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Research Article

HOW DOES MAIZE FODDER MATURITY IMPACT FORAGE YIELD AND NUTRITIONAL COMPOSITION?

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ABSTRACT. This study was conducted to find maize germplasms that provide higher forage yield with a high nutritional composition. Eight local maize landraces were cultivated with a control variety Badra in Agrotech Park, Malwatta, Sri Lanka, with all recommended agronomical techniques. The nutritional contents and yield characteristics of fodder maize were examined at 70, 80, and 90 days after planting (DAP) and the responses were compared with Badra. The results revealed that SEU17 recorded the maximum fresh fodder yields of 95.71, 79.84, and 73.14 at 70DAP, 80DAP, and 90DAP harvest, respectively. The total number of leaves and the number of dry leaves of all maize fodder landraces increased with maturity. The highest number of leaves was observed at 90DAP in SEU17 (14.81) and SEU15 (12.35) had the lowest total number at 70DAP. With maturity, the total number of leaves and the number of dry leaves of all maize fodder landraces increased. SEU17 (14.81) had the highest total number of leaves at 90DAP, while SEU15 (12.35) had the lowest total number of leaves at 70DAP. The dry matter of SEU15 was highest followed by SEU06 and SEU02 at 80DAP. Only the SEU17 had the significantly highest ash content at both 70, 80 and 90 DAP. SEU16 reported the highest value of Ether Extract (EE) and Crude Protein (CP) content at 70, 80, and 90DAP. At 70 and 80DAP of harvest, SEU02 and SEU15 had the greatest fiber content of 27.23 and 30.65, respectively. The two-way interaction between landraces and harvest stage caused significant ($p<0.05$) variation in fresh weight, dry matter and CP content. It is suggested that SEU16 and SEU17 landraces be grown forage production under circumstances similar to the current study. Therefore, these landraces should be used in future breeding programs to generate improved fodder types.

Keywords: *Forage, fodder maize, landraces, stage of harvest.*

INTRODUCTION

Livestock supports humans with nutrition and food security and contributes over 40% of worldwide agricultural production value. The demand for livestock products is always increasing due to their widespread usage in human diets [1]. Appropriate livestock nutrition is required for abundant milk supply, high growth rates, and successful reproduction. With a rising livestock population, feed production should be increased with limited land resources and a lack of new technologies. Green forage is the best alternative for combating future feed scarcity. Green forages are a high-quality and low-cost source of carbohydrates, protein, vitamins, and minerals for livestock. Good quality fodder plays a decisive role in the livestock production system with increasing milk and meat production. Quality fodder has a high value in our country since they are the cheapest kind of feed available in Sri Lanka [2].

Cereal crops have been utilized as livestock feed due to their high dry matter yield and nutritional composition. Maize (*Zea mays*) is a versatile and important cereal crop that is widely cultivated across the country and is used for both human food and animal feed [3]. The climatic conditions and irrigation facilities are well suited for growing maize as forage in the dry zone. In comparison to other fodder crops, maize has a greater fresh matter and dry matter yield, and it is the only fodder crop that produces high-quality biomass as well as excellent nutritional quality in Sri Lanka [3-4]. The typical production from maize is 40-50 tons per hectare for each cut. While assessing the nutritional content, when compared to other competitor fodders, maize has the highest levels of crude protein and in-vitro dry matter digestibility (IVDMD). CP and IVDMD are two essential nutritional quality criteria that determine fodder quality [5]. Maize is effectively cultivated for livestock consumption as fodder and has a fully balanced feed owing to a high level of CP (6.1-8.3), EE (1.72-7.6), crude fiber (CF) (23.1-40.06), and ash (4.9-9.0) in its forage [6].

One of the most significant aspects impacting the nutritional content of fodder is the growing stage [6] and genetics [7, 8]. Different harvesting phases of maize such as tasselling, milking, and late dough have been demonstrated to have a considerable impact on the nutritional composition of fodder maize in previous studies [6, 9, 10]. Dry matter (DM) and CF content increased as fodder maize matured, whereas EE, Ash, and nitrogen-free extract (NFE) declined [6], although CP content dropped with maturity [11, 12]. The nutritional content and palatability of fodder crops are affected by CP, which influences livestock body weight gain. According to Rehman et al. [13], harvesting time has a substantial effect on Acid Detergent Fiber (ADF) and Neutral Detergent Fiber (NDF), and in the same study, a maximum of 3.6 percent lignin content was obtained during the late maturity stage of harvest. The maturity and fiber content of fodder maize have a positive connection. Through effects on the development, milk production, and general health of the animals, changes in crude protein, fiber, and other nutritional components have a direct impact on livestock nutrition and productivity. Balanced fiber content promotes healthy digestion and nutrition absorption, while higher crude protein levels enhance milk supply and muscle growth [14]. Thus, improving these nutritious elements in fodder can result in greater cattle performance and more effective feed consumption. According to recent research, there are around 697 maize germplasm accessions in Sri Lanka, 35 of which are landraces [15]

