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Seasonal Change in the Spatial Distribution of Sward Height under Intensive Grazing of Lactating Dairy Cows.

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Summary

This study investigated seasonal change in the spatial distribution of compressed sward height (CSH) on intensive grazing by lactating dairy cows. The Pre-and post-grazing CSH ranged 4.5−9.5 cm and 3.5−6.5 cm, respectivery. Both pre- and post grazing CSH as well as their standard deviation, increased from late May to early June and decreased gradually thereafter. The coefficient of variation (CV) in post-grazing CSH was higher than that of pre-grazing. This suggests that uneven spatial distribution of the CSH increase whit grazing. Although cows grazed more herbage in location with high pre-grazing CSH, post-grazing CHS remaind relatively high. The CV decreased slightly toward next grazing cycle, although the relationship between post-grazing CSH and plant regrowth was not clear. A significant difference was observed between post-grazing CSH in dung-deposited locations and dung-free locations. This difference was maintained throughout the grazing season. The presence of dung appears to be a factor in the uneven spatial distribution of CSH in the pasture and keep the difference high.

Key words : Distribution of sward height, Intensive grazing, Lactating dairy cows, Seasonal change

Introduction

Herbage masses in a grazed pasture generally show uneven spatial distribution,which decreases pasture utilization and animal production. Thus, changes in the uneven spatial distribution of harbage mass can be considered as a indicator of grazing management. Some studies have shown that unevenness in the herbage mass increased with grazing[3−7,9,10] and fouling by animal dung[2,3] and decreased with plant regrowth[9,10]. However, few stusies have considered relation between the animal grazing, cattle dung pats, plant regrowth throughout grazing season on unevenness in the herbage mass, also the mechanisms of these phenomenon were not clearly elucidated. For such an eco-dynamic study, the herbage mass to be measured nondestructively at a number of fixed places in the pasture[7]. The compressed sward height (CSH), which can be measured non-destrctivity with a rising-plate metter, is a useful and simple parameter of herbage mass.

The object of this study was to investigate changes in the spatial distribution of CSH and to consider the effect of animal grazing, plant regrowth and cattle dung pats on the spatial distribution of the CSH under intensive grazing by lactating dairy cows through an entire grazing season.

Materials and Methods

This experiment was carried out on about 1 ha grass-clover pasture at the Experimental Farm of Hokkaldo University. The dominate species in this pasture were perennial rye grass (*Lolium perenne* L.) and white clover (*Trifolium repens* L.). Seven lactating Holstein cows grazed on this pasture from May to October. The initial mean body weight, milk yield and days in milk were 601kg, 32.7kg and 63 days, respectively. The pasture was strip-grazed with a back fence and grazed twice per day, evening (17:00−19:30) and next morning (5:30

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−8:00). In addition to grazing, cows fed corn or alfalfa silage, hay and concentrate in a barn. The daily roughage allowance for the cows was equivalent to total digestible nutrient (TDN) for the maintenance + 13 kg milk suggested in the Japanese Feeding Standard for Dairy Cattle[8)]. Concentrate was supplied to each cow at rate of 0−28% of the milk yield.

The annual fertilization rate of N−P_2O_5−K_2O−MgO were 60−120−100−50 kg/ha, respectively, and were applied evenly in April, June and September. Only MgO was applied once in April. During the grazing season, the pasture was not mown.

In this pasture, we installed one fixed transect (34m × 24m) across the pasture. This transect was divided into 1m × 1m squares for measurements in each pre-and post-grazing cycle. Measurements of compressed sward height (CSH) were taken at each square using a rising-plate meter (ASHGROVE, New Zealand). For each square, a mean value of 5 CSH measurements was used as the CSH. The number of newly deposited dung pas were also recorded for each square. Sward surface height (grass) for pre-and post-grazing samples in each grazing cycle was measured using a ruler. Pre-grazing herbage mass was also msesured at 4 points using a 50 cm × 50 cm quadrate. In each quadrate, herbage was cut 5 cm above ground level and oven-dried at 70 ℃ for 48hrs to determine the dry matter content.

Results and Discussion

There were 163 total grazing days in the grazing season, which was divided into 11 cycles, with an average of 15.5 days between cycles.

