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RESEARCH

Effect of Change of Agronomic Practices on Nutritive Value of Hybrid Fodder Sorghum Cultivated in Lowland Paddy Fields of the Dry Zone of Sri Lanka

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ABSTRACT

This study was conducted to investigate the effect of low fertilizer rate and irrigation along with increased plant density on nutritive value of hybrid fodder sorghum cultivated in lowland fallowed paddy fields in dry zone during May to September. Seeds were sown in *Yala* season and continued as a ratoon crop to inter-monsoonal (*Third*) season. Four agronomic management packages (AMP1, AMP2, AMP3 and AMP4), which differ in fertilizer application rates, plant spacing, and irrigation intervals were tested with two fodder sorghum varieties (SX-17 and Dairygreen) in a split-plot design. The initial and first ratoon crops were harvested at dough grain stage. High fertilizer rate in combination with short irrigation interval, resulted in high (P<0.05) crude protein content in the initial harvest. AMP2 and AMP4 produced equally high (P<0.05) total dry matter yield (DMY) for SX-17 (24.7 and 20.9 MT/ha, respectively) and Dairygreen (27.7 and 25.7 MT/ha, respectively) varieties. Total digestible organic matter, crude protein and metabolizable energy yields were higher under AMP2 and AMP4 compared to other two packages for both varieties. Nutritive value was high in SX-17 under AMP1 for ratoon crop. In conclusion, AMP4 with plant spacing of 45 x 15 cm, low fertilizer rate (338-47-28 kg/ha, urea-TSP-MOP) and extended irrigation interval, could be recommended for cultivation of hybrid fodder sorghum in lowland paddy fields in the dry zone during *Yala* season. However, for cultivating SX-17 targeting to produce fodder with high nutritive level, AMP1 with spacing of 45 x 30 cm, high fertilizer rate (400-62-37 kg/ha of urea-TSP-MOP) and frequent irrigation could be recommended.

INTRODUCTION

Sorghum (*Sorghum bicolor* L. Moench) is a moderately drought tolerant crop which requires high temperatures for good germination and growth. A temperature of 27-30 °C is required for optimum growth and development of the crop. Therefore, sorghum can be successfully grown under irrigated and rain-fed conditions in semi-arid regions in tropical and sub-tropical zones (Cameron, 2006). Fodder sorghum is widely grown for livestock feeding in diverse agro-ecological regions of the world (Miron et al.,2005). Owing to the drought tolerant ability, short growing season, potential to produce ratoon crops and suitability in crop rotation systems, sorghum has gained an extensive acceptance as a forage crop (Smith and Frederiksen, 2000). Forage quality and forage yield are equally important for profitable livestock production (Saini, 2012). The nutritive value of forage sorghum at harvest depends on number of genotypic characters and agronomic management practices including fertilizer application rates, plant density, irrigation management and harvesting stage (Ayub et al., 1998: Carmi et al., 2005: Almodares et al., 2009; Mekasha et al.,2022). It has been observed that high N fertilizer application increased the crude protein (CP) content of fodder sorghum (Afzal et al., 2013), while the composition of fodder sorghum at harvest affects its ensiling process thereby determine the silage quality (Miron et al., 2005). Further, when conserved under anaerobic condition high soluble carbohydrates in sorghum contributes to produce silage with high lactic acid contents (Tolentino et al., 2016). Fodder sorghum variety also affects the silage losses and nutritive quality (Costa et al., 2016).

Fodder sorghum has become a crucial source of forage, especially for intensively managed dairy cattle in Sri Lanka. Though this crop is predominantly grown in upland areas with supplementary irrigation, the expansion of fodder sorghum cultivation in uplands is constrained due to the growing demand for these lands to cultivate more profitable Other Field Crops (OFC). However, a substantial area of lowland paddy fields in the dry zone remains fallowed after *Maha* season which ends in March and during the *Yala* (April-August) cultivation season (SEPC, 2019, 2020), offering an opportunity for cultivating fodder sorghum. Therefore, sorghum can be established in *Yala* season and continue as a ratoon crop during inter-monsoonal period until the commencement of *Maha* (October-March) season generating additional income for dry zone farmers. The period between *Yala* and *Maha* (August-October) is referred to as *Third* cultivation season.

