INTERNATIONAL JOURNAL OF SCIENCE AND NATURE

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STATUS OF RUBBER DISEASES (*Hevea brasiliensis* Muell. Arg.) IN NIGERIA

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ABSTRACT
The current status of four categories of diseases of *Hevea brasiliensis* Muell. Arg. (root diseases, panel diseases, stem and branch diseases and leaf diseases) was studied in six local (NIG 800, 801, 802, 803, 804, and 805) and three exotic (PR107, RRIM 707 and GT1) clones. The study was carried out in a 40 ha polyclonal garden at the Rubber Research Institute of Nigeria (RRIN), in a randomized complete block design. Significant ($p > 0.05$) differences existed among the different clones on mistletoe infestation. Significant differences were observed between the nine clones evaluated on *Corynespora* leave disease, Bird's eye spot, *Colletotrichum* leave disease and *Phytophthora* leaf disease. Leave infection with Algal spot; abnormal leaf fall; Powdery mildew and South American Leaf Blight (SALB) were not observed in the polyclonal field assessed. The study showed that leaf diseases are on the increase in plantations in Nigeria. Incidences of Red root disease, Brown root disease, *Ustulina* root rot, Poria root rot and Stinking root rot were not seen in the polyclonal field assessed. White root disease incidence on the different clones was not significant ($p < 0.05$) with GT 1 been the most tolerant with the lowest DI of 22.43 followed by NIG 800; and the most affected NIG 802 had the highest DI of 22.75. The highest level of disease resistance to Black stripe and canker and panel necrosis was recorded in PR 107 with disease index of 0.00. Significant ($p >0.05$) differences existed among the different clones on mistletoe infestation and the study indicating mistletoe incidence to be on the increase in the plantation. This study suggests adequate control measures for rubber diseases are of necessity to forestall epiphytotic proportions where latex yield could be affected adversely.

KEYWORDS: - *Hevea brasiliensis*, Disease assessments, Polyclonal garden.

INTRODUCTION

Hevea brasiliensis Muell. Arg. (Para rubber) is an economically important tree as the most important source of natural rubber. It an economic tree whose healthy existence is significant to the productivity of the crop (Rao, 1975). Virtually every part of the tree is affected by diseases caused by pathogens and parasites as well as by others of non-pathogenic origin. For convenience the diseases that affect the rubber tree are divided to four groups based on the part of the tree affected into root diseases, panel diseases, stem and branch diseases and leaf diseases. Root rot infections are the most devastating of the diseases that affect rubber trees in Nigeria. *Rigidoporus lignosus* commonly called white root rot is the pathogen most feared by planters throughout the rubber-growing regions of the world (Rao, 1975; Nandris *et al*., 1983) except in India where it is absent (Jayasinghe, 2010), because of its ability to kill the tree directly. Its effects results in bare patches in rubber lands which remain as a source of inoculums for further infection. Afflictions of the stem and branches have been implicated to bring about extensive destruction of branches, especially of certain highly susceptible clones in the wetter areas. Infections of the rubber tree by leave pathogens are more common in the nursery than in the plantations. Awoderu, 1969; Rao, 1975; Begho, 1995; Jayasinghe, 2000; Ogbebor 2010). Harinidi *et al*. (1996) reported that prolong infection of susceptible clones by *Corynespora cassiicola* could cause the crown to become defoliated for the whole year. Folial infection in immature trees could cause dieback, stunting or death of trees, while in mature trees it reduces latex production to less than 45%.

Panel disease are of less economic importance, they have not been reported to kill the tree even in severe outbreaks, although the wounds they cause disfigure the renewed bark making it unsuitable for re-tapping. This study evaluated the occurrence of the four groups of categories of rubber diseases in nine rubber clones in a 40 ha polyclonal garden at Rubber Research Institute of Nigeria, main station, Iyanomo, Benin City.

