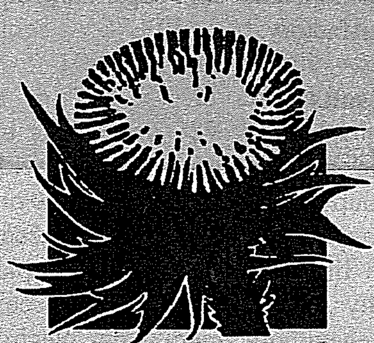
A Good Weed



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With the global demand for agricultural surfactants set to increase, and that mainly for use with post-emergent herbicides, it is timely that their role in weed control is assessed. In this article, Allan Murphy looks at some results with adjuvants from the literature as well as from their own trials at DowElanco. He concludes that while surfactants are important in the formulation of products, the benefit to biological activity for many uses still has to be resolved by results in the field.

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... Adjuvants - the State of Play

The consumption of surfactants used with pesticide products in 1993 was about 230,000 tonnes (US$380 million) or about 3.3% of the consumption of surfactants for all end uses.

It is forecast that the global demand for agricultural surfactants will increase in the future, mainly for use with post-emergent herbicides. The future growth and commercial success of adjuvants will depend on: reducing formulation and application costs; developing improved, effective formulations; optimising field performance; and overcoming regulatory obstacles.

During spray application, surfactants which are present in the formulation or are added separately to the spray tank mixture can enhance the biological activity of the pesticide (herbicides, insecticides and fungicides).

The exact mode of action of the surfactant in enhancing biological activity is not fully understood, but it is likely that improved leaf wetting, spreading, retention and penetration are important factors, coupled with the basic mode of action of the pesticide itself.

In his review of adjuvants - "Are They Worthwhile?" from the 4th International Symposium on Adjuvants for Agrochemicals, 1995, Combellack found that there were many praiseworthy claims made for adjuvants, such as: ameliorating efficacy; helping overcome variable adverse environmental conditions; assisting in minimising off-target losses, thus lessening the environmental hazard; along with improving economic returns. Although Combellack posed the question as to whether these claims were valid, he went on to say that he found no sound data in the literature to substantiate the purported benefits of adjuvants.

He also suggested that labelling of adjuvants was not precise and that there was no sound economic analysis to redress the persistent "snake oil" image of adjuvants. Such a situation for an industry worth US$150 million globally (for adjuvants sold separately) is not very satisfactory.

Results

The need to use adjuvants with certain groups of broadacre herbicides on specific groups of weeds is widely accepted and the literature has many examples of the folly of using herbicides at commercial rates without an adjuvant. Such herbicide groups include the aryloxyphenoxypropionate grass weed herbicides such as diclofop-methyl, fluazifop-butyl, haloxyfop-ethyl or methyl, and the cyclohexanedione grass herbicides such as sethoxydim and tralkoxydim (see Figure 1).

For these herbicide groups, the effect of improved uptake and transport with adjuvants is reflected in the improved levels of control. Commercial herbicides should all be applied with adjuvants if specified on the label. The effect of the adjuvant depends on the rate of herbicide and adjuvant. The specified nonionic adjuvants or oils can generally be substituted without serious loss of activity. Promotion of one adjuvant over another with these chemical groups is often clutching at straws.

It is recommended that an adjuvant (but not oil) be used in many cases with the aromatic herbicide, glyphosate, in the 360 g/L formulation and that a nonionic surfactant be used for all uses with the 450 g/L formulation.

The following results relate to selected situations which demonstrate herbicide, adjuvant and plant specificity and suggest the need to be selective with the use of adjuvants, the use of which may not improve the results but may make them worse. Often the effect is only an early cosmetic one with no real improvement in the end result.

I have concentrated in this paper on results for brushweeds with the DowElanco pyridine herbicides because of our experience with them.

For example, the control of 30-60 cm long caltrop in fallow 56 days after application (DAA) with 2,4-D amine alone was 17% and with the addition of 1% v/v mineral oil was increased to 71%. In comparison, Sprayseed alone gave 38% control and the addition of 1% oil gave similar control at 40%.

Ulvapron mineral oil had minimal effect with Grazon DS (picloram/triclopyr, EC formulation) on St. John's wort at Rouchel, NSW and a slight negative effect with Garlon 600 (triclopyr, EC).

Improved control of regrowth of *Eucalyptus* spp. has been achieved under powerlines in eastern Australia with Grazon, EC formulation (picloram 33.3g + triclopyr 99.9g/100L spray) with Decol S35B (dodecyl benzene sulphonate anionic surfactant) at 0.25% v/v. Commercial results with this adjuvant have been satisfactory. More recent work with Grazon DS on eucalypt regrowth at Armidale, NSW and at Nebo and Rockhampton, Qld, comparing Decol S35B, organosilicone (Pulse) and pyrrolidone (Surfadone LP300) nonionic surfactant has supported the use of Decol S35B.

The results of organosilicone surfactants with Lontrel (clopyralid amine aqueous concentrate formulation) with handgun spraying of silver wattle (*Acacia dealbata*) regrowth in *Pinus radiata* forests in NSW and Victoria have been variable but generally beneficial.

