REGENERATIVE CAPACITY OF ROOT FRAGMENTS OF *CARDARIA DRABA*

A.R. Harradine
Department of Primary Industry and Fisheries, Research Laboratories,
St John's Ave, New Town Tas 7008, Australia

Summary. *Cardaria draba* roots collected from a field infestation in autumn 1990 were separated into three thickness classes, cut into 5 or 10 cm pieces and planted in pots at 2, 5 or 10 cm depth. Shoot emergence was recorded. Shoots emerged from all fragment classes and lengths at all depths. The overall mean number of emerged shoots per viable root fragment was 2.0. The mean percentage of fragments which produced shoots was 41% but it varied widely between treatments. Calculations based on these data indicate that a *C. draba* shoot density of over 5,000 per square metre could result from regrowth from root fragments within 4 weeks of cultivation.

INTRODUCTION

Cardaria draba, hoary cress, is a significant weed of crops in many temperate areas of the world (2). Its declaration under Noxious Weeds legislation in five Australian States (4) is indicative of its serious weed status in this country.

C. draba is an herbaceous perennial plant, regenerating each autumn from an extensive root system which may reach a depth of 9 m (1). Following cultivation of infested areas, the plant is capable of regrowth from roots below the depth of cultivation (5) and from root fragments (6). The plant may also spread to new areas following transport of root fragments on cultivation implements.

This paper reports work which studied the regenerative capacity of root fragments as part of a wider research program to develop integrated control methods for *C. draba* in intensive cropping systems.

METHODS

C. draba roots were collected from a heavily infested pasture at Kempton in the Midlands area of Tasmania on 19 March 1990, about the time when seed-bed preparation would begin for an autumn-sown field crop in the region. The area had not been cultivated for at least 5 years. At the time of sampling, *C. draba* had completed its seasonal growth cycle and no green shoots were present.

All *C. draba* roots large enough to be readily separated from the associated grass roots were collected from an area 1 m x 1 m x 10 cm deep. Roots were washed carefully and then separated (with cutting as necessary) into three "thickness" classes based on lignification and size (Table 1). Within these classes, roots were cut into 5 and 10 cm lengths.

On 21 March 1990, the root fragments were planted at depths of 2, 5 or 10 cm in 20 cm diameter plastic pots filled with a 50/50 composted pine bark/sand medium. Seven fragments of one of the six thickness x length categories were planted in each pot with five replicates of each depth treatment. Pots were maintained in a semi-controlled glasshouse environment (temperature range 10 to 25°C) with daily watering.

The time of emergence of shoots at the soil surface was recorded. At four, ten, sixteen and twentysix weeks after the start of the experiment, pots with shoots at the surface were emptied. *C. draba* root fragments with emerged shoots were recorded and discarded. The remaining fragments were replanted as before, using the same soil and taking extreme care not to damage any shoots present which had not yet reached the soil surface. At twenty-six weeks, emergence had almost finished and thereafter fragments were removed from pots as shoots emerged. The trial was terminated 52 weeks after the initial planting.

Data were analysed by analysis of variance for a completely random design of three thickness x two length x two depth factors at each of two times. Mean shoot number per fragment and percentage of fragments which produced emerging shoots were the parameters analysed. The latter data were transformed (arcsin $\sqrt{X}$) prior to analysis.

RESULTS AND DISCUSSION

The total fresh weight of roots collected from the sampled area was 372 g.

The first shoots emerged 10 days and the last shoot 51 weeks after planting. Over 99% of the final shoot number had emerged by 26 weeks and this was taken as the finish of the trial for data analysis.

The rate of shoot emergence was high over the first four weeks and decreased thereafter. Over all treatments, shoot emergence during this initial four week period was 68%, 80% and 89% of the final shoot number for thickness classes 1, 2 and 3 respectively.

For the fragments which produced emerged shoots, the overall mean shoot number per fragment was 2.0, with a maximum of five.

Mean shoot number per fragment (SN/F) was significantly greater for thickness class 2 (1.23) than for the other two classes (0.58, 0.69) and almost twice as high for the 10 cm fragment length (1.10) than for the 5 cm length (0.56). Final SN/F at 10 cm depth of planting (0.52) was significantly less than for the other two depths (1.04, 0.93).

Over all treatments, the greatest SN/F at all times of sampling was for thickness class 2 fragments of 10 cm length planted at 2 or 5 cm (Table 1). Thickness class 1 fragments of 5 cm length generally had the lowest emerged shoot number. The relative differences between treatments were the same at the 4 and 26 weeks sampling times (Table 1).

Overall, 41% of the 630 fragments produced at least one emerged shoot over the 52 week duration of trial.

The percentage of fragments with emerged shoots (%FS) was significantly greater for thickness class 2 (65%) than for the other two classes (35%, 22%) and for the 10 cm fragment length (51%) relative to the 5 cm length (30%). Overall, depth of planting had no significant effect on %FS.

The %FS was greatest for 10 cm fragments of thickness class 2 and least for 5 cm fragments of class 1 and both lengths of class 3 fragments (Table 1). As for SN/F, the relative differences between treatments were the same at the 4 and 26 weeks sampling times (Table 1).

