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INTERACTIVE EFFECTS OF PLANTING SEASON, MULCHING AND VARIETY SELECTION ON GROWTH, DEVELOPMENT AND YIELD OF WHITE YAM IN THE TROPICAL WET-AND –DRY CLIMATE OF NIGERIA

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ABSTRACT

The effects of planting season, mulching and variety selection on growth, development and yield of white yam were evaluated in two trials in 2007 and 2008 cropping seasons. Mulching and planting season significantly increased tuber yield and also increased the expression of yield components and vegetative characters. The yield of Efuru and Ise-osi were more than that of Oneyere, particularly on mulched plots during the dry season planting. Early season planting significantly ($P < 0.05$) influenced emergence rate, phenological growth and tuber yield. Irrespective of mulching materials, it was found that mulching significantly ($P< 0.05$) increased tuber yield by about 6-8 tonnes ha^{-1} $season^{-1}$ over the unmulched. Furthermore, grass mulch had tuber yield of about 4-6 tonnes ha^{-1} $season^{-1}$ greater than the polythene mulch and the unmulched plots. Growing yam variety that synchronizes the crop growth cycle with effective water availability during the early planting season with proper mulching is therefore recommended.

Key words: *Dioscorea rotundata*, mulching, planting date, variety

INTRODUCTION

Yams (*Dioscorea spp.*) are widely grown in the tropics. Nigeria produces about 74-76% of about 25 million tonnes of the total world annual output with production concentrated in the rain- forest and southern Guinea savanna zones (Olasantan, 2007). However despite their importance from the traditional point of view, yam cultivation has been on a decline in the last decade and it is being replaced by cassava which is less nutritious. This is as a result of agricultural inputs, selection of low yielding varieties, poor agronomic practices and vagaries of the weather, which are the means through which crop production can be improved.

Yam production in tropical wet-and-dry climate of Nigeria is largely rain-fed. Hence, planting depends mainly on the onset, amount and distribution of rainfall. However, in Nigeria, the onset of the rains is variable from year to year such that farmers find it extremely difficult to accurately determine the reliable beginning of the rain vis-à-vis the time start planting the crops. Consequently, the schedules of farm operations are often wrongly phased while agricultural crop failure, replanting and ultimate low yield have characterized the agricultural food crop production in Nigeria (Bello, 2000). However, for yam *(Dioscorea spp.)*, timely planting is believed to be a key to a successful harvest in Nigeria as in other parts of West Africa. Planting date contributes to the variation in yam yields (Ferguson and Gumbs, 1981). Moreover, since soil moisture is essential for the survival of setts before the rain is established, it is imperative to determine accurately the reliable onsets and cessation of the rain vis-à-vis planting date of yam. Furthermore, the occurrence of wet-season- dry spells which may last for a few days to more than three weeks is another serious limiting factor to agricultural management in South Western Nigeria. Incidence of wet season dry spells particularly during the full vegetative stage when evaporative demand is high can lead to retardation of yield formation. The damage is more severe for field crops with shallow root system (Fageria, 1980). However, for locations with good soil moisture retention, plants may manage to utilize soil moisture reserve contained in soil pores, or depend on the very limited reserve contained in its own tissue during dry spells between rains. Crops may also adapt physiologically or behaviorally to prevent temporary depletion of the stored tissue moisture in order to prevent impairment of normal physiological function that may cause irreversible damage and plant death. More so, yam is highly susceptible to dry spells that occur during the onset of the rains and particularly before the rain has fully established. As yam is planted between the period around the cessation of the rains in a given year to the time of onset in the succeeding year, it implies that as soon as germination starts, soil moisture become critical. Hence, there is the need for efficient soil moisture conservation strategy in order to optimize soil physical condition affecting crop yield.

