ID NO. 1047

EFFECT OF NITROGEN ON THE RESERVE NUTRIENTS OF RHIZOMES AND THEIR RELATION TO SHOOT REGROWTH IN *MISCANTHUS FLORIDULUS*

Y. C. Wang[1] and M. L. Lee[2]

Department of Forage Crops[1], and of Animal Nutrition[2],
Taiwan Livestock Research Institute, Hsin-Hua, Tainan, Taiwan, ROC.

ABSTRACT

A 3-week-treatment of nitrogen dressings and of shoot cuttings were conducted on *Miscanthus floridulus* before the harvest. The nitrogen dressing increased the fresh weight and dry matter of the plants, but did not increase the plant height and shoot number. The reserved nutrients, especially the sugars and starch in the rhizomes were decreased by the cut treatments. Crude protein in the rhizomes was increased with the nitrogen amounts applied, though the carbohydrates were decreased. The decrease in reserved nutrients caused the growth inhibition of new shoots, and the more the reserved nutrients decreased the more severely was the growth inhibited. There was a positive correlation between the numbers of stubble and of new shoots. The number of new shoots was settled at 3 weeks after the harvest. The sugar contents in the stubble and rhizomes were correlated with the leaf area, the fresh weight and dry matter of new shoots.

KEYWORDS

Miscanthus, reserve nutrients, rhizomes, shoot cut, nitrogen, regrowth

INTRODUCTION

Miscanthus floridulus, a dominant species of native grass in Taiwan, ranges from plain to mountain throughout this island. It has been a wild weed in mountain areas and becomes very troublesome in afforestation (Hsu 1975). However, it is rich in nutrients and is desirable to the herbivore, so it could be grazed (Hoshino 1978).

The rhizomes of *Miscanthus* are the main organ both for propagation and for nutrient storage (Wang 1991). The establishment of *Miscanthus* population depends upon the rhizomes (Kobayashi 1981). Growth of rhizomes might be affected by soil conditions and the state of shoot conditions (Nojima et al. 1984, Komai and Ueki 1982) The purpose of this experiment is to determine the response of the reserved nutrients of the stubble and rhizomes to the nitrogen applied to the soil, and to shoot cut treatments, as well as the relationship between the reserved nutrients and growth of new shoots after harvest.

MATERIALS AND METHODS

Rhizomes of the *Miscanthus* were collected from the nursery plots and were propagated in the 1/2000 a. of Wanger pots. They were grown under natural conditions. A 3-week pre-treatment of shoot cuttings and nitrogen dressings were conducted before the harvest. At the beginning of the treatment, the nitrogen was applied as ammonium sulfate fertilizer at N_0=0, N_1=100, N_2=300 and N_3=500 kg/ha . Shoot cutting treatments were including C_0 (no cut), C_1(cut 1 time), C_2(cut 2 times) and C_3(cut 3 times). A successive cut(multiple cuttings) in C_2 and C_3 plots were conducted upon the new shoots with a one week interval.

On finishing the pre-treatment, all the shoots of the test plants were harvested. Growth characteristics of the new shoots were recorded immediately before and after the harvest. The investigation was thus continued for one month, and on each investigation the shoots and rhizomes were sampled for determination of reserved nutrients.

RESULTS AND DISCUSSION

Nitrogen dressings increased the fresh weight and dry matter of the plants but decreased the number of leaves in the high nitrogen plots. Crude protein in the rhizomes increased with increasing nitrogen rate, but the carbohydrates (sugars and starch) were decreased. Increasing nitrogen in soil will increase nitrogen and chlorophyll content in the leaves, resulting in increasing photosynthesis (Wang 1985), and thus the fresh weight and dry matter were increased.

Three weeks after the first cut, the plant height, leaf numbers, fresh weight and dry matter of the plants were all inhibited. The inhibition was more severe in the multiple cut plots than others. On the other hand, though the number of shoots or tillers was also decreased by the cut treatment, those plants in multiple cut plots bear more shoots and tiller buds than other cut treatments. As well the reserved carbohydrates (sugars and starch) in the stubble and rhizomes were decreased significantly by the cut treatments and the decrease was more severe in the multiple cut. It is suggested that the shoot cut might promote tillering or shooting by reducing apical dominance of the shoot terminals, and the necessary energy for the initial growth of new shoots was mainly obtained from the stubble and rhizomes.

Though a negative relation between the carbohydrate contents and the nitrogen content in the rhizomes was shown both in shoot cut plots and nitrogen dressing plots, there was a positive correlation between the numbers of stubble and the number of new shoots. The correlation reached its peak at 1 week after the harvest and kept a high relation until 4 weeks after the harvest. The sugars were highly correlated with the leaf area, the fresh weight and dry matter of the new shoots, and the correlation persisted through the regeneration period. The carbohydrates in the stubble and rhizomes were not related to the plant height of the new shoots. On the other hand, the nitrogen content in the stubble and rhizomes showed a high correlation with the leaf numbers of new shoots in the first week of the regeneration period.

