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Evaluation of *Hevea brasiliensis* clonal resistance to wind damage in Nigeria

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Keywords: *Hevea* clones, wind damage, canopy load, clonal garden.

1 SUMMARY

A field survey was conducted to determine the effect of wind damage on *Hevea* clones in a 40-hectares polyclonal garden at the Rubber Research Institute of Nigeria (RRIN). Nine *Hevea* clones were evaluated for resistance to wind damage. These included six local (NIG. 800, 801, 802, 803, 804, 805) and three exotic (PR 107, GT1 and RRIM 707) clones. Parameters assessed were branch/trunk snapping, canopy load damage and root lodging. A total of 463 trees planted in a sub plot were sampled for each clone replicated thrice in three blocks. Wind velocity was evaluated for three months during the rain stormy period from August to October, 2006. Results showed that mean percentage *Hevea* resistance to wind damage varied among the clones with the least and highest damage ranging from 2.23 to 8.05% in RRIM 707 and NIG 804 clones, respectively and with values between the two extremes. The low damage level indicated that the clones are generally tolerant to wind damage. However, the least level of resistance recorded in NIG 804 clone was significantly different from the other clones (LSD=5.83>4.10-3.85) except for NIG 805 clone (LSD= 3.02<3.85) and NIG 802 (LSD=2.94<3.85). Average wind velocity was generally low (1.7m per sec.) to produce any significant wind damage effect on the branch and trunk. Effect of wind damage on canopy load was significant (P<0.05). NIG 804 clone was the most affected (87.83%) while the least affected was in NIG 800 clone (16.42%). The high percentage of canopy load damage recorded in NIG 804 clone was significantly different from values obtained for other clones (LSD=39.77<71.41 – 46.15) except for NIG 802 clone (LSD=39.77>37.43). The susceptibility of canopy to wind damage was observed to be related to the heavy canopy load bearings. No appreciable incidence of root lodging was obtained. The present study reports the evaluation of wind damage on *Hevea* clones which was generally low and also showed that wind damage may not be of serious economic consequence to rubber farmers.

1 INTRODUCTION

Hevea brasiliensis, like any other forest tree, is subject to risk of wind damage which can lead to reduced performance and low productivity (Yee et al., 1969). Plant parts prone to wind damage include branch, trunk, canopy, and root. Wind influences may vary among clones due to clonal inherent resistance capacity, and clonal susceptibility to wind damage is usually associated with both above and below ground characteristics.

Above ground characteristics that may predispose trees to damage may include tree or stand age, height, crown form, and clonal composition. Tree height, unbalanced branches, heavy canopy load and additional weight from rain water deposited on the leaves together with poor girth increment on tapping contribute significantly to crown heaviness with high turning movement around the trunk which can easily predispose the trees to snapping and toppling (Vijayakumar et al., 2000). The effect of wind is pronounced in elevated areas, and is more severe during rainstorm especially when accompanied with high wind velocity. Wind effect is implicated in morphological damage and drastic effect on the physiological processes (Vijayakumar et al., 2000). Grace (1977) attributed asymmetric structural disposition of trees with branches tending to the leeward side, to trees having heavy canopies. Such trees with heavy canopies are known to loose resilience and topple over. Vijayakumar et al. (2000) reported that parts of tree with structural crotches, as well as those having maximum girthing and canopy development are more easily damaged by wind.

The impact of wind depends on its severity. In rubber plantations, wind speeds have been determined in the range of 1 to 4m/s (Oldeman & Frere, 1982). In India, wind velocities and their consequences were categorized as 1.0 to 1.9 m/s with no retardation consequence and from 2.0 to 2.9 m/s affected latex flow (Vijayakumar et al., 2000). At above 3 m/s, severe effect on growth and latex flow were observed. From 8 to 14 m/s, the strong winds caused crinkling and laceration of young trees. Above 17 m/s, the wind velocity resulted to snapping of branch and trunk of trees while stronger winds with velocity over 24 m/s were capable of uprooting trees. Generally, the rate of transpiration is greatly increased at high wind velocity (Milne, 1979).

Various remedial approaches to wind damage have been suggested (Vijayakumar et al., 2000). Planting of wind breaks such as the fast growing and wind resistant Acacia species, *Eucalyptus*, *Homslium hainsnensis*, *Michelia macclurei* and *Camellia oleifera* have been employed in China to counteract wind damage (Zongdao & Xuegin, 1983). Intercropping such as planting of bananas, cassava, and coffee can "protect" young rubber trees from the effect of strong winds. Generally, selective pruning at the early growth stages, of heavy lateral branches and reduction of canopy weight as well as adequate fertilizer application can also be effective measures to forestall the devastating effect of wind damage in rubber plantations.

The present study aimed at determining the consequences of the various degrees of wind intensity in a rubber plantation, and suggesting measures for improving wind resistance for effective growth and biomass (latex) production.

