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EFFECT OF UREA TREATMENT ON CHEMICAL COMPOSITION AND OXALATE CONTENT OF SUGARCANE TOPS

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ABSTRACT
The study was conducted in Maharashtra state to investigate the effect of urea treatment on chemical composition and oxalate content of sugarcane tops. The treatment was done in under-ground concrete silo pit. Four kg urea was dissolved in 50 litres of clean water for 100 kg sugarcane tops on dry matter basis. As a result of urea treatment, crude protein (CP), acid detergent fibre (ADF), cellulose and acid detergent lignin (ADL) content of sugarcane tops (SCT) increased by 127.72, 10.45, 10.75 and 29.25 per cent, respectively. Whereas neutral detergent fibre (NDF) and oxalate content of SCT was reduced by 6.78 and 52.28 per cent, respectively. There was significant difference ($P< 0.05$) in DM, CP, Ash, oxalate, NDF, ADF, ADL and cellulose content of SCT after urea treatment. However, non significant variation ($P>0.05$) was observed in crude fibre (CF), ether extract (EE) and nitrogen free extract (NFE) content of SCT. Urea treatment can considerably reduce the oxalate content of sugarcane top. Besides, it showed significant improvement in proximate nutrients and cell wall constituents of sugarcane top after urea treatment.

KEYWORDS: Urea treatment, oxalate content, sugarcane tops, proximate nutrient, cell wall constituent.

INTRODUCTION

Sugarcane top is a major by-product of the sugar industry which is often left in the field unutilized after harvest. The sugarcane top consists of 3 distinct parts: the green leaves (blades), the leaf sheath bundle and variable amount of immature cane. The yield of tops varies considerably with variety, age at harvest, growing condition and management practices (Naseeven, 1988; Nguyen *et al*., 1997; Granzin, 2005). In Maharashtra state approximately 20 million tons of cane tops are available which is extensively used for animal feeding. In this state during the season of sugarcane crushing, the livestock owners use sugarcane tops as a major source of feed. Village survey across different farmer categories in Maharashtra indicated that sugarcane tops constitutes between 20 to 70 per cent of the dry matter available to cattle during the dry season. In some parts it is common to strip leaves from sugarcane for feeding animals without loss of cane yield (Dhavan, 2002). Sugarcane tops are poor quality roughage, lacking in protein and minerals and the feed has low energy value (Leng and Preston, 1985). Sugarcane tops, however, acquire some importance in view of their availability at low cost during the period when other green fodders are not available. It is generally highly palatable and its voluntary consumption is good when they are chaffed and fed. The total digestible nutrients and digestible crude protein content vary between 50 to 55 and 2.0 to 2.5 per cent, respectively (Rangnekar, 1988a). Sugar cane tops treated with urea had shown a remarkable increase in its crude protein contents (Noroozy and Alemzadeh, 2006; Pholsen *et al.* 1996; Rangnekar,1988b). Whereas, there was slight change in fibre content with higher cellulose and lignin contents and lower hemicellulose content (Pholsen *et al.*, 1996).This study was conducted with the aim of investigating the effect of urea treatment on chemical composition and oxalate content of sugarcane tops.

MATERIAL AND METHODS

Location and climate f the study area

The study was conducted at Research Cum Development Project (RCDP), which is located 160 km North East of Pune city. The area lies at 569 m above sea level on the 18^o 32' north latitude and 73^o 51' at east longitude, also this area is categorized under semi-scarcity zone of Maharashtra state. The area has a bimodal pattern of rainfall and it receives an annual rainfall of 530.5 mm. The average maximum (39 ^{0}C) and minimum (10.8^{0}C) temperature was recorded in May and December month, respectively. The average minimum humidity of 39.55% and the maximum humidity of 73.99% were observed in the month of March and August, respectively. The study area has three main seasons: rainy season (June to October), winter season (November to February) and summer season extends from March to May month (Mahathama Phule Agricultural University Meterology Station).

Procedures for urea treatment of sugarcane top

The treatment was done in under-ground concrete silo pit. Four kg urea was dissolved in 50 litres of clean water for 100 kg sugarcane tops on dry matter basis. Green sugarcane tops of C0- 86032 variety which had 32% dry matter was chopped in to the size of 2-3 cm prior to ensiling process. Green sugarcane top in batches of 25 kg

was spread in the silo. Four litres of urea solution were sprinkled uniformly over 25 kg green sugarcane top by using a sprinkler. The treated sugarcane top was mixed using a fork. Further batches were treated following similar procedures. After treating one layer of sugarcane top, it was pressed by trampling before the next layer was placed. The silo pit was filled and the stack was covered tightly with a plastic sheet to exclude the entrance of oxygen and prevent ammonia from evaporating. The stack was loaded with sacks full of soil. The treated sugarcane top was ensiled for three weeks.

