

Commercial weeds: roles, responsibilities and innovations

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Addressing the challenges of commercial weeds

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Summary

'Commercial weeds' are species from which commercial products are harvested, or where there is an expectation or hope of commercial harvest, and yet which also have or could have negative economic, social or environmental impacts. It has been common for costs associated with any negative impacts of such species to be borne at the 'enterprise' level by those who are affected, while others are free to benefit from cultivating them. An alternative approach is to apply a 'polluter pays' principle to such species by transferring costs to the producers of commercial weeds. This could be done by voluntary or regulatory means, through the use of codes of practice, payments of bonds or levies and other mechanisms. Regulation of commercial weeds may require modifications to current pest plant legislation in some states. Incipient and established industries and enterprises will vary in their capacities to bear the costs of weedy impacts that their crop or pasture species would otherwise impose others.

Introduction

Humans have always moved plants around the world, either deliberately or accidentally, and this transfer of plant species from their native ranges to other regions has been a key factor in human colonization, population growth, cultural development and economic achievement (Lonsdale and Milton 2002). In Australia, the success of European cultures has been

crucially dependent upon plant introductions. It is estimated that more than 26 000 plant species have been introduced to Australia in the last 200 years (Randall 2007), most of them deliberately (Groves 1998, Cook and Dias 2006). These plants have been used in agriculture and horticulture, as forage plants for livestock industries, in revegetation, and for ornamental uses. While introduced plants have had major economic and cultural benefits, it is also true that some have had negative impacts as weeds of agriculture, horticulture and pastoral and natural systems, and plants that are deleterious to human health. There has been increasing recognition of the negative environmental impacts of introduced plants in recent decades, and environmental weeds have been identified as being amongst the highest ranking threats to biodiversity (Groves *et al.* 2003).

It is the case, then, that Australia has many beneficial introduced plants and others that have deleterious effects. Only a relatively small proportion fall into the latter category: of the many thousands of introduced plants, only about 10% naturalize and, of these, only about 10% become serious weeds (Williamson and Fitter 1996, Lonsdale and Milton 2002, Randall 2006). However, the situation is more complicated than this because introduced species do not fall into mutually exclusive categories of beneficial and deleterious plants (e.g. Lonsdale 1994). Many simultaneously have both beneficial and deleterious effects; benefits and costs may

be economic, social or environmental. Any particular plant species may bestow benefits and impose costs at a single point in time and space, or at different times or under different circumstances. Importantly, any 'benefits' and 'costs' may accrue to different stakeholders, and may relate to the different values and perceptions of those stakeholders.

Because a large proportion of recognized weeds were deliberately introduced as garden plants, a common scenario is one in which species, whose main benefits are or were ornamental or aesthetic, impose economic or environmental costs on particular industries or ecosystems. Economic benefits of such species pertain to the sale of plants through the nursery industry or informal trade. In this paper we address the issues related to another group of plants that we refer to as 'commercial weeds' (Grice 2006). These are plants that have negative (weedy) impacts but from which products are or were harvested, directly or by livestock, and so which either have or had commercial value, or where there is an expectation or hope of commercial harvest in the future. We do not restrict the use of the term 'commercial weed' to species whose negative effects are formally recognized in legislation or regulations, that is, to 'declared' plants.

At the national level, Australia operates with a *laissez faire* approach to the post-introduction management of commercial weeds, for both new introductions and for plants already under cultivation. There are generally no restrictions on whether, where or how species are cultivated once they are allowed into Australia. Under this common scenario, any benefits from cultivation of a plant accrue to those who cultivate it, while costs are incurred by those who experience any consequences of it becoming weedy. We suggest that there are other possible scenarios that could involve voluntary and/or regulatory approaches to dealing with any negative impacts of commercial weeds and under which there is some transfer of costs and benefits and so accountability on the part of industries that depend on those plants.

The issue of commercial weeds

Commercial weeds are plants that have real or perceived net benefits to one enterprise, industry or sector whilst simultaneously imposing net costs on another enterprise, industry or sector. The real or perceived benefits from cultivating commercial weeds may relate to any of a wide range of products or uses, including agricultural and horticultural crops, forage and timber (Table 1). Negative effects of these species may relate to other commercial enterprises, to the structure, function and composition of native ecosystems and so-called ecosystem services, or to human health and animal welfare. Moreover, there may also be spatial separation of costs and benefits at various scales.

