a problem have been subjected to past land use and tenure changes – e.g. pastoral leases where Gamba grass has previously been planted were subdivided for alternative land uses or converted to other tenures for conservation purposes. Disturbance of soil and vegetation throughout the region through development, road maintenance – including slashing roadsides – and frequent fires is compounding the problems and providing ideal conditions for the spread and establishment of seed. The issues are very complex, and to describe the problems outside commercial properties as "the fault of the relevant residents" is to reduce the credibility of the TGS to the level of the *Courier Mail* as a source of science.

The author of the TGS article also asks in relation to the newspaper story: "Just where in Queensland is it posing the described threat?". In northern Queensland there have been a number of commercial plantings around Mareeba and on Cape York Peninsular. One property of note is Kalinga on the Cape. Kalinga has just been acquired by the Queensland Parks and Wildlife Service to add to its conservation estate. Unless the Gamba grass paddocks are well managed – and from my perspective this means appropriately stocked – there is potential for this iconic area of northern Australia to end up degraded like many parts of the top end of the Northern Territory. Some Queensland cattlemen in other areas are also planting Gamba grass out of concern that it might be banned by government. This is akin to the country that was hastily pulled by graziers without the capital to further develop and maintain it, prior to the implementation of the outrageously restrictive vegetation management laws.

Some years ago I argued[1] that an industry code of practice, along the lines of the Leauceana Network Code of Practice[2], should be considered for Gamba grass and would certainly be preferable to any legislative intervention. Seven years on it is probably far too late. In that same year, a paper presented at the Sixth Tropical Pastures Conference in Emerald[3] urged us as "professional thinkers about tropical grasslands" to be more mindful of the socio-political context in which we work and to engage constructively with the conservation movement. Genuinely acknowledging the seriousness of Gamba grass as a <u>current</u> environmental weed as well as a useful pasture would be a good start.

Trevor Howard
Townsville

Temperate pastures looking at GM

The Victorian dairy industry recently revealed its interest in German research showing a 25 per cent increase in milk production from a high-digestibility perennial ryegrass—developed using gene technology. The dairy industry is also being tantalised by the prospect of frost-tolerant pastures after the discovery of frost-tolerance genes in Antarctic hairgrass. The implications of such research, however, extend to a number of industries, including beef and lamb and the turf industry. There is also the potential for human health benefits through dietary improvements and reduced incidences of hay fever. A wide range of pasture species exist across Australia, including native perennial grasses with some annual legumes such as sub-clover, annual grasses and legume-based pastures, and sown exotic perennial grass pastures and annual or perennial legumes.

The quantity, quality and use of pasture and feed can greatly affect farm productivity and profitability. Traditionally, pastures have been enhanced through fertilisers, grazing management and herbicides. More recently, in laboratories, gene technology has been tested. Agrifoods Awareness Australia has compiled the following summary of GM research in pasture improvement in Australia and New Zealand.

Commercially available GM animal feed

In 2005, 90 million hectares of GM crops were grown in 21 countries. Herbicide tolerance and insect resistance were the dominant GM characteristics for soybean, corn, cotton and canola crops. While these modifications largely benefit broadacre producers, these crops are all routinely and safely used as components of animal feed rations. The latest addition to this suite of crops is herbicide-tolerant GM lucerne. The GM lucerne was approved for commercial use in the US in 2005 and the first seed became available to growers in 2006. The benefit of GM lucerne is claimed to be fewer weeds, resulting in better-quality hay and feed.

The first GM crop directly targeting animal health, a corn variety, has also received final regulatory approval in the US. The GM corn contains higher levels of lysine than conventional corn. Lysine, an amino acid, is essential as a building block for proteins and muscle development. By incorporating lysine into the crop, synthetic lysine supplements will no longer be required. The new crop is being planted on a limited area in 2007 while regulatory clearances in key export markets are being sought.

