Agricultural Journal 9 (1): 45-50, 2014
ISSN: 1816-9155

Potential Usefulness of Planting Ginger (*Zingiber officinale* Rosc.) in or Near Established Oil Palm Plantation in South Eastern Nigeria

E.N. Nwaogu, T.N.C. Echendu and E.C. Nwauzor
National Root Crops Research Institute, Umudike, Abia State, Nigeria

Abstract: The growth and yield performances of 4 ginger varieties under oil palm plantation environment and different mulch management practices in South Eastern Nigeria were evaluated in a field study conducted in 2007 and 2008 cropping seasons in a privately owned oil palm plantation at Uratta village in Isiala Ngwa North Local Government Area of Abia State, South Eastern Nigeria. Treatment consisted of four ginger varieties [yellow ginger (UG1), black ginger (UG2), Wynad Local (WYL) and Himachel Pradesh (HPL)] in combination with 2 mulch management practices (mulched and unmulched). The treatments were laid out in a split plot arrangement fitted into a randomized complete block design with 3 replications. Results showed that although fresh rhizome yield was consistently lower under the oil palm plantation environment relative to the control, there was a delay and significant reduction in the occurence of yellow leaf spot disease in the plantation compared to the control. UG1 and wynad local varieties out-yielded Himachel Pradesh and UG2 in both plantation environment and in the control irrespective of mulch management practice.

Key words: Ginger yield, oil palm plantation, mulching, Uratta village, South Eastern Nigeria

INTRODUCTION

Ginger (*Zingiber officinale* Rosc.) is a very important cash crop in Nigeria and the world over. Nigeria is the largest producer of the crop in Africa and the third largest producer in the world after India and China (FAO, 2008). Ginger has been in export and international trade for centuries and today the demand is higher with the expansion of industrial markets for processed food, drugs and cosmetics in which ginger is used as flavour, base and components, respectively (Asumugha *et al*., 2006). In South Eastern Nigeria, oil palm (*Elaeis guineensis*) is a major source of food oil for people in the zone. A large portion of the land in this zone is planted to oil palm. The closed canopy formed at the maturity of such palms limits use of the plantation land for the production of other crops as it prevents effective use of radiant energy for photosynthetic activities by other crops around the plantation environment. But with pressure on land in South Eastern Nigeria due to population growth, farmers have begun utilizing theinter and intra-row spaces in oil palm plantations to produce other cash crops and to increase the productivity of their lands. Practices such as under planting of cocoyam, cassava, melon, vegetables and grain legumes with oil palm have become common among farmers in this zone (Ofoh and Lucas, 1988). Certain measures, such as periodic clearing of the plantation floor and pruning of the palms are usually done by plantation owners as a way of improving the productivity of the system and increasing light penetration into the plantation floor. The palm fronds that are cut out from such pruning activities are usually used in mulching the plantation floor (Emereole, 2005). Among other benefits, this practice is reported to enhance the fertility (especially potassium) of the plantation soil (Emereole, 2005).

Despite the huge economic and medicinal potentials of ginger, no serious efforts have so far been made to integrate this crop into the oil palm plantation cropping system in South Eastern Nigeria. The researches of Meerabai *et al.* (2001) indicated that ginger yields higher under light shading. Planting ginger under light shade is an age long practice by farmers (Amoah *et al*., 2004, Jessykutty *et al*., 2006). In Jamaica, ginger is produced as an intercrop in the lower canopy with yams while in India, pigeon peas and castor oil are intercropped with it to provide light shade (Ravindran and Babu, 2005). Meerabai *et al.* (2001) also reported the possibility of producing ginger using the diffused light reaching a coconut garden floor in Kerella, India.

Planting of ginger under oil palm plantation may be beneficial as the closed canopy may reduce weed intensity and weeding frequency. Weed management is among the factors that constitute the highest cost in ginger production (RMRDC, 2005).

However, information is scanty in Nigeria on the growth and yield responses of ginger under planted with

Corresponding Author: E.N. Nwaogu, National Root Crops Research Institute, Umudike, Abia State, Nigeria

oil palm. This study aims at determining the growth and yield responses of 4 ginger varieties under different mulch management practices in an oil palm plantation using the diffused light reaching the plantation floor.

