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Full Length Research Paper

Biomass yield potential and nutritive value of selected Alfalfa (*Medicago sativa L.*) cultivars grown under tepid to cool sub-moist agro-ecology of Ethiopia

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Five alfalfa cultivars (FG10-09 (F), FG9-09 (F), Magna801-FG (F), Magna788 and Hairy Peruvian) were evaluated for forage biomass yield potential and quality at Debre Zeit Agricultural Research Center. The experiment was planted on 4 July 2012 on 12 m^2 plots, each consisting of 15 rows with intra-row spacing of 0.2m at a seed rate of 20 kg/ha. The plots were laid out in randomized complete block design with four replications, and a starter fertilizer at a rate of 100 kg/ha diammonium phosphate was applied at planting. Significantly higher (P=0.05) herbage dry matter yield was recorded for FG10-09(F), FG9-09(F), Magna788 and Hairy Peruvian, while herbage yield was inferior for Magna801-FG (F). Plant height was higher (P≤0.001) for Hairy Peruvian, medium for FG9-09(F) and Magna801-FG (F), and lower for FG10-09(F) and Magna788. Regarding the leaf to stem ratio, though differences between cultivars were not significant (P>0.05), Hairy Peruvian had a lower value. Between October 2012 and October 2013, eight cuts were taken at an average interval of 54.6±12.4 days between harvests. Cuts following long and short rainy months gave superior herbage yield values, while those taken during low rainfall months had inferior values (P≤0.001). Crude protein content was higher (P=0.05) for Magna788, FG10-09 (F), FG9-09 (F) and Magna801-FG (F), but lower for Hairy Peruvian. Neutral detergent fiber and acid detergent fiber contents were higher in Hairy Peruvian (P=0.05), with the other cultivars exhibiting consistently low and comparable values for both fractions. *In vitro* DM digestibility (P=0.05) and relative feed value index (P≤0.001) values were significantly lower for Hairy Peruvian, with the remaining four cultivars exhibiting comparable values for both traits. Cultivars other than Hairy Peruvian exhibited consistently superior crude protein, *in vitro* DM digestibility and relative feed value index indicating their potential for promotion to advanced varietal evaluation stages and release as better alternatives for use in the farming system.

Key words: Plant height, leaf to stem ratio, chemical composition, crude protein, digestibility Relative Feed Value,

Abbreviations: DM, dry matter; DMY, dry matter yield; CP, crude protein; NDF, neutral detergent fiber; ADF, acid detergent fiber; ADL, acid detergent lignin;

INTRODUCTION

Crop residues are the dominant livestock feed resources in Ethiopia. But they are characterized by high fiber (>55%) and low crude protein (CP) (<7%) contents (Dereje *et al*., 2010; Osuji *et al*, 1995). Consequently, their intake level is limited and they barely satisfy even the maintenance requirements of animals. The expanding demand for agricultural products induced by human population growth is constantly increasing the pressure on native grazing lands that have traditionally been used as a source of livestock feed (Solomon *et al*., 2005), resulting in the increasing role of such fiberous feeds. At present, the larger proportion of livestock products is produced by smallholder crop-livestock mixed farmers operating under such poor quality feeds in mixed farming systems. As much of the arable land is already under cultivation, increased livestock productivity will thus have to come through enhancing qualities of these fibrous feed resources. One way to achieve this is through integration

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of low cost feed technologies that are easy and suitable, and within the limits of the resource poor farmers. Supplementation of crop residues with plant protein sources such as leguminous forage crops may alleviate protein deficiency as these contain medium to high levels (12 – 25%) of CP (Solomon, 2005). This suggests the need for selecting and integrating potential leguminous forages that would enhance the quality of the dominantly used low quality feeds besides their useful contribution to soil fertility.

To this effect, forage legumes cultivar selection activities have been in progress under different agro-ecologies of the country with a number of candidate materials promoted to advanced varietal selection stages. One of such potential legume species for integration into the existing livestock feeding system is alfalfa (*Medicago sativa* L.). Alfalfa is a perennial forage legume known for its high forage quality and positive effects on soil fertility (Campiglia *et al*., 1999). It was also reported to withstand long periods of water deficit by impeding its vegetative growth (Annicchiarico *et al*., 2010) and accessing water from depth through its deeper root system (Volaire, 2008). The current and projected decrease of agricultural water resources further implies the persistently growing interest for water saving forage production strategies through introducing drought tolerant forage legumes such as alfalfa.

