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EFFECT OF INTERCROPING PIGEON PEA WITH ELEPHANT GRASS ON GROWTH, DEVELOPMENT AND NUTRITIONAL VALUES OF THE GRASS

***Kuku S. J., Ekeocha A. H. and Aganga, A. A.**

Department of Animal Production and Health*, Federal University, Oye-Ekiti, Ekiti State, Nigeria*

***Corresponding author's email:** solape.kuku@fuoye.edu.ng

ABSTRACT

This experiment was carried out between the months of August-October 2021 during planting season to determine the growth and nutritional value of sole Elephant grass and Elephant grass intercropped with Pigeon pea in Ikole-Ekiti, Ikole Ekiti was located on Latitude N 07° 48.308, Longitude E 005° 29.573 and elevation 548.4m above sea level with annual rainfall of 1778mm. Planting was done in a Randomized Complete Block Design (RCBD). A plot size of 4m x 2m with 1m spacing between plots and blocks with 0.5m intra-spacing and 1m inter-spacing were the measurements used for planting. Treatments were replicated four times. Data collected were analyzed using T-test of the SAS package to determine the effect of legume intercrop on Elephant grass. Significant means were separated using Tukey's Honestly Significant difference at 5% level of probability. The result shows a significant (P<0.05) positive influence on elephant grass intercropped with pigeon pea on all the parameters measured with elephant grass intercropped with pigeon pea having the highest (192.62cm) value for plant height, leaf length (86.34cm), leaf width (4.17cm), leaf area (204.21cm) and average number of leaves (11.95cm) while sole elephant grass recorded the lowest (146.34cm) value for plant height, leaf length (65.38cm), leaf width (3.17cm), leaf area (143.92cm) and average number of leaves (9.96cm). Intercropping had no statistically significant (P> 0.05) influence on all parameters measured on the nutritive value with the following values for leaf, sole (242.3g/kgDM) and intercropped (249.3g/kgDM) and stem, sole (127.5 g/kgDM) and intercropped (121.4 g/kgDM) on dry matter (DM), for crude protein (CP) for leaf, sole (72.6 g/kgDM) and intercropped (74.3 g/kgDM) and for stem, sole (40.1 g/kgDM) and intercropped (42.4 g/kgDM), for the neutral detergent fibre (NDF) the value for the leaf shows thus, sole (630.8 g/kgDM), intercropped (634.9 g/kgDM) and for stem, sole (629.5 g/kgDM) and intercropped (642.7 g/kgDM), and the result also shows no significant differences in both the acid detergent fibre (ADF) and ash of both the leaf and stem of the grasses. Hence, intercropping Pigeon pea with Elephant grass enhanced growth and yield.

Keywords: Elephant grass, Pigeon pea, intercropping, growth.

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INTRODUCTION

Elephant grass *(Pennisetum purpureum)*, also known as Napier grass, is a perennial bunch grass with a high yield and a wide range of habitats in west, eastern and central Africa. It is a narrow-leaved plant that has an impact on secondary crops in over 20 countries, and well-suited to sustainable cultivation as a feed crop because of its low-input requirements (Woodard *et al*., 2005; Holm *et al*., 2007). Low protein availability is the primary constraining factor for grasses. It is vegetatively propagated using stem cuttings and root splits (Tessema, 2008). Elephant grass and harvesting can take place four times or more in a year (Farrell *et al.,* 2002). The peak crude protein (CP)

awareness was recorded by Tessema *et al*. (2010) at a slicing interval of around thirteen weeks. When collected at less than a 9-week cutting interval, Ansah *et al*. (2010) found the greatest CP content but the lowest dry matter (DM) yield.

According to Orodho (2006) Elephant grass performs best in locations with heavy and evenly distributed rainfall, when annual rainfall exceeds 1000mm, and it prefers temperatures between 25°C and 40°C (FAO, 2015). Soils that are mild loamy and sandy are most favoured and heavy soils are not often appropriate for Elephant grass.