Chemical analysis of feed samples

Samples of urea-treated sugarcane top was aerated for 24 hours and pre-dried at 65^{o}C for another 24 hours to allow evaporation of free water and loosely bound ammonia. The main purpose of the aeration and pre-drying was to help for detecting the amount of nitrogen which was chemically fixed to the sugarcane top structure after treatment.

The treated and untreated sugarcane samples were analyzed for dry matter (DM), Ash, crude protein (CP), ether extract (EE) and crude fibre (CF) content according to the methods of AOAC (1990).

The neutral detergent fibre (NDF) content of untreated and urea-treated sugarcane top samples was analyzed according to Goering and Van Soest (1970), while acid detergent fibre (ADF) and acid detergent lignin (ADL) contents were determined according to AOAC (1990). Oxalate content of untreated and urea-treated sugarcane top samples was determined according to Abeza *et al.* (1968). All the analyses were run in triplicates.

Statistical analysis

The statistical analysis regarding the proximate nutrients, cell wall constituents and oxalate content of untreated and urea-treated sugarcane top samples was analyzed by employing two sampled t-test through Microsoft Excel Programme. Besides, the standard error was analyzed according to JMP5 statistical package.

RESULTS & DISCUSSION

Chemical composition of untreated and urea-treated sugarcane tops

The results pertaining proximate composition and cell wall constituents of untreated and urea-treated sugarcane top in terms of per cent DM, CP, EE, CF, NFE, Ash, NDF, ADF, ADL, Cellulose and cell contents are presented in Table 1.

TABLE 1. Proximate and cell wall constituents of untreated and urea-treated sugarcane tops

Parameters (%)	USCT	UTSCT	Overall mean ± SE	t_{cal}	Remark
DM	31.43	28.9	30.17±0.50	3.61	*
CP	2.49	5.67	4.08±0.90	3.55	*
EE	1.98	1.74	1.86±0.64	0.38	NS
CF	30.81	29.02	29.92±3.24	0.55	NS
Ash	6.99	7.63	7.31±0.20	3.30	*
NFE	57.73	55.94	56.84±0.58	0.60	NS
NDF	68.30	63.67	65.99±0.16	29.63	*
Cell contents	31.70	36.33	34.02±0.16	29.63	*
ADF	36.35	40.15	38.25±0.04	93.08	*
Cellulose	29.30	32.45	30.88±0.12	26.47	*
ADL	4.65	6.01	5.33±0.10	12.97	*

USCT = Untreated sugarcane tops, UTSCT = Urea-treated sugarcane tops

t_{cal} = t-calculated, t_{tab} = t- tabulated = 2.78, * = P<0.05;NS = Non-Significant

The per cent DM, CP and ash showed a significant variation (P<0.05) between untreated and urea-treated sugarcane top. Higher CP (5.67%) was observed in urea-treated sugarcane top and the CP increased by 127.72% after urea treatment. As a result of urea treatment of sugarcane top, a significant change in nutrient content was obtained. According to Noroozy and Alemzadeh (2006), the CP content of sugarcane top increased from 1.25 to 6.75 per cent after urea treatment. Similarly, Rangnekar (1988b) found that sugarcane top silage treated with 0.5% urea contained 8.10% crude protein. Pholsen *et al.* (1996) also reported that treating of sugarcane top with 6% urea increased the CP content from 4.2 to 8 per cent. The CP content of urea-treated samples of the present finding was lower than the above reported findings. The per cent DM of urea-treated sugarcane top was in conformity with the result reported by Noroozy and Alemzadeh (2006). However, the per cent DM of untreated sugarcane top samples was lower by 11.17% than the results reported by Patil *et al.* (1999). There was slight increment in EE and Ash content of urea-treated sugarcane tops samples. However, slight reduction was observed in DM, CF and NFE content after urea treatment. There was no significant difference (P>0.05) in respect of EE, NFE and CF contents between untreated and urea-treated sugarcane tops samples. The CF content of USCT sample was in conformity with the findings of Patil *et al.* (1999) and Rangnekar (1988b), however it was lower than the results of 37.40 and 33.50% reported by Rangkuti and Djajanegara (1983) and Naseeven (1988), respectively. The slight reduction in the CF content of UTSCT samples was also in agreement with the findings of Pholsen *et al.* (1996). The Ash content of USCT was lower than the results of 8.50% reported by Naseeven (1988). The NFE content of USCT was higher than the results of 50.30 and 52.96% reported by Naseeven (1988) and Patil *et al.* (1999), respectively. The present study was in agreement with the finding of Bui *et al.* (2000) who reported that the CF and NFE content of sugarcane leaves reduced after urea treatment, but the ash and CP content increased after urea treatment.With regard to cell wall constituents, the NDF content was reduced by 6.78% after urea treatment.

