Research Note

Effect of nitrogen fertilization on chemical composition and digestibility of sorghum silage

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Many workers, as reviewed by OWEN⁶⁾, have reported on the factors which affect the feeding value of corn and sorghum silages. In sorghum silage, however, there is little information available concerning its response to nitrogen fertilization.

The present study was designed, therefore, to determine the effect of nitrogen fertilization on the chemical composition and digestibility of sorghum silage.

Materials and Methods

This experiment was carried out at the experimental field of the Faculty of Agriculture, Okayama University in 1966. Hybrid sorghum was planted on a sandy loam soil and ensiled in the experimental small silos at the heading stage of maturity. The nitrogen treatments used were: (1) high-N (1 kg N per a), (2) medium-N (0.6 kg N per a) and (3) low-N (0 kg N per a). Nitrogen treatments were applied in the form of ammonium sulphate. All plots received 0.6 kg of P_2O_5 (as superphosphate) and 0.5 kg of K_2O (as muriate of potash) per a at sowing and at 2 months later. Size of each plot was 10×10 m (100 m^2). Two sheep were fed the same silage in a series of three digestion trials. The total fecal collection method was employed, with a seven-day preliminary period followed by a seven-day collection period. During the digestion trials the sheep were restricted to 2 kg daily silage intake. Each animal had free access to water and salt. Samples of feed and feces were taken daily during the collection period for chemical analyses according to the method used in a previous report⁵⁾.

Results and Discussion

The yields of sorghum forage on a moisture-free basis were 40, 62.5 and 71 kg per a for plots treated with 0, 0.6 and 1 kg of nitrogen, respectively. The 0.6- and 1-kg-of-nitrogen plots produced, respectively, 1.5 and 1.8 times as much forage as the control plot (0 kg of nitrogen).

The chemical composition of the silages fed in the digestion trial are shown in Table 1. Increased application of nitrogen increased the contents of crude protein, crude ash, crude lignin and nitrate as KNO_3 , while NFE and crude fiber contents decreased. GENTER *et al.*³⁾ have reported a pronounced improvement in the protein content of corn silage was obtained in a study with levels of nitrogen ranging from 24 to 224 lb per acre. JORDAN *et al.*⁴⁾ and CUMMINGS *et al.*²⁾ indicated similar increase in nitrate of corn silage due to nitrogen fertilization.

Digestion trial data are shown in Table 1. The apparent digestibility of crude protein increased with increasing nitrogen application. The crude protein digestibility of the high-N silage was remarkably higher than those of the medium-N and low-N silages, and that of the

Table 1. Composition, digestibility and feeding value of nitrogen-fertilized sorghum silage

Nitrogen application, kg, per a	0	0.6	1
Composition, % on DM basis			
Moisture	79.0	86.4	86.1
Crude protein	6.3	7.2	12.3
Crude fat	2.3	3.7	3.7
Nitrogen-free extract (NFE)	45.7	43.7	39.8
Crude fiber	34.9	34.1	31.7
Crude ash	10.8	11.3	12.5
Crude lignin	12.3	13.5	14.8
Nitrate as KNO ₃	1.59	2.12	2.53
Digestibility, %			
Dry matter	55	56	56
Crude protein	38	41	51
Crude fat	67	72	74
Nitrogen-free extract	55	57	57
Crude fiber	71	71	70
Feeding value, % on DM basis			
Total digestible nutrients	55.5	54.3	57.1
Digestible crude protein	2.4	3.3	6.3

medium-N silage was slightly higher than that of the low-N silage. The apparent digestibility of crude fat also increased with nitrogen treatments, but the difference in the digestibility between the high-N and medium-N silages was not found. The apparent digestibility of any of dry matter, NFE or crude fiber did not show any difference by the various nitrogen application levels. ALEXANDER *et al.*¹⁾ have reported that increasing the N-P-K fertilizer per acre from 56-48-48 to 112-96-96 lb increased the apparent digestibility of crude protein and ether extract of corn silage in the highest plant population. The feeding values of the silages expressed as total digestible nutrients (TDN) and digestible crude protein (DCP) are presented in Table 1. The TDN contents of the silages from high-, medium- and low-N levels were 57.1, 54.3 and 55.5 % (on dry matter basis), respectively. ALEXANDER *et al.*¹⁾ in the same study cited above have found a slight increase in TDN content of silage in the high fertilizer treatment when compared the low fertilizer treatment. The DCP contents increased with increasing nitrogen application, which were 6.3, 3.3 and 2.4 % (on dry matter basis) for the high-N, medium-N and low-N silages, respectively.

From the above results, it is apparent that nitrogen fertilization generally has a larger effect on DCP than on TDN of sorghum silage.

Summary

Data are presented on the chemical composition and digestibility of hybrid sorghum silage due to the three nitrogen application levels, 1, 0.6 and 0 kg per a. Two sheep were used in a conventional total collection digestion trial. The crude protein and nitrate contents increased remarkably with increasing nitrogen application. The apparent digestibility of crude protein and DCP content also increased with nitrogen treatments, whereas the TDN content remained almost unchanged.

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ソルガムサイレージの化学的成分と消化率に およぼす窒素施用の効果

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ソルガムサイレージの化学的成分と消化率におよぼす窒素施用水準の効果を明らかにするため実験を行なった。a あたり 0, 0.6, 1 kg の3窒素施用水準で栽培された雑種ソルゴを出穂期に収穫してサイレージを調製し

た。綿羊を用いて全糞採集法により消化試験を実施した。窒素の増施によって粗蛋白質と硝酸塩含量が増加した。粗蛋白質消化率と DCP 含量もまた増加した。しかし TDN 含量は窒素増施によりほとんど変化しなかった。