As reported by IITA (1995), mulching is very important in yam cultivation. Maduakor *et al.* (1984), Okoh (2004) and Iyang (2005) reported that majority of the traditional yam farmers in West Africa use different mulching materials for yam cultivation. The materials range from dry grass, palm frond to wood shaving. Of recent however, IITA and some less conservative farmers have started using polythene plastic mulch in the production of seed yam. However, research into the use of polythene plastic mulch in yam production is not widespread in Nigeria. Furthermore, soil and thermal factors have been shown not to limit yam production in the study area and the duration of rain is within the range of optimum annual rainfall (1000-1500 mm) reported for yam growth (Orkwor, 1990; Onwueme, 1973; Ferguson and Gumbs, 1976). However, this is not enough criteria for suitable crop variety selection in the study area. Selection of a specific variety will have a large impact on the way in which planting date should be managed. Similarly, the time frame in which a crop can be planted due to weather and/or other circumstances should have a large impact on the selection of a suitable variety. Hence, for successful cropping, it is pertinent to identify the characteristics of the variety and then synchronize crop growth cycle with the period of effective water availability particularly because the rainfall in the area is characterized by an unpredictable distribution, variability and seasonality. The selection of cultivar (variety) has been noted to be among the factors contributing to the realization of a successful cropping (Bello, 1999; Bello, 2000; Olasantan, 2007). This study therefore investigated the interactive effects of planting date, mulching and variety on the growth, development and yield of white yam (*Dioscorea rotundata).*

MATERIALS AND METHODS

Description of study area

Two field trials using three local white yam cultivars (Efuru, ‘A_1; Ise-osi ‘A_2; and Oniyere ‘A_3) were set up at the Teaching and Research farm of University of Agriculture along Alabata road, Abeokuta (7^o 15’N, 3^o25’E) in Odeda Local Government Area of Ogun State, South Western Nigeria (Fig. 1) during the 2007 and 2008 cropping seasons. The Efuru, ‘A_1; and Ise-osi ‘A_2; are early maturing varieties with rough tuber and more herbaceous growth whan the Oniyere ‘A_3 that is late maturing but with smooth tuber. The study area is characterized by a tropical climate, having distinct wet and dry seasons with bimodal rainfall pattern and mean annual air temperature of about 30^oC. The actual rainfall totals during the 2007 and 2008 cropping seasons were 1177.2 and 1201.6mm, respectively.

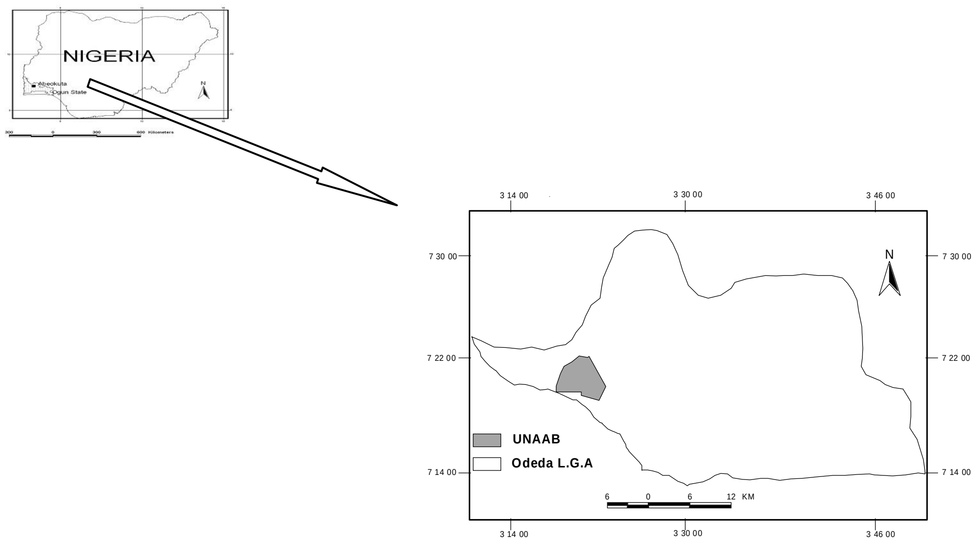

Fig. 1: Location of Federal University of Agriculture, Abeokuta within Odeda Local Government Area in Ogun State, Southwestern Nigeria.

The region is characterized by relatively high temperature with mean annual air temperature being about 30^oC. The soil at the experimental site was categorized as a well-drained tropical ferruginous soil. The A horizon of the soil is an Oxic Paleudulf of the Iwo series with 83% sand, 5% silt and 12 % clay as well as a pH of 6 considered tolerable for yam cultivation (Olasantan, 2007).

Experimental design and field measurement

The experimental site had previously carried beans and groundnut intercrop but had been fallowed for over 3 years (from 2004-2006). The site was cleared manually using cutlass in November 2006, in preparation for the 2007 cropping following the popular practice by the farmers in the study area. This period marks the preparatory period for the cultivation of early yam planting in the study area.

