Effect of Planting Time on Maize (*Zea Mays L.*) Yield in Bayelsa State

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Abstract
The study investigated the most suitable time of maize cultivation in Bayelsa State. The study was carried out in the Niger Delta University Teaching and Research Farm, Wilberforce Island, Bayelsa State. The study lasted for fifteen (15) months with three cultivars (Tein-aka, kwekwe-aka and Pina-aka) obtained locally and two cultivars (Oba super 11 and TZBRWC$^{A}{}_{3}$) from Premier Seed Nigeria Limited, Zaria and International Institute for Tropical Agriculture (IITA) Ibadan. The study revealed that rain introduces pests and diseases. The study also showed that 80% of the cultivars used were sensitive to rainfall with regard to kernel weight gain or loss. There was significant difference in both kernel yield and kernel weight between the two seasons using Duncan Multiple Range Test (DMRT). To obtain an optimum or maximum yield in maize production in Bayelsa State, the planting period should be early December to January the following year. This will enable the plants to utilize the early rains to give better yield and avoid pests and diseases.

INTRODUCTION

Food security is the ability to supply adequate food to human beings in order to attain productive and healthy life. To achieve high production of good and healthy food products, agriculturists require a specific system of farming called "organic agriculture" or "organic farming".

Organic farming is a system of farming in which all inputs are based on natural resources of agricultural inputs by excluding synthetic products (inorganic fertilizers, pesticides, growth hormones, etc). This system of farming requires a relationship between human and the natural resources (soil, plants and animals) in the production of quality food products for human needs and service for human and industrial consumption. According to Acquaah, (2001), this system of farming creates an integrated environmentally sound and economically sustainable agricultural production. An important feature in organic agriculture is the major dependence on SITE- SPECIFIC natural resources and the ability to develop them locally (e.g. compost manure, farm yard manure, green manure, droppings and carcass of livestock instead of synthetic inputs like inorganic fertilizers, pesticides, etc. To achieve effective organic farming, integrated farming must be encouraged to provide the needed resources. In this system of farming, a waste in one sector is a resource to another sector.

Maize (*Zea mays*) is an essential tropical crop par excellence for food, feed and industrial utilization. It grows well in a low land tropics, and grown on many soil types. It also grows well within the temperature range of 10^0C to 40^0C. Maize is a C_4 plant. It requires a fertile, well drained loamy soil and a rainfall of 750mm to 2500mm (FAO, 1994). Maize is a short-day light plant and requires warmth sunlight and enough water supplies to grow well.

Maize has worldwide significance as human food, animal feed and as raw materials for the manufacture of different industrial products such as fermentation and distillation industries,

corn starch maltodextrins, corn oil and corn syrup.
In Bayelsa State, the cost of food products is expensive because of deficiencies of these products. The shortage of these products is caused by three major factors; soil pollution, short period of production and ignorance to change in the planting season due to climate change. Farmers in the region are still struggling to accept and adapt to change in planting time. They are still conservative to planting seasons of the 1980s to 1990s. It is therefore necessary to provide solution to the polluted soil and identify the most appropriate planting season in order to enhance productivity and encourage maize production in the state.
The objective of this study is to study the most appropriate planting time in the region and recommend to farmers for optimal productivity.

MATERIALS AND METHOD

The study was carried out in a period of fifteen (15) months at the Niger Delta University Teaching and Research Farm, Amassoma Wilberforce Island in Bayelsa State. The first planting was done from March at every two weeks interval to April and the second planting was from December toFebruary also at every two weeks interval the following year.

LAND PREPARATION AND PLOT LAYOUT

The land was cleared manually and ploughed. It was marked out into 15 plots. The size of each plot was 7m x 5m. The distance in-between plots were 1m apart. The plots were laid out in Randomized Complete Block Design (RCBD).

PLANTING MATERIALS AND PLANTING

Maize (Zea mays) planting materials were obtained from Premier Seed Nigeria Limited Zaria (Oba Super 11), International Institute for Tropical Agriculture (IITA) Ibadan (Ama-TZBRW C^{A}_{3}) and three other cultivars locally identified as Tein -aka, Kwekwe -aka and Pina - aka from Amassoma local market.

PLANTING

Maize was planted three (3) seeds per hole at a planting space of 90cm x 30cm which gave a plant population of 111111 plants/ha. Two weeks after planting, seedlings were thinned to a density of two plants per stand giving a plant population of 74074 plants /ha.

DATA FOR EVALUATION

- The date of planting was taken
- The leaf area for 10 plants from each plot
- The height of plants; 10 plants from each plot
- The first cob attachment height; 10 plants from each plot
- Date of teaselling for each cultivar and plot
- Number of plants that lodged/plot and cultivar
- Disease and insect pests effect
- Date of maturity for each cultivar
- The length and circumferenceof cob; 10 from each plot
- Number of kernels per cob; 10 from each plot
- The weight of 1000 kernels/replicate were also taken

Simple ANOVA and DMRT were used for the kernel weight and yield statistical analysis, while Pearson's correlation was also used to correlate all parameters.