Important brushweeds which have incurred considerable research effort and expenditure on a range of control methods include rubber vine (*Cryptostegia grandiflora*), prickly acacia (*Acacia nilotica*), chinee apple (*Ziziphus mauritiana*) and *Mimosa pigra* in Qld and the NT.

Figure 2 shows the results from 1990 ground boom spraying of rubber vine regrowth at Charters Towers with Grazon DS and organosilicone (Pulse). Pulse initially improved brown-out with all rates of Grazon DS. The effect of Pulse was only significant with the lower commercial use rate of Grazon DS of 2.5L/ha and half of this rate. Results from a repeat experiment on rubber vine regrowth at Charters Towers in 1991 showed that the adjuvant Pulse improved the level of control with Grazon DS at 1.25, 2.5 and 5.0 L/ha. The adjuvant Surfadone (LP300) did not improve the level of control with 2.5L/ha and five other adjuvants significantly reduced the level of control.

Progress with further work on rubber vine has been hampered by drought. Past aerial spray trial results support the use of Pulse surfactant with Grazon DS, but more importantly, the effectiveness of higher aerial spray volumes. Current trials at Charters Towers support these findings and also indicate that 'Uptake' spray oil (DowElanco COC) at 2L/ha may be more effective than organosilicone surfactant with Grazon DS on rubber vine.

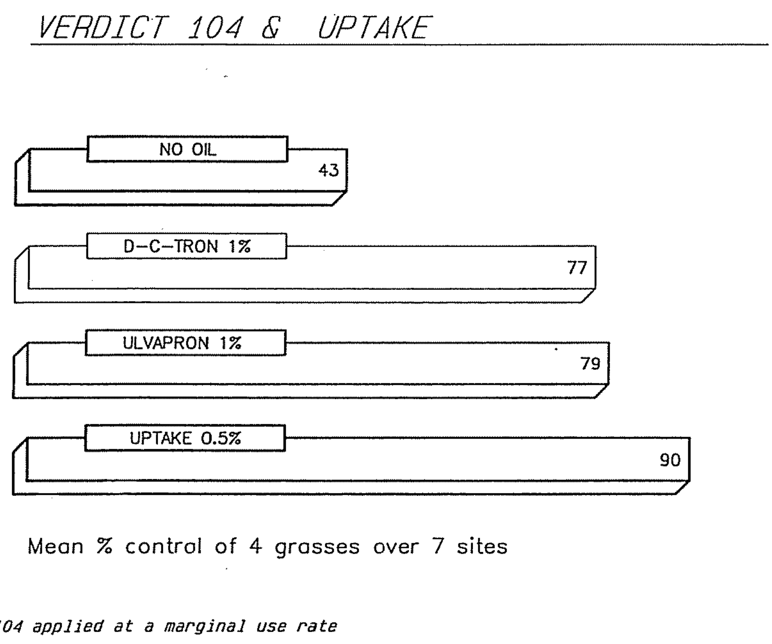


Figure 1 *Verdict 104 applied to grasses with and without surfactants.*

The herbicide Starane (fluroxypyr, EC formulation) is used commercially on *Mimosa pigra* as an aerially applied spray and has also been effective on *Acacia nilotica*. Use rate, herbicide and efficacy of spray technique have been found to be more influential than surfactants on these bi-pinnate leaf species. Too much initial herbicide can result in reduced control. Basal bark spraying of chinee apple is a better option than foliage spraying and adjuvants are not an option.

