

THE NITRATE ACCUMULATION IN SORGHUM SUDANGRASS HYBRIDS VARYING WITH THE LEVEL OF NITROGEN FERTILIZER

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ABSTRACT

A field experiment with 80, 160 and 240 kg N/ha application levels was carried out to study the nitrate nitrogen accumulation in the sorghum sudangrass hybrids at Iri National College of Agriculture and Technology farm in 1995. The nitrate nitrogen content of Xtragraze II exceeded the safe level of ruminants at the level of 160kg application, and decreased at the low level in the later stage of growth, but that in Civa 1990 was almost kept constant at the same level. Nitrate nitrogen accumulation of Civa 1990 was higher than that of Xtragraze II. A sum exceeding 160kg N does not necessarily result in increasing nitrate nitrogen in the sorghum sudangrass hybrids. It is suggested that 160kg application may result in toxic levels of nitrate nitrogen in the early stage of growth, and special attention must be given in feeding them.

KEYWORDS

Nitrate, toxicity, sorghum hybrids, nitrogen application, growing stage, safe level

INTRODUCTION

It has long been known in the field of plant physiology that nitrate, which is taken up by the plants, is partly reduced and assimilated to amino acids and protein. However, when the intake of nitrate by the plant exceeds the consumption, nitrate is accumulated in large amounts in the plants. When cattle or sheep are fed with the forage containing much nitrate, there is a danger of nitrate poisoning (Bradley et al., 1940; Miyazaki et al., 1967a; Miyazaki et al., 1967b; Ryan et al., 1972). The concentration of nitrate in plants varies widely according to the growing stages and the environmental conditions such as amounts of nitrogen fertilizer applied, shading and herbicide treatments. Recently, increased frequency of application of nitrogen fertilizer or barnyard manure came to be not so much uncommon in the field in Korea, has been observed to lead to nitrate accumulation in plants. Therefore, it is important to know the pattern of concentration of nitrate in forage crops in Korea. The investigations reported in this paper were undertaken to determine the concentrations of nitrate in cultivated sorghum sudangrass hybrids commonly used in summer in Korea.

MATERIALS AND METHODS

Two varieties of sorghum sudangrass hybrid were seeded on June 20, 1995, and cultivated. Prior to seeding about 1,000kg of barnyard manure, and 80, 160 and 240kg of N as urea per hectare, respectively, had been applied to the experimental field. The soil properties of the experimental field are shown in Table 1. The samples of each experimental field were taken at about 7-day intervals from July 12 to August 10, 1995. All samples were dried at 80°C for 30 minutes, and at 70°C for 48 hours, then finely ground. The contents of nitrogen were determined by the BÜCHI 343 Kjeltac automatic system, and those of nitrate nitrogens by the ion chromatography (Dionex, DX-300).

RESULTS AND DISCUSSION

Total nitrogen content. Table 2 shows the variation of the total nitrogen content among sorghum sudangrass hybrids according to the nitrogen fertilizer use level. As the growth period progresses, total nitrogen content, according to the growth period, has a tendency to decrease. The decline is greater in Xtragraze II than in Civa 1990.

The reason is that Civa 1990 is a non-heading variety, and has a considerably greater content of total nitrogen in the later growth period. The changes in total nitrogen content according to the growth period relative to the nitrogen fertilizer shows that Xtragraze II decreased from 3.11% on July 12 to 1.88% on Aug. 10, while Civa 1990 decreased from 3.48% to 2.31% in the level of 80kg, that is, they decreased 39.5%, 33.6%, respectively. With 160kg, they decreased 43.8% and 37.4% respectively, while they decreased 45.6% and 33.9% respectively at the level of 240kg. Therefore, Xtragraze II has, irrespective of the nitrogen fertilizer level, the high rate of decrease in the total nitrogen content with growth period. The average value of the total nitrogen content during all the growth period did not differ greatly with the nitrogen fertilization level. In spite of these facts, it seems that Civa 1990 has a higher nitrogen accumulation rate than Xtragraze II.

