Tolerance of *Trifolium tumens* (Talish Clover) to pre- and post-emergent herbicides

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Abstract

Trifolium tumens (Talish Clover) is a long-lived, deep rooting perennial legume, with the potential to be developed as a drought tolerant forage plant suitable for growing in low rainfall temperate regions. The research objective was to develop an effective herbicide program for management of weeds in seed crops of *T. tumens* during establishment. Glasshouse experiments were undertaken using 8 pre-emergent and 29 post-emergent herbicides. The effect of herbicides on plant numbers, leaf number, shoot number, leaf width, plant height, and damage rating, were recorded, and lists of potential pre- and post-emergent herbicides were assembled. Further field and glasshouse experiments will confirm acceptable rates of application for implementing a successful weed control program in seed crops of *T. tumens*.

Key Words

Perennial legumes, pasture, persistent

Introduction

Trifolium tumens (Talish Clover) is a long-lived, deep rooting perennial legume, with a natural distribution across Turkey, Caucasus and Iran (Zohary and Heller, 1984), but can be found growing across a broad range of environments (Hall and Hurst, 2008). There are a number of varieties of *T. tumens* described by (Zohary and Heller, 1970), but no commercial cultivars were developed until recently. Preliminary work identified *T. tumens* germplasm with the potential for development as a drought tolerant, deep rooted perennial forage plant suitable for growing in low rainfall regions, and 'Permatas', the first cultivar of *T. tumens*, is currently being commercialised in Tasmania.

The success of the introduction of *T. tumens* into Australian farming systems is heavily dependent on commercially viable seed production, of which developing a suitable weed control programme is critical. Thus, the objective of this study was to evaluate the seedling tolerance of *T. tumens* to a number of commercially available pre- and post-emergence herbicides under glasshouse conditions.

Methods

For both pre- and post-emergent experiments, plant material included the cultivar 'Permatas' and a second breeding line, 'Azerbaijan', based on germplasm of a different origin. Herbicide rates were based on recommended label rates for clovers. The high rate was equivalent to the highest label rate for clover species, and the low rate was half the high rate. All results were analysed using the GLM procedure in SAS 9.1, and effects were considered significant at the $P<0.05$ level.

Post-emergent studies

Seeds were scarified and germinated in petri dishes, and planted into 4x4-cm pots containing a standard potting mix and slow release fertiliser. At the 3-4 true leaf stage plants were sprayed in a spray cabinet with a low or high rate of one of 29 herbicides treatments (Table 1), or left as an unsprayed control. Pots were arranged in a glasshouse in a randomized complete block design with four replicates. Plant measurements included leaf number (three times), number of vegetative shoots (two times), height (two times) and damage rating adapted from the European Weed Research Council (EWRC) scale (1: no effect; 2: very light symptoms; 3: light symptoms; 4: symptoms not reflected in yield; 5: yield depression likely; 9: complete kill) (10 times).

Pre-emergent studies

Seeds were scarified and four seeds were planted into each 8x8-cm square pot containing either a red ferrosol (Jetsonville, north-east Tasmania) or chromosol (Cambridge, south-east Tasmania) soil. Herbicides (Table 2) were applied using a spray cabinet and incorporated according to label recommendations. Pots were arranged in a randomized complete block design with four replicates. Plants measurements included plant emergence (five times), number of leaves (two times), and leaflet width (one time).

Table 1. Herbicides and rates used in the post-emergence screening of *Trifolium tumens*.

