THE CURRENT STATUS OF WEED MANAGEMENT TECHNOLOGY IN URBAN SITUATIONS

C.J. Nazer
Canberra City Parks, Department of Urban Services, PO Box 3906, Weston, ACT 2611, Australia

Summary Most Australians live in urban situations where economic considerations and public scrutiny have led to the management of weeds in these areas increasingly being carried out by environmentally sound and cost-effective means. Such pressures are frequently giving rise to new weed management strategies and technologies.

Increasingly, urban weed managers are using effective weed prevention practices and ensuring all suitable control methods are used in an integrated manner. Existing and newly developing weed management methods and equipment are discussed along with likely future requirements in product development, training and integration of methods.

INTRODUCTION

Weed control is critical to the maintenance of acceptable horticultural standards in urban parklands and playing fields. The degree of weed control or vegetation management depends on the maintenance objectives for an area. These may include aesthetics, optimum growth of amenity plantings, protection of engineered facilities, clear line of sight for traffic, controlling noxious weeds, producing suitable turf sward, fire hazard reduction, and a reduction in maintenance costs.

Weed control in parkland is constrained by a number of factors which affect the choice of the control method and require innovative use of technology to find improved methods of control. Such factors include:

- Constant public scrutiny and concern with the use of chemical weed control.
- The wide range of habitats for weeds created by disturbance and site modification, and consequent wide spectrum of weed types and species.
- The frequent and rapid dispersal of weed propagules by humans, animals and vehicles throughout urban areas.
- The close proximity of the public to the operations requires particular care in choosing suitable chemical control methods.
- The need for suitably trained staff and the correct equipment is essential for safe and effective application of many weed control methods such as herbicides, flame and high temperature water. Both public and operator safety are of primary concern in determining control measures.
- Choice of chemical control agents must consider environmental residues and non-target plant effects.
- The need to approach weed control as an integrated management strategy, utilizing an array of both chemical and non-chemical techniques to provide effective, long-term control within budget limitations.

URBAN PARKLAND WEED SITUATIONS

The urban environment provides a diversity of potential situations where weed problems can occur. Depending on rainfall patterns and the use of irrigation, both summer and winter annuals can be major problems along with perennial grasses and herbs, woody weeds and in some parkland situations aquatic weeds.

Typical weed situations in urban open space requiring management actions include:

- shrub, ground-cover and flower bed plantings
- single or group tree plantings
- lawn areas, sports fields and wickets
- hard-standing areas
- industrial areas, fence-lines, kerbs and drains
- aquatic features and ponds
- bushland areas.

URBAN WEED MANAGEMENT

In many instances, weed problems simply reflect poor development and management of land areas and the lack of an integrated approach to weed control. For example, correct design and maintenance of turf irrigation systems is essential to overcome turf weed problems. If the irrigation of turf grass is uneven giving a variable distribution of water, this leads to poor turf density. Weeds easily invade this weakened turf.

The advent of new herbicides has allowed park managers to reduce their dependency on mechanical control of weeds, a dependency that was doomed by economics. In particular, the arrival of glyphosate on the market has brought about cost-effective control of many urban weeds, especially perennials.

Recent technological advances have provided much improved herbicide products and a greater array of non-chemical weed control methods to choose from. For instance, the use of propane flame burners has been shown to give selective removal of winter grass (*Poa annua* L.) from Kentucky bluegrass (*Poa pratensis* L.) sward

Table 1. Methods of weed control towards developing an integrated weed management system for urban areas.