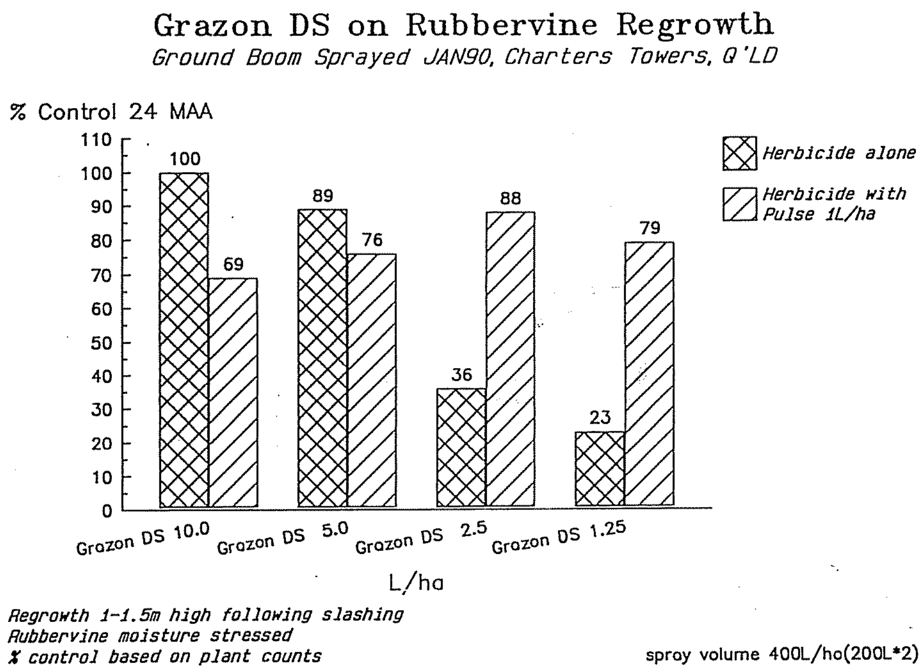


***Figure 2** The control of rubber vine using Grazon DS with and without the adjuvant Pulse.*

Blackberry is a very significant weed commercially in Australia. Considerable work here and in New Zealand has found no significant improvement in results with adjuvants using commercial rates of DowElanco emulsifiable concentrate pyridine herbicides, despite some data supporting improved uptake. Correct use rate and efficacy of spray technique have been found to be most important. The use of a range of adjuvants has actually reduced effectiveness. In my experience, the use of adjuvants with competitive herbicides, such as metsulfuron methyl and glyphosate on blackberry have been useful.

In contrast to blackberry, the use of specific adjuvants with DowElanco products and other herbicides for control of gorse (furze, *Ulex europaeus*) can significantly improve the level of control.

Lantana and associated weeds are also important commercially. Aerial spray trials with fluroxypyr (Starane), picloram and triclopyr (Grazon DS) and picloram + 2,4-D (Tordon 50-D) in Qld and NSW did not resolve the effectiveness of organosilicone, nonionic or mineral oil adjuvants. However, preliminary results from handgun trials indicate that organosilicone, nonionic and oil adjuvants can improve results with several herbicide groups. No clear recommendations are available at this stage for the pyridine herbicides.

Conclusion

While surfactants are important in the formulation of products, and have been found to be important for some field uses, the benefit to biological activity for many uses still has to be resolved by results in the field. Claims for efficacy are only relevant if consistent field results can be obtained. This will counteract the "snake-oil" image referred to by Combellack.

(Allan Murphy is Past President of The Weed Society of NSW. This is an edited version of his talk to the AGM late last year). ❑

The Medd Report ~ 3rd International Bioherbicide Workshop

The third biennial gathering of the International Bioherbicide Group, which is an informal body of research specialists interested in developing herbicides using naturally occurring pathogenic microorganisms as the active ingredient, met over the weekend of 19-21 January 1996, at Stellenbosch, South Africa, immediately prior to the IX International Symposium on Biological Control of Weeds.

Thirty seven delegates from 13 countries (Australia 5, Brazil 2, Canada 5, China 1, Germany 1, Japan 1, Malaysia 1, New Zealand 1, South Africa 3, Switzerland 1, Russia 2, USA 4, UK 10) contributed 16 oral presentations and 7 posters. These were presented in two morning sessions with a visit to the Plant Protection Research Institute, Stellenbosch on the first afternoon to inspect facilities and research projects.

There was also a brief field excursion to inspect the use of *Cylindrobasidium laeve* as a cut stump method for control of *Acacia meanseii*, a serious invader native to Australia.

Abstracts of contributions were available for the meeting and full manuscripts will be included in the Proceedings of the IX International Symposium on Biological Control of Weeds, due to be published in August 1996.

Dr Helmuth Zimmermann noted in his opening address that after several years of concerted research, bioherbicides have failed to attract the interests of multinational companies, a topic that was considered at some length in a subsequent discussion session.

He foreshadowed that, in South Africa at least, bioherbicides in the immediate future will target niche markets that can be serviced by small specialist organisations or cottage industries and where registration costs can be minimal. Whilst innovation was necessary to advance bioherbicides into the market place, he cautioned that unless these are affordable and practical they are unlikely to be successfully adopted.

A majority of the presentations dealt with the evaluation of pathogens with very little new methodological information or few new ideas emerging on spore production, epidemiology etc. The wide ranging targets and agents under investigation are compiled in Table 1.

...after several years of concerted research, bioherbicides have failed to attract the interests of multinational companies...

A considerable number of surveys are also under way in a number of countries, indicating a continuing commitment. One interesting development involves the potential synergistic exploitation of pathogens with classical biological control agents.

For instance *Colletotrichum* sp. nov. near *graminicola* generally causes only minor damage to *Rottboellia cochinchinensis* but may be more potent if the plant has been assaulted by a rust *Puccinia rottboelliae* and/or systemic head smut *Sporisorium ophiuru*. Potential synergism between inundative and classical agents is being investigated for several aquatic weeds also.

Another trend is the growing interest in non-specific microorganisms. Whilst these may have low virulence they have the advantage of being broad spectrum.

Use of "cocktails" of pathogens has potential to both increase spectra and virulence. Although aware of this opportunity, I have yet to pursue it in my work with *Pyrenophora semeniperda.*

Despite there being general awareness of the possibilities of exploiting phytotoxins, there appears to be only limited research activity in this field. This would seem to be an area worth resourcing given its alliance to the interests to the multinational pesticide companies.

