Effects of Grass/Legume Pasture on Forage Production, Forage Nutritive Values and Live Weight Gain of the Grazing Heifer

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ABSTRACT : A grazing trial was carried out to determine the effects of different grass/legume pastures on forage production, legume proportion, nutritive value, and animal performance. The pasture mixtures were mainly orchardgrass (OG) + ladino clover (T1), OG + alfalfa (T2), perennial ryegrass + alfalfa (T3), and grass alone mainly OG (T4). The pastures were rotationally grazed 7 times with heifers which had an initial liveweight of about 243kg in 1991 and 1992. The average plant height at each grazing was 32.4 cm. The annual dry matter yield ranged from 9.19 MT in T4 to 9.61 MT/ha in T3, but no significant difference among different mixture combinations was found. The proportion of ladino clover in T1 mixtures rapidly increased from 21% to 68% during the grazing season. However, the proportion of alfalfa in T2 and T3 ranged from 12% to 23%. The contents of crude protein and calcium, respectively, in the forages were highest in T1 (23.2%, 0.68%) and lowest in T4 (18.5%, 0.13%), while crude fiber content showed the opposite trends. Liveweight gain was greatest on T1 (1,073 kg) and lowest on T4 (643 kg). It was concluded that pasture mixtures containing legume (ladino clover) can increase forage nutritive value and animal performance.

(**Kew Words**: Grazing, Clover, Alfalfa, Animal Performance, Nutritive Value, Legume, Grasses)

INTRODUCTION

Orchardgrass (*Dactylis glomerata* L.) and ladino clover (*Trifolium repens* L.) are the major pasture species sown in Korea. The ability of pasture legumes to fix nitrogen and to produce good quantities of forage is well known. It is also generally recognized that nutritive value of legumes is superior to that of most grasses.

The beneficial role of legumes in grazing systems has been reviewed by Ulyatt (1981), Brown (1990) and Posler et al. (1993). They reported the performance of animals grazing forage legume was better than when grazing grass, as demonstrated by Wilman and Williams (1993) for liveweight gain and milk yield of dairy cows.

Little information, however, is currently available comparing the forage production, quality and animal performance of ladino clover and alfalfa (*Medicago sativa* L.) in grass/legume pastures that could be used in Korea. Therefore, this study was conducted to compare the forage yield, botanical composition, nutritive value, and liveweight gain of grazing heifer on some different grass/clover, grass/alfalfa and grass alone pastures under rotational grazing management.

MATERIALS AND METHODS

In 1991 and 1992, pasture productivity and animal performance on four different grass/legume pastures were examined with two replications. The grasses consisted of orchardgrass, tall fescue (*Festuca arundinacea* Schreb.), perennial ryegrass (*Lolium perenne* L.), and Kentucky bluegrass (*Poa pratensis* L.). The pasture mixtures used in this study were grasses (mainly orchardgrass) + ladino clover (T1), grasses (mainly orchardgrass) + alfalfa (T2), grasses (mainly perennial ryegrass) + alfalfa (T3), and grasses only (mainly orchardgrass, T4).

The pastures were rotationally grazed in late April, mid-May, early-June, late-June, late-July, late-August, and late-September (table 1), with growing dairy heifers (1991) and beef heifers (1992), which had an initial liveweight of about 243 kg. Each pasture mixture was 0.2 ha and was grazed with two heifers. The pastures were divided into 0.05 ha paddocks. Nitrogen, phosphorus, and potassium were applied at 280, 200 and 240 kg/ha respectively, to all treatments.

The livestock were weighed at the end of each month. Most energy (96%) of heifers was supplied by forages. Small amounts (4%) of concentrate were provided during summer and autumn, and mineral supplement was

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Received January 27, 1997; Accepted March 17, 1997

provided throughout the grazing season. Plant height and dry matter yield were measured before each grazing. Crude protein and calcium (AOAC, 1984), neutral detergent fiber (NDF) and acid detergent fiber (ADF) (Goering and Van Soest, 1970) were investigated at the first grazing each season. The legume content (% of DM) was measured in April (initial) and September in 1991 and 1992 (Jones and Hargreaves, 1979).

Table 1. Grazing date

Year	Date of each grazing						
	1st	2nd	3rd	4th	5th	6th	7th
1991	May 7	May 22	Jun. 13	Jul. 2	Jul. 25	Aug. 22	Sep. 19
1992	Apr. 22	May 10	Jun. 1	Jun. 25	Jul. 27	Aug. 28	Sep. 28

Grazing period: 154 days (May 7-Oct. 7) in 1991, and 176 days (Apr. 22-Oct. 15) in 1992.

RESULTS AND DISCUSSION

Forage production

The forage yield of different grass/legume pastures throughout the grazing season is shown in table 2. The annual dry matter yield ranged from 9.19 MT (T4) to 9.61 MT/ha (T3), but there was no significant difference in forage yield for different grass/legume pastures. Most of the yield was produced in spring season, particularly in May.

Table 2. Forage yield at each grazing on different grass/legume pastures during 1991 and 1992

Treatment	Dry matter yield (MT/ha)							
	1st	2nd	3rd	4th	5th	6th	7th	Total
Grasses (mainly OG) + LG (T1)	1.97	1.23	1.25	1.40	1.39	1.01	1.17	9.42
Grasses (mainly OG) + ALF (T2)	1.98	1.37	0.97	1.30	1.51	1.02	1.25	9.40
Grasses (mainly PRG) + ALF (T3)	2.38	1.35	1.10	1.27	1.38	0.94	1.19	9.61
Grasses alone (T4)	2.20	1.45	0.92	1.19	1.02	1.05	1.36	9.19
LSD (0.05)								NS

NS: not significant, OG: orchardgrass, LC: ladino clover, ALF: alfalfa, PRG: perennial ryegrass.