Table 1 indicates the seasonal changes of mean CSH as well as the standard deviation (SD), coefficient of variation (CV) and sward surface height. Mean CSH at pre-and post-grazing measurements ranged between 4.5−9.5 cm and 3.5−6.5 cm, and these valuse corresponded to pre-and post-grazing sward surfce heights about 11.5−27 cm and 7.5−15 cm in respecrively. Both the mean CSH and the SD increased from late May to early June (2nd−3rd grazing cycles) and decreased gradually thereafter. The CV in the CSH increased from May to June (1st−4th grazing cycles) and then decreased slightly. HIRATA[4)], however, reported that mean herbage mass appears to increase from May to July or August and decrease thereafter, while the CV of the herbage mass appers to decrease from May to August and increase from September to October. The differences in the seasonal pattern of the CV in herbage mass between HIRATA[4)] and the present study may be caused by the differences in grazing conditions such as stocking rate, herbage allowance

Table 1. Mean compressed sward height with standard deviation (SD), coefficient of variation (CV), sward surface height (SSH) and herbage allowance (HA).

No. of grazing cycle (Date)	Compressed sward height Mean(cm) Pre 1)	Post 2)	SD Pre	SD Post	CV(%) Pre	CV(%) Post	SSH(cm) Pre	SSH(cm) Post	HA (kgDM/cow/d)
1 (14−15 May)	6.3	5.2	1.53	1.32	24.4	25.3	15.8	10.4	14.9
2 (29−30 May)	9.6	6.7	2.92	2.51	30.4	37.4	27.3	14.3	20.6
3 (11−12 June)	9.5	6.3	3.20	2.70	33.7	43.1	24.3	12.1	19.0
4 (26−27 June)	7.5	6.2	3.26	2.35	43.3	38.0	22.6	12.8	24.9
5 (15−16 July)	8.1	5.9	3.03	2.29	37.4	39.1	25.4	15.2	17.0
6 (2−3 Aug.)	7.2	5.4	2.69	2.18	37.6	40.0	20.9	13.6	25.2
7 (17−18 Aug)	6.9	4.3	2.42	1.63	35.1	37.6	21.8	11.0	11.8
8 (2−3 Sept.)	6.3	4.6	2.26	1.73	36.1	37.2	18.4	12.6	12.7
9 (17−18 Sept.)	5.5	4.5	1.99	1.51	35.9	33.4	16.9	10.5	14.4
10 (2−3 Oct.)	5.1	3.8	1.75	1.34	34.2	35.5	14.3	8.8	12.4
11 (16−17 Oct.)	4.5	3.3	1.62	1.29	35.9	38.7	11.6	7.4	10.2

1) Pre-grazing
2) Post-grazing

or area allowance.

The CV in the post-grazing CSH was higher than that of the pre-grazing, and the CV in the CSH slightly decreased at the following grazing. Some studies[5-7,9,10] have shown that the CV in the herbage mass increases with grazing. Results of the present study coincided with these studies. In our study, the CV in the CSH slightly decreased at the following grazing tendency. SHIYOMI et. al[10]. reported pasture heterogeneity decreases with a lapse of time after grazing due to plant regrowth.

Figure 1 shows the relationships between pre-grazing and post-grazing CSH measurements, and Figure 2 shows the relationships between pre-grazing CSH and grazing associated changes in CSH in the 1st, 3rd, 5th, 7th, 9th, and 11th grazing cycles. Changes in the CSH and the post-grazing CSH always positively correlated with the pre-grazing CSH, those show that the areas with comparatively high pre-grazing CSH remained high after grazing (Fig.1) and were more frequently grazed by the cows (Fig.2). This phenomenon coincided with the results of HIRATA and FUKUYAMA[6].

There are fewer relationships between the post-grazing CSH and the change in CSH until following grazing (Fig.3). These results suggest that plant regrowth does not have a definite relationship to post-grazing CSH in the present study. Although, in the present study as well as a previous study by SHIYOMI et. al[10]. the CV in the herbage mass decreased until following grazing.

