

Studies on Grass Productivity of Steep Mountainous Grassland

1. Observations on the Grazing Behaviour of Young Steers of Japanese Black Breed

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There is a vast area of mountainous grassland (about 149,000 ha) in the Chugoku District in Japan. This grassland is not yet fully utilized, hence we should promote dairy and beef cattle farming in order to improve the nutrition of the people as well as to make use of mountainous grasslands more effectively.

Studies of grazing behaviour of livestock aid in establishing principles for good pasture management, since the behaviour of an animal on pasture is conditioned by many factors, including environment, forage availability, digestibility of forage, forage species and the individual animal.

Although AOKI et al.¹⁾²⁾³⁾, KUROSAKI et al.⁴⁾, etc. have studied the grazing behaviour of Japanese Black breed of cattle, there are only a few reports on young steers on steep mountainous grasslands. The purpose of this paper is, therefore, to report three series of observation on the grazing behaviour of young steers of Japanese Black breed at Chiya in the north-eastern part of Okayama prefecture.

Materials and Methods

The grassland used is situated in the Okayama Prefectural Experiment Station of Wagyu Cattle at an altitude of 490-540 m. The slope of the grassland facing south-east has a gradient of 26-48 degrees. The grassland was improved by the topdressing and oversowing method, without plowing and disking, in the fall of 1965.

This was divided into four paddocks of about 0.6 ha each and ten steers were pastured on a three-day rotational grazing management plan during the entire day from April 30 to October 28 in 1966. A loose barn with a capacity of 3.3 m² per head was built on a flat along the ridge of the grassland. The steers which have grazed could enter the barn by way of a corridor any time of the day. The distance from the gate of the paddock to the barn was 30m.

The herd under observation consisted of ten steers of Japanese Black breed of cattle. Observations were carried out in three trials as shown in Table 1; the first trial in early June, the second in early August and the third in early October. The herd was observed from 13.00 hr. of the first day to 13.00 hr. of the third day in each trial.

The mean body weight of the steers was 239.2 kg at the start of the first trial, and this increased to 256.3 kg and 310.7 kg, respectively, by the commencement of the second and third trials. The mean ages were 304 days, 359 days and 421 days at the start of the respective trials.

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Table 1. Details of observations

Trial	Date*	Temperature in barn min. -max. °C	Mean body weight of steers** kg	Mean age of steers** day	Supplement feed	Weather condition
1st	6-7 June	9.9-19.8	239.2	304	Concentrate 0.5% per body weight, hay ad lib.	Cloudy Fine
	7-8 June	10.5-24.8				
2nd	1-2 August	19.0-26.5	256.3	359	Concentrate 0.7% per body weight, hay ad lib.	Rain Cloudy
	2-3 August	20.0-27.0				
3rd	3-4 Oct.	14.0-18.0	310.7	421	Concentrate 0.7% per body weight, hay ad lib.	Fine Fine
	4-5 Oct.	12.0-18.0				

* Observed from 13.00 hr. of the first day to 13.00 hr. of the third day in each trial.

** At the start in each trial.

Table 2. Pasture analysis*

Item	June	August	October
Plant composition as % of fresh weight			
Orchard grass	25.6	47.0	57.4
Perennial ryegrass	7.7	27.3	15.6
Italian ryegrass	40.0	1.5	0.0
Kentucky 31 fescue	0.0	4.0	6.3
New zealand white clover	5.3	0.7	2.1
Wild grass	21.4	19.5	18.6
Standing crop as fresh weight, kg per 10 a	1085	590	280

* Just before grazing at each trial period.

The steers were grazed in the same paddock (0.62 ha) during the three trial periods.

An analysis of the grassland sward was carried out before each of the three periods of observation, and the results are shown in Table 2.

Each steer was given once a day (at 9 a.m.) concentrate feed at a level of 0.5% per body weight in the first trial and at a level of 0.7% both in the second and third trials, and fed hay ad libitum during the three trial periods.

In the three observation periods the grazing behaviour of the steers was recorded for 48 hr. under the following activities: 1. grazing; 2. eating concentrate; 3. eating hay; 4. ruminating standing; 5. ruminating lying; 6. resting standing; 7. resting lying; and 8. walking but not grazing. The activity of resting standing includes that of drinking, for the latter is not shown to scale.