GM virus-resistant white clover

In Australia, according to a report published by the Bureau of Rural Sciences (BRS), pasture research involving gene technology is focusing on superior pasture grasses with modified lignin biosynthesis, fructan metabolism and reduced pollen allergens. The most advanced pasture research in Australia is a virus-resistant white clover project. The Victorian Department of Primary Industries (DPI) has been granted a licence by the Office of the Gene Technology Regulator (OGTR) to undertake GM clover field trials. The GM clover is resistant to alfalfa mosaic virus (AMV). AMV infection of white clover has been observed in many sites across Australia and, in some cases, the level of infection has exceeded 90 per cent. The trials aim to evaluate GM white clover to assess its AMV resistance under field conditions and to produce GM white clover seed for future trials, subject to further approvals.

Ryegrass research

Lignin is the part of the plant cell wall that gives it strength and rigidity. High lignin means a stiffer and less palatable grass. Researchers are trying to alter lignin production and develop ryegrass with higher digestibility. Researchers have also identified the genes involved in fructan metabolism, and are working to produce grasses with high fructan content for the dairy industry. Fructan is a naturally occurring sugar in pasture grasses and is an excellent energy source. Increasing a grass's fructan content will increase live weight, milk production and possibly fertility.

Most of the pollen causing hay fever in Australia is produced by ryegrass. Up to 25 per cent of people living in temperate climates are affected by hay fever and seasonal asthma. Ryegrass is used in turfs, lawns and pastures. Australian scientists have identified the genes responsible for producing the protein in the pollen which causes the allergic reaction and have switched them off. The result is low-allergy ryegrass.

Benefits in relation to this research include:

- improving forage quality could provide a $320 million benefit to Australia's graziers if high-quality grass replaces supplements
- high-digestibility (modified lignin content and composition) perennial ryegrass has the potential to increase milk production by 25 per cent
- perennial rye grass with increased water-soluble carbohydrates may increase lamb production per hectare by 23 per cent
- hypoallergenic ryegrass could save Australia $86 million through reduced hay fever and asthma incidences.

None of these projects have yet reached the field trial stage in Australia, although trials of the low-allergen ryegrass are taking place in the US. On completion of the US study, and an Australian study of gene flow using non-GM ryegrass, it is expected that a field-trial application to the OGTR will be made in 2008 for a ryegrass with high fructan and low lignin content and allergy-free characteristics.

Other research

By looking to genes in other native and exotic plants, researchers are also hoping to develop pasture varieties that deal better with factors such as drought, low soil fertility, cold and frost and saline and acid soils. For example, 30 million tonnes of phosphorus fertiliser is applied each year around the world, and Australian fanners alone spend up to $600 million a year. Further, up to 80 per cent of phosphorus is lost. It is estimated that a $10 billion phosphorus 'bank' exists in Australian soils. Researchers are investigating the potential of developing a white clover to extract some of the nutrients already existing in the soil.

Across the Tasman

GM pasture research is being undertaken by AgResearch, New Zealand's largest Crown Research Institute (CRI), including projects in partnership with Australian researchers.

The following are examples of rye grass research.

Early results indicate that by giving ryegrass a healthier lipid profile these healthy lipids are incorporated in meat and milk, which could result in health-promoting long-chain omega-3 polyunsaturated fatty acids entering the human diet through meat and dairy products.

Improved forage quality through a generic flowering switch is the aim of research under way to control flowering in ryegrass. Researchers have 'switched off' key flowering genes in ryegrass and the resulting GM plants show delayed flowering. Switching off flowering allows the plant to focus its energy on growing.

Research into modifying ryegrass endophytes to improve insect resistance and animal health is also under way at the Victorian DPI and AgResearch. An endophyte is a fungus that lives inside the plant and is transmitted only through seed. Although it benefits the plant in several ways, for example by providing increased insect resistance; it can also negatively affect animal health.

By identifying the genes responsible for insecticidal/bioactive compounds and biologically active secondary metabolites, scientists hope to develop new endophytes that protect grass against insect pests but reduce toxic effects on animals. •

This article is taken from the booklet ***Futurecrop: Biotechnology and the grains industry*** printed by the Grains Research & Development Corporation

Editor's note: It would be interesting to know the progress of GM research into tropical pasture species and how practical the results could be with the harsher tropical conditions and with the high cellulose of C4 grasses.