MATERIALS AND METHODS

The study was conducted in 2007 and repeated in 2008 in a privately owned oil palm plantation at Uratta village in Isiala Ngwa North Local Government Area of Abia State in South Eastern Nigeria. The soil of the oil palm plantation used for this trial was a sandy loam with N, P and K values of 0.16%, 8.10 mg kg^{-1} and 0.32 cmol kg^{-1}, respectively. The soil had a pH in water value of 5.5, organic carbon of 2.50% and Ca and Mg of 2.20 and 1.60 cmol kg^{-1}, respectively. The soil of the site used as the control experiment (without oil palm tree) had N, P and K values of 0.11%, 11.20 mg kg^{-1} and 0.14 cmol kg^{-1} respectively with a pH in water value of 5.58 and organic carbon content of 1.50%. Pre-cropping analyses of the soils used for the study were carried out using standard methods. Total N was analyzed using the semi-micro Kjeldahl method as reported by Bremner and Mulvany (1996). Available P was determined by Bray and Kurtz -2 as modified by Olsen and Sommers (1982).

Exchangeable K, Ca and Mg were measured by the 1N neutral NH_4OAc saturation method of Thomas (1982). While, K was measured flame photometrically using atomic absorption spectrophotometer, Ca and Mg were done using the EDTA complexometric titration method. Organic matter was estimated by the Walkley and Black (1934)'s wet oxidation method. Soil pH was determined by the combined glass electrode pH meter method of McLean (1982) at a soil: Solution ratio of 1: 2.5. Particle size distribution measurement was carried out using the Bouyoucous hydrometer method as reported by Tel and Hagarthy (1984) using sodium hexametaphosphate as the dispersant.

The oil palm plantation used for this study has existed for 25 years (personal communication). The palms were planted in a triangular pattern with 9×9×9 m spacing giving a plant density of 143 palms ha^{-1}. Apart from previous regular pruning of the palms by the plantation owner, all the palm trees within the experimental plots were pruned such that equal number of palm fronds was retained on each palm before commencement of study. This measure was taken to ensure equal light penetration to the plantation floor.

The plantation land used for the study was prepared manually using a spade. Clearing, stumping and seed bed preparations were done by hand. Treatments consisted of 4 ginger varieties (yellow ginger (UG 1)), black ginger (UG 2), Wynad Local (WYL) and Himachael Pradesh (HPL) in factorial combinations with 2 mulch management practices (mulched and un-mulched). A control experiment comprising the 4 ginger varieties and the 2 mulch management practices being tested but having no oil palms was also set up one kilometre away from the plantation. Mulching of both the control and the oil palm plantation experiments was done 2 days after planting using 20 ton ha^{-1} palm fronds from the pruned palms.

Table 1: Disease score of visual observation and ranking

Severity estimation (%)	Scale	Interpretation
0	0	No infection
1-20	1	Slight infection
21-40	2	Moderate infection
41-60	3	Extensive infection
61-80	4	Very extensive infection
81-100	5	Leaves completely infected

Rhizome setts weighing about 20 g were cut from large, healthy and disease-free mother rhizomes of the various ginger varieties. The treatments were laid out on 3×2 m beds in a split plot arrangement fitted into a randomized complete block design. Variety constituted the main plot while mulch management practice was the sub plot. The rhizomes were planted up on 14th June and on 24th May for the 2007 and 2008 cropping seasons, respectively. The rhizome seeds were sown at an intra-row spacing of 0.20 m and inter row spacing of 0.20 m giving a plant population of 250,000 plants ha^{-1}. The inter-plot distance was maintained at 0.5 m. Disease score was made using the following visual observation and ranking as described by Ford and Hewitt (1980) (Table 1).

Data on establishment, plant height, fresh rhizome yield, number of rhizome fingers/plant, number of leaves/plant, yellow leaf spot disease incidence and rhizome post harvest storability were collected and analyzed using ANOVA. Differences among treatment means with significant effects were detected using LSD (0.05).

RESULTS AND DISCUSSION

Ginger establishment was consistently higher in the mulched plots than in the un-mulched in both the control and in the plantation. Except for UG 2 in 2008, there was no significant difference in mean ginger establishment between the control plots and the plots in the plantation. Ginger establishment differed significantly ($p \leq 0.05$) among the varieties tested (Table 2). For the 2 years of study, highest mean establishment was recorded with Wynad Local followed by UG 1 variety across the 2 mulch management practices.