Legume proportion and nutritive value

A summary of legume content of the grass/legume pastures is shown in table 3. There was a significant difference between pasture mixtures in their botanical composition. Initially, the percentage of legume ranged from 12% (T3) to 21% of DM (T1) on all legume treatments. However, ladino clover in T1 increased to 54-68%, while the proportion of alfalfa was 15% to 23% in T2, and 12% to 19% in T3 throughout the grazing season. Most grass/clover pastures in Korea, tend to be rapidly dominated by ladino clover (Seo, 1986).

Table 3. Legume proportion and nutritive value on different grass/legume pastures during 1991 and 1992

Treatment	Legumes (%)			Nutritive value (%)			
	Init.	Mid.	Final	CP	NDF	ADF	Ca
Grasses (mainly OG) + LC (T1)	21	68	54	23.2	51.8	28.4	0.68
Grasses (mainly OG) + ALF (T2)	15	23	17	19.5	52.0	29.4	0.41
Grasses (mainly PRG) + ALF (T3)	12	19	15	19.1	53.0	30.0	0.29
Grasses alone (T4)	1	3	2	18.5	55.1	30.8	0.13

OG: orchardgrass, LC: ladino clover, ALF: alfalfa, PRG: perennial ryegrass.

The crude protein content of the forages was highest in T1 (23.2%) and lowest in T4 (18.5%). The contents of NDF and ADF of the forages were lowest in T1 (NDF 51.8%, ADF 28.4%), highest in T4 (NDF 55.1%, ADF 30.8%), and within these ranges in T2 and T3 (table 3). Also the highest calcium content was found in T1 (0.68%), and lowest in T4 (0.13%).

In this experiment, high nutritive value of T1 was likely due to a high proportion of clover. Our results support the findings of others (Ulyatt et al., 1976) that the superiority of legumes over grass was due to a higher nutritive value, a higher intake, and a higher ratio of protein/energy absorbed (Moseley and Jones, 1979; Ulyatt, 1981; Posler et al., 1993; Wilman and Williams, 1993).

Animal performance

There was a significant difference ($p < 0.05$) between treatments on animal gain, and a similar result was observed in both years of the experiment (table 4). The average daily gain (ADG) was greatest in T1 (0.67 kg), lower in T2 (0.50 kg), lower again in T3 (0.49 kg), and lowest in T4 (0.39 kg).

Table 4. Animal performance on different grass/legume pastures during 1991 and 1992

Treatment	Liveweight gain (kg)				
	Daily Ave.	Per head Ave.	Per ha		
			'91	'92	Ave.
Grasses (mainly OG) + LC (T1)	0.67	107.3	1,080	1,066	1,073
Grasses (mainly OG) + ALF (T2)	0.50	81.0	815	804	810
Grasses (mainly PRG) + ALF (T3)	0.49	78.4	762	806	784
Grasses alone (T4)	0.39	64.3	552	733	643
LSD (0.05)	0.13	20.9	221	198	209

OG: orchardgrass, LC: ladino clover, ALF: alfalfa, PRG: perennial ryegrass.

The liveweight gain per ha followed the same pattern: 1,073 kg in T1, 810 kg in T2, 784 kg in T3, and 643kg in T4. The ADG by month was highest in May (0.77-0.90 kg) but lowest in August (0.03-0.48 kg), and the ADG was particulary low during August in T4 (table 5).

Table 5. Daily liveweight gain by month on different grass/legume pastures during 1991 and 1992

Treatment	Daily liveweight gain (kg)					
	May	June	July	Aug.	Sep.	Ave.
Grasses (mainly OG) + LG (T1)	0.90	0.79	0.69	0.48	0.46	0.67
Grasses (mainly OG) + ALF (T2)	0.81	0.40	0.57	0.36	0.37	0.50
Grasses (mainly PRG) + ALF (T3)	0.77	0.47	0.43	0.40	0.37	0.49
Grasses alone (T4)	0.80	0.40	0.45	0.03	0.34	0.39
LSD (0.05)	NS	0.20	NS	0.13	NS	0.11

NS: not significant, OG: orchardgrass, LC: ladino clover, ALF: alfalfa, PRG: perennial ryegrass.

These results confirmed observations made in several studies that performances of calves (Lancashire, 1971), sheep (Ulyatt, 1981; Brown, 1990), and lactating dairy cows (Wilman and Williams, 1993) were affected by whether animals were grazed on grass alone or grass and clover. In this study, growing heifers gained 67% more liveweight on a grass/ladino clover pasture than on a grass alone pasture which contained similar forage dry matter yield (table 4).

In conclusion, pasture mixtures which include legumes (particularly ladino clover) can increase animal performance, and could be recommended for use in Korea. However, more research is required to investigate the rapid dominance of ladino clover, and to compare the carrying capacities of ladino clover, alfalfa, and other forage legumes, and to compare the pasture productivity

and persistence of the top-grasses (orchardgrass and tall fescue) and bottom-grasses (perennial ryegrass and Kentucky bluegrass) with legumes for rotational grazing management.

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