Herbicides and their application for the control of mimosa in the Northern Territory, Australia

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Abstract

There is a wide range of habits in which mimosa, *Mimosa pigra* L., can effectively colonise, and the selection of a herbicide and application technique must be appropriate to the situation. There are several interacting factors that can influence the effectiveness of a herbicide and the application technique including environmental, infestation characteristics and human resourcing issues. There are effective herbicides that are currently not registered for use in the Northern Territory and this limits the availability of choices in some situations. The registration of these options should be a priority.

Keywords: *Mimosa pigra*, chemical control, application techniques.

Introduction

In the Northern Territory (NT), mimosa occurs from the Victoria River in the west to the Phelp River in the south-east of Arnhem Land. The favoured habitats of mimosa are river systems and particularly their associated wetlands and floodplains. In these areas mimosa has the ability to completely dominate the landscape with extensive monocultures that replace most other plant species over considerable areas of land. These are considered high-density infestations. The size of infestations varies between river systems, but the largest infestations are on floodplains of the Adelaide River, Mary River, Finniss River and in the Daly River/Port Keats Land Trust. Mimosa, however ,also grows in other habitats such as roadsides, quarries, and in upland habitats areas of a number of river systems. These infestations, which are generally scattered patches of plants away from high-density infestations, are referred to as low-density infestations.

Given the range of habitats that mimosa will survive in and the range of infestation characteristics that tend to develop across habitat types, serious consideration must be given to the range of herbicides and application methodologies available, before the start of a chemical control program. The selection of an appropriate application method should consider environmental variables, infestation characteristics, infestation location and resource availability.

Environmental variables

Environmental variables can limit the efficiency and effectiveness of a herbicide control program through affecting how much herbicide is available to the target plant and also by affecting the target plant's ability to absorb and subsequently translocate the herbicide to the particular site of action.

Soil conditions and type can influence the effectiveness of herbicides. This can occur by limiting

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the activity of the target plant and hence the amount of herbicide that can be absorbed, and also by limiting the availability of herbicide to the plant through adsorption to some clay and organic matter particles within the soil profile.

Herbicides registered and recommended for the control of mimosa in the NT through foliar application include dicamba, fluroxypyr and metsulfuron methyl. With each of these products, maximum effectiveness is gained under ideal soil moisture conditions and hence active plant growth. Generally speaking, these conditions occur during the early wet season and at the start of the dry season. Outside of this, periods of insufficient soil moisture during the mid to late dry season and periods of soil saturation during the mid wet season limit plant activity and therefore herbicide effectiveness. Fluroxypyr and dicamba will give a level of control during periods of less than ideal soil conditions. However, application during these times is still not recommended.

Herbicides registered for the treatment of mimosa through soil application within the NT include hexazinone and tebuthiuron. Hexazinone has been shown to be less effective in soils with relatively high clay and organic matter contents, a finding supported by Miller (1988) who reported reduced effects on target plants in heavy clay soils as opposed to lighter alluvial solodic soils. Similarly, research has demonstrated soil clay content to be the most consistent variable influencing the effectiveness of tebuthiuron (Duncan and Scifres 1983), with the best results being obtained on soils with lower clay contents.

Atmospheric conditions experienced during the foliar application of herbicide to mimosa can significantly influence both the amount of herbicide reaching and the amount of herbicide available to the plants. Unfavourable variables such as high evaporation rates, low humidity, high temperature and excessive air movement can significantly reduce the amount of herbicide reaching the target. In the NT, most aerial spraying is undertaken during the wet season and is timed to avoid periods of high temperatures and low humidity.

Infestation location and characteristics

The location and characteristics of a mimosa infestation can influence the selection of a suitable herbicide and also the selection of an appropriate application methodology. In areas where significant numbers of non-target plants are present, the use of non-selective herbicide may not be recommended, as levels of off-target damage may be unacceptable. The application of non-selective herbicides in some situations may not be warranted as the destruction of competitive grass species can reduce the long-term effectiveness of the control program. Where movement of soil is likely, such as slopes greater than 1:5, or in riparian areas, the use of residual herbicides may be limited both legally and practically to prevent erosion.