There has been growing recognition and awareness of 'environmental weeds' as an issue for natural environments and of the fact that even valuable crops, forestry and pasture species can have serious negative effects on other industries. Thus, commercial weeds present a dilemma. It has been common for costs associated with any negative impacts that they cause to be borne at the 'enterprise' level by those who are affected, while others are free to benefit economically from cultivating the species. Some widespread and important commercial weeds have largely been dealt with in this way. For example, this has been true of species such *Olea europaea*

L. (European olive), *Pinus radiata* D.Don (radiata pine) and other *Pinus* spp., and pasture grasses such as phalaris, buffel grass and para grass. However, approaches to the 'commercial weed dilemma' have often been adversarial even to the point where some proponents of particular commercial weeds may deny the existence or seriousness of negative consequences. In some cases, denial may be based partly on a fear of a 'domino effect' wherein proponents hold a view that acknowledgement of negative consequences of one species may prompt restriction of not only its use, but that of similar species. This appears to be the case, for example, with northern Australian pasture grasses where there has been considerable resistance to effective action against *Hymenachne amplexicaulis* Nees (olive hymenachne), even though it is a Weed of National Significance (Thorp and Lynch 2000), and *Andropogon gayanus* Kunth (gamba grass), in spite of the weight of scientific evidence that quantifies the negative environmental impacts of that species (Rossiter *et al* 2003, 2004).

The details of the situation are different for each commercial weed species. They differ, for example, in the stage of both commercialization and naturalization. Some commercial weeds, for example olives, buffel grass, leucaena and radiata pine, are economically important and very well-established commercial species. They

are cultivated extensively across broad agro-ecological zones and widely naturalized. Others are established as minor crops or provide little economic benefit, even for those who cultivate them, though there are proponents who strongly advocate their potential commercial or environmental benefits. Species in this category are generally less widely naturalized. *Azadirachta indica* A.Juss. (neem), which is promoted for the claimed insecticidal properties either *in situ* or of derived products, falls into this latter category. A third group of species are potential 'commercial weeds' in that they have either not yet been introduced, or they have not yet been cultivated commercially, whether or not they have naturalized. *Jatropha curcas* L. (physic nut) falls into this category. It is present in Australia, naturalized but not widespread, and, though currently it is not being cultivated commercially, it is being strongly promoted as a potential source of 'bio-fuel'.

The challenge of commercial weeds is to determine whether and how it is possible to reap the benefits that may be derived from their cultivation, whilst avoiding, minimizing and/or redirecting the costs that could be incurred as a result of their impacts as weeds. In the following sections, we will describe the key decisions that must be made in order to take a strategic approach to a commercial weed,

Table 1. Some common commercial weeds of Australia. These species are both commercially cultivated and naturalized in Australia.

Scientific name (Family)	Common name	Growth form	Use	Weed impacts
<i>Desmodium</i> spp. Desv. (Fabaceae)	desmodium	forb	pasture	environmental: northern woodlands
<i>Cenchrus ciliaris</i> L. (Poaceae)	buffel grass	grass	pasture	environmental: tropical and warm temperate rangelands woodlands
<i>Andropogon gayanus</i> Kunth (Poaceae)	gamba grass	grass	pasture	environmental: tropical savannas
<i>Hymenachne amplexicaulis</i> Nees (Poaceae)	hymenachne	grass	pasture	environmental: northern coastal wetlands, sugar cane crops
<i>Urochloa mutica</i> (Forssk.) T.Q.Nguyen (Poaceae)	para grass	grass	pasture	environmental: northern coastal wetlands
<i>Ehrharta calycina</i> Sm. (Poaceae)	perennial veldt grass	grass	pasture	environmental: southern woodlands
<i>Phalaris aquatica</i> L. (Poaceae)	phalaris	grass	pasture	annual crops
<i>Rubus fruticosus</i> L. (Rosaceae)	blackberry	shrub	horticulture	environmental: southern forests, riparian zones
<i>Stylosanthes</i> spp. Sw. (Fabaceae)	stylos	shrub	forage	environmental: northern woodlands
<i>Chamaecytisus palmensis</i> (Christ) F.A.Bisby and K.W.Nicholls (Fabaceae)	tagasaste	shrub	forage	environmental: southern woodlands
<i>Leucaena leucocephala</i> (Lam.) de Wit (Fabaceae)	leucaena	shrub/tree	forage	environmental: northern woodlands
<i>Coffea arabica</i> L. (Rubiaceae)	coffee	tree	horticulture	environmental: rainforest
<i>Ficus carica</i> L. (Moraceae)	fig	tree	horticulture	environmental: southern forests
<i>Azadirachta indica</i> A.Juss. (Meliaceae)	neem	tree	ornamental, horticulture	environmental: northern riparian zones
<i>Olea europaea</i> L. (Oleaceae)	olive	tree	horticulture	environmental: southern woodlands, forests
<i>Pinus caribaea</i> Morelet (Pinaceae)	Caribbean pine	tree	forestry	environmental: forests, woodlands
<i>Pinus radiata</i> D.Don (Pinaceae)	radiata pine	tree	forestry	environmental: southern forests and woodlands

