NON-SPRAY METHODS TO CONTROL INVASIVE WEEDS IN URBAN AREAS

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ABSTRACT

Public concern about spraying herbicides in urban areas has pressured territorial authorities to explore alternate techniques for controlling invasive weeds. This paper reviews urban weed control and places an emphasis on high priority weeds of concern to five city and district councils within New Zealand. The paper also looks at possible non-spray techniques including the simultaneous application of herbicidal gels to cut stems of shrubs and saplings during pruning, rolling herbicidal gels onto crushed plants, injection of herbicidal gels or solutions into rhizomes, bulbs, corms or fibrous tissue and pressure-injection of herbicide solutions or pathogens into trunks of trees.
Keywords: Weeds, environment, non-spray, herbicides, urban, pathogen.

THE URBAN WEED PROBLEM

In highly populated urban localities, the control of invasive weeds growing near waterways, in wetlands, on roadside berms, on hilly terrain, or in reserves and bush remnants, can pose major problems to territorial authorities for a variety of reasons. Many regional, district and city councils throughout New Zealand now have pest management strategies in which environmental weeds have been categorized into high, medium and low impact species. Around 140 environmental weed species have been identified in the Auckland City Council area alone (Davis and Bellingham 1998). Many of these weeds are ubiquitous in New Zealand. Most high priority urban weeds are also categorized as significant ecological weeds by the Department of Conservation (DoC) and can be found on DoC administered land (Owen 1997).

In the Auckland region, high impact weeds include Mexican daisy (*Erigeron karvinskianis*) and mistflower (*Ageratina riparia*). These weeds grow prolifically along roadside berms and have the potential to invade important ecological areas such as the Waitakere ranges via contamination of machinery during routine mowing of the berms. Climbing asparagus *(Asparagus scandens)* and Smilax (*Asparagus asparagoides*) are also widespread in the Waitakere district where they grow under native bush in gullies and reserves and totally smother under-storey plants, inhibiting regeneration. Likewise, many gullies in and around major North Island cities contain populations of Japanese honeysuckle (*Lonicera japonica*), moth plant (*Araujia sericifera*), morning glory (*Ipomoea indica*) and German ivy (*Senecio mikanioides*). These vines are known to climb up and through the canopy of native trees, eventually smothering and killing the tree. In Auckland, Tauranga, Waikato and other localities, roots of willows (*Salix cinerea, Salix fragilis*) cause problems by blocking drains and narrow waterways. In lowland estuaries and wetlands such as the Te Henga and Whangamarino swamps, willow encroachment exacerbates flooding and stifles native plant growth.

Other dominating weeds which are proving problematic to control in many urban localities include hedgerow plants such as Chinese and tree privet (*Lugustrum sinense, Lugustrum lucidum*), Darwin's barberry (*Berberis darwinii)* and elaeagnus (*Elaeagnus x reflexa)*. The latter two species grow extensively on many hills and gullies in and around Wellington and are considered major threats to this environment by the City Council (Oates 1998).

Proc. 52nd N.Z. Plant Protection Conf. 1999: 1-5

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For a number of these weeds, foliar spraying with herbicides is inappropriate, because of a high risk of collateral damage to adjacent native species e.g. spraying *Selaginella kraussiana* or kahili ginger (*Hedychium gardnerianum*) in native bush. Many herbicide sprays are also only marginally effective on difficult to control weed species e.g. wandering jew (*Tradescantia fluminensis*), agapanthus (*Agapanthus praecox),* or climbing asparagus.

Territorial authorities have identified a number of high priority weeds where alternate control strategies to foliar sprays are urgently required. These include: grey willow, Darwin's barberry, wandering jew, Chinese privet, tree privet, Japanese honeysuckle, kahili ginger, selaginella, agapanthus, elaeaganus, pampas grass (*Cortaderia selloana*) and the walkway weeds, kikuyu grass (*Pennisetum clandestinum*) and purple nutsedge (*Cyperus rotundus*). Several of these weeds grow in shady locations in or near waterways and currently glyphosate is the only herbicide used extensively by councils in such locations. Mechanical and flame weeding methods to control kikuyu grass and purple nutsedge growing along footpaths in North Shore and Wellington cities were shown to be less effective and less economic than glyphosate spraying (Popay *et al.* 1992). Territorial authorities have indicated that foliar or cut stump application of glyphosate does not always provide effective control of plants with glossy leaves (e.g. German ivy, wandering jew, agapanthus) and some deep-rooted woody plants (e.g. Darwin's barberry, privet). There is a need, therefore, to identify more effective methods of selectively killing certain high priority weed species and verify that these methods do not pose any risks to the environment.

