THE BIOLOGY OF TUSSOCK SEDGE (*CAREX APPRESSA*) AND ITS CONTROL IN UNPLOUGHED LAND

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Summary. Tussock sedge seed germinated readily in a laboratory 5 months after collection and maintained viability for at least three years thereafter. Seedlings emerged from 0 to 40 mm depth in soil but not from 80 mm. Seedling growth in the 39 days after sowing seed was inferior to improved pasture species. Mature tussock sedge plants on non-arable land were killed by glyphosate but regeneration from seed in the soil threatens long term control because improved pasture species could not control them by competition (despite the comparatively slow growth of the sedge seedlings), because legumes were unable to establish in the wet environment inhabited by tussock sedge. Further research is necessary to find a practical method of controlling seedling regeneration of tussock sedge after mature plants have been killed by herbicide.

INTRODUCTION

In some regions of New South Wales (NSW) and Victoria tussock sedge (*Carex appressa* R. Br.), a native plant, has spread from swamps and drainage lines and replaced native and improved pastures on mid-slope areas. A heavy infestation can substantially reduce animal production because it is unpalatable to sheep and cattle and physically dominates the pasture causing shading and competition. Tussock sedge is difficult to control on arable land because its large leaf bases makes ploughing ineffective unless heavy implements are used. Although preliminary investigations have been made into the effects of herbicides on tussock sedge on non-arable land (J.B. Shovelton, pers. comm.; (2)) no research has been conducted into the associated biology of the plant. The prospect of tussock sedge becoming a weed in NSW prompted the following investigations into its biology and control.

METHODS

Germination. Seeds of tussock sedge were collected from Boorowa and Bigga NSW in late spring or summer (Table 1), stored in metal containers in a laboratory and germinated at annual intervals in petri dishes under constant fluorescent light (20 $\mu Em^2.s$) and temperatures of 15-25°C.

Emergence. Seeds collected from Bigga in December 1991 were sown at 0, 5, 10, 20, 40 and 80 mm depths in liberally watered clay loam soil (bulk density 1.16 g/cm^3; mean strength of soil surface 0.7 kg/cm^2) in July 1992 and emergence observed over 47 days at 25°C. On day 48 soil was washed off the underground parts of seedlings to measure the length of the stem and primary root at each depth.

Seedling growth. Growth of tussock sedge, subterranean clover cv. Karridale (*Trifolium subterraneum*), white clover cv. Haifa (*T. repens*), cocksfoot cv. Currie (*Dactylis glomerata*) and phalaris cv. Sirosa (*Phalaris aquatica*) was recorded in soil in pots in a glasshouse at 25°C for 39 days after sowing the seeds.

Control. The effect of herbicides and oversowing on the control of tussock sedge was ascertained near Bigga where the soil is derived from granite. The mature sedge plants were 1 m high and growing on a mid-slope area subject to free surface water in wet winters and springs. Plots were sprayed on March 13 and May 8, 1990 with glyphosate (Table 4) in 200, 500 and 1000 L/ha of water with 0.2% adjuvant Turbo®. The March treatments were oversprayed with glyphosate on May 8 1990 and all treatments surface-sown with seed of cocksfoot cv. Currie, phalaris cvs Australian and Sirosa, subterranean clover cv. Karridale and white clover cv. Haifa and topdressed with Mo superphosphate (300 kg/ha) on 14 May 1990. Good rain in summer 1989/90 (247 mm) and autumn 1990 (339 mm) ensured that there was adequate moisture for growth of tussock sedge at each time of spraying. The kill of tussock sedge was recorded on December 6 1991 and establishment and growth of sown species and re-infestation of seedling tussock sedge from winter 1990 till April 1993.

RESULTS AND DISCUSSION

Germination. Ripe seeds harvested in late spring or summer germinated readily in the laboratory 5 or 6 months later (Table 1). The germination of 3 out of 4 seed samples, collected in different years from 2 locations, did not decline over time; germination of the fourth sample declined in the second year (Table 1).

Germination to the radicle emergence stage took 9 days under the conditions imposed in these experiments which is slower than for phalaris and cocksfoot which took 4 days.

