Herbicide tolerance of five young perennial grasses

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Summary The planting of perennial grasses is being encouraged in Western Australia to reduce ground water recharge, subsequent salinification and improve animal production. Typically these grasses have slow initial growth rates and suffer competition, especially from annual grasses, resulting in poor establishment of the perennial. Few herbicides are registered for weed control in young perennial grasses. Eleven pre-emergence herbicides and seventeen post-emergence herbicides were applied to winter active 'Resolute' tall fescue, summer active 'Quantum' tall fescue, tall wheatgrass, Rhodes grass and kikuyu. The herbicides were applied with a logarithmic sprayer at rates ranging from one half to five times the normal use rates. Establishment and growth of the grasses was assessed and a chart of herbicide tolerances of the various species was produced. There was useful tolerance to pre-emergence applications of atrazine, simazine, cyanazine, metribuzin and diuron. Post-emergence there was useful tolerance to atrazine, simazine, triasulfuron, metsulfuron, chlorsulfuron, diuron, metribuzin and a metribuzin plus diflufenican mix. Metolachlor, pendimethalin and trifluralin were poorly tolerated as pre-emergence applications and propyzamide, diquat, clethodim, amitrole and 2,2-DPA were poorly tolerated as post-emergence applications.

Keywords *Chloris gayana*, *Festuca arundinacea*, herbicide, kikuyu, *Lophopyrum elongatum*, perennial grass, *Pennisetum clandestinum*, 'Quantum', 'Resolute', Rhodes grass, tall fescue, tolerance.

INTRODUCTION

The planting of perennial grasses is being encouraged in Western Australia to reduce ground water recharge, subsequent salinification and improve animal production. Typically these grasses have slow initial growth rates and suffer competition, especially from annual grasses, resulting in poor establishment of the perennial (Anon. 2006). Controlling these annual grasses has been difficult, with current recommendations relying on multiple sprays before a delayed planting and control of seed set in the previous spring (Ryder *et al*. 2000). Few herbicides are registered for weed control in young perennial grasses (Moore and Moore 2010).

This paper reports the tolerance of five perennial grasses to eleven pre-emergence and seventeen post-emergence herbicides.

MATERIALS AND METHODS

Two tropical perennial grasses, Rhodes grass cv. 'Callide' (*Chloris gayana* Kunth) and kikuyu cv. 'Whittet' (*Pennisetum clandestinum* Chiov.), and three temperate perennial grasses, tall wheatgrass cv. 'Tyrell' (*Lophopyrum elongatum* (Host) A.Love) and tall fescue cv. 'Resolute' and cv. 'Quantum' (*Festuca arundinacea* Schreber), were planted in 20 m wide strips and treated with eleven pre-emergence and seventeen post-emergence herbicides at Mt Barker Research Station, Western Australia, on a sand-over-gravel-over-clay soil in the 600 mm rainfall zone. The species were chosen to represent the most commonly planted perennial grasses in the region. The temperate species were planted on 8 July 2007 and the herbicides applied pre-emergence on 6 July or post-emergence, 10 weeks later on 19 September. The tropical species were planted on 4 October and the herbicides applied pre-emergence between 19 and 24 September or post-emergence on 8 January 2008, 13 weeks after planting. Two replicates of each treatment were applied using a logarithmic sprayer applying the herbicides at the rates shown in Tables 1 and 2 on 5 m by 20 m plots. The logarithmic sprayer applies the high rate at the beginning of the plot and the rate decreases logarithmically along the length of the plot to the low rate at the end of the plot. The rates were chosen to approximate one half to five times the normal use rates. The plots were visually rated for growth of the perennial grass compared to untreated areas on 30 April 2008. The area was not grazed.

