Herbage Yield and Intake by Sheep of Four Japanese Orchardgrass (*Dactylis glomerata* L.) Cultivars

Suguru SAIGA, Kazuo IWANE and Kiyoshi WATANABE

Synopsis


Four Japanese orchardgrass cultivars were evaluated in dry matter (DM) yield, DM intake and animal gain, and compared with a perennial ryegrass (*Lolium perenne* L.) and a tall fescue (*Festuca arundinacea* Schreb.) cultivars. Sheep were rotationally grazed on swards sown as monoculture, and were weighed every 7 or 14 days. Animal gain of each cultivar was estimated in TDN kg units using the NRC standard because the weight and the number of grazed sheep differed in each plot.

Significant differences were obtained in DM yield, TDN percentage, TDN yield and animal gain between orchardgrass cultivars. Cv.Okamidori was significantly higher in TDN % but lower in DM yield, TDN yield, and animal gain than the other three cultivars. As means of TDN % over three years, cv.Okamidori was higher by 2.4 to 3.1 units than the other cultivars. Although the difference contributed to higher intake, that created only the slight increase in animal gain. Compared with orchardgrass cultivars, cv.Yatugane perennial ryegrass showed higher DM yield and TDN yield, and cv.Hokuryo tall fescue was lower in TDN and intake.

**Key words**: Animal gain, *Dactylis glomerata*, Herbage yield, Intake, TDN.

---

**Introduction**

Since grass breeding in Japan was started about twenty-five years ago, eight cultivars have been released in orchardgrass so far. Before releasing a new cultivar, many evaluation tests are conducted at various parts in dry matter (DM) yield, *in vitro* digestibility, disease resistance and so forth. However, the evaluation for animal productivity is not always thorough enough.

It is commonly recognized that there are apparent differences in the palatability of orchardgrass cultivars, and a highly positive relationship between digestibility and intake. MARTEN stated that the relatively small differences in nutritive value and intake of forage can lead to large differences in animal performance. Compared with five ryegrass cultivars, RYAN obtained a greater difference in carrying capacity. However, the information on the contribution of high quality cultivars to animal productivity including...
voluntary intake is limited.

This study is a reevaluation of four representative Japanese orchardgrass cultivars under grazing conditions and to obtain information concerned with the contribution of high quality cultivars to animal productivity.

Materials and Methods

1. Grasses and their management

Four Japanese orchardgrass cultivars including Akimidori, Kitamidori, Natumidori (early) and Okamidori (late), a perennial rye grass (Lolium perenne L.) cultivar Yatugane (late) and a tall fescue (Festuca arundinacea Schreb.) cultivar Hokuryo (late) were sown as monoculture in August 1986. The experiment field is located at Shizukuishi (39°41′N, 140°58′E, annual mean temperature 9.5°C). The area of each plot was 2.5 a (25 m×10 m) and a three randomized blocks design was used. The sward received 1.2 kg N, 0.65 kg P, 0.62 kg K/a per year. After each grazing, the residue of each cultivar was mown and the grass was discarded.

Investigations of the characteristics indicated in Table 1 were conducted through early May to early October over three years from 1987 to 1989. DM yield was corrected by the same cultivar’s DM yield of the adjacent block, taking into account herbage growth during grazing period. All grasses were in the vegetative stage of growth except for the third block in spring. Samples were collected from the forage which was harvested before grazing, and analyzed for TDN by the actinase-cellulase method

2. Animal management

Six different groups of sheep, each comprising one to four ewes (2 to 4 years old, approximate live weight 50 kg, mainly Suffolk and partially hybrid between Suffolk and Corriedale) were rotationally grazed. Grazing was started from the first block in early May, continued to the third blocks in turn, and returned to the first block. Each block was grazed four times during each growing season. Animals were weighed every 7 or 14 days, as the grazing period was 7 days on the first two blocks in spring and the last block in fall and 14 days on the other blocks. Intake was determined by the difference between DM yields of a plot before and after a grazing period, and expressed in metabolic size as g/kgW0.75 per day, where W was the mean body weight of the sheep.

3. Animal gain

Because of the different number of sheep per plot, and the differences in live weight among the sheep, animal gain of each cultivar was estimated in TDN unit on the bases of weight change by the following equation

Animal gain (TDN kg) = (.058 × D + 5.1 × .029 × G) × W0.75

Where D is the number of grazing days, G is the gain in kg during grazing periods, and W is body weight before grazing. The maintenance requirements of sheep was estimated as 100 percent higher than those fed indoors. Animal gain of each sheep was summed up by each plot.
Results

