

## GOLDEN DODDER IN WESTERN AUSTRALIA—ITS STATUS AND ERADICATION ISSUES

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**Summary** Golden dodder (*Cuscuta campestris* Yuncker), a twining vine that is a parasite of many broadleaf plants, has recently become the target of an eradication campaign in Western Australia. Small infestations have been discovered on the south coast and near Broome. This paper considers the significance, potential and host range of golden dodder in various ecosystems, the strategies used for control and the benefit:cost ratio.

### INTRODUCTION

Golden dodder was discovered in the south-west of Western Australia (WA) in January 1995 by Mrs. Gwen Pendry in her home garden. She recognized it as an aggressive weed and brought it to Agriculture WA for identification. It is now the focus of an eradication campaign.

The status of golden dodder in WA, the strategies adopted and the impacts of changing attitudes of government and the public will be considered in this paper.

### DESCRIPTION

Golden dodder is a parasitic, fast growing vine that has a very wide host range including some native species. It has golden yellow, slender (1 mm) twining stems with clusters of creamy white flowers. Haustoria (suckers) attach to the host plant to remove water and nutrients. Golden dodder can only survive a few days without a suitable host. It prefers succulent species and particularly the legumes. It is distinguished from other *Cuscuta* species by its 1 mm long style with a globular stigma, acute and often inflexed corolla lobes and scales subtending the stamens being longer than the corolla tube and much divided (Johnson 1992). Carter *et al.* (in press) have recently suggested that the Australian specimens of *Cuscuta campestris* Yuncker are actually *Cuscuta pentagona* Engelm.

### SIGNIFICANCE

Without intervention, it is expected to cost agriculture \$A5–7 million per year, have a significant environmental impact by killing plants that stabilize foredunes and be of considerable nuisance value in home gardens and nurseries. Infested plants usually have to be killed because the dodder can not be removed selectively. It is expected to have a major impact on the vegetable, lucerne and floriculture industries. Golden dodder is a declared plant

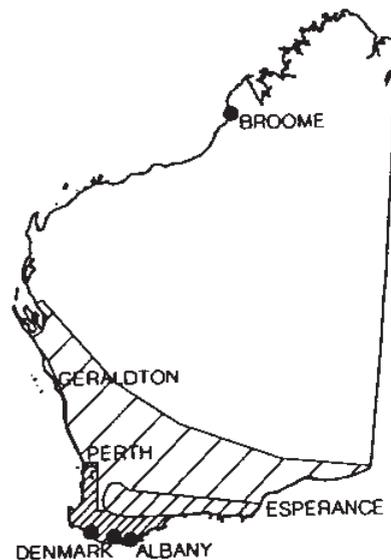
under The Agricultural and Related Resources Protection Act (1976).

In other states, it was ignored or misidentified initially, but now large control programs have been implemented to stop it spreading (Parsons and Cuthbertson 1992). For example, in the Hunter River region, where early control was not practised, over 55 000 litres of spray is applied to 72 km of river (Nielson personal communication). In WA we are in a fortunate position of being able to contain it at an earlier stage of spread.

### DISTRIBUTION

The only significant infestations known in Western Australia occur between Albany and Parrys beach (80 km west of Albany), on the Warren River, 200 km west of Albany, and in Broome. The Broome infestations are ephemeral and vary widely between seasons.

Climatic analysis using CLIMAX indicated that golden dodder could become a widespread weed of WA (Figure 1).



**Figure 1.** The current and expected distribution of golden dodder in WA. Predicted infestations. light, medium, heavy.

The seven Mediterranean climate ecosystems in the south-west of WA that have been invaded are:

- Taylorina (*Psoralea pinnata*) dominant winter waterlogged valley floors,
- Swamp pennywort (*Centella cordifolium* {formerly *asiatica*}) dominant winter waterlogged valley floors and lake margins,
- Pennyroyal (*Mentha pulegium*) dominant river banks,
- Euphorbia (*Euphorbia paralias*) dominant beach dunes,
- Sea rocket (*Cakile maritima*) dominant beach dunes,
- Broad leaf ornamentals in home gardens and pot plants, and
- Market gardens.

Golden dodder has also been found in a subtropical climate ecosystem (near Broome, WA) that is dominated by kapock (*Aervia* spp.) and *Boerhavia* spp.

The total area infested in WA is around 100 ha. This is composed of 20 ha as scattered strips on beaches between Albany and west of Denmark, 25 ha along the banks of the Warren River near Pemberton, 25 ha on Wilsons Inlet between Albany and Denmark and 30 ha mainly on Taylorina around Albany.

