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Dry Matter Yield, Chemical Components and Dry Matter Degradability of Ten Sorghum Cultivars (*Sorghum bicolor* L. Moench) Grown on Oxic Paleustult Soil

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Abstract
An experiment on ten sorghum cultivars with respect to growth and feed quality was carried out at Khon Kaen University Farm during rainy season of 1996. The experiment was laid in a randomised complete block design with four replications. The plant samples were taken at days 90 and 160 after emergence. The plant materials were used for the determinations of dry matter yield per plant, extractable juice concentration, crude protein (CP), neutral and acid detergent fibre contents (NDF and ADF) and dry matter degradability (DMD). The results showed that with the first cutting, the first three highest dry matter yield were with Rio, IS 23585 and E 35-1 whilst Suphan Burl 1, UT 470-2 and U-Thong 1 gave the highest extractable juice concentration. All cultivars gave CP content not exceeded 7 percent and the first four lowest cultivars for NDF and ADF contents were with IS 23585, PB 12891, Suphan Burl 1 and Rio. The contents of CP, NDF and ADF of the second cutting were lesser than the first cutting. The highest values of DMD were found with E 35-1, UT 470-2 and Suphan Buri 1 for the first cutting whilst the second cutting was with Rio, IS 23585, UT 538-B, PB 12891 and E 35-1. Out of the ten sorghum cultivars being used, IS 23585 and Rio could be considered as the best cultivars for feed stuffs of ruminant animals.

Key words: Cultivars, sorghum, dry matter yield, chemical components and dry matter degradability

Introduction
In term of animal feed, sorghum generally plays its significant role in providing nutritious feed stuff to herd of cattle both dairy and beef. This crop has its outstanding drought tolerant to dry conditions which is generally found in most area of the tropics where erratic rainfall pattern is obviously observed. Sorghum plants as feed stuff could be fed to animals as fodder i.e. cut and carry and also in the form of silage. The silage of sorghum plants could be preserved and used as an excellent feed stuff for dry season when grass and legume crops could not thrive on well. In Thailand, there is only a limited amount of published data on forage sorghum cultivation available. Therefore, it is of a tangible value to carry out more experiments of sorghum plants in order to search for outstanding cultivars those adapted well to the environment and produce high out put of both quantity and quality of feed stuff. Suonato *et al.* (1991) showed that U-Thong variety adapted well to the Thai environment. The plants produced such an excellent fodder for feed stuff and the ratoon produced a considerable amount of seeds whilst Phaikaew *et al*. (1992) reported that sucrose content of sorghum stem increased with time whilst that of the HCN decreased. The highest protein content (7.7%) of the whole plant was found at day 45 after emergence and did the values of NDF, ADF and DMD, 59, 32 and 61 percent, respectively. Agnal *et al*. (1992) showed that Rio cultivar gave the highest seed yield, juice quality and sugar concentration at 120 days after sowing due to the highest ratio of NPK chemical fertilizer added to the soil (100, 60, 30 kg/ha, respectively). Similarly, Powell and Hons (1992) reported that among sorghum cultivars, forage sorghum plants (cv. Grass 1) produced the highest both efficiency of fertiliser being used and dry matter accumulation.
The objective of this study was to identify and select sorghum for outstanding characters both quantity and quality of feed stuff for livestock production and also to produce more data on this particular cash crop since there are less amount of published works available.

Materials and Methods
The experiment was carried out at Khon Kaen University Farm, Khon Kaen, Thailand during rainy season of 1996. Seeds of ten sorghum cultivars were obtained from Saraburi Field Crop Research Station, Thailand. The experiment was laid in a randomised complete block design with four replications. Each cultivar was used as a treatment. The soil being used was an Oxic Paleustult with the mean values of soil pH, percentage of nitrogen, available phosphorus and exchangeable potassium of 5.8, 0.026%, 36 ppm and 44 ppm, respectively. The land was ploughed twice and harrowing once. A few seeds of each sorghum cultivar were sown directly into the soil to the depth of 3-4 cm per hill at the distances between rows and within the row of

60x10 cm, respectively. The plot size being used was a 4×6 m. Three weeks after emergence, seedlings were thinned out leaving only one seedling per hill. The first application of chemical fertiliser 15-15-15 NPK at the rate of 78 kg/ha was banded along the rows of the sorghum plants at the same day of thinning. At day 90 after emergence, ten sorghum plant samples of each plot were taken for the determinations of extractable juice concentration, dry weight per plant and chemical component analysis. The second application of chemical fertiliser at the rate of 78 kg/ha was banded right after the first cutting to ease the growth of ratoons. The ratoon plant samples from each plot were taken at day 70 after the first cutting and then these ratoon plant materials were used as that of the first cutting.

The whole plant materials at each harvest were dried in an oven at 60°C for 5 days to determine dry matter yield per plant and then ground into meshes for the analysis of chemical components. The determination of extractable lice concentration was carried out by a hand refractometre, Atago, N1, Japan. The analysis of crude protein (CP) was carried out by Kjeldal method, neutral detergent fibre (NDF), acid detergent fibre (ADF) by the method of Goering and Van Soest (1970) and dry matter degradability (DMD) by the method of nylon bag technique of Orskov *et al.* (1980). All of the data obtained were statistically analysed except that of chemical components.