discuss the challenges of containment and control as elements of that strategy, and identify possible mechanisms for implementing it. This discussion is focused primarily on the Australian situation though many of the issues and approaches are more broadly applicable.

Strategic approaches to dealing with commercial weeds

A key piece of information about any particular 'commercial weed' is whether it is already in Australia (or another jurisdiction of interest). If the species is not present, a process regulated by Biosecurity Australia requires that any plant proposed for importation into Australia be subject to a formal Weed Risk Assessment (WRA) process that is used to determine whether introduction is to be permitted (Spafford Jacob *et al.* 2004). It is at this level that the WRA process has the capacity to critically determine the strategic direction taken. If a species' introduction is precluded, so are its legal commercial exploitation and any weed risk associated with it.

However, the possible scenarios are quite different if introduction of the species is permitted. If it is cultivated, its negative impacts can be addressed by managing its 'off-site' abundance. Ideally, this would involve completely preventing its naturalization, that is, by containing it to sites where it is intentionally cultivated. A regulatory approach to achieving this aim would have to be conducted under State legislation as Biosecurity Australia does not place restrictions on its management subsequent to their importation. The same applies to species that are not 'declared' plants but which are already on the continent.

Decisions are required about how impacts of commercial weeds are to be dealt with. A *laissez faire* approach would see no restrictions on whether, where or how the species is cultivated. In this case, any benefits from cultivation would accrue to those who cultivate it, while the costs would be incurred by those who experience any consequences of it becoming weedy. All other scenarios involve voluntary and/or regulatory approaches to dealing with any negative impacts and under each there is some transfer of costs and benefits.

I. *Cultivation is prohibited even though the plant is present in the country.* Under this scenario, the greatest costs are borne by those who would have benefited had cultivation been permitted. That is, they lose the potential for income generation from the species. Society as a whole pays any costs associated with developing, implementing and policing the regulations that are required to impose prohibition. This is not a strategy that is likely to be reasonably applied to a species whose entry to Australia

has been permitted following formal Weed Risk Assessment. Prohibition would most likely be exercised through formal weed declaration mechanisms applied at State or local government levels.

II. *Cultivation is permitted and those who experience negative impacts that result from the plant being weedy are compensated by a third party.* Under this scenario, mechanisms are established whereby at least some of the costs that would otherwise be borne by those who experience negative consequences from a commercial weed, are transferred to a third party. The most likely 'third party' is society as a whole through mechanisms such as compensation administered by government departments. Such a role could fall mainly to Australian State and Territory governments given that they have primary responsibility for pest plants and animals.

III. *Cultivation is permitted, but cultivators of the commercial weed voluntarily take steps to prevent naturalization, spread or negative consequences in general.* In such cases, cultivation is not regulated through legislation. Voluntary action on the part of those who cultivate the crop or pasture would be designed to mitigate its effects as a weed. The actions required would vary from species to species and with the circumstances under which it is grown. It would be important to deal appropriately with the area of crop or pasture as a source of propagules; other parts of the properties on which the species was cultivated; and any areas off those properties to which the species is or could be dispersed. Voluntary approaches to dealing with 'commercial weeds' are susceptible to non-compliance and to non-acceptance of responsibility once the species has spread away from the locations at which it was sown (see IV below). One possibility here would be to link voluntary arrangements with a certification process that acknowledges environmental and social values.

