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EFFECT OF YAM TYPES AND MULCH MATERIALS ON SOIL PHYSICAL PROPERTIES, YAM TUBER YIELD AND ACCEPTABILITY AMONG OKUN PEOPLE OF KOGI STATE, NIGERIA

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ABSTRACT

Two field experiments were conducted at the farmers' field in Ponyan, Yagba East Local Government of Kogi State to evaluate the effect of yam types and mulch materials on soil physical properties, tuber yield and yam acceptability among Okun people of Kogi State, Nigeria. The treatment includes three yam types (white yam (YTA), yellow yam (YTB) and water yam (YTC)) and three mulch materials ((MMG), white polythene (MMB) and black polythene (MMC) and` no mulch material plot as the control (NMM). The treatments were laid out in a 3 x4 Factorial arrangement in a randomized complete block design (RCBD) with three replications. Data collected were on vegetative growth (vine length, main growth diameter, number of branches and average branch length at 12 weeks after planting (WAP), Soil physical properties (soil temperature and soil moisture content) and Yam tuber characters (tuber size, length and width of tuber and tuber yield per ha). Results showed that water yam recorded the longest vine, thickest stem, highest number of leaves better than other yam types. Plots treated with mulch materials exhibited superior vegetative growth and tuber yield characters than the control plots irrespective of the yam types used. All the vegetative growth characters were best in plots with black polyethylene among the mulch plots. Black polythene conserved water and regulate the soil better that other mulch material used. In terms of pounded yam preparation; cultural acceptability; yam storability and yam marketability. White yam was the best and general accepted the by the people.

Keywords: Cultural acceptability; Okun people; yam marketability; yam poundability; yam storability.

INTRODUCTION

Yam (*Dioscores* species) is in the Dioscoreaceae family, that produce edible tuber (Dansi *et al*., 2001). It is indigenous to Africa especially West Africa (Degras, 2000). The edible tuberous underground stem produced by yam is of high economic value in Nigeria. Ukpadi and Okoli (2002) reported that yam is adapted well to savanna condition where it performs better. Katung *et al.* (2006) stated that yam is cherished for food, and it is food of choice for ceremonies and festivals. Yam is a component of fine and bride price presentation in Nigeria (IITA, 2004). Yam can be consumed in various ways; it may be peeled and dry in sun and ground in-to yam flour (Udoh *et al.,* 2005). The tuber could be peeled, sliced and cooked either with beans or pound into yam pasty and eaten with good soup (Joseph, 2018). Yam tubers contain high amount of calcium, phosphorus and iron (Eka, 1995). Fresh yam tuber contains about 70 % water, 25% Starch, 2% Protein and 3% of vitamin and traces of sugar (Showemimo, 2006). The different yam types grown in Nigeria can be group into four categories namely: white yam, yellow yam, water yam and three leaf yam. However, the most popular yam among Okun people of Kogi State of Nigeria is white yam, yellow yam and water yam.

Mulching is the provision of a surface layer of dead vegetable matter to keep the soil around the plants moist and enrich it with organic matter. Opeke (1987) opined that mulch is beneficial to crop plants by conserving soil moisture, regulate the soil temperature around the plant and add organic matter to the soil on decomposition and mineralization. Mulch also suppresses weeds around the plants and act as an anti-erosion measure.

Mahadeen (2014) reported that mulch materials can either be organic or synthetic and that the common organic mulch is straw which is slow to decay. While synthetic mulch includes fabric and plastic materials which are commonly used in commercial crop production. Straw stimulates vegetative growth compared to un-mulched but to a lesser extent than polythene mulch (Sweeney *et al.*, 1987). Plastic mulches contributed significantly to reduction in losses as a result of weed competition. The objective of the study was to assess the influence of different mulch materials on soil physical properties, growth and tuber yield characters of yam types.

MATERIALS AND METHODS

Experimental Site

The experimental site was the farmers' farm at Ponyan. Ponyan is located on latitude of 7.9632^{0}N and longitude 5.7240^{0}E with altitude of 396.05m above sea level. Ponyan is within the forest savanna agro-ecological zone of Nigeria with average rainfall of 1370 mm per annum (Ogundare and Bodunde, 2017). The soil of Ponyan is characterized by an ultisols derived from basement complex. Soil samples of the site obtained from 0– 15cm were randomly collected from 10 different points, bulked together to constitute composite sample, and analyzed for their physical and chemical properties before the application of the treatments.

