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Productivity of Sugarcane as a Component of Animal Feed

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ABSTRACT

The present research work was undertaken to study the quantitative and qualitative evaluation of sugarcane by products as live-stock feeds.Germplasms available in Bangladesh Sugarcane Research Institute (BSRI) were screened and 53 potential clones were selected for fodder sugarcane. All the clones were cultivated at BSRI. Finally eight clones of sugarcane were selected on the basis of their total biomass yield, nutritive value and their physical growth. Biomass yields of these clones from 212 t ha^{-1} to 334 t ha^{-1}. Seven local varieties ofsugarcane available at farm level were cultivated introducing cowpea as a mixed crop at the beginning. Biomass yield of different local varieties of sugarcane varied from 46 to 108 t ha^{-1}. *Noati* (local name) gave the highest biomass yield (108 t ha^{-1}) followed by V-527 (75 t ha^{-1}), Ishurdi (67 t ha^{-1}), Nol-527 (59 t ha^{-1}), Calping (49 t ha^{-1}) and Misridana (46 t ha^{-1}). Significant (p 0.05) difference in biomass yields of different varieties of sugarcane was found. The biomass yield of cowpea was 26.0 t ha^{-1}. It concluded that the fresh matured sugarcane leaves may be harvested and fed to ruminants throughout the year without affecting the growth of the plant. Sugarcane tops, bagasse enriched with urea and molasses may be fed to the cattle in the sugarcane growing areas.

Key words : Sugarcane, sugarcane by-product, variety, clone, biomass yield.

INTRODUCTION

Feed shortage is the major constraint to livestock production in Bangladesh. The chief source of roughage for cattle is the paddy straw. Present production of strow is inadequate. Therefore, attention has been diverted to make the best possible utilization of unconventional sources of agricultural and industrial by-products as cattle feed. Morrison (1954) suggested that cattle could be kept in good condition on a mixture of sugarcane bagasse, molasses and soyabean oil meal. He also found that dried bagasse can supply as much TDN as straw. Murty and Sharma (1969) used sugarcane bagasse successfully as roughage for adult ruminants. Joshi and Rangukar (1979) reduced cost of feeding by using bagasse without affecting growth. Sugarcane is highly productive and efficient in converting solar energy into biomass. Traditionally, it has been cultivated and processed

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primarily for production of sugar since mid-1960s. However, sugarcane has been a focal point of activities directed at developing alternatives to straw of cereal grains as a means of intensifying tropical livestock production (Preston, 1995). Presently it is envisaged as a multipurpose crop with an important role in animal production (Mui., 1996). Land scarcity and high population density in the country resulted in a competition for sparing land to produce forage crops. Integration of forage crops with cash crop production systems and development of dual purpose crops for human and animal feed are few options for alleviating livestock feed shortage in the country.

Although some grasses produce a lot of biomass during rainy season but they do not produce much in the dry season. The unique feature of sugarcane is that it remains green throughout year and has more sugar in dry season than the wet season. These features make it an excellent feed researve at the time when it is needed most. Most of the research with sugarcane as feed for ruminants involve in feeding tops, pressed stock (bagasse) or whole cane (Preston, 1995). However, these products/by-products can only be obtained at end of harvest. While sugarcane stand in the field for 10-14 months, when a large production of matured green leaves are allowed to dry with the stock. These matured leaves can be harvested and fed to rumiants throughout the year without affecting growth of the plant. However, these leaves contain very low N (<1%) and high fibre (38-40% ADF) which as such cannot meet nutrient requirement for the microbes in the rumen. Enriching leaves with urea and molassses can ensure fermentable N and energy supply to microbes in rumen (Huque and Chowdhury, 1995). After harvesting of sugarcane, these products or by-products may be used as a feed supplement for cattle. Hence, the present research work was undertaken with a view to study quantitative and qualitative evaluation of products/by-products of different available varieties/clones of sugarcane.

MATERIALS AND METHODS

The experiments were conducted in the research field at the Bangladesh Sugarcane Research Institute (BSRI) and Bangladesh Livestock Research Institute (BLRI). BSRI selected 53 clones of sugarcane plants considered to be potential to utilize as fodder crops from sugarcane germplasms bank. All the clones were cultivated in the BLRI research plot. Finally, eight clones of sugarcane were selected on the basis of their total biomass yield, nutritive value and their physical growth. On the other hand, extraction rates of juice, green leaves, seeds, bagasse and raw sugar (gur) of local varieties were determined at BLRI and variations in the extraction rates among the available sugarcane varieties were also determined at BSRI. Biomass produced from sugarcane was preserved following method developed by the BLRI. Experiments were carried out desberment biomass production performance of different varieties/clones of sugarcane.

