FATE OF SERRADELLA, MEDIC AND BISERRULA SEEDS IN PODS INGESTED BY SHEEP

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Abstract

Apen feeding experiment with sheep was conducted to investigate the fate of seeds ingested as pods for three cultivars of yellow serradella (Ornithopus compressus L.), and one cultivar each of French serradella (O. sativus Brot.), burr medic (Medicago polymorpha L.) and biserrula (Biserrula pelecinus L.) A single meal of legume pods (equal pod weights) mixed with chaff was fed to sheep acclimatised to the diet, and the quantity of free seeds was measured in the faeces that were collected over the next five days. The proportion of seeds which passed undigested through the animals was 10% or less for all cultivars of serradella but was about 30% for burr medic and 45% for biserrula. In all cultivars, the passage of seeds was greatest two days after feeding (50 - 75% of total faecal seed) and was negligible after five days. The degree of segmentation of the pod in yellow serradella appeared to have little influence on the passage of seeds through the gut but the pod itself effectively increased seed size and this may be partly responsible for the low seed recovery in this species. Small, hard seeds (as in biserrula) and an oval seed shape (as in burr medic) are likely to be desirable characteristics to increase the quantity of seeds passing through sheep and thereby reduce the decline in the soil seed bank normally associated with grazing aerial seeded pasture species over summer.

Key words: serradella, legume, seed, grazing, digestion

The consumption of seeds by grazing animals over the summer/autumn period can rapidly deplete the soil seed bank of annual pasture legumes, particularly those which produce their seed above ground (2). The return of viable seeds to the soil after ingestion is an important component of seed bank dynamics. Large differences in seed recovery after ingestion by sheep have been reported between species of annual legumes. Recoveries range from <2% to nearly 25% in medics and up to 59% in the small-seeded species Trifolium campestre L. (4). An inverse curvilinear relationship exists between seed mass and the recovery of seeds after ingestion by grazing ruminants (1, 4). However, the high recovery of seeds in some large-seeded species of medic suggests that seed size is not the only factor which determines seed recovery. Other variables such as the number of seeds ingested and hardseededness are also likely to influence the passage of seeds through the gut (4). There is little information on the recovery of seeds ingested by sheep in yellow serradella (Ornithopus compressus L.), French serradella (O. sativus Brot.) or biserrula (Biserrula pelecinus L.). Values for yellow serra- della range from as low as 2 - 6.8% (1) to 10.7 - 18.4% (3) but the number of sheep involved in these studies is low. The seeds of yellow serradella are similar in size to burr medic (Medicago polymorpha L.) but they are not released from the pod as readily as those of burr medic. However, pods of yellow and French serradella break into individual segments to varying degrees. The size of the pod segment in serradella maybe more important than the size of the single seed in determining the level of seed recovery after ingestion by sheep. Biserrula is a small seeded species only recently commercialised in Australia and detailed grazing studies with this species are yet to be conducted. The objective of this paper was to determine the influence of seed and pod characteristics on the seed recovery of several cultivars of yellow serradella and French serradella in comparison with burr medic and biserrula.

Materials and methods

Pods of three cultivars of yellow serradella (cvv. Paros, Madeira and Santorini) and one cultivar each of French serradella (cv. Cadiz), burr medic (cv. Santiago) and biserrula (cv. Casbah) were grown in 1994 at Medina, Western Australia in seed increase plots. For each variety, three replicate samples each containing 50 intact pods were weighed and, after hand extraction, the number of seeds were counted and single-seed mass was determined. A sub-sample of 100 seeds from each replicate was tested for

germination in petri dishes at 20°C for 14 days and the number of viable soft seeds and hard seeds determined.

Weaner, castrated male Merino sheep weighing (60-70 kg) were treated for internal parasites and kept in individual metabolism crates with free access to water. Eight replicate sheep were randomly selected for each pasture cultivar, except biserrula, for which there were only two sheep due to limited quantities of pod material. The sheep fed biserrula were excluded from the main experiment which was structured as a randomised block design. All sheep were individually fed ad lib oaten chaff for two weeks prior to the experiment. A small amount of legume pod (25-50 g) was added to the diet to acclimatise the sheep in the first of these weeks. A straight chaff diet was fed in the second week to allow the initial seed to pass through the digestive system and to calculate feed intake. At the commencement of the third week sheep were fed 200 g of legume pod in a single (pulse) feed at 09:00 h mixed in their chaff feed. Chaff was restricted to 90% of average daily intake (approx. 1 kg) to ensure all pod was eaten. Faeces from individual sheep were collected in harnesses at the time of the pulse feed and thereafter twice daily for five days. The faeces were weighed, dried at 100°C, re-weighed and a 100 g sample taken from which all seed was recovered by wet sieving. The seeds were then dried rapidly at 50°C to prevent germination and weighed.

Table 1. Pod and seed characteristics of six pasture cultivars fed to sheep in a single meal.