The ten steers were observed as a single herd. The interval between recordings was 5 min., using the results obtained from trials carried out by MITSUMATA et al.¹⁰⁾

Results and Discussion

Table 3 shows the time spent in each behaviour of the herd of ten steers for two successive days in each trial. It can be seen from this Table that the differences in time spent on each activity between the first and second days of each trial are relatively small in June and large in October and are not found in August. Next, the histograms in Fig. 1 illustrate the difference in the grazing behaviour of the herd.

Each column in the histograms represents the percentage time spent on each activity for 1 hr. Although these histograms show that the main difference in grazing activity between two 24 hr. periods in each trial occurred at midnight in June and about midday in October, a general similarity of pattern in grazing behaviour was found for the two successive days within each trial period.

Table 3. Time in minutes spent in each behaviour of the herd for the two separate days and nights of each trial

Trial		Grazing	Eating concent.	Eating hay	Ruminating standing	Ruminating lying	Resting standing	Resting lying	Walking
1st	Day 1	338	50	14	45	142	153	144	37
	Day 2	339	50	7	33	129	121	191	33
	Mean	339	50	10	39	136	137	168	35
	Night 1	30	0	13	30	230	61	134	19
	Night 2	0	0	2	4	247	68	211	5
	Mean	15	0	8	17	239	64	173	12
	Total 1	368	50	27	75	372	214	278	56
	Total 2	339	50	9	37	376	189	402	38
	Mean	354	50	18	56	374	201	340	47
2nd	Day 1	184	30	44	23	139	199	268	5
	Day 2	259	30	43	16	102	244	194	10
	Mean	222	30	43	20	121	221	231	7
	Night 1	114	0	15	76	77	117	124	25
	Night 2	53	0	10	81	120	80	196	2
	Mean	83	0	13	78	99	99	160	14
	Total 1	298	30	59	99	216	316	392	30
	Total 2	312	30	53	97	222	324	390	12
	Mean	305	30	56	98	219	320	391	21
3rd	Day 1	350	40	32	13	60	108	151	10
	Day 2	215	30	33	14	72	168	194	10
	Mean	282	35	33	13	66	138	172	10
	Night 1	46	0	42	0	218	140	227	3
	Night 2	72	0	44	13	265	48	258	4
	Mean	59	0	43	7	241	94	243	4
	Total 1	396	40	74	13	278	248	378	13
	Total 2	287	30	77	27	337	216	452	14
	Mean	341	35	76	20	307	232	415	14

The data presented in Table 3 indicate that the total grazing time in August has decreased conspicuously as compared with those in June and October and also the total ruminating time in August has decreased from that in June. This decrease in grazing and ruminating time was accompanied by a marked increase in total resting time, and this decreasing tendency in August was similar to the results reported by KUROSAKI et al.⁸⁾

The total hay eating time, as shown in Table 3, increased from 18 min. in June through 56 min. in August up to 76 min. in October. Grass yields per 10 a shown in Table 2 are highest in June and lowest in October. HANCOCK⁴⁾ have contended that ruminating time is dependent on the quality and quantity of the herbage. In view of this, the ratio of ruminating time to grazing time (RT/GT) and the ratio of ruminating time to eating total feed time (RT/ET) are shown in Table 4. The RT/GT value varied seasonally from 1.2 in June down to 1 in August and October, and also the RT/ET value showed a tendency similar to the above. From these data, it is probable that the decrease in total grazing time in August is due not only to the hot humid conditions prevailing in summer season but also to the lower grass yield. It

is, in addition, considered that the increase in time spent eating hay in August and October is indicative of a decrease in herbage intake.

Table 4. Ratio of ruminating time to grazing time (RT/GT) and ratio of ruminating time to all feeds eating time (RT/ET) for the herd of ten steers

Trial	Month	RT/GT*	RT/ET*
1 st	June	1.21	1.01
2 nd	August	1.04	0.81
3 rd	October	1.00	0.75

* Each mean is the average of two days in each trial.

The mean total grazing times of the two days in June, August and October presented in Table 3 are 354 min. (5.9 hr.), 305 min. (5.1 hr.) and 341 min. (5.7 hr.), respectively. HUGHES et al.⁶⁾, JONSTON-WALLACE et al.⁷⁾ and LAMPKIN et al.⁹⁾ have reported 7.9 hr., 7.5 hr. and 6.5 hr. for the grazing time of steers, respectively. These are longer than those obtained by the authors. As one of the reasons for this, it is considered that concentrate and hay were fed to the steers in our trials.

