THE EFFECT OF VARIETY AND PLANTING DATE ON THE GROWTH AND YIELD OF PEARL MILLET IN THE SOUTHERN GUINEA SAVANNA ZONE OF NIGERIA

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ABSTRACT

The effect of planting date and variety on the growth and yield components of Millet in the Southern Guinea Savanna Zone of Nigeria was evaluated in the research farm of the School of Agriculture and Agricultural Technology, Federal University of Technology, Minna during the 2006 cropping season. Minna lies within the Southern Guinea Savanna Zone of Nigeria, latitude $9^0 41^1$ N and logititude $6^0 31^1$ E Treatment consisted of three planting dates (10th, 17th and 24th of June) and three varieties (Maiwa, Ex-bronu and Sosaat-c88). The experiment was a 3x3 factorial experiment in a randomized complete block design (RCBD) and data collected were: Plant height, leaf area, Flag leaf length, grain, panicle and husk weights respectively. Results obtained showed that Sosaat-C88 recorded a grain weight of 2,246 kg ha^{-1}while Ex-bronu gave 2,324 kg ha^{-1}. The lowest was 2,083 kg ha^{-1} recorded by local variety Maiwa. Results also revealed that 17th June was the suitable planting date irrespective of varieties followed by 24th June. Sosaat –c88 which had the best growth and yield components irrespective of planting date should therefore be recommended for further studies.

Keywords: Growth and Yield Component; Millet variety; Planting date; Southern Guinea Savanna.

INTRODUCTION

Pearl millet *(Pennesetum glaucum* (L). R. Br) is the most draught tolerant of all domesticated cereals and can yield grain under rainfall as low as 200 to 250mm (Bidinger and Hash, 2003) making it one of the reliable cereals in the direct rain fed regions of the arid and semi-arid tropics. Although, Peal Millet is the 6th most important Cereal Crop in the world, it is second in importance only to Sorghum as a staple food in the Savanna area of Nigeria (ICRISAT,2006; Ikwelle, 1998). Word's production records that 28 Million ha of production are split equally between Africa and the Indian Subcontinent(Lee *et al.*,2004) However over 40% of land sown annually to cereals in Nigeria's agro-ecological zones is devoted to millet. Thus millet is sown annually on about 5million hectares between latitude 7^0N and l4^0N with a yield of about 4 million metric tones of grains (Ikwelle, 1998). Millet has a small seed of low vigour, which is often grown where stand establishment is low (Peacock, 1982). The grain is used in Nigeria primarily for human consumption (Anyawu *et. al.,* 1984). It is processed into 'tuwo', 'kunu', and 'akamu', while the stem is used for fencing, roofing, and fodder for livestock. Millet supplies 9.2g of protein per day (Thakare and Oyinloye, 1980). In the United States, pearl millet is grown primarily as a forage crop, although some grain production occurs as a result of development of adopted hybrids (Hanna, 1995) and recognition of its high feeding value by the poultry industry (Amato and Forrester, 1995).

Pearl millet is (generally) a quantitative short day plant (Billiard and Pernes, 1985) in which long photoperiod delays floral initiation. Craufurd and Bidinger (1989) reported that the yield potential as number of grains in (m^{-2}) of short-duration crops may be limited by low radiation interception particularly if the plant population is low.

Ong and Monteth (1984) have also demonstrated that the yield potential and plumule extension in pearl millet are strongly influenced by temperature, with optimum temperature for the process being 30-35^{0C}. Above this optimum, germination and shoot elongation rates decline early and rapidly. Also in 1985, studies by Ong and Monteith have shown that development process in millet (e.g. leaf and tiller appearance) can be described in terms of a base temperature (T. b) and a thermal time, and that growth and development can be combined in radiation per unit thermal basis to describe grain yield (Ong and Squire, 1984). Therefore, temperature data are essential inputs over the season to describe millet growth, development and grain yield at the end of the season on the basis of thermal time.

In Sahelian locations, manipulation of planting dates in pearl millet offers flexibility owing to the narrowness of the optimum time of sowing as conditioned by erratic onset of the rains and shorter raining season. However, in the Guinea Savanna Zone, millet planting date is amiable to management, especially with the genotype of' gero' millet that is day-neutral and early maturing. Differences in grain yield can be caused by differences in either biomass accumulation or in partitioning to the grain and could be associated with genotype differences in tillering habit. In the absence of stress, biomass accumulation is a function of the amount of radiation intercepted by the leaves and the efficiency with which this is conyerted into biomass (Van Oosterm *et. al.*, 2002). The tropical crop literature is short of reports citing the combined influence of sowing time and variety on millet cultivated in Guinea Savanna. This indeed was the motivation for the research that was aimed at investigating the effect of planting date on growth and yield components of millet varieties in the Southern Guinea Savanna Zone of Nigeria.