Pigeon pea (*Cajanus cajan*) is a robust, fast-growing, and drought-resistant perennial legume that is widely farmed for its edible seeds across the tropics and sub-tropics. It belongs to the Fabaceae family of plants (Bekele-Tessema, 2007). It is used as grain, vegetable, animal feed, green manure and firewood (Daniel and Ong, 1990). Peoples *et al*. (1995) mentioned that the nitrogen fixing ability of pigeon pea has been a desirable way for environmental sustainable agricultural production. Production of more N per unit area from plant biomass and 235kg Nitrogen (N)/ha can be fix by pigeon pea.

The forage's yield of dry matter and crude protein content both improved when herbaceous legumes are planted alongside elephant grass (Kabirizi *et al.,* 2006). Adie *et al.* (2018) reported increase in yields when intercropped with legumes like *Desmodium* and pigeon pea when irrigated. Planting elephant grass which is common for high biomass yield along with legumes enhanced the quality of nutrients supplied to animals.

Having a better understanding of the connection between accumulated biomass with relation to grass growth and intercropping legumes with grass in order to fix the soil nitrogen for yield has been a major problem for the farmers in Nigeria. The study, therefore, sought to look into the effect of intercrop on growth, biomass accumulation and nutritive value of Elephant grass.

MATERIALS AND METHODS

Experimental site: The experiment was carried out at the teaching and research farm of Animal Production and Health, Federal University of Oye-Ekiti, behind the green house at the faculty of Agriculture, Federal University Oye-Ekiti, Ikole Campus. Ikole Ekiti having Latitude 7.7979ºN, Longitude 5.3286ºE and elevation 548.4m above sea level with annual rainfall of 1778mm (Ekeocha *et al*. 2023).

Treatment and experimental Design: The treatment for this study comprises of two treatments: Sole Elephant grass and Elephant grass intercrop with Pigeon pea, planted on a 4m x 2m plot design using Randomized Complete Block Design having four replicates per treatment. The planting was carried out between the months of August-October 2021.

Stem and Seed source: The elephant grass (*Pennisetum purpureum*) stems of merker cultivar used for planting were gotten from Agricultural Development Project (ADP) office in Ikole, Ekiti State, Nigeria. The pigeon pea seeds ICP7338 cultivar used were gotten from International Institute of Tropical Agriculture (IITA) Ibadan, Oyo

Soil collection: The soil of the experimental area was a sandy clay loam having sand (60.78%), silt (16.10%) and clay (23.12%). The analysis of the soil was carried out in the Soil Science laboratory of Afe Babalola University Ado-Ekiti, Ekiti-State, Nigeria.

Sowing: The Elephant grass stems were sown at a depth of 15cm with split having 3

nodes (2 underground and 1 above ground) at an angle of 30ºC. The pigeon pea seed were also sown at 3cm depth at 2 seeds per hole which was later thinned to one plant per hole after 2weeks of planting.

Routine practices: Weeding was done at 2weeks interval by hand picking to prevent any damage that might occur by using hoe.

Data collection

Plant height: Every two weeks, Elephant grass heights in each treatment were measured by using a meter rule from the base of the plant to the terminal and the values obtained were recorded.

Leaf length: Leaf length was determined at 2weeks interval by measuring the length of the leaf from its tip to the ligule with the aid of a short and long meter rule on five stands that were randomly selected from each plot and the values obtained were recorded.

Leaf Width: The leaf width was done by measuring the length of the leaf half way and at that point measured its width. This was done with the aid of a 30cm meter rule on five stands that were randomly selected from each plot and the values obtained were recorded.

Leaf Area: The leaf area was determined by multiplying the leaf length by the leaf breadth of the five stands that were randomly selected from each plot at 2weeks and values obtained were recorded in cm^2. Leaf area= leaf length (cm) x leaf breadth (cm) x 0.75.