2 MATERIALS AND METHODS

A field trial was carried out between August and October, 2006 in a 40 ha polyclonal garden at the main station of the Rubber Research Institute of Nigeria, Iyanomo, Benin City, Nigeria. The experimental field plot (Table 1) contained Hevea clones which were evaluated for resistance against wind damage, and included six local clones (NIG. 800, 801, 802, 803, 804, 805) and three exotic clones (PR 107, GT1, RRIM 707). A total of 463 trees were planted to a sub plot for each clone in one whole block which was replicated three times in a complete randomized block design.The plant parts investigated for wind damage were branch /trunk, and canopy load. Each sub-plot contained 463 rubber trees and was evaluated for wind damage in three replications. The extent of damage or severity of individual plats per plot was assessed and their percentage values obtained.

The prevailing wind velocity was assessed for 156 days between 2006 and 2007 at fortnightly and the intensity calculated in meters per second. Wind damage on the trees and its concomitant effect on latex (biomass) yield were assessed monthly for the period.

Data were subjected to analysis for statistical significance for wind damage, using analysis of variance (ANOVA), and significantly different mean values for each clone were separated from each other using the least significant difference (LSD) test.

Table 1: Layout of the experimental plot

21	NIG 800	PR 107	RRIM 707	NIG 805	9
21	NIG 805	NIG 802	NIG 803	GT 1	8
21	NIG 801	RRIM 707	NIG 804	NIG 802	7
21	PR 107	NIG 805	NIG 800	NIG 803	6
21	GT 1	NIG 800	NIG 801	NIG 804	5
21	NIG 803	GT 1	PR 107	RRIM 707	4
21	NIG 802	NIG 804	GT 1	NIG 801	3
21	RRIM 707	NIG 803	NIG 802	NIG 800	2
21	NIG 804	NIG 801	NIG 805	PR 107	1
21	22	22	22	22	
	I	II	III	IV	
				REPLICATES	

3 RESULTS AND DISCUSSION

The results showed that wind damage varied among the clones (Fig. 1) but the clones were generally tolerant to wind damage. NIG 804 clone sustained the highest damage (8.05%) while least damage was in RRIM 707 (2.23%) clone; for other clones the percentage damage recorded between the highest and the least damage were 3.45, 2.59, 5.18, 3.96, 5.04, 2.52 and 3.82, for NIG 800, NIG 801, NIG 803, NIG 805, PR 107 and GT 1 respectively (Fig. 1), which indicated the numbers of trees damaged in each plot. The numbers of trees affected showed a variation among the clones as 48, 36, 72, 55, 112, 70, 35, 53 and31 in NIG 800, NIG 801, NIG 802, NIG 803, NIG 804, NIG 805, PR 107, GT 1 and RRIM 707 respectively. Statistical analysis of the effect of the wind damage was not significantly different, however, the highest effect of damage on NIG 804 clone was significantly different from the other clones (LSD = 5.83-4.10 > 3.85) except for NIG. 805 (LSD = 3.02 < 3.85) and NIG. 802 (LSD = 2.94 < 3.85).

The average wind velocity in the plantation during the period of study was 1.7m per sec. which tends to agree with the 1-4m per sec mean speed existed in rubber growing areas reported by Oldeman and Frere (1982). As observed by Vijaykumar et. al., (2000) that wind velocity of 1.0 to 1.9m per sec may not cause wind damage or retardation, our results (1.7m per sec.) did not produce significant effect of wind damage on the clones investigated.

The effect of wind damage on canopy load was inconsistent, being significant (P<0.05) in some of the clones. NIG 804 clone was the most affected (87.83%) while least affected was NIG. 800 clone (16.42%) (Fig. 2). The high score of damage in NIG 804 clone was significantly different from the values obtained for other clones (LSD = 71.41 > 39.77 except for the non significant value with NIG. 802 clone (LSD=37.43<39.77). There were no significant differences of the effect of wind damage among the other clones. Again the low wind velocity (1.7m per sec.) lacked the capacity to cause consequential damage on the canopy load. Of the total number of rubber trees (1389) for the three sub-plots i.e. of the three replications, the numbers of trees that snapped or toppled and percentage values of damage were 228 (16.41%), 438 (31.53%), 748 (53.85%), 499 (35. 93%), 1220 (87.83%), 579 (41.68%), 304 21.89%), 457 (32.90%) and 322 (23.18%) for NIG 800, NIG 801, NIG 802, NIG 803, NIG 804, NIG 805, PR 107, GT 1 and RRIM 707, respectively (Fig 2). The clones that snapped

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or toppled were mainly due to the heavy canopy load bearings due to lack of pruning.