Figure 4 shows seasonal chages in CSH in dung-free and dung-deposited post-grazing squares in each month (1st, 3rd, 5th, 7th, 9th, and 10th grazing cycles). Immediately after dung deposition, there were no differences in CSH between dung-free and dung-deposited areas, except in June (3rd grazing cycle). In the grazing cycle after dung was deposited, however, the CSH was significantly higher than that of the dung-free area ,and this phennomenon continued through the grazing season. Total weight and area occupied by cattle dung pats in the pasture continued to rise throughout the grazing season[1,3]. Thus, cattle dung pats appear to be one of the effective factors which could contributes the high uneven spatial distribution of CSH throughout the grazing season.

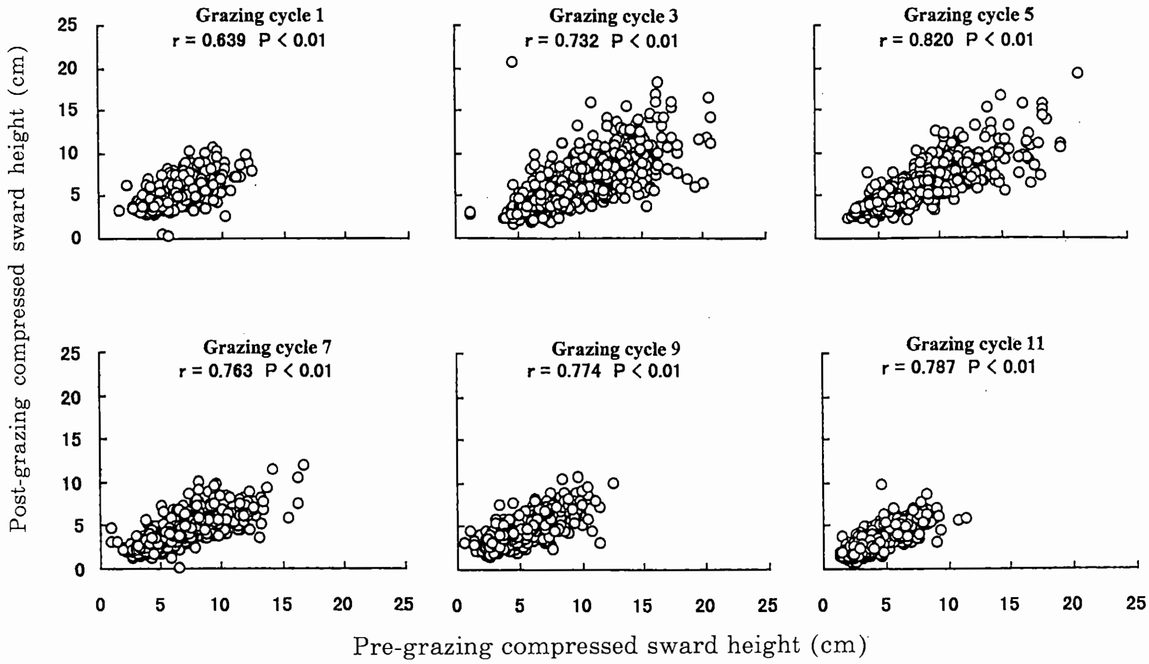

Figure 1. Relationships between pre-grazing and post-grazing compressed sward height.