1. Sheep weight and stocking rate

Seasonal change of sheep weight is shown in Fig. 1. Mean live weight gains of sheep were 3.7 kg, 0.8 kg and 4.6 kg in 1987, 1988 and 1989, respectively. Sheep weight was affected by seasonal temperatures, and was generally low in mid summer. Stocking rate is indicated in Table 1. As the number of grazing sheep was roughly adjusted to DM yield of each cultivar, stocking rates ranged from $1.53 \text{kgW}^{0.75}$ of cv.Okamidori to $1.80 \text{kgW}^{0.75}$ of cv.Akimidori in

![Fig. 1. Seasonal change of sheep weight. Values in 1987 (--□--), 1988 (--○--), 1989 (--☆--), and mean values over three years (--).](image)

![Fig. 2. Seasonal change of dry matter yield (mean of 1987, 1988 and 1989). Cultivars are Akimidori (--■--), Kitamidori (--☆--), Natumidori (--●--), and Okamidori (--▲--).](image)

<table>
<thead>
<tr>
<th>Species</th>
<th>Cultivar</th>
<th>Stocking rate (kg W^{0.75}_{day/a})</th>
<th>DM yield (kg/a)</th>
<th>TDN (%)</th>
<th>TDN yield (g/kg W^{0.75}_{day})</th>
<th>Intake (g/kg W^{0.75}_{day})</th>
<th>Animal gain (TDN kg/a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orchard grass</td>
<td>Akimadiori</td>
<td>1.80</td>
<td>79.5a</td>
<td>64.1b</td>
<td>48.3ab</td>
<td>64.5ab</td>
<td>31.3a</td>
</tr>
<tr>
<td></td>
<td>Kitamidori</td>
<td>1.73</td>
<td>80.1a</td>
<td>64.3b</td>
<td>48.6a</td>
<td>67.0ab</td>
<td>28.7ab</td>
</tr>
<tr>
<td></td>
<td>Natamidori</td>
<td>1.64</td>
<td>77.7a</td>
<td>63.6b</td>
<td>47.2ac</td>
<td>67.2ab</td>
<td>31.4a</td>
</tr>
<tr>
<td></td>
<td>Okamidori</td>
<td>1.53</td>
<td>63.3b</td>
<td>66.7a</td>
<td>40.9bc</td>
<td>69.3a</td>
<td>26.6b</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>1.68</td>
<td>75.2</td>
<td>64.7</td>
<td>46.3</td>
<td>67.0</td>
<td>29.5</td>
</tr>
<tr>
<td>Perennial ryegrass</td>
<td>Yatugane</td>
<td>1.91</td>
<td>81.7a</td>
<td>67.8a</td>
<td>53.7a</td>
<td>65.9ab</td>
<td>29.5ab</td>
</tr>
<tr>
<td>Tall fescue</td>
<td>Hokuryo</td>
<td>1.80</td>
<td>63.4b</td>
<td>63.6b</td>
<td>39.3c</td>
<td>57.0b</td>
<td>26.3b</td>
</tr>
</tbody>
</table>

a) Expressed as DM intake in percentage of available DM yield.

b) Means followed by the same letters are not significantly different (p<0.05).

2. Dry matter yield

Seasonal change of DM yield is shown in Fig. 2, and statistical data are indicated in Table 1. DM yields of four orchardgrass cultivars were high in early June and early August, and seasonal changes of these cultivars were similar to each other. Statistical analysis indicates that there was significant difference between cultivars, and DM yield of cv.Okamidori was lower than those of the other three. The most productive cultivar was cv.Kitamidori with a mean DM yield of 80.1 kg/a, and was superior to cv.Okamidori by 16.8 kg/a. DM yield of Yatugane perennial ryegrass was 1.6 kg/a higher than cv.Kitamidori, and Hokuryo tall fescue was almost same as cv.Okamidori.

3. TDN percentage and TDN yield

Significant difference in TDN % was obtained between cultivars (Table 1). TDN of cv.Okamidori was 66.7%, and the highest among orchardgrass cultivars. The differences between cv.Okamidori and the other three cultivars in TDN % were 2.4 to 3.1 units. TDN % of cv.Yatugane was higher than cv.Okamidori by 1.1 unit, and that of cv.Hokuryo was the same as the lowest cultivar Natumidori.

TDN yield was calculated by multiplying DM yield by TDN. Seasonal change of TDN yield was similar to that of DM yield, but the differences among cultivars were decreased though significant differences were observed. The range among orchardgrass cultivars was from 63.3 kg to 80.1 kg. TDN yield of Yatugane ryegrass was higher than the most productive cv.Kitamidori by 5.1 kg/a, and Hokuryo fescue was lower than the least cv.Okamidori by 1.6 kg/a.

4. Intake

Intake shown in Table 1 are expressed in metabolic size as g/kg W^{0.75} per day. Significant differences were not found between cultivars in orchardgrass, however, the intake of cv.Okamidori was higher than those of the other three. As reported by SAIGA and HOJITO, digestibility of cv.Okamidori is higher than the other Japanese cultivars. Greater intake of
the cultivar is probably caused by the high quality characteristics. Intake of Yatugane ryegrass was in the range of orchardgrass, and that of Hokuryo fescue was significantly lower than the other cultivars.

