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(RESEARCH ARTICLE)

Germplasm of *Hevea brasiliensis* in Nigeria

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Abstract

New countries adopting the cultivation of the rubber tree have the challenge of sourcing for germplasm of *Hevea brasiliensis*. In addition, breeding for adverse weather occasioned by climate change will require robust germplasm for genetic improvement. The objective of this study therefore was to provide inventory of available germplasm of *Hevea brasiliensis* in Nigeria. Census of germplasm of *H. brasiliensis* in Rubber Research Institute of Nigeria was conducted, and data was subjected to t-test. There was percentage representation of the various types of germplasm. There were seventy six genotypes represented by the highest number of 50 from Malaysia, 10 from Indonesia, 6 from Nigeria, 4 from Sri Lanka, 3 from Brazil, 2 from Liberia and one of Vietnam origin. The germplasm consisted of 4% of genotypes of unknown pedigree, 20% of primary clones and 76% of improved clones. This number, origin and type of germplasm suggest potential for utilization of *Hevea* germplasm in Nigeria for genetic improvement. Possible exchange under suitable bilateral or multilateral arrangement is hereby recommended.

Keywords: *Hevea brasiliensis*; Germplasm; Budwood/source bush garden

1. Introduction

The plant *Hevea brasiliensis* Muell. Arg. is valued for the natural rubber obtained from the tree. Among other crops producing natural rubber called latex are *Parthenium* spp., *Funtumia* spp., *Ficus* spp., *Manihot* spp. etc [1]. The advantage of *H. brasiliensis* is the ability to produce latex with repeated cuttings at close and regular frequency. The scientific interest in natural rubber from *H. brasiliensis* dates back to 1736 and in 1876 there was seed collection from its place of origin, which is the Amazon basin in South America [2]. The first use of latex from *H. brasiliensis* was the eraser to clean pencil writing. It is believed that the name rubber is closely associated with this early discovery to rub off pencil writing. The boost to the interest in *H. brasiliensis* was the discovery of vulcanization in 1839 leading to the production of tyre and tubes using vulcanized natural rubber [3]. Till date, the production of automobile tyres and tubes, rubber bearings and bushings requires high input of natural rubber. Natural rubber has the advantage of heat resistance over synthetic rubber, hence the relevance of natural rubber in production of heat tolerant items such as tyre, tube, bushings and bearings.

With the discovery of the importance of natural rubber in the nineteenth century, several countries in Asia and Africa embarked on germplasm collection, evaluation, recommendation of improved planting materials and plantation development. Among these countries were Malaysia, Thailand, India, Vietnam in Asia and Liberia, Cote d'Ivoire, Nigeria, Cameroun, Democratic Republic of Congo in Africa. In recent times, Ghana in Africa and Myanmar in Asia have embarked on research and development of *H. brasiliensis* and they will source for *Hevea* germplasm. The International Rubber Research and Development Board is encouraging member countries to exchange genetic materials of *H. brasiliensis* [4]. In addition, the concerns of environmental degradation occasioned by climate change require an environment-friendly long duration crop such as the rubber tree. In this regard, extensive germplasm collection,

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conservation and evaluation will be required to develop new clones adapted to adverse weather conditions [5]. The knowledge of available genetic materials of *H. brasiliensis* in the various countries to facilitate exchange is necessary in order to address these challenges. The objective of this paper therefore was to provide update on available germplasm of *H. brasiliensis* in Nigeria.

2. Material and methods

The Department of Crop Improvement and Management of the Rubber Research Institute of Nigeria (RRIN) carried out census of germplasm available in source bush gardens of the institute. The available clones in the source bush gardens at RRIN, Iyanomo, Nigeria were documented by simple census and classified based on the country of origin. The location coordinates were 6°00' - 6°15' N and 5° 30' - 5°45' E as described by Begho et al. [6]. There was mean separation using t-test to determine the relative abundance of country clones in the source bush gardens. Percentage of status of the clones was calculated.

3. Results

The Rubber Research Institute of Nigeria (RRIN) has the national mandate for research and development of all latex producing plants in Nigeria including *Hevea brasiliensis* [7]. It is a member of the International Rubber Research and Development Board [4]. Germplasm collection in RRIN commenced in the 1960s till the 1980s and there is effort to benefit from the on-going multilateral clone exchange coordinated by the IRRDB [8]. From the 1960s till the 1980s, germplasm collected included clones of the following countries: Malaysia, Indonesia, Sri Lanka, Vietnam, Brazil and Liberia. Since the 1960s, RRIN embarked on genetic improvement of *H. brasiliensis* leading to the development of two sets of improved clones called NIG 800 series and NIG 900 series [9]. The RRIN therefore has germplasm of *H. brasiliensis* consisting of primary and improved cultivars. The term clone was used to describe the cultivars of *H. brasiliensis* since propagation is by vegetative means [10]. Field germplasm of *H. brasiliensis* was maintained in source bush gardens, also called budwood gardens [11].