#### THE DISCOVERERS

Two out of the eight ecosystems that have been invaded were discovered by government employees during the course of duties, two by off duty agriculturists and the other four by the public. Once identified in an ecosystem the majority of the infestations have been discovered by government employees searching similar areas. The role that the public play in weed surveillance should not be underestimated and requires support by trained staff. In fact, when old herbarium specimens were re-examined in 1995, an earlier collection from Albany in 1984 was found, but had been misidentified.

#### BENEFIT TO COST RATIO

A benefit to cost ratio of 20 for the initial eradication style program is expected. This should increase to 250 after five years for a continuing surveillance program. If adjusted for future values, externalities etc., I expect the ratio would be around 100 for the whole golden dodder control program.

Benefits accrue from:

- direct effect of golden dodder on crop and pasture plants,
- reduced expenditure required to control small compared to large infestations if allowed to spread,
- effects on coastal flora that could destabilize dunes,
- loss of export markets due to the threat of golden dodder contamination of goods and produce, and

- reduced environmental damage due to control when golden dodder infests sensitive areas.

Initial estimates of the direct costs to the community for lost production and cost of control when golden dodder reaches its natural spread limits in WA are around \$A5 000 000 per annum. No allowance has been made for environmental effects or loss of export markets.

The cost of the current control program is \$A250 000 per year and is expected to continue for five years. This is composed of about 50% for manpower for searching and education, 35% for control and 15% for research.

#### CONTROL

The control program is based on selectively removing host plants and allowing grasses and native plants to regenerate. As most of the areas that golden dodder currently infests are non agricultural, a research program is running concurrently to evaluate methods of selective control in native and other vegetation.

Brush Off™ (metsulfuron) herbicide is being used to selectively remove *Psoralea* from *Acacia*, *Callistemon*, *Hakea* and *Sollya* scrub and Lontrel™ (clopyralid) in eucalyptus plantations. Grazon™ (triclopyr plus picloram) is used on scattered infestations and as a follow up treatment. Logran™ (triasulfuron) is used on extensive infestations on coastal heath with Tordon 75-D™ (2,4-D plus picloram) for scattered infestations and as a follow up.

#### HOSTS

Most of the confirmed hosts for golden dodder in WA are introduced plants (Table 1). We have classified these plants into three groups based on the propensity of golden dodder to grow on them. The major hosts carry prolific growth of golden dodder and the minor hosts carry minimal growth but are penetrated by the haustoria.

#### EDUCATION

Public education has been a significant factor in the golden dodder control program. Initially, the media were used to alert people to the presence of the problem and justify the effort of control. The public were asked to report suspect plants and many reports were investigated. Over half of the infestations were located from public reports. This is a very cost effective method of surveying broad areas. Samples of the plant were displayed at local shows, field days and schools. The side benefit of this media exposure was most apparent when negotiating with various groups and landholders seeking support for control programs. Some areas, such as the Yakamia valley and William Bay National Park beaches are socially sensitive areas. However, because of prior knowledge of the problem, most people showed a willingness to

**Table 1.** Plants confirmed as hosts for golden dodder in WA and a qualitative appraisal of their field status.

Latin name	Common name	Status
<i>Aervia</i> spp.	Kapock	
<i>Agonis juniperina</i>		
<i>Aster subulatus</i> *	Starwort	
<i>Aster subulatus</i> *	Bushy starwort	
<i>Bellis perennis</i> *	English daisy	
<i>Boerhavia</i> spp.	Tarvine	
<i>Brachyscome</i> spp.	Ground daisy	
<i>Cakile maritima</i> *	Sea rocket	Major
<i>Carpobrotus</i> spp.	Pigface	
<i>Centella cordifolium</i> { <i>asiatica</i> }*	Swamp pennywort	Major
<i>Chenopodium album</i> *	Fathen	
<i>Chenopodium pumilio</i> *	Small crumbweed	
<i>Chrycosoma</i> *		
<i>Coma aurea</i> *		
<i>Epilobium billardierianum</i>	Willow herb	
<i>Euphorbia paralias</i> *	Sea spurge	Major
<i>Fragaria × ananassa</i> *	Strawberry	
<i>Holcus lanatus</i> *	Yorkshire fog	Minor
<i>Hypochoeris glabra</i> *	Catsear	
<i>Lavendula</i> spp.*	Lavender	
<i>Lobelia</i> spp.*	Lobelia	
<i>Lotus minor</i> *	Lotus	
<i>Lycopersicon esculentum</i> *	Tomato	Major
<i>Mentha pulegium</i> *	Pennyroyal	Major
<i>Muellenbeckia addpressa</i>		Major
<i>Olearia axillaris</i>	Native rosemary	
<i>Pelargonium capitatum</i> *		Major
<i>Petunia</i> spp.*	Petunia	
<i>Phebalium anceps</i>	Blister bush	
<i>Phytolacca octandra</i> *	Red ink weed	Major
<i>Pimelia ferruginea</i>	Riceflower	
<i>Psoralea pinnata</i>	Taylorina	Major
<i>Pteridium aquilinum</i>	Bracken	Minor
<i>Rhagodia</i> spp.		
<i>Rubus fruticosus</i> *	Blackberry	Minor
<i>Rumex acetocella</i>	Sorrel	
<i>Senecio elegans</i> *	Purple groundsel	
<i>Senecio lautus</i>	Fireweed	
<i>Solanum aviculare</i> *	Kangaroo apple	
<i>Sollya heterophylla</i>	Australian bluebell	
<i>Spinifex hirsutus</i>	Hairy spinifex	Minor
<i>Trifolium balansae</i> *	Balansa clover	
<i>Trifolium subterraneum</i> *	Sub clover	
<i>Wilsonia backhousei</i>		
<i>Zantedeschia aetiopica</i> *	Arum lily	

