Relative Aerial Biomass Yield and Changes in Chemical Composition after Cutting of Sugarcane in Northeast Thailand

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Abstract

A total of nineteen sugarcane fields in six villages of Khon Kaen province, Northeast Thailand, were randomly selected to carry out the survey from 10 to 27 January 1995. Sugarcane in Khon Kaen was characterized by a relatively high ratio of stalk, and very low ratio of top. Stalk may have a high potential for utilization as roughage for cattle because of its high yield, although the crude protein content was low. About 200 kg of sugarcane stalks were cut in three farms of Khon Kaen province and kept under the shade. There was no definite change in the chemical composition after cutting and stock-piling except for the dry matter content, which started to increase after 3 days.

Key words: cattle, feeding, sugarcane, Thailand

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Introduction

Due to the economic development in Thailand, the demand for meat and milk has increased. The Northeast region of Thailand is a center of large ruminant production in the country. Dairy production has been promoted there during the past several years. Feed shortage, especially in the dry season, is a key constraint on further development of dairy production as well as beef production. It is necessary, therefore, to exploit locally available feed resources and to develop feeding strategies compatible with the local environment in the region. The production of sugarcane in the Northeast increased markedly in the past decade. There may thus be a high possibility to utilize sugarcane as cattle feed in the dry season. The use of sugarcane as cattle feed has been investigated and data have been accumulated in other countries[8]. The environment and the varieties of sugarcane grown in the Northeast are different from those in such countries. This survey was undertaken to characterize sugarcane in terms of chemical composition, relative aerial biomass yield and changes in the chemical composition after harvest, in order to develop a feeding strategy for cattle production using sugarcane.

Materials and Methods

Nineteen sugarcane fields in six villages of Khon Kaen province, Northeast Thailand were randomly selected to carry out the survey from 10 to 27 January 1995. While sugarcane was being harvested in the sugarcane fields to be sent to a sugar mill, two plots (either 3m*3m or 5m*5m in area depending on the density of the sugarcane plants) were set up in each field for the collection of sugarcane stalk, top and trash. The procedure to separate stalk, top and trash followed the traditional method applied by the farmers. Each component was weighed in the field, and aliquots of samples were taken back to the laboratory and dried at 60 ℃ to measure the dry matter (DM) content. Ten samples were subjected to chemical analysis.

About 200 kg of sugarcane stalks were cut in three farms in Khon Kaen province and piled up under the shade. Two sets of sugarcane (5 stalks each) were taken from the piles on days 0, 3, 6, 10, 20, 30, 60 after harvest, chopped to be dried in a drying oven at 60 ℃ and subjected to chemical analysis.

Crude protein (CP), ether extract (EE), crude fiber (CF) and ash were determined by the method of AOAC[2], while acid detergent fiber (ADF) and neutral detergent fiber (NDF) by the method of Goering and Van Soest[4].

A general linear model[9] was used to analyze the changes in the chemical composition after harvest. The model included the date after harvest and piled set.

Results and Discussion

There are two distinct seasons in the region where the survey was conducted; the rainy season and the dry season. The rainy season starts in May and ends in October. The average annual rainfall in Khon Kaen is about 1,200 mm but it varies considerably. The maximum temperature in summer exceeds 40 °C. The soil conditions are very poor due to the presence of sandy and saline soil. The environment surrounding agriculture is very harsh.

The fresh matter yield, DM content and relative aerial biomass yield of sugarcane are shown in Table 1. The average yield from 1994 to 1998 in Northeast

Table 1. Fresh matter yield, dry matter content and relative aerial biomass yield of sugarcane in Northeast Thailand

	Fresh matter yield (kg/10a)	Dry matter content (%)	Relative aerial biomass yield (% of total)
Stalk	820 (349)	29.5(2.2)	69.5(5.6)
Top	908 (408)	36.7 (3.8)	8.2(2.6)
Trash	8990 (3370)	91.0(3.8)	22.2(5.5)

Data are expressed as means (standard deviation) of 19 sugarcane fields in 6 villages of Khon Kaen Province.

Table 2. Chemical composition of sugarcane stalk, to and trash

	CP[1)]	EE	NFE	CF	ADF	NDF	Ash
Stalk	1.9(0.5)	0.5(0.3)	77.4(1.2)	18.2(1.5)	23.2(2.4)	37.8(1.9)	1.9(0.3)
Top	4.4(0.5)	1.3(0.2)	54.5(3.2)	33.6(2.5)	38.9(5.9)	74.7(2.1)	6.2(1.2)
Trash	2.1(0.4)	1.7(0.2)	52.5(2.1)	37.3(2.0)	43.4(1.8)	79.3(2.0)	6.5(1.0)

Data show means (standard deviation) of 10 samples.
[1)]:CP, crude protein; EE, ether extracts; NFE, nitrogen-free extract; CF, crude fiber; ADF, acid detergent fiber; NDF, neutral detergent fiber.