The nitrogen and carbohydrates in the stubble and rhizomes decreased immediately after the harvest and reached a minimum at the first week after harvest. During the period a sharp increase in fresh weight and dry matter was seen. It is suggested that the decrease of nutrients was contributing to the dry matter production of the new shoots.

The regrowth pattern of this species was the same as that in napiergrass. The number of new shoots or tillers, the plant height, the leaf area, the fresh weight and dry matter increased immediately after the harvest and a sharp increase was seen in the first week in the regeneration period. Increment of the fresh weight and dry matter came slowly but steadily 2 weeks after the harvest, though the plant height and leaf area still kept rapidly increasing. The number of new shoots or tillers was no longer increasing 3 weeks after harvest.

From the results obtained, it is suggested that the necessary energy for new shoots or tillers was from the reserved nutrients in rhizomes during the first week after the harvest. The number of new shoots was settled at 3 weeks after the harvest. There was a positive and obvious correlation between the numbers of stubble and the number of new shoots. Moreover, the carbohydrate contents in rhizomes were correlated with the leaf area, the fresh weight and dry matter of new shoots during the regeneration period. Being able to fix nitrogen, *Miscanthus* is somewhat different from other grasses on the response to nitrogen fertilizer.

REFERENCES

Hoshino, S. 1978. Futurity of Miscanthus use for crops and its role in field utilization. J. of Niigata Agricultural Experiment Station No.27 1-10. Japan

Hsu C. H. 1975. Illustrations common plants Taiwan. Vol. VII(2)Taiwan grass:737-745. Taiwan Provincial Education Association.

Kobayashi, K. 1981. Studies on the growth and maintenance of path of Miscanthus Sinensis Anderss—Formation process of the patch and its ecological characteristics in a warm region. J. Japan Grassl. Sci. **27(1)**:71-78.

Komai, K. and K. Ueki. 1982. Effect of shoot-cutting treatment in the regrowth ability and carbohydrates contents of Purple nutsedge (Cyperus rotundus L.) tuters. J. of Japan Weed Sci. **27**:272-277

Nojima, H., H. Oizumi and Y. Takasaki. 1984. Effect of nitrogen levels on the utilization of 14C-carbohydrate in regrowth of orchardgrass. J. Japan Grassl. Sci. **30(3)**:250-254.

Wang, Y. C. 1985. Relationship between leaf nitrogen content and photosynthesis in napiergrass(pennisetum purpureum). J. of Taiwan Livestock Research **18(1)**:159-166.

Wang, Y. C. 1991. The distribution of the reserve carbohydrates and their relation to the shooting ability in Miscanthus species in Taiwan. J. of Taiwan Livestock Research **24(1)**:41-49.

Wilson, A. M. 1984. Nonstructural carbohydrates and root development in blue grama seedlings. J. of Range Management **37(1)**:28-30.

Table 1

Effect of nitrogen dressings and shoot cuts on growth characters of the stubble and rhizomes in *Miscanthus floridulus.*

	tillers or new shoots					stubble and rhizomes			
Treatment	plant height (cm)	shoot no.	leaf no.	fresh weight g/shoot	dry weight g/shoot	total sugar %	starch %	total N %	crude protein %
N_0	86.7	13.7	11.3	435	204	6.50	9.5	1.10	5.38
N_1	86.8	13.5	11.0	445	211	3.95	9.0	1.11	5.69
N_2	82.2	14.6	10.1	457	238	3.40	6.8	1.22	6.69
N_3	73.6	13.1	9.0	475	242	2.25	7.6	1.26	9.69
C_0	87.8	22.3	7.0	407	179	3.05	9.3	0.86	6.88
C_1	60.7	13.6	4.8	260	114	1.45	4.6	0.91	6.94
C_2	34.2	18.3	3.5	236	107	1.15	3.8	1.07	7.63
C_3	17.1	21.0	2.4	215	96	0.75	2.9	1.55	7.88

Table 2

The correlation between the reserved nutrients in stubble and rhizomes (on 30 March) and the growth characters of new shoots at different stage in *Miscanthus floridulus.*

	growth characters of the regrowth shoots					
stubble characters	shoot no.	plant height	leaf no.	leaf area	fresh weight	dry weight
			6, April (1 week after the harvest)			
stubble no.	**0.940	0.389	0.427	0.063	0.099	0.033
nitrogen	0.119	0.465	*0.765	0.468	0.438	0.527
total sugar	0.272	0.175	0.228	*0.699	**0.840	**0.861
reducing sugar	0.078	0.273	0.333	**0.693	**0.884	**0.915
starch	0.129	0.198	0.033	**0.886	**0.508	**0.551
			27, April (4 week after the harvest)			
stubble no.	0.614	0.542	0.404	0.198	0.228	0.191
nitrogen	0.120	0.062	0.529	0.468	0.092	0.091
total sugar	0.347	0.378	*0.746	0.735	0.617	0.672
reducing sugar	0.227	0.262	0.659	0.683	0.616	0.674
starch	0.355	0.175	0.628	0.486	0.345	0.484

* and ** mean significant coefficients at 5 % and 10 % .