Number of Leaves per plant: At 2 weeks interval the number of leaves was counted and recorded from the five randomly selected plants in each plot.

Leaves and stems collection: Samples were taken from 5 plants from each plot and were separated into leaves and stems by hand to represent the two botanical fractions. At 60°C the fractions were dried for 48 hours and ground using a laboratory mill to pass through 1 mm sieve screens for laboratory analysis. The AOAC (1990) procedure was used in the determination of dry matter (DM), crude protein (CP) and ash. The method of Van Soest *et al*. (1991) was used to determine neutral detergent fibre (NDF) and acid detergent fibre (ADF) and was analysed using the Ankom200 fibre analyser of Method 5 and 6.

Statistical Analysis: The growth and yield parameters were subjected to T-test according SAS (1999) to determine the effect of legume intercrop on Elephant grass. Significant means were separated using Tukey's Honestly Significant difference at 5% level of probability.

RESULTS AND DISCUSSION

Effect of legume (*Cajanus cajan*) intercrop on Elephant grass Plant Height

The effect of legume intercrop on Elephant grass plant height was summarized in table 1 below. Elephant grass intercropped with pigeon pea had the highest plant height and there was significant ($P< 0.05$) increase over the sole Elephant grass precisely from the fourth week to the end of the experiment which is the thirteenth week. At 2nd week of planting there was no significant difference ($P>0.05$) in the height of the sole Elephant (25.93cm) and Elephant grass that was intercrop with pigeon (25.98cm). Legume intercrop brings about higher margin of increase in plant height after 4th weeks to the end of the growth period which was contrary to increase in plant height after 8th weeks reported by Tenakwa *et al*. (2019). The differences in yield can be attributed to a probably high uptake of nitrogen supplied by the pigeon pea.

Effect of legume (*Cajanus cajan*) intercrop on Elephant grass leaf length

The intercrop with Pigeon pea significantly ($p<0.05$) increased the leaf length of Elephant grass than the sole Elephant grass (86.34 vs 64.38). The weekly result shown in table 1 also shows that there is no significant difference ($p<0.05$) in leaf length of sole Elephant grass and Elephant grass intercrop with Pigeon pea at the 2nd week. Starting from the 4th week there was statistical difference ($p< 0.05$) in the leaf length of Elephant grass intercrop with Pigeon pea compare to the sole Elephant grass. The differences in the leaf lengths can easily be explained by the same causes of difference in the plant height such as better competition for light than the sole elephant grass, this may be as a result of the fact that the intercropped is exposed to more light and as a result having more energy to make it grow faster than the sole elephant grass. According to Barre *et. al.* (2010) when there's increase in plant height there is occurrence of adaptive responses to light competition in plants which is related to leaf length during the vegetative period in grasses.

Effect of legume (*Cajanus cajan*) intercrop on Elephant grass leaf width

Bi weekly leaf width of the Elephant grass as influenced by the legume intercrop can be seen in table 2. No significant ($P>0.05$) difference at 2weeks (1.25 vs 1.26) but at the fourth week to the thirteenth week differences ($P<0.05$) are seen in the leaf width of intercrop elephant having higher values than the sole Elephant grass. The changes in their results can also be attributed to high up take of nitrogen supplied by the legumes thereby giving room for competing for light, which was in line with what Tenakwa *et al*. (2019) reported the influence of legumes intercrop on plant yield.

Effect of legume (*Cajanus cajan*) intercrop on Elephant grass (*Pennisetum purpureum*) leaf area

The effect of legume intercrop on Elephant grass leaf area is as shown in table 3. The leaf area was significantly ($p<0.05$) increased in legume intercrop (204.21cm) than the sole elephant grass (143.92cm) from the fourth week to the thirteenth week. The changes are due to the nitrogen fixed by the pigeon pea which causes expansion in the leaf area, this is in accordance with what Tadaki and Shimpei (2012) reported for leaf area, that when dry mass and nitrogen are invested in other to expand the leaf area, it is also attributed to the increase in both leaf length and leaf width of elephant grass intercrop with pigeon pea.

