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Seed Production, Herbage Residue and Crude Protein Content of Centro (*Centrosema pubescens*) in the Year of Establishment at Shika, Nigeria

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Keywords: *Centrosema pubescens* - Phosphorus - Establishment - Herbage residue - Seed - Nigeria

Summary

*A field trial was carried out on seed production pattern of centro (*Centrosema pubescens*) in the year of establishment in a sub humid environment of Nigeria as influenced by sowing date and phosphorus application levels. The herbage residue and its crude protein content were also determined after pod harvest. The variation in seeds per pod for plantings between June 21 to August 2 was from 16.5 to 14.5, while for unfertilized and fertilized plots seeds number varied between 12.6 and 16.2/pod. The weight of 1000 seeds decreased with delayed planting. Phosphorus application improved seed weight. Seed yield was highest (1000 kg/ha) for July 5 sowing with phosphorus application of 60 kg/ha P_2O_5 combination. The variation in mean seed yield for planting between June 21 and August 2 was 782.0 to 360.3 kg/ha. The application of 0 to 60 kg/ha P_2O_5 resulted in mean seed yields of 405.7 to 776.8 kg/ha. Herbage residue was favoured more by June 21 sowing and the application of 60 kg/ha P_2O_5. The crude protein content was better with August sowing and 60 kg/ha P_2O_5 .*

Résumé

Etude de la production de graines, de fanes et du contenu en matières protéiques brutes de *Centrosema pubescens* lors de sa première année de récolte à Shika, Nigeria

Un essai au champ a été réalisé dans une zone subhumide du Nigeria pour étudier l'effet de la date de semis et celui de différentes doses d'une fumure phosphatée sur la production de graines de Centrosema pubescens *lors de sa première année de récolte. La quantification de la production en fanes et de leur teneur en matières protéiques brutes a été faite après la cueillette des gousses. Le nombre de graines par gousse variait de 16,5 à 14,5 graines en fonction de la date de semis (21 juin et 2 août) et de 12,6 à 16,2 en fonction de la fumure (0 et 60 kg/ha P_2O_5). Il a été constaté que le poids de 1000 graines diminuait avec les retards de semis et que l'application du phosphore a eu un effet positif sur le poids des graines. Le plus haut rendement en graines (1000 kg/ha) a été obtenu pour le semis effectué le 5 juillet avec une application de 60 kg/ha P_2O_5. Ce rendement s'est élevé à 782,0 et 360,3 kg/ha pour les semis effectués respectivement le 21 juin et le 2 août. L'application d'une fumure phosphatée (60 kg/ha P_2O_5) a permis d'augmenter le rendement en graines de 405,7 à 776,8 kg/ha par rapport au témoin non fumé. La meilleure production de fanes a été obtenue pour la date de semis la plus précoce (21 juin) et dans les parcelles ayant reçu 60 kg/ha de P_2O_5. Quant au contenu en matières protéiques brutes, il a été le plus élevé pour les plantes semées en août et ayant également reçu une fumure phosphatée (60 kg/ha P_2O_5).*

Introduction

The National Animal Production Research Institute (NAPRI) is located at Shika, Zaria in the northern Guinea Savanna zone of Nigeria. The zone is suitable for seed production of food and forage crops because of its climate, topography and soil conditions. The mandates of NAPRI, include research, training and development of forage resources for animal production. Forage species have other uses apart from providing feed for livestock. The legumes in particular are used as green manure, cover crops and short term pastures in rotation with cereal crops. Production of forage seeds in the Institute commenced for commercial purpose over twenty years ago. The Institute remains the major seed producer of most forage/cover crop in the country. How-

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ever, one of the main constraints in use of centro (*Centrosema pubescens*) on large scale in the country is availability of foundation seeds in sufficient quantity. Despite the fact that NAPRI is situated within the zone that is suitable for seed production of food and forage crops, seed yields are comparatively low. Concomitant with this is the paucity of research data on pasture seed production. Increases in demand of centro seeds by both private and government establishments from National Animal Production Research Institute (NAPRI) for establishing legume-based pastures strongly suggest the need for intensive investigations on ways and means of increasing seed production.