The recommended basal-dressing (BD) fertilizer mixtures (Urea-TSP-MOP) for cultivation of SX-17 and Dairygreen fodder sorghum varieties in the uplands is 100-90-65 kg/ha (BD1) and 150-62-37 kg/ha (BD2), respectively, along with 150 kg/ha of urea as top dressing (TD). In addition, plant spacing of 45 x 30 cm (WS) and 45 x 15 cm (NS) have been recommended for SX-17 and Dairygreen, respectively for upland sorghum crops. However, the best agronomic management practices (fertilizer rate, spacing, irrigation interval) for the cultivation of fodder sorghum in lowland paddy fields in dry zone during *Yala* and *Third* seasons, which are drier than *Maha* season, are yet to be determined. Therefore, the objective of this study was to examine the effects of a low fertilizer application rate (75% of the recommended rate), increased plant density (45 x 15 cm) and extended irrigation intervals, on the nutritive value of selected hybrid fodder sorghum varieties cultivated in the lowland fallow paddy fields in the dry zone during the *Yala* and *Third* seasons.

METHODOLOGY

The Ethical Clearance Committee (ECC) of the Faculty of Agriculture, University of Peradeniya approved the experimental proposal (ECC/2022/E/043). Fodder sorghum varieties were cultivated at the Field Crops Research and Development Institute – Mahailluppallama (FCRDI), which classified under DL1b Agro-Ecological region of low country dry zone. The undulating terrains of the agro-ecological region predominantly consist of Reddish Brown Earth (RBE) and Low Humic Gley (LHG) soils. Further, the land in the region is abundant with rain-fed upland crops, paddy, scrub, mixed home-gardens and forest plantations (Banerjee et al., 2013).

Experimental design and crop management

The experimental design employed was a split-plot design with three replicates, where the plot size was 25 m^2. Sorghum seeds of two hybrid sorghum varieties (SX-17 and Dairygreen) were manually sown during early May in the *Yala* season and continued for the ratoon crop during the *Third* season. The agronomic management practices applied were four basal dressing fertilizer rates (100-90-65 kg/ha of urea-TSP-MOP (BD1), 150-62-37 kg/ha of urea-TSP-MOP (BD2)), 75% of BD1 (0.75BD1) and 75% of BD2 (0.75BD2) (75-68-49 kg/ha of urea-TSP-MOP and 113-47-28 kg/ha of urea-TSP-MOP, respectively), two top-dressing fertilizer rates as urea at 150 kg/ha (TD) and at 75% of TD (i.e. urea at 112.5 kg /ha) (0.75TD), plant spacing (cm x cm) of 45x30 (WS) and 45x15 (NS), and two irrigation interval regimes consist of 5-day interval until 30 days followed by 8-day interval (SI) and 7-day interval until 30 days followed by 10-day interval (LI). These agronomic management practices were grouped into four agronomic management packages (AMPs), namely AMP1 (BD1, TD, WS, SI), AMP2 (BD2, TD, NS, SI), AMP3 (0.75BD1, 0.75TD, WS, LI) and AMP4 (0.75BD2, 0.75TD, NS, LI) as shown in Table 1. The respective basal-dressing fertilizer mixture was applied 2 days before seeding to experimental plot. The top-dressing fertilizer mixture was applied 5 weeks after seeding for the initial crop, and 1 week after harvesting the initial crop in the case of the ratoon crop. The experimental plots were manually weeded and applied with recommended pesticides and fungicides. The initial crop and the ratoon crop were harvested at 9 and 8 weeks age, respectively when 50% panicles of the sorghum plants reached at dough grain stage. During the study period, the experimental site received a total of 201.8 mm of rainfall spread over 25 rainy days, with an average minimum and maximum temperature of 24.6°C and 32.5°C, respectively.

