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RESEARCH ARTICLE

FLOWERING, POD FORMATION AND ABSCISSION AND SEED YIELD OF AFRICAN YAM BEAN *(Sphenostylis stenocarpa)* UNDER VARIED NPK APPLICATION

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ABSTRACT

Flowering, pod formation and abscission and seed yield following application of NPK (20-10-10) fertilizer at the rate of 0 Kg ha^{-1}, 30 Kg ha^{-1}, 60 Kg ha^{-1}, 90, and 120 Kg ha^{-1} respectively were studied in variety of African yam bean (AYB), Benue Brown (BB) in a field trial at the Research Farm, University of Ibadan Ibadan, Nigeria. AYB cultivars produce 100 to 300 flower buds per plant of which forty to sixty percent form pods. About forty to fifty-five percent more of the immature pods are shed leaving only twenty to thirty percent forming mature pods. The excessive rate of flower and fruit abscission limits grain yield of AYB. Agronomic practices such as the application of fertilizers has been found to improve flower production, pod formation and seed yield in most grain legumes. Application of fertilizer to AYB may therefore constitute a way of reducing flower abscission, enhanced fruit production and increased seed yield in the legume.

INTRODUCTION

African yam bean, *Sphenostylis, Stenocarpa* belongs to the family *Papilionaceae* which is sometimes classified as the sub-family *Papilionnoideae* (*Lotoidae*) of the all inclusive family *leguminosae*. The *Papilionaceae* constitute one of the largest families of plant and in economic importance is only next to the grasses since it contains almost all our grain edible legumes in addition to several forage and ornamental species. Many grain legumes such as *Phaseolus vulgaris, Pisum, satirum, Soja max, Vicia faba* shed most of their flowers as unopened buds and premature fruits so that only a small fraction produce mature fruits (Inuoe, 1955), Ojehomon, (1968), Schaik and Probst, (1958), Togun and Tayo (1990) all observed that 10-30% flowers opened, form retained pods in most grain legumes. Presently there is a dearth of information on the physiology of AYB production. This paper focuses on the quantitative analysis of flowering, pod formation and abscission and seed yield in AYB.

MATERIALS AND METHOD

The variety of AYB (BB) used for the study has been described by Togun and Egunjobi (1997). The experiment was carried out on a sandy loam soil in the crop garden and farm of the University of Ibadan, Ibadan, Nigeria. Seeds of Benue brown variety of AYB were sown on flat (unridged) in an 11.4 x 27 m plot at 0.6m between row and 0.4m within the rows.

After germination, the seedlings were thinned to one per stand and one stake supported two plants. The experiment was a Randomized Complete Block Design (RCBD) with four replicates. Each block measured 11.4 x 6m with 1m gap between blocks. A single dose of NPK (20-10-10) fertilizer at the rate of 0 Kg ha^{-1}, 30 Kg ha^{-1}, 60 Kg ha^{-1}, 90, and 120 Kg ha^{-1} were applied in drills to the plants four weeks after sowing (W.A.S) as treatments, T_1, T_2, T_3, T_4, and T_5 respectively to boost the growth of the of plant. Two plants per treatment were tagged for reproductive development studies. The number of open or aborted flowers per plant was determined. A total of forty plants were tagged for flower and pod production studies. At plant maturity, the number of pods per plant, total seed dry weight, of 100 seeds was determined. The data collected were subjected to analysis of variance (ANOVA) from which the least significant difference was calculated at 5% level.

RESULTS AND DISCUSSION

Effect of Fertilizer on Reproductive Development of AYB (BB)

The flower and pod formation characteristics of BB (AYB) improved under fertilization. Flower production was significantly higher in all fertilized plants than the control. The highest number of flower production was obtained under the 60 Kg ha^{-1} NPK application (Table 1 and Figure1). Flower production increased progressively with increase in the level of fertilizer application. Flower abscission rate follows the same pattern. The number of flower that form pods increased

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Table 1. Flower and Pod Formation and abscission in AYB (BB) under varied NPK fertilizer application*

