OROBANCHE BROOMRAPES - STATUS AND POTENTIAL IN AUSTRALIA

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Summary. Broomrapes, *Orobanche* spp., are major weeds of broadleaf crops in the Old World, but the three species established in Australia are not yet important weeds here. Four species, crenate broomrape, *O. crenata* Forsk., Egyptian broomrape, *O. aegyptiaca* Pers., branched broomrape, *O. ramosa* L., and nodding broomrape, *O. cernua* Loefl. are potentially major agricultural weeds in Australia. A program to eradicate branched broomrape began in South Australia in 1992. The key is early identification of broomrape infestations and exhausting seed reserves by stimulating germination using host plants, prior to herbicide treatment.

INTRODUCTION

The parasitic broomrapes are major weeds of broadleaf crops in the Mediterranean, Europe and Asia, however despite warnings 30 years ago (3,7,21) broomrapes are not important weeds in Australia (5). Crenate broomrape, Egyptian broomrape, branched broomrape, and nodding broomrape are internationally important in a range of broadleaf crops (8). The comprehensive review by Foy, Jain and Jacobsohn (8) provides a background to the control and biology of broomrapes.

With the increase in field grown tomatoes and grain legume production in southern Australia over the past 20 years, it is surprising that broomrapes have not established as major weeds as they have in the northern hemisphere.

Australia remains almost free of broomrape. Until 1992, only the native Australian broomrape *O. cernua* Loefl. var. *australiana* (F. Muell ex Tate) J. Black ex G.Beck, and the introduced clover or small broomrape, *O. minor* Smith, occurred in Australia (6). The commercially important species, branched broomrape is now established in Australia near Murray Bridge, SA (W. Barker and M. Hyde, pers. comm. 1992). This was not the first time branched broomrape occurred in Australia. In 1911 it was collected in the sandhills near Glenelg in South Australia, however this population has not survived (6).

The recent discovery near Murray Bridge appears to be a new introduction. It is separated by 70 km and 82 years from the previous record, however the disappearance of the former infestation suggests that branched broomrape may not become a problem in Australia.

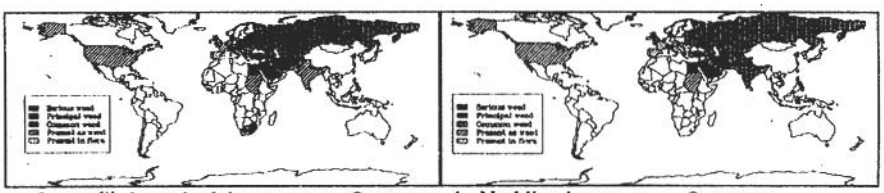
With this paper I hope to restart the discussion as to why broomrapes have not become a problem in Austalian agriculture and suggest ways to ensure the status quo continues.

DISCUSSION

Impact of broomrapes. Crenate broomrape dramatically reduces yield in peas and lentils (4) and faba bean (15) crops in Spain and is responsible for reducing grain legume plantings as farmers extend rotations to avoid parasitisation. Some crops in Morocco (1) and Spain (15) are totally destroyed. In Spain yield of faba bean was halved due to as few as four emerged crenate broomrape plants (14). Even vetch is affected and hay made un-marketable due to contamination (8).

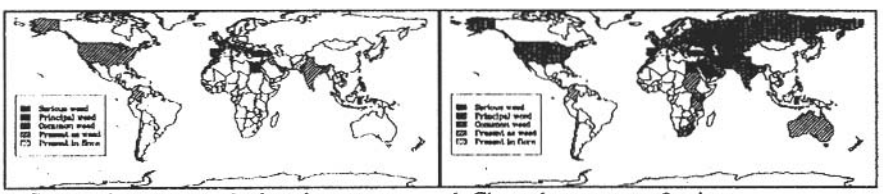
Weed status

Branched broomrape is a recurring problem in tomato production in California (16) and Greece (12) and tomato and potatoes in Lebanon (2). Tomato yield losses of 30 to 75% are reported from California and Hungary respectively (8). Both crenate and Egyptian broomrape reduce carrot yield and quality (19), and branched and Egyptian broomrape both affect tomato fields (17) in Israel.



a. *O.mutelii*, branched broomrape, *O.ramosa*, and Egyptian broomrape, *O.aegyptiaca*.

b. Nodding broomrape, *O. cernua*.



c. Crenate broomrape, *Orobanche crenata*.

d. Clover broomrape, *O.minor*.