Table 1: The agronomic management packages of the experiment

Agronomic management practices	Agronomic Management Package (AMP)			
	AMP1	AMP2	AMP3	AMP4
Fertilizer level:	F1	F2	75% F1	75% F2
- Basal-dressing (Urea-TSP-MOP kg/ha)	100-90-65 (BD1)	150-62-37 (BD2)	75-68-49 (0.75BD)	113-47-28 (0.75BD2)
- Top-dressing for first crop (Urea kg/ha)	150 (TD)	150 (TD)	112.5 (0.75TD)	112.5 (0.75TD)
- Top-dressing for ratoon crop (Urea kg/ha)	150 (TD)	150 (TD)	112.5 (0.75TD)	112.5 (0.75TD)
Plant density (plants/ha)	73,926 (LD)	147,852 (HD)	73,926 (LD)	147,852 (HD)
Plant spacing (cm x cm)	45 X 30 (WS)	45 X 15 (NS)	45 X 30 (WS)	45 X 15 (NS)
Irrigation interval:				
- Up to 30 days (days)	5 (SI)	5 (SI)	7 (LI)	7 (LI)
- After 30 days (days)	8 (SI)	8 (SI)	10 (LI)	10 (LI)

F1; Recommended fertilizer rate for SX-17, F2; Recommended fertilizer rate for Dairygreen, BD; Basal dressing, TD; top-dressing, WS; Wide spacing, NS; Narrow spacing, LD; low density, HD; High density, SI; Short irrigation interval, LI; Long irrigation interval

Fodder sampling and analysis

Three randomly selected sorghum plants were harvested from each replicate plot and dried at 60°C until constant weight is achieved using a hot air driven oven. The fresh matter (FM) and dry matter (DM) weights of the plants were recorded and DM percentage was determined. The dried plants of each replicate plot were chopped separately, and composite laboratory samples were prepared. They were ground using a laboratory hammer mill to pass through 1 mm sieve. Ground laboratory samples were assessed for DM, organic matter (OM), crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) contents following standard protocols (AOAC, 2004-2005). Additionally, the samples were analyzed for *in-vitro* organic matter digestibility (OMD) and *in-vitro* metabolizable energy content (ME) following *in-vitro* gas fermentation assay (Makkar, 2003). The nutrient and energy yields of the initial and ratoon fodder sorghum crop harvests were added together, and the total nutrient and energy yields were computed.

Statistical analysis

The influence of AMPs on the nutritive value and yields of the hybrid fodder sorghum varieties was assessed following analysis of variance procedure(ANOVA) and means were compared using Duncan's Multiple Range Test (DMRT) with the SAS statistical package (SAS Inc., 2009).

RESULTS AND DISCUSSION

Nutrient content of hybrid fodder sorghum in initial crop harvest

The influence of sorghum variety was found to be significant (P<0.05) on DM, OM, NDF, ADF, and ME contents and OMD but not on the CP content (P>0.05) of the harvest (Table 2 - 4). Dairygreen recorded significantly greater (P<0.05) DM, OM, NDF, and ADF content than those of SX-17 with AMP1, AMP2, and AMP3 but not with AMP4 (P>0.05). In contrary, SX-17 recorded a significantly greater (P<0.05) OMD and ME contents than Dairygreen with AMP1, AMP2 and AMP3. Further, the ADL content of Dairygreen was significantly higher (P<0.05) than that of SX-17 with AMP1 and AMP4, and not with AMP2 and AMP3 (P>0.05). Low digestibility of plant parts with high lignin content is a typical characteristic in ruminants. The finding is in consistent with Miron et al*.* (2005) who reported the low digestibility in NDF rich fodder sorghum leaves compared to other parts of sorghum plants. They reported the lowest *in-vitro* DM digestibility for sorghum leaves with the highest NDF content (56% and 686 g/kg DM, respectively) compared to sorghum stems (63% and 499 g/kg DM, respectively) and sorghum seed heads (73%, 542 g/kg DM, respectively).

