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Potassium Content of Forages Regrown after Cuttings

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牧草의 再生에 따른 칼륨함량의 변화

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摘 要

목초의 再生에 따른 칼륨(K) 및 마그네슘(Mg) 함량의 변화를 알아보기 위해 6가지 목초에 대해 수경액중의 K_2O 농도를 10 ppm 및 300 ppm으로 하여 수경재배실험을 수행했다.

약간의 예외가 있었으나 2 처리구 모두 예취회수가 늘어갈수록 목초중 칼륨함량이 낮아졌으며, 이러한 경향은 콩과보다 화본과목초에서 두드러졌다. 한편, 목초중 마그네슘함량은 예취회수가 많아질수록 증가했다.

제1차 예취때 높은 칼륨함량과 낮은 마그네슘함량으로 인해 K/Mg 함량비가 가장 높았다. 6종류의 목초가운데 이탈리안라이그라스의 함량비가 K_2O 10 ppm 처리구에서 가장 낮았으나, 300 ppm구에서는 이와 반대로 가장 높았다.

이상의 결과로부터 다른 예취때보다 제1차 예취때에 목초중 칼륨함량은 높고 마그네슘함량은 낮게 된다는 것과 온도가 급격하게 올라갈 때는 少量의 칼륨비료질 시용과 多量施用 사이에 K/Mg 함량비에 큰 차이가 생길 수 있음을 알았다.

Ⅰ. INTRODUCTION

Solution culture techniques are often used to simulate situations which occur when plants are growing on the field, though there might be a difference between performance on the model experimental system and on soil media (Asher and Edwards, 1983). In the present report, water culture method was used with the purpose of obtaining fundamental knowledge on the effects of regrowth after cutting of 6 forage plants to potassium contents. In the former reports (Kim *et al.*, 1987; Kim *et al.*, 1990), forage growth responded clearly to potassium level in water culture solution. But the duration of the study was only one month each of the spring and autumn. Therefore, investigations were carried out for four months by cutting the forages four times during the period. The temperature of the glass-house was changed after the second cutting and the effect of the change was also investigated.

Ⅱ. MATERIALS AND METHODS

Water supplementation, preparation of samples for analyses, and determination of K and Mg contents were the same to those described in a previous report (Kim *et al.*, 1990).

Plastic container (capacity, 40 liters) were used for water culture in a glass-house, and K_2O levels in the culture solution were kept at 10 and 300 ppm by applysing K_2SO_4 to each container. The composition of the basal media was NH_4NO_3 95.3 mg, $NH_4H_2PO_4$ 126.5 mg, $Ca(No_3)_2$ 146.4 mg, $CaCl_2$ ·

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$2H_2O$ 97.8 mg, $MgSO_4 \cdot 7H_2O$ 229.2 mg and NaEDTA · Fe 13.1 mg/liter. The basal media was applied to each container as to supply 25 ppm NH_4-N, 35 ppm NO_3-N, 100 ppm P_2O_5, 75 ppm CaO, 75 ppm MgO and 3 ppm Fe. After the culture solution was prepared, a formed styrol plate with 3 drilled holes (20 × 10 cm) was floated in each container.

The forage species were Italian ryegrass(*Lolium multiflorum* Lamark), orchardgrass (*Dactylis glomerata* Linn.), tall fescue (*Festuca arundinacea* Schreb.), alfalfa (*Medicago sativa* Linn.), red clover (*Trifolium pratense* Linn.) and white clover (*Trifolium repens* Linn.). A half gram of seed for gramineous forages and 0.2 g for legumes, respectively, was sown in a rectangular plastic tray (20 × 10 cm, 4 cm depth) filled with vermiculite. Immediately after the root reached the bottom of the tray, the tray was firmly inserted into each of the holes in each styrol plate.

Water culture was carried out under an aerated condition in a glass-house from October 1, 1985 to January 28, 1986, and forages were harvested and sampled on October 29, 1985 (1st), November 23 (2nd), December 30 (3rd) and January 28, 1986 (4th). And after the 2nd harvest in November, 1985, the containers were moved from the glass-house to another one where temperature was conditioned above 20℃. Because the former glass-house was not equipped with the temperature controller and mean air temperature fell to lower than 10℃, it became necessary to move the containers to the latter glass-house for supporting the forage growth. The renewal of culture solution was performed after each harvest.

Ⅲ. RESULTS AND DISCUSSION

Table 1 shows the effect of K level in culture solution on K and Mg contents of forage regrown

Table 1. Effects of potassium level and regrowth after cuttings on magnesium and potassium contents of forages grown on culture solution.

(mg Mg, K/g DW)[1]