In the existing forage legume germplasm selection programs in Ethiopia, more attention, however, has been given to assessment of the environmental adaptation, herbage DM yield potential and seed bearing ability of candidate accessions, while data on their nutritive value is generally scarce. This suggests the need for research works focusing on characterization of the herbage nutritional quality of elite forage cultivars grown under varying production systems and agro-ecological conditions if their potential in livestock feeding is to be effectively exploited. In the forage varietal testing and release system recently adopted in Ethiopia, generating such information has also become crucial before the candidate genotypes are officially registered as a variety. The objective of the present study was, therefore, to identify best performing alfalfa cultivars through assessing their herbage dry matter yield potential and nutritive value at Debre Zeit Research Center, a site representing tepid to cool sub-moist agro-ecologies of Ethiopia.

MATERIALS AND METHODS

Location

The experiment was conducted at Debre Zeit Agricultural Research Centre (Latitude: $08^0 44'$ N; Longitude: $38^0 38'$ E) located in East Shewa Zone of Oromia Regional State, Ethiopia. The Center is located at 47km away from the capital Addis Ababa to the East at an altitude of 1900 m above sea level. The average maximum and minimum temperatures of the center are 28.3 and 8.9 $^{\circ}$C, respectively, with a mean annual rainfall of 1100mm, having a bimodal pattern. The site is characterized by tepid to cool sub-moist agro-ecology, with dominant soil types consisting of light alfisols/holisols and heavy black soil (vertisols) (EIAR, http://www.eiar.gov.et).

Treatments and experimental design

Five selected alfalfa cultivars were grown at forage and pasture research site of the Debre Zeit Agricultural Research Centre on finely prepared seed beds. The cultivars were: FG10-09 (F), FG9-09 (F), Magna801-FG(F), Magna788 and Hairy Peruvian, with Hairy Peruvian used as a standard check. The experiment was planted on 4 July, 2012 on 12 m^2 plots (4 m long and 3 m wide). Each plot consisted of 15 rows arranged length-wise in an east-west direction, with intra-row spacing of 0.2m. A seeding rate of 20 kg/ha was used and diammonium phosphate (DAP) fertilizer was applied at the rate of 100 kg/ha at planting. The plots were laid out in randomized complete block design with four replications. At early stages of seedling development, weeds were controlled through manual weeding followed by hoeing. Subsequent weed and other plot management practices were undertaken when deemed necessary.

Determination of herbage yield, plant height and leaf to stem ratio

At full bloom stage, described as a stage when open flowers emerge on average of 2 or more nodes and no seed pods present (Ball, 1998), four randomly selected adjacent middle rows with a net area of 3.2 m^2 were harvested, and the fresh weight of the cut biomass was recorded just after mowing using field balance. The harvested biomass was manually chopped into small pieces using sickle and a subsample of 200 g was taken and dried in air draft oven at 65°C for 72 hours to determine herbage dry matter yield (DMY). For plant height determination, mean height of five randomly selected plants was recorded for each plot. Leaf to stem ratio was determined by separately harvesting a central section of two adjacent middle rows with a sampling area of 0.2 m^2 (0.5 m length x 0.4 m width), followed by partitioning the harvested biomass in to leaf and stem fractions, and drying the fractions using similar procedures described above for herbage DM yield determination.

Table 1: Variance ratios (F-value) and levels of significance from the analysis of variance for herbage dry matter yield (DMY), plant height and leaf to stem ratio of alfalfa as affected by cultivar, cutting cycle and their interaction

		Herbage traits		
Source of variation	**DF**	**DMY**	**Stand height**	**Leaf to stem ratio**
Cultivar	4	1.26*	10.81***	0.54NS
Cutting cycle	7	109.36***	85.72***	52.66***
Interaction	28	0.96NS	1.42NS	0.88NS

Note: DF, degrees of freedom; *, significant at P=0.05; ***, significant at P≤0.001; NS, not significant

Chemical analysis

For forage quality analysis, chopped herbage of the four replications were pooled into one and properly homogenized and one representative subsample was taken for each cultivar within each cutting cycle. The DM and ash contents were determined by oven drying at 105℃ overnight and by igniting in a muffle furnace at 500℃ for 6 hours, respectively. Nitrogen (N) content was determined by Kjeldahl method and CP was calculated as N x 6.25 (AOAC, 1995). The neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) fractions were analyzed according to Van Soest and Robertson (1985). The modified Tilley and Terry *in vitro* method (Van Soest and Robertson, 1985) was used to determine the *in vitro* dry matter digestibility (IVDMD).

