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Dry Matter Yield and Agronomic Performance of Herbaceous Legumes Intercropped With Napier Grass (*Pennisetum Purpureum*) in the Semi-Arid Areas of Eastern Amhara Region

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Abstract: **The study was conducted at the two trial sites (Cheffa and Sirinka) of Sirinka Agricultural Research Center which represents the low and mid altitude agro ecologies of the eastern Amhara region to identify legume species that would have best compatibility with Napier grass and to examine the DM herbage yield of mixed cultures of legumes and Napier grass. Seven adaptable and recommended perennial herbaceous legume species (Desmodium unicinatum, Macrotyloma axillare, Clitoria ternatea, Macroptilium atropurpreum, Stylosanthes guianensis, Stylosanthes hamata and Medicago sativa) were intercropped with recommended Napier grass (Pennisetum purpureum) Acc. No. 14984 for the areas were included in the study. With in the three years experimental periods a total of six and four harvests, with an average harvesting interval of 135 and 206.75 days were obtained at Cheffa and Sirinka trial site, respectively. The agronomic performances of legumes among intercropped treatments and during each harvesting stages, respectively were significantly (P<0.001) different at each trial site (Cheffa and Sirinka) and at Cheffa. Only the DM yield of intercropped legumes was significantly (P<0.01) different at each location. However, the DM leaf and total (leaf + stem) yield of Napier and both (Napier + Legume) yield difference among the intercropped treatments were significant (P<0.05) at Sirinka. Hence, among the intercropped treatments highest Napier DM leaf and total (leaf + stem) yield, legume and both (Napier and legume) of (7.85, 1.39 and 9.23 t/ha) at Cheffa and (8.61, 2.15 and 10.76 t/ha) at Sirinka, respectively were obtained from treatment in which Stylosanthes guianensis was intercropped with Napier grass. The average Napier DM leaf and total yields in sole and intercropped treatments were similar at each location. As the result of climatic (RF and Maximum temperature) variations and better adaptation, the DM herbage yield responses of Napier within both sole and intercropped treatments and legumes in intercropped treatments were increases significantly (P<0.001) in advancement of harvesting stages. As the study result indicates, intercropping Napier grass with herbaceous legumes has significant advantage than growing Napier grass solely in increasing the DM yield harvested. Therefore, among the tested legumes and Napier grass combinations, intercropping Stylosanthes guianensis with Napier grass was found to be the best for its compatibility and higher Napier total (leaf + stem), legume and both (Legume + Napier) DM yields at each (Cheffa and Sirinka) trial site. Therefore, we recommend this combination for future use. However, further studies are needed to evaluate the effect of legume intercropping on herbage quality and soil fertility improvement, and the economic advantage of legumes and Napier intercropping.**

Keywords: **Napier grass, intercropping, herbaceous legume, DM yield, compatibility.**

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I. INTRODUCTION

Livestock production is a major component of the economy of the country. It accounts for 15 to 17% of total GDP and 35 to 49% of agricultural GDP [2]. Currently productivity per animals is very low and hence the contribution of the livestock sector to the overall economy is much less than expected. Among the major livestock constraint in the region in particular and the nation in general feed shortage is the important one [3]. Feed deficiency in the region ranges from 28% to 40% [1]. Feed scarcity is most critical in eastern Amhara region, where 90% of the feed is drive from crop residues [3]. These feed stuffs are grossly low in amount and nutritional values to sustain animal production.

Principally, when a pure grass pasture is grown without a legume complement, it eventually suffers yield losses through N depletion. Conversely pure stand legume pasture fixes excess N of its requirement which results insect attracts, non-legume weeds or grasses invasion [4]. A sustainable fodder grass and legume mixture can address these constraints, because compared to a pure grass stand; grass and legume mixtures have the potential to produce higher total dry matter yield of higher quality to suppress weed and to improve soil fertility [5].

