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Biomass Yield and Nutritive Values of *Pennisetum pedicellatum* and *Lablab purpureus* Mixed Pasture as Affected by Planting Pattern Under Nekemte Condition, Western Ethiopia

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Abstract: This experiment was conducted to evaluate effect of planting pattern on herbage yield and nutritive values of *Pennisetum pedicellatum* and *Lablab purpureus* mixed swards. The planting pattern treatments include pure *P. Pedicellatum*, *P. pedicellatum* grass planted with *L. purpureus* legume by broadcasting, both the grass and the legume planted in the same row and alternate rows and pure *L. purpureus*. The experiments were managed using randomized complete block design (RCBD) with three replications. The data collected were analyzed using the General Linear Model (GLM) procedure of the statistical analysis system and means were separated using Tukey's Honestly Significant Differences test. The legume dry matter yield (DMY) ($P=0.0964$), leaf to stem ratio (LSR) ($P=0.3344$) and plant height (PH) ($p=0.1175$) did not vary with planting patterns whereas the number of root nodules was significantly affected ($p=0.0001$) and the alternate row planting pattern resulted highest number. Concerning the grass species, all the parameters studied dry matter yield (DMY), leaf to stem ratio (LSR) and plant heights (PH) were significantly ($P<0.001$) affected by the planting patterns while the internode length (INL) was not. The alternate row planted and the sole planted *P. pedicellatum* has got the highest DMY. The LSR and PH were highest for broadcasting method of planting. The relative yield of the grass (RYG) and relative yield total (RYT) were significantly ($P<0.0001$) affected by the planting method while that of the legume component was not affected ($P=0.0964$). Inter cropping of *P.pedicellatum* and *L. purpureus* in alternate row planting pattern in this experiment had yield advantage (80%) more than the sole grass. The total biomass yield of the mixed components was found to be dominated by DMY of the grass this indicates that the legume couldn't compete well in this experiment. The fiber (NDF & ADF) and CP content of the grass was not affected by the planting patterns the grass with the legume and so did the *in vitro* DM digestibility. Further studies to investigate proper planting date for *P. pedicellatum* intercropped with *L. purpureus* may be important.

Key words: Dry Matter Yield · Ethiopia · Grass-Legume Mixture · *L. purpureus* · Planting Pattern · *P. pedicellatum*

INTRODUCTION

Ethiopia owns the largest livestock population among African countries [1]. The livestock sector is a significant contributor to Ethiopia's economy at the national and household level. Livestock contributes to the livelihoods of approximately 70% of Ethiopians and accounts for 15-17% of the total national gross domestic product (GDP) and 35-49% of the agricultural GDP [2]. IGAD [3] indicated that the livestock sector contributes about 47% to the AGDP, including monetary values and the non-marketed services (traction and manure) in Ethiopia. At the household level, livestock plays a significant role as sources of food and family income for smallholder farmers and pastoralists. About 80% of the Ethiopian farmers use animal traction to plough cropping fields [4].

Livestock also play an important role in urban and peri-urban areas evoking a living out of it and for those involved in commercial activities [5]. Hence, livestock remains as a pillar for food security, human nutrition and

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economic growth of the country [6]. In developing countries (including Ethiopia) demand for a human food of animal origin is increasing from time to time due to human population growth and rise in urbanization [7]. In addition to direct income benefits, livestock provides indirect benefits, such as fuel and fertilizer from animal manure and draught power for farm production.

However, the contribution of the Ethiopian livestock resource to human nutrition and export earning of the country is disproportionately low due to poor productivity of the animals as compared to the regional and continental average [8, 9]. This is mainly due to low quality and insufficient feed supply [8, 10, 11]. In spite of its significant contribution, the country's livestock productivity is low. Lack of adequate quantity and quality of feed is a major factor in poor livestock productivity. According to CSA [1] information on feed usage in rural areas of the country, a very limited amount (0.3%) of improved fodder or pasture is used by livestock holders. Animal feed shortage remains the main constraint on herd size and productivity in both the lowlands and highlands.

