CONTROL OF HOREHOUND, *MARRUBIUM VULGARE* L., IN WYPERFELD NATIONAL PARK, VICTORIA

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Summary Horehound (*Marrubium vulgare* L.) is an introduced weed of Mediterranean origin. Widely distributed throughout south-eastern Australia, it is mainly a problem in areas receiving less than 400 mm rainfall per annum. Wyperfeld National Park in north-west of Victoria, had dense monocultures of horehound in the dried lake beds and on the surrounding source bordering dunes. Reliance wholly on chemical control is infeasible due to financial cost and off target damage to native plants. Integrated pest management using fire, reduced grazing pressure, selective spraying and biological control may provide the answers to horehound control.

INTRODUCTION

Horehound is a member of the Lamiaceae, and is a perennial weed of pastures, roadsides and conservation areas in southern Australia. The heaviest infestations are found in north-western Victoria and south-eastern South Australia where semi-arid conditions contribute to decreased vigour of competing plant species (Anon. 1976). In 1980, the total infestation in Victoria was estimated at 6 million ha, with dense infestations covering 100 000 ha, medium infestations 1.5 million ha, and scattered infestations 4.38 million ha (Lane *et al.* 1980).

Horehound is a drought tolerant plant, occurring in areas that receive a minimum of 200 mm annual rainfall (Anon. 1988). In Wyperfeld National Park (35° 35'S, 142° 05'E), a drought prone mallee region of Victoria receiving only 290 mm annual rainfall, moisture availability is the major limitation to further spread of horehound (Weiss and Sagliocco 1994).

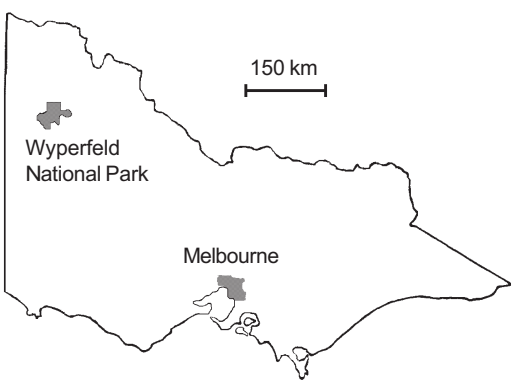

Figure 1. Location of Wyperfeld National Park, Victoria.

Horehound is estimated to infest at least 9000 ha of the Wyperfeld's 356 000 ha. However, it is localized around the watercourses of the Outlet Creek, the dried lake beds and surrounding source bordering dunes. Horehound does not appear to be invasive in undisturbed native vegetation.

The success of horehound as a weed is due to both its high seed production and its ability to establish in adverse climatic conditions. Horehound is an 'opportunistic germinator', with most seeds germinating in response to autumn rainfall, but some germination also occurs throughout winter and spring (Parsons and Cuthbertson 1992, Lippai *et al.* 1996).

Horehound will establish on infertile soil and is often the first species to colonize eroded areas, although it rarely persists with competition from annual or perennial pasture species. Horehound leaves contain marrubin, a bitter alkaloid (Everist 1981), which deters grazing, so that stock preferentially graze the surrounding pasture, hence reducing palatable competitive species and aiding its establishment and persistence (Parsons and Cuthbertson 1992).

Present control methods rely on chemical control, and in agricultural areas on grazing management and pasture improvement. Large scale use in conservation areas of the recommended sprays, dicamba, MCPA or 2,4-D, is costly, damages native vegetation and requires yearly follow up treatment. This paper reports on an ongoing experiment to evaluate an integrated approach to the management of horehound in public and in some cases private land using fire, reduced grazing pressure, chemical and biological control. The initial impact of the control burn and of a biological control program in the Park is also discussed.

MATERIALS AND METHODS

Integrated control A control burn under moderate conditions (McArthur Grassland Fire Danger Meter) burnt approximately 5 ha of dried lake bed during April 1996. Sixty pre- and post-burn soil cores were randomly taken from a transect line running through the middle of the

lake bed. Soil cores were washed, sieved and whole seeds sorted under a dissecting microscope. Seeds were placed in germination cabinets (15/25°C, 10 h night/14 h day) to determine viability for one month as per Lippai *et al.* (1996). Half the burnt and a similar sized unburnt area was fenced off with kangaroo-proof fencing. After the spring germination, selected plots will be sprayed with 2,4-D ester to kill emergent horehound seedlings. In a stratified random block design with three replicate plots (20 × 10 m) per treatment, vegetation changes will be monitored quarterly using point quadrat sampling. The first post-burn sampling occurred in July 1996.

Biological control A biological control program for horehound commenced in 1990. Potential biological control agents were identified in the plant's centre of origin, southern Europe. Rigorous host specificity testing was undertaken before agents are considered for release in Australia. Long-term surveys of plant, seedling and seed bank populations at Wyperfeld will be used to monitor the effectiveness of biological control agents for horehound.

RESULTS AND DISCUSSION

Chemical control Horehound has been a low priority for control in Wyperfeld, due to the lack of a specific control technique that is cost effective and specific to the weed. Present control strategies involve spraying 2,4-D ester and hand pulling along roadsides and camping areas, but once these measures stop horehound quickly invades from surrounding infested areas. The main seed distributing vectors are rabbits, kangaroos and water dispersal via flooding.