Treatment and Experimental Design

Treatment involved three yam types: white yam (YTA), yellow yam (YTB) and water yam (YTC)) and three mulch materials: grasses (MMG), white polythene (MMB) and black polythene (MMC) and` no mulch material plot as the control (NMM)). Design was a 3x 4 Factorial arrangement fitted into a randomized complete block design (RCBD) with three replications.

Sowing and Cultural Practices

After clearing of the existing vegetation, the land was ploughed, harrowed and heaped. The plot size was 4 x 3 m while the distance between plots was 0.5m. Heap was constructed using 1x 0.8 m which gave a total of 12,000 plants per hectare. Planting was done on 1st April in both cropping seasons (2019 and 2020).

Yam tubers were cut into yam sets of between 300 and 310g on 29th February of each year. This was according to farmers practice in the study area. The cut sets were deep into neem extract and air dried under shade before arranged in a pit filled with saw dust which was lightly watered artificially for pre-sprouting. All the sprouted sets were transferred to the field and planted on a heap of 1 x 0.8m using hoe. Mulching was done a day after planting according to the specification of the treatments. Individual plants were supported with a bamboo stick of 1.6m in length. Weeding was done manually using handpicking at two weeks intervals. Rodent attacked was controlled by passing the young, germinated tendril through a pivorated bamboo 45cm in length. The yam shoot was sprayed with cypermethrin at the rate of 80g/15litres of water to control insect attacks on the leaves (Omotunde, 1996).

Data Collection and Analysis

Data were collected from ten randomly selected plants in the middle of each plot. Growth characters observed includes vine length, main growth diameter, number of branches and average branch length at 12 weeks after planting (WAP). Vine length and average branch length were measured with a meter rule, main growth diameter measured using Vernier caliper. All parameters were taken from ten sample plants and the average recorded. The soil physical properties observed were soil temperature and soil moisture content which were taken at 3pm. Soil temperature was measured at 15hr with the aid of soil thermometer while soil moisture was calculated using oven dry weight of soil. Yam tuber characters observed were individual tuber weight, length and width of tuber and tuber yield per ha. Evaluation of tuber characters was conducted by 20panelists consisting of five (5) men, ten (10) women and five (5) youths (housewife and food vendor). The sample size was taken in proportionate to population of people in the sample area. The tubers were arranged, and panelists were allowed to judge the level of Yam Pound ability, cultural acceptability, tuber storability and marketability.

All growth and yield data were subjected to analysis of variance (ANOVA) for factorial experiment in a randomized complete blocks design. Fisher's least significant difference (F-LSD) at 5% probability level (Gomez and Gomez, 1984) was employed for the mean separation.

RESULTS AND DISCUSSION

The properties of the soils of the experimental sites are presented in Table 1. The soil is rich in soil nutrient but deficient in available P and effective cation exchange capacity, porous and free of concretion. Effect of yam types and mulch materials on growth characters of yam are presented in Table 2. Vine length, main growth diameter, number of branches produced, and branch length were all significantly ($P<0.05$) different among yam types used. Water yam recorded the longest vine, thickest stem, highest number of leaves in both cropping seasons. When both years were pooled together, white and yellow yams had similar vine length, growth diameter, number of leaves, and number of branches and length of branches. Water yam had significantly ($P<0.05$) superior vegetative growth characters than white and yellow yam. This could have arisen due to variation in the genetic constitution of the tested yam types (water yam, yellow yam and white yam).

Table 1: Pre- planting physical and chemical properties of soils of the experimental sites

Properties	Mean of 2019 and 2020
Sand (%)	67.20
Clay (%)	21.70
Silt (%)	11.10
Soil texture	Sand clay loam
pH	6.01
Bulk density (g/cm^3)	1.73
Total porosity (%)	38.80
Organic matter (%)	2.26
Total N (%)	0.27
Available P (mg/kg)	3.57
Exchangeable K (cmol/kg)	0.14
Exchangeable Ca (cmol/kg)	2.77
Exchangeable mg (cmol/kg)	1.76