The major available feed resources in Ethiopia are natural pasture, crop residues and after math grazing, supply [12, 13, 14]. The current report of CSA [1] revealed that 56%, 30% and 1.2% of the total livestock feed supply of the country is derived from grazing on natural pasture, crop residues and agro industrial byproducts respectively. This shows that the dominant part (86%) of the available feed resources for livestock comes from native pasture and crop residues of poor nutritive values. These native pasture and crop residues were high in fiber content and low in digestibility supply [13]. Moreover, they have low crude protein contents (CP).

Researchers have suggested that grass legume mixtures increase plant diversity, productivity and pasture persistence supply [15]. A key aspect in the design of pasture mixtures is the correct selection of species and cultivars, which must combine different reproductive strategies and be able to establish supply [16, 17].

To establish and maintain a good performing grass-legume mixed pasture, selection of the planting pattern is very important. Grass-legume mixed pasture could play an important role in improving both the quantity and quality of forage without additional organic and/or inorganic fertilizer applications compared to pure-stands supply [18]. Therefore, it could be hypothesized that inter-cropping *L. purpureus* with *P. pedicellatum* can improve herbage yield and nutritive value of the swards. Thus the current study was carried out to investigate effect of planting pattern on biomass yield and nutritive values of *P. pedicellatum* and *L. purpureus* mixed forages under Nekemte Condition, Western Ethiopia.

MATERIALS AND METHODS

The Study Area: The agronomic study of the mixture of *P. pedicellatum* and *L. purpureus* was conducted under Nekemte condition in the campus of engineering workshop of Wollega University located in East Wollega Zone of Oromia Regional State, Western Ethiopia at an altitude of 2,088 m.a.s.l. Nekemte town is located at 9°5`N latitude and 36°33`E longitude /9.083°N 36.550°E at a distance of 325kmwest of Addis Ababa. The average annual rainfall is 1988mm.The mean annual temperature is 20°C with a mean maximum of 27°C and mean minimum 13°C.

Treatments and Experimental Design: The mixture of *L. purpureus* and *P. pedicellatum* was established at different planting patterns. Even though *L. purpureus* was annual legume and *P. pedicellatum* was perennial grass, it was planted with the assumption that the legume could be annually reseeded in the grass sward. The single factor experiment, planting patterns includes sole *P. pedicellatum* planting, sole *L. purpureus* planting, broadcasting equal proportion of *P. pedicellatum* with *L. Purpureus*, same row planting of both species and alternate row planting of the mixtures. The experiments were managed using randomized complete block design (RCBD) with three replications. The blocking was used to control soil heterogeneity effects, in cases, on the different treatments of the plots. The spacing between rows and between plants was 30 and 10 cm, respectively. The individual plot size was 3m x 2m ($6m^2$).

Land Preparation and Planting: Land was ploughed and harrowed in June 2018 cropping year. Land preparation, planting, weeding and harvesting was made according to supply [19]. Soil composite samples were taken using soil auger from all the plots diagonally before planting and from each plot during harvesting the herbage at the depth of 0-20 cm [20] and analyzed at Nekemte Soil Research Center of Oromia Agricultural Research Institute for testing some major elements such as total nitrogen (TN), cation exchange capacity (CEC) (mole/kg) and pH of the soil. Planting material of *P. pedicellatum* was collected from a nursery site at Eastern Wollega Zone of Guto Gidda District Office of Agriculture and *L purpureus* seeds were obtained from the Bako Agricultural Research Center.

The plantation was take place in the campus of engineering workshop of Wollega University on 2 July, 2018. The *P. pedicellatum* was planted using vegetative root splits in rows on a finely prepared soil when the seed of *L. purpureus* was planted with base seed rate 15kg/ha by hand between row space of 30 cm and between plants spacing of 10 cm within same rows and alternate rows with *P. pedicellatum* root splits [21]. For broadcasting pattern of planting, both the root splits of *P. pedicellatum* and seeds of *L. purpureus* planted in scattered manner but evenly spaced. The forage planted in this way was managed under rain-fed system [19,22]. Manual weeding was done from time to time as necessary based on close follow up to control the weeds.

