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Research Paper

THE EFFECT OF COCOA POD HUSK AS ORGANIC FERTILIZER ON THE GROWTH OF TEA (*Camellia sinensis* (L) O. Kuntze) UNDER VARYING LIGHT INTENSITIES IN IBADAN – SOUTH WEST NIGERIA

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Abstract

Tea is one of the components of human diets due to its antioxidative properties and nutritive values. Light intensity and soil fertility are the major abiotic factors affecting the growth of tea (C*amellia sinensis*(L) O. Kuntze). Tea performs well under low light intensity and fertile soil. In Nigeria, tea production is predominant in Mambilla Plateau due to cool weather. To meet the increasing demand for tea, there is need for soil fertility improvement and expansion of the growing area of tea to the lowland ecology of Nigeria. A pot experiment was conducted in Cocoa Research Institute of Nigeria (CRIN), Idi-Ayunre, Ibadan, South-West Nigeria to assess the effect of varying light intensities and soil amendment with Cocoa Pod Husk (CPH) and NPK fertilizer on the growth and dry matter production of tea cuttings. Milled CPH fertilizer was applied at the rate, 75kgN ha^{-1} (13.39g pot^{-1}), 150kgN ha^{-1} (26.79g pot^{-1}) and 300kgN ha^{-1} (53.57g pot^{-1}), and NPK 5:1:1 (150kgN ha^{-1}) fertilizer while zero fertilizer served as control. The tea plants were grown under four different light intensities of 25, 45, 65 and 100% by using varying densities of palm fronds to cover the top and sides of the sheds. The results showed that CPH at 300kgN ha^{-1}, 45% and 65% light intensities enhanced vegetative growth and dry matter accumulation in the tea plants. The 65% light increased the number of leaves, leaf area, number of branches, plant height, stem diameter and total dry matter by 188%, 400%, 14%, 30%, 21% and 620% respectively compared to the 100% light. The 45% light increased the number of leaves, leaf area, plant height, stem diameter and total dry matter by 155%, 369%, 21%, 16% and 656% respectively compared to the 100% light. CPH at 300kgN ha^{-1} increased number of leaves, leaf area, number of branches, plant height, stem diameter and total dry matter by 69%, 155%, 62%, 28%, 24% and

75% respectively compared to the control. When compared to the NPK fertilizer, CPH at 300kgN ha^{-1} increased number of leaves, leaf area, number of branches, plant height and total dry matter by 25%, 32%, 12%, 1% and 47% respectively. On interaction, tea cuttings grown under 45 and 65% light intensities and received CPH at 300kgN ha^{-1} produced significantly (P=0.05) higher number of leaves, leaf area, number of branches, root dry weight, stem dry weight, leaf dry weight and total dry matter; while 65% light interaction with NPK fertilizer enhanced significantly (P=0.05) higher plant height and stem diameter.
Key words: Tea plant, cocoa pod husk, sheds, light intensities, organic fertilizer, palm fronds, vegetative growth, dry matter accumulation.

INTRODUCTION

Tea (*Camellia sinensis (L)* O. Kuntze) is a light sensitive plant. Its production is limited by prevailing light intensity. Although light is an absolute requirement for plant growth, excessive light intensity predisposes tea to photoinhibition which is the reduction in photosynthetic capacity of plants due to excessive light intensity. Hence, the beneficial effect of reduced light intensity in tea production and product quality has been reported. Panda (2011) reported that yield of plucked shoots of tea cultivars was generally maximum under moderate light intensity. This explains the predominance of tea production in Mambilla Plateau of Nigeria, an area characterized by extremely low temperature and low light intensity in most part of the year.