MATERIALS AND METHODS

A field survey was conducted in the Polyclonal garden of RRIN planted in 1991 and opened for tapping in 1998. This study was conducted in January 2018 for Mistletoe infestation, while the other rubber disease assessments were carried out in the months of April, May, June and July respectively on nine rubber clones (NIG 800, 801, 802, 803, 804, 805, PR 107, RRIM 707 and GT1) planted in a randomize complete block design (Table 1). Each clone was replicated four times with 21 X 22 trees per experimental unit at a planting spacing of 3.34m X 6.7m.

TABLE 1: Layout of the experimental plot

21	NIG 800	PR 107	RRIM 707	NIG 805
21	NIG 805	NIG 802	NIG 803	GT 1
21	NIG 801	RRIM 707	NIG 804	NIG 802
21	PR 107	NIG 805	NIG 800	NIG 803
21	GT 1	NIG 800	NIG 801	NIG 804
21	NIG 803	GT 1	PR 107	RRIM707
21	NIG 802	NIG 804	GT 1	NIG 801
21	RRIM 707	NIG 803	NIG 802	NIG 800
21	NIG 804	NIG 801	NIG 805	PR 107
	22	22	22	22
	Block I	Block II	Block III	Block IV

REPLICATES

Assessment of leave disease Incidence

Four quadrants of 2m x 2m per each experimental unit were mapped out for the survey. The quadrants were cleared and left for three days to allow sufficient falling leaflets to gather in it. Twenty leaflets were picked at random from each quadrant for disease assessment. The leaflets were assessed for incidence of leaf infection based on disease severity. The disease score –rating chart (IRRDB, 2000; Ogbebor & Adekunle, 2005), was used to assess disease infection level (Table 2) from which the disease index (D.I) was calculated according to Parry (1990). The field was access for the following leave diseases *viz*, Algal spot, *Corynespora* leaf fall, abnormal leaf fall, *Colletotrichum* leaf disease, Powdery mildew, South American Leaf Blight and *Phytophthora* leaf disease. For *Phytophthora* leaf disease incidence, petioles with lesion of oozed coagulated latex at the centre were used for the assessment, and depending on the level of preponderance of the affected parts, incidence of severity was rated accordingly.

TABLE 2: Disease score chart for leave diseases

Infection categories	Rating
No Infection spot (free)	0
Less than 10% of leaves infected (Very light) up to 5 spot	1
Light – 5 to 10 spots and 10-25% leaves fall	2
Moderate > 10 spots and 26 to 50% leaf fall	3
Severe – Large lesions and 51 to 75% leaf fall	4
Very Severe – Large lesions and > 75% leaf fall	5

$$\text{Disease Index (DI)} = \frac{(0 \times a)+(1 \times b)+(2 \times c)+(3 \times d)+(4 \times \epsilon)+(5 \times f)}{a+b+c+d+e+f} \text{ X } \frac{100}{X}$$

Where:-
0, 1, 2, 3, 4, 5 = Infection categories
a, b, c, d, e, f = No of leaves/ plant that falls into the infection categories
X =Maximum No of infection categories.

FIGURE 1. Root rot rating /Category of infection and description
(a) No infection - No rhizomorph on stem or lateral roots
(b) Light infection - rhizomorph present, tissue not penetrated
(c) Severe infection - More than one lateral root penetrated
(d) Very severe infection - All roots rotted and trees dying or dead

Assessment of root rot Incidence

In each experimental block 50 rubber trees were assessed for root rot incidence. The recommended method of checking and rating the lateral roots of rubber for the presence of rhizomorph growth (Rao, 1975; IRRDB, 2000) was employed: No infection (score, a) -No rhizomorph on stem or lateral roots; Light infection (score, b) - Rhizomorph present, tissue not penetrated; Moderate infection (score, c) - Portion of one lateral root penetrated; Severe infection (score, d) - More than one lateral root penetrated; Very severe infection (score, e) - All roots rotted and trees dying or dead (see pictorial representation in figure 1). The field was assessed for the following root diseases *viz*, White root disease, Red root disease, Brown root disease, *Ustulina* root rot, Poria root rot and Stinking root rot.