Data Collection

Dry Matter Yield and Related Components Determination: Dry matter yield: The dry matter yields (DMY), was determined by harvesting the middle row using sickle and weighted by using a field balance immediately after mowing. The fresh weight was taken for all the herbage harvested from the row. Chopped sub-samples (300gm) harvested from the rows were taken and oven-dried in Wollega University biology laboratory at 105^0C for 24 hours to determine the dry matter content (DM). The DM yield obtained from those rows was converted to hectare to determine biomass yield on hectare basis. This was done for the grass and the legume components separately [23].

Leaf to stem ratio (LSR): Plants on a row were mown using clean sickle. The leaves weight and the stems weight for the same plants was separately recorded and dried in air draft oven at 105°C for 24 hours and hot weight was taken to determine DM. The weight of leaves was divided to the weight of stems for each plot and recorded.

The number of root nodules (NRN): After all the herbage samples were taken and recorded, ten legumes from every middle row was uprooted by digging carefully and number of root nodules per plants were counted and recorded. These numbers was summed up and divided by ten to get an average number of root nodules per plant [24].

Plant height (PH): and inter node length (INL): From every plot, before harvesting for any sample, the height of ten plants, from the middle row, was randomly taken and measured from the ground to the tip of the plant by using measuring tape. This was summed up and divided by ten to get the mean value for plant height in cm. This was done when the grass reached 50% flowering stage, 120 to135 days after planting [21, 25].

The Relative Dry Matter Yields (RDMY): The RDMY of the components in the mixtures was calculated using the equations developed by DeWit [26] as:

$$RYG = \frac{DMYGL}{DMYGG} \textit{ and } RYL = \frac{DMYGL}{DMYLL} \qquad (1)$$

where DMY_{GG} is the dry matter yield of the grass 'G' as a monoculture; DMY_{LL} is the dry matter yield of the legume 'L' as a monoculture; DMY_{GL} is the dry matter yield of the grass component 'G' grown in mixture with the legume 'L'; and DMY_{LG} is the dry matter yields of legume components 'L' grown in mixture with any grass 'G'.

Relative Total Yield (RTY): The RTY was calculated according to the formula of [26]:

$$RTYGL = 1 + \frac{DMYGL}{DMYGG} + \frac{DMYLG}{DMYLL} \qquad (2)$$

Forage Samples Chemical Analysis: The DM and ash content of the different samples was determined according to AOAC [27]. The total Nitrogen (N) content was determined by the Kjeldahl method [27] and crude protein (CP) content was calculated as N x 6.25. The plant cell wall constituents: neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) was analyzed using the detergent extraction method [28].

Forage Samples *In vitro* DM Digestibility: Dried samples were ground to pass through 1 mm sieve size and *in vitro* dry matter digestibility (IVDMD) of feed samples was determined by the method of Tilley and Terry [29] as modified by Van Soest and Robertson [28].

Statistical Analyses: The forage biomass yields, yield related components, chemical composition and *in vitro* DM digestibility of the sole stands and the mixed pasture were analyzed using analysis of variance (ANOVA) following the General Linear Model Procedure of the Statistical Analysis System [30] version 9.1.3 at á=0.05. Means which significantly varied was separated using Tukey honestly significant difference test. The following model was fitted to the data:

$$Yijk = \mu + + \tau i + \beta j + \varepsilon ijk \qquad (3)$$

where, μ=overall mean of the population, τi= the 1-3^{rd} planting pattern effect, βj= the 1-3^{rd} block effect and εijk=random error associated with yij.

RESULTS AND DISCUSSION

In this result and discussion part, each of the legume and grass components were separately treated even though they were grown together as a mixed pasture [31] reported in a similar way for *Panicum coloratum* and *Stylosanthes guieninensis* mixed swards. This was happened for three main reasons: first if the mixed components (*Lablab purpureus* and *Pennisetum pedicellatum*) were mown together and analyzed together, the nutritive value obtained during first cut inevitably varies from what is expected in the second cut due to dynamic agronomic progress of the two components and hence the recommendation may not, later on, apply for *P. pedicellatum and L. purpureus* mixed pasture grown elsewhere and the parameter taken from both component may not always similar. Secondly, if the herbages are cut together and analyzed together, it brings difficulty to separately calculate the amount of nitrogen fixed by the legume and supplied to the grass through its root in mixed stand since it can be confused with the nitrogen coming from the leaves of the legume to the total mixture. Thirdly, the different nutrients contained in separate components (*L. purpureus* and *P. pedicellatum*) are more constant than the composition of their mixture (depends on the relative proportion of the components) and is more important in feedlot ration formulation.