Trade Name	Active Ingredients	High Rate	Low Rate
Agritone 750	MCPA Amine 750 g/L	0.96 L/ha	0.48 L/ha
Agtryne MA	Terbutryn 275 g/L + MCPA 160 g/L	1.5 L/ha	0.75 L/ha
Amicide 625	2,4-D Amine 625 g/L	1.7 L/ha	0.85 L/ha
Basagran	Bentazone 480 g/L	1.0 L/ha	0.5 L/ha
Basta	Glufosinate-ammonium 200 g/L	2.0 L/ha	1.0 L/ha
Broadstrike	Flumetsulam 800 g/kg	25 g/ha	12.5 g/ha
Brodal options	Diflufenican 500 g/L	0.2 L/ha	0.1 L/ha
Bromicide 200	Bromoxynil 200 g/L	1.4 L/ha	0.7 L/ha
Bromicide MA	Bromoxynil 200 g/L + MCPA 200 g/L	1.4 L/ha	0.7 L/ha
Buttress	2,4-DB 500 g/L	3.2 L/ha	1.6 L/ha
Comet 400	Fluroxypyr 400 g/L	0.75 L/ha	0.375 L/ha
Estericide Xtra 680	2,4-D Ester 680 g/L	1.6 L/ha	0.8 L/ha
Factor WG	Butroxydim 250 g/kg	180 g/ha	90 g/ha
Flowable Diuron	Diuron 500 g/L	1.0 L/ha	0.5 L/ha
Fusion Super	Butroxydim 250 g/kg + fluazifop 212 g/kg	320 g/ha	160 g/ha
Goal EC	Oxyfluorfen 240 g/L	0.08 L/ha	0.04 L/ha
Ingran 500	Terbutryn 500 g/L	0.7 L/ha	0.35 L/ha
Minder	Bromoxynil 250 g/L + Diflufenican 25 g/L	0.75 L/ha	0.375 L/ha
Nugrass	diclofop-methyl 375 g/L	2.0 L/ha	1.0 L/ha
Nugrex	MCPA 250 g/L + Diflufenican 25 g/L	1.0 L/ha	0.5 L/ha
Raptor WG	Imazamox 700 g/kg	50 g/ha	25 g/ha
Reglone	Diquat 200 g/L	0.7 L/ha	0.35 L/ha
Sencor 480sc	Metrabuzin 480 g/L	0.15 L/ha	0.075 L/ha
Sequence	Clethodim 240 g/L	0.15 L/ha	0.075 L/ha
Sertin 186 EC	Sethoxydim 186 g/L	1.0 L/ha	0.5 L/ha

Simazine 900DF	Simazine 900 g/kg	900 g/ha	450 g/ha
Spinnaker 700 WDG	Imazethapyr 700 g/kg	140 g/ha	70 g/ha
Targa	Quizalofop-P-ethyl 99.5 g/L	0.3 L/ha	0.15 L/ha
Verdict 540	Haloxyfop-R 130 g/L	0.1 L/ha	0.05 L/ha

Table 2. Herbicides and rates used in the pre-emergence screening of *Trifolium tumens*.

Trade Name	Active Ingredients	High Rate	Low Rate
Affinity Force	Carfentrazone-ethyl 240 g/L	0.1 L/ha	0.05 L/ha
Bouncer	Metolachlor 720 g/L	0.5 L/ha	0.25 L/ha
Flowable Diuron	Diuron 500 g/L	1.0 L/ha	0.5 L/ha
Kerb	Propyzamide 500 g/L	1.5 L/ha	0.75 L/ha
Sencor 480sc	Metrabuzin 480 g/L	0.58 L/ha	0.28 L/ha
Spinnaker	Imazethapyr 700 g/kg	140 g/ha	70 g/ha
Stomp	Pendimethalin 330 g/L	1.8 L/ha	0.9 L/ha
Triflur X	Trifluralin 480 g/L	1.7 L/ha	0.85 L/ha

Results

Post-emergent studies

Herbicides had a significant effect on the number of leaves and vegetative shoots on both *T. tumens* lines 32 days after application (Table 3). Agritone 750, Agtryne MA, Amicide 625, Basta, Bromicide 200, Bromicide MA, Buttress, Comet 400, Estercide Xtra 680, Flowable diuron, Goal EC, Ingran 500, Minder, Nugrex, Reglone and Simazine 900DF significantly reduced the number of leaves and/or vegetative shoots.

Herbicides had a significant effect on the plant height on both *T. tumens* lines 32 days after application (Table 3). The high rate of Amicide 625 and both rates of Basta significantly reduced 'Azerbaijan' plant height 32 days after application. The high rate of Agritone 750, both rates of Amicide 625, both rates of Basta, high rate of Estercide Xtra, high rate of Reglone and the high rate of Simazine 900DF significantly reduced the height of 'Permatas' plants 32 days after application.

Herbicides that caused a high level of damage (>5 on the EWRC rating) (Table 3) included Basta and Reglone. Herbicides that caused moderate damage (EWRC 3-5) included Agtryne MA, Amicide 625, and Fusion Super. Herbicides that had no significant effect on any plant characteristic and a low damage rating included Basagran, Broadstrike, Factor WG, Fusion super, Nugrass, Raptor WG, Sencor 480SC, Sequence, Sertin 186EC, Spinnaker 700WDG, and Targa.

