International Invention Journal of Agricultural and Soil Science (ISSN: 2408-7254) Vol. 5(3) pp. 39-45, December, 2017
Available online http://internationalinventjournals.org/journals/IIJAS

Full Length Research Paper

Comparative plant resistance in fifty-five tea accessions (*Camellia sinensis L.*) in Ibadan, South West, Nigeria

O. M. Azeez

Department of Crop and Soil Science, University of Port Harcourt, Choba; Port Harcourt, Nigeria
Email: azeezowolabi@yahoo.com

Received 15 October, 2017; Accepted 13 November, 2017

Fifty five accessions comprising both local and exotic clones were assessed for their resistance to field pest at Abarakata farm, CRIN. The accessions derived from Mambilla plateau, CRIN out-station, Taraba State were screened for resistance to infestation by leaf defoliators. Results showed that there were significant differences among the accessions in terms of number of holes on the leaf and plant damage both in the dry and raining season. On NGC15, NGC17, NGC19, C235, C357 tea clones recorded fewer number of holes and total damage of leaves and thus considered highly resistant to field insect pests. Based on the rating, Clones NGC 8, NGC12, NGC14, NGC24, NGC27, NGC40, NGC41, NGC42, NGC49, NGC50, NGC51, C68, C270, C318, C359, C377 were significantly resistant to the insect infestations, while NGC18, NGC22, NGC23,NGC25, NGC26, NGC29, NGC35,NGC47, NGC48, NGC53, NGC54, NGC55, C61, C136, C143, C228, C236, C327, C353, C354, C369, C370 were moderately resistant. NGC13, NGC32, NGC37, NGC38, NGC45, NGC46, C56, C74, C108, C363, C367 and C368 were the most susceptible with the highest damage indices values ($P<0.05$). The range of each of the resistance indices measured in the susceptible clones in both dry and wet seasons were; number of leaf damage (43-51)(37-46), number of leaf holes (18-19)(16-20).

Keywords: Clones; Tea; Resistance; Damage; Susceptible.

INTRODUCTION

Tea, *Camellia sinensis* L is an important export crop dated back to about 3000BC but it got to Nigeria by 1971 with commercial cultivation on the Mambilla plateau. In a commercial plantation, tea tree is commonly established by seedlings as an intensively-managed row crop (Colton et al., 2000). High yielding plantations are influenced by many agronomic factors and growing conditions such as a continuous supply of moisture during the growing season either from irrigation or rainfall, adequate and balanced nutrition either naturally provided in the soil or through fertilizer input, a minimum level of pest and disease attacks (Colton et al., 2000).

Tea, (*Camellia sinensis L.*) is a non-alcoholic beverage drink, which is native to Southeast Asia (Njuguna, 1984). It is consumed regularly by many individuals worldwide for its biologically active vitamins, flavanones, and medicinal properties, etc (Dou, 2009; Alipoor and Rad, 2012; Thirugnanasambantham et al., 2013). Dried and cured leaves widely used for a beverage, which has a stimulant effect due to caffeine. Green tea is made from leaves steamed and dried, while black tea leaves are withered, rolled, fermented and dried. Steam distillation of black tea yields an essential oil. Tea extract is used as a flavor in alcoholic beverages, frozen dairy, desserts, candy, baked goods, gelatins and puddings (Leung, 1980).

Camellia sinensis L. thrives on the high altitude region of Mambilla Plateau in Nigeria. Its production has however been limited to the mountainous area of Mambilla plateau, Taraba State. The region is however limited in land area for tea production because of other competing needs such as cattle grazing, industrial use and residential buildings. The annual tea leaf yield from the Mambilla has become grossly too low to meet the growing market demand for tea. It becomes imperative to increase area of tea cultivation across South western, Nigeria with different agro-ecosystem. Early studies have shown clones 143, 236, 318 and 35 to be adaptable to lowland area (Omojola et al., 2001) whose seedlings were brought from Mambilla for the cultivation in Ibadan (Oloyede et al. 2001).

