Control of annual grasses with particular reference to *Briza maxima*

Andrew R. G. McMahon, Ecological Horticulture Pty Ltd, 69 Spensley Street, Clifton Hill, Victoria 3068, Australia.

Exotic annual grasses are an important component of the weed flora of many Victorian plant communities. One of the most widespread and abundant annual grasses of grassy woodlands and dry forests is *Briza maxima* L. (large quaking-grass), a native of the Mediterranean region. In Box-Stringybark Woodland north-east of Melbourne, Carr *et al.* (1988) demonstrated that at high cover (50 – 60%) and density (>200 plants m^{-2}) *B. maxima* could reduce the species richness of native vegetation by approximately 75%. They also suggested that these effects begin to operate when the percentage cover for *B. maxima* exceeds 10% or density exceeds 50 plants m^{-2}.

The most important life-history attribute of *B. maxima* which favours the use of non-herbicide control measures is synchronization of flowering and fruiting in late spring to early summer. However, the persistence of a soil-stored seed bank (Raynor 1989, Lunt 1990) means that consecutive control treatments are mandatory. These flowering and seed-bank characteristics are shared by a number of genera of invasive annual species, for example *Vulpia* and *Aira* (Lunt 1990, Molnar *et al.* 1989).

Non-herbicide control of *B. maxima* involves an initial treatment of infructescences to remove the current seasons seed crop, and subsequent treatments to exhaust the soil-stored seed bank. Residual seed banks (i.e., seed remaining after the first and major germination cohort) for *B. maxima* of 110 – 180 seeds m^{-2} have been recorded by Raynor (1989) and Molnar *et al.* (1989). Both *Vulpia* and *Aira* appear to have numerically larger seed banks, as Lunt (1990) recorded 23,000 and 3,500 seeds m^{-2} for these genera respectively. This, however, was from soil samples collected prior to the first germination event.

Three non-herbicide options are generally available for the initial control of *B. maxima*; two involve the use of fire, i.e., prescribed burning or the use of a weed-burner. A weed-burner can either be a hand-held torch connected to a LPG cylinder, or a pressurized kerosene 'blow-torch'. Both implements emit flames under pressure which are generally lethal to annual grasses within a range of about 0.5 – 1 m, depending on the moisture content of the vegetation being burnt. The third technique involves removal of flowering and fruiting stems by a 'whipper-snipper' or an equivalent 'heading' implement. Heading and weed-burner techniques generally have the following limitations:

- They are labour-intensive, particularly if large areas are involved;
- Heading or removal of fruiting and flowering stems must account for height variability in *B. maxima* and its close, often entangled proximity with native species. The treatment results in a mown appearance to the vegetation;
- Both techniques must be carried out at the correct time in the growing season otherwise plants may flower a second time. There may also be some ripening of seed after infructescences have been cut, as occurs in other grasses (Andersen and Andersen 1980, Harper 1977).

Prescribed burning has a number of advantages over these techniques. It is cost-effective and is likely to kill more of the available seed, and the prescribed burn can accord with other ecological objectives, for example stimulating recruitment of indigenous species. Raynor (1989) described the following attributes of *B. maxima* which are relevant to all control techniques, but particularly to prescribed burning:

- *B. maxima* germinates *en masse* in early autumn, leaving some residual seed, the majority of which is stored in the litter;
- Soil-stored seed can remain from one season to the next;
- There is a very high plant survival rate – most germinates reach reproductive maturity;
- Seed production coincides with the beginning of plant senescence in late spring to early summer, and is weather-dependant (see also McMahon *et al.* 1990).

The optimum time for burning for *Briza* control is at the commencement of plant senescence, when the majority of seed is unripe and still attached to the plant. At this stage plants are browning-off and should burn readily. Burning is also likely to consume some of the soil-stored seed, at least that fraction stored in the loose litter. Effective results should be achieved with a fire intensity in the order of 500 – 700 KW m^{-2}, well within the desirable range of a controllable fire.

The post-fire recruitment of *B. maxima* is most appropriately controlled by the use of a whipper-snipper or weed-burner; hand weeding may be applicable if numbers are low. Although there are few data available on fire-effected *B. maxima* populations, Carr *et al.* (1991) described a vast reduction in abundance following an early summer fire at Hochkins Ridge Flora Reserve Croydon, and Robertson (1985) recorded a decline in *B. maxima* on all of his spring-burnt treatment sites at Gellibrand Hill Park, north of Melbourne.

Land managers are often reluctant to use prescribed fire. They may lack expertise or be concerned about potential threats to adjoining land. Furthermore, they may consider the construction and maintenance of fire breaks an unacceptable impact on biological values. Finally, the resources and organization required may appear daunting if management is already stretched to the limit. These are valid constraints but all are reconcilable given a sufficient lead-time and commitment of resources.

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