Relative feed value

Relative feed value (RFV) is an index used to rank feeds relative to the typical nutritive value of full bloom alfalfa hay, containing 41% ADF and 53% NDF on a DM basis, and having a RFV of 100, which is considered to be a standard score. This index is widely used to compare the potential of two or more forages on the basis of energy intake. Accordingly, forages with RFV greater than 100 are considered to have better quality than full bloom alfalfa hay and those with RFV lower than 100 are regarded as of lower quality than the same. Such a single parameter is considered to be of useful practical significance in forage pricing and marketing (Schroeder, 2013; Uttam *et al.*, 2010) and, was calculated as:

$$RFV = DDM\ (\%DM) \times \frac{DMI(\%BW)}{1.29}\ (Uttam\ et\ al., 2010);$$

where DDM (digestible dry matter) and DMI (dry matter intake potential as % of body weight) were calculated from ADF and NDF, respectively as:

$$DDM\ (\%\ DM) = 88.9 - 0.78 \times ADF\ (\%\ DM)\ \text{and}$$

$$DMI\ (\%BW) = \frac{120}{NDF}\ (\%\ DM)$$

Data analysis

The herbage DMY, plant height and leaf to stem ratio data were subjected to analysis of variance where cultivar, cutting cycle and the interaction between cultivar and cutting cycles were considered as class variables in the model as shown below:

$$Xijk = \mu + Vi + Cj + (Vi * Cj) + eijk$$

; where *Xijk* is the measured variable, μ is the overall mean; *Vi* is the effect of i^{th} cultivar; *Cj* is the effect of j^{th} cutting cycle; and, *Vi*Cj* is the interaction between i^{th} cultivar and j^{th} cutting cycle, and *eijk* is the random error.

For herbage quality traits, cutting cycles were considered as replication as composite samples pooled over the four replications were used within each cutting cycle, and the data was hence fitted to the following statistical model.

$$Xij = \mu + Vi + Cj + eij;$$

where *Xij* stands for the measured quality traits; μ for the overall mean; *Vi* for the effects of i^{th} cultivar; *Cj* for the effect of j^{th} cutting cycle, and *eij* for the random error.

The GLM procedure of SAS was used to analyze both agronomic and quality data (SAS, 2002) and significant mean differences were declared at P ≤ 0.05 using LSD (Least Significant Difference) test (Snedecor and Cochran, 1980).

RESULTS

Herbage DMY, stand height and leaf to stem ratio

Summary of variance ratios (F-values) associated with the different sources of variation and their levels of significance from the analysis of variance for herbage DMY, stand height and leaf to stem ratio of the five alfalfa cultivars are presented in Table 1. The effect of cultivar was significant for DMY (P=0.05) and stand height (P≤0.001), while it was not significant for leaf to stem ratio (P>0.05). Cutting cycle significantly affected

Table 2: Herbage DMY (t/ha), plant height (cm) and leaf to stem ratio of the five alfalfa cultivars

Cultivar	DMY	Plant height	Leaf to stem ratio
FG10-09(F)	4.36^{ab}	74.48^{d}	1.09
FG9-09(F)	4.77^{a}	81.74^{b}	1.21
Magna 801-FG(F)	4.22^{b}	78.78^{bc}	1.06
Magna 788	4.45^{ab}	75.01^{dc}	1.09
Hairy peruvian	4.52^{ab}	86.51^{a}	0.95
SE	0.18	1.52	0.13
P-level	*	***	NS

Note: SE, standard error; *significant at P=0.05; *** significant at P≤0.001; NS, not significant; cultivar means for DMY and stand height with common superscript letters are not significantly different

Table 3: Effect of cutting cycles on herbage DMY (t/ha), plant height (cm) and leaf to stem ratio averaged over the five alfalfa cultivars

Cutting cycles	DMY	Stand height	Leaf to stem ratio
Cycle 1	4.27^{d}	55.45^{d}	0.63^{c}
Cycle 2	4.03^{d}	79.67^{c}	0.63^{c}
Cycle 3	5.82^{c}	96.69^{a}	0.46^{c}
Cycle 4	6.90^{b}	83.32^{c}	0.37^{c}
Cycle 5	1.66^{e}	84.94^{bc}	1.53^{b}
Cycle 6	0.69^{f}	48.98^{e}	3.85^{a}
Cycle 7	4.60^{d}	95.89^{a}	0.56^{c}
Cycle 8	7.72^{a}	89.48^{b}	0.64^{c}
SE	0.23	1.92	0.16
P-level	***	***	***