Significantly taller plants were produced in the oil palm plantation environment than in the control (Table 3). This was probably due to etiolation arising from reduced

Table 2: Varietal establishment (%) of ginger as influenced by mulch management practice under the oil palm plantation in South Eastern Nigeria

	Control			Oil palm plantation		
Variety	Mulched	Un-mulched	Mean	Mulched	Un-mulched	Mean
2007						
UG 1	81.4	69.3	75.4	84.3	69.4	76.9
UG 2	89.2	71.3	80.3	88.8	73.7	81.3
Wynad local	94.8	76.6	85.7	92.2	80.1	86.2
Himachael pradesh	81.2	60.9	71.1	80.4	63.3	71.9
Mean	86.7	69.5	-	86.4	71.6	-
LSD (0.05)						
Variety = 8.671						
Mulch management = 10.329						
Variety X mulch management = NS						
2008						
UG 1	80.5	63.9	72.2	85.7	60.4	73.1
UG 2	87.3	64.5	75.9	86.6	72.3	79.5
Wynad local	90.8	75.5	83.2	91.3	74.4	82.9
Himachael pradesh	82.2	68.8	75.5	89.9	67.8	78.9
Mean	85.2	68.2	-	88.4	68.7	-
LSD (0.05)						
Variety = 5.942						
Mulch management = 11.341						
Variety X mulch management = 3.466						

Table 3: Effect of mulch management practice on the varietal plant height (cm) response of ginger grown under oil palm plantation in South Eastern Nigeria

	Control			Oil palm plantation		
Variety	Mulched	Un-mulched	Mean	Mulched	Un-mulched	Mean
2007						
UG 1	91.7	82.7	87.2	154.3	108.4	131.4
UG 2	108.9	88.7	98.8	137.4	96.4	116.9
Wynad local	112.7	93.6	103.2	180.6	124.9	152.8
Himachael pradesh	86.9	69.9	78.4	104.4	79.8	92.1
Mean	100.1	83.7	-	144.2	102.4	-
LSD (0.05)						
Variety = 18.611						
Mulch management = 12.334						
Variety X mulch management = 3.721						
2008						
UG 1	138.3	102.2	120.3	154.6	110.3	132.5
UG 2	145.6	114.4	130.0	132.3	122.6	127.5
Wynad Local	186.2	128.7	157.5	196.6	132.8	164.7
Himachael pradesh	112.2	89.6	100.9	135.5	104.4	119.9
Mean	145.6	108.7	-	154.8	117.5	-
LSD (0.05)						
Variety = 20.341						
Mulch management = 10.932						
Variety X mulch management = 2.713						

sun light in the plantation. Among the varieties tested, Wynad local followed by UG 1 gave the best performance in terms of plant height in both the control and in oil palm environments irrespective of mulch management practice. Leaving the plots un-mulched resulted in 16% mean plant height reduction in the control and 29% reduction in the plantation environment in 2007. In 2008, the reductions were 25 and 24% for the control and plantation environments, respectively.

Despite the taller plant height advantage observed, fresh rhizome yields were significantly lower in the plantation than in the control irrespective of mulch management. This is attributed to reduced photosynthesis as a result of reduction in sun light. In general, the 4 varieties tested were of the decreasing yield order of UG 1>Wynad local>UG 2>Himachael Pradesh. The low rhizome yield obtained in the plantation relative to the control poses a serious limitation to its use as an alternative niche for ginger production in South Eastern Nigeria. But, when viewed from the backdrop of the fact that additional revenue is attracted to the plantation owners from ginger, inter-planting of oil palms with ginger may be considered an attractive enterprise despite the low rhizome yield especially in South Eastern Nigeria where high population density and soil erosion pose serious challenge to available cultivable land resources (Table 4).

Table 4: Effect of mulch management practice on the varietal fresh rhizome yield (ton/ha) response of ginger grown under oil palm plantation in South Eastern Nigeria

	Control			Oil palm plantation		
Variety	Mulched	Un-mulched	Mean	Mulched	Un-mulched	Mean
2007						
UG 1	34.6	24.7	29.7	17.3	11.6	14.5
UG 2	18.5	10.3	14.4	10.6	8.8	9.7
Wynad local	25.8	18.4	22.1	12.3	10.2	11.3
Himachael pradesh	12.4	9.4	10.9	8.4	7.4	7.9
Mean	22.8	15.7	-	12.2	9.5	-
LSD (0.05)						
Variety						
Mulch management						
Variety X mulch management						
2008						
UG 1	28.6	18.8	23.7	18.6	12.7	15.6
UG 2	17.7	11.6	14.7	11.4	8.8	10.1
Wynad local	22.8	14.9	18.9	15.5	10.9	13.2
Himachael pradesh	11.6	9.3	10.5	9.9	8.0	9.0
Mean	20.2	13.7	-	13.9	10.1	-
LSD (0.05)						
Variety						
Mulch management						
Variety X mulch management						