To increase the availability of good quality of feeds several experiments has been carried out by Sirinka Agricultural Research Center and promising forage grasses and legumes were recommended for different agro ecologies of eastern Amhara region [7]. Among the recommended forage grasses Napier (*Pennisetum purpureum*) and legumes (*Desmodium unicinatum, Macrotyloma axillare, Clitoria ternatea, Macroptilium atropurpreum, Stylosanthes guianensis, Stylosanthes hamata* and *Medicago sativa*) were the major one. However, the adaptability and yield performance of these recommended perennial grasses and legumes so far have been evaluated only on pure stands. Hence, information on the studies of yield evaluation and compatibility of different herbaceous legumes intercropped/mixed with Napier is scanty. Therefore this study was initiated to identify legume species that would have best compatibility with Napier grass, and to examine herbage yield of mixed cultures of different herbaceous forage legumes and Napier grass.

II. MATERIALS AND METHODS

The study was conducted for three years at the two trial sites (Cheffa and Sirinka) of Sirinka Agricultural Research Center, which respectively represents the low and mid altitude agro ecologies of the eastern Amhara region. Cheffa and Sirinka are located at $10^{O}30'$ -11^{O} and $11^{O}30'$-12^{O} N latitude and $39^{O}30'$ - 40^{O} and $39^{O}30'$- 40^{O} E longitude, respectively. The climate data of the trial sites is presented in Table 1.

TABLE 1. Average monthly and study period's rainfall amount (mm.), maximum and minimum temperature (^{O}C) at Cheffa and Sirinka

Parameters	Study years	Cheffa	Sirinka
Average monthly RF	1st	1037.9	791.7
	2nd	926.7	1089.5
	3rd	1036.80	1094.70
Study period average		***1000.47***	***991.97***
Minimum temperature	1st	13.43	13.89
	2nd	13.66	13.61
	3rd	14.78	13.60
Study period average		***13.96***	***13.70***
Maximum temperature	1st	29.84	26.64
	2nd	29.98	26.49
	3rd	29.99	26.25
Study period average		***29.93***	***26.46***

Seven adaptable and recommended herbaceous perennial legume species (Desmodium unicinatum, Macrotyloma axillare, Clitoria ternatea, Macroptilium atropurpreum, Stylosanthes guianensis, Stylosanthes hamata and Medicago sativa) and grass species Pennisetum purpureum (Napier grass) Acc. No. 14984 for the areas were included in the study. The combination of legumes and Napier grass with sole Napier grass (control) makes a total of 8 treatments. The treatments were arranged in Randomized Complete Block Design (RCBD) with three replications.

In all treatments, root split for Napier grass and direct seeding using the recommend seeding rate for legumes were used for establishment. To allow a uniform re-growth, both Napier and legumes were cut initially when the plots had full cover.

The middle rows of both Napier and legume in the plots were harvested when the Napier grass reach at the recommended harvesting height of 1.5m. [6] and intercropped legumes at 50% of flowering/heading at which optimum herbage yield and quality could obtained. To determine the botanical proportion of the Napier grass, stem and leaf part of the harvests were separated manually. A fresh herbage yield of both Napier and legumes were measured immediately after each harvest. To determine the DM% of the harvest, sub-sample was taken from each botanical proportion of Napier grass and total legumes fresh yield and dried in drought oven at 65^{O}C for 72 hours.

III. DATA ANALYSIS

The data were analyzed using the General Linear Model (GLM) of SAS [8]. Duncan's Multiple Range and t-Test was employed for separation of treatment means. Depend on the type of treatments two sets (intercropped alone and with sole treatment) of analysis were carried out. With this fact, the following mathematical models were applied to analyze the effect of all possible factors in the two sets of analysis.

For intercropped treatments:

$y_{ijl} = \mu + T_i + H_j + L_l + e_{ijl}$

Where:

y_{ijl} = Score for plant vigor, plot cover, compatibility, height at harvest and DM herbage yield with i legume species, at j harvesting stage and within location l.

μ = overall mean

T_i = the effect due to the i^{th} legume species (i = 1… 7)

H_j = the effect due to j^{th} harvesting stage (1, 2… 6).

L_l = the effect due to the l^{th} location (l = 1, 2)

e_{ijl} = random error effect.

