Weeds in the Burdekin Rangelands:
Principles of weed management

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Realistic goals of weed management

It is especially important in rangeland areas such as the upper Burdekin region that managers obtain maximum benefit from the limited resources available for weed management. Weed control should be based on a strategy that has realistic objectives.

Discussions of weed management often use the word 'eradication' but eradication is rarely a realistic objective (see boxed story *Control of Kochia in Western Australia* overleaf). In most cases, eradication is achievable only when a concerted effort is made very early in the invasion process, that is, when the infestation is very restricted. It is highly probable that most of the invasive species currently present in the Burdekin Rangelands will remain components of the regional environment. This means that, for these species, management strategies should focus on minimising impact within areas currently occupied and preventing spread to areas that are not currently occupied. Several important principles provide a basis for achieving these goals (Grice 2000).

Methods of weed management

Prevention

Possibly the most important principle of weed management concerns prevention. This should operate across scales from paddock to national. It is important to prevent the introduction of new potential weeds at a national scale, in line with the National Weeds Strategy (Anon 1997). This inevitably involves decisions about which plants should be allowed into the country. It is notoriously difficult to predict which species have weed potential though plants that are a problem in climatically similar regions are also likely to present a problem in Australia (Scott and Panetta 1993). At least one system for assessing weed potential has been developed specifically for Australia.

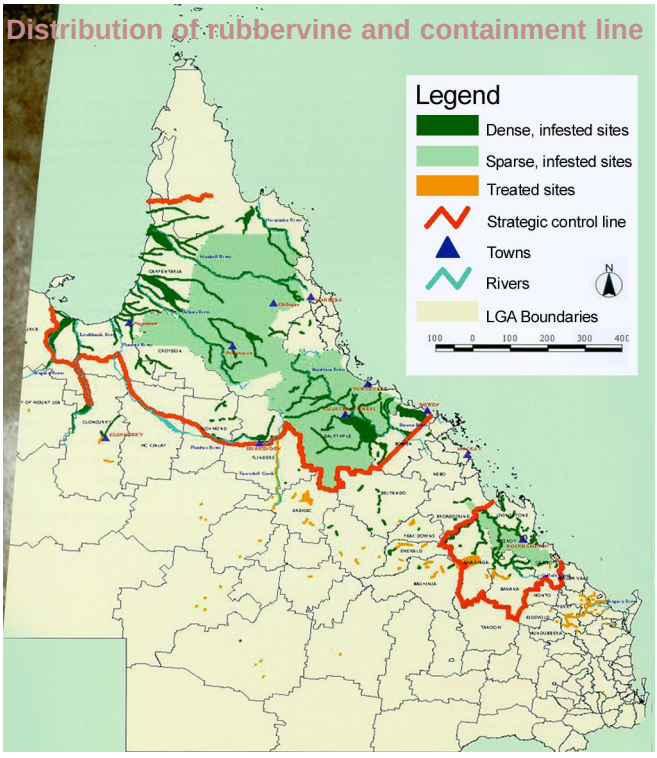
The principle of prevention should also be applied at scales below the national level, including at the regional scale. There are exotic plants that occur elsewhere in Australia but that are not yet found in the Burdekin Rangelands. Others, although already present, are still well short of having reached their potential within the region. It is important, therefore, to prevent both the arrival of new species with weed potential, and the proliferation of currently restricted weeds. This can only be achieved by taking actions based on knowledge of how different weed species are dispersed. An example of this is the voluntary or legislative policing of livestock transport into the region to minimise that risk of weed being introduced either through the animal's digestive tract or attached to its coat.

Containment

The principle of prevention at the regional scale should be linked to the idea of containment. Containment has been incorporated into State-level management strategies for weeds such as rubber vine and prickly acacia. State-level strategies aim to contain the weed within clearly delineated portions of the State by concentrating government-supported control activities on the infestations outside containment lines (see illustration below). However, there is also a role for containment at finer scales. This would involve actions at sub-catchment, property and paddock levels that depend on the fact that weeds are unevenly distributed at these scales. The value of attempting to contain weeds at these finer scales depends upon modes and rates of spread and rates of population increase.

Early intervention

Another important principle of weed management is that of early intervention. In general, the earlier action is taken to counter a weed invasion, the more effective that action is likely to be in preventing invasion or containing spread. Effective early intervention in turn depends upon an ability to detect weed invasions when they are in their early stages. This is particularly chal-



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Control of Kochia in Western Australia

Kochia (*Kochia scoparia*) is an annual chenopod that was first imported to Australia in 1990 as a salt-tolerant forage plant for pastoral and cropping areas of Western Australia. It was widely sown on salt-affected land in the south-west of the state. By 1992, the Western Australian Agricultural Protection Board recognised the weed potential of the species and it was targeted, initially for containment, and subsequently for eradication (Dodd and Moore 1993). By 1996, the number of infestations had been greatly reduced, eradication of individual infestations apparently achieved, but some populations persisted. The program's success was facilitated by intervention within two years of initial introduction, the ability to trace most of the sites to which it was introduced, and the implementation of a well-organised, government-funded campaign (Dodd 1996). In spite of these advantages, complete eradication had not been achieved four years after the program was initiated.

lenging in large areas, such as the Burdekin Rangelands, that have a sparse human population. It also relies on an ability to recognise the weeds.