Table 1 *Weeds and pathogens considered in bioherbicidal studies at Stellenbosch.*

Weed	Country	Pathogen	Reseach emphasis
Abutilon theophrasti	Canada	*Colletotricum gloeosporioides* f.sp. *malvae;* *Colletotrichum coccodes*	Survey, molecular markers, infection process; Field evaluation
Acacia mearnsii	South Africa	*Cylindrobasidium laeve;* *Ceratocystis* sp.	Development; Questionable value
Alisma lanceolatum + *Alisma plantago-aquatica*	Australia	*Rhynchosporium alismatis*	Evaluation
Amaranthus spp.	Brazil, USA	- *Phomopsis amaranthicola*	Survey; Patented, commercial development
Avena spp.	Australia Canada China	*Pyrenophora semeniperda;* Root, shoot and seed; *Pyrenophora chaetomioides*	Evaluation, provisional patent; Survey; Evaluation
Bromus spp. *Bromus tectorum*	Australia Canada	*Pyrenophora semeniperda;* Rhizoorganisims	Evaluation, provisional patent; Evaluation; soil delivery systems
Cenchrus echinatus	Brazil; USA	- *Helminthosporium* spp.	Survey; Evaluation
Chenopodium album	The Nether-lands + Italy	*Ascochyta caulina*	Field evaluation + phytotoxins
Chrysanthemoides monilifera	Australia	Leaf and stem dieback organisms	Survey
Cirsium arvense	Canada	-	Survey + evaluation
Cynodon dactylon	USA	*Helminthosporium* spp.	Evaluation
Cyperus rotundus	Brazil; USA	*Cercospora (caricis);* *Dactylaria higginsii*	Survey + evaluation; Evaluation
Cyperus esculentus+ C. iria	USA	*Dactylaria higginsii*	Development
Damasonium minus	Australia	*Rhynchosporium alismatis*	Evaluation
Digitaria spp.	USA	*Helminthosporium* spp.	Evaluation
Eichhornia crassipes	Brazil; Malaysia	- *Myrothecium roridum* + *Alternaria* sp.	Survey; Survey, evaluation of microorganisms to complement insect damage
Eleusine indica	USA	*Helminthosporium* spp.	Evaluation
Hakea serecia	South Africa	*Colletotricum gloeosporioides* strain	Cottage industry mycoherbicide

Hydrilla verticillata	USA	*Mycoleptodiscus terrestris*	Microorganisms to complement insect damage
Imperata cylindrica	Malaysia	*Colletotrichum caudatum*	Evaluation
Lolium spp.	Australia	*Pyrenophora semeniperda*	Evaluation, provisional patent
Malva neglecta	Canada	*Colletotricum gloeosporioides* f.sp. *malvae*	Infection process, disease enhancement
Malva parviflora *Malva pusilla*	Canada	*Colletotricum gloeosporioides* f.sp. *malvae*	Post registration commercialisation
Myriophyllum aquaticum; *Myriophyllum spicatum*	South Africa; USA	*Xanthomonas campestris*; *Mycoleptodiscus terrestris*	Evaluation; Evaluation + further survey
Panicum maximum	USA	*Helminthosporium* spp.	Evaluation
Panicum repens	USA	*Helminthosporium* spp.	Evaluation
Papaver somniferum *Papaver* spp.	Russia + USA	*Fusarium oxysporum* and *Rhizoctonia callae*	Survey, evaluation
Pteridium aquilinum	UK	*Asochyta pteridis*	Formulation
Rottboellia cochinchinensis	UK	*Colletotrichum* sp. nov. near *graminicola*	Prototype mycoherbicide + classical biocontrol with a rust and systemic head smut
Rumex obtusifolius	UK	*Armillaria mellae*	Evaluation
Senna obtusifolia	Brazil	*Alternaria cassiae*	Survey, evaluation
Setaria glauca	USA	*Helminthosporium* spp.	Evaluation
Setaria viridis	Canada	Rhizoorganisims	Evaluation
Solanum viarum	USA	*Pseudomonas solanacearum*	
Sphenoclea zeylanica	Canada + Philippines; Malaysia	*Alternaria* sp.; *Colletotricum gloeosporioides*	Evaluation; Evaluation
Striga hermonthica	Germany; Canada	*Fusarium nygamai*; *Fusarium semitectum* var. *majus*; *Fusarium oxysporum*	Evaluation + phytotoxins; Evaluation; Evaluation
Ulex europeus	New Zealand	*Fusarium tumidum*	Evaluation, formulation, mycotoxin properties
Vulpia spp.	Australia	*Pyrenophora semeniperda*	Evaluation, provisional patent
Xanthium occidentale; *Xanthium spinosum*	Australia; "	*Alternaria zinniae*; *Colletotrichum orbiculare*	Formulation; "

Overcoming the requirement for prolonged periods of dew or free water remains a major constraint to efficacy. Encouraging progress was reported with using vegetable oils and surface active agents to form invert emulsions. These have proven non-toxic to spores and appear to eliminate the need for dew. Their high viscosity causes a number of problems, not the least being the need for air assisted spray technology for field application.

The Bioherbicide Group produces a very informative biannual newsletter and should you wish to contribute articles, or sponsorship, or be placed on the mailing list, contact the editor:

Dr Louise Morin, Manaaki Whenua - Landcare Research, Private Bag 92170, Auckland, New Zealand. Fax: +64 9 849 7093 E-mail: morinl@landcare.cri.nz.