Note: SE, standard error; *** significant at P≤0.001; cutting cycle means of all traits with common superscript letters are not significantly different; Cutting dates: Cycle 1, Oct.19, 2012; Cycle 2, Dec. 26, 2012; Cycle 3, Feb. 26, 2013; Cycle 4, April 2, 2013; Cycle 5, May 20, 2013; Cycle 6, June 25, 2013; Cycle 7, Aug. 20, 2013; Cycle 8, Oct. 10, 2013;

herbage DMY, stand height and leaf to stem ratio (P≤0.001). The effect of the interaction of the two factors, however, was not significant for the three measured agronomic traits (P>0.05), and as a result the average effects of the cultivars and cutting cycles were presented separately.

Mean values for herbage DMY, stand height and leaf to stem ratio for the five alfalfa cultivars are presented in Table 2. Four of the cultivars: FG10-09 (F), FG9-09 (F), Magna788 and Hairy Peruvian had significantly higher (P=0.05) and comparable herbage DMY than Magna801-FG (F). Plant height was significantly higher (P≤0.001) for Hairy Peruvian, medium for FG9-09 (F) and Magna801-FG(F), and lower for FG10-09(F) and Magna788. Though cultivars were statistically similar in their leaf to stem ratio (P>0.05), Hairy Peruvian had a relatively low leaf to stem ratio.

The mean herbage DMY, plant height and leaf to stem ratio as affected by cutting cycles is presented in Table 3 pooled over the five accessions. A total of eight harvests were taken at an average interval of 54.6±12.4 days during October 2012 and October 2013. The interval between harvests was observed to be longer for wetter months of the year compared to months of low or no rainfall. It was evident that harvests taken during or following the long and short rainy months had comparatively higher herbage DMY, while those taken during months of low or no rainfall had lower yields. Consequently, herbage yields were significantly lower for the 6th and higher for the 8th cutting cycles in the 2013 season (P≤0.001). The 1st and the 2nd cuts that were taken following the main rainy seasons of 2012, and the 7th cut that followed the main rainy season of 2013 had intermediate and comparable herbage yields. On the other hand, harvests taken during the low rainfall months of the year (5th and 6th) gave significantly lower yields (P≤0.001). Regarding plant height, significantly higher mean plant height values (P≤0.001) were observed for the 3rd and the 7th cuts, while it was least for the 6th one. The leaf to stem ratio was significantly higher (P≤0.001) for the 5th and 6th cuts with the remaining harvesting cycles exhibiting comparable values.

Table 4: Chemical composition and *in vitro* DM digestibility of the five alfalfa cultivars

Cultivars	DM %	Herbage quality traits (% DM)						
		Ash	CP	NDF	ADF	ADL	IVDMD	RFV
FG10-09(F)	89.2[a]	10.69[a]	18.43[ab]	38.85[b]	22.59[ab]	5.59	84.55[ab]	174.05[a]
FG9-09(F)	89.14[a]	10.52[a]	18.87[ab]	39.28[b]	21.67[b]	5.24	85.41[ab]	174.79[a]
Magna 801-FG(F)	89.09[ab]	10.63[a]	18.66[ab]	37.69[b]	21.49[b]	5.63	87.35[a]	188.36[a]
Magna 788	88.42[b]	10.46[ab]	19.56[a]	36.86[b]	20.71[b]	5.97	86.35[a]	189.55[a]
Hairy peruvian	89.40[a]	10.03[b]	18.15[b]	43.53[a]	26.19[a]	5.69	83.07[b]	154.01[b]
SE	0.22	0.16	0.45	1.09	1.3	0.46	0.89	6.19
P-level	*	*	*	*	*	NS	*	**

Note: SE, standard error; * significant at P=0.05; ** significant at P=0.01; NS, not significant; cultivar means with common superscript letter are not significantly different