Assessment of Panel diseases incidence

In each experimental block, 50 rubber trees were assessed for panel diseases. The disease assessments were evaluated by the severity of the symptoms on the panels, using a gradual grade scale from 0 to 5, in which: 0, no infection; 1, low; 2, below average; 3, average; 4, above average; 5, high. The data where transformed into infection indexes according to Parry (1990). The following diseases were considered:- White fan blight, Panel necrosis, Black stripe and canker, Mouldy rot.

Assessment of stem and branch disease incidence

In each experimental block 50 rubber trees were assessed for the root disease incidences. Stem and branch disease assessments were evaluated by the severity of the symptoms on the stem and branches, using a gradual grade scale from 0 to 5, in which: 0, no infection; 1, low; 2, below average; 3, average; 4, above average; 5, high. The data where transformed into infection indexes according to Parry (1990). The following diseases were considered: - Pink disease, *Ustulina* stem rot, *Phellinus* stem rot and Back necrosis, Thread bight, mistletoes. For Mistletoe evaluation, eighty four trees (4 trees X 21 rows) were randomly evaluated per block. Assessments of infestation were done by using the disease score rating chart from which infestation indices were calculated according to parry (1990). The ratings were 0 = no infestation, 1 = mild infestation (1 to 5 infestation spots), 2= moderate infestation (>5 to <10 infestation spots) and 3= severe infestation (>10 and above infestation spots). All experiments were repeated and mean readings were used for assessments. All data were subjected to analysis of variance and treatment means separated by the use of the least significant difference.

RESULT AND DISCUSSION

The results of the field survey on leaf disease assessments are summarized in Table 3. There were no significant differences on Bird's eye spot (BES) infestation on the different clones observed. Clone Nig 802 recorded the least disease index (DI) of 18.84 while the GT 1 was most susceptible with the highest DI (34.89) recorded. The DI recorded in the other clones had varied DI in the range of 18.84 to 34.89.

Clone GT 1 was most tolerant with the lowest DI (9.41) with *Colletotrichum* leave disease infestation. The DI in GT 1, NIG 800, NIG 801, NIG 802, NIG 803 and NIG 805 did not differ significantly ($p < 0.05$); except with DI recorded in NIG 804, PR 107 and RRIM 707. The most susceptible clone was PR 107 and had the highest DI (20.63).

Corynespora leave disease infestation in the nine clones observed were not significantly ($p < 0.05$) different except in NIG 801 and NIG 803 ($p > 0.05$). RRIM 707 was most tolerant and had the lowest DI (34.39), while the highest was recorded NIG 803 (51.32) which was most susceptible to *Corynespora* leave disease.

Leave infestation with Algal spot; abnormal leaf fall; Powdery mildew and South American Leaf Blight (SALB) were not noticed in the polyclonal field assessed.

TABLE 3. Disease index (D.I) of leaf diseases of rubber at the Rubber Research Institute of Nigeria polyclonal garden

Clone	**Disease Index of leaf diseases (%)**								
RRIN–developed:	BES	CoLD	CLD	AS	ALF	PM	SALB	PLD	
NIG 800	25.84	12.17	39.17	0.00	0.00	0.00	0.00	32.48	
NIG 801	29.53	11.79	47.51	0.00	0.00	0.00	0.00	45.62	
NIG 802	18.84	15.84	35.84	0.00	0.00	0.00	0.00	47.65	
NIG 803	25.12	8.69	51.32	0.00	0.00	0.00	0.00	30.10	
NIG 804	25.01	20.24	42.39	0.00	0.00	0.00	0.00	36.00	
NIG 805	25.36	9.84	40.24	0.00	0.00	0.00	0.00	51.10	
Exotic									
GT 1	34.89	9.41	39.41	0.00	0.00	0.00	0.00	50.50	
PR 107	22.51	20.63	39.82	0.00	0.00	0.00	0.00	32.02	
RRIM 707	26.47	19.17	34.39	0.00	0.00	0.00	0.00	37.65	
Lsd	**16.07**	**7.19**	**12.20**	**0.00**	**0.00**	**0.00**	**0.00**	**4.93**	**α = 0.05**

BES =Bird's eye spot; CoLD = *Colletotrichum* leaf disease; CLD = *Corynespora* leaf disease; AS = Algal spot; ALF = Abnormal leaf fall; PM = Powdery mildew; SALB = South American Leaf Blight; PLD = *Phytophthora* leaf disease.