MATERIALS AND METHODS

Study Area

This study was carried out on the farm of the school of Agriculture and Agricultural Technology, Federal University of Technology Permanent Site. Minna lies within the Southern Guinea Savanna Zone of Nigeria, Latitude $9^{0}41^{1}$N and Longitude $6^{0}31^{1}$E and has a sub-humid tropical climate with a mean annual rainfall of 1200mm (90% of their falls between the month of June and August). The temperature rarely falls below 22^{0}C. The peaks are 40^{0}C (February-March) and 36^{0} (November-December) (Rabe, 1998). Soils from Minna association are derived from basement complex rock (FDALR, 1985). They range from shallow to very deep soils overlying deeply weathered gneisses and magnatites. Some are underlain by iron pan at varying depths. Twenty bulk samples were collected from surface soil (0-15cm depth) using auger and sample bags. The bulked samples were mixed together, air dried and passed through a 2mm sieve to determine routine physiochemical analysis using the procedure described by IITA (1979). Soil particle size was determined using the Hydrometer method.

pH was done in duplicate using 0.0lm $CaCl_2$ and water at the ratio of 1:2, Organic carbon and organic matter contents were determined by Walkley-black method. Total Nitrogen was estimated by the Micro-kjeldahl procedure and Available Phosphorus by Bray 1 method while the Exchangeable cations were estimated by the NH_40AC extraction method. Results of the soil analysis shows that the soil is sandy clay loam, slightly acidic and low in organic matter, nitrogen and available P.

TREATMENT, EXPERIMENTAL DESIGN AND CROP MANAGEMENT

TREATMENT

1. Three planting dates at one week interval (10^{th}, 17^{th} and 24^{th} June)
2. Three millet varieties (Maiwa, Ex-Bronu and Sosaat-C88)

- Maiwa Millet is a local variety mostly grown in the Southern and Northern Guinea Savanna areas on heavy soils. It matures at 120-150 days (Sharon, 2004).
- ExBronu is a commercial cultivar of millet in Nigeria (FAO, 1990) it has Cylindrical ear head (34-53cm) in length with maturity period of 70-90 days at height of 210 to 230cm and with an outstanding potential for high yield (Ajayi *et al.* 1990).
- Sossaat-C88 is early maturity cultivar which attains full maturity at 70-90 days.

EXPERIMENTAL LAYOUT AND CROP MANAGEMENT

The experiment was 3 x 3 factorial experiment in a Randomized Complete Block Design (R C B D) i.e three pearl millet varieties sown at three different planting dates (10th 17th, 24th June). Seeds of improved millet Ex Bronu, Sosaat - C88 and local millet 'Maiwa' were sown on different plots at the rate of ten seeds per hole and at a spacing of 75cm - 25cm inter and intra row. The seedlings were tinned to three plants per stand.. At 50% tasselling, plant height (cm), leaf area (cm^2), flag leaf length (cm) were taken by measuring tape while at harvest, yield parameters like panicle weight, Husk weight and grain weight were taken by weighing balance.

STATISTICAL ANALYSIS

Growth and yield data were subjected to Anova to determine treatment effects at 5% level of significance using statistical package (SAS 2002). Duncan Multiple test was used to separate means.

RESULTS AND DISCUSSION

Soil Physicochemical Properties of the Experimental Farm

Results of the physicochemical properties of the experimental farm prior to planting of millet (Table 1) showed that the soil is Sandy Clay Loam, Slightly Acidic and very Low in Nitrogen and organic carbon and exchangeable bases. The Low nutrient content of the soil justifies the condition for screening millet for better adaptation to low soil nutrient content and nutrient use efficiency.

Table 1: Some Physico-Chemical properties of the Soil at the Experimental farm Prior to Planting of Millet

Parameter	Values
Sand	60.84
Clay	27.6
Silt	11.56
pH0.01m $Cacl_2$	5.61
PH H_20 (1:2)	6.16
Available P (Ugg^{-1})	30.50
Organic Carbon (%)	0.55
Organic Matter (%)	0.95
Nitrogen (%)	0.18
Exchangeable cations (C mol Kg^{-1})	
Mg^{2+}	6.16
Ca^{2+}	1.92
K^{+}	0.97
Na^{+}	4.6
Exchangeable (C mol Kg^{-1})	
$A1^{3+} + H^{+}$	6.2

GROWTH COMPONENT OF MILLET AS AFFECTED BY VARIETY AND PLANTING DATE

Growth can be measured as increase in length, width or area, volume, mass or weight (Bidinger *et al.,* 2003). Results obtained from this study showed that there was a significant difference ($P \leq 0.05$) in plant height due to the effect of variety and planting date (Table 2).