For both intercropped and sole treatments together:

$y_{ijkl} = \mu + T_i + H_j + TG_k + L_l + e_{ijkl}$

Where:

y_{ijkl} = height at harvest and, DM leaf and total (leaf and stem) yields of Napier with treatment i, at j harvesting stage, with in k treatment group and location l

μ = overall mean

T_i = the effect due to the i^{th} treatment (i = 1… 8)

H_j = the effect due to j^{th} harvesting stage (1, 2… 6).

TG_k = the effect due to the K^{th} treatment group (k = 1, 2)

L_l = the effect due to the l^{th} location (l = 1, 2)

e_{ijkl} = random error effect.

IV. RESULTS AND DISCUSSION

Harvesting intervals (days):

Within the study periods, a total of six and four harvests were obtained at Cheffa and Sirinka trial sites with an average harvesting interval of 135 and 206.75 days, respectively (Table 2). The highest number of harvests obtained at Cheffa mainly related with the highest rainfall and maximum temperature prevailed during the study periods.

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TABLE 2. Harvesting interval (days) of the successive harvests in the study period, at Cheffa and Sirinka locations

Harvesting periods	Interval Between successive harvesting periods	
	CHEFFA	SIRINKA
1st	70	89
2nd	193	237
3rd	68	134
4th	64	367
5th	110	-
6th	305	-
Average	**135**	**206.75**

Intercropped treatments result:

Legumes agronomic performance:

The agronomic performance of forage legumes among intercropped treatments were different ($p<0.001$) at each and both locations. Accordingly, *Macrotyloma axillare* and *Stylosanthes guianensis* have shown best performance at Cheffa and Sirinka locations, respectively. Moreover, the performances of legumes were found to be variable ($p<0.001$) during the different harvesting stages at Cheffa. Hence, due to better adaptation of legumes for the stress of companion plant (Napier) they had shown good vigor and plot coverage at the last harvesting stage. However, at each location due to less shading effect of Napier grass before the first harvesting stage the intercropped legumes have shown better compatibility at first harvesting stage than the other succeeding stages. As the interaction effect of legume species and harvesting periods indicates, those intercropped legumes have shown variable agronomic performances across each harvesting period at both locations in general and at Sirinka in particular (Table 3). This may resulted due to rainfall amount variations received at Sirinka during the three study years.

TABLE 3. Average agronomic performance score (0-9) and height at harvest (cm.) of legumes in intercropped treatments

VARIALES & GROUPS	CHEFFA			SIRINKA			BOTH LOCAIONS		
	Legume Score for			Legume Score for			Legume Score for		
	Vigor	Plot cover	Compatibility	Vigor	Plot cover	Compatibility	Vigor	Plot cover	Compatibility
LEGUMS									
C. ternatea	5.50^{C}	5.11^{B}	3.11^{C}	4.38^{C}	3.50^{ED}	4.25^{CD}	5.15^{BC}	4.62^{BC}	3.46^{C}
D. unicinatum	5.94^{BC}	6.16^{AB}	3.61^{BC}	7.75^{A}	8.17^{A}	7.58^{A}	6.67^{A}	6.96^{A}	5.20^{A}
M. axillare	7.06^{A}	6.41^{A}	4.67^{AB}	7.08^{A}	6.50^{B}	6.58^{AB}	7.07^{A}	6.45^{A}	5.43^{A}
M. atropurpureum	6.67^{AB}	6.78^{A}	4.61^{AB}	4.20^{C}	3.10^{E}	3.70^{D}	5.79^{B}	5.46^{B}	4.29^{BC}
M. sativa	6.94^{A}	6.99^{A}	4.83^{A}	6.75^{AB}	6.00^{BC}	5.67^{B}	6.87^{A}	6.60^{A}	5.17^{AB}
S. guianensis	6.39^{ABC}	6.67^{A}	4.56^{AB}	8.00^{A}	8.00^{A}	7.50^{A}	7.03^{A}	7.20^{A}	5.73^{A}
S. hamata	4.29^{D}	3.18^{C}	2.50^{C}	5.42^{BC}	4.58^{CD}	5.33^{BC}	4.76^{C}	3.76^{C}	3.63^{C}
LSD	***0.97***	***1.27***	***1.18***	***1.40***	***1.44***	***1.33***	***0.82***	***0.94***	***0.90***
P-VALUE	***<.0001***	***<.0001***	***0.0003***	***<.0001***	***<.0001***	***<.0001***	***<.0001***	***<.0001***	***<.0001***

