Prevention and early intervention in the management of *Mimosa pigra*

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Abstract

Programs for prevention and early intervention in the management of mimosa, *Mimosa pigra* L., may be developed for a country, state, province, region, district, catchment or for an individual farm. In establishing a program, knowledge of the climatic regions suitable for mimosa, its favoured habitats, the vectors that enable spread, the long-term dormancy of seeds, growth rate, and reproductive pattern enables predictions to be made of the areas most at risk from invasion. Processes to prevent entry of mimosa, and preparedness for early intervention, can then be targeted at areas of high risk, whilst maintaining some vigilance in areas of lower risk.

Preventing the movement of seed is imperative to avoid the development of new infestations. Stopping the large-scale movement of seed on floodwaters is difficult, but the transport of seed by people, vehicles, equipment, animals, fodder, soil and other vectors can be prevented. There needs to be a commitment to minimise contamination by mimosa seed in the first place, and vigilance to ensure that items are clean before transporting them to uninfested areas.

When land is free of mimosa, quarantine and surveillance provide the best means of preventing its entry and establishment. The success of quarantine and surveillance at all levels relies on public cooperation that, in turn, is dependent upon education.

Upon detection of mimosa, its successful management depends upon early intervention and knowledge of control options. Prompt action improves the prospects for effective eradication of the weed, provided that regular monitoring and control are combined with a long-term commitment to the task.

***Keywords*:** *Mimosa pigra*, early intervention, early detection, management, risk, quarantine, control.

Introduction

Prevention and early intervention are key components in the integrated management of mimosa, *Mimosa pigra* L., and can be applied at various geographic levels, depending on the status of the weed in a country. Programs may be developed for an entire country, a state, province, region, district, catchment, or for an individual farm.

In Australia, the principles of prevention and early intervention have been key components of the strategy for the integrated control of mimosa since the 1980s (Miller and Pickering 1983). They are also included in the "Prevention of spread program" under Australia's current mimosa strategy (Agriculture & Resource Management Council of Australia & New Zealand *et al*. 2001).

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Prediction of spread

Prediction of where new outbreaks of mimosa will occur is a valuable tool in the prevention and early intervention process. By knowing the areas most at risk, surveillance, preventative action and preparedness for early intervention can be targeted. However, some vigilance should be maintained in areas of lower risk where mimosa may also become established and become a source of seed for other habitats.

Prediction on its own is of little practical use if the parameters are not chosen carefully, and if measures for preventative action are not put in place as a result of the prediction. Prediction depends upon knowledge of the biology and ecology of the plant, and the vectors that enable spread. Observations on the biology and ecology of mimosa in various habitats over the past 35 years have enabled a description of susceptible habitats to be developed. Mimosa favours a wet–dry tropical climate and is most commonly found in moist situations such as floodplains, riverbanks, irrigation canals and reservoirs, generally at altitudes of less than 500 metres (Lonsdale *et al*. 1989, Napompeth 1983). Mimosa will, however, grow in a range of soils from heavy clays to sands and in well-drained upland situations such as road verges. Plants have been recorded as far north as 29° in Florida (W. Haller, pers. comm. 1990), at an altitude of 1,670 metres in Thailand (B. Napompeth, pers. comm. 1985) and at 2,000 metres in Mexico (J. Gillett, pers. comm. 1986).

In Australia, predictions have been made on the potential distribution of mimosa. Using a manual comparison of temperature and rainfall data from mimosa's native range with the introduced range, Miller (1983) predicted the future distribution of mimosa in tropical Australia in rainfall zones down to 750 mm. This closely matched the range predicted by Lonsdale (1992) who used a computer software system (CLIMEX; for latest version see Sutherst and Maywald (1999)) that predicts the potential distribution of plants and other organisms. The potential distribution in Australia was later extended to include northern New South Wales (Heard and Forno 1996). Lonsdale (1992) also predicted the eventual distribution in Asia, and commented that the weed has only just begun to take over suitable habitats.

Predictions of areas at risk to invasion by mimosa can also be made by studying the land systems or vegetation units where mimosa occurs. These can be mapped within a climatically suitable area of interest to show areas at risk. This can be done manually, but it may be possible to do this using a geographic information system, or by defining and mapping the spectral signature of susceptible areas through satellite imagery.

Prevention

Prevention incorporates education, knowledge of the vectors of mimosa seed and the preventative actions to reduce the risk of spread.