There was a total of seventy six clones of *H. brasiliensis* in the source bush gardens of the Rubber Research Institute of Nigeria from seven countries (Tables 1 and 2). The number of collections from Malaysia was the highest at fifty clones (Table 2). Other collections were ten, six, four, three, two and one from Indonesia, Nigeria, Sri Lanka, Brazil, Liberia and Vietnam respectively. The relatively high number of clones from Malaysia, Indonesia and Sri Lanka was due to early effort of research and development of natural rubber dating back to the 1890s, 1913 and 1926 in Indonesia, Sri Lanka and Malaysia respectively.

This genepool in Nigeria suggests that were some of these clones may have been lost in their countries of origin, Nigeria may provide such clones under relevant bilateral or multilateral arrangement. This is the advantage of duplicate gene pool as same genotypes conserved in various rubber producing countries can serve as back up in the event of loss of genotype as recommended by Normah et al. [12]. The six Nigerian clones have been registered with the relevant agencies in Nigeria [13]. Poor representation of germplasm of four countries viz Sri Lanka, Brazil, Liberia and Vietnam at less than five clones per country suggests improvement in germplasm exchange between Nigeria and these countries. It is noteworthy that Nigeria has no representation of clones from India and Thailand, which are among the first generation nations in the research, development and production of natural rubber from *H. brasiliensis* [14]. This will be addressed in future.

Among the *Hevea* germplasm in Nigeria, 3% consisted of clones of unknown status, 20% of primary clones and 76% for improved clones (Table 2). Clones of unknown status present a challenge as clarification may be obtained from the country of origin. The primary clones were rich sources of unexploited genes as they were selected from wild collections. The first set of improved clones was derived from crosses among the wild genotypes. For instance, RRIM 600 and RRIM 635 were selected from the cross between Tjir 1 and PB 86 that are primary clones (Table 1). The importance of the primary clones was also evident in many of the improved clones who have a parent as a primary clone. An example is PB 86, a primary clone which was a parent to a number of improved clones developed in Brazil and Malaysia. In Nigeria, three primary clones (Har 1, PR 107 and Tjir 1) were parents of improved clones (Table 1). The high number of improved clones at 76% was due to more than century gap between the earlier research effort of Malaysia, Sri Lanka, Indonesia, and Nigeria such that during introduction of germplasm in Nigeria in the 1960s, there was a pool of improved clones for collection [15].

Table 1 Clones of *Hevea brasiliensis* in Rubber Research Institute of Nigeria

S/No	Clone	Origin	Parentage
1.	IAN 2880	Brazil	Fx 516 x PB 86
2.	IAN 2960	Brazil	Fx 4073 x PB 86
3.	IAN 2967	Brazil	Unknown
4.	AV 49	Indonesia	Primary clone
5.	AV 157	Indonesia	Primary clone
6.	AV 275	Indonesia	Primary clone
7.	AV 1581	Indonesia	AV 214 x AV 256
8.	AV 1734	Indonesia	AV 214 x AV 374
9.	BR 2	Indonesia	Primary clone
10.	GT 1	Indonesia	Primary clone
11.	LCB1320	Indonesia	Primary clone
12.	PR 107	Indonesia	Primary clone
13.	Tjir 1	Indonesia	Primary clone
14.	Har 1	Liberia	Primary clone
15.	Har 2	Liberia	Unknown
16.	CH 26	Malaysia	BR 2 x BR 2
17.	CH 30	Malaysia	BR 2 x BR 2
18.	RRIM 501	Malaysia	Pil A 44 x Lun A 44
19.	RRIM 509	Malaysia	Pil A44 x Lun N
20.	RRIM 513	Malaysia	PB 49 x Pil B 84
21.	RRIM 519	Malaysia	Pil A 44 x Pil B 16
22.	RRIM 526	Malaysia	Pil B 58 x Pil D 65
23.	RRIM 527	Malaysia	Pil B 50 x Pil B 84
24.	RRIM 600	Malaysia	Tjir 1 x PB 86
25.	RRIM 602	Malaysia	Tjir 1 x Gl 1
26.	RRIM 603	Malaysia	PB 86 x Pil B 84
27.	RRIM 604	Malaysia	Tjir 1 x PB 49
28.	RRIM 605	Malaysia	Tjir 1 x PB 49
29.	RRIM 606	Malaysia	Tjir 1 x PB 49
30.	RRIM 607	Malaysia	Tjir 1 x PB 49
31.	RRIM 608	Malaysia	AV 33 x Tjir 1
32.	RRIM 609	Malaysia	AVROS 157 x BD 5
33.	RRIM 610	Malaysia	RRIM 504 x Tjir 1
34.	RRIM 611	Malaysia	RRIM 504 x Tjir 1
35.	RRIM 612	Malaysia	AV 157 x PB 49
36.	RRIM 613	Malaysia	Tjir 1 x RRIM 509
37.	RRIM 614	Malaysia	Tjir 1 x RRIM 509
38.	RRIM 616	Malaysia	Tjir 1 x RRIM 507

