Chemical control of *Emex* sp. in Western Australia

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Summary

The use of herbicides for control of doublegee, *Emex australis*, in Western Australia is summarized for field crops, pasture and horticultural uses. The control strategies and costs of herbicides used in the various crops is discussed. The integration of cultural and chemical control methods provides satisfactory control of doublegee on an annual basis.

Introduction

Doublegee (*Emex australis* Steinh.) is a major pest plant of field crops and pastures in Western Australia and is considered to be a serious weed throughout temperate Australia (Figure 1). It also occurs in some orchards and vineyards but in Western Australia it is not considered a weed of major importance in these crops. A close relative of doublegee, *Emex spinosa* (L.) Campd. is also found in the northern agricultural and Pilbara pastoral areas of Western Australia, but is not considered a major pest because it is generally confined to homestead areas and watering points (Gilbey 1974, Gilbey and Weiss 1980).

Germination can occur at almost any time of the year but occurs mainly in autumn and winter (May to July). If there is an early break to the season or in areas where summer rainfall is likely, germination may occur from late February onwards. These plants may persist through a subsequent dry period because of the early development of a strong taproot. Seeds may continue to germinate following rain until at least August. Flowering usually occurs in late winter to spring. The flowers and seeds develop first in the crown at the base of the rosette, and then in the axils of leaves at nodes along the stems for most of the remainder of the growing season. Thus seed maturation may occur continuously from spring to early summer (Gilbey and Weiss 1980).

Research on the control of doublegee has focused on selective chemical control in field crops. However, considerable effort has also been directed towards cultural methods, and in more recent years several potential agents for biological control have been studied.

The emphasis on chemical control arises from one of the most important results of cultural control research, which showed that cultivation stimulates doublegee seedling emergence (Pearce 1973). This is one explanation for the dense infestations of doublegee that frequently occur in the first year of pasture following a cereal crop in a clover/pasture rotation. Many cereal farmers now cultivate specifically to stimulate seedling emergence so that pre-seeding chemical control more effectively reduces the potential emergence after seeding.

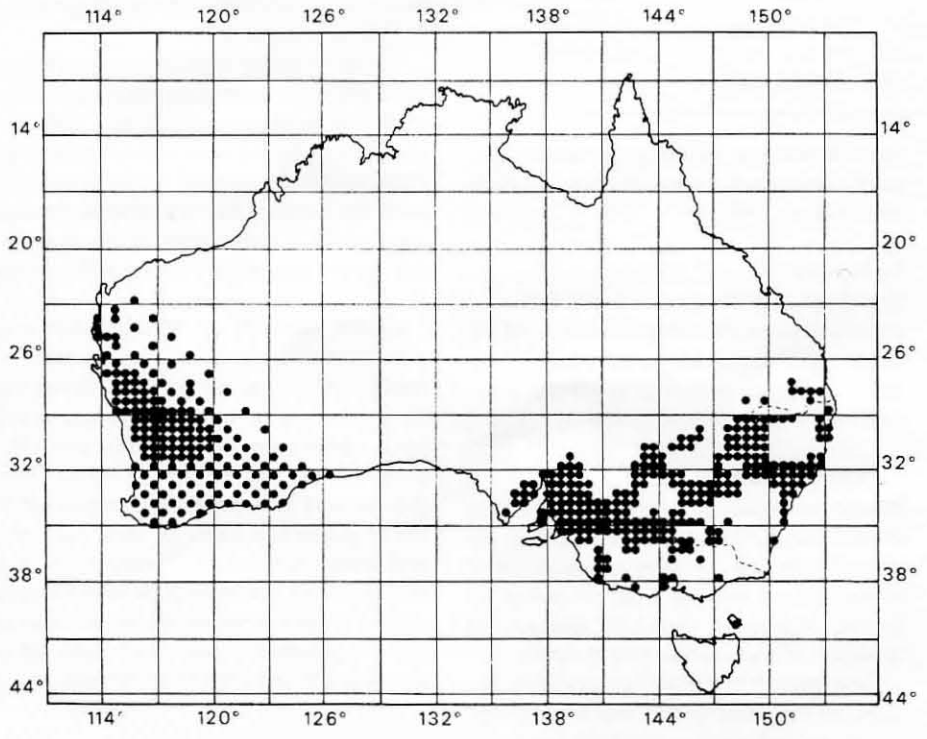

Fig. 1. Distribution of *E. australis* in Australia (Gilbey and Weiss 1980).

By relying on integrated cultural and chemical methods, farmers in Western Australia can control doublegee on an annual basis, but it has yet to be demonstrated that long term control or eradication is achievable.

This paper is a brief summary of the main herbicides that are used for controlling doublegee in Western Australia, with approximate costs per hectare (Anon 1990a).

Chemical Control

Time of Spraying

Time of spraying is one of the most important elements of successful post emergence doublegee control. Post emergence herbicides are most effective if they are applied before the doublegees have grown more than 4-5 leaves, after which control becomes less reliable as the doublegees become more advanced. By the time large runners have formed, most herbicides would be virtually ineffective at the recommended label rates, and the viability of mature seeds which would have formed in the crowns and on the runners would not be affected by herbicide.