Cutting period		1st cut(Oct. 29, 1985)		2nd cut(Nov. 23)		3rd cut(Dec. 30)		4th cut(Jan. 28, 1986)	
K-level in solution		10 ppm	300 ppm	10 ppm	300 ppm	10 ppm	300 ppm	10 ppm	300 ppm
Italian ryegrass	Mg[1]	4.9±0.1	2.6±0.1	4.6±0.2	2.5±0.0	7.1±0.2	2.7±0.0	5.7±0.3	3.5±0.1
	K[1]	36±2	96±2	30±1	85±4	22±2	88±2	34±0	88±1
Orchard-grass	Mg	4.8±0.1	3.0±0.1	5.1±0.4	3.0±0.3	6.6±0.6	3.0±0.1	5.6±0.4(2)	3.1±0.3
	K	45±2	89±4	36±2	72±2	27±3	75±1	47±3(2)[3]	76±1
Tall fescue	Mg	7.2±0.9	5.3±0.4	5.3±0.7	3.1±0.2	8.0±0.2	4.2±0.1	7.0±0.1	4.8±0.3(2)
	K	52±5	77±3	39±5	68±2	27±2	73±3	41±0	68±0(2)
Alfalfa	Mg	3.1±0.2	2.1±0.0	3.1±0.0	2.2±0.1	4.6±0.3	2.8±0.2	4.1±0.1	2.3±0.1
	K	43±4	71±3	51±2	61±3	41±3	63±0	38±2	60±3
Red clover	Mg	5.3±0.2	3.3±0.2	4.8±0.2	3.4±0.2	7.4±0.4	4.5±0.5	6.4±0.3	3.7±0.2
	K	49±3	64±2	42±2	62±0	32±4	59±2	33±3	58±1
White clover	Mg	2.8±0.1	2.2±0.1	2.8±0.1	2.5±0.1	4.3±0.1	3.2±0.1	4.0±0.2	3.1±0.2
	K	43±1	70±2	43±1	61±1	33±2	68±2	36±2	62±1

[1] Mg, K; magnesium or potassium content of plant.

[2] Mean±S.D. of 3 replicates.

[3] Figure in the parenthesis indicates number of the samples used.

after cuttings. Higher K in culture solution raised the K content and decreased Mg content in all the forage plants, and the result of this experiment showed the same tendency to that of Kim *et al.* (1990). The K contents of forage plants at both 10 ppm and 300 ppm K_2O levels decreased with the progress of cutting time except those of orchardgrass at 4th cutting and alfalfa at 2nd cutting on 10 ppm. The decrease of K content was more significant on gramineous plants than on leguminous plants. On the other hand, the Mg contents of forage plants increased with the progress of cutting time, though there were some exceptions. Therefore, the K content of the forage was the highest while the Mg content was the lowest at the 1st cutting.

Temperature seemed to have effects on the response of mineral contents to K_2O level in culture solution. At 3rd cutting after moving the containers, K and Mg contents of forages responded more sensitively to K application than other regrowing period. At 10 ppm K_2O in culture solution, Mg contents of the forages were higher and the K contents of them were lower in the 3rd regrowth than those of the other regrowth periods, while at 300 ppm the difference was not clear. This increase of Mg content with the increase of temperature was also reported by Kemp(1960). From this fact, it was considered that the effect of rapid increase of temperature seemed to be favorable for mineral balance of grazing ruminants in the grazing pasture, especially at the low K application level. But Ohno *et al.* (1985) reported that wheat forage grown in lower temperature (10℃) contained less K than in higher temperature (20℃), though the difference of temperature did not influence the Mg content of it.

Table 2 shows the ratio of K/Mg in forages grown under the two K_2O levels in culture solution. The K/Mg ratio was the highest at 1st growing period with the higher K and lower Mg contents of the forages. The ratio at 10 ppm of 3rd regrowth was the lowest. Gramineous plants at 10 ppm ranged in lower ratios of 3.1 to 9.4 than leguminous plants of 4.3 to 16.4, while at 300 ppm the difference was not clear. There were apparent difference of the ratio between forage species. The ratio of Italian ryegrass at 10 ppm K_2O was lowest, while at 300 ppm it was the highest among the forages.

From the facts, the K and Mg contents of forages at 1st cutting were higher and lower, respectively, than those observed in the other cutting times. Rapid rise of temperature could result in great difference on the ratio of K/Mg between lighter and heavier K applications. It was concluded that lighter K application was recommended in spring when the 1st growth of forage and rapid change of temperature would occur.

Ⅳ. SUMMARY

Water culture method was used with the pur-

Table 2. Effects of potassium level and regrowth after cutting on the ratio of K / Mg.

Forage	1st cut(Oct. 29, 1985)		2nd cut(Nov. 23)		3rd cut(Dec. 30)		4th cut(Jan. 28, 1986)	
species	10[1]	300[2]	10	300	10	300	10	300
Italian ryegrass	7.3	36.9	6.5	34.0	3.1	32.5	6.0	25.1
Orchardgrass	9.4	29.6	7.0	24.0	4.1	25.0	8.4	24.5
Tall fescue	7.2	14.5	7.4	21.9	3.4	17.3	5.9	14.1
Alfalfa	13.8	33.8	16.4	27.7	8.9	22.5	9.3	26.0
Red clover	9.2	19.3	8.8	18.2	4.3	13.1	5.2	15.6
White clover	15.3	31.8	15.3	24.4	7.7	21.2	9.0	20.0

[1] Ratio of K/Mg in 10 ppm.
[2] Ratio of K/Mg in 300 ppm.

pose of obtaining fundamental knowledge on the effects of regrowth after cutting of 6 forage plants to potassium(K) and magnesium(Mg) contents.

Though there were some exceptions, the K contents of forage plants at both 10 ppm and 30 0 ppm K_2O levels decreased with the progress of cutting time. The decrease of K content was more significant of gramineous plants than on leguminous plants. On the other hand, the Mg contents of forage plants increased with the progress of cutting time.

The K/Mg ratio was the highest at 1st growing period with the higher K and lower Mg contents of the forages. The ratio of Italian ryegrass at 10 ppm K_2O was the lowest, while at 300 ppm it was the highest among the forages.

From the facts, the K and Mg contents of forages at 1st cutting were higher and lower, respectively, than those observed in the other cutting times. Rapid rise of temperature could result in great difference on the ratio of K/Mg between lighter and heavier K applications.

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