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RED, FAR RED WAVELENGTH, THE RATIO RED TO FAR RED, TEMPERATURE AND VEGETATION AT A SECONDARY FOREST REGROWTH AND UNDER THE CROWNS OF THREE PLANTATION TREE SPECIES AT UMUDIKE, NIGERIA.

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ABSTRACT

Measurements of temperature, red, far red wavelength of light and the ratio red to far red were made at every 10 minutes interval at marked points along a 15 m transect using thermometers and a Skye 660/730 Radiation Detector and Measuring unit (SKR100: SKR110) at Umudike, Nigeria. Readings were made during the dry and wet seasons under the forest floor of a secondary forest regrowth, under the crowns of *Treculia africana, Dacryodes edulis, Irvingia gabonensis* and in a 1 –year old abandonded farmland. Readings were taken at a height of 50cm above the ground. Plant species within 2.5 X 2.5m^2 quadrats were enumerated every two months. Data revealed that there were variations within and between the red and far red wavelength at the studied sites. The ranges of the far red during the dry season were from -0.30 to 18.77; -0.42 to 10.18; -0.40 to 7.70; -0.60 to 1.36 and -0.39 to 0.31 in abandoned farmland, under the crowns of *Treculia africana, Dacryodes edulis, Irvingia gabonensis* and a secondary forest regrowth, respectively. The ranges during the wet season were – 0.88 – 16.79; - 0.86 – 5.54; - 0.86 – 4.26; - 0.70 – 3.38 ; - 0.83 – 0.12. The ranges of far red followed the same pattern. The ratio red to far red ranged between 1.7 and 1.8; 1.35 and 2.1; 1.4 and 1.8; 1.32 and 3.08 and 1.14 and 2.26. Simultaneous colonization of pioneers and climax tree species was not observed at the studied sites because of the poor dispersal appendages of most climax and pioneer tree species seeds within the studied areas. Grasses such as *Alternathera* sessilis were not observed at the secondary forest regrowth because adequate light for their seed germination was not available under the crown of the tree species. The grasses were abundant under the crowns of the plantation tree species especially *Irvingia gabonensis.* It was recommended that seeds of desirable tree species such as *Khaya ivorensis* and *Entandrophragma cylindricum* be germinated at the university nursery and the seedlings sold to farmers at cost lower than the cost of production.

KEY WORDS: Red, far red, simultaneous colonization, pioneer, plantation, secondary forest regrowth.

INTRODUCTION

The tropical rainforest of Nigeria consists of a complex mixture of vascular plant species. Three distinct layers of tree canopies, the emergent, upper and lower canopies exist in parts of some reserved forest areas such as Permanent Sample Plots and Strict Nature Reserves where logging is restricted. It is mainly at the lower tree canopy that the canopy is continuous except where it is broken by either the course of a river or a tree fall gap. During the day, the rays of the sun strike on green leaves. Some rays are reflected back to the atmosphere (Oguntala and Okali 1979), deflected, refracted, transmitted or absorbed. Several writers such as Lee, (1989) have observed that in areas having either two or three canopy layers, it is difficult for the rays of the sun to strike at the forest floor, without striking the leaves except, presumably at some rare occasions when wind is blowing at a speed of over 5ms^{-1} at a height of 20 m from the ground. Sunflecks (Oguntala and Okali, 1979; Longman and Jenik, 1987) could occur as the leaves were blown about. Chazdon and Fetcher (1986) and Lee, (1989) recorded higher photosynthetic photon flux in open than in understorey. Sasaki and Mori, (1981) and Whitmore, (1983); Bazzaz, (1991) recorded that light which passed through the green leaves was poor in red wavelength. In particular, wavelength at 660nm is absorbed by green leaves thereby reducing the ratio of red to far red. The ratio of red to far red influences morphogenesis (Whitmore, 1996). It appears that light interception efficiency of tree species varies within and between tree species, more especially as trees have varied architechural patterns (Oldeman and Dijk 1991) and varied angles of attachment of the leaves to the branches and twigs. Moreover, climber tangles and a mixture of plant leaves as a result of interlocking of branches; make it difficult for most of the sun's rays to reach the forest floor. There is paucity of literature on the quality of light at the forest floor. Adequate knowledge of the light quality at the forest floor is important because numerous seeds produced by various plants species fall vertically down on the forest floor annually (Appanah, 1985; Dike 2001).

Plant seeds at the forest floor needed adequate light for seed germination, seedlings growth and establishment. Also, all plant seedlings after utilizing the food reserve in the cotyledons needed adequate light for the manufacture of food for it's growth and maintenance. Inadequate light contributed to many seedlings dying in their first year of growth if the light condition did not improve (Oldeman and Dijk 1991). Plant species have been grouped into ecological guilds according to their requirement for light.