Table 5: Effect of mulch management practice on the varietal yellow leaf spot disease incidence of ginger measured at 5 map (No. of diseased plants/plot) grown under oil palm plantation in South Eastern Nigeria

	Control			Oil palm plantation		
Variety	Mulched	Un-mulched	Mean	Mulched	Un-mulched	Mean
2007						
UG 1	46.4	68.4	57.4	20.7	33.8	27.3
UG 2	36.6	54.3	45.5	19.8	22.5	21.2
Wynad local	20.2	38.2	29.2	7.4	20.8	14.1
Himachael pradesh	26.9	49.6	38.3	15.7	21.6	18.8
Mean	32.5	52.6	-	15.9	24.7	-
LSD (0.05)						
Variety = 6.542						
Mulch management = 4.334						
Variety X mulch management = 2.122						
2008						
UG 1	40.6	54.6	47.6	30.7	42.3	36.5
UG 2	32.2	48.9	40.6	23.3	37.6	30.5
Wynad local	23.8	32.4	28.1	16.5	28.8	22.7
Himachael pradesh	28.9	38.8	33.9	10.7	18.8	14.8
Mean	31.4	43.7	-	20.3	31.9	-
LSD (0.05)						
Variety = 7.823						
Mulch management = 3.886						
Variety X mulch management = 1.764						

Furthermore, the relatively higher performances of the mulched plots comparative to the un-mulched in terms of establishment, plant height and yield in both the control and in the plantation are indicative that the oil palm plantation canopy cannot adequately moderate weather variables such, as moisture and temperature which Njoku *et al.* (1995) identified as critical factors for ginger production.

Table 5 shows the effect of mulch management practice on the varietal yellow leaf spot disease response of 4 ginger varieties at 5 Months After Planting (MAP) in both the plantation and in the control. Mulching reduced the mean incidence of yellow leaf spot disease of ginger by 62 and 55% in the control and in the plantation, respectively in 2007. In 2008, the reduction was by 39 and 57% for the control and plantation, respectively. Averaged over the 2 cropping systems (control and oil palm plantation), significantly higher level of yellow leaf spot disease infestation was recorded in the control plots than in plots in the plantation. This is attributed to higher levels of K in the plantation soil than in the control. Earlier research works (Jansson, 1978; Liu *et al.*, 2006) have

shown that adequate K nutrition assists in hardening the epidermal tissues of root and tuber cells against microbial pathogens. Palm bunches are known to be high sources of fertilizer K and therefore were suspected to be responsible for the high K levels recorded in the plantation.

Severity of yellow leaf spot disease differed significantly among the four ginger varieties. UG 1 variety was most amenable to the disease in both the control and in the plantation than UG 2, Himachael Pradesh and Wynad local. Wynad local was least affected by the disease in both years. Variability in yellow leaf spot disease infestation among the ginger varieties studied could be ascribed to differences in genetic constitution.

CONCLUSION

The results of this study have shown that planting ginger under the oil palm plantation significantly reduced the rhizome yield response relative to the control irrespective of the variety. Oil palm plantation environment without mulch cannot adequately moderate critical elements of climate for sustainable ginger production in South Eastern Nigeria. Although, rhizome yield was lower in the plantation than in the control, Wynad local and UG 1 varieties showed promises of better adaptation in the plantation environment than Himachael Pradesh and UG 2. In addition, the reduced incidence of yellow leaf spot disease and the possibility of additional revenue from the ginger are compelling factors making the inter-planting of oil palm trees with ginger an adoptable production technology, especially in South Eastern Nigeria where there is shortage of cultivable land due to problems of erosion and population pressure.

REFERENCES

Amoah, F.M., B.N. Nuertey, K. Baidoo-Addo, F.K., Oppong, K. Osei-Bonsu and T.E.O. Asamoah, 2004. Under-planting oil palm with Cocoa in Ghana. J. Agrofor., 30: 289-299.