Pre-seeding strategy for all field crops

If doublegee have emerged in April or earlier due to late summer rain, heaving grazing with sheep or heavy grazing following a 2,4-D spray (i.e. Spray-graze) are options to prevent the plants from growing large by early winter, when it is necessary to control all emerged plants with cultivation or a knockdown herbicide before the crop is sown.

Cereals

Doublegees that germinate and emerge with the cereal crop concern farmers because of their competitive effect, and the consequent reduction in cereal grain yield. Therefore, the object of control is to prevent seedlings from emerging in the crop, or to remove the seedlings from the crop early in the growing season before competitive pressure is exerted on the cereal.

A large research program which was carried out in the 1960s identified several herbicides that selectively controlled doublegee in cereal crops. On-going research since then enables the Western Australian Department of Agriculture to now recommend twelve herbicide options to cereal growers (Anon 1990b). (Table 1.)

All of these options would be expected to achieve excellent control of doublegee in cereals, and the final choice by cereal growers is usually based on a combination of price, and the product's capacity to control other weeds in the crop.

Lupins

As with cereals, doublegees emerge with the lupins in early winter, compete with lupins and reduce grain yields if they are not controlled. Furthermore, doublegee achenes

Table 1. Herbicides for doublegee control in cereal crops

Pre-emergence		
Glean® (750 g L^{-1} chlorsulfuron)	20 g ha^{-1}	≈ $18
Logran® (714 g L^{-1} triasulfuron)	30 - 35 g ha^{-1}	≈ $12.75-14.90
Post-emergence		
Combine®(188 g L^{-1} diclofop methyl) (140 g L^{-1} bromoxynil) (140 g L^{-1} MCPA)*	2 L ha^{-1}	≈ $31
Ally® (600 g kg^{-1} metsulfuron methyl)	5 g ha^{-1}	≈ $6
diuron (500 g L^{-1}) + MCPA (500 g L^{-1})	350 mL + 400 mL ha^{-1}	≈$5
diuron + 2,4-D amine (500 g L^{-1})	500 mL + 250 mL ha^{-1}	≈$4.80
bromoxynil (140 g L^{-1}) + dicamba (40 g L^{-1}) + MCPA (280 g L^{-1})*	0.75 - 1.4 L ha^{-1}	≈$8-16
bromoxynil (200 g L^{-1}) + MCPA (200 g L^{-1})*	1 - 2 L ha^{-1}	≈$11-22
bromoxynil (200 g L^{-1})	2 L ha^{-1}	≈ $22
dicamba (200 g L^{-1})	700 mL ha^{-1}	≈ $9
dicamba (80 g L^{-1}) + 2,4-D (300 g L^{-1})*	1 - 1.7 L ha^{-1}	≈$9.80-13.00
dicamba (80 g L^{-1}) + MCPA (340 g L^{-1})*	1 - 1.7 L ha^{-1}	≈ $8.40-14.30

*Formulated mixes

Table 2. Herbicides for doublegee control in lupins

simazine (500 g L^{-1})	1 - 2 L ha^{-1}	≈$4.80-9.60
simazine (500 g L^{-1}) + atrazine (500 g L^{-1})	1 - 2 L ha^{-1}	≈$4-8
diuron (500 g L^{-1})	2 L ha^{-1}	≈$12

Table 3. Herbicides for doublegee control in field peas

Pre-emergence		
diuron (500 g L^{-1})	1.5 - 2 L ha^{-1}	≈ $9.20-12.20
Bladex® (500 g L^{-1} cyanazine)	2 L ha^{-1}	≈$20.60
Post-emergence		
Bladex®	1 L ha^{-1}	≈$10.30
metribuzin (750 g kg^{-1})	300 g ha^{-1}	≈ $24
Tribunil® (700 g kg^{-1} methabenzthiazuron)	850 g ha^{-1}	≈$25.30

Table 4. Herbicides for doublegee control in subterranean clover

2,4-D amine	750 ml ha^{-1} (spray-graze)	≈$3.80
2,4-DB (400 g L^{-1})	1.5 L ha^{-1}	≈$11.80
Tribunil®	850 g ha^{-1}	≈ $25.30
diuron + 2,4-DB	200 - 400 mL ha^{-1} + 300 - 500 mL ha^{-1}	$3.60-6.40

that contaminate grain may result in price dockages, so the object of control is two-fold. Firstly to remove the competitive effect of the weed, and secondly to prevent grain contamination.

Reliable in-crop weed control strategies developed for lupins during the early to mid 1980s showed that satisfactory commercial control of doublegee is achieved with pre-emergence herbicides. (Table 2)

The doublegee control achieved with these herbicides is usually considered to be commercially satisfactory rather than excellent, because the upper limit on the application rate is determined by the tolerance of the lupins to the chemicals. When the same products are used at higher rates in more tolerant crops extremely good doublegee control can be expected. Field trials and farmer experience in recent years has shown that doublegee control in lupins is further improved by post-emergence "top up" applications of simazine following the normal pre-emergence simazine spray (Gilbey and Piper 1987, Gilbey 1990).

