Weed Risk Analysis of a Proposed Importation of Bulk Maize (Zea mays) from the USA

Weed Technical Working Group

Dr Acharee Pheloung
AQIS, Canberra
Dr John Swarbrick
Weed Science Consultancy, Toowoomba, Queensland
Chair: Dr Bill Roberts
Chief Plant Protection Officer
National Office of Animal, Plant & Fish Health, Canberra

Maize Import Risk Analysis
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1. Introduction

1.1 Objectives

The objectives of the Technical Working Group (TWG) on Weed Risk Analysis in the Issues Paper were as follows:

1.1.1. Identify quarantine weeds associated with proposed imports of maize grain from the USA consistent with the International Standard for Phytosanitary Measures (ISPM), Guidelines for Pest Risk Analysis developed by the Food and Agriculture Organization of the United Nations (FAO), and in particular assess the potential of these weeds to enter, establish and spread in Australia and to cause economic damage, including crop losses and loss of export markets.

1.1.2. Consider various risk management options consistent with Australian government policy, the World Trade Organization (WTO) Agreement on the Application of Sanitary and Phytosanitary Measures (the SPS Agreement) and relevant international standards including the FAO International Standards for Phytosanitary Measures.

1.1.3. Liaise on relevant issues with the other TWGs established under the Risk Analysis Panel (RAP) on the import of maize grain from the USA, and other national and international technical experts as necessary.

1.1.4. Report the findings of the TWG to the Risk Analysis Panel (RAP).

1.2 Definition of quarantine weeds

To be classified as a quarantine weed, a weed taxon needs to be "*a pest of potential economic importance to the area endangered thereby and (either) not yet present there, or present but not widely distributed and being officially controlled*" (FAO, 1993).

Being under "*official control*" in this context is taken to mean that they are on a published list of Declared or Noxious Plants or Prohibited Plants and are subject to control by or under the legislated instruction of a the Commonwealth or of state or local government body in some part of Australia.

The matter is complicated by the presence of different genotypes within many species of common weeds. Is the possible introduction of a new genotype sufficient reason for excluding further entry of an already widely established species? The TWG believed that this would not be appropriate, unless there are particular and identifiable genotypes of the weed in the US that not known to be present in Australia and which could be expected to be of economic importance if introduced and established here, eg. herbicide resistant strains. The TWG agreed that herbicide resistant strains of weed species would be included as potential quarantine species.

2. Categorisation of weed species

Table 1 lists the weed species recorded in fields of maize, sorghum and soybean in USA and species recorded as contaminants in maize exported from the USA. Weed species found in sorghum and soybean crops are included, not only because they are likely to share the same fields as part of a rotational cropping system, but also share postharvest facilities. The TWG considered that there is a high chance of cross contamination among these species with maize. The species are mostly common summer weeds found in the USA. However, winter weeds, and other species, found recorded as contaminants in US maize exports to other countries (Anon, 1994), are also listed.

Table 1. Quarantine status of weed species associated with maize grain imported from USA

Q: Quarantine species

Not present in Australia: not known to be present in Australia and may not be listed on current permitted/prohibited/noxious lists.

Permitted: either present in Australia or recorded in permitted lists of AQIS or of Western Australia.

Prohibited: either present in Australia or absent from Australia and listed as a prohibited import by federal or state legislation.

Noxious: Present in Australia and listed as a noxious or declared plant (ie. under official control) by state or federal legislation.

No.	Species	Synonyms	Common name	Q	Comments
1	*Abutilon theophrasti* (herbicide resistant)	*A. avicennae*	velvet leaf	X	not present in Australia
2	*Acanthospermum hispidum*		star burr, goat's head	X	prohibited
3	*Aeschynomene virginica*	*A. hispida*	Northern jointvetch	X	not present in Australia
4	*Agropyron repens*	*Elymus repens, Elytrigia repens Triticum repens*	quackgrass		permitted
5	*Alopecurus myosuroides*	*A. agrestis*	slender foxtail		permitted
6	*Amaranthus albus*	*A. leucanthus*	tumble pigweed		permitted
7	*Amaranthus arenicola*		sandhills amaranth	X	not present in Australia
8	*Amaranthus chlorostachys*	*A. hybridus* var. *erythrostachys*		X	not present in Australia
9	*Amaranthus hybridus*	*A. bouchonii, A. patulus*	smooth pigweed		permitted
10	*Amaranthus hybridus* (triazine resistant)		smooth pigweed	X	not present in Australia
11	*Amaranthus palmeri* (herbicide resistant)		plmer amaranth	X	not present in Australia
12	*Amaranthus retroflexus*	*A. quitensis*	redroot pigweed		permitted
13	*Amaranthus retroflexus* (triazine resistant)		redroot pigweed	X	not present in Australia
14	*Amaranthus rudis* (triazine resistance*)*		common waterhemp	X	not present in Australia
15	*Amaranthus tamariscinus*		pigweed	X	not present in Australia
16	*Ambrosia artemisiifolia* (herbicide resistant)	*A. elatior*	common ragweed	X	noxious species
17	*Ambrosia trifida*		giant ragweed	X	prohibited
18	*Ampelamus albidus*		honeyvine milkweed	X	not present in Australia
19	*Anoda cristata*	*A. lavaterioides*	spurred anoda		permitted
20	*Apocynum cannabinum*	*A angustifolium, A. cordigerum*	hemp dogbane	X	not present in Australia
21	*Artemisia annua*	*A. sacrorum*	wormwood		permitted
22	*Asclepias syriaca*	*A. curassavica*	common milkweed	X	prohibited, noxious
23	*Avena fatua*	*A. aemulans*	wild oat		permitted
24	*Avena sativa*		oat		permitted
25	*Barbarea vulgaris*		wintercress		permitted
26	*Berteroa incana*	*Alyssum incanum*	hoary Alison	X	not present in Australia
27	*Bidens aurea*	*Coreopsis aurea*		X	prohibited (WA)
28	*Brachiaria platyphylla*	*Panicum platyphyllum*	broadleaf signalgrass	X	not present in Australia
29	*Brassica japonica*	*Sinapis japonica*	wild mustard	X	not present in Australia
30	*Brassica kaber*	*Sinapis arvensis, S.*	charlock		permitted

No.	Species	Synonyms	Common name	Q	Comments
		orientalis			
31	*Brassica nigra*	*Sinapis nigra*	black mustard		permitted
32	*Bromus tectorum*	*B. sericeus*	downy brome, drooping brome	X	prohibited (WA)
33	*Brunnichia ovata*	*Rajania ovata*	redvine	X	not present in Australia
34	*Calystegia sepium*	*Convolvulus sepium* var. *americanus, Convolvulus repens*	hedge bindweed		permitted
35	*Campsis radicans*	*Tecoma radicans*	trumpet creeper		permitted
36	*Cardiospermum halicacabum*		balloonvine		permitted (WA)
37	*Cenchrus incertus*		spiny burgrass	X	prohibited, noxious
38	*Cenchrus longispinus*		longspine sandbur	X	prohibited, noxious
39	*Chenopodium album*	*C. glomerulosum*	common lambsquaters		permitted
40	*Chenopodium album* (atrazine resistant)		common lambsquaters	X	not present in Australia
41	*Cirsium arvense*	*Cnicus arvensis*	Canada thistle	X	prohibited, noxious
42	*Citrullus vulgaris* var. *citroides*		wild watermelon		permitted
43	*Cocculus carolinus*		redberry moonseed	X	not present in Australia
44	*Conringia orientalis*		hare's ear	X	prohibited
45	*Convolvulus arvensis*		field bindweed	X	noxious (SA, Vic, WA), prohibited WA
45	*Convolvulus arvensis* (herbicide resistant)		field bindweed	X	not present in Australia
46	*Conyza canadensis*	*Erigeron canadensis*	horseweed		permitted
47	*Cynodon dactylon*	*C. glabratus*	bermuda grass		permitted
48	*Cyperus esculentus*	*C. longus*		X	prohibited
49	*Cyperus rotundus*	*C. bulbosus, C. fenzelianus*	purple nutsedge	X	prohibited, noxious
50	*Datura inoxia*		downy thornapple	X	prohibited, noxious
51	*Datura inoxia* (resistant to ALS herbicides)	*D. fastuosa*	downy thornapple	X	not present in Australia
52	*Datura stramonium*	*D. trapezia*	jimsonweed	X	prohibited, noxious
53	*Daucus carota*		wild carrot	X	noxious
54	*Desmodium tortuosum*	*D. spirale*	Florida beggarweed		permitted
55	*Digitaria ischaemum*	*Panicum ischaemum*	smooth summer grass		permitted
56	*Digitaria sanguinalis*	*Panicum sanquinale, P. aegyptiacum*	crabgrass		permitted
57	*Echinochloa colona*		awnless barnyard grass		permitted
58	*Echinochloa crus-galli*	*E. caudata. Panicum echinatum, E. macrocarpa*	barnyard grass		permitted
59	*Echinochloa crus-galli* (herbicide resistant)		barnyard grass	X	not present in Australia

No.	Species	Synonyms	Common name	Q	Comments
60	*Eleusine indica*	*E. africana, E. japonica*	goosegrass		permitted
61	*Equisetum arvense*		common horsetail	X	prohibited, noxious
62	*Eragrostis cilianensis*	*Poa cilianensis*			permitted
63	*Eriochloa villosa*		woolly cupgrass	X	not present in Australia
64	*Eupatorium capillifolium*	*E. foeniculaceum*	dog fennel	X	not present in Australia
65	*Euphorbia supina*	*E. maculata*	prostrate spurge	X	prohibited
66	*Helianthus annuus* (herbicide resistant)	*H. argophyllus, H. debilis*	sunflower	X	not present in Australia
67	*Hibiscus trionum*		venice mallow		permitted
68	*Ipomoea hederacea* var. *integriuscula*		entireleaf morningglory, ivyleaf morningglory	X	prohibited
69	*Ipomoea lacunosa*		morningglory	X	not present in Australia
70	*Ipomoea purpurea*	*Pharbitis purpurea*	tall morningglory	X	prohibited
71	*Ipomoea turbinata*	*I. muricata*	morningglory	X	not present in Australia
72	*Jacquemontia tamnifolia*		morningglory	X	prohibited (WA)
73	*Kochia scoparia*	*Bassia scoparia*	kochia	X	prohibited, noxious
74	*Lamium amplexicaule*		hen bit		permitted
75	*Lolium multiforum* (herbicide resistant)		italian ryegrass	X	not present in Australia
76	*Lychnis alba*		white campion		permitted
77	*Malva neglecta*	*M. rotundifolia*	dwarf mallow		permitted
78	*Melochia corchorifolia*	*Waltheria indica*	redweed		permitted
79	*Mollugo verticillata*	*M. oppositifolia*	Indian chickweed		permitted
80	*Muhlenbergia frondosa*		wirestem muhlys	X	not present in Australia
81	*Panicum capillare*	*P. commelinaefolium, P. barbipulvinatum*	witchgrass		permitted
82	*Panicum capillare* (herbicide resistant)			X	not present in Australia
83	*Panicum dichotomiflorum*	*P. autumnale*	fall panicum	X	not present in Australia
84	*Panicum fasciculatum var. reticulatum*	*P. maximum*		X	prohibited
85	*Panicum miliaceum*	*Isachne pulchella, P. proliferum*	wild proso millet		permitted
86	*Panicum racemosum*	*P. reptans*			permitted
87	*Panicum ramosum*			X	not present in Australia
88	*Panicum texanum*		Texas panicum	X	not present in Australia
89	*Paspalum ciliatifolium*	*P. conjugatum, P. setaceum*			permitted
90	*Paspalum dilatatum*	*P. dasypleurum*	paspalum		permitted
91	*Passiflora incarnata*	*P. edulis*	mayhop passionfruit		permitted
92	*Poa pratensis*	*P. trivialis, P. angustiglumis*	Kentucky bluegrass		permitted
93	*Polygonum aviculare*		knotweed	X	prohibited

No.	Species	Synonyms	Common name	Q	Comments
94	*Polygonum convolvulus*	*P. pauciflorum*	knotweed	X	prohibited
95	*Polygonum lapathifolium*	*P. persicaria*	knotweed	X	prohibited
96	*Polygonum pensylvanicum*	*P. lapathifolium*	Pennsylvania smartweed	X	prohibited
97	*Portulaca oleracea*	*Aldabra archipelago*	pigweed		permitted
98	*Raphanus raphanistrum*	*R. microcarpus*	wild radish	X	noxious (NSW)
99	*Richardia scabra*	*Richardsonia pilosa*			permitted
100	*Rottboellia cochinchinensis*	*Stegosia cochinchinensis*	itchgrass		permitted
101	*Rottboellia exaltata*		itchgrass		permitted
102	*Rubus allegheniensis*		wild blackberry	X	not present in Australia
103	*Rubus fruticosus*	*R. plicatus, R. villosus, R. rhamnifolius*	blackberry	X	prohibited, noxious
104	*Rumex crispus*	*R. longifolius, R. maritimus*	curled dock		permitted
105	*Salsola collina*		tumble thistle	X	not present in Australia
106	*Salsola iberica*		thistle	X	not present in Australia
107	*Salsola kali*		Russian thistle	X	prohibited
108	*Salvia reflexa*	*S. lanceolata*	mintweed	X	noxious (NSW)
109	*Senecio vulgaris*		common groundsel	X	prohibited (AQIS)
110	*Senna obtusifolia*	*Cassia obtusifolia C. tora*	Java bean	X	prohibited, noxious (QLD, WA)
111	*Senna occidentalis*	*Cassia occidentalis, C. homophylla*			permitted (WA)
112	*Sesbania exaltata*	*Darwinia exaltata*	Hemp sesbania		permitted
113	*Setaria faberi*		giant foxtail	X	prohibited, noxious (WA)
114	*Setaria glauca*	*S. pumila, S. penicillata*	yellow foxtail		permitted (WA)
115	*Setaria italica*	*Panicum pycnocomum*	foxtail		permitted (AQIS)
116	*Setaria lutescens* (herbicide resistant)	*Panicum lutescens S. pumila*	foxtail	X	not present in Australia
117	*Setaria verticillata*	*Panicum verticillatum* var. *ambiguum*	foxtail	X	noxious (NSW)
118	*Setaria viridis*	*S. glareosa*	foxtail		permitted
119	*Sicyos angulatus*		burcucumber	X	not present in Australia
120	*Sida spinosa*	*S. capensis*	prickly sida		permitted
121	*Solanun nigrum*	*S. denticulatum, S. humile*	black nightshade		permitted
122	*Solanum sarrachoides*		nightshade		permitted
123	*Solanum ptychanthum*		eastern black nightshade	X	not present in Australia
124	*Sorghum* x *almum*		Columbus grass	X	prohibited (WA), noxious (NSW)
125	*Sorghum bicolor*	*S. vulgare*	wild sorghum		permitted
126	*Sorghum halepense*	*Andropogon halepensis*	johnson grass	X	prohibited, noxious
127	*Stellaria media*	*S. micrantha, S. crispata*	common chickweed		permitted
128	*Striga asiatica*		witchweed	X	prohibited,

No.	Species	Synonyms	Common name	Q	Comments
					noxious
129	*Taraxacum officinale*		dandelion		permitted
130	*Verbesina encelioides*		crownbeard	X	prohibited
131	*Xanthium pensylvanicum*		cocklebur	X	prohibited
132	*Xanthium spinosum*		common cocklebur	X	prohibited, noxious
133	*Xanthium strumarium*	*X. pungens*	noogoora burr	X	prohibited, noxious
134	*Xanthium strumarium* (herbicide resistant)		noogoora burr	X	not present in Australia

Data sheets for these weeds detailing their biological attributes, potential entry and establishment are given in Appendix 1.

3. Weed risk assessment

3.1 Weed risk assessment (WRA) of species recorded as not present in Australia

AQIS uses a Weed Risk Assessment (WRA) system to assess the weed potential of new plant species for which applications to import into Australia have been lodged. The system is a question based scoring system. The information required to input into the system includes knowledge of the species' ability to adapt to Australian climates, history as weeds elsewhere, undesirable characters, and the ability to spread, reproduce and persist. An overall score is generated which is correlated to weed potential. When the score is lower than 0, the species is accepted as having a low potential to become a weed in Australia. Scores between 0 -5 present a small to medium risk of becoming a weed in Australia and sometimes may require more information in addition to that specified by the system to make a decision. For scores in excess of 5, the species is likely to become a weed and is rejected. These rejected species are then recorded by AQIS as prohibited species.

Table 2 lists species not yet present in Australia for which assessment, using the WRA system resulted in scores above 6 (mostly above 10), which confirmed that they have a high potential to establish, spread and become weeds in Australia, both in agricultural and environmental contexts. These species have been added to the AQIS prohibited list.

Table 2 Weed species associated with maize grain imported from USA which are not recorded as present in Australia and not listed in current permitted/prohibited/noxious lists. WRA: Weed Risk Assessment system**.**

No	Species	Synonym	Family	WRA score	WRA results
1	*Aeschynomene virginica*	*A. hispida*	Fabaceae	17	reject
2	*Amaranthus arenicola*		Amaranthaceae	13	reject
3	*Amaranthus chlorostachys*	*A. paniculatus*	Amaranthaceae	14	reject
4	*Amaranthus palmeri* (herbicide resistant)		Amaranthaceae	11	reject
5	*Amaranthus rudis* (herbicide resistant)		Amaranthaceae	14	reject
6	*Amaranthus tamariscinus*		Amaranthaceae	10	reject
7	*Ampelamus albidus*		Asclepiadaceae	15	reject
8	*Apocynum cannabinum*	*A. cordigerum, A. angustifolium*	Apocynaceae	13	reject
9	*Berteroa incana*	*Alyssum incanum*	Brassicaceae	14	reject
10	*Brachiaria platyphylla*	*Panicum platyphyllum*	Poaceae	15	reject
11	*Brassica japonica*	*Sinapis japonica*	Brassicaceae	10	reject
12	*Brunnichia ovata*	*Rajania ovata*	Polygonaceae	13	reject
13	*Cocculus carolinus*		Menispermaceae	6	reject

No	Species	Synonym	Family	WRA score	WRA results
14	*Eriochloa villosa*		Poaceae	17	reject
15	*Eupatorium capillifolium*	*E. foeniculaceum*	Asteraceae	19	reject
16	*Ipomoea lacunosa*		Convolvulaceae	12	reject
17	*Ipomoea turbinata*	*I. muricata*	Convolvulaceae	10	reject
18	*Muhlenbergia frondosa*		Poaceae	14	reject
19	*Panicum dichotomiflorum*	*P. autumnale*	Poaceae	16	reject
20	*Panicum ramosum*		Poaceae	14	reject
21	*Panicum texanum*		Poaceae	16	reject
22	*Rubus allegheniensis*		Rosaceae	19	reject
23	*Salsola collina and S. iberica*		Chenopodiaceae	17	reject
24	*Setaria lutescens* (herbicide resistant)	*Panicum lutescens*	Poaceae	19	reject
25	*Sicyos angulatus*		Cucurbitaceae	18	reject
26	*Solanum ptycanthum*		Solanaceae	13	reject

Conclusion: Based on WRA results, all of weed species listed in Table 2 should be prohibited from entry into Australia and should be added to the list of prohibited species.

3.2 Risk assessment of herbicide resistant maize in bulk maize imported from the USA

The use of herbicide resistant maize varieties allow more effective weed control in crops by allowing application of a wider range of post emergence herbicides without damaging the crop.

A number of maize hybrids with resistance to herbicides such as imidazolinone, sethoxydim and glufosinate ammonium, produced by Pioneer, ICI, and Cargill have been widely commercialised in the USA (Table 3). There is a high potential that maize grain imports from USA will contain a component of herbicide resistant varieties. Various activities during loading, transportation and processing of imported maize have the potential to unintentionally release genetically modified herbicide resistant maize into the environment.

Table 3. Genetically modified herbicide resistant maize lines commercialised in USA

Maize lines resistant to:	Gene modification technique	Status in Australia
Acetyl coenzyme A carboxylase (ACCase) group: sethoxydim, haloxyfop, cycloxydim	mutation, inbred lines developed *in vitro* selection and crossing with other lines to develop hybrid	not yet present
Glufosinate ammonium	gene transformation	not yet present
Imidazolinone groups: imazethapyr, imazapyr, imazaquin, clomazone	point mutation, inbred lines developed *in vitro* selection and crossing with other lines to develop hybrid	not yet present

3.2.1 The risk of herbicide resistant maize becoming weedy

Although maize carrying herbicide resistant genes could germinate along the roadside, the chance of survival until the reproductive stage is low. Generally, maize appears as a volunteer in some fields and roadsides, but it has never been shown to become established and reproduce in the wild (Gould 1968). Maize is non-invasive in natural habitats and likely to be controlled by natural herbivores during early stages of growth. Shed pollen of maize can remain viable for 10-30 minutes. If viable pollen of herbicide resistant maize were to be transferred by wind to any receptive maize stigma within the 30 minute period of pollen viability, an escape of genetic material could take place. This potential transfer

is very unlikely at a distance beyond 200 m. There is only a small chance that volunteer maize will survive until the flowering stage and transfer genes to other maize varieties.

Even if genes do escape into other maize varieties, the added character of herbicide resistance would still not significantly increase weediness provided that none of the reproductive or growth characteristics were modified. Maize seed has little or no dormancy and loses germinability within 2 years under natural conditions and therefore does not develop a soil seed bank. If accidentally introduced into cropping systems, there is a moderate risk of herbicide resistant volunteer maize persisting, particularly in soybean crops or in crop rotation systems (Young & Hart 1997, Vengessel *et al*, 1997).

3.2.2 The risk of gene escape to wild relatives:

No *Zea* species are either naturalised or recognised as weeds in Australia. However, there are wild relatives of maize imported from South America (Teosinte: *Euchlena mexicana*) whose distribution may overlap with that of cultivated maize. Teosinte is an ancient wild grass found in Mexico and Guatemala. Teosinte can be found in Queensland and Western Australia. Although teosinte has the ability to establish in the wild, it has no pronounced tendency to weediness (Gould, 1968). Cultivated maize and teosinte are sexually compatible and can produce fertile F1 hybrids (Table 4). However, in the wild introgression between maize and teosinte rarely occurs, probably because of the difference in flowering time. Related *Zea* species are geographically restricted and occur only in Mexico and Guatemala. There is low potential for interspecific gene flow to wild relatives to occur in Australia.

Table 4. Wild relatives of maize

Maize relative	Distribution in Australia	Crossability with maize
Teosinte (*Euchlena mexicana)*	North Queensland, WA	viable seed produced in the wild and artificially crosses
Zea perennis	not present	viable seed produced in artificial crosses
Zea diploperennis	not present	as above
Tripsacum dactyloides	not present	as above
Tripsacum floridanum	not present	as above
Tripsacum lanceolatum	not present	as above
Zea mexicana	not present	as above

Conclusion: The TWG considered that the importation of herbicide resistant maize in bulk feed grain for processing would not present a significant risk to agricultural systems or the environment because it lacks other weedy characters, particularly the ability to naturalise in the wild. The risk of herbicide resistant genes escaping from maize into other species is also low because sexually compatible species are rare.

3.3 Quarantine implications of *Striga asiatica* in the USA

Striga asiatica is the most serious root parasite of maize and other grass crops (including sorghum and sugarcane) in the world. It is absent from Australia but present in the USA. Its seed size is very small (0.5x0.2 mm) and would be difficult to detect by normal sampling and analytical methods. The risk of it being imported into Australia with feed maize has been assessed.

3.3.1 Distribution and spread of Striga spp.

Striga is a genus of about 40 species of annual root parasitic herbs of grassy and broadleaved herbs. They are commonly referred to as the witchweeds. The genus is present throughout the Old World Tropics (Mabberley 1997), with 3 Australian native species (Hnatiuk 1990).

Striga asiatica (=*S. lutea*) is the most widespread and economically important species of witchweed (Holm *et al*. 1977). It parasitises the roots of maize, sorghum, sugarcane and other cultivated and wild

warm to hot season grasses in at least 35 countries throughout Asia and Africa. Whilst it is most serious in drought-stricken impoverished sandy soils, it also causes significant losses in heavier, moister and more fertile soils. Once established in an area it is extremely difficult (and expensive) to eradicate. *Striga asiatica* was first recorded in North Carolina in 1956 (Sand 1979), immediately triggering concerted efforts to limit its further spread and to eradicate it from the country; this program has continued over the last 42 years and is only now nearing completion (Eplee 1998).