A similar trial has been conducted in England (6) in which *C. draba* roots were collected from the field in April (northern hemisphere spring). Although the root fragments used were smaller at between 1.3 and 5.0 cm in length, the overall viability of fragments was greater (approx. 75%) than in the current trial. The mean number of shoots per fragment was similar. The rate of emergence was considerably less in this earlier trial, even though the maximum depth of planting was less (7.5 cm). These results indicate that *C. draba* is able to regenerate readily from root fragments in both spring and autumn.

Limited observation indicates that normal seedbed preparation using disc implements does not result in many *C. draba* root fragments of less than 5 cm in length and that most fragments are much greater than this unless intense secondary cultivation is undertaken (Harradine, personal observation). Tine cultivation implements would be expected to reduce fragment length even less.

From the above experimental data, cultivation of a well-established C *draba* infestation to 10 cm depth for an autumn sowing of a field crop could result in a *C. draba* population of over 5,000 plants per square metre within 4 weeks of cultivation, from regrowth of root fragments alone.

Table 1. Mean shoot number per fragment and percentage of C *draba* root fragments that had produced shoots at four and twenty-six weeks after planting.

Thickness class[a]	Length (cm)	Depth (cm)	Shoot no. per fragment		Percentage of fragments with shoots			
			4 weeks	26 weeks	4 weeks		26 weeks	
1	5	2	0.11	0.40	5.7	(13.8)[b]	20.0	(26.6)
1	5	5	0.11	0.22	11.4	(19.7)	22.8	(28.5)
1	5	10	0.09	0.14	8.6	(17.0)	14.2	(22.2)
1	10	2	1.06	1.22	48.5	(44.1)	62.8	(51.8)
1	10	5	0.83	0.91	48.5	(44.2)	54.2	(47.4)
1	10	10	0.54	0.60	31.4	(34.1)	37.1	(37.5)
2	5	2	0.80	0.86	40.0	(39.2)	45.7	(42.5)
2	5	5	1.00	1.14	69.0	(56.2)	74.2	(59.4)
2	5	10	0.20	0.37	20.0	(26.6)	34.2	(35.8)
2	10	2	1.80	1.97	71.4	(57.6)	80.0	(63.4)
2	10	5	1.77	1.86	80.0	(63.4)	82.9	(65.6)
2	10	10	0.66	1.14	40.0	(39.2)	74.3	(59.5)
3	5	2	1.06	1.06	31.4	(34.0)	31.4	(34.1)
3	5	5	0.71	0.71	20.0	(26.6)	20.0	(26.6)
3	5	10	0.09	0.14	5.7	(13.8)	8.6	(17.2)
3	10	2	0.71	0.71	20.0	(26.6)	20.0	(26.5)
3	10	5	0.74	0.74	20.0	(26.6)	20.0	(26.6)
3	10	10	0.54	0.74	22.9	(28.5)	31.4	(34.2)
l.s.d. (P=0.05)			0.32	0.27		(13.2)		(16.1)

[a] Thickness classes
1: "Thin, non-lignified": Approx. diameter 1-3 mm, fresh weight 0.14-0.30 mg/mm. (13% of total simple on fresh weight basis).
2: "Thick, non-lignified": Approx diameter 3-6 mm, fresh weight 0.30-1.00 mg/mm. (33% of total simple on fresh weight basis).
3: "Thick, lignified": Approx diameter 3-8 mm, fresh weight 0.724.20 mg/mm. (54% of total simple on fresh weight basis).

[b] Figures in parentheses are the transformed values to which the l.s.d. applies.

This experiment confirms local field experience that cultivation for field crop establishment would be expected to exacerbate an existing *C. draba* weed problem. It also indicates that normal cultivation alone is unlikely to control *C. draba*. This is confirmed by experiments which found that 39 (3) and 22 to 24 (7) cultivations over a three-year annual cropping program were necessary for *C. draba* control.

If cultivation is to be used to reduce *C. draba* density in an integrated control program it should be aimed at chopping roots into fragments as small as possible and burying them as deeply as possible.

REFERENCES

1. Corns, W.G. and Frankton, C. 1952. Sci. Agr. 32, 484.
2. Holm, L., Pancho, J.V., Herberger, J.P. and Plucknett, D.L. 1979. A Geographical Atlas of World Weeds. (John Wiley & Sons: New York).
3. Jenkins, L. and Jackman, E.R. 1938. Oregon State Coll. Ext. Bull. No. 522. (in 6).
4. Parsons, W.T. and Cuthbertson, E.G. 1992. Noxious Weeds of Australia. (Inkata Press, Melbourne).
5. Pemberton, E.J. and Prunster, R.W. 1940. J. Counc. Sci. & Industr. Res., Aust. 13, 107. (in 6).
6. Scurfield, B. 1962. J. Ecol. 50, 489-499.
7. Sexsmith, J.J. 1956. 13th Annual Rept. N. Central Weed Conf., Chicago (in 6).