Control strategies	Non-selective pre-emergent	Selective pre-emergent	Non-selective post-emergent	Selective post-emergent
Biological		• Introduced natural agents – seed eating insects		• Introduced natural agents – plant eating insects • Mycoherbicide
Cultural	• Allelopathy • Avoid weedy species • Select plants which resist weed invasion. • Hygiene practices	• Allelopathy • Fire • Dense cover planting • Test soil for weed seed	• Dense cover plantings	• Habitat manipulation e.g. fire
Physical / Mechanical	• Mulch sheetings and mulches • Correct composting to kill weed seeds • Solarization	• High temp water • Flame burner • Slashing to remove flowers	• Hand or mechanical cultivation • Hand weeding • Solarization • Mowing • Grazing • High temp water • Flame burner	• Hand weeding • Bradley method for bushland • Solarization • High temp water • Flame burner • Grazing
Chemical	• Residual herbicides	• Pre-emergent herbicides (germination inhibiting) – spray application – soil drench – granules – wick wiper – soil injection	• Post-emergent herbicides – low-high spray volume – granules – CDA – rotary wick wiper – stem/soil injection – basal bark spray	• Post-emergent herbicides – wick wipers – granules – spray application – CDA • Rotary wick wiper with height differential between target/ non-target • Graminicides • Broad-leaf herbicides • Spot application • Growth regulators

(Desjardins *et al.* 1995). The high temperature water systems such as that developed in New Zealand by Waipuna Systems Ltd., and being tested in Australia by Leichhardt and other municipal Councils, may offer considerable environmental advantages over herbicides for weed control in storm water drains and other urban sites. Also a formulation of glyphosate that is safer for use in aquatic environments has finally been introduced to Australia.

Until recently there was a dearth of technical information available to managers that was directly applicable to specific urban weed problems. Usually, managers now have sufficient information to ensure that they choose the control method, potential herbicide, application technique etc. which best suits their situation.

Sound technical knowledge is required to analyse weed problems and plan solutions. Integrated weed management principles should be followed which involves identifying the weed, regular monitoring, identifying any weakness in the plant's system or life cycle, avoiding control methods with problematic impacts on the environment and attempting to anticipate any problems which could result from control actions. The manager must be able to assess levels of weed infestation, measure and predict change, estimate impact and identify control options. Having built the chosen options into a system, they require application and then evaluation of success with modification as necessary.

Morgan (1992) outlined alternatives to herbicides whilst recognising that an integrated approach to weed control involving efficient herbicide use with various weed control strategies will be the first step in reducing dependence on herbicides. Some of the control methods that may offer potential towards integrated weed management in urban areas are given in Table 1.

Where aquatic features, ponds or wetlands are part of an urban parkland a number of issues can emerge. Firstly, water bodies are important features of the park and this needs to be recognised in management budgets. Effective design of ponds should include the capacity to vary water level easily. This allows periodic removal of sediment and excess plant material or draw-down of the water level as a means of controlling plant growth. Authorities may need to permit use of some herbicides in urban aquatic systems where serious weed threats such as alligator weed (*Alternanthera philoxeroides* (C. Martius) Grisep.) may occur.

HERBICIDES USED IN URBAN PARKLAND

Since the 1960s park managers have relied on herbicides with short-term or nil residual effects for most weed control situations. These types of herbicides are generally more useful for urban weed control than residual herbicides. Unfortunately, residual herbicides can pose serious phytotoxicity problems when used close to amenity plants.

Contemporary herbicides are generally more target specific, have relatively short residual lives and can be used at lower dose rates than the products they replaced. They are also being provided in formulation types and packaging systems which improve safety to staff and the environment.

Diquat, paraquat and amitrole, once extensively used, have been largely replaced with glyphosate. This herbicide has become the cornerstone of chemical weed control. Its effectiveness has been enhanced by use in mixture with other herbicides or adjuvants.

Canberra City Parks has developed some new approaches to the use of glyphosate. For example, Nazer (1986) outlined the use of glyphosate to remove paspalum (*Paspalum dilatatum* Poir.) from irrigated sports turf by either spot spraying or overspraying methods. This was followed by overseeding of treated areas with turf species. The method proved more manageable and cost-effective than the selective herbicide approach it replaced.

Carder *et al.* (1995) evaluated glyphosate applied through a rotary, rope-wick applicator (Weedbug™) for selective control of tall growing weeds in native grasslands. This technology has also been tested with success against tall growing weeds such as paspalum in sports turf. It also offers the advantage of reducing the amount of herbicide applied in areas such as roadway kerbs and gutters where herbicides offer environmental impacts.

