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Effect of Seed and Vegetative Forage Propagules on Pasture Establishment

Nweze Basil Obasi

Department of Animal Science, Ebonyi State University, Abakaliki – Nigeria.

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Corresponding Author
Nweze Basil Obasi
E-mail: *obasinweze@ gmail.com*

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ABSTRACT

Four forage propagules consisting of two grass species namely *Andropogon gayamus* and *Panicum maximum* and two legumes species, *Centrosema pubescen* and *Calopogonum mucunoides* were investigated to determine the effect of their propagules on pasture establishment. The propagules were cultivated by seed and vegetative methods twice yearly for periods of four years. The forages were harvested from each plot and the carrying capacities on each plot determined. The Tropical Livestock Unit (TLU) of the propagules was also calculated using the forage yield in each plot. The results indicated significant differences (p <0.05) among the carrying capacities from the propagules. The legumes seed propagules were superior to their vegetative counterparts. However, the grass vegetative propagules had a better carrying capacity than grass seed propagules. Both seed and vegetative propagules cultivated during the rainy season were better than those cultivated during dry season. The TLU of seed propagules were superior to vegetative propagules with legumes seed sole cropping propagules having the highest carrying capacity. The grass/grass mix cropping had the least value among other propagules because of intra species competition.

INTRODUCTION

Presently in many Sub-Saharan African regions including Nigeria, large proportion of grazing land is usually retained in the natural state (Adowsun, 1988). The dream of maintaining good ruminant stock performance through proper feeding management in these regions is becoming a very difficult task to achieve due to huge eco-climatic and human factors effect on pasture and rangeland resources (Nweze *et al*., 2000 and Rain, 1963). Report has shown that the humid areas of Sub-Saharan Africa have shorter growing seasons due to natural selection existing among plant species. Also, there are high incidence of lignifications of forages and low plant density on the natural grassland of these areas (Rain, 1972). Ademosun (1973a) reported other constraints of Sub-Saharan grassland as lack of good pasture maintenance such as reseeding, uncontrolled grazing and other pasture improvement process that usually decreases pasture productivity. In addition, there is scarcity of water to provide for the animals, such that the movement of nomadic herdsmen within these regions increased during the dry season (Ademosun, 1973). Both government and non-government agencies are already concerned about this socio-economic burden of nomadic pastoral system in these areas that a country like Nigeria is considering instituting laws such as grazing reserve and other laws on the stock route within the legislative aim of government.

Moreover, the distinct seasonality of forage production in countries like Nigeria in response to dry and wet season has created more pastoral problem in terms of clashes between the nomadic herdsmen and arable crop farmers due to encroachment on crop farmland by the ruminant animals.

The concept of pasture establishment is therefore based on the fact that improved grass species could provide more grazing materials for ruminant animals than natural grassland because of better management and improved pasture environment (Haggar, 1984). Also a successful pasture establishment can be said to be achieved when the forage species propagules sown are able to germinate, initiate roots and shoots and guarantees seedling emergence to produce high tillering ability, persistency and high forage yield under good grazing management. The process requires the knowledge of agronomic process, proper physical assessment and intelligent selection of pasture species adapted to planting situations within given environment (Nweze *et al.,* 2001 and Yayock *et al.,* 1978).

Pasture establishment in many tropical environments could be an expensive and hazardous process because of varying environmental conditions such as climate, soil and socio-economic factors (Nweze and Omeje, 2001 and Ezedinma *et al.,* 1986). These interacting factors within the tropical environment in addition to morphological and physiological attributes of forage plants are the major consideration taken by pasture agronomists and pastoralists in making decisions and formulating ideas on agronomic procedures during pasture production process.

The four forage species involved in this study are commonly distributed pasture species within Africa Sub-Saharan regions, including Nigeria that is highly cherished by ruminant animals (Humphrey, 1987). The utilization and nutrient composition of these forage species had been studied (Mosi *et al.,* 1980). The agronomic procedures of some of them have been looked at (Omeje and Nweze, 1988). In spite of these, the need to look at the factors affecting planting methods as it affects pasture production is timely because the information provided could assist the pastoralist for a better pasture establishment.

