HERBICIDE TOLERANCE OF POTENTIAL ORCHARD GROUND COVERS

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Summary. This paper presents initial results from a study to minimize herbicide use in orchards by growing ground cover species. The philosophy of growing ground cover species which tolerate herbicides under orchard trees is discussed, and results of herbicide tolerance studies for some potential ground cover species are presented. Three prostrate perennial species, ajuga (*Ajuga reptans*), pearlwort (*Sagina procumbens*) and pratia (*Pratia pedunculata*) have been treated with a wide range of herbicides suitable for use in orchards. Ajuga and pearlwort tolerated enough of the herbicides to make establishment and maintenance of pure swards of these species under orchard trees feasible.

INTRODUCTION

Competition from vegetation growing under fruit trees is usually minimised by removing all vegetation near the base of trees with herbicides, and by regularly mowing vegetation between the rows of trees. The lack of ground cover in the sprayed areas is very conducive to germination of weed seeds, so residual herbicides are generally applied to prevent rapid reinvasion by weeds. Regular applications of foliar herbicides are usually also required to remove weeds resistant to the residual herbicides or which colonise the bare ground when the residual herbicides lose effectiveness (2). Thus several types of herbicide are present under trees as fruit is developing.

With the increasing public pressure to reduce the use of pesticides for food production, some growers are interested in developing alternative strategies for reducing competition under fruit trees. One possibility would be to establish low-growing non-competitive ground cover species under trees. Such species would need to be dense enough to prevent weed seeds from germinating yet not compete with trees for nutrients or water, and not require mowing. Ground cover species have been used for many years in amenity horticulture (5). However they generally require considerable labour during the establishment phase to remove weed species which germinate before a dense canopy has formed. In orchards, research into possible ground cover species has concentrated mainly on small grass species (1) and also various legumes such as clovers (3).

However there is a wide range of other perennial species which could potentially act as ground cover in orchards and which may be less competitive than grasses or legumes, allowing them to be planted right to the base of trees. Such species are often considered as weeds. The main problem with growing such species is that more competitive weed species usually invade such swards during their establishment (4). Thus selective herbicides are needed to remove unwanted plant species from ground cover swards. If the objective of growing ground covers in orchards is to minimise the use of herbicides during the growing season, such herbicides could be used while trees are immature to aid establishing swards, and during crop dormancy to maintain pure swards.

This paper describes initial experiments at Massey University to test the herbicide tolerance of potential ground cover species. Ajuga and pratia were chosen as species already used as ground

covers in amenity horticulture, while pearlwort is a mat-forming weed species tolerant of several herbicides used in nurseries.

METHODS

Experiment 1. Individual plants of ajuga, pratia and pearlwort were established in polythene bags containing a 60:40 mixture of peat and pumice. A slow release fertiliser was added and the plants were established from transplants taken from the field. They were kept in a heated glasshouse which remained between 16 and 22°C for the duration of the trial. Bags were placed on felt mats which were automatically moistened twice daily.

Once plants were well established in each bag, herbicide treatments were applied on 12 June 1992. Herbicide treatments are listed in Table 1. Each treatment was applied to five ajuga, five pearlwort and four pratia plants, and treatments were allocated using a completely randomised design for the first two species and a randomised complete block design for the pratia. Herbicides were applied in 243 l/ha of water using a laboratory pendulum sprayer similar to that described by Wiese (6).

The tolerance of plants to the herbicides were visually assessed using a scoring technique on nine occasions over the subsequent 14 weeks. An analysis of variance was performed on the arcsine transformed scores, and means were separated using the Student-Newman-Keuls multiple range test.

Experiment 2. Based on results from Experiment 1 and unpublished field trials, a second glasshouse experiment tested the tolerance of ajuga and pearlwort to further herbicide treatments. Plants were established in polythene bags containing a Kiwitea loam soil with a pH of 5.0 and 7.7% organic matter. The plants were grown in a glasshouse and watered as for Experiment 1, though the temperature for this experiment was between 18 and 26°C. Treatments were replicated five times using a completely randomised design for each species and applied on 28 January 1993 using the same sprayer as in Experiment 1 with a water rate of 320 l/ha. Plants were scored three times and analyzed as above.

RESULTS AND DISCUSSION

Pratia did not tolerate enough herbicides to be worth studying further after the initial screening trial. It was also found to die back with frosts in winter, allowing winter-germinating weeds to establish. However ajuga and pearlwort appear more promising. Oxadiazon, simazine and pendimethalin are all residual herbicides that can be used to assist with the establishment of ajuga. It forms a dense canopy once it has established, and its tolerance of haloxyfop, paraquat, diquat, clopyralid and asulam will allow many weed species which do establish to be removed at a time of the year when fruit trees are dormant. The paraquat and diquat do cause some initial knock-back of the plants, but they soon recover. The strong tolerance of pearlwort to residual herbicides such as oxadiazon, pendimethalin, oxyfluorfen and dichlobenil should allow a sward of this species to be successfully established. Haloxyfop, clopyralid, asulam, dalapon, 2,4-DB, MCPB and low rates of 2,4-D should allow most weeds which do establish to be successfully removed. However field trials are now required to determine whether this small plant can form a dense enough canopy to prevent weeds from establishing during the growing season when herbicides are not assisting it.

Table 1. The effects of herbicides applied at post-emergence on the health of three potential ground cover species as assessed by a scoring technique (1 = unaffected, 10 = dead) at 7 and 14 weeks after application. Means within a column sharing the same letter are not significantly different (p = 0.05).