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HP									
1st	7.24^{AB}	7.25^{AB}	6.29^{A}	6.52	6.19	6.62^{A}	6.88^{B}	6.72^{AB}	6.45^{A}
2nd	3.95^{E}	3.81^{E}	4.05^{B}	6.10	5.91	4.05^{B}	5.02^{D}	4.86^{D}	4.05^{C}
3rd	5.33^{D}	4.95^{DE}	4.76^{B}	7.12	6.24	6.59^{A}	6.13^{BC}	5.53^{CD}	5.58^{B}
4th	6.00^{CD}	6.16^{BC}	0.00^{C}	5.84	5.16	6.68^{A}	5.92^{C}	5.66^{CD}	3.18^{D}
5th	6.40^{BC}	5.90^{CD}	4.76^{B}	-	-	-	6.40^{BC}	5.90^{BC}	4.76^{BC}
6th	7.76^{A}	7.40^{A}	4.05^{B}	-	-	-	7.76^{A}	7.43^{A}	4.05^{C}
LSD	***0.895***	***1.18***	***1.089***	***1.052***	***1.081***	***1.000***	***0.801***	***0.911***	***0.869***
P-VALUE	***<.0001***	***<.0001***	***<.0001***	***0.110***	***0.110***	***<.0001***	***<.0001***	***<.0001***	***<.0001***
MEAN	**6.11**	**5.91**	**3.98**	**6.37**	**5.87**	**5.94**	**6.21**	**5.90**	**4.73**
SEM	**2.07**	**3.60**	**3.15**	**2.65**	**2.80**	**2.40**	**2.49**	**3.23**	**2.99**
P-VALUE									
TREAT Vs HP	**0.006**	**0.127**	**0.280**	**0.000**	**0.000**	**0.020**	**<.0001**	**<.0001**	**0.053**

Mean in the column followed by different letters are significantly different at the specific P-value.

D. unicinatum= *Desmodium unicinatu*;, M. axillare= *Macrotyloma axillare*; C. ternatea= *Clitoria ternatea*; M. atropur= *Macroptilium atropurpreum*; S. guianensis= *Stylosanthes guianensis*; S. hamata,=*Stylosanthes hamata*; M. sativa= *Medicago sativa*; SEM= standard error of means; LSD= least significant differences; Treat.= Treatment; HP= Harvesting period;

Herbage, DM yield:

The average DM leaf and total (leaf + stem) yield difference of Napier grass intercropped with different forage legumes were not significant (P>0.001) at each location (Table 4).

However, at each and both locations among the intercropped treatments highest average DM leaf and total yields were obtained from Napier grass which was intercropped with *Stylosanthes guianensis* (Table 4). Moreover, this forage legume also gave significantly (p<0.01) highest DM yield of 1.39, 2.15 and 1.69 t/ha at Cheffa, Sirinka and both locations, respectively. Due to highest total Napier and legume DM yields, this treatment also gave highest both (Napier and legume) DM yields at each and both locations. In general, both Napier leaf and total DM yield were not variable among intercropped treatments at each and both locations. Due to the climatic variability over the study periods, the Napier leaf and total, and legumes DM yields at each location were also variable during the different harvesting stages obtained at each and both locations. At Cheffa both Napier and legume herbage yields were found to be higher at the last harvesting stage which might resulted due to better adaptation and establishment of the plant for the existing environments conditions of the location and the same holds true for legume DM yield at Sirinka. Unlike to Cheffa site, due to highest average rainfall received at 2nd year of study period at Sirinka both leaf and total DM yield of Napier were higher during the second harvesting stage than other stages.

