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PROXIMATE AND FIBRE FRACTION OF ENSILED *bRACHARIA MULATO ii* UNDER DIFFERENT IRRIGATION METHODS AND FERTILIZER TYPES

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ABSTRACT

The study investigated the proximate and fibre fraction of ensiled Brachiaria mulato II harvested under different irrigation and fertilizer types in a 4x2 factorial arrangement using Randomized Complete Block Design (RCBD), there were four irrigation methods and two fertilizer types replicated in triplicate. Data were collected on Crude Protein (CP), Crude fibre (CF), Ether extract (EE), Neutral detergent fibre (NDF), Acid detergent fibre (ADF), Acid detergent Lignin (ADL). All data were subjected to analysis of variance using a general linear model of SAS (2002).

CP was significant for irrigation methods (8.11-11.08), but not for fertilizer types (P=0.33), the interaction effects (p=0.00) significantly affect CP, CF was significant for irrigation methods (18.42-19.65), fertilizer types (P=0.00), and the interaction effects (p=0.00). EE was significant for irrigation methods (P=0.00), fertilizer types (P=0.00), and interaction effects (p=0.00). NDF was significant for irrigation methods (P=0.00). NDF was not significant for irrigation methods (P=0.05), fertilizer types (P=0.31), and their interaction effects (P=0.20), but was significant for ADF and ADL. The study revealed that irrigation methods, manure fertilization and their interactions showed positive effects on the proximate and its fibre fractions

Key words: *Overhead sprinkling, Drip system, Hand watering, Irrigation methods, Cattle dung.*

INTRODUCTION

The availability of a reliable feed supply is a critical determinant of livestock productivity. As green fodder constitutes a major component of ruminant diets (Amole *et al*., 2022). However, inadequate improvements in feed supply and feeding management remain persistent challenges in ruminant production systems, where low productivity is often attributed to the poor quality and limited availability of forage. This scarcity is particularly acute during the dry season, when pastures decline in nutritive value and fail to meet the nutritional requirements of ruminants (Ahamefule, 2010).

Enhancing forage availability requires the adoption of improved agronomic practices and the cultivation of high-performing tropical forage species, which have been shown to outperform indigenous varieties in both yield and nutritional quality (Santos *et al*., 2015). Among the available forages, *Brachiaria mulato II* is recognized as one of the most productive and adaptable improved forage species, capable of thriving across diverse environments and farming systems (Ghimire *et al*., 2015). Its desirable attributes; ease of establishment, resistance to pests and diseases makes it a pasture of right choice (Nyambati *et al*., 2010). Moreover, its productivity and nutritive value can be further optimized through irrigation and fertilization strategies, coupled with forage conservation techniques such as silage production (Sumran *et al*., 2009).

Soil nutrient and water management are central to sustainable forage production. Organic fertilizers function as valuable soil amendments, enhancing organic matter content, nutrient availability, and water-holding capacity while simultaneously reducing bulk density (FAO, 2019). Irrigation systems play a vital role in extending forage production into the dry season by ensuring timely and efficient water application, thus cut the dependence on erratic rainfall (Aras, 2006). Proper irrigation scheduling and the adoption of efficient techniques increase forage yield and optimize water-use efficiency (Al-Dakheel *et al*., 2015). The development of feed conservation strategies, such as silage and haylage, is critical for preserving surplus forage during periods of abundance to redistribute feed availability throughout the year (Muhammad *et al*., 2008). This study aim to investigate the nutrtional profile of *BM II* harvested under different irrigation and fertilizer types.

Materials and Methods

Experimental Site

The experiment was carried out at the Pasture Demonstration plot unit of Teaching and Research Farm, Ladoke Akintola University Technology (LAUTECH), Ogbomoso, Oyo State.

Plot Measurement and Planning

The area of land used measured 24m x 24m, the field was divided into four equal plots (Drip Irrigation, Overhead Sprinkler Irrigation, Hand Spraying and Drenching Irrigation System) with walkway between every two plots, each plot and was replicated thrice and replicates were divided into two different organic fertilizers application (Cattle dung and Rabbit manure).

Experimental design

The experiment was laid in a 4x2 factorial arrangement in a Randomize Complete Block Design. With four irrigation system and two fertilizer types

Procurement of the Seed

Seeds of *Brachiaria mulato II* was procured from Wasambazaji: Amiran Ltd, Abeokuta, Ogun State.