Asumugha, G.N., H.N. Anyaegbunam, T.O. Ezulike and K.I. Nwosu, 2006. Guide to Ginger Production and Marketing in Nigeria. National Root Crops Research Institute, Umudike, Nigeria.

Bremner, J.M. and C.S. Mulvany, 1996. Nitrogen-Toal. In: Methods of Soil Analysis Part 3: Chemical Methods, Sparks, D.L., A.L. Page, P.A. Helmke, R.H. Loeppert and P.N. Soltanpour *et al*. (Eds.). Soil Science Society of America, USA., pp: 1085-1122.

Emereole, C.N., 2005. Maximizing the Potentials of Oil Palm for Sustainable Intercrop Production in the Rainforest Ecology of Nigeria. Izybest Productions, Owerri, Nigeria, Pages: 123.

FAO., 2008. Food and Agriculture Commodities Production. Food and Agriculture Organization of the United Nations, Rome, Italy.

Ford, J.E. and D. Hewitt, 1980. Protein Quality in Sorghums and Field Beans (*Vicia faba* L.) as Measured in Biological and Microbiological Assays. In: Vicia Faba: Feeding Values, Processing and Viruses, Bond, D.A. (Ed.). Martinus Nihoff, The Hage, pp: 125-140.

Jansson, S.L., 1978. Potassium requirements of root crops. Proceedings of the 11th Congress of the Potassium Research Review and Trends, (CPRRT`78), International Potash Institute, Bern, Switzerland pp: 267-273.

Jessykutty, P.C., B.K. Jayachandran and A. Balakrishnan, 2006. Influence of oil palm shade on the physiology of Galanga. Indian J. Plant Physiol., 11: 415-420.

Liu, X.Y., P. He and J.Y. Jin, 2006. Advances in effect of potassium nutrition on plant disease resistance and its mechanism. Plant Nutr. Fertil. Sci., 12: 445-450.

McLean, E.O., 1982. Soil pH and Lime Requirement. In: Methods of Soil Analysis Part 2: Chemical and Microbiological Properties, Page, A.L., R.H. Miller and D.R. Keeney (Eds.). 2nd Edn., ASA and SSSA, New York, USA., pp: 199-224.

Meerabai, M., B.K. Jayachandran, R.K. Asha and V. Geetha, 2001. Boosting spice production under coconut gardens of Kerela: Yield maximization of ginger with balanced fertilization. Better Crops Int., 15: 25-27.

Njoku, B.O., E.N.A. Mbanaso and G.N. Asumugha, 1995. Ginger Production by Conventional and Tissue Culture Techniques. Dolf Publishers, Owerri, pp: 23-26.

Ofoh, M.C. and E.O. Lucas, 1988. The performance of oil palm (*Elaeis guineensis* Jacq.) and some food crops under inter-crop system and the effects on the soil factors. Proceedings of the 2nd Annual Meeting of the Collaborative Group in Cassava Based Cropping System Research, Ibadan, November 7-10, 1988, IITA, Ibadan Nigeria, pp: 57-67.

Olsen, S.R. and L.E. Sommers, 1982. Phosphorus. In: Methods of Soil Analysis, Part 2, Page, A.L., R.H. Miller and D.R. Keeney (Eds.)., Soil Science Society of America, Madison, WI., pp: 403-430.

RMRDC., 2005. Survey report of ten selected agro raw materials in Nigeria: Ginger. Raw Materials Research and Development Council, Abuja, Nigeria.

Ravindran, P.N. and K.N. Babu, 2005. Ginger: The Genus Zingiber. CRC Press, Boca Raton, FL., ISBN: 978084 9320217, Pages: 552.

Tel, D. and R.E. Hagarthy, 1984. Mechanical analysis of soil by the hydrometer technique. IITA Training Manual No. 7, pp: 122.

Thomas, G.W., 1982. Exchangeable Cations. In: Methods of Soil Analysis, Part 2: Chemical and Microbiological Properties, Page, A.L., R.H. Miller and D.R. Keeney (Eds.). 2nd Edn., America Society of Agronomy, Madison, USA., ISBN-13: 9780891180722, pp: 159-165.

Walkley, A. and I.A. Black, 1934. An examination of the degtjareff method for determining soil organic matter and a proposed modification of the chromic acid titration method. Soil Sci., 37: 29-38.