RESULTS

Tables 3 and 4 summarise the tolerance of the five perennial grasses to the herbicides. The more damaging herbicides are sorted toward the bottom of the tables. The expected rates of use of the various products are shown together with the range of rates in brackets that caused a 10% reduction in visually estimated dry matter. Where the expected use rate is somewhat lower than the tolerance the cells are unshaded. Light shading indicates that that the use rate is close to the tolerance observed and damage may occur in other situations. The dark shading indicates that damage is likely in most situations.

Overall the tall fescue was more sensitive to herbicides than the other species and the tropical grasses

Table 1. Pre-emergence herbicides.

Active ingredient	Product	Group	Low rate[1]	High rate[1]
Atrazine 900 g kg^{-1}	Atradex 900®	C	500	5000
Chlorsulfuron 750 g kg^{-1}	Glean®	B	10	100
Cyanazine 500 g L^{-1}	Bladex 500 SC®	C	1000	10000
Diuron 900 g kg^{-1}	Diurex 900®	C	500	5000
Metribuzin 750 g kg^{-1}	Lexone DF 750®	C	200	2000
Pendimethalin 440 g L^{-1}	Di Pend® (Stomp®)	D	1000	10000
Simazine 900 g kg^{-1}	Simazine 900®	C	500	5000
S-metolachlor 960 g L^{-1}	Dual Gold®	K	500	5000
Triasulfuron 750 g kg^{-1}	Logran®	B	30	300
Trifluralin 125 g L^{-1} + oryzalin 125 g L^{-1}	Yield®	D	1000	10000
Trifluralin 480 g L^{-1}	Trifluralin 480®	D	1000	10000

[1] Rates are product (g or mL) per hectare.

Table 2. Post-emergence herbicides.

Active ingredient	Product	Group	Low rate[1]	High rate[1]
2,2-DPA 740 g kg^{-1}	Propon®	J	1000	10000
Amitrole 250 g L^{-1}	Weedazol TL®	F	500	5000
Atrazine 900 g kg^{-1}	Atradex 900®	C	500	5000
Chlorsulfuron 750 g kg^{-1}	Glean®	B	10	100
Clethodim 240 g L^{-1}	Select® + oil	A	100	1000
Diclofop 375 g L^{-1}	Hoegrass®	A	500	5000
Diflufenican 500 g L^{-1} + metribuzin 750 g kg^{-1}	Brodal® + Lexone®	C	50+50	500+500
Diquat 250 g L^{-1}	Reglone®	L	200	2000
Diuron 900 g kg^{-1}	Diurex 900®	C	250	2500
Iodosulfuron 50 g kg^{-1}	Hussar®	B	100	1000
Metribuzin 750 g kg^{-1}	Lexone DF®	C	100	1000
Metsulfuron 600 g kg^{-1}	Ally®	B	5	50
Propyzamide 500 g kg^{-1}	Kerb 500 SC®	K	200	2000
Sethoxydim 186 g L^{-1}	Sertin® + oil	A	250	2500
Simazine 900 g kg^{-1}	Simazine 900®	C	500	5000
Tralkoxydim 400 g kg^{-1}	Achieve® + oil	A	250	2500
Triasulfuron 750 g kg^{-1}	Logran 750®	B	10	100

[1] Rates are product (g or mL) per hectare.

(Rhodes grass and kikuyu) tended to be more tolerant of the herbicides than the temperate grasses. The group D herbicides (pendimethalin as Di Pend and trifluralin as Trifluralin 480) and metolachlor as Dual Gold were too damaging at useful rates. However, Yield (a trifluralin and oryzalin mix) was tolerated at rates where the trifluralin component should have caused damage.

The group B herbicides were generally damaging to the temperate grasses when applied pre-emergence. However some combinations on the tropical grasses, such as chlorsulfuron as Glean on Rhodes grass and triasulfuron as Logran on kikuyu, were well tolerated.