The Legume Component

Effect of Planting Pattern on Dry mater Yield and some Selected Agronomic Parameters of *L. purpureus* in *P. pedicellatum* Mixed Pasture: Effect of Planting Pattern on Dry mater Yield, leaf to stem ratio, numbers of root nodules and plant height of *L. purpureus* were given in Table 1. The effect of treatment was non-significant for *L. purpureus* mixed stand herbage dry matter yield (P>0.05), leaf to stem ratio (P>0.05) and plant height (P>0.05), while significant effect was observed for number of nodules (P<0.001). Non-significantly (p>0.05) higher dry matter yield was noted for alternate row than same row and broadcasting planting patterns in all treatment. The number of root nodules was significantly (p<0.001) higher for alternate row planted legume while least was for the same row pattern (p<0.001) (Table 1).

As reported by Juntanam *et al.* [32], sowing lablab with low quality roughages increased forage yield and overall chemical composition. In Nigeria, a mixed crop of *Panicum maximum* and *L. purpureus* gave a higher forage yield and better chemical composition [33]. Alternate row planted *Stylo guianensis with Panicum coloratum* mixed pasture resulted in higher DMY than broadcasting and same row planting pattern as reported by Diriba Diba and Diriba Geleti [18]. The DMY of *L. purpureus* in the current study did not indicate vigorous performance. This might be due to late sowing date that caused less competition of the legume in the grass mixture. This is because sowing date is one of the factors affecting sward performance.

Table 1: Dry matter yield and yield related components of *L. purpureus* in the grass mixture

Planting patterns	DMY	LSR	NRN	PH (cm)
Broadcasting	1.27	1.14	16.33^{b}	134
Within row	1.22	1.10	14.00^{C}	143
Alternate row	1.40	1.25	25.00^{a}	124
SEM	0.0398	0.0751	0.3849	0.0486
P-level	0.0964	0.3344	0.0001	0.1175

DMY= dry matter yield; LSR= leaf to stem ratio; NRN=number of Root nodules; PH=plant height; SEM= standard error of the mean.

Table 2: Dry matter yield and some yield components of *P. pedicellatum* in the mixed stand as affected by different planting pattern

Planting patterns	DMY	LSR	INL	PH (cm)
Sole *P. pedicellatum*	2.58^{a}	0.74^{b}	7.33	130^{a}
Broadcasting	2.42^{b}	0.84^{a}	8.10	128^{ba}
Within row	2.14^{c}	0.64^{b}	8.43	139^{a}
Alternate row	2.70^{a}	0.30^{c}	7.81	118^{b}
SEM	0.0294	0.0631	0.3325	0.0243
P-level	0.0001	0.0018	0.2207	0.0053

DMY= dry matter yield; LSR= leaf to stem ratio; INL=Inter-node length; PH=plant height; SEM= standard error of the mean.

Grass Component

Effect of Planting Pattern on Dry mater Yield and some Selected Agronomic Parameters of *P. pedicellatum* in *L. purpureus* Mixed Pasture: Table 2 shows the effect of planting pattern on dry matter yield, leaf to stem ratio, internode length and plant height of *P. pedicellatum* mixed with *L. purpureus*. The dry matter yields (DMY) of the grass in legume mixture did not significantly (p>0.05) differ from the sole planted *P. pedicellatum*. However, there was a difference in DMY of grasses sown in different patterns in that the highest was for alternate row while the least was recorded for same row pattern.

The with-in a row pattern resulted in least herbage yield for both species, which is possibly due to a negative competitive interaction between the species which is similar to other reports [18]. For *Panicum Coloratum* and *Stylosanthes guieninensis* mixtures. The highest biomass yield of the grass in alternate row sowing method was mainly due to the less competition exerted from the legume component. This is because the soil analysis result (Table 4) has indicated that the total nitrogen fixed was non- significant and less amount of nitrogen was contributed by the legume.