Diurnal changes in the grazing behaviour of the herd throughout the 24 hr. period in each trial are shown in Fig. 1. Moreover, Table. 3 shows the time spent in each behaviour of the herd for the two separate days and nights of each trial. It has been reported that no peculiar difference exists between the grazing patterns of the two separate days within a trial. From Fig. 1, it can be seen that the grazing pattern in June was divided into three separate periods; 1. a period of relatively heavy grazing beginning 1.5 hr. after dawn which continued for about 3 hr.; 2. a second, relatively short period of grazing which started about 13.00 hr. and continued for about 1 hr.; and 3. a third, vigorous period beginning before dusk and lasting for about 3 hr. The grazing pattern in August was divided into two separate parts, one starting about 13.00-14.00 hr. and lasting for 4 hr., and the second commencing about sunset and continuing for 2-3 hr. In October, there was a distinct grazing period, which started about midday and lasted for 7-8 hr. until after dusk. Thus in June there were three distinct grazing periods, two in August and one period could be distinguished in October, and each was separated from the other by periods of ruminating and resting.

The percentages of grazing time to the hours of darkness were 1.5% in June, 27.6% in August and 17.3% in October (figures in percentage are the averages of two days within a trial). These figures in August and October indicate a marked contrast with the figure of 7% reported by HARKER et al.⁵⁾, but that in August was close to 25.2% of the dry season reported by WILSON¹¹⁾. It is not known whether the lower percentage of night grazing time in June is due to influence of climatic conditions, especially lower temperature or other factors which could not be shown in the trial.

In June, August and October 59.4%, 56.2% and 75.9% of the total ruminating time took place at night, respectively. In June and October most of the night ruminating time was spent in the lying position and in August the night ruminating time was 55.6% in the lying and 44.4% in the standing position. Most of the day ruminating was spent in the lying position during the three periods. The main resting in June and August took place during the day and at night in October.

The percentage of each behaviour time spent at different locations in the grassland for 24 hr. is presented in Table 5. As indicated in this Table, most of the ruminating and resting times in June and August were spent in the loose barn, and in October

