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now

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PRODUCTIVE PARTNERSHIPS

Partnership is the key

Dr Tom Richardson
Chief Executive

This issue of AgResearch NOW focuses on a vital input to all of our pastoral industries – pasture. How can we grow more and better pasture? How can we eliminate weeds that occupy land in place of pasture, and that discourages animals from eating some of the pasture that remains?

In addressing these questions, the articles in this issue show the importance of partnerships on the farm and beyond - that are vital to the success of New Zealand's world-class pastoral sector.

Some of these partnerships are between people - but others are between plants, and between plants and animals. For example, grasses co-exist with clovers to produce a sward that partly fertilises itself. Grazing animals consume plant material and spread nutrients around the farm which keeps both the pasture and animal growing.

Farmers must carefully balance animals and plants to manage weeds and pests, they need to balance feed supply, animal demand, and the demands of consumers for the farm's products, all to run a productive and profitable enterprise.

More partnerships extend through the value chain from farm inputs through to food and textile processing, exporters and retailers.

Another partnership has been essential to the success of New Zealand agriculture for more than a hundred years and will continue to be essential in the future – the partnership between the pastoral sector, scientific research and agricultural technology.

As the leader of New Zealand's largest group of agriculture, food and textile researchers, of course I would say that! But as I have met with the leaders of New Zealand's most important pastoral sector organisations over the last several months, I have been very pleased to hear that message from them too.

Delivering AgResearch's Core Purpose: "To enhance the value, productivity and profitability of New Zealand's pastoral, agri-food and agri-technology sector value chains" can only be achieved in partnership with key stakeholders, including industry, government and Māori.

Many of these partnerships are delivering real benefits to farmers in weed, pest and pasture management, and we are delighted to present some real-world examples in the following articles.

Mowing in the rain

Long-term research leads to simple control technique for Californian thistle

Californian thistle (*Cirsium arvense*) is the most destructive pastoral weed in New Zealand. Introduced by early European colonists, it spread quickly and it is now found throughout the country.

Synthetic herbicides are not effective in eliminating the weed, and it costs an estimated $873 million to the New Zealand sheep and beef industry annually.

Since 1991, a team of scientists from the Crown Research Institutes AgResearch and Landcare Research, Bio-Protection Research Centre, industry organisations and community groups have been working collaboratively for effective control methods. One of the outcomes of this long-term research is the recent discovery of a simple, free technique that farmers can use to control the thistle: mowing in the rain.

Project leader Dr Graeme Bourdôt says the finding emerged from a national survey of diseases found on Californian thistle, funded by Meat and Wool NZ (now Beef + Lamb NZ). The team collected samples from hundreds of farms throughout New Zealand and found several pathogens of particular interest.

One of these, the vascular wilt fungus Verticillium dahliae, a pathogen that causes diseases in many crops, was common on the thistle in this survey. The fungus produces spores inside the thistle that are released by mowing, dispersed by splashing rain and then gain entry into other thistle plants through wounds.

This finding sparked the researchers' interest, because there is anecdotal evidence that mowing pasture in the rain helps to reduce the thistle's abundance. Although no quantitative evidence existed to show that mowing in the rain really worked, the team hypothesised that the spread of the fungus by splashing rain and wet mower blades could be the explanation for this phenomenon.

To investigate this intriguing possibility, Beef + Lamb NZ funded an experiment on twelve farms throughout New Zealand over two years. The experiment showed that mowing in the rain produced a 30% reduction in the ground cover of thistle in the spring compared to mowing in dry conditions.

The team also sampled for the wilt fungus, but found no correlation between its abundance and the mowing effect. It may be that more samples were needed to show the effect, or alternatively it is possible that a combination of different pathogens contributes to the effect, or even that it is caused by a different pathogen altogether.

For now, the biological basis of the mowing in the rain effect remains unproven. However, the research does show conclusively that mowing in the rain works to reduce Californian thistle abundance. As Dr Bourdôt says, "It is a simple technique that farmers can use right now at little cost."