Evans and Turnbull, 2004 reported that a mixture of cultivated clones provides greater stability in available environment, less risk of pest and disease attack, and increased yield as diverse genotypes can exploit different part of the site. Therefore, the choice of number of clones being used in a plantation depends on the level of risk that can be accepted by plantation managers, clonal resistance to pests and diseases attack and gene frequencies associated with susceptible alleles (Bishir and Roberds, 1999).

Libby (1985) and Evans and Turnbull (2004) recommended that well adapted clones to a particular site should be used to maximize the advantages of clonal plantations. Therefore, a multiple site clonal trial should be established before the selected clones are deployed to commercial plantations to investigate clone-by-environment interactions as the rank of clones might be change across the various site (Frampton and Foster, 1993). This knowledge is necessary to efficiently deploy clonal material (Frampton and Foster, 1993).

Several insect pests and diseases have been identified in tea tree plantations. However, the full pest complex of tea tree remains unknown and the magnitude of any pest attack depends on the weather conditions (Campbell and Maddox, 1999). Colton et al., (2000) noted that only a small number out of 100 insect species found in tea tree plantations are considered as significant pests by tea tree growers. The most common pests are pyrgo beetle (*Paropsisternatigrina*), psyllids (*Triozaspp*), pasture scarabs (*Diphucephalalineata*), leaf hoppers, and African black beetles (Colton et al., 2000).

Zonocerrusvariegatus and Lagriavilosa damage the crop by cutting off the commercially important young shoot tips, while *Gryllusdomesticus* cut off both the shoot and root tips of tea plants resulting in wilting, die-back and sometimes death of the plant (Filani, 1984). *Helopeltisschoutedenii*, *Lygaeusfestivus* and *Aspaviaarmigera* particularly cause damage by sucking plant sap from young leaves, buds and stem tips. In the process, they poison the plants with their saliva. The injuries caused by these pests result in the development of lesions and necrosis at injured sites, wilting of plant, die-back, fungal attack, and in severe infestations, death of the plant (Filani, 1985). However, the intensive cultivation and production in Nigeria,some of the insect pests which currently appear to be minor may become major pests, with the attendant modifications of the tea agro-ecosystem. Future research efforts may therefore be focused on the control of the various insect pests, in relation to cultural operations and environmental factors associated with tea production. Cultural operations such as pruning cycle, leaf plucking and host-plant factors including the nutritional status and the presence or absence of certain flavor compounds in tea plants (Sudoi, 1983; 1987). The populations of some of the pests are also known to be affected by climatic and environmental factors (Danthanarayana and Ranaweera, 1972; Sudoi, 1983; 1985). This investigation was to look into the possibility of growing tea in the humid area of Ibadan with respect to the prevalent insect pests.

MATERIALS AND METHODS

Study site

The study was carried out at the cocoa germplasm plots, Abarakata farm located at the Cocoa Research Institute of Nigeria (CRIN) Headquarters in Ibadan, Nigeria. Ibadan has an annual rainfall average of 2000 mm with a bimodal pattern. It is located in the tropical rain forest ecosystem between latitude 7^{o} 30’N and longitude 3^{o} 54’E at an altitude of 200 m above sea level.

Sources of materials

Fifty-five tea clones were used for the study and were brought from tea germplasm, out-station, Cocoa Research Institute of Nigeria, Mambilla, Taraba State in the first quarter of the year 2012. These are part of imported seedlings to Nigeria from the warmer regions of Asia and South America (Opeke, 1992)(Table 1).

Field experiment

The experiments were carried out in the late planting seasons of July-October, 2012-2013. The land area was cleared manually using hoe and cutlass and planted with plantain (shade crop) a year before the introduction of the tea seedlings so as to provide adequate shade for the materials. There were fifty five treatments within each block with four accessions representing each treatment in a randomized complete block design. A plot of 100 m by 200 m made up of three blocks of 25 m by 200 m each with 1 m spacing between blocks was used.The seedlings were transplanted when the rainfall was stable. Weeding and other cultural maintenance were done as at when necessary.