Several other species of *Striga* also cause significant loss of crop yield in Asia and Africa, including *S. angustifolia* (dryland rice, sorghum and sugarcane), *S. densiflora* (millet, sorghum and sugarcane), *S. hermonthica* (maize, sorghum and sugarcane), and *S. gesnerioides* (tobacco, legumes and sweet potato). *Striga euphrasioides, S. forbesii* and *S. latericea* also cause economic damage in Africa (Musselman and Ayensu 1984).

The only *Striga* species present in Australia are 3 native species. *S. curviflora* and *S. multiflora* both occur in Western Australia, the Northern Territory and Queensland, whilst *S. parviflora* only occurs in the Northern Territory and Queensland (Hnatiuk 1990). *S. curviflora* and *S. parviflora* are major causes of concern in sugar cane in Queensland, where they are either called cane-killing weed or witchweed. *S. parviflora* has been recorded as a serious weed of maize crops in the Atherton tableland (Henderson 1984). *Striga asiatica* was previously reported from the North Kennedy Grazing District of Queensland (Hnatiuk 1990), but is no longer considered to be present in Queensland (Phillips 1994, Hucks 1998) since the herbarium record was shown to be a misidentification (Carter et al, 1996).

3.3.2 Biology of Striga spp.

The biology of *Striga* spp. is remarkably uniform across the genus. All are root parasitic annual herbs, although the degree of parasitism varies between species from slight (apparently extracting water only and fully autotrophic) to almost complete (extracting all photosynthates as well as water from the host).

The plants reproduce by seeds, which are very small (0.5 x 0.2 mm) and are distributed by the wind as well as in soil and plant trash. The seeds accumulate in the upper layers of the soil, and have prolonged dormancy (up to 20 years). Germination occurs when the roots of a suitable host plant grow within 2-3 mm of a dormant seed, which becomes aware of their proximity through their release of volatile ethylene-like chemicals. During germination the seedling root seeks out and attaches to the root of the host, dissolving the outer layers and penetrating through the endodermis to infiltrate the vascular tissues within. Multiple germinations usually result in dense infestation of host roots.

The parasites grow by extracting water and photosynthates from the host roots, weakening the host (especially in drought) leading either to reduced or total loss of harvestable crop. The life cycle may be very rapid, with flowering occurring within 8-10 weeks of germination. The flowers are pollinated by insects, and produce very large numbers of seeds of high viability (Holm et al. 1977, Doggett 1984, Visser 1985).

3.3.3 The risk of importing Striga asiatica from the USA with feed maize

The following response was received from Dr Robert Eplee, Senior Research Scientist and Director of the Raleigh Plant Protection Centre, North Carolina, USA in response to a general enquiry dated 11/8/1998 from a member of the Technical Working Group:

'Possibility of *Striga* contaminating export feed maize

The *Striga* infestation poses a 'presumptive zero' as a pest risk in the exportation of maize and other crops from the USA. The infestation only occurred in the Eastern North and South Carolina. This is a maize deficit area requiring importation of maize to meet the needs of the hog and poultry production of the area. Maize, exported from the USA, would be from areas that have never been infested with *Striga*.

Striga has been under an intensive eradication program over the past years. All but about 10,000 acres of the original 435,000 infested acres has been declared eradicated. On the remaining infested areas, reproduction (seed production) is denied through the use of herbicides. Without seed production, it would only be possible to 'export' *Striga* seeds with the movement of soil. Movement of soil out of a

maize field is inconsistent with our machine harvest methods. Much of the '*Striga* infested sites' are non-crop areas that have been more difficult to achieve eradication. The population of these sites is extremely low. Our protocol requires that a site meet a set of conditions, accumulated over at least three years, before eradication can be declared. Virtually all of the remaining infested acreage falls into this category.

As a professional scientist who has fought *Striga* around the world for the past 36 years, I can assure you that the pest risk of *Striga* in maize from the USA is presumably zero. (An absolute zero is impossible to prove or presume). I would have no hesitancy in importing maize under the identical circumstances'.

This information was later confirmed by USDA/APHIS, however, peeled corn cob were allowed to distribute outside *Striga* infested areas.

Conclusion: The TWG agreed that even though the risk of *Striga asiatica* being present as a contaminant species in maize imported from USA is low, maize grain should not be sourced from any area infested or previously infested with this weed.

4. Weed Risk Management

Weed risk identification and assessment confirmed the previous conclusion of Phillips (1994), Anon (1994) and Roberts *et al.* (1995) that bulk import of feed maize poses a significant risk of accidentally introducing a number of quarantine weeds species into Australia. To reduce the risk to a manageable level, a number of management methods are proposed (some of which have been proposed in the previous reviews of Roberts *et al* 1995, and Evans *et al* 1996).

4.1 Sourcing US maize from *Striga* free areas

Although it is concluded that the risk of exporting bulk grain contaminated by *Striga* is low, the risk of establishment of the species is high. Once the species can establish in Australia, it would be very difficult to control. The minute seed would be difficult to detect by normal sampling and analytical methods. Therefore, the consignments still may require an accompanying Phytosanitary Certificate with an additional declaration that the consignment of maize is bulked from maize grown in *Striga* spp. free areas. To ensure the lowest risk protocol, the importer may need to provide relevant information to confirm the declaration by including information on the source of maize, a map of *Striga* infested or controlled areas, recent survey data and the current management program. (APHIS later provided some of these information).

4.2 Weed management in the field

To reduce weed contaminants, a specific weed management program may be recommended for maize growing areas destined for export to Australia.

After black layer formation in maize seed, which indicates the crops have reached physiological maturity, it may be possible to apply glyphosate plus 2,4-D or dicamba. Long term experiments have confirmed that the treatments can effectively control most late emergence weed species. These species included *Apocynum cannabinum*, *Asclepias syriaca*, *Calystegia sepium*, *Ampelamus albidus*, *Sida* spp., *Sorghum halepense* and *Cynodon dactylon* (Carringer *et al*. 1980). If this control practice is applied to maize contracted for export to Australia, the number of weed seed contaminants in maize grain can be significantly reduced.

4.3 Screening and scalping

According to previous reviews (Evans, *et al.* 1996), maize shipments contained a smaller number of contaminants than other imported grain. One of the reasons was that the size of maize seed is larger than that of most weed species and has a smooth surface. Consequently, many weed seeds can be excluded by appropriate screening. Potential contaminants have a wide range of seed size (1-20mm, Table 5).

Table 5. Seed size of quarantine weeds

No.	Taxon	Seed length (mm)	Reference:
1	*Zea mays*	6-10	Anon. 1997.
2	*Abutilon theophrasti*	3	Anon. 1970
3	*Acanthospermum hispidum*	6	Holm *et al*. 1997
4	*Aeschynomene virginica*	4.5	Martin and Barkley, 1961
5	*Amaranthus arenicola*	1-1.5	Average for genus
6	*Amaranthus chlorostachys*	1-1.5	Average for genus
7	*Amaranthus hybridus* (herbicide resistant)	1-1.5	Average for genus
8	*Amaranthus palmeri*	1-1.5	Davis 1993
9	*Amaranthus retroflexus*	1.5-2	Holm et al. 1997
10	*Amaranthus rudis*	1-1.5	Average for genus
11	*Amaranthus tamariscinus*	1-1.5	Average for genus
12	*Ambrosia trifida*	6-13	Frankton 1961
13	*Ambrosia* spp.[1]	3-13	Parsons & Cuthbertson 1992: Frankton 1961
14	*Ampelamus albidus*	7-9	Stubbendieck *et al*, 1994
15	*Apocynum cannabinum*	4-6	Anon. 1970
16	*Asclepias syriaca*	6	Anon. 1970
17	*Avena fatua* (herbicide resistant)	6-8	Holm *et al*. 1977
18	*Avena sativa* (herbicide resistant)	10-12	McDonald *et al*. 1993
19	*Brachiaria platyphylla*	3	Underwood 1965
20	*Brassica japonica*	na	
21	*Bromus tectorum*	10-15	Anon, 1970
22	*Brunnichia ovata*	7-10	Average for genus
23	*Cassia (Senna) obtusifolia*	3.5-4.5	Holm et al. 1997
24	*Cenchrus incertus*	4-7	Parsons & Cuthbertson 1992
25	*Cenchrus longispinus*	4-7	Average for genus
26	*Chenopodium album*	2	Holm *et al*. 1977
27	*Cirsium arvense*	2.5-4	Holm *et al*. 1977
28	*Cocculus carolinus*	5	Martin and Barkley 1961
29	*Conringia orientalis*	2-2.5	Clapham *et al*. 1952
30	*Convolvulus arvensis*	3-5	Holm et al. 1977
31	*Cyperus esculentus*	1.5	Holm *et al*. 1977
32	*Cyperus rotundus*	1.5	Holm *et al*. 1977
33	*Datura inoxia*	3-4	Parsons & Cuthbertson 1992
34	*Datura stramonium*	3-6	Parsons & Cuthbertson 1992
35	*Echinochloa crus-galli* (herbicide resistant)	3-4	Holm *et al*. 1977
36	*Eriochloa villosa*	3-4	Average for genus
37	*Eupatorium capillifolium*	3	Martin and Barkley 1961
38	*Euphorbia supina*	1	Anon. 1970
39	*Helianthus annuus* (herbicide resistant)	4-6	Davis 1993
40	*Ipomoea hederacea*	6	Anon. 1979
41	*Ipomoea lacunosa*	na	
42	*Ipomoea purpurea*	4-5	Anon. 1970
43	*Ipomoea turbinata*	9-10	http://herbaria.harvard.edu/china/convo
44	*Jacquemontia tamnifolia*	na	
45	*Kochia scoparia*	1.5-2	Anon. 1970
46	*Lolium spp.* (herbicide resistant)	2-3	Hitchcock 1950
47	*Muhlenbergia frondosa*	2	Anon. 1971 (*M. schreberi*)
48	*Panicum capillare*	1.5	Anon. 1979
49	*Panicum dichotomiflorum*	2-3.5	Anon. 1970
50	*Panicum fasciculatum*	2-3	Anon. 1952
51	*Panicum miliaceum*	3-3.5	Davis 1993
52	*Panicum ramosum*	2-3.5	Average for genus
53	*Panicum texanum*	2.5-3.5	Anon. 1952
54	*Polygonum lapathifolium*	2-3.5	Average for genus

No.	Taxon	Seed length (mm)	Reference:
55	*Polygonum pensylvanicum*	2-3.5	Anon. 1970
56	*Raphanus raphanistrum*	1.5-4	Stanley & Ross 1986
57	*Rubus allegheniensis*	1	Anon. 1970
58	*Rubus fruticosus*	2-3	Parsons & Cuthbertson 1992
59	*Salsola collina, S. iberica S. kali*	2-3	Holm *et al*. 1997
60	*Salvia reflexa*	2.5-3	Parsons & Cuthbertson 1992
61	*Senecio vulgaris*	3-4	Holm *et al*. 1997
62	*Setaria faberi*	1.5	Anon. 1970
63	*Setaria lutescens*	2.5-3	Anon. 1970
64	*Setaria verticillata*	2-3	Holm *et al*. 1977
65	*Sicyos angulatus*	7-8	Davis 1993
66	*Solanum ptycanthum*	na	
67	*Sorghum almum*	5-6	Friend 1983
68	*Sorghum halepense*	3-4	Parsons & Cuthbertson 1992
69	*Striga asiatica*	0.2-0.5	Holm et al 1977
70	*Verbesina encelioides*	5-7	Stanley & Ross 1986
71	*Xanthium spinosum*	10-15	Holm *et al* 1977
72	*Xanthium strumarium*	10-20	Parsons & Cuthbertson 1992

[1] *Ambrosia artemisiifolia* and *A. trifida* are the commonest US weed species; this range covers both, with *A. artemisiifolia* the smaller at 3-5 mm.

Vibrating screens or revolving cylinders allow seed particles to pass through, while chaff, long pieces of stem, larger weed seeds (or pods), leaves etc which are bigger than the maize seed are retained and shaken off to the side. This process of removing the particles larger than maize seed is colloquially known as “scalping”. The second stage of cleaning involves air blasting and vibrating screens. The possibility of combining screening with scalping would exclude most weed seed which is smaller or larger than maize. Weed seed of similar size to maize, however, will still remain in the consignment which limits the efficacy of this technique.

A number of seed cleaning treatments are available which can exclude weed seed of different physical properties such as size, shape, texture, length, width, thickness or density to maize. Theoretically, if an intensive cleaning technique is adopted, many quarantine weed seeds should be excluded. However, the technique is likely to be too expensive for low cost feed grain.

Conclusion: The TWG considered that although intensive cleaning techniques are available to exclude many of the quarantine weed species, the technique would be too expensive to use for stock feed grain and a risk of introducing a significant number of new quarantine weed species into Australia would remain. However, a basic cleaning procedure for maize, using a suitable vibrating air screen cleaner and scalping, would remove many of the weed seed contaminants and should be a part of post harvest seed handling.

4.4 Seed Sampling Intensity

Currently, the examination of quarantine weeds from consignments of grain imported for sowing is based on International Seed Testing Association (ISTA) guidelines. The requirement that all consignments are free from quarantine weed species is checked by randomly or systematically taking primary samples from each 100-700 kg of seed lots, depending on the size of the consignment. These primary samples are combined and mixed to form a single composite sample then mechanically (or by gravity), reduced to a submitted sample for analysis. ISTA guidelines recommend that the size of submitted or working sample of maize should be 1 kg, but the TWG considers that this would not provide an adequate assurance of freedom from quarantine weed seeds.

A statistician of the Bureau of Resource Sciences has advised on the appropriate representative sample size of bulk maize grain in which a nil tolerance for quarantine weed seeds could be presumed. The rate and system of drawing the primary sample should be adjusted according to the size of the consignment. After mechanical reduction of the composite sample, the working sample should be at least 50kg. Within this amount of working sample, the analysis results should specify that no quarantine weed seed were found. The sample size is quite large for a practical working sample, it is possible that seed

technologists could use appropriate screening techniques to assist in isolating weed contaminants before performing seed identification of any found. However, this would be labour and equipment intensive and would require strong taxonomic support in identification of species found.

Even if no weed seeds were found in the working sample, statistically (with 95 % certainty), it can be shown that up to 70 weed seeds may be present in each tonne of maize grain (Roberts *et al*, 1995). Extrapolating, if the bulk grain consignment size is 50,000 tonnes, up to 3,500,000 weed seeds could be present.

The above discussion is based on the assumption that weed seeds are spread uniformly throughout the consignment. Realistically, such uniformity is rare. During handling and shipment by truck or train a segregation effect due to vibration was found (Bould, 1986). Before sampling is undertaken, it may be necessary to test the heterogeneity of the bulk shipment and/or ensure that the primary samples are drawn systematically throughout the shipment.

Conclusion: The group considered an intensive sampling method for bulk grain shipments is neither practical nor ensures confidence of detecting quarantine weed seeds. Relying on this protocol presents a medium to high risk of introducing quarantine weed species. However, if the consignment is devitalised, these sampling guidelines could be used to confirm freedom of viable weed seed.

4.5 Devitalisation treatments

4.5.1 Steam heat treatments

In the event that viable quarantine weed seed is found in samples from consignments destined for processing in rural areas, devitalisation before export or at the port of entry would be necessary. Preliminary studies undertaken by AQIS found that steam treatments at 95-100°C for 12-15 minutes killed the following weed seeds contaminated in maize, sorghum and barley: *Abutilon* spp., *Ambrosia trifida, Amaranthus* spp., *Avena sativa, Brassica* spp., *Cirsium arvense, Chenopodium* sp., *Echinochloa* sp.,*Galeopsis bifida, Galium* sp., *Glycine max, Hibiscus* sp. *Hordeum* sp., *Lolium* sp., *Polygonum convolvulus, Raphanus raphanistrum, Rapistrum rugosum, Secale cereale, Setaria italica, Sorghum bicolor, Spergula arvensis, Stellaria media, Thlaspi arvense, Triticum sp., Xanthium spinosium*, and *Xanthium pungens* (Grain Taskforce file, 1995).

Conclusion: The group considered that steam heat treatment of imported maize would present the lowest risk protocol, particularly if the treatment can be conducted at the port of entry or prior to export. To optimise the temperature and time required to kill all quarantine weed species and admixtures, it may be necessary to conduct further trials. If the steam heat treatment was carried out at the point of export, additional operational requirements should include appropriate hygienic measures during the pre-entry handling process to avoid re-contamination.

4.5.2 Infrared energy management system

Infrared radiation converts to heat once an absorbent material is struck. When energy produced by the infrared radiation penetrates the material, it causes vibration of the constituent molecules, thus elevating the temperature. As opposed to microwave radiation, which is dependent to a large extent on a sufficient moisture content in the material to be successful, infrared systems can effectively heat dry material. This infrared heat treatment is available in an AQIS registered premise in Sydney, but capacity to devitalise is limited to about 2-3 tonne/day. This system can devitalise grain in a shorter time frame than steam heat treatment and is less likely to damage grain. AQIS has been using this system to devitalise linseed by treating at 105°C for 260 seconds.

Conclusion: The TWG agreed that if the system is further developed to devitalise much higher volumes of grain, it may be the best devitalisation option for maize grain. Currently, this system may be a suitable option to devitalise weed contaminants in smaller consignments of maize. The treatment and time frame may need to be adjusted to ensure that all potential contaminants are devitalised.

4.5.3 Fumigation

Trials on devitalisation of maize using methyl bromide and chloropicrin were undertaken by CSIRO scientists as AQIS consultants in 1995 (William Magee, personal communication). The results indicated that despite the very high dosage of methyl bromide used, all samples of maize maintained some germinability after treatments. At five times normal dosages and twice normal explosure period, more than 10% germination of maize remained.

Chloropicrin at 4 times the commercial dosage was also found to be ineffective in devitalisation of maize, reducing germination by only few percent.

Conclusion: Inferring from these results, the TWG believes that many weed seeds would survive these fumigation treatments, and that there would be practical difficulties in their use and chemical residue problems in the treated maize. The group agreed that fumigation treatments are unlikely to be effective in killing weed contaminants in maize consignments.

4.6 Reducing the risk of leakage and spillage

The TWG considered the possibility of using stringent controls to prevent spillage of untreated grain which may occur during transport. A previous review (Evans, *et al.* 1996) indicated that this strategy presents a high risk. The results of the trials indicated that measures to prevent spillage were impractical. The group agrees with this view.

5. Summary

The Weed Technical Working Group has identified clearly that the risk of introducing weed seed contaminants in maize grain imports for processing is high. The TWG has proposed a number of possible strategies to reduce the weed risk.

The TWG does not believe that it would be possible to source imported bulk feed maize grain from anywhere in the USA that would be free from quarantine weed seeds other than *Striga asiatica*.

The TWG agreed that whilst modern seed cleaning technology is available and would remove many quarantine weed seeds from maize grain, the techniques are too expensive and would not be practical for bulk quantities of stockfeed grain.

The TWG considers that using high intensity seed sampling, to detect and analyse the presence of viable quarantine weed seed in the consignment, is not only impractical but will still present a high risk of introducing an unacceptably high number of quarantine weed seeds. However, ISTA sampling and seed analysis procedures would remain necessary after any devitalisation treatments of the imported grain to confirm that viable quarantine weed seeds are not present in the working samples.

The TWG recommends that effective devitalisation may be required for imported bulk grain to eliminate the risk of importation of viable quarantine weed seeds. If this method is implemented, other methods would become less important or even unnecessary. However, devitalisation treatments in Australia may be acceptable only if the facilities are available in close proximity to the port of entry. Effective devitalisation could be carried out at the point of export, but it would then be necessary to implement strict operational procedures to prevent re-contamination during subsequent handling and transport. Further trials to optimise devitalisation treatments to ensure that most of quarantine weed seeds are killed will be necessary.

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7. Appendices

7.1 Appendix 1: Datasheets on quarantine weeds

7.1.1 Species: Abutilon theophrasti Medikus. Family: Malvaceae.

Synonyms: *Sida abutilon* L., *Sida tiliifolia* Fischer, *Abutilon avicennae* Gaertner
Common names: Velvetleaf, butterprint, piemarker, Indian mallow (USA)
Status as a quarantine weed: Already present in Australia, but not known to be resistant to any herbicides in this country. A genotype resistant to the herbicide atrazine occurs in the USA.

Distribution:
Oceania: Australia
North & Central America: USA (all states except the far southwest and northern midwest), Canada
Asia: China and Tibet (fibre and medicinal), India, Turkey, Near East, Afghanistan
North Africa: unspecified countries
Europe: Balkans, Italy, Greece

Biology: Annual herb 0.5-1.2 m tall. Deep strong taproot. Stems branched, smooth, with short velvety hairs. Leaves large, alternate along stems, bases deeply cordate, margins finely toothed, tips tapering, velvety. Flowers in clusters in leaf axils, yellow, 5 petalled, 2 cm across. Fruits cup-shaped, 2.5 cm across, with 10-15 erect prickly radial segments each with several flattened greyish 3 mm long seeds.

Abutilon theophrasti reproduces only by seed. The flowers occur in late summer. The seeds are shed before crop harvest, lie dormant in the soil for at least 50 years, and germinate in spring in warm moist cultivated soils.

The plant occurs in cultivation (especially in irrigated summer crops including soybeans and maize), field edges, ditches, wasteland and gardens.

Entry potential: *Abutilon theophrasti* is a common contaminant of maize and sorghum from the USA. New strains could enter this country either as contaminants of these and other summer crops such as soybean or as cross-contaminants from associated grains and pulses stored and carried in the same silos, barges, railwagons and ships holds.

Establishment: Following entry into Australia as a grain contaminant *Abutilon theophrasti* could establish along roadsides and around feedlots and other grain handling areas as a result of spillage. The hard seeds are probably resistant to digestion in the gut of ruminants and could be spread in dung.

Spread: Following establishment in Australia new strains of *Abutilon theophrasti* would be unlikely to spread rapidly since the seeds are mainly transported in fodder and soil and with travelling animals.

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7.1.2 Species: Acanthospermum hispidum DC. Family: Asteraceae.

Synonyms None recorded.
Common name: Star burr (Australia),
Status as a quarantine weed: Prohibited in Western Australia.

Distribution:
Oceania: Australia, Hawaii
Africa: Angola, Ghana,Mozambique, Zimbabwe, Ivory Coast, Madagascar, Nigeria, Ethiopia, Kenya, South Africa, Senegal, Botswana, Mauritius, Tanzania, Mauritius, South Africa, Nigeria, Zambia, Zimbabwe
South America: Argentina, Brazil, Peru, Colombia, Bolivia, Paraguay

Asia: Sri Lanka, India, Thailand
North & Central America: USA, Honduras, Canada, Puerto Rico, Dominican Republic

Biology: *Acanthospermum hispidum* is an ephemeral herb 20-60 cm tall. The taproot is short and branched. The erect stems regularly branch into two, and are dull green and coarsely hairy. The small oval dull green leaves are stalkless and have rounded tips, and occur in pairs. The flowers occur in small (4-5 mm across) star-shaped clusters in the stem branches and leaf axils, each cluster consisting of 7-8 female flowers surrounding a few males. The fruits consist of a circle of 7-10 thick flat triangular pale brown achenes, each with a pair of long prickles, forming a disintegrating burr.

Acanthospermum hispidum occurs in a wide range of disturbed open situations, especially in summer crops as well as in impoverished or drought-stressed pastures, along roadsides, rubbish dumps, animal paths, moist areas, and other uncultivated places. It tolerates sandy to clay soils even when compacted. The fruits are distributed by clinging to animals as well as in soil, trash, hay and straw, and after infestation both spread rapidly and persist throughout an area.

Pollination is both by wind and by selfing, and seeds may be formed within two months of germination. Pure stands may produce more than half a billion seeds per hectare per year. The seeds have high viability and may remain dormant in the soil for up to 5 or 6 years. They germinate in the spring and sporadically throughout the summer (making control before seeding difficult) , and summer growth is rapid under favourable conditions. Under unfavourable conditions the plant flowers precociously and sets a few seeds very early in its life.

