EFFECTS OF SEED RATE AND IRRIGATION FREQUENCY ON GROWTH AND FORAGE YIELD OF CENTRO (*Centrosema pascuorum* Mart. ex Benth)

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ABSTRACT

An experiment was conducted to evaluate the effects of seed rate and irrigation frequency on growth attribute and forage yield of *Centrosema pascourum*. The experimental design was a split-plot replicated 3 times. The treatments consisted of three levels of seed rate (8kg/ha, 10 kg/ha and 12 kg/ha) and three irrigation frequencies (2, 4 and 6 days intervals), respectively. Results indicated that growth of *Centrosema pascourum* was significantly affected (P<0.05) by seeding rate. There was 31% increase in plant height at seed rates of 10 and 12 kg/ha at 8 weeks after sowing, respectively. Irrigation frequency of 6 days significantly (P<0.05) increased plant height by 45% at 8 weeks after sowing. The highest (P<0.05) forage yield (9.99t/ha) was produced at seed rate of 10 kg/ha at 8 weeks after sowing. Also, 2 days irrigation interval produced 18% higher forage yield at 8 weeks after sowing compared with 2 weeks after sowing. There were significant (P<0.05) interactions between the factors investigated at all levels. It was therefore concluded that seed rate of 10 kg/ha and irrigation frequency of 2 days are important factors to consider by farmers before establishing *Centrosema pascourum* in northern guinea savanna. However, this cannot be achieved without the full knowledge of the size of farm land to be cultivated for better performance and yield.

INTRODUCTION

In Nigeria, one of the limiting factors to ruminant livestock production during the dry season is lack of qualitative feed supply (Garba and Jinjiri, 2013). This problem is common to other developing countries especially in Africa (Madzonga and Mogotsi, 2014). The trend in ruminant livestock population in Nigeria is gradually favoring the production of small ruminants compared to cattle. This situation has been attributed to dramatic increase in human population, decreasing land holdings and increase in demands of livestock products (Hoffmann, 2002). Although in recent years there is increasing interest in rearing ruminant livestock by different categories of farmers in Nigeria (Hoffmann, 2002), but cost of production will continue to be high at present and in future, due to purchase of expensive concentrate feeds such as oilseed cakes. Therefore, farmers need to drastically reduce the production costs, using cheap and readily available forage resources under irrigation for improved productivity and profit gain. *Centrosema pascuorum* is a suitable rotation crop with cereal crops such as maize and is capable of producing high forage yield and good returns under irrigation (Dalgliesh *et al.*, 2014). This forage legume could therefore serves as an option for farmers to address the lingering feed shortages, especially during the dry season period in Nigeria. The aim of this research was to investigate the potential of irrigated *Centrosema pascourum* at different seed rates for agronomic performance and forage yield in the Nigerian savannah.

MATERIALS AND METHODS

The experiment was conducted at the Irrigation Research Station of the Institute for Agricultural Research, Samaru, Zaria located on latitude 11°11'N and longitude 0.7°11'E. It lies within the northern Guinea savanna vegetation of Nigeria. The climatic condition of Samaru is the same with that of Zaria located at altitude of 670.6m above sea level (Ovimaps, 2014). The loamy-sand soil from the study area had a pH of 7.2 and contained clay 12%, silt 18%, sand 70%, carbon 0.80%, Phosphorus 26.25mg/kg, total N 0.07%, Sodium 2.08Cmol/kg, Calcium 5.20Cmol/kg and CEC 8.90Meq/100g in the 0-15cm layer. The treatments consisted of factorial combination of three seed rates (8, 10 and 12kg/ha) and three irrigation frequencies (2, 4 and 6 day intervals), respectively. The experiment was laid out in split-plot design with three replications. Irrigation frequency was

allocated to the main plot while seed rate to the sub-plot, given a total of 27 net plots measuring 2m with 1m inter-row path and watering channels. Nursery beds of $2m^2$ were marked out and cleared; ploughed and harrowed using hoes and seeds were drilled into rows of 15cm apart. Irrigation treatment was imposed at 3 weeks after sowing according to the sub-plot treatment. Soil moisture content was measured in each plot using Tensiometer (Jet-Fill®) when the soil moisture content reached 80-85% Field Capacity. Plots were weeded manually using hoe. A uniform dressing of phosphorus was applied to all plots at the rate of 60kg/ha in form of Single Super Phosphate (SSP) fertilizer. Five (5) plants were selected at random from each plot and labeled. Plant height was measured using a meter rule from the ground level to the tip of the flag leaf. This was done at weekly interval. Fresh forage yield was estimated in each plot using 0.5m ×0.5m quadrat. The total fresh forage was weighed using a weighing balance in the field. Plants were cut from a small area in each plot at 15cm height using a hand sickle. A sample of 250-300g of the forage material was taken to the Biochemical Laboratory of the Department of Animal Science, Ahmadu Bello University, Zaria and oven dried at 60^0C for 48 hours, weighed and the average dry weight per plot was determined according to AOAC (2000) method.

Statistical analysis

All data generated from the study were subjected to statistical analysis using a General Linear Model (GLM) Procedure for Split-Plot Design using SPSS (Version 17.0: 2009). Significantly different means were separated using the Dunnet's Test. Because of significant interactive effects of seed rates and irrigation frequencies, only interaction tables are presented in this paper.