The experiment was laid out in 3 x 3 x 2 factorial arrangement in randomized complete block design (RCBD) with three replicates. Yam mounds were made manually using African hoe during the two experimental years. The mounds were of height 60cm and spaced 1.5 x 1.5m2 with a walk way of 1m between adjacent rows. The mound tillage system was selected for the study not only because it is the most widely used method in the study area, but also because it improves soil aeration and hydrothermal conditions for crop emergence, root development, crop growth and yield (Kutugi, 2002).

During each year of study, rainfall-potential evapotranspiration (P-PE) model according to the procedure of Cocheme and Franquin (1967) was followed to determine planting date. The model used in this study was formulated to incorporate farmer's conventional calendar for yam cultivation. Consequently, planting date was selected based on the following general model:

$0.1PE < P < 0.5PE$

Where:

PE = Potential evapotranspiration
P = Rainfall
0.1PE = One tenth of the potential Evapotranspiration
0.5PE= Half the potential evapotranspiration

Two specific planting dates (T_1 & T_2) generated from the general model above is as below:

$\Sigma(P-0.1PE) \leq 0$ ………….. T_1

$\Sigma(P-0.5PE) \leq 0$ …………… T_2

Where

$\Sigma(P-0.1PE) \leq 0$ = accumulated difference between rainfall (P) and one tenth of the potential evapotranspiration (PE) is zero

$\Sigma(P-0.5PE) \leq 0$ = accumulated difference between P and half PE records zero

The terms P, PE, 0.1PE and 0.5PE are as previously defined.

It follows that the two planting dates (T_1 & T_2) in each experimental years were determined from the model as shown in Figures 2 & 3.

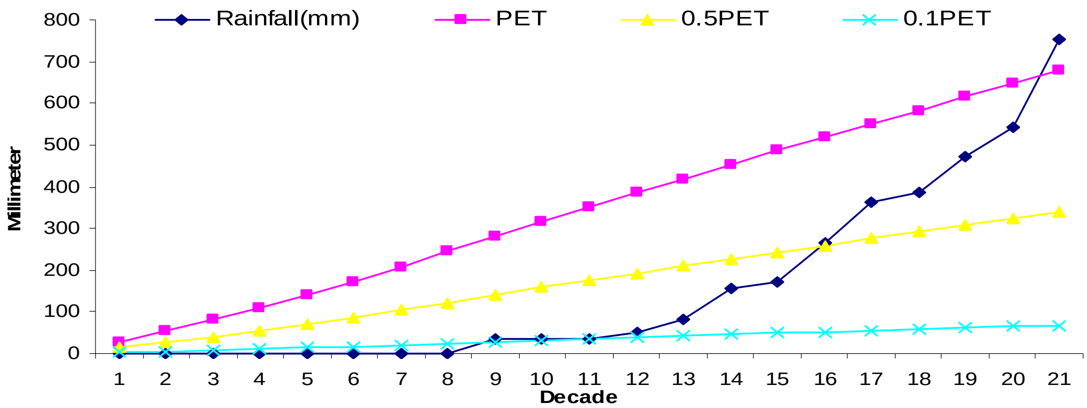

Fig. 3: Planting dates as determined by using decadal cumulative rainfall – potential evapotranspiration (P-PE) model in 2008 season.

For instance, the planting dates for the 2006 -2007 experimental year are as below

$T_1 = \Sigma(P\text{-}0.1PE) \leq 24 =$ March 22 which fell in the 9th decade of 2007

$T_2 = \Sigma(P\text{-}0.5PE) \leq 259 =$ June 5 which fell in the 16th decade of 2007

Whereas the planting dates for the 2007-2008 experimental year happened to be:

$T_1 = \Sigma(P\text{-}0.1PE) \leq 10 =$ January 21 which fell in the 3rd decade of 2008

$T_2 = \Sigma(P\text{-}0.5PE) \leq 182 =$ April 6, 2008 which fell in the 10th decade of 2008

Using a new knife, tubers of each yam cultivar were cut into setts weighing an average of 550grams, and planted at an average depth of 15cm on mounds. After sprouting, the yams were staked to about 3m high and the vines were trained regularly. No fertilizer of insecticide was applied and all plots were regularly hand weeded. Bush rat was controlled by regular clearing of the surroundings of the project site. The climatic requirements of yam from planting to harvesting were measured according to phenological stages of the crop. In this study, five developmental stages of yam growth cycle form the time-scale for which the collected data have been processed. These growth stages are emergence, vine elongation, vegetative, bulking and senescence – harvesting.