In other studies very low rates of glyphosate as an overspray have proved effective in selective control of certain *Poa* weed species in some cool season turf grasses, selective weed control in some amenity groundcover plants (Brereton 1992) and also bitou bush control in coastal native plant communities (Toth *et al*. 1993).

The use of glyphosate is not without some problems especially phytotoxicity caused by misuse. As shown by Clark *et al*. (1984), there is a strong need to not only avoid application of the herbicide onto the foliage of most amenity plants, but also onto the bark of young trees. Trained operators with suitable equipment, however, are unlikely to cause problems.

Brereton (1992) states that the parks and gardens divisions of many city councils appear to have become totally dependent on glyphosate for the purpose of weed control and probably have reached a point of overdependence.

With careful management, the length of weed control can be extended by the use of residual herbicides either separately or in mixture with non-residuals. Long-term residual herbicides (e.g. ethidimuron) have some

potential for wider use in urban weed control. Nazer and Clark (1984a) showed that for certain weed situations in urban areas these herbicides can be cost-effective. Recent evaluation in Canberra of sulfometuron methyl has shown that this herbicide offers value in providing longer-term weed control for some suitable urban sites.

In amenity plantings such as screen plantations, shrub beds and parkland, several methods are used to control weeds, including mulches, hand or mechanical cultivation and repeated use of non-residual herbicides. Pre-emergent herbicides offer the potential to provide a weed-free area for longer periods than the other methods. In evaluation trials conducted in the 1970s, Nazer and Clark (1984b) showed the advantages of several pre-emergent herbicides in combination for long-term weed control around trees. Some recently developed pre-emergent herbicides including thiazopyr have been evaluated for nursery container plants, cut flowers and bulbs (Bing 1985, Lamont 1986, Watkins 1986, Harradine and Dix 1995, Arney and Nazer in preparation), and warrant investigation for use in amenity plantings.

From the range of selective post-emergent herbicides available, fluazifop, sethoxydim and other graminicides, developed for grass control in certain crops, are gaining widespread use in landscape maintenance. They are useful for removing unsightly perennial grasses from many amenity ground-cover plantings and offer some potential for weed control in native grasslands (Hitchmough *et al*. 1994, Nazer and Carder 1996) and sports fields.

Judging by their widespread use overseas, granular formulations of herbicides deserve consideration for further development in Australia. Recently, Canberra City Parks has begun using sulfometuron methyl as a granular herbicide in some urban sites and oxadiazon in plant nursery weed management.

DISCUSSION

Increasingly, investigation into herbicide use in urban areas is concentrating on having herbicides more precisely applied to the intended target. A major objective for the herbicide industry marketing in urban Australia must be the reduction in unnecessary introduction of herbicides into the environment.

Recommendations for further research and development with regard to weed control technology in parklands include:

- Develop a greater range of guidelines as well as application methods to minimize off-target hazards and problems. Examples of these would be the guidelines produced by Canberra City Parks to ensure that herbicides are safely applied adjacent to waterways and the spray management valve to reduce drift from Fluid Technology Australia Ltd.
- Develop herbicide mixtures such as those of glyphosate and metsulfuron methyl which increase the knockdown effect, provide residual properties where appropriate and broaden the spectrum of weed control.
- The use of pre-emergent herbicides for amenity plant and turf culture under Australian conditions, including evaluation of natural product herbicides such as corn gluten hydrolysate (Liu and Christians 1995).
- Further development of herbicide formulation types, adjuvants and packaging systems which not only improve efficacy, but also safety to staff and the environment.
- Further development of growth regulating or vegetation suppressing chemicals (including sub-lethal rates of herbicide) for use in certain parkland situations.
- Further evaluation of the use of wick wiper technology for weed control in urban areas.
- Further evaluation of the use of flame technology or of high temperature water weed control systems.

To meet the requirements of an integrated approach to urban weed management many factors need to be addressed. For instance, the training of park maintenance staff in weed control practices needs further improvement at tertiary education institutions, and by many employers.

There is a large number of urban weed species for which detailed biological and ecological studies have not been carried out. This information is required to improve the integrated management of such weeds, and weed scientists should be given the resources to do more in this area.