In conclusion, bioherbicide technology is still in its infancy - progress is slow and there has been little interest from the multinational companies. Many are critical of the lack of significant progress, but this criticism should not be used to condemn the enterprise.

Progress is resource driven....

Progress is resource driven - so I would advocate more resources means more progress. Biological control is under utilised in most natural and agricultural ecosystems and no endeavour should be ignored or too lightly dismissed in order to satisfy the desire to reduce the dependence on pesticides.

It does not help the bioherbicidal cause that none of the three registered bioherbicides is currently being marketed, although we were assured that negotiations to remarket all of them were in progress.

Dr Mike Morris and his committee are to be congratulated on an excellent job of organising the workshop, venue, transport and hospitality. The Workshop was supported by the *Plant Protection Research Institution, South African Plant Improvement Organisation* and *Stellenbosch Farmers Winery.*

My thanks also go to the Weed Society of NSW Inc. for granting me $500 to assist in attending the meetings in South Africa.

I presented two papers at the meetings:

Medd, R.W. and Campbell, M.A. (1996). A rationale for regulating some annual grass weeds of arable lands using a non-specific fungal seed pathogen. *Proceedings IX International Symposium Biological Control of Weeds, Stellenbosch,* In press.

Campbell, M.A., Medd, R.W. and Brown. J. F. (1996). Cultural and Infection Studies on *Pyrenophora semeniperda:* a Possible Bioherbicide for Annual Grass Weeds. *Proceedings IX International Symposium Biological Control of Weeds, Stellenbosch,* In press.

(Dr Richard Medd is Principal Research Scientist with NSW Agriculture at the Agricultural Research & Veterinary Centre, Forest Road, ORANGE NSW 2800.) ❑

Constraints on the Evolution of Glyphosate Resistance in Weeds

Glyphosate is a post-emergence, non-selective herbicide used in weed control programs around the world since its commercialisation in 1974. Despite its widespread and long term use, weeds have not evolved resistance to glyphosate.

An examination of the literature on glyphosate-tolerant crops, the mechanism of action and glyphosate use, suggests that the lack of glyphosate resistant weeds may be attributed to two factors. First, genetic and biochemical constraints on the evolution of a mechanism for resistance appear to exist in higher plants. Second, the use pattern for glyphosate in agriculture may preclude the evolution of resistance in weed populations.

Three mechanisms of glyphosate resistance are generally assumed to be possible in plants: (1) overproduction of 5-enolpyruvyl-shikimate-3-phosphate synthase (EPSPS) at glyphosate's site of action, (2) alteration of EPSPS, and (3) metabolic degradation of glyphosate. Constraints associated with the evolution of these mechanisms in weed populations may be preventing the occurrence of glyphosate resistance.

EPSPS overproduction confers too low a level of resistance for plants to survive field rates of glyphosate.

EPSPS alterations that confer resistance to glyphosate in bacteria are alterations in the active site of the enzyme. In bacteria that produce EPSPS with a high degree of homology and identity to plant EPSPS, the alterations interfere with binding of phosphoenolpyruvate, the enzymes normal substrate, and reduce EPSPS's catalytic efficiency. As a result, untreated transgenic plants with the glyphosate-resistant EPSPS exhibit significant reductions in fitness relative to plants with glyphosate-susceptible EPSPS. Similarly, marked fitness reductions associated with an altered EPSPS may prevent the transmission of glyphosate resistance to succeeding generations in weed populations.

Finally, metabolic degradation of glyphosate is improbable as a mechanism of resistance. Definitive evidence of its occurrence in higher plants, even at low levels, has not been demonstrated. Moreover, enzymes that degrade glyphosate, although found in numerous species of bacteria, have not been shown to occur naturally in plants.

In addition to the constraints on the evolution of a resistance mechanism, two features of the use pattern for glyphosate in agriculture impede resistance evolution in weed populations.

First, glyphosate has been and will continue to be used primarily for the control of perennial weeds. In general, the evolution of adaptation takes much longer in perennial than annual plants due to the lower reproductive effort (seed production) and seedling recruitment per growing season, as well as the increased generation time of perennials. As a result, the probability of evolution of resistance in perennial weeds is likely to be low.

Second, the use of glyphosate for annual weed control is almost always associated with the application of a second herbicide class that targets the major annual weed(s) in a field. The second herbicide is applied either as a tank mixture with glyphosate or as an in-crop treatment during the same growing season. Because the most abundant annual weeds in a field are the weeds most likely to evolve resistance, this practice of applying a second herbicide class, in addition to glyphosate, on the same weed population, reduces the likelihood of glyphosate resistance evolution.

In summary, genetic and biochemical constraints associated with potential mechanisms of resistance, as well as the use pattern for glyphosate in agriculture, preclude the evolution of glyphosate resistance in weed populations. Although one cannot state with certainty that resistance to glyphosate will never occur in weeds, it appears to be considerably less likely than resistance to many other herbicide classes.

(Written by Marie Jasieniuk and reprinted in part from the biannual newsletter, Resistant Pest Management, Vol 7, No. 2, 1995). ❑

Recent Progress on Biological Control of Silverleaf Nightshade from South Africa

Pioneering research undertaken by biocontrollers in the Plant Protection Research Institute, Pretoria, has resulted in notable achievements in the fight against invasive *Solanum* weeds.