RESULTS AND DISCUSSION

The results showed that 80% of the cultivars (Oba super 11, kwekwe-aka, pina-aka and Ama-

TZBRW C^{A}_{3}) reacted to environmental factors and time of planting while 20% of the cultivars (Tein-aka) maintained the same level of 1000 kernel weight. Among the cultivars that showed sensitive to environmental factors only Pina-aka had a higher yield and kernel weight in the first planting season than the second planting season (Table 1 and 2).

Table 1: **Weight of 1000 kernels of corn grains for both seasons/ all cultivars (g)**

Cultivar	Seasons			
	First	Second	Avg. diff.	Ranking
Oba Super 11	140	156.67	16.67	3
Tein - aka	203.33	203.33	0	1
Kwekwe - aka	196.67	200	3.33	2
Pina – aka	186.67	170	*16.67	5
Ama-	138.02	140	1.98	4

*The mean was significant at 0.05 levels

Table 2: **Grain Yield for the two seasons Ton/ha**

Cultivar	Seasons			
	First	Second	Avg. diff.	Ranking
Oba Super 11	2.79	2.99	0.2	3
Tein - aka	3.94	4.93	0.99	1
Kwekwe - aka	3.19	3.7	0.51	2
Pina – aka	4.6	3.68	*-0.92	5
Ama-	2.61	2.81	0.2	4

*The mean was significant at 0.05 levels

Table 3: **Average Leaf Areas**

Oba Super 11	40.72
Tein - aka	77.38
Kwekwe - aka	48.74
Pina – aka	50.71
Ama- TZBW C^{A}_{3}	43.92

Table 4:**Average Plant Heights**

Oba Super 11	170.31
Tein - aka	287.75
Kwekwe - aka	244.38
Pina – aka	253.25
Ama- TZBW C^{A}_{3}	182.6

Table 5:**Average First Cob Attachments**

Oba Super 11	49.51
Tein - aka	174.62
Kwekwe - aka	125.92
Pina – aka	142.87
Ama-TZBW C^{A}_{3}	76.92

First Season
The CORR Procedure

5 Variables: FKW FYIELD LA PH FCT

Simple Statistics

Variable	N	Mean	StdDev	Sum	Minimum	Maximum
FKW	5	172.93800	31.54215	864.69000	138.02000	203.33000
FYIELD	5	3.42600	0.83194	17.13000	2.61000	4.60000
LA	5	52.29400	14.56476	261.47000	40.72000	77.38000
PH	5	227.65800	49.66045	1138	170.31000	287.75000
FCT	5	113.96800	50.45847	569.84000	49.51000	174.62000

Pearson Correlation Coefficients, N = 5
Prob> |r| under H0: Rho=0

	FKW	FYIELD	LA	PH	FCT
FKW	1.00000	0.72008	0.72374	0.96349	0.93314
		0.1701	0.1669	0.0083	0.0205
FYIELD	0.72008	1.00000	0.53783	0.78802	0.79512
	0.1701		0.3498	0.1134	0.1078
LA	0.72374	0.53783	1.00000	0.84632	0.84688
	0.1669	0.3498		0.0706	0.0703
PH	0.96349	0.78802	0.84632	1.00000	0.99271
	0.0083	0.1134	0.0706		0.0007
FCT	0.93314	0.79512	0.84688	0.99271	1.00000
	0.0205	0.1078	0.0703	0.0007	

First season kernel weight (SKW), Second season yield (SYIELD), Leaf Area (LA), Plant Height (PH) and First Cob attachment (FCT)

Second Season
The CORR Procedure

5 Variables: SKW SYIELD LA PH FCT

Simple Statistics

Variable	N	Mean	StdDev	Sum	Minimum	Maximum
SKW	5	174.00000	27.42525	870.00000	140.00000	203.33000
SYIELD	5	3.62200	0.83353	18.11000	2.81000	4.93000
LA	5	52.29400	14.56476	261.47000	40.72000	77.38000
PH	5	227.65800	49.66045	1138	170.31000	287.75000
FCT	5	113.96800	50.45847	569.84000	49.51000	174.62000

Pearson Correlation Coefficients, N = 5
Prob> |r| under H0: Rho=0

	SKW	SYIELD	LA	PH	FCT
SKW	1.00000	0.86090	0.71036	0.84818	0.78600
		0.0610	0.1788	0.0694	0.1150
SYIELD	0.86090	1.00000	0.95876	0.93143	0.90803
	0.0610		0.0100	0.0213	0.0330
LA	0.71036	0.95876	1.00000	0.84632	0.84688
	0.1788	0.0100		0.0706	0.0703
PH	0.84818	0.93143	0.84632	1.00000	0.99271
	0.0694	0.0213	0.0706		0.0007
FCT	0.78600	0.90803	0.84688	0.99271	1.00000
	0.1150	0.0330	0.0703	0.0007	

Second season kernel weight (SKW), Second season yield (SYIELD), Leaf Area (LA), Plant Height (PH) and First Cob attachment (FCT)

All the parameters (kernel weight, yield, leaf area, plant height and first cob attachment) were correlated using Pearson correlation for both planting seasons. There was significant difference in both seasons.