Chemical control of horehound in the park using 2,4-D or MCPA, costs approximately $A2000 in operating costs and 20 man days per annum. The recent inclusion of the Pine Plains in the northern part of the park, a previously leased and grazed area of dried lake beds currently with large areas of horehound, extensive biennial control measures are likely to be required to prevent the expansion of horehound. The impact of these herbicide treatments on native vegetation such as *Senecio* and *Ajuga* spp. has not been measured.

Biological control The horehound plume moth, *Pterophorus spilodactylus* L., was approved for release in 1994 and 7900 pupae and adults have been released at three sites in the lake bed area of Wyperfeld. The larvae feed in the shoot tips reducing the flowering and seed production. Additionally, the horehound clearwing moth, *Chamaesphecia mysiniformis* Rambur, a univoltine insect with root boring larvae is planned to be released for summer of 1996/97. Other potential biological control agents currently under investigation include a pollen/seed feeding beetle, *Meligethes rotrouri* Easton, and an unidentified stem/root boring beetle, *Phytoecia* sp.

Integrated control Burning decreased the viable seeds in the soil seed bank by 78% (Table 1).

However, at a long term monitored site nearby a similar reduction in the seed bank was noticed during the long drought of 1990–92. Plant densities and seed banks (Table 2) decreased by 87% during the drought. Seedling recruitment after the above average summer rains in 1992/93 was sufficient to replenish mature plants in excess of pre-drought densities.

This indicates that for effective control, the seed bank has to be reduced to well below 1000 seeds m^{-2} for a number of years.

A control burn regime combined with spray treatment may reduce costs and quicken the reduction in soil seed banks. The impact of the autumn burn on native vegetation is currently being assessed. The project will also include native regeneration experiments with local native grasses (*Stipa* and *Danthonia* spp.) and saltbushes (*Maireana* spp.). Seed of native short-leaf bluebush (*Maireana brevifolia*) collected from the lake bed are presently undergoing germination testing and native grass seeds will be collected at the next flowering opportunity. Horehound rarely persists in the presence of combined annual and perennial plant competition.

Biological control of horehound may be the only long term control method for widespread horehound infestations and those with restricted access. Chemical control

Table 1. Effects of autumn burning on horehound soil seed banks in Lignum Plain, Wyperfeld National Park (number of viable seeds m^{-2} ± standard error).

Treatment	Viable seeds
Pre-burn	8731 ± 1393
Post-burn	1937 ± 227

Table 2. Mature plant and seed bank dynamics during drought at Wyperfeld 1990–1992.

Date	Mature plant density (m^{-2})	Seed bank viable seeds (m^{-2})	Annual rainfall (mm)
October 1990[A]	1.0	20450	346
June 1991	0.3	18760	221
June 1992	1.9	2760	321
April 1993[B]	19.2	1650	513

[A] October 1990 pre-drought, [B] April 1993 post-drought.

has the potential for immediate results but is costly, requires yearly treatment and affects non-target species.

Other measures may aid in the control of horehound. Reducing rabbit grazing in infestations will reduce the amount of soil disturbance, which favours the establishment of horehound, as well as the vectors which distribute burrs and seeds. Horehound, as with most members of the Lamiaceae, is bee pollinated. Wyperfeld has a high population of feral bees, and control of these pollinators has the potential to reduce the amount of seed set by the weed.

A combination of physical (burn regime), chemical, land management (grazing pressure from kangaroos and rabbits), revegetation to increase competition, feral animal (rabbit and bee) and biological control may provide the answer to an integrated pest management approach to horehound control in Wyperfeld National Park.

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REFERENCES

Anon. (1976). The threat of weeds to bushland: A Victorian study. Land Use Project Committee of the Australian Institute of Agricultural Science, pp. 23-24. (Inkata Press, Melbourne).

Anon. (1988). Horehound (*Marrubium vulgare*). Issues and Options. South Australian Animal and Plant Control Commission, Adelaide, 32 pp.

Everist, S.L. (1981). 'Poisonous plants of Australia. Second Edition', p. 382. (Angus and Robertson, London).

Lane, D. Ritches, D.K., and Combellack, H. (1980). A survey of the distribution of noxious weeds of Victoria. Unpublished report, Department of Natural Resources and Environment, Keith Turnbull Research Institute, Victoria.

Lippai, A., Smith P.A., Price, T.V., Weiss, J. and Lloyd, C.J. (1996). Effects of temperature and water potential on germination of horehound (*Marrubium vulgare*) seeds from two Australian localities. *Weed Science* 44, 91-9.

Parsons, W.T. and Cuthbertson, E.G. (1992). 'Noxious weeds of Australia', pp. 496-9. (Inkata Press, Melbourne).

Weiss, J. and Sagliocco, J-L. (1994). Horehound, *Marrubium vulgare*—A Global perspective. Fourth Biennial Proclaimed Animal and Plant State conference. Animal and Plant Control Commission, South Australia, pp. 39-43.