PRODUCTIVITY OF PASTURE CONSISTING OF BOTH UNIMPROVED AND IMPROVED AREAS IN ASO REGION OF KYUSHU DISTRICT

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ABSTRACT

Productivity of pasture consisting of both unimproved and improved areas was investigated in terms of conversion efficiency of solar energy into products and nutrient intake of animal. It was shown that animal production is mainly supported by the improved area in spring and late-autumn while the production is supported together by both areas in summer by reasons of increases in productivity of the unimproved area and productive depression in the improved area. CP/DE balance of grazed herbage was close to the requirement ofthe animal in the case where the unimproved area was grazed with the improved area rather than in the case where the improved area only was grazed. Therefore, it appears that the use of the unimproved area with the improved area is more advantageous to stabilize seasonal animal production, to extend the available term per year for grazing and to supply nutrition required by animals than the use of unimproved area alone.

KEYWORDS

Breeding cow, energy flow, grazing, improved pasture, native pasture

INTRODUCTION

Aso area is a national park in Japan because the region has the greatest landscape of native grassland. In this region, 16,000 ha of native grassland and 9,000 ha of improved grassland with temperate grasses are being used to feed beef cattle which are 42,000 head of Japanese Brown cattle, 31% of which are breeding cows. However, the areas of native grassland without management are being reduced because of decreases in number of cattle and concentration of use of improved grassland. Therefore, the succession progresses in the wide area of native grassland and condition of the area will be wrong. In native grassland, there is a characteristic that productivity rises in summer. On the other hand, the improved grassland has a problem of depression of productivity in the same season. The authors (1992 and 1994) have conducted use of native grassland with improved grassland to feed breeding cows as a way of management of native grassland. In the present study, productivity of pasture consisting of both unimproved and improved areas was investigated in terms of conversion efficiency of solar energy into products and nutrient intake of animal.

METHODS

This experiment was carried out on a pasture of Kyushu Tokai University (32° 55' N, 131° 6' E) in Aso region of Kyushu district in 1987 to 1989. Annual mean air temperature and annual precipitation in this place are 12.6 °C and 2,600 mm, respectively.

The pasture consisted of both unimproved and improved areas. The major constituents of community of the unimproved area and its dominant ratios (SDR_2') were *Zoysia japonica* (9-14%), *Arundinella hirta* (9-16%), *Pleioblastus chino* var. *viridis* (7-12%) and *Miscanthus sinensis* (4-12%). Those species are C4 plants except *Pleioblastus chino* var. *viridis*. The improved area was established in 1981 by plowing method with festulolium (*Festuca* x *Lolium*), tall fescue (*Festuca arundinacea*), orchardgrass (*Dactylis gromerata*) and white clover (*Triforium repens*). The SDR_2' of each species was 12-40% of festulolium, 8-20% of tall fescue, 2-9% of orchardgrass and 11-29% of white clover, respectively. Nitrogen, P_2O_5 and K_2O were annually applied only to the improved area at the amounts of 160, 120 and 140 kg/ha. The experimental pasture was used as an area consisting both 1.09 ha of unimproved area and 0.84 ha of the improved area in 1987 and as an area consisting both 0.78 ha of the former and 0.63 ha of the latter in 1988 and 1989, respectively. Breeding Japanese Brown cows (8-16 cows/grazing period) were grazed among 6-7 pastures in a rotation. Annual grazing intensity (day/ha/500 kg body weight) and annual times of rotation in the experimental pasture were 443 days per four times in 1987, 539 days per six times in 1988 and 499 days per seven times in 1989, respectively. Calves were separated to an area exclusive to them but cows could give milk only over the fence. Amounts of herbage available were measured by the portions higher than 3 cm above ground level. Amounts of herbage grazed were estimated by a method of Linehan et al. (1947). Energy digestibility in vivo of herbage grazed, energy retained in animal and energy stored in milk was determined by the methods of the author/s (1995a, 1990 and 1995b, respectively). Ratio of crude protein intake to digestible energy intake (CP/DE ratio) was calculated as follows: CP intake(kg)/DE intake(Mcal) x 100.