DISCUSSION

All successful farmers tend to identify all yield- limiting factors and eliminate or minimize the influence of those that can be managed. The importance of this principle was first identified in the efforts of Justus Von Leibig and Carl Sprengel of the 19th century scientists (Havlin, *Beaton, Tisdale and Nelson*, 2006). Farmers use this important principle, either knowingly or unknowingly. A farmer might have planted the correct variety at the optimum time and population and may have applied all the optimum nutrients using the most effective methods, but still may not attain maximum yield potential because plant available water was the most limiting factor. As a result, until the farmer minimizes water as a limiting factor to yield potential, yield response management of any other factor(s) will be substantially less than if plant available water was not limited.

In Bayelsa State, because of the topography of the region, effective planting period begins from November to March/April. By March / April, the rain is already at its peak. That is, heavy and frequent. By May/June, greater portion of land available for agriculture are already submerged. This restricts cultivation of arable crops to short gestation period crops and varieties for agricultural production in the region. For crops like maize which is a hot plant crop and is sensitive to frequent heavy rainfall, for optimum production, the month of November to January is the best planting period. In Bayelsa, there is only one planting season (November – February) that is, rain fed agriculture. There is no room for dry season (irrigation) farming.

Kernel Weight

The kernel weight of one thousand grains each from all the cultivars in both seasons showed that 75% of the cultivars (Oba super 11, Kwekwe-aka and Pina-aka) reacted to environmental factors and time of planting. While 25% of the cultivars- Tein-aka maintained the same level of kernel weight as shown in the table 1 for both years.

Yield

The yield from 75% of the cultivars used for the study increased in yield in the second planting season. Twenty five percent (25%) depreciated in yield in the second planting season. The highest yield was recorded in Tein-aka in the second planting season. The

average difference between the first and the second planting season was 0.99ton/ha (Table 2). The increase in yield is due to intensity of sunlight. This is because maize is a C_4 plant. It is a hot season crop and grown principally in areas with temperature range of 21-30^{0}C (Sowunmi and Akintola, 2010)

DISEASE/ INSECT-PEST INFECTIONS

In the first planting season of this study (March – June), Stem borer (*Buseola fusca*) infected the plants and was severe in Pina-aka. Appreciable yield was still obtained from Pina-aka because of the size of its cobs and about 80- 90% of the cobs were filled although, many were damaged by the infection. Only Pina-aka lodged among the cultivars used.

In the second planting season (January – May), all the cultivars appreciated in yield except Pina-aka that declined. There was neither disease infection nor insect manifestation.

The study showed that for optimum and maximum maize production in Bayelsa State, planting should be between November to February the following year. In Bayelsa, because of Global warming effect, by March/ April, the region is already experiencing high rainfall. Maize is a hot plant. It does not need frequent and heavy rainfall. It is a C_4 plant. In other words, it does well in hot temperature in as much as there is sufficient moisture in the soil. The most critical point of water and nutrient needs and supply for the maize plant is from a week before teaselling to the milky dough stage. Planting maize by this period allows the plant to make use of the available moisture in the soil after flood recess before the plant gets to the critical period of water demand; rainfall has already begun which will not be an effect on yield performance or introduce pests and diseases. Maize is sensitive to high and frequent rainfall. It causes stunted growth and greater percentage of the cobs is usually unfilled. Again, insect-pests and disease are introduced or common in the rainy season.

SOIL BIOREMEDIATION/POLLUTION CONTROL

The study revealed that organic agriculture (Integrated farming) will be in a better position to other agricultural practice in the region. The nutrient holding capacity of the soil in the region is very low, as a result, if inorganic fertilizers are applied only 20- 30% are effectively utilized. Seventy to eighty percent (70 - 80%) are leached out into the soil beyond the reach of plants thereby increasing the toxicity (pollution) level of the soil. But using organic fertilizers (poultry droppings and other livestock waste, farmyard manure, etc), it purifies the soil by balancing the soil structure and texture. It increases the nutrient holding capacity of the soil due to increase in organic matter. It increases the bufa capacity of the soil. It reduces Al^{+3} in acidic soil, increases mobility rate of phosphorus (P) and form carbon canopy for plants where there is restriction in air circulation(Havlin *et al* 2006).

CONCLUSION

For optimum and maximum yield, maize planting time in Bayelsa should begin from November to January/February the following year. Using organic manure increases the water holding capacity of soil which will provide sufficient soil moisture for the period before the early rainfalls. This period is also pests and disease free. This is will enable the plants to utilize the early rains to give better yield and the problems of diseases and pest can be avoided.

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