	Fertilizer Level Kg ha^{-1}					
	T1	*T2*	*T3*	*T4*	*T5***	*LSD (P=0.05)*
No of opened Flowers	*659.00*	*669.00*	*728.00*	*719.00*	*679.00*	*21.88*
No of flowers that formed pod	*324.00*	*378.00*	*398.00*	*367.00*	*328.00*	*27.57*
No of pods carried to maturity	*192.00*	*217.00*	*253.00*	*248.00*	*221.00*	*20.54*
% open flower forming matured pods	*29.10*	*32.40*	*35.00*	*34.50*	*32.50*	*2.22*

** Values, means of 40 plants*
*** T_1=0kg NPK* ha^{-1}, *T_2=30Kg NPK* ha^{-1}, *T_3=60Kg NPK* ha^{-1}, *T_4=90Kg NPK* ha^{-1}, *T_5=120Kg NPK* ha^{-1}

progressively with the level of fertilizer application up to 60 Kg NPK ha^{-1} and then decline (Table 1 and Figure 1). Pod formation from open flower was highest in plants with 60 Kg NPK ha^{-1}; and significantly higher in all fertilized plants than the control (Table 1 and Figure 1). The number of pods carried to maturity was significantly higher in 60Kg NPK ha^{-1} plants than other plants.

Effect of Fertilizer on Yield characteristics of AYB(BB)

Fertilizer application improved the yield and yield components of AYB (Table2). The number of productive pods increased progressively for all level of fertilizer application compared with the control unfertilized plants. Primary branches which serve as loci for flower bud production increased progressively with increase level of fertilizer application.

with improved crop nutrition, legumes especially AYB can be physiologically and reproductively improved. Tayo and Togun (1894) recorded similar improvements in the growth of pigeon pea (*Cajamus cajan*).

Three physiological hypotheses has been proposed for flower and fruit abscission in legumes especifically, Cowpea by Ojehomon (1968). First, that the oldest fruits monopolizes all the available mobile nutrients and starve the young fruits and bud which aborts and drop The same trend was noticed in AYB as most of the mature pods were from early opened flowers. This monopoly may be meditated through growth substances production by the oldest fruits which become active nutrient sinks. Secondly, the oldest fruits produce substances which are inhibitory to the development of buds and young fruits. Thirdly, pollination and fertilization are unsuccessful in younger fruits especially those days – old open flowers which drop twenty to twenty-four hours after opening.

The improved performance of plants that received fertilizer has been attributed to large leaves for adequate source of photo-assimilate and mineral nutrients by the pods as reported by Togun and Egunjobi (1997). The application of fertilizer to AYB enhanced flower and pod formation. Furthermore, partitioning of photo-assimilate and nutrients between husk and seed resulting in improved performance of AYB under the fertilizer regime of 60 Kg NPK ha^{-1}, the level at which the partitioning of photo-assimilate and nutrients seems to be optimum. This rate of fertilizer application also recorded the highest number of branches, thereby providing loci for pod development. Several authors, Lathwell and Evans, (1951), Hashimoto and Yanomoto, (1970), Mann and Jarworski, (1970) and Hashimoto, (1971) have indicated the critical importance

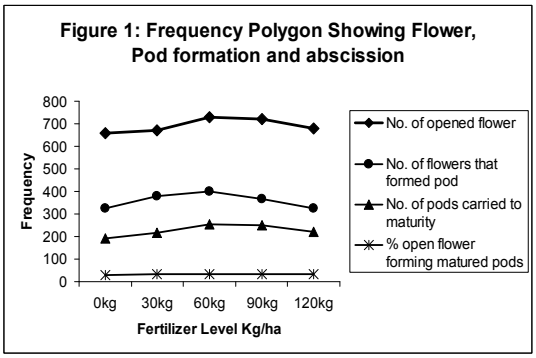
Table 2: Yield characteristics of AYB (Benue Brown) under varied NPK fertilizer application*