Figure 1. Distribution of the four major weedy broomrape species by countries (2,4,9,12,15,17,19).

Nodding broomrape reduces tobacco leaf by up to 52% in India and attacks sunflowers in eastern Europe, Russia and the Middle East (13).

Australian broomrape by contrast is a rarely problem in subterranean clovers in Western Australia (3).

Figure 1 shows the geographical distribution of the broomrape species with a major impact on agriculture.

Biology and control. Broomrapes damage hosts by using there nutrients especially sugar. Broomrapes reduce quality of carrots, drawing on sugars from the roots (19). Tomatoes and eggplant have less fruit, and faba beans have reduced seed yield (16).

Broomrapes have tubers which store starch (20). Often the host dies, while the parasite is able to produce large amounts of seed using starch from the tuber (16).

Once broomrape is established, control is difficult. Fumigation with methyl-bromide, low doses of glyphosate and soil solarisation are all used with varying success (8). The false host plants such as flax reduce soil seed pools (Westbrooks, pers. comm. 1993).

Weed status

An average broomrape plant produce over one hundred thousand small seeds (2). The seed remains viable for at least 10 years and possibly up to 20 years in the soil and germination is stimulated by moist preconditioning and stimulation from host plant root exudates. Only seeds close to host plant roots germinate. Other seed remains dormant and viable. It is not affected by pre-emergent herbicides, and cultivation is of no value as it germinates with the crop. Broomrapes can attach to roots up to 30 cm deep so any soil fumigation must also be deep (8). Hand pulling is not effective as only emerged plants are removed, and the crop has already been damaged.

Clover broomrape is controlled in subterranean clover pastures by superphosphate and grazing (22), and spread in pasture seed is minimised by certified seed schemes (7).

Potential in Australia. Broomrapes have the potential to impact on a wide range of broadleaf crops grown in Australia. Some are listed on Table 1.

Table 1. Major Australian crops likely to be affected by broomrape, *Orobanche* sp. The more (+) the greater the damage

Crop	Broomrape				Source[a]
	crenata	*minor*	*ramosa* *aegyptiaca*[b]	*cernua*	
Burr medic (*Medicago polymorpha* L.)			++		Pers. obs
Carrot (*Daucus carota* L.)	+++	+	+++		18
Celery (*Apium graveolens* L.)	++		++		
Chickpeas (*Cicer arietinum* L.)	++		++		
Cole crops (*Brassica oleracea* L.)			++		
Cucumber (*Cucumis sativa* L.)			++		
Faba bean (*Vicia faba* L.)	+++	++	++		
Field peas (*Pisum sativum* L.)	+++				
Lentil (*Lens culinaris* Medic.)	+++	+			4
Lettuce (*Lactuca sativa* L.)		++	++		
Lucerne (*Medicago sativa* L.)	++	++			18
Potato (*Solanum tuberosum* L.)			+++		
Rockmelon (*Cucumis melo* L.)			++		
Safflower (*Carthamus tinctorius* L.)		++	++		
Subterranean clover (*Trifolium subterranean* L.)		++			21
Sunflower (*Helianthus annuus* L.)	+	++	++	+++	
Tobacco (*Nicotiana tabacum* L.)		++	+++	++	
Tomato (*Lycopersicon esculentum* Mill.)			+++	+++	
Turnip (*Brassica rapa* L.)			+++		
Vetch (*Vicia sativa* L.)	++	+++			
Zucchini (*Cucurbita pepo* L.)			+		

[a] Based on (8) unless otherwise indicated.
[b] Closely related species often described as *O. mutelii* (8,17).

Australian broomrape. It is likely that Australian broomrape, being mainly restricted to uncleared and newly developed farmland, at least in SA, has not coincided with host crops. Tomato, tobacco and sunflowers are the main host crops of nodding broomrape. Australian broomrape may have a different host preference to the variety of nodding broomrape, (*O. cernua* Loefl. var. *desertorum* Beck.) affecting crops in Eastern Europe and the Middle East (8) through Asia to India (13).