Landraces are profusely described as an old population of a well-developed farmed agricultural crop that has adapted to local environments as well as farmer agronomic methods [16]. Landraces are often diverse, giving them an important source of potentially advantageous traits as well as an irreplaceable bank of co-adapted genotypes. Mufeeth et al. [17] investigated the morphometric, physiological, and biomass production of 17 native maize landraces in Sri Lanka and they observed that some landraces have naturally enhanced morphological, physiological, and yield characteristics. However, the characteristics behind the fodder biomass and nutritional composition diversity of these accessions are poorly explored.

Similarly, the fodder harvesting time affects each cultivar's fodder quality. As a result, it is critical to assess the nutritional value of maize landraces at different maturity stages, which may have a larger potential for popularity as a fodder crop among dairy producers in Sri Lanka. The current study was conducted to evaluate and compare the fodder production and nutritional value of fodder maize landraces and hybrid maize varieties cultivated under local conditions.

MATERIALS AND METHODS

Location of the Study

The field study was carried out at the South Eastern University of Sri Lanka's research farm, Agro-Tech Park, Malwatta (7°20'N and 81°44'E; altitude16.0 m above sea level), located in Ampara district, Sri Lanka. Agro-ecologically, this experimental site is classified under the dry zones (DL 2b, Natural resource management centre, Department of Agriculture, 2017) characterized with sandy loam soils which typically receives annual rainfall through the north-east monsoon. The average monthly rainfall and temperature of the experimental field were 127.13 mm and 30.29 ˚C respectively

Accessions and Experimental Design

Eight maize landraces and an open-pollinated variety of Badra were used in this experiment as planting materials, collected from major maize-growing areas in Sri Lanka (Table 1). The eight maize landraces used in this study were named and designated as SEU02, SEU06, SEU09, SEU10, SEU14, SEU15, SEU16, and SEU17. The experiment was conducted in a randomized complete block design (RCBD) with four replications, where the blocks were arranged against the slope of the land. in order to reduce the experimental error at the experimental plot, randomization was used within each plot, four replicates were implemented, uniform agronomic practices such as land leveling, uniform application of fertilizers, irrigation, pest control, and other field management practices were conducted throughout the research period. Moreover, guard rows were used to minimize edge effects, and precise plot management was maintained. The plot size used for planting was 5 m x 5 m (25 m^2). The maize landraces were planted on each replicate at the seed rate of 15 kg/ha. One seed was planted per hole in a depth of 3cm and at a spacing of 60 cm inter-row and 30 cm intra-row to produce a plant of the population of 55 500 plants/ha. All the agronomic management practices were carried out according to the recommendation of the Department of Agriculture (DOA), Sri Lanka.

***Table 1**. Maize landraces collected from major maize growing area of Sri Lanka*

Landrace code	Collected area (Village-District)	Landrace code	Collected area (Village-District)
SEU02	Ridimaliyadda-Badulla	SEU14	Udakumbure Gedara-Badulla
SEU06	Aadiyathalawa-Ampara	SEU15	Kadapoththawa-Badulla
SEU09	Kadapoththawa -Badulla	SEU16	Kadapoththawa -Badulla
SEU10	Kirawana-Ampara	SEU17	Udakumbure Gedara-Badulla

Harvesting of fodder maize

The harvesting was done for each fodder maize landraces at 70, 80, and 90DAP, where the whole plants were harvested from a height of 10 cm above ground level. At each harvesting stage, one plant stand from each replication was harvested for yield and nutritional analyses. Following the harvesting of fodder maize, the fresh weight was measured and packed in a paper bag. The bags were placed in a laboratory oven at 80°C for 48 hours until they attained a consistent weight. Then the forage yield and dry matter yield per hectare were obtained.