Nitrate nitrogen content. Table 3 shows the variation in the nitrate nitrogen content among the sorghum sudangrass hybrids with nitrogen fertilizer use level. The nitrate nitrogen content of Xtragraze II was high in the early stage of the growth, but tends to decrease as the growth period progresses (Murphy and Smith, 1967; Wright and Trautman, 1962). On the contrary the Civa 1990 had an almost constant level irrespective of the growth period, especially in the level of 240kg, where it had the higher level in the later stage of growth (July 29) than in the early stage of growth (July 12). Compared with the nitrate nitrogen content between two kinds according to the nitrogen fertilization level, at 80kg, they all were below the intoxication danger value, but there were differences in the mean content between two kinds. But these values are below the danger level presented by Bradley et al. (1940) and the safety level, 0.15%, proposed by Ryan et al. (1972) and George et al. (1973). At 80kg N, neither cultivar accumulated nitrate nitrogen to the danger level of nitrate intoxication. At 160 and 240kg, Xtragraze II had the nitrate nitrogen of 0.2%, which is over the danger level, before the heading date (Aug. 4), but that value decreases later to the safety level. Civa 1990 was over the danger level during all the growth period and had a large difference compared with Xtragraze II at 160kg. The reason for the remarkable difference between two kinds seems that Civa 1990 has higher nitrate accumulation than that of Xtragraze II, genetically. So we pay great attention to cultivate Civa 1990 by the high level of nitrogen fertilizer irrespective of the growth period. But Civa 1990 has a greater moisture content than that of Xtragraze II. Therefore, nitrate levels are similar on a wet basis, but Civa 1990 has a great nitrate content and risk of nitrate intoxication if allowed to dry for several hours.

REFERENCES

- Bradley, W.B., H.F. Eppson and O.A. Beath.** 1940. Livestock poisoning by oat hay and other plants containing nitrate. Wyo. Agric. Exp. Sta. Bull. No. 241.
- George, J.R., C.L. Rhykerd, C.H. Noller, J.E. Dillon and J.C. Burns.** 1973. Effect of N fertilization on dry matter yield, total-N, N recovery and nitrate-N concentration of three cool season forages grass species. *Agron. J.* **65**:211-216.
- Miyazaki, A., S. Uesake and E. Tsuda.** 1967a. The concentration of nitrate in grasses, legumes, soiling crops and silage practically used in Japan. *Jap. J. Zootech. Sci.*, **38**, (3): 86-95.
- Miyazaki, A., S. Uesaka and K. Ikeda.** 1967b. The concentrations

of nitrate in soiling cereals varying with cutting dates. Jap. J. Zootech. Sci., **38**, (4):133-140

Murphy, L.S. and G.E. Smith. 1967. Nitrate accumulations in forage crops. Agron. J. **59**:171-174.

Ryan, M., W.F. Wedin and W.B. Bryan. 1972. Nitrate-N levels of perennial grasses as affected by time and level of nitrogen application. Agron.J. **64**:165-168.

Wright, N. and R.J. Trauman. 1962. Influences of management on nitrate accumulation in blue paniegrass. Agron. J. **54**:363-364.

Table 1
Chemical soil properties of the experimental field

pH (1/5H ₂ O)	OM (%)	Total N ₂ (%)	P ₂ O ₅ (ppm)	Exch.(me/100g)			CEC (me/100g)
				K	Ca	Mg	
5.5	2.80	0.21	28.7	1.12	4.20	1.05	13.0

Table 2
Total nitrogen content of sorghum-sudangrass hybrids in the 1st growth period

Varieties	Level of N (kg/10a)	Growth period						Mean
		7/12	7/17	7/24	7/29	8/4	8/10	
Xtragraze II	80	3.11	3.15	3.05	2.50	2.23	1.88	2.65a
Civa 1990		3.48	2.67	2.75	2.75	2.65	2.31	2.77a
Xtragraze II	160	3.52	3.46	2.98	2.62	2.29	1.98	2.80a
Civa 1990		3.96	3.34	3.30	2.78	2.70	2.48	3.09a
Xtragraze II	240	3.84	3.75	3.17	3.00	2.27	2.09	3.02a
Civa 1990		3.72	3.56	3.52	2.60	2.65	2.46	3.09a

Table 3
Nitrate nitrogen content in sorghum-sudangrass hybrids in the 1st growth period

Varieties	Level of N (kg/10a)	Growth period						Mean
		7/12	7/17	7/24	7/29	8/4	8/10	
Xtragraze II	80	0.132	0.155	0.186	0.096	0.091	0.105	0.128b
Civa 1990		0.166	0.165	0.161	0.172	0.169	0.165	0.166a
Xtragraze II	160	0.275	0.243	0.291	0.219	0.157	0.139	0.221b
Civa 1990		0.305	0.313	0.342	0.281	0.305	0.254	0.300a
Xtragraze II	240	0.290	0.271	0.271	0.230	0.170	0.185	0.236a
Civa 1990		0.254	0.289	0.338	0.294	0.282	0.257	0.286a