IV. *Cultivation is regulated.* Under this scenario cultivation is permitted but regulated. The logical regulatory authorities are again state governments rather than local or Commonwealth governments. Regulations could deal with where, how much of and by whom a commercial weed is cultivated. They could also govern the management that must be applied to a cultivated area and its surrounds, in order to minimize the risk of naturalization and spread, and mitigate the negative effects of the commercial weed.

Mechanisms of cost transfer and compensation

Scenarios II – IV described above represent strategic approaches that allow cultivation of a 'commercial weed' but compensate those who suffer negative effects through its weediness. Scenarios I, III and IV impose costs on would-be cultivators of a commercial weed. Scenarios III and IV involve transferring some of the benefits of cultivation from the cultivators to those who suffer negative consequences. Each of these strategic options requires mechanisms whereby they can be made operational. There are several possible approaches though these are not mutually exclusive:

(a) A voluntary code of practice could be established for a commercial weed species. This approach would be facilitated by the existence of an industry body that dealt specifically with the commercial weed in question. The code could cover such things as the varieties that might be grown to reduce weed risks, how the crop, pasture or plantation is managed to minimize the chance that it would serve as a source of propagules, and the creation and maintenance of buffer zones to reduce the risk of naturalization. A code of practice could be linked to a certification process.

A Code of Practice has been developed by 'The Leucaena Network' (<http://www.leucaena.net/codeofconduct.pdf>) for *Leucaena leucocephala* (Lam.) de Wit (leucaena), a forage shrub, widely grown in north-eastern and northern Australia but also acknowledged as an environmental weed (Walton 2003). The proportion of leucaena growers who subscribe to this Code of Practice, or its effectiveness if and where it is applied, have not been measured. The case of leucaena also illustrates some of the challenges of attempting to deal with commercial weeds through a code of practice. These include the difficulties of dealing with weed infestations that exist prior to a code being developed, and out-breaks that are not on properties being managed according to the code.

(b) Management of weedy occurrences of the plant could be subsidized by a third party, most likely through government agencies. Management activities that could be included here are detection and mapping as well as weed control itself. Government-sponsored research aimed at improving the efficacy and efficiency of management would also constitute a subsidy to land-users who are negatively affected. One possible advantage of this approach is that it could be used to drive a regional weed management strategy rather than have individual land-users operating

independently in their weed control operations.

- (c) Compensation payments could be made directly to land users who are negatively affected. Such payments could be used to finance control operations by affected land-users or to more generally off-set the costs incurred due to the presence of the weed.

Government-subsidized weed management (b) and compensation payments (c) could be funded out of general revenue. However, other possibilities are regulated schemes for transferring some of the costs from those who suffer negative consequences from a commercial weed to the would-be beneficiaries of that cultivation. Methods for transferring costs include:

- (d) Cultivators of a commercial weed could be required to pay a one-off bond prior to undertaking any action that imposes a weed risk. Bond conditions could relate to containment and control measures that must be put in place by the enterprise, and include measures to restore the weed-free status of sites if and when the enterprise is abandoned. Bonds that were withheld because bond conditions were not met could be used to counter naturalization and further incursions from naturalized populations, effect control measures against off-site impacts or fund research to improve the efficacy or efficiency of counter-measures. Bonds would relate to individual species and individual enterprises.

Two important questions arise from this approach. One concerns the size of any bond that is required, and the other the process whereby bond money might be returned to those who paid it. The size of a bond should be adequate to effectively counter any weedy consequences of introduction and cultivation. However, it may be difficult to determine what would be adequate given that weed risk cannot be precisely quantified, and it may take years or decades before any threat is fully realized. It is important to recognize that the risks associated with a commercial weed are likely to be independent of the profitability of the enterprises that depend on it.

The size of the bond should also take into account the life-span of the commercial enterprise and industry that depend upon the weed. The value of one-off bonds to the enterprises that paid them would depreciate over time. This means that there could be a declining likelihood that any conditions attached to return of the bond are met by the enterprise. If the bond is too small, it may be more economical for the enterprise to neglect bond conditions and sacrifice the bond. Return of bonds

could be tied to independent assessment of the risks associated with the commercial weed. This may occur after an enterprise ceases, when the site on which it occurred has been restored, and any infestations derived from it (including seed-banks) have been removed. Return of bonds could also be staged in line with independent assessments that determine that risks associated with the species are low.

A bond arrangement for commercial weeds is analogous to bonds paid by mining companies to help ensure that off-site effects are avoided and sites are restored once mining ceases. They represent a 'polluter pays' approach to commercial weeds (Larson 2005, Cook and Dias 2006).