Data collection

Data were collected both seasons on number of leaf holes and plant damage. Data generated were used to rank the clones according to their level of resistance using the ratings of weighted average of damage parameters as described by Azeez, (2012). Highly Resistant (1 – 1.99), Resistant (2 - 2.99), Moderately

Table 1. Some morphological features and source of tea clones tested for resistance to field insect pests

S/N	Clones	Origin	Source	Leaf colour	Leaf texture
1	NGC 8	Kenya	CRIN	Light green	Smooth
2	NGC 12	Kenya	CRIN	Light green	Smooth
3	NGC 13	Kenya	CRIN	Light green	Smooth
4	NGC 14	Kenya	CRIN	Light green	Smooth
5	NGC 15	Kenya	CRIN	Light green	Smooth
6	NGC 17	Kenya	CRIN	Light green	Smooth
7	NGC 18	Kenya	CRIN	Light green	Smooth
8	NGC 19	Kenya	CRIN	Light green	Smooth
9	NGC 22	Kenya	CRIN	Light green	Smooth
10	NGC 23	Kenya	CRIN	Light green	Smooth
11	NGC 24	Kenya	CRIN	Light green	Smooth
12	NGC 25	Kenya	CRIN	Light green	Smooth
13	NGC 26	Kenya	CRIN	Light green	Smooth
14	NGC 27	Kenya	CRIN	Light green	Smooth
15	NGC 29	Kenya	CRIN	Light green	Smooth
16	NGC 32	Kenya	CRIN	Light green	Smooth
17	NGC 35	Kenya	CRIN	Light green	Smooth
18	NGC 37	Kenya	CRIN	Light green	Smooth
19	NGC 38	Kenya	CRIN	Light green	Smooth
20	NGC 40	China	CRIN	Deep green	Smooth
21	NGC 41	Kenya	CRIN	Light green	Smooth
22	NGC 42	Kenya	CRIN	Light green	Smooth
23	NGC 45	Kenya	CRIN	Light green	Smooth
24	NGC 46	Kenya	CRIN	Light green	Smooth
25	NGC 47	Kenya	CRIN	Light green	Smooth
26	NGC 48	Kenya	CRIN	Light green	Smooth
27	NGC 49	Kenya	CRIN	Light green	Smooth
28	NGC 50	Kenya	CRIN	Light green	Smooth
29	NGC 51	China	CRIN	Deep green	Smooth
30	NGC 53	China	CRIN	Deep green	Smooth
31	NGC 54	Kenya	CRIN	Light green	Smooth
32	NGC 55	Kenya	CRIN	Light green	Smooth
33	C 56	Kenya	CRIN	Light green	Smooth
34	C 61	Kenya	CRIN	Light green	Smooth
35	C 68	Kenya	CRIN	Light green	Smooth
36	C 74	Kenya	CRIN	Light green	Smooth
37	C 108	Kenya	CRIN	Light green	Smooth
38	C 136	Kenya	CRIN	Light green	Smooth
39	C143	Kenya	CRIN	Light green	Smooth
40	C 228	Kenya	CRIN	Light green	Smooth
41	C235	Kenya	CRIN	Light green	Smooth
42	C236	Kenya	CRIN	Light green	Smooth
43	C270	Kenya	CRIN	Light green	Smooth
44	C318	Kenya	CRIN	Light green	Smooth
45	C327	Kenya	CRIN	Light green	Smooth
46	C353	Kenya	CRIN	Light green	Smooth
47	C354	Kenya	CRIN	Light green	Smooth
48	C357	Kenya	CRIN	Light green	Smooth
49	C359	Kenya	CRIN	Light green	Smooth
50	C363	Kenya	CRIN	Light green	Smooth
51	C367	Kenya	CRIN	Light green	Smooth
52	C368	Kenya	CRIN	Light green	Smooth
53	C369	China	CRIN	Deep green	Smooth
54	C370	China	CRIN	Deep green	Smooth
55	C357	China	CRIN	Deep green	Smooth

resistant (3 -3.99) and Susceptible (4 – 5).