Method of evaporation suppression

The method of evaporation suppression used in the study was basically mulching. Two mulch materials were used:

1. Grass mulch = M_1
2. Polythene nylon = M_2.

About 40cm diameter of each mound was covered with dry grass mulch. The grass mulch was sourced from the cleared grass land in the University farm area. The polythene nylon of an average size of 70 x 50cm^2 was used. The polythene nylon was perforated and has the side covering the mound as black surface and white surface facing the atmosphere. This was adopted in other to regulate the soil temperature. The black surface is to conserve the Long Wave Radiation while the white surface facing up is to reflect excessive Short Wave Radiation. However, mulching was done after planting usually between 6.30-7.30 am when radiation intensity was nil. In addition to the mulched plot, an un-mulch treatment was included in the experiment which served as control (C). In order to achieve a proper sprouting and aeration of setts and effective roots development, the mulching materials were removed from mounds during the humid period when accumulated difference between P and PE records zero [i.e., $\Sigma(P\text{-}PE) \geq 0$]. The mulch was removed on the 25th July, (21st Decade) for 2007 experimental year and June 25th (18th Decade) for 2008 experimental year. This period coincided with the early tuber formation stage of yam. This period according to Odjugo (2008) is the time when most traditional farmers in West Africa normally remove mulch materials. According to his work, it revealed that if the mulch materials are not removed during the tuber formation stage, it will prevent the infiltration of rainwater to encourage good tuberization.

During each of the phonological stages, daily observation of air temperature (^oC), wind speed at a height of 2m (ms^{-1}), and rainfall (mm) were made at meteorological enclosure adjacent to the experimental field. Phonological crop growth parameter and yield characters were also measured. Data collected were subjected to analysis of variance (ANOVA) using GenStat Release 7.2 statistical software (Discovery Edition 3) to evaluate the effects of planting date (season), "mulching and mulching materials" and variety. The significant difference of treatment means were determined using least significance difference (LSD) 5% level of probability (Steel and Torrie, 1988).

RESULTS

The effects of planting season, mulching and variety on emergence, vine elongation, number of branches, number of roots, branch length and root length were not statistically significant ($P < 0.01$) in both trials (Tables 1 & 2). However, treatment effects on the number of leaves and Leaf Area Index (LAI) were significant ($P < 0.01$) in both trials. Generally, the selected yam varieties under mulched plots at both the wet and dry season planting periods produced the highest emergence percentages and longer vines with more stem branches and number of roots than the un-mulched plots. The yam varieties grown on plots with Grass mulch at both seasons grew taller and produced more vegetative parts than the Nylon-mulched plots. In both trials, the Efuru variety produced more of these growth components than both the Ise-osi and Oniyere varieties in all the treatments tested.

Tables 3 and 4 show the yam yield and yield component value for the 2007 and 2008 trials. The response of the three varieties to mulching and planting seasons were similar in both years. The yield and yield components were significantly more with mulched plots at the dry season planting than with the unmulched plots and dry season planting. Plots with Grass mulch significantly yielded tubers with the greatest weight and length compared to those of Nylon-mulched and unmulched plots. However, the number of tubers was generally similar (1 tuber/ mound). It would seem, therefore, that mulching was more effective than planting season in response as factor controlling yield, irrespective of yam variety. The Efuru and Ise-osi varieties had significantly more tuber yields and larger tuber weights than the *Oniyere*, particularly on unmulched plots and during dry season planting. On the whole variety *Efuru* give the largest values.

Table 5 shows the factorial effects of planting season, mulching and variety on growth of white yam in both trials. There was no significant interaction among the factors in either trial. Dry season planting appeared to increase yam growth as well as tuber yield and yield components (Tables 6) of each yam variety in the presence of mulching. All the varieties also responded in the same way to mulching and/or planting season treatments, hence the factorial effects of season x mulching, season x variety, mulching x variety and season x mulching x variety on virtually all the parameters were not statistically significant.

