An examination of the seedbank distribution, seedling emergence and seed survival of Apiaceae weeds in pyrethrum

R.P. Rawnsley[1], P.A. Lane[1], P.H.Brown[1] and T. Groom[2]

[1] School of Agriculture Science, University of Tasmania, GPO Box 252-54, Hobart 7001.
[2] Botanical Resources Australia Pty Ltd. Industrial Drive, Ulverstone, Tasmania 7315.

Abstract

An assessment of the seedbank for the presence of Apiaceae weed seeds in pyrethrum fields found that more than 85% of the seedbank population of *Anthriscus caucalis* and *Daucus glochidiatus* occurred the upper 5 cm. An assessment of seedling emergence found that the initial seedling density of *A. caucalis*, *D. glochidiatus* and *Torilis nodosa* was 4037 ? 368 m^{-2}, 3647 ? 779 m^{-2} and 5558 ? 519 m^{-2}, respectively. Following seedling removal, emergence was sparse; with discernible peaks in emergence occurring in autumn for *A. caucalis* and following soil disturbance for *D. glochidiatus* and *T. nodosa*. Seedbank depletion for each species appeared quite rapid. An understanding of emergence pattern and seedbank distribution of these Apiaceae weeds will provide valuable information for successful forecasting of germination trends and the development of an effective integrated control program.

Key words

Seedbank, Anthriscus caucalis, Torilis nodosa, Daucus glochidiatus.

Introduction

The prevalence and dominance of Apiaceae weeds; *Anthriscus caucalis* M. Bieb (Burr Chervil), *Torilis nodosa* (L.) Gaertn (Knotted Hedge Parsley) and *Daucus glochidiatus* (L.) (Native Carrot) in pyrethrum suggests they are favoured by the no-till production system and the herbicide regime associated with pyrethrum production. Tillage systems have been shown to effect the vertical distribution of weed seeds in soil (1), with a more heterogenous distribution occurring under a no-till system (2).

All three Apiaceae species have been observed to emerge in dense patches, with emergence predominantly occurring in autumn and spring. However, no quantitative evidence has been recorded on the level or periodicity of emergence. To effectively manage these Apiaceae weeds more detailed information is required on the seedbank distribution and their emergence behaviour. The aim of this study was to investigate the seedbank distribution, seedling emergence and seed survival of *T. nodosa*, *A. caucalis* and *D. glochidiatus*.

Methods

Three commercial pyrethrum fields were selected based on the presence of weed species *A. caucalis*, *T. nodosa* and *D glochidiatus*. Two 9 m^2 plots within each field where selected as being representative of a typical weed infested area. A total of 40 soil cores were extracted using a 7.5 cm diameter thread auger at depths of 0 to 5 and 5 to 10 cm. To extract weed seeds, soil samples were deflocculated (2) and sieved through 2 mm, 1 mm and then 0.5 mm screens. Seedbank analysis was only performed for *A. caucalis* and *D. glochidiatus*. In addition twenty 0.09 m^{-2} soil sections, to a depth of 5 cm were carefully removed with minimal soil disturbance and placed in similar sized trays. Initial seedling density was determined and seedlings were removed by cutting below the cotyledons. Trays were exposed to natural temperature and light conditions at the University of Tasmania, Hobart (42?90′ S, 147?32′ E) and newly emerged seedlings recorded and removed weekly. Soil was disturbed slightly in early January 2002 to mimic the event of harvests within a pyrethrum field.

Results and Discussion

The number (mean ? s.e.) of *A. caucalis* and *D. glochidiatus* seeds in the 0 to 5 cm soil layer was 3497 ? 1063 m^{-2} and 11033 ? 1590 m^{-2} respectively. This was significantly higher ($P < 0.001$) than the mean number of seeds found in the 5 to 10 cm layer; 588 ? 143 m^{-2} and 1630 ? 196 m^{-2}, respectively. These findings are consistent with the observed trend for no-till systems where the greatest proportions of weed seeds occur in the upper soil layer (1,2).

Initial seedling densities were 4037 ? 368 m^{-2} (*A. caucalis)*, 3647 ? 779 m^{-2} (*D. glochidiatus*) and 5558 ? 519 m^{-2} (*T. nodosa*). Following seedling removal significant emergence of *A. caucalis* occurred in the autumn period (Table 1) and it is conceivable that high temperatures during spring and summer following removal restricted their emergence, as *A. caucalis* has been shown to have a low optimal temperature for germination (3). The number of emerged *D. glochidiatus* seedlings was significantly higher than *A. caucalis* reflecting the higher ($P < 0.001$) number of *D. glochidiatus* seeds within the seedbank. There was also a discernible pattern to the emergence of *D. glochidiatus* and *T. nodosa*, which coincided with soil disturbance. The total number of emerged seedlings was lower ($P < 0.001$) than the initial seedling density, suggesting that depletion of seeds capable of emerging within the seed bank is quite rapid. This is consistent with the findings for a number of other Apiaceae weeds (4).

Table 1. Mean monthly emergence (seedling m^{-2}) of Apiaceae weeds.

	Anthriscus caucalis	**Daucus glochidiatus**	**Torilis nodosa**
September 2001	15.2 ? 6.5	0.0 ? 0.0	0.0 ? 0.0
October 2001	0.0 ? 0.0	0.0 ? 0.0	6.5 ? 2.7
November 2001	0.0 ? 0.0	2.2 ? 2.2	4.3 ? 4.3
December 2001	0.0 ? 0.0	10.8 ? 4.8	2.2 ? 2.2
January 2002	5.4 ? 1.8	251.1 ? 89.5	19.5 ? 13.0
February 2002	21.6 ? 5.6	320.3 ? 120.5	39.0 ? 13.9
March 2002	7.6 ? 2.8	235.9 ? 73.3	36.8 ? 8.8
April 2002	103.9 ? 18.7	350.6 ? 126.1	90.9 ? 15.9
May 2002	72.5 ? 16.8	114.7 ? 35.8	17.3 ? 7.3

Conclusion

It appears that pyrethrum production favours the accumulation of seed of Apiaceae weeds in the upper soil layer, resulting in continued germination and accumulation of viable seed within the seedbank. However this study also suggests that removal of established seedlings of Apiaceae weeds *T. nodosa*, *A. caucalis*, and *D. glochidiatus* by chemical or cultural means and prevention of any addition to the seedbank will significantly reduce infestation levels.

References

(1) Ball, D.A. 1992. Weed Sci., 40: 654-659.

(2) Dorado, J., Del Monte, J.P. and Lopez-Fando, C. 1999. Weed Sci., 47: 67-73.

(3) Rawnsley, R., Lane, P., Brown, P. and Groom, T. 2002. Proc.13th Aust. Weeds Conf., Perth, 212-217.

(4) Roberts, H.A. 1979. J. Appl. Ecol., 16: 195-201.