\* Introduced plant.

co-operate with control programs even though they may have been philosophically opposed to the use of herbicides in these areas. The best example of this was the aerial spraying of the Yakamia valley. Over 300 residents adjacent to the valley were given information by letter and allowed to comment on the proposed spraying. In addition, other agencies, environmental groups, politicians, media and councils were fully briefed. The effort expended in this public education campaign effectively stifled opposition because adversaries could not argue from points of ignorance. Issues and points raised were fully investigated and publicized even if they could not be fully resolved.

## ISSUES

The decision to control any weed raises a number of issues that involve both the biology of the weed and the current political climate. In the case of golden dodder, we were faced with a small known area but the possibility of a very large area. The size of the area determines the control cost and there is a point where the costs of control outweigh the benefits. As a new weed it has to compete for priority with existing control programs at both the individual and the government level. In determining the appropriate response a number of assumptions or guess-timates need to be made. In WA we estimate that, without intervention, the infested area doubles every two years based on its current distribution and assuming it was introduced 20–30 years ago. Thus each years delay increases the control cost by 50%. It also means that at least half of the actual infestation must be controlled each year to achieve containment. At present we are spraying around 75% of the known infestations and achieving about 90% control. This should mean that significant

**Table 2.** EWRC ratings of control 3 months after spring application of herbicides.

Herbicide	Rate ha <sup>-1</sup>	Dodder seedlings	Dodder vine	<i>E.</i> <i>paralias</i>
Kerb	4 kg	1	6.5	7.5
Spinnaker	500 mL	2	4.5	6
Basta	5 L	5	2	3
Glean	40 g	1	1	3.5
Logran	40 g	1	1	4
Broadstrike	40 g	1	1.5	3.5
Eclipse	20 g	1	3	4.5
Ally	20 g	5	1	3
Casoron granules	20 kg	1	3	8
Picloram granules	20 kg	1	1.5	2.5

All rates are for formulated product.

EWRC rating 1=complete kill, 9=no effect.

progress is being made even if 20% of the infestation that has not been discovered.

Who pays for control is another issue that has been addressed. The economic beneficiaries of golden dodder control will mainly be the lucerne, flower and vegetable growers. At present most of it does not occur on their properties and it is of little immediate economic consequence where it does occur. Thus, it is one of those situations described by Pannell (1994) where government involvement is indicated. However, this needs to occur in a political climate where government services and budgets are being reduced. One solution is to seek funds from grower organizations representing the industries most likely to be affected. In areas where environmental damage is expected it falls to government funding to provide support. This may be a case for matching funding because an integrated control program is required to prevent the agricultural infestations invading the amenity areas and vice versa.

#### RESEARCH

Twenty eight herbicides were applied to dodder infested, coastal heath on 12 October 1995 and evaluated on 2 January 1996. *Euphorbia paralias* was the main host for dodder. The EWRC ratings of control for the effective herbicides are in Table 2.

Logran provided good control of golden dodder without eliminating the host or severely affecting associated coastal vegetation. It was subsequently used on several beaches with good results. Other herbicides identified above will be used to minimize damage to non target plants in various situations.

#### CONCLUSION

Golden dodder was discovered in WA in early 1995. A government funded control program has been initiated. At present levels of expenditure the dodder infestation level is expected to slowly decline on a State-wide basis. About half the budget is spent finding new infestations by searching or investigating reports from the public. The control program has a high benefit:cost ratio because of the relatively early identification of the problem before the weed has spread significantly. Professional support to investigate public concern over 'weedy' species is essential to identify species that require containment whilst it is economically feasible. Australia enjoys a considerable market advantage by being relatively free of weeds—it is good policy to maintain this position.

#### ACKNOWLEDGMENTS

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