Laboratory Analysis

Dried samples were firmly ground using a grain grinding machine, passed through a 2 mm sieve, and further dried in an oven (Model UF 10) at 1050C overnight to determine the dry matter. The proximate constituents of the dried samples were determined according to the AOAC [18] procedure, while the nitrogen (N) content was analyzed by the Kjeldahl procedure [18], by sequentially using the Semi-Automatic UDK 139 Kjeldahl apparatus. CP content was calculated from the N content (CP=N×6.25), assuming that proteins are the main source of nitrogen in the sample. The percentage of ether extract was determined by the Soxhlet apparatus (FAT-06A). Determines the fat or lipid content of the sample, which is important for energy content analysis. The ash content was determined by incineration of the sample in a muffle furnace (MF1400-30) at 600°C for 3h [17]. Determines the total mineral content of the sample by measuring the inorganic residue left after burning the sample. The crude fiber content of the feed samples was determined according to the procedures of Goering and Vansoest [19]. The NFE contents of the samples were determined by calculation by using the following formula: Nitrogen Free Extract (%) = 100 – (CP + EE + CF + Ash). In addition, the grounded sample's gross energy content was determined using a bomb calorie meter (IKA C600).

The Rank Summation Index (RSI) was used to assess genotype performance for yield and nutritional composition. Genotypes were scored (1-9) at three distinct stages and computed with Mulamba and Mock [20]. The total rating was calculated by adding the rank values of each genotype. The genotype with the lowest overall RSI value produced a high performance in fodder characteristics, and vice versa.

Statistical Analysis

Data analysis was performed using SPSS (Version 25.00) software. Two-way ANOVA was carried out to test the interaction between the landraces and the stage of harvest. Tukey test was used ($p<0.05$) to compare the mean differences between the landraces.

RESULTS AND DISCUSSION

The plant yield component and forage yield of landraces were analyzed along with the commercial hybrid maize variety Badra as a control. The results indicated that the mean value of fresh forage yield per hectare was significantly ($p< 0.05$) different compared with the control variety (Figure 01). At 70DAP, 80DAP, and 90DAP harvest, the highest fresh fodder yield was reported in SEU17 landrace 95.714.11, 79.843.66, and 73.145.45, respectively.

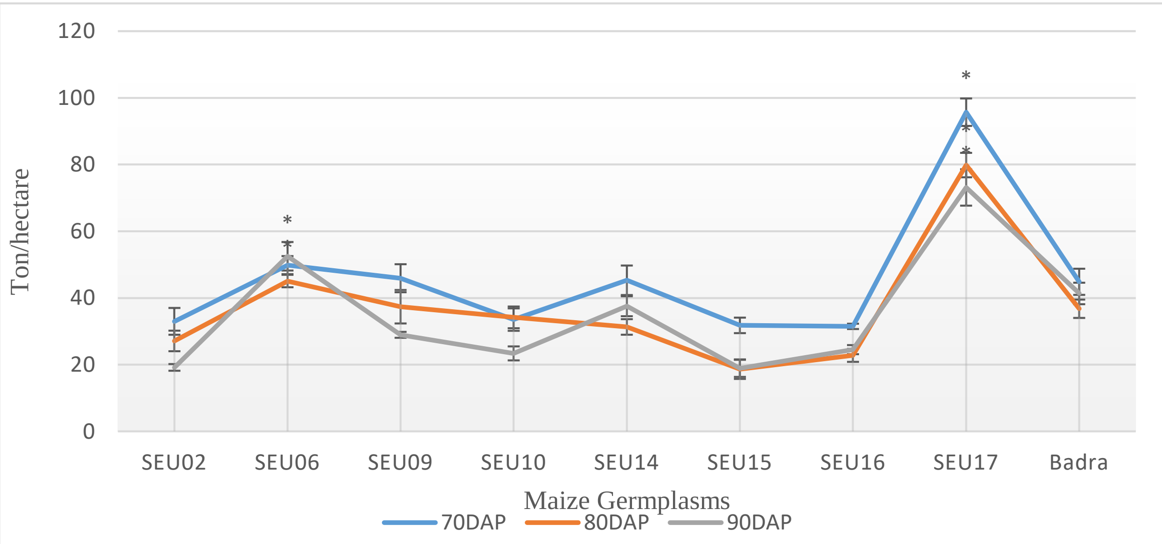

***Fig. 1**. Fresh forage weight of local landraces at three different harvesting stages. Bars on the lines indicate the standard error. The symbol (*) indicates significant differences between the corresponding landrace and Badra (p-value<0.05) (n=).*