A study by Akinola and Agishi (4) showed that seed production of centro was significantly improved by staking and successive pod harvests. Recently, Omokanye (11) reported the beneficial effect of early sowing with the application of 60 kg/ha P_2O_5 on forage yield and quality of centro. No report was found in the literature on the effect of time of sowing and phosphorus levels on its seed production in Nigeria within a specific time of one growing season in order to ensure wide outreach of centro seed distribution. This study was therefore designed to examine the effect of sowing date and phosphorus levels on seed yields and yield characteristics of centro in the year of establishment.

Table 1
Weather observations at Shika and Samaru during the experimental period

Month	Total rainfall (mm)	*Mean daily temp (0°C) Min	Max	*Relative humidity (%)	*Sunshine (hours/ day)
1991					
May	314.60	21.3	30.8	68.6	6.4
June	162.90	20.7	30.1	71.3	6.9
July	243.20	20.0	28.1	75.1	5.7
August	341.10	19.7	27.9	78.5	5.0
September	080.80	20.0	31.3	65.8	8.1
October	042.55	18.0	32.0	44.5	8.5
November	-	12.9	31.6	19.0	8.9
December	-	12.6	28.6	18.7	7.7
1992					
January		12.3	28.6	18.0	5.3
February	-	15.0	26.7	10.8	7.3

* Records from Institute for Agricultural Research, Samaru (Latitude 11°11' N, Longitude 7°38' E) is about 12 kilometers from Shika (Latitude 11°15' N, Longitude 7°32' E), Nigeria.

Materials and methods

Site description

The experiment was sited at the National Animal Production Research Institute (NAPRI), Shika, in the sub humid zone of Nigeria (Latitude 11°15' N, Longitude 7° 32' E, altitude 610 m above sea level). The climate of the study area is characterised by a well- defined wet and dry season. The wet season begins in April/May and ends in late September/mid October. The dry season on the other hand lasts from October to April with a low relative humidity and a dry north-east wind. The long-term annual rainfall (1980 - 1991) averaged 1118.2 mm. The highest mean maximum air temperature of 36.0°C is recorded in April while the lowest mean minimum temperature of about 11.5°C occurs in December/January. The soils of the study site have been classified as belonging to the ferruginous tropical soils derived from sandy parent material and crystalline acid rock (8). Kowal (9) described the physical properties of the soil as well-drained sandy loam soil with a clay fraction consisting mainly of kaolinite and small quantities of illite deficient in N and P. Based on World Reference Base for Soil Resources (WRB) and the FAO/UNESCO Soil Map of the World (7), Shika soil could be classified as Arenosols. This site (0-15 cm topsoil) just before the trial consisted of 10% clay; 11% silt; 79% sand; 5.6 pH; 0.030% total N; 11.9 ppm total P; 2.17 meq/100 g Ca^{2+}; 0.098 meq/100 g K^{+} and 0.118 meq/100 g Mg^{2+}. The weather observations during the trial period are reported in table 1.

Experimental design and procedures

The experimental area was disc-ploughed and twice harrowed to obtain a fine seedbed prior to sowing. Seeds harvested in November 1990 and treated with 98°c sulphuric acid for nine minutes to break hardiness, were used in the trials. Seeding was accomplished by hand drilling of the dry treated seeds into seedbeds. The experimental design was a split plot design with four sowing dates (21st June, 5th July, 19th July and 2nd August, 1991) as main plots and three phosphorus (P) levels (0, 30 and 60 kg/ha P_2O_5) as sub-plot. The treatment combinations were replicated twice. Each sub plot measured 2 m x 3 m with 1m allowance between plots. Seeding was done by drilling at the rate of 7.5 kg seeds/ha in 50 cm rows. Basal fertilizer application of 10 kg N/ha as starter dose was hand broadcast on individual plots at planting.

Establishment stands/m^2 branching/plant were determined 6 WPP. Plots were cross-staked 12 weeks after planting in order to facilitate hand picking of pods and to increase flower density and/ or pod set. Successive hand pickings as described by Akinola and Agishi (4) were used to obtain seed yields. Cypermetrin, an insecticide, was sprayed at the rate of 25 ml to 15 litres of water onto all the plots at flowering in order to control the attack of mealy bugs (*Ferrisia virgata*) and blister beatles (*Mylabris trifaciata*).

