

Eradication: lessons learnt from 17 years of the National Siam Weed Eradication Program

Mick Jeffery

Project Coordinator, Biosecurity Queensland, Department of Agriculture, Fisheries and Forestry,
PO Box 20, South Johnstone, QLD 4860
(mick.jeffery@deedi.qld.gov.au)

Summary Siam weed is the target of a national weed eradication program which commenced in 1994. The program has learnt a range of lessons during this period which have improved its effectiveness, including active and passive surveillance techniques, strong research — operational linkages, resourcing, data collection, adaptive management and governance. These lessons will assist other programs to avoid pitfalls on the path to eradication.

Keywords *Chromolaena odorata*, Siam weed, eradication, program management.

INTRODUCTION

Biosecurity Queensland, a business group within the Queensland Department of Agriculture, Fisheries and Forestry, is responsible for managing the National Siam Weed Eradication Program which commenced in North Queensland in 1994. This program is tasked to eradicate one of the world's worst tropical weed species, Siam weed (*Chromolaena odorata* (L.) King and Robinson) from mainland Australia. It is one of only two national cost-shared funded weed eradication programs in Australia.

Siam weed was chosen as an eradication target due to its restricted distribution in Australia, proven invasiveness in many other countries, and its potential to significantly impact agriculture and the environment across tropical and sub-tropical Australia if allowed to expand to its full potential range (Kriticos *et al.* 2005, Goswami 2008, Zachariades *et al.* 2009).

Over the past 17 years, a number of lessons have been learnt which could be applicable to other eradication programs. With very few examples of successful weed eradication programs in the global literature, there has yet to be a definitive 'how to' guide to achieve the desired endpoint. The Siam weed program has been guided by eradication theory with an ongoing need for adaptive management to maintain the upper hand over the target species.

DELIMITATION

This is the most difficult yet fundamental component of any eradication program. Confirming the boundaries of a weed incursion needs to be achieved as early as possible in the eradication journey. This will provide

clarity on the scale of the task ahead and the resources required to survey and control the infestation. It also provides confidence to those funding the program that eradication is truly feasible.

Determining the extent of a weed incursion is much easier in theory than in practice. Depending on the length of time between the introduction of the weed into Australia and its detection, a weed incursion may have had many opportunities to disperse across the landscape. This spread could be *via* a range of dispersal mechanisms including wind, water, wildlife or humans (e.g. vehicle contamination). Detecting all plants that result from all of these pathways is the eradication challenge, especially for accidental or deliberate human mediated dispersal. Siam weed was first detected in the Tully River catchment in north Queensland in 1994. Anecdotal evidence suggests it was introduced in the 1960s *via* contaminated pasture seed from Brazil (Scott and Lange 1996). Thus, the weed had a 30 year head start to establish and disperse before the initial detection and commencement of the eradication program.

Although wind, water and animal mediated dispersal can be modeled and predicted with a certain degree of confidence, the capacity of people to move weed material across the landscape is enormous, random and difficult to model. To maintain a high level of confidence that Siam weed was contained within a small number of catchments in north Queensland, the program has had to regularly undertake broad-scale media campaigns, including television and radio advertisements across northern Australia to encourage public reports of Siam weed.

The take home message is that it is vitally important to maintain delimitation activities and to remain vigilant. Never presume that you know where all locations of your target weed are. The Siam weed program spent nine years eradicating within two adjoining catchments. In 2003, a Siam weed television infomercial resulted in two further detections, 150 km south and 125 km north of the core infestations. Without the broader media campaign, the Siam weed program would have continued to eradicate in the Tully and Johnstone River catchments, oblivious to the fact that other infestations existed and were expanding in

the region. In hindsight, the detection of Siam weed much earlier in Townsville may have increased the chances of the program being successful.

At a more targeted level, the program has also invested heavily in Siam weed identification training and toolbox talks for a wide variety of organisations that employ field staff who may encounter Siam weed during their normal day to day activities. This has targeted obvious groups such as Local Government Pest Management and National Parks staff, but also workers involved in road maintenance, mosquito control, irrigation management and earthworks. This has provided hundreds of extra trained eyes looking for, detecting and reporting Siam weed across north Queensland.

Once all the infestations have been identified and are being effectively managed then any further spread of the incursion needs to be halted. Operating concurrently with delimitation activities is the need to contain Siam weed. The program has compliance officers who prepare spread prevention plans with all impacted property owners to ensure infestations are properly managed and contained on a property scale.