Seperation of different varieties of sugarcane : Seven local varteties of sugarcane were cultivated with cowpea as intercrop at the beginning under same management and production of biomass for feeding ruminants were evaluated and seperated at BLRI. Yield of biomass of different parts of a variety of sugarcane was determined. Production of green leaves, dry leaves, stalks and tops were also measured after harvesting of sugarcane. The stalks were further divided into juice and bagasse. Extracted juice was boiled for gur and molasses production. Matured leaves, bagasse and juice were used as ruminant feed.

Yield of matured leaves : The initial leaves starting from bottom of stock having slight yellowish taint were considered as the matured leaves. Matured leaves from each variety from three different locations having an area of 2x2m^2 were collected and masured.

Clonal selection of sugarcane plants for fodder production : All the clones were grown at BLRI research farm to determine potential one. Data were recorded in terms of plot coverage, new growth, height, spread, leafiness, biomass yield, number of clumps per meter square and number of tiller per clump. The chemical composition of different potential fodder cane was also determined. In situ, digestibility of clone number S-14, S-25 and S-EX of sugarcane were measured by incubating dried and ground (hammer milled through 4 mm sieve) samples in rumen of normal roughage fed animals respectively for 8, 16, 24, 48 and 72 h on following method of Ørskov and McDonad (1979). Data of DM degradability were then fitted to the exponential model $Y = a + b\ (l\text{-}e^{-ct})$ of McDonald (1981) using NAWAY computer programme.

Chemical analysis : Samples of feeds, refusals and faeces were analyzed for dry matter (DM), ash, organic matter (OM) and N according to AOAC (1984). Urinary N also meassured in the same way. The acid detergent fibre (ADF) was determined according to Georing and Van Soest (1970).

Statistical Procedure : Data were analyzed by an ANOVA of completely randomized design using SPSS analysis by computer. Statistical methods of Snedecor and Cochran (1976) was used for the analysis.

RESULTS AND DISCUSSION

Biomass yield : Biomass yields of different parts of different varieties of sugarcane varied from 16 to 108 t ha^{-1} are shown in the Table 1. It was the highest for Noati (108 t ha^{-1}) followed by V-527 (75 t ha^{-1}), Misridana (46 t ha^{-1}), Nol-527 (59 t ha^{-1}), Calping (49 t ha^{-1}) and Ishurdi (67 t ha^{-1}). The biomass yields of green leaf in different varieties did not vary significantly (P> 0.05), but significant (P<0.05) were recorded changes in biomass yields of dry leaf, cane, juice and bagasse in different varieties of sugarcane (Table 1). The biomass yield of cowpea was 26 t ha^{-1}.

Yield of Mature Leaves : Yield of mature leaves in different varieties of sugarcane are shown in the Table 2. Yield of fresh mature leaves varied from 3.33 to 6.46 t ha^{-1}. Higher yield was observed in local varietiers (e.g., Mishridana, Noati) of sugarcane.

Biomass yield and other characteristics of different clones of fodder cane : Out of 53 fodder cane, fifteen clones grew well. Soft leaf and their fresh biomass yields (t ha^{-1}) of immature and mature potential fodder cane from a harvest are shown in the Tables 3 and 4. Other clones of fodder cane did not grow well. Biomass yield and other characteristics of less potential clones of fodder cane are shown in the Table 5.

Table 1. Biomass yields (t. ha^{-1}) of different parts from different varieties of Sugarcane.