Field peas

The object of doublegee control in field peas is also to remove the competitive effect of the weed, which germinates at the same time as the crop, and in particular to prevent grain contamination at harvest. (Table 3)

Legume pasture

Doublegee in pasture is competitive with the sown legume although grazing stock will eat the seedlings. It is the spiny achene that is of major concern, because it can cause foot infection, consequent lameness and loss of condition in stock, particularly in lambs.

Even though herbicides are available, because of the variable late summer-autumn rainfall pattern selective chemical control of doublegee in Western Australian pastures is unreliable. When germinating rainfall occurs from March to May doublegee and the pasture legume may germinate simultaneously, but during subsequent dry periods the shallower rooted legumes are more susceptible to mortality than the weed. This can result in a doublegee infested pasture with plants at various growth stages in the early part of the winter growing season when decisions need to be made about spraying. Under these circumstances it is very difficult to time a single herbicide spray for satisfactory selective doublegee control. (Table 4)

Spray-graze is a very effective method of changing pasture composition from doublegee dominance to legume dominance. Heavy grazing (preferably with sheep) is essential for a short time after spraying, so the technique is most useful in small paddocks where stock can be easily managed.

The herbicide 2,4-DB is most effective when used in autumn before temperatures fall to normal winter levels. Tribunil is less sensitive to temperature and controls a wide range of other species besides doublegee, but is expensive compared to the other options. Diuron + 2,4-DB is the most effective option for doublegee control, but its usefulness is limited because it can cause considerable damage to the pasture legume.

Orchards and vineyards

Many orchardists and a majority of grape growers in Western Australia now use herbicides for under-tree/under-vine weed control, in preference to cultivation. A particular benefit of chemical weed control to grape growers was demonstrated at Bramley Research Station (W.A.) in 1980-81 where the weight of fruit harvested was increased by 60% as a result of using herbicides instead of under-vine weeding (strip digging)(J.E. Cripps, pers comm.).

The most widely used herbicides are Spray Seed and glyphosate. These products control small doublegees reasonably well, and this is one reason why the weed is not a serious pest. Other herbicides used in orchards and vineyards are Surflan, Flandor, diuron, simazine and amitrol + atrazine which are also effective against doublegee (Gilbey 1983). (Table 5)

Recent research in Western Australian with chlorsulfuron (Glean) and metsulfuron methyl (Ally) in grapevines has shown that these products have a wide margin of crop safety above rates of application that effectively control doublegee in cereal crops (Moore and Elliott 1989). If registered for use in grapevines either of these two products would substantially contribute to doublegee control in vineyards. Similar tolerance studies in fruit crops would be useful to assess the potential of these herbicides for selective doublegee control in orchards.

Table 5. Herbicides for doublegee control in vines

Winter Weeds		
Spray Seed (125 g L^{-1} paraquat + 75 g L^{-1} diquat)	2 - 4 L ha^{-1}	≈$12.80-25.60
amitrol (320 g L^{-1}) + atrazine (320 g L^{-1})*	4 - 5 L ha^{-1}	≈$49.70-62.00
Spray Seed + simazine	2 L + 2 L ha^{-1}	≈$22.40
diuron	4 L ha^{-1}	≈$24.40
Summer Weeds		
glyphosate (360 g L^{-1})	6-9 L ha^{-1}	≈$123.80-185.60
Surflan (500 g L^{-1} oryzalin)	9 L ha^{-1}	≈$309
Surflan + simazine	9 L + 2.5 L ha^{-1}	≈$321.60
Flandor (400 g L^{-1} oryzalin + 96 g L^{-1} simazine)	8.4 L - 11.5 L ha^{-1}	$NA

* Formulated mix

Non-crop situations

Doublegees growing in non crop areas such as around sheds, stockyards, contour banks, roadsides and fence-lines are likely to provide a source of seed that can reinfest other areas, particularly if the spiny achene is picked up on vehicle tyres, footwear etc. This can also be a source of contamination of agricultural produce during storage or handling.

The options for chemical control in non crop areas include some non selective, residual herbicides as well as those already mentioned.

Acknowledgements

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Questions and discussion

Q. Graeme Robertson. Do you see any phytotoxicity effects with the use of Flandor in young vines?

A. In experimental situations we have applied up to 24 L ha^{-1} on young sultana vines on rootstocks without phytotoxic effects. We are therefore happy to recommend 12 L ha^{-1}.

Q. Gary Thomas. Why don't you use Diuron?

A. Amitrol and atrazine seems to be better in W.A.

Q. Dick Johnstone. What chemicals are useful in controlling spiked weeds in drying greens during winter?

Comment from Alison MacGregor. Couch is dormant during winter so you can use knockdowns. Simazine could also be used.

Comment from Des Gilbey. Ally may also have role as a knockdown with a short residual effect.

Comment from Vic Szabo. Stomp would be worth consideration. It would give up to four months residual control.