- (e) Cultivators of a commercial weed could be required to pay a levy during the period they are cultivating the plant. Such levies could be paid at intervals of, for instance, one year, on the basis of the area cultivated. Funds would be used to monitor naturalization and spread, to take counter-measures against the species and to fund weed research. There may be advantages in having any levies held in trust and linked to a specific plant species. This may be preferred by both cultivators of a commercial weed and those who suffer, or are likely to suffer, negative consequences from it. Alternatively, levies related to a number of species could be amalgamated and used for any of those commercial weeds as needs emerge.

The advantage of a levy over a bond is that it provides a continuing source of revenue for dealing with the negative impacts of a commercial weed. It imposes a continuing cost of cultivation of a commercial weed in addition to the 'normal' costs of production. These costs include non-economic costs such as those on the environment.

As for a bond, the size of a levy should be proportional to the weed risks involved. A disadvantage is that, because a levy is a repeat payment, in the initial stages of cultivation, when the risks are least well known, the total levy collected may be inadequate to deal with negative consequences should they occur. This provides an argument for a variable levy such that a grower of a commercial weed is charged more in the initial stages of development of the enterprise or industry and less as subsequent assessment demonstrates lower risk. This could mean that growers who enter an industry early in its development contribute more to the resourcing of a weed management strategy. If this was deemed undesirable, more elaborate cost-sharing arrangements could be put in place. The expense imposed by establishment of bonds or levies could be passed on to consumers of the products derived from the commercial weed. They represent a

practical recognition of the true costs of production.

All of these strategies assume that the means exist whereby naturalization and spread can be controlled.

The challenge of containment or control of commercial weeds

Regardless of which strategy (II–IV above) is used to deal with a particular commercial weed, or the approaches taken to applying these strategies (a – e above), there must be the means to contain or control the species. Containment aims to prevent the plant from spreading outside defined areas. Ideally, this would involve preventing the plant from spreading away from areas in which it is deliberately cultivated. "Control" in this context means suppressing a species on areas away from those locations where it is deliberately cultivated, though not necessarily eliminating it.

The feasibility of containment of a commercial weed will be influenced by three sets of factors: (i) the characteristics of the plant species to be contained; (ii) the circumstances under which that species is cultivated; and (iii) the characteristics of the broad landscape within which cultivation takes place (Grice 2006). Species that produce large numbers of propagules, are readily dispersed over long distances, establish frequently from seed, and have short generation times, are likely to be difficult and expensive to contain. Similarly, the greater the population and area under cultivation and the more diffuse the area that is cultivated, the greater will be the effort required to achieve containment. The means and purpose of cultivation are indirectly important. Species that are grown in intensively managed situations, such as well-managed orchards or plantations are likely to be more readily contained than species that are grown in extensively-managed pastures (Grice 2006).

Whether efforts are voluntary or compulsory, there are several of ways of attempting to contain a commercial weed (Grice 2006). These include:

- cultivating less weedy varieties,
- breeding and using sterile forms,
- preventing or suppressing seed production,
- preventing dispersal of seed (or other propagules),
- creating and maintaining buffer zones in which establishment of the commercial weed is prevented, and
- locating plantings in locations where naturalization and/or spread are less likely.

These approaches to containment obviously focus on plantings as sources of invasion. Alternatively, or in addition, effort could be directed at control of abundance and impacts of a commercial weed at locations in which its presence is not wanted. The success of such efforts would

rely upon application of an appropriate suite of weed control techniques (use of herbicides, mechanical or manual control methods, fire, grazing etc.). In the case of commercial weeds, the risk of damage to deliberate plantings is likely to preclude the use of classic biological control.

Discussion

Effective management of the negative consequences of commercial weeds requires a strategy, the means of funding that strategy and practical tools for implementing it. In the past, negative consequences of commercial weeds have often been ignored, denied or considered unimportant. Costs of those negative consequences, whether due to lost production, expenses associated with weed control, social or environmental impacts, have traditionally been borne by those who experience them. An alternative is for at least some of those costs to be transferred to either producers of commercial weeds or a third party. In the latter case, the most likely candidate is society via government-funded programs.