Results and Discussion

Dry Matter Yield: Of the ten sorghum cultivars being used, in the first cutting, the results showed that mean total dry matter yield per plant was considerably highest with Rio, IS 23585 and E 35-1 (Table 1). These three cultivars seem Rio adapt themselves well to the environment and also This produced the highest amount of total dry matter yield per plant followed by IS 23585 and E 35-1, hence these three cultivars may be of significant value for crop production. Other cultivars gave less amount of total dry matter yield. This may be attributed to their genetic traits of the crop plants. With the second cutting of ratoons, the results revealed that Rio did not give total dry matter yield as high Suphanburi 1 and IS 23585. These cultivars were the highest followed by UT 470-2, UT 480-1, Rio, UT 538-B, UT 786-B, PB 12891, E 35-1 and U-Thong 1, respectively. Most of the cultivars gave a similar amount of total dry matter yield of ratoons except that of the E 35-1 and U-Thong 1. These two cultivars gave the lowest ratoon dry matter yields. The results indicated that if ratoon yield has significant value in adding to total dry matter yield then those cultivars of secondary level of dry matter yield should be accounted. Nevertheless, it seems more likely that the sorghum plants being used produced a similar habit of ratoon production and the ratoon being produced may have contributed only a small amount of dry matter yield in adding to the first cutting. Therefore, ratoon yields may not of value if the plants are grown under rain-fed condition where dry spells reach out more rapidly. It may be inferred that total dry matter production per plant as a whole from the first cutting should be of importance in providing the that amount of fodder and silage production. The results confirm the work reported by Phaikaew *et al*. (1992). With total dry matter yield as a whole, the results revealed that the highest was with Rio, IS 23585, E 35-1 and the rest were of secondary importance. Therefore, these three cultivars have adapted well to Northeast Thailand environment better than the rest and they may be of significant value for further experiments.

Extractable Juice Concentration: With extractable juice concentration, the results showed that at the age of 90 days after emergence, brix values were highest with Suphanburi 1, UT 470-2 and U-Thong 1 followed by UT 408-1, Rio, UT 786-B, UT 538-B, PB 12891, IS 23585 and E 35-1, respectively (Table 2). The results indicated that at this plant age, there were only three cultivars gave statistically significant differences. However, brix values of the cultivars could be related to plant age as reported by Phaikaew *et al*. (1992). Therefore, in term of brix values, it may be of imperative value to carry out experiment of each cultivar in order to justify brix value for utility purposes since life cycle of the crop plants may not be the same. Brix value may be recognised as soluble carbohydrate in water and it normally plays its significant role in silage making i.e. an adequate amount of soluble carbohydrate content facilitates high quality of silage product as reported by McDonald (1981).

Table 1: Dry matter yield of ten sorghum cultivars at days 90 (first cutting) and 160 (second cutting) after emergence grown on Oxic Paleustult soil at Khon Kaen University, Thailand

	Dry matter yield (g/plant)		
Cultivars	First cutting	Second cutting	Total
UT 408-1	113.2cd	74.0a-c	187.2bc
UT 786-B	87.9c-e	67.9a-c	155.8cd
UT 538-B	91.5c-e	69.6a-c	161.0cd
UT 470-2	81.5de	77.1ab	158.6cd
E 35-1	149.5ab	51.7bc	201.2a-c
PB 12891	122.9bc	61.4a-c	184.3bc
IS 23585	151.2ab	78.2a	229.4ab
Rio	166.4a	72.6a-c	239.0a
U-Thong 1	64.5e	49.3c	113.8d
Suphanburi 1	98.2c-e	85.6a	183.8bc
CV (%)	20.56	22.48	18.06

Table 2: Extractable juice concentration (Brix value) of ten sorghum cultivars at days 90 (first cutting) and 160 (second cutting) after emergence grown on Oxic Paleustult soil at Khon Kaen University, Thailand

Cultivars	First cutting	Second cutting
UT 408-1	18.0bc	15.2b-d
UT 786-B	16.3de	13.1d
UT 538-B	16.2de	14.8b-d
UT 470-2	20.1a	19.2a
E 35-1	13.4f	14.6b-d
PB 12891	14.8ef	13.2d
IS 23585	14.3f	13.0d
Rio	17.1cd	15.8bc
U-Thong 1	18.9ab	13.9cd
Suphanburi 1	20.4a	16.3b
CV (%)	5.99	9.49

Table 3: Chemical components (CP, NDF and ADF) of ten sorghum cultivars at days 90 (first cutting and 160 (second cutting) after emergence grown on Oxic Paleustult soil at Khon Kaen University, Thailand

