The Branched Broomrape Eradication Program: methodologies, problems encountered and lessons learnt

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Summary Branched broomrape (*Orobanche ramosa* L.), a parasitic weed of broadleaf crops, is the target of a national eradication campaign in South Australia. Over the past three years this program has demonstrated the difficulties and the legislative issues that can hinder or support an attempt to eradicate a serious weed. The parasitic nature of the weed and the minimal impact on production of the predominant industries present in the area affected has presented some unusual challenges to the program and these are also discussed.

The structures that have been put into place such as community support and involvement in the decision making within this program have proven invaluable. The broader industry support within South Australia has also had an important role to play in the program. The program is highly integrated with social, scientific, legislative, and agronomic projects working as a coordinated program. This paper reviews the lessons learnt and the legislative and administrative structures that are required to support an eradication campaign in the medium to long term.

Keywords Branched broomrape, methodologies, lessons.

INTRODUCTION

Branched broomrape (*Orobanche ramosa* L.) is a parasite of a range of broadleaf crops. It is mainly Mediterranean in distribution but is also found in Central Europe, the Middle East and northern Africa. It has been introduced into a number of countries including South Africa, Mali, Cuba, Central America, and the USA (Parker *et al*. 1993).

The first branched broomrape identified in Australia was an infestation found growing in sandhills near Glenelg in South Australia in 1911. This infestation apparently died out within a few years of its discovery. The only other known population of branched broomrape in Australia was discovered in 1992 in the Bowhill area. The detected plants were eradicated by methyl bromide fumigation. Between 1993 and 1997, plants were found at six more sites on the original property and an adjoining property. These plants were eradicated by a combination of fumigation and manual control.

In late 1998/99 branched broomrape was detected at a further 16 sites within 15 kilometres of the original infestation. Wide scale surveys followed these discoveries, resulting in detection of a total of 137 infestations covering 1344 ha of land. Since then large surveys have confirmed the plant to be present North East of the Murray Bridge area only, infesting 4800 ha of land.

This strain of branched broomrape has been confirmed to have a wide host range capable of parasitising plants from the Brassicaceae, Apiaceae, Asteraceae, Onagraceae, Solanaceae, Fabaceae and Boraginaceae families (see Virtue *et al*. 2002 for details).

The program to eradicate branched broomrape has eight main components including Management, Quarantine, Eradication, Survey, Research, Social issues, Farming Systems and Communication. Partners in this program include the Grains Research and Development Corporation, the CRC for Australian Weed Management, and Rural Solutions SA.

This is a national program funded through a cost share arrangement between State and Federal governments. Additional funding and in-kind support from the South Australian Government is still an option but has not been finalised at the writing of this paper.

METHODS

Several methods were used in the program that may be useful for other eradication programs in the future. Only some of the more important initiatives are described here for brevity.

Trace back Landholders were asked to provide information on the movement of vectors such as livestock, farm machinery, and soil from their properties. This included any movement by contractors or sharefarmers. All landholders within the Quarantine Area were sent a questionnaire with a reply paid envelope enclosed. Some landholders required help filling out their questionnaire. This was usually given over the telephone but some required a personal visit. Sixty six percent of landholders whose properties were infested with branched broomrape returned a questionnaire.

Records on the movement of machinery from infested properties were collected from all machinery dealers operating in the region. Primary Industries and Resources, South Australia has an obligation to protect the privacy of landholders infested with branched broomrape. To maintain this obligation, dealers could

not be told which specific landholders had infestations of branched broomrape on their properties. Machinery dealers were sent a list of all landholders inside of the quarantine area (including those without broomrape) and asked to supply information on the movement of any machinery from those properties.

It was not always certain whether or not each potential vector had actually come into contact with branched broomrape seed. For example, some machinery may not have been used in infested paddocks and some livestock may not have grazed in infested paddocks. At the same time, there was a risk that even though branched broomrape had only been detected on part of an infested property, seed may have been spread across other paddocks. This risk was compounded by the fact that, at the time of previous surveys, many paddocks had been planted to cereal crops and potential host plants for branched broomrape had been removed by herbicides (thus reducing the chance of detection). To address this issue, vectors were not assessed according to where they had been used. All vectors leaving an infested property were included in the trace-back program.

It was thought that some links identified by the trace back program would be more important than others. For example, the movement of livestock applied to the movement of broadacre (e.g. sheep and cattle), intensive (e.g. pigs) and domestic (horses and poultry) animals. Native and feral animals were not seen as a major risk of long distance dispersal. Each of these has a different chance of coming into contact with and moving branched broomrape seed. Links needed to be ranked in relation to their risk of spreading branched broomrape seed. A risk assessment was applied to all links to prioritise those most likely to have spread seed.

