

# Improved Strategic Planning and management of Alligator Weed- Myth or Reality?

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**Summary** Despite considerable efforts to arrest its spread, Alligator Weed (*Alternanthera philoxeroides*) has expanded territory in both aquatic and terrestrial habitats. Although much planning has been done, a review of the information available and institutional frameworks, points to deficient management efforts, with little integration of knowledge into management. In this paper, some critical issues are discussed, with suggestions for improving Alligator Weed management.

Poor understanding of the weed's strengths and weaknesses has hindered progress and this aspect needs to be rectified with more effective R&D. Information on control of growth, vegetative reproduction as well as seasonal variations is patchy. Inadequate knowledge of factors, which govern uptake and translocation of promising herbicides, have led to lack of consistency in their performance. Several new bio-control agents appear promising, but inadequate funding has hampered the progress of their evaluation and integration into management regimes.

We contend that Alligator Weed management could be improved at all levels with rigorous implementation of the existing Strategic Plan, focusing on outcomes, continuous assessment and adjustment of direction. For more effective management of the weed, 'site-specific' planning is critical, based on site characteristics and infestation levels. Control plans, as specific as the property level, can then be rolled up to form larger plans for a local government area and thence, into regional plans. Whilst efforts continue to enhance knowledge, improved Program implementation and Evaluation should be more rigorously practiced incorporating many aspects of the available know-how. Implementing the Strategic Plan with increased commitment from Stakeholder agencies and adequate funding should reduce the current levels of infestation and the rate of spread into new areas.

**Keywords** Alligator Weed, *Alternanthera philoxeroides* integrated weed management.

## INTRODUCTION

In recent years there has been increased attention on integrated management of Alligator Weed, a noxious Weed of National Significance. In particular, we refer to the important research conducted by scientists at CSIRO Entomology and NSW Agriculture, whose labors have been complemented by the efforts of the National Weeds Strategy Committee, NSW Agriculture, Victoria's Department of Primary Industries and Queensland's Department of Natural Resources. Several Alligator Weed Fact Sheets have been produced, highlighting the problem and management options. The management frameworks developed include a Strategic Plan (NWSEC 2000) and an Alligator Weed Management Guide (CRC 2003). These efforts have been further augmented by deliberations at two Alligator Weed Management Workshops sponsored by the CRC for Australian Weed Management and a report (CRC 2002).

Despite these efforts, which are considerable, Alligator Weed has continued to invade more territory. The reasons why weed managers of all levels, including us, have not been able to contain the weed more successfully are the subject of this paper. For those of us, involved in implementing Alligator Weed control, it is clear that several major knowledge gaps on the weed's biology, ecology and control options have constrained successful management. In addition, we feel that deficiencies in institutional and implementation frameworks have delayed progress. However, these are not altogether unfamiliar territory for the weed management community.

Against this background, we would like to argue that Alligator Weed infestations can be better managed, even with the existing information, by improved planning, project implementation, stakeholder commitment, and attitude changes at both personal level (weed managers) and institutional (agencies). A higher level of effort from all parties, combined with better allocation of resources (funding) are the essential requirement, rather than more information.

## INTEGRATED WEED MANAGEMENT

Broadly, integrated management involves the integration of a number of control options in any possible way, to achieve the most favorable outcomes for managing an invasive organism like Alligator Weed. Simply, this involves a control program, which combines two or more weed control methods, hopefully synergistically, to increase the economic (cost-benefit ratio), sociological and ecological benefits obtained. The key steps in IWM are depicted in Figure 1.

In our experience, the lack of success in Alligator Weed management in various catchments, regions and situations has been too readily attributed to knowledge gaps and resource limitations. Whilst these deficiencies exist, the success of managing deeply entrenched Alligator Weed in some situations, such as in the Botany Wetlands, Sydney (CRC 2003) and in backyards of ethnic communities (Gunasekera *et al.* 2002), indicate that much more is achievable if weed managers focus more on planning, and then effective program implementation and management. 'Knowing the enemy', in terms of its strengths and weaknesses will no doubt enable more effective management of the threat posed by Alligator Weed. However, not every aspect of its biology and life cycle needs to be known to plan and rigorously act on managing infestations better.

