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Full Length Research Paper

Effects of Age of Oil Palm on Growth and Yields of Cassava, Maize and Pepper Intercrops in the Alleys of Oil Palm of Different Ages at NIFOR Ohosu Experimental Farm Edo State, Nigeria

Obi, Ezinwanne A[1]., Imogie, A. E[2]*., Osawaru, Ogbesoyen[3], Ayemere, A.[2] and Osazuwa, Aituariagbon J. O.[3]

[1]Plantations Management Division, NIFOR, Benin City, Edo State, Nigeria.
[2]Agronomy Division, NIFOR, Benin City, Edo State, Nigeria.
[3]Extension Division, NIFOR, Benin City, Edo State, Nigeria.
*Corresponding Author E-mail: imogie@yahoo.com

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ABSTRACT: This study was designed to examine the growth and yield response of cassava, maize, and pepper as influenced by age of oil palm of different ages within the available resources (nutrients and water). The cassavas, pepper, and maize were planted into existing oil palm plantations of different ages of 2, 3, and 5 years old at NIFOR Demonstration Farm, Ohosu, Edo State. The experiment design was a complete block design replicated 3 times. The data collected were number of leaves, plant height, leaf area, root and shoot biomass, cob weight, number of seed or fruit or tuber/plant, seed or fruit or tuber weight, seed or fruit or tuber yield, harvest index (HI), canopy spread and average soil and air temperature. Data collected were subjected to statistical analysis using analysis of variance (ANOVA). Results of the statistical analysis of data collected show that the effects of interaction between the oil palms and component crops yields were significant (P≤ 0.5) in terms of growths, developments, and yields of component crops. Fresh Fruit Bunch (FFB) production of oil palm was not affected by the intercropped food crops. Oil palm fresh fruit bunch obtained from 5 years old palms was 98 bunches/plot. The average yield recorded from the component crops sowed into oil palms plots across the ages (2, 3, and 5) years were: cassava 4.38kg / plot, maize 0.485kg / plot, and pepper 39.3g /plot respectively. The yield obtained from cassava 2, 3, and 5 years old were 5.42kg, 4.81kg, and 4.23kg/ plot respectively, maize 510.5g, 500g, and 444.4g/stand for 2, 3 and 5 years old palm plots respectively and pepper 41.3g, 39.1g, and 36.6g/ plot from 2, 3 and 5 years of oil palm. The 2 years old oil palm plots recorded Highest followed by 3 and 5 years old oil palm plots.

Keywords: Intercrop, yield, growth, development space

INTRODUCTION

Intercropping is common feature of the farming systems of the tropics and it is simultaneous growing of two or more species in the same field for a significant period of their growth. It offers crucial ecosystem service that supports food supplies and other livelihood activities. Such practices provide sustainable yields, diversity of flora and fauna and lower risks of crop failure, and sustain and enhance environmental quality, ecosystem services and livelihoods and sustainable landscapes (Ajayi *et al.,* 2016). Intercropping practices are reported to optimize ecological processes including the cycling of nutrients, maintains carbon stocks and its sequestration, conservation of soil water and modification of microclimate and reduce soil degradation (Vanlauwe

et al., 2001a).

Agroforestry involves growing trees in mixtures and arable/food crops and fruit tree species simultaneously on a farm (growing arable crops and fruit tree species in mixtures). Alley cropping is an agroforestry technique in which trees are planted in hedgerows, and annuals (arable or fodder) crops are planted in the "alley ways" between the hedge row plants. Alley cropping involves growing trees and shrubs that are compatible with arable or fodder cropping (interrow spaces).

Research on intercropping has shown that fruit trees can be intercropped successfully with arable crops during the early stages within 2 to 5 years of establishment (Ajayi et al., 2016). There is death of information with respect to the performance of alley crops in the fruit tree-based agroforestry systems of the rainforest agro ecologies of Nigeria.

The optmum species combination in arable specie in the alleys of oil palm would optimize the benefits of competitive interactions based on resource availability and use by the intercrops and oil palm. There is therefore merit in research for enhanced understanding of performance of arable species such as cassava, maize and pepper as alley crops in the early years of oil palm and as alternative cash crop for fruit tree farmers and crop diversification during the early stages (establishment) The specific objectives of the study are to examine the effects of ages of oil palm on growth and yield of cassava, maize and pepper strip-intercropped in alleys of 2-5 years old oil palm fields with the view of understanding the compatibility of oil palm with some selected arable crops in oil palm-based intercropping.