Carmi et al*.* (2005) reported that the plant density had no significant effect on the DM and NDF content as well the DM digestibility of forage sorghum. Similarly, a study by Pushparajah and Sinniah (2018) reported that DM, NDF, ADF or CP content of Sugargraze and Jumbo-plus hybrid sorghum varieties harvested at 60 days were not influenced by the plant density.

A previous study reported that Sugargraze and Jumbo-plus varieties grown with three plant spacing (15 X 30 cm, 15 X 45 cm and 15 X 60 cm) resulted in average DM, NDF, ADF and CP percentages of 17.91,69.36, 47.08 and 8.77, and 17.26, 70.57, 45.54 and 7.52, respectively (Pushparajah and Sinniah, 2018). These values agree with the values recorded in the present study. In contrary, a comprehensive analysis of the performance of three sorghum varieties (Melkam, Chelenko, Masugi) shown at three locations in Ethiopia during two consecutive years reported a significant increment (6%) in the *in-vitro* OMD when the seed rate increased from 12.5 kg/ha to 100 kg/ha (Mekashaet al*.,* 2022).

The application of more fertilizer as basal-dressing and top-dressing together with shorter irrigation intervals in AMP1 and AMP2 resulted in significantly high CP (P<0.05) contents in both varieties (Table 3). Increased CP content in forage sorghum with high rate of N fertilizer application (Mahmud et al.,2003; Afzal et al., 2013) and with high rate of P fertilizer application (Afzal et al., 2013) is in agreement with previous findings. The favorable effect of P fertilizer application on CP content is due to the involvement of P in the protein synthesis in plants (Mengel and Kirby, 2001). Fodder sorghum reported to increase N uptake from the dense root systems resulting in great CP content when they are grown on favorable soil moisture condition by frequent irrigation (Saini, 2012).

Nutrient content of hybrid fodder sorghum in ratoon crop harvest

In the ratoon harvest, the variety of crop showed a significant (P<0.05) effect on nutritive properties, including the CP content (Table 5 - 7). Similar to the initial fodder harvest, Dairygreen recorded higher (P<0.05) DM, NDF, and ADF contents with all AMPs than those recorded for SX-17, except for ADF content (P>0.05) with AMP3. Although, AMPs did not influence (P>0.05) the DM content of SX-17, the low fertilizer rate combined with high plant density and extended irrigation interval in AMP4 influenced Dairygreen to record significantly low DM content (P<0.05). Carmi et al. (2005) reported a reduction in DM content from 30.0% to 23.3% with increased irrigation levels from 20 to 180 mm in the sorghum variety Tal. The results of the present study provided evidence for a significant (P<0.05) effect of variety and AMPs x variety interaction on the CP content of sorghum ratoon harvest. While the CP content of Dairygreen was not influenced (P>0.05) by AMPs, SX-17 recorded a high (P<0.05) CP content when grown with AMP1 which carried a high fertilizer rate, short irrigation interval, and wide plant spacing. Shahrajabian et al. (2020), also reported a significant increase of CP content in sorghum due to application of N fertilizer at 160 kg/ha, compared to zero application. Further, high CP content recorded at low plant density in SX-17 in the present study is in consistent with Jahanzad et al. (2013), who reported increased CP content for sorghum sown at low plant density compared to high plant density (250,000 vs. 150,000 plants/ha). Crops grown at low plant density experience less intra-specific competition, resulting in enhanced accumulation of nitrogen and leading to high protein synthesis in plants thereby produce more nutritious forage.