Significant differences were observed between the nine clones on *Phytophthora* leaf disease infestation (F. pr. < 0.01). Clone Nig 803 was most tolerant to *Phytophthora* leaf disease and had the lowest DI (30.10). The incidences in NIG 801, NIG 803, NIG 804 and PR 107 were not significant ($p < 0.05$). The most susceptible clone was NIG 805 with the highest DI of 51,10 and was not significantly ($p < 0.05$) different from GT 1.

Corynespora leave disease and *Phytophthora* leaf disease recorded higher disease indices compared to the other leave diseases. The results in this study agrees with earlier result by Ogbebor, 2010, where *Corynespora* leaf disease recorded the highest incidence (DI 29.47 to 40.19)

compared to *Colletotrichum* leaf disease (DI 7.61 to 29.86) and Bird's eye spot (DI 14.62 to 32.02). Also *Colletotrichum* leaf fall recorded the least DI in both study. However, this present study consistently recorded higher DIs for Bird's eye spot and *Corynespora* leave disease, while *Colletotrichum* leaf disease is seen to record lower DI in this present study. The higher DI recorded in this study compared to study carried out in 2010 could be attributed to resistance breakdown of the clones to this disease or to changing climatic condition. This study also agrees with report by Ogbebor, 2013; where extensive field inspection of rubber plantations for the incidence of SALB in the rubber growing regions of the country did not record any incidence of the disease.

The study showed that leaf diseases are on the increase in plantations in Nigeria and therefore suggest adequate management measures to be put in place to forestall an epiphytotic situation where latex yield could be affected adversely.

Disease index of root diseases assessments are summarized in table 4. White root rot incidence on the different clones was not significant ($p < 0.05$). However, GT 1 was most tolerant with the lowest DI of 22.43 and was followed by NIG 800. The most susceptible Clone was NIG 802 and had the highest DI of 22.75. The report in this study did not show resistance of the clones to the white root disease. The result is in line with earlier report by Ogbebor *et al.* (2013a) in which incidences of white root rot, carried out in three different rubber estate based on plantation managements demonstrated that incidences of the disease depended on the management practices in the plantations. Similarly, Rao (1975) reported that regular attention to estate sanitation brings about measures in keeping down root diseases.

Incidences of Red root disease, Brown root disease, *Ustulina* root rot, Poria root rot and Stinking root rot were not seen in the polyclonal field assessed. The result agrees with report by Ogbebor *et al*., 2010 and 2013b in which red root rot was reported not to cause damage to rubber trees in plantations in Nigeria. However, fruiting bodies were noticed on dead decaying rubber trees. No documented work had been carried out on Brown root disease, *Ustulina* root rot, Poria root rot and Stinking root rot in Nigeria. This study presents first studies on these root diseases in the country and is reported not to be present in the plantations in Nigeria.

TABLE 4. Disease index (D.I) of root diseases of rubber at the Rubber Research Institute of Nigeria polyclonal garden

Clones	Disease index of root diseases (%)					
	WRD	RRD	BRD	URR	PRR	SRR
RRIN–developed						
NIG 800	22.45	0.00	0.00	0.00	0.00	0.00
NIG 801	22.65	0.00	0.00	0.00	0.00	0.00
NIG 802	22.75	0.00	0.00	0.00	0.00	0.00
NIG 803	22.50	0.00	0.00	0.00	0.00	0.00
NIG 804	22.70	0.00	0.00	0.00	0.00	0.00
NIG 805	22.50	0.00	0.00	0.00	0.00	0.00
GT 1	22.43	0.00	0.00	0.00	0.00	0.00
PR 107	22.50	0.00	0.00	0.00	0.00	0.00
RRIM 707	22.65	0.00	0.00	0.00	0.00	0.00
Lsd	**3.404**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
						α=0.05

WRD = White root disease; RRD = Red root disease; BRD = Brown root disease, URR = *Ustulina* root rot; PRR = Poria root rot; SRR = Stinking root rot.