Character	Noati	V-527	Misridana	Nol-527	Calping	Ishurdi	Mean	SED	Significance
Total biomass yield	108.1	74.6	45.9	58.8	48.9	67.4	67.28	25.13	$p<0.05$
Dry leaf yield	9.0	5.2	2.3	3.7	3.2	3.2	4.4	1.94	$p<0.01$
Green leaf yield	17.3	13.9	10.1	7.9	10.2	14.2	12.3	6.77	$p>0.05$
Cane yield	81.8	55.6	31.6	47.2	35.6	50.0	50.3	18.72	$p<0.01$
Yield of juice	38.4	30.3	17.5	26.0	18.2	25.7	26.02	9.59	$p<0.01$
Bagasse yield	30.9	25.3	14.0	19.2	13.9	20.2	20.58	6.79	$p>0.01$
Gur yield	5.1	4.0	2.2	3.3	2.6	3.5	3.5	1.22	$p<0.05$
Yield of mature leave	5.8	5.0	6.5	3.3	5.3	4.78			

Table 2. Mean yield of mature sugarcane leaves by different varieties of sugarcane

Name of variety	Yield (t. ha^{-1})	SEM
Noati	5.83	0.819
Ishurdi	4.75	0.248
Calping	5.29	0.179
V-527	5.00	0.361
Nol-527	3.33	0.81
Mishridana	6.46	0.531

SEM = Standard error of mean

The chemical compositions of less potential and potential clones of fodder cane are presented in the Tables 6 and 7 respectively. Table 7 shows that S-1, S-15, S-2 and S-3 numbered clones contained the highest ADF. Finally, eight clones of sugarcane were selected on the basis of their total biomass yield, nutritive value and their physical growth. Biomass yield of these clones varied from 212 to 334 t ha^{-1}. These clones have been shifted to experimental plots of germplasm bank and grown for further study to determine potential one.

Rumen degradability of potential clones of sugarcane : Rumen degradability of clone number S-14, S-25 and S-EX of sugarcane at different hours of incubation are shown in the Table 8. The 48 h in situ degradability of clone number S-14, S-25 and S-EX were 55, 49 and 57% and rate of degradation were 0.02, 0.06 and 0.03% respectively.

It may be concluded that Noati was the best local variety among varieties tested on basis of total biomass yield. Eight clones of fodder cane were selected on the basis of their total biomass yield, nutritive value and their physical growth among the clones. Sugarcane is generally cultivated for sugar/gur production. It is a very high bio-mass yielding 4-plant which remains green throughout the year. During its growth matured green leaf can be harvested round the year and at harvest, tops and bagasse can be used for feeding ruminants.

Table 3. Total biomass yield and other characteristics in different potential clones of (immature fodder cane) at 173 d.

Name of clone	Fresh biomass yield (t ha^{-1})	Total biomass yield DM basis (t ha^{-1})	No. of clump/m^2	No. of tiller/ clump	Height (cm)	Spread (cm)
S-14	190	34	4	28	126	81
S-EX	160	28	4	32	106	76
S-16	140	20	4	47	105	77
S-15	120	21	4	43	118	93
S-25	110	18	4	46	50	88
S-27	90	17	4	27	75	80
S-64	90	20	4	21	75	94
S-1	80	15	4	41	101	62
S-2	80	16	4	20	75	95
S-3	80	15	4	32	100	61
S-19	80	17	4	26	100	72
S-4	70	13	4	31	95	67
S-28	70	11	4	15	55	80
S-33	70	14	4	11	60	89
S-37	70	12	4	24	90	87

Table 4. Yield (t. ha^{-1}) of different mature potential fodder cane clones.

Name of clone	Biomass yield (t. ha-1)					
	Total biomass	Dry leaf	Green leaf	Stem	Seed yield	Height (cm)
S-14	296	12	92	40	152	292
S-EX	229	14	53	27	135	257
S-16	322	16	108	50	148	275
S-15	258	8	70	36	144	263
S-25	160	6	34	18	102	263
S-27	312	12	84	36	180	270
S-1	139	12	41	21	64	245
S-2	334	8	94	40	192	288
S-3	212	16	40	24	132	218
S-4	176	12	56	28	80	235
S-28	148	8	40	28	72	260
S-33	116	12	16	32	56	240
S-37	152	12	28	32	80	280

Table 5. Total biomass yield and other characteristics of different less potential clones (immature fodder cane) at 173 d.