MATERIALS AND METHODS

Study area. The experiment was conducted between 2014 and 2015 cropping seasons in 2, 3 and 5 years old existing oil palm fields at the Nigeria Institute for Oil Palm Research (NIFOR) Oil Palm Demonstration Farm, Ohosu, Benin City, Edo state Nigeria. It lies within Latitude 06°3'N, Longitude 05° 37'E, altitude 149.4m above sea level. Rainfall ranges from 1500mm to 2135mm while minimum and maximum temperature are 29^{oc} and 31^{oc} respectively with a mean of 30^{oc}. The food crop planting materials were obtained from research institute. Cassava (*Manihot spp*) TMS 30572 was obtained from National Root Crops Research Institute, Umudike in Abia State Nigeria, maize (*Zea mays*) were obtained from National Cereal Research Institute Badeggi Mina, Niger State, Nigeria and Chilli pepper (*Capsicum annum*) were obtained from NIFOR vegetable garden. Mature cassava stems were obtained and the stems were allowed to stay for one week to dehydrate or reduce water content for easy sprout. Each stem cuttings had at least four buds, the seed of maize and fruits of pepper were harvested at maturity and dried to reduce moisture content to 13 - 14 %. Ground-beds nursery was prepared for pepper and used to raise pepper seedlings. Pepper seeds were sow on the ground beds with the seeds mixed with dried sand to avoid crowdedness and help space the seeds. The mixture were spread on the ground-beds and covered with thin layer of soil to protect the seeds. Shade was built over the ground beds to avoid direct sunlight and watered regularly. The seeds were monitored directly for seed emergence and thus for 3 months.

Land preparation, handling and planting of materials

The existing oil palm plantations with ages of 2, 3 and 5years old oil palms were marked into plots (0.053 hectare) and they were cleared. The plots were marked out using meter tape and pegs to measure the planting distance, interrow and boarder. The palms were established at a spacing of 9 m x 9 m triangular to give plant population of 143 palms / ha. Healthy stem cuttings of cassava, viable seeds of maize and healthy and vigorous grown seedlings of pepper were selected for planting.

The ground-beds nursery for the pepper seedlings were soaked with water before pulling the seedlings with the use of hand trowel to avoid damage of young roots and they were transplanted immediately into the holes in a distance of 1m x 1m and pressed firmly with soil because much delay will cause shock to the young seedlings. The stem cuttings were planted 1m x 1m spacing in a slighting method or at angle 45^{oc} to receive sunlight and to quicken leaf emergence and not to rotten especially when moisture content in soil is high. Seeds of maize were planted 2 per hole with spacing of 1m x 1m and later tilled to 1 plant/stand to give a plant population of 10,000 plant / ha. The oil palm constitute the main plot while arable crop species (cassava, maize and pepper) constitute the sub-plot, strip intercrop system was adopted. The experiments were carried out during the rainy Season.

Experiment lay out

The experiment was lay out as a split-plot design where oil palm plants constitute the main plot and arable crop species as sub-plot treatment. Treatments were replicated 3 times in the oil palms of different ages. There were 3 replicates within each species of cassava, maize and pepper. Weeding and other cultural practices were carried out manually using hoe and cutlass in all the plots. Maize was weeded 2 times while cassava and pepper were weeded 3 times before the termination of the experiment as recommended by BNARDA (2003) to avoid weeds competition with the crops and insect attacks.

Data collection and statistical analysis

Data were collected on growth and yields from all the sampled plants. The vegetative data collected includes: number of leaves, plant height, leaf area using rule calibrated in centimeters (cm) except number of leaf and canopy spread of oil palms were measured using meter (m) tape rule. Number of leaves production data collection commenced at 2 WAP for maize, while for cassava and pepper it was at 4 WAP. As the weeks of planting progressed, the number of leaves, plant height and size of leaves increased with vigorous growth. Data on plant height and leaf area were obtained at maturity for individual crops (maize 12 WAP, pepper 36 WAT and cassava 40 WAP), before the yield were harvested.. The seed/fruit/tuber were counted and weighed and seed/fruit/tuber yield per stand or sample were recorded. The root and shoot biomass and harvesting index (HI) were recorded and calculated. The yield data collected from oil palm and component crops were; number and weight of fresh fruit bunch per palm (FFB) for 5 years old oil palms that have started production of FFB. Number of seed / fruit / tuber, seed / fruit / tuber weight and seed / fruit / tuber, using a weighting balance (metter Toledo). The climate data on rainfall, relative humidity and solar radiation were obtained from NIFOR meteorological station. Temperature (minimum and maximum) of soil and air surface were monitored forth nightly using soil thermometers inserted to the soil at 5cm depth for 15 minutes at each measuring dates. For air temperature, the thermometer was suspended in the air for 15 minutes at each measuring dates. Data collected were subjected to analysis of variance test using the PROC GLM procedure in statistical Analysis system, (SAS2011, version 9.3) to statistically examine the effects of different ages 2, 3 and 5 old oil palms on the component crops and the effects of cassava, maize and pepper on the growth and yields of oil palms. Treatment means were separated using the least significant difference (LSD) test at 5% level of probability.