In addition to these considerations, the density, age and area of an infestation can influence the selection of an application method. For example the selection of an aerial application technique to a situation of scattered, low-density juvenile plants in the uplands would be economically impractical. However, such a method would be ideally suited to the management of extensive mature plants in a floodplain situation.

Resource availability

With the undertaking of any weed control program, the consideration of resource issues such as labour availability, labour cost, skills required and equipment availability before the commencement of control will assist in ensuring maximum effectiveness of operations. Ensuring that herbicide application is undertaken using the correct equipment with trained staff is as important as ensuring control takes place under ideal environmental conditions using the correct chemical.

Herbicides and their application

Soil application

The application of residual herbicides to soil for the control of mimosa (see Tables 1 and 2) can be carried out from either air or ground, depending on the area requiring treatment, the age of plants and the location of the infestation.

Herbicides that can be applied to the soil are available in a range of formulations. However, all require rainfall to incorporate the herbicide into the soil profile to allow uptake by the target plant.

The major benefit of application to soil is that the products all give a level of residual control, controlling emerging seedlings over time. This provides the benefit of extended weed management in areas that may be difficult and or expensive to access on a repeated basis. In addition, an effective control program can continue to operate while the plant is inactive, a period where other control options would have reduced effectiveness. The length of residual control depends upon the characteristics of the soil and application rate.

The application of soil applied herbicides is suited to isolated plants and patches of plants in the uplands, floodplain fringes and on floodplains. Application of residual herbicides to riparian situations is not recommended as the risk of off-target damage through soil and water movement is significant. The ideal time for application is before expected rainfall events that will minimise the time that the herbicide is exposed to sunlight and the risk of fire which reduce the effectiveness of the product. These herbicides can also be used to complement the effect of knockdown weed-management methodologies by providing a period of time where emerging seedlings may be managed.

Research has also demonstrated that effective results from ground-applied herbicides are sometimes dependent upon effective distribution over the soil surface. In the case of tebuthiuron, effectiveness is dependent upon distribution over an area radiating 2 m from the trunk. This distance correlates with the soil surface area covering the secondary root system, measured at 4.4 m in the NT.

Particular care should be exercised to ensure that damage to off-target species is minimised both through herbicide application rates and application techniques. Some species, particularly grasses, provide valuable competition for emerging mimosa seedlings and their removal will reduce future competition for emerging mimosa seedlings. In addition to this, herbicide application above the recommended label rate may lead to the creation of bare areas that may lead to other land-management problems in the future.

Foliar application

The foliar application of herbicides for the control of mimosa (see Tables 3 and 4) can be carried out from either air or ground-based equipment, depending on the area requiring treatment, the age of plants and the location of the infestation.

Table 1. A guide to the application of soil-applied herbicides for mimosa in the Northern Territory.

Location of infestation	Season	Early wet			Mid-late wet			Early dry			Late dry		
	Infestation description	I	M	D	I	M	D	I	M	D	I	M	D
Uplands	Seedling	✔	✔	✔	✔	✔	✔	?	?	?	✔	✔	✔
	Juvenile	✔	✔	✔	✔	✔	✔	?	?	?	✔	✔	✔
	Adult	✔	✔	F	✔	✔	F	?	?	?	✔	✔	F
Riparian	Seedling	×	×	×	×	×	×	×	×	×	×	×	×
	Juvenile	×	×	×	×	×	×	×	×	×	×	×	×r
	Adult	×	×	×	×	×	×	×	×	×	×	×	×
Floodplain fringe	Seedling	✔	✔	✔	?	?	?	?	?	?	✔	✔	✔
	Juvenile	✔	✔	✔	?	?	?	?	?	?	✔	✔	✔
	Adult	✔	✔	F	?	?	?	?	?	?	✔	✔	F
Floodplain	Seedling	✔	✔	✔	?	?	?	?	?	?	✔	✔	✔
	Juvenile	✔	✔	✔	?	?	?	?	?	?	✔	✔	✔
	Adult	✔	✔	F	?	?	?	?	?	?	✔	✔	F

Notes:
I = individual and/or isolated plants.M = isolated patchesD = dense, significant areas.
✔ = recommended application.
× = application not recommended.
F = application recommended to be used in conjunction with other method or as follow-up treatment.
? = seasonal conditions of excess or insufficient moisture make application risky.