Acanthospermum hispidum is a C_3 plant, and is relatively intolerant of shade. It is mainly a nuisance because of the sharp and irritating burrs, rather than as a competitor with crops. It is not grazed by stock. The burrs contaminate clothing and wool.

Entry potential: *Acanthospermum hispidum* could enter Australia as a contaminant of maize or other summer crop (eg sorghum) seed.

Establishment: Following entry as a feed contaminant *Acanthospermum hispidum* could establish along roadsides and around feedlots following spillage of viable seed. It is particularly well suited to growth it these conditions.

Spread: After establishment this weed is likely to spread locally and to rapidly form dense infestations. Spread is mainly by the adherence of fruits to animals and to human clothing, but also occurs in soil, hay and straw, by floodwater, and by adherence to vehicle tyres.

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7.1.3 Species: Aeschynomene virginica Britton Stern et Poggenb. Family: Fabaceae

Synonyms: *A hispida*

Common Name(s): Sensitive joint vetch

Status as quarantine weeds: Not recorded as present in Australia, prohibited.

Distribution: USA (Maryland, New Jercy, N Carolina, Virginia)

Biology: Sensitive joint vetch is an annual plant native to the eastern United States and reproduces by seed only. Typical plant height is 1-2 m in one season, but grow further to 2.4m. The stems are single, sometimes branched near the top, with stiff or bristly hairs. The leaves are evenly pinnate, 2-12 cm long. Each leaf consists of 30-65 leaflets. Leaflets are 0.8 to 2.5cm long and 0.2-0.4 wide. The leaf folds when touched. The yellow, irregular flowers are 1-1.5 cm across, streak with red, and grow in racemes. The fruit is a loment with 4 to 10 one seeded segments, turning dark brown when ripe. Fruit are 3-7cm long and shallowly scalloped along one side.

Bees have been observed pollinating the flowers. Fruit forms shortly after flowering. Seedlings grow quickly, doubling in size every two weeks during the first 6 weeks.

The species has been confused with other members in the genus, especially *A indica* and *A. rudis*. These two species, not native to USA, have spread northward to N Carolina, where the ranges now overlap with that of this threatening species.

Entry Potential: This species is recorded in maize fields in USA and has potential to enter Australia in feed maize as a contaminant.

Establishment and Spread Potential: Sensitive joint vetch appears to be a species that maintains itself by colonising new habitats where it may compete successfully with other species.

Estimated Risk: The WRA results indicated this species has high potential (score 17) to establish and spread and become a serious weed in tropical Australia.

Reference:

Boyette CD, Templeton GE and Smith RJ (1979) Control of winged water primrose and northern jointvetch with fungal pathogens. *Weed Science* 27: 497-501.

7.1.4 Species: Amaranthus arenicola IM Johnston, *A. rudis* J Sauer , *A. chlorostachys* Moq Tand

Family: Amaranthaceae
Synonyms: for *Amaranthus chlorostachys*: *A. paniculatus, A. hybridus* var. *erythrostachys*
Common Name(s): common waterhemp
Status as quarantine weeds: Not recorded as present in Australia.

Distribution: USA (Kansas, Colorado, Oklahoma, Texas, South Dakota), Hungary, Nigeria, Ethiopia, Germany, Israel.

Biology: *Amaranthus* spp. are erect annual monoecious herbs, erect. Flowers bisexual. Fruit are small, indehiscent, seed smooth.

Amaranthus spp. are indeterminate and produce seed at different parts of the plant and scatter them over the season. Their seed is readily spread by birds. They frequently occur as weed in crops, pasture or along roadsides. The seed have remarkely long viability.

Amaranths adapt to many environments and tolerate adversity because they use the C4 photosynthetic pathway. This process is used by a few other well-known fast growing crops-sorghum, corn and sugarcane, for example. Plant that use C4 system tend to require less water than the more common C3 carbon fixation pathway plants. For this reason, *Amaranthus* spp. are serious weeds, particularly, in hot and dry regions. *Amaranthus chlorostachys* can form dense infestations and probably constitute a great danger to maize.

Entry Potential: These species have recorded in many field crops and vegetable in USA and have potential to enter Australia in feed maize as contaminants.

Establishment and Spread Potential: High

Estimated Risk: The WRA results indicated these species have high potential (score 13-14) to establish, spread and become serious weeds in Australia.

References:

Anderson DD, Roeth, FW and Martin AR (1996) Occurrence and control of triazine resistant common waterhemp (Amaranthus rudis) in field corn (Zea mays). *Weed Technology*. 10, 570-575.

7.1.5 Species: Amaranthus palmeri S Watson*, Amaranthus retroflexus* L Family: Amaranthaceae

Synonyms: None have been recorded.
Common name: Palmer's amaranth or careless weed and redroot amaranth respectively. The amaranths are called pigweeds in the USA.
Status as quarantine weeds: *Amaranthus palmeri* has developed resistance to triazine, dinitroaniline and imazethapyr herbicides in the USA, and also does not yet occur in Australia. *Amaranthus retroflexus* has developed resistance to triazine and ALS inhibitor herbicides in the USA and to triazine herbicides in Canada.

Distribution: *Amaranthus palmeri* appears to be restricted as a weed to the USA.

Amaranthus retroflexus has been recorded as a weed as follows:

Oceania: Australia

Asia: Afghanistan, Israel, Korea, Iran, Jordan, Japan, Lebanon, China, India, Nepal, Iraq, Nepal, Mongolia, Myanmar, Philippines. Malaysia, Indonesia

South America: Brazil, Colombia, Ecuador, Peru, Argentina, Chile, Venezuela, Bolivia

North & Central America: Canada, USA (all states), Mexico, Costa Rica, Puerto Rico

Europe: France, Germany, Hungary, Italy, Poland, Russia, Spain, Turkey, Yugoslavia, Bulgaria, Czechoslovakia, Portugal, Greece, Romania, Sweden, UK, Denmark, Finland, Netherlands, Norway

Africa: Mozambique, Tanzania, Tunisia, Morocco, Egypt, South Africa, Madagascar

Biology: All species of *Amaranthus* are erect indeterminate annual herbs which reproduce only by seed.

Amaranthus palmeri is a stout erect hairless annual herb 0.5-2 m tall with a single main stem (which often turns red with age) and several short laterals. The simple alternate rhombic leaves often have a distinct chevron mark about halfway along, very prominent whitish veins below, and taper to the base and apex (which may be finely notched). The very small chaffy brownish flowers are carried in a slender 15-50 cm long spike at the tip of the stem and in shorter spikes in the upper leaf axils. Each flower produces a single oval to rounded dark reddish brown shiny seed 1.0-1.5 mm long.

Amaranthus retroflexus is a stiffly erect and finely hairy usually upward branching annual herb 0.5-1.5 m tall. The strong taproot is pink to bright red. The simple alternate rhombic leaves have smooth margins, taper to their tips and may be up to 10 cm long. The numerous tiny chaffy flowers are crowded into short thick spikes 1-5 cm long among the upper leaves and at the tip of the stem. Each flower produces a single oval or rounded flattened dark brown to black and shiny seed about 1 mm long.

Amaranthus retroflexus is a variable species, and several varieties have been described. Species of *Amaranthus* have been shown to hybridise readily, opening the possibility of herbicide resistance spreading to other species if herbicide resistant genotypes of these species were introduced into Australia.

Amaranthus retroflexus thrives in crops, gardens, wasteland, roadsides, around animal pens and in other disturbed places, especially where there is extra moisture and nutrients and the area is unshaded by taller growing crops.

Amaranthus retroflexus is a C_4 plant. It exhibits little photo- or thermoperiodism, and flowers 100-120 days after germination in Brazil. Plants may produce 250,000-500,000 seeds per year. The seeds remain viable in field soils for ten or more years. Germination occurs when seeds are brought to the surface of warm moist soil by cultivation or other soil disturbance.

Entry potential: Both species of *Amaranthus* have the potential to enter Australia in feed maize from the USA, in which they occur as contaminants.

Establishment: Following entry into Australia with feed maize both species of *Amaranthus* have the potential to establish along roadsides, around feedlots and in dung piles, situations which admirably suit their requirements. *Amaranthus palmeri* is also a major weed of irrigated pastures in Arizona.

Spread: *Amaranthus* seeds are spread mainly in soil, plant trash and dung and by irrigation and flood waters. Neither species is likely to spread rapidly unless transported, eg, with mud under vehicles or in dung from feedlots.

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Wells MJ, Balsinhas AA, Joffe H, Engelbrecht VM, Harding G, Stirton CH. 1986. A Catalogue of the Problem Plants in Southern Africa. P. 73-74. Pretoria, South Africa; Department of Agriculture and Water Supply.

7.1.6 Species: Ambrosia artemisiifolia L., *Ambrosia trifida* L. Family: Asteraceae

Synonyms: No synonyms have been recorded for either species.
Common names: *Ambrosia artemisiifolia* is known as annual ragweed in Australia and common ragweed in the USA. *Ambrosia trifida* is called giant or kinghead ragweed, horseweed or buffalo weed in the USA.
Status as quarantine weeds: *Ambrosia artemisiifolia* has developed resistance to atrazine in Canada. *Ambrosia trifida* does not yet occur in Australia and is both Prohibited by AQIS and Western Australia and listed as a Noxious Weed by the Commonwealth of Australia, Victoria and Western Australia. The various species of Ambrosia are not always identified to species during seed testing.

Distribution: *Ambrosia artemisiifolia* has been recorded as a weed in:
Oceania: Australia Hawaii
North & Central America: Canada, USA, Guatemala, Jamaica, Mexico

South America: Colombia, Brazil, Chile
Africa: Mauritius
Asia: Japan
Ambrosia trifida has been recorded as a weed in Canada (Quebec to British Columbia), the USA (all areas except Florida, the southwest and the western states), and Japan.

Biology: *Ambrosia artemisiifolia* is an erect branched annual plant 1-2 m tall which reproduces only by seed. It has a stout white taproot. The rather woody stems are finely hairy. The first leaves occur in a rosette, followed by opposite pairs of leaves on the lower stems with alternate leaves above. The leaves are divided into rather fern-like segments and are very finely hairy and up to 10 cm long. The flowers occur at the ends of the branches in erect green spikes, which consist either of a few female flowers at the base below a slender spike of male flowers or male flowers only. Fertilised female flowers develop into short thick fruits about 3 mm long with 5-7 short blunt spines around the apex.

Ambrosia trifida is an erect branched annual herb 1-3 m tall, reproducing only by seed. The plant has a strong taproot, and the stems are coarsely hairy. The large stem leaves all occur in opposite pairs, and have short slightly winged petioles. The blades are entire or more commonly deeply 3 (occasionally 5) lobed and slightly hairy, with the margins finely toothed and each lobe tapering to a point. The numerous small green male flowers occur in slender terminal and upper axillary spikes, whilst the few inconspicuous green female flowers occur in the axils of the upper leaves. Fertilised female flowers develop into thick blunt grey woody fruits 6-13 mm long with a central boss surrounded by several short blunt spikes, and each contains a single seed.

The fruits of both species of *Ambrosia* are distributed in soil and plant trash, and in flood and irrigation water.

Both species of *Ambrosia* are weeds of cultivation, especially of irrigated summer crops such as cotton and soybeans. They also occur in ditches and other damp places (including pastures), and the pollen of both species of A*mbrosia* is a major cause of hay fever.

Entry potential: *Ambrosia trifida* and *A. artemisiifolia* may enter Australia as contaminants of feed maize and other grains.

Establishment: Following introduction as feed or grain contaminants Ambrosia species may be spilled along roadsides or around feedlots and storage areas, where they would often find suitable conditions for growth and reproduction.

Spread: The fruits of Ambrosia species are spread in mud on vehicles, as contaminants of harvested produce including straw and hay, in flood and irrigation waters and in animal dung.

References:

Alley HP, Lee GA. 1969. Weeds of Wyoming. P. 38. Bulletin 498. Laramie, Wyoming, USA; University of Wyoming.

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Anon. 1979. Weeds of the North Central States. P. 160, 162. Urbana, Illinois, USA; University of Illinois.

Hanf M. 1983. The Arable Weeds of Europe, with their Seedlings and Seeds. P. 238. Ludwigshafen, Germany; BASF.

Haselwood EL, Motter GG. 1983. Handbook of Hawaiian Weeds. 2nd edition. P. 388-389. Honolulu, Hawaii, USA; University of Hawaii Press.

Hnatiuk RJ. 1990. Census of Australian Vascular Plants. P. 11. Australian Flora and Fauna Series No. 11. Bureau of Flora and Fauna. Canberra, Australia; Australian Government Publishing Service.

Holm L. Pancho JV, Herberger JP, Plucknett DL. 1979. A Geographical Atlas of World Weeds. P. 21. New York, USA; John Wiley & Sons.

Wells MJ, Balsinhas AA, Joffe H, Engelbrecht VM, Harding G, Stirton CH. 1986. A Catalogue of the Problem Plants in Southern Africa. P. 73-74. Pretoria, South Africa; Department of Agriculture and Water Supply.

Underwood JK. 1965. Tennessee Weeds. P. 86. Knoxville, Tennessee, USA; University of Tennessee.

7.1.7 Species: Ampelamus albidus (Nutt) Britt. Family: Asclepiadaceae

Synonyms: *Cynanchum laeve* (Michx.) Pers., *Gonolobus laevis* Michx.

Common Name(s): Honeyvine milkweed

Status as Quarantine weeds: *A. albinus* has not yet recorded as present in Australia, prohibited.

Distribution: USA (Eastern Nebraska).

Biology: *A. albidus* is a perennial climbling species native to USA and reproduces by seed and by rhizome. The opposite simple triangular-lanceolate leaves to deltoid are 3-12 cm wide long and 2-8 cm wide, surfaces hairless with petioles 1-7.5 cm long. The inflorecence is a cyme, umbellate or corymbose (1.5-2.5 cm wide) of 5-40 florets. The white corolla is 4-7mm long, and 5-8mm in diameter. Seed are ovate, 7-9 mm diameter, flattened, with marginal wings and light brown in colour with silky hairs.

Honeyvine milkweed is reported to be poisonous to livestock, but this has not been confirmed. This species has characters similar to other *Asclerpias*. Vine emergence is relatively late, making post emergence weed control difficult in most row crops. Honeyvine has rapidly increased in reduced or no-till row crops and has become a severe problem in field crops.

Entry Potential: The species is recorded in maize fields and has a high potential to contaminate maize feed imports from USA.

Establishment Potential: If honeyvine milkweed has a chance to spill on the road side it will have high potential to establish and become a weed in environmental and agricultural areas.

Spread Potential: The species can spread by rhizome and seed. As many as 45 daughter shoots were reported from a single plant originating from seed and 27 daughter shoots were observed from a root section 131 days after planting. The maximum distance daughter shoots were observed from original plants 131 days after planting was 11 cm.

Estimated Risk: Assessing potential to establish and spread in Australia of this species using Weed Risk Assessment system resulted in the score of 15, indicating high risk.

References:

Stubbendieck J, Friisoe GY and Bolick MR (1994) Weeds of Nebraska and the Great Plains. Nebraska Department of Agriculture. P 63.

Fawcett RS (1977) Control of honeyvine milkweed. Proceedings North Central Weed Control Conference, 1977, **32**, 116-117.

Carringer RD, Fawcett RS and Bryant WE (1980) Perennial broadleaf weed control with pre harvest applications of glyphosate. *Proceedings North Central Weed Control Conference*. **34**, 56.

Soteres JH and Murray DS (1981) Germination and development of honeyvine milkweed (*Ampelamus albidus*) seed. *Weed Science*. **29**, 625-628.

7.1.8 Species: Apocynum cannabinum L. Family Apocynaceae

Synonyms: None recorded.
Common names: Hemp dogbane, Indian hemp (USA).
Status as a quarantine weed: Not recorded as present in Australia, prohibited

Distribution
North & Central America: USA (most mainland states), Canada (western Quebec to Alberta).

Biology: *Apocynum cannabinum* is a perennial herb with annual rather woody stems, reproducing both by seed and by far-spreading rhizomes.

The plant body consists of extensive underground rhizomes and aerial stems. The rhizomes are slender, branched and brownish, exude white latex when damaged, and give rise to vertical

aerial stems at intervals. The aerial stems tend to be woody at the base and are erect, branched, 30-120 cm tall, green, and hairless or almost so. The pairs of leaves are carried on very short stalks and are erect or ascending, 5-12 cm long, oval, smooth-edged, hairless above and often finely hairy below. The whitish-green bell-shaped flowers are 2-4 mm long, and occur in clusters at the tips of the stems and branches. Each fertilised flower develops into a pair of 15-20 cm long slender drooping green fruits, which at maturity split to release large numbers of seeds. The seeds are brown, slender, pointed at the base and 4-6 mm long, and each carries a 2.5-3 cm long deciduous tuft of fine silky hairs at the apex.

Apocynum cannabinum is a serious and persistent weed of cultivation, pastures, roadsides, wasteland, and other open unshaded areas, especially of moist soils and creek banks. It is also poisonous to stock

Entry potential: Seeds of *Apocynum cannabinum* occur as contaminants of maize seed exported from the USA, and could be carried to all parts of Australia in feed maize.

Establishment: Seeds spilled along roadsides and around feedlots etc. may germinate, especially if they fall or are washed into ditches and damp places. Once established they would probably flourish, grow, spread vegetatively and reproduce.

Spread: Once established the seeds of *Apocynum cannabinum* could be spread by the wind and in plant debris, and both the seeds and rhizomes in soil. It is not yet present in Australia.

References

Anon. 1970. Selected Weeds of the United States. P. 284-285. Agriculture Handbook No. 366. Washington DC, USA; United States Department of Agriculture.

Anon. 1976. Weeds of the North Central States. P. 118. Urbana, Illinois, USA; University of Illinois.

Frankton C. 1961. Weeds of Canada. P. 122. Ottawa, Canada; Canada Department of Agriculture.

Holm L, Pancho JV, Herberger JP, Plucknett DL. 1979. A Geographical Atlas of World Weeds. P. 30. New York, USA; John Wiley & Sons.

Holmgren AH, Andersen BA. 1976. Weeds of Utah. P. 65. Logan, Utah, USA; Utah State University.

7.1.9 Species: Asclepias syriaca L. Family: Asclepiadaceae

Synonyms: *Asclepias speciosa* Torr.
Common name: Milkweed, common milkweed, showy milkweed (USA).
Status as a quarantine weed: Prohibited Plant and Noxious Plant on AQIS lists;Prohibited Plant in Western Australia;Not yet present in Australia.

Distribution:
North & Central America: USA (Eastern and Midwest States except Gulf Coast and Florida), Canada (Manitoba and eastern Provinces especially Ontario & Quebec)
Asia: Iraq

Biology: *Asclepias syriaca* is a perennial woody herb with annual stems 0.5-2.0 m tall, and spreads both by seeds and extensive rootstocks (sometimes misrepresented as rhizomes). It has a deep taproot with long thick fleshy horizontal roots arising from the upper part. The erect rather woody annual stems are usually unbranched, are covered with short downy hairs, and exude copious latex when cut. The grey-green prominently veined leaves are oblong and 10-25 cm long, and occur in opposite pairs; the base and apex are rounded and the margins are smooth, the lower surface is finely downy, and they also contain copious latex. The sweet-smelling pink or purple to white or greenish flowers occur in dense spherical clusters on short stalks in the upper leaf axils and at the apex of the stems, and are about 1 cm across. Fertilised flowers develop into pairs of shortly stalked greyish hairy tapering fruits 6-12 cm long covered with soft spiny projections. Ripe fruits split to release 150-200 oval flattened and winged brown seeds about 6 mm long, each with a deciduous tuft of silky white hairs at the apex.

The plant spreads by seed, which are mainly carried on the wind; seeds may also be dispersed in soil (eg on machinery), in plant trash and probably by irrigation and flood waters. Established plants rapidly form dense masses of separate stems which develop from buds along the horizontal roots.

Asclepias syriaca is a weed of cultivation, pastures, roadsides, fallows, wasteland and creek banks, and once established in an area is difficult to eradicate. It occurs over a wide range of climates, and thrives in both moist and seasonally dry soils. It is not readily controlled by cultivation, which tends to spread sections of the roots and create new infestations. It is poisonous, but distasteful to grazing animals.

Entry potential: *Asclepias syriaca* has the potential to enter Australia by seed as a contaminant of feed maize and other agricultural commodities from the USA and Canada.

Establishment: Following entry into Australia, *Asclepias syriaca* has the potential to establish on roadsides and around feedlots and grain handling areas as a result of spillage and loss of grain.

Spread: After establishment this weed has the potential to spread rapidly both by wind-blown seeds and by seeds and possibly root sections in moist soil, eg under vehicles. Its wide adaptability to climate and soils makes it a potentially widespread and serious weed.

References

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Anon. 1965. Tennessee Weeds. P. 70. Knoxville, Tennessee, USA; University of Tennessee.

Anon. 1970. Selected Weeds of the United States. P. 286-287. Washington DC, USA; United States Department of Agriculture.

Anon. 1979. Weeds of the North Central States. P. 120. Circular No. 718. Urbana, Illinois; University of Illinois.

Frankton C 1961. Weeds of Canada. 1961 Reprint. P. 122-123. Ottawa, Ontario, Canada; Canada Department of Agriculture.

Holm L. Pancho JV, Herberger JP, Plucknett DL. 1979. A Geographical Atlas of World Weeds. P. 35. New York, USA; John Wiley & Sons.

Holmgren AH, Andersen BA. 1976. Weeds of Utah. P. 66. Logan, Utah, USA; Utah State University.

Rice PR Jnr., Putnam AR., Lockerman RH. 1976. Problem Perennial Weeds of Michigan. P. 15. East Lansing, Michigan, USA; Michigan State University.

7.1.10 Species: Berteroa incana DC Family: Brassicaceae

Synonyms: *Alyssum incanum*
Common Name(s): Hoary Alison, hoary Alyssum
Status as a quarantine weed: Not yet recorded as present in Australia, prohibited

Distribution: USA (Tennessee, Wisconsin, Nebraska), Canada, USSR

Biology: *Berteroa incana* is annual or perennial herbs of 1m in height with reproduced by seed. Leaves lanceolate-obovate, usually entire. Inflorescence a lax raceme, sepal 4, petals 4, 4-6mm, cleft to base white or pale cream, sometimes flushing red. Fruit a siliqua slightly inflated, 3-5x as long as wide, ellipsoid-subglobose, style 1-4mm. *B incana* ocurs naturally on rocky and sandy soils, sometimes on arable or waste ground. The is species naturalised in N America and found scattered across Nebraska.

The species was recorded to be unpalatable and is rejected nearly completely by grazing lambs. There are also many records of toxicity in horses caused by the species when used as hay. The mechanism of toxicity is still unknown.

Entry Potential: The species is found in maize fields and has potential to enter as a contaminant of maize.

Establishment Potential: The species has potential to establish along roadsides, and around feed lots.

Spread Potential: The seed of this species can be spread by ground foraging birds. The seed may also be spread as a hitchhikers of passing vehicles or by soil cultivation.

Estimated Risk: Weed risk assessment results (score 14) showed that the species has high risk of becoming established and spreading in Australia after being introduced.

References:

Stubbendieck J, Friisoe GY and Bolick MR (1994) Weeds of Nebraska and the Great Plains. Nebraska Department of Agriculture. P 63.

Hovda LR and Rose ML (1993) Hoary alyssum (*Berteroa incana*) toxicity in a herd of broodmare horses. *Veterinary and Human Toxicology*. **35**, 39-40.

Doll JD and Visocky M. (1989) 1986 Survey of perennial weeds in Wisconsin. In *Proceedings, North Central Weed control conference*, 1986, **41**, 67-74.

7.1.11 Species: Brachiaria platyphylla (Griseb.) Nash. Family: Poaceae

Synonym: *Brachiaria extensa* Chase.
Common names: Broadleaf signalgrass, arm grass (USA).
Status as a quarantine weed: A Prohibited Plant by AQIS.

Distribution
North & Central America: USA (southern states), Cuba, Mexico, Central America
South America: Trinidad, Argentina, Brazil
Africa: Central and West Africa
Europe: Southwest Europe

Biology: *Brachiaria platyphylla* is a tufted annual grass which spreads by seed.