Statistical analysis

Data obtained were subjected to statistical analysis of variance and difference means that are significance were separated with Duncan new multiple test.

RESULTS

Significantly higher number of holes was recorded on NGC13, NGC32, NGC37, NGC38, NGC45, NGC46, C56, C74, C108, C363, C367 and C368 than on other clones. However, fewer number of holes were recorded on NGC15, NGC17, NGC19, C235 and C357(Table 3). The leaf eater caused the numerous holes in the leaves which caused reduction in the photosynthetic process. Corresponding high damage was recorded on NGC13, NGC32, NGC37, NGC38, NGC45, NGC46, C56, C74, C108, C363, C367 and C368 due to the combined effect of leaf and shoot insect borer. Some also feed on the sap of the tea plant. However, the damage is intense that caused the total removal of the leaf blade (Table 2).

Table 4 showed that tea plant damage was significantly higher in 12 clones (NGC13, NGC32, NGC37, NGC38, NGC45, NGC46, C56, C74, C108, C363, C367 and C368) than in others. No seed damage was recorded on NGC15, NGC17, NGC19, C235, C357 but this was not significantly different from the quantity of damaged seeds in clones that are resistant.

Significantly higher number of holes was recorded on NGC13, NGC32, NGC37, NGC38, NGC45, NGC46, C56, C74, C108, C363, C367 and C368 than on other clones. However, fewer number of holes were recorded on NGC15, NGC17, NGC19, C235 and C357 than on other clones(Table 4). The leaf eater caused the numerous holes in the succulent leaves which caused reduction in photosynthetic process. Corresponding high damage was recorded on NGC13, NGC32, NGC37, NGC38, NGC45, NGC46, C56, C74, C108, C363, C367 and C368 due to the combined effect of leaf and shoot insect borer. Some also feed on the sap of the tea plant. Due to enough moisture, more damage was recorded on the clones because of the intense effect of leaf and shoot feeder. Then, the population of insect pests is more abundant and therefore caused more damage in the raining season.

Means were separated using Duncan new multiple test ($P<0.05$). Means followed by the same letter along a column are not significantly different from one another.

DISCUSSION

Based on number of holes and plant damage in leaf defoliator attack: NGC13, NGC32, NGC37, NGC38, NGC45, NGC46, C56, C74, C108, C363, C367 and C368. They are therefore, more likely to suffer severe losses when planted without protection. Earlier reports have indicated that farmers are not willing to protect tea plant because of the long time belief that it has natural defense against the attack of insect pest. This corroborated the findings by Griffiths (1991) who reported that effectiveness of reducing plant damage by insects and both wild and domesticated vertebrate herbivores are due to condensed tannins present in the plants.

Though Campbell and Maddox (1999) reported that the full complex of tea tree remains unknown they attached the magnitude of insect pests attack to the prevailing weather conditions. This is also in agreement with the report by Colton et al., (2000) who reported that only a small number out of 100 insect species found in tea tree plantations are considered as significant pests by tea tree growers. The five most resistant clones in this study were: NGC15, NGC17, NGC19, C235 and C357. These clones had fewer leaves holes and were free from damage. The implication is that the clones did not support the feeding by the insect pests or tolerated the attacks of the leaf defoliators. The highly resistant clones represent 9.09% of the total number of clones screened for this experiment. The resistant of these clones could be attributed to long time belief of farmers that tea plant has a natural defense against insects attack. According to Harbourne (1984), plant tissues high in tannin are largely avoided by most feeders because of the astringent taste they impart. In a similar experiment, various anti-nutritional factors (secondary metabolites) have been implicated in the seed resistance of cowpea to bruchids (Gatehouse et al., 1990; Macedo et al., 1993). From the study, the leaves texture and composition did not support the feeding habits of the insects in the resistant clones compared to the susceptible ones, suggesting the possible presence of anti-nutritional or growth inhibiting substances in the shoot of the resistant clones.