Table 2: Effect of agronomic management practices on dry matter and organic matter contents of the initial crop of hybrid fodder sorghum harvested in the *Yala* season

AMP	DM (%)ǂ		OM (%)ǂ	
	SX – 17	Dairygreen	SX - 17	Dairygreen
AMP1	16.0 ± 0.3^{aB}	22.0 ± 0.4^{aA}	85.9 ± 0.2^{aB}	88.0 ± 0.8^{aA}
AMP2	16.7 ± 0.4^{aB}	21.1 ± 1.2^{aA}	87.0 ± 0.4^{aA}	87.6 ± 0.6^{aA}
AMP3	16.6 ± 0.4^{aB}	20.9 ± 0.6^{aA}	86.1 ± 0.8^{aB}	87.4 ± 0.3^{aA}
AMP4	16.6 ± 0.4^{aB}	26.3 ± 4.4^{aA}	86.8 ± 0.5^{aB}	88.8 ± 1.5^{aA}
Significance of effects:				
- AMPs	0.1801		0.0599	
- Variety	<0.0001		<0.0001	
- AMPs x Variety	0.1703		0.1358	
CV	15.6		0.8	

ǂ; Mean±SE, AMP-agronomic management package; DM- dry matter; OM- organic matter.
Within a column means followed by different lower case superscript letters are significantly different at p<0.05.
Within a row means followed by different Upper case superscript letters are significantly different at p<0.05.

Table 3: Effect of agronomic management practices on neutral detergent fibre, acid detergent fibre and crude protein contents of the initial crop of hybrid fodder sorghum harvested in the *Yala* season

AMP	NDF (%)ǂ		ADF (%)ǂ		CP (%)ǂ	
	SX – 17	Dairygreen	SX – 17	Dairygreen	SX – 17	Dairygreen
AMP1	66.3 ± 1.3[bB]	75.2 ± 0.3[aA]	41.9 ± 0.5[aB]	50.2 ± 0.4[aA]	6.5 ± 0.8[aA]	5.7 ± 0.2[aA]
AMP2	66.7 ± 1.1[abB]	73.0 ± 1.8[aA]	42.9 ± 1.0[aB]	49.4 ± 2.2[aA]	6.2 ± 0.3[aA]	6.1 ± 0.4[aA]
AMP3	66.6 ± 0.6[abB]	76.7 ± 1.5[aA]	38.9 ± 1.1[bB]	48.0 ± 1.5[aA]	5.0 ± 0.2[bA]	4.7 ± 0.5[bA]
AMP4	68.8 ± 1.3[aB]	74.4 ± 4.1[aA]	41.1 ± 2.0[abB]	46.7 ± 3.2[aA]	5.3 ± 0.2[bA]	4.7 ± 0.6[bA]
Significance of effects:						
- AMPs	0.0465		0.0222		0.0369	
- Variety	<0.0001		<0.0001		0.1998	
- AMPs x Variety	0.0164		0.2147		0.8742	
CV	2.3		3.0		13.7	

ǂ; Mean±SE; AMP-agronomic management package; NDF-neutral detergent fiber; ADF-acid detergent fiber; CP-crude protein.
Within a column means followed by different lowercase superscript letters are significantly different at $p<0.05$.
Within a row means followed by different uppercase superscript letters are significantly different at $p<0.05$.

Table 4: Effect of agronomic management practices on *in-vitro* organic matter digestibility and in-vitro metabolizable energy contents of the initial crop of hybrid fodder sorghum harvested in the *Yala* season

AMP	In-vitro OMD (%)ǂ		In-vitro ME (MJ/kg DM)ǂ	
	SX – 17	Dairygreen	SX – 17	Dairygreen
AMP1	54.7 ± 2.1[aA]	49.6 ± 0.9[aB]	8.1 ± 0.3[aA]	7.3 ± 0.1[aB]
AMP2	56.4 ± 1.9[aA]	52.2 ± 1.6[aB]	8.4 ± 0.2[aA]	7.7 ± 0.2[aB]
AMP3	58.4 ± 2.2[aA]	49.9 ± 2.9[aB]	8.7 ± 0.3[aA]	7.4 ± 0.4[aB]
AMP4	56.5 ± 2.8[aA]	51.4 ± 0.3[aA]	8.4 ± 0.4[aA]	7.6 ± 0.0[aA]
Significance of effects:				
- AMPs	0.3079		0.2851	
- Variety	0.0017		0.0021	
- AMPs x Variety	0.3343		0.3429	
CV	4.4		4.6	

ǂ; Mean±SE. AMP-agronomic management package; OMD-organic matter digestibility; ME-metabolizable energy.
Within a column means followed by different lowercase superscript letters are significantly different at $P<0.05$.
Within a row means followed by different uppercase superscript letters are significantly different at $P<0.05$.