The plant consists of a loosely tufted clump of tillers. The tillers join at the base and are supported by a sometimes extensive branched fibrous root system. The tillers vary from prostrate to erect and up to 60 cm tall, sometimes root at the lower nodes, and carry numerous leaves at the base. The leaf bases lack both ligules and auricles, but the edges of the leaves usually carry distinct glandular hairs especially towards the base. The leaf blades are short (4-12 cm) and broad (6-13 mm), and have a distinct midrib on the lower side. The youngest leaves are rolled. Within the centre of each tiller the culm terminates in a 2-6 branched erect to spreading inflorescence consisting of 3-8 cm long flattened branches. The short broad spikelets may be purplish-brown, and the grains are also short and broad.

Brachiaria platyphylla is a widespread summer growing weed of cultivation, gardens, roadsides and other disturbed places, especially in moist sandy soil.

Entry potential: Seeds of *Brachiaria platyphylla* occur as contaminants of maize seed exported from the USA, and could be carried to all parts of Australia in feed maize.

Establishment: Seeds spilled along roadsides and around feedlots etc. may germinate, especially if they fall or are washed into ditches and damp places. Once established they would probably flourish, grow, and reproduce.

Spread: Once established the seeds of *Brachiaria platyphylla* could be spread by implements such as headers, in irrigation and flood water, in soil, and in plant debris. It is not yet present in Australia.

References

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Hafliger E, Scholz H. 1980. Grass Weeds 1. P. 21. Basle, Switzerland; CIBA-GEIGY Ltd.

Holm L, Pancho JV, Herberger JP, Plucknett DL. 1979. A Geographical Atlas of World Weeds. P. 52-53. New York, USA; John Wiley & Sons.

Underwood JK. 1965. Tennessee Weeds. P. 15-16. Knoxville, Tennessee, USA; University of Tennessee.

7.1.12 Species: Brassica japonica Makino Family: Brassicaceae

Synonyms: *Sinapsis japonica*
Common Name(s): none
Status as quarantine weed: Not recorded as present in Australia, prohibited species

Distribution: USA (Maryland), Japan, Nepal, Pakistan, The Netherlands

Biology: Annual or biennial weed, stem erect. Flowers in terminal racemes, petals 4. Fruit a silique, linear. *B. japonica* seed has a short dormancy periods of 1 month. *Brassica japonica* can cross between species and genus with members in the same family.

Entry Potential: This species is recorded in many field crops and vegetable in USA and has potential to enter Australia in feed maize as a contaminant.

Establishment and Spread Potential: High

Estimated Risk: The WRA results indicated this species has high potential (score 10) to establish, spread and become a serious weed in Australia.

7.1.13 Species: Bromus tectorum L. Family: Poaceae

Synonym *Anisantha tectorum* (L.) Nevski
Common names: Drooping brome (Australia), downy brome, downy chess, early chess, cheat grass (USA, Canada), June grass, bronco grass (USA)
Status as a quarantine weed: A Prohibited Plant in Western Australia.

Distribution
North & Central America: USA (all mainland states except Florida and southeast), Canada (New Brunswick to Pacific coast)
South America: Trinidad, Argentina, Brazil
Africa: Morocco
Europe: Turkey, Russia, Netherlands, Germany, Spain, France, Italy, UK
Asia: Lebanon, Iraq, Jordan, Afghanistan, Israel, India, China, southeast Asia, Philippines
Oceania: Hawaii, Australia (NSW, Vic), New Zealand

Biology: *Bromus tectorum* is a tufted annual grass which spreads by seed.

The plant consists of a large dense tuft of tillers, usually with dead leaves around the base. The tillers join at the base and are supported by a sometimes extensive branched fibrous root system. The tillers are erect or geniculate and 60-80 cm tall, and carry numerous leaves around their bases. The light green leaf sheaths and blades are covered with long soft hairs, the leaves carry thin dentate ligules about 5 mm long, and the slender tapering leaf blades are 10-15 cm long. The youngest leaves are rolled. Within the centre of each tiller the culm terminates in a branched one-sided open panicle 5-20 cm long of drooping often purplish spikelets. Each spikelet is carried on a slender flexuous stalk and consists of several florets, each with a slender 1-1.5 cm long awn. The grains are slender, 1-1.5 cm long, and straw-coloured.

Bromus tectorum is a winter growing weed of cultivation, gardens, roadsides, rubbish dumps and other disturbed places. It prefers dry warm alkaline sandy or loamy soils

Entry potential: Seeds of *Bromus tectorum* occur as contaminants of maize seed exported from the USA, and could be carried to all parts of Australia in feed maize.

Establishment: Seeds spilled along roadsides and around feedlots etc. may germinate, especially if they fall or are washed into ditches and damp places. Once established they would probably flourish, grow, and reproduce.

Spread: Once established the seeds of *Bromus tectorum* could be spread by implements such as headers, in irrigation and flood water, in soil, and in plant debris to join the presently scattered infestations in New South Wales and Victoria or to extend the infestation to other states.

References

Anon. 1970. Selected Weeds of the United States. P. 46-47. Agriculture Handbook No. 366. Washington DC, USA; United States Department of Agriculture.

Anon. 1976. Weeds of the North Central States. P. 14. Urbana, Illinois; University of Illinois.

Behrendt S, Hanf M. 1979. Grass Weeds in World Agriculture. P. 58-59. Ludwigshafen, Germany; BASF Akt.

Frankton C. 19161. Weeds of Canada. P. 14-15. Ottawa, Canada; Canada Department of Agriculture.

Hafliger E, Scholz H. 1980. Grass Weeds 1. P. 45. Basle, Switzerland; CIBA-GEIGY Ltd.

Holm L, Pancho JV, Herberger JP, Plucknett DL. 1979. A Geographical Atlas of World Weeds. P. 56. New York, USA; John Wiley & Sons.

Holmgren AH, Andersen BA. 1976. Weeds of Utah. P. 9. Logan, Utah, USA; Utah State University.

7.1.14 Species: Brunnichia ovata (Walt) Shinners Family: Polygonaceae

Synonyms: None recorded
Common Name: redvine
Status as quarantine weeds: Not recorded as present in Australia, prohibited

Distribution: USA (Mississippi, California)

Biology:. Perennial woody tendril bearing vine, stem high climbing, much branched, sometimes 2 cm thick. Leaves alternate, deciduous. Fruit indehiscent winged, 2.5-3.5mm. Seed 7-10mm.

Entry Potential: This species is recorded in many field crops in USA and has potential to enter Australia in feed maize as a contaminant.

Establishment and Spread Potential: High

Estimated Risk: The WRA results indicated this species has high potential (score 13) to establish, spread and become a serious weed in Australia.

References:

Elmore, CD, Heatherly LG and Wesley RA (1989) Perennial vine control in multiple cropping systems on clay soil. *Weed Technology* 3, 282-287.

Shaw DR and Mack RE (1991) Application timing of the post emergence herbicide for the control of redvine (*Brunnichia ovata*). *Weed Technology*. 5, 125-129.

7.1.15 Species: Cenchrus incertus M.Curtis Family: Poaceae

Synonyms: *Cenchrus pauciflorus* Benth.*Cenchrus tribuloides* L.
Common names: Spiny burr grass, innocent weed (Australia); field sandbur, burgrass (USA).
Status as a quarantine weed: Prohibited Plant by AQIS and in Western Australia.

Distribution
Oceania: Australia
Africa: South Africa, Morocco
North & Central America: USA (Southern California across the Gulf states to Virginia), Mexico, Puerto Rico,
South America: Argentina, Chile, Uruguay,
Asia: Afghanistan, India, Lebanon,
Europe: Portugal

Biology: *Cenchrus incertus* is an annual or occasionally biennial or shortly perennial tufted grass, and reproduces only by seed.

The plant has a spreading fibrous root system. Multiple stems arise from the base of the plant, and may root from the nodes along their length if covered with moist sand or soil. Each stem is branched at the base, smooth and hairless between the leaf sheaths, is rather flattened at the nodes, and may be erect or more usually prostrate at first, with an ascending tip. The leaves are

5-8 mm wide and up to 20 cm long, often twisted or wrinkled, with flattened sheaths and a 1-1.5 mm long ligule fringed with fine hairs. The youngest leaves are rolled. The terminal inflorescence consists of 3-20 individual spikelets, each of which develops into a separate burr. Each burr is green ripening pale brown, finely hairy, ovoid to globular, 3-7 mm across (without the spines), with 10-40 broad-based but sharply pointed radiating spines 2-5 mm long. Each burr contains several seeds.

Up to 1000 seeds are produced per plant in many burrs. The spines of ripe burrs adhere to skin and clothing. The burrs break off separately when touched, and are dispersed by people (mainly on clothing) and on the wool, fur and skin of animals, as well as in flood and irrigation water, on vehicle tyres, and with plant trash, hay and soil. The largest seed in each burr is germinable within months, but the smaller seeds may remain dormant in the soil for several years. Most seedlings emerge in the spring when the soil is warm., moist and disturbed, but occasional germination may occur throughout the year.

Cenchrus incertus grows best in sandy soils and does well on roadsides, in weak or eroded pastures, in gardens, in cultivation (especially after irrigation) and in dry river beds, but the plants are not very competitive with dense crops and pastures. They grow best where there is ample moisture, fertiliser and light.

Entry potential: Seeds of *Cenchrus incertus* have been found in maize seed exported from the USA, and could be carried to all parts of Australia as a contaminant of American feed maize.

Establishment: Seeds spilled along roadsides and around feedlots etc. would be placed in suitable environments for germination, growth and reproduction. Under suitable conditions of moisture, temperature and light they may be expected to establish in warm temperate and tropical parts of Australia.

Spread: Once established along roadsides or feedlots in Australia new genotypes of *Cenchrus incertus* could be expected to spread rapidly on vehicle tyres. Local spread would be more modest, on stock, clothing, and in irrigation and flood water.

References

Anon. 1970. Selected Weeds of the United States. P. 50-51. Washington DC, USA; United States Department of Agriculture.

Behrendt S, Hanf M. 1979. Grass Weeds in World Agriculture. P. 142-143. Ludwigshafen, Germany; BASF Akt.

Hafliger E, Scholz H. 1980. Grass Weeds I. P. 30. Basle, Switzerland; CIBA-GEIGY Ltd.

Henderson M, Anderson JG. 1966. Common Weeds in South Africa. P. 14-15. Pretoria, South Africa; Department of Agricultural Technical Service.

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Holmgren AH, Andersen BA. 1970. Weeds of Utah. P. 10. Logan, Utah, USA; Utah State University.

Hnatiuk RJ. 1990. Census of Australian Vascular Plants. P. 461. Australian Flora and Fauna Series No. 11. Bureau of Flora and Fauna. Canberra, Australia; Australian Government Publishing Service.

Parker K. 1972. An Illustrated Guide to Arizona Weeds. P. 30. Tucson, Arizona; University of Arizona.

Parsons WT, Cuthbertson EG. 1992. Noxious Weeds of Australia. P. 97-100. Melbourne, Victoria; Inkata Press.

Wells MJ, Balsinhas AA, Joffe H, Engelbrecht VM, Harding G, Stirton CH. 1986. A Catalogue of the Problem Plants in Southern Africa. P. 137. Pretoria, South Africa; Department of Agriculture and Water Supply.

7.1.16 Species: Cenchrus longispinus (Hack.) Fern. Family Poaceae

Synonyms: *Cenchrus pauciflorus* Benth., *C. tribuloides L., C. incertus* Curtis (there is considerable confusion among the taxa of *Cenchrus* in the various references checked)
Common names: Longspine sandbur (USA), innocent weed, spiny burr-grass (Australia).
Status as a quarantine weed: A Prohibited Plant by AQIS and in Western Australia.

Distribution
North & Central America: USA (midwest and several isolated areas), Mexico, Puerto Rico
Europe: Portugal
Oceania: Australia
Africa: South Africa
South America: Chile, Uruguay
Asia: Afghanistan, India, Lebanon

Biology: *Cenchrus longispinus* is a tufted annual grass which spreads by seed.

The plant consists of a loosely tufted clump of tillers. The tillers join at the base and are supported by a sometimes extensive branched fibrous root system. The tillers vary from prostrate to erect and are 10-90 cm tall, may root at the lower nodes, and carry leaves along their length. The leaf bases have both ligules and auricles consisting or a line and tufts of hairs, the edges of the leaves are smooth, and the leaves are slightly rough to the touch. The leaf blades are 6-18 cm long and 3-8 mm broad, and taper towards the tip. The leaf sheaths are strongly keeled, and the young leaves rolled. Within the centre of each tiller the culm terminates in a dense spike of burr-like spikelets along a zigzag rachis. Each burr is globular, 7-14 mm across, and covered with 3-7 mm long sharp radiating spines that catch on clothing. The spiklets fall as burrs, and each contains several seeds.

Cenchrus longispinus is a summer growing weed of cultivation, gardens, roadsides and other disturbed places, especially where the soil is sandy and moist. The burrs aggravate animals and contaminate wool.

Entry potential: Seeds of *Cenchrus longispinus* occur as contaminants of maize seed exported from the USA, and could be carried to all parts of Australia in feed maize.

Establishment: Seeds spilled along roadsides and around feedlots etc. may germinate, especially if they fall or are washed into ditches and damp places. Once established they would probably flourish, grow, and reproduce.

Spread: Once established the seeds of *Cenchrus longispinus* could be spread by cattle, sheep and clothing, in irrigation and flood water, in soil, and in plant debris to join the already widespread but scattered populations around Australia.

References

Anon. 1970. Selected Weeds of the United States. P. 52-53. Agriculture Handbook No. 366. Washington DC, USA; United States Department of Agriculture.

Behrendt S, Hanf M. 1979. Grass Weeds in World Agriculture. P. 143. Ludwigshafen, Germany; BASF Akt.

Holm L, Pancho JV, Herberger JP, Plucknett DL. 1979. A Geographical Atlas of World Weeds. P. 74. New York, USA; John Wiley & Sons.

Parsons WT, Cuthbertson EG. 1992. Noxious Weeds of Australia. P. 97-100. Melbourne, Victoria; Inkata Press.

7.1.17 Species: Chenopodium album L. Family: Chenopodiaceae

Synonyms: No scientific synonyms are used for this species.
Common names: Fat hen (Australia); lamb's quarters (USA, Canada), pigweed, white goosefoot (Canada).
Status as a quarantine weed: Atrazine resistant strains have developed in both the USA and Canada, but herbicide resistant genotypes have not yet been reported in Australia.

Distribution
Oceania: Australia, New Zealand, Hawaii
Africa: South Africa, Algeria, Ethiopia, Tanzania, Tunisia, Egypt, Kenya, Zimbabwe, Morocco, Mozambique, Zambia
North & Central America: USA (all states), Canada (all provinces), Mexico

South America: Argentina, Brazil, Chile, Colombia
Asia: India, Iran, Pakistan, Japan, Korea, Lebanon, China, Iraq, Israel, Taiwan, Nepal, Afghanistan
Europe: Finland, France, Germany, Ireland, Italy, Romania, Russia, Belgium, Bulgaria, Czechoslovakia, UK, Hungary, Norway, Portugal, Spain, Sweden, Turkey, Yugoslavia, Denmark, Iceland, Netherlands, Poland

Biology: *Chenopodium album* a genetically very variable annual herb which reproduces only by seed.

The plant has a strong white taproot, with many lateral roots in the surface soil. The stems grow 0.5-2.0 m tall and are usually erect, woody and angled, unbranched in crowded conditions but branching (mainly from the base) where there is plenty of lateral light. They vary in colour from grey to green, red or purple, and are often striped. The single leaves develop spirally around the stems; they have a slender stalk and usually ovate leaf 2-7 cm long with wavy margins, and are covered when young with mealy glands. The leaves are however quite variable in shape, size and colour, and may be deeply toothed. The inconspicuous small green flowers develop in dense irregular clusters at the tips of the stems and in leaf axils. Each flower is 2-3 mm across. Fertilised flowers (most of them!) develop into chaffy fruits each surrounding a 1-2 mm diameter disc-shaped shiny black seed covered by a fine papery covering..

The seeds remain viable for many years in undisturbed soils, and germinate in disturbed moist soils throughout the year but especially in spring. The seedlings grow rapidly and compete both above and below ground with those of crops and pastures. The life cycle may be very rapid. Flowering usually starts early in the life of the plant, and continues for as long as conditions permit.

Chenopodium album is a very variable weed both genetically and phenologically, with an exceptionally wide tolerance of climatic, soils and moisture conditions. It grows abundantly in crops, gardens, pastures, roadsides, around feedlots and buildings, along creek banks, and anywhere where there is disturbance, preferring (but not limited to) high moisture and fertility situations. It is readily eaten by stock, but the seeds pass unharmed through their guts and germinate wherever they are deposited.

Entry potential: Seeds of *Chenopodium album* have been found in maize seed exported from the USA, and could be carried to all parts of Australia as a contaminant of American feed maize.

Establishment: Seeds spilled along roadsides and around feedlots etc. would be placed in suitable environments for germination, growth and reproduction. Under suitable conditions of moisture, temperature and light they may be expected to establish throughout temperate, subtropical and tropical parts of Australia.

Spread: Once established along roadsides or feedlots in Australia herbicide resistant and other new genotypes of *Chenopodium album* could be expected to spread slowly in soil and plant trash and in irrigation and flood water. The plant spreads widely as an very common contaminant of crop and pasture seed.

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7.1.18 Species: Cirsium arvense (L.) Scop. Family: Asteraceae

Synonyms: *Cirsium argenteum* Payer, *Cirsium horridum* (Wimmer & Grab.) Stankov., *Cirsium incanum* Bieb., *Cirsium lanatum* Spreng., *Cnicus arvensis* Hoffm.
Common names: Canada or creeping thistle (Australia, USA, Canada), field thistle (Canada), perennial thistle (Australia).
Status as a quarantine weed: Prohibited plant in Western Australia.

Distribution:
Oceania: Australia, New Zealand
Africa: South Africa, Sudan, Zimbabwe, Tunisia
North & Central America: USA (mid and northern states), Canada (southern provinces), Mexico
South America: Chile
Asia: China, Japan, Korea, India, Pakistan, Afghanistan, Iran, Lebanon, Turkey, Russia
Europe: Portugal, Spain, France, Italy, Greece, Albania, Turkey, Romania, Poland, Germany, Netherlands, UK, Sweden, Finland, Iceland, Netherlands, Yugoslavia, Belgium, Bulgaria, Czechoslovakia, Switzerland.

Biology:

Cirsium arvense is a spreading perennial herb, and reproduces both by seed and by horizontal surface root extensions which give rise to new plants. The plant is variable both genetically and in its reactions to the environment.

The root system of an extensive mat of white to cream horizontal roots up to 5 m long and up to 2 m deep, which carry small white secondary roots and produce buds which develop into new shoots. Each sterile or fertile shoot is erect, 40-130 cm tall, grooved, green and slightly hairy. The single prickly leaves develop in a spiral around the stem. Each leaf is 10-30 cm long and has a winged stalk, irregularly lobed and crinkled margin, and is often white-hairy below. The flowers develop in dense heads arranged in clusters towards and at the top of the plant, with male and female flowers on different plants. Each flower head is 2-3 cm across when open, and consists of dense overlapping rows of slender outer bracts surrounding a dense mass of narrow purplish florets. Fertilised flowers develop into smooth shiny elongate straw-coloured fruits 2.5-4 mm long, with a terminal knob surrounded by a deciduous tuft of long fine feathery hairs. 4,000-5,000 seeds per plant per year have been recorded.

The fruits are dispersed mainly by the wind, but also in hay, straw, soil and possibly irrigation and flood water. The seeds germinate and grow slowly, later developing horizontal roots which give rise to buds and further stems. Large patches of *Cirsium arvense* soon appear, which are further spread as sections of root are carried about during cultivation.

Once established in an area most spread seems to be by root fragments and root extension, rather than by seed.

Cirsium arvense is an important weed of pastures, cultivation, roadsides, wasteland and around animal facilities in cooler and moister parts of Australia, being most common where there is additional moisture and nutrition such as along drains and irrigation ditches and around animal pens.

Entry potential: Seeds of *Cirsium arvense* occur as contaminants of maize seed exported from the USA, and could be carried to susceptible (cool and moist) parts of Australia in feed maize.

Establishment: Seeds spilled along roadsides and around feedlots etc. may be placed in cool moist situations suitable for their germination, growth and reproduction.

Spread: Once established along roadsides or feedlots in southern Australia new genotypes of *Cirsium arvense* would spread slowly by root extension and faster by wind, water and produce movement of seeds.

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7.1.19 Species: Cocculus carolinus (L) DC Family: Menispermaceae

Synonyms: None recorded
Common Name(s): redberry moonseed
Status as quarantine weeds: Not recorded as present in Australia, prohibited species

Distribution: USA

Biology: Deciduous twiner to 4m. Flowers are uni-sexual: the males are in short panicles, the females are in raceme. Fruit 0.5-0.75 cm diameter, drupe, bright red. Seeds are horseshoe shape. The species has low competitive ability and sometimes reduced yield of maize by 9 %. In some years no effect on crop yield were evident.

Entry Potential: This species is recorded in many field crops in USA and has potential to enter Australia in feed maize as a contaminant.

Establishment and Spread Potential: medium

Estimated Risk: The WRA results indicated this species has medium potential (score 6) to establish, spread and become a weed in Australia.

References:

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7.1.20 Species: Conringia orientalis (L.) Dumort Family: Brassicaceae

Synonyms: *Conringia orientalis* (L.) C.Presl, *Brassica orientalis* L., *Erysimum orientale* (L.) Cr.
Common names: Hare's-ear, treacle mustard
Status as a quarantine weed: Prohibited plant in Western Australia.

Distribution
Oceania: Australia.

North & Central America: Canada (all provinces), USA (all states except southwestern and southeastern).
Asia: Iran, Afghanistan, Israel.
Europe: Russia, Germany, Turkey, Italy, Greece, Albania, Spain, Portugal, UK, Ireland, France, Germany, Denmark, Netherlands, Austria, Sweden.

Biology: *Conringia orientalis* is an annual herb which reproduces only by seed.
The plant has a strong white taproot, and the hairless rather waxy erect stem is stout and usually unbranched, up to 70 cm tall, and surrounded at the base by a rosette of shortly stalked unlobed leaves. The bluish-green basal leaves are obovate and 10-12 cm long, whilst the stem leaves are similar but smaller, narrower, stalkless, and tend to clasp around the stem with ear-like basal lobes. The flowers occur in slender terminal racemes, and are pale yellowish-white to yellow, 4-petalled, and 1.0-1.5 cm across. Fertilised flowers are followed by very slender erect to spreading 4-angled fruits 6-14 cm long which curve upwards. At maturity the fruits split to release many dark brown seeds 2-2.5 mm across.

Conringia orientalis is a weed of cultivation, roadsides, waste places and other disturbed non-competitive situations, where it germinates in autumn or winter to form a rosette of leaves, flowers in the spring, and seeds in early summer before dieing.

Entry potential: Seeds of *Conringia orientalis* have contaminated maize from the USA, and could enter the country by that route.

Establishment: Seeds spilled along roadsides and around feedlots etc. in the southern states may be placed in moist enough situations for their germination, growth and reproduction.

Spread: Once established along roadsides or feedlots in southern Australia, *Conringia orientalis* could be spread by seed in soil, flood and irrigation waters and plant material to increase the presently scattered local populations.

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7.1.21 Species: Convolvulus arvensis L. Family: Convolvulaceae

Synonyms: None.
Common names: Field or European bindweed
Status as a quarantine weed: A Noxious Weed in South Australia, Western Australia and Victoria, a Prohibited Weed in Western Australia, and a weed with a herbicide (2,4-D) resistant strain in the USA.

Distribution
Oceania: Australia, New Zealand, Hawaii
Africa: South Africa, Tunisia, Egypt, Morocco, Uganda

North & Central America: Canada (all provinces), USA (all states except the extreme southeast), Mexico
South America: Argentina, Chile, Peru, Brazil, Uruguay
Asia: Sri Lanka, Iran, Lebanon, Pakistan, Philippines, Iraq, Israel, Japan, Afghanistan, Jordan, India
Europe: France, Germany, Greece, Yugoslavia, Belgium, Bulgaria, Czechoslovakia, UK, Portugal, Romania, Russia, Spain, Switzerland, Turkey, Finland, Hungary, Iceland, Italy, Poland

Biology: *Convolvulus arvensis* is a perennial herb with weak annual climbing stems, and spreads both by seed and by buds which develop on the extensive horizontal root system.

