Effects of pasture management on germinable seed bank in a degraded phalaris pasture

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Abstract

Can grazing management be used to change the composition of the germinable seedbank to encourage the recruitment of desirable perennial species? To answer this question various pasture rest and a hay cut treatments were compared to a set stocked control over three years in a degraded phalaris stand at Cootamundra in NSW. A treatment designed to increase phalaris recruitment by resting pasture from grazing to ensure seed set and early plant development had more phalaris seedlings than the other treatments (control, spring rest, grazing hard in spring and hay cutting). However, there were also 4-10 times more annual grasses in this treatment providing a potentially competitive environment for the phalaris. Other treatment effects on various components are recorded but these were sporadic in nature with no consistent trend through the years. The stability (across treatments) of these species or species groups within any one year is a feature of the data set. The results are discussed with respect to the possibility of combining weed control measures with grazing management to achieve recruitment of phalaris.

Key words

Seedbank, phalaris, grazing management, botanical composition.

Perennial pastures in the southern Australia contain both annual and perennial components. The presence of the perennial grass (Phalaris aquatica and/or Dactylis glomerata) component depends mostly on the survival of individuals that were originally sown. In some studies recruitment of new individuals has been observed, as in cocksfoot (1), and the spread of phalaris along roadsides is another indicator of the potential of recruitment. The annual component, by definition, will be a function of the germinable seed bank at the commencement of the growing season (ie. autumn break). Understanding the capacity of components of the seedbank to regenerate is important in designing strategies for pasture management (4).

There have been few studies that have measured either the size or composition of the germinable seed bank in the perennial pastures of the higher rainfall zone in southern Australia. The population dynamics of the annual components, which play an important role in these pastures, make it difficult to predict the effects of management strategies on botanical composition. Linking management to botanical composition can be view-ed as a two stage process. Firstly, the effects of various management strategies on the seed bank need to be assessed; and secondly, the processes that determine the eventual fate of the seedlings need to be understood.

The work described in this paper deals with the effects of management strategies on the germinable seed bank of a "degraded" pasture originally sown to P. aquatica and Trifolium subterraneum but which had become dominated by annual species such as Lolium rigidum, Vulpia spp. and Echium plantagenium. The measure-ments were taken as part of a broader study into the effects of grazing management on botanical composit-ion. The experiment was designed to measure the effects of various grazing regimes on a perennial pasture over 3 years. The seed bank was monitored in the subset of treatments which were most likely to have an impact.

Material and methods

An experiment was set up in 1993 to test the effect of various grazing management regimes on pasture composition. The site (34&degree;40'S, 147&degree;54'E) near Cootamundra, was sown to P. aquatica and T. subterraneum in 1977. By June 1993, the botanical composition of the site was E. plantagenium

(31.8%), annual grasses (main-ly Vulpia spp, 36.1%), P. aquatica (23.7%) and T. sub- terraneum (7.3%) other species (1%) measured using a method similar to the rod point technique (2).

Eleven treatments were established on the site with two replicates and two times of commencement (spring 1993 and spring 1994) in a communal grazing design (3). Plots (11 x 16 m) were fenced and laid out as two replicates of 22 plots each monitored regularly for changes in botanical composition. A sub-set of the treat-ments were selected for the seed bank study these were:

- Control (Con) - plots set stocked with merino wethers. The base stocking rate was 10 DSE but this was varied for times of extreme feed shortage (drought in 1994 - 2.5 DSE) and during spring to simulate a lambing enterprise (1993 and 1995 - 17 DSE)
- Spring Lock-up (SpLU) - plots closed in the first week of September and opened again in the first week of December.
- Spring Short (SS) - plots grazed with extra sheep to maintain available dry matter at between 500-1500 kg/ha during spring
- Hay cut (Hay) - plot locked up as above and cut for hay in the first week of November. All cut forage was immediately removed and plots were then locked up until the first week of December.
- Recruitment Lock-up (RecLU) - plots locked up in the first week of October and opened when phalaris seed fall had occurred (mid-February). Plots were again locked up from Mid-April to September to encourage seedling development of phalaris.

Soil cores (55 mm diam. and 45 mm depth) were sampled from the plots in April before the autumn break. The cores (12/plot in 1994, 20 in 1995 and 1996) were bulked and spread over sand and vermiculite in seed raising flats and placed in a glasshouse (temperature range 5-25?C). As seedlings could be identified they were counted and pulled out. Seedlings that could not be identified were transplanted into small (150 mm) pots and grown until identification was made. The samples were kept moist by daily watering until seedling emergence had significantly slowed. At this time the remaining seedlings were removed and water was withheld, the soil sample stirred and re-watered to initiate another cohort of germination. The cycle was repeated 4-6 times over a 8-10 month period depending on year.

For statistical analysis the species were either left separate (eg. phalaris, subclover and toadrush) or com-bined into functional groups (eg. annual grasses and broadleaf weeds). The experiment was analysed as a randomised complete block and data was Loge trans-formed before analysis.