Post-emergence, the group B and C herbicides were tolerated, albeit marginally in about half the combinations and iodosulfuron as Hussar killed the fescues. Chlorsulfuron as Glean and triasulfuron as Logran were better tolerated as a post-emergence than pre-emergence application. The 'grass selective' group A herbicides were generally damaging although there was useful tolerance to tralkoxydim as Achieve, diclofop as Hoegrass and sethoxydim as Sertin, which could be useful in salvage situations. Clethodim as Select was the only group A herbicide that killed all the species tested at normal rates.

The group F (amitrole as Amitrole 250), K (propyzamide as Kerb), J (2,2-DPA as Propon) and L (diquat as Reglone) herbicides were all too damaging to be useful.

Table 3. The rates of pre-emergence herbicides suggested for adequate weed control and the range of rates in brackets that caused a 10% reduction in visually estimated dry matter. Dark, light and no shading indicates damage, marginal tolerance and good tolerance respectively. NR indicates the product is not recommended as the rate tolerated is below the label rate for weed control.

Pre-emergence Herbicide	Tall fescue cv.'Resolute'	Tall fescue cv.'Quantum'	Tall wheat grass cv.'Tyrell'	Rhodes grass cv.'Callide'	Kikuyu cv.'Whittet'
Simazine 900 (g ha^{-1})	1000 (1000–1100)	1000 (2800–4400)	1000 (2800–3100)	1000 (2500–4400)	1000 (4400)
Atradex 900 (g ha^{-1})	1000 (1600–1700)	1000 (2500–4000)	1000 (1600–2000)	1000 (1000)	1000 (3100–4400)
Bladex (mL ha^{-1})	2000 (1800–4000)	2000 (3100–4000)	2000 (1800–4000)	2000 (4000–6300)	2000 (5000–6300)
Lexone DF 750 (g ha^{-1})	250 (300)	250 (600–800)	250 (500–1200)	250 (200–1000)	250 (500–1600)
Diurex 900 (g ha^{-1})	1000 (1600–2000)	1000 (1600–3100)	1000 (1800–4400)	1000 (800–1000)	1000 (1900–4400)
Logran (g ha^{-1})	NR (<30)	NR (<30)	35 (50–240)	NR (<30)	35 (120–200)
Glean (g ha^{-1})	NR (10–14)	NR (<10)	NR (12–20)	20 (63)	15 (16–50)
Yield (mL ha^{-1})	2300 (1800–3100)	NR (<1000)	2300 (1200–6300)	2300 (2500)	2300 (4000)
Dual Gold (mL ha^{-1})	NR (<500)	NR (<500)	NR (700–900)	NR (<500–900)	NR (1000–1200)
Di Pend (mL ha^{-1})	NR (2500–3100)	NR (1200–1600)	NR (1800–3100)	NR (1600–6300)	NR (1200–3100)
Trifluralin480 (mL ha^{-1})	NR (<1000)	NR (<1000)	NR (1800–3100)	NR (<1000)	NR (1200–3100)

The range of tolerances observed was often associated with soil type differences within the site. On the sandier areas the perennial grass growth was generally poorer and damage at lower rates of herbicide was observed.

DISCUSSION

Pre-emergence annual grass control could be achieved with the group C herbicides (simazine, atrazine, cyanazine as Bladex, metribuzin as Lexone and possibly diuron). Simazine or atrazine would often be a reasonable option where mixed species are being planted. In single species plantings the choice would be governed by the particular species and the weedy grasses present. For example, metribuzin as Lexone may be chosen if brome grasses were the prevalent weeds and kikuyu, 'Quantum' fescue and tall wheat grass were being planted. The group B herbicides (chlorsulfuron as Glean and triasulfuron as Logran) were better tolerated when applied post-emergence. A similar situation occurs in cereals where both these herbicide are registered for post-emergence but not pre-emergence applications on barley and oats (Moore and Moore 2010).

The group D herbicides were generally too damaging but Yield (a mixture of trifluralin and oryzalin) was tolerated at rates where damage from the trifluralin component would be expected. This could be worth further investigation in situations where there is resistance to group B and C herbicides.