Table 3: Effect of different planting pattern of *L. purpureus* and *P. pedicellatum* on Relative yields of the components and RYT of the mixed pasture

Planting pattern	RYG	RYL	RYT (LER)
Broad casting	0.94[b]	0.69	1.64[b]
Within row	0.83[c]	0.67	1.50[c]
Alternate row	1.04[a]	0.76	1.80[a]
SEM	0.029	0.0398	0.027
P-level	0.0001	0.0964	0.0001

SEM=standard error of mean; RYL= relative yield of legume; RYG= relative yield of grass; RYT=relative total yield; LER=land equivalent ratio

The non-significant amount of total nitrogen contributed by the legume in turn may be due to late planting of the materials. In plots where broadcasting was used, the seeds of the legume and roots of *P. pedicellatum* species are normally distributed at relatively distant positions spatially, leading apparently to low competitive interaction as opposed to with-in same row pattern. In the latter case, the seeds of the two species fall closer to each other, leading to severe competition, resulting in poor performance of both the grass and legume components [21, 34].

The alternate row planting pattern was found to be the most favorable strategy for DMY of the grass; the legume and their mixed stand as compared to with-in the same row and broadcasting patterns. Similarly [18] also confirmed in their report on *Panicum coloratum* and *Stylosanthes guieninensis* mixtures. The other agronomic parameters, LSR (p=0.0018) and PH (p=0.0053) were significantly affected by the planting patterns in that the broadcasting was with highest record followed by within row planting pattern. In this particular experiment, the alternate row planting was resulted in the least LSR. The thin nature of stems from within the row pattern and broadcasting, due to competition for light, has brought the LSR highest compared to the alternate row in which the stem was relatively thicker [35].

Relative Yield Total (RYT): Effect of different planting patterns of *L. purpureus* and *P. pedicellatum* on Relative yields of the components and relative yield total (RYT) and/or LER of the mixed pasture were given in Table 3. The relative yield (RY) and land equivalent ratio (LER) is one way of evaluating productivity of a given land when different crops are planted in mixtures. On the other hand the LER is defined as the amount of land required under monoculture to obtain the same dry matter yield as produced in the intercrop.

Accordingly, intercropping, *L. purpureus* in *P. pedicellatum* sward has shown significantly higher RYT (LER) in that the alternate row pattern has the highest (1.8) followed by broadcasting method (1.64) while the same row planting resulted in the least value. The results showed that intercropping *L. purpureus* with *P. pedicellatum* in the alternate row pattern *produced* higher total yield advantage (80%) than the sole grass. This indicates that 80% more area would be required for a sole cropped *P. pedicellatum* to balance the yield from an intercropping system. This finding was similar to other reports [36, 37]. Kazemi [38] also reported that in the grass-legume mixtures; grasses showed higher herbage dry matter yield and the yield advantage increased with intercropping legumes in the grass sward.

Cinar *et al*. [39] confirmed this situation in their report that the inter cropping of Rhodes grass and alfalfa mixed pasture resulted in the highest value of land equivalent ratio (LER). In addition, Diriba Diba and Diriba Geleti [18] have reported increased LER values when *P. Coloratum* was intercropped with *D. uncinatum* than the sole grass. Beside improvement of nutritive value of the pasture, it is therefore, advisable to use legumes intercropped in grass swards during the current situations of land scarcity and encroached grazing lands in most parts of Ethiopia.

The CEC, Total nitrogen (TN) and pH of the Soils before and after Plantation of the *L. purpureus and P. pedicellatum* Mixed Pasture: The analyzed selected soil parameters for samples taken before planting and during harvesting were given in Table 4 below. The soil color of the experimental plots was 65% black and 35% red brown soils. The nature of the soil was generally *vertisol*, taken from gentle slope and well drained plots. The analysis of surface soil resulted for total nitrogen before the plantation was 0.32% and increased to 0.41% average values for all planting patterns at harvesting time which indicates nitrogen fixation of the legume (Table 4). There was observation in this particular experiment in that the sole grass has also attained 0.44% total nitrogen, which is higher numerical value than the total nitrogen values of the legume intercropped plots.