URBAN ENVIRONMENTAL ISSUES

The potential to contaminate the environment, affect human health (Wheeler 1999) and damage non-target plant species are issues that are becoming increasingly important when deciding on the appropriate management strategies for controlling weeds in urban areas. Some of the issues that need to be considered are:

Could the chemical disrupt local aquatic or estuarine ecology through leachate or runoff entering waterways? For instance, in many Auckland gullies in suburbs bordering estuaries and harbours, stands of kahili ginger up to two metres high grow alongside shallow streams. Foliar spraying kahili ginger in such situations carries a high risk of both collateral damage and overspray contaminating the small streams and waterways leading directly into the estuaries and harbours. Likewise, Tauranga District Council is concerned about spraying pampas grass growing along motorways bordering the numerous estuaries in the district.

Does the chemical have the potential to contaminate water storage reservoirs, stormwater systems and agricultural water supplies? For instance, recent problems with triclopyr residues in water from the Hayes dam reservoir have led to a ban on agrichemical use in all the Auckland catchments (pers. comm., WaterCare Services). Auckland City Council has also recently approved a policy to use non-herbicidal weed control methods wherever possible and only Roundup GII, Escort or Versatill can be used without a consent where there is no viable alternative.

What is the chance of the chemical coming into contact with the general public through spray drift? Public concerns about agrichemical use have also been heightened through issues relating to spray drift. Although some guidelines have been issued regarding the handling of drift incidents (Ministry of Health 1998), there is pressure for all spraying activities to cease in urban or con-urban situations.

Will the widespread or rapid death of treated weeds on slopes cause soil erosion? For instance, Wellington City Council has an eradication policy for Old Man's Beard and widespread removal of infestations on slopes within the city can lead to extensive slippage problems. The Hamilton City Council has similar concerns about the removal of wandering jew along the banks of the Waikato river.

Will agrichemical use lead to damage to non-target species through overspray or longer term effects on regeneration? In many situations, particularly in bush settings where weeds are extensive, it is impossible to avoid collateral damage if spray application techniques are used, particularly with hormone active materials such as

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triclopyr. Persistent materials such as picloram and hexazinone can also cause longer term effects through residual activity in the soil.

CURRENT WEED CONTROL STRATEGIES

Foliar spraying with synthetic herbicides is the most widely used method for controlling environmental weeds although when treating larger trees, painting cut stumps with a herbicide concentrate is also a common practice (Environment Bay of Plenty 1998). Increasingly available are methods that place herbicides directly onto plants (Madden and Swarbrick 1990). They include basal prill treatment (Jackson 1986), frill ringing and stem injection at regular intervals into the outer cambium around the circumference of shrubs and trees (McLemore and Yeiser 1987; Johansson 1985). These methods are generally inappropriate or impractical in the dense canopies of the New Zealand bush where shrubs, trees and vines are intertwined and often grow on undulating and hilly terrain where access is limited. Picloram prill treatments around the base of plants, particularly on slopes, can affect vegetation within four metres of the application zone (Jackson 1986). Handling, transportation and application of herbicides in bush locations can be difficult, carry an associated high risk of environmental contamination through spillage or runoff of herbicide concentrates from treated surfaces, and exacerbate operator exposure.

Other strategies for controlling or suppressing urban weeds include manual or mechanical removal (e.g. pulling, mowing, mulching), flaming (Popay *et al.* 1992), rolling or weed wiper applications of herbicides (van Toor *et al.* 1995), frilling (Groninger *et al*. 1998), EZJECT capsule injection (Maclaren *et al.* 1999), use of herbicides from natural sources (e.g. fatty acids, inorganic salts, pathogens), hot water or steam (Riley 1995), weed mats, mulches or fertilisers.

In general, foliar application of herbicides is usually the preferred method for contractors when controlling environmental weeds. However, due to mounting public pressure against the use of chemical sprays in urban areas, councils are keen to seek alternatives to the foliar application of chemicals. Another trend within some urban councils is the desire to restore weed-infested areas back to native reserves (Wilson 1997). This further highlights the need to develop more selective weed eradication techniques that do not affect adjacent, host or under-storey native plants.

POSSIBLE ALTERNATIVE TECHNOLOGIES FOR URBAN WEED CONTROL

There are a number of potentially useful technologies for the targeted eradication of invasive weeds in urban gullies or reserves. Ideal strategies should kill the target plant without affecting any adjacent plant species or contaminating the environment (e.g. soil, water) while minimizing the possibility of public exposure to herbicides. Possible concepts are discussed below.

Gel Pruning or Crush Wiping

During the late 1980s and early 1990s HortResearch developed the Tipit gel pruner and registered pruning gels (Tipit, Actin) containing 5% naphthalene acetic acid to control summer growth on kiwifruit vines (Henzell and Ward 1991). The pruner is used to apply the gel to cut stems simultaneously while pruning stems up to about 15mm diameter.