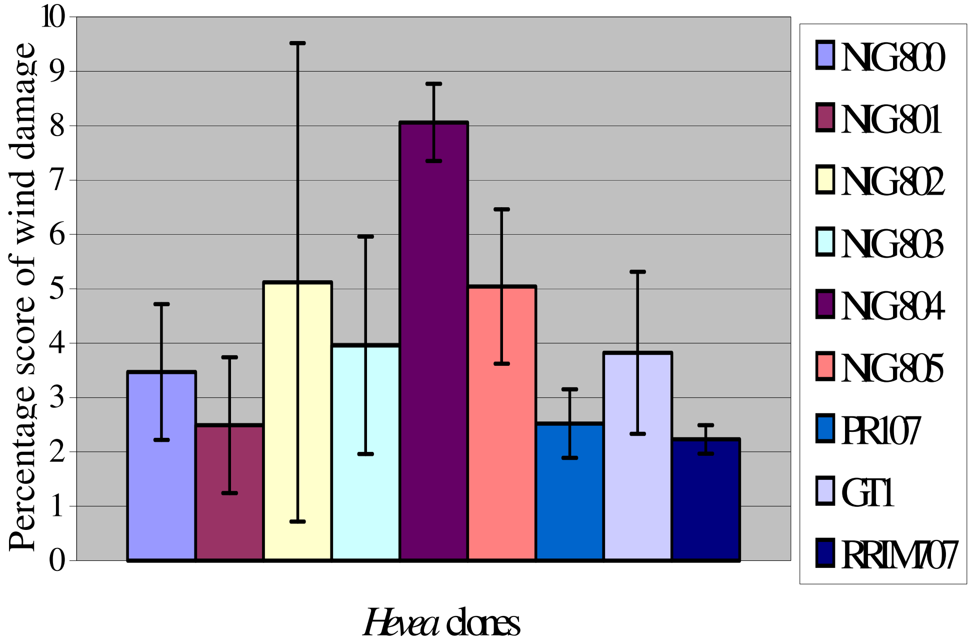

Figure 1: Percentage of wind damage on branch/ truck of *Hevea* clone
█=Legend represent mean of three replications; **I**=bar represents Standard Error (SE)

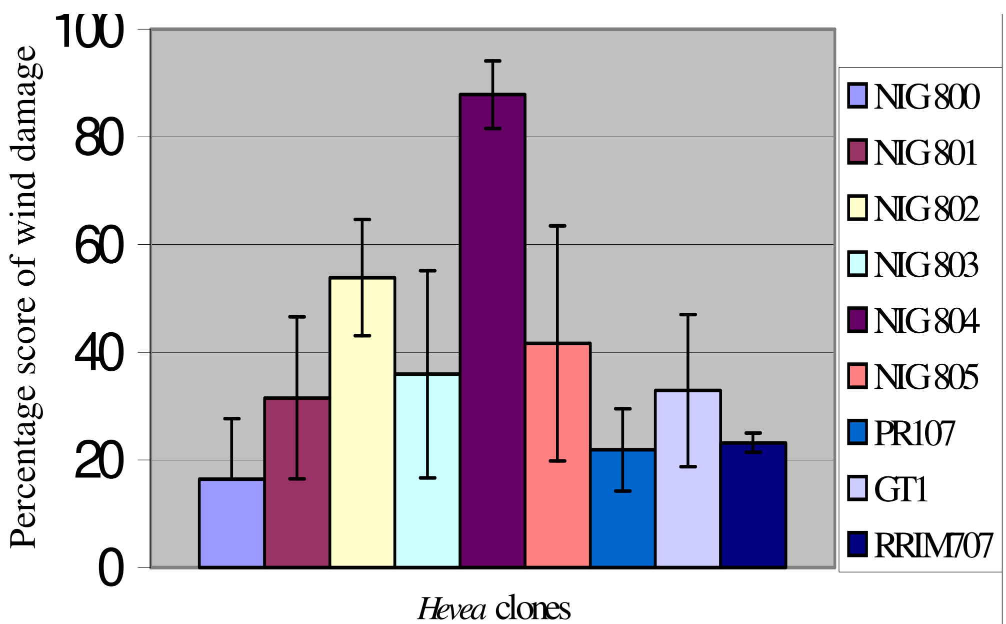

Figure 2: Percentage of wind damage on canopies of *Hevea* clones
█=Legend represent mean of three replications; **I**=bar represents Standard Error (SE)

Latex (biomass) yield obtained for August, September and October were 25, 047.13; 23, 167.66 and 27, 546.57kg totaling 78, 863.16kg) which was higher than the yield recorded in dry windy harmantan periods of January, (19,414.93kg), February (15,947.60kg) and March (11,033.81kg) totaling 46,396.14kg. These yields do not indicate any adverse effect of wind or any of the other factors associated with the raining season.

No effect of wind damage on root lodging was obtained and the root geometry distribution was intact for firm anchorage. These results are preliminary reports indicating possible damage effects of wind to rubber trees. The results suggest precautionary measures to avoid wind damage effects especially in plantation establishment. Generally, exotic clones are more resistant to wind damage than the local clones. Breeding improvement is suggested for further investigation. No serious wind damage to rubber trees was recorded but results imply that factors that predispose serious damage can be prevalent in the rubber plantation. Farmers may need not worry about wind damage effects but should carry out adequate sanitation of plantation especially decreasing disease inoculum materials. Disease such as white root rot (*Rigidoporus lignosus*), and insect borers that can lead to loss of tree stands should be controlled. Severe loss of stands leaving spaces can result in great wind storm that can cause damage effect. This is in addition to the traditional control strategy such as avoidance of strong wind routes, exclusion, eradication, protection, resistance and therapy in designing the comprehensive strategy of wind damage effect.

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