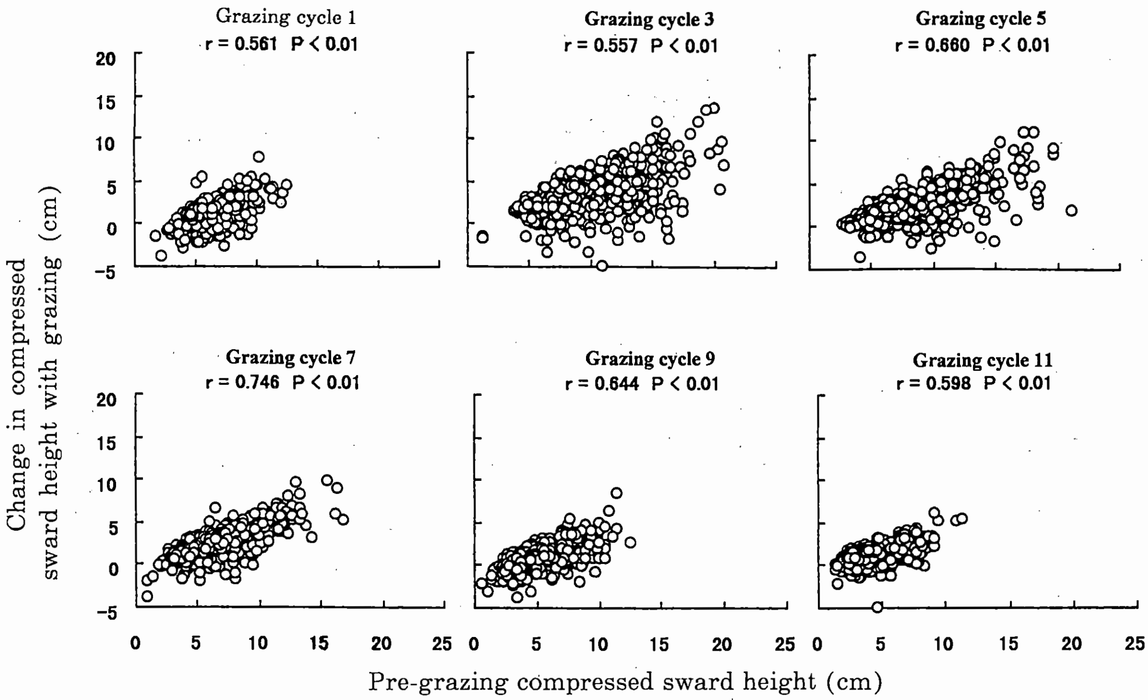

Figure 2. Relationships between compressed sward height on pre-grazing and change in compressed sward height with grazing.

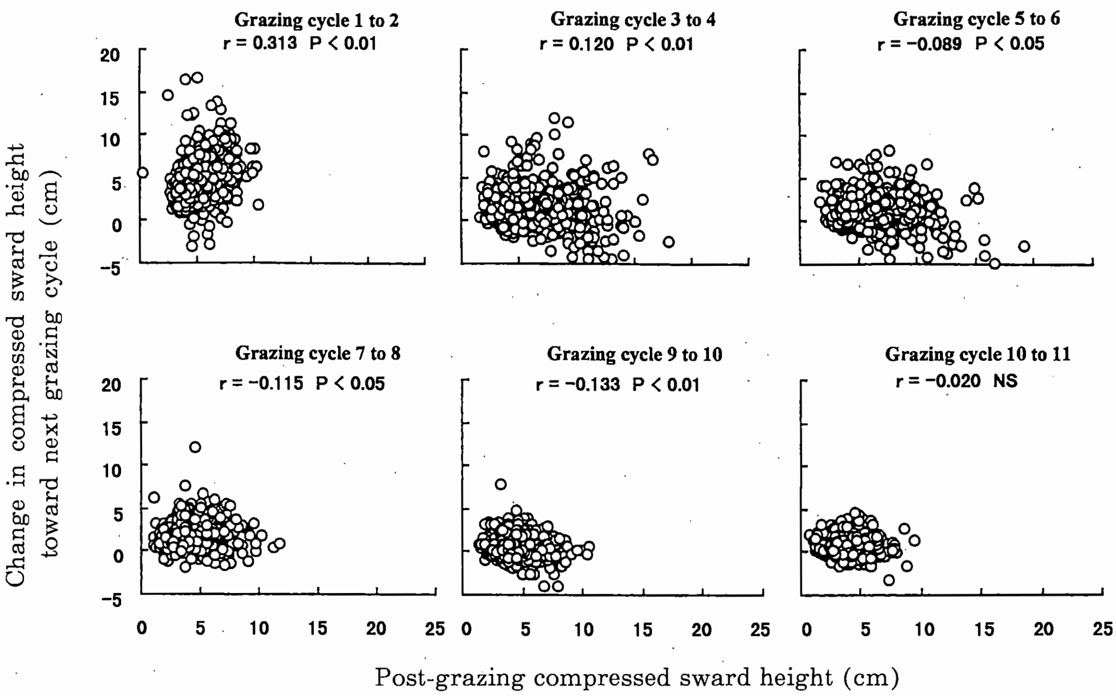

Figure 3. Relationships between compressed sward height on post-grazing and the change in compressed sward height until following grazing.