The results indicated that the delayed harvesting decreased the fresh fodder yield in all maize landraces which is compatible with Rehman et al. [13] who harvested maize cultivars at 80, 90, and 100 days after sowing (DAS) and found the same pattern of decreases in the fresh fodder yield and also Amodu et al. [6] found the lowest forage yield at late harvesting date (119 days after showing). However, on the contrary, Darby & Lauer [12] found maximum yield at the last harvest date. The ideal time of harvest optimizes the forage quality and yield. SEU17 showed a higher growth rate and a more significant number of leaves than other landraces, producing the highest fresh fodder yield in all harvesting stages. SEU15 reported the lowest fresh fodder yield at 70DAP, 80DAP, and 90DAP with 31.78±2.32, 18.65±2.92, and 18.88±2.56 of harvest, respectively. This result indicated varietal differences among the landraces concerning forage yield. Therefore, even though all agronomic practices were optimized throughout the field experiment, variances in fresh weight were discovered, which may be due to genetic variability among landraces. In a previous study, Nashath et al. [21] [22] characterized the Sri Lankan maize landraces using SSR (Simple Sequence Repeats) molecular markers and found higher genetic diversity among them. It is widely agreed that genetic variability among the landraces plays an important role in forage yield variation among landraces [23]. The rate of leaf development and dry leaf development at the stage of the harvest was compared among all landraces. No significant difference ($p<0.05$) was recorded compared with the control variety. The results indicated that the total number of leaves and the number of dry leaves of all maize fodder landraces increased with maturity. The highest total number of leaves was observed at 90DAP in SEU17 (14.81), and SEU15 (12.35) had the lowest total number of leaves at 70DAP (Fig. 2). This variance might be interpreted as the survival of varied genetic composition across tested landraces. However, other field conditions for tested germplasms are kept at their optimum [24]. The dry leaf formation showed the same pattern as leaf development with maturity (Fig. 3).

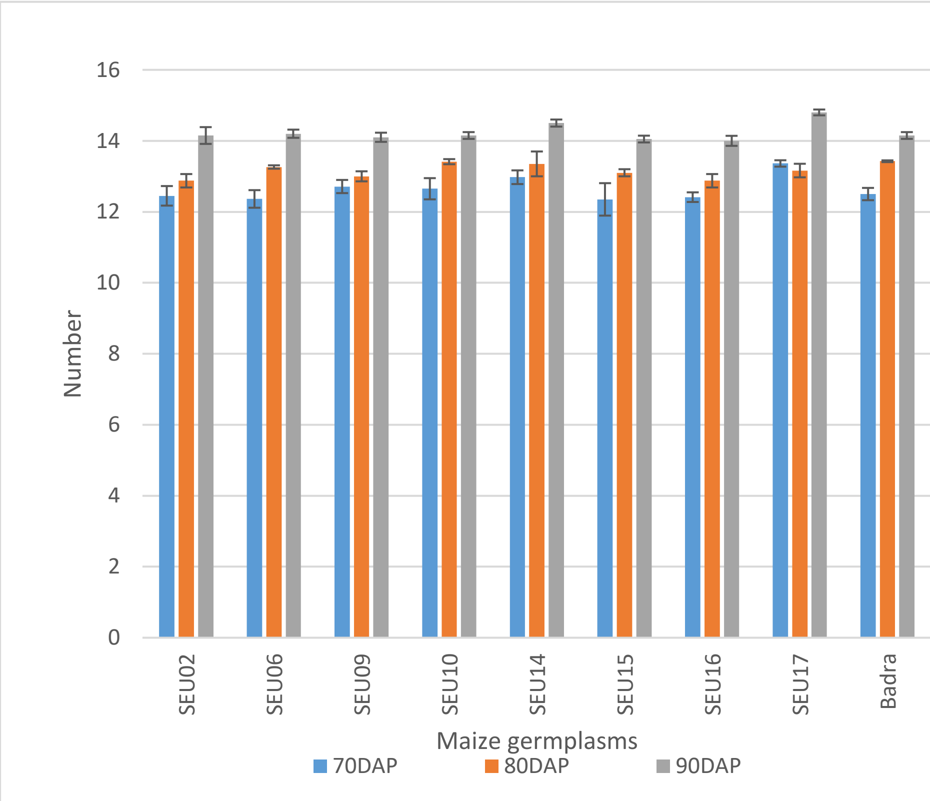

***Fig. 2**. Number of leaves of maize landraces at harvest. Lines on the bars indicate the standard error (n=)*

The effect of three different harvesting stages on the nutritional composition of maize landraces is presented in Table 2. The results indicated that the mean values of most of the nutritional compositions were significant ($p<0.05$) among landraces. Results revealed that the dry matter had shown significant ($p<0.05$) variations among landraces at 70 and 80DAP. SEU10 (38.35±1.97) and SEU02 (31.68±0.56) showed significantly higher dry matter content than Badra at 70DAP. Dry matter of SEU15 (40.54±0.26) was highest followed by SEU06 and SEU02 at 80DAP. The dry matter content of fodder maize increased with maturity due to a higher proportion of dry leaves due to the translocation of nutrition from leaves and stems to cobs and grains. This observation was consistent with the findings of Salama et al [25], who discovered yield and nutritive value of maize (*Zea mays* L.) forage as affected by plant density, sowing date and age at harvest and they found that the maximum dry matter at 65 DAS, rather than 45 and 55 DAS for each sowing date. In this study, the dry matter content varied significantly ($p<0.01$) due to two-way interaction between landraces and the harvest stage.