Table 2. Soil-applied herbicides registered for mimosa control in the Northern Territory.

Active ingredient	Application rate and method	Application notes
Tebuthiuron (200 g/kg)	5–10 kg/ha (aerial)	Apply before onset of wet season for best results. Apply before surface flooding. Avoid burning area before product absorbed into soil profile.
Tebuthiuron (200 g/kg)	1 g/m^2 (ground)	Apply before onset of wet season for best results. Apply before surface flooding Avoid burning area before product absorbed into soil profile.
Hexazinone (750 g/kg)	2 kg/ha (ground)	Apply before onset of wet season for best results.

Foliar-applied herbicides are suited to infestations ranging from isolated plants through to extensive high-density floodplain infestations, with the main difference being the method used. In the case of smaller infestations, effective control can be achieved through ground control operations using a boom spray or high volume handgun for situations involving seedlings, whilst a high volume handgun is best suited to more mature plants. In these types of situations application rates of 1,000 L/ha are recommended. In the case of extensive high-density infestations such as those occurring on floodplains, aerial application of foliar-applied herbicides can give good results under suitable conditions.

The ideal time for application is under conditions of low evaporation and high humidity. These conditions maximise the amount of herbicide reaching the target, and target plants are not stressed by insufficient or excess soil water. These conditions generally occur in the NT in the early wet season and the early dry season. Ideally, applications should target the period of active growth before mature seed production occurs, that is, at the end of wet season.

Other application techniques

There is a range of other application methods for small, isolated infestations, riparian infestations and other places where the aim is to minimise the application of herbicide into the environment. These include cut-stump, basal-bark and stem-injection treatments. Effective cut-stump and basal-bark treatment can be achieved using triclopyr, triclopyr + picloram, fluroxypyr, hexazinone and dicamba, which is, in addition to hexazinone, an effective stem-injection option.

Table 3. A guide to the application of foliar applied herbicides for mimosa in the Northern Territory.

Location of infestation	Season	Early wet			Mid-late wet			Early dry			Late dry		
	Infestation description	I	M	D	I	M	D	I	M	D	I	M	D
Uplands	Seedling	✔	✔	✔	✔	✔	✔	✔	✔	✔	?	?	?
	Juvenile	✔	✔	✔	✔	✔	✔	✔	✔	✔	?	?	?
	Adult	✔	✔	✔	✔	✔	✔	✔	✔	✔	?	?	?
Riparian	Seedling	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
	Juvenile	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
	Adult	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Floodplain fringe	Seedling	✔	✔	✔	?	?	?	✔	✔	✔	?	?	?
	Juvenile	✔	✔	✔	?	?	?	✔	✔	✔	?	?	?
	Adult	✔	✔	✔	?	?	?	✔	✔	✔	?	?	?
Floodplain	Seedling	✔	✔	✔	?	?	?	✔	✔	✔	?	?	?
	Juvenile	✔	✔	✔	?	?	?	✔	✔	✔	?	?	?
	Adult	✔	✔	✔	?	?	?	✔	✔	✔	?	?	?

Notes:
I = individual and/or isolated plants.
M = isolated patches.
D = dense, significant areas.
✔ = recommended time of application with active plant growth.
? = not recommended as plants stressed by insufficient or excess water will reduce activity level and therefore herbicide effectiveness.

Table 4. Foliar applied herbicides registered for mimosa control in the Northern Territory.