MATERIAL AND METHODS

Experimental Site

The study was conducted on sub-humid tropical environment of Ebonyi State, Southeast Nigeria. The experimental site is located within the latitude of 08º05' and 08º20'E and Longitude of 06º40' and 06º45'N of derived Savanna. The weather condition during the period include an average atmospheric temperature of 28ºc at the day and 27-28ºc at night, humidity of 70-80% and an average photoperiod of 8 hours obtained by the local metrological observation. The soil is dysteric leptosol (FAO, 1974).

Experimental design

The experimental plot was a 500m x 600m piece of land which was divided into 120 blocks separated by two meters pathway. There was randomized treatment allocation using 2 x 4 factorial completely randomized block design (CRBD).

Experimental materials

The propagules were seedling sources from wild of the surrounding environment of Ebony State. The seed propagules include mature ripped harvested seeds from *Andropogun gayanus Kunth, Panicum maximum, Centrosema pubescens Benth* and *Calopogonium mucunoides* which were previously tested for their viability. The vegetative propagules were tillers of existing *A. gayanus* and *P. maximum* within the surrounding environment which were uprooted as transplants. The legumes vegetative propagules was stems of *C. pubescen* and *C. mucunoides* cut between their node and internodes at about 3cm length.

Agronomic procedure

The land preparation activities such as clearing, tillage, planting and weeding were carried out as described by Humphrey (1978). Plating distance and planting depth

were carried out as recommended by Skerman (1988). The chemical composition of the soil pre-establishment of the propagules is shown in table 1.

Table 1: Chemical Properties of Experimental Plot

Properties	Qty
Nitrogen (%)	0.31
Organic carbon (%)	2.51
Extractible Phosphorus mg/g	87.30
Potassium mol/100g	0.10
Calcium mol/100g	1.95
Magnesium mol/100g	0.15
Sodium mol/100g	0.70
p.H	6

The soil analysis involved was micro-keijldeh to determine the soil nitrogen (Brema, 1965). The organic carbon content was determined using Walky and Black modified method (1934). The available soil phosphorus was determined by Bray and Kurtz method (1965). Extractable calcium, magnesium were analyzed with Atomic absorption Spectro-photometer while exchangeable potassium and sodium was determined with flame photometer and the soil pH level was determined by Bate Method (1954) at soil water ratio 1:5.

Planting date and time were carried out between March to July, for raining seasons and November to January, for dry season.

Data collection

At eight weeks interval, each forage species were cut at 15cm stable height for the grass propagules while the legumes were harvested between second and third internodes and weighed. Samples from each plot were collected for dry matter determination, involving oven drying at temperature 105ºC for 24 hours.

Carrying capacity was calculated by using the expression below

$$\text{Carrying capacity} = \frac{\text{Dry matter yield of a plot}}{\text{Area of a Plot}} \quad \text{and Expressed in tone/Ha}$$

Tropical Livestock Unit (TLU) was determined using Deleeuw *et al.,* (1972) method.

Data analysis

The data obtained were subjected to analysis of variance and the treatment means determined using 2 x 4 factorial design least square mean (Harvy, 1977) with linear model expressed below.

$X_{ijk} = \mu + L_i + M_j + L_{mij} + e_{ijk}$
X_{ijk} = population mean
μ = error effect form block
L_i = effect of forage species
M_j = effect planting method
L_{mij} = interacting error from species and planting method
E_{ijk} = random error associated with experiment

RESULT

Table 2 summarizes the least square performance of the forage propagules according to year, season and planting combination. There was significant difference ($p < 0.05$) among the carrying capacities obtained from the four forage species under seed and vegetative propagules. The legume species were generally superior to grass species forage yield. The legume seed propagules were better than vegetative propagules while the gross vegetative propagules were better than their seed propagules. The rainy seasons yield was better than dry seasons yield while sole legume propagules were the best among the planting combination. The least planting combination was obtained among the grass/grass mix planting seed propagules.

Table 2. Least Square mean carrying capacity (Tone/Ha) of four forage species established by seeds and vegetative propagules

