EFFECT OF PHOSPHOROUS FERTILIZER RATE ON GROWTH AND YIELD OF BUFFALO CLOVER (*Alysicarpus vaginalis)* AT VARYING HARVEST AGES

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ABSTRACT
Stages and frequency of harvest in pasture establishment are crucial factors influencing the quality and quantity of forage species used for animal feed. The study was carried out at the National Animal Production Research Institute in Shika-Zaria to examine the effect of different phosphorus fertilizer rates (0, 20, and 40 kg/ha) on the growth and yield of buffalo clover (Alysicarpus vaginalis) at varying harvest ages (8, 12, and 16 weeks after sowing, WAS). The experiment followed a 3 x 3 factorial arrangement in a Randomized Complete Block Design (RCBD) with three replicates, resulting in 27 plots, each measuring 3 x 3 m². Soil samples were collected from representative areas to assess the pre-sowing nutrient content of the soil. Seeds were sown using the drilling method, with an intra-row spacing of 0.5 meters. Growth parameters measured included plant height, leaf length, leaf width, leaf number, number of vegetative branches, and dry matter yield (DMY). The collected data were analyzed using a two-way Analysis of Variance (ANOVA). The results indicated that phosphorus fertilizer rates had no significant (P>0.05) effect on most growth parameters, except for leaf number and dry matter yield, which increased with higher phosphorus application. Leaf numbers ranged from 52.00 to 63.00, while DMY ranged from 259.37 to 290.14 kg/ha. Harvest age significantly influenced both dry matter yield and growth parameters, with increases observed in plant height (17.92–27.72 cm), leaf number (30.00–100.00), leaf width (1.08–1.21 cm), and branch number (5.00–8.00) from 8 to 16 WAS. The highest DMY (435.12 kg/ha) was recorded at 16 WAS, compared to 57.65 kg/ha at 8 WAS. Based on these findings, it was concluded that single super phosphate (SSP) could be applied at 20 or 40 kg/ha, with harvesting at 12 or 16 WAS, to achieve optimal growth and DMY.
Keywords: Legumes, Fertilizer Application, Forages, Nutritive value, Feed Quality

INTRODUCTION

Forage legumes are typically regarded as having greater nutritive value compared to grasses, primarily due to higher intake levels, a better protein-to-energy absorption ratio (Guy *et al*., 2018), and superior digestibility (Brink *et al*., 2015). Buffalo clover, in particular, has long been a key component of grazed pastures, enhancing feed quality and nutritive value, improving the distribution of dry matter across seasons and supplying biologically fixed nitrogen that benefits both the clover and neighboring plants (Caradus *et al*., 2023). Understanding the optimal harvest stage and frequency is crucial, as these factors significantly influence the quality and quantity of forage species used for animal feed (Ball *et al*., 2001). Effective agronomic practices, including proper spacing, sowing timing, and fertilizer application, are linked to higher biological and economic yields. Therefore, identifying the right agronomic conditions to maximize forage yield is essential (Sheaffer *et al*., 2001). This study aims to assess the impact of fertilizer rates on the growth parameters and dry matter yield of buffalo clover (*Alysicarpus vaginalis*) at 8, 12, and 16 weeks after sowing.

MATERIALS AND METHODS

The experiment was conducted during the late rainy season, from August to December, at the experimental plot of the National Animal Production Research Institute in Shika-Zaria. The land was cleared and ploughed, followed by a two-week resting period before harrowing. A total area of 37 x 37 meters (1,369 m²) was mapped out and divided into three blocks, each measuring 11 x 11 meters, with 1-meter pathways between them. Each block contained nine plots, each measuring 3 x 3 meters (9 m²), separated by 0.5-meter pathways, resulting in a total of 27 plots after harrowing. Before land preparation and planting, soil samples were randomly collected from the plots at a depth of 0–15 cm using a soil auger to represent the topsoil. The samples were combined per replicate, thoroughly mixed, and sub-sampled for analysis to determine the pre-planting nutrient status of the soil. The soil analysis revealed available phosphorus at 33.25 ppm, organic carbon at 0.40%, and total nitrogen at 0.28%. Buffalo clover seeds were scarified using hot water at 80°C, air-dried, and sown using the drilling method with an intra-row spacing of 0.5 meters. The study followed a Randomized Complete Block Design (RCBD) with three replicates. Treatments were arranged in a 3 x 3 factorial layout, with factors including three fertilizer rates (0, 20, and 40 kg/ha of single super phosphate fertilizer) and three harvest ages (8, 12, and 16 weeks after sowing). After sowing and allowing the forage to grow for a period, a timely irrigation schedule of

every two days was implemented during the final 40 days of the experiment when rainfall stopped. At each harvest age, growth parameters and biomass yield were recorded.

