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Role of grazing cattle on seed dispersal of plants in a hill pasture 4 . effects of dung patch on environmental condition in dung and seedling establishment

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Introduction Our previous study indicated that most seedlings of herbaceous plants germinated from dung pats died in both sunny (SUN) and shading (SHA) places , due to high temperature in SUN and deficiency of solar radiation in SHA , in a 10-week periods from early summer to early autumn (Ogura *et al.* , 2008) . This suggests that more moderate shading created by tall grasses surrounding a dung patch provides proper environmental condition for seedling establishment . In this study , a field experiment was conducted to examine if a dung patch provided proper environmental condition for seed germination and seedling survival .

Materials and methods *Trifolium repens* , *Poa pratensis* and *Carex albata* seeds were mixed with dung of a single dairy cows fed grass silage (neither anti-parasitic medication nor ionophores were dosed) , respectively (1,500 seeds/1,200 g of fresh dung pats , n=3) . Two treatments ; *i.e.* , sunshine (SUN) and dung patch (DPA) were established on a pasture dominated by *Dactylis glomerata* . The dung pats ($\varphi=20$ cm) were placed on the pasture in areas where the sward was cut to a height of 3 cm . In SUN , the sward surrounding the dung pats was cut at the height of 8 cm , before the experiment and at 2 weeks intervals during the experimental period ; whereas , in DPA , the sward height was 40 cm at the beginning of the experiment and no cutting treatment followed . The number of seedlings germinated from the dung pats and seedling mortality were recorded from 4 August to 29 September , 2006 . The temperature and moisture conditions in the dung were monitored (Ogura *et al.* , 2008) .

Results and discussion Maximum temperature exceeded to 40°C in SUN , whereas temperature fluctuations were small in DPA . Moisture content of dung responded to precipitation in both SUN and DPA , meaning that there was no obvious difference of moisture content in dung between the treatments . Seed germination and its survival differed among plant species (Figure 1) . In *T. repens* , seed germination rate was greater for SUN than DPA , but most of the seedlings died during the experiment . In *P. pratensis* , 34.0 seedlings/dung pat germinated and 22.7 seedlings/dung pat survived in DPA , which were greater than in SUN . The inconsistency of the survival of seedlings in SUN compared to the previous study (Ogura *et al.* , 2008) is probably due to the difference of the season when the experiment began . In *C. albata* , seed germination rate was greater for SUN (6.3 seedlings/dung pat) than DPA (3.3 seedlings/dung pat) , and most of the seedlings survived in SUN . The result suggests that sunny place is beneficial to seed germination and the survival of the seedlings in *C. albata* .

Conclusions While the dung patch may protect the seedlings from high temperature and dryness in summer in *P. pratensis* , the results suggest that sunny place may be beneficial to seed germination and the survival of seedlings in *C. albata* . From the previous (Obara *et al.* , 2008a ; 2008b ; Ogura *et al.* , 2008) and the present study , it is concluded that *C. albata* is adapted for seed dispersal by ruminants .

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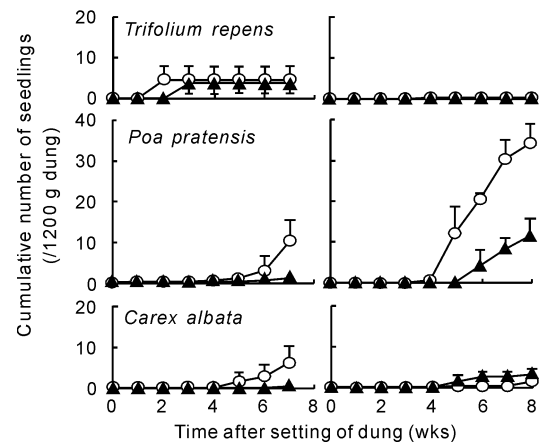


Figure 1 Cumulative number of seed germination (○) and death (▲) of seedlings in SUN (left) and DPA (right) .