KNOW YOUR ENEMY

Scientific research is crucial to understanding the weeds you are trying to eradicate. Critical weed biology questions that need answering include: seed longevity, time to maturity and dispersal mechanisms. Answers to these questions will inform the length of time it may take to eradicate the weeds, how often you need to conduct field surveillance, the optimum time for treatment and where you should be searching.

Often, answers to these fundamental weed biology and ecology questions are not available for species which are new to Australia. A search of the literature can highlight the paucity of directly applicable weed research for even the most widespread invasive species. Often these weeds are so widespread overseas that eradication is not contemplated, leading to research which is more focused on suppression or even utilisation. The Siam weed program has invested in research programs and partner with CSIRO to address research gaps (Patane *et al.* 2009, Brooks and Setter 2011). A strong scientific basis is necessary to make sound operational decisions. Although the Siam weed program has been a long term eradication program, research has continued through the life of the program to ensure the program is constantly improving and adapting. Host testing of the first biocontrol agent for Siam weed in Australia and trial flights of unmanned aircraft to detect Siam weed remotely are the latest areas of research in Queensland.

RESOURCES

Estimating the resources required to achieve eradication is an inexact art, but requires responsiveness within rigid funding frameworks. Modelers and statisticians can build trends and projections, but the ability of invasive species to confound the experts often appears to be unlimited. Build in the vagaries of climatic conditions and natural disasters with the consequent impact on field operations, and the end result is a crystal ball gazing exercise. Nonetheless, within this environment of multiple, ever-changing variables, estimates of the annual cost to achieve eradication objectives are necessary.

It is much easier to estimate resources for a known (delimited) static surveillance area. In reality, discovery of new or outlying infestations do occur, and need rapid mobilisation of resources to delimit and control. The Siam weed eradication program found that the ongoing detection of new infestations continued to put pressure on budgeted expenditure throughout the life of the program. The national cost-share funding environment normally requests three-year budgets which are agreed to at Ministerial Council level. The ability to seek approval to modify these budgets during the three-year cycle, as new infestations have been detected, has also been problematic. To avoid this cyclical shortfall in funding, it is suggested that future program budgeting should include a contingency component to allow an eradication program to rapidly respond to new detections while maintaining strict surveillance timelines for previously known infestations. As new detections decline over time, this contingency fund will become redundant.

Another important resourcing lesson is that the budget needs to be sufficient to meet the stringent surveillance re-visitation regime required for eradication. The ultimate aim is to sterilise infestations by not allowing seeding events to occur. Any seeding event will provide further dispersal opportunities and lengthen the life of the eradication program. It is better to allow for frequent and thorough searches of infestations than to budget for 'just enough' to cover the current known extent.

ADAPTIVE MANAGEMENT

To remain one step ahead of an aggressive invader such as Siam weed, an eradication program needs to be able to respond quickly by changing or improving operational strategies.

The program has developed a very effective aerial surveillance program to delimit the incursion and provide quality assurance monitoring of field operations. These annual surveys coincide with the peak flowering period for Siam weed in late June,

which is the optimum time for detection from the air. The surveillance has allowed the program to conduct extended surveillance across tens of thousands of hectares of preferred Siam weed habitat to confirm the incursion is contained within known boundaries.

Once Siam weed is detected by aerial surveillance, a means of controlling every infestation must be developed. Treatment of remote infestations, particularly in some of the rocky escarpment areas near Townsville, has been problematic. In 2009 the program utilised two new techniques for Siam weed control to address this issue: helicopter spot spraying and backpack splatter guns.

The aerial spot spraying was a new treatment technique for Queensland. This utilised a helicopter mounted spray rig with herbicide application *via* a 200 metre hose with an inverted cone surrounding the spray nozzle to minimise non-target impacts. Many other Siam weed infestations are inaccessible to vehicle mounted spray rigs. The program, with research support from Biosecurity Science, has developed the use of gas powered splatter guns to treat plants using high concentration of herbicides and low volumes of water (Brooks *et al.* 2011). This has allowed teams to trek into remote areas where surface water is unavailable and treat large areas of Siam weed.

DATA, THE KEY

Large scale eradication programs are very expensive and require continuous funding commitment for a prolonged period to achieve the desired outcome. A high standard of very detailed data needs to be recorded to track progress, analyse trends and to inform resourcing decisions and budget approvals. The Siam weed eradication program has a purpose built MS Access database, a very strong GPS-GIS integration, and receives technical support from Biosecurity Science to analyse the data on an annual basis for stringent reporting purposes.