Table 3. The effects of post-emergent herbicides on vegetative shoots, leaf number, height, and damage rating of 'Permatas' and 'Azerbaijan' lines of *T. tumens*.

Product	Permatas				Azerbaijan			
	Vegetative Shoots	Leaf Number	Plant Height	Damage Rating	Vegetative Shoots	Leaf Number	Plant Height	Damage Rating
Agritone 750	*	*	-	2.9	*	*	-	1.9
Agtryne MA	*	*	-	1.3	*	*	-	3.8
Amicide 625	*	*	*	3.0	*	*	*	3.9
Basagran	-	-	-	1.0	-	-	-	1.0

Basta	*	*	*	9.0	*	*	*	9.0
Broadstrike	-	-	-	1.2	-	-	-	1.0
Brodal options	-	-	*	1.2	-	-	-	2.1
Bromicide 200	-	*	*	2.0	-	*	-	1.8
Bromicide MA	-	-	-	1.1	*	*	-	1.2
Buttress	-	-	*	2.6	*	*	-	1.7
Comet 400	*	*	-	1.3	*	*	-	2.5
Estericide Xtra 680	*	-	*	2.1	*	*	-	1.8
Factor WG	-	-	-	1.1	-	-	-	1.0
Flowable Diuron	*	*	-	2.0	*	*	-	1.3
Fusion super	-	-	-	3.0	-	-	-	1.1
Goal EC	-	-	-	2.1	*	*	-	2.8
Igran 500	-	*	-	1.5	*	*	-	1.3
Minder	-	-	-	1.5	*	*	-	1.3
Nugrass	-	-	-	1.0	-	-	-	1.0
Nugrex	-	-	-	1.4	*	*	-	1.5
Raptor WG	-	-	-	1.0	-	-	-	1.1
Reglone	*	*	*	5.7	*	*	-	5.2
Sencor 480SC	-	-	-	1.0	-	-	-	1.0
Sequence	-	-	-	1.0	-	-	-	1.0
Sertin 186 EC	-	-	-	1.0	-	-	-	1.0
Simazine 900DF	*	*	*	1.4	-	-	-	1.0
Spinnaker 700 WDG	-	-	-	1.0	-	-	-	1.0
Targa	-	-	-	1.0	-	-	-	1.0
Verdict 520	-	-	-	1.1	-	-	-	1.0

[1] *Indicates a significant effect of either the low or high rate at P<0.05; - indicates no significant effect.

Pre-emergent studies

'Permatas' leaflet width was reduced by Spinnaker 700WDG and TriflurX, but no other plant measurements were affected by herbicides. 'Azerbaijan' leaflet width was reduced by Flowable Diuron, Spinnaker 700WDG, Stomp, and TriflurX. Number of leaves was not affected by herbicides. Herbicides that had no significant effect on any plant characteristic included Affinity Force, Bouncer, Kerb, and Sencor 480SC.

Table 4. The effects of pre-emergent herbicides on leaf stage, leaflet width, and number of plants of 'Permatas' and 'Azerbaijan' lines of *T. tumens*.

Product	Permatas			Azerbaijan		
	Leaf Stage	Leaflet Width	Number of plants	Leaf Stage	Leaflet Width	Number of plants
Affinity Force	-	-	-	-	-	-
Bouncer	-	-	-	-	-	-
Flowable Diuron	-	-	-	-	*	-
Kerb	-	-	-	-	-	-
Sencor 480SC	-	-	-	-	-	-
Spinnaker 700WDG	-	*	-	-	*	-
Stomp	-	-	-	-	*	-
TriflurX	-	*	-	-	*	-

[1] *Indicates a significant effect of either the low or high rate at $P<0.05$; - indicates no significant effect.

Conclusion

Under controlled environment conditions in the glasshouse, a number of pre- and post-emergent herbicides were identified as damaging to *T. tumens*. Consequently a list of potential herbicides for weed control in *T. tumens* swards was assembled. These include herbicides such as Basagran, Bromicide MA, Broadstrike, Nugrass, and Sequence that are registered for use on other types of clover, and would provide control of a wide range of weeds. Further field and glasshouse experiments will confirm acceptable rates of application for implementing a successful weed control program in *T. tumens* seed crops.

References

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