Different words used in describing the light level required by a plant species at the forest floor include heliophilous, sciophilous, light demanding species, shade – tolerant; climax and pioneer species (Swaine and Whitmore, 1988; Press et al., 1990; Whitmore,

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1996). In addition to the dichotomy, germination and establishment of tree seedlings under shade, Swaine (1996) suggested the need for quantitative values to be attached to these to minimize the confusion among species. There is paucity of literature on the numerical values of the quality of light under tree species in Nigerian rainforest. There is the need to understand the precise range of wavelength of light under different canopy tree species in Southeastern Nigerian rainforest. Previous silvicultural experiments such as the Tropical Shelterwood System aimed at opening the canopy to admit more light at the forest floor, to induce the germination of desirable tree seeds and the establishment of the resultant tree seedlings failed to achieved it's aim. Instead of the desirable plant species, worthless plant species germinated (Lowe, 1975) and established because of poor knowledge of the range of wavelength of light required exclusively by each desireable plant species. Adequate attention is necessary to find out the range of light required by each plant to enable ecologists salvage the problems of disappearing tropical forests. This paper reports 660 nm, 730 nm and their ratio at the forest floor of a secondary forest regrowth, an abandoned farmland and under the canopies of three plant species. The result would be useful in comparing the quality of light under the canopy of various plants in the same and different ecological zones. The result would also be useful to ecologists, plantation manager and people wishing to minimize the rapid rate of disappearance of the rainforest and animals that feed on these plant species.

MATERIALS AND METHOD

Study Area

The study area is the 75 year old secondary forest regrowth at the University of Agriculture, Umudike, Nigeria. Umudike lies between latitudes 05^0 27^1 and 05^0 32^1 N and longitudes 06^0 30^1 and 07^0 50^1 E. The climate is of the equatorial type. The topsoil temperature ranges between 16^0C and 45^0C (Dike, 2003). There are two seasons; a wet and a dry season. The wet season starts from mid-March and ends in mid –November. The dry season continues till the mid-March of the following year. The humidity was often above 60 percent during the wet season but fluctuafted between 40 and 90 percent during the dry season. The annual rainfall ranged between 1, 500 and 3, 000 mm. The months of December and January had the least total monthly rainfall of less than 50 mm. The dusty harmattan wind blew intermittently in the two months. During the harmattan period, visibility was very poor between 0430 and 0730 GMT.

The vegetation is tropical rainforest (White, 1983). The most abundant tree species are *Alchornea cordifolia, Anthonotha macropylla, Dactyladenia barteri, Elaeis guineensis, Piptadeniastrum africanum* and *Pentaclethra macrophylla.* Some of the primary forests were cleared and converted to farmlands. Presently, some of the abandoned farmlands are in various degrees of degradations. The slope is gentle and in many areas less than (3^0) three degrees. The soil is very deep and often without stones. The soil in some parts of Umudike is sandy clay and in other parts sandy clay loam. The soil parent material is the Pre-Cambrian Basement Complex.

METHODOLOGY

A 2 x 5 Factorial experiment in a Randomised Complete Block Design was used to evaluate the effect of seasons on the quality of light at the 5 experimental sites. A 15.0 m trace line connecting the secondary forest regrowth; the plantations and he 1 – year old abandoned farmland was cut. Points where readings were taken under the respective tree crowns, under closed forest canopy and at the abandoned farmland were marked. A thermometer calibrated in degree centigrade was placed at each reading point. A Skye 660/730 Radiation Detector and Measuring Unit (SKR 100; SKR 110) were used to take the reading of red, far red and their ratio at each reading point at every 10 minutes interval. Readings were taken from 0500 GMT and stopped at 1700 GMT for 5 days, within the wet season and 5 days within the dry season. Readings of red, far red and the ratio red to far red were taken in the open and under the leaf of each of the 11 plant species. The percent of the ambient was obtained.

Two quadrats each 2.5 X 2.5 m were laid under the crown of each tree; in the forest and in the abandoned farmland. All the vascular plants up to 1.0 cm in height were enumerated every two months for a period of 12 months. The plant species percent frequency and the relative abundance were calculated. Sorensen's similarity index (Mueller – Dombois and Ellenberg, (1974) was used to compare the similarity of the sites. The data obtained in the red and far red were statistically analysed for difference between treatment means using the Fisher's – Least significant differences (F-LSD) at P> 0.05, according to the procedures of Steel and Torrie (1980).