Soil sampling

Soil samples were randomly collected at locations across the entire experimental field using a soil auger, reaching a depth of 15 to 20 centimeters. These soil samples were bulked for each replicate, thoroughly mixed and sub-samples were taken to the laboratory for routine analysis.

Plant Establishment

Bracharia mulato II Seeds were sown at the nursery site of the Pasture Demonstration plot of Ladoke Akintola Teaching and Research Farm for about 6-8 weeks, after which tillers were transplanted to the experimental site.

Planting and Post Planting Operation

The experimental site was cleared before ploughing. This lose the top soil for easy propagation thereafter beds were made at 3 by 3 meters. Seedlings of *Brachiaria mulato II* was planted by vegetative propagation with required spacing of 50 cm between plants with 3 tillers per hole as instructed on the pack. All post planting operations such as cutback, weeding, supplying and fertilizer application were duly carried out at appropriate timing.

Laboratory analysis

Chemical Analysis

Forage samples were harvested at 15th weeks after planting, samples of about 200g were taken within 0.75m^2 quadrants and ground to pass a 1-mm sieve screen using laboratory hammer mill. Then analyzed for crude protein, ether extract and ash contents (AOAC, 1995). Fibre and its fractions including neutral detergent fibre (NDF), acid detergent fibre (ADL) and acid detergent lignin (ADL) were determined (Van Soest *et al.,* 1991). Cellulose was calculated from the difference between ADF and ADL while hemicellulose was also calculated from difference between NDF and ADF.

Statistical analysis

All the laboratory data were subjected to analysis of variance using the general linear model of SAS (2002) and the treatment means were separated using Duncan's multiple range test (DMRT) of the same package at 5% level of significance.

Results

Table 1 Effect of irrigation methods on Proximate and fibre composition of ensiled *Bracharia mulato* II

Effect of irrigation methods on the proximate and fibre fraction of ensiled *Bracharia mulato* II is presented in Table1. All proximate and fibre fractions of ensiled *B mulato* II were significantly affected by irrigation methods (P<0.05) except for Dry matter and neutral detergent fibre that was observed to be similar across treatments (P>0.94). The highest crude protein value (11.08%) was recorded for ensiled *B mulato* II harvested from Overhead irrigation method. This differed significantly (P<0.05) from those harvested from other irrigation methods which had similar values.

Meanwhile, The EE and CF value were significantly (P<0.05) similar across the irrigation methods for ensiled *B mulato* II respectively.

The highest ash (4.57%) content was recorded for ensiled *B mulato* II harvested under Drenching irrigation method while the value in other irrigation method were significantly similar (P<0.05) respectively for ensiled *B mulato* II.

The ADF content of ensiled *B mulato* II harvested from Hand watering irrigation method were significantly (P<0.05) higher (40.22%) than those from other irrigation method, meanwhile the ADL content of ensiled *B mulato* II was observed to be higher (20.18%) in Drench irrigation method and lower (15.48%) under Over head irrigation method.

The Hemicellulose and Cellulose value was observed to be similar across treatment respectively.

Table1. Effect of irrigation types on the Proximate and fibre composition of ensiled *Bracharia mulato* II

Parameter (%)	Over-head irrigation	Drip irrigation	Hand watering	Drenching irrigation	SEM	P-Value
DM	40.12	39.3	41.78	38.36	0.74	0.94
CP	11.08^{a}	8.11^{b}	8.32^{b}	8.42^{b}	0.34	0.00
EE	1.65^{c}	1.92^{a}	1.94^{a}	1.77^{b}	0.03	0.00
CF	19.38^{c}	19.65^{a}	18.42^{d}	19.55^{b}	0.39	0.00
Ash	4.33^{b}	4.38^{b}	3.78^{c}	4.57^{a}	0.21	0.98
NDF	66.1	64.88	65.98	65.03	1.74	0.00
ADF	36.39^{c}	39.91^{b}	40.22^{a}	39.80^{b}	0.45	0.00
ADL	15.48^{c}	20.08^{a}	19.25^{b}	20.18^{a}	0.58	0.00
Hemi	24.57^{c}	25.30^{b}	25.75^{a}	25.24^{b}	0.11	0.00
Cellulose	20.02^{a}	19.83^{b}	21.98^{a}	19.67^{b}		0.00

abc means with different superscripts along the rows are significantly different (P<0.05)

Where, DM= Dry matter, CP = Crude protein, CF = Crude fibre, EE = Ether extract, NDF =Neutral detergent fibre, ADF=Acid detergent fibre, ADL=Acid detergent Lignin SEM = Standard error of means

Table 2. Effect of fertilizer types on the proximate and fibre fraction of ensiled *Bracharia mulato* II.