Active ingredient	Application rate and method	Application notes
Fluroxypyr	3 L/ha + uptake (aerial)	Applied in 60 L water per ha. Best results gained with active plant growth. Wetting agent may be required. Will give visually quicker result.
Fluroxypyr	0.3 L/100 L water + wetter (ground)	Applied in 1000 L of water per ha. Wetting agent may be required. Will give visually quicker result.
Metsulfuron methyl	60 g/ha + non-ionic wetting agent (aerial)	Applied in 60 L water per ha. Best results gained with active plant growth.
Dicamba (200g/kg)	5–6 L/ha (aerial)	Apply to actively growing plants.
Dicamba 200 g/kg	L/100 L (ground)	Apply to actively growing plants. Seedling regrowth may require re-treatment.

Currently, none of these herbicides are registered for such use in the NT and therefore before use a permit is required from the Australian Pesticides & Veterinary Medicines Authority (APVMA).

Cut-stump application

The application of herbicides using the cut-stump method for the control of mimosa involves cutting stems off 10 to 20 cm above ground, followed by the immediate application of a herbicide solution to the stumps. This is an effective management tool when the target plants are scattered, low-density juveniles or adult plants. Labour cost usually prohibits treating extensive, dense infestations using this technique. The benefits provided by cut stumping are that plant removal is immediate, access is improved, competition with desirable species is immediately decreased and immature seeds present at the time of cutting will not mature. Cut-stump treatments are ideal in environmentally sensitive conservation and riparian areas as the potential for off-target damage is low.

Maximum effectiveness is obtained under conditions of active growth, such as in the early wet season and early dry season where good moisture is available. Treatment outside of these times when plants are stressed from excess or insufficient moisture will result in significant regrowth from stumps. There are no herbicides registered for this purpose in the NT for the control of mimosa and all work carried out using this method requires a permit from the APVMA.

Basal-bark application

The application of herbicides using the basal-bark method for the control of mimosa involves spraying stems using a knapsack from a point 30 cm above ground level to the ground around the entire circumference of the trunk. This is an effective management tool where mimosa occurs as scattered, low-density juveniles or mature plants. Attempts can be made at treating extensive dense infestations using this method, but labour costs generally prove prohibitive. The benefits of this method are that less herbicide carrier is required than using foliar-applied methods, and the operation is less labour intensive compared to the cut-stump method as plants do not have to be cut down.

Basal-bark treatments are also useful when targeting mimosa in environmentally sensitive areas such as conservation or riparian areas, as the opportunity for off-target damage due to the application technique and herbicide used is reduced.

Maximum effectiveness is obtained under conditions where active growth is occurring such as during the early wet season and early dry season where good moisture is available. Treatment outside of these periods when plants are stressed from excess or insufficient moisture will result in significant regrowth of treated plants. There are no herbicides registered for this purpose in the NT for the control of mimosa and all work carried out using this method requires a permit from the APVMA

Stem injection

The application of herbicides using the stem-injection technique for the control of mimosa involves the direct injection of a trans-locatable herbicide into the trunk of the plant. A specialised injection tool or a small axe or machete can be used to form a pocket in the bark of the plant close to the base of each stem, into which herbicide is injected. Stem injecting is an effective technique when the mimosa plants are scattered adult plants. Labour costs usually restrict the use of this method from managing extensive, dense infestations. The benefits provided by stem injection are that less herbicide carrier is required than using foliar-applied methods and the operation is less labour intensive than the cut stump methods as plants do not have to be cut down. Stem-injection treatment is also an effective option when targeting mimosa in environmentally sensitive areas such as conservation or riparian areas as the opportunity for off-target damage is reduced.

There are no herbicides registered for this purpose in the NT for the control of mimosa and all work carried out using this method requires a permit from the APVMA.

Maximum effectiveness is obtained under conditions where active growth is occurring such as early wet season and early dry season when good moisture is available. Treatment during other periods when plants are stressed from excess or insufficient moisture will result in significant regrowth of treated plants.

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