RESULT AND DISCUSSION

The readings of temperature, red, far red and the ratio red to far red for the wet and dry seasons are in Tables 1, 2, and 3 respectively. Each day temperature was at a minimum between 0400 and 0600 GMT. A similar observation was recorded by Longman and Jeniks (1987) and Dike (1992). A rise in temperature occurred after 0600 GMT and continued upto 1030 GMT when fluctuations often started. It was observed that fluctuations in temperature reduced after 1430 GMT. Data revealed a gradual decrease in temperature after 1500 GMT because the sun's rays have started to travel longer distances to the earth until sunset. During the dry season the temperature at the 1 –year old abandoned farmland ranged between 16.5^0 and 29^0C. The temperature ranges for the *Treculia africana, Dacryodes edulis, Irvingia gabonensis* and the secondary forest regrowth were between 19 and 27. 1; 19 and 27. 1; 18 and 27 and 18.5 and27^0C, respectively. During the wet season the ranges of temperature were 16.5-29; 19-27 1; 19 – 27 1: 19-27 and 18-27^0C at the five sites respectively (Table 1). The ranges were of shorter duration because the rain bearing cloud scattered and absorbed the sun's rays. It was observed that fluctuations in temperature were of shorter duration and range when the sky was cast with rain bearing cloud such as cumulo-nimbus. Also during the dry season, fluctuations in temperature were of shorter duration during the dusty harmattan period. Each day, at all the studied sites, fluctuations in temperature had the least range and duration at the secondary forest regrowth.

Dike (1992) working at Omo Biosphere Reserve, Nigeria recorded poor fluctuations in temperature under closed forest canopy. The ranges of temperatures under closed forest canopy under the crown of plantation tree species and in abandoned farmland are in Table 1.

Table 1: Range of temperature (^{0}C) measured at 50cm above the ground at 1 – year old abandoned farmland, under the crowns of *Treculia africana, Dacryodes edulis, Irvingia gabonensis* and forest floor of a secondary forest regrowth at Umudike, Nigeria in the month of July, 2005.

Local time	1-year old abandoned farmland	*Treculia Africana*	Dacryodes edulis	*Irvingia gabanenesis*	Secondary forest regrowth (> 75 year)
6.00-7.00	16.5-18.5	19-20	19-20	18-19.0	18.5-18.5
7.00-8.00	20-20.5	19-20	19-20	19.0-19.0	18.5-18.5
8.00-9.00	20.5-21	19-20	19-20	19.0-19.5	19.5-20.0
9.00-10.00	21-22	20-21.5	20.5-21	19.5-20.5	20-21
10.00-11.00	22-23	22-23	21-22.5	20.5-22	21-22
11.00-12.00	23-25	23-24	23-24	22.5-24	22.5-24
12.00-13.00	25-27	24-25	24-25	24-25	24-25
13.00-14.00	27-28	26-27	26-27	25-27	25—26
14.00-15.00	28-29	27-27.1	27-27-1	27-27.0	26-27
15.00-16.00	29-28.5	27-26.5	27-26.5	27-26.0	27*26
16.00-17.00	28.5-28	26.5-26.0	26.5-26	26-25.5	26-25.5
17.00-18.00	28-27.5	26.0-25.5	26.0-25.5	25.5-25.0	25.5-25.1
Range	**19.5-29**	**19-27.1**	**19-27**	**19-27**	**18-27**

Table 2: Range of red, far red and the ratio red to far red made at 50 cm above the ground at an abandoned farmland, *Treculia africana, Dacryodes edulis, irvingia gabonensis* and a secondary forest regrowth at Umudike , Nigeria in July, 2005.