Effect of fertilizer types on Proximate and fibre fraction of ensiled *B mulato* II is presented in Table 2. All proximate and fibre fractions of ensiled *B mulato* II were significantly affected by fertilizer types except for DM, CP and NDF that was observed to be similar across treatments (P<0.05). The Ester-extract higher significantly (P<0.05) than other treatment for ensiled *B mulato* II fertilized with Rabbit dung (1.86%) and lowest in Cow dung (1.77%). The CF was observed to be higher significantly (P<0.05) than other treatment for ensiled *B mulato* II fertilized with Cow dung (19.68%) and lowest in Rabbit dung (18.81). Ash higher significantly (P<0.05) than other treatment for ensiled *B mulato* II fertilized with Cow dung (4.50%) and lowest in Rabbit dung (4.04%). The NDF higher significantly (P<0.05) than other treatment for ensiled *B mulato* II fertilized with Cow dung (66.38%) and lowest in Rabbit dung (64.17%). The ADF was recorded to be significantly higher (P<0.05) than other treatment for ensiled *B mulato* II fertilized with Cow dung (39.29%) and lowest in Rabbit dung (38.87%). The ADL was observed to be significantly higher (P<0.05) than other treatment for ensiled *B mulato* II fertilized with Cow dung (18.81%) and lowest in Rabbit dung (18.61%). Hemicellulose higher significantly (P<0.05) than other treatment for ensiled *B mulato* II fertilized with Cow dung (25.39%) and lowest in Rabbit dung (25.04%). Cellulose higher significantly (P<0.05) than other treatment for ensiled *B mulato* II fertilized with Cow dung (20.50%) and lowest in Rabbit dung (20.25%).

Table 2. Effect of fertilizer types on the Proximate and fibre composition of ensiled *B mulato* II

Fertilizer types	DM (%)	CP (%)	EE (%)	CF (%)	Ash (%)	NDF (%)	ADF (%)	ADL (%)	Hemi (%)	Cellulose (%)
Cow dung	93.48	9.21	1.77^{b}	19.68^{a}	4.50^{a}	66.38	39.29^{a}	18.81^{a}	25.04^{b}	20.50^{a}
Rabbit dung	92.72	8.76	1.86^{a}	18.81^{b}	4.04^{b}	64.17	38.87^{b}	18.68^{b}	25.39^{a}	20.25^{b}
SEM P-	0.05	0.03	0.04	0.34	0.16	1.61	0.59	0.74	0.14	0.13
Value	0.34	0.33	0.02	0.01	0.01	0.31	0.01	0.00	0.00	0.04

abc means with different superscripts along the rows are significantly different (P<0.05)

Where, DM= Dry matter, CP = Crude protein, CF = Crude fibre, EE = Ether extract, NDF =Neutral detergent fibre, ADF=Acid detergent fibre, ADL=Acid detergent Lignin SEM = Standard error of means

Table 3. Interaction effect of irrigation types and fertilizer types on the proximate and fibre composition of ensiled *Bracharia mulato* II