The Siam weed program is a good example of how data collection has evolved over time. For the first few years, no data was collected at all. After four years, a data recording system and database was developed, but absence records for previously treated infestations were not recorded. This oversight was counter productive as recording absences after treatment would have provided early evidence that the program was succeeding. By 2006, locational data was collected on a much more thorough spatial basis, which then fed into the first attempt to coarsely analyse the data in 2007, 13 years after the program had begun. Consistent data analysis across the whole incursion did not occur until 2008, and a more detailed spatial recording system based on a grid of one hectare squares was rolled out in 2010.

The data standard the program has today allows program staff, external parties and funding bodies transparency in how we track and report progress towards eradication. It would have assisted the Siam weed program enormously to measure these trends and retire sites more quickly if we had been accurately and consistently recording data from day one. Records showing the continual absence of plants, especially reproductive plants from previously controlled areas, provide compelling evidence of progress towards eradication.

GOVERNANCE

The scale and governance of the Siam weed program has increased dramatically since 1994. This was partly due to stricter requirements by the national cost-share partners to ensure the program was making adequate progress to eradication. The program has been subject to three external reviews in 2003, 2008 and 2011 (Wickes *et al.* 2011). These reviews have provided excellent independent appraisals of the program, and assisted in re-aligning and scaling-up activities, together with providing a stronger case for funding extensions. It would have assisted the program if these reviews were scheduled more regularly, rather than 9 years after commencement and the second review five years later.

In 2006, a Management Committee was formed to act as a steering committee for the program. This included local, state and national government agencies, NRM bodies and industry representatives. This committee meets biannually, providing an opportunity for stakeholders to critically assess the effectiveness of the program.

Both of these processes have provided the Siam weed program with an improved level of transparency and allowed for continuous improvement *via* input from external parties.

BELIEF

Finally, once the nuts and bolts are in place, a culture of eradication needs to be instilled at all staff levels. There needs to be a belief by the field teams undertaking the hard work that eradication is achievable so that they conduct their surveillance to the highest possible standard. Without this internal drive, the goal of eradication will fall at the first hurdle. In support of the field teams, supervisors and managers must also be fully committed and convinced of the eradication aim. This includes supporting field staff being adequately remunerated for the stringent standards required of eradication, and providing the best possible technology and equipment to undertake operational activities effectively.

ACKNOWLEDGMENTS

I would like to acknowledge Simon Brooks for his ongoing scientific input into the eradication program, and to all the Siam weed program staff and regional collaborators (Local Government, QPWS, Defence) who have worked enormously hard to achieve the ultimate goal.

REFERENCES

- Brooks, S.J., Gough, K.L. and Campbell, S.D. (2011). Testing the efficiency of low volume herbicide applications on *Chromolaena odorata*. Proceedings of the 23rd Asian-Pacific Weed Science Society Conference, Vol 1, pp. 60-68.
- Brooks, S.J. and Setter, S.D. (2011). Soil seed bank longevity information for weed eradication target species. Proceedings of the 23rd Asian-Pacific Weed Science Society Conference, Vol 1, pp. 69-77.
- Goswami, S. (2008). National Siam weed (*Chromolaena odorata*) Eradication Program: economic Cost Benefit Analysis. Internal report. Queensland Department of Primary Industry and Fisheries.
- Kriticos, D.J., Yonow, T. and McFadyen, R.E. (2005). The potential distribution of *Chromolaena odorata* (Siam weed) in relation to climate. *Weed Research* 45, 246-254.
- Patane, K.A., Setter, S.D. and Graham, M. (2009). Effect of foliar herbicides on the germination and viability of Siam weed (*Chromolaena odorata*) seeds located on plants at the time of application. *Plant Protection Quarterly* 24(4).
- Scott, L.J. and Lange, C.L. (1996). Genetic Variation and Origin of Siam weed (*Chromolaena odorata*) in Northern Australia (Cooperative Research Centre for Tropical Pest Management).
- Wickes, R., Ramsey, M. and Grice, T. (2011). Review of the Siam Weed Eradication Program, North Queensland, Internal report conducted for the Department of Agriculture, Fisheries and Forestry.
- Zachariades, C., Day, M., Muniappan, R. and Reddy, G.V.P. (2009). *Chromolaena odorata* (L.) King and Robinson (Asteraceae). In 'Biological Control of Tropical Weeds using Arthropods', eds R. Muniappan, G.V.P. Reddy and A. Raman, pp. 130-162. (Cambridge University Press, UK).