RELATIONSHIP BETWEEN BROADLEAF DOCK (*RUMEX OBTUSIFOLIUS* L.) AND SEASONAL YIELD OF ORCHARDGRASS GRAZED PASTURE

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ABSTRACT
In order to grasp the ecology of *R. obtusifolius* and the effects of it on seasonal yield of grass in grazing pasture, we investigated seasonal sward characteristics and dry matter yield in grazing pasture.

Dry matter yield and coverage of *R. obtusifolius* predominated those of grass after mid-June and mid-August, respectively. Throughout the year the coverage of *R. obtusifolius* negatively correlated to the grass yield. After August, the grass yield was negatively related to the yield and the population density of *R. obtusifolius*.

From the facts described above, *R. obtusifolius* seems to reduce grass yield throughout the year, especially after August.

KEYWORDS
Rumex obtusifolius L., grazing, seasonal yield, orchardgrass, coverage

INTRODUCTION
R. obtusifolius has inhibitory influences on grass yield and the growth of grazing ruminant. Therefore, it is necessary to find out the effective method for controlling the growth of *R. obtusifolius*. In recent times, it is often discussed that the conventional agriculture should be converted into the sustainable agriculture. Integrated Pest Management (IPM) is attracting attention as a method for pest control in sustainable agriculture, and Economic Injury Level (EIL) is an important element in IPM (Bird *et al*., 1990). To establish EIL, it is necessary to grasp the effect of pests on production.

The objective of this study was to grasp the ecology of *R. obtusifolius* and the effects of it on seasonal grass yield in grazing pasture.

MATERIALS AND METHODS
1. Experimental site: This study was conducted during the growing season of pasture in 1995 at the University Farm (Tukui), Tokyo University of Agriculture and Technology. This pasture was established in October 1993 by hoof cultivation and at that time, orchardgrass (*Dactylis glomerata* L.) and red top (*Agrostis alba* L.) were sown. Orchardgrass was also sown in October 1994.

2. Pasture management: 6-8 female Japanese Black cattle were grazed 4 times from April to October in 1995 (each duration was 8-10 days) . A total of 48 kgN/ha, 48 kgP_2O_5/ha and 48 kgK_2O/ha were applied annually.

3. Sampling methods: (1) Sward characteristics: At the beginning of grazing and the end of grazing, coverage and height of each species and the population density of *R. obtusifolius* were investigated in 9 fixed sites of a quadrat (1m x 1m) in the pasture. (2) Dry matter yield: At the beginning of grazing and the end of grazing, all herbage within 1 m^2 area were cut to 3cm above ground. Cutting was conducted at 9 sites which had similar sward characteristics to the sites investigated for sward characteristics, and 3 sites where grass coverage was more than 70% and 3 sites where *R. obtusifolius* coverage was more than 70%.

RESULTS AND DISCUSSION
Dry matter yield and coverage of *R. obtusifolius* predominanted those of grass after mid-June and mid-August, respectively (Table 1). Based on the variance of yield or sward characteristics within pasture, correlations between yield or sward characteristics of *R. obtusifolius* and grass yield were investigated. Significant negative correlation between grass yield and *R. obtusifolius* coverage (Table 2) indicates the inhibitory effect of *R. obtusifolius* on grass yield throughout the grazing season. Significant negative relationship between grass yield and *R. obtusifolius* coverage and population density, and an increase in *R. obtusifolius* coverage and population density after August (Table 2) suggest a greater effect of *R. obtusifolius* on grass yield after August.

To verify the seasonal change in the effect of *R. obtusifolius* on grass yield, we calculated the reduction rate of grass yield owing to *R. obtusifolius* (R) as follows:

$$R=1-\{(G_1/G_0)\}\times 100\ (\%)$$

where G_0 was grass yield at 0% of *R. obtusifolius* coverage from the regression equations shown in Table 2, and G_1 was grass yield at actual *R. obtusifolius* coverages. R was 40.4% on 26 April, 42.1% on 1 August and 62.3% on 30 September.

Until early May, there were only *R. obtusifolius* in the vegetative stage. The population density of the bolting, blooming and ripening stages were highest in early June, early August and mid-August, respectively. In mid-August, aboveground parts of *R. obtusifolius* were withered temporarily and all population density apparently decreased. But by late September, much of the *R. obtusifolius* regenerated and this increase in the population density of the vegetative stage caused the increase in *R. obtusifolius* coverage after September.

Seasonal change in the effect of *R. obtusifolius* on grass yield seems to consist of changes in the dominance of grass and *R. obtusifolius* owing to (1) seasonal changes in the population densities of each stage of *R. obtusifolius* (Table 1), (2) seasonal changes in the growth rate of grass itself and *R. obtusifolius* (Anslow and Green, 1967), and (3) preference of grass over *R. obtusifolius* by grazing cattle (Hayakawa, 1985).

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Table 1
Seasonal changes in sward characteristics and dry matter yield.

	Date	19-Mar.	26-Apr.		8-May		7-Jun.		19-Jun.		1-Aug.		9-Aug.		30-Sep.	9-Oct.
			Beginning[a)]	End[b)]	Beginning	End	Beginning	End	Beginning	End	Beginning	End				
Grass	Yield (gDM/m^2)	20.5	122.1		15.4		131.9		19.5		54.8		11.1		19.9	5.7
	Coverage (%)	35.6	36.7		48.0		47.7		46.3		36.3		31.3		24.0	23.7
	Height (cm)	11.5	36.2		12.9		56.6		15.8		45.7		11.0		34.4	12.3
Rumex	Yield (gDM/m^2)	5.1	41.5		10.1		66.2		63.6		103.6		46.7		75.2	50.7
	Coverage (%)	20.0	36.0		30.0		38.0		37.2		41.0		38.0		56.0	53.8
	Height (cm)	9.9	23.5		19.4		54.8		50.9		67.9		58.6		33.6	20.6
	Density (plants/m^2)															
	Vegetative stage	37.4	49.4		13.6		14.8		25.6		21.9		12.3		32.9	30.9
	Bolting stage	0.0	0.0		0.1		6.0		4.5		1.2		1.6		0.0	0.0
	Blooming stage	0.0	0.0		0.0		0.0		1.2		7.8		4.4		0.1	0.1
	Ripening stage	0.0	0.0		0.0		0.0		0.0		3.7		7.1		0.0	0.1

a) at the beginning of grazing
b) at the end of grazing

Table 2
Correlation coefficients between grass yield and each element of *R. obtusifolius* (at the beginning of grazing).

	Date	Correlation coefficients (Regression equations) 26-Apr.	7-Jun.	1-Aug.	30-Sep.
Between grass yield (gDM/m^2) and					
Rumex	Yield (gDM/m^2)	-0.231	-0.362	-0.820** (y=86.1-0.24x)	-0.657** (y=60.0-0.30x)
	Coverage (%)	-0.690** (y=209.2-2.35x)	-0.456	-0.897** (y=95.5-0.98x)	-0.790** (y=85.5-0.95x)
	Density (plants/m^2)	-0.509	-0.241	-0.798** (y=92.6-1.89x)	-0.607* (y=78.5-2.05x)

* and ** denote significant correlation at P<0.05 and P<0.01, respectively.