Effect of legume (*Cajanus cajan*) intercrop on number of leaves

The average number of leaves shown in table 3 was significantly ($P< 0.05$) affected by elephant grass intercrop, with pigeon pea having highest number of leaves across weeks (14.36, 48.86, 69.90, 72.37, 84.69 and 86.34 at 2,4,6,8,10,12 and 13th week respectively) compared to sole elephant grass (4.20, 5.92, 7.20, 8.08, 8.55, 9.58 and 9.96 respectively). This is can be connected to high absorption of nitrogen supplied by the legumes. The result obtained was in support of the report of Tadaki and Shimpei (2012) who documented a larger number of leaves produced in high nitrogen invested plants than none or low nitrogen plants.

Effect of legume (*Cajanus cajan*) intercrop on nutritive values of leaves and stem of Elephant grass (*Pennisetum purpureum*)

The result of the effect of legume intercrop on nutritive value is presented in Table 4. The results revealed that there were no significant ($P>0.05$) differences in the parameters measured on both the leaves and the stems for both the intercropped and sole

elephant grass. The crude protein content was higher in the leaf fractions than the stem fractions in Elephant grass, as earlier reported by Tang *et al.* (2008) and Ansah *et al.* (2010) on the influence of botanical fraction and age on crude protein levels in leaves and stems. The crude protein concentration reported for Elephant grass in both sole (72.6g/kgDM) and intercrop planting (74.3g/kg) was lower than the requirement (110 to 130g/kg) for the maintenance of small ruminants (NRC, 2007) therefore protein supplementation like pigeon pea can be adopted. The Acid Detergent Fiber (ADF) values for Elephant grass intercrop with Pigeon pea (418.8 g/kgDM and 414.2 g/kgDM) was lower in stem than the leaves (419.8g/kgDM and 418.8g/kgDM), while the ADF values for sole Elephant grass are also similar having higher ADF in leaf than stem (418.3 g/kgDM and 414.2 g/kgDM) although, numerical increase was seen in leaves and stem of intercrop Elephant grass than sole Elephant grass.

The Ash content in Elephant grass shown in table 3 is higher in stem than the leaf both for sole and intercrop planting, the ash content in stem of intercrop Elephant grass is a bit higher than the ash content in sole Elephant grass (138.8g/kgDM vs 129.7g/kgDM). This result tallied with the report of Tilahun *et al.* (2017) who also reported (143.2g/kgDM vs 133.4g/kgDM) for intercrop and sole elephant grass respectively.

CONCLUSIONS

- Intercropping Pigeon pea with Elephant grass enhance a fast growth on the plant height, leaf length, leaf width and number of leaves better than sole planted elephant grass.
- The performance of intercropped elephant grass at 2weeks of planting did not show the effect of intercropping Pigeon pea hence, the positive influence of intercropping pigeon pea with elephant becomes more visible grass and prominent after 2 weeks of growth.
- Higher DM and CP were seen in the leaf of the grass than the stem and most nutrients are store in the leaves than in the stem therefore, loss of leaves during harvest and utilization should be avoided.

RECOMMENDATIONS

- Farmers can cultivate *Pennisetum purpureum* with *Cajanus cajan* to provide farmers enough forage with a source of energy and protein for feeding the animals thereby enhancing optimum growth performance for the animal and increase the farmers' profit.
- Since results obtained in this study were for one season and was conducted in the tropics, it is suggested that the experiment be repeated over a number of seasons and locations. .