Recently, there has been an increasing public concern with the establishment of environmental weed species in urban parkland and native bushland. Most States and Territories are developing or have developed weed strategy plans which address this issue. Improved methods to control these weeds are constantly being sought.

Practices to prevent weed introduction to local areas through importing clean soil, mulches, container plants, etc., all reduce weed problems. In Canberra, specifications for government landscaping now include testing of certain imported soil and mulch materials for the presence of weed seeds.

A number of both public and private organizations have developed effective publicity campaigns to inform the public about the problems posed by weed species. More action needs to be taken to expand programs which educate the public in this area. A major aim of such efforts is to ensure that the public have a better appreciation of the contribution they can make in preventing the establishment and spread of weeds.

In urban planning more emphasis on prevention of weed problems would lessen the need for control measures. Weed science can play a useful role in reducing the substantial costs involved in maintaining urban landscapes. Greater efforts are required by the manufacturers of herbicides and other weed control technology, government funded weed scientists, educators, planning authorities and local government organizations to fund or develop weed management for urban areas.

ACKNOWLEDGMENTS

The author wishes to thank Zel Bodulovic for constructive criticism of the manuscript.

REFERENCES

Arney, M. and Nazer, C. (In preparation). Evaluations of thiazopyr for weed control in bulbs and other amenity plants. Canberra City Parks Report.

Bing, A. (1985). Which herbicides are safe for bulbs? *American Nurseryman* February 1985, pp. 69-70.

Brereton, J. (1992). The future of agrochemicals in the management of urban vegetation. Proceedings Scientific Management of Plants in the Urban Environment, VCAH Burnley, Victoria, pp. 126-33.

Carder, J., Nazer, C. and Arney, M. (1995). Evaluation of the Weedbug™ for its ability to selectively control tall growing weeds in native grasslands. Canberra City Parks Report.

Clark, J., Nazer, C. and Wotzko, A. (1984). Phytotoxic effects of glyphosate and diquat plus paraquat on landscape trees. Proceedings 7th Australian Weeds Conference 1, p. 261.

Desjardins, Y., Laganiere, M. and Allard, G. (1995). Control of annual bluegrass in Kentucky bluegrass sod with propane flame burners. *Agronomy Abstracts*.

Harradine, A. and Dix, A. (1995). 'Herbicide tolerance of temperate container-grown nursery stock'. (Horticultural Research and Development Corporation).

Hitchmough, J., Kilgour, R., Morgan, J. and Shears, I. (1994). Efficacy of some grass specific herbicides in controlling exotic grass seedlings in native grassy vegetation. *Plant Protection Quarterly* 9, 28-34.

Lamont, G. (1986). Herbicide evaluation trials on cut flowers. *Australian Horticulture* July 1986, pp. 89-91.

Liu, D. and Christians, N. (1995). Bioactive compounds isolated from corn gluten hydrolysate used for weed control. *Agronomy Abstracts*.

Morgan, W. (1992). Strategies to reduce dependence on herbicides. Proceedings First International Weed Control Congress, Melbourne, pp. 289-94.

Nazer, C. (1986). Controlling paspalum in turf. Weed Talk. Monsanto Australia Ltd., No. 3, p. 7.

Nazer, C. and Carder, J. (1996). Preliminary trials of selective herbicides to provide post-emergent control of broad-leaf weeds in established native grasslands. Canberra City Parks Report.

Nazer, C. and Clark, J. (1984a). Total weed control in urban areas using residual herbicides. Proceedings 7th Australian Weeds Conference 1, pp. 305-9.

Nazer, C. and Clark, J. (1984b). Evaluation of pre-emergent herbicides for landscape tree establishment. *Australian Weeds* 3, 128-32.

Toth, J., Milham, P. and Nazer, C. (1993). Aerially applied herbicides selectively control bitou bush growing in communities of indigenous plants on sand dunes. Proceedings 10th Australian and 14th Asian-Pacific Weed Conference, Brisbane, pp. 67-71.

Watkins, P. (1986). Weed control in ornamental plants. *Australian Horticulture* July 1986, pp. 92-102.