Approaches that seek to transfer at least some of the costs incurred as a result commercial plants behaving as weeds may depend upon voluntary action on the part of producers or on regulatory constraints imposed upon them. Under current legislation in most States and Territories, weeds are 'declared' as such in one of several classes and typically the legislation requires that land-holders eradicate or control listed plants (Table 2). A large proportion of these systems implicitly preclude the commercial exploitation of declared plants though there are exceptions. For example, the system operated under the Tasmania Weed Management Act (2003) (Table 2) establishes species-specific requirements in relation to declared plants and so may make it possible for a declared species to be exploited commercially provided certain conditions are met. Likewise, the system of declaration of pest plants in South Australia includes categories with special provisions; for example, while the olive industry is very important in South Australia, feral olives (*Olea europaea*) are a declared pest plant. In states where the legislation allows, it may be possible to declare a plant as a weed, then make special dispensations to permit that declared plant to be grown under licence. In jurisdictions where this is not possible under existing legislation, formal recognition of a category of 'regulated plants' may be a useful tool. Under a system that recognized 'regulated plants' (=commercial weeds) it would be possible to devise a set of practices that would be required of producers of the species. These practices would have to be specific to individual species. It would then be necessary to police the application of these practices.

In general, one might expect that measures to help manage a commercial weed, would remain in place indefinitely. In the event of the demise of an industry based on that species, decisions would need to be made about how any subsequent weed impacts would be managed. Decisions would have to consider its status at the time (whether naturalized, how abundant and widespread etc) and likely future impacts. A requirement could be that producers destroy any surviving plants and monitor sites where the species was cultivated. By contrast, it is also conceivable that, as an industry develops, improved information indicates that weed risks associated with it are lower than previous evaluations indicated and restrictions could be eased accordingly. Such a move would have to take into consideration the fact that weed problems sometimes take years or even decades to emerge.

The challenge of dealing with a species as a commercial weed may be much greater for species that are already present in Australia or any other area of interest, particularly if it is already under cultivation. A regulatory approach would require imposing restrictions relative to current practice and the more widely cultivated and/or important a species is, the greater is likely to be the resistance to new conditions and restrictions. Even in cases where conditions are placed on producers from the time an industry or enterprise is established, any infestations that arise from that industry will have to be conclusively attributed to it. The challenges of making appropriate attribution will be greater when mechanisms for imposing a 'polluter pays' principle operate at the enterprise rather than whole-of-industry level.

It may be easier to impose restrictions on the cultivation of species that are not already in the country or not yet under commercial cultivation. In such cases, conditions could be applied from the outset. *Jatropha curcas* is a declared plant in both Western Australia and the Northern Territory; it is closely related to the serious weed *J. gossypifolia* L. (bellyache bush) (Smith 2002). However, there is interest in the commercial use of physic nut in Australia. In cases such as this, a precautionary approach would impose restrictions on how and where such a species may be cultivated, if commercial exploitation of it is to be permitted. A precautionary approach with species newly permitted into Australia recognizes that even a well developed Weed Risk Assessment system may occasionally permit entry of a species that subsequently becomes problematic.

The capacity of an industry or enterprise to bear the costs of weedy impacts of a plant species, upon which that industry or enterprise depends, will vary from case to case. Less profitable enterprises will

have less capacity to resource preventative measures, control actions, research or education programs. Applying a 'polluter pays' principle to commercial weeds could deter enterprises of marginal economic value and help avoid weed problems that might derive from them. It could also retard the emergence of more profitable enterprises or industries if substantial costs are imposed during a development phase. Either way, the approach would encourage useful consideration of the full economic implications of cultivating a species with weed potential. Economic analysis in relation to commercial weeds, specifically or generally, would be a useful contribution.

A model for negotiating the costs associated with pest incursions and eradication exists in the Emergency Plant Pest Response Deed (EPPRD) (http://www.planthealthaustralia.com.au/our_projects/display_projects.asp?category=2). This legally binding document was ratified in 2005 by industry and government signatories. The EPPRD articulates responsibilities for each party (National, State and industry) when a new plant pest (insect pest or pathogen) incursion occurs. These responsibilities include how each party is to prepare, respond, and mitigate the risks for an emergency plant pest. The document outlines a shared role in decision making, costs (public versus private benefits of eradication) and reimbursement. Potential pests are allocated to one of four categories according to who receives the benefit of the prevention and eradication program and the costs for the program are proportionally allocated. Before the EPPRD was endorsed, there were few formalized agreements on how to respond to an incursion, low levels of involvement by industry and little incentive to report incursions. Now there are agreements with shared responsibilities in place. Although there are very distinct differences between the management of a new accidental pest incursion and an introduction of a desirable plant that has become weedy, a similar process of negotiation towards development of a management plan and shared costs across stakeholders could be followed. Ideally, in the case of a potential commercial weed, such negotiations should take place at the time of importation rather than once deleterious impacts have been detected.