This created controversy that either the plots of the sole cropped grass were arbitrarily enriched with other nitrogen sources such as cow dung, decayed materials and previous legume stands has fixed it or the *L. purpureus* intercropped into the grass has not fixed enough nitrogen into the plots (Table 4). The pH value 5.37 which is acidic before the application was increased to 5.73 during harvesting time, which is a little acidic, cation exchange capacity before application 15.97

Table 4: The CEC, total nitrogen and pH of soil sample before planting and during harvesting for *L. purpureus* and *P. pedicellatum* mixed pasture

Treatments	CEC (mole/kg)	%TN	pH
Sole Sole *P.pedicellatum*	20.80	0.44	5.84
Broadcasting	19.70	0.43	5.53
Within row	20.74	0.40	5.80
Alternate row	19.10	0.39	5.76
Before planting (composite)	15.97	0.32	5.37
SEM	2.4430	0.0273	0.1125
P-level	0.5826	0.1161	0.1041

CEC: cation exchange capacity; TN: total nitrogen SEM: standard error of mean.

(mole/kg) was averagely increased to 20 (mole/kg) of the surface soil sample taken from legume intercropped plots during harvesting of the herbage.

[20] reported that characterization of surface soil indicated that it was suitable for the plant growth, organic carbon, total nitrogen and cation exchange capacity could be also considered as high level of soil nutrients. *L.purpureus* grows well in a wide range of soil types from deep sands to heavy black clays and can tolerate pH ranges of 4.5-7.5 [40] which indicates that the current experimental plots soil nature was conducive for *L. purpureus* intercropping and for the grass plantation.

Chemical Composition and *in vitro* DM Digestibility of *P. pedicellatum* and *L. purpureus* Mixed Pasture: Chemical composition and *in vitro* DM digestibility of *P. pedicellatum* and *L. purpureus* samples in pure stands and mixtures was presented in Table 5. The effect of planting pattern on both the grass and the legume nutrient composition was non-significant (P>. 05). The mean DM content of the grass was within a narrow range and all were nearly 90% for both sole and mixed stand grass in the legume pasture while that of the legume component was between 91.87-92.73%. Such relatively higher figures of DM percentage of the legume component were attributed to the DM analysis made based on the previous partially dried sample that was sent to the laboratory.

This was an indication of the fact that the legume component has lost much water during partial drying (at 65°C) for 24 hours in the oven compared to the grass component. The ash content of the grass was within the range of 11.51-12.8% of the grass whereas it was 11.50 to 12.85% for the legume. The mean CP content of the grass (12.16%) was much lower than that of the legume component (24.88%) and the CP content of the legume component was nearly a double figure as that of the grass component and this is in line with the expected fact that legumes contain more CP than grasses [41]. The relatively higher figure of CP for sole grass compared to grasses harvested from legume intercrop was against the hypothesis that legume intercropping could enhance the CP content of grasses. This may be an attribute of the higher nitrogen content of the plots on which the sole grass was planted (Table 5).

Legumes, grasses and grass-legume mixtures containing greater than 19% CP are rated as having prime standard and those with CP values lower than 8% are considered to be of inferior quality [38]. The mean CP content of *L. Purpureus* in the present study (24.87%) and that of *P. pedicellatum* (12.15%) was greater than the indicated critical value which indicates the highest CP content (Table 5). Also, it is apparent that the legume component had CP levels greater than 15%, a level which is usually required to support lactation and growth performance [39] suggesting the apparent role of legume integrations in improving overall nutritional quality of mixed stand herbage.

The percent NDF for the grass component was all above 68% whereas that of the legume was between the ranges of 47-48%. According to Singh and Oosting [42], feeds containing NDF values of less than 45% are classified as high, those with values ranging from 45% to 65% as a medium and those with values higher than 65% as having low quality. Generally NDF values for grass samples were higher than 65% so that it was in the poor quality forage category. The NDF range of the legume component has shown that the legume forage produced in the current experiment was medium quality.