RESULTS AND DISCUSSION

Table 1 shows the combined effects of seed rate and irrigation frequency on plant height of *Centrosema pascuorum*. Generally, seed rate and irrigation frequency affected plant height significantly ($P<0.05$). There were progressive increases in plant height as *Centrosema pascuorum* forage advanced in maturity. The value recorded for plant height in this study (97cm) was lower than the reported value of 125cm for annual forage crops in Tibet, China (Cui *et al.*, 2014). The lower value of plant height observed in this study might be related to the creepy canopy and horizontal growth habits of *Centrosema pascuorum*. However, the values of plant height observed in this study were higher than the reported values of 34 to 54cm reported in Ghana (Fening *et al.*, 2009) and 86.51cm in hairy Peruvian cultivar of *Medicago sativa* in Ethiopia (Geleti *et al.*, 2014). The increase in plant height with increasing levels of seed rates and irrigation frequencies indicates that these factors could increase the tolerance responses to flooding in *Centrosema pascuorum* plant depending on the management scenario. This result is in tandem with the findings of Loreti and Oesterheld (1996) in Argentina. The significant increase in plant height was an indication that there was an increase in root permeability and respiratory activities which might be facilitated by soil chemical status. Previous studies showed negative effects of flood irrigation on plants physiological responses (Sigua *et al.*, 2013). Muhammad et al. (2009) opined that the yield potential of pasture sward depends on plant growth components such as plant height. Seed rates (8, 10 and 12 kg/ha) used in this study were within the recommended rates of 5 to 10 kg/ha for good germination (Cameron, 2003). Okpara *et al.* (2003) reported seed rate of up to 15 kg/ha for *Centrosema pascuorum*. Table 2 shows the effect of seed rate and irrigation frequency on forage yield of *Centrosema pascuorum* at 2, 4, 6 and 8 weeks after planting, respectively. The highest forage yield recorded in this study (9t/ha) was at par with the report of Dalgliesh *et al.* (2014) but higher than the reported values of 3.4t/ha in Kano (Muhammad *et al.*, 2009), 4.77t/ha in Ethiopia (Geleti *et al.*, 2014), 7t/ha in West Timor (Dalgliesh *et al.*, 2014), 7.4t/ha in Minjibir (Grings *et al.*, 2012) and 8.33t/ha in China (Cui *et al.*, 2014), respectively. However, Dost (2012) reported much higher values (19 and 45t/ha) for local and Sundar cultivars of Lucerne in Pakistan. The significant increase in forage biomass with increase in seed rate and irrigation frequency in this study shows that flood irrigation increases uptake of nutrients especially nitrogen and phosphorus (Singua *et al.*, 2013), which result in more vegetative growth in *Centrosema pascuorum* plant. Plant height is related to dry matter yield in most forage crops. For example, Pasquale (1998) reported significant correlation ($r = 0.80$) between stem density and dry matter yield in irrigated Lucerne in Foggia, Italy. In this study, there was a

29% increase in forage yield when *Centrosema pascuorum* was irrigated at 6 days interval at 8 weeks after sowing compared to 2 weeks after sowing. However, this result disagrees with the findings of Pandey *et al.* (2013) who observed 60% decrease in forage yield of irrigated *Avena species* in moisture stressed plants compared to the control.

CONCLUSION

In this study, it was revealed that seed rate and available moisture are vital in promoting growth and forage yield of *Centrosema pascuorum* in northern guinea savanna of Nigeria. However, farmers are often ignorant about the size of their farmlands. This may leads to waste of resources by the farmers unless it is properly addressed. Hence, the following recommendations are suggested: Seed rate of 10 kg/ha and irrigation frequency of 2 days are enough for optimum performance and forage yield of *Centrosema pascuorum* in northern guinea savanna. Farmers should purchase their seeds on the basis of their farm size rather than the number of livestock they owned.

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Table 1: Effect of seed rate and irrigation frequency on plant height of *Centrosema pascuorum* at 2,4, 6 and 8 weeks after planting

	Age of harvest (weeks)					
Seed rate (kg/ha)	2	4	6	8	SEM	LOS
8	23.50^{d}	50.00^{c}	70.00^{b}	90.00^{a}	1.20	*
10	22.40^{d}	54.00^{c}	65.00^{b}	85.00^{a}	0.90	*
12	16.50^{d}	58.00^{c}	75.00^{b}	95.00^{a}	1.00	*
Irrigation (days)						
2	24.00^{d}	37.00^{c}	70.00^{b}	90.00^{a}	1.01	*
4	22.00^{d}	36.00^{c}	75.00^{b}	95.00^{a}	1.11	*
6	16.00^{d}	42.00^{c}	67.00^{b}	97.00^{a}	1.24	*

^{abc} Means with different superscripts along the row differed significantly (P<0.05), SEM = Standard error of means, LOS = Level of significance

Table 2: Effect of seed rate and irrigation frequency on forage yield of *Centrosema pascuorum* (t/ha) at 2,4, 6 and 8 weeks after planting

	Age of harvest (weeks)					
Seed rate (kg/ha)	2	4	6	8	SEM	LOS
8	7.56^{b}	7.78^{b}	9.33^{a}	9.50^{a}	0.40	*
10	4.89^{d}	7.11^{c}	8.79^{b}	9.99^{a}	0.18	*
12	5.21^{d}	6.44^{c}	7.70^{b}	8.35^{a}	0.21	*
Irrigation (days)						
2	8.00^{c}	8.33^{c}	8.90^{b}	9.46^{a}	0.20	*
4	6.63^{d}	7.11^{c}	8.24^{b}	8.88^{a}	0.15	*
6	6.99^{d}	7.53^{c}	8.57^{b}	9.00^{a}	0.12	*

^{abc} Means with different superscripts along the row differed significantly (P<0.05), SEM = Standard error of means, LOS = Level of significance