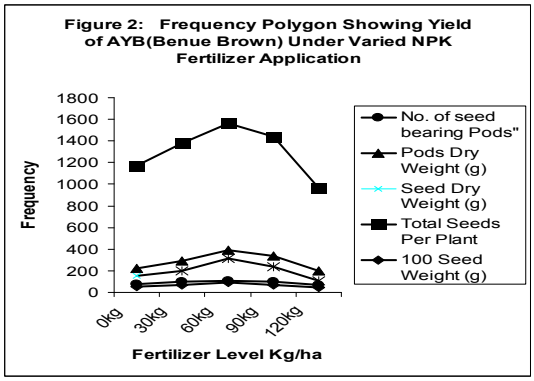
	FERTILIZER LEVEL Kg ha^{-1}					
Parameters	T_1	T_2	T_3	T_4	T_5**	LSD (P=0.05)
No of Primary Branches	5.50	6.50	7.50	7.00	5.30	0.80
No of seed bearing Pods	80.00	101.00	107.00	103.00	72.00	8.76
Pods dry weight $_{(g)}$	225.12	288.40	398.00	338.24	197.20	97.40
Seed dry weight $_{(g)}$	155.24	201.08	310.52	237.68	106.00	104.80
Total seeds plant $^{-1}$	1171.88	1376.24	1562.64	1443.16	965.16	361.22
100 seed weight $_{(g)}$	53.32	71.72	91.24	65.52	44.16	33.49
Seed: Husk ratio	1.58	2.30	3.55	2.36	1.16	1.25
Harvest Index	0.37	0.42	0.54	0.46	0.26	0.10
Seed Yield (tha^{-1})	0.815	1.47	1.62	1.64	0.55	0.284

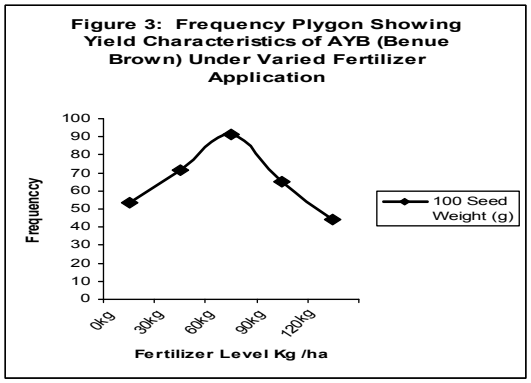
* Values, Means of 40 plants
** *T_1=0kg NPK* ha^{-1}, *T_2=30Kg NPK* ha^{-1}, *T_3=60Kg NPK* ha^{-1}, *T_4=90Kg NPK* ha^{-1}, *T_5=120Kg NPK* ha^{-1}

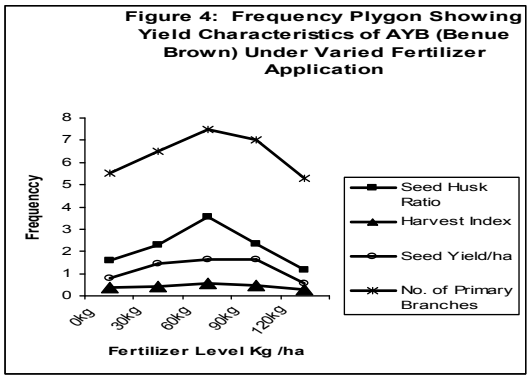
Total seed plant^{-1} also increased progressively up to the application of 60 Kg NPK ha^{-1} and declined. Fertilized plants except 120 Kg *NPK* ha^{-1} plant had higher number of seeds plant^{-1} than the control (Figure 2). Seeds dry weight, 100 seed weight and seed yield were significantly higher in fertilized plants than the control (Table 2, Figure 2 & 3) The results obtained in this research shows that of adequate nitrogen to high yield during vegetative development, flowering and seed set, while vine, (1953) , Sobulo, (1972) reported that Nitrgen is probably one of the major nutrients limiting crop production. Dirk and Hagurty, (1984), recommends supplementary amount of nutrient to the soil in form of organic fertilizers to improve crop growth. The percentage of open flower that

formed matured pods increased considerably. The percentage pod formation ranges between thirty-two (32.4%) percent to thirty-six (36.20%) percent in fertilized









plants (Figure 1), this is higher than the six percent (6%) to sixteen percent (16%) recorded for cowpea grown without fertilization (Ojehomon, 1968). This is a clear indication that improved nutrition apart from enhancing plant vigour, also improves plant capability of flower production, pod formation and retention, and subsequently crop yield.

CONCLUSION

The results of the experiment shows that with improved nutrition, flower production and pod formation are enhanced. However, it is not yet clear if the rate of flower and immature pod abscission can be improved upon with supplementary plant nutrient as there seems to be a direct correlation between the number of flower produced and rate of abscission.

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