Total nutrient and energy yield of initial and ratoon crop of hybrid sorghum

Total DM, DOM, CP, and ME yield represents the sum of these values of the initial and ratoon hybrid fodder sorghum harvests per unit land area. Both AMPs and variety significantly (P<0.05) influenced the total fodder DMY, whereas the total DOMY, CPY, and MEY were solely (P<0.05) influenced by the AMPs (Table 8, and 9). When grown with narrow plant spacing in AMP2 and AMP4, the yield parameters tested were significantly (P<0.05) higher in both varieties. Further, the reduction of fertilizer application rate did not influence the fodder DMY in the present experiment (AMP1 vs. AMP3 and AMP2 vs. AMP4). Yet, Afzal et al. (2013) reported a reduction in fodder sorghum DMY due to the application of N fertilizer at very low rates. They observed that N application rates of 57.50, 45.00, 28.75, and 0.00 kg/ha resulted in DMY of 54.74, 46.58, 42.04, and 37.63 MT/ha, respectively.

The present observation of increasing fodder sorghum DMY with decreasing plant spacing (AMP1 vs. AMP2 and AMP3 vs. AMP4) is consistent with those of Pushparajah and Sinniah (2018) who reported 9.76, 10.82, and 14.03 MT/ha of fodder DMYs when grown at 15 x 60 cm, 15 x 45 cm, and 15 x 30 cm plant spacing, respectively. The present study recorded a high CP content in SX-17 with AMP1 and Dairygreen with AMP1 and AMP2. However, the DOMY, CPY, and MEY follow a similar trend observed in DMY, showing high nutrient and energy assimilation in fodder sorghum with increased plant density (AMP1 vs. AMP2 and AMP3 vs. AMP4). Jahanzad et al. (2013) also reported a reduction in CPY with decreasing irrigation level (1549, 1352, and 1179 kg/ha with respect to high, moderate, and low irrigation levels, respectively). While OMD did not vary with plant density in the present study, Makasha et al. (2022) observed that increasing the seed rates within the range from 12.5 to 100 kg/ha significantly increased OMD. The strong root system of sorghum is excellent at utilizing unused N salts in soil thus neither the reduction of N fertilizer application rate nor the irrigation interval makes a significant impact of nutrient yield of the crop. Glamoclija et al. (2011) also reported that the amount of total digestible substance has not affected by N application rate despite N utilization is influenced by the amount and the distribution of rainfall.

Table 5: Effect of agronomic management practices on dry matter and organic matter contents of the ratoon crop of hybrid fodder sorghum harvested in the *third* season

AMP	DM (%)ǂ		OM (%)ǂ	
	SX – 17	Dairygreen	SX - 17	Dairygreen
AMP1	18.9 ± 0.3^{aB}	26.9 ± 0.8^{aA}	86.1 ± 1.5^{aA}	88.5 ± 1.0^{aA}
AMP2	18.2 ± 0.2^{aB}	25.5 ± 1.1^{abA}	86.4 ± 1.6^{aA}	88.5 ± 0.9^{aA}
AMP3	18.9 ± 1.0^{aB}	25.1 ± 1.1^{abA}	86.5 ± 1.8^{aA}	88.0 ± 0.6^{aA}
AMP4	17.6 ± 0.3^{aB}	23.4 ± 0.6^{bA}	85.6 ± 1.0^{aA}	87.8 ± 0.9^{aA}
Significance of effects:				
- AMPs	0.0040		0.5948	
- Variety	<0.0001		0.0007	
- AMPs x Variety	0.2952		0.8418	
CV	7.9		1.0	

ǂ; Mean±SE. AMP-agronomic management package; DM-dry matter, OM-organic matter.
Within a column means followed by different lowercase superscript letters are significantly different at P<0.05.
Within a row means followed by different uppercase superscript letters are significantly different at P<0.05.