Rainfall on the Downs brings a recovery of sorts

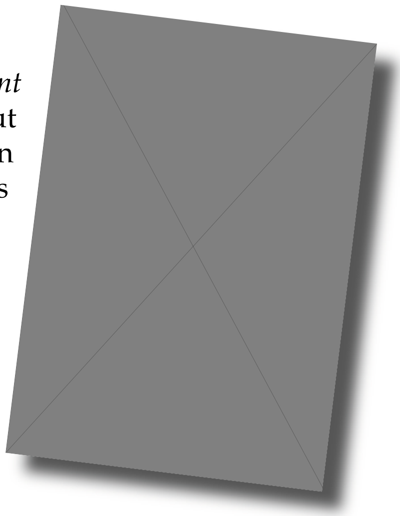
Grazing country on the Downs

Mid-June.

*Mid-September. Fifty millimetres of rain transforms the scenery but poor ground cover after the long drought allowed wild turnip (*Brassica tournefortii*) to go really wild.*

Coming soon

Jenny Milson's best-selling 1995 book *Plant Identification in the Arid Zone* has been out of print for a couple of years. It has been scanned and is being reprinted. Stocks should be available in early November.

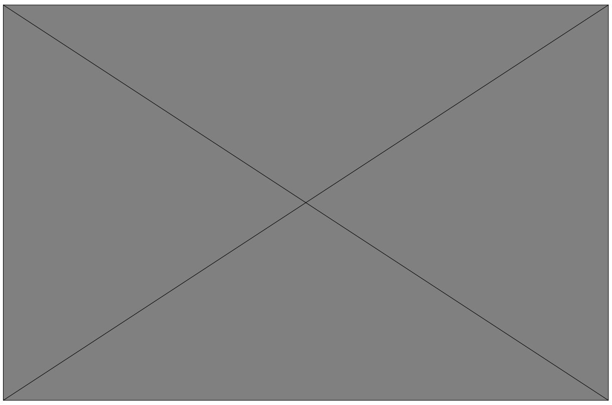


2007 – a cold and frosty winter

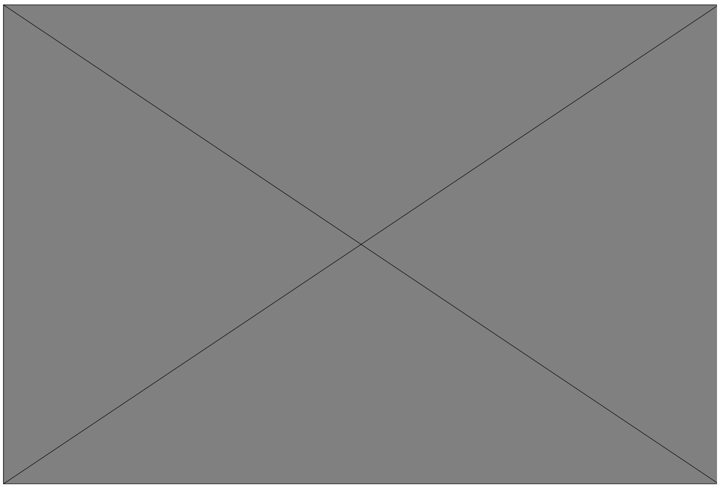
Leucaena in south Queensland

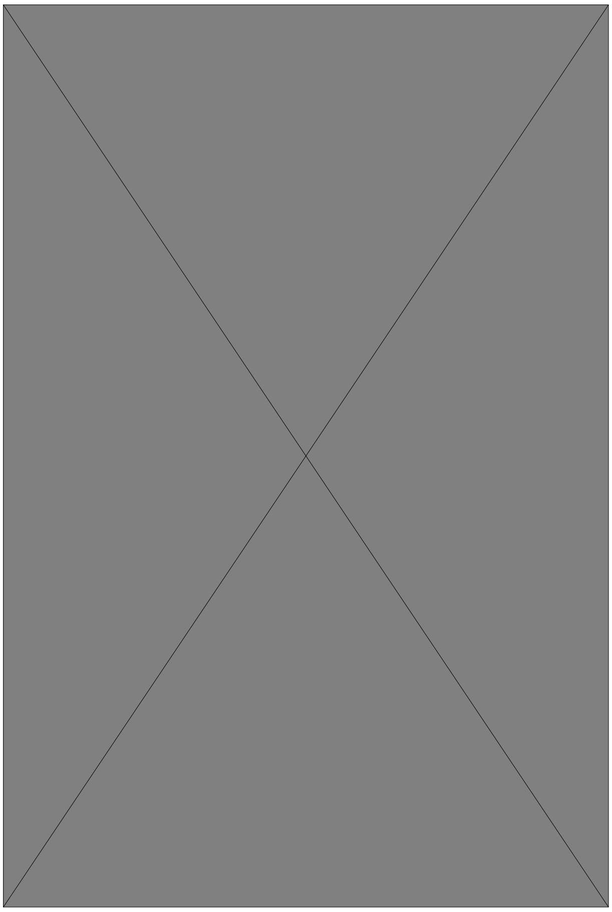
Remember the article on the chances of leucaena surviving some of the heavy frsots that we experienced this winter?