Local time	Abandoned 1-year old farmland	*Treculia Africana*	Dacryodes edulis	*Irvingia gabonensis*	Secondary forest regrowth (> 75 year)
6.00-6.59	-0.30-096 (red) - 0.88 - -0.07 (far red) 1.0-1.00 (ratio)	-0.42—0.16 - 0.86- - 0.63 1.00 - -1.00	- 0.40- -0.19 -0.86-0.61 -1.00-1.00	-0.60- - 0.34 -0.07 - -0.75 - 1.00- - 1.00	-0.39 - - 0.33 - 0.83 - - 0.74 - 1.00 - - 1.00
7.00 – 7.59	1.10 – 7.10 - 0.03 – 2.40 1.00 – 2.79	- 0.06 – 0.7 -0.56 – 0.1 1.00 – 1.00	-0.03 – 0.5 - 0.54- - 0.2 - 1.00 -1.00	- 0.27 - -0.1 -0.67- - 0.6 - 1.00 - -1.00	- 0.35 - -0.2 - 0.72 - - 0.70 - 1.00 – 1.00
8.00-8.59	3.4- 15.13 1.0 – 6.80 3.24 – 2.33	0.2 – 4.53 0.4- 0.65 1.00 – 3.58	0.3 -2.76 0.4 - 0.91 1.0 – 3.52	-0.1 – 0.33 -0.7- 0.29 1.0 -1.00	-0.2 - - 0.5 -0.7 - - 0.58 -1.0 – 1.00
9.00 – 9.59	1.00 – 18.95 1.00 – 16.79 2.06 – 2.90	1.91 – 4.59 0.46 – 2.44 1.95 – 3.52	1.66 – 6.14 0.29 – 2.20 1.46 – 6.31	0.13 – 1.52 -0.15 – 0.56 1.00 – 2.40	- 0.42-0.10 -0.68- - 0.44 1.00 – 1.00
10.00 – 10.59	1.0 – 12.36 1.0 – 11.84 2.02 -2.27	4.17 -5.42 14.43- 2.58 1.92 – 2.39	2.67 – 5.64 1.77 – 3.71 1.96 -2.30	0.61 – 0.94 -0.05- 040 1.00- 4.33	0.04 – 0.63 -0. 47-0.12 1.00-1.00
11.00-11.59	8.57-18.69 1.03 – 9.21 2.10-3.07	2.22-3.67 1.08 – 1.73 2.15 – 2.40	1.48 – 4.20 0.56 – 1.93 2.09 – 2.60	0.20 – 1.23 -0.14 – 0.45 1.00 – 3.19	0.01 – 0.68 -0.28 – 0.11 1.00 – 1.00
12.00-12.59	10.51- 18.77 2.04 – 8.87 2.03 -2.12	4.11 – 10.18 2.04 – 5.54 1.95 – 2.09	3.70 – 7.70 1.92 – 4.26 1.90 – 2.35	0.20-1.36 -0.13 – 0.57 1.00 – 4.34	0.06 – 0.33 -0.25 – - 0.13 1.00 – 1.00
13.00 – 13.59	12.48 – 12.92 6.26 – 6.48 2.07 – 2.07	4.11 – 6.99 2.02 – 3.30 1.96 – 2.04	3.70 – 6.81 1.92 – 3.66 1.83 – 2.04	0.51 – 1.15 0.07 – 0.50 1.01 – 4.15	0.08 – 0.40 -0.26 - - 0.04 1.00 – 1.00
14.00- 14.59	18.10 – 19.38 8.86 – 13.24 2.06 – 2.10	2.91 – 4.86 1.70 – 2.46 1.94 – 2.16	3.0 – 7.33 1.29 – 4.13 1.99 – 2.08	0.47 – 0.89 0.10 – 3.38 2.34 – 4.07	0.15 – 0.31 -0.12 - - 0.05 1.00 – 1.00
15.00 – 15.59	17.02 – 18.50 8.66 – 12.44 2.07 – 2.10	2.56 – 11.40 1.04 – 4.95 1.96 – 2.03	2.60 – 11.97 1.15 – 5.03 1.86 – 2.07	0.33 – 0.90 0.16 – 0.35 2.53 – 3.05	0.09 – 0.25 -0.15 - - 0.08 1.00 – 1.00
16.00 - 16.59	9.61 – 9.50 4.40 – 4.27 2.11 – 2.38	1.30 – 1.33 0.53 – 1.03 2.18 – 3.25	1.25 – 1.28 0.49 – 0.50 2.11 – 3.25	0.17 – 0.19 -0.18 - - 0.04 1.0 – 1.00	0.10 – 0.09 - 0.19 - - 0.26 - 1.00 – 1.00

Table 3: Range of readings of red, far and the ratio red to far red measured at 50 cm above the ground level at Umudike, Nigeria in the month of January 2005.

