Undermining WEEDS

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Californian thistle in a cattle pasture near Lincoln, Canterbury

Progress update

Weeds threaten the sustainable development of New Zealand's primary production sectors by reducing yields, quality and profitability, and through environmental impacts from control methods.

Pastoral weeds, collectively, are estimated to cost the NZ economy $1.2 billion p.a. Individually, they can greatly reduce the profitability of pastoral farming. Forestry would simply be uneconomic without cost-effective and environmentally acceptable weed control.

In our last Newsletter (#2) we reported on a programme of scientific research involving the three CRIs, AgResearch, Scion and Landcare Research, and Plant Protection Chemistry NZ Ltd (PPC_{NZ}). This partnership is working to improve the management of weeds in the pastoral and forestry sectors, and reported that it had:

1. Developed herbicide spray adjuvant technologies that enable reduced water rates in forestry without compromising the level of weed control achieved by aerial spraying

2. Identified fungi that live inside Californian thistle plants (endophytes) that can either promote or inhibit the activity of a biological herbicide being considered for use against this weed, and

3. Revealed the threat that yellow bristle grass, an invader from China now naturalised in the North Island, presents to dairy farms throughout much of New Zealand.

In the current Newsletter we present some examples of how research in Undermining Weeds has quantified the impacts and costs of weeds to forest growers and pastoral farmers.

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Giant buttercup infesting dairy pasture in Golden Bay

Giant buttercup reduces the profitability of dairy farming

Giant buttercup (*Ranunculus acris* L. subsp. *acris*), a weed of European origin, currently infests pastures in six of our 17 dairying regions. While it is well known to reduce the quantity of pasture available by deterring grazing through the production of the acrid-tasting and toxic protoanemonin, its enormous impact on whole-farm profitability has only just been revealed.

Giant buttercup occurs in dairy pastures in the South Auckland, Hawke's Bay and Taranaki regions and in the districts of South Wairarapa, Horowhenua and Tasman. In the 2001-02 milking season, when the payout to dairy farmers was $5.35/kg milk-solids, these infestations resulted in a gross national revenue loss to dairy farmers of $156 million through reduction in utilisable pasture dry matter. Assuming no spread of the weed since 2001-02, it is estimated to have caused a loss in dairy farmer revenue of $155 million in the 2008-09 season across the six dairying regions infested in 2001-02. If it had spread across all 17 dairying regions at that time, to occupy either 10% (as in Hawke's Bay) or 30% (as in Tasman) of the pasture area, the additional losses would have been $173 million and $593 million, bringing the potential gross national revenue loss to $328 million and $748 million respectively in the 2008-09 season. A recently completed bio-climatic niche model indicates that all 17 dairying regions are climatically highly suitable for the weed and therefore vulnerable to invasion.

While the estimated gross revenue losses give an indication of the economic significance of this weed to the New Zealand dairy industry they do not measure its effect on farm profit nor the potential benefits to dairy farmers of controlling the weed. We have addressed this lack of knowledge by developing a series of farm system models using the modeling package FarmaxDairyPro®, examining the effect of the weed on the profitability of a typical dairy farm in Golden Bay under various chemical and biological control scenarios.

On the 'typical' farm modelled, with the ground cover of giant buttercup peaking at an average per paddock of 12% in November, profit was reduced by $1040/ha ($1830 vs. $2870). Herbicides had a positive effect on profitability but only where the 'kill' was better than ~30% with MCPA or ~60% with Preside. A bio-herbicide with a 50% kill rate (as measured in field trials with the fungus, *Sclerotinia sclerotiorum*) increased profitability by $485/ha. The models show that giant buttercup significantly reduces the profitability of a typical dairy farm (by 36%) and that its effective control can bring large financial gains for the farmer.

Given the clear financial benefits from controlling giant buttercup illustrated by this modelling study, the challenge now is to develop an effective control method for dairy farmers to replace the currently registered herbicides that are failing due to the evolution of herbicide-resistance in the buttercup. A bio-herbicide is one possibility. Another is alternative chemical herbicides applied using modern "weed-wiper" technology to selectively remove the weed from infested pastures.