Table 2: Growth and Yield Performance of Millet Varieties as Affected by Planting Dates

Treatment	Plant Height (cm)	Leaf Area (cm^2)	Flag leaf Length (cm)	Panicle Weight Kg ha^{-1}	Husk Weight Kg ha^{-1}	Grain Weight Kg ha^{-1}
Planting Date						
10th June	266[a]	3.7[a]	55[a]	1076[c]	365[b]	719[c]
17th June	164[b]	3.4[b]	55[a]	5057[a]	1684[a]	3371[a]
21st June	155[b]	3.2[b]	54[a]	3876[b]	1413[a]	2571[b]
Variety						
Maiwa	129[c]	3.0[a]	49[c]	3128[a]	2083[a]	1043[a]
Ex-Bronu	208[b]	3.4[a]	56[b]	3495[a]	2324[a]	1171[a]
Sossaat-C88	250[c]	3.8[a]	60[a]	3495[a]	2246[a]	1249[a]
P*V	*	NS	NS	NS	NS	NS

NS: not significant

Means with the same letter indicated in columns are not significantly different ($P \leq 0.05$).

Table 3: Plant Height (cm) as Affected by Planting Dates and Varieties

Varieties				
Planting Dates	**Maiwa**	**Ex-Bronu**	**Sosaat - C88**	**Means**
10th June	200[c]	288[c]	311[f]	266[a]
17th June	99[a]	172[b]	222[d]	164[b]
24th June	88[a]	163[b]	217[d]	155[b]
Means	129[c]	208[b]	250[c]	

MEANS WITH THE SAME LETTERS INDICATED IN COLUMNS ARE NOT SIGNIFICANTLY DIFFERENT ($P \leq 0.05$)

Irrespective of planting date, Sossat-c88 with an average value of 250cm was the tallest followed by Ex-bronu (208cm). Maiwa recorded the lowest value of 129cm. This is consistent with the report of Gareth Jones (1989) and Bielorai (1981) who maintained that growth stability is a complex product of genetic growth potential and tolerance to stress condition. Results also revealed that varieties that were planted on the 10th of June were the tallest while those planted on the 24th of June were the shortest. Averagely, growth components maintained the same trend observed for height of millet ie they produced their best on the 10th of June. This is consistent with the report of Aldrich, (1970) and tends to suggest that timeliness in planting has great effect on the growth of millet because it aligns the crop growth cycle with the distribution of rain, prevents serious pest infestation and also takes advantage of the soil moisture condition and early fruiting.

YIELD COMPONENT OF MILLET AS AFFECTED BY VARIETY AND PLANTING DATE

Results of grain weight indicated that there was a significant difference due to the effect of planting date (Table 2) but there was no significant different ($P \leq 0.05$) due to variety. Sossat C88 however recorded the highest grain weight of 1.25 ton per ha followed by Ex-Bronu and Maiwa in that sequence. (Table 2) With the exception of grain weight values, and regardless of planting dates, Ex-Bronu gave the best yield component values followed by Sossat C88 and Maiwa varieties in that order. The differences in varietal response could have been caused by differences in either biomass accumulation or in partitioning of biomass to the grain and this could be associated with the genotypic differences in tillering habit. Although Sosaat C88 gave better biomass records due to varietal difference as reflected by the leaf area and flag leaf length (Table 2), this probably translated to better grain yields compared to the yields of Ex Bornu and Maiwa respectively. This shows that the leaves of Ex-Bronu were probably more efficient in the conversion of biomass formed from solar radiaton into assimilates for grain filling (Van Oosterm *et al*., 2002). Regardless of varietal difference, planting millet on the 17th of June recorded the highest averages grain weight of 3.4 ton ha^{-1} followed by grain weights at 24thand 10th of June in that order. Similar response was observed for panicle weight and husk weight counts (Table 2). This is consistent with the report of Pittman (1961) and Smith (1982) that substantial yield loss may be associated with even slight delay in planting as in the case of those planted on the 24th of June or slight earliness in planting as of those planted on the 10th of June.

CONCLUSION AND RECOMMENDATION

In our report, periods spanning from 10th to 17th of June has evidenced that time of planting could be an important husbandry factor. Averagely, the most ideal date for yield improvement is on the 17th of June and this may correspond to periods of reduced photoperiod, striga infestation, temperature and adequate rain fall which probably translated into better growth components. With concerns about global warming, erratic weather patterns and water scarcities, Sosaat-c88 cultivar which had the best growth and yield components regardless of planting dates may well be the variety of the future and should therefore be recommended for further studies.

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