Low soil fertility is also one of the major constraints to tea production in most tropical and subtropical regions of the world. Ruan (2007) had postulated that limited supply of plant nutrients was the major factor restricting tea productivity and synthesis and accumulation of its quality components. The soils of South Western Nigeria, (where various adaptability trials have been carried out) have been reported to be rapidly declining in plant nutrients (FAO, 2001; Ande, 2017). The deficiency of the tropical soils in essential plant nutrients often results in low tea production. Soils under tea cultivation and adaptation trials in Nigeria are poor in fertility when compared to soils of other tea producing nations especially on Mambilla Plateau in Nigeria where deficiency of most macro and micro nutrients has been implicated in poor tea seedling establishment, poor yield, depressed growth of apical meristem, dark green, thick, leathery, misshapen and crinckled leaves (Ipinmoroti, 2006). The over cultivation of the limited land on Mambilla Plateau in Nigeria has led to nutrient depletion, thus making fertilizer application inevitable. However, application of fertilizer especially among tree crop farmers is marginal probably because of its scarcity, delay in supply and high cost. Agbede and Kalu (1995) opined that Nigeria farmers' access to fertilizers is limited by poor funding and availability. This must have led to increased use of organic fertilizer by tea farmers on Mambilla Plateau (Ipinmoroti, *et al*., 2018). The problem of high cost, scarcity and delay in supply that often constitute a bane in the use of inorganic fertilizers can be mitigated by its replacement with organic fertilizers.

Application of organic fertilizers has been reported to promote crop growth, increase crop yield (Wallace, 1994), improve physical properties of the soil, maintains soil in better tilth and increase water holding capacity (Lal, 1986). Many farm wastes have been used as sources of organic fertilizers. The potentials of organic fertilizers and organic farm wastes in ameliorating poor soil fertility have been documented. Organic fertilizers enhanced tomato yield (Togun *et al,* 2004), better growth performance of

Kola (Adeosun *et al.,* 2013) and yield and nutrient uptake of young tea cuttings (Ipinmoroti and Iremiren, 2010)

Availability of plant nutrients in the applied organic manure can be affected by light intensity of its growing environment. Smith *et al* (1993) observed that plants that received N fertilizer rates of 225kg N ha^{-1} $year^{-1}$ showed photoinhibition at higher light intensity.

Therefore this study seeks to assess the effect of cocoa pod husk (CPH) based organic manure on the growth and yield of tea cuttings when grown under varying light intensities

MATERIALS AND METHODS

This pot experiment was carried out in Cocoa Research Institute of Nigeria (CRIN) Ibadan, South-West Nigeria between 2014 and 2015. Ibadan is located on Latitude 07 10'E and Longitude 03 52'E in the Derived Savanna geographical zone of Nigeria. Ibadan is characterized by annual rainfall of 1100-1150mm during the raining season that extends from early April to late October; average maximum and minimum temperature of 27^0C and 19.8^0C respectively and relative humidity of 89% during raining season and 57% during dry season.

This trial is a 4 x 5 factorial experiment which consisted of four levels of light intensity (25%, 45%, 65% and 100%) and five levels of fertilizer (three rates of cocoa pod husk - 75kgN ha^{-1} (13.39g pot^{-1}); 150kg N ha^{-1} (26.79g pot^{-1}); and 300kgN ha^{-1} (53.57g pot^{-1}) and a single rate of NPK at 5:1:1 (150kg N ha^{-1} (0.82g urea pt^{-1}); 30kg P ha^{-1} (0.9g SSP pot^{-1}) and 30kg K ha^{-1} (0.2g MoP pot^{-1})) as a check being standard NPK fertilizer requirement for tea production in Nigeria (Obatolu, 1987); Zero (0kg ha^{-1}) fertilizer served as control. These treatments were applied on potted tea of C143 cultivar and laid out in Completely Randomized Design with 4 replications.

Pre-cropping soil sampling and analysis

The top soil used for this trial was collected from CRIN Ibadan at a depth of 0-30cm. The soil was thoroughly mixed, dried and sieved with a 2mm mesh screen and analyzed for physical and chemical properties as described below:

Soil pH (1:1 soil/water) was determined with pH meter; while organic matter was determined by Wet Oxidation method (Walkley and Black, 1934). Soil P was extracted by the Bray PI and measured by the Murphy blue colouration and determined on a Spectronic 20 at 882μm (Murphy and Riley, 1962). Soil K and Ca were extracted with IMNH4 OAC. P, Total N and Mg were determined with flame photometer, Microkjedahl methods and atomic absorption spectrophotometer respectively (AOAC, 1990)

Sources of planting materials

Tea cuttings of C143 cultivar were raised in CRIN Substation, Kusuku, Mambilla Plateau, Taraba State for 12 months and were transported to the experimental site at Ibadan.