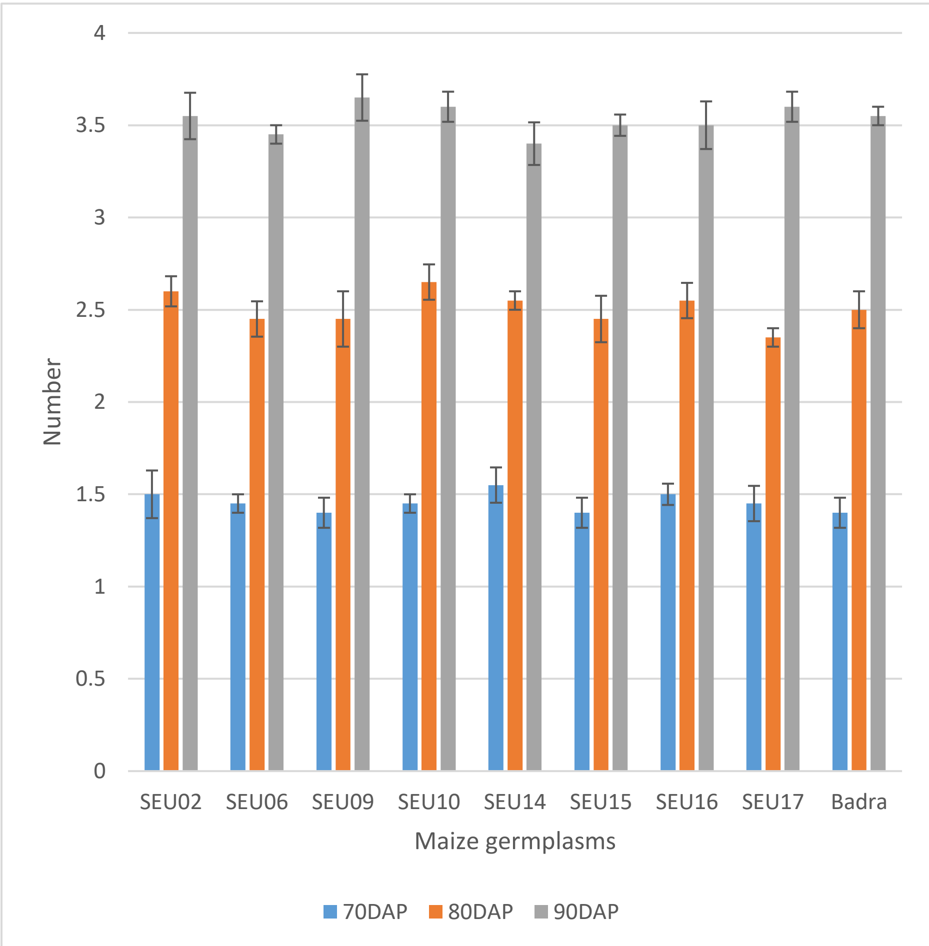

***Fig. 3**. Number of dry leaves of maize landraces at harvest. Lines on the bars indicate the standard error. (n=)*

The early harvest (70DAP) produced forage with the highest significant ash content, amounting to 5.88±0.09 and 5.35±0.48, for the respective landraces SEU17 and SEU15 compared with control (Table 2). On contrary SEU09 at 70DAP, SEU14, SEU02, SEU15 and SEU16 at 80DAP and SEU14, SEU10, SEU02, and SEU06 at 90DAP possessed lower ash content than the Badra. Only the SEU17 landrace showed significantly the highest ash content at both 80DAP and 90DAP. The ash content was reduced with the maturity of the landraces.