There are a number of benefits in using herbicides as gel formulations rather than aqueous solutions. Gels are safer for the operator to use as the product can be provided ready to use so mixing of chemicals is not required. The gels also adhere to plant material more readily than aqueous solutions reducing the possibility of runoff from cut surfaces. Gelling also allows high concentrations of active ingredient to be applied to the cut stem surface to help ensure effective control is achieved with a single application. The gel pruning equipment is compact and can be easily taken and used in dense scrub or isolated areas that are inaccessible to vehicles or where it is cumbersome for carrying backpack sprayers.

Tipit gel pruning is applicable for controlling flimsy vines such as Old Man's Beard, climbing spindleberry, or Japanese honeysuckle, plants such as Mexican daisy

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and mistflower (where handfuls of shoots can be treated simultaneously) or ground creepers such as selaginella or wandering jew. For the latter plant types, the soft leaf tissue could be crushed and gel wiped across the crushed leaves that provide an entry point into the plant for herbicide uptake. Gel pruning could also be used for larger plants such as Chinese privet or willow saplings or even clusters of grass species such as pampas. Pruning the main stems or trunk of saplings or mowing pampas grass close to ground level and then separately spreading a herbicidal gel over the cut stems are options here.

Alternate solution application technologies

Of all the chemical application techniques referred to earlier, only the roller (e.g. Weedball) or cut-stump techniques are currently being widely used by some urban territorial authorities. The former technique is mainly restricted to grass control on footpaths/roads while the latter is used on tree stumps. The advantage of these solution application methods is that they eliminate overspray but there is a need to further develop these concepts to avoid the possibility of soil contamination. Possible options are to inject herbicidal solutions under high pressure into the trunk of large trees (e.g. tree privet) or corms (e.g ginger and agapanthus) to directly force the herbicide into the root system and allow the plants to gradually degrade *in situ.*

Naturally occurring wound pathogens

Fungal wound pathogens that are already present in the New Zealand environment could be potentially useful to control particular invasive weed species. Initial investigations have identified silverleaf (*Chondrostereum purpureum*) and the wood rot fungus, *Trametes versicolor,* in dead wood from grey willow and Chinese privet trees respectively. These observations raise the possibility of bulking up these pathogens and applying them in gel formulations to wounds or as aqueous suspensions as pressure injection treatments into the trunks of selected tree species.

Natural herbicides

Natural herbicides also offer an alternative treatment to synthetic herbicides and include a fatty acids product, Greenscape (Yates Ltd), a pine oil based product, Organic Interceptor (Organic Products Ltd), and a pelargonic acid product, Scythe (Mycogen Corporation Inc). The former two products are currently commercially available in New Zealand and Scythe, is being evaluated here under an experimental use no sale permit. Glasshouse assays with Greenscape have been carried out in New Zealand on a range of pasture and cropping seedlings (James and Rahman 1992). All of these products are fast acting, causing rapid wilting and collapse of leaf tissue. They often need to be applied regularly for an effective kill of target plants but may give adequate control levels, similar to those of contact synthetic herbicides. They are considered environmentally friendly and may be suitable for application in urban regions where synthetic chemicals are restricted or banned.

CONCLUSIONS

In urban localities there is a need to develop effective and sustainable methods for weed control that address the needs of territorial authorities and the public to reduce both spray drift and the potential for pesticide contamination of waterways with conventional herbicide application technologies. A range of possible non-spray herbicide application concepts that meet these needs have been described in this paper including the use of herbicidal gels, fungal wound pathogens occurring in the New Zealand environment, trunk injection and crush leaf techniques.

These non-spray technologies are likely to be practical for selective weed control in ecologically sensitive areas or in dense bush canopies where potential for collateral damage with foliar applications of herbicides is extensive. These technologies could also be appropriate for use in areas of high traffic flows where herbicides could be applied without the possibility of overspray or spraydrift contacting the passing public.

The use of naturally occurring wound pathogens avoids the need to introduce new biological organisms into the country. Herbicides from natural sources that degrade rapidly in soils also appeal to land managers as alternative ways of controlling invasive weeds.

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HortResearch are currently exploring a number of these approaches to minimize the use of synthetic herbicides under a Ministry for the Environment Sustainable Management Fund (SMF) grant.

ACKNOWLEDGEMENTS

We would like to thank the Ministry for the Environment along with Auckland, Wellington, Waitakere and Hamilton City Councils, Auckland Regional and Tauranga District Councils for their input and support of the SMF project. In particular we are most grateful to Mike Oates (Wellington City Council) and Bryan Gould (Auckland City Council) who have taken on the major task of managing the SMF project.

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