Data collection

The plant height was measured from the base of the plant to the point where the last leaf emerges on the stem, using a tape measure. This was done on three randomly selected plants per plot at 8, 12, and 16 weeks after sowing (WAS). Leaf length was determined by measuring from the base to the tip of the ligule, also using a tape measure, on three randomly chosen plants per plot at 8, 12, and 16 WAS. Leaf width was measured at the midpoint of the leaf, halfway between the base and tip, using a tape measure on three randomly selected plants per plot at 8, 12, and 16 WAS. The number of leaves and branches was estimated by counting the leaves and branches, respectively, on three randomly selected plants per plot at 8, 12, and 16 WAS.

Estimation of dry matter yield

The total fresh and dry matter yields was determined by harvesting the fresh forage within each plot using a $0.5m^2$ quadrat at 5cm above the ground using a knife for total fresh forage weight and sub sample of 500g was weighed and oven dried at 500 ˚C for 48 hours and reweighed to estimate dry matter yield.

Dry matter production is calculated as:

(Total FW x (DWss/FWss)) x 10 = Dry matter kg/ha. (Tarawali *et al*., 1995)

Where: Total FW = Total fresh weight from 0.5 m^2 in (g)

DWss = Dry weight of the sub-sample in (g)

FWss = Fresh weight of the sub-sample in (g)

Statistical Analysis

Data obtained were subjected to two-way Analysis of Variance (ANOVA) and significant means were separated using Duncan Multiple Range Test.

RESULTS AND DISCUSSION

Table 1 show the effects of phosphorus fertilizer rate and harvest age on the growth parameters and dry matter yield (DMY) of buffalo clover. Most of the parameters evaluated were not significantly affected by fertilizer rate, except for the number of leaves, which showed a significant influence. The highest number of leaves (63.00) was recorded at a fertilizer rate of 40 kg/ha, compared to 20 kg/ha and 0 kg/ha (control), which had lower values of 56.00 and 52.00, respectively. The results in this study are higher than the value (16.60) reported by Bature *et al*. (2020) for lablab, which may be attributed to differences in harvest age. For dry matter yield (DMY), the fertilizer rate of 40 kg/ha recorded the highest value of 290.14 kg/ha, while the control (0 kg/ha) had the lowest value of 259 kg/ha. The application of fertilizer was observed to increase DMY, aligning with the findings of Turuko and Amin (2014), who reported that dry matter accumulation rises with phosphorus application. This could be attributed to the plant having access to greater share of available nutrients (response to phosphorous) in the soil which resulted to higher DMY.

All parameters evaluated for harvest age were significant, except for leaf length. Buffalo clover harvested at 16 weeks after sowing (WAS) recorded the highest values for plant height (27.72 cm) and leaf width (1.21 cm), compared to the lowest values of 17.92 cm and 1.08 cm, respectively, at 8 WAS. The number of leaves and branches also increased with harvest age. At 16 WAS, the highest values for leaves (100.00) and branches (8.00) were recorded, while the lowest values (30.00 and 5.00, respectively) were observed at 8 WAS. Similarly, DMY increased with harvest age, with the highest value (435.12 kg/ha) recorded at 16 WAS and the lowest (57.65 kg/ha) at 8 WAS. This significant increase in DMY with advancing plant age is consistent with findings by Yasin *et al*. (2003) and Tessema and Alemayehu (2010) for cultivated grasses, as well as Feyissa *et al*. (2014) for natural pastures in Ethiopia.

Table 1: Effects of fertilizer rate, harvest age on growth parameters and dry matter yield of buffalo clover

Factors	Plant height (cm)	Leaf length (cm)	Leaf width (cm)	Leaves number	Branch number	Dry matter yield (kg/ha)
Fertilizer rate (kg/ha)						
0	24.51	2.93	1.21	52.00^{b}	5.00	259.37^{c}
20	20.77	2.93	1.17	56.00^{b}	5.00	260.30^{b}
40	22.71	2.80	1.10	63.00^{a}	6.00	290.14^{a}
SEM	3.88	0.14	0.06	9.20	0.77	3.64
Age at harvest (WAS)						
8	17.92^{b}	2.96	1.08^{b}	30.00^{c}	5.00^{b}	57.65^{c}
12	25.69^{a}	2.77	1.18^{a}	83.00^{ab}	7.00^{ab}	317.02^{b}
16	27.72^{a}	2.76	1.21^{a}	100.00^{a}	8.00^{a}	435.12^{a}
SEM	3.88	0.14	0.06	9.20	0.77	3.65

^{abc}: mean on the same row with different superscript are significant ($p<0.05$), SEM: standard error mean.

CONCLUSION:

It was concluded that single super phosphate (SSP) could be applied at 20 or 40 kg/ha, with harvesting at 12 or 16 WAS, to achieve optimal growth and DMY.

RECOMMENDATION:

This approach could be particularly beneficial for livestock production during the dry season when forage availability and quality are typically low.

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