Preparation and analysis of the organic and inorganic fertilizers used

Fresh cocoa pod husk was collected from the Fermentary Unit of CRIN Ibadan. The cocoa pods were sun-dried for two weeks, and milled into powder with milling machine. For the NPK fertilizer used in this study: Nitrogen, Phosphorus and Potassium nutrients were sourced and formulated in ratio 5:1:1. Urea (46%N), Single Super Phosphate (SSP)

(18%P_2O_5) and Muriate of Potash (MoP) (60%K_2O) were obtained as sources of N, P and K respectively. Urea and SSP were obtained from CRIN Ibadan, while MoP was obtained from International Institute of Tropical Agriculture (IITA) Ibadan.

Nursery establishment and construction of sheds for different light intensities

Four different light intensities were used for the current experiment. These were 25, 45, 65 and 100%.Three sheds of dimension 10x2x2m were constructed with bamboo poles and oil palm fronds covering the top and the sides. Each shed represents different light intensities. Light intensities of 25, 45 and 65% were determined by varying the density of oil palm fronds at the sides and top of the three sheds while the open space with no shed cover represented 100% light intensities. Bamboo poles were cut to a length of 2.6m. Each shed was made of two rows of 6 bamboo poles each. The poles along each row were 2m apart, giving the shed a rectangular shape. The palm fronds covering the sides were held in place by a pair of slit bamboo stem tied to the poles with polythene thread horizontally along the length of the shed wall. The density of oil palm fronds used for each shed was varied according to the different degrees of light intensity. For 25, 45 & 65% light intensities, 4-5, 3-4 and 1-2 oil palm fronds per square meter were used respectively. Lux Meter, model LX1010BS was used to determine the light intensities.

Forty (40) plastic pots of 5-litre capacity were filled with 5kg of the sieved soil each. The plastic pots were perforated at the base to allow drainage of excess water. The tea cuttings of C143 which were raised for 12 months were transplanted into the soil-filled pots. The cuttings were transplanted at 6-8 leaves stage. The soil was watered to field capacity. The transplanted tea cuttings were later set in the already constructed light sheds. Five rows of 4 potted tea plants were set inside the sheds. There was a space of 100cm between the rows and 30cm within the rows. Four weeks later both the cocoa pod husk and NPK fertilizers were applied to the established tea plants. The tea plants were watered regularly to maintain the field capacity: 1liter of water was applied to each plant two times per week. Weeding was done by uprooting with the hands fortnightly. At 8MAT, all the plants were uprooted by pouring the soil out and separating the plants from the soil. The plant roots were washed in clean water to remove soil particles. They were air-dried afterwards. The plants were partitioned into root, stem and leaf. The plants were enveloped and dried to constant weight with Electric oven at 70^0C for 72 hours.

Data collection and analysis

At two months after transplanting (MAT), the following morphological parameters were taken on each plant per treatment on monthly basis: number of leaves, leaf area, number of branches, plant height, and stem diameter. Number of leaves, and number of branches were determined by visual count, plant height (cm) by meter rule and stem diameter (cm) by veneer calipers. Leaf area (cm^2) was determined by measuring the length and width of the 5^{th} and 6^{th} leaves from the apex of each plant. The area of the leaves (Length x Width) was multiplied by Leaf Area Factor of 6.1 which gave the actual leaf area of each leaf. The area of each leaf was multiplied by the number of leaves per plant to give leaf area per plant. Plant height was determined by measuring the height of the plants from the soil surface to their apex with meter rule. Stem diameter was measured in cm at the stem base with veneer calipers.

The root and shoot length were determined by measuring the length with cotton thread and placing the thread on a meter rule. The fresh and dry weight of the root, stem and leaf were taken with KERRO Electronic Compact Scale (Model BL5002).

