stocking rates needed to justify superphosphate. The cost of legume seed would be better diverted to the purchase of Nadi blue grass seed and then fertilizer.

Oversown Nadi blue grass will spread through grazed mission grass with time. As optimum LWG over a four-year period of 145 and 380 kg ha^{-1} from unimproved and fertilized Nadi blue grass pastures respectively have been demonstrated (Partridge 1979b), there are obvious advantages from its inclusion into the unstable hill land pasture.

RECOMMENDATIONS TO FARMERS

Practical recommendations for developing beef farms in this hill land have evolved from this trial. The creeping Nadi blue grass should be oversown into the natural mission grass in early years while livestock numbers are building up. As stocking increases it will aid the spread of the Nadi blue grass and the naturalised hetero and increase animal production per hectare. At this stage low levels (100–200 kg ha^{-1}) of superphosphate can be applied to boost the hetero growth. Maintenance dressings of 100 kg ha^{-1} can be applied in alternate years. Higher rates of superphosphate could be applied later as the farmers gain in animal husbandry expertise, and if relative costs and prices continue to give attractive returns.

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THE EFFECT OF STORAGE IN CATTLE DUNG ON VIABILITY OF TROPICAL PASTURE SEEDS

M. Simao Neto[1] and R. M. Jones[2]

[1]CPATU/EMNRAPA, C.P. 48, 66.000 Belem—PA, Brazil.
[2]CSIRO, Division of Tropical Crops and Pastures, Cunningham Laboratory, St. Lucia, Queensland, 4067.

ABSTRACT

Seeds of two grasses (Brachiaria decumbens *and* Axoponus affinis) *and two legumes* (Trifolium semipilosum *cv. Safari and* Stylosanthes scabra *cv. Seca*) *were stored in cattle faeces for 0, 2, 7 and 21 days at temperatures of 10°C, 35°C and 35°/10°C (8 hours/16 hours diurnal fluctuation).*

Longer periods of storage in faeces and higher temperatures of storage markedly decreased the viability of grass seed and soft legume seed but had little effect on hard legume seed. Survival of the susceptible seeds was virtually zero after 21 days storage at the two higher temperatures.

INTRODUCTION

Seedlings of many plant species have been found emerging from ruminant faecal patches (e.g. Ozer 1979). This has several practical implications. For example, grazing management can be manipulated to aid the spread of seed from desirable plants or to minimise the spread of undesirable plants. Also seed can be deliberately fed to animals to introduce new plant species into grazing lands. The effect of passage through the digestive tract on some tropical pasture seeds has been reported elsewhere (Simao Neto *et al.* 1987, Jones and Simao Neto 1987). The experiment reported here examines the effect of storage within the faeces on seed viability of some tropical pasture species. Published work on similar studies are confined to temperate species and mostly relate to the effect of lengthy periods of storage (e.g. Oswald 1908, Ozer 1979), as occurs with faeces collected from animals housed over winter. This experiment examined changes in seed viability of two legumes and two grasses under three temperature regimes over short periods of time which could relate more to conditions in faecal patches excreted by cattle under field conditions.

MATERIALS AND METHODS

Faecal samples were collected from each of four penned Hereford steers fed a diet free of pasture seed. Two hundred and fifty seeds of each of four pasture species [*Brachiaria decumbens* (signal grass), *Axonopus affinis* (carpet grass), *Trifolium semipilosum* cv. Safari and *Stylosanthes scabra* cv. Seca.] were mixed with each of twelve 100 g subsamples of faeces from each animal.

All samples were placed in plastic bags loosely tied with rubber bands, but not completely sealed. (Previous tests had shown that faeces in slightly open bags did not change colour and lost only 10% of water over three weeks, whereas there was a change in faecal colour with complete sealing.) The faecal samples were stored for four periods (P) of time (0, 2, 7 and 21 days) at three temperature (T) regimes (10°C, 35°C and 35°/10°C—8 hour day/16 hour night diurnal fluctuation).

After storage, the seeds were recovered from the faeces as described by Jones and Bunch (1977) and were tested for germination, according to recommendations for each pasture species (Anon 1973). Percentage viability was determined by adding the percentage germination to the percentage of hard legume seeds which germinated after scarification by hand or to the percentage of ungerminated grass seed which stained positively with tetrazolium (Grabe 1970).

The experimental design was a factorial 4(P) $\times$ 3(T), with four replications, one for faeces from each animal.

RESULTS

Disappearance of Seed

Some of the Safari seeds disappeared during storage in faeces. The percentage disappearance increased with increasing length of storage and higher temperatures. At temperatures of 10°C, 35°/10°C and 35°C, 8%, 25% and 30% of seed were lost after 7 days while 15%, 39% and 50% were lost after 21 days. All Seca seeds were recovered intact in pods and all the grass seeds were recovered although some had lost their outer coverings.

Viability

There were highly significant depressions of seed viability with increasing length of storage and higher temperature of storage (Fig. 1), and also highly significant interactions between length of storage, temperature, and species. For example, there was no effect of storage temperature on carpet grass seed after two days incubation but a marked effect after 21 days, whereas the reverse result was obtained with Safari seed.

Safari seed that disappeared was regarded in Figure 1 as dead seed, hence the four species can be compared. The viability of Seca seed was less affected by temperature and length of storage than the other species. Carpet grass and signal grass seed were particularly susceptible to damage by high temperatures.