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Table 2. Classes of weeds under Australian State and Territory legislation.

State/Territory	Legislation	Weed class	Action required under legislation
Australian Capital Territory	Pest Plants and Animals Bill (2005), http://www.weeds.org.au/act2.htm	Class 1	Species is notifiable
		Class 2	Species must be suppressed
		Class 3	Species must be contained
		Class 4	Propagation and supply are prohibited
New South Wales	Noxious Weeds Control Act (1993), http://www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds/definition#Noxious-Weeds	Class 1	Not present in the State or limited in extent; notifiable; must be eradicated and the land must be kept free of the species; sale prohibited; restrictions apply to movement
		Class 2	Not present within target region or limited in extent; notifiable; must be eradicated from the land and the land must be kept free of the species; sale prohibited; restrictions apply to movement
		Class 3	Not widely distributed in target region and likely to spread there or in other regions; species must be fully and continuously suppressed and destroyed; sale prohibited
		Class 4	Widely distributed in target region and likely to spread there or elsewhere; growth and spread of the species must be controlled according to the measures specified in a management plan published by the local control authority
		Class 5	Likely, by their sale or the sale of their seeds or movement within the State or part of the State, to spread in the State or outside the State; notifiable though there are no requirements to control existing plants; sale prohibited; restrictions apply to movement
Northern Territory	Weed Management Act (2001), http://www.nt.gov.au/nreta/natres/weeds/ntweeds/declared.html	Class A/C	Reasonable effort must be made to eradicate species; must not be introduced
		Class B/C	Reasonable attempts must be made to control growth and prevent spread; must not be introduced
		Class C	Not present; must not be introduced
Queensland	Land Protection (Pest and Stock Route Management) Act (2002), http://www.dpi.qld.gov.au/cps/rde/xchg/dpi/hs.xsl/	Class 1	Not commonly present in QLD; subject to state-wide eradication
		Class 2	Established in QLD; subject to control programs led by local government, community or landowners; land-owners must take reasonable steps to keep land free of these plants; it is an offence to introduce, keep or supply them
		Class 3	Established in QLD; landholders are required to control these plants if their land is adjacent to an environmentally significant area
South Australia	Natural Resources Management Act (2004), http://www.dwlbc.sa.gov.au/biodiversity/pests/weeds/plants_list.html	Class 1	Notifiable and requiring destruction throughout the state
		Classes 2 and 4	Notifiable in at least part of the state and requiring destruction throughout the state
		Classes 3, 5 and 7	Control required in part of the state
		Classes 6, 8 and 9	Special provisions apply to plants declared under these classes
		Classes 10 and 11	Sale is restricted
Tasmania	Weed Management Act (2003), http://www.dpiw.tas.gov.au/inter.nsf/ThemeNodes/SSKA-52J2K4?open	Declared weeds	Requirements are species-specific
Victoria	Catchment and Land Protection Act (1994), http://www.dpi.vic.gov.au/DPI/nreninf.nsf/	State Prohibited	Not present or limited in extent; targeted for eradication by State Government; land-owners may be directed to prevent growth and spread
		Regionally Prohibited	Not widely distributed; must be managed for eradication; land-owners must take all reasonable steps to eradicate these species
		Regionally Controlled	Usually widespread in particular region(s); land-owners must take all reasonable steps to prevent spread and growth
		Restricted	Trade of plants or their propagules prohibited
Western Australia	Agriculture and Related Resources Protection Act (1976), http://www.agric.wa.gov.au/content/PW/WEED/DECP/200712_declaredplants.pdf	P1	Movement of plants or their seeds is prohibited; movement of contaminated machinery and produce are prohibited
		P2	Propagation and spread must be prevented and plants must be destroyed until the population is eradicated
		P3	Seed set and spread of plant parts or seeds must be prevented
		P4	Seed set and spread of plant parts or seeds must be prevented
		P5	Infestations on public lands must be controlled

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