The root system consists of a few very deep taproots and an extensive system of cord-like surface roots throughout the upper soil; these roots produce buds which develop into new stems and shoots. The slender herbaceous annual stems are smooth to finely hairy and 1-3 m long, and twine around crops or any other available support. The alternate leaves are widely spaced along the stems, and consist of a long stalk and a usually arrow-shaped blade with basal lobes, smooth margins and a bluntly pointed tip. They are thin, smooth and green, and 3-6 cm long. The flowers are rolled in the bud and open into broadly funnel-shaped white to pink flowers 1.5-2.5 cm across. Fertilised flowers develop into 2- to 4-seeded dry spherical fruits about 5 mm across, which break up to release dark brown to black finely roughened sectoroid seeds 3-5 mm long.

Convolvulus arvensis is a persistent and troublesome weed of well lit places such as fields, roadsides, wasteland, railways, gardens, urban areas, pastures, and around farm buildings. It usually invades these areas as seed, but once established rapidly develops an extensive root system and is then very hard to eradicate. Cut sections of roots may grow into new plants.

It is most common in permanently moist soils (even if only moist at depth), and in cool to warm temperate areas. The plant withstands cultivation well and rapidly regrows from deeper undamaged roots. It damages crops both by smothering and pulling then down, and by contaminating their harvest with its seeds.

Entry potential: Seeds of *Convolvulus arvensis* occur as contaminants of maize seed exported from the USA, and could be carried to susceptible parts of Australia in feed maize.

Establishment: Seeds spilled along roadsides and around feedlots etc. may be placed in situations suitable for their germination, growth and reproduction.

Spread: Once established new genotypes of *Convolvulus arvensis* would spread slowly by root extension and faster by seeds transported by the wind, by flood or irrigation water or in agricultural produce.

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7.1.22 Species: Cyperus esculentus L. Family: Cyperaceae

Synonyms: None.
Common names: Yellow nutgrass (Australia), yellow nutsedge or nutgrass (USA).
Status as a quarantine weed: A Prohibited Plant in Western Australia.

Distribution

Oceania: Australia, Hawaii
Africa: Angola, Kenya, Madagascar, Mozambique, South Africa, Zimbabwe, Tanzania, Ethiopia, Ghana, Nigeria, Senegal
North & Central America Canada, USA (all states except central north), Mexico, Cuba, Nicaragua, Puerto Rico, Jamaica
South America: Peru, Argentina, Chile, Colombia, Venezuela, Guiana, Brazil
Asia: India, Iran, Cambodia, Thailand
Europe: Switzerland, Portugal, France, Albania

Biology: *Cyperus esculentus* is an erect perennial sedge with short-lived annual shoots, propagating both by seed and by underground tubers.

The main stem consists of a basal corm, from which arises a single leafy shoot ending in a single flowering culm. A number of slender rhizomes develop from the axillary buds on the corm and radiate through the surrounding soil. Each rhizome ends in a single tuber, which eventually gives rise to one or more slender vertical stems which again develop corms just below ground level and repeat the process.

The erect yellow-brown corms are 1-2 cm long and rather narrower, and surrounded by the leaf bases of the leafy shoot. The leaves arise only from the corm, and are 4-6 mm wide, 20-50 cm long, dark green and shiny, and taper from the base to the tip. The culm arises from the apex of the corm and is green, triangular in section and 30-80 cm tall. It ends in 2-4 slender leaf-like spreading bracts 5-20 cm long, which surround the dense compound umbel of 1-2 cm long slender spikelets of tiny yellow-brown flowers. Fertilised flowers may produce fruits which are slender triangular yellow-brown nuts 1-2 mm long.
The radiating rhizomes are yellowish, 10-20 cm long, and carry minute scale leaves. The single tubers at their ends are ovoid, about 1 cm long, scaly, and yellow-brown.

Cyperus esculentus spreads mainly by tubers, which are produced in very large numbers and are carried in soil and by flood waters. The tubers do not tolerate desiccation well. It also reproduces by seed, although more rarely. It withstands cultivation extremely well, and this process rapidly spreads the tubers around and between fields.

Cyperus esculentus is a very persistent weed of cultivation (especially vegetables), gardens, roadsides, river and creek banks, ditches, and other relatively non-competitive, often disturbed, and generally moist areas. It competes strongly with low-growing and uncompetitive crops such as vegetables, and its rhizomes may penetrate root crops such as potato tubers. The seeds may contaminate crop, pasture and fodder crop seeds.

Entry potential: Seeds of *Cyperus esculentus* occur as contaminants of maize seed exported from the USA, and could be carried to susceptible parts of Australia in feed maize.

Establishment: Seeds spilled along roadsides and around feedlots etc. may be placed in sufficiently moist situations to enable their germination, after which they would be likely to establish, grow and reproduce.

Spread: Once established *Cyperus esculentus* would spread slowly by tuber transfer and perhaps by seed, spreading mainly in soil and by floodwaters, to join the scattered infestations in Queensland and New South Wales (it also occurs in Perth), or to start new infestations in the other states.

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7.1.23 Species: ***Cyperus rotundus*** **L. Family: Cyperaceae**

Synonyms: None.
Common names: Nutgrass (Australia); purple nutsedge or nutgrass (USA).
Status as a quarantine weed: A Prohibited Plant in Western Australia and by AQIS, and a Noxious Plant in South Australia.

Distribution
Oceania: Australia (all states), Fiji, Hawaii, New Zealand
Africa: Ghana, Kenya, Madagascar, Mozambique, Nigeria, Zimbabwe, South Africa, Egypt, Ethiopia, Mauritius, Morocco, Angola, Sudan, Swaziland, Tanzania, Tunisia, Uganda, Zambia
North & Central America: Costa Rica, Honduras, Jamaica, Mexico, Panama, Cuba, Nicaragua, Puerto Rico, USA (only southeastern states and California)
South America: Argentina, Brazil, Colombia, Guiana, Peru, Chile, Surinam, Bolivia, Uruguay, Trinidad, Venezuela
Asia: Sri Lanka, Indonesia, India, Iran, Israel, Japan, Philippines, Pakistan,. Afghanistan, Saudi Arabia, Cambodia, Papua New Guinea, Vietnam, China, Iraq, Jordan, Cambodia, Korea, Lebanon, Thailand
Europe: Greece, Italy, Portugal, Russia, France, Spain, Turkey, Yugoslavia

Biology: *Cyperus rotundus* is an erect perennial sedge with short-lived annual shoots, propagating both by seed and by underground tubers.

The main stem consists of a basal corm, from which arises a single leafy shoot ending in a single flowering culm. A number of slender rhizomes develop from the axillary buds on the corm and radiate through the surrounding soil. Each rhizome produces one to several tubers along its length, each of which may eventually give rise to one or more slender vertical stems which again

develop corms just below ground level and repeat the process, often forming a group of interconnecting shoots

The erect dark brown corms are 1-2 cm long and rather narrower, and surrounded by the persistent leaf bases of the leafy shoot. The leaves arise only from the corm, and are 4-7 mm wide, 20-60 cm long, dark green and shiny, and taper from the base to the tip. The culm arises from the apex of the corm and is green, triangular in section and 10-60 cm tall. It ends in 2-4 slender leaf-like spreading bracts 2-6 cm long, which surround the dense compound umbel of 1-2 cm long slender spikelets of dark brown to purplish flowers. Fertilised flowers may produce fruits, which are slender triangular dark brown nuts 1-2 mm long.

The rhizomes are mid to dark brown, 10-20 cm long, and carry minute scale leaves. They develop one to several tubers along their length, each 1-2 cm long, scaly, and dark brown to black.

Cyperus rotundus spreads mainly by tubers, which are produced in very large numbers and are carried in soil and by flood waters. The tubers do not tolerate desiccation well. It also reproduces by seed, although apparently only rarely. It withstands cultivation extremely well, and this process rapidly spreads the tubers around and between fields.

Cyperus rotundus is a very persistent weed of cultivation (especially vegetables), gardens, roadsides, river and creek banks, ditches, and other relatively non-competitive, often disturbed, and generally moist areas. It competes strongly with low-growing and uncompetitive crops such as vegetables, and its rhizomes may penetrate root crops such as potato tubers. The seeds may contaminate crop, pasture and fodder crop seeds.

Entry potential: Seeds of *Cyperus rotundus* occur as contaminants of maize seed exported from the USA, and could be carried to susceptible parts of Australia in feed maize.

Establishment: Seeds spilled along roadsides and around feedlots etc. may be placed in sufficiently moist situations to enable their germination, after which they would be likely to establish, grow and reproduce.

Spread: Once established *Cyperus rotundus* would spread slowly by tuber transfer and perhaps by seed, spreading mainly in soil and by floodwaters, to join the existing infestations in all states of Australia.

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7.1.24 Species: Datura inoxia Miller Family: Solanaceae

Synonyms: None. Often given as *Datura innoxia*, and by horticulturists sometimes as *Datura metel*.
Common names: Downy thornapple (Australia)
Status as a quarantine weed: A Prohibited Plant in Western Australia and by AQIS.

Distribution
Oceania: Australia (all states except Tasmania)
Africa: Egypt, South Africa
North & Central America: USA
Asia: Saudi Arabia

Biology: *Datura inoxia* is an erect softly hairy dichotomously branched annual or shortly perennial woody herb, reproducing only by seed.

Datura inoxia has a strong white taproot with shorter, more slender laterals in the surface soil. The single stem is erect, rather woody, repeatedly dichotomously branched, densely but finely glandular hairy, and usually 50-100 cm tall but occasionally taller. The large ovate leaves occur singly along the stem and branches, up to 20 cm long, thin, silvery, and with an unpleasant smell when crushed. The conspicuous white flowers develop singly in the stem forks. Each has a short stalk, a long green collar-like sepal tube, and a spreading trumpet-shaped tube of 5 fused white petals (often with slightly projecting tips) 15-20 cm long. Fertilised flowers develop into reflexed globular green fruits 3-4 cm across and thickly covered with short sharp woody spines, which harden towards maturity as the fruit turns woody and brown. The tips of ripe fruits split into 4 sections to release large numbers of seeds. The flattened kidney-shaped seeds are yellow to dark brown, 3-4 mm long, and very finely pitted.

Datura inoxia spreads by seeds, which are transported as contaminants of crop seeds, in soil and in flood and irrigation water, and in hay, straw and plant trash. There have also been reports of regrowth from damaged root fragments distributed by farm machinery, but this needs checking. The seeds have long dormancy in the soil and are probably allelopathic to the germination of a number of crop, pasture and forage seeds. The plant germinates in the spring and summer, grows rapidly in warm moist fertile conditions, and continues to produce flowers and fruits over a long period. It may either die after the first summer, or in the absence of cultivation persist as a perennial woody herb for a few years.

Datura inoxia is usually a minor weed of summer crops, pastures and fodders, but is occasionally serious. Apart from competing with crops and pastures the seeds contaminate crop, pasture and fodder seed, hay and straw, the plants are unpalatable, the spiny fruits contaminate wool, and the plants and their seeds are poisonous. It is sometimes grown ornamentally.

Entry potential: Seeds of *Datura inoxia* occur as contaminants of maize seed exported from the USA, and could be carried to susceptible parts of Australia in feed maize.

Establishment: Seeds spilled along roadsides and around feedlots etc. are likely to have prolonged dormancy, and may well be placed in sufficiently moist situations to enable their germination (especially in nitrogen rich areas around feedlots), after which they would be likely to establish, grow and reproduce.

Spread: Once established *Datura inoxia* could spread rapidly in flood, drainage and irrigation water, in manure, and in mud on vehicles etc. It would increase the currently fairly scattered infestations of this weed in the various states.

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7.1.25 Species: Datura stramonium L. Family: Solanaceae

Synonyms: *Datura tatula* L., but this is now recognised as a being only a colour form of *D. stramonium.*
Common names: Common thornapple (Australia), Jimson weed (USA)
Status as a quarantine weed: A Prohibited Plant in Western Australia and by AQIS, a Noxious Weed in Victoria, Western Australia and Queensland, and with herbicide (atrazine) resistant genotypes in the USA which are not yet present in Australia.

Distribution
Oceania: Australia (all states except the Northern Territory), Hawaii, Fiji, New Zealand
Africa: Botswana, Ethiopia, Ghana, Egypt, Kenya. Mozambique, South Africa, Tanzania, Uganda, Morocco, Zimbabwe, Senegal, Sudan
North & Central America: USA (most mainland states except northcentral and northwest & Alaska), Honduras, Puerto Rico, Canada, Costa Rica, Jamaica, Mexico
South America: Chile, Argentina, Peru, Brazil, Colombia, Venezuela
Asia: Afghanistan, Israel, Saudi Arabia, Korea, Indonesia, Iran, Lebanon, Iraq, Jordan, Nepal, Pakistan, Thailand
Europe: Portugal, Switzerland, UK, Belgium, Poland, Germany, Hungary, Turkey, Bulgaria, Czechoslovakia, Italy

Biology: *Datura stramonium* is an erect hairless dichotomously branched annual rather woody herb, reproducing only by seed.

Datura stramonium has a strong white taproot with shorter, more slender laterals in the surface soil. The single stem is erect, rather woody, repeatedly dichotomously branched, hairless, and usually 50-100 cm tall but occasionally taller. The large broadly lobed leaves occur singly along the stem and branches and are up to 20 cm long, with an unpleasant smell when crushed. The conspicuous white or lilac to purple (var. tatula) flowers develop singly in the stem forks. Each has a short stalk, a long green collar-like sepal tube, and a spreading trumpet-shaped tube of 5 fused petals (usually with slightly projecting tips) about 10 cm long. Fertilised flowers develop into erect green fruits about 3 cm across and 4 cm long, covered with sharp woody spines. The fruits harden when ripe and turn woody and brown. The tips of ripe fruits split into 4 sections to release large numbers of seeds. The flattened kidney-shaped seeds are dark brown to blackish, 3-4 mm long, and very finely pitted.

Datura stramonium spreads by seeds, which are transported as contaminants of crop seeds, in soil and in flood and irrigation water, and in hay, straw and plant trash. They have long dormancy in the soil and are allelopathic to the germination of a number of crop, pasture and forage seeds. The plant germinates in the spring and summer, grows rapidly in warm moist fertile conditions, and continues to produce flowers and fruits over a long period before dieing in the autumn.

Datura stramonium is a major weed of most summer crops, pastures and fodders. Apart from competing with crops and pastures the seeds contaminate crop, pasture and fodder seed, hay and straw, the plants are unpalatable, and the plants and their seeds are poisonous.

Entry potential: Seeds of *Datura stramonium* occur as contaminants of maize seed exported from the USA, and could be carried to susceptible parts of Australia in feed maize.

Establishment: Seeds spilled along roadsides and around feedlots etc. are likely to have prolonged dormancy, and may well be placed in sufficiently moist situations to enable their germination (especially in nitrogen rich areas around feedlots), after which they would be likely to establish, grow and reproduce.

Spread: Once established new genotypes of *Datura stramonium* would spread rapidly in flood, drainage and irrigation water, in manure, and in mud on vehicles etc. It would increase the currently widespread infestations of this weed in most states.

References

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7.1.26 Species: Eriochloa villosa Kunth Family: Poaceae

Synonym: none
Common names: woolly cup grass
Status as a quarantine weed: not yet recorded as present in Australia, prohibited species

Distribution: Asia, USA (Oregon, Colorado, Iowa, Minnesota, Wisconsin and Illinois), Mexico

Biology: Annual grass with spikelets about 5mm long. Stems clumped. Inflorescence racemose or paniculate, terminal flowers hermaphrodite, fertile, lower flowers sterile, occasionally male, usually awned.

Controlling woolly cupgrass in maize fields can increase yield by 11-28%.

Woolly cup grass has been recorded as difficult to control in maize fields because of staggered germination and the requirement for sequential treatments that included postemergence herbicides. Seed dormancy may be caused by the seed coat which may inhibit germination by controlling oxygen availability to the embryo.

Entry Potential: This species is recorded in maize in USA and has potential to enter Australia in feed maize as a contaminant.

Establishment and Spread Potential: High

Estimated Risk: The WRA results indicated this species has high potential (score 17) to establish, spread and become a weed in Australia.

References:

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Hatterman VH, Bello IA and Owen MDK (1996) Physiological basis of seed dormancy in woolly cupgrass (*Eriochloa villosa*). *Weed Science*. Weed Science Society of America. 44, 87-90.

7.1.27 Species: Equisetum arvense L. Family Equisetaceae

Synonyms: None.
Common names: Horsetail, common horsetail (Australia, USA, Canada)
Status as a quarantine weed: .Noxious Weed in Western Australia, South Australia, New South Wales and Queensland, and Prohibited Plant in Western Australia and Australia.

Distribution
Oceania: Australia, New Zealand
Africa: Madagascar, Mauritius
North & Central America: Canada, USA (all states except the southeast)
South America: Argentina, Brazil, Chile
Asia: Japan, India, Iran, China, Korea
Europe: Belgium, UK, Finland, Russia, Germany, Yugoslavia, France, Czechoslovakia, Poland, Romania, Sweden, Spain, Iceland, Italy, Turkey

Biology: *Equisetum arvense* is a perennial siliceous herb related to the ferns. It spreads by rhizomes, tubers and spores, and overwinters by rhizomes and tubers.

The plant body consists of an extensive and deep (several metres) perennial rhizome system, which produces small tubers at some of the nodes and annual shoots. The rhizomes are slender, well branched, whitish and distinctly jointed, with brown scale leaves at each node. The tubers have not been well described. Axillary buds on the rhizomes give rise to hollow jointed annual shoots 20-60 cm tall, of two kinds. The commoner kind are slender green sterile shoots which have whorls of lateral branches, with minute scale leaves at each node on the main stems and laterals. The fertile shoots are paler, thicker, and lack lateral branches, but end in a cone-like mass of sporocarps which produce spores underneath.

Long distance dispersal is by spores, which probably have a short life before desiccating, and are dispersed by the wind. If they settle in moist places they may germinate to produce new plants. Short distance spread is by rhizomes, which grow rapidly and produce new plants. Portions of rhizomes and tubers also spread the plants, but again are very liable to desiccation. Most dispersal is by rhizome fragments and tubers in soil, either accidentally or deliberately.

Equisetum arvense is sometimes a serious competitor with other plants in moist disturbed places, as well as being poisonous to stock. It is a persistent weed in gardens, horticulture, railway banks, roadsides etc., but less of a problem in agriculture. It does not tolerate shade at all well, and grows best in moist to wet situations. It is sometimes illegally distributed as a pot herb or for its curious nature.

Entry potential: *Equisetum arvense* is listed as a contaminant of maize from the USA, which is curious since it does not produce seed. The contaminants are presumably tubers, through how they come from the soil to contaminate maize is unknown. It is unlikely that the tubers would survive the desiccation associated with removal from the soil and mixing with stored dry grain. Spores are also probably only on short viability and unlikely to remain alive when moving with maize.

Establishment: *Equisetum arvense* is most unlikely to establish in new locations from desiccated tubers or spores contaminating maize.

Spread: Should *Equisetum arvense* become established outside its presently very limited distribution in a few moist places in Australia, it could be spread in moist soil or possibly as spores.

References

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7.1.28 Species: Eupatorium capillifolium (Lam.) Small. Family: Asteraceae

Synonym: *Eupatorium foeniculaceum* Willd
Common names: Dog fennel (USA).
Status as a quarantine weed: A Prohibited Plant by AQIS.

Distribution
North America: USA (southeastern states from Texas to New England)

Biology: *Eupatorium capillifolium* is an erect rather woody annual herb which spreads only by seed.

The plant has a strong woody taproot, with many brownish woody laterals in the surface soil. The single or several rather woody stems are 50-80 cm tall, and branch mainly towards the apex to give flowering branches. The lower leaves occur in opposite pairs, and the upper stem leaves singly. Lower and mid stem leaves are 2-10 cm long and once or twice pinnately divided into linear segments, whilst the uppermost stem leaves and those of the inflorescence tend to be less divided or even simple. The leaves are smooth, hairless and glandular, and often have tufts of smaller leaves in their axils. Large heads of tiny green to bronze flower clusters develop on slender branches towards the tops of the stems. Each cluster is 2-3.5 mm long with 2 distinct rows of bracts enclosing 3-6 minute greenish-white flowers. Fertilised flowers develop into slender tapering fruits 2-3 mm long which terminate in a deciduous tuft of fine hairs. The fruits are distributed mainly by the wind.

Eupatorium capillifolium is a summer growing weed of cultivation, gardens, pastures, field borders and roadsides, rubbish dumps, and other disturbed well-lit situations, where it may form dense masses that exclude other plants.

Entry potential: Seeds of *Eupatorium capillifolium* occur as contaminants of maize seed exported from the USA, and could be carried to all parts of Australia in feed maize.

Establishment: Seeds spilled along roadsides and around feedlots etc. may germinate, especially if they fall or are washed into ditches and damp places. Once established they would probably flourish, grow, and reproduce.

Spread: Once established the seeds of *Eupatorium capillifolium* would be spread by the wind and also perhaps on vehicles, in irrigation and flood water, in soil, and in plant debris. It is not yet present in Australia.

References

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7.1.29 Species: Euphorbia supina Raf. ex Boiss. Family: Euphorbiaceae

Synonym: *Euphorbia maculata* non L. This is one of a world-wide group of very similar species, between which the differences are often very small and among which some taxonomic confusion occurs.
Common names: Prostrate spurge, hairy spurge, milk spurge or purslane (USA).
Status as a quarantine weed: A Prohibited Plant in Western Australia, and also by AQIS as 'Euphorbia (other species)'.

Distribution
North & Central America: USA (eastern to midwest states, Idaho, Arizona and western coastal areas), Canada (Quebec to Ontario)
Asia: Japan
Oceania: New Zealand

Biology: *Euphorbia supina* is a prostrate annual to shortly perennial herb which spreads only by seed.

The plant has a slender vertical taproot with short laterals along its length. Immediately above ground level the stem branches to produce several prostrate primary branches, each of which carries secondary and tertiary branches so that the whole forms an approximate circle 10-60 cm across. The stems are reddish and finely hairy, and exude white latex when broken. The 4-10 mm long oval leaves occur in opposite pairs along all branches, may have finely toothed tips, and are often reddish or purplish with a darker central spot or streak. Clusters of small hairy greenish to reddish flowers occur in the leaf axils, each consisting of a larger female flower surrounded by several smaller males. Fertilised female flowers develop into spherical green to red fruits about 2 mm across, which split into 3 parts at maturity to violently eject the 3 seeds. Each of the brownish sectoroid seeds is about 1 mm long.

Euphorbia supina occurs mainly dry open places without plant cover, such as paths, tracks and other trafficked areas, dry lawns, wasteland and roadsides.

Entry potential: Seeds of *Euphorbia supina* occur as contaminants of maize seed exported from the USA, and could be carried to all parts of Australia in feed maize.

Establishment: Seeds spilled along roadsides and around feedlots etc. are likely to be deposited in the open often trafficked conditions that suit them best, and may germinate. Once established they would probably flourish, grow, and reproduce.

Spread: Once established the seeds of *Euphorbia supina* could be spread on vehicle tyres etc. and in irrigation and flood water, in soil, and in plant debris. It has not yet been recorded in Australia, but since it is a member of a group of very similar annual prostrate Euphorbia species of which several occur in Australia, it may well be present.

References

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7.1.30 Species: Helianthus annuus L. Family: Asteraceae

Synonyms: None
Common name: Sunflower.
Status as a quarantine weed: A herbicide (imazethapyr) resistant genotype has developed in the USA; no herbicide resistant genotypes are known to exist in Australia.

Distribution: Sunflowers are a very important agricultural crop throughout the world, especially in warm temperate and subtropical areas. The crop is very important in parts of Australia, where it is mainly grown for oilseed but also for birdseed, whilst horticultural varieties are also grown.

Helianthus annuus has been recorded as a weed (=? naturalised) as follows:
North and Central America: Mexico, USA
South America: Argentina, Brazil, Peru, Uruguay, Venezuela, Dominican Republic
Asia: Israel, Philippines, Cambodia
Europe: Turkey
Oceania: Australia

Biology: *Helianthus annuus* is an erect annual herb which reproduces only by seed.