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Yellow bristle grass infesting a dairy pasture in coastal Taranaki

Yellow bristle grass reduces pasture quality and milk yield on dairy farms

Yellow bristle grass (*Setaria pumila*) is a summer-active grass weed prevalent in Waikato and other dairy pastures in the North Island. It can have a significant impact on farm profit as this weed provides poor quality forage over the summer months in comparison to ryegrass and clover.

The weed is spreading into new areas in the North Island, which is causing much concern to farmers. It can dominate some pastures with up to 60% of the total dry matter comprising yellow bristle grass and other summer-active grass weeds. In Central Waikato, a 5-year annual survey of the same 39 dairy pastures in which yellow bristle grass was present has shown that on average, 20-25% of total pasture dry matter comprised summer-active grasses with yellow bristle grass making up 50% of this grass weed component. It has been estimated that a pasture comprising 25% of its total dry matter as yellow bristle grass (or other summer-active annual grass weeds) can cause an 11% drop in milk production.

Yellow bristle grass increased particularly after the severe 2008 drought. It is a prolific seeder – a seedhead contains 100 to 200 seeds. This prolific seed production enables it to take advantage of drought years and spread within and between paddocks by occupying the gaps left by the death of ryegrass and clover.

You can find out more about yellow bristle grass on PestWebNZ: www.pestweb.co.nz. PestWebNZ is a website which provides information on the control, biology and impact of key pasture weeds and pests. It also has an identification tool - use this to identify yellow bristle grass and find out how best to control it. You can sign up for free alerts on weeds and pests in your region, to ensure a timely management response.

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Integrated management of broom in a young pine stand using chemical and cultural control

Weed management options for eco-certified forestry

Weed control around newly planted trees is the single most important silvicultural practice aimed at maximising timber yield. The New Zealand forestry sector relies on herbicides for cost-effective weed management. This chemical dependency conflicts with environmental principles of chemical reduction and avoidance endorsed by the dominant forest eco-certification body, Forest Stewardship Council (FSC). Research undertaken by Scion will help the industry to identify an integrated approach to weed management that strikes a balance between economic and environmental impacts.

Two of the most commonly used herbicides in New Zealand forestry, hexazinone and terbuthylazine, are defined as hazardous by FSC. Scion conducted a review of vegetation management in New Zealand plantation forests to provide information on alternative methods (manual, mechanical, biological) for the control of the major weeds in New Zealand forestry. This information is useful to FSC-certified forest growers as a benchmark for assessing the implications of certification (and vegetation management) for the profitability of their business.

Scion calculated the cost to the industry of five hypothetical alternative (to current) vegetation management regimes. These options included two potential chemical alternatives (that used either FSC-compliant herbicides or spot weed control) and three non-chemical alternatives (manual methods, mechanical methods and the use of weed mats). The study showed that (if proven effective) using FSC-compliant herbicides could mean a marginal increase in direct costs with overall greater financial impacts for marginal land than for highly productive land. The results do however assume no adverse effect of the chemicals on tree growth and further research should be undertaken to determine the magnitude of long term phytotoxic effects before these FSC-compliant herbicides are widely used.

The assessment of non-chemical vegetation control alternatives showed that combinations of fire, mechanical and manual control methods (including weed mats) are prohibitively expensive, incurring a more than 100% increase in direct vegetation management costs. For sites with average *Pinus radiata* yields very large increases in timber volume (20% to 70%) would be required to offset the high treatment costs of non-chemical control at discount rates of 6 to 8%. When expressed as an impact on the internal rate of return (IRR) forest companies could see a potential decrease in IRR of between 2.0 to 2.5%.

This study showed that removal of terbuthylazine and hexazinone from the forester's vegetation management toolbox in FSC-certified forests will have direct cost implications for the New Zealand forestry sector. Non-chemical vegetation control is not a cost-effective option and, if enforced, is likely to have severe consequences for forestry in New Zealand. Spot control and the use of FSC-approved herbicides could provide feasible alternatives depending on site factors.

It is likely that the best way forward for vegetation management in forestry is to research and develop a management approach that integrates cultural, biological and chemical methods. The integrated approach can be designed to have minimum environmental impact at a cost that does not undermine the practice of forestry.

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