5. Animal gain

Animal gain is liable to include errors, because the live weight of sheep is greatly affected by the intake and excreta. However, significant differences were observed between orchardgrass cultivars. The ranking order within orchardgrass was cv.Natumidori with 31.4 kg, cv.Akimidori with 31.3 kg, cv.Kitamidori with 28.7 kg and cv.Okamidori with 26.6 kg. As a mean of four cultivars, TDN kg utilized for animal gain was equivalent to around 64% of TDN yield. The values may possibly have been underestimated.

It is said that the relatively small differences in nutritive value lead to large differences in animal performance. DAVIES reported net animal liveweight gains were positively correlated with herbage production. Yatugane ryegrass was higher than cv.Kitamidori in DM yield and than cv.Okamidori in TDN %, but the animal gain of the cultivar was not high. The reason for this contradiction was probably caused by the unsatisfactory grassland management including grazing interval for ryegrass.

Discussion

1. Number of animals

EVANS and POTTER insisted that at least three preferably six to eight sheep are required for each feed to evaluate nutritive quality of herbage cultivars. In this experiment, two to four sheep were used depending on the herbage yield of each cultivar. Therefore, the number of animals does not necessarily follow this condition, especially in low herbage yield cultivars in fall. The values, including intake and animal gain estimated in this experiment, are liable to include some errors. In many cases, however, means of several figures cover the errors to some extent. For this reason, we put much importance not on individual figures but on means over three years, or those over twelve times' measurements.

2. Evaluation of a high quality cultivar

There is a widely accepted opinion that late types are preferred to early ones. In a study evaluating five perennial ryegrass cultivars under grazing conditions using steers, RYAN reported that the late cultivar Vigor was superior in carrying capacity to early cultivars and that those early cultivars were similar to each other. A similar result was obtained by this experiment only in the point that apparent differences were seen between the early and the late types, and early cultivars were similar to each other. One marked difference was that the late type was inferior to the early type as seen in the carrying capacity noted in RYAN's report. In our experiment, the late type cv.Okamidori indicated higher TDN % by 2.4 to 3.1 units than the other three as means over three years. The differences contributed to higher daily intake per kgW0.75, but not so greatly in animal gain. Cv.Okamidori was 19 to 21% lower in DM yield but the differences in animal gain between cv.Okamidori and the other cultivars decreased to 7 to 15%. The difference of 2 to 3 units in TDN % created only the slight improvement in animal gain. Further work will be required to confirm the superiority of high quality orchardgrass cultivars.
Acknowledgment

We thank Mr. S. TOYODA, Mr. H. YONEYA and Mr. T. HANABUSHI for measurement of intake and live weight of sheep.

References


(Received on September 20, 1990)
国内育成オーチャードグラス（Dactylis glomerata L.）
4品種の牧草収量とめん羊による採食性

川口 優・岩根和夫・渡辺 潔
岩手大学農学部（020 盛岡市上田）

要 約

めん羊の放牧条件下で、国内育成オーチャードグラス4品種とベネリアルライグラス、トールフェスク各1品種の乾物収量及び乾物採食量を比較した。1987年から1989年の3年間各年とも5月上旬から10月上旬までの5か月間、反復毎にめん羊を1区当たり1〜4頭で輪換放牧した。乾物収量は放牧前の収量に放牧期間中の生育量を加えた値とし、採食量は放牧前後の収量差から求めた。さらに各試験区毎に、めん羊の放牧頭数及び体重増加量からNRC飼養標準に基づき増分に寄与したTDN量を推定し、品種比較を行った。

草収により放牧頭数を調節した結果、放牧強度はオーチャードグラス品種間に1.53〜1.80 kgW0.75/day/a の差となった。分散分析の結果、乾物収量、TDN%、TDN収量、増体TDN量でオーチャードグラス品種間に有意差が認められ、「オカミドリ」はTDN%が高かったもののその他は全て低い値を示した。TDN%で2.4〜3.1%高かった「オカミドリ」は、有意差は認められないものの採食量では他の品種に比較して4.8〜2.1 g/kgW0.75/day 高い値を示した。しかし増体量への貢献はわずかであり、乾物収量で他の3品種に比較して21〜19%低かったのが、増体TDN量では15〜7%に縮小するにとどまった。

オーチャードグラス品種と比較して、ベネリアルライグラスの「ヤツガネ」は乾物収量、TDN%、TDN収量で高い値を示し、トールフェスクの「ホクリョウ」はTDN収量、採食量及び増体量で最低値を示した。

キーワード：オーチャードグラス、採食性、増体量、牧草収量、TDN。