The team's next step is to apply the fungus to some plots and not to others, and then mow the paddocks in the rain and in the dry. If the fungus is found to be the causal agent behind the mowing in the rain effect, it could potentially be formulated and marketed as a biological herbicide that farmers would apply when they mow paddocks in the rain to increase the effect.

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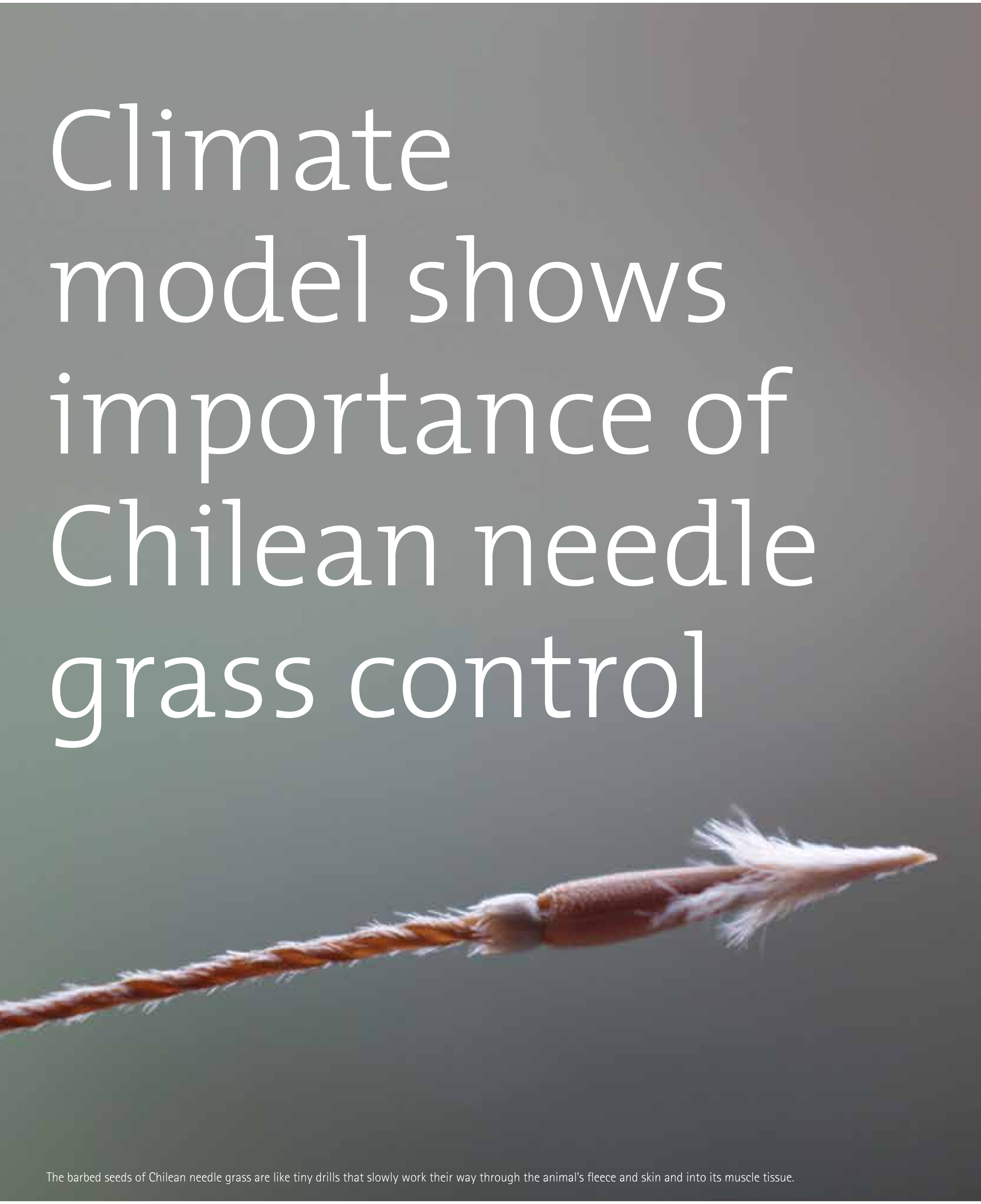
rain

A female flower head of Californian thistle at the pollination stage.