Numerous species of *Solanum* (Solanaceae) are weeds in many countries worldwide. However, outside of South Africa none have been deliberately subjected to biological control programs. In any biocontrol program it is the closest relatives of the host plant which are most likely to be at risk from the biocontrol candidates. Thus one reason for the dearth of biocontrol programs within the Solanaceae could be the large number of cultivated species in the family. Consideration and release of biocontrol agents has possibly been delayed because of the perceived risks. The research undertaken by the Plant Protection Research Institute has been necessitated by the fact that three alien *Solanum* species are major environmental and agricultural weeds in South Africa.

The biocontrol campaign against *Solanum* weeds was initiated in the early 1970's because of the threat of *S. elaeagnifolium* (commonly known as silverleaf nightshade) to arable and pastoral land in the Karoo, Orange Free State and northern Transvaal. Intensive chemical and mechanical control operations were not successful and this prompted the search for natural enemies. However, over the next decade, progress was intermittent. Although some 15 potential agents were identified, four species were found not to be host specific and one was released but failed to establish.

Biological control of S. elaeagnifolium *had thus reached an apparent stalemate in that eggplant seemed to be a "neutral" host for otherwise suitable biocontrol candidates*

A turning point came in 1985, when two defoliating beetles, *Leptinotarsa texana* and *L. defecta* were imported from North America. These were potentially the most destructive of the known candidates. Because of the close relationship between the weed and crop species like potato (*S. tuberosum*) and eggplant (*S. melongena*), host-specificity testing was intensive and spanned a number of years. The research showed that the beetles were able to survive on eggplant in the laboratory. Biological control of *S. elaeagnifolium* had thus reached an apparent stalemate in that eggplant seemed to be a "neutral" host for otherwise suitable biocontrol candidates, probably because it lacks the deterrents that many wild plants in the family possess.

Considerable deliberation and further investigation followed and the conclusion reached was that *L. texana* and *L. defecta* are unlikely to become pests of eggplant for the following reasons:

- Neither species has ever been reported as attacking eggplant in the Americas (the country of origin of the beetles). Although both species are able to develop on eggplant they prefer to lay eggs on their natural host plant.
- Major eggplant cultivations in South Africa do not overlap with *S. elaeagnifolium* infestations and the beetles are thus unlikely to have access to eggplant cultivations.
- In the unlikely event that the beetles were to colonise eggplant, routine eggplant cultivation practices would curb establishment. Crop rotation would disrupt beetle populations, regular soil fumigation for nematodes would cause mortality in pupating larvae and diapausing adults of *L. texana* and *L. defecta* and application of insecticides and miticides would kill feeding adults and larvae, as experimentally illustrated during this study.

In late 1992, following this submission of research findings, the beetles were cleared for release at three restricted release sites at Pretoria, Kendrew (Karoo) and Winburg (Orange Free State) for initial field evaluations. The beetles established and performed well at all three sites, making them the first biocontrol agents to be deliberately established on a Solanaceous weed anywhere in the world.

These promising results and the completion of further host specificity tests under field conditions were sufficient to allow the unconditional release of the beetles country-wide. An evaluation of the impact and potential of these beetles has been initiated, in conjunction with scientists from the University of Cape Town. The possibility of introducing other agents known from North America to supplement these beetles will also be considered by the Plant Protection Research Institute.

(Reprinted from Weedscene Vol 7, Issue 1, 1996). ❑

Nodding Thistle on the NSW Tablelands

Jim Dellow

Nodding thistle (*Carduus nutans*) is continuing to spread on the Northern, Central and Southern Tablelands. In the last two years, it has dramatically spread in the Central Tablelands. In many situations, both the weed authorities and graziers appear to be either little concerned about the spread of this most competitive weed or feel it is in the "too difficult" category.

Nodding thistle, because of its biennial growth habit, is not a 'one-spray' weed. Consequently, concerted control programs which integrate herbicides, perennial pastures and grazing strategies are necessary for long-term, effective control.

Research and demonstrations undertaken by the "Weeds Research and Demonstration Unit" at Orange since 1983 have shown the effectiveness of herbicides applied at the correct time and growing conditions.

The results of trials established on Sandy and Rob Colquhoun's "Edith" property in spring 1995 showed that under good growing conditions (October), 1.5 to 2 L/ha MCPA (500 g/L) applied in 100 L/ha of water gave 100% control. These results are consistent with trials conducted on the Central and Northern Tablelands since 1983. The addition of the herbicide Lontrel L® can often improve control when conditions are not ideal and the plants may be stressed by a dry spring.

Nodding thistle (Carduus nutans).

Summary

- Nodding thistle is not a "one-spray" weed.
- Plants should be actively growing for best spray results.
- Apply in the rosette stage.

- Apply herbicide in at least 100 L water/ha.
- Herbicides will have some effect on pasture, particularly subclover.
- Mixtures of MCPA and Lontrel L ® are more damaging to the pasture than when applied alone.