Whereas, after urea treatment cell contents, ADF, cellulose and ADL increased by 14.6, 10.45, 10.75 and 29.25%, respectively. Significant variation (P<0.05) was observed between untreated and urea-treated sugarcane top samples in respect of the cell wall constituents of (NDF, ADF, cellulose and ADL) and cell contents. Treatment of sugarcane tops with urea had shown a significant effect on the cell wall constituents. The NDF content of USCT was lower than the finding of 72.44% reported by Gendley *et a1.* (2003), but it was higher than the result of 65.15% reported by Naseeven (1988). Moreover, Mesfin and Ledin (2004) and Datt and Singh (1996) supported the reduction of NDF content after urea treatment.

The ADL content of USCT was lower than the finding of 6.35% reported by Gendley *et a1.* (2003), but it was conformable with finding of Naseeven (1988). Mesfin and Ledin (2004) and Pholsen *et al.* (1996) reported ADL content increases after urea treatment. The ADF content of USCT was lower than the results of 41.2 and 40.48% reported by Gendley *et al.* (2003) and Naseeven (1988), respectively. The increment of ADF and cellulose content after urea treatment was supported by the findings of Mesfin and Ledin (2004) and Datt and Singh (1996). The increase in ADF and lignin is due to the fact that soluble nutrients like crude protein, nitrogen free extract, ether extract and soluble carbohydrates are dissolved and lost in solution, resulting in increased in cell wall constituents and ash contents in urea-treated samples (Musimba, 1981). The variation in the nutrient content of untreated and urea-treated sugarcane top of the present study as compared with the findings of other researchers might be due to differences in variety, harvesting stage, fertilization practices, treatment period, urea level, quality of forage material, temperature, hermetic condition and ureolysis reaction.

Oxalate content of untreated and urea-treated sugarcane top

The results obtained with regards to oxalate content of untreated and urea-treated sugarcane tops are presented in Table 2. The oxalate content was higher in untreated sugarcane top (3.94 gm/kg) and lower in urea-treated sugarcane top (1.88 gm/kg). After urea treatment, the oxalate content of sugarcane top was reduced by 52.28 per cent. The reduction of oxalate during ensiling might be due to the action of anaerobic microbes which degrades oxalates into carbonates and finally converted to carbon dioxide (Ahuja *et al.*, 1998). Significant variation (P<0.05) was observed between untreated and urea-treated sugarcane top samples in respect of oxalate content.

TABLE 2. Oxalate content of untreated and urea-treated sugarcane tops

Sample type	oxalate (gm/kg)	Overall mean ± SE	t_{cal}	$t_{tab(0.05)}$	Remark
Untreated sugarcane top	3.94				
Urea-treated sugarcane top	1.88	2.91±0.49	4.18	2.78	*

t_{cal} = t-calculated, t_{tab}= t- tabulated, * = P<0.05

The oxalate content of untreated sugarcane samples was in accordance with the finding reported by Anon (2003) in which the oxalate content of sugarcane top was in the range of 0.13 to 0.58 per cent. In the present study the reduction of oxalate content after ensiling with urea treatment was in agreement with the related findings of Ahuja *et al.* (1998) who reported ensiling of hybrid napier bajra variety of PBN-231 and PBN-83 was considerably reduced the oxalate content by 80 per cent. Similarly, Pham (2006) reported that ensiling of *Alocasia macrorrhiza* leaves with 7% rice bran and 2% molasses reduced the calcium oxalate content by 78.8 per cent.

CONCLUSION

Urea treatment can considerably reduce the oxalate content of sugarcane top. Besides, it resulted in significant improvement in proximate nutrients and cell wall constituents of sugarcane top after urea treatment.

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