Table 1: Interactive effects of planting date, mulch / mulching material and variety on growth of white yams grown in the first trial in 2007

Treatment	Emergence %	Vine elongation (cm)	No. of branches	No. of leaves	No of roots	Vine diameter (cm)	Branch length (cm)	Root length (cm)	LAI
T1xUm x E	23.4±12.59	100±57.74	18.7±3.28	356.7±8.82	25.7±6.84	1.633±0.20	69.0±18.56	26.0±4.73	0.100±0.1
T1x Um x I	21.4±4.13	71.7±64.3	13.7±3.93	32.7±8.82	18.7±6.56	1.000±0.2	51.0±7.23	23.0±7.09	0.033±0.03
T1x Um x O	16.7±2.37	15.0±8.66	17.0±4.93	451.7±8.82	29.3±11.46	1.300±0.00	49.3±14.19	34.3±15.38	0.133±0.03
T1 x G x E	95.2±4.77	288.3±66.47	36.7±2.96	1636.7±8.82	36.3±9.53	1.600±0.12	85.7±24.33	41.3±9.94	5.00±0.66
T1 x G x I	85.7±7.15	263.3±40.96	20.3±8.56	1169.7±8.96	36.0±1.15	1.350±0.15	83.0±21.96	43.3±4.26	2.467±0.14
T1x G x O	69.0±2.37	233.3±41.06	31.7±4.67	829.3±10.09	18.0±1.53	1.333±0.17	53.7±15.84	32.7±4.18	1.433±0.09
T1x N x E	64.3±4.13	553±14.15	14.7±1.76	406.7±8.82	18.0±4.16	1.633±0.07	87.7±22.26	37.3±8.76	0.767±0.23
T1x N x I	65.4±3.19	78.3±32.19	17.3±5.21	1412.0±8.33	21.0±4.16	1.600±0.1	51.3±6.12	32.7±3.84	1.933±0.96
T1x N x O	50.0±8.26	132.7±73.94	26.0±7	691.7±8.82	16.0±6.11	1.367±0.03	87.7±8.41	24.3±5.61	0.700±0.06
T2x Um x E	11.9±6.29	0.00±0.0	13.3±1.76	37.7±8.82	16.0±10.54	1.200±0.26	43.7±23.67	20.3±9.35	0.00±0.00
T2 x Um x I	10.5±2.09	0.0±0.0	9.3±2.73	418.0±8.72	16.7±0.88	1.467±0.03	92.0±10.50	21.3±3.76	0.00±0.00
T2x Um x O	4.8±4.77	0.0±0.0	13.7±3.67	140.7±8.82	14.7±2.84	1.033±0.67	48.0±15.87	17.6±2.71	0.00±0.00
T2 x G x E	38.1±8.59	55.0±22.91	18.0±4.04	411.3±8.69	17.7±4.10	1.700±0.1	89.0±9.29	28.3±6.36	0.433±0.15
T2 x G x I	50.0±4.20	28.3±10.93	22.0± 10.01	356.7±8.82	18.3±5.37	1.333±0.03	73.7±6.36	32.7±5.17	0.267±0.13
T2 x G x O	72.1±11.59	34.0±1.00	17.3±8.51	139.7±8.82	15.7±8.57	1.367±0.07	64.7±11.29	20.7±5.81	0.300±0.06
T2x N x E	16.7±6.32	5.0±5.0	23.3±10.35	148.0±9.45	13.0±3.21	1.300±0.12	56.0±20.21	33.3±8.41	0.167±0.09
T2 x N x I	31.0±2.37	5.0±5.0	10.3±0.88	41.7±8.82	17.7± 6.33	1.400±0.23	41.0± 9.02	21.3±5.49	0.033±0.03
T2 x N x O	50.0±17.97	10.0±5.0	9.7±1.20	31.0±5.77	16.0±4.93	1.367±0.13	28.3±8.57	24.7±1.33	0.067±0.03
P	0.073	0.613	0.152	< 0.001*	0.601	0.053**	0.284	0.750	< 0.001**

T_1 = wet season planting date , T_2 = dry season planting date, N = Nylon mulch, G = Grass mulch Um = Unmulched (Control), E = Efuru yam variety, O = Oniyere yam variety, I = Ise-osi yam variety *Significant at P< 0.01 **Significant at P< 0.05

Table 2: Interactive effects of planting date, mulch / mulching material and variety on growth of white yams grown in the second trial in 2008

