SOME IMPROVABLE POINTS FOR BETTER UTILIZATION OF REED CANARYGRASS CULTIVARS IN JAPAN

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ABSTRACT

Relationships among growth stage, herbage quality, and dry matter accumulation of reed canarygrass cultivars were investigated in a rainy mountainous district of Japan. Fiber content accumulated during the primary growth correlated with some growth characters of this grass, especially with preferential culm expansion, so that total amount of cell wall constituents reached a remarkably high level about the time when culm/foliage (C/F) ratio in dry matter was elevated above 1.5. In aftermaths, whose early regrowth went on rather quickly, dry matter accumulation began to decline at the stage that C/F ratio of standing crop became ca. 1.0 and fiber content exceeded 60 %. Although annual total yield decreased considerably as cutting frequency increased, cell wall constituents were lowered well enough, in spite of the essentially coarse character of the plant. Therefore, earlier harvestings both in primary and aftermath canopies seem to be of vital importance in better utilization of reed canarygrass cultivars.

KEYWORDS

Cell wall constituents, culm/foliage ratio, cutting frequency, dry matter production, *Phalaris arundinacea* L., plant height.

INTRODUCTION

Reed canarygrass (*Phalaris arundinacea* L.) is suitable for herbage cultivation in Japan because of its higher productivity both under cool-humid and hot-dry climatic conditions. Cultivation areas of this grass are, therefore, getting larger in recent years. However, reed canarygrass is considered to have far less palatability as compared with other temperate grasses, such as orchardgrass, when swards are harvested in a usual manner with 3 or less cuttings per year (Otani et al., 1992). The cause of this low rating might partly arise from very extensive practices in reed canarygrass management as repetition of delayed cutting, that will result in enlargement of fiber-rich culm portion (Ito, et al., 1990; Otani et al., 1992; Otani et al., 1996), together with essentially robust tissue textures (Grabber and Allinson, 1992). Therefore, we intended to make some observations on developmental changes in culm/foliage ratio and cell wall constituents under several cutting managements, in order to get information for better utilization of reed canarygrass cultivars.

MATERIALS AND METHODS

Experiment 1: Two cultivars, Palaton and Venture, were used for an examination of relationships among growth characteristics and cell wall constituents in primary and aftermath swards being put to practical use in Zootechnical Station, Tokyo University of Agriculture (located in the lower mountainside of Mt. Fuji, 830m above sea level). In 1991, both swards were fertilized with 7.8, 10.2 and 7.2 kg/10a of each N, P_2O_5 and K_2O, and harvested 3 times (June 5, July 17 and September 27). Changes in plant height, dry matter yield of standing crop, and culm/foliage ratio in dry matter yield (C/F ratio) were measured during the growth periods of primary and aftermath canopies (see Table 1). Detergent fibers (NDF, ADF and ADL) of culm (leaf sheath and internode) and foliage (leaf blade) parts were determined separately. Amounts of cellulase-indigestible fraction (Ob) in cell wall constituents (CWC) of whole crops were also measured with the enzymatic method of Abe et al. (1979).

Experiment 2: Effects of cutting frequency on the concentration of CWC were examined in 1993 in a corner of a reed canarygrass sward (cv. Venture) in Zootechnical Station of TUA. Three plots with different cutting frequencies (3, 5 and 8 times per year, respectively) were set in this sward, each fertilized with 7.8 kg N, 10.2 kg P_2O_5 and 7.2 kg K_2O per 10a. Dry matter yield was determined in each cutting time, and detergent fibers and Ob fraction of harvested dry matter were analyzed as in Experiment 1.

RESULTS AND DISCUSSION

Experiment 1: The dry matter increase in primary canopy was very rapid in parallel with a quick increment of plant height and C/F ratio until the time when C/F ratio exceeded about 1.5 at the late boot stage. Afterwards, dry matter accumulation rate fell gradually, while C/F ratio of harvestable top increased still more. Concentration of every fraction of CWC tended to be relatively high throughout the seasons (Table 1), especially in culm (10% or more). Cellulase-indigestible fraction (Ob) in CWC showed high ratio as compared with that of orchardgrass (Otani et al., 1992).

Fiber contents generally correlated with the growth characters, especially, C/F ratio revealed high correlation with each of NDF, ADF and ADL contents in herbage of primary canopy (Figure 1), so that the total amount of CWC constituents reached a very high level at the latest stage when plant height exceeded about 110cm and C/F ratio came near 2.0. In aftermaths, early regrowth went on fairly quickly, but dry matter accumulation retarded after ca. one month regrowth, since when C/F ratio of standing crop became ca. 1 and NDF content rose to 60 % or more. Then, subsequent culm growth was slowed down with gradual CWC increase.