Hand picking of dessicated, ripped pods was done at four-day intervals from late November, 1991 to early February, 1992. The harvested pods were then threshed and winnowed to extract the seeds. Herbage residues after pod harvest were determined by cutting two 1 m x 1 m quadrat from each plot at a height of 7.5 cm above the ground level after oven drying at 60°C for 48 hours.

Chemical analyses of whole plant samples

The oven dried samples were ground with Christy and Norris Laboratory mill using a 1 mm mesh. These were subsequently analysed for N content on DM basis according to the standard Micro-Kjedahl method (5). Crude protein (CP) content was calculated as 6.25 x % N.

Statistical analysis

Data were statistically analysed using Proc GLM procedures of SAS (14). Only the means pooled across treatments are presented and discussed.

Results

Table 2 presents data on establishment stands, branching and days to 50 % flowering. Sowing date and P levels significantly (P< 0.05) affected plant density.

Table 2
Establishment stand count and branching (6 WPP) and days to 50 % flowering of centro (C. *pubescens)* as influenced by sowing date and phosphorus level at Shika, Nigeria

Treatment	Stand count (NO./m²)	Branching (NO/plant)	Days to 50 % flowering
Sowing date:			
June 21	27.4[a]	2.9	118 [a]
July 5	23.2[b]	3.1	111 [b]
July 19	17.7[c]	2.5	103 [c]
August 2	11.5[d]	2.5	98 [c]
Phosphorus level (kg P_2O_5/ha):			
0	18.4	2.2[b]	103[b]
30	21.2	2.8[a]	107[b]
60	20.3	3.3[a]	113[a]

Means in a column with different superscripts differ significantly (P< 0.05).

Number of stands was highest (27.4 plants/m²) and gradually decreased with delay in sowing date to 11.5 plants/m² with the last sowing date. The application did not show any significant difference on number of stands at establishment. Branching was higher with early July sowing and the dates was not significant (P> 0.05). Branching however increased from 2.2/plant when no P was applied though 2.8/plant for 30 kg/ha P_2O_5 to 3.3/plant for 60 kg/ha P_2O_5. Late sowing favoured early days to 50 % flowering than did earlier sowings. The application of P delayed days to 50 % flowering.

Table 3 presents data on seed number/pod, weight of 1000 seeds, seed yield, herbage residues and CP content of centro as influenced by sowing date and phosphorus level in establishment year. Seed number per pod decreased (P< 0.05) as the sowing date was delayed till August. The responses due to phosphorus application were not significant. Seeds per pod was best (i.e. 16 seeds/pod) for sowing between June 21 and July 19. The range in seeds per pod for plantings between June 21 to August 2 was 16.5 to 14.5. The lower seed number (i.e. 14.5 seeds/pod) was obtained with delayed planting in August. For unfertilized and fertilized plots seeds number varied between 15.6 to 16.2/pod.

The viability of seeds is normally estimated from weight of the seed. The weight of 1000 seeds is used as standard procedure. Weight of 1000 seeds decreased (P< 0.05) with delayed planting. Phosphorus application improved weight of seed but there was no significant difference in weights obtained at 30 or 60 kg/ha P_2O_5 application. Mean weights of 1000 seeds for plantings between June 21 and August 2 varied between 19.5 to 18.3 g. For unfertilized and fertilized plots the mean weights varied between 18.2 and 19.3 g/1000 seeds.

Seed production was influenced by both sowing date and phosphorus application with significant interaction (P< 0.05) between the two factors. Seed yield decreased (P< 0.05) with delayed sowing date but increased with P application. Seed yields was highest (1000 kg/ha) for July 5 sowing with phosphorus application of 60 kg/ha P_2O_5. The variation in mean seed yields for planting between June 21 and August 2 was 782.0 to 360.3 kg/ha. The application of 0 and 60 kg/ha P_2O_5 resulted in mean seed yields of 405.7 to 776.8 kg/ha, respectively.