Table 3. Changes in the chemical composition of sugarcane stalks after harvest and Stock-piling

		Days after harvest							
		0	3	6	10	20	30	60	SE
DM[1)]	%	29.7^{d}	30.4^{d}	32.5^{c}	34.0^{c}	32.9^{c}	38.2^{b}	51.3^{a}	0.6
CP	%DM	1.2	1.1	1.1	1.3	1.4	1.2	1.4	0.1
EE	%DM	0.6^{ab}	0.6^{ab}	0.5^{ab}	0.5^{ab}	0.4^{b}	0.4^{b}	0.7^{a}	0.1
NFE	%DM	78.5^{a}	79.4^{a}	78.7^{a}	77.7^{ab}	78.1^{a}	78.9^{a}	76.1^{b}	0.6
CF	%DM	17.9^{b}	17.5^{b}	18.2^{b}	18.1^{b}	18.4^{b}	18.0^{b}	20.0^{a}	0.5
ADF	%DM	22.8^{abc}	21.4^{cd}	22.0^{bcd}	21.1^{d}	23.4^{ab}	22.5^{abcd}	24.0^{a}	0.5
NDF	%DM	39.5^{abc}	38.1^{c}	38.4^{bc}	37.3^{c}	41.4^{a}	38.9^{abc}	40.9^{ab}	0.8
Ash	%DM	1.8^{a}	1.4^{b}	1.5^{ab}	1.6^{ab}	1.8^{a}	1.5^{ab}	1.8^{a}	0.1

[1)]: Means with different superscript letters are significantly different at $p<0.05$. DM, dry matter; CP, crude protein; EE, ether extracts; NFE, nitrogen-free extract; CF, crude fiber; ADF, acid detergent fiber; NDF, neutral detergent fiber; SE, standard error.

Thailand was 5,710kg/10a[3)]. The value of the yield in the present study was about 60 % higher than that recorded in the statistics and the standard deviation of the yield was large, partly due to the relatively small plot used for sampling. The data from Natal, Hawaii and Mauritius showed that stalk, top and trash accounted for 56.2-62.4 %, 12.6-18.1 %, and 24.3-25.6 % of the aerial biomass, respectively[6)]. Compared with these values, sugarcane in Khon Kaen was characterized by a relatively high ratio of stalk, and very low ratio of top. Sugarcane harvest takes place from November until April, which corresponds to the dry season in the region. This survey was carried out in the middle of the dry season. The ratio of top is considered to decrease towards the end of the dry season when feed shortage becomes serious. Although the top is a valuable feed resource, its availability is limited especially in the late dry season. In the local harvest procedure, the top is used to tie up a bundle of sugarcane stalks for transportation. Thus, about 20 % of the top is used for this purpose and is not available for feed.

Chemical analysis of sugarcane stalk, top and trash is shown in Table 2. The chemical composition of top and trash was similar, although the CP and NFE contents were higher and CF, ADF and NDF contents were lower in the top than in the trash. In the withering process, CP and NFE were considered to have been lost in the trash. Chemical composition of the stalk was characterized by a higher NFE content and lower CP, CF, ADF and NDF contents. The CP content of the top in this study was 4.4%, which was much lower than the value (9.2% on DM basis) listed in Standard Tables of Feed Composition in Japan[1)], while the chemical composition of the top was similar to that reported by Naseeven[6)]. The difference in the CP contents of the top between Japan and Thailand may be due to differences in variety, fertilizer application, environment, *etc.*

Few studies on trash utilization as feed are available. As trash completely withered, it may require either chemical or physical treatment in order to be used as cattle feed. However, as a considerable amount was left in the field, it would be worth determining how to utilize this resource as roughage for ruminants.

Stalks could show a high potential for utilization as roughage for cattle because of their high yield, although the CP content was low. Pate and Coleman[7)] carried out a chemical analysis of stalks in 66 varieties of sugarcane. They suggested that the fiber content was negatively correlated with *in vitro* digestibility and that emphasis should be placed on a lower fiber content when selecting a variety for feeding purposes. Chemical analysis in this study showed that the CF, ADF and NDF contents of the sugarcane stalks collected from Khon Kaen Province

were even lower than the lowest value among the varieties studied in their report. In this sense, sugarcane grown in Khon Kaen province would be suitable for feeding purposes.

Sugarcane can survive during the dry season without watering. Therefore, it is not necessary to preserve it during the rainy season prior to the dry season. And besides, sugarcane stalks cannot be easily dried. It is not recommended to make silage due to the large loss of energy[5]. It would be more practical to apply a cut-and-carry system for the use of sugarcane stalks as animal feed. It would be easier for this purpose to cut a relatively large amount and to keep the stalks for a while before feeding them to animals. Changes in the chemical composition were observed after cutting and stock-piling (Table 3). Dry matter content started to increase after 3 days, although there was some variation probably due to the sampling procedures. There was no clear change in the chemical composition after harvest. However, further studies in the nutritive value, palatability, *etc.* are required in order to determine whether the stalks stock-piled for a relatively longer period can be fed to animals without any adverse effect.

Sugarcane stalk could be a promising roughage for feeding cattle because of its high yield under the severe environment prevailing in Northeast Thailand. However, its nutritive value and the digestion physiology of the animals given sugarcane stalks should be examined prior to the practical use of sugarcane stalks for feeding cattle.

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タイ国東北部におけるさとうきび地上部の相対収量と収穫後の化学成分の変化

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摘　要

1995年1月10日から27日の間にタイ国コンケン県の6村における合計19のさとうきび畑を無作為抽出し刈り取り調査を実施した。コンケン県のさとうきびは茎部の割合が比較的高く、梢頭部の割合が非常に小さいことが判明した。茎部は粗蛋白質含量が少ないが、生産量が大きいことから牛用の粗飼料として利用できる可能性が示唆された。約200kgのさとうきびをコンケン県内の3農家から刈り取り、日陰に放置した。そして、刈り取り後の化学成分の変化を調べたところ、乾物率は放置後3日以降に上昇し始めたが、その他の化学成分については明確な変化は認められなかった。

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