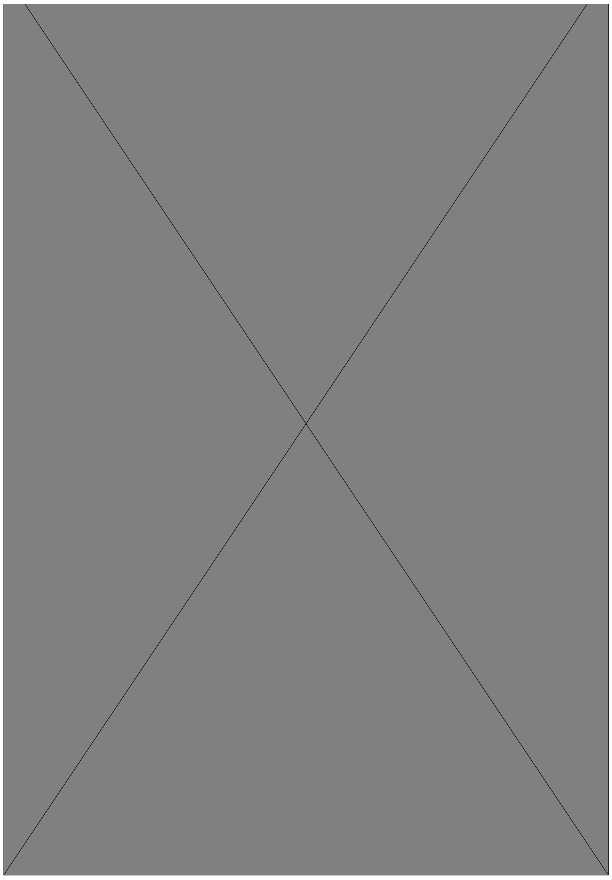
The photo below was taken in mid-June the day after a good frost touched the young leaflets. Subsequent frosts dropped all the leaf in this young leucaena. The photos on the right were taken in mid-September and show that even very young seedlings have survived., although other seedlings look as if they have been killed completely.



Top. These very small seedlings survived frost.







Above. Leucaena seedlings recovering from the base after being frosted.

Left. These apparently dead leucaena stems still have green bark.

Frosted signal grass on the Tableland

Bernie English and Kev Shaw, Kairi

The unusually cold 2007 winter has killed or severely damaged many signal grass (brachy) pastures on the southern Atherton Tablelands. Signal grass is one of the most important grasses for beef cattle production on the Tablelands and wet coastal areas of north Queensland, being easy to manage, strongly perennial grass and able to give good weight gains from cattle.

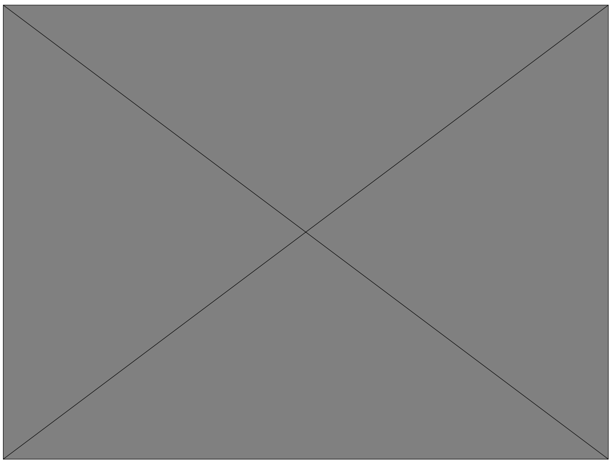
Many areas of the Southern Tablelands recorded up to 20 frosts during July with ground temperatures falling to as low as –10°C. The worst hit areas were on the higher country near Ravenshoe.