Treatment	Emergence %	Vine elongation (cm)	No. of branches	No of leaves	No of roots	Vine diameter (cm)	Branch length (cm)	Root length (cm)	LAI
T1 xUm x E	45.2±17.19	150±65.19	13.3±3.84	233.0±11.55	26.3±7.22	1.467±0.09	77.0±15.28	33.7±5.78	0.317±0.16
T1 xUm x I	57.1±0.0	125±7.42	11.3±2.33	222.0±11.55	26.7±7.69	1.167±0.19	63.7±10.20	287±7.06	0.357±0.02
T1 xUm x O	57.2±8.23	231±31.44	16.7±1.20	354.0±11.55	34.3±18.77	1.367±0.07	85.0±7.93	42.7±14.19	0.453±0.09
T1 x G x E	95.2±24	710±102.14	31.0±8.08	788.0±11.55	37.0±9.85	1.767±0.09	152.0±67.11	44.7±9.06	2.457±0.26
T1 x G x I	95.2±4.77	379±45.99	44.0±11.50	1167.0±11.55	34.0±12.70	1.450±0.25	108.0±20.53	42.0±7.02	2.753±0.64
T1 x G x O	90.5±4.77	440±55.08	32.3±10.48	692.0±11.55	21.7±2.60	1.333±0.17	107.7±30.49	30.0±8.33	1.623±0.22
T1 x N x E	76.1±12.64	608±104.58	23.3±7.36	589.0±11.55	30.0±3.06	1.700±0.12	88.3±19.22	36.7±9.74	1.213±0.28
T1 x N x I	73.3±9.95	372±66.48	21.7±2.33	360.0±11.55	28.7±7.84	1.600±0.1	65.3±3.93	31.3±5.90	0.817±0.08
T1 x N x O	76.1±6.32	413±28.48	32.7±13.67	708.0±11.55	26.3±5.84	1.333±0.03	98.7±12.35	29.7±4.26	1.133±0.17
T2 x Um x E	59.5±9.53	412±12.33	13.0±2.52	295.0±11.55	5.7±16.05	1.167±0.27	57.0±21.93	25.0±8.19	0.001±0.0
T2 x Un x I	47.6±2.4	467±59.45	9.3±3.93	141.0±11.55	16.3±5.21	1.200±0.25	70.3±32.62	22.0±2.52	0.381±0.0
T2 xUn xO	42.9±12.38	237±49.32	12.0±2.65	285.0±11.55	13.7±3.84	1.200±0.21	55.3±16.70	21.3±2.33	0.526±0.0
T2 x G x E	100.0±0.0	580±40	28.3±10.17	402.0±11.55	18.7±3.53	1.667±0.67	81.0±11.53	26.7±3.84	1.120±0.09
T2 xG x I	90.5±6.29	387±47.65	27.0±9.02	690.0±11.55	31.0±7.0	1.433±0.09	83.7±5.8	34.0±5.0	1.407±0.16
T2 x G x O	92.9±0.00	360±40	32.0±11.14	343.0±11.55	24.3±6.23	1.400±0.06	74.3±10.73	30.7±3.53	0.873±0.06
T2 x N x E	56.9±18.72	310±126.62	24.0±12.06	284.7±43.72	17.3±2.03	1.400±0.06	44.0±26.69	27.0±7.02	0.503±0.15
T2 x N x I	64.3±10.91	227±56.57	15.3±1.45	324.0±11.55	24.3±5.49	1.367±0.23	46.0±14.11	28.7±2.91	0.510±0.09
T2 x N x O	61.9±2.4	232±60.01	13.3±2.96	229.0±11.55	22.0±2.52	1.300±0.12	53.0±13.65	38.7±12.72	0.327±0.02
P	0.621	0.252	0.694	<0.001*	0.538	0.904	0.963	0.508	0.043**

*Significant at P< 0.01 **Significant at P< 0.05

Table 3: Interactive effects of planting date, mulch / mulching material and variety on yield and yield characteristics of white yams grown in the first trial in 2007

