A Technique for Assessing Seed Survival of New Pasture Legumes Following Grazing by Sheep

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ID # 01-39

A TECHNIQUE FOR ASSESSING SEED SURVIVAL OF NEW PASTURE LEGUMES FOLLOWING GRAZING BY SHEEP

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Abstract

A technique for assessing the fate of seed grazed by sheep in small field plots was examined using the pasture species *Trifolium michelianum* cv. Paradana, *Medicago truncatula* cv. Mogul, *Trifolium spumosum* and *Trigonella balansae*. *Trifolium spumosum* lost the greatest proportion of seed from dry pasture residues (88% seed eaten), whereas *Trigonella balansae*, Paradana and Mogul lost 61%, 55% and 53% respectively. However, *Trifolium spumosum* and Paradana had high levels of seed in the faeces (56.8 kg/ha and 65.2 kg/ha respectively), whereas Mogul and *Trigonella balansae* had low levels (10.3 kg/ha and 11.0 kg/ha respectively). Mogul, due to it's large pod and seed sustained the greatest losses of seed eaten by sheep. Structure and size of the seed head, proximity of the seed head to the ground, seed size and hardseededness all influence the survival of seed grazed by sheep.

Keywords: *Trifolium spumosum*, *Trifolium michelianum* cv. Paradana, *Medicago truncatula* cv. Mogul, *Trigonella balansae* and seed survival

Introduction

Dry pasture residues are commonly grazed by sheep during summer/autumn in the Mediterranean environment of southern Australia, with ecological consequences on the persistence of pasture legumes (Carter *et al.*,1989 and Thomson *et al.,* 1990). New genera and species are being evaluated as potential pasture legumes in Australia, with little or no prior knowledge of the ability of their seed to survive summer/autumn grazing. Therefore it is important that promising new species are evaluated for their seed survival following ingestion and passage through grazing sheep so the best adapted plants are selected and management packages can be formulated.

Much research on seed survival has focused on pen feeding studies which can not take into account grazing behaviour. Large scale field studies are labour intensive and not practical when seed from new species is limited. Grazing small field plots may be a useful tool (Beale 1975)

This paper describes a simplified field assessment technique that quantifies the fate of pasture legume seed grazed by sheep.

Material and Methods

Four pasture legume species were chosen with contrasting pod size, pod structure and seed size. *Trigonella balansae* and *Trifolium spumosum* are new promising species being developed and *Trifolium michelianum* cv. Paradana and *Medicago truncatula* cv. Mogul are commercially available cultivars. On the 7th June 1999 each of the four pasture legume species were sown into individual plots at 10kg/ha at Turretfield Research Centre, South Australia (Long. 138^{o}50'E, Lat. 34^{o}33'S). Seed was inoculated with the appropriate Rhizobia. Plots were 15 m x 13 m and un-replicated. Plots were not grazed during the

growing season and allowed to set seed. Each plot was individually fenced so no cross contamination between species could occur during grazing.

Seed reserves were measured (Time 1) by harvesting 10 randomly placed quadrats (20 cm x 30 cm) per species plot, prior to introducing sheep onto the plots on the 10th January 2000. Seed was again measured at Time 2 = 14th Jan. 2000, Time 3 = 17th Jan. 2000, Time 4 = 21st Jan. 2000 and Time 5 = 24th Jan. 2000 (when sheep were removed) using the same sampling procedure as described for Time 1.

Three sheep grazed each plot, equivalent to 154 sheep/ha, for a total of 14 days. Faecal samples were collected at Time 5, after sheep were removed, from four quadrats (45 cm x 45 cm) in an identified campsite area (6.6% of the paddock) with high density faeces, and six quadrats (45sm x 45 cm) randomly placed in the remaining 93.4% of the paddock. Seed was separated from samples and seed yield and percentage hard seed (impermeable seed) determined.

Each species was analysed separately for disappearance of seed from residues. Two alternative simple models for changes over time were fitted; first a linear regression over time, and second, comparing Time 1 (before grazing) with subsequent times assumed to have similar means. Apart from fixed time effect (1 df), the remaining variation due to time differences (3 df) was assumed random. A test of the fixed effect was conducted in the time stratum, on 1 and 3 df, and the remaining random variation between times could be tested against the quadrat variation within times, on 3 and 45 df. The square root transformation was used to approximately stabilise the variance. Means and standard errors for the amount of overall seed in faeces were calculated from stratified means.

Results and Discussion

Seed disappearance from dry pasture residues: *Trifolium spumosum* lost the greatest proportion of seed through grazing (88% eaten). *Trigonella balansae*, Paradana and Mogul lost 61%, 55% and 53% respectively. The pattern of seed disappearance from pasture residues is presented in Figure 1. For Mogul and *Trifolium spumosum*, seed continued to decrease linearly over the 2 - week period ($p = 0.014$ and $p = 0.004$ respectively). The linear trend for Paradana and *Trigonella balansae* is not significant ($p = 0.172$ and $p = 0.123$ respectively), rather the amount of seed remained approximately constant over Times 2 to 5 ($p = 0.359$ and $p = 0.705$ respectively), at a lower level than the amount of seed at Time 1 ($p = 0.016$ and $p = 0.004$ respectively).