RESULTS AND DISCUSSION

The physical and chemical properties of the soils used for the current study are shown in Table 1. The soil contained 10, 84.5 and 5.5 % sand, silt and clay respectively; thus classifying the soil as Sandy-loam which could enhance better drainage and prevention of water logging. However, the soil might not retain enough water for optimum growth during the dry season unless irrigation was applied and shade cover was provided. The slightly acidic soil of pH 6.71 is considered suitable for tea production (Egbe, *et al*., 1989). The soil had values of 0.11cmolkg^{-1}, 0.08 cmolkg^{-1}, 1.29 and 0.92 for Al^+, H^+, CEC and ECECme/100g respectively. The N content of the soil (2.12%) was above the critical soil value of 3.4 g/kg (0.34%) for soils under tea production (Othieno, 1980). The low values of K, Ca and Mg were indication of low soil fertility and the need for fertilizer application.

Table 2 shows the nutrient content of the fertilizer materials used in the current study. CPH contained 1.4%, 0.01%, 0.01%, 218.7 mgkg^{-1} and 34.54 mgkg^{-1} of N, P, K, Ca and Mg respectively. Its micro-nutrients were 54.22 mgkg^{-1} Fe, 27.18 mgkg^{-1} Mn, 24.82 mgkg^{-1} Zn and 31.81mgkg^{-1} Cu. The % OC, OM and C:N were 19.59, 33.77 and 7.5 respectively. The NPK fertilizer used contained 46, 7.92 and 49.8 % N, P and K respectively.

All the growth parameters under consideration revealed that reduced light intensity enhanced vegetative growth of the tea plants compared to the full light intensity (Table 3). Number of leaves, leaf area, number of branches, plant height and stem diameter increased from 25 to 65% light intensities. The 65% light produced the highest number of leaves, leaf area, number of branches, plant height and stem diameter, followed by 45%, 25% and 100% which gave the least values of all these parameters. The growth values of tea plants under 65% light intensity were significantly different from the values of 25 and 100% light intensities but was not significantly ($P<0.05$) different from those under 45% light. The 65% light increased the number of leaves compared to 25, 45 and 100% light by 30%, 13% and 188% respectively; leaf area by 4%, 7% and 400% respectively; number of branches by 29%, 24% and 14% respectively; plant height by 30%, 7% and 30% respectively and stem diameter by 16%, 4% and 21% respectively. This result is similar to that of Odeleye *et al.* (2001) who reported that soya beans plants that were grown under subdued light had more leaf area and grew taller as compared to plants grown in full day light. Also, Famaye (2002) found out that 50% light reduction enhanced seedling growth of coffee. The reason for this could be due to the fact that photosynthesis rate is lower in unshaded tea plants. The unhindered photosynthesis in tea under reduced light must have led to expanded leaf area which enhanced the growth of other plant parts. This corroborates the earlier report of Wijeratne *et al.* (2008) which states that medium shade favors leaf photosynthesis compared to no shade and high shade. Besides, the excessive evapo-transpiration especially in the absence of shade makes the soil water less available for plant growth and build up of vapour pressure gradient between the leaf and the surrounding air

Similarly, moderate light intensity of 45 and 65% enhanced significantly ($P>0.05$) higher leaf dry weight (LDW), stem dry weight (SDW), root dry weight (RDW) and total dry matter (TDM) compared to low light intensity (25%) and high light intensity

(100%) (Table 4). However, 45% light increased total dry matter compared to 25, 65 and 100% light by 48%, 4% and 620% respectively. This is consistent with the postulation of Panda (2011) that yield of plucked shoots of tea cultivars was generally high under moderate light intensity.