Treatment	Tuber length (cm)	Tuber diameter (cm)	Tuber weight (kg)	No of tuber	Harvest yield t/ha
T1x Um x E	12.3±7.22	4.67±2.33	1.73±0.87	2.00±1.00	3.53±1.77
T1x Um x I	26.7±13.33	6.67±3.33	1.67±0.83	0.667±0.33	1.07±0.53
T1x Um x O	24.7±12.33	6.00±3.00	1.67±0.83	0.667±0.33	2.03±0.26
T1x G x E	36.4±2.95	10.33±0.88	3.77±0.72	1.00±0.00	17.00±2.89
T1x G x I	32.2±0.59	9.03±0.55	2.40±0.1	1.167±1.17	9.27±0.43
T1x G x O	33.1±1.24	11.87±0.13	3.67±0.09	1.00±0.0	15.37±2.11
T1x N x E	36.4±1.85	9.67±0.88	3.00±0.29	1.00±0.0	9.10±0.8
T1x N x I	40.7±1.76	9.80±0.99	3.43±0.52	1.00±0.0	8.80±3.29
T1 x N x O	27.3±13.67	6.67±3.33	2.07±1.03	0.667±0.33	6.20±3.1
T2 x Um x E	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0
T2 x Um x I	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0
T2 x Um x O	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0
T2 x G x E	16.7±8.82	4.67±2.33	1.53±0.79	0.667±0.33	2.67±1.33
T2 x G x I	20.2±0.73	6.00±0.0	1.00±0.0	1.00±0.0	2.10±0.1
T2 x G x O	27.7±1.88	7.90±0.21	1.83±0.17	1.00±0.0	6.03±0.38
T2 x N x E	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0
T2x N x I	20.3±10.17	4.70±2.35	0.83±0.44	0.667±0.33	2.00±1.0
T2x N x O	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.
P	0.441	0.719	0.950	0.596	0.758

Table 4: Interactive effects of planting date, mulch / mulching material and variety on yield and yield characteristics of white yams grown in the second trial in 2008

Treatment	Tuber length (cm)	Tuber diameter (cm)	Tuber weight (kg)	No of tuber	Harvest yield t/ha
T1x Um x E	18.3±9.70	5.90±3.12	1.35±0.91	0.667±0.33	2.08±1.63
T1x Um x I	35.6±6.36	10.57±2.14	2.83±0.72	1.233±0.23	7.60±1.91
T1x Um x O	40.4±7.21	12.13±0.97	3.67±0.81	1.200±0.1	9.47±1.77
T1x G x E	40.6±4.23	10.07±1.62	4.40±0.31	1.100±0.1	19.80±1.74
T1x G x I	40.0±1.68	11.33±1.15	3.67±0.41	1.200±0.06	16.30±1.36
T1x G x O	38.9±5.18	13.90±1.25	4.07±0.64	1.133±0.07	17.50±3.62
T1x N x E	41.7±2.68	12.40±1.23	4.10±0.78	1.200±0.12	13.73±0.82
T1x N x I	39.0±7.08	13.93±0.57	4.27±0.27	1.167±0.12	14.77±2.41
T1x N x O	44.4±2.87	13.20±0.97	3.63±0.15	1.300±0.1	13.07±1.43
T2x Um x E	31.9±5.05	9.73±1.53	3.00±0.61	1.167±0.09	8.63±2.4
T2x Um x I	26.5±1.29	9.67±0.34	2.27±0.43	1.067±0.07	5.20±1.2
T2x Um x O	38.0±6.08	9.10±0.75	2.10±0.25	1.133±0.13	4.47±1.54
T2x G x E	35.5±4.17	11.97±1.07	4.03±0.62	1.100±0.1	19.00±2.93
T2x G x I	33.9±4.55	13.57±0.63	3.60±0.26	1.133±0.09	15.33±1.45
T2x G x O	45.8±4.51	13.30±1.29	4.03±0.44	1.233±0.09	17.63±1.95
T2x N x E	36.0±5.37	10.47±0.98	3.10±0.50	1.100±0.1	8.40±2.94
T2x N x I	30.2±1.88	13.23±0.19	3.53±0.35	1.033±0.03	10.67±2.0
T2x N xO	34.2±3.69	9.23±0.70	2.47±0.29	1.067±0.07	7.07±0.58
P	0.305	0.501	0.156	0.291	0.183

Table 5: Factorial effects of planting date, mulch / mulching material and variety on growth of white yams grown in the first and second trials in 2007 and 2008

Treatment	Emergence %	Vine elongation (cm)	No. of branches	No. of leaves	No of roots	Vine diameter (cm)	Branch length (cm)	Root length (cm)	LAI
					2007				
S x M	0.09	<0.00*	0.58	<0.00*	0.38	0.39	0.07	0.70	<0.00*
S x V	<0.00*	0.92	0.43	<0.00*	0.75	0.16	0.30	0.97	0.01*
M x V	0.61	0.47	1.00	<0.00*	0.47	0.51	0.30	0.43	<0.00*
S x M x V	0.07	0.61	0.15	< 0.00*	0.60	0.05**	0.28	0.75	<0.00**
					2008				
S x M	0.34	<0.00*	0.79	<0.00*	0.90	0.59	0.55	0.43	<0.00*
S x V	0.66	0.10	0.63	<0.00*	0.89	0.51	0.47	0.61	0.21
M x V	0.97	0.05	0.87	<0.00*	0.87	0.52	0.83	0.70	<0.00*
S x M x V	0.62	0.25	0.69	<0.00*	0.54	0.90	0.96	0.51	0.04**