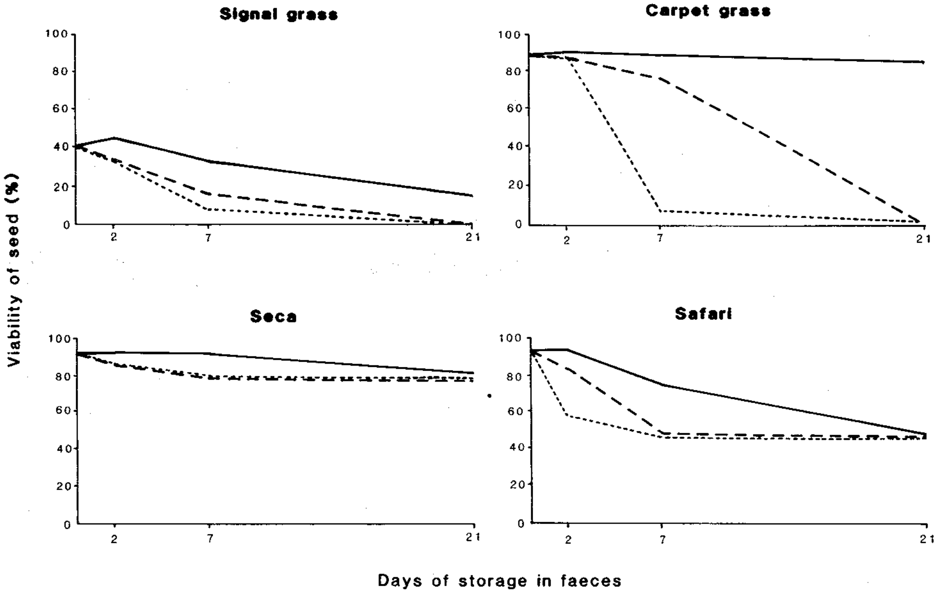

FIGURE 1

Changes in percent viability with time, of seeds of signal grass (*Brachiaria decumbens*), carpet grass (*Axonopus affinis*), *Stylosanthes scabra* cv. Seca and *Trifolium semipilosum* cv. Safari stored in faeces at 10 °C (________), 35 °/10 °C (__ __) and 35 °C (. . . . . . .).

Dormancy and hardseededness

Carpet grass had no dormant seed, that is seed which failed to germinate yet stained with tetrazolium. In contrast, 75% of the viable signal grass was dormant prior to storage in faeces, but there was no dormant seed after 21 days of storage. The proportion of hard legume seed was 75% for Seca and 47% for Safari and this was not affected by increasing temperatures or length of storage. As the percentage viability of legume seed after 21 days storage (Fig. 1) was only slightly higher than the percentage of hard seed, we conclude that most of the originally soft legume seed was destroyed by storage in faeces.

DISCUSSION

Death of grass seed and soft legume seed following prolonged storage in faeces has been recorded for temperate species (Suckling 1950; Lennartz 1957; Ozer 1979). Similar effects were measured after only 7 days storage at the temperatures of 35 °C and 35 °/10 °C used in this study. Storage for 21 days at these temperatures resulted in the loss of all viability in grass seed and almost all of the soft Safari and Seca seed, even though the soft Seca seed was protected from direct contact with the faeces because it was enclosed by seed pods. The seeds used in this study had not passed through the digestive tract of animals. However, we would expect similar trends in relation to temperature and length of storage with seed that had passed through the digestive tract (M. Simao Neto, unpublished data). Legume seed which was still hard after passage would be resistant to storage in faeces. Soft legume or grass seed that was excreted in faeces would be susceptable to storage in faeces, possibly even more so than the seed used in this study. It is not surprising that storage at 35 °C or 35 °/10 °C had little effect on hard legume seed because higher temperatures than this are required to break hardseededness of dry seed (Mott *et al.* 1981).

Although there are good descriptions of the longevity of dung patches in pastures (Marsh and Campling 1970; Ferrar 1975), we were unable to find data for faecal temperatures following the deposition of faeces from grazing cattle. Temperatures in faeces would depend on ambient temperature, direct radiation, the moisture content and biological activity of faeces, and the presence of dung beetles. Temperatures of 35 °C, 35 °/10 °C and 10 °C were chosen to provide contrasting regimes within the likely range of summer and winter temperatures of wet faeces in the tropics.

If it is desired to introduce or disseminate a legume species via the grazing animal, then a high initial level of hard seed is most important. Firstly, little soft seed remains viable after passage through the digestive tract of ruminants (Simao Neto *et al.*, 1987). Secondly, as this study shows, soft seed is also likely to be destroyed by retention in cattle faeces. In contrast, viability of seeds within faecal pellets of sheep and goats, as compared with cattle faeces, may well be less affected because the dung pellets are smaller and usually have a lower moisture content.

This experiment has demonstrated that grass seed and soft legume seed of tropical pasture species stored in faeces is markedly reduced in viability within 7 to 21 days. To relate this information more directly to faecal patches excreted by grazing animals we need information on micro-environmental conditions within excreted faecal patches.

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OBSERVATIONS ON THE DIET SELECTED BY FRIESIAN COWS GRAZING TROPICAL GRASS AND GRASS-LEGUME PASTURES

R. T. COWAN[1], T. M. DAVISON[1] and R. K. SHEPHARD[2]

[1]Queensland Department of Primary Industries, Mutdapilly Research Station, M.S. 825, Ipswich, 4305.
[2]Queensland Department of Primary Industries, Oonoonba Veterinary Laboratory, Townsville, 4810.

ABSTRACT

The composition of the diet selected by Friesian cows grazing pure tropical grass pasture containing Panicum maximum *cv. Gatton and mixed tropical pasture containing* P. maximum *cv. Gatton and the legumes* Neonotonia wightii *cv. Tinaroo and* Desmodium intortum *cv. Greenleaf was measured during summer and winter on the*