Species/ Cultivar	Degree of pod segmentation[1]	Seed:pod ratio	Single-seed mass (mg)	Number of seeds fed[2]	Initial soft seeds (%)
Yellow serradella					
cv. Paros	++	33.3	2.5	26600	2
cv. Madeira	+++	31.8	1.5	42380	4
cv. Santorini	+	32.1	3.3	20965	2
French serradella					
cv. Cadiz	+++++	44.3	2.0	44300	99
Burr medic					
cv. Santiago		32.1	2.7	23785	3
Biserrula					
cv. Casbah		31.5	1.2	52415	1

[1] + little pod segmentation; +++++ pod readily breaks into individual segments

[2] number of seeds in 200 g pod

Results

Seed and pod characteristics of each cultivar are shown in Table 1. Seeds represented about one-third of the weight of pods in all cultivars except Cadiz serradella in which the seeds accounted for nearly half the pod weight (Table 1). There was much greater variation in single-seed mass between the cultivars which accounted for most of the differences in the number of seeds fed. Casbah biserrula produced seeds with the lowest single-seed mass. Over 95% of the newly ripened seeds in all cultivars were impermeable (hard) except for Cadiz which produces few hard seeds at maturity. The proportion of seeds recovered after ingestion was 10% or less for all cultivars of serradella compared with 30% for burr medic and 45% for biserrula (Fig.1). Recovery of seeds was 5% or less in both Paros and Cadiz serradella despite differing widely in the proportion of soft seeds and the number of seeds fed. The recovery of seeds was similar for Madeira and Santorini serradella despite large differences in single-seed mass and the degree of pod segmentation. In all cultivars the passage of seeds was negligible one day after feeding, was at its highest level two days after feeding (50 - 75% of total faecal seed) and then gradually declined to be almost negligible again after five days (Fig. 2).

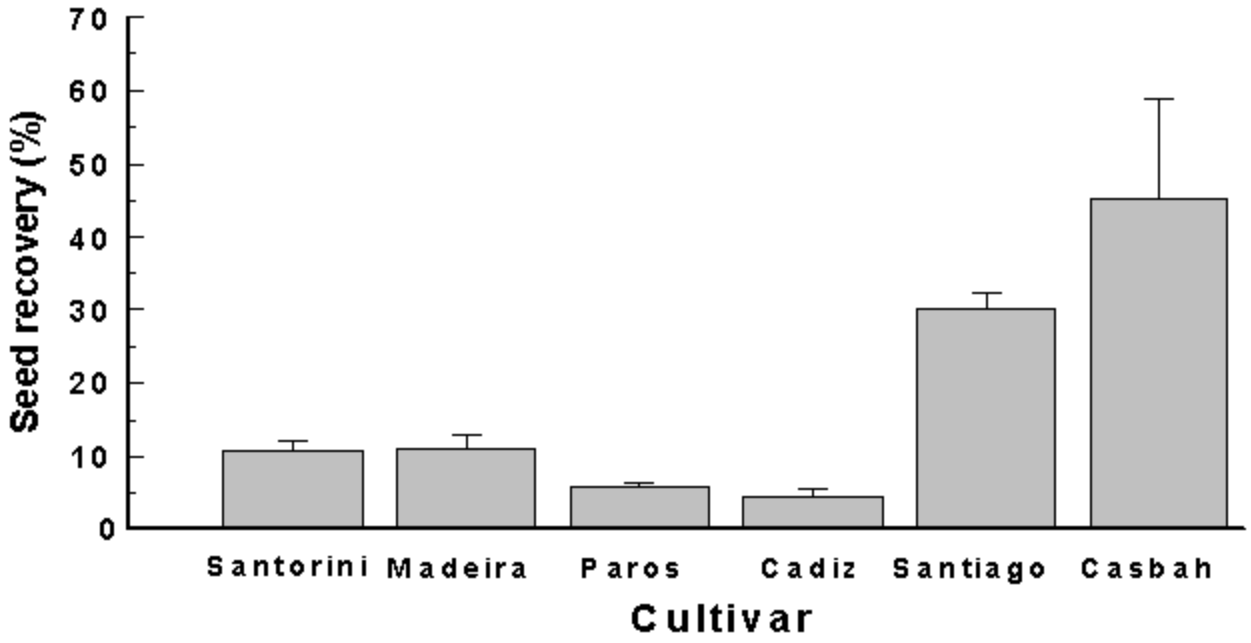

Figure 1: The weight of seeds excreted by sheep as a percentage of the weight of seeds ingestedin six cultivars of annual pasture legumes. bars represent s.e. of the mean.