Nodding thistle generally behaves as a biennial plant. It requires a winter chilling period (vernalisation) to initiate flowering and seed set. In other words, a plant germinating in late spring/summer will not flower till the next spring/summer (more than one year later). Conversely, a plant germinating in autumn will flower in the following spring/summer due to winter chilling.

(Adapted from the Newsletter of The Grassland Society of NSW Inc. Vol:11, No. 1, 1996.)

Pasture Survey

Several recent reports have shown that the quality and productivity of pastures have declined in the high rainfall areas of temperate Australia.

In order to better understand what is currently happening on properties throughout the high rainfall zone, Jim Lees and Ian Reeve, from the University of New England, undertook a mail survey of 2000 producers in districts in which grazing management trials were already underway.

Interestingly, 55% of respondents said that they felt that pasture quality had declined on their own properties, with the main causes for this decline being given as dry seasons (47%), not enough fertiliser (42%), rain at the wrong time (40%), and weed invasion (34%).

When asked about pasture management problems in need of research, the highest priority issue in all but one of the 9 districts surveyed was weed control. And in that one district, weed control was a close second to soil acidity.

The districts surveyed were Glen Innes, Tamworth, Orange, and Wagga Wagga in NSW; Canberra in the ACT; Rutherglen and Hamilton in Victoria; Victor Harbour in SA; and Tasmania.

The results of this survey form part of a much larger research project being funded by the Meat Research Corporation known as the Temperate Pasture Sustainability Key Program (TPSKP).

CRC Scholarships Awarded

The Cooperative Research Centre for Weed Management Systems recently awarded a number of scholarships for student research projects on weeds. Those students from NSW who were successful were:

Honours

Robert Haddrill - A comparison between conventional cultivation and herbicidal weed control measures in fallow and their effects on the following wheat crop (University of New England).

Kylie Lance - Production and fate of *Vulpia* (*V. bromoides*, *V. myuros*) seeds over summer (NSW Agriculture and University of New South Wales).

Glenn Shepherd - The effects of Paterson's curse on the germination and establishment of a valuable pasture component, such as subterraneum clover (University of New South Wales and NSW Agriculture).

Postgraduate

Amanda Bartowski - Genetic markers for herbicide resistance in wild oats (Charles Sturt University).

Karl Gigulis - The population ecology of *Echium plantagineum* (Paterson's curse) (Australian National University - ACT).

Congratulations to these students and their supervisors. We look forward to hearing of their research results.

Members Matter

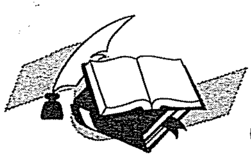
☐ Roger Cousens, a previous President of our Society, has recently taken up an appointment at La Trobe University on the ourskirts of Melbourne. When in NSW, Roger was lecturing in Weed Science at Sydney University. At the end of 1993 he moved to the Department of Agriculture in WA, taking on a more managerial role. We wish him all the best in Victoria and in his new position at La Trobe University.

☐ *Mrs Ruth Graddon of Sutherland, a member of the Society, writes:* "Has anyone got information on the control of *Anredera cordifolia* (madeira vine) that works? All available techniques using glyphosate have been followed. Some leaf treatments gave some success; others did not. My conclusion is that the herbicide is not circulated through to in-ground tubers. There is some withering and scar tissue from the original shoot, but also plenty of nodes left for regrowth. The only real success so far is from bagging all the leaves, stems and tubers in plastic and leaving them in the sun for a year. Most plants, however, get taken to be buried at the tip (deep enough to die I hope)!"

Any suggestions could be sent to the Secretary to be passed on, or to the Newsletter Editor for inclusion in the next edition. Thanks.

☐ We welcome the following new members who have recently joined the Society:

J Caldicott of Pappinbarra;
Michael Crothers of Katherine Research Station, Katherine, NT;
Nigel Crump of Charles Sturt University, Wagga Wagga;
Robert Duncan of the University of New Enagland, Armidale;
Mark Gardener of the University of New England, Armidale;
N Hibberso of Holbrook Shire Council, Holbrook;
Ian Johnson of Elderslie;
Michael Long of Wyong Shire Council, Wyong;
M Rusby of Parks and Reserves, Broken Hill;
Samantha Olsen of Belrose;
Steve Orr of the North West Catchment Management Committee, Tamworth;
Craig Shepherd of Cronulla;
Val Stubbs of Mid-Western County Council, Mudgee;
Jeff Thomas of Grafton; and
N Ward of Tamworth.



Other Good 'Reads'

Managing Mistletoe

By Nick Reid, North-West Slopes and Plains Vegetation Committee

In the agricultural and grazing districts of northern NSW, large clumps of mistletoe infest many trees along roadsides, in farmland and in parks and reserves. Mistletoes are sometimes so abundant that infected trees die. Some people are concerned that too many trees are dying due to mistletoes, or that mistletoes are increasing and threaten remaining trees in rural ares, particularly where there is little remaining tree cover.

This small booklet describes mistletoes, their ecology and the problems they cause and ways to manage them.