The results show that the cows grazed more herbage in areas with higher pre–grazing CSH. The cows rejected in locations which had dung pats cousing the CSH in these areas to remained high in post–grazing measurements. Thus, the uneven spatial distribution of CSH or herbage mass increases over a period of continued grazing.

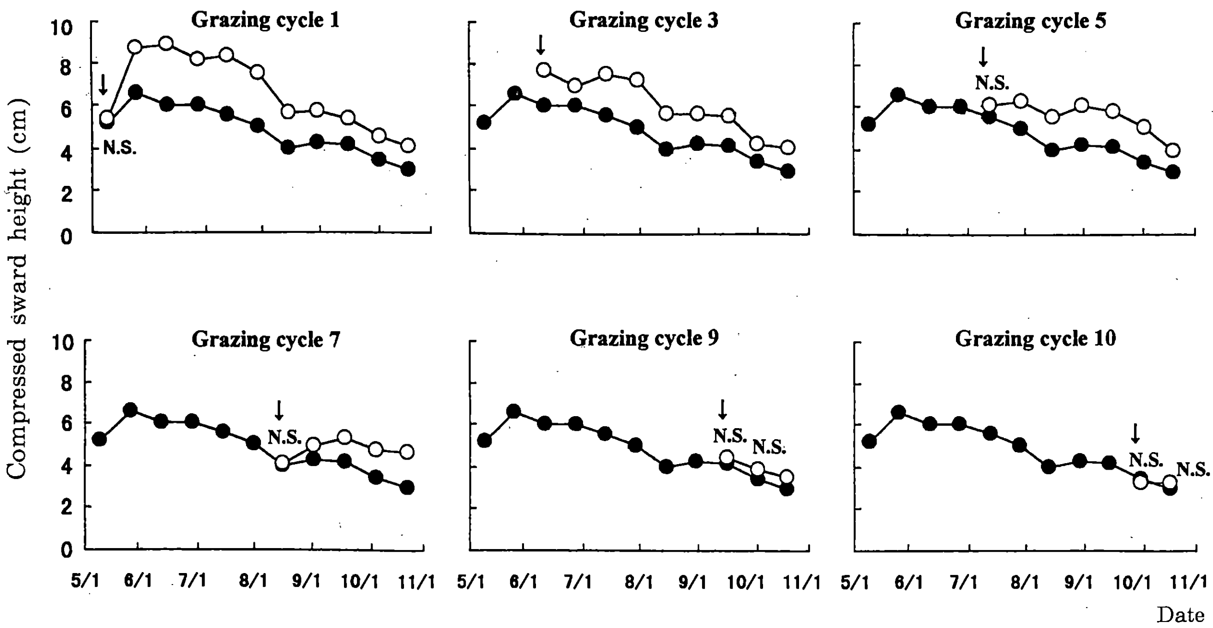

Figure 4. Post-grazing compressed sward height in dung-free (●) and dung deposited (○) squares.
Arrow (↓) indicates dung deposited day.
N. S. : Not significant (P>0.05, dung-free vs. dung deposited place)

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泌乳牛の集約放牧における草高分布の変化

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摘　　要

泌乳牛の集約放牧における圧縮草高の分布の変化をライジングプレートメータを用いて測定した。放牧前後の圧縮草高は、それぞれ4.5－9.5cmおよび3.5－6.5cmの範囲であった。放牧前後ともに平均圧縮草高とその標準偏差（SD）は5月後半から6月前半にかけて増加し、その後徐々に減少した。圧縮草高の変動係数（CV）は、おおむね放牧後が放牧前より高く、放牧に伴い放牧地の圧縮草高の分布が不均一になった。また、牛は放牧前の圧縮草高が高い場所を多く採食したが、放牧前の圧縮草高が高い場所は放牧後の圧縮草高も高いままに維持される傾向にあった。放牧後に比べ次回放牧前の圧縮草高の変動係数は低下したが、放牧後の圧縮草高と牧草の再生には明確な関係が見られなかった。排糞場所周囲の圧縮草高は、排糞のない場所に比べ高く、その傾向は放牧期間を通して維持され、排糞は圧縮草高の不均一分布を増加または維持する要因と考えられた。

キーワード：季節変化、集約放牧、草高の分布、泌乳牛

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