TABLE: 4 Average DM yield (t/ha) of legumes and Napier grass (*Pennisetum Purpureum*) in intercropped treatments

VARIABLES & GROUPS	**CHEFFA**				**SIRINKA**				**BOTH LOCAIONS**			
	Nap. Leaf	**Nap. Total**	**Leg.**	**Both (Nap + Leg)**	**Nap. Leaf**	**Nap. Total**	**Leg.**	**Both (Nap + Leg)**	**Nap. Leaf**	**Nap. Total**	**Leg.**	**Both (Nap + Leg)**
TREAT.												
C. ternatea	**5.93**	**7.12**	**0.62^{BC}**	**7.74**	**5.73**	**7.15**	**0.01^{C}**	**7.16^{B}**	**5.85^{AB}**	**7.13^{AB}**	**0.38^{DE}**	**7.51^{BC}**
D. unicinatum	**4.70**	**5.50**	**1.03^{AB}**	**6.53**	**3.89**	**4.96**	**2.04^{A}**	**7.00^{B}**	**4.38^{BC}**	**5.28^{BC}**	**1.43^{AB}**	**6.71^{BC}**

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M. axillare	6.07	7.19	1.06^{AB}	8.25	5.37	6.41	1.37^{B}	7.79^{AB}	5.79^{AB}	6.88^{ABC}	1.18^{BC}	8.06^{AB}
M. atropur	3.82	4.42	1.25^{A}	5.66	4.38	5.40	0.22^{C}	5.62^{B}	4.05^{C}	4.81^{C}	0.83^{DC}	5.64^{C}
M. sativa	5.35	6.46	0.96^{AB}	7.43	3.42	3.62	1.18^{B}	4.79^{B}	4.58^{ABC}	5.32^{BC}	1.05^{BC}	6.37^{BC}
S. guianensis	6.45	7.85	1.39^{A}	9.23	5.53	8.61	2.15^{A}	10.76^{A}	6.08^{A}	8.15^{A}	1.69^{A}	9.84^{A}
S. hamata	6.17	7.12	0.21^{C}	7.33	4.96	6.18	0.31^{C}	6.49^{B}	5.69^{ABC}	6.74^{ABC}	0.25^{E}	6.99^{BC}
LSD	*2.53*	*3.14*	*0.61*	*2.95*	*2.12*	*3.43*	*0.47*	*3.46*	*1.65*	*2.201*	*0.46*	*2.12*
P-VALUE	*0.280*	*0.271*	*0.002*	*0.300*	*0.230*	*0.130*	*<.0001*	*0.04*	*0.074*	*0.032*	*<.0001*	*0.003*
HP												
1st	4.08^{BC}	5.54^{BC}	0.48^{BC}	6.02^{C}	2.10^{C}	3.15^{C}	0.25^{C}	3.407^{B}	3.09^{C}	4.35^{DC}	0.37^{D}	4.714^{C}
2nd	4.66^{B}	5.22^{DC}	0.07^{C}	5.28^{DC}	6.47^{A}	9.93^{A}	1.11^{B}	11.043^{A}	5.57^{B}	7.57^{AB}	0.59^{CD}	8.163^{B}
3rd	5.40^{B}	8.25^{AB}	0.64^{B}	8.89^{B}	6.62^{A}	7.25^{B}	1.21^{B}	8.45^{A}	6.01^{B}	7.75^{AB}	0.92^{BC}	8.67^{B}
4th	8.03^{A}	8.86^{A}	0.65^{B}	9.51^{AB}	3.83^{B}	3.85^{C}	1.60^{A}	5.45^{B}	5.93^{B}	6.36^{BC}	1.12^{B}	7.478^{B}
5th	2.29^{C}	2.32^{D}	0.93^{B}	3.25^{D}	-	-	-	-	2.29^{C}	2.32^{D}	0.93^{BC}	3.25^{C}
6th	8.55^{A}	8.96^{A}	2.80^{A}	11.76^{A}	-	-	-	-	8.55^{A}	8.96^{A}	2.80^{A}	11.76^{A}
LSD	*2.339*	*2.907*	*0.564*	*2.728*	*1.60*	*2.59*	*0.35*	*2.61*	*1.61*	*2.15*	*0.45*	*2.10*
P-VALUE	*0.0001*	*0.0003*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*
MEAN	5.50	6.52	0.93	7.45	4.76	6.05	1.04	7.09	5.20	6.33	0.97	7.31
SEM	14.52	22.43	0.85	19.76	6.7	17.61	0.33	17.84	10.43	18.62	0.82	17.23
P-VALUE												
TREAT Vs HP	0.999	0.999	0.001	0.978	0.82	0.88	<.0001	0.87	0.951	0.928	<.0001	0.712

Mean in the column followed by different letters are significantly different at the specific P-value.