The quality of the grass component was evidently low and this high cell wall content can be a limiting factor to DM intake [41]. The mean NDF content of the legume (47.5%) observed in the present work is comparable with that reported previously (47%) for eleven herbaceous [43] and eight browse legume (46%) species. Jingura, Sibanda and Hamudikuwanda [44] also reported relative result on lablab green forage NDF%, ADF% and ADL% was 42.4, 31.8, 5.74 respectively, which was comparable to the current study. Diriba [45] indicated that the NDF contents above the critical value of 60% results in the decreased voluntary feed intake, feed conversion efficiency and longer rumination time.

According toVan Soest [46] the critical level of NDF which limits intake was reported to be 55%. However, the NDF content of all the legume planting patterns in the present study were observed to be below this threshold level, which indicates higher feed intake except grass

Table 5: Chemical composition and *in vitro* DM digestibility (% DM) of the grass and the legume component grown in pure stands and mixtures

Planting Pattern	Chemical composition and *in vitro* digestibility						
GRASS	DM%	Ash%	CP%	NDF%	ADF%	ADL%	IVDMD%
Sole *P.Pedicellatum*	89.74	14.03	12.80	68.96	38.61	5.98	76.20
Broadcasting	90.20	14.64	11.63	68.70	39.02	5.93	74.98
Within row	90.15	14.76	11.51	69.67	39.13	6.10	74.82
Alternate row	90.18	14.96	12.69	68.14	37.92	5.76	75.89
SEM	0.130	0.530	0.580	0.990	0.770	0.140	1.345
P-level	0.132	0.645	0.340	0.754	0.705	0.595	0.858
LEGUME							
Sole *L.purpureus*	91.87	12.32	24.74	47.12	32.40	5.14	65.33
Broadcasting	92.65	12.55	25.25	47.26	32.90	5.28	65.64
Within row	92.54	12.85	24.81	47.97	33.58	5.72b	65.35
Alternate row	92.73	11.50	24.71	47.46	32.87	5.38	65.71
SEM	0.145	0.544	0.402	0.479	0.436	0.166	0.269
P-level	0.676	0.293	0.633	0.597	0.493	0.260	0.643

DM=dry matter; CP=crude protein; NDF=neutral detergent fiber; ADF=acid detergent fiber; ADL=acid detergent lignin; IVDMD=in vitro dry matter digestibility

component, which had values of 68% on average. Acid detergent fiber (ADF) is the percentage of indigestible and slowly digestible material in a feed or forage [47]. This fraction includes cellulose, lignin and pectin. Acid detergent fiber has a positive relationship with the ages of the plant [48]. In the present study ADF content of *L. purpureus* was lower indicating that it is more digestible and more desirable which agrees with the reports of other authors [49,50] study on vetch varieties. The non-significance of acid detergent lignin (ADL) contents of the treatments does agree with observations of Diriba [45]. The higher the ADL content and the lower will be the digestibility of the feed. As indicated by (Table 5), in the present study the ADL content of both grass and legume was not higher and didn't show variation among treatments which shows the higher digestibility mixed pasture. The result of *in vitro* DM digestibility in all planting pattern in both species showed no significant variation (P>0.05). The mean *in vitro* DM digestibility for both components was higher than the critical threshold level of 50% required for feeds to be considered as having acceptable digestibility [33]. The *in vitro* dry matter digestibility in this study indicated that *P. pedicellatum* intercropped with *L. purpureus* was less digestible than sole *P. Pedicellatum*. The higher digestibility in the sole stand grass may be linked to its higher CP content (Table 5) which provides more N for microbial utilization [52]. Ovalle *et al.* [17] showed that *in vitro* gas production technique was sensitive to the nitrogen levels of the medium and roughages with more N are more degradable than those with low N content. The extent of digestion of *P. pedicellatum* when intercropped with *L. purpureus* was less than for sole *P. pedicellatum* and this disagrees with other reports [53].

CONCLUSION

The alternate row planting pattern resulted in highest DMY performances for both the legume and the grass species. The total biomass yield of the mixed components was found to be dominated by DMY of the grass this indicates that the legume couldn't compete well in this experiment. The fiber (NDF & ADF) and CP content of the grass was not affected by the planting patterns the grass with the legume and so did the *in vitro* DM digestibility. Further studies to investigate proper planting date for *P. pedicellatum* intercropped with *L. purpureus* may be important.

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