### KEY KNOWLEDGE GAPS

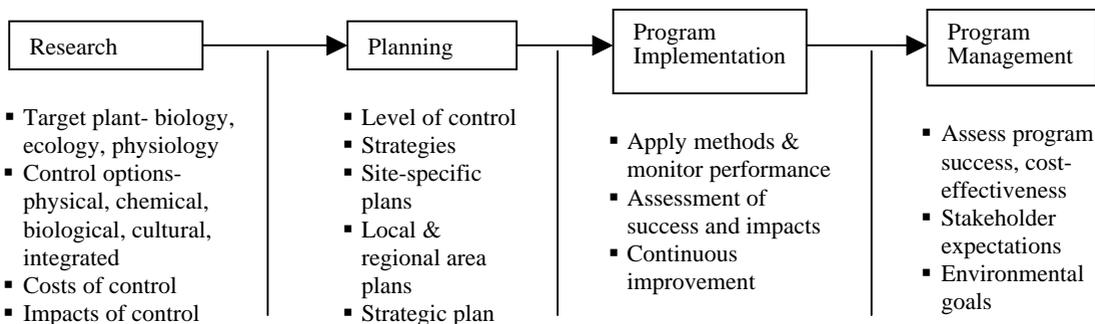
The recent CRC report (2002) identified several major knowledge gaps, related to Alligator Weed's biology and ecology, as well as deficiencies in know-how related to control options. A summary of these is pertinent to the theme of this paper and therefore, is given in Table 1. There can be no argument that to apply the model in Figure 1 optimally, and conduct IWM of Alligator Weed successfully on a given site, more information on these key aspects would be helpful.

Increased knowledge of growth, biomass production, resource allocation and vegetative reproduction of the two habits of Alligator Weed and factors affecting these in different habitats will enable better understanding of how the weed interacts with its environment. If weaknesses are recognised, they can then be targeted for intervention. The ecological information is also essential for developing predictive plant growth models (CRC 2002), to rationalize management strategies. Being able to quantitatively predict the probable effects of any combination of management interventions can be the basis for setting realistic performance targets during implementation of a control program.

Increased understanding of seasonal effects, response to stress such as caused by shade, flooding, drought and leaf and stem damage caused by bio-control agents will lead to better treatment timing and better integration of control methods. Such information will improve the effectiveness of integrated treatment regimes with herbicides, upon which much of the current management efforts are based.

The most promising herbicides and dose ranges for Alligator Weed management are known (CRC 2002). However, key questions remain on how many treatments per year, and under what situations are they to be given. Inadequate foliar uptake and translocation to kill stolons and roots and the overall consistency of performance also pose questions. Possible herbicide combinations (Glyphosate and Metsulfuron-methyl, for example) and treatment regimes need to be optimized. Multiple herbicide treatments with small time gaps between them, as has been practiced in Botany Wetlands (CRC 2003), may have to become part of an improved treatment regime, rather than the current recommendation of three treatments per year. Sequential treatments, involving more than one herbicide also hold promise.

**Figure 1.** Components of an integrated weed management (IWM) program



**Table 1.** Some key knowledge gaps in Alligator Weed biology, ecology and response to control.

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**Biology & Ecology-related:**

- Biomass production, seasonality, rate of growth
- Factors controlling growth and resource allocation under aquatic and terrestrial habits
- Response to environment/stress- (shade, flooding, drought, nutrients, grazing)

**Vegetation reproduction:**

- Factors influencing shoot/stolon production
- Longevity, viability and behavior of nodes and buds from tap root

**Control-related: Physical control-**

- Effect of continued defoliation on CHO reserves

**Control-related: Herbicides-**

- Mode of action of most promising herbicides (uptake, translocation & factors affecting)
- Effective treatment regimes-combinations, multiple and/or sequential treatments
- Environmental factors affecting control
- Plant factors- Leaf surface characteristics, related to habit, response to stress (drought or flooding)
- Formulation factors- additives, water source

**Control-related: Biological Control agents-**

- Evaluation of most promising new agents
- Advantages of augmenting existing ones

**Control-related: Cultural control-**

- Effect of presence of competitive plants
- Possible use of barriers (such as weed matting)

**Integrated Control:**

- Possible integration of several methods
  - Site-specific treatment regimes, based on a nominated level of control
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Biactive™ Glyphosate has been implicated in increasing the risk of fragmentation at nodes. Although this is not fully proven, sub-lethal effects of glyphosate may be involved. Nevertheless, glyphosate is one of the best herbicides available against Alligator Weed, because of its capacity for translocation and favorable environmental profile. However, to assist its uptake in less than ideal conditions, use of an additive, which is more environmentally friendly than the now proscribed tallow amine surfactants, may have to be considered. Additives, such as ammonium salts or vegetable oils offer opportunities, because they enhance glyphosate activity. Nalewaja and Matysiak (1991) reported cation antagonism of glyphosate by a number of metal ions (iron>zinc>calcium>magnesium >sodium> potassium). Due to the likelihood of reduced activity of glyphosate, the use of hard-water as its carrier is not recommended. In contrast, anions have no antagonism toward glyphosate and are often added in the form of ammonium

compounds to overcome the antagonistic effect of salts (Nalewaja and Matysiak 1991). It seems that the overall gains of using an additive for glyphosate may far outweigh the potential environmental impacts of endless, ineffective treatments.

We believe that a review of control achieved by herbicides registered for Alligator Weed (Glyphosate, Dichlobenil and Metsulfuron-methyl) and others with potential for different situations (Triclopyr, Diquat, 2,4-D Amine, Picloram, Fluroxypyr) is timely. Knowledge of seasonal variations in carbohydrate (CHO) reserves will assist the development of treatments targeting these. Better understanding of constraints to the entry and translocation of foliar-applied herbicide will improve their delivery. Rationalizing herbicide options (when, how frequent, combinations, doses) would make them vastly more effective and will arrest the current rate of Alligator Weed spread in terrestrial environments.