***Table 2**. Proximate composition of maize landraces at different days of harvest*

Nutritional compound	Days after planting	SEU02	SEU06	SEU09	SEU10	SEU14	SEU15	SEU16	SEU17	Badra
Dry matter (%)	70DAP	31.68±0.56^{ab}	30.43±1.50^{abc}	26.19±3.62^{bc}	38.35±1.97^{a}	27.04±0.24^{bc}	31.28±2.10^{abc}	30.42±1.88^{abc}	24.90±2.32^{bc}	22.16±0.45^{c}
	80DAP	38.66±1.26^{ab}	39.74±0.83^{a}	32.95±1.65^{bcd}	34.77±1.05^{abcd}	30.54±1.11^{d}	40.54±0.26^{a}	37.61±1.61^{abc}	36.56±1.34^{abcd}	31.86±1.6^{cd}
	90DAP	41.59±1.76	32.94±1.38	37.72±3.04	35.01±1.01	35.01±2.42	37.91±2.16	38.14±3.04	34.04±2.98	38.79±2.57
Ash (%)	70DAP	4.59±0.26^{aabc}	5.14±0.35^{abc}	5.03±0.31^{abc}	3.61±0.13^{c}	3.81±0.16^{ab}	5.35±0.48^{a}	4.65±0.46^{abc}	5.88±0.09^{a}	5.19±0.38^{ab}
	80DAP	4.22±0.04^{cd}	4.01±0.06^{d}	4.55±0.11^{bc}	3.01±0.21^{e}	4.06±0.09^{cd}	4.31±0.08^{cd}	4.31±0.11^{cd}	5.24±0.11^{a}	4.98±0.12^{ab}
	90DAP	4.11±0.05^{bc}	4.03±0.05^{cd}	4.45±0.06^{bc}	3.03±0.17^{e}	3.53±0.14^{de}	4.2±0.1^{bc}	4.11±0.08^{bc}	5.42±0.14^{a}	4.56±0.06^{b}
Ether Extract (%)	70DAP	2.47±0.18	2.17±0.09	2.21±0.25	1.99±0.16	1.98±0.02	2.21±0.22	2.52±0.17	2.35±0.12	2.45±0.21
	80DAP	2.47±0.12	2.32±0.13	2.37±0.21	2.25±0.11	2.22±0.11	2.23±0.14	2.59±0.15	2.51±0.04	2.54±0.12
	90DAP	2.53±0.01	2.35±0.14	2.38±0.18	2.4±0.04	2.4±0.11	2.41±0.04	2.61±0.13	2.47±0.05	2.54±0.09
Protein (%)	70DAP	5.52±0.15^{d}	6.92±0.21^{b}	6.38±0.07^{bc}	5.59±0.11^{d}	6.93±0.09^{ab}	5.59±0.12^{d}	7.51±0.14^{a}	6.06±0.09^{cd}	6.28±0.03^{c}
	80DAP	4.67±0.29^{c}	5.25±0.55^{bc}	6.07±0.08^{ab}	5.07±0.19^{ab}	6.09±0.21^{bc}	4.84±0.3^{bc}	7.05±0.29^{a}	5.54±0.12^{cd}	6.03±0.07^{ab}
	90DAP	5.15±0.17^{bcd}	4.91±0.26^{d}	6.01±0.08^{ab}	4.99±0.16^{cd}	5.8±0.03^{abcd}	4.84±0.3^{d}	6.12±0.28^{a}	5.69±0.21^{abcd}	5.95±0.1^{abc}
Fiber (%)	70DAP	27.23±0.35^{a}	24.51±0.35^{b}	26.2±0.57^{ab}	26.5±0.54^{aab}	25.73±0.34^{ab}	26.64±0.39^{ab}	24.61±0.47^{b}	25.14±0.47^{ab}	25.78±0.68^{ab}
	80DAP	30.09±0.5^{ab}	27.78±0.51^{b}	30.09±0.75^{ab}	29.25±0.48^{ab}	28.53±0.59^{ab}	30.65±0.21^{a}	27.82±0.44^{b}	28.54±0.39^{ab}	29.63±0.7^{ab}
	90DAP	33.52±0.74	31.94±0.61	32.67±0.55	33.85±0.61	31.75±0.54	33.58±0.46	32.48±0.52	33±0.53	33.86±0.57
NFE (%)	70DAP	60.18±0.45	61.24±0.75	60.17±0.83	62.3±0.67	61.55±0.47	60.21±0.77	60.7±0.69	60.56±0.33	60.29±0.93
	80DAP	58.54±0.43^{abc}	60.63±0.67^{a}	56.9±0.9^{b}	60.43±0.44^{a}	59.09±0.51^{ab}	57.95±0.12^{ab}	58.23±0.69^{ab}	58.16±0.5^{ab}	56.81±0.55^{b}
	90DAP	54.68±0.73^{ab}	56.76±0.6^{a}	54.49±0.38^{abc}	55.71±0.58^{ab}	56.5±0.58^{a}	54.96±0.48^{abc}	54.66±0.33^{abc}	53.41±0.51^{bc}	53.08±0.6^{c}
Gross energy (kj/kg)	70DAP	4083.29±42.61	4078.85±38.79	4170.76±26.08	4181.13±29.56	4146.7±51.62	4116.54±42.49	4195.27±31.23	4095.04±36.57	4039.42±27.24
	80DAP	4222.35±17.76^{ab}	4183.74±23.47^{ab}	4265.82±32.64^{a}	4237.92±64.95^{ab}	4218.02±32.25^{ab}	4253.93±33.79^{a}	4306.77±29.68^{a}	4213.89±31.04^{ab}	4074.66±17.1^{b}
	90DAP	4267.17±25.34	4360.32±27.28	4357.38±24.81	4340.93±35.79	4239.05±21.22	4269.1±22.53	4310.04±47.19	4310.32±19.69	4234.67±28.89