Weed status

Grain legume crops. The broomrape species posing the greatest risk to the developing grain legume growing industries are not yet in Australia. Faba beans are readily attacked by Egyptian and crenate broomrape (11). There is no record of either species in Australia yet.

The branched broomrape and Egyptian broomrape are very similar, although they vary in their host preference. Branched broomrape plants attached to tobacco twice as readily as Egyptian broomrape (10). The strain of branched broomrape tested did not attach to lucerne, although in Britain it parasitised lucerne (18).

Eradication programs. Recently an eradication program for branched broomrape began in Texas and for clover broomrape in South Carolina (23). Clover broomrape was eradicated from Washington County, Virginia, USA (Foy, pers. comm. 1993).

False hosts have reducing seed reserves of branched broomrape in Texas. Seed per 400 g soil sample declining from 367 in 1984 to 3 in 1990, and 0 in 1991 after annual planting of flax to encourage germination (Westbrooks, pers. comm. 1993).

At Murray Bridge immediately after discovery of branched broomrape in October 1992, we hand pulled all 125 emerged plants prior to seed production. We fenced the 3000 m^2 infested area to stop spread on livestock and vehicles. During 1993 we intend to plant a sacrifice host crop. In September 1993 we plan to destroy it with glyphosate.

Provided we do not find any other infestations we believe the infestation may be eradicated in 10 years. If allowed to spread, it may become an important weed of the grain legume, oilseed, vegetable and seed industries in southern Australia.

REFERENCES

1. Aber, M. 1984. EWRC 3rd Sym. Weed Prob. Med. 1, 285-291.
2. Abu-Shakra, S., Miah, A.A. and Saghir, A.R. 1970. Hort. Res. 10, 119-124.
3. Anon 1964. Broomrape. J. Dept. Agric. W. Aust. 5, 483.
4. Arjona-Berral, A., Vazquez-Cobo, A. and García-Torres, L. 1984. EWRC 3rd Sym. Weed Prob. Med. 1, 293-298.
5. Auld, B.A. and Medd, R.W. 1987. Weeds. (Inkata: Melbourne) p 194.
6. Barker, W.R. 1986. In: Flora of South Australia 3, 1313-1314 (SA Govt Print: Adelaide).
7. Evans, D.C. 1962. Agric. Gaz. NSW 73, 200-202.
8. Foy, C.L., Jain, R. and Jacobsohn, R. 1989. Rev. Weed Sci. 4, 123-152.
9. Holm, L.G., Pancho, J.V., Herberger, J.P and Plucknett, D.L. 1991. A Atlas of World Weeds (Krieger Pub. Co.: Florida) pp. 255-257.
10. Jain, R. and Foy, C.L. 1989. Weed Tech. 3, 608-614.
11. Kasasian, L. 1973. PANS 19(3), 368-371.
12. Kotoula-Syka, E. and Eletherohorinos, I.G. 1991. Weed Res. 31, 19-27.
13. Krishnamurthy, G.V.G. and Chandwani, G.H. 1975. PANS 21(1), 64-66.
14. Mesa-García, J. and García-Torres, L. 1984. Weed Res. 24, 379-382.
15. Mesa-García, J., Vazquez-Cobo A. and García-Torres, L. 1984. Proc EWRS 3rd Sym. Weed Prob. Med. 1, 277-284.
16. Musselman, L.J. and Sand, P.F. 1982. Weeds Today 13, 10-11.
17. Musselman, L.J. 1986. In: Proc Workshop Biol. Control *Orobanche* LH:VPO, Wageningen, The Netherlands. pp 2-10.
18. Rumsey, F.J. and Jury, S.L. 1991. Watsonia 18, 257-295.

19. Schaffer, A.A., Jacobsohn, R., Joel, D.M., Eliassi, E. and Fogelman, M. 1991. Hort Sc. 26(7), 892-893.
20. Singh, M., Singh, D.V., Misra, P.C., Terwari K.K. and Krishnan, P.S. 1968. Physiol. Plant 21, 525-538.
20. Southwood, O.R. 1971. Weed Res. 11, 240-246.
21. Western Australian Dept Agriculture, 1984. Farmnote 18/84.
22. Westbrooks, R. 1992. Proc. 1st Int. Weed Cont. Cong., Melbourne 1, 110-112.