The interaction effect of irrigation methods and fertilizer types on the proximate and fibre fraction of ensiled *B mulato* II are presented in table 3. The interaction effect of irrigation methods and fertilizer types had a significant (P<0.05) effect on all parameters measured except for DM, ADF and NDF (P> 0.46). The CP content of ensiled *B mulato* II harvested from Overhead irrigation and fertilized with cow dung and rabbit dung were significantly (P<0.05) higher (11.86 and 10.29%) than those from other irrigation method and fertilizer types mean while CP of ensiled *B mulato* II from other irrigation methods fertilized with cow and rabbit dung were however similar. The EE content for the ensiled *B mulato* II was observed to be significantly (P<0.05) similar across the irrigation methods and fertilizer types. The CF value of ensiled *B mulato* II harvested from those Drip irrigation method and fertilized with Cow dung were significantly (P<0.05) higher (21.62%) than other irrigation method and fertilizer types while other methods were significantly (P<0.05) similar. The Ash highest content (5.20%) was observed for the ensiled *B mulato* II harvested from Drip irrigation method and fertilized with cow dung while the value were significantly (P<0.05) similar in other irrigation method fertilized with Cow dung and Rabbit dung. The highest ADF (41.79%) and ADL (22.65%) content was recorded for the ensiled *B mulato* II harvested from Drenching irrigation method and fertilized with cow dung which differed significantly (P<0.05) from those irrigated with other methods, ADF and ADL of *B mulato* II from other methods were however similar. The Hemicellulose content of ensiled *B mulato* II irrigated with Drenching irrigation and fertilized with Cow dung showed significantly higher (25.55%) than those from other irrigation methods and fertilizer types while the value were significantly (P<0.05) similar from all other irrigation methods respectively. The highest Cellulose (21.20% and 21.04%) content was recorded for the ensiled *B mulato* II harvested from Overhead and Hand watering irrigation method and fertilized with Cow dung while their lowest value (19.12%) was observed to be irrigated by Drip irrigation method and fertilized with Rabbit dung.

Table 3. Interaction effect of irrigation types and fertilizer types on the proximate fibre of ensiled *Bracharia mulato* II

Irrigation types	FT	DM (%)	CP (%)	EE (%)	CF (%)	Ash (%)	NDF (%)	ADF (%)	ADL (%)	Hemi (%)	Cellulose (%)
Over heard	CD	42.40	11.86^{a}	1.58^{f}	19.97^{c}	4.05^{d}	60.10	35.98^{h}	14.95^{h}	24.12^{e}	21.04^{a}
	RD	40.49	10.29^{a}	1.73^{e}	18.78^{d}	4.60^{b}	72.11	36.80^{g}	16.00^{g}	25.02^{d}	21.00^{a}
Drip	CD	41.96	^{b} 7.94^{b}	1.89^{bc}	21.62^{a}	5.20^{a}	63.50	38.70^{g}	18.16^{e}	25.43^{bc}	20.55^{ab}
irrigation	RD	41.96	8.28^{b}	1.95^{ab}	17.68^{f}	3.55^{e}	66.30	41.12^{b}	22.00^{b}	25.18^{cd}	19.12^{c}
Hand watering	CD	41.78	7.99^{b}	1.85^{bcd}	18.50^{e}	4.25^{cd}	66.25	40.70^{c}	19.50^{c}	25.55^{b}	21.20^{a}
	RD	34.40	8.65^{b}	2.03^{a}	18.37^{e}	3.30^{f}	65.70	39.75^{d}	19.00^{d}	25.95^{a}	20.75^{ab}
Drenching irrigation	CD	39.07	9.03^{ab}	1.79^{cde}	18.68^{d}	4.45^{bc}	66.86	41.79^{a}	22.65^{a}	25.07^{d}	19.21^{c}
	RD	40.65	7.80^{b}	1.75^{de}	20.41^{b}	4.69^{b}	63.20	37.80^{f}	17.70^{f}	25.41^{bc}	20.13^{b}
	SEM	0.86	0.25	0.02	0.02	0.04	2,14	0.05	0.06	0.05	
	P-Value	0.46	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00

abc means with different superscripts along the rows are significantly different (P<0.05)
Where, DM= Dry matter, CP = Crude protein, CF = Crude fibre, EE = Ether extract, NDF =Neutral detergent fibre, ADF=Acid detergent fibre, ADL=Acid detergent Lignin, FT=Fertilizer types SEM = Standard error of means.

Discussion

Proximate composition is usually the basic and most common form of forages evaluation by animal nutritionists. There are many factors affecting proximate composition of forages such as stage of growth maturity, species or variety (Agbagla-Dohnani *et al*., 2001; Promkot and Wanapat, 2004). The proximate and fibre compostion of the treatments were significantly affected by the interaction between irrigation techniques and fertilizer types. Among the irrigation techniques, overhead irrigation produced the highest CP content especially when combined with CD, which might be due to consistent water distribution and the nutrient density of cow dung, this combination seems to have created optimal conditions for nitrogen absorption and forage growth prior to ensiling.