Plots with mulch materials had better vegetative growth than the control (un-mulched) plots. Vine length ranged between 2.98 and 5.01 cm and 3.64 and 4.71 cm in 2019 and 2020, respectively. When both cropping seasons were combined, black polyethylene recorded significant longest vines, followed by plots mulched with white polyethylene and grass mulch plots which recorded similar vine length. No mulch plots recorded the shortest vines. Main vine diameter ranged between 1.26 to 1.91 and 1.48 and 1.81 cm among mulches in 2019 and 2020, respectfully. In the combined analysis, polyethylene mulches had similar vine thickness which was significantly different from yam with grass mulch. The shortest main vine diameter occurred in no mulch plots. Number of branches per plant ranged between 17.3 to 29.4 and 16.9 to 27.3 cm among yam types in 2019 and 2020, respectively. All the growth characters were better in plots with black polyethyene than either white polyethyene or grass mulch plots. The result of the present findings is in accordance with those of the earlier researchers who reported significantly higher yield under black plastic mulch as a result of effective soil temperature regulation, weed control and conservation of soil moisture (Singh *et al*., 2005; Mehta *et al*., 2010). No mulch plots recorded the least vegetative growth characters.

Table 2: Effect of yam types and mulch materials on growth characters of yam

Treatment	Vine length (cm)			vine diameter			Number of branches			Branch length (cm)		
Yam Types	2019	2020	Pooled mean	2019	2020	Pooled Mean	2019	2020	Pooled mean	2019	2020	Pooled mean
White Yam	2.74c	5.12a	3.93b	1.41b	1.31b	1.36b	17.7b	16.9b	17.3b	32.3a	34.1b	33.2b
Yellow Yam	3.99b	4.37b	4.18b	1.51b	1.25b	1.38b	17.3b	17.1b	17.2b	33.9a	35.9b	34.9b
Water Yam	6.11a	5.61a	5.86a	2.46a	2.16a	2.31a	29.4a	27.3a	28.3a	81.4a	54.8a	68.1a
LSD	1.31	0.76	0.86	0.27	0.21	0.11	4.88	5,93	6.53	7.44	7.51	5.86
Mulch materials												
MMG	4.13b	4.03b	4.08b	1.64a	1.48c	1.56b	18.6b	20.1a	19.4a	42.0b	35.9a	39.0ab
MMW	4.00b	4.42b	4.21b	1.86a	1.62b	1.74a	22.3a	19.3a	20.8a	36.8c	38.0a	37.4b
MMB	5.01a	4.71a	4.86a	1.91a	1.81a	1.86a	23.7a	16.4b	21.1a	54.6a	31.6b	43.1a
NMM	2.98c	3.64c	3.31c	1.26b	1.48c	1.37c	14.3c	12.3c	13.3b	21.7d	25.2c	23.5c
LSD	0.65	0.62	0.43	0.34	0.16	0.21	3.61	1.74	2.73	8.41	3.21	4.82
YT vs MM	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns

Legend: MMG = grasses, MMW = white polythene, MMB = black polythene, NMM = no mulch material plot as the control, LSD = least significant difference, ns = non significance

The effect of mulch materials on soil physical properties are presented in Table 3. Soil temperature and soil moisture content differs significantly among mulches. The highest temperature and lowest moisture content were observed in plots with no mulch materials, while plots mulched with black polythene had lowest soil temperatures and highest moisture contents. Plots with grasses and white polythene had similar soil temperatures and soil moisture contents.

Table 3: Effect of mulch materials on soil physical properties

Treatments	Soil temperature			Soil moisture content		
	2019	2020	Pooled	2019	2020	Pooled
Mulch materials						
MMG	28.6c	29.4b	29.0bc	11.6b	15.8b	13.7b
MMW	29.4b	31.8ab	30.6b	11.4b	16.0ab	13.7b
MMB	26.4c	28.9b	27.7c	13.1a	17.2a	15.2a
NMM	31.4a	33.3a	32.4a	9.45c	13.6c	11.5c
LSD	0.99	2.14	2.00	0.48	1.02	1.39

Legend: MMG = grasses, MMW = white polythene, MMB = black polythene, NMM = no mulch material plot as the control, LSD = least significant difference

Soil physical condition was enhanced with the use of mulch materials. The lower soil temperatures observed in black polythene mulched plots could have led to higher soil moisture content (Asiegbu, 1991; Olasantan, 1999; Uwah and Iwo, 2011).

Black polythene conserved water and cools the soil better that other mulch material used. The result of the present findings is in accordance with those of Singh *et al*. (2005) and Mehta *et al*. (2010) who reported that black plastic cool soil temperature, better weed control and higher conservation of soil moisture.