Variables	Seed/propagules	Vegetative propagules	SEM
Overall LSM	2.89	2.31	0.35
Forages			
Panicum maximum Jcq	2.13^{b1}	2.19^{b1}	0.11
Andropogan gayanus Kunth	2.35^{b1}	2.89^{ab2}	0.15
Centrosema pubenscens Benth	3.25^{a1}	2.75^{ab2}	0.10
Calopogonium mucunoides	3.39^{a1}	2.15^{b2}	0.10
Year			
2006	2.75^{ab1}	2.30^{b2}	0.60
2007	2.15^{b1}	1.87^{c2}	0.95
2008	3.63^{a1}	2.83^{ab2}	0.75
2009	2.45^{b1}	1.95^{b2}	0.75
Season			
Dry season	2.05^{b1}	1.75^{c2}	0.11
Rainy season	3.49^{a1}	2.08^{b2}	0.11
Planting combination			
Sole grass cropping	2.35^{b1}	2.85^{ab2}	0.10
Mixed grass/grass cropping	1.55^{c1}	1.65^{c1}	0.11
Mixed legume/legume cropping	2.35^{b1}	1.85^{b1}	0.10
Mixed grass/legume cropping	2.75^{ab1}	2.65^{ab1}	0.11

a, b, c mean in the row with different super script are significantly different (P<0.05)
1, 2 means in the same column with different superscripts are significantly different (P<0.05)
LSM1 = Least Square Mean

Table 3 shows the sole cropping method of the four forage species. There was significant difference ($p < 0.05$) among the rainy and dry season forage carrying capacity for the four propagules. The yield from legume seed propagules were more than the grass seed propagules on both wet and dry season while the yield from grass vegetative propagules on both wet and dry season were better than their seed counterpart.

Table 3. Carrying Capacity of the Sole Cropping of the Four Forages Species (Tone/Ha)

	Seeds Propagules		Vegetative propagules		
Forages	**Dry season**	**Wet season**	**Dry season**	**Wet season**	**SEM**
PM	1.43^{c1}	2.83^{a2}	1.66^{c1}	2.74^{b2}	0.11
AG	1.75^{b1}	2.85^{a2}	1.94^{b1}	2.91^{a2}	0.12
CD	2.95^{a1}	3.45^{a3}	1.35^{c1}	2.95^{a2}	0.10
CM	2.99^{A1}	3.68^{A3}	1.40^{c1}	2.80^{a2}	0.10

a, b, c means in the row with different superscript are significantly different (p<0.05)
1, 2 means in the same column with different superscript are significantly different (p<.05)
AG = *Andropogan gayanus Kunth* Cm = *Calopogonium mucunoides*
PM = *Panicum maximum Jcq* Cp = *Centrosema pubescens Benth*
SEM = Standard error of mean

Table 4. Carrying Capacity of Mixed Cropping of the Four Forage Species (Tonne/Ha)

Variables	Seed propagules		Vegetative propagules		SEM
Forages	Dry season	Wet season	Dry season	Wet season	
PM + AG	1.33^{c1}	1.75^{b2}	1.45^{c1}	1.95^{b2}	0.15
CP + CM	1.79^{b1}	2.81^{a2}	1.75^{b1}	2.05^{b2}	0.09
CP+AG	2.05^{b1}	2.75^{a2}	1.60^{b1}	2.90^{b2}	0.11
CP +PM	1.99^{b1}	2.85^{a2}	1.35^{c1}	1.87^{b2}	0.12
CM+PM	2.00^{b1}	2.65^{b2}	1.99^{b1}	2.95^{a2}	0.11

a, b, c mean in the same row with different superscript are significantly difference ($p<0.05$) 1, 2 mean in the column with different superscript are significantly different ($P<0.05$).
AG = *Andropogan gayanus Kunth* CM = *Calopogonium mucunoides*
PM = *Panicum maximum Jcq* CP = *Centrosema pubescens Benth*

Table 4 shows the mixed cropping propagules yield. There was significant difference ($p < 0.05$) among the mixed cropping propagules. There were generally low forage yield among the mixed cropping propagules under dry season planting season with mixed grass/grass most affected.

Fig 1 shows the Tropical Livestock with TLU of seed and vegetative propagules. The seed propagules were generally higher than vegetative propagules among the forages.