Table 6: Effect of agronomic management practices on neutral detergent fibre, acid detergent fibre and crude protein contents of the ratoon crop of hybrid fodder sorghum harvested in the *third* season

AMP	NDF (%)ǂ		ADF (%)ǂ		CP (%)ǂ	
	SX – 17	Dairygreen	SX – 17	Dairygreen	SX – 17	Dairygreen
AMP1	68.9 ± 0.7^{aB}	75.9 ± 1.3^{aA}	44.5 ± 0.5^{aB}	50.2 ± 1.1^{aA}	5.3 ± 0.0^{aA}	4.1 ± 0.2^{aB}
AMP2	64.9 ± 0.2^{bB}	77.0 ± 0.2^{aA}	42.5 ± 0.6^{aB}	51.4 ± 1.0^{aA}	4.3 ± 0.3^{bA}	4.3 ± 0.2^{aA}
AMP3	67.0 ± 1.7^{abB}	76.5 ± 1.1^{aA}	43.5 ± 2.4^{aA}	49.1 ± 1.2^{aA}	4.3 ± 0.0^{bA}	4.1 ± 0.3^{aA}
AMP4	69.1 ± 1.2^{aB}	77.4 ± 0.9^{aA}	44.6 ± 0.9^{aB}	50.4 ± 1.6^{aA}	4.6 ± 0.1^{bA}	4.3 ± 0.1^{aA}
Significance of effects:						
- AMPs	0.1064		0.3406		0.0945	
- Variety	<0.0001		<0.0001		0.0096	
- AMPs x Variety	0.0694		0.0957		0.0480	
CV	1.9		2.4		6.7	

ǂ; Mean±SE. AMP-agronomic management package; NDF-neutral detergent fiber, ADF-acid detergent fiber, CP-crude protein.
Within a column means followed by different lowercase superscript letters are significantly different at P<0.05.
Within a row means followed by different uppercase superscript letters are significantly different at P<0.05.

Table 7: Effect of agronomic management practices on *in-vitro* organic matter digestibility and in-vitro metanolizable energy contents of the ratoon crop of hybrid fodder sorghum harvested in the *third* season

AMP	In-vitro OMD (%)ǂ		In-vitro ME (MJ/kg DM) ǂ	
	SX – 17	Dairygreen	SX – 17	Dairygreen
AMP1	54.9 ± 3.4^{aA}	49.6 ± 1.9^{aA}	8.2 ± 0.5^{aA}	7.4 ± 0.3^{aA}
AMP2	57.3 ± 0.9^{aA}	46.9 ± 3.0^{aB}	8.5 ± 0.1^{aA}	7.0 ± 0.4^{aB}
AMP3	54.0 ± 3.1^{aA}	44.8 ± 2.1^{aA}	8.0 ± 0.4^{aA}	6.6 ± 0.3^{aA}
AMP4	51.2 ± 1.2^{aA}	48.7 ± 2.2^{aA}	7.6 ± 0.1^{aA}	7.2 ± 0.3^{aA}
Significance of effects:				
- AMPs	0.2916		0.2900	
- Variety	0.0005		0.0005	
- AMPs x Variety	0.1632		0.1552	
CV	5.7		5.9	

ǂ; Mean±SE. AMP-agronomic management package; OMD-organic matter digestibility; ME-metabolizable energy.
Within a column means followed by different lowercase superscript letters are significantly different at P<0.05.
Within a row means of a parameter followed by different uppercase superscript letters are significantly different at P<0.05.