Herbage nutritive value

Table 4 shows least square means of the different herbage quality traits for the five alfalfa cultivars. The DM content was significantly (P=0.05) higher for four of the cultivars: FG10-09 (F), FG9-09 (F), Magna801-FG (F) and Hairy Peruvian, while Magna788 had lower and comparable values with Magna 801-FG (F). The ash content was significantly higher (P=0.05) for FG10-09(F), FG9-09(F), Magna801-FG (F) and Magna788), whereas it was lower for Hairy Peruvian and Magna788. Similarly, the CP content was significantly (P=0.05) higher for Magna788, FG10-09(F), FG9-09(F) and Magna801-FG (F), but lower for Hairy Peruvian. The NDF and ADF concentrations were superior for Hairy Peruvian (P=0.05), with the other cultivars exhibiting comparable values for both fractions. The cultivars evaluated did not significantly differ in their ADL contents. The IVDMD (P=0.05) and RFV (P≤0.001) index were significantly lower for Hairy Peruvian, with the remaining ones having comparable values for these traits. The study further revealed cultivars other than Hairy Peruvian to consistently exhibit superior CP, NDF, ADF, IVDMD and RFV values.

DISCUSSION

Herbage DMY, plant height and leaf to stem ratio

The significant cultivar differences observed for herbage DMY in the present study concurs with other reports (Monirifar, 2011; Sun *et al*., 2011; Marijana *et al*., 2008). In evaluating 16 alfalfa varieties, Hayek *et al*. (2008) observed significant differences between varieties for herbage DMY with overall mean of around 12 t/ha. Mean herbage DMY in the order of 11 t/ha was also reported in a study where three alfalfa cultivars were evaluated (Zeinab *et al*., 2013), evidently showing the low yield levels of the cultivars in the present work. Quite the reverse, other researchers (Awad *et al*., 2009; Afsharmanesh, 2009) reported a respective herbage DM yield values ranging from 1.78 - 3.23 t/ha and 0.67 - 2.16 t/ha, figures that are lower than those recorded for the cultivars in the present work. The wide range of herbage DMY values observed in different reports could be attributed to varietal or environmental differences and/or their interactions.

The non-significant effect of the interaction between cultivars and cutting cycles for the three agronomic traits suggests that the phenotypic performance of the cultivars was independent of harvesting cycles, with a vital implication on germplasm selection endeavors. Had the effect of the interaction between cultivars and cutting cycles been significant, it could have been suggested that the relative rank of the performance of the cultivars had changed across the cutting cycles (Fernandez, 1991), the situation that normally complicates selection for a stable forage variety because of the resultant reduction in the progress from selection in any one season (Yau, 1995).

The significant varietal differences observed for plant height in the present study was also in agreement with other reports (Altinok and Karakaya, 2002; Sengul, 2002). Ullah *et al.* (2009) also stated variations in plant height to be linked to genotypic differences and explained this trait to be influenced by differential genotypic response to prevailing site and crop management scenarios. Similarly, Dineshkumar (2007) indicated that plant height in alfalfa can be influenced by crop management factors such as application of fertilizers. Variety and the interaction between variety and fertilizer were also indicated to be important agronomic factors influencing plant height in alfalfa (Mohammadjanloo *et al.,* 2009).

Leaf to stem ratio is an important trait in the selection of appropriate forage cultivar as it is strongly related to forage quality (Juan *et al*., 1993; Kratchunov and Naydenov, 1995; Julier *et al*., 2000; Sheaffer *et al.,* 2000). The non-significant cultivar differences in leaf to stem ratio observed in the present study is in disagreement with other reports (Heidarian and Mostafavi, 2012; Monirifar, 2011; Hayek *et al*., 2008; Lamb *et al.,* 2003), but concurs with that of Afsharamanesh (2009). Among the cultivars evaluated, Hairy Peruvian had inferior leaf to stem ratio, and this could be attributed to its distinctly higher plant height as stand height and stem proportion are correlated positively.

Dynamics of herbage traits across cutting cycles

A total of eight harvests (October 2012 – October 2013) obtained per year in the current study was low in view of what was usually attainable for alfalfa stands managed under Debre Zeit site conditions (Solomon, personal communication). Evidence shows that alfalfa could be harvested at shorter intervals, around 30 days, with higher number of cuts achieved during the dry months of the year under irrigated conditions, which indeed is lower than an interval of around 55 days recorded in the present study. The interval between harvests in the current study was longer during wetter months compared to dry months, and this could be explained by the fact that when light conditions do not trigger transition from vegetative to reproductive growth, shoots remain in the vegetative stages of development (Gramshaw *et al.,* 1981; Sheaffer *et al.,* 1988; Gramshaw *et al.,* 1993) thereby delaying the predetermined stage of biomass removal which in here was full bloom stage (Ball, 1998).