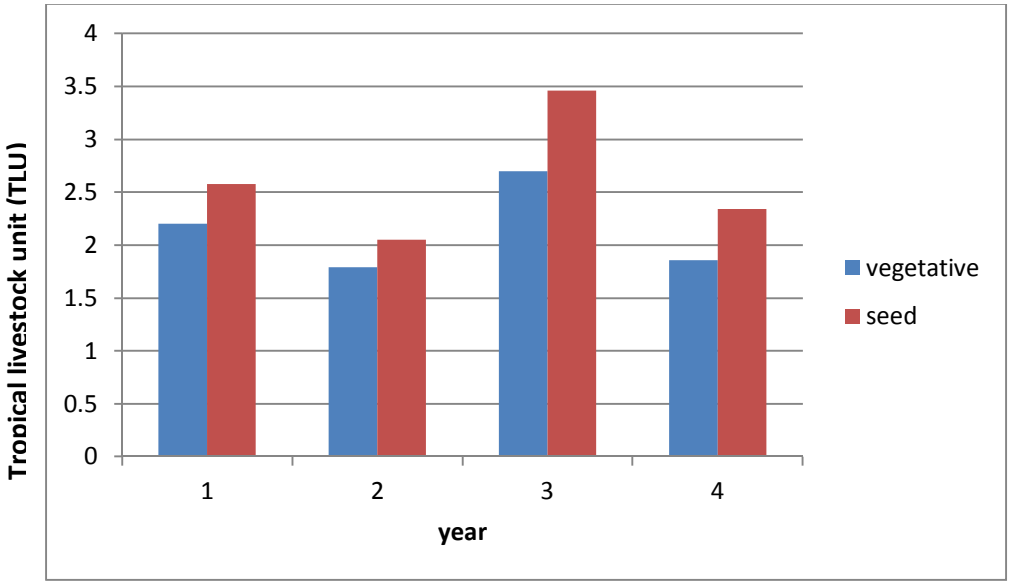

Fig 1: Tropical Livestock with TLU of seed and vegetative propagules

Fig 1 shows the Tropical Livestock with TLU of seed and vegetative propagules. The seed propagules were generally higher than vegetative propagules among the forages.

DISCUSSION

The result in table 2 indicated higher yields among the legume seed propagules than vegetative propagules while grass vegetative propagules were better than the seed counterpart indicating that the method of seedling propagation has effect during pasture establishment. There exist complex interacting factors surrounding the establishment of pasture species. (Nweze and Omeje, 2001). Humphrey (1978) argued that whereas some plants could be propagated through sexual means (seed propagules) others could be through asexual means (vegetative propagules) while there could be propagated through both methods. However, Ezedinma *et al.,* (1986) and Nweze *et al.,* (1981) reported that plant with seed propagules are quicker to establish and adapt more to

their environment than similar vegetative propagules that have slower rooting process and shoot development. Many legumes propagules can not survive particularly on a low moisture condition thereby leading to low density (Skeman, 1988); however, there are some perennial legume species that could survive under vegetative propagules but their performance during pasture establishment are relatively lower than their grass counterpart (Humphrey, 1978). Many grass species particularly the perennial grass species such as *Panicum maximum* and *Andropogon gayanus* can be propagated through seed and vegetative propagules (Nweze and Omeje, 2001). This could be due to high tillering ability and relative good seed germination rate (Omeje and Nweze, 1999).

The forage propagules established during rainy season were superior to those of the dry season; this is understandable because soil moisture among other factors account in great deal the ease of pasture establishment and persistency of forage species (Humphrey, 1998). Soil moisture enhances seed germination, rooting, shoot development and fast growth among forage species (Nweze *et al.,* 2001). Soil water enhances soil nutrients availability to plant root and plant photosynthesis (Higgar, 1985; Rain, 1976 and Edye *et al.,* 1964).

The result indicated that sole legume planting had the best capacity as against sole grass, mix grass/grass cropping and grass/legume planning, indicating the variation that exists among the propagules cropping combinations. Thus variations could be explained from the type of competition that existed among the propagules on their environment. The sole cropping had no competition for soil mineral, water, sun, light and air, while the mixed grass/grass or legume/legume cropping has intra competition for those resources. The mix grass/legume cropping has inter-competition for resources within pasture environment. Intra competition has more disadvantage effect on pasture crops then inter- competition.

In Table 2 and 3, the legume seed propagules were better than vegetative propagules. This could be explained by the fact that rainy season provide a more favourable environment for fast growth among the forage.

Also, it has been observed that ruminant animal tends to graze more on grasses than legume thereby creating unfavorable condition for grasses than legume species (Nweze, *et al.,* 2003).

CONCLUSION

The legume seed propagules were superior to legume vegetative propagules while grass vegetative propagules were better than their seed counterpart. All the four forage propagules under sole cropping were better than mix cropping method. The grass/grass mix cropping had the least performance due to interspecies competition. From all these findings, seed and vegetative propagules affect pasture establishment.

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