Published by the North West Catchment Management Committee of NSW, this booklet is available from their Publicity Officer, Allan Grogan, PO Box 601, Tamworth, 2340, Phone: 067 66 7977. For further information about mistletoes themselves, contact Dr Nick Reid, Department of Ecosystem Management, University of New England, Armidale, NSW, 2351, Phone: 067 73 2539.

Herbicide-Resistant Crops and Pastures in Australian Farming Systems

The commercial production and use of transgenic herbicide-resistant crops is generating much public debate. Some concern has been raised by consumer and environmental groups along with agriculturalists about recent developments in the technology. The Bureau of Resource Sciences recognised the needs of governments for more advice on these developments and organised a workshop in March 1995 called 'The Roles of Herbicide-Resistant Crops and Pastures in Australian Agriculture'. This workshop was attended by scientists and regulators together with industry, consumer and environmental representatives.

This book is a compilation of the papers presented at that workshop. It contains information on the integration of herbicide-resistant crops into agricultural systems and the transfer of herbicide-resistant genes to weedy relatives and the development of resistance to non-selected herbicides.

This book is one of the few to cover the integration of herbicide-resistant crops into farming systems. It will be a valuable reference for agricultural scientists, agriculturalists and consumer and environmental groups wanting the latest information on the subject. The cost is $30 plus $10 postage and handling.

Post orders and payment to: Publications Officer, Bureau of Resource Sciences, PO Box E11, Queen Victoria Terrace, Parkes ACT 2600.

For information and telephone orders phone: (06) 272 4114. Fax orders to: (06) 272 5050.

The Biology of Australian Weeds

This previously advertised book is being offered to Weed Society members, free of postage ($10) where an order of 6 or more copies can be mailed to one address. If you were thinking of buying a copy but haven't yet done so then let Leon Smith (our Secretary) know on 047 39 3564 and he will place a bulk order. The cost without postage is $59.50.

Weed Identification Booklet

The Gympie and District Landcare Group, Qld, has launched a full colour weed information booklet covering 21 weeds such as giant rats tail grass, annual ragweed, parthenium weed, mother of millions and camphor laurel. Copies are available for $1 from Ken Hutton on (074) 828 830.

Weed Control in Lucerne and Pastures 1995-96

By Jim Dellow. This booklet contains information about weeds found in lucerne and pastures and about herbicides, application techniques and pasture manipulation. Available free of charge from NSW Agriculture, phone (063) 913 433.

Noxious Weed Control Handbook - Herbicide Control

By Hugh Milvain. This booklet lists weeds declared noxious in NSW along with chemicals and spray rates that may be used on them. Available free of charge from NSW Agriculture, phone (063) 913 433.

Plant Protection Quarterly 10 Year Index

A 10 year index has recently been published for this Australian journal and is available at a cost of $15 per copy. This index provides fast access to all the articles published in the last ten years and is arranged by subject and by author (including the full paper title), with reference to the volume, issue and page number. It is an invaluable tool for all those people interested in plant protection.

Plant Protection Quarterly is an Australian journal that publishes original papers on all aspects of plant protection. Topics represented cover all aspects of the protection of economic plants from weeds, pests and diseases and include the protection and ecology of vegetation on public land such as roadsides, railways, national parks, gardens and reserves. Subscription is $50 per year.

Orders should be sent to RG and FJ Richardson, PO Box 1108, Frankston, Vic 3199, Tel: (03) 9787 3804, Fax: (03) 9775 4245.

Upcoming Events

Seminar: Herbicides or Poisons?

Tuesday 21 May 1996 at the North Melbourne Football Club, Social Club, Fogarty Street, North Melbourne, 3pm - 9pm. Full registration, which includes the evening meal and proceedings, is $90 or $50 for students.

This seminar, which is being organised by the Weed Science Society of Victoria Inc., aims to examine some of the myths about agricultural chemicals. For example, if agricultural chemicals are used correctly and judiciously, are they really a danger to us, our plants and the environment? Are agricultural chemicals as nasty as the green movement makes out, or on the other hand are they as safe as the chemical companies insist?

Further information from Bob Richardson (phone 03 9785 0137; fax 03 9785 2007).

Annual Dinner of the Society

The Annual Dinner of the Society (Christmas in July) will be held on Friday, 26 July. The dinner will be preceded by a seminar and executive meeting. Details will be sent to members soon.

11th Australian Weeds Conference

This is a reminder that the closing date for abstracts for papers and posters to be presented at the conference (30 Sept to 3 Oct 1996) has been extended. So those people who have not registered and sent in an abstract should do so now. Registrations will be accepted after 6 May (the extended date) but oral presentations may have to be poster presentations if there are no more time slots for oral presentation. The sections on Rangeland, Urban and Public Lands and Forests have few participants as yet.

Book your flight early and do not forget to use the special group airfare negotiated through Ansett who are acting as the official airline. The toll free number is 1800 632654 and quote the reference WSS01.

Contact the Weed Science Society of Victoria, PO Box 987, Frankston 3199, Ph/Fax (03) 9783 6876.

Management of Weeds in Wetlands

A seminar and the Annual General Meeting of the Society is to be held on October 28 and 29 at the Lakes Golf Club, Sydney. Please put these dates in your diary and plan to attend.

A Good Weed

the NEWSLETTER of
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