Three of the species in this trial retain their seed pods well above ground (*Trifolium spumosum*, Paradana and *Trigonella balansae*) this makes them vulnerable to grazing. However, much Paradana and *Trigonella balansae* seed escaped ingestion as pods started to shed their seed onto the ground. Both species have small seed so sheep are less able to pick the seed from the ground surface. Mogul pods fall to the ground as they mature, seed is retained in a large pod and can easily be picked up by sheep. However, the Mogul seed did not disappear rapidly probably because the sheep were deterred by the spines on the pods. A less spiny or spineless medic pod may have resulted in far more pod removal by sheep. *Trifolium spumosum* flower heads do not break up easily, therefore they were easily eaten from the ground surface. Although the disappearance of seed was related to how easily the pod/seed was ingested, the scattering of seed from seed pods was found to greatly aid the escape of small seed from ingestion.

Hard seed (impermeable), seed size and seed in faeces: Mogul and *Trigonella balansae* had the lowest amount of seed in the faeces (10.3 kg/ha, and 11.0 kg/ha,

respectively). This was not related to quantities eaten but to low survival levels of seed eaten. Paradana and *Trifolium spumosum* had higher levels of seed in the faeces (65.2 kg/ha, and 56.8 kg/ha, respectively). Almost half the Paradana seed found in faeces was hard (44.3%). This high survival can be attributed to small (Table 1), hard and round seed (Cocks 1992). Seed size accounted for 80% of the survival of seed in studies conducted by Thomson *et al.*, 1990. *Trigonella balansae* seed survival levels were lower than expected for relatively small hard seed. The flattened elongated shape of the *Trigonella balansae* seed probably slowed the passage through the digestive tract of sheep. Although *Trifolium spumosum* had the second largest seed size, it had a high survival rate in the faeces. The round shaped seed of *Trifolium spumosum* and its high hard seed prior to grazing (see Table 1) probably allowed a high percentage of hard seed to pass through to the faeces. Similarly, Edwards *et al.*, 1998 found the relatively large seed of burr medic (*Medicago polymorpha* cv. Santiago) had higher than expected survival following ingestion by sheep and postulated that the seed shape (oval) and hardseededness contributed to its survival. However, more detailed research would be needed to verify this hypothesis.

The technique of grazing by sheep *in situ* small field plots of newly developed pasture legumes provides a realistic insight into the relationship between dry sward structure/pod structure and seed size which is not possible in pen feeding studies. This technique will be an important tool for assessing new pasture legume species in Mediterranean environments where dry pasture residues, containing seed are eaten by grazing sheep in summer and autumn.

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Table 1 - The amount of seed at Time 1, seed eaten, seed in faeces (Standard Errors in brackets), hard seed and size of seed for four pasture legume species grazed over summer at Turretfield Research Centre, South Australia.

Species	*Seed (Time 1) kg/ha*	*Seed eaten kg/ha*	*Seed in faeces kg/ha*	*Hard seed (Time 1) %*	*Hard seed (in faeces) %*	*Seed size (Time 1) mg/seed*	*Seed size (in faeces) mg/seed*
Medicago truncatula cv. Mogul	631	334	10.3 (2.3)	78.0	47.0	4.01	3.36
Trifolium michelianum cv. Paradana	589	324	65.2 (8.0)	94.0	44.3	0.80	0.84
Trifolium spumosum	740	651	56.8 (11.7)	98.3	87.7	2.82	2.75
Trigonella balansae	663	404	11.0 (2.1)	89.3	78.3	1.45	1.35

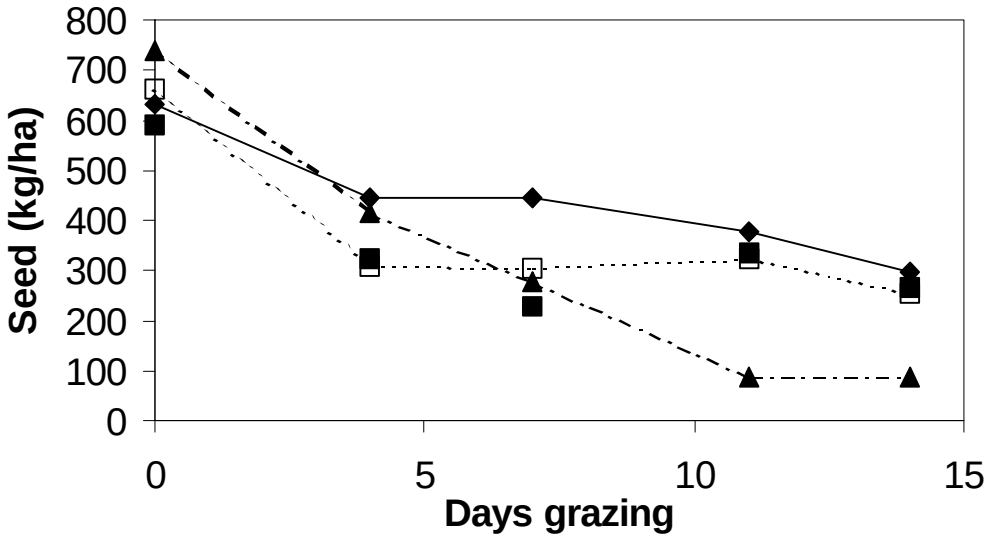

Figure 1 - The disappearance of seed (kg/ha) from the dry pasture residues for (♦) *Medicago truncatula* cv. Mogul, (■) *Trifolium michelianum* cv. Paradana, (▲) *Trifolium spumosum* and (□) *Trigonella balansae* grazed by sheep for 14 days.