Education

The effectiveness of preventative action at the national, state and farm level relies on public cooperation, which in turn, is dependent upon effective public education. Knowledge of the detrimental impact of mimosa to agriculture and the environment in a new area may motivate people to prevent spread. It is important that the community knows how seed is spread, is aware of the practices that can be put in place to prevent contamination, and how to clean contaminated items.

Vectors

Seed pods of mimosa are covered with bristles, enabling whole pods or seed segments to float and be dispersed on floodwaters or to stick to animals and clothing. Seeds are also transported by vehicles, equipment, railroad cars, as contaminants in river sand, soil and fodder, by mud on animals, and in the intestines of animals after browsing on the plant (Miller 1983, Napompeth 1983). It has been speculated that birds also carry seed as they have been observed feeding on pods and seeds (C. On, pers. comm. 1986).

Vegetative reproduction of cut stems can occur if they come into contact with wet soil (J. Gillett, pers. comm. 1987) but this is not considered to be a major cause of spread.

Preventative action

Preventative measures may be carried out at the source of seed, in transit, or at the destination. These measures may include reducing the movement of seed from infestations that occur in strategically important areas, quarantine, and management practices that reduce the susceptibility of an area to invasion.

Reducing the movement of seed from infestations

Both small and large infestations may occur in isolation of other infestations and be identified as being strategically important enough to warrant control to reduce the spread of seed to clean areas. Control of mimosa upstream of uninfested areas is particularly important. However, preventing the large-scale movement of seed on floodwaters is difficult. Where a river such as the Mekong is the boundary of a number of countries, and flows through others, seed can readily spread from country to country (Benyasut and Pitt 1992).

In some cases, control of large infestations may be justified to reduce the amount of seed and its movement by floodwaters and other vectors to uninfested areas. This protective mechanism was the rationale in undertaking control of a large, isolated infestation of mimosa near Oenpelli in Arnhem Land in the 1990s (Anon. 1991). The aim was to prevent the spread of this infestation, which posed a threat to the wetlands of Arnhem Land and Kakadu National Park. The long-term nature of such an undertaking, and its continuation in a strategic manner, is recognised (Ross 2002).

Where it is not justified to carry out control over an entire infestation, control may be carried out in strategically important sections of the infestation. For example, control on road and railway verges, riverbanks and in public access areas will reduce the risk of contamination by vehicles and boats.

Small, isolated infestations of mimosa also pose a risk for spread of seed. Their control as a high priority is discussed in the later section on early intervention.

Quarantine

Preventing movement of feral animals, birds and floodwaters is difficult, but movements of seed by people, vehicles, equipment, livestock, fodder, soil and other vectors can be prevented by implementing quarantine measures to reduce the risk of movement of seed from one place to another. Quarantine may include precautionary measures on the assumption that a propagule is present, or it can be applied when contamination is definitely known to have occurred.

Contamination by mimosa seed can be reduced by avoiding entry to infestations and preventing the removal of sand or soil from contaminated areas. In high-risk areas, access to infestations can be reduced by erecting fences together with the use of signs that prohibit entry. Signs may be used alone where fences are too costly. However, these practices should be backed by weed legislation that enables declaration of quarantine areas and provides penalties for illegal entry.

Voluntary inspection, cleaning or washdown of vehicles, equipment and livestock that have been in high-risk areas is essential for effective prevention of seed movement into uninfested areas. This is important at all geographic levels, but it is most important that individuals implement these practices at the farm level. Each property should have a designated quarantine area where inspection and cleaning is always carried out upon entry to a property, and which provides for monitoring of weeds of any kind within a small area. If necessary, weed legislation should be applied which provides for inspection, compulsory cleaning and penalties for the movement of mimosa seed by any means.

When purchasing livestock, stock feed, and crop and pasture seed, buyers must insist on products that are free of mimosa seed. Buyer–seller interaction is necessary to determine the risk of contamination and whether action is necessary to avoid or remove contamination. Livestock from infested areas should be held for at least three days until seed passes through the intestine, before introducing them into clean areas (G. Schultz, pers. comm. 2002).

Management of susceptible areas

Some plant communities and landforms are more susceptible to invasion by mimosa than others. They can be managed to reduce susceptibility to invasion. Maintaining a dense ground cover will provide competition against developing mimosa and provide a form of protection against invasion. Burning may reduce the ground cover and assist invasion but it may also assist in stimulating germination and control of seedlings.

Early intervention

As with prevention, education is central to successful early intervention. People faced with a new infestation need to understand the biology of the plant and the importance of a rapid response, the need to record locations of outbreaks, the control methods that are available to manage small infestations, and the need for long-term monitoring.