RESULTS AND DISCUSSION

Data collected were analysed used the PROC GLM procedure in statistical Analysis and the results of the statistical analysis were presented in Table 1 and Figures 1- 3. The results obtained show that vegetative character and yield of all the crops cultivated had good performance. Table 1 showed the effects of oil palm different ages on vegetative character while Figures 1 - 3 showed the effects on yield of cassava, maize and pepper. At 4 weeks after planting, the appearance of the leaves became pronounced and grew healthy. The vegetative growth and performance of the component crops were not affected by the ages of the oil palm. The component crops vegetative performance and yield crops under the palms of difference ages were not significantly affected. The non-significant differences obtained may be attributed to the fact that the oil palm canopy spread has not closed thus permit adequate sunlight to penetrate the inter rows for the food crops to utilized. The vegetative performance of the intercrops increased with crops ages while the yield decreases with ages. Yield of the intercrops was higher at 2 years followed by three years while the least was obtained at 5years old palm plantation. This may be attributed to interrow spacing available for the intercrops. Therefore, their interaction in the system did not affect each other. The yield of (FFB) obtained from 5 years old oil palm that has started production unlike 2 and 3 years old oil palm had good result. However, the pepper transplanted into 2 and 3 years old oil palm plots started producing fruits earlier than the pepper transplanted into 5 years old oil palm plot. They started producing fruit early enough, reach their peak, dropped and some of the plants died after termination of the experiment as a result of direct high intensity of sun. While the pepper transplanted into 5 years old oil palm plot had a delay in production of fruits, reach peak and many of the plants survived after harvest and continue to produce fruits. The result showed that the interaction between component crops and oil palm over the available resources (soil nutrient and water) had no negative effect on growth, performance and yield of the major crop and component crops in the system.

The yield obtained from component crops increased based on the ages of the oil palms. The 2 years old oil palm gave the highest yield followed by 3 and 5 years old palms. All the same, the yields obtained generally were good. Figure 2 showed that the maize shoot biomass, cob and seed weights for 5 years were significantly low. Shoot biomass and fruit yields of pepper were lowest for 5 years old. Plant height and tuber yields of cassava were better under 2 and 3 years old fields. The number of leaves and canopy spread was largest for 5 years old palm plants. The sole and intercrop combinations of cassava, maize and pepper appeared to have optimized resources (space and nutrients) use when grown in the alleys of oil palm of different ages (2 to 5 years). Oil palm growth and development was not affected by the presence of alley crops of cassava, maize and pepper. Findings indicate that cassava, maize and pepper can grow together in mixture with oil palm or other tree crops. There was no significant difference in the growth performance and yields of the crops intercrops including the oil palms across the ages of the oil palm fields. Similar results were also obtained for cocoyam (*Xanth - soma sagittifollium*) experiment in the fifth and sixth years after planting (Salako *et al.,* 1995). The pepper which continued to produce scantly and survived in 5 years old oil palm was in line with Okpara-Jose and Lucas, (1995) findings in intercropping oil palm with cassava in Nigeria. There was a general shading effect due to the cassava, which necessitates increased of the planting distance

Table 1: Effect palm ages on growth and yield of food crops.

Parameters		**2 Years**		
	Maize	**Cassava**	**Pepper**	**LSD**
Plant Height (cm)	94.7	55.4	63.6	NS
No o Leaves	10.7	45.8	181.8	4.27
Leaf Area (cm)	126.8	43.94	18.77	8.50
No of seeds (g)/fruits (g) /tubers weight (kg)	494.7	4.3	67.5	14.44
seeds (gm)/fruits (gm) /tubers weight (kg)	90.7	4.1	42.1	12.67
Parameters		**3 Years**		
	Maize	**Cassava**	**Pepper**	**LSD**
Plant Height (cm)	93.3	57.1	63.3	NS
No o Leaves	10.8	45.3	162.8	4.17
Leaf Area (cm)	358.7	38.6	19.52	9.01
No of seeds (g)/fruits (g) /tubers weight (kg)	502.4	4.6	67.1	46.1
seeds (gm)/fruits (gm) /tubers weight (kg)	91.8	3.3	39.8	22.5
Mean seeds (gm)/fruits (gm) /tubers weight (kg)	502.2	3.3	398	84.7
Parameters		**5 Years**		
	Maize	**Cassava**	**Pepper**	**LSD**
Plant Height (cm)	92.2	57.1	63.4	NS
No o Leaves	10.8	46.1	165.9	4.12
Leaf Area (cm)	270.5	41.25	19.23	8.71
No of seeds (g)/fruits (g) /tubers weight (kg)	450.6	3.9	64.3	8.21
seeds (gm)/fruits (gm) /tubers weight (kg)	81.0	3.1	37.5	9.5
Mean seeds (gm)/fruits (gm) /tubers weight (kg)	450.6	3.1	397.9	7.53