Disease index of panel disease assessments are summarized in table 5. Significant ($p > 0.05$) differences existed among the different clones on Black stripe and canker infestation. There was no incidence of the disease on PR 107 clone. Infestation of PR 107 was not significantly ($p < 0.05$) different from those in NIG 802, NIG 804, NIG 805and GT 1. Clone RRIM 707 recorded the highest DI (16.70). The DIs in RRIM 707, NIG 800, NIG 801 and NIG 803 were not significantly different ($p < 0.005$).

Infestation by Mouldy rot was significant ($p > 0.05$). Clone NIG 804 and NIG 805 had the lowest DI of both 14.60 and were not different from NIG 801, NIG 802 and GT 1. The most affect was PR 107 and had recorded the highest DI (44.80).

Infestation by panel necrosis was not significantly ($p < 0.005$) among the clones. The lowest DI was recorded in PR 107 (0.00), while the highest was recorded in NIG 801 (15.60). Results indicated that the highest level of disease resistance was recorded in PR 107 where as the most susceptible clone was NIG 801.White fan blight incidence was not recorded in any of the clones assessed.

TABLE 5. Disease index (D.I) of Panel diseases of rubber at the Rubber Research Institute of Nigeria polyclonal garden

Clones	Disease index of Panel diseases (%)			
RRIN–developed:	Black stripe and canker	Mouldy rot	Panel necrosis blight	White fan
NIG 800	15.60	40.40	9.40	0.00
NIG 801	15.60	30.20	15.60	0.00
NIG 802	5.20	25.00	7.30	0.00
NIG 803	10.40	40.60	13.50	0.00
NIG 804	7.30	14.60	4.20	0.00
NIG 805	6.30	14.60	1.00	0.00
Exotic:				
GT 1	9.40	18.80	2.10	0.00
PR 107	0.00	44.80	0.00	0.00
RRIM 707	16.70	35.40	3.10	0.00
Lsd	**10.26**	**17.42**	**17.08**	**0.00**
				α=0.05

Disease index of stem and branch disease assessments are summarized in table 6. Pink disease, *Ustulina* stem rot, *Phellinus* stem rot and Thread blight infestation were not recorded in any of the clones assessed. Significant ($p > 0.05$) differences existed among the different clones on mistletoe infestation. Disease indexes recorded among the nine clones varied from the least to the highest incidence ranging from 28.80 to 50.70 in NIG 804 and NIG. 801 respectively with intermediate scores. Incidence of mistletoe in NIG 800, NIG 802, NIG 803, NIG 804, GT 1 and PR 107 were not significant ($p < 0.05$). The result of the disease indexes in this study (DI 28.80 to DI 50.70) indicated higher disease index compared to earlier result in the field reported by Ogbebor *et al*., 2007 (DI 4.55 to DI 19.22).

TABLE 6. Disease index (DI) of stem and branch infestation on rubber at the Rubber Research Institute of Nigeria polyclonal garden

Clones	Pink Disease	*Ustulina* *Ustulina*	*Phellinus* stem rot blight	Thread	Mistletoes
RRIN–developed					
NIG 800	0.00	0.00	0.00	0.00	38.10
NIG 801	0.00	0.00	0.00	0.00	50.70
NIG 802	0.00	0.00	0.00	0.00	39.40
NIG 803	0.00	0.00	0.00	0.00	41.80
NIG 804	0.00	0.00	0.00	0.00	28.80
NIG 805	0.00	0.00	0.00	0.00	50.00
Exotic:					
GT 1	0.00	0.00	0.00	0.00	38.00
PR 107	0.00	0.00	0.00	0.00	43.20
RRIM 707	0.00	0.00	0.00	0.00	48.80
Lsd	**0.00**	**0.00**	**0.00**	**0.00**	**16.89**
					α=0.05

The high disease index of white root rot and mistletoe recorded in this study are responsible for high numbers of dead trees seen in the polyclonal plantation. The disease severity in all the clones was generally high and potent some grave danger as epiphytotic out brakes are possible if precautionary management are not enforced.