Herbage residue was significantly (P< 0.05) affected by sowing date. This was highest (3205 kg DM/ha) for June 21 sowing and lowest (2491 kg DM/ha) for August 2 sowing. There was an impressive performance of centro when given P fertilizer. The application of 30 and 60 kg/ha P_2O_5 recorded herbage residue of about 65 and 68 % higher than the unfertilized control plot.

Surprisingly, sowing in the first week of August which performed least for other parameters examined had the highest CP content (12.25 %) after pod harvest in the dry month of February in a sub humid zone of Nigeria. A cursory look at Table 3 on CP content shows that CP content gradually increased with delay in sowing date. The application of 0; 30 and 60 kg/ha P_2O_5 respectively had 8.19; 13.13 and 13.69 % CP.

Table 3
Seed yield and yield components, herbage residues and crude protein (CP) content of centro *(C. pubescens)* as influenced by sowing date and phosphorus level at Shika, Nigeria

Treatment	Seeds/ pod (NO./m²)	1000 seeds weight (g)	Seed yield (kg/ha)	Herbage residue (kg/ha)	CP content (%)
Sowing date:					
June 21	16.4[a]	19.4[a]	718[b]	3205[a]	11.25[b]
July 5	16.5[a]	19.5[a]	782[a]	3016[a]	11.44[b]
July 19	16.0[a]	18.5[b]	572[c]	2782[b]	11.69[a]
August 2	14.5[b]	18.3[b]	360[d]	2491[c]	12.25[a]
Phosphorus level (kg P_2O_5/ha):					
0	15.6	18.2[b]	406[c]	1755[c]	8.19[b]
30	16.2	19.3[a]	642[b]	3217[b]	13.13[a]
60	15.8	19.3[a]	777[a]	3649[a]	13.69[a]

Means in a column with different superscripts differ significantly (P< 0.05).

Discussion

The data on establishment stand and branching recorded in this study are similar to an earlier findings in the same environment (12). Observations of the plots showed that the application of 60 kg/ha P_2O_5 on centro under rainfed condition prolonged the vegetative stage by about 7 days and caused profuse flowering than did at 30 kg/ha P_2O_5 or unfertilized control plots. These observations had earlier been reported for horsegram (*Macrotyloma uniflorum*) (12 & 13) and centro (*Centrosema pubescens*) (11) in the same environment.

Seed production from a given area is a function of seed number and weight of seed produced. Results in this study indicated that seed number per pod is a genotype characteristics as it was not influenced by P-fertilizer application. The low number observed from the late

planted plots which differed significantly from other planting date treatments could have resulted from incomplete development of reproductive organs - an effect further reflected in seed weight and total seed yield. Early plantings (June 21 and July 5) in combination with P-fertilizer application (30 and 60 kg/ha P_2O_5) resulted in heavier seeds. The yields for the 21 June and 5 July plantings were 718.0 and 782.0 kg/ha, respectively while yields for the 30 and 60 kg/ha treatments were 642.0 and 776.8 kg/ha. These yields, with respect to either planting date or P-fertilizer treatment, were considerably higher than the seed yields (overall average of 390 kg/ha) obtained by Akinola and Agishi (4) working in the same environment. In the latter study 12 kg/ha P_2O_5 was applied in the form of 20 N: 4 P: 8 K which could have favoured fodder over seed production. For seed production in forage legume the results in this study support numerous reports in the literature (2, 3, 4, 5, 7, 15) and these indicate that P-fertilization should take precedence over N-fertilization. The data obtained seems to suggest that during the year of establishment, centro if planted earlier with adequate amount of P fertilizer following staking as earlier recommended (4), would suffice for satisfactory amount of seed yield. Another advantage is that centro would also produce substantial amount of herbage residue that would be well above the 7 % CP contents considered for maintenance of livestock (10) and in the range recommended in the diet of ruminants (1).

Conclusion

The results of this study seem to suggest that early plantings (June 21 and July 5) in combination with phosphorus fertilizer application (30 and 60 kg/ha P_2O_5) will suffice for satisfactory heavier seeds and seed production per unit area. Seed yield in the present circumstances are considerably higher than the seed yields (overall average of 390 kg/ha) obtained by Akinola and Agishi (4) working in the same environment.

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