It is therefore likely that the resistance recorded in the resistant clones in this study is most likely attributable to inherent biochemical substances in the leaves (Sudoi, 1983 and 1985). Oparaeke (2005) however attributed the lower attack of Gmelinaarborea tree by insect pests to its high tannin contents. However, the presence of the chemical compositions may interfere with the physiological processes of feeding and metamorphosis with the result that few instars survive to adulthood. The level of insect damage marked the significant differences observed between resistant and susceptible clones in the level of resistance, though the early developing instars was reported more vulnerable to the harmful effect of these biochemical compounds (Azeez, 2012).

In a similar experiment, Bishir and Roberds, (1999)

Table 2. Field insect pests of lowland tea plant

SN	Insect pest	Common name	Parts of the plant attacked
1	*Zonocerousvariegatus*	Grasshopper	Leaves
2	*Lagriavillosa*	Leaf beetle	Leaves
3	*Helopeltisscoutedenii*	Tea mosquito	Foliage
4	*Dysdercussupersitiosus*	Cotton-stainer	Leaves, buds & stem tips
5	*Gryllusdomesticus*	Cricket	Shoot and root tips
6	*Lygaeusfestivus*	Leaf bug	Leaves, buds & stem tips
7	*Aspaviaarmigera*	Leaf bug	Leaves, buds & stem tips

Table 3. Categorization of 55 tea clones in CRIN germplasm, at Abarakata, CRIN Headquarters Ibadan for Susceptibility/Resistance status

S/N	Level of Resistant	Number of clones	Identity of Clones
1	Highly Resistant	5	NGC15, NGC17, NGC19, C235, C357
2	Resistant	16	NGC 8, NGC12, NGC14, NGC24, NGC27, NGC40, NGC41, NGC42, NGC49, NGC50, NGC51, C68, C270,C318, C359, C377
3	Moderately Resistant	22	NGC18, NGC22, NGC23, NGC25, NGC26, NGC29, NGC35, NGC47, NGC48, NGC53, NGC54, NGC55, C61, C136, C143, C228, C236, C327, C353, C354, C369, C370
4	Susceptible	12	NGC13, NGC32, NGC37, NGC38, NGC45, NGC46, C56, C74, C108, C363, C367, C368,

Table 4. Damage characteristics in seven five tea clones tested for resistance to field insect pests

S/N	Clones	Dry season		Raining season	
		Leaf damage	Leaf holes	Leaf damage	Leaf holes
1	NGC 8	21^{fghi}	7^{bcde}	12^{cdef}	5^{bc}
2	NGC 12	23^{efgh}	6^{cdef}	13^{cdef}	6^{bc}
3	NGC 13	26^{defgh}	12^{abcd}	28^{abcd}	7^{abc}
4	NGC 14	22^{efgh}	7^{bcde}	25^{abcd}	8^{abc}
5	NGC 15	0^{f}	1^{ef}	3^{f}	0^{c}
6	NGC 17	0^{f}	0^{f}	4^{f}	0^{c}
7	NGC 18	21^{fghi}	12^{abcd}	18^{abcd}	15^{ab}
8	NGC 19	0^{f}	1^{ef}	3^{f}	0^{c}
9	NGC 22	34^{abcd}	8^{bcde}	35^{bcd}	14^{abc}
10	NGC 23	20^{fghi}	14^{abcd}	24^{abcd}	15^{abc}
11	NGC 24	34^{abcd}	10^{abcd}	15^{bcd}	6^{bc}
12	NGC 25	38^{abcd}	12^{abcd}	21^{abcd}	11^{abc}
13	NGC 26	44^{abc}	8^{bcde}	46^{a}	12^{abc}
14	NGC 27	28^{cdef}	7^{bcde}	13^{bcde}	6^{bc}
15	NGC 29	22^{efgh}	6^{cdef}	46^{a}	13^{abc}
16	NGC 32	51^{a}	15^{abcd}	28^{abcd}	20^{a}