Climate model shows importance of Chilean needle grass control



The barbed seeds of Chilean needle grass are like tiny drills that slowly work their way through the animal's fleece and skin and into its muscle tissue.

Chilean needle grass (*Nassella neesiana*) is a tufted grass native to temperate South America that has become a serious grassland weed in New Zealand and Australia. It causes the downgrading of wool, skin, hides and carcasses, and it reduces both stock carrying capacity and grassland biodiversity.

The grass's barbed seeds are like tiny drills that curl and uncurl with changes in humidity, slowly working their way through the animal's fleece and skin and into its muscle tissue. In this way, the seeds damage the pelts and the meat and also cause stock handling problems when they get into an animal's eyes.

Chilean needle grass was first recorded in New Zealand in Auckland sometime before 1940, and it is now locally distributed in Marlborough and Hawke's Bay. It is a 'Total Control Plant' in Hawke's Bay, which means landholders must work to eradicate it, and a 'Containment Plant' in Marlborough, where landholders must try to contain it.

It is rarely a problem in heavily irrigated pastures, but dry hill regions are highly susceptible.

In 2008, Chilean needle grass was found for the first time in North Canterbury, probably due to seeds that arrived on livestock transported from Marlborough. As a result, a team of scientists at AgResearch led by Dr Graeme Bourdôt worked with Scion and CSIRO to develop a model to investigate the grass's potential to spread in New Zealand.

This work showed that the grass was currently only occupying 0.5% of its potentially climatically suitable range. Another 15 million hectares are climatically suitable in large parts of regions such as Northland, Auckland, Waikato, Gisborne, Hawke's Bay, Manawatu-Wanganui, Wellington, Nelson, Marlborough, eastern Canterbury, eastern Otago and much of Southland. This potential range suggests that the grass could become a much greater ecological and economic problem and that management is needed to limit its spread.

Environment Canterbury employed Harris Consulting to compare the economic outcomes of either containing the weed, or letting the weed spread and dealing with it where necessary. This study gave Environment Canterbury the evidence necessary to support the control of the grass under their Regional Pest Management Strategy.

To contain the weed, constraints are being put on the movement of animals, people, crops and vehicles into and out of the areas already infested with the grass. Roadside spraying will also help to contain the grass. The natural dispersal of the weed by wind is limited to close to the parent plant, so the primary long-distance means of dispersal is through human activities.

AgResearch is also working with the Chilean Needle Grass Action Group and Environment Canterbury to develop control options such as mulching and spraying with herbicides.

In addition, Landcare Research and the collective of Regional Councils are currently working to introduce a South American rust fungus that has potential as a biological control agent. The fungus attacks the grass in its home range in Argentina and it is hoped that it can be used in New Zealand as another tool to control the grass.

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ministry of science + innovation | Environment Canterbury Regional Council | CSIRO | SCION Next generation biomaterials | HARRIS CONSULTING

Research considers options for giant buttercup control

Giant buttercup (*Ranunculus acris*) is a native European species that is widespread throughout New Zealand and is a serious weed in dairy pastures particularly in Golden Bay and Taranaki.

Herbicide responses of the seedling progeny of herbicide-susceptible (top) and herbicide-resistant (bottom) populations of giant buttercup. The single plant at the front is the untreated control.

Giant buttercup competes with grasses and clover, reducing their content in a pasture. It is toxic and acrid-tasting to cattle, and therefore cows avoid it and also avoid anything in close proximity to it. As a result, the weed causes a loss of 33% annually in utilisable pasture dry matter in an average infested pasture and, in the 2001-02 milking season, caused an estimated national loss of $156 million in dairy farmer milk solids revenue.