Low herbage DMY for the dry months of the year in this study clearly suggests the significant role of moisture availability in growth and development of alfalfa crop (Sammis, 1981). In this regard, water deficiency was reported to diminish shoot growth rate through a variety of mechanisms, among which the following were reported in the literature: reduced shoot elongation rate, decreased internode length, slow rates of leaf development and reduced leaf area expansion (Brown *et al.,* 2009; Grimes *et al*., 1992; Durand *et al.,* 1989). In the present study, leaf to stem ratio was higher during the drier months of the year and this concurs with what was documented by other workers (Halim *et al.,* 1989; Carter and Sheaffer 1983), who indicated a negative effect of water deficiency on stem growth than on leaf area, leading to higher leaf to stem ratios for stands grown under water stress.

Herbage nutritive value

High quality alfalfa was reported to contain >19 % CP, <31% ADF and <40 % NDF (Kazemi *et al*., 2012; Ball *et al*., 1997). In this study, the cultivar Magna788 had CP content in the order of 0.6 percentage units more than the indicated threshold value, while the other four cultivars had comparable CP values, ranging from 18.15% for Hairy Peruvian to 18.87% for FG9-09(F), values lying slightly below the threshold of 19 %. Indeed, all the cultivars had CP contents of above 15%, a level suggested for a protein source feed to be considered optimal for use as supplement for lactation and growth in dairy cattle. Thus each one of the cultivars can be used as a potential source of plant protein supplement for dairy cattle (Nsahlai *et al*., 1996). The NDF content of Hairy Peruvian was comparatively higher than the figure recorded for the other cultivars, and apparently exceeds the threshold level of 40%. On the other hand, the ADF content of all the cultivars was observed to be below the 31% upper threshold level that good quality alfalfa hay was reported to contain. The NDF values of all the cultivars fell below the reported higher levels of 55.2% (Laura *et al*., 2012) or 46.9% (Yu *et al*., 2003). However, the NDF content of Hairy Peruvian was comparable to those values reported by Sheaffer *et al*. (2000) and Markovic *et al*. (2007), which respectively were 42.70 % and 43.59 %. The ADL content of the cultivars (ranging from 5.24 – 5.97 %) was closer to that reported by Markovic *et al*., (2007) (4.64 %), but much lower than that reported by Yu *et al*., (2003) (19.9 %). A wider range of values observed in the literature for CP and fiber fractions of alfalfa can be attributed to various factors such as cultivar, climatic and agronomic management practices, and/or their interactions.

The IVDMD values varied significantly among the cultivars and this agrees with what has been reported extensively. For instance, Volenec and Cherney (1990) reported significant differences in IVDMD among alfalfa cultivars and accessions and these differences were indicated to be associated with variation in digestibility of the stem fraction (Tremblay *et al*., 2002). Similarly, significant differences in IVOMD were reported for 14 alfalfa varieties, with values ranging from 59.15 to 66.33% (Kamalak *et al*., 2005), which were much lower than values recorded for the cultivars in the present study. Selection for improved forage quality has also been successful for increasing IVDMD in alfalfa (Monirifar, 2011). The RFV index was proposed to reflect how well an animal will eat and digest a particular forage species when it is fed as the only source of energy (Kazemi *et al*., 2012). The RFV index observed for the cultivars evaluated was higher than a threshold of 151, apparently indicating the cultivars to have prime quality standard, with the highest value being for Magna788.

In conclusion, better herbage DMY was recorded for four of the cultivars evaluated: FG10-09(F), FG9-09(F), Magna788 and Hairy Peruvian. Plant height was significantly higher for Hairy Peruvian and lowest for FG10-09(F) and Magna788. Hairy Peruvian was also observed to have a relatively low leaf to stem ratio. The study also showed the effect of cutting cycles to be significant for all measured agronomic traits, with harvests taken during the wetter seasons exhibiting superior herbage DMY, and those taken during the dry seasons to have higher leaf to stem ratio. Four of the cultivars (FG10-09(F), FG9-09(F), Magna788 and Magna801-FG (F)) exhibited a consistently higher leaf to stem ratio, CP, IVDMD and RFV, and lower fiber fractions compared to the standard check. Therefore, the cultivars other than the check can be further promoted to the next variety verification stages for further evaluation, and to finally identify superior cultivar for release as variety.

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