Table 5 and 6 show that various rates of fertilizers applied enhanced the growth and dry matter yield of tea. Tea plants under 300kgN ha^{-1} CPH produced more leaves, more branches and higher leaf area significantly (P>0.05) in comparison with those under other fertilizer rates and the control except in 150kgN ha^{-1}NPK where the values of these vegetative parts were lower but not significantly. The 300kg N ha^{-1} CPH increased the number of leaves compared to 75 kgN ha^{-1}CPH, 150 kgN ha^{-1}CPH, 150kgN ha^{-1} NPK and control by 37%, 38%, 25% and 69% respectively; leaf area by 47%, 32%, 32% and 155% respectively; number of branches by 32%, 26%, 12% and 62% respectively; plant height by 7%, 8%, 1% and 28% respectively; and total dry matter by 46%, 26%, 47% and75% respectively. This underscores the importance of organic manuring to the growth performance of tea plants. In similar studies on other crops, organic fertilizers had been found to promote the growth and yield of crops like okra (Dada and Adejumo, 2015), Tomato (Togun, *et al.*, 2004) and Kola (Adeosun, *et al*., 2013).

It is apparent in table 7 and 8 that the interaction of light intensities with CPH and NPK fertilizers produced significant effect on vegetative growth and dry matter accumulation of potted tea plants. Application of 300kgN ha^{-1} CPH under 45% light and 150kgN ha^{-1} NPK under 65% enhanced significantly (P>0.05) higher number of leaves, leaf area, number of branches, plant height and stem diameter. Very low light intensity of 25% and full light intensity of 100% reduced the effectiveness of CPH in enhancing the vegetative growth parameters as the lowest values of these growth parameters were produced by the fertilizers under these light intensities. This result corroborates the earlier submission of Smith *et al* (1993a) as they observed that plants that received N fertilizer showed photoinhibition at higher light intensities. Besides, the high soil temperature occasioned by full light intensity might have engendered excessive evaporation and subsequent lower soil water. This must have of hindered the mineralization of the fertilizers and the subsequent absorption of minerals by plant root.

Similarly in dry matter accumulation, tea fertilized with CPH under reduced light intensities maintained their significant (P>0.05) superiority over those under full light intensity. The CPH at 300kgN ha^{-1} produced the highest leaf dry weight, stem dry weight, root dry weight and total dry matter under each light intensity except 100% light. However, the highest total dry matter produced by 300kgN ha^{-1} CPH under 45% (21.71g per plant) and 65% light (21.06g per plant) were significantly (P>0.05) higher than those produced by other treatment combinations. This could be probably due to the fact that soil nutrients in these fertilizers were readily made available due to optimum conditions of the soil occasioned by moderate light intensities. Moreover, reduced transpiration and optimum leaf temperature engendered by moderate light intensities could have enhanced optimum photoassimilate accumulation which could have precipitated the better growth.

Table 1: Pre-planting physical and chemical properties of the soil used

Soil properties	Values
pH	6.71
Na (cmolkg-1)	0.37
K(cmolkg-1)	0.45
C(cmolkg-1)	0.22
Mg(cmolkg-1)	0.18
%OC	21.06
%OM	36.00
%Total N	2.12
Av. P (mgkg-1)	31.75
Mn (cmolkg-1)	0.12
Al+(cmolkg-1)	0.11
H+(cmolkg-1)	0.08
CEC	1.29
ECEC me/100g	0.92
%Base Saturation	94.19
Sand	10
Silt	84.5
Clay	5.55
Textural class	Sand-loam

Table 2: Pre-planting chemical properties of the fertilizer materials used

Properties	CPH	Urea	SSP	MoP
%K	0.013	-	-	49.8
Ca (mgkg-1)	218.7	-	-	-
Mg (mgkg-1)	34.54	-	-	-
%OC	19.59	-	-	-
%OM	33.77	-	-	-
%TN	1.4	46	-	-
%P	0.011	-	7.92	-
Mn (mgkg-1)	27.18	-	-	-
pH	6.4	-	-	-
C/N	7.5	-	-	-
Iron (mgkg-1)	54.22	-	-	-
Zn (mgkg-1)	24.82	-	-	-
Cu (mgkg-1)	31.81	-	-	-

Table 3: Effects of light intensities on growth parameters of young tea plants 8 MAT at Ibadan