The plant has a deep strong taproot and produces an extensive system of horizontal feeder roots in the surface soil. The single erect stem is 1-2 m tall (varieties up to 4 m tall also exist) and is unbranched in commercial varieties (resulting in a single flower head) but branched in wildlings and horticultural varieties. The stem is woody and has a ridged and roughly hairy surface. The alternate leaves are widely spaced along the stem and are carried on long stout stalks. Leaf blades vary from cordate on the lower stem to ovate towards the apex, are 10-30 cm long, stiffly hairy, and generally have 3 main veins. Flower heads are 10-40 cm across and consist of 3 rows of bracts surrounding a single row of usually bright yellow sterile ray florets. The centre of the flower head is occupied by spiral rows of yellow-brown disc florets, each topping a single-seeded ovary. The flowers are pollinated by insects (especially bees), and fertilised disc florets develop into oval to elongate flattened fruits 5-10 mm long which vary from white through brown and grey to black and may be striped. The fruits have no natural method of dispersal, but are dropped during harvest, transport and handling.

Helianthus annuus is mainly a crop, but due to spillage during transport and handling is frequently seen along roadsides and railways and around yards where the seeds are handled. Since most commercial varieties are F1 hybrids the plants that develop from them are usually variable and often multiheaded.

Entry potential: Seeds of American genotypes of *Helianthus annuus* occur as contaminants of maize seed exported from the USA, and could be carried to all parts of Australia in feed maize.

Establishment: Some of the seed spilled along roadsides and around feedlots etc. are likely to be deposited in suitable conditions for germination and growth. Once established they would probably flourish, grow, and reproduce, with herbicide resistance possibly being transferred to breeding or commercial crops.

Spread: Once established herbicide resistance may complicate breeding and management of the crop in Australia.

References

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7.1.31 Species: ***Ipomoea hederacea*** **(L.) Jacq. Family: Convolvulaceae**

Synonyms: *Convolvulus hederaceus* L.
Common name: Ivy-leaf morning glory (USA)
Status as a quarantine weed: A Prohibited Plant in Western Australia and in Australia.

Distribution
Oceania: Australia (Qld)
Africa: Ghana
North & Central America: USA (Florida to Arizona and Northward to New England and North Dakota)
South America: Brazil
Asia: India, Philippines

Biology: *Ipomoea hederacea* is a twining annual herb, and it reproduces only by seed.
The plant has of a strong white taproot, with many laterals in moist fertile surface soil. The usually single hairy stem grows to 1-3 m tall, branches mainly near the base, and twines around any available support or forms masses on the ground. The deeply 3-lobed (occasionally 5-lobed or without lobes), alternate leaves are well spaced along the stem. They are long-stalked and heart-shaped, with pointed tips and deeply rounded lobed bases, are somewhat hairy, and 2-12 cm wide and long. One to several flowers develop on short hairy stalks in the axils of the upper leaves, each with a distinctly hairy calyx with 5 long slender points and blue to white or mauve trumpet-shaped petal tube 2-5 cm long. Fertilised flowers develop into globular green hairy fruits about 1 cm across, which are brown and papery when mature and split to release the 4-6 sectoroid dark brown 6 mm long seeds.

Ipomoea hederacea is a weed of cultivation (summer crops), gardens, wasteland, roadsides, creek banks etc. It causes problems by climbing crops, binding them together, shading the leaves, and contaminating the harvest.

Entry potential: Seeds of *Ipomoea hederacea* occur as contaminants of maize seed exported from the USA, and could be carried to all parts of Australia in feed maize.

Establishment: Seeds spilled along roadsides and around feedlots etc. may well be placed in sufficiently moist situations to enable their germination (especially in nitrogen rich areas around feedlots), after which they would be likely to establish, grow and reproduce.

Spread: Once established *Ipomoea hederacea* could spread in flood, drainage and irrigation water, in manure, and in mud on vehicles etc. It would increase the currently quite restricted areas of infestations of this weed in Australia.

References

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7.1.32 Species: Ipomoea lacunosa Linn. Family: Convolvulaceae

Synonyms: None recorded
Common Name: Pitted morning-glory
Status as quarantine weeds: Not recorded as present in Australia, prohibited species

Distribution: USA (from Georgia to eastern Texas and northward to Pennsylvania, Ohio and Kansas), Japan

Biology: Pitted morning-glory is a twining annual with a slender tap root. Leaves are ovate and may be 9.5x 8cm in size. Fruits are round, hairy capsules upto 10 mm wide. Pitted morning-glory occurs in cultivated fields, meadows, roadsides, and waste areas throughout most of the eastern USA. *I. lacunosa* can cross with *I trihocarpa*. Seed production may be as high as 6000-14000 seeds/plant. Seeds are viable after being stored for 39 years.

Entry Potential: This species is recorded in many field crops in USA and has potential to enter Australia in feed maize as a contaminant.

Establishment and Spread Potential: High

Estimated Risk: The WRA results indicated this species has high potential (score 12) to establish, spread and become a serious weed in Australia.

References:

http://128.227.103.58/438.

http://herbaria.harvard.edu/china/convo/ipomoea.htm.

7.1.33 Species: Ipomoea purpurea (L.) Roth. Family: Convolvulaceae

Synonyms: *Convolvulus purpureus* L.
Common names: Morning glory, common morning glory (Australia, USA), tall or annual morning glory (USA).
Status as a quarantine weed: A Prohibited Plant in Western Australia and in Australia.

Distribution
Oceania: Australia.
Africa: South Africa, Angola
North & Central America: Mexico, USA (eastern & central states, western seaboard), Honduras
South America: Argentina, Chile, Venezuela, Brazil

Biology: *Ipomoea purpurea* is a twining annual to shortly perennial herb, reproducing mainly by seed but the stems sometimes rooting where they touch moist soil.

The plant has of a strong white taproot, with many laterals in moist fertile surface soil. The usually well branched rather hairy stems grow 2-5 m tall, and either sprawl over the ground or twine around any available support, often forming dense masses. The usually heart-shaped but occasionally 3-lobed alternate leaves are well spaced along the stem. They are long-stalked, with short pointed tips and deeply lobed bases, are finely hairy-bristly, and 2-12 cm long. One to several flowers develop on short hairy stalks in the axils of the upper leaves, each with a distinctly hairy calyx. The flowers appear pleated in the bud, and open bright purple or occasionally red, pink, mauve, whitish or striped, with a deeply trumpet-shaped petal tube 3-7 cm long. Fertilised flowers develop into globular green hairy fruits 7-11 mm across, which are brown and papery when mature and split to release the 2-4 sectoroid dark brown to black 4-5 mm long seeds.

Ipomoea purpurea is a weed of summer crops, gardens, wasteland, roadsides, creek banks etc., and can be a serious environmental weed in warm moist areas. It causes problems by climbing

crops, binding them together, shading the leaves, contaminating the harvest, and choking out native plants.

Entry potential: Seeds of *Ipomoea purpurea* occur as contaminants of maize seed exported from the USA, and could be carried to all parts of Australia in feed maize.

Establishment: Seeds spilled along roadsides and around feedlots etc. may well be placed in sufficiently moist situations to enable their germination (especially in nitrogen rich areas around feedlots), after which they would be likely to establish, grow and reproduce.

Spread: Once established *Ipomoea purpurea* could spread in flood, drainage and irrigation water, in manure, and in mud on vehicles etc. It would increase the currently restricted areas of infestations of this weed in Australia.

References

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7.1.34 Species: Ipomoea turbinata Lag Family: Convolvulaceae

Synonyms: *I. muricata* Jacq, *Calonyction longiflorum* Hasskarl
Common Name(s): morning glory
Status as quarantine weeds: Not recorded as present in Australia, prohibited species.

Distribution: USA, China, India, Indonesia, Japan, Kashmir, Myanmar, Nepal, Pakistan, Philippines, Sri Lanka, Vietnam, Africa, North America and South America.

Biology: Herb annual, twining, sap milky. Stems 2-10m. Inflorescences 1 to few flowered. Flowers nocturnal. Corolla pale purple. Capsule ovoid, 1.8-2 cm. Seeds black, 9-10mm. Reproduces by seed.

Entry Potential: This species is recorded in many field and vegetable crops in USA and has potential to enter Australia in feed maize as a contaminant.

Establishment and Spread Potential: High

Estimated Risk: The WRA results indicated this species has high potential (score 10) to establish, spread and become a serious weed in Australia.

References:
http://herbari.harvard.edu/china/convo/conv084.htm

7.1.35 Species: Kochia scoparia (L.) Roth Family: Chenopodiaceae

Synonyms: *Kochia scoparia* (L.) Schrader

Common names: Kochia, Mexican fireweed (USA). The ornamental form is called summer cypress or burning bush.
Status as a quarantine weed: A Prohibited Plant in Western Australia and by AQIS, a Noxious Weed in South Australia and the Commonwealth of Australia, and with herbicide (atrazine, chlorsulfuron/metsulfuron) resistant genotypes not yet found in Australia in the USA and chlorsulfuron resistant genotypes in Canada but not yet found in Australia.

Distribution
Oceania: Australia
North & Central America: USA (northeastern & northcentral states), Canada
Asia: Afghanistan
Africa: South Africa

Biology: *Kochia scoparia* is an erect branched rather woody annual herb, and reproduces only by seed.

The root system of *Kochia scoparia* consists of a strong woody taproot with fine woody laterals. The stem is usually single, but branches widely near the base to give a rounded plant. The rather woody stems are 0.3-1.5 m tall, usually smooth below but more commonly finely hairy above. The slender leaves arise singly along the stems, are stalkless, hairless to densely hairy, and 2-5 cm long. Slender spikes of small inconspicuous greenish flowers develop singly or in pairs in of the all upper leaf axils. Fertilised flowers develop into dry chaffy fruits, each enclosing a single hard dry ovate flattened brown seed about 1.8 mm long. At maturity the leaves turn orange and red (hence its ornamental value) and the plant may break off at ground level and be blown across the landscape, scattering seeds as it rolls.

Kochia scoparia is a potentially very serious weed of Australian dryland agriculture, especially in the cooler Mediterranean bioclimatic regions. It was introduced into Western Australia as a salt-tolerant forage plant, but very quickly became weedy and is now under intensive control everywhere that it occurs. The ornamental form has been grown in gardens for a long time, but is now also prohibited.
Kochia scoparia is very drought resistant, and in the USA is a serious weed of cultivation, roadsides, wasteland and dry pastures

Entry potential: Seeds of *Kochia scoparia* occur as contaminants of maize seed exported from the USA, and could be carried to all parts of Australia in feed maize.

Establishment: Seeds spilled along roadsides and around feedlots etc. are likely to germinate, flourish, grow and reproduce.

Spread: Once established *Kochia scoparia* would be spread largely by the wind, although seeds could also be dispersed in flood, drainage and irrigation water, in manure, and in mud on vehicles etc. It would increase the currently very restricted areas of infestations of this weed in Australia.

References

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7.1.36 Species: Lolium multiflorum Lam. and *Lolium perenne* L. Family: Poaceae

Synonyms: *Lolium italicum* ABr. and *L. linicolum* ABr. respectively. A number of hybrids occur within the genus *Lolium*.
Common names: Italian rye grass and perennial ryegrass respectively.
Status as quarantine weeds: Herbicide resistant genotypes occur in the USA but not in Australia as follows: *L. multiflorum* - diclofop, *L. perenne* - sulfmeturon
Distribution: Ryegrasses are very important pasture plants throughout the moist temperate world, and frequently persist as weeds when grown in rotation with crops.

Lolium multiflorum has been recorded as a weed as follows:
North and Central America: Canada, USA
South America Brazil, Argentina, Peru, Uruguay, Chile, Colombia, Ecuador
Asia Afghanistan, Japan, Lebanon, India, Iran, Iraq, Jordan, Nepal
Europe: Poland, Italy, Greece, Belgium, UK, France, Germany, Netherlands, Portugal, Spain, Yugoslavia
Africa: Tunisia, Egypt, Morocco, South Africa, Kenya, Zimbabwe
Oceania: Australia, Fiji, New Zealand, Hawaii
Lolium perenne has been recorded as a weed as follows:
North and Central America: Canada
South America: Argentina, Chile
Asia: Iran, Jordan, Israel, India, Taiwan
Africa: Egypt, South Africa
Europe: Spain, Italy, Turkey, Finland
Oceania: New Zealand, Hawaii

Biology: *Lolium multiflorum* and *L. perenne* are tufted annual and perennial grasses respectively; both reproduce only by seed.

The plants consist of clumps of tillers, united by a common base and extensive branched fibrous root system. The tillers are erect and may be branched at the base, and are enclosed in the leaf bases. The leaf bases of both species are smoothly rounded, green (turning reddish in stressed plants) and hairless, and terminate in distinct auricles and membranous ligules. The leaf blades are 5-20 cm long, linear, bright green, hairless and shiny in both species, 4-10 mm wide in *L. multiflorum* and 2-5 mm wide in *L. perenne*. Each tiller or branch surrounds a slender erect cylindrical culm, which terminates in a slightly zigzag rachis bearing alternate spikelets, the whole held in a flattened plane. Each spikelet consists of about 10 florets. The grains are elongate, 4-8 mm long, pale brown, and either awned or awnless (*L. multiflorum* and *L. perenne* respectively).

Lolium spp. are primarily weeds of cultivation in rotation with pastures.

Entry potential: Seeds of *Lolium multiflorum* and *L. perenne* occur as contaminants of maize seed exported from the USA, and could be carried to all parts of Australia in feed maize.

Establishment: If spilled with feed maize along roadsides and around feedlots etc. the seeds are likely to be deposited in suitable conditions for germination and growth. Once established they would probably flourish, grow, and reproduce, with herbicide resistance possibly being transferred to breeding or commercial crops.

Spread: Once established herbicide resistance may complicate breeding and management of the grasses either as pastures or as weeds in Australia.

References

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7.1.37 Species: Muhlenbergia frondosa (Poir) Fern Family: Poaceae

Synonyms: None recorded
Common Name: wirestem muhly
Status as quarantine weeds: Not recorded as present in Australia, prohibited spcies

Distribution: USA (Pennsylvania, Nebraska, Indiana)

Biology: Perennial grass native to USA reproducing by rhizome and seed. Average height is 1.3 m. Inflorescence: panicle, densely flowered, occasionally partly enclosed in the upper sheath. Spikelet: 1 flowered. Culm: erect, often branching at the middle nodes. The internodes are smooth and shining.

Wirestem muhly is one of the serious grass weeds invading maize fields, particularly in no-tillage systems.

Entry Potential: This species is recorded in many field crops in USA and has potential to enter Australia in feed maize as a contaminant.

Establishment and Spread Potential: High

Estimated Risk: The WRA results indicated this species has high potential (score 14) to establish, spread and become a serious weed in Australia.

References:

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7.1.38 Species: Panicum capillare L. Family: Poaceae

Synonym: *Panicum barbipulvinatum* Nash
Common name: Witchgrass, tumbleweed, tumble panic, ticklegrass (USA)
Status as a quarantine weed: Prohibited by AQIS. A herbicide (atrazine) resistant genotype has developed in Canada; no herbicide resistant genotypes are known to exist in Australia.

Distribution:
North and Central America: USA(throughout), Canada, Mexico
Asia: India
South America: Chile, Argentina
Oceania: Australia (WA, SA, NSW, Vic), Hawaii, New Zealand
Europe: France, Germany, Spain, Italy, UK, central Europe, Russia

Biology: *Panicum capillare* is an annual tufted grass, and reproduces only by seed.

The plant consists of a mass of tillers joined at the base by a common branched fibrous root system. The tillers are 20-100 cm tall and normally erect, but may be geniculate (and then may root at the lower nodes) and often branch near the base. The leaf blades are 10-25 cm long and 5-15 mm wide, and taper towards the tip. The nodes and leaf sheaths are densely hairy. Ligules consist of short fringed collars, and whilst auricles are absent the leaf base has a tuft of long fine hairs. The lower parts of the leaf margins are also distinctly hairy. Within each tiller the apex of the culm develops into an inflorescence, which at maturity consists of a very large and profusely branched spreading panicle with fine stalks, 20-40 cm long and up to half the size of the mature plant. The small spikelets are straw-coloured, and break off either before the plant dies or as the

dead inflorescence breaks away and blows over the surface of the ground as a tumbleweed, scattering the remaining seeds.

Panicum capillare is a weed of summer cultivation, fallows, gardens, pastures and field margins, as well as roadsides, wasteland etc.

Entry potential: Seeds of *Panicum capillare* occur as contaminants of maize seed exported from the USA, and could be carried to all parts of Australia in feed maize.

Establishment: Seed spilled along roadsides and around feedlots may be deposited in suitable conditions for germination and growth. Once established they would probably flourish, grow, and reproduce.

Spread: Once established *Panicum capillare* would extend the scattered populations already present in Australia, and may possibly introduce herbicide resistance into this country.

References

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7.1.39 Species: Panicum dichotomiflorum Michx. Family: Poaceae

Synonym: *Panicum autumnale* Michx
Common name: Fall panicum, spreading panic grass (USA)
Status as a quarantine weed: Prohibited by AQIS.

Distribution:
North and Central America: USA (mainland states except northeast, northcentral and parts of Texas), Canada, Mexico
South America: Argentina, Brazil, Colombia, Chile
Oceania: New Zealand, Hawaii
Asia: Bangladesh, China, Japan
Europe: Italy, France, southeast Europe, Russia

Biology: *Panicum dichotomiflorum* is an annual tufted grass, and reproduces only by seed.

The plant consists of a mass of tillers joined at the base by a common branched fibrous root system. The tillers are 50-100 cm tall and normally geniculate and may root at the lower nodes, and often branch near the base. The slightly roughened leaf blades are 10-50 cm long and 5-25 mm wide, have a prominent white midrib, and taper towards the tip. The leaf bases may be purplish, the nodes are hairless, the ligules consist of a dense ring of white hairs, and auricles are absent. The youngest leaves are rolled. Within each tiller the apex of the flattened culm and often axillary buds develop into inflorescences, which at maturity are often partly enclosed in the uppermost leaf and consist of open 10-40 cm long ascending branches ending in very fine spikelets and florets. The small spikelets are straw-coloured, and break off before or after the plant dies.

Panicum dichotomiflorum is a weed of summer cultivation, fallows, gardens, pastures and field margins, as well as roadsides, wasteland etc.

Entry potential: Seeds of *Panicum dichotomiflorum* occur as contaminants of maize seed exported from the USA, and could be carried to all parts of Australia in feed maize.

Establishment: Seed spilled along roadsides and around feedlots may be deposited in suitable conditions for germination and growth. Once established they would probably flourish, grow, and reproduce.

Spread: Once established *Panicum dichotomiflorum* would be spread by vehicles, irrigation and flood water, and in soil and plant debris. It is not known to occur in Australia.

References

Anon. 1970. Selected Weeds of the United States. P. 72-73. Agriculture Handbook No 366. Washington DC, USA; United States Department of Agriculture.

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7.1.40 Species: Panicum ramosum Arech Family: Poaceae

Synonyms: None recorded
Common Name(s): browntop millet
Status as quarantine weeds: Not recorded as present in Australia, prohibited species

Distribution: USA (Florida), USSR, Iraq, Nigeria, India

Weediness: *Panicum ramosum* is a very competitive species and can reduce yield of many crops. Browntop millet can reduce the yield of rice by 44-56%. Experiments indicated that the species was the most rapid to establish among companion grasses and also most competitive of warm season turfgrasses.

Entry Potential: This species is recorded in many field crops and vegetable in USA and has potential to enter Australia in feed maize as a contaminant.

Establishment and Spread Potential: High

Estimated Risk: The WRA results indicated this species has high potential (score 16) to establish, spread and become a serious weed in Australia.

References:

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7.1.41 Species: Panicum texanum Buckley Family: Poaceae

Synonyms: None recorded
Common Name: Texas Panicum
Status as quarantine weed: Not recorded as present in Australia, prohibited species

Distribution: USA (Mississippi, Arkansas, Oklahoma, Florida, New Mexico, Western States, Alabama, Georgia)

Weediness: Texas panicum can reduce yield of a variety of crops by competition. Twenty five percent of seed of *P. texanum* is found to be viable after being buried for 21 years.

In glasshouse experiments, texas panicum was subjected to flooding for 9 days followed by drainage for 4 days. The roots were reduced by 50% under all flooding experiments. The experiments may partially explain why Texas panicum competes well in well-drained sandy soil and not during wet periods.

Entry Potential: This species is recorded in many field and vegetable crops in USA and has potential to enter Australia in feed maize as a contaminant.

Establishment and Spread Potential: High

Estimated Risk: The WRA results indicated this species has high potential (score 16) to establish, spread and become a serious weed in Australia.

Reference:

Egley GH and Chandler JM (1978) Germination and viability of weed seeds after 2.5 years in a 50 years buried seed study. *Weed Science*. **26**: 230-239.

7.1.42 Species Polygonum convolvulus L. Family: Polygonaceae

Synonyms: *Fallopia convolvulus, Polygonum pauciflorum*
Common names:
Status as a quarantine weed: A Prohibited Plant
Distribution: Australia, New Zealand, USA, Canada, Argentina, Chile, Japan, Iran, Jordan, India, Morocco, Tunisia, Germany, Hungary, Poland, Portugal, Russia, Yugoslavia, UK, Norway, Sweden, Turkey, Finland, Spain, Belgium, Czechoslovakia, France, Greece, Iceland, Italy, Denmark, Netherlands, Switzerland.
The species appear to remain outside the humid tropics. But its can adapt to a wide range of climate around the globe.

Biology *Polygonum convolvulus* is an annual herb twining plant and only reproduces by seed.

Polygonum convolvulus is an annual vining herb; root fibrous, stems slender, freely branched from the base, trailing on the ground or twiningabout other plants, 2.5 m long. Leaves are simple heart shaped, flowers are in spikelike racemes, small, greenish white, fruit are egg shape, seeds are 3 mm long, dull or shiny black.

Polygonum convolvulus is a serious weed of many grain crops. Its twining habit causes lodging in grain sothat the crop is difficult to harvest. A single plant which emerge early in the season can produce as many as 30,000 sedds. The seed can remain dormancy in the soil for several years. Most seed are found emerged from 1.3-5 cm, some can came from 19 cm depth. The cultivation practice by burying the seeds with tillage operations is likely to fail.

Entry potential: Seeds of *Polygonum convolvulus* occur in maize fields, and could be carried to all parts of Australia in feed maize.

Establishment: Seeds spilled along roadsides and around feedlots etc. are likely to germinate, especially if they fall or are washed into ditches and damp places. Once established they would probably flourish, grow and reproduce.

Spread: Once established *Polygonum convolvulus* would be spread largely by flood, drainage and irrigation water, but also in soil, in crop and pasture seed and in plant debris. It would increase the currently fairly widespread infestations of this weed in Australia.

References

Holm, LG, Plucknett DL, Pancho, JV and Herberger JP (1977) The world's worst weeds distribution and biology. The University Press of Hawaii, Honolulu.

7.1.43 Species: Polygonum lapathifolium L. Family: Polygonaceae

Synonyms: *Polygonum nodosum* Pers., *Persicaria nodosa* Pers., *Persicaria lapathifolia* (L.) Gray.
Common names: Pale knotweed (Australia), pale smartweed (USA, Canada), willow weed (New Zealand)
Status as a quarantine weed: A Prohibited Plant by AQIS.

Distribution
Oceania: Australia, New Zealand
North & Central America: USA, Canada
South America: Argentina, Chile
Asia: Afghanistan, Korea, Taiwan, China, Iraq, Japan, Lebanon, Indonesia, Iran, Jordan, Pakistan, Israel, Saudi Arabia, Thailand
Africa: South Africa, Tunisia, Algeria, Egypt, Morocco
Europe: Germany, Hungary, Poland, Portugal, Russia, Yugoslavia, UK, Norway, Sweden, Turkey, Finland, Spain, Belgium, Czechoslovakia, France, Greece, Iceland, Italy, Denmark, Netherlands, Switzerland

Biology *Polygonum lapathifolium* is an erect annual herb (often of damp places), and only reproduces by seed.