Herbicide	Appln. Rate	Ajuga		Pearlwort		Pratia	
	kg ai/ha	7 wk	14 wk	7 wk	14 wk	7 wk	14 wk
amitrole	3.2	4.4 cd	7.4 ab	9.0 bcd	9.6 ab	7.4 cd	9.9 a
asulam (sodium salt)	1.2	2.1 de	1.0 c	1.0 e	1.0 c	1.7 e	2.1 b
atrazine	1.0	7.9 b	9.3 a	10.0 a	10.0 a	10.0 a	10.0 a
clopyralid (amine salt)	0.3	1.3 e	1.0 c	1.0 e	1.0 c	6.0 d	8.3 a
2,4-D (amine salt)	1.2	7.1 b	10.0 a	8.6 cd	8.9 ab	2.4 e	7.9 a
dichlorprop (potassium salt)	2.5	7.3 b	10.0 a	9.8 ab	9.4 ab	7.5 cd	8.9 a
diquat (dibromide salt)	0.6	9.8 a	4.7 bc	10.0 a	7.8 b	10.0 a	10.0 a
glufosinate (ammonium salt)	1.0	10.0 a	10.0 a	10.0 a	9.4 ab	10.0 a	10.0 a
glyphosate (isopropylamine salt)	0.36	6.1 bc	9.8 a	10.0 a	8.5 ab	8.2 c	9.1 a
haloxyfop (ethoxyethyl ester)	0.25	1.0 e	1.0 c	1.0 e	1.0 c	1.2 e	1.0 b
ioxynil (octanoyl ester)	0.67	7.7 b	4.3 bc	9.6 abc	8.9 ab	9.7 ab	6.9 a
linuron + diuron	1.7 + 1.1	6.4 bc	4.5 bc	10.0 a	10.0 a	10.0 a	10.0 a
MCPA (potassium salt)	1.1	7.6 b	10.0 a	9.6 abc	9.2 ab	8.8 bc	8.3 a
oxadiazon	1.6	2.5 de	1.4 c	1.0 e	1.0 c	2.2 e	1.2 b
paraquat (dichloride salt)	0.4	7.4 b	1.2 c	9.6 abc	2.9 c	9.6 ab	9.1 a
pendimethalin	1.3	1.7 e	1.0 c	1.6 e	1.2 c	1.6 e	2.2 b
propanil + carbaryl	4.2 + 0.67	8.4 b	3.2 bc	10.0 a	10.0 a	10.0 a	10.0 a
tribenuron	0.011	2.3 de	5.2 bc	8.4 d	10.0 a	2.7 e	7.4 a
untreated	-	1.5 e	1.5 c	1.2 e	1.2 c	1.0 e	1.0 b

A number of other low-growing perennial species are being assessed for their tolerance of herbicides at present. Emphasis is being placed on herbicides registered for use in fruit crops. The most promising species will be planted out into an orchard to observe how well they prevent weeds from establishing, tolerate orchard traffic, shade and drought, and whether weeds which do establish can be successfully removed during winter with herbicides.

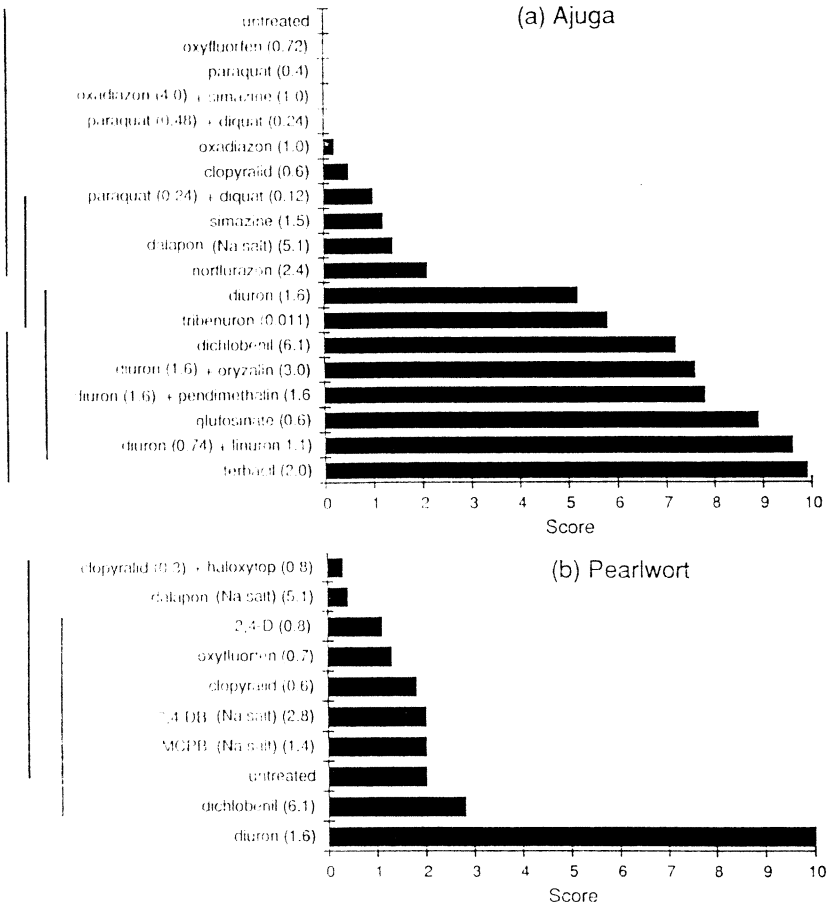

Figure 1. The tolerance of ajuga and pearlwort to post-emergence herbicide treatments as assessed by a scoring technique (0 = unaffected, 10 = dead) at 7 weeks after application. Treatments joined by the vertical lines on the left are not significantly different (p = 0.05). Formulations are as in Table 1 except where shown otherwise. The oxadiazon + simazine and dichlobenil treatments were applied as granules.

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