In the mid-1980s, a team of scientists at AgResearch was approached by a group of dairy farmers from the Takaka Valley in Golden Bay. The farmers had noticed that the phenoxy herbicides MCPA and MCPB, which had been used to combat the weed since the 1950s, were no longer working on some farms.

The scientists took giant buttercup seed from different farms and raised the plants in a greenhouse. Once mature, these plants also varied in their response to the herbicides just as they did on the farms, which suggested that the plants had evolved a genetically based herbicide resistance.

This theory was strengthened when the team reviewed the herbicide history of the various farms. They found that farms where the herbicides were still giving good control had not used the chemicals much, if at all, in the past, whereas the farms where the herbicides had stopped working had been using them frequently for many years.

Essentially, the dairy farmers had inadvertently been selecting for giant buttercup genes that confer resistance to the herbicide. This was one of the first cases in the world of phenoxy herbicide resistance evolution and the first case of herbicide resistance evolution in a pasture weed.

The options for farmers were quite bleak,

Takaka farmer Greg Fellowes (left) speaks with Dr Graeme Bourdôt (right) in a pasture with a typical infestation of giant buttercup.

since no other effective herbicides were on the market at that time. About 12 years ago, two new chemicals came on the market which showed some promise, but they both belong to the ALS-inhibitor group which have a high risk for resistance developing in the weeds they aim to control. Only one of the chemicals was widely used, and sure enough, it is now failing to control giant buttercup on some dairy farms.

In 2010, the Giant Buttercup Management Group in Takaka received funding from Dairy NZ to research their options for combating the weed. Several options were identified, including the use of a bioherbicide and five synthetic chemical herbicides that have proven effective against the weed in the USA and Canada.

The project also developed a model to show the impact of giant buttercup on the profitability of a typical giant buttercup-infested dairy farm in Golden Bay, using historical data on the weed's ground cover. This model showed that giant buttercup results in a decrease in the profitability of the typical dairy farm of $1,040 per hectare.

Project leader, Dr Graeme Bourdôt, says that this study shows just how damaging this weed really is and "provides a good business case for research to find an effective solution."

The models also suggested that the use of a bioherbicide would be profitable even at a cost of $450 per hectare, assuming an average kill rate of 50%. This analysis was unique in integrating real farm data with ecological data, and could be applied to other weeds to determine cost effective management strategies.

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Research helps long-term management of yellow bristle grass

Yellow bristle grass (*Setaria pumila*) is a native of southern China. It is an extremely aggressive annual plant which spreads rapidly through clean pasture.

This weed reduces pasture quality in the late summer and autumn, and can also result in lower pasture utilisation because cows often avoid eating it when seed heads are mature. This stock avoidance leads to massive seed set which can result in rapid re-infestation of pasture.

Yellow bristle grass (YBG) is difficult to see until it produces a seed head, and by then its seed is probably viable and dropping to the ground, ready to germinate in the next summer.

Until recently, chemical control options were limited, but field trials show that a herbicide called Puma S controls YBG selectively in pasture. AgResearch Scientist Dr Trevor James is currently working with the proprietor Bayer CropScience to register its use in New Zealand pastures.

YBG was first recorded in New Zealand in 1905, but it was not until the 1990s that farmers and scientists observed it spreading along roadsides. Within the following decade it became a significant problem in pastures.

The spread of YBG along roadsides coincided with the cessation of using residual herbicides to control weeds around road markers and drains. Now, weeds are controlled in spring with a non-residual herbicide, leaving a perfect, open environment for this summer germinating plant.

Its prolific seeding is one of the factors which may explain why it has replaced other summer-active grasses in pastures. Other factors are more intensive grazing, including increasing stocking rates over the last ten years, and the use of less toxic endophytes that have led to lower pasture residuals after grazing.

Also contributing to the problem is the increasing use of bought in maize for silage, which is sometimes contaminated with YBG seed.

YBG is now present throughout the North Island and in Nelson and Marlborough in the South Island. It is particularly invasive in Waikato, where it can cover 20-40% of the ground within five years of invading a pasture.