The plant has a weak, slender taproot. The stems may be semiprostrate or erect, and are strongly jointed, swollen above the nodes, red to green, hollow, branched and 30-120 cm tall. They may root at the lower nodes (especially if the soil is damp), and the upper stems are often glandular and gummy. There is a distinctive cylindrical membranous ochrea around the stem above each node. The leaves are alternate, slender to lanceolate, 5-15 cm long, rolled in the bud, fringed with hairs, with oil glands beneath, and often with a darker chevron above. The small whitish, greenish or pink flowers occur in slender nodding spikes above the leaves. Fertilised flowers develop into oval shiny brown or triangular nuts 1.5-3 mm long. The fruits are dispersed by water and also probably in soil and on aquatic birds and in plant debris.

Polygonum lapathifolium is a sometimes serious weed of many types of crops in both dryland and damp situations, as well as being a weed of damp pastures. The plants are unpalatable and rarely grazed.

Entry potential: Seeds of *Polygonum lapathifolium* occur as contaminants of maize seed exported from the USA, and could be carried to all parts of Australia in feed maize.

Establishment: Seeds spilled along roadsides and around feedlots etc. are likely to germinate, especially if they fall or are washed into ditches and damp places. Once established they would probably flourish, grow and reproduce.

Spread: Once established *Polygonum lapathifolium* would be spread largely by flood, drainage and irrigation water, but also in soil, in crop and pasture seed and in plant debris. It would increase the currently fairly widespread infestations of this weed in Australia and may introduce it into Western Australia.

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7.1.44 Species: Polygonum pensylvanicum L. Family: Polygonaceae

Synonyms: none

Common names: Pennsylvania smartweed (USA)
Status as a quarantine weed: An Prohibited Plant of AQIS and Western Australia; a herbicide (atrazine) resistant genotype occurs in the USA which is not present in Australia.
Distribution: USA (central and eastern states, Alaska)

Biology *Polygonum pensylvanicum* is an erect annual herb, and only reproduces by seed.

The plant has a weak, slender taproot. The stems are ascending to erect, strongly jointed, swollen above the nodes, branched, often roughly hairy, and 50-150 cm tall. There is a distinctive cylindrical membranous ochrea around the stem above each young node, but they soon fall away. The leaves are alternate, lanceolate to oval, 5-15 cm long, rolled in the bud, and often shortly hairy. The flowers occur in dense erect bright pink spikes 1-1.5 cm thick at the top of the plant. Fertilised flowers develop into oval shiny flattened black nuts 2.5-3.5 mm long. Pennsylvania smartweed may cause skin irritation and photosensitivity in cattle.

The fruits are dispersed in soil, as a contaminant of crop and pasture seed, possibly on aquatic birds, and in plant debris.

Polygonum pensylvanicum is a significant weed of crops in the USA, and also occurs in damp situations and pastures, roadsides, and wasteland. The plants are unpalatable and rarely grazed.

Entry potential: Seeds of *Polygonum pensylvanicum* occur as contaminants of maize seed exported from the USA, and could be carried to all parts of Australia in feed maize.

Establishment: Seeds spilled along roadsides and around feedlots etc. are likely to germinate, especially if they fall or are washed into ditches and damp places. Once established they would probably flourish, grow and reproduce.

Spread: Once established *Polygonum pensylvanicum* would be spread in soil, in crop and pasture seed and in plant debris. It is not yet present in Australia.

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Stubbedieck J, Friisoe GY and Bolick MR (1994) Weeds of Nebraska and Great Plains. Nebraska Department of Agriculture, Bureau of Plant ndustry, Lincoln, Nebraska, p 526.

7.1.45 Species: ***Rubus allegheniensis*** **Porter Family: Rosaceae**

Synonyms: None recorded
Common names: Allegheny blackberry.
Status as a quarantine weed: A Prohibited Plant by AQIS.

Distribution

North America: USA (northeastern states from Great Lakes to New England), Canada (Great Lakes to Nova Scotia)

Biology: *Rubus allegheniensis* is a prickly perennial shrub, reproducing by seed and by rhizomes.

The plant consists of a sprawling mass of branched prickly canes of two kinds - primocanes which are more leafy but do not produce flowers, and floricanes which are less leafy but carry flowers. Primocanes are 1-3 m tall, erect or arching, with scattered 3-5 mm long prickles. They are finely hairy and carry 5-palmate prickly leaves with 5-12 cm long finely toothed leaflets.

Floricanes tend to be shorter, and although erect at first may droop under the weight of fruit. They are generally hairless, and carry 3-palmate less prickly leaves. Flowers are carried only on the floricanes. The flowers occur in lax racemes 8-25 cm long at the tips of the branches, on slender hairy stalks. Each flower has 5 white rounded petals surrounding a mass of stamens and central styles. Fertilised flowers develop into compound fruits consisting of 50-70 drupelets, each containing a single woody seed about 1 mm long. The seeds are distributed by frugivourous birds and animals.

Rubus allegheniensis occurs naturally throughout its range in woodlands, hillsides, creek and river banks, roadsides, cleared areas and other well lit places.

Entry potential: Seeds of *Rubus allegheniensis* occur as contaminants of maize seed exported from the USA, and could be carried to all parts of Australia in feed maize.

Establishment: Seeds spilled with feed maize along roadsides and around feedlots etc. are unlikely to germinate, unless washed into cool moist shady ditches and other damp places. If they were to establish they would probably only flourish, grow, and reproduce in cool moist areas similar to those from which the species originated.

Spread: Once established in cool moist areas the seeds of *Rubus allegheniensis* may be spread by birds, foxes and other frugivourous animals. It may then go undetected for some time, since it is similar to *Rubus fruticosus* agg. (blackberry). It is not yet present in Australia.

References

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7.1.46 Species: Rubus fruticosus L. agg Family: Rosaceae

Synonyms: The aggregate species *R. fruticosus* (*R. fruticosus* s.l.) has been divided into a great many species by some taxonomists, based on its apomictic reproduction and resulting fine but stable differences in morphology. All are treated here as *Rubus fruticosus* agg.
Common names: Blackberry, bramble.
Status as a quarantine weed: A Prohibited Plant in Western Australia; a Noxious or Declared Plant in South Australia, Western Australia, New South Wales and Queensland.

Distribution (undifferentiated between *Rubus fruticosus* s.l. and s.s.)
North America: USA, Canada
Oceania : Australia (all states except NT), New Zealand
Europe: Turkey
Asia: Afghanistan
Africa: South Africa
The aggregate species is certainly much more widely distributed than is shown here.

Biology: *Rubus fruticosus* is a prickly perennial shrub, reproducing by seed, as well as by rooting at the tips of canes and by rhizomes.

The plant consists of a sprawling tangled mass of branched prickly canes up to 7 m long, though generally not so high. The canes may climb over any available support, and tend to smother all other ground vegetation. The canes are erect, sprawling or prostrate, red to green, hairless or finely hairy, and carry sharp prickles 3-12 mm long. Canes are biennial, in the first year (primocanes) growing rapidly with many leaves. In the second year these canes (now floricanes) produce flowers in dense racemes 5-15 cm long at the tips of short lateral branches. Each flower has 5 white to pink rounded petals surrounding a mass of stamens and central styles. Fertilised flowers develop into compound fruits 1-3 cm long consisting of 10-25 drupelets, each

containing a single woody seed 2-3 mm long. The seeds are distributed by frugivourous birds and animals.

Rubus fruticosus occurs in humid and subhumid cool to temperate areas, often in less accessible areas such as hillsides, creek banks and under trees. It forms dense mats which restrict movement, grazing and other uses of the land.

Entry potential: Seeds of *Rubus fruticosus* occur as contaminants of maize seed exported from the USA, and could be carried to all parts of Australia in feed maize.

Establishment: Seeds spilled with feed maize along roadsides and around feedlots etc. are unlikely to germinate, unless washed into cool moist shady ditches and other damp places.

Spread: Once established in cool moist areas the seeds of *Rubus fruticosus* may be further spread by birds, foxes and other frugivourous animals. It is already widely distributed in suitable environments throughout southern, southeastern and southwestern Australia, but there is a strong likelihood of new genotypes being introduced which would complicate existing efforts at its biological control by leaf rust fungi.

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7.1.47 Species: Salsola kali L., *Salsola iberica* Sennen & Pau Family: Chenopodiaceae

Synonyms: None
Common names: Russian thistle, tumbleweed (USA), soft rolypoly, prickly saltbush (Australia).
Status as a quarantine weed: A Prohibited Plant by AQIS and in Western Australia.

Distribution:
North and Central America: USA (western, midwest and all coastal states), Canada, Mexico
Oceania : Australia, New Zealand, Hawaii
Europe: Denmark, UK, France, Germany, Hungary, Italy, Netherlands, Norway, Portugal, Russia, Spain, Sweden, Turkey, Greece, Poland
Asia: Iran, Japan, Lebanon, Afghanistan, Iraq, Indonesia, Jordan, Pakistan, Israel
Africa: Egypt, Morocco, South Africa
South America: Argentina, Chile

Biology: *Salsola kali* is a bushy, woody, thorny annual herb, which spreads only by seed.

The plant has a strong woody taproot, from which a woody flexuous erect stem usually 50-100 cm tall develops. The main stem branches strongly from the base to give a rounded bush-like plant. Young stems are grey-green and somewhat succulent, but they soon become woody, hard and thorny. The single leaves are green, slender and pointed and 1-3 cm long, and tend to shrivel, being largely replaced later in life by the sharp-pointed floral bracts. The small green flowers occur singly in the axils of the pointed bracts. The inconspicuous fruits are also green, with 5 spreading dry sepals surrounding the single seed. The seeds are yellow-brown, top-shaped and 2-3 mm across.

Salsola kali is a summer growing plant, growing well in a very wide range of climates, soils and moisture regimes. It is largely confined to disturbed areas such as cultivation, roadsides, pastures, rubbish dumps and wasteland, but also occurs in most other situations. Mature plants dry off, break away at the base and are rolled across open areas by the wind as tumbleweeds, scattering seeds as they go.

Entry potential: Seeds of *Salsola kali* occur as contaminants of maize seed exported from the USA, and could be carried to all parts of Australia in feed maize.

Establishment: Seeds spilled with feed maize along roadsides and around feedlots etc. are most likely to find suitable situations for germination, growth and reproduction.

Spread: Following establishment seeds of American *Salsola kali* plants would join the already almost universal infestations of these plants across Australia.

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7.1.48 Species: Salvia reflexa Hornem. Family: Lamiaceae

Synonyms: None recorded.
Common names: Mintweed (Australia), lanceleaf sage (USA)
Status as a quarantine weed: A Noxious Weed in Western Australia and New South Wales.

Distribution:
North and Central America: USA , Mexico
Oceania : Australia (WA, SA, Qld, NSW, Vic), New Zealand
Biology: *Salvia reflexa* is an erect annual herb, spreading only by seed..

The plant has a weak whitish taproot, and generally has a single erect stem 40-60 cm tall. The stems are weak, grey-green, finely hairy and 4-angled, and under good growing conditions branch from the base upwards. Opposite pairs of leaves develop along all stems; they are grey-green, very finely hairy, narrowly elliptical, smooth-edged and 1.5-5 cm long, and have a strongly mint-like smell when crushed. The pale blue flowers develop in short spikes in the leaf axils and at the ends of the stems. Each flower is 5-7 mm long and strongly 2-lipped, with the lower lip protruding. Fertilised flowers develop into a group of 4 small brown sectoroid nutlets, which are located at the bottom of the deep cup formed by the dried sepals. Fruits are dispersed in soil, plant debris, and by irrigation and flood water.

Salvia reflexa is a weed of summer cultivation, especially of crops on blacksoil and irrigated areas. It also occurs in pastures and on sandbanks, roadsides, wasteland, rubbish dumps, and anywhere else where there is light and disturbance. The plant is somewhat toxic to stock.

Entry potential: Seeds of *Salvia reflexa* occur as contaminants of maize seed exported from the USA, and could be carried to all parts of Australia in feed maize.

Establishment: Seeds spilled with feed maize along roadsides and around feedlots etc. are most likely to find suitable situations for germination, growth and reproduction.

Spread: Following establishment *Salvia reflexa* of American origin would join the already widespread infestations of this species across Australia.

References

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7.1.49 Species: Senecio vulgaris L. Family: Asteraceae

Synonyms: None recorded.
Common names: Groundsel.
Status as a quarantine weed: **A** Prohibited Plant by AQIS.

Distribution:
North and Central America: Canada, USA
Oceania: New Zealand, Australia (WA, Qld, NSW, Vic, Tas)
Europe: Austria, UK, Netherlands, Poland, Sweden, Belgium, Germany, Greece, Hungary, Norway, Spain, Czechoslovakia, Finland, France, Ireland, Iceland, Italy, Portugal, Russia, Turkey, Yugoslavia
Asia: Jordan, Korea, Iran, Israel, Afghanistan, China, Iraq, Lebanon, Japan
Africa: Egypt, Kenya, Tunisia
South America: Argentina, Colombia, Chile, Ecuador

Biology: *Senecio vulgaris* is a weak annual rather fleshy herb which spreads only by seed.

The plant has a weak white taproot and laterals. The main stem is erect, weak, hollow, green, and usually branched, with cottony hairs on its upper part, and is 10-60 cm tall. The alternate leaves are 2-10 cm long, dark green, hairless, and variable in shape from elliptic to toothed or deeply lobed, often with wavy margins. The lower leaves are stalked, and merge into the upper leaves which usually clasp the stem. The minute yellow flowers occur in stalked clusters of several tightly compact heads; each head is enclosed in several rows of slender green bracts and is about 5 mm across. Most plants have only yellow disc florets in the heads, but some populations also contain plants with spreading yellow ray florets. Fertilised disc florets develop into elongate greyish fruits 3-4 mm long, topped by a deciduous tuft of white feathery hairs. The fruits are distributed mainly by the wind but also in soil and plant debris, and since they are somewhat sticky when wet also on people, animals, clothes and shoes. Much distribution occurs through dormant seeds in soil under nursery plants.

Senecio vulgaris is an ephemeral weed of nurseries, vegetables, gardens and wasteland, mainly in cool moist environments.

Entry potential: Seeds of *Senecio vulgaris* may contaminate maize seed exported from the USA, and could be carried to all parts of Australia in feed maize.

Establishment: Seeds spilled with feed maize along roadsides and around feedlots etc. are unlikely to find suitable situations for germination, growth and reproduction outside the cooler and moister areas of Australia.

Spread: Following establishment seeds of American *Senecio vulgaris* plants would join the already widespread (but often localised to protected environments) infestations of this species across Australia.

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7.1.50 Species: Senna obtusifolia (L) Irwin & Barneby. Family: Caesalpiniaceae

Synonyms: *Cassia obtusifolia* L., *Ditremexa occidentalis* (L.) Britton & Rose., *Senna tora* (L.) Roxb. (see below), *Cassia tora* L. (see below)

Senna (*Cassia*) *obtusifolia* has been lumped with *Senna* (*Cassia*) *tora* (L.) Roxb. by many authors including Holm et al. 1997 and Parsons & Cuthbertson 1992, although the two taxa are usually considered by botanists to be separate species. Because of the confusion of taxa *Senna tora* is conflated with *Senna occidentalis* in this discussion as *Senna obtusifolia* sl.

Common names: *Senna obtusifolia* is known as sicklepod or Java bean (Australia).
Status as a quarantine weed: Noxious Weed and Prohibited Plant in Western Australia, Declared Plant in Queensland;

Distribution
Senna obtusifolia sl:
Oceania: Australia (NT, Qld)
Asia: Indonesia, India, Malaysia
Northern & Central America: USA
South America: Brazil
Africa: South Africa, West Africa (unspecified, Terry 1983)
South America: Brazil.

Biology: *Senna obtusifolia* sl is an erect branched annual woody herb 0.5-1.5 m tall, and spreads only by seed.

The plant has strong deep white taproot, but the lateral roots do not nodulate. The stems are smooth, green, and usually well branched and often reddish-purple. The alternate leaves have 3 pairs of oval leaflets each 2-4 cm along a central rachis, are foetid when crushed, and have a prominent gland between the lowest pair (*S. obtusifolia* ss.) or lowest 2 pairs (S. tora ss.) of leaflets and prominent thread-like stipules at the base. The bright yellow flowers are 1-2 cm across and develop in pairs in the upper leaf axils. Fertilised flowers develop into conspicuous slender curving pods 3-5 mm wide and 10-25 cm long, containing 25-30 rhomboidal 4-5 mm long shiny brownish seeds.

The seeds are spread in irrigation and flood waters, in soil on machinery, vehicles and animals, as seed contaminants, and through the gut of ruminants. They are hard seeded, and have considerable dormancy in the soil.

Senna tora sl germinates in moist disturbed warm soil and whilst the usually dense stands of seedlings develop slowly they eventually compete vigorously with pastures and crops. Unless slashed the plants flower towards the end of the warm season and die; if slashed they often perennate and reshoot from the cut stump the same or the next season.

The plant infests tropical pastures (preferring moister and more fertile areas), sugarcane and other tropical crops, roadsides, wasteland and fallows.

Entry potential: Both *Senna obtusifolia* ss and *Senna tora* are already present in Australia. The seeds of both contaminate export grains from the USA and may enter Australia by this route.

Establishment: Following entry into Australia *Cassia obtusifolia* sl. may be transported to areas in which it will germinate and reproduce, especially throughout coastal Queensland and north coastal New South Wales and probably Western Australia.. If spilled in these areas it could germinate, establish and reproduce, extending the areas already infested.

Spread: The seeds of Cassia obtusifolia sl are spread by irrigation and flood waters, in soil under vehicles etc. and through the gut of ruminants. Spread is likely to be mainly local except for long-distance transport of contaminated stock.

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7.1.51 Species: ***Setaria faberi*** **Herrm. Family: Poaceae**

Synonyms: None recorded**.**
Common name: Giant foxtail (USA)
Status as a quarantine weed: A Prohibited Plant in Western Australia, a Noxious Plant as listed by the Commonwealth of Australia, and has herbicide (atrazine, fluazifop, and nicosulfuron) resistant genotypes in the USA.

Distribution:
North and Central America: USA (eastern and central inland states and Florida), Canada, Mexico
Asia: Japan, China, Middle East
Europe: Central areas, Russia

Biology: *Setaria faberi* is a tufted annual grass, and reproduces only by seed.

The plant consists of a number of tillers joined at the base by a common branched fibrous root system. The tillers are 80-200 cm tall and may be geniculate (and then rooting at the lower nodes) or collapsing, and often branch near the base. The leaf blades are softly hairy below and stiffly hairy above, 8-17 mm wide, and taper towards the tip. The leaf bases are mostly hairless but become hairy on the margins below the collar. The ligules consist of a ring of hairs, and

auricles are absent. The youngest leaves are rolled. Within each tiller the culm develops to produce a single dense spike-like inflorescence 7.5-20 cm long and 2-3 cm thick. The inflorescences are erect to nodding, and consist of a dense mass of stalkess spikelets each with 3-6 bristles at the base, giving the whole head a smooth feel when stroked upwards. The grains are plump and 1.5-2 mm long.

Setaria faberi is a summer growing weed of cultivation, roadsides, wasteland and other disturbed sunny situations where there is adequate water.

Entry potential: Seeds of *Setaria faberi* contaminate maize seed exported from the USA, and could be carried to all parts of Australia in feed maize.

Establishment: Seed spilled along roadsides and around feedlots is likely to be deposited in suitable conditions for germination and growth. Once established they would probably flourish, grow, and reproduce.

Spread: Once established seeds of *Setaria faberi* could be spread by vehicles, irrigation and flood water, in soil and plant debris, and as contaminants of crop and pasture seed. It is not known to occur in Australia.

References

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7.1.52 Species: ***Setaria lutescens*** **(Weig.) Hubbard Family: Poaceae**

Synonyms:, *Setaria glauca* (L) Beauv f *longiseta*, *Setaria glauca* f. *pallens*, *S. pumila* (Poir.) Roem. & Sch.
Common name: Yellow foxtail, yellow bristlegrass (USA), pale pigeon grass (Australia)
Status as a quarantine weed: The species has a herbicide (imazapyr) resistant genotype in the USA.

Distribution:
North and Central America: USA (all states), Canada, Mexico, Cuba
South America: Argentina, Colombia, Dominican Republic, Venezuela
Asia: Japan, China, Bangladesh, Burma, India, Indonesia, Iran, Iraq, Israel, Lebanon, Japan, Pakistan, Sri Lanka, Taiwan, Thailand
Europe: Russia, Austria, Denmark, UK, Finland, France, Germany, Hungary, Italy, Netherlands, Norway, Poland, Portugal, Spain, Switzerland, Sweden, Turkey, Yugoslavia
Oceania: Australia (all states), Fiji, Hawaii, New Zealand
Africa: Egypt, Madagascar

Biology: *Setaria lutescens* is a tufted annual grass, and reproduces only by seed.

The plant consists of a number of tillers joined at the base by a common branched fibrous root system. The tillers are 50-80 cm tall, and often have reddish bases. They may be geniculate and root at the lower nodes, and often branch near the base. The leaf blades are blue-green, 6-30 cm long and 4-10 mm wide, and have a few long silky hairs on the upper surface near the collar. The leaf sheaths are slightly keeled towards the base, and the ligule consists of a short fringed collar. The youngest leaves are rolled. Within each tiller and branch each culm develops a dense spike-like inflorescence 5-12 cm long and 1-1.5 cm thick. The inflorescences are erect and yellow-brown, and consist of a dense mass of stalkess spikelets each with 3-6 bristles at the

base, giving the whole head a smooth feel when stroked upwards. The grains are plump and 1.5-2 mm long.

Setaria lutescens is a summer growing weed of cultivation, roadsides, wasteland and other disturbed sunny situations where there is adequate water.

Entry potential: Seeds of Setaria lutescens contaminate maize seed exported from the USA, and could be carried to all parts of Australia in feed maize.

Establishment: Seed spilled along roadsides and around feedlots is likely to be deposited in suitable conditions for germination and growth. Once established they would probably flourish, grow, and reproduce.

Spread: Once established seeds in Australia the herbicide resistant genotype could be spread by vehicles, irrigation and flood water, in soil and plant debris, and as contaminants of crop and pasture seed.

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7.1.53 Species: Sicyos angulatus L Y Asai Family: Cucurbitaceae

Synonyms: None recorded

Common Name: burcucumber, star cucumber

Status as quarantine weed: Not recorded as present in Australia, prohibited species

Distribution: USA (Delaware, Illinois, Indiana, Iowa, Kentucky, Maryland, Ohio, Tennessee, Mississippi), Netherlands, Norway, Yugoslavia, Germany, Mexico, Canada, Pacific islands, Japan, Korea Republic.

Biology: A summer monoecious, annual climbers and trailers to 6 m. Leaves simple and palmately lobes, sometimes branche. Female flowers solitary. Fruit small, ovoid, indehiscent, spiny, seed solitary.

This species is a very aggressive vining plant that pulls maize or soybean to the ground creating harvest loss. Burcucumber can germinate throughout the entire growing season. Even one plant/m^2 can render maize fields unharvestable. The seed are readily scattered by mechanical harvesters, animals and as contaminants in seed.

The species has been introduced into many country of Europe as a decorative plant from America. In some paces it has run wild and become a weed. It has been recorded that burcucumber is one of the weed species introduced into Norway as a contaminant in soybean imported from South America and especially the USA.

Emergence is reduced as depth of sowing increased with limited emergene occurring at depth of 15-16 cm. In experiments, it was found that intact seed of *S. angulatus* failed to germinate and required mechanical scarification or stratification at 4°C for 18 weeks to modify the permeability of seed coat to increase germinability.

Burcucumber is the host of the pest *Heliothis virescens*. It was suggested that burcucumber may become important in the build up of early season and overwintering populations of the pest.

Entry Potential: This species is recorded in many field crops in USA and has potential to enter Australia in feed maize as a contaminant.

Establishment and Spread Potential: High

Estimated Risk: The WRA results indicated this species has high potential (score 18) to establish, spread and become a serious weed in Australia.