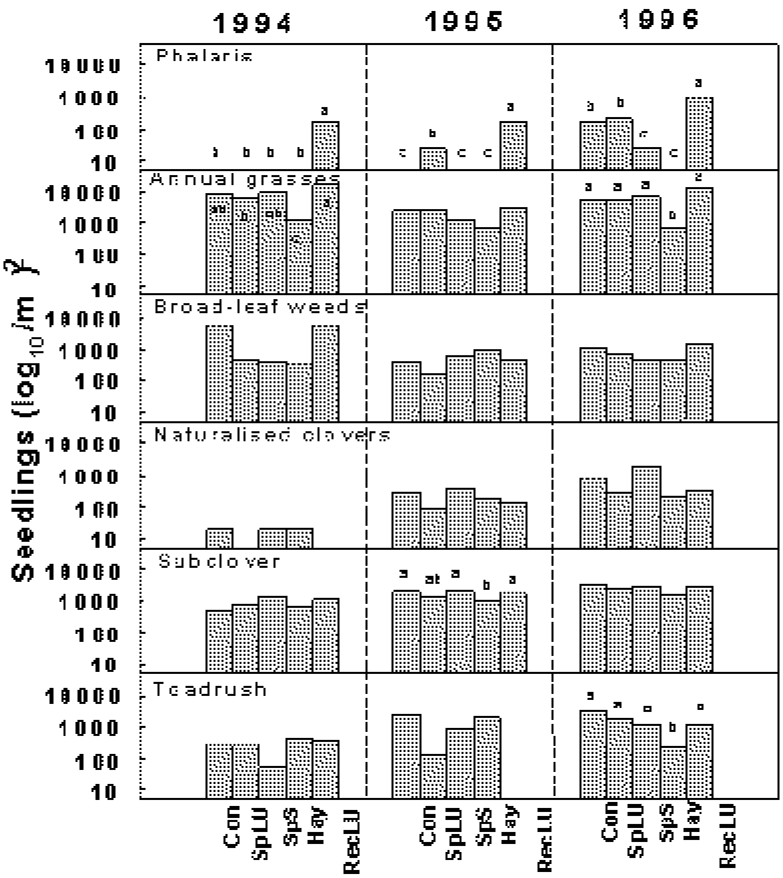
Results

The number of species found in the seed bank varied slightly between years from 20 in 1994 to 25 and 26 in 1994 and 1996, respectively. Due to difficulties in early identification, the naturalised clover (T. campestre, T. glomeratum and T. striatum) were counted as one 'species' group. Across the plots and years the most common species in order were Vulpia spp., T. subterraneum, L. rigidum, Juncus bufoius, Moenchia erectis, Bromus mulliformis, naturalised clovers and E. plantagenium. Interestingly, the total number of seeds found varied with year, the number being low in 1995 (5554) after the 1994 drought and much higher in 1994 (13211) and 1996 (12381).

Numbers of key species or species groups are shown in Fig. 1. The recruitment lock-up treatment had the highest level of phalaris seedlings in each year, the spring lockup had low number present in 1995 and 1996 as did the control and spring-short treatment in 1996. The annual grasses were the largest component in each year and treatment effects were only significant in 1994 and 1996. In both years the recruitment lock-up treat-ment had the highest or equal highest number of annual grass seedlings and the hay cut treatment significantly depressed the number of grass seedlings present. There were no significant effects of the treatments on the number of broadleaf weeds or naturalised clovers present. Similarly, the T. subterraneum and J. bufonius seed banks were also unaffected by the treatments except for the hay treatment in 1995 and 1996, respectively. It is worth noting that there was a large increase in the number of naturalised clovers from 1994 to 1995.

Discussion

Grazing management can effect the composition of the germinable seed bank but the effect is highly depend-ant on year. The recruitment lock-up treatment was designed to encourage the recruitment of phalaris seedlings. This treatment was certainly able to increase the amount of P. aquatica in the seed rain (5). As a result there was a significant effect on the number of P. aquatica seedlings present but the number was still relatively small (about one tenth) compared to the annual grasses. Further work not reported here found that there was no appreciable recruitment of phalaris in these plots. This was probably due to competition from the large number of annual grasses in the recruitment treatment and possible loss of seed due to ant theft after the samples were taken.



The hay cut treatment changed the composition of the germinable seed bank by reducing the number of annual grass seedlings present but not after the drought year and reducing the number of subclover seedlings and toadrush seedlings in 1995 and 1996, respectively. For this treatment the herbage was cut and removed on the same day, after anthesis but well before seed maturity of the annual grasses. Other components of the seed bank were not consistently affected by the management treatments imposed. However, this does not mean that individual species were not affected as we have dealt at the level of the 'functional group' for reasons of brevity. For sub and the naturalised clovers the year to year variation was larger than any treatment difference. The hardseededness of these species can play a role in maintaining these components even under conditions which could change the level of seed set in the previous year.

Conclusion

It is possible to use changes in grazing management to manipulate the composition of the germinable seed bank. For phalaris this means that it is possible to dramatically increase the number of seed but treatments that do this also increase the seed of other species particularly the annual grasses. It is unlikely then that grazing management alone will lead to recruitment of P. aquatica due to the competitive effects from annual species. Further work should assess the tactical use of weed control measures in combination with appropriate grazing management for the encouragement of recruitment of phalaris where this is desired.

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