The values corresponded to the mean value of each parameter ± SE, $^{a.b.c.d,\ e}$ indicates significant differences between corresponding maize landraces and Badra (p<0.05).

No significant difference in EE was detected between landraces for the three harvesting stages. However, a mild increase was observed in EE with the maturity of the fodder maize landraces. 90DAP showed the highest EE content compared with the other two stages of harvest. SEU16 reported the highest value of EE content among other landraces in 70DAP, 80DAP, and 90DAP. No significant interaction was observed between landraces and the harvesting stage in the EE content of the maize germplasm.

Only the SEU16 landrace was reported to have significantly higher (7.51±0.14, 7.05±0.29, and 6.12±0.28) CP content than control at 70, 80, and 90DAP of harvest. This outcome agreed with the results of 7% CP for maize at the milky stage by Chaudhary et al. [26] and Amodu et al. [27]. Contrary to our findings, Epasinghe et al. [28] found 16.33% of CP in the 7th week of growth in the wet zone of Sri Lanka. The landrace SEU02 showed the lowest (5.52±0.15) at 70DAP between the landraces. Most of the landraces showed an above-average level of CP content. This might indicate that few landraces had higher nitrogen improvement ability and could supply more CP to the ruminant. The two-way interaction between landraces and harvest stage caused significant ($p<0.05$) variation in the CP content of fodder maize (Table 3). CP percentage reduces with increasing maturity where the highest CP value is observed at 70DAP and lowest at 90DAP of all the landraces. A similar trend was observed (16.34, 11.75, and 9.91) at harvested fodder maize's pre-heading, heading, and milking stages [29]. Tang et al. [29] also noted decreased CP content in fodder maize with increasing stages of maturity.

A significant difference in fiber content was observed at 80DAP and 90DAP of all landraces. SEU02 and SEU15 showed significantly highest fiber content 27.23±0.35 and 30.65±0.2 than Badra at 70DAP and 80DAP of harvest, respectively (Table 2). The very lowest fiber content was observed in SEU06 (24.51±0.3) at 70DAP in all three stages and landraces. As same as dry matter, fiber content increased with maturity. This result is contrary to the findings of Cone et al. [26], who observed lower fiber and very high starch levels at the ripening growth stage of fodder maize. Tang et al. [29] also reported the same pattern that maize harvested at an earlier stage showed higher fiber content than the advanced stage. In this study, fiber content showed significant differences within landraces but no interaction was observed between the landrace and harvesting stage (Table 3). This variance between the landraces might have arisen due to the genetic composition across tested landraces.

Table 3. *Interaction between landraces and harvest stage*

	Number of leaves	Number of dry leaves	Fresh Weight(ton)/Hectare	Dry matter (%)	Ash (%)	Ether Extract (%)	Protein (%)	Fiber (%)	NFE (%)	Gross energy (kJ/kg)
L	**	NS	**	**	*	0.06	**	**	**	**
S	**	**	**	**	*	0.16	**	**	**	**
L×S	NS	NS	0.014*	**	NS	NS	0.03*	NS	NS	NS

L= Landrace; S= Stage of harvest; L×S = Interaction between landrace and stage of harvest * $p<0.05$, ** $p<0.01$

The results showed significant differences ($p< 0.05$) at 70DAP and 80DAP NFE content of maize landraces. However, the highest NFE content was recorded in SEU14 (60.63±0.67) at 70DAP. The landrace SEU06 at 80DAP and SEU02, SEU06 and SEU10 reported significantly higher NFE content than control. There was no significant variation between landraces for the gross energy at 70DAP and 90DAP. At 80DAP, SEU09, SEU15, and SEU16 showed the highest significant difference in gross energy when compared to Badra.