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7.1.54 Species: Solanum ptycanthum Dun Family: Solanaceae

Synonyms: None recorded

Common Name: eastern black nightshade

Status as quarantine weed: Not recorded as present in Australia, prohibited species

Distribution: USA (Kentucky, Washington, Idaho, Illinois, Michigan, Minnesota, Nebraska, Ohio, Pennsylvania), Canada (Ontario)

Biology: Viable seed is produced at 4-6 weeks after flowering. In field trials in Minnesota, *S. ptycanthum* produced up to 7000 berries (800 000 seeds)/ plant. Seed can emerge from depths of 10-40 mm. *S. ptycanthum* is mainly a self-pollinated species but some ecotypes were found to exhibit an out crossing rate of 3-17%. The observed flexibility in crossing systems may have played an important role in the colonisation success of *S. ptycanthum.*

In Kentucky, to prevent weed seed contamination, fields with 10 *S. ptycanthum* plants/acre were rejected by the Seed Improvement Association. Recommendations for controlling this weed include planting weed free seed, using Imazaquin, alachlor and metolachlor pre emergence, and lactofen, acifluorfen with imazethapyr post emergence. Glyphosate and paraquat were both effective as harvest aids. However, paraquat provided more rapid nightshade desiccation and berry drop.

Eastern black nightshade has been recorded as difficult to control due to sporadic and staggered emergence.

Entry Potential: This species is recorded in many field crops and vegetable in USA and has potential to enter Australia in feed maize as a contaminant.

Establishment and Spread Potential: High

Estimated Risk: The WRA results indicated this species has high potential (score 13) to establish, spread and become a serious weed in Australia.

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7.1.55 Species: Sorghum x almum Parodi Family: Poaceae

Synonyms: None recorded.
Common name: Columbus grass (Australia)
Status as a quarantine weed: A Noxious Weed in New South Wales.

Distribution:
North and Central America: USA
South America: Argentina
Oceania: Australia (Qld, NT)
Africa: South Africa

Biology: *Sorghum x almum* a tall tufted perennial grass, reproducing mainly by seed but also spreading a little by short rhizomes..

The plant consists of a number of tough woody tillers joined at the base by a common branched weakly spreading rhizome system with long tough fibrous roots. The tillers are 1-2.5 m tall and 1-2 cm thick at the base. The leaves are about 50 cm long by 2 cm wide, taper to the apex, and have strong white midribs. Each tiller terminates in a red to brown much branched pyramidal inflorescence about 25 cm long, consisting of a strong whitish rachis producing many forked branches, each of which ends in 2 or 3 russet spikelets, only one of which is fertile. Fertilised florets develop into ovoid red or brown or black 3.5-4 mm long grains, which may either be retained in or shed from the head.

Sorghum x almum is a hybrid species and is somewhat variable. It is summer growing and is normally cultivated for forage or silage, but is also a weed when seedlings germinate among summer crops. It is a major alternate host for sorghum midge. It is found in cultivation and along roadsides and railways, in wasteland, and in other disturbed sunny situations where there is adequate water. Under some conditions the foliage is poisonous to stock.

Entry potential: Seeds of *Sorghum x almum* contaminate maize seed exported from the USA, and could be carried to all parts of Australia in feed maize.

Establishment: Seed spilled along roadsides and around feedlots is likely to be deposited in suitable conditions for germination and growth. Once established they would probably flourish, grow, persist and reproduce.

Spread: Once established seeds of American genotypes of *Sorghum x almum* could be further spread by vehicles, irrigation and flood water, in soil and plant debris, and as contaminants of crop and pasture seed.

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7.1.56 Species: Sorghum halepense (L.) Pers. Family: Poaceae

Synonyms: *Andropogon halepensis* (L.) Brot., *Holcus halepensis* L., *Sorghum bicolor* (L) Moench ssp. *halepense*
Common name: Johnson grass (Australia & USA)
Status as a quarantine weed: Prohibited in Western Australia, a Noxious Weed in New South Wales, having herbicide (ALS inhibitor) resistant strains in the USA, and having hybridised

with wild sorghums in the USA to produce weedy genotypes ("shattercanes") which are not present in Australia.

Distribution:
North and Central America: USA, Cuba, Mexico, Jamaica, Honduras, Nicaragua
South America: Argentina, Colombia, Peru, Venezuela, Chile, Brazil, Bolivia, , Uruguay
Oceania: Australia (all states except Tasmania ?& NT), Fiji, Hawaii, New Zealand
Africa: South Africa , Mozambique, South Africa, Morocco, Tanzania
Asia: India, Israel, Lebanon, Pakistan, Philippines, Iran, Iraq, Indonesia, Papua New Guinea, Thailand, Afghanistan, China, Sri Lanka, Jordan, Taiwan
Europe: Poland, Romania, Russia, Turkey, Yugoslavia, Italy, Spain, Bulgaria, Portugal

Biology: *Sorghum halepense* is a tall tufted perennial grass, reproducing mainly by seed but also spreading rapidly by rhizomes..

The plant consists of a number of tough woody tillers joined at the base by a common vigorous branched rhizome system with long tough fibrous roots. The tillers are 1-2 m tall and 1-2 cm thick at the base. The leaf sheath is smooth and often waxy, and the ligule is short and erect. The leaves are 20-60 cm long by 2-3 cm wide, taper to the apex, and have strong white midribs. Each tiller terminates in a purplish much branched pyramidal inflorescence 20-30 cm long, consisting of a strong whitish rachis producing many forked branches, each of which ends in 2 or 3 spikelets, only one of which is fertile. Fertilised florets develop into ovoid red or brown 3 mm long grains, which tend to be shed before harvest of the associated crop.

Sorghum halepense is a very vigorous summer growing weed of summer crops, pastures, wetlands, along roadsides and railways, in wasteland, and in other disturbed sunny situations where there is adequate water. Under some conditions the foliage is poisonous to stock. It is a major alternate host for sorghum midge.

Entry potential: Seeds of *Sorghum halepense* contaminate maize seed exported from the USA, and could be carried to all parts of Australia in feed maize.

Establishment: Seed spilled along roadsides and around feedlots is likely to be deposited in suitable conditions for germination and growth. Once established they would probably flourish, grow, persist and reproduce.

Spread: Once established seeds of American genotypes of *Sorghum halepense* would be further spread by vehicles, irrigation and flood water, in soil and plant debris, and as contaminants of crop and pasture seed.

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7.1.57 Species: Striga asiatica (L.) Ktze. Family: Scrophulariaceae

Synonym: *Striga lutea* Lour., *S. hirsuta* (Benth.) Benth.

Common name: Witchweed
Status as a quarantine weed: A Prohibited Plant by AQIS.

Distribution
North America: USA (North and South Carolina)
Africa: South Africa, Mauritius, Zambia, Egypt, Ghana, Ivory Coast, Kenya, Liberia, Malawi, Madagascar, Mozambique, Nigeria, Zimbabwe, Sudan, Tanzania, Uganda
Asia: India, Pakistan, Sri Lanka, China, Cambodia, Indonesia, Japan, Thailand, Vietnam

Biology: *Striga asiatica* is an annual herb which parasitises the roots of grasses and cereals; it reproduces only by seed.

The plant lacks a taproot, instead producing a number of haustoria which attach to and penetrate the roots of grassy hosts. The stem is erect, branched or unbranched, and 10-30 cm tall. Smoothly and narrowly oval finely but roughly hairy leaves 5-30 cm long occur in pairs on the lower stem and singly on the upper stems. Single flowers develop in the axils of the leaf-like bracts towards the apices of the stems. Each flower has a bent tube and 5 rounded petals and is 6-9 mm across; plants vary in flower colour from white through cream and yellow to pink, orange or red. Fertilised flowers produce dry ovoid fruits about 4 mm long, each containing a very large number of 0.2 mm dust-like golden seeds. The seeds are distributed by the wind as well as by water, soil movement, in plant trash, and attached to people and animals. They may remain dormant in the soil for many years, until stimulated to germinate by the close proximity of the root of a suitable host. After germination the root attaches directly to that of the host.

Striga asiatica is a very serious summer growing root parasitic weed of many grasses and cereals, including sorghum, maize, sugarcane, wheat, oats, barley and rice. It is endemic throughout the warmer parts of Asia and Africa and was introduced into the USA in the 1950s, but has now been largely eliminated from that country.

Entry potential: Seeds of *Striga asiatica* are not known to contaminate maize seed exported from the USA, and strenuous efforts are made by the Americans to prevent witchweed contaminating any crop or crop seed. It is extremely unlikely (though theoretically just possible) for it to be introduced into Australia in this way.

Establishment: Were seeds of *Striga asiatica* to be introduced into Australia in American maize or by any other route (especially directly from Asia or Africa) they may well establish, spread and form large intractable infestations before discovery, as happened in the USA.

Spread: Were *Striga asiatica* to become established in Australia further spread would be by the wind, in drainage, flood and irrigation water, in soil, in plant trash, and attached to people and stock.

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7.1.58 Species: Verbesina encelioides (Cav.) A Gray Family: Asteraceae

Synonyms: *Ximenesia exauriculata* Rydb.
Common name: Crownbeard (Australia)
Status as a quarantine weed: A Prohibited Plant in Western Australia.

Distribution
North America: USA
Africa: South Africa
Asia: India
Oceania: Australia (NT, SA, Qld, NSW, Vic), Hawaii
South America: Argentina

Biology: *Verbesina encelioides* is an annual herb which reproduces only by seed.

The plant has a white taproot with many laterals in moist fertile surface soils. The erect branching stem is 60-120 cm tall, green, densely white-hairy, and rather woody at the base. The leaves occur in pairs on the lower stem and singly higher up and on the branches. They are dull green above and whitely hairy below, irregularly broadly ovate, 4-10 cm long, with toothed or lobed margins and long stalks with a leaf-like lobe at the base. The yellow daisy-like flowers occur singly on long stalks towards the ends of the stems and branches. Each of the flattened flower heads is 3-5 cm across, and consists of several rows of green bracts, a row of bright yellow 3-toothed ray florets, and a central mass of yellow disc florets. Fertilised disc florets develop into ovate whitish fruits about 4 mm long which are narrowly winged and carry several bristles at the apex. Fertilised ray florets develop into flattened irregularly triangular fruits without wings or bristles, but with warty surfaces.

Verbesina encelioides is a summer growing weed of cultivation, overgrazed pastures, roadsides, wasteland creek banks, roadsides and other disturbed, open, uncompetitive places.

Entry potential: Seeds of *Verbesina encelioides* contaminate maize seed from the USA (its area of origin), and could be introduced into all parts of Australia by this route.

Establishment: Seeds spilled with feed maize are likely to be deposited in areas suitable for their germination, growth and reproduction.

Spread: Seed of new genotypes of *Verbesina encelioides* would be likely to be distributed by cattle and sheep as well as in drainage and flood waters, and in soil on vehicles etc. They would then join or extend the currently restricted Australian distribution of this weed.

References

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7.1.59 Species: Xanthium spinosum L. Family: Asteraceae

Synonyms: None recorded.
Common name: Bathurst burr (Australia), spiny clotbur, spiny burweed (USA)
Status as a quarantine weed: A Declared or Noxious Weed in Queensland, South Australia, Western Australia, Victoria, the ACT and Western Australian, and a Prohibited Plant in Western Australia.

Distribution
North America: USA
Africa: South Africa, Egypt, Morocco, Zimbabwe, Ethiopia, Tanzania
Asia: Israel, Papua New Guinea
Oceania: Australia (all states), New Zealand
South America: Argentina, Brazil, Chile, Uruguay
Europe: Spain, Greece, Poland, Portugal, Russia, Turkey, Yugoslavia

Biology: *Xanthium spinosum* is a woody annual herb which reproduces only by seed.

The plant has a strong brown woody taproot, with many laterals in moist fertile soil. The main stem is erect, branched, woody finely hairy, greenish-yellow and 50-100 cm tall, and all stems have one or two 10-20 mm long sharp trifid yellowish prickles at every node. The single leaves are usually 3-lobed with the middle lobe longest, shiny and dark green above with prominent white midveins, and whitish and very finely hairy below. The flowers are inconspicuous and yellow-green; male flowers occur in clusters at the ends of the stems and turn brown after maturity, whilst female flowers occur in the leaf axils. The fruits are ellipsoid pale brown burrs 1-1.5 cm long, covered with small yellow hooks and usually carrying two 5 mm long straight sharp spines at the apex. Each fruit contains 2 seeds, which tend to germinate in sequential years. The fruits are mainly distributed attached to wool and the fur of other animals, and in flood and drainage water.

Xanthium spinosum is a summer growing weed of pastures, cultivation, creek banks, wasteland, stock routes, roadsides etc., where it competes with crops and pastures, contaminates fleece, and prevents effective grazing.

Entry potential: Seeds of *Xanthium spinosum* contaminate maize seed from the USA, and could be introduced into all parts of Australia by this route.

Establishment: Seeds spilled with feed maize are likely to be deposited in areas suitable for their germination, growth and reproduction.

Spread: Seed of new genotypes of *Xanthium spinosum* would be likely to be distributed by cattle and sheep as well as in drainage and flood waters, and in soil on vehicles etc. They would then join or extend the already widespread Australian distribution of this weed.

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7.1.60 Species: Xanthium pungens agg. Family: Asteraceae

Synonyms: *Xanthium pungens* agg. is a group of taxa which includes *X. strumarium, X. orientale, X. canadense, X. canavillesii, X. chinense, X. occidentale, X. macrocarpum, X. longirostre, X. pungens, X. italicum. X. californicum, X. pensylvanicum* and others. The differences between these taxa are trivial, and they may readily be confused.
Common name: Noogoora burr (Australia), cocklebur (USA).
Status as a quarantine weed: A Declared or Noxious Weed in Queensland, South Australia, Victoria, a Prohibited Plant in Western Australia and by AQIS, and with herbicide (MSMA/DSMA, imidazolinone) resistant genotypes in the USA which do not occur in Australia.

Distribution
North & Central America: USA (all mainland states except New England and Alaska), Mexico, Canada, Puerto Rico

Africa: South Africa, Ethiopia, Zimbabwe
Asia: Israel, India, Iran, Iraq, Japan, Lebanon, Taiwan, China, Philippines, Pakistan, Korea
Oceania: Australia (all states), Hawaii, Fiji
South America: Trinidad, Colombia
Europe: Spain, Poland, Russia, Turkey, Yugoslavia, Hungary

Biology: *Xanthium pungens* agg. are woody annual herbs which reproduce only by seed.

The plants have a strong brown woody taproots, with many laterals in moist fertile soil. The main stems are erect to much branched, woody, coarsely hairy, green (often with purple blotches), rather zigzag, and 1-2.5 m tall. The large coarse dull green leaves are usually shallowly 3-5 lobed and 10-15 cm across. The green flowers are inconspicuous, and both male and female flowers occur in clusters in the upper leaf axils. The fruits are ellipsoid mid to dark brown burrs 1.5-2.5 cm long, covered with small hooks and usually carrying two sharp spines at the apex. Each fruit contains 2 seeds, which tend to germinate in sequential years. The fruits are mainly distributed attached to wool and the fur of other animals, and in flood and drainage water.

Xanthium pungens agg. are summer growing weeds of pastures, cultivation, creek banks, wasteland, stock routes, roadsides etc., where they compete with crops and pastures, contaminate fleece, and prevent effective grazing. They are particularly prevalent on seasonally flooded areas of rough pasture. The seedlings are toxic to stock.

Entry potential: Seeds of *Xanthium pungens* agg. contaminate maize seed from the USA, and could be introduced into all parts of Australia by this route.

Establishment: Seeds spilled with feed maize are likely to be deposited in areas suitable for their germination, growth and reproduction.

Spread: Seed of new genotypes of *Xanthium pungens* agg. would be likely to be distributed by cattle and sheep as well as in drainage and flood waters, and in soil on vehicles etc. They would then join or extend the already widespread Australian distribution of this weed.

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Wilson BJ, Hawton D, Duff AA. 1995. Crop Weeds of Northern Australia. P. 138. Brisbane, Queensland; Department of Primary Industries.

7.2 Appendix 2: Some contaminant species found in imported grain during 1994-1995

This table is comprised of available data held by the Imported Grain Taskforce.

Commodity	Species	Contamination (no/g seed)
maize ex USA		
	Abutilon sp.	1/1000
	Amaranthus sp.	2/1000
	Ambrosia sp.	1/1000, 6/1000
	Ambrosia trifida	
	Avena sativa	
	Avena sp.	5/1000, 1/1000, 1/425
	Cassia spp.	
	Chenopodium sp.	
	Convolvulus sp.	
	Crotalaria sp.	
	Echinocloa sp.	2/1000, 1/425
	Glycine max	1/245, 2/1000, 3/1000
	Helianthus sp.	2/1000
	Hordeum sp.	
	Ipomoea sp.	
	Lolium sp.	
	Panicum sp.	1/1000, 20/1000
	Polygonum sp.	
	Raphanus raphanistrum	
	Rottboelia cochinchinensis	
	Setaria italiaca	20/1000, 30/1000, 5/1000
	Sida sp.	20/1000
	Sorghum bicolor	7/1000, 4/1000, 5/1000, 3/425
	Sorghum halepense	32/1000
	Triticum sp.	100/1000
	Xanthium sp.	4/1000
	Xanthium spinosum	1/1000
Sorghum ex USA		
	Abutilon sp.	8/1000, 15/1000, 18/1000, 10/1000, 80/5969
	Abutilon theophrasti	10/1000, 33/4630, 56/4630
	Amaranthus sp.	70/1000, 93/1000, 1084/4630, 2500/4630, 16200/5969 (22/800g composite samples representative of 1000T)
	Ambrosia sp.	1/1000, 2/4630, 1/5969
	Ambrosia trifida	2/4630
	Avana fatua	1/264
	Avena sativa	5/1000
	Avena sp. (poss. *A. sativa*)	1/254, 4/1000, 14/4630, 6/5969
	Bassia hyssopifolia	30/4630
	Brassica sp.	322/5969
	Bromus mollis	2/1000, 1/1000, 5/1000
	Bromus sp.	3/1000, 21/4630, 13/4630, 49/5969
	Bromus unioloides	
	Chenopodium sp.	413/1000, 2/1000, 2/1000, 12/4630, 119/5969
	Convolulus erubescens	1/1000
	Digitaria sp.	8/300, 2/1000, 5/1000, 20/1000, 62/4630, 66/4630, 489/5969

Commodity	Species	Contamination (no/g seed)
	Echinocloa crus-galli	4/4630
	Echinocloa sp.	1/1000, 7/1000, 6/4630, 48/5969
	Glycine max	1/300,1/254, 4/1000, 8/1000, 31/4630, 18/5969, 1/300
	Helianthus sp.	1/300, 1/307, 8/1000, 5/1000, 19/4630, 7/4630
	Hibiscus sp.	1/4630, 6/4630, 1/5969
	Helianthus annuus	1/1000, 16/5969
	Hordeum sp.	4/1000, 5/4630
	Hordeum vulgare	1/1000
	Ipomoea hederacea	4/4630, 5/4630, 8/5969
	Kochia scoparia	29/1000
	Lepidium sp.	1/4630
	Lolium sp	5/1000, 17/1000, 1/1000, 14/4630
	Lupinus angustifolius	9/1000
	Maireana sp.	2/1000, 30/1000
	Medicago sativa	1/4630, 1/4630
	Panicum coloratum	57/1000
	Panicum sp.	4/307, 7/1000, 26/1000, 173/4630, 16/300, 2/264, 170/4630, 716/5969
	Parthenium hysterophorus	32/1000, 62/1000
	Phytolacca octandra	1/5969
	Polygonum convolvulus	4/1000, 1/1000, 4/4630, 7/5969
	Polygonum pensylvanicum	16/4630, 21/4630, 30/5969
	Polygonum sp.	8/1000, 7/1000, 2/1000
	Ranunculus sp.	1/1000
	Rapistrum rugosum	1/264, 1/4630
	Rudbeckia sp.	1/1000
	Rumex sp.	1/1000
	Salvia sp.	2/1000
	Saponaria sp.	1/1000
	Secale sp.	1/4630
	Secale cereale	5/5969
	Setaria glauca	80/1000
	Setaria sp.	26/307, 23/1000, 201/1000, 80/1000, 836/4630, 1636/5969
	Setaria spp.	115/300, 54/1000, 7/264, 767/4630
	Sida acuta	1/4630
	Sida sp.	1/1000
	Silena sp.	1/4630
	Solanum rostatum	5/1000
	Sorghum halepense	153/1000, 46/1000
	Sisymbrium sp.	36/5969
	Sisymbrium officinale	3/4630
	Thlaspi arvense	4/1000, 6/4630, 1/4630, 36/5969
	Trifolium hirtum	
	Triticum aestivum	2/1000, 10/1000, 13/300, 80/1000, 66/254, 21/307 142/1000, 161/1000, 189/1000, 880/4630, 243/4630,
	Triticum sp. *(aestivum)*	181/1000, 665/5969, 36/5969
	Xanthium sp.	1/1000, 3/1000
	Zea mays	2/1000, 23/1000, 28/4630, 50/4630, 29/5969, 3/300
	unidentified legume	1/5969
	unidentified seeds	5/4630, 4/4630,
Barley ex USA		
	Agropyron sp.	6/1000

Commodity	Species	Contamination (no/g seed)
	Avena fatua	162/1000
	Avena sp	30/5000
	Avena sativa	6/1000
	Brassica	
	Chenopodium sp.	
	Linum sp.	3/1000
	Lolium sp.	
	Pisum sativum	1/1000
	Polygonum convolvulus	3/1000
	Secale cereale	2/1000
	Setaria sp.	
	Sinapsis alba	
	Triticale	3/1000
	Triticum aestivum	57/1000
Barley ex Finland		
	Avena sativa	20/1000
	Aviculare sp.	
	Brassica spp.	15/1000
	Chenopodium sp.	34/1000
	Fumaria sp.	2/1000
	Galeopsis bifida	16/1000
	Galium sp.	12/1000
	Lapsana sp.	
	Lolium sp.	
	Napistrum rugosum	
	Pisum sativum	
	Polygonum sp.	7/1000
	Polygonum convulvolus	2/1000
	Secale cereale	40/1000
	Spergula arvensis	55/5000, 1/1000
	Stellaria media	2/1000
	Thlaspi arvense	2/1000, 8/5000
	Triticum sp.	102/1000
	Vicia sp.	
Barley ex Canada		
	Amaranthus sp.	54/1000
	Avena fatua	
	A. sativa	10/5000, 4/1000
	A. sterilis	
	Avena spp.	30/5000
	Agropyron sp.	26/5000
	Avena fatua	
	Bilens sp.	8/1000
	Brassica sp.	4/1000
	Chenopodium sp.	6/1000
	Circium arvense	23/5000
	Conringia orientalis	1/5000
	Dracocephalum sp.	1/5000
	Echinochloa crus-galli	6/5000
	Erodium sp.	1/5000
	Festuca sp.	
	Galeopsis tetrahit	30/5000
	Galium sp.	94/5000
	Kochia sp.	42/5000
	Lappula achinata	1/5000
	Lens culinaris	1/5000
	Linum usitatissimum	70/5000
	Lolium sp.	
	Malva sp.	2/5000

Commodity	Species	Contamination (no/g seed)
	Medicago sativa	23/5000
	Neslia paniculata	3/5000
	Panicum sp.	1/5000
	Phalaria canariensis	8/5000
	Pisum sativum	4/5000
	Plantago major	5/5000
	Polygonum convolvulus	62/5000
	Potentilla sp.	8/5000
	Rumex sp.	7/5000
	Setaria sp.	
	Sisymbrium sp.	
	Sonchrus saper	
	Spergula arvensis	55/1000
	Sonchus asper	8/5000
	Stellaria media	90/5000
	Thlaspi arvense	
	Trifolium sp.	31/5000
	Triticum aestivum	
Soybean		
	Ambrosia trifida	
	Cirsium arvense	2/100
	Xanthium pungens	2/100
Rye		
	Polygonum convolvulus	492/1000
	Sinapsis arvensis	50/1000
	Agropyron sp.	50/1000
	Avena spp.	150/1000
	Triticum sp. (poss. *T aestivum*)	240/1000
	Hordeum vulgare	117/1000
	Panicum sp.	92/1000
	Linum usitatissimum	58/1000
	Medicago sativa	8/1000
	Chenopodium sp.	
	Brassica sp.	
	Amaranthus sp.	
	Thlaspi arvense	
	Silene sp.	
	Spergularia sp.	
	Polygonum sp.	
	Galium sp	
	Medicago lupulina	
	Lappula sp.	
	Iva xanthifolia	
	Descurainia sp.	
	Axyris sp.	
	Crepis sp.	

Remarks

Bromus sp. is one of *Bromus commutatus, B. japonicus, B. racemosus* and *B. sacalinus* which are indistinquishable and integrate with one another.