Biology of mimosa and the need for a rapid response

Mimosa possesses many characteristics that necessitate a rapid response when dealing with new infestations. In the Northern Territory, the time from germination to flowering is six to eight months. Flowering and seeding of mimosa is usually seasonal, but it will seed throughout the year under favourable conditions and it produces large quantities of seed, many of which remain viable for long periods (Lonsdale e*t al*. 1989). In flooded areas there is uncontrolled spread of seed.

In its favoured habitats, mimosa will spread quickly and get out of control. The doubling time of an infestation is about one year (Lonsdale *et al*. 1989) and the plant grows in places that are not easily accessible, meaning that the sooner a plant is detected and controlled, the higher the chances of effective management. In addition, mimosa is both flood and drought-tolerant (Miller and Pickering 1983), so in planning a prevention and early intervention program, consideration needs to be taken of the fact that it may appear in habitats where it is not expected.

Location of infestations

An integral part of early intervention is surveillance of the areas at risk and mapping the locations of new infestations so that follow-up control can be practised. All locations of new infestations should be marked with a peg and the geographic coordinates determined. Methods that can potentially be used for mapping mimosa are field surveys from the ground and aircraft, and various forms of remote sensing (Pitt and Napompeth 1992). However, when infestations are small, and control is carried out in association with mapping, field surveys from the ground or helicopter using a global positioning system (GPS) are most practical. Data from a GPS can be transferred to a geographic information system for producing maps and storing the coordinates of infestations for follow-up control (Sanford-Readhead 1999).

Although remote sensing can be used to map large healthy areas of mimosa, the accuracy varies, and small outbreaks or mimosa at low density cannot be discriminated (Miller 2001, McIntyre 2001). Further research is required before using this technology for mapping small, scattered infestations (McIntyre *et al*. 2002).

Control measures

Although the presence of small, isolated infestations of mimosa in clean areas may seem relatively harmless, they are a nucleus for the development of large infestations within a short period. Therefore their control must be assigned a high priority and plants need to be controlled before seeding. Several techniques have been utilised to control small infestations. For example, hand-pulling, cutting, burning and herbicides have been used for such infestations in Kakadu National Park (Cook *et al*. 1996).

Physical control

Seedlings can be hand-pulled or removed with a hand-held implement such as a mattock, ensuring that roots are removed. For larger plants, any seed should be collected and burnt in a container. The branches should then be cut off with long-handled cutters or a machete and the roots removed with an implement. The plant should be dried before burning (Siriworakul and Schultz 1992). In wet conditions, it is important that no portion of the plant be dropped as it may take root. In some cases, large plants growing in water may also be pulled out by hand. Hand weeding may also be carried out in crops.

Chemical control

Foliar applications of herbicides can be made to small infestations using hand-held sprayers. Where there is a large number of scattered plants, helicopter application may be justified. Herbicides can also be used in association with physical control; mimosa stems are cut and herbicide is immediately applied to the cut stump (Miller and Siriworakul 1992).

Basal bark application and stem injection of herbicides are other methods that are useful for the control of individual or small groups of mimosa without posing the risk of spray drift.

Where plants have seeded in new localities, treatment with a residual, soil applied, selective herbicide that kills mature mimosa and germinating seed, but does not kill ground cover, should be considered.

Fire

If fire is contemplated for control of new infestations, the benefits and disadvantages should be considered. After removal of a mature plant, fire may be beneficial for controlling seedlings, for stimulating germination of seeds, and to kill seeds (Lonsdale and Miller 1993). However, burning will reduce the ground cover and may assist in establishment of more mimosa.

Ground cover

As is the case for preventing invasion in the first place, maintenance of a dense ground cover will provide competition against germinating mimosa (Lonsdale *et al*. 1989, Benyasut and Pitt 1992, Lonsdale and Farrell 1998) and reduce the development of isolated infestations.

Monitoring

In implementing an early intervention program, regular monitoring of the area and follow-up control is essential (Miller *et al*. 1992). An intermittent, short-term approach to management will result in plants developing from dormant seeds that may still be in the ground from the initial incursion. These will become a focus for further spread if not controlled.

It is essential that responsibility for follow-up control be defined — whether it is landholder, government or both — so that a regular pattern of monitoring is established. The time-span required for follow-up will vary with the age and size of the infestation, whether it has seeded and whether re-infestation is occurring from an outside source. Lonsdale *et al*. (1989) reported that the half-life of seeds in the soil varied from nine and a half weeks in a heavy clay soil, to almost two years in a sandy soil. Therefore, monitoring may be necessary for 10 years or more in order to be confident that the plants have been eradicated.

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