ACKNOWLEDGEMENT

The actor wishes to thank the Management of Rubber Research Institute of Nigeria for her assistance during the course of this study.

REFERENCES

Awoderu, A.V. (1967) Studies on the pathogenic fungi of *Hevea brasiliensis* in Nigeria. B.Sc. project thesis, University of Ibadan, Nigeria. p. 82.

Begho, E.R. (1995) *Hevea* plantation establishment. Proceeding of training Workshop on the *Hevea* Plantation establishment held at RRIN Iyanomo 2nd –4th August 1995. 55 pp.

Harinidi, S.S. and Wisma, S. (1996) Chemical control of Corynespora Leaf - fall. Proceedings of the Workshop on Corynespora Leaf fall disease of Hevea Rubber, Indonesian Rubber Research Institute, Medan, Indonesia, 16-17 December 1996, 215-224.

International Rubber Research and Development Board (2000) International Rubber Research and Development Board (IRRDB) Workshop on *Corynespora* leaf fall of Rubber, 6-9 June, 2 pp.

Jayasinghe, C. K. (2000). *Corynespora* leaf full of rubber in Sri Lanka. Diversity of The Pathogen and Pathogenesis.

Proceedings of the International Rubber Research & Development Board *Corynespora* leaf fall disease workshop in Kuala Lumpur and Medan from 6th to 14th June, 2000.

Nandris, D. Nicole, M., Geiger, J.P. (1983) Inoculations of young plants of *Hevea brasiliensis* by *Rigidoporus lignosus* and *Phellinus noxius***.** *Eur. J. For. Pathol*. 13:65-76.

Ogbebor, N.O. and Adekunle, A.T. (2005) Inhibition of conidial germination and mycelial growth of *Corynespora cassiicola* (Berk and Curt) of rubber (*Hevea brasiliensis* Muell. Arg.) Using extracts of some plants. *African Journal of Biotechnology*, 4(9): 996 – 1000.

Ogbebor, N.O., Omorusi, V.I., Evueh, G.A. (2007) Evaluation of nine *Hevea brasiliensis* clones for mistletoe infestation and the effect on latex yield. **Journal of Natural Rubber Research,** 20 (1 & 2): 87 – 89.

Ogbebor, N.O. (2010) Intensity of occurrence of three common leaf diseases on mature rubber trees in Nigeria. **Journal of Natural Rubber Research,** 23 (1&2): 105-108, 2010.

Ogbebor, N.O., Adekunle, A.T., Eghafona, N.O., Ogboghodo, A.I. (2010) *Ganoderma psuedoferreum*: Biological control possibilities with microorganisms isolated from soils of rubber plantations in Nigeria. African Journal of General Agriculture. Vol. 6, No. 4, December 31, 2010.

Ogbebor, N.O. (2013). South American Leaf Blight: Identification and Management of disease outbreak in Nigeria. **Nature and Science,** 11(12): 106-109. (ISSN: 1545-0740).

Ogbebor, N.O., Adekunle, A.T., Eghafona, O.N., Ogboghodo, A.I. (2013a) Incidence of *Rigidoporus lignosus* (Klotzsch) Imaz of Para rubber in Nigeria. *Researcher* 2013;5(12):181-184]. (ISSN: 1553-9865). http://www.sciencepub.net/researcher. 24

Ogbebor, N.O., Omorusi, V.I., Adekunle, A.T. (2013b). Incidence of red root disease in Hevea caused by *Ganoderma psuedoferreum*: a first report from Nigeria. **Rubber Science,** 26(2): 304-307.

Parry, D. (1990) Plant Pathology in Agriculture. Cambridge University Press. U. K. 55pp.

Rao, B.S. (1975) Maladies of *Hevea* in Malaysia. Rubber Research Institute Malaysia; Kuala Lumpur. 108 pp.