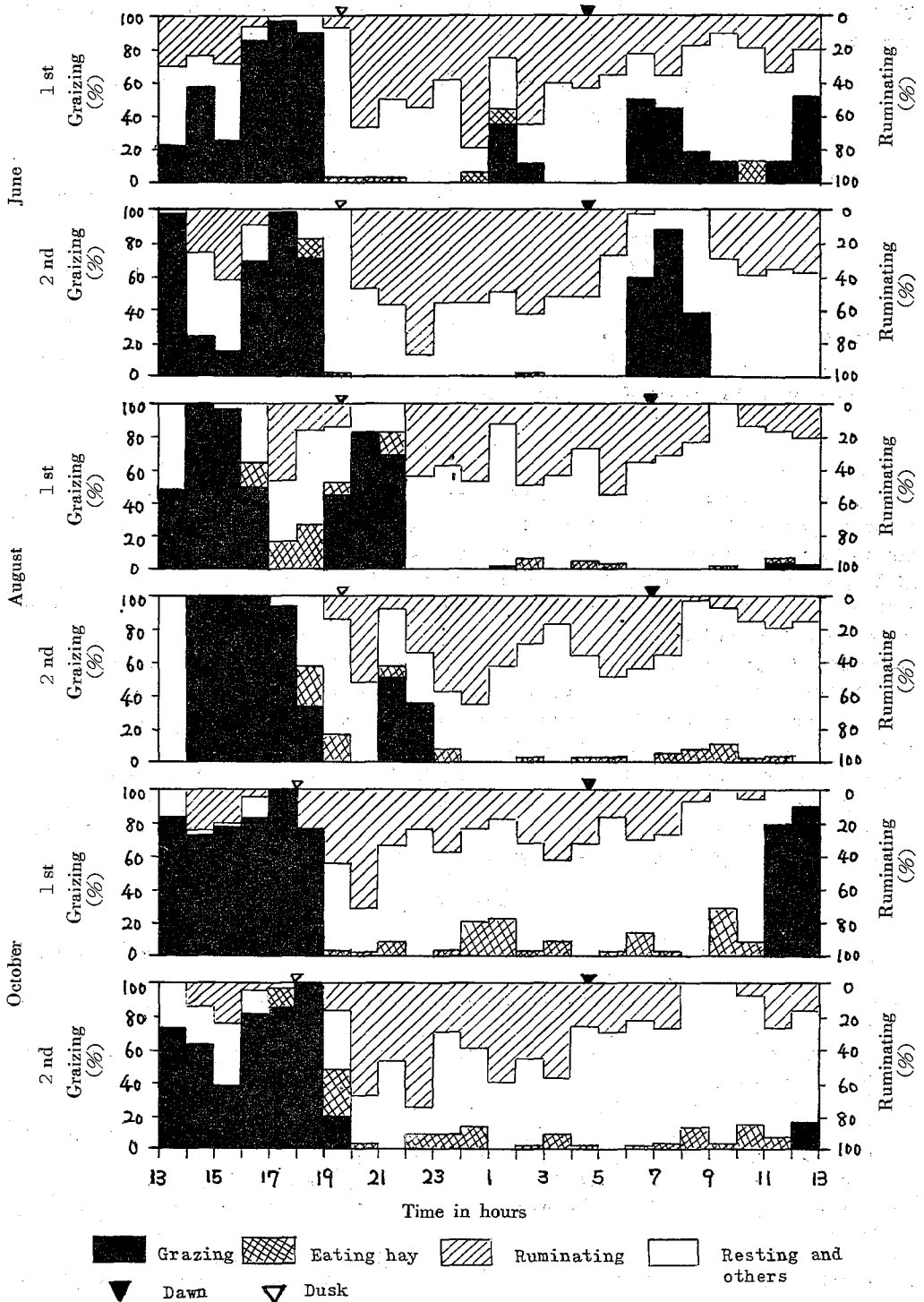


Fig. 1. Histograms showing diurnal changes in the grazing behaviour of the herd of ten steers throughout 24 hr. period.

72.1% of the total ruminating time and 65% of the total resting time were spent in the barn and a greater part of the rest was spent in the corridor.

Table 5. Percentage of minutes spent in ruminating and resting at three locations in the grassland

Category	Month	Location in the grassland		
		Barn	Corridor	Pasture
Ruminating	June	80.4%	0.0%	19.6%
	August	83.2	4.4	12.4
	October	72.1	18.6	9.3
Resting	June	79.7	1.4	18.9
	August	83.1	3.1	13.8
	October	65.0	27.5	7.5

Each mean is the average of two days in each trial.

Summary

In June, August and October of 1966, observations were made on the grazing behaviour of young steers of Japanese Black breed of cattle on an improved pasture of steep mountainous grassland. The behaviour of the herd of ten steers was recorded at 5 min. intervals throughout 48 hr. and classified into grazing, eating concentrate, eating hay, ruminating, resting and walking. The day to day variation in behaviour varied with the trial period of the year, but a general similarity of grazing pattern was found in the two successive days within each trial period. In June, the grazing pattern was divided into three distinct periods: early in the morning, about midday and in the evening. In August, the pattern was divided into two periods: in the afternoon and at night. In October, there was one distinct period in the afternoon. RT/GT value varied seasonally from 1.2 in June to 1 in August and October. The hay eating time increased to three times as long as that of June in August and four times in October. Therefore, an increase in herbage intake in June and a reserve decrease both in August and October are clearly indicated.

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急傾斜山地草地の牧草生産力に関する研究

(第1報) 黒毛和種若令去勢牛の放牧行動 に関する調査

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要 約

急傾斜山地の人工草地(傾斜26—48度)における黒毛和種若令去勢牛の放牧行動を1966年に岡山県新見市千屋において調査した。0.64haの牧区に昼夜放牧された10頭の去勢牛を一つの群として、6月、8月、10月の各初旬に5分間隔で48時間、食草、濃厚飼料摂取、乾草摂取、反芻起立、反芻横臥、休息起立、休息横臥、歩行の8活動形について調査した。

放牧行動の日周変化は調査期によって相違した。しかし、各調査期の2日間の中に食草パターンの一般的な類似性がみとめられた。すなわち、6月には朝早くと昼頃そして夕方に活潑な3食草期がみられた。8月には午後と夜間に2食草期が、10月には午後に1食草期がみられた。

6月、8月、10月の食草時間はそれぞれ354分、305分、341分であった。調査期の暦日がすすむにつれて乾草摂取時間が増加し、放牧草地の産草量が減少したから、食草摂取量が6月に増加し、8、10月に減少したことが予想される。

反芻と休息時間の大部分は6月と8月には畜舎内で、10月には畜舎内と牧道ですごされた。