The effect of yam types and mulch materials on yield and yield components of yam are presented in Table 4. Number of tubers produced, tuber weight per plant, and tuber yield per hectare were all significantly ($P<0.05$) affected by the yam types. Number of tubers produced and tuber yield per hectare were highest in water yam but produced the least tuber size. Number of tubers produced was least in white yam but it produces heaviest tubers. The yield of white yam and yellow yam were similar in 2019 and 2020 cropping seasons but significantly lower than that of water yam. Water yam gave higher yield compared to both white yam and yellow yam. This was expected as water yam had best vegetative growth attributes than white and yellow yams.

Plots with mulch materials significantly had better tuber characters (number of tubers produced, tuber size and tuber yield per hectare) than plot without mulch material. Among the mulched plots, plots treated with black polythene recorded the highest values for number of tubers produced per plant and the heaviest tubers but the lowest tuber yield. Plots with grass and white polythene mulches recorded highest yield per hectare.

The beneficial effects of grass mulch on yam growth could be attributed to the nutrients released by decomposing mulch (Olasantan, 1999), and its physical effect on the possible reduction of nutrient losses by surface erosion and leaching. Polythene mulches were outstanding in enhancing tuber yield characters over no mulch control in this study. This observation was earlier reported by Hahn*et al*. (1987) who reported that using polyethyene nylon mulch will considerably improve the production of yam and in particular the seed yam by checking the weed growth. A survey carried out in Nigeria showed tremendous increase in the adoption of the use of polyethyene nylon, hence there is a clear promise for a future bloom in the supply of seed yam in particular (IITA, 1995).

Table 4: Effect of yam types and mulch materials on yield and yield components of yam

Treatment	Number of tubers			Tuber weight per plant (kg)			Tuber yield (t ha^{-1})		
	2019	2020	Pooled	2019	2020	Pooled	2019	2020	Pooled
Yam Types									
YTA	1.30b	1.06b	1.18b	2.41a	2.37a	2.39a	31.3b	23.7b	27.5b
YTB	1.31b	1.48b	1.40b	2.20b	1.96b	2.08b	28.8b	29.0b	28.9b
YTC	2.16a	3.81a	2.99a	1.82c	1.16c	1.49c	39.3a	44.2a	41.8a
LSD	0.11	0.56	0.41	0.15	0.34	0.25	4.33	9.41	3.47
Mulch material									
MMG	1.31a	1.41a	1.36a	2.66a	2.82a	2.74a	34.8a	39.7a	37.3a
MMW	1.44a	1.34a	1.39a	2.49b	2.85a	2.67a	35.9a	38.2a	37.1a
MMB	1.36a	1.26a	1.31a	2.63a	2.55a	2.59a	35.8a	32.1b	34.0b
NMM	1.03b	0.71b	0.87b	1.71c	1.61b	1.66b	17.6b	17.8c	17.7c
LSD	0.21	0.24	0.20	0.13	0.51	0.31	10.91	8.67	7.44
YT vs MM	ns	ns	ns	ns	Ns	Ns	ns	Ns	Ns

Legend: YTA = White yam, YTB, Yellow yam, YTC = Water yam, MMG = grasses, MMW = white polythene, MMB = black polythene, NMM = no mulch material plot as the control, LSD = least significant difference

Yam types' acceptability among the people of Okunland in Kogi State, Nigeria in terms of yam pound ability, cultural acceptability, yam storability and yam marketability are presented in Table 5. White yam was the best and general accepted the by the people. Pound ability of yellow yam was good but poor in terms of cultural acceptability, storability and yam marketability. Though water yam store well than yellow yam but poor in pounded yam preparation, and cultural acceptability and command low market value. Both yellow yam and water yam will only be eaten where white yam is not available.

Table 5: Yam types acceptability among the people of Okunland in Kogi State, Nigeria

Yam types	Poundability	Cultural acceptability	Storability	Marketability
White yam	5.0a	5.0a	4.3a	4.8a
Yellow yam	4.5a	2.6b	2.1b	2.6b
Water yam	2.5b	1.2b	4.0a	2.3b
LSD	1.21	1.68	1.41	0.56

CONCLUSION

It is concluded that black polythene conserved more water and regulates the soil better than other mulch materials used. In terms of pounded yam preparation; cultural acceptability; yam storability and yam marketability, white yam was the best and generally accepted the by the people. Therefore, for optimum production of yam, farmers in the study area are encouraged to grow white yam and use black polythene as mulch materials.

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