Treatments Light Intensities (%)	NL	LA(cm^2)	NB	PH(cm)	SD(cm)
25	19.44	444.83	3.44	26.09	0.45
45	22.35	560.53	3.56	31.68	0.50
65	25.32	597.52	4.43	34.04	0.52
100	8.78	119.50	3.88	26.15	0.43
Means	19.02	430.60	3.83	29.49	0.48
LSD (P<0.05)	4.92	162.26	1.50	3.40	0.05

NL = Number of leaves; LA = Leaf area; NB = Number of branches; PH = Plant height; SD = Stem diameter. MAT = Months after transplanting

Table 4: Effects of light intensities on dry matter accumulation of young tea plants 8 MAT at Ibadan

Treatments Light Intensities (%)	LDW(g)	SDW(g)	RDW(g)	TDM(g)
25	4.33	3.41	3.64	11.39
45	6.01	5.18	5.68	16.86
65	6.26	5.12	4.82	16.20
100	0.61	0.89	0.78	2.23
Means	4.30	3.65	3.73	11.68
LSD (P<0.05)	1.17	0.84	0.92	2.38

LDW = Leaf dry weight; SDW = Stem dry weight; RDW = Root dry weight; TDM = Total dry matter; MAT = Months after transplanting

Table 5: Effects of CPH and NPK fertilizers on growth parameters of young tea plants 8 MAT at Ibadan

Treatments CPH (kg N ha^{-1})	NL	LA(cm^2)	NB	PH(cm)	SD(cm)
75	18.02	407.57	3.58	29.78	0.48
150	17.92	455.73	3.74	29.45	0.48
300	24.71	599.96	4.71	31.77	0.51
NPK (150)	19.83	454.58	4.21	31.56	0.51
Control	14.65	235.15	2.90	24.89	0.41
Means	19.03	430.60	3.83	29.49	0.48
LSD (P<0.05)	5.50	162.26	0.99	3.80	0.05

NL = Number of leaves; LA = Leaf area; NB = Number of branches; PH = Plant height; SD = Stem diameter; CPH = cocoa pod husk; MAT = Months after transplanting

Table 6: Effects of CPH and NPK fertilizers on dry matter accumulation of young tea plants 8 MAT at Ibadan

Treatments CPH (Kg N ha^{-1})	LDW(g)	SDW(g)	RDW(g)	TDM(g)
75	3.90	3.38	3.46	10.74
150	4.62	3.77	4.00	12.39
300	6.26	4.67	4.73	15.66
NPK (kg N ha^{-1})				
150	3.44	3.17	4.04	10.65
Control (0 Kg N ha^{-1})	3.29	3.26	2.41	8.97
Means	4.30	3.65	3.73	11.68
LSD (P<0.05)	1.95	0.94	1.03	2.66

LDW = Leaf dry weight; SDW = Stem dry weight; RDW = Root dry weight; TDM = Total dry matter; CPH = cocoa pod husk; MAT = Months after transplanting

Table7: Effect of interaction of light intensities and fertilizers on growth parameters of young tea plants 8MAT at Ibadan

Treatments Light intensities (%)	x	Fertilizers ($kgNha^{-1}$)	NL	LA	NB	PH	SD
25	x	75 CPH	17.08	363.71	3.04	25.07	0.46
		150 CPH	18.21	414.00	4.00	28.77	0.47
		300 CPH	23.50	703.76	4.92	31.47	0.54
		150 NPK	23.29	508.93	3.25	23.16	0.44
		0(control)	15.13	233.75	2.00	22.00	0.37
45	x	75 CPH	22.25	618.84	2.91	33.73	0.51
		150 CPH	21.33	637.34	3.54	34.36	0.51
		300 CPH	30.38	799.95	5.21	31.32	0.52
		150NPK	18.67	423.13	2.63	33.68	0.53
		0(control)	19.12	323.40	3.50	25.32	0.45
65	x	75 CPH	24.88	547.30	4.29	31.93	0.52
		150 CPH	23.46	620.20	3.54	31.24	0.49
		300 CPH	28.17	697.75	4.25	39.72	0.56
		150NPK	31.63	776.67	6.33	35.48	0.61
		0(control)	19.50	345.67	3.71	31.81	0.45
100	x	75 CPH	7.88	100.44	4.08	28.39	0.42
		150 CPH	8.67	151.36	3.88	23.43	0.45
		300 CPH	16.79	198.39	4.46	24.58	0.43
		150NPK	5.75	109.57	4.63	33.92	0.47
		0(control)	4.83	37.77	2.38	20.41	0.39
Means			19.03	430.60	3.83	29.49	0.48
SE (df=19)			3.37	103.80	0.60	3.40	0.04