Table 4. Continued

17	NGC 35	40^{abcd}	14^{abcd}	27^{abcd}	12^{abc}
18	NGC 37	43^{abcd}	13^{abcd}	35^{bcd}	14^{abc}
19	NGC 38	51^{abcd}	14^{abcd}	46^{a}	20^{a}
20	NGC 40	$25d^{efgh}$	8^{bcde}	14^{bcd}	5^{bc}
21	NGC 41	11^{klmn}	6^{cdef}	24^{abcd}	7^{abc}
22	NGC 42	34^{abcd}	6^{cdef}	16^{bcde}	5^{bc}
23	NGC 45	45^{abc}	11^{abcd}	44^{a}	15^{ab}
24	NGC 46	36^{abcd}	10^{abcd}	45^{a}	11^{ab}
25	NGC 47	44^{abc}	16^{abcd}	39^{ab}	6^{bc}
26	NGC 48	24^{efgh}	14^{abcd}	23^{abcd}	13^{abc}
27	NGC 49	14^{ijkl}	5^{def}	25^{abcd}	15^{ab}
28	NGC 50	38^{abcd}	8^{bcde}	23^{abcd}	4^{bc}
29	NGC 51	33^{abcd}	5^{def}	15^{bcde}	6^{bc}
30	NGC 53	45^{abc}	10^{abcd}	17^{bcde}	6^{bc}
31	NGC 54	21^{fghi}	15^{abcd}	27^{abcd}	5^{bc}
32	NGC 55	22^{efgh}	6^{cdef}	28^{abcd}	14^{abc}
33	C 56	50^{a}	10^{abcd}	46^{a}	12^{abc}
34	C 61	26^{efgh}	10^{abcd}	25^{abcd}	11^{abc}
35	C 68	24^{efgh}	6^{cdef}	13^{bcde}	7^{abc}
36	C 74	39^{abcd}	19^{ab}	35^{abcd}	20^{a}
37	C 108	36^{abcd}	12^{abcd}	36^{abcd}	20^{a}
38	C 136	35^{abcd}	10^{abcd}	27^{abcd}	6^{bc}
39	C143	37^{abcd}	11^{abcd}	37^{abcd}	5^{bc}
40	C 228	21^{fghi}	18^{abc}	8^{cdef}	15^{ab}
41	C235	3^{ef}	2^{ef}	3^{f}	1^{bc}
42	C236	14^{abcd}	13^{abcd}	24^{abcd}	7^{bc}
43	C270	24^{efgh}	5^{def}	15^{bcde}	6^{bc}
44	C318	17^{ghij}	11^{abcd}	18^{abcd}	5^{bc}
45	C327	45^{abc}	8^{bcde}	31^{abcd}	14^{abc}
46	C353	21^{efgh}	7^{bcde}	27^{abcd}	12^{abc}
47	C354	24^{efgh}	13^{abcd}	33^{abcd}	6^{bc}
48	C357	2^{ef}	0^{f}	3^{f}	0^{c}
49	C359	46^{abc}	10^{abcd}	46^{a}	12^{abc}
50	C363	23^{efgh}	6^{cdef}	16^{bcde}	5^{bc}
51	C367	38^{abcd}	18^{abc}	25^{abcd}	15^{ab}
52	C368	38^{abcd}	18^{bc}	26^{abcd}	15^{ab}
53	C369	36^{abcd}	14^{abcd}	26^{abcd}	6^{bc}
54	C370	15^{ghij}	10^{abcd}	24^{abcd}	15^{bc}
55	C377	20^{fghi}	8^{bcde}	27^{abcd}	6^{bc}