Pequeno *et al*. (2015) discovered that irrigated Mulato II (Brachiaria hybrid CIAT 36087) showed higher crude protein levels and forage yield than rainfed treatments, emphasizing how irrigation favorably affects nitrogen assimilation. Likewise, McRoberts *et al*. (2017) found that Mulato II under irrigation had a notably higher CP when urea was used in combination with composted manure. Some studies on *Brachiaria ruziziensis* also showed that cow dung use greatly enhanced dry matter yield and agronomic characteristics. Although this study involved a different Brachiaria species, its results are similar to those reported by Pequeno *et al*. (2015), where cow dung offers a rich source of organic nitrogen that promotes enhanced nitrogen uptake and protein production in the context of uniform water delivery (such as overhead irrigation). Although it tends to produce higher levels of CP, overhead irrigation often produced lesser ether extract (EE) and modest fibre quality, therefore implying possible trade-offs between protein build-up and fat/lipid preservation.

Drip irrigation produced rather lower CP content but higher EE values, particularly when combined with RD. This implies that drip irrigation may better preserve plant lipids by lowering oxidation and regulated humidity levels but not maximizing nitrogen uptake as effectively as overhead irrigation. Still, drip irrigation and cow dung yielded the greatest crude fibre (CF) content and ash, indicating a good biomass retention and mineral content, but probably less digestible. The higher ash content in this group confirms the idea that cow dung greatly helps to enrich soil minerals, which then translates to more inorganic matter in the feed.

Hand watering (HW) produced relatively high EE and CP values. Notably, HW with rabbit dung resulted in the highest EE, which might be as a result of slower, less intense water application, which might have reduced leaching. In this treatment, the CF content was also lowest, which could indicate greater digestibility especially in conjunction with decreased ash content from rabbit manure. This implies that HW may produce nutrient-dense forage with good digestibility even though it is labour-intensive.

Drench irrigation produced the highest DM and high CF values. CP values, on the other hand, stayed at a mid-level, whereas EE values reduced. The high DM seen in drench irrigation might be as a result of rapid water loss from oversaturation or run off; while moderate CP and EE values may indicate possible nutrient leaching during forage development.

Highest ADF and ADL values were observed in treatments under drench irrigation combined with cow dung, suggesting a large concentration of structural carbohydrates and lignin. This suggests more fibrous forage, which might be less digestible but helpful for meeting fibre needs and rumen fill. On the other hand, plants treated with cow dung and subjected to overhead irrigation revealed the least ADF and ADL, implying that their interaction allowed for more digestible silage with lower structural rigidity, probably due to better moisture balance and forage maturity at harvest.

Notably, rabbit dung consistently increased EE and hemicellulose values regardless of irrigation method, while cow dung increased cellulose and ADF levels. While RD, perhaps owing to its lower microbial diversity or less nitrogen richness, fosters softer tissue accumulation and energy-dense elements (Behera and Ray, 2021; Ibrahim *et al*., 2024), this pattern reinforces the knowledge that cow dung promotes structural growth and fibre development.

Hemicellulose and cellulose, which are important indicators of digestible fibre (Popoola-Akinola *et al*., 2022), were highest under the interaction of Hand watering and rabbit dung. These findings indicate that HW, especially with rabbit dung, may generate silage with a beneficial mix of energy potential and fibre digestibility.

Interaction effects revealed that that Over Head and cow dung had the optimal protein content and reduced lignin, hence preferable for protein-rich silage. Drip irrigation with cow dung, meanwhile, increased ash and fibre content, which indicates that this is more suited for mineral supplementation and bulk in ruminant diets. The current result revealed that, the quality of *B Mulato* II grass can be enhance through appropriate management practices, particularly the integration of irrigation, fertilization, and ensiling methods, notably the use of overhead irrigation in combination with cow dung fertilizer resulted in the highest crude protein (CP) content. This outcome may be attributed to the uniform water distribution provided by overhead irrigation and the high nutrient density of cow dung, which together likely created optimal conditions for nitrogen uptake and forage growth prior to ensiling. This research empirically shows that the proximate and fiber characteristics of silage *Brachiaria mulato* II are highly affected by the interaction among irrigation and fertilizer. Overhead irrigation and cow dung produce the best protein-rich silage optimally, while drip irrigation and rabbit dung maximize the retention of lipids. The findings support the need for the incorporation of accurate irrigation and organic nutrient management for raising the nutritive value of forage and improving the productivity of ruminants in tropical environments.

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