Each February, between 2008 to 2011, Dr Katherine Tozer surveyed 39 Waikato dairy farms to look at changes in the ground cover of yellow bristle grass and other pasture species.

The first year, the amount of YBG increased threefold while the amount of ryegrass decreased. This change was probably caused by an extreme drought during early 2008, which created gaps in the perennial sward and enabled YBG to establish. Farms with greater post-grazing pasture cover had less YBG in the following year, showing how low

post-grazing residuals can help YBG to spread.

In years with more normal rainfall such as 2009 and 2010, YBG did not increase substantially, most likely because it did not establish and compete as well in the more vigorous ryegrass/white clover swards. However, it rapidly fills in gaps in run-out or damaged pastures that have been opened up due to drought, pugging, overgrazing, dung patches or the death of flat weeds or winter annual grasses such as annual poa.

Research suggests that long term management of YBG should probably focus on three key areas. First, damage to pastures at the time when YBG germinates, between October and December, should be reduced as much as possible.

Second, seed production should be reduced by turning the pasture into silage before viable seed are set. In addition, farmers should avoid grazing stock on heavily infested pastures and then moving the animals to a clean paddock, because the animals may excrete the seed in the clean paddock.

YBG seed survives in the dung, which provides a perfect environment for it to grow. If the infestation is small, farmers should remove the infestation manually (or for other options see the new edition of "Yellow Bristle Grass – The Ute Guide") and avoid grazing during seed production at all costs.

Finally, for pastures dominated by YBG, complete renewal is the best option. As part of pasture renewal, it is important to go through two summers of cropping, with plants such as chicory or turnips, where grass weeds are easily controlled. This depletes the reservoir of YBG seed in the soil so it will not rapidly reinvade the new pasture.

A revised manual called "Yellow Bristle Grass – The Ute Guide, 2nd edition" will be available at the AgResearch stand at the National Field Days or from Trevor James.

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Yellow bristle grass (YBG) is difficult to see until it produces a seed head, by which time its seed is probably viable and dropping to the ground, ready to germinate in the next summer.

New website launched to help farmers manage pests and weeds

Weeds and insect pests severely limit pasture and livestock production on New Zealand farms and information on their control is often fragmented and difficult to access.

A team of scientists and farm consultants, led by AgResearch's Dr Katherine Tozer, has developed 'PestWebNZ', which she says is "a website to allow farmers and people in the pastoral agricultural sector to find information on the identification and management of insect pests and weeds."

The website currently covers over 20 key New Zealand pasture weeds and pests, such as clover root weevil, Argentine stem weevil, giant buttercup, yellow bristle grass and nodding thistle. These species have been chosen in consultation with key farming, industry and research personnel, and the website will continue to be expanded with other important species.

Dr Tozer says that PestWebNZ provides an independent source of information to assist both farmers and consultants in decision-making regarding pest management, leading to better control and reduction in productivity losses. It increases dissemination of existing knowledge and makes solutions more readily available to industry.

The website is intended to be a supplementary, easily accessible source of information for farmers to use alongside other existing sources. It provides information on identification, control, biology and impact of key pasture weeds and pests.

An alert function, available by free subscription, sends emails about outbreaks or potential outbreaks of insect pests, along with suggestions for their management.

The site can be searched by weed or pest name or by what the species looks like. Using a short series of links, the site will then give information on the biology of the pest or weed, an impact assessment and options for management and control.

The site does not use commercial brand names, but instead gives users the chemical names that they can then take to a retailer who can suggest an appropriate herbicide.

Dr Tozer says, "It has been an enjoyable experience to collaborate with the many people involved, including experienced entomologists such as Colin Ferguson who have prepared all the pest information and are drivers behind the alert function.

The enthusiasm and input of Simon Glennie, a consultant from AbacusBio, has helped to ensure that the website is meeting farmers' expectations.

The project has also utilised the computer programming expertise of AgResearch staff and Otago Polytechnic students such as Glenn Tocher. There has been strong industry and local council support, which is essential for the success of PestWebNZ."