NL = Number of leaves; LA = Leaf area; NB = Number of branches; PH = Plant height; SD = Stem diameter. MAT = Months after transplanting

Table 8: Effect of interaction of light intensities and fertilizers on dry matter accumulation of young tea plants 8MAT at Ibadan

Treatments Light intensities (%)	x	Fertilizers ($kgNha^{-1}$)	LDW(g)	SDW(g)	RDW(g)	TDM(g)
25	x	75 CPH	3.41	2.53	2.63	8.57
		150 CPH	3.46	3.51	3.94	10.91
		300 CPH	8.22	4.29	4.35	16.86
		150 NPK	3.47	3.49	4.37	11.33
		0(control)	3.10	3.12	2.94	9.28
45	x	75 CPH	5.85	4.65	5.96	16.47
		150 CPH	7.11	5.83	6.43	19.37
		300 CPH	8.42	6.75	6.55	21.71
		150NPK	4.33	4.27	6.46	15.06
		0(control)	4.32	4.38	2.98	11.68
65	x	75 CPH	5.87	5.25	4.29	15.41
		150 CPH	6.91	4.34	4.40	15.64
		300 CPH	7.37	6.50	7.19	21.06
		150NPK	5.95	4.93	5.35	16.23
		0(control)	5.20	4.59	2.87	12.66
100	x	75 CPH	0.47	1.07	0.97	2.51
		150 CPH	1.01	1.40	1.24	3.65
		300 CPH	1.05	1.13	0.84	3.01
		150NPK	0.00	0.00	0.00	0.00
		0(control)	0.55	0.84	0.86	2.25
Means			4.30	3.64	3.73	11.68
SE (df=19)			0.79	0.69	0.66	1.82

LDW = Leaf dry weight; SDW = Stem dry weight; RDW = Root dry weight; TDM = Total dry matter MAT = Months after transplanting

CONCLUSSION

The enhancement of the vegetative growth of tea plants by the application of 300kgN ha^{-1} of CPH was achieved when grown under moderate light intensities of 45 and 65%. Therefore, it could be inferred that the effect of fertilizer application on tea plants is widely dependent on their growing environment. It follows that applied fertilizer can be effective on tea plants when grown under reduced light intensities. High light intensity of 100% in the lowland ecology of Nigeria greatly reduced the effectiveness of cocoa pod husk fertilizer on growing tea plants; hence, it is recommended that for tea to be grown successfully in Ibadan, South-West of Nigeria, it should be grown under palm fronds shade densities that reduce light intensity to 65% or 45%; and that application of milled cocoa pod husk at the rate of 300kgN ha^{-1} could be applied. Cocoa pod husk at the rate of 300kgN ha^{-1} competed favourably with NPK fertilizer in enhancing the vegetative growth and dry matter yield of young tea plants.

REFERENCES

Adeosun S.A., Adejobi K.B., Famaye A.O., Idrisu M., Ugioro O., and Nduka B.A. (2013): Combined effect of kola testa based organic manure and NPK fertilizer on soil, leaf chemical composition and growth performance 0f kola (*Cola nitida*). *Research Journal of Agricultural and Environmental Management Vol. 2(7), pp. 183-189*

Agbede O.O. and B.A. Kalu (1995): Constraints of small-scale farmers in increasing crop yields: farm size and fertilizer supply. *Nigeria Journal and Soil Science. Vol. 11: 139-152*

Ande O.T., Jerome Huising, A.O. Ojo, J. Azzez, K.S. Are, S.A. Olakojo, I.O. Fademi and S.O. Ojeniyi (2017). Status of integrated soil fertility management (ISFM) in SouthWestern Nigeria. *International Journal of Sustainable Agricultural Research 2017 Vol.4, No. 2, pp.28-44*.