Rank summation index (RSI) of yield characteristics and nutritional composition at different stages of harvest are presented in Table 4. At 70DAP, SEU16, SEU17, SEU10, SEU15, SEU06, SEU09, SEU14, SEU02, and Badra had the lowest RSI of 35, 38, 38, 40, 40, 40, 41, 43, and 45 for traits tested. At this stage, SEU16 and SEU17 had the lowest cumulative

RSI, indicating that they were the best genotypes for fodder production. However, when forage yield was considered, SEU17 outperformed SEU16. Table 4 revealed that SEU16, SEU02, and SEU16 were the best performing genotypes at 80DAP, with RSI of 32, 33, and 34. Genotype Badra had the greatest total yield and nutritional characteristics at 90DAP, followed by SEU16 and SEU17 with 34 and 36 RSI, respectively. When comparing the three harvest stages, SEU17 and SEU16 performed the best for the yield and nutritional characteristics. When the three harvest stages were compared, 80DAP had the lowest RSI values for SEU17 and SEU16, which performed the best in terms of yield and nutritional quality.

Landraces, such as SEU17, may perform better than others in a variety of criteria because of distinct genetic features that improve their development, adaptation, and uptake of nutrients in the particular environmental conditions of the research location.

According to the research, SEU16 and SEU17 maize landraces, which have greater yields and better nutritional profiles, could greatly improve fodder production and cattle nutrition in areas that are similar to Malwatta, Sri Lanka. These landraces are excellent choices for breeding initiatives that seek to create better fodder types and support environmentally friendly farming methods. Furthermore, they are useful for climate-adaptive farming because to their resilience and nutritional value, which guarantees steady animal productivity even in the face of changing environmental conditions.

Table 4*. Genotype rankings and rank summation indices (RSI) showing yield components and nutritional yield at different harvesting stages in maize genotypes*

Harvesting stage	Genotype	Fresh weight per hectare	Dry Matter %	Ether-extract %	Ash %	Fiber %	Protein %	NFE	Gross energy	Rank summation index (RSI)
	SEU02	7	2	2	7	1	9	8	7	43
	SEU06	2	4	7	4	9	3	3	8	40
	SEU09	3	7	5	5	4	4	9	3	40
	SEU10	6	1	8	9	3	8	1	2	38
70DAP	SEU14	4	6	9	8	6	2	2	4	41
	SEU15	8	3	6	2	2	7	7	5	40
	SEU16	9	5	1	6	8	1	4	1	35
	SEU17	1	8	4	1	7	6	5	6	38
	Badra	5	9	3	3	5	5	6	9	45
	SEU02	7	3	4	6	3	9	4	5	41
	SEU06	2	2	6	8	9	6	1	8	42
	SEU09	3	7	5	3	2	3	8	2	33
	SEU10	5	6	7	9	5	7	2	4	45
80DAP	SEU14	6	9	9	7	7	2	3	6	49
	SEU15	9	1	8	5	1	8	7	3	42
	SEU16	8	4	1	4	8	1	5	1	32
	SEU17	1	5	3	1	6	5	6	7	34
	Badra	4	8	2	2	4	4	9	9	42
	SEU02	8	1	3	6	4	6	5	7	40
	SEU06	2	9	9	7	8	8	1	1	45
	SEU09	5	5	8	3	6	2	7	2	38
	SEU10	7	6	7	9	2	7	3	3	44
90DAP	SEU14	4	7	6	8	9	4	2	8	48
	SEU15	9	4	5	4	3	9	4	6	44
	SEU16	6	3	1	5	7	1	6	5	34
	SEU17	1	8	4	1	5	5	8	4	36
	Badra	3	2	2	2	1	3	9	9	31

CONCLUSION

The current study found that forage maize landraces differed considerably in nutritional composition and forage yield when compared to the variety Badra. Landrace SEU17 had the maximum fresh forage yield and ash content at all three harvest stages. SEU16 had the maximum CP content at 70DAP, 80DAP, and 90DAP however, fresh forage yield was much lower than SEU17. The differences across the landraces were minimal, particularly in terms of EE and gross energy content. In terms of forage yield and nutritional composition, SEU09, SEU16, and SEU17 performed better than the Badra at 80DAP under the present climatic conditions. According to the RSI, SEU16 and SEU17 outperformed other landraces in forage yield and nutritional composition at all three harvest stages. This study indicated that there were varietal differences among the landraces in respect to forage yield and it is recommended to grow SEU16 and SEU17 landraces forage production in conditions comparable to the current study. By using these landraces in breeding programs, future maize harvests may have greater genetic diversity and resilience, producing more fruitful and nutrient-dense fodder choices. Potential future studies would provide a more forward-looking perspective on this field.

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