Local Time	Abandoned 1-year old farmland	*Treculia Africana*	*Dacryodes edulis*	Irvingia gabonensis	Secondary forest regrowth (> 75 year)
6.00 – 6.59					
7.00 – 7.59	2.8 – 7.9 (red) 1.4 – 4.3 (far red) 1.79 – 1.82 (ratio)	1.8 – 5.9 1.0 – 4.8 1.20 – 1.56	0.6 – 2.8 0.3 – 1.9 1.20 – 1.51	0.6 – 1.22 0.34 – 0.69 1.32 – 1.75	0.5 – 1.04 0.34 – 0.52 1.32 – 1.69
8.00 – 8.59	8.5 – 23.6 4.7 – 13.0 1.76 – 1.82	1.9 – 6.8 1.0 – 4.8 1.34 – 1.61	0.8 – 3.4 0.5 – 2.1 1.21 – 1.54	0.7 – 1.42 0.42 – 0.81 1.36 – 1.77	0.69 – 1.4 0.42 – 0.67 1.38 – 1.69
9.00 – 9.59	22.6 – 36.9 12.6 – 20.9 1.76 – 1.79	2.2 – 7.9 1.2 – 5.2 1.46 – 1.70	0.9 – 3.6 0.5 – 2.2 1.41 – 1.65	1.0 – 1.6 0.50 – 0.89 1.49 – 1.82	0.9 – 1.5 0.5 – 0.8 1.49 – 1.72
10.00–11.59	33.5 – 51.8 18.0 – 28.7 1.76 – 1.79	2.6 – 3.9 1.7 – 2.5 1.40 – 1.59	3.8 – 4.7 2.2 – 3.1 1.47 – 1.65	1.5 – 2.8 0.9 – 1.4 1.38 – 1.62	1.2 – 1.8 0.8 – 1.3 1.48 – 1.86
11.00–11.59	50.4 – 57.0 28.1 – 31.5 1.76 – 1.79	3.0 – 52 2.0 – 3.1 1.40 – 1.56	4.9 – 14.9 3.1 – 11.1 1.51 – 1.64	1.7 – 1.9 1.2 – 1.3 1.31 – 1.60	1.0 – 1.7 0.6 – 1.1 1.49 – 1.77
12.00-12.59	53.2 – 60.8 30.5 – 34.5 1.76 – 1.81	2.8 – 4.6 1.7 – 2.5 1.46 - 1.64	5.5 – 24.8 3.3 – 13.9 1.52 – 1.71	1.5 – 2.7 1.1 – 1.6 1.38 – 1.49	0.9 – 1.3 0.4 – 0.7 1.52 – 1.73
13.00–13.59	40.0 – 57.7 23.2 – 32.5 1.78 – 1.81	2.4 – 4.3 1.5 – 2.6 1.47 – 1.67	5.3 – 10.1 3.5 – 6.7 1.55 – 1.67	1.4 – 2.8 1.2 – 1.6 1.32 – 1.53	0.8 – 1.0 0.4 – 0.5 1.47 – 1.94
14.00–14.59	39.0 – 52.3 21.0 – 29.1 1.78 – 1.84	1.9 – 2.6 1.1 – 1.5 1.45 – 1.71	4.6 – 77 2.8 – 4.7 1.59 – 1.69	1.7 – 2.3 1.1 – 1.4 1.34 – 1.59	0.6 – 0.9 0.2 – 0.5 1.14 – 2.25
15.00–15.59	24.5 – 44.0 13.1 – 24.1 1.74 – 1.82	1.1 – 2.2 0.6 – 1.1 1.38 – 1.80	2.3 – 4.8 1.2 – 3.0 1.57 – 1.80	0.8 – 2.3 0.4 – 1.4 1.28 – 2.05	0.3 – 0.7 0.1 – 0.3 1.34 – 2.26
16.00-16 .59	12.5 – 23.2 6.6 – 12.9 1.79 – 1.85	0.9 – 1.5 0.5 – 1.1 1.44 – 1.80	1.7 – 2.5 0.9 – 1.4 1.54 – 1.84	0.5 – 0.8 0.2 -0.5 1.45 – 2.31	0.3 – 0.5 0.1 – 0.2 1.47 – 2.20
17.00-17.59	5.7 – 13.3 3.0 – 7.2 1.78 – 1.85	0.3 – 1.1 0.1 – 0.6 1.35 – 2.10	0.9 – 1.5 0.2 1.1 1.62 – 2.06	0.1 – 0.4 0.00 – 0.2 1.42 – 3.08	0.0 – 0.3 0.0 – 0.1 1.89 – 2.49

Temperature recorded by the day time under *Irvingia gabonensis* was at least between 0.1 and 1.0^{0}C lower than that recorded under either *Dacryodes edulis* or *Treculia africana*. The observation could be attributed to the fat that *Irvingia gabonensis* has between four and six leaves on each twig. Each of the leaf was attached to the twig at an angle of between 45 and 60 degrees. The crown is also roundish. It was observed that each ray of the sun passing through the crown often stuck two or more leaves of *Irvingia gabonensis* before striking the ground. By passing through these leaves, the thermal effects of the rays were therefore reduced.

The readings of red, far-red and the ratio red to far had the highest recorded values at the abandoned farmland (Tables 2 and 3). The observation agreed with the records of Sasaki and Mori (1981). They recorded that light which passed through green leaves was poor in red wavelength. Generally, the red and far-red were not filtered in abandoned farmlands except where some trees were left standing in the farmland during the clearing operation. According to Aweto (1981) and Dike (2003), farmers rarely leave tree species listed as 'economic' (Lancaster, 1961) in their farms. In farmlands, the values of red and far-red wavelength increased from 0630 GMT and had a peak between 1100 and 1430 GMT. After 1430 GMT, the values decreased until 1700 GMT (Tables 2 and 3). The observation agrees with the different positions of the sun. In the tropics the sun's rays had a shorter distance to the earth before 1100 and 1230 GMT.