Table 1: Effect of *Cajanus cajan* intercrops on plant height and leaf length of *Pennisetum purpureum*

Parameters	**Plant height (cm)**							**Leaf length (cm)**						
Cutting times (cm)	**2**	**4**	**6**	**8**	**10**	**12**	**13**	**2**	**4**	**6**	**8**	**10**	**12**	**13**
Sole E. G	25.93	34.16^{a}	65.64^{b}	93.26^{a}	127.92^{b}	143.92^{b}	146.34^{b}	14.27	23.47^{b}	35.49^{b}	47.78^{b}	58.80^{b}	62.87^{b}	65.38^{b}
E.G intercrop with P.P	25.98	61.67^{b}	107.37^{a}	133.81^{b}	168.26^{a}	184.90^{a}	192.62^{a}	14.36	48.86a	69.90^{a}	72.37^{a}	79.27^{a}	84.69^{a}	86.34^{a}
SEM	0.01	0.04	0.78	0.16	1.22	0.78	1.18	0.04	0.08	0.04	0.48	1.12	0.52	0.84

^{ab}Means on the same column with different superscripts differ significantly ($p<0.05$).
SEM = Standard Error of Mean; E.G = Elephant grass; P.P = Pigeon pea.

Table 2: Effect of *Cajanus cajan* intercrops on leaf width of *Pennisetum purpureum*

	Leaf width (cm)						
Cutting times (weeks)	**2**	**4**	**6**	**8**	**10**	**12**	**13**
Sole E. G	1.25	2.28^{b}	2.82^{b}	3.32^{b}	3.57^{b}	3.68^{b}	3.71^{b}
E.G intercrop with P.P	1.26	2.85a	3.41a	3.88a	4.07a	4.13a	4.17a
SEM	0.04	0.06	0.04	0.08	0.12	0/06	0.18

^{ab}Means on the same column with different superscripts differ significantly ($p<0.05$).
SEM = Standard Error of Mean; E.G = Elephant grass; P.P = Pigeon pea.

Table 3: Effect of legume intercrops on leaf area and number of leaves

Parameters	Leaf Area (cm^2)							Average number of leaf (cm)						
Cutting times (weeks)	2	4	6	8	10	12	13	2	4	6	8	10	12	13
Sole E.G	20.97	37.72^{b}	68.77^{b}	98.22^{b}	137.92^{b}	143.92^{b}	146.34^{b}	4.20	5.92^{b}	7.20^{b}	8.08^{b}	8.55^{b}	9.58^{b}	9.96^{b}
E.G intercrop with pigeon pea	20.99	86.24^{a}	100.62^{a}	149.81^{a}	197.49^{a}	204.21^{a}	209.35^{a}	4.25	7.14^{a}	8.35^{a}	9.85^{a}	10.72^{a}	11.75^{a}	11.95^{a}
SEM	0.01	0.24	0.15	0.32	0.18	0.34	0.38	0.02	0.11	0.08	0.06	0.18	0.15	0.19

^{ab}Means on the same column with different superscripts differ significantly ($p<0.05$).
SEM = Standard Error of Mean; E.G = Elephant grass; P.P = Pigeon pea.

Table 4: Effect of legume (*Cajanus cajan*) intercrop on nutritive values of leaves and stem of Elephant grass (*Pennisetum purpureum*)

Treatments		Sole EG	EG Intercrop with pigeon pea	SEM
Parameters (g/kgDM):				
Dry matter	**Leaf**	242.3	249.3	0.18
	Stem	127.5	121.4	0.32
Crude protein	**Leaf**	72.6	74.3	0.26
	Stem	40.1	42.4	0.18
Neutral Detergent Fibre	**Leaf**	630.8	634.9	0.28
	Stem	629.5	642.7	0.25
Acid Detergent Fibre	**Leaf**	418.3	419.8	0.38
	Stem	414.2	418.8	0.14
Ash	**Leaf**	140.4	144.7	0.16
	Stem	129.7	138.8	0.23

Means on the same row are not significantly ($p>0.05$) different.
SEM = Standard error of mean.

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