Means separated using Duncan new multiple test (P<0.05)
Means followed by the same letter along a column are not significantly different from one another

stated that the choice of number of clones being used in a plantation depends on the level of risk that can be accepted by plantation managers, intensity of pest attack, level of clonal resistance to attack and gene frequencies associated with susceptible alleles. Therefore, the low level of clone susceptibility to leaf defoliator shows that the insect is a serious economic pest of tea plant on the fields whose attack must be made a priority in crop improvement program. There is also need for periodic reassessment of clones resistant to the defoliator since there is the possibility of the existence of many species of insect pests that defoliate the leaves arising from place of high altitude to down south of low altitude (i.e. between various zones in the country). The identified resistant clones should be made adaptable to the various intercropping systems of the country, and be encouraged for cultivation in the Southwest, Nigeria.Consequently, this would bring about high production of tea and associated nutritional benefits that could be derived by the citizenry that made tea their daily delicacy. This however, corroborates the reports of several workers (Dou, 2009; Alipoor and Rad, 2012; Thirugnanasambanthamet al., 2013) who posited the nutritional composition (e.g vitamins, flavanones etc) and medicinal properties of C.sinensis (L.) individuals stand to gain regularly from tea extract all over the world.

CONCLUSION

The working out of integrated control strategies through the manipulations of the cultural operations, the nutritional status, the presence or absence of certain flavor compounds in tea plants, the continous research for high yielding tea clones which are reasonably tolerant to pests and diseases coupled with the screening of non-residual insecticides, particularly, the pyrethroids and other botanical insecticides should form the basis for future entomological research activities on the control of tea pests in Nigeria.

ACKNOWLEDGEMENTS

The author is grateful to Mr. Olaniyi Olayinka, Crop Breeding Department, Cocoa Research Institute of Nigeria, Ibadan, Nigeria for his valuable assistance for this study.

REFERENCES

Alipoor B, Rad AH (2012). A Review on the Therapeutical Effects of Tea. Asian Journal of Clinical Nutrition 4, 1–15.

Azeez OM (2012). Studies on host resistance integrated with botanicals for the control of cowpea seed bruchid, *Callosobruchusmaculatus*, Fabricius (Coleoptera: Bruchidae) Ph.D Thesis, Federal University of Agriculture, Abeokuta. 181 pp

Bishir J, Roberds JH (1999). On number of clones needed for managing risk in clonal forestry. Forest Genetic Research, 6, 149-155.

Campbell AJ, Maddox CDA (1999). Insect pests of tea tree: can plantation pests be managed? In Southwell, I & Lowe, R. (Eds). Tea Tree: the genus *Melaleuca* Harwood Academic Publishers, Amsterdam.

Colton RT, Murtagh GJ, Drinnan J, Clarke B (2000). Tea tree oil. Agfact P6, 4.6 Seconded. NSW Agriculture, Orange.

Danthanarayana W, Ranaweera DJW (1972). The effects of rainfall and shade on three mite pests of Tea in Ceylon. Ann. Appl. Biol. 70: 1-12

Dou QP (2009). Molecular mechanisms of green tea polyphenols. Nutrition and cancer 61, 827–835.

Evans J, Turnbull J (2004). Plantation forestry in the tropics: the role, silviculture and use of planted forest for industrial social, environmental, and agroforestry purposes. Third eds Oxford University Press. Oxford.

Filani GA (1984). Diseases of Tea in Nigeria. Ann. Rept. CRIN, Ib., Nig. 1983 pp. 51-52.

Filani GA (1985). Diseases of Tea in Nigeria. Ann. Rept. CRIN, Ib., Nig. 1984 pp. 69.

Frampton LJ, Foster GS (1993). Field testing vegetative propagules. Pp 110-134, In Ahuja, M. R. and Libby, M. J (Eds). Clonal Forestry I: genetics and biotechnology. Springer Verlag, Berlin.