RESULTS AND DISCUSSION

Seasonal changes in efficiency of use of solar energy to herbage and animal are shown in Fig. 1. The efficiency in the improved area was higher during the year than that in the unimproved area. It was suggested that the potential productivity of community composed of introduced C3 species is greater in Aso region than that of native community which is mainly composed of C4 species. Okubo et al. (1985) showed that conversion of the stored energy in herbage into the use or product by animal is poor in the pasture based on subtropical C4 species. However, there were no differences in this conversion efficiency from herbage to animal between both areas. In spring, autumn and late-autumn season, the efficiency of use of solar energy in the improved area was especially higher than that in the unimproved area. By contrast, the efficiency in the unimproved area increased in summer season and showed few differences with that in the improved area in this time. The contrast in seasonal productivity of herbage between both areas may be caused by differences in physiological characteristics of composing species. When the efficiency was evaluated for the whole of the pasture of both areas, the seasonal variance of the efficiency decreased. Therefore, it appears that the use of unimproved areas with improved areas is more advantageous to stabilize seasonal animal production and to extend the available term per year for grazing than a single use of unimproved area. Fig. 2 indicates annual efficiency of conversion of solar energy to animal products per the pasture consisting of both areas. The conversion of solar energy into the grazed digestible herbage was raised by intensive use such as increase in times of rotational use per year. The conversion into gains in cow decreased as times of the rotational use increased, but the conversion into both milk and gain of fetus, which are important as breeding production, increased. Seasonal changes in the ratio of crude protein intake to digestible energy intake (CP/DE ratio) of animals are shown in Fig. 3. In general, breeding cows require lower CP/DE ratio than growing cattle and the ratios required by cows was from 3.1 to 4.1 in this experiment. Compared with the ratios required, the ratios in herbage grazed in the improved area was moderately high. The CP/DE ratios approached the ratio required as the unimproved area was grazed with the improved area. This is because the ratios in herbage grazed in the unimproved area was low. Since the cows can graze ad libitum from both areas in those cases, it may be possible to select both areas and variable species with individual requirements for

nutritional conditions. In conclusion, it was suggested that some useful characteristics for managing breeding cows in Aso region occur by using together both unimproved and improved areas.

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Figure 1
Seasonal changes in efficiency of use of solar energy to herbage and animal during grazing periods. •, o and x indicate improved area, unimproved area and whole of pasture, respectively. The dotted circle and the solid bar show daily mean temperature and monthly precipitation, respectively.

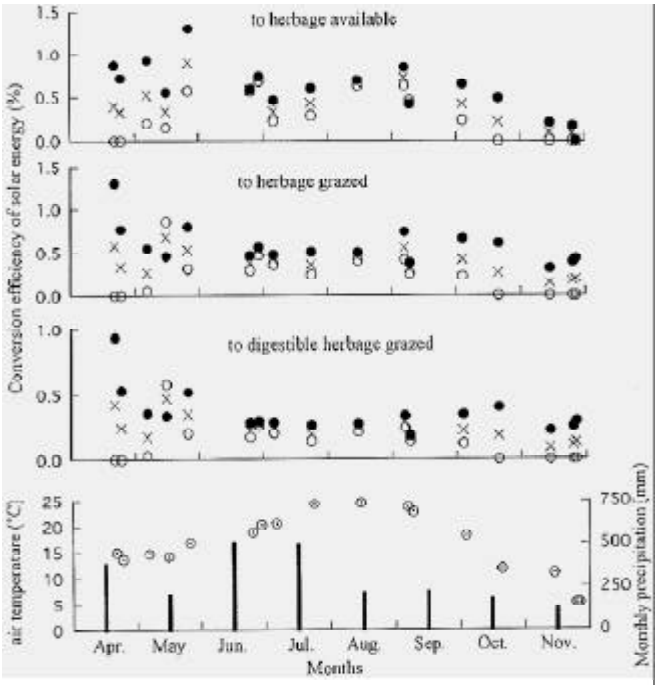

Figure 2
Annual efficiency of use of solar energy per whole of pasture consisting of both unimproved and improved areas.

Animal production includes production for breeding and gain in cow. The production for breeding is composed of both productive energy of milk and retained energy as fetus.

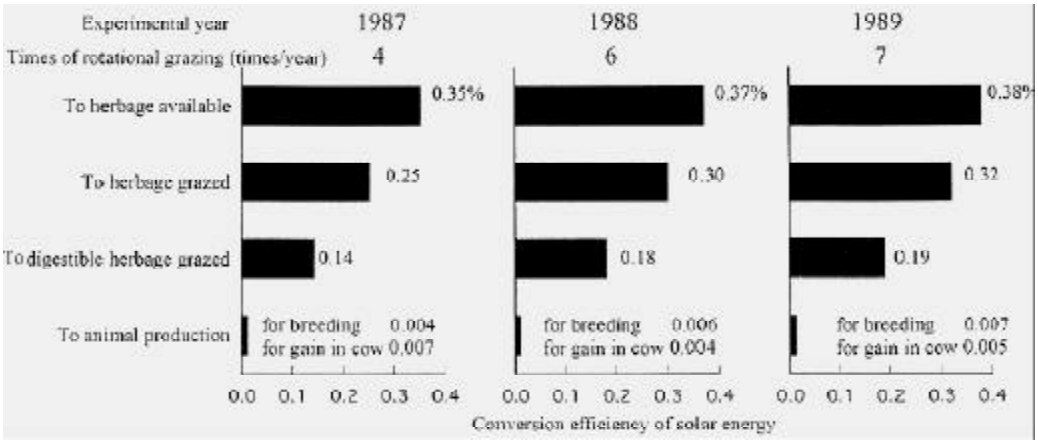

Figure 3
Seasonal changes in ratio of crude protein (CP) intake to digestible energy (DE) intake of animal.

•, o and x indicate improved area, unimproved area and whole of pasture, respectively.