Figure 1. Effect of age of oil palm field on cassava tuber yields in oil palm-based intercropping system (Ohosu)

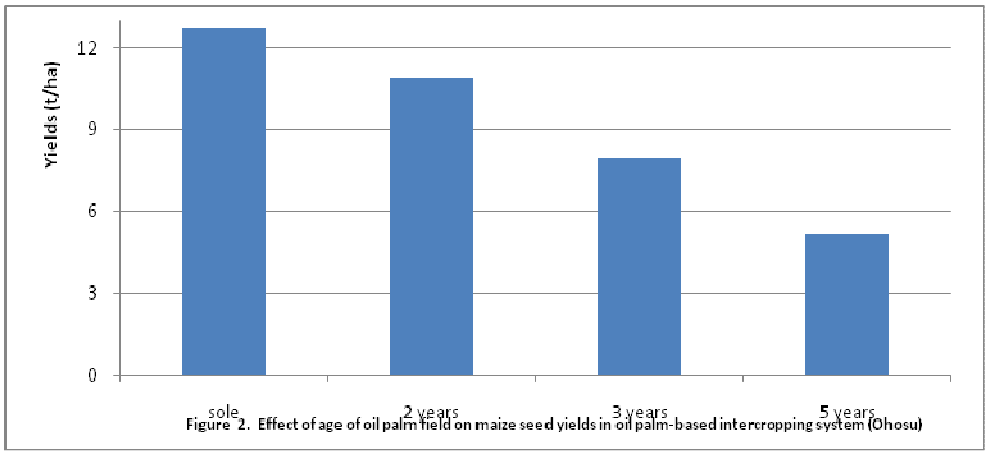

Figure 2. Effect of age of oil palm field on maize seed yields in oil palm-based intercropping system (Ohosu)

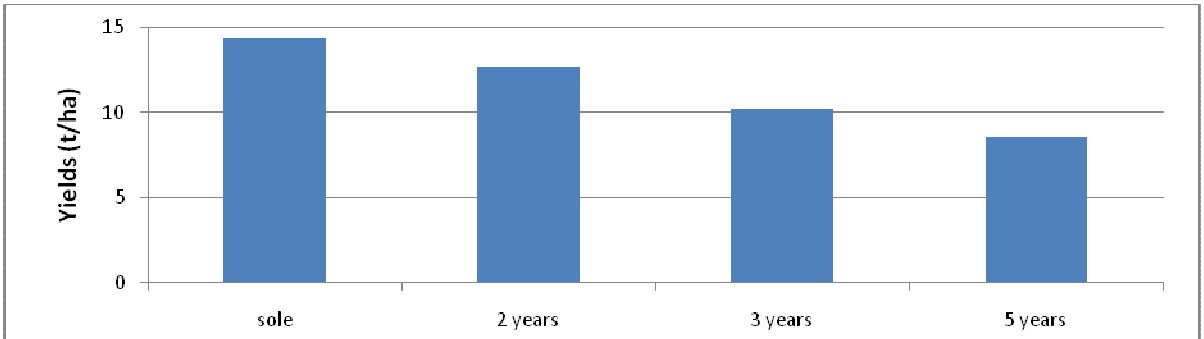

Figure 3. Effect of age of oil palm on pepper fruit yields in oil palm-based intercropping system (Ohosu)

between cassava and pepper. If this distance exceeded 2.3 m the yield from the intercropping palms was greater than that from palms as a sole crop.

Conclusion

The growth and yields of sole and strips-intercropped cassava, maize and pepper in alleys of 2-5 years old oil palm fields were not significantly differed. Strip-intercropping of cassava, maize and pepper in the alleys of 2, 3 and 5 years old oil palm plants had no detrimental effects on the growth and yield of oil palm. Adoption / inclusion of cassava, maize and pepper as alley crops during the early years of oil palm establishment had no effect on palm growth, development and yield.

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