Gatehouse AMR, Minney BH, Dobbie P, V. Hilder V (1990). Biochemical resistance to bruchid attack in legume seeds, investigation and exploitation. In: K. Fujii, A.M.R Gatehouse, C.D. Johnson, R. Mitchell and T. Yoshida (eds), Bruchids and Legumes: Economic Ecology and Coevolution, Kluwer Academic Publishers Dordrecht, pp 241-256.

Griffiths DW (1991). Condensed Tannins. In: D'Mello, J.P.F., Duffus, C.M. and Duffus, J.H. (Eds) Toxic substances in crop plants. The Royal Society of Chemistry, Cambridge, pp 180-201.

Harbourne JB (1984). Phytochemical methods.A guide to modern techniques of plant analysis. 2nd edition, Chapman and Hall, Hongkong, 287 pp

Leung AY (1980). Encyclopedia of common natural ingredients used in food, drugs and cosmetics. John Wiley & Sons, New York. https://hort.purdue.educ/newcrop/dukeenergy/Camelliasinensis html.

Libby WJ (1985). Potential of clonal forestry.Pp 1-11. In Zsuffa, L., Rauter, R. M. &Yeatman, C. W. (Eds). Clonal Forestry: Its impact on tree improvement and our future forest. Proceedings of the 19th Meeting Canadian Tree Improvement Association, Part 2. Toronto.

Macedo MLR, Andrade LBS, Morales RA, Xavier-Filho J (1993). Vicilin variants and the resistance of cowpea (*Vignaunguiculata*) seeds to the cowpea weevil (*Callosobruchusmaculatus*). Comparative Biochemistry and Physiology 105: 89-94.

Njuguna O (1984). Tea Tree uses. In: Encyclopedia of common natural ingredients used in food, drugs and cosmetics. John Wiley & Sons, New York. https://hort.purdue.educ/newcrop/dukeenergy/Camellia sinensis html.

Oloyede AA, Omolaja SS, Adedeji AR (2001). Evaluation of establishment abilities of cuttings at different tea clones from different media. In: CRIN mandate crops stakeholders, Forum. 228 pp

Omolaja SS, Esan EB, Obatolu CR (2001). Production of tea in lowland area of Nigeria. In: CRIN mandate crops stakeholders, Forum. 228pp

Oparaeke AM (2005). Studies on insecticidal potential of extracts of *Gmelinaarborea* products for control of field pests of cowpea, *Vignaunguiculata* (L.)Walp; the pod borer, *Marucavitrata* and coreid bug, *Clavigrallatomentosicollis*. Journal of Plant Protection Research. Vol. 45, 1-7.

Opeke LK (1992). Tropical Tree Crops, Spectrum Books Ltd., Ibadan, Nigeria. 327pp

Sudoi V (1983). Role of plant protection in Tea production: Tea (i): pp. 10

Sudoi V (1985). Effects of rainfall and shade on the incidence of yellow tea thrips (*Scirthothripskenyensis*) in Kenya. Tea, 6(2): 7-12.

Sudoi V (1987). Evaluation of pesticides against the Red spider mites, *Oligonychuscoffeae* (Nietner) on Tea in Kenya. Tea 8(2): 68-72.

Thirugnanasambantham K, Prabu G, Palanisamy S, Chandrabose SRS, Mandal, AKA (2013). Analysis of dormant bud (Banjhi) specific transcriptome of tea (*Camellia sinensis* (L.) O. Kuntze) from cDNA library revealed dormancy-related genes. Applied Biochemistry and Biotechnology 169, 1405–1417.

How to cite this article: Azeez OM (2017). Comparative plant resistance in fifty-five tea accessions (*Camellia sinensis L*.) in Ibadan, South West, Nigeria. Int. Inv. J. Agric. Soil Sci. Vol. 5(3): 39-45