Table 8: Effect of agronomic management practices on total dry matter yield and digestible organic matter yields of the initial and ratoon harvests of hybrid fodder sorghum in the *Yala* and the *third* seasons

AMP	Total DMY (MT/ha)ǂ		Total DOMY (MT/ha)ǂ	
	SX – 17	Dairygreen	SX – 17	Dairygreen
AMP1	18.9 ± 0.9abA	21.5 ± 1.2bcA	8.9 ± 0.7abA	9.4 ± 0.3bcA
AMP2	24.7 ± 2.8aA	27.7 ± 0.1aA	12.1 ± 1.1aA	11.9 ± 0.3aA
AMP3	16.5 ± 1.3bA	20.1 ± 1.2cA	8.0 ± 0.4bA	8.3 ± 0.5cA
AMP4	20.9 ± 2.7abA	25.7 ± 3.8abA	9.7 ± 1.4abA	11.2 ± 1.5abA
Significance of effects:				
- AMPs	0.0028		0.0021	
- Variety	0.0064		0.1316	
- AMPs x Variety	0.5814		0.2936	
CV	11.0		11.2	

ǂ; Mean±SE. AM-agronomic management package; DMY-dry matter yield; DOMY digestible organic matter yield.
Within a column means followed by different lowercase superscript letters are significantly different at *P*<0.05.
Within a row means followed by different uppercase superscript letters are significantly different at *P*<0.05.

Table 9: Effect of agronomic management practices on total crude protein and metabolizable energy yields of the initial and ratoon crop harvests of hybrid fodder sorghum in the *Yala* and the *third* seasons.

AMP	Total CPY (MT/ha) ǂ		Total MEY (MJ/ha) ǂ	
	SX – 17	Dairygreen	SX – 17	Dairygreen
AMP1	1.1 ± 0.1abA	1.0 ± 0.0abA	154.9 ± 10.7abA	159.1 ± 5.1bcA
AMP2	1.3 ± 0.1aA	1.4 ± 0.0aA	209.6 ± 19.8aA	202.2 ± 6.5aA
AMP3	0.7 ± 0.0bA	0.8 ± 0.1bA	138.1 ± 5.8bA	141.1 ± 8.9cA
AMP4	1.0 ± 0.1abA	1.1 ± 0.2abA	168.7 ± 25.5abA	189.3 ± 26.5abA
Significance of effects:				
- AMPs	0.0002		0.0020	
- Variety	0.0688		0.2342	
- AMPs x Variety	0.1579		0.2897	
CV	8.9		11.1	

ǂ; Mean±SE. AMP-agronomic management package; CPY-crude protein yield; MEY-metabolizable energy yield.
Within a column means followed by different lowercase superscript letters are significantly different at *P*<0.05.
Within a row means of a parameter followed by different uppercase superscript letters are significantly different at *P*<0.05.

Hybrid fodder sorghum varieties (SX-17 and Dairygreen) cultivated at twofold higher plant density along with reduced fertilizer application rate and less irrigation (AMP4) yielded comparable nutrient and energy yields to those cultivated with more fertilizer and frequent irrigation with low plant density (AMP2). However, when SX-17 fodder sorghum variety was grown at low plant density along with greater fertilizer application rate and frequent irrigation (AMP1) it produced more nutritious fodder (high CP, low fiber, high OMD, high ME).

CONCLUSION

Both AMP2 (high fertilizer rate along with short irrigation interval) and AMP4 (low fertilizer rate along with extended irrigation interval) resulted in statistically similar yields with high plant density (spacing of 45 x 15 cm) for both hybrid fodder sorghum varieties used in the present study. Therefore, for the cultivation of hybrid fodder sorghum in lowland paddy fields in dry zone during *Yala* and continue to the *Third* season low fertilizer application rate (75% of the recommended dosage for Dairygreen), high plant density (45 x 15 cm) and extended irrigation interval, could be recommended. The ratoon crop of SX-17 produced forage containing greater CP content with AMP1 (high fertilizer rate along with, high plant spacing and short irrigation interval). Therefore, for the cultivation of SX-17 to produce nutritious fodder in the dry zone during the two seasons, application of high fertilizer rate (at the rate recommended for SX-17) along with low plant density (plant spacing at 45 x 30 cm) and frequent irrigation could be recommended.

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