The increased research effort on promising new bio-control agents, both herbivorous insects and pathogenic fungi (CRC 2002) needs to be recognised. With the experience of the past few years, it is clear that too much reliance on chemicals for Alligator Weed management is a folly, and natural enemies are the tools for long-term management, despite the fact that inadequate funding has hampered the progress of this research. However, it would be a similar folly to not act aggressively to contain the spread of Alligator Weed across infested regions, while awaiting the release of new agents.

#### STRATEGIC PLAN AND WAYS TO IMPROVE ITS IMPLEMENTATION

The current Alligator Weed Strategic Plan (NWSEC 2000) has a clear enough vision and provides a good framework to follow. The on-ground direct action required by the Plan are of two kinds- i.e. eradication of non-core infestations (those relatively small and new infestations) and management of core infestations (those areas in which the weed is so deeply entrenched that containment is the only realistic option). Implementation of the Plan, however, requires commitment from all parties, particularly Stakeholders and funding sources.

NSW Agriculture's Regional Weed Management Plan for Greater Sydney and Hunter Region, in its intent matches those of the Strategic Plan. According to the Plan, Councils, with their own funds, would concentrate on small isolated infestations in their jurisdiction, and carry out property inspections. Additional funding is provided by NSW Agriculture to enable effective treatment of the main infestations along the Nepean and Georges Rivers, and various creeks under Council control. It is clear that incomplete treatments of Alligator Weed in the major waterways would permit excessive growth, providing propagules for dispersal following treatments or other disturbance, resulting in wasted resources and spread of the weed.

Evidence is emerging, largely from Council Weed Officers, staff of governmental agencies and independent observers that in the last few years, the area infested by Alligator Weed has increased. We believe that what has failed recently is rigorous Program implementation and evaluation. Evaluations should be based on on-ground achievements in real terms (% change in infestation levels against cost) and strategic (prevention of spread and control in high priority areas).

No doubt there are competing priorities for limited resources within organisations. However, given that Contractors deliver much of the on-ground works, one way of succeeding is for all Weed Managers to be up skilled in Project Management, particularly Contract Management. Better described 'Scopes of Works' than those we currently see, dogged persistence and on-going commitment, which transcends short-term resourcing issues (Thorp and Lynch 1999), would be useful. Whilst team work, such as through regional committees, is needed, in the end, successful implementation of the Weed Management Plans in any area or region will come only through the dedication of the individual, as highlighted by Thorp and Lynch (1999).

Essentially, the focus of implementing the Regional Plan should be on 'Site-specific' planning. For success to be measured against, a level of control achievable for a site needs to be established on a given time frame, based on site characteristics and infestation levels. Adequate mapping, ranking of infestations for control, assessments of site characteristics, such as the presence or absence of competitive vegetation, and the level of probable disturbance, are necessary. The focus of site-specific planning should be strategic; i.e. to prevent further spread and new infestations. To achieve this, methods, such as manual removal and physical barriers to prevent spread should be combined with herbicides. The methods to be 'integrated' depend on situations, and hence, Control Action Plans, specific for a property, should be developed. For a given jurisdiction, such Plans can then be rolled up to form larger Plans for a local government area, and thence, into regional plans.

There is an urgent need for more rigorous reporting and accountability, rather than distractions based on property ownership, or lack of action due to insufficient knowledge. Measuring outcomes against nominated performance targets is critical to demonstrate the value of dollars spent by Stakeholders. Poor performances must also receive more attention than at the present, and the onus of demonstrating success should be placed on organisations, which received funding.

## CONCLUSIONS

We have heard the widely expressed sentiment that Alligator Weed management is rarely successful or even possible. Our view is more optimistic than that, based on own experiences. We believe that eradication of local infestations from infested parcels of land, ponds or creeks is possible with committed programmes. A much higher level of success in 'maintenance management' or containment is also achievable by integrated actions.

We believe that poor planning and lack of performance-based implementation in many situations exacerbate the effect of knowledge gaps and resource deficiencies. Whilst we await more effective biological control agents and treatment regimes, we contend that to win the battle against Alligator Weed, a more dedicated effort is needed. A much more clear commitment from all Stakeholders would allow better access to sharing of resources, funding, expertise, public involvement and review. Such a commitment will ease the organisational lethargy, lack of resources and inadequate priority attached to Alligator Weed. Above all, we believe that the success of integrating any of the control options available to stop the further spread of the weed in any geographical jurisdiction, depends on an outcome-oriented resolve to rigorously monitor the effectiveness of control actions, report on overall success and learn from experiences. In our view, the above can be achieved with the current Strategic Plan, whilst the gaps in knowledge on key aspects are incrementally filled.

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