In late winter and after the frosts, most country received about 50mm of rain but many paddocks of signal grass showed no response as the mature plants had been killed in large patches — especially in the lower, more frost-prone areas.

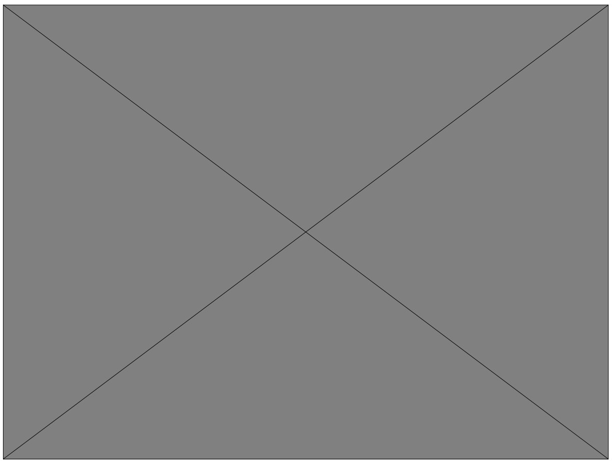
This widespread pasture death from frosts is a first for improved pastures on the Atherton Tableland since these grasses were introduced across the district in the early 1960s.

Other perennial subtropical grasses, such as the Setarias, in the same or adjacent paddocks were not been killed and have since grown back.

Signal grass seedlings have germinated and begun to recolonise the frosted areas but paddocks with low ground cover have also seen rapid establishment of weeds, and will need careful grazing management to ensure the new signal grass seedlings survive to become productive pastures.



Brylee English looks at signal grass killed by frost on the Tableland. Below. New signal grass seedlings will need careful grazing management to return to productive pasture.



Then it's the turn of the leaf hoppers

Bernie English, Kairi

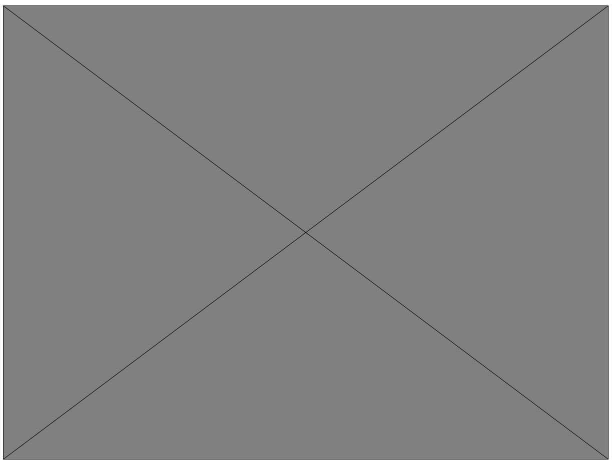
Signal grass is the most important pasture grass for beef production on the wet coast and the northern Atherton Tablelands, but has been widely damaged by large numbers of the leaf hopper (*Toya dryope*) in the spring this year.

Damage is usually seen in well-fertilised signal grass when the weather warms up in spring and early summer.

Symptoms include leaf blotches on the leaves of plants, progressing to light-coloured spots in the pasture sward (see photo) and then dead patches. Walking through infested areas will disturb large numbers of these 3 mm long leaf hoppers.

Insect infestations may not occur for several years and then they appear in large numbers causing significant pasture damage.

Rainfall over 25 mm seems to suppress the leaf hopper activity and damage, but beef producers usually need to spray affected patches to stop the hoppers spreading. Control is usually by spraying insecticides with a short withholding period, such as carbaryl.



Patches of dead signal grass after attack by leaf hoppers

TGS news & views

If not delivered, please return to
Tropical Grassland Society Inc.
306 Carmody Road
ST LUCIA QLD 4067

PRINT POST
424043–00007

POSTAGE
PAID
AUSTRALIA

Contents