Integrated weed management

There is not a suite of control techniques that are unique to extensive land use systems though there are constraints on how the techniques that are available can be applied. These constraints include the large areas of land involved, the extent of weed infestations, the low density of human populations and the low economic returns per unit area. The term 'integrated weed management' refers to how the various weed control techniques can be combined to greatest effect in a particular situation. There are four general techniques that can be used to reduce weed infestations: application of herbicides, mechanical control, burning and biological control. Each has advantages and disadvantages relating to effectiveness and efficiency.

Herbicides

Suitable herbicides are available for the most serious weeds of the Burdekin Rangelands. Although effective when used correctly, weed control can be expensive relative to the returns from the land that is being treated. Treatment can also be time-consuming given that it is often necessary to treat individual plants. In such cases, the effectiveness of the operation will in part depend on the ability to locate individual weeds.

Mechanical control

Mechanical control can be effective for many perennial weeds, especially woody species. The technique used must be appropriate to the sprouting capacity of the species involved. Broadacre techniques such as chaining do not require that plants are individually located. Many mechanical methods usually result in considerable soil disturbance, opening up the prospect that germination and establishment of the same or different weeds will be encouraged.

Burning

Burning is useful for the control of fire-sensitive species. Many species, though, are resilient even in the face of frequent burning. In pastoral country, burning has the disadvantage that it consumes forage. It is often necessary to destock an area that is targeted for burning in order to achieve fire intensities that will be effective. Post-fire destocking is also highly desirable to allow herbaceous vegetation to recover. Fire is useful to counteract proliferation of native species such as *Carissa* spp. and *Acacia* spp. The latter can be stimulated to germinate by fire but tactically timed fires can reduce this problem.

Table 1 Weed species of the Burdekin Rangelands that are the subject of biological control programs, the numbers of agents that have been released, and the numbers of agents that have established (from Vitelli 1999)

Species	Agents released	Agents established
Prickly acacia *Acacia nilotica*	5	2
Rubber vine *Cryptostegia grandiflora*	2	2
Harissia cactus *Eriocereus* spp.	4	3
Bellyache bush *Jatropha gossypiifolia*	4	0
Lantana *Lantana camara*	29	16
Prickly pear *Opuntia* spp.	21	14
Parkinsonia *Parkinsonia aculeata*	3	3
Parthenium *Parthenium hysterophorus*	9	7
Mesquite *Prosopis* spp.	4	2
Noogoora burr *Xanthium occidentale*	1	1

Biological control

Biological control involves the release of insects or pathogens that are specific to particular weeds. Most biological

control agents come from the natural range of the pest species. It is necessary to identify potential biological control agents, propagate them under controlled conditions, test them for their impacts on non-target species, and release them onto wild populations of the weed.

The potential biological control agent must then establish in the field and have a significant ecological impact on the weed. These steps are time-consuming and expensive. There have been some very notable successes with biological control in Australia, such as the use of the moth *Cactoblastis cactorum* to control prickly pear (*Opuntia* spp.). Often, though, results are less dramatic. Establishment of a biological control agent does not constitute success.

There have, moreover, been few attempts to quantify the effects of biological control agents on their target weeds. Weed species from the Burdekin Rangelands for which biological control agents have been established are shown in Table 1 (see page 2).

These four control techniques (herbicides, mechanical, fire, biological control) should form only part of a package of weed management. In addition, effort should be made to reduce the flow of weed seeds and so reduce the risk that new weed infestations will develop.

In particular, it is important to give attention to the risks posed by weed seeds being transported on or in motor vehicles, livestock, or animal feeds. To do this it is necessary to be aware of which seeds might be so transported and the routes that they may take.

Mesquite, prickly acacia and chinee apple are three weeds of the Burdekin Rangelands that are commonly transported with livestock. Managers should be aware of risks associated with livestock transported from weed-infested districts or properties.

There is also considerable risk associated with vehicles that have been used in or livestock fodder obtained from parthenium-infested areas. Attention to property hygiene can go a long way toward circumventing expensive weed problems.

Summary

All of these approaches to weed management will be most effective when developed into a comprehensive weed management strategy. A strategy should include clear and realistic objectives, identify priorities in terms of the weeds and locations to be targeted, specify the techniques and combinations of techniques that are most appropriate to different situations, and develop a time-frame for the completion of different tasks. It should take into account not only the weeds that are present but also the weeds that could invade. Such a strategy will help maximise the gains from the limited resources that are available for weed management

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