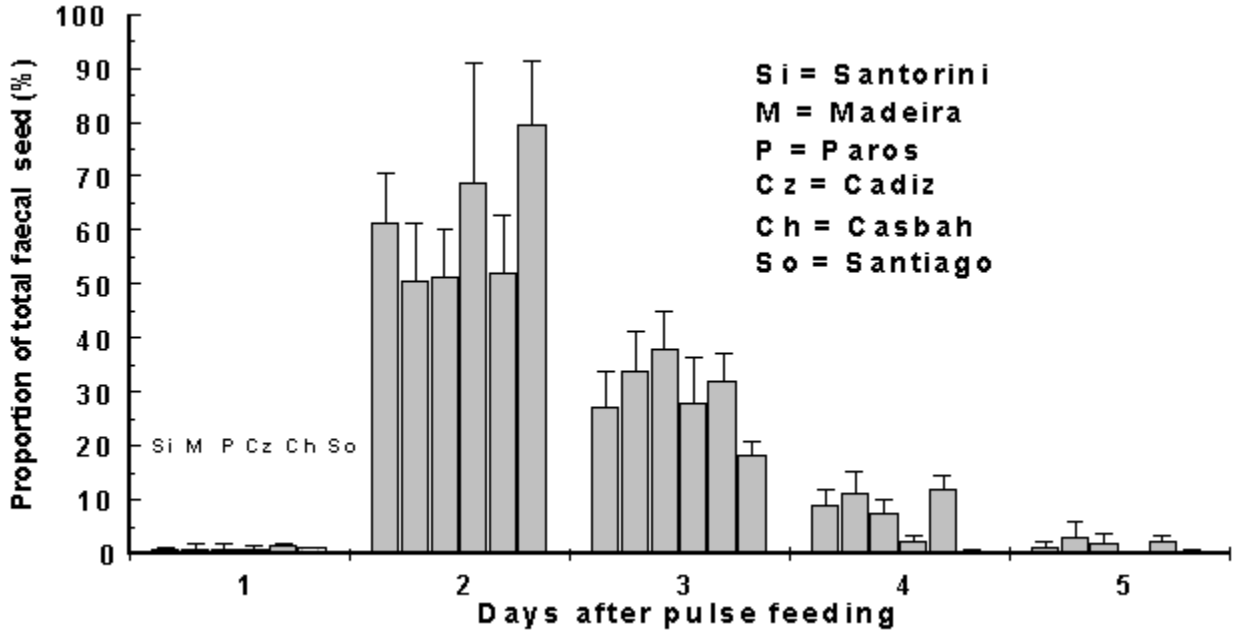

Figure 2: The weight of seeds recovered each day as a percentage of the total weight of seeds recovered over five days in six cultivars of annual legumes. Bars represent s.e. of the mean.

Discussion

Grazing management of aerial-seeded pasture legume species, such as yellow and French serradella, needs to be carefully regulated during flowering to ensure high seed production. The low level of seed recovery after ingestion by sheep in both species (10% or less) is consistent with results reported by (1) and places additional requirements for grazing management during the dry summer period. Excessive grazing of pods, particularly in newly sown pastures, could seriously deplete the legume seed bank. The degree of segmentation of yellow serradella pods did not appear to influence the recovery of ingested seeds but it may influence the ease with which sheep pick up pods from the soil surface. Highly segmented pods, as in Cadiz serradella would be more difficult to pick up and thereby offer some protection from overgrazing.

The low level of seed recovery in Cadiz serradella is probably a consequence of the high proportion of soft seeds which would rapidly imbibe in the gut. A high proportion of hard seeds combined with a small seed mass, as in Casbah biserrula, appears to offer advantages for maximising the recovery of ingested seeds. The seed characteristics of Madeira serradella were similar to Casbah biserrula yet seed recovery of Madeira was substantially lower. This may be a consequence of the pod segment which effectively increases the size of the serradella seed making it more vulnerable to mastication.
The high recovery of ingested Santiago medic seeds (30%), despite a relatively large seed mass, is consistent with other results for burr medic reported by (4) and (5). It is not clear why burr medic falls outside the typical relationship between seed recovery and single-seed mass but it is certainly of considerable benefit in removing the danger of overgrazing in summer. Perhaps the oval shape of the seed is as important as seed mass in influencing the passage of seed through the gut. The high levels of recovery in some large-seeded cultivars of medic suggest that it may be worthwhile to study the variability in recovery amongst a greater range of yellow serradellas if differences in seed shape can be demonstrated. The passage of larger seeds through the digestive tract is desirable since large seeds are likely to establish more readily when the pasture regenerates, particularly if the seeds are buried as a consequence of cereal cropping.

Thomson et al. (4) suggest that the recovery of seeds is influenced by the number of seeds ingested. The number of seeds fed in pen feeding experiments is likely to be much less than that in the field, hence actual seed recovery may be underestimated. Around 30,000 seeds fed at a single meal appears desirable (4). This critical number was not achieved in two of the three yellow serradella cultivars but given the influence of the pod segment in these cultivars, seed number is unlikely to be the main limitation to recovery. Indeed, seed numbers were similar to Santiago burr medic in which seed recovery was high.

Conclusion

Considerable variability exists between pasture legumes in the proportion of ingested seeds which pass undigested through the gut. Seed recovery was high in burr medic and biserrula and this appears to be related to high levels of hardseeds (in both species), seed shape (in burr medic) and a small seed size (in biserrula). In contrast the recovery of serradella was low which may, in part, be due the effect of the pod segment which effectively increases seed size. The grazing of serradella pastures will need to be carefully regulated over the summer period.

Acknowledgments

This work was supported by the International Wool Secretariat as part of a wider project to evaluate yellow serradella in southern Australia. We are grateful to Michelle Murfit, Suzanne Murray and the staff at the Medina Research Station (Agriculture WA) for their assistance in carrying out the experiment.

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