The website will be launched in June 2011 at the National Agricultural Field Days at Mystery Creek.

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New Zealand Plant Protection Society (Inc.)

ABACUSBIO LIMITED Bridging Science & Business

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Sustainable Farming Fund

Measure it better,

New technology enables easier, accurate pasture mass measurements

The C-DAX Pasturemeter is a tow-behind attachment for a quad bike, which enables much quicker and more accurate pasture mass estimation.

manage it better:

One of the key drivers of pasture productivity is grazing management. How much and how often the pasture is grazed has a direct impact on both pasture production and quality.

Industry 'best practice' guidelines suggest that pre-graze covers of around 2800 kilograms of dry matter per hectare and post-graze residuals of around 1500kg DM/ha are optimal. Higher pre-graze covers result in lower pasture quality, as the grass contains more less digestible fibre, not enough protein and lower energy levels. Likewise, if the pasture is grazed too short, re-growth will be slower and plant deaths can mean less persistent pastures.

Funded by the Pastoral 21 feed programme, a team of researchers led by Dr Robyn Dynes has been working to improve pasture mass estimation techniques by developing what her colleague Dr Warren King calls "useful tools that could drive farm production by maximising use of pastures."

In the past, the common tool to measure pasture was the Rising Plate Meter (RPM), which looks like a walking stick with a dinner plate attached to the bottom. The bottom of the stick is dropped into the pasture, and the plate is pushed upwards by the grass sward, giving an estimate of the pasture height. This height measurement is then used to calculate the pasture mass.

The RPM is a very subjective tool prone to operator error, and it takes many measurements across a paddock to give a reasonable estimate, which makes it time-consuming and laborious to operate. As a result, very few New Zealand dairy farms actually use such technology to estimate pasture mass.

A new technology called the C-DAX Pasturemeter has recently been introduced to address the RPM's shortcomings. The device is a tow-behind attachment for a quad bike, which enables much quicker and more accurate pasture mass estimation.

It continuously measures average pasture height as the bike moves, thus enabling a wide area to be covered quickly. A calibration equation is then used to convert height into pasture dry matter. The calibrations used to make this conversion have, until recently, been based on restricted field data.

To address this issue, Dr Dynes's team began a project to develop customised calibrations to improve the accuracy of the C-DAX Pasturemeter.

The team selected a range of paddocks in regions across New Zealand, and each month they measured the grass height and then cut, dried and weighed the grass to develop a set of calibrations converting grass height into pasture mass.

These measurements were repeated for a year, so that customised calibrations for each day by region could be calculated. The calculations were done for a number of dairy farms, as well as for beef and sheep farms in a reduced number of regions.

In a second phase of the project, the team then chose another set of farms that had quite different environmental parameters to the first pastures, and tested their calibrations to determine how widely they could be applied. These experiments showed that the calibrations were fairly robust even in quite different conditions within each region.

The calibrations should give farmers greater confidence in their ability to measure pasture mass, and now that the calculations have been included in the C-DAX Pasturemeter package, it is even easier for farmers to use them.

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Using hybrid vigour to improve pasture breeding

New research shows hybrid vigour may help farmers to break the pasture feed barrier. This work is about bringing new seed to farm using a different breeding system, one that captures hybrid vigour and makes it available on farm.

Conventional approaches to pasture breeding have lagged behind yield advances in annual species like maize. For example, recent benchmarking of perennial ryegrass has shown its genetic merit for yield improved less than half a percent per year, whereas improvements in maize have translated into a 1.5 - 2% genetic gain each year.

With funding from the Pastoral 21 feed programme, Brent Barrett's plant breeding team at Grasslands has led research to find a better breeding system that can be used to improve pasture production. In particular, the team has looked at the use of hybrid vigour to improve breeding progress.

Hybrid vigour is the occurrence of genetically superior plants from mixing favourable complementary genes of both parents. It has the potential to both increase yield and to enhance the plant's resilience to conditions such as disease or drought.