	First cutting (%)			Second cutting (%)		
Cultivars	CP	NDF	ADF	CP	NDF	ADF
UT 408-1	5.51	67.63	36.90	3.95	65.71	35.51
UT 786-B	4.84	69.04	36.93	4.54	62.74	34.49
UT 538-B	4.60	66.65	37.08	4.24	65.39	35.76
UT 470-2	5.47	61.71	33.33	4.04	60.59	33.22
E 35-1	6.38	66.71	34.65	3.59	62.80	34.88
PB 12891	6.79	55.19	30.02	4.95	65.91	35.54
IS 23585	6.14	52.10	26.05	4.37	57.14	29.81
Rio	5.66	61.06	31.28	3.30	59.56	31.49
U-Thong 1	4.80	65.08	36.28	4.34	66.64	35.63
Suphanburi 1	5.88	60.23	36.68	5.10	61.67	32.22

Table 4: Dry matter degradabilty (DMD,%) of ten sorghum cultivars at days 90 (first cutting) and 160 (second cutting) after emergence grown on Oxic Paleustult soil at Khon Kaen University, Thailand

	First cutting		Second cutting	
Cultivars	24	48	24	48
UT 408-1	52.81d	69.98d	51.61d	67.46b
UT 786-B	54.29b-d	69.77d	51.61d	64.11c
UT 538-B	60.34a	74.23a-c	56.00a-d	69.94ab
UT 470-2	58.78a-c	74.95ab	59.14ab	67.56b
E 35-1	61.60a	75.41a	59.09ab	70.05ab
PB 12891	59.39ab	72.14a-d	57.80a-c	69.68ab
IS 23585	60.36a	73.16a-d	54.23b-d	70.14ab
Rio	60.15a	71.42b-d	60.24a	71.75a
U-Thong 1	53.54cd	70.71cd	52.55cd	63.52c
Suphanburi 1	62.91a	74.74ab	55.11a-c	69.22b
CV (%)	05.92	02.59	05.71	02.17

Chemical Components: For chemical components of ten sorghum cultivars at the first cutting, the results revealed that CP content was highest with PB 12891 followed by E 35-1, IS 23585, Suphanburi 1, Rio, UT 408-1, UT 470-2, UT 786-B, U-Thong 1 and UT 538-B, respectively (Table 3). The results indicated that CP contents of sorghum cultivars differed among cultivars (3-6%). Nevertheless, with this plant age, the CP content was not up to acceptable value. That is the value was not exceeded 7 percent as stated by Milford and Minson (1966). These workers have stated that the CP content was not exceeded 7 percent. This could be considerably inadequate for metabolic process of microorganisms in the ruminant animals. The results attained were similar to the work reported by Andrew and Robins (1971). Nevertheless, if these sorghum plant materials must be used for feed stuffs then some additional amount of calcium and phosphorous at the ratio of 1:1 must be added. This could possibly assist in gestating and lactating cows, plus avitamin A supplemented as reported by Corah (1979). It may be possible that at this stage of growth, a large amount of nitrogen may have transferred to seeds, hence less amount of crude protein available in the plant tissues as reported by Blaser *et al*. (1986). With NDF content, the highest value was with UT 786-B followed by UT 408-1, E 35-1, UT 538-B, U-Thong 1, UT 470-2, Rio, Suphanburi 1, PB 12891 and IS 23585, respectively. The greater the NDF value the poorer the quality of feed stuff. High NDF content affects digestibility of ruminant animals and reduces feed intake as metabolic process is affected by low amount of nitrogen in feed stuffs, hence reducing microorganism activities.

With ADF contents of the first cutting, the results showed that UT 538-B gave the highest value followed by UT 786-B, UT 408-1, Suphanburi 1, U-Thong 1, E 35-1, UT 470-2, Rio, PB 12891 and IS 23585, respectively. The ADF contents at day 90 after emergence were much lower than those reported by Phaikaew *et al*. (1992). The results indicated that feed quality of these sorghum cultivars could be of acceptable feed stuff although ADF may have some effects on digestibility process in ruminants. There were no trends found on CP, NDF and ADF contents of the second cutting of ratoons. In general, CP, NDF and ADF contents of the ratoons were smaller than that of the first cutting. Therefore, these ratoon plant materials could be of value for use as feed stuffs for ruminant animals.

Dry Matter Degradability: With DMD, the results indicated that dry matter being degraded in rumen for 24 hours of the first cutting was highest with Suphanburi 1, E 35-1, UT 538-B, IS 23585 and Rio, followed by PB 12891, UT 470-2, UT 786-B, U-Thong 1 and UT 408-1, respectively (Table 4). The differences were large and statistically significance. With 48 hours, the results showed that DMD values were highest with E 35-1 followed by UT 470-2, Suphanburi 1, UT 538-B, IS 23585, PB 12891, Rio, U-Thong 1, UT 408-1 and UT 786-B, respectively. There was no trend found between the two degraded periods and only E 35-1 retained the highest DMD followed by the rest. The results were similar to those reported by Devahuti *et al*. (1992) but greater than those reported by Phaikaew *et al*. (1992). With the second cutting, the results revealed that DMD values, in most cases, were similar to that of the first cutting. The results indicated that a large amount of degradable feed stuff must have been used at a large extent and only some small amount left out by the digestibility processes. The results also indicated that sorghum feed stuff could be fed as fodder or silage for herd of cattle particularly during dry season.

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