Field survey Branched broomrape seed will germinate in the field only when a suitable broadleaved host plant root is within a few millimetres of the conditioned seed. While some landholders grow pulse crops and most encourage medics in the pasture rotation, the highest densities of broadleaved plants are found around the perimeter of paddocks (conventional weed control does not target these areas). Teams of two people trained in weed identification undertook a visual inspection of paddock perimeters on foot, or where possible, on a 4WD motorbike, to identify and record the location of branched broomrape plants (Figure 1, step 1).

Branched broomrape is also found inside paddocks where it has been observed growing in sandy soil types and in areas where high densities of host plants are growing. After completing a perimeter search, teams undertook three transects across each paddock. Targeting obvious sandy areas or areas where host plants appeared to be growing in high densities was seen as a priority (Figure 1, step 2).

Quarantine Protocols for the movement of grain, machinery, soil, horticultural produce and livestock were established under the Fruit and Plant Protection Act (1992). These protocols were encapsulated in a code of practice, which was developed in consultation with industry representatives in a very short time frame of two weeks, and which has been further refined over the past three years. Ratification of the section on horticulture within the code of practice with the horticultural industry was particularly difficult to obtain, due to the fragmentation and complexity of the industries involved.

A suitable decontamination chemical was required to give us confidence in containing the weed by the survey operations and farming machinery. Niproquat®, a quaternary ammonium compound, was found to be 97% effective at killing branched broomrape seeds at concentrations of 0.1% after an exposure of 12 minutes (Virtue, unpublished data) and is now used

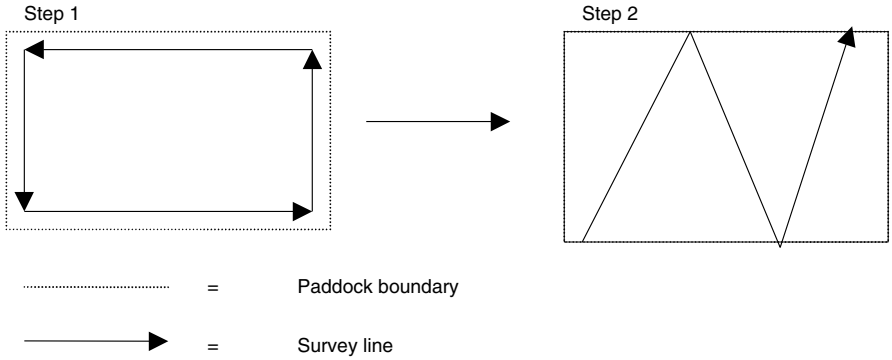

Figure 1. Survey technique for branched broomrape.

for a number of decontamination purposes within the program.

RESULTS

Four hundred properties were surveyed as part of the branched broomrape trace-back program during the 2000 and 2001 seasons. Of the 244 properties surveyed in 2000, 40 (16.4%) were found to be infested with branched broomrape. All of these properties were found within 70 kilometres of the original quarantine area.

Links to infested properties were identified as a result of the trace back program across South Australia and in Victoria (Figure 2). When planning the searching of these linked properties, it was found that teams could survey no more than 250 ha per day; even so, a total of 484,000 ha have been surveyed in the past two seasons (see Table 1).

A link is defined as a movement of a potential vector of branched broomrape seed. Vectors move more frequently closer to the quarantine area. While this was the case, the type of link was not geographically stratified (i.e. there was no correlation with the type of vector and the distance it moved from the quarantine area). At this time it is uncertain why all newly discovered infestations of branched broomrape were found within 70 km of quarantine.

Analysis of the type of vector linking properties suggests that machinery was the most important vector for the spread of seed (Figure 3). The next most important vectors were livestock, cereal seed and then hay. Tracing the movement of bulk soil/gravel did not result in the discovery of any infestations, but many of the infestations found on roadsides can be linked back to maintenance work that used soil from infested paddocks.

DISCUSSION

Over the past three years it became apparent that the presence of branched broomrape was being masked by a number of factors. The plant is palatable to stock (Jacobsohn *et al*. 1987) and grazing has masked the presence of the weed. Further, many of the chemicals used within cereal cropping systems, such as 2,4-D ester, clopyralid and MCPA, effectively suppressed branched broomrape, leaving the pasture phase as the only period when the plant became apparent.

The privacy policy of the South Australian Government (Cabinet Administrative Instruction No. 1 of 1989) has inhibited the program from divulging information on the location of branched broomrape. This has made it difficult for subcontractors, utility services and other concerned authorities to determine their risk of spreading the weed. As a result, signs have been erected on infested paddocks, and only stylised maps have been released to these third-party groups.