Sole and intercropped results:

The height at harvest, DM leaf and total yield response of Napier grass under intercropped and sole treatments were evaluated and the result is presented in Table 5. At Cheffa the height at harvest and both leaf and total DM yield were highest for sole Napier and these difference were not statistically significant. However, among the intercropped treatments the highest Napier leaf and total DM yield of 6.45 and 7.85 t/ha, respectively were obtained from treatment in which *Stylosanthes guianensis* were intercropped. Similar treatment (*Stylosanthes guianensis* + Napier) was also gave highest height at harvest and leaf and total DM yield of 163.07 cm, 5.53 and 8.61 t/ha, respectively at Sirinka and it were also true for the two locations result.

Regarding the height at harvest and DM leaf and total Napier yield responses among all (sole and intercropped) treatments at different harvesting stages at each and both locations, the height, DM leaf and total yields at Cheffa and both locations were highest during the 6th harvesting stage. However, with climatic factors variability before each harvesting stage the height at harvest and leaf and total DM yields of Napier at Sirinka, respectively during 3rd and 2nd harvesting stages were higher than others stages (Table 5).

Except, the height at harvest of Napier which were highest for sole and intercropped treatments, respectively at Cheffa and Sirinka the DM leaf and total yields were not different between sole and intercropped treatments for each and both locations (Table 5).

At each location, the response of Napier for height at harvest and DM leaf and total yield between sole and intercropped treatments in general and among each treatment were not affected by harvesting stages difference.

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TABLE: 5 Average height at harvest (cm.) and DM yield (t/ha) of intercropped and sole Napier grass (*Pennisetum Purpureum*)