Table 1.
Germination (%) of tussock sedge seeds at annual intervals, examining different after-ripening periods (AP) in months

Collection date of seed	Germination in 45 days in May or June:					
	1990		1991		1992	
	%	(AP)	%	(AP)	%	(AP)
			Boorowa			
30 Nov 89	64	(4)	83	(18)	81	(31)
18 Dec 90			85	(5)	51	(18)
12 Dec 91					89	(6)
			Bigga			
1 Dec 89	86	(4)	89	(18)	84	(31)
22 Nov 90			90	(5)	86	(19)
8 Dec 91					92	(6)

Emergence. Increasing depth of sowing reduced percentage emergence of tussock sedge (Table 2). In general the time taken for emergence increased and growth rate decreased

with increasing depth of sowing; the exception to this trend being the surface-sown seed (Table 2).

The method of emergence of tussock sedge was for the stem to grow from the seed to the soil surface where the buds for leaf and root growth developed. This resulted in increasing length of stem and decreasing length of primary root (from the seed) with increasing depth of sowing (Table 2). Seeds sown at 80 mm failed to emerge, the stem growing 44 mm towards the surface before dying.

Table 2.
Effect of depth of sowing of tussock sedge seeds on emergence and growth in the 47 days after sowing

Sowing depth (mm)	Emergence (%)	Mean time for emergence (days)	Mean height (mm)	Length of stem[b] (mm)	Length of primary root (mm)
Surface	100 a[a]	22 bc	76 b	0	70
5	77 b	17 a	90 a	5	68
10	41 c	19 ab	75 bc	11	41
20	29 cd	22 bc	65 cd	22	12
40	14 d	24 c	55 d	42	7
80	0 e	-	-	44	3

[a] Values in columns not followed by a common letter differ significantly ($P<0.05$).
[b] From seed to soil surface.

Seedling growth. Tussock sedge grew more slowly ($P<0.05$) than the other species tested (Table 3).

Table 3.
Growth of seedlings of tussock sedge and improved pasture species in 39 days after sowing

Species	Dry weight/plant (mg)
Subterranean clover	58.6a[a]
Phalaris	16.2b
Cocksfoot	10.5c
White clover	6.8d
Tussock sedge	1.3e

[a] Values not followed by a common letter differ significantly ($P<0.05$).

Control. The split applications of glyphosate (March and May) were more ($P<0.05$) effective in killing tussock sedge than single applications in May (Table 4). Rate of water carrier had no ($P<0.05$) effect of herbicide efficiency.

Good establishment of cocksfoot and phalaris and poor establishment of sown legumes occurred on all sprayed treatments in winter 1990. By late spring 1990 ground cover of cocksfoot, phalaris and volunteer species was 30% on the sprayed plots which was insufficient to control a heavy infestation of seedling tussock sedge. These seedlings died during the dry 1990/91 summer and autumn (172 mm rain). By December 1991 the mean ground cover of cocksfoot and phalaris on sprayed plots was 61% with no seedling tussock sedge. However in winter 1992 seedling sedge established from seed in the soil despite competition from sown species. By April 1993 the ground cover of seedling sedge was 9% and that of cocksfoot and phalaris 57%. During the period of the experiment sown legumes contributed less than 5% ground cover; phalaris was the dominant sown grass contributing 55% of the 57% total ground cover of sown grasses in April 1993.

Table 4.
Effect of glyphosate on percentage kill of tussock sedge, recorded on December 6, 1991; each treatment meaned for three rates of water carrier

Glyphosate (kg a.i./ha) applied on:			Kill
March 3, 1990		May 8, 1990	(%)
0.9	+	0.7	99.6a[a]
1.4	+	0.7	100.0a
1.8	+	0.7	100.0a
Nil		0.9	67.7c
Nil		1.4	91.7b
Nil		1.8	94.0b
Nil		Nil	3.0d

[a] Values not followed by a common letter differ significantly ($P<0.05$).

Conclusions. Despite good kills of tussock sedge with split applications of glyphosate in 1990, regeneration from seed in the soil threatens to undermine long term control. Because the seed remains viable for at least three years, regeneration from seed will be a constant threat unless seedlings can be killed by pasture competition soon after germination when their growth is slow compared to that of sown species. In the experiment on control of sedge, the sown grasses were unable to kill tussock sedge seedlings by competition. Generally legumes are relied upon to kill seedlings of grass weeds, e.g. serrated tussock (1), by excluding their light supply whilst the pasture is ungrazed. In the wet environment of the control experiment, subterranean and white clovers were unable to establish and thus could not provide the competition for light necessary to kill tussock sedge seedlings. Other legumes were tested in 1991 and 1992 with lotus cv. Maku (*Lotus pedunculatus*) proving most promising in 1992. Further

research is necessary to investigate methods of controlling seedling regeneration of tussock sedge.

REFERENCES

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