Assessing market risk has been particularly difficult and although 43% of our grain markets have broomrape as a prohibited plant, the actual impact on these markets is hard to gauge, as it has to be assessed on a market by market basis, and neither Australian

Table 1. Total area surveyed by year.

Year	Area surveyed (ha)
2001	323,834
2000	276,421
Total	484,204

NB. The total area surveyed is not the sum of both 2000 and 2001 as some sections were surveyed in both years.

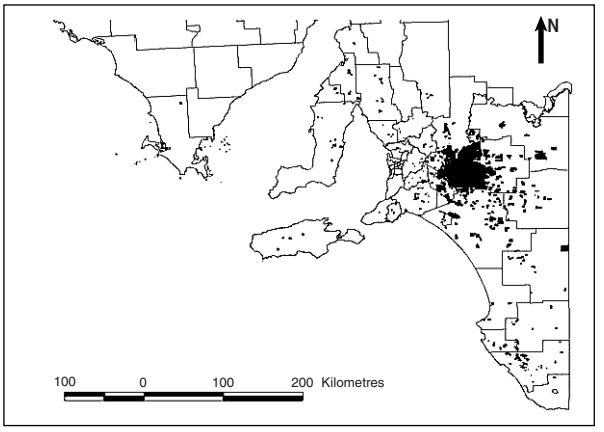

Figure 2. Area surveyed in South Australia for branched broomrape.

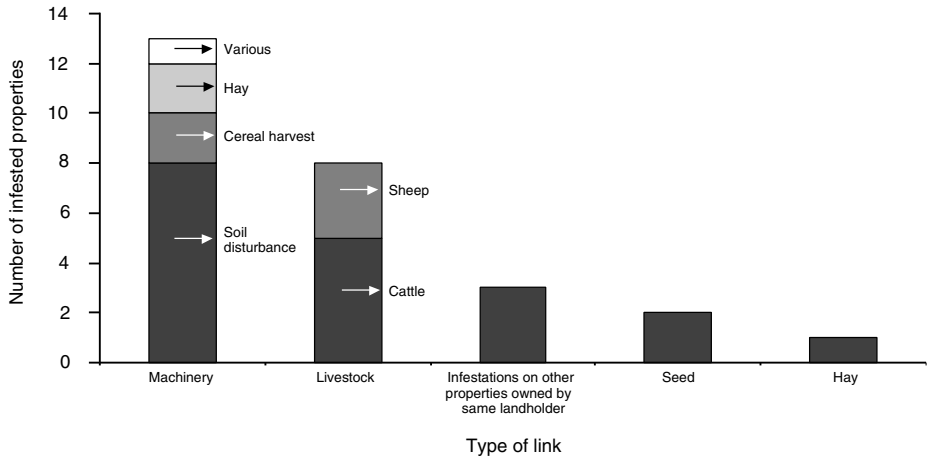

Figure 3. Types of links producing positive recordings of branched broomrape.

Quarantine Inspection Service or industry bodies can give complete market risk analysis.

The greatest challenge to any emergency response is human resource management and communication. It was clear from the program that public service human resource structures employing large numbers of casual staff for short periods of time were unable to cope. The employment of a designated human resource person who specialises in this area would have been helpful. The difficulties experienced by the branched broomrape program have illustrated the challenges for an eradication program where the weed is not directly affecting the farming community involved. The shortcoming of the legislation in the lack of powers to issue on the spot fines (expiation fees), the difficulties of introducing a quality assurance system, and the lack of a national compensation formula continue to affect the program. The short term nature of national funding has made it difficult to obtain and maintain staff in critical positions within the program.

A strategy for progressively allowing farmers to be released from quarantine is becoming an urgent issue for the program. This is a difficult issue as agronomic scientific information specific to the mallee farming system to control and diminish the seed bank of the weed is still requiring experimentation. The greatest impediment to this strategy is being able to delineate an infestation for treatment. The development of a DNA probe specific for detecting branched broomrape in soil, the agronomic research done to date and the work done overseas on germination stimulants will help to progress this issue in the future.

The lack of compensation for farmers in quarantine, whether the cost is real or perceived, is particularly poignant in the Branched Broomrape Eradication Program. The predominant agriculture in the area is cereal rotations, dairy and dry land grazing. None of these enterprises will realise a significant loss in production due to the presence of branched broomrape. However there are costs to farming flexibility, decontamination costs and the increased time in general farming practices. The community feel that they are protecting other industries that are not present in the area to any extent. The compensation of those that become embroiled in incursions is a matter for Plant Health Australia and governments, both federal and state, to determine. However, this issue is becoming a major hurdle for an eradication program that relies heavily on the good will of the farming community.

ACKNOWLEDGMENTS

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