VARIALES & GROUPS	CHEFA			SIRINKA			BOTH LOCATION		
	Napier Ht. at harvest	Napier DM yield		Napier Ht. at harvest	Napier DM yield		Napier Ht. at harvest	Napier DM yield	
		Leaf	Total		Leaf	Total		Leaf	Total
TREAT									
Napier alone	162.09	6.61	8.62	136.70	4.46	5.24	151.93	5.75^{AB}	7.27^{AB}
C. ternatea	152.82	5.93	7.12	155.43	5.73	7.15	153.87	5.85^{AB}	7.13^{AB}
D. unicinatum	150.76	4.70	5.50	147.50	3.89	4.96	149.45	4.38^{BC}	5.28^{BC}
M. axillare	151.47	6.07	7.19	156.55	5.37	6.41	153.50	5.79^{AB}	6.88^{ABC}
M. atropur	147.50	3.82	4.42	139.07	4.38	5.40	144.13	4.05^{C}	4.81^{C}
M. sativa	150.87	5.35	6.46	152.23	3.42	3.62	151.41	4.58^{ABC}	5.32^{BC}
S. guianensis	152.44	6.45	7.85	163.07	5.53	8.61	156.69	6.08^{A}	8.15^{A}
S. hamata	150.78	6.17	7.12	145.60	4.96	6.18	148.71	5.69^{AB}	6.74^{ABC}
LSD	***12.96***	***2.47***	***3.14***	***16.46***	***2.09***	***3.28***	***9.76***	***1.61***	***2.17***
P-VALUE	***0.986***	***0.289***	***0.322***	***0.100***	***0.252***	***0.149***	***0.200***	***0.038***	***0.02***
HP									
1st	144.54^{CD}	4.07^{BC}	5.81^{B}	156.92^{A}	2.14^{C}	3.176^{C}	150.73^{B}	3.11^{C}	4.49^{C}
2nd	123.42^{E}	4.90^{B}	5.56^{B}	127.21^{B}	6.52^{A}	9.811^{A}	125.31^{D}	5.71^{B}	7.69^{AB}
3rd	154.08^{BC}	5.54^{B}	8.56^{A}	160.52^{A}	6.46^{A}	7.018^{B}	157.30^{B}	5.99^{B}	7.79^{AB}
4th	156.07^{B}	8.36^{A}	9.23^{A}	153.43^{A}	3.76^{B}	3.777^{C}	154.75^{B}	6.06^{B}	6.50^{B}
5th	135.64^{D}	2.30^{C}	2.33^{C}	-	-	-	135.64^{C}	2.30^{C}	2.33^{D}
6th	200.29^{A}	8.67^{A}	9.23^{A}	-	-	-	200.29^{A}	8.67^{A}	9.23^{A}
LSD	***11.23***	***2.14***	***2.72***	***11.64***	***1.48***	***2.32***	***8.91***	***1.47***	***1.98***
P-VALUE	***<.0001***	***<.0001***	***<.0001***	***<.0001***	***<.0001***	***<.0001***	***<.0001***	***<.0001***	***<.0001***
TREAT GRP									
Sole Napier	162.09^{A}	6.61	8.62	136.7^{B}	4.47	5.24	151.93	5.75	7.27
Intercropped	150.95^{B}	5.50	6.52	151.35^{A}	4.76	6.05	151.11	5.20	6.33
LSD	***9.80***	***1.86***	***2.37***	***12.44***	***1.58***	***2.48***	***7.38***	***1.22***	***1.64***
P-VALUE	***0.034***	***0.320***	***0.106***	***0.023***	***0.652***	***0.401***	***0.853***	***0.412***	***0.274***
MEAN	**152.34**	**5.64**	**6.79**	**149.52**	**4.72**	**5.95**	**151.21**	**5.27**	**6.45**
SEM	**383.63**	**13.88**	**22.52**	**407.11**	**6.56**	**16.14**	**367.31**	**10.02**	**18.06**
P-VALUE									
TRET GRP Vs HP	**0.782**	**0.933**	**0.971**	**0.534**	**0.850**	**0.949**	**0.125**	**0.970**	**0.125**
TREAT Vs HP	**0.918**	**0.998**	**0.999**	**0.788**	**0.812**	**0.840**	**0.780**	**0.955**	**0.780**

Mean in the column followed by different letters are significantly different at the specific P-value.

TRTGRP= Treatment group; Compat, Compatibility; D. unicinatum= *Desmodium unicinatum*;, M. axillare= *Macrotyloma axillare*; C. ternatea= *Clitoria ternatea*; M. atropur= *Macroptilium atropurpreum*; S. guianensis= *Stylosanthes guianensis*; S. hamata,=*Stylosanthes hamata*; M. sativa= *Medicago sativa*; SEM= standard error of means; LSD= least significant differences; Treat.= Treatment; HP= Harvesting period;

V. CONCLUSIONS

When a pure grass pasture is grown without a legume complement, it eventually suffers yield losses through N depletion. Conversely pure stand legume pasture fixes excess N of its requirement exposes the plant for insects attracts and non-legume weeds or grasses invasion [4]. A sustainable fodder grass and legume mixture can address these constraints, because compared to a pure grass stand, grass and legume mixtures have the potential to produce higher total dry matter yield with better herbage quality through suppressing weed growth and improving soil fertility [5]. This study was also verified that the advantage of growing mixture of Napier grass and legume in improving the total DM yield harvested.

According to the study result at each and both trial sites, intercropping Napier grass with herbaceous perennial legume has significant advantage than growing Napier grass solely in increasing the DM yield harvested. Among the tested legume and Napier grass intercropped treatments, growing *Stylosanthes guianensis* with Napier grass was found to be the best for its compatibility, higher Napier total (leaf + stem), legume and both (Legume + Napier) DM yields at the two locations. Therefore, from this study we recommend that intercropping Napier grass with *Stylosanthes guianensis* was found to be the best combination and can be promoted for further use. However, detail studies are needed to evaluate the effect of legume intercropping on the DM yield quality and soil fertility improvement, and to evaluate the economical advantage of the practice.

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