Experiment 2: Annual total yield retarded considerably as cutting frequency increased, especially the yield of 8 cuttings per year was reduced to a third of that in 3 cuttings. These steep reduction in dry matter accumulation with increased cutting frequency might be caused by suppression of internode elongation in the sward (Ito et al., 1990; Otani et al., 1996). However, CWC were lowered passably with properly increased cutting frequency as compared with 3 cuttings.

Conclusion: Thus, the harvesting before the stage of C/F ratio=1.5 in primary canopy, or at any stage when C/F still stayed below ca. 1 in aftermaths, which will be certainly approached before one month of regrowth, may result in better herbage quality with lowered CWC, keeping balance with an adequate level of yielding. Yield depression in reed canarygrass, which is caused by frequent cuttings, may be partially compensated with a larger amount of nitrogen application.

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Table 1.
Changes in detergent fiber contents (%) of foliage and culm portions of reed canarygrass cultivars harvested in different stages during growing periods.

Fraction	Portion		Primary crop						Second crop		Third crop	
		Apr. 24	May 01	May 08	May 15	May 22	May 29	Jun. 05	Jun. 28	Jul. 17	Sep. 07	Sep. 27
N D F[a]	Pa[b]	foliage	38.2	40.3	39.3	40.7	51.2	53.9	57.0	55.7	58.5	54.7	59.9
		culm	50.1	54.9	49.0	58.3	60.2	68.1	69.4	74.4	71.1	66.3	67.7
	Ve	foliage	37.0	40.2	34.4	40.7	50.2	54.2	54.3	57.7	59.7	54.9	62.0
		culm	48.1	54.4	48.9	59.7	62.9	71.1	68.8	71.4	72.7	67.0	63.6
A D F	Pa	foliage	18.0	19.0	18.8	19.8	26.6	27.0	28.5	26.6	31.4	27.3	33.7
		culm	25.4	29.9	26.2	33.2	37.2	42.1	44.0	42.6	51.4	40.4	47.4
	Ve	foliage	19.0	19.7	17.7	20.1	22.9	27.2	25.9	29.9	30.2	27.4	35.0
		culm	25.6	30.5	27.4	34.3	39.1	44.4	47.3	45.5	50.9	45.9	43.4
A D L	Pa	foliage	1.4	1.8	2.6	2.3	3.6	4.9	5.8	5.3	6.5	5.6	8.0
		culm	1.7	2.6	2.5	3.3	4.4	6.1	8.0	6.0	10.0	6.3	8.6
	Ve	foliage	1.7	1.5	1.6	2.0	2.9	4.1	4.7	5.7	5.5	5.9	8.2
		culm	2.4	3.6	2.6	3.6	4.6	6.7	7.3	6.9	9.4	8.3	8.5

[a] NDF=neutral detergent fiber, ADF=acid detergent fiber, ADL=acid detergent lignin; [b] Pa=Palaton, Ve=Venture

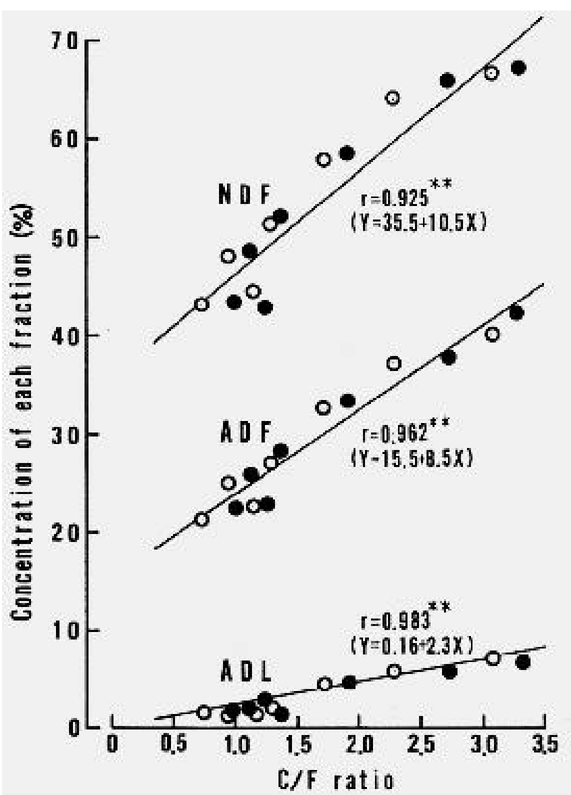

Figure 1
Relationships between C/F ratio and concentrations of each detergent fiber fraction (NDF, ADF, ADL) and crude protein (CP) of reed canarygrass cultivars harvested in different stages of primary canopy. (O) and (●) indicate data of Palaton and Venture, respectively.