It was observed that during the dry and dusty harmattan period, the dust particules in the air scattered some of the rays before the rays could get to the leaves. The dust particules on the leaves refracted and deflected some of the rays. It was a fraction of the sun rays that was recorded under the canopy of the tree species (Table 2 and 3). It was observed that at 0730 GMT the quality of light at the forest floor was very poor. Also, at 1500 GMT and after, the visibility was also very poor at the forest floor (Tables 2 and 3), except in large gaps.

The red and the far- red wavelengths of light had higher values at the 1- year old abandoned farmland. The values decreased from *Dacryodes edulis,*

Treculia africana, Irvingia gabonensis and the least values were recorded in the secondary forest regrowth where climbers such as *Hippocratea pallens* and *Landolphia owerensis* were on some the trees. It was observed that light often struck two or more leaves of different plant species before getting to the shrub and herbaceous layers. It was observed that the shrubby layer consisted essentially of *Rinorea welwitschii* and few *Carpolobia lutea.* The herbaceous layer consisted of *Cyanastrum cordifolium, Geophila afzelii* and *Lankesteria thyrsoidea*. The leaves of these plant species further reduced the quality of light that would eventually strike the soil. The soil contains the soil seed bank. These seeds needed adequate light for both seed germination and seedlings establishment. In this study, it was observed that seeds of *Ceiba pentandra* that germinated under closed forest canopy could not establish. The seedlings of *Khaya ivorensis* and *Entandrophragma utile* that germinated under closed forest canophy had poor growth rate but did not die within three months as those of *Ceiba pentandra* did. They remained as seedling bank. Consequently, different tree species seedlings have different light level where they could survive. Data analysis using either the lower or upper range values of red or far red revealed that there were statistically significant differences (P> 0.05) between the light under the crown of the three planation trees, abandoned farmland and a secondary forest regrowth (Table 5, 6, 7, 8,). The red and far – red wavelength of light received under a leaf of some tree species are shown in (Table 5). The light measured under the leaf surface and expressed as a percentage of the ambient varied from one species to another. The ratio red to far red varied between the five study sites. The range was between 1.00 and 2.00. At all seasons and time, the ratio many conopies recorded were between 1.7 and 1.8. There were few exceptions where reading upto 4.00 were recorded (Tables 2 and 3). The exceptional reading were observed early in the morning, after 1720 GMT and during the blowing of rain bearing cloud such as *Cumulonimbus.* In the 1-year old abandoned farmland, it was *Harungana madagascariensis* and *Musanga cecropioides* that were tree species (Table 5). Under the crown of Treculia *africana,* three tree species *Harungana madagascariensis, Pentaclethra macrophylla* and *Treculia africana were enumerated.* Under the crown of *Dacryodes eduliis* and *Irvingia gabonensis,* it was their respective tree seedlings and seedlings of *Pentaclethra macrophylla* that were tree species. Other plant species were mainly grasses. *Alternathera sessilis* had the highest relative abundance and percent frequency of occurrence. The number of *Alternathera sessilis* increased from the 1 –year old abandoned farmland and had the highest number under the crown of *Irvingia gabonensis.* It was however, absent at the secondary forest regrowth where five climax tree species, one pioneer tree seedlings and abundant *Geophilia afzelii* were enumerated (Table 4).

The few number of tree species at the plantation and abandoned farmland was attributed to the inadequate dispersal appendages of most fruit and seeds of the rainforest. The observation agreed with the record of Dike (2001) that it is difficult for fruits and seeds of Nigerian rainforest tree species to fly up to 200 m. It was observed that most community owned abandoned farmland were over 500 m wide and 10, 000 m in length. Moreover, presently most trees species listed as 'economic' (Lancaster 1961) are mainly restricted to forest reserved areas. Economic plants which could produce fruits near abandoned farmlands were rare and in some cases absent within 500 m from the farmland. The fruit bearing *Pentaclethra macrophylla* was near the plantation. It was observed that the seeds were dispersed by explosive mechanism. Each seed had a lot of food stored within it. Consequently, the seed that germinated under the crown of *Dacryodes edulis, Irvingia gabonensis, Treculia africana* and secondary forest regrowth were healthy.