S = planting season , M= mulching, V = yam variety, *Significant at P< 0.01 **Significant at P< 0.05

Table 6: Factorial effects of planting date, mulch / mulching material and variety on yield and yield components of white yams grown in the first and second trials in 2007 and 2008

Treatment	Tuber length (cm)	Tuber diameter (cm)	Tuber weight (kg/ plant)	No of tuber/ plant	Harvest yield t/ha
			2007		
S x M	0.13	0.33	0.32	0.03**	<0.00*
S x V	0.87	0.67	0.69	0.08	0.07
M x V	0.22	0.15	0.08	0.10	0.03**
S x M x V	0.44	0.72	0.95	0.60	0.76
			2008		
S x M	0.30	0.09	0.33	0.26	0.08
S x V	0.31	0.05**	0.27	0.21	0.27
M x V	0.41	0.31	0.26	0.61	0.27
S x M x V	0.31	0.50	0.16	0.29	0.18

S = planting season , M= mulching, V = yam variety, *Significant at P< 0.01 **Significant at P< 0.05

DISCUSSION

Mulching and planting season significantly increased tuber yield and also increased the expression of yield components and vegetative characters. The yield of Efuru and Ise – osi were more than the Oneyere, particularly on mulched plots during the dry season planting. In this study, mulching appeared to be more effective than planting time in promoting the growth and yield of yam, suggesting the advantage of mulching over planting time for late (wet) season planting (T_2). The increase in growth parameters as well as tuber yield and yield components of yam probably resulted from the effects of mulch on the soil temperature, conservation of soil moisture and biotic population and activities near soil surface as reported by Olasantan (2007) and Odjugo (2008). Early planting season (T_1) was observed to result to higher yields than late planting in both trials. This could be related to the higher LAI which ensures higher bulking rate for a longer period (Okoh, 2004) and can also be attributed to phosphorus and mineralized nitrogen absorbed by yams during growth which are naturally high during the early rains (Solubo, 1972).

Rainfall in 2008 was more bimodal than in 2007. It's onset being May in 2007 but March in 2008 indicating the unpredictable distribution, variability and seasonality in the study area. Though the total rainfall (1177.2 and 1201.6mm for 2007 and 2008 experimental years respectively) recorded at the study site fell within the range of optimum annual rainfall (1000-1500mm) reported for yam growth, it is not enough criteria for suitable crop variety selection in the study area. For instance if assessment is based only on the total annual rainfall, the present study area would fall within the optimal range for yam cultivars and it might be assumed that no further investigation would be meaningful. However, the unpredictable distribution, variability and seasonality of rainfall during the 2007 trial due to one or two sporadic downpours widely separated by periods of dry spells which resulted in high total rainfall, might not contribute meaningfully to crop growth. Usually such downpours often generate flash flood which is loss to evaporation rather than effectively recharging the soil for subsequent use by plant. It follows therefore that adequacy for good plant growth does not depend solely on total rainfall but a combination of rainfall and evaporation. Hence, it might be possible to develop a cropping pattern that would involve planting early maturing variety in the study area since soil and thermal factors are not constraints though the duration of rains is appreciably longer and more reliable in Southwest than elsewhere in Nigeria. A selection of yam variety with appropriate phenologies that synchronize the crop growth cycle with the period of effective water availability is required. For instance, it was observed from study that though there were no significant difference in most of the yam growth parameters measured like the emergence rate, vine length, number of stem branches, number of stem roots, branch length, tuber length, tuber diameter, tuber weight, number of tuber and the yield for the different yam variety planted during the 2007 and 2008, there were still some significant difference in some major parameter like the number of leaves, vine diameter and the LAI. It was observed that the Efuru and Ise-osi had higher number of leaves and LAI followed by the Oniyere. This implies that though all selected yam varieties are suitable for planting in the study area, there are still some early maturing and moisture tolerant varieties that could have a larger canopy

(LAI) and produce more yield even if the difference is little.

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