39.	RRIM 617	Malaysia	BR 2 x RRIM 500
40.	RRIM 619	Malaysia	Tjir 1 x RRIM 501
41.	RRIM 620	Malaysia	RRIM 501 x RRIM 511
42.	RRIM 621	Malaysia	RRIM 504 x Tjir 1
43.	RRIM 622	Malaysia	Tjir 1 x Pil B 84
44.	RRIM 624	Malaysia	Tjir 1 x RRIM 529
45.	RRIM 625	Malaysia	Tjir 1 x RRIM 526
46.	RRIM 627	Malaysia	Tjir 1 x RRIM 526
47.	RRIM 628	Malaysia	Tjir 1 x RRIM 527
48.	RRIM 630	Malaysia	Tjir 1 x RRIM 527
49.	RRIM 631	Malaysia	RRIM 500 X Lun N
50.	RRIM 632	Malaysia	Tjir 1 x PB 49
51.	RRIM 634	Malaysia	Tjir 1 x PB 186
52.	RRIM 635	Malaysia	Tjir 1 x PB 86
53.	RRIM 636	Malaysia	Pil B 84 x PB 86
54.	RRIM 637	Malaysia	PB 49 x Pil B84
55.	RRIM 638	Malaysia	RRIM 500 x Lun N
56.	RRIM 707	Malaysia	RRIM 632 x RRIM 501
57.	PB 5/51	Malaysia	PB 56 x PB 24
58.	PB 5/63	Malaysia	PB 56 x PB 24
59.	PB 28/59	Malaysia	Primary clone
60.	PB 23	Malaysia	Primary clone
61.	PB 86	Malaysia	Primary clone
62.	PB 213	Malaysia	PB 56 x PB 86
63.	PB 217	Malaysia	PB 5/51 x PB 6/9
64.	PILLA 44	Malaysia	Primary clone
65.	FRIMSE	Malaysia	Unknown
66.	NIG 800	Nigeria	RRIM 501 x Har 1
67.	NIG 801	Nigeria	RRIM 600 x PR 107
68.	NIG 802	Nigeria	RRIM 501 x RRIM 628
69.	NIG 803	Nigeria	RRIM 600 x PR 107
70.	NIG 804	Nigeria	RRIM 600 x Tjir 1
71.	NIG 805	Nigeria	RRIM 628 x RRIM 501
72.	NAB 15	Sri Lanka	Tjikadoe seedling
73.	RRIC 45	Sri Lanka	RRIC 8 x Tjir 1
74.	RRIC 75	Sri Lanka	RRIC 8 x Tjir 16
75.	War 4	Sri Lanka	Primary clone
76.	IRCI 7	Vietnam	BD 10 x BD 5

Table 2 Country of origin of germplasm of *Hevea brasiliensis* in Rubber Research Institute of Nigeria

S/No.	Country	Number of clones*	Status		
			Primary	Improved	Unknown
1.	Malaysia	50a	4	45	1
2.	Indonesia	10b	8	2	Nil
3.	Nigeria	6b	Nil	6	Nil
4.	Sri Lanka	4b	2	2	Nil
5.	Brazil	3b	Nil	2	1
6.	Liberia	2b	1	Nil	1
7.	Vietnam	1b	Nil	1	Nil
	Total	**76**	**15 (20%)**	**58 (76%)**	**3 (4%)**

*: Frequencies followed by different letters are significantly different (t-test, p = 0.05)

4. Conclusion

Nigeria has germplasm obtained from seven countries out of the first nine countries involved in development of the natural rubber industry world-wide. These included improved clones developed in Nigeria. The country, Nigeria is therefore in a position to feed new entrant-countries in improvement and cultivation of *H. brasiliensis* with germplasm. The available germplasm may also facilitate breeding for adaptation to climate change as breeding *Hevea* for adaptation to adverse conditions will require wide genetic variability.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors hereby declare that there is no conflict of interest.

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