Mr Barrett's team conducted their first trial using perennial ryegrass under sheep grazing at Aorangi Farm in the Manawatu Plains for two years, so that the results would better reflect on farm conditions. This work found that hybrids improved yield by up to 7% per year above the better parent, and some hybrids showed up to 19% higher yield in certain seasons.

This initial research used six hybrid combinations, and has shown that the concept of using hybrids has good potential for delivering value to farmers via an improved pasture breeding system. The next steps are to test more combinations to search for a hybrid that is successful across all seasons, and to use DNA markers to fingerprint relatedness patterns and help predict hybrid vigour.

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Using pasture quality measurements to optimise animal nutrition

Pasture quality varies widely with pasture composition, season and even time of day. These variations make it difficult to accurately measure the true intake of carbohydrate and protein by animals. This is important because the variations in quality have a direct impact on animal production and environmental performance.

There are currently no off-the-shelf devices available to farmers for measuring pasture quality in real time. However, the development of prototype devices such as the one shown here will speed the delivery of this technology on-farm in the near future.

With funding from the Pastoral 21 programme, a team led by Dr Robyn Dynes, in collaboration with Prof Ian Yule at Massey University, is working to develop real-time pasture quality measurements that can be used to create simple, practical tools for improving farm performance.

In the past, to get measurements of pasture quality parameters such as protein, carbohydrate, minerals and fibre, farmers would have to cut a sample of grass and send it off to a laboratory for analysis. They would then wait anywhere from three days to three weeks to get the results, by which time pasture conditions had changed and the measurements were no longer relevant to farm management.

Dynes's team are developing new methods that can measure pasture quality parameters in real time, which will enable farmers to respond to diurnal and seasonal changes in nutrients such as protein and carbohydrates.

For example, protein is often too high in pasture grass relative to its carbohydrate content, which leads to sub-optimal animal production. Real-time measurements would enable farmers to address such an imbalance by feeding animals supplemental carbohydrates in the shed, thereby improving their productivity.

In addition, such feeding could also improve environmental performance. When animals ingest too much protein, they excrete the excess in their urine, which is a primary source of nitrogen leaching into groundwater and nearby waterways. High carbohydrate supplementary feed can reduce excreted nitrogen.

Another example of how knowledge of pasture quality can be used to improve animal nutrition is by monitoring diurnal changes in carbohydrate levels (see Afternoon Delight on following page).

One further example of how pasture quality measurements can be used to drive both increased production and environmental performance is by using real-time measurements of nitrogen content in pasture to determine whether fertilisers are needed, and to develop a finely tuned, more efficient system for applying fertilisers, rather than simply using a crude calendar schedule. Such a system could improve pasture production, reduce fertiliser costs and limit nitrogen losses to the environment.

Although currently no affordable devices are available to farmers for measuring pasture quality in real time, such a device should soon be available for some parameters. The device may operate similar to the C-DAX Pasturemeter, using an attachment on a quad bike to take real-time measurements.

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Afternoon delight

Dr David Pacheco leads a research programme aimed at enhancing animal nutrition and thus improving productivity by using diurnal changes in the composition of pasture species.

Generally, soluble carbohydrates and dry matter concentrations are at their lowest in pasture offered during the morning and increase to a maximum level by mid afternoon (up to ~ 1 to 2 hours before sundown). This means that if animals are fed grass in the afternoon, they get a better balance of protein and carbohydrates than if they are offered a fresh grass break in the morning, which is currently common practice.

This simple change in management has been shown to improve milk solids production and could also help to reduce the amount of nitrogen that animals release into the environment.

Moreover, there is an interaction between pasture quality and behaviour, because animals having a new feed break in the afternoon extended their grazing time during the night. Importantly, they obtained more of their intake while the forage offered a greater nutritive value, compared to their herd mates that had access to a new feed break in the morning.

Dr Pacheco says that harnessing these feedback loops can multiply the effect of pasture quality, so that "farmers have opportunities through small changes in management to have greater responses in productivity than could be expected from the difference in quality alone."

"To me the fascinating thing is how small changes can result in ripple effects that result in increased production," he says.

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