Table 4: Plant species upto 1 cm in height enumerated in 2.50 m^2 at 1 year old abandoned farmland, under the crowns of *Treculia africana, Dacryode sedulis, Irvingia gabonensis* and a secondary forest regrowth at Umudike, Nigeria

	PLANTATION SPECIES							
Species	1 Year old abandoned farmland	*Treculia Africana*	*Dacryodes edulis*	*Irvingia gabonensis*	Secondary forest Regrowth	Total	Percent frequency	Relative abundance
Acanthospermum hispidum	2	-	-	-	-	2	20	0.329
Ageratum conyzoides	35	1	6	-	-	42	60	6.908
Alternathera sessilis	2	47	62	69	-	180	80	29.605
Brachystegia eurycoma	-	-	-	-	31	31	20	5.099
Chromolaena odorata	45	*2*	*1*	*1*	-	49	80	8.059
Cleistopholis patens	-	-	-	-	2	2	20	0.329
Combretum hispidum	-	-	-	-	6	6	20	0.987
Dacryodes edulis	-	-	*8*	-	-	8	20	1.315
Entandrophragma angolense	-	-	-	-	1	1	20	0.164
Geophilia afzelii	-	-	-	-	15	15	20	2.467
Geophila obovata	-	-	-	-	23	23	20	3.783
Gossweilerodendron balsamiferum	-	-	-	-	11	11	20	1.809
Harungana madagascariensis	3	1	-	-	-	4	40	0.658
Icacina trichintha tru	2	1	1	1	6	11	100	1.809
Ipomea involucrate	6	1	2	-	-	9	60	1.480
Irvingia gabonensis	-	-	-	13	-	13	20	2.138
Microdesmis puberula	-	-	-	-	19	19	20	3.125
Milicia excelsa	-	-	-	-	6	6	20	0.987
Musanga cecropioides	2	-	-	-	-	2	20	0.329
Panicum maximum	36	-	-	-	-	36	20	5.921
Paspalum polystachyum	7	-	-	-	-	7	20	1.151
Pennisetum purpureum	8	-	-	-	-	8	20	1.315
Pentaclethra macrophylla	-	2	1	1	16	20	80	3.289
Piptadeniastrum africanum	-	-	-	-	31	31	20	5.099
Treculia Africana	-	72	-	-	-	72	20	11.842
Total	148	127	81	85	167	608	100	100.000

Table 5: The lower range of red wave length measured at 50cm above the ground level at an abandoned farmland under *Treculi Africana, Dacryodes edulis, Irvingia gabonensis* and a secondary forest regrowth at Umudike, Nigeria.

	Species					Time
Local Time	Abondoned 1 year old farmland	*Treculia africana*	Dacryodes edulis	Irvingia gabonensis	Secondary a forest regrowth	Mean
6.00-6.59	-0.30	-0.42	-0.40	-0.60	-0.39	-0.42
7.00-7.59	1.10	-0.06	-0.03	-0.27	-0.35	0.08
8.00-8.59	3.4	0.2	0.3	-0.1	-0.2	0.72
9.00-9.59	1.00	1.91	1.66	0.13	-0.42	0.86
10.00-10.59	1.0	4.17	2.67	0.61	0.04	1.70
11.00-11.59	8.57	2.22	1.48	0.20	0.01	2.50
12.00-12.59	10.51	4.11	3.70	0.20	0.06	3.72
13.00-13.59	12.48	4.11	3.70	0.51	0.08	4.18
14.00-14.59	18.10	2.91	3.0	0.47	0.15	4.93
15.00-15.59	17.02	2.56	2.60	0.33	0.09	4.52
16.00-16.59	9.61	1.30	1.25	0.17	0.10	2.49
Species Mean	75.0	2.09	1.81	0.15	-0.08	2.30

F – LSD (0.05)
Species = 2.37
Time = 3.53

Table 6: The upper range of red Wave length measured at 50 cm above the ground level at an abandoned farmland, under *Treculia Africana, Dacryodes edulis, Irvingia gabonensis* and a Secondary forest regrowth at Umudike Nigeria.

Species	Time					
Local Time	Abandoned 1 year old farmland	*Treculia africana*	Dacryodes edulis	*Irvingia gabonensis*	Secondary a forest regrowth	Mean
6.00 – 6.59	0.96	-0.16	-0.19	-0.34	-0.34	-0.01
7.00 – 7.59	7.10	0.7	0.5	-0.1	-0.1	1.6
8.00 - 8.59	15.13	4.53	2.76	0.33	0.33	4.45
9.00 – 9.59	18.95	4.59	6.14	1.52	1.52	6.26
10.00 – 10.59	12.36	5.42	5.64	0.94	0.94	5.00
11.00 – 11.59	18.69	3.67	4.20	1.23	1.23	5.69
12.00 – 12.59	18.77	10.18	7.70	1.36	1.36	7.67
13.00 – 13.59	12.92	6.99	6.81	1.15	1.15	5.65
14.00 – 14.59	19.38	4.86	7.33	0.89	0.89	6.55
15.00 – 15.59	18.50	11.40	11.97	0.90	0.90	8.60
16.00 – 16.59	9.50	1.33	1.28	0.19	0.19	2.48
Species Mean	13.84	4.87	4.92	0.73	0.16	4.90

F - LSD (0.05)
Species = 2.25
Time = 3.33

Table 7: The lower range of far red wavelength measured at 50 cm above the ground level at an abandoned farmland, under *Treculia africana, Dacryodes edulis, Irvingia gabonensis,* and a Secondary forest regrowth at Umudike Nigeria.