This work also provides information for control of perennial grasses establishing from seed. Clethodim as Select at rates greater than 250 mL product ha^{-1} applied post-emergence provided good control of all species tested and would be useful in a range of broad-leaved crops.

The tables provided give an indication of the expected tolerances of these species. Variations in seeding systems, soil type and environment will affect the level of tolerance. Generally, if tolerance is more than three times the normal use rate then few problems are experienced in different application situations or on different cultivars. In some areas, some of these herbicides will not be registered for use in pasture or grazing situations and more work will be required. Permits for use will be required for most combinations of herbicide and species listed before commercial use.

Table 4. The rates of herbicides, applied 10–13 weeks after planting, suggested for adequate weed control in various perennial grasses and the range of rates in brackets that caused a 10% reduction in visually estimated dry matter. Dark, light and no shading indicates damage, marginal tolerance and good tolerance respectively. NR indicates the product is not recommended as the rate tolerated is below the label rate.

Post-emergence herbicide	Tall Fescue cv. 'Resolute'	Tall fescue cv. 'Quantum'	Tall wheat grass cv. 'Tyrell'	Rhodes grass cv. 'Callide'	Kikuyu cv. 'Whittet'
Atradex 900 (g ha^{-1})	1000 (2800–4400)	1000 (2800–4400)	1000 (3100–4000)	1000 (2000–3900)	1000 (3100–3500)
Simazine 900 (g ha^{-1})	500 (500–4400)	500 (800–1600)	500 (500–2500)	500 (1200–2000)	500 (1200–2500)
Logran 750 (g ha^{-1})	10 (31–90)	10 (12–56)	10 (20–90)	10 (25–50)	10 (25)
Ally (g ha^{-1})	5 (7–40)	5 (6–31)	5 (12–31)	5 (16–20)	5 (10–12.5)
Glean (g ha^{-1})	20 (70–90)	20 (20–90)	20 (45–90)	20 (50–80)	20 (20–40)
Brodal (mL ha^{-1}) + Lexone (g ha^{-1})	100+100 (300+300–450+450)	100+100 (150+150–450+450)	100+100 (350+350–450+450)	100+100 (150+150–250+250)	100+100 (100+100–250+250)
Diurex 900 (g ha^{-1})	500 (450–2200)	500 (1000–1100)	500 (800–1200)	500 (800–1200)	500 (400–1200)
Lexone DF (g ha^{-1})	250 (900)	250 (400–500)	250 (250–900)	250 (400–600)	250 (200–600)
Achieve + oil (g ha^{-1})	NR (250)	300 (600)	300 (800–1000)	300 (1200)	300 (600–800)
Hoegrass (mL ha^{-1})	NR (<500)	NR (<500)	750 (1000–1900)	750 (2500–3900)	750 (1200–1900)
Hussar (g ha^{-1})	NR (<100)	NR (100)	200 (250–400)	200 (500–600)	200 (300)
Sertin + oil (mL ha^{-1})	NR (<250–300)	NR (250–300)	NR (<250–400)	500 (800–1200)	500 (630–1200)
Kerb 500SC (g ha^{-1})	NR (350–1600)	NR (600)	NR (<200–250)	NR (300–1000)	NR (300–400)
Reglone (mL ha^{-1})	NR (400–600)	NR (400–900)	NR (<200–900)	NR (400–1000)	NR (600)
Select + oil (mL ha^{-1})	NR (<100)	NR (<100)	NR (<100)	NR (250–500)	NR (200–250)
Weedazol (mL ha^{-1})	NR (<500–4500)	NR (1100–2800)	NR (<500–3900)	NR (1200–2500)	NR (2500–3000)
Propon (g ha^{-1})	NR (1000–8000)	NR (1200–1700)	NR (<1000)	NR (2000–5000)	NR (2000–2500)

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