AOAC (1990): Association of Official Analytical Chemists. Official Methods of Analysis, Washington D.C. 49-188

Dada V.A. and Adejumo S.A. (2015). Growth and Yield of Okra (*Abelmoschus esculentus* Moench) as influenced by compost application under different Light intensities. *Not Sci Biol, 7(2):217-226. DOI: 10.15835/nsb.7.2.9437.*

Egbe, N.E., S.T. Olatoye and Obatolu C.R. (1987): Fertilizer use of the production of cocoa, coffee, kola, cashew and tea in Nigeria. In: Towards the efficiency of fertilizer use and development in Nigeria. *Proceedings of the National Fertilizer Seminar held at Portharcourt October 28-30, 1987 organized by the FPDD/FMAWRD. 197-201*

FAO (2001). Soil fertility management in support of food security in Sub-Saharan Africa. Available on ftp://ftp.fao.org/agll.docs/foodsec.pdf

Famaye A.O. (2002). Effect of shade regimes on growth of coffee species in Nigeria. *Moor Journal of Agricultural Research. Vol. 3 No.2 2002 184-194*

Hopkin, W.G. (1995): The Physiology of Plant under Stress. In: Introduction to Plant Physiology. Pp434-438.

Ipinmoroti, R.R. (2006): Assessment of growth and productivity of tea (*Camellia sinensis*) seedlings as influenced by organomineral and NPK fertilizers in Ibadan and kusuku, Nigeria. PhD Thesis, University of Ibadan. Pp15-18.

Ipinmoroti, R.R.; A.R. Adedeji, O.O. Olaniyi, S.O. Aroyeun, A.A. Oloyede, K.A. Oluyole, B.A. Adebowale, I. Ndagi, O.S.O. Akanbi, S.A. Adeosun, A.T. Yahaya, and E. Agbebaku (2018). Assessment of problems confronting sustainable tea production along the value chain in Nigeria. *Acta Hortic. 1225. ISHS 2018. DOI 10.17660/ActaHortic.2018.1225.45 Proc. III All Africa Horticultural Congress*

Lal, R. (1986): Soil surface management in the tropics for intensive land use and sustained production. In: *Advance in Soil Science. Vol.5.Pp1-108*

Murphy J. and J. P. Riley (1962): A Modified single solution method for determination of phosphate in national waters. Analytics Glumiacta 27:31-36

Odeleye F.O., Togun, A.O. and Tayo, T.O. (2001): The effect of light intensity on the growth, development and yield of soyabean in SouthWest Nigeria. *African Crop Science Journal, Vol. 9, No. 3,pp557-590*

Othieno, C.O. (1980): Nitrogen requirements of the tea plants. Tea 1(2): Pp11-20

Panda H. (2011): The complete Book on Cultivation and Manufacture of Tea. http://books. Google.com.ng/books?isbn=8178331497

Jianyun Ruan (2007). Research progress of mineral nutrition and fertilization of tea plants for sustainable production in China. *The 4th International Conference on O-CHA (Tea) culture and Science Abstracts, November 2-4 2007. P45.*

Smith, B.G., W. Stephens, P.J. Burgess, and M.K.V. Carr (1993): Effect of light, temperature, irrigation and fertilizer on photosynthetic rate in tea (*Camellia sinensis*). *Exp. Agric. 29:291-306*

Togun A.O., W.B. Akanbi and J.A. Adeniran (2004): Growth, nutrient uptake and yield of tomato in response to plant residue compost. *Journal of Food, Agriculture and Environment 2(1): 310-316.*

Walkley, A. and I. A. Black (1934): An examination of dergtajaroff methods for determining soil organic acid filtration method. *Soil Science 37: 29-38*

Wallace, A. (1994): Soil organic matter as essential material in solving environmental problems. Com. Soil Science and Plant Analysis 25: 1-2