Species						Time
Local Time	Abandoned 1 year old farmland	*Treculia africana*	Dacryodes edulis	*Irvingia gabonensis*	Secondary a forest regrowth	Mean
6.00 – 6.59	-0.88	-0.86	-0.86	-0.07	-0.83	-0.7
7.00 – 7.59	-0.03	-0.56	-0.54	-0.67	-0.72	-0.50
8.00 – 8.59	1.0	0.4	0.4	-0.7	-0.7	0.08
9.00 – 9.59	1.00	0.46	0.29	-0.15	-0.68	0.18
10.00 – 10.59	1.0	1.43	1.77	-0.05	-0.47	0.74
11.00 – 11.59	1.03	1.08	0.56	-0.14	-0.28	0.45
12.00 – 12.59	2.04	2.04	1.92	-0.13	-0.25	1.12
13.00 – 13.59	6.26	2.02	1.92	0.07	-0.26	2.00
14.00 – 14.59	8.86	1.70	1.29	0.10	-0.12	2.37
15.00 – 15.59	8.66	1.04	1.15	0.16	-0.15	2.17
16.00 – 16.59	4.40	0.53	0.49	-0.18	-0.19	1.01
Species Mean	3.03	0.84	0.76	-0.16	-0.42	0.81

F – LSD (0.05)
Species = 1.21
Time = 1.80

Table 8: The upper range of far red wavelength measured at 50 cm above the ground level at an abandoned farmland, under *Treculia africana, Dacryodes edulis, Irvingia gabonensis* and a secondary forest regrowth at Umudike, Nigeria.

Species						Time
Local Time	Abandoned 1 year old farmland	*Treculia africana*	*Dacryodes edulis*	*Irvingia gabonensis*	Secondary a forest regrowth	Mean
6.00 – 6.59	-0.07	-0.63	-0.61	-0.75	-0.74	-0.56
7.00 – 7.59	2.40	0.1	-0.2	-0.70	-0.70	0.2
8.00 – 8.59	6.80	0.65	0.91	-0.58	-0.58	1.61
9.00 – 9.59	16.79	2.44	2.20	-0.44	-0.44	4.31
10.00 – 10.59	11.84	2.58	3.71	0.12	0.12	3.73
11.00 – 11.59	9.21	1.73	1.93	0.11	0.11	2.69
12.00 – 12.59	8.87	5.54	4.26	-0.13	-0.13	3.82
13.00 – 13.59	6.48	3.30	3.66	-0.04	-0.04	2.78
14.00 – 14.59	13.24	2.46	4.13	-0.05	-0.05	4.63
15.00 – 15.59	12.44	4.95	5.03	-0.08	-0.08	4.54
16.00 – 16.59	2.27	1.03	0.50	-0.26	-0.26	1.1
Species Mean	8.39	2.20	2.32	-0.25	-0.25	2.62

F-LSD (0.05)
Species = 1.75
Time = 2.60

CONCLUSION AND RECOMMENDATIONS

The study revealed that adequate light is essential for tree seedlings growth and maintenance. The quality of light at the forest floor differed from that at 1- year old abandoned farmland. The light under tree species differed deepending on the number of leaves per twig and the architectural patterns of the branches. Light was very poor in *Irvingia gabonensis* because of the architectural pattern and the numerous leaves. The temperature is high enough for the survival and establishment of tree seedlings. The variation in light level could have induced the abundance of *Alternathera sessilis* under the crown of the plantation tree species and the absence of it at the forest floor.

It is recommended that to aid natural tree regeneration, the seeds of the desirable tree species should be collected for 'plus' trees and germinated at the university Nursery. The seedling should be planted at suitable positions in the forest. Gradual canopy opening should be carried out as required before debarking of the unwanted plant species. These desirable trees should be sold to farmers by the university at reduced prices. The farmers should be taught how to handle, plant and maintain tree seedlings in abandoned farmland. The rate of disappearance of the rainforest would be reduced if the farmers understand properly how to plant and maintain the seedlings.

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