Name of clones	Fresh biomass yield (t ha^{-1})	No. of clump/M	No of tillers/ clump	Height (cm)	Spread (cm)	No of new growth tiller/clump
S-7	50	4	23	75	53	6
S-8	40	4	19	50	65	5
S-9	50	4	21	70	62	6
S-17	30	3	15	60	82	4
S-18	40	3	16	75	77	5
S-21	20	3	12	45	70	6
S-22	30	4	28	65	69	6
S-23	40	4	10	50	88	5
S-30	60	4	21	555	83	6
S-31	50	4	13	60	73	5
S-34	60	4	36	85	74	5
S-35	40	4	11	70	63	5
S-36	20	3	8	65	57	4
S-40	40	4	25	55	65	6
S-41	30	3	25	35	78	6
S-42	20	3	18	50	64	4
S-43	30	3	15	45	74	4
S-53	20	4	15	50	76	6
S-54	10	3	13	50	59	5
S-55	30	4	12	30	75	5
S-56	30	4	23	50	88	6
S-57	20	4	10	50	91	5
S-58	30	4	11	35	92	5
S-59	60	4	18	85	93	5
S-60	20	4	11	55	93	6
S-61	30	4	11	60	61	5
S-62	50	4	21	90	85	5
S-63	50	4	19	95	87	6

Table 6. Chemical composition (% DM) of different less potential clones of fodder cane.

Name of clone	Dry matter (%)	Ash	Crude protein	ADF
S-5	23.08	8.65	10.53	47.52
S-6	21.95	7.87	13.61	41.15
S-7	23.16	8.67	13.33	43.48
S-8	23.14	7.81	8.92	49.90
S-9	19.78	8.33	18.90	53.22
S-10	22.30	10.25	12.61	44.80
S-11	19.63	8.78	11.16	41.78
S-12	22.55	8.63	8.49	43.69
S-17	23.50	2.74	8.79	48.42
S-18	21.02	6.37	10.54	51.39
S-21	18.43	1.29	11.50	61.16
S-22	17.08	6.24	14.64	64.65
S-23	17.82	7.15	11.63	46.51
S-24	19.57	3.75	13.68	52.47
S-26	17.04	7.14	13.04	53.40
S-29	18.24	3.31	8.98	54.08
S-30	21.01	4.17	10.03	43.80
S-31	17.42	5.65	14.19	43.89
S-32	17.97	7.58	10.54	44.90
S-34	23.94	8.11	13.42	36.83
S-35	23.78	8.55	16.12	41.38
S-36	19.65	16.10	17.62	43.41
S-39	21.08	8.10	15.32	41.09
S-40	20.27	13.39	15.05	35.08
S-41	22.69	5.86	20.15	32.91
S-42	21.09	7.17	15.67	43.54
S-53	19.83	4.89	8.97	48.89
S-54	24.63	4.55	10.30	41.99
S-55	27.55	5.70	11.50	38.38
S-56	24.87	5.63	12.00	34.21
S-57	26.03	4.66	8.60	30.58
S-58	25.16	4.27	9.70	42.20
S-59	20.36	8.83	11.65	41.10
S-60	24.18	5.53	7.50	43.87
S-61	22.88	6.15	13.72	45.03
S-62	14.17	10.66	23.01	40.00
S-63	24.09	6.97	-	36.70

Table 7. Chemical composition (% DM) of different potential clones of fodder cane.

Name of clone	Dry matter (%)	Organic matter	ADF	Crude protein	Lignin
S-1	19.02	87.62	58.26	9.75	3.25
S-2	19.88	88.29	55.16	15.71	3.15
S-3	18.63	91.68	54.59	13.72	2.94
S-4	19.11	88.94	43.68	12.34	1.98
S-14	17.91	94.44	49.80	8.22	6.98
S-15	17.58	93.93	56.05	10.07	3.96
S-16	14.59	93.72	48.74	7.29	3.77
S-19	21.42	94.72	41.02	14.32	4.09
S-25	15.98	96.53	45.22	7.70	4.58
S-27	18.46	91.21	39.65	8.51	8.81
S-28	15.89	97.97	50.49	8.76	6.76
S-33	20.05	90.85	42.05	14.58	4.48
S-37	17.69	84.92	33.40	7.12	2.88
S-64	22.23	93.44	42.85	14.00	3.61
S-EX	17.28	90.29	43.87	15.31	3.43

Table 8. Rumen degradability of clone number S-14, S-25 and S-EX at different hours of incubation and rate constants of the equation $Y = a + b\,(l\text{-}e^{-ct})$

Hours of incubation	Clone number S-14	Clone number S-25	Clone number S-EX
8	22.08	21.46	23.19
16	31.10	33.56	33.65
24	31.85	44.31	39.59
48	48.75	54.94	56.56
72	54.43	57.58	61.47
a	14.65	-0.23	10.20
b	53.44	59.08	57.82
c	0.0195	0.056	0.032
RSD	2.76	1.08	1.40

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