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ASSESSMENT OF NIGERIAN WILD OIL PALM (*ELAEIS GUINEENSIS* JACQ.) POPULATIONS IN CROSSES WITH DELI TESTERS

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A B S T R A C T

To widen the genetic variability and especially to enrich agronomic qualities of populations of oil palm (*Elaeis guineensis* Jacq.) of Group B used in the breeding scheme, a study was led on four populations (Abak, Ahoada, Ayangba and Uli) prospected in Nigeria. Sixteen palms chosen in these populations were evaluated in crosses with 10 Deli testers derived from the second cycle of reciprocal recurrent selection scheme. The LM 2 T × DA 10 D and LM 2 T × DA 115 D progenies derived from the first breeding cycle were used as controls. The bunch production components, vascular wilt susceptibility and vertical growth rate were used as criterion of evaluation. The Abak × Deli, Ahoada × Deli and Uli × Deli materials were characterized at the young age by bunch productions higher than that of the LM 2 T × DA 10 D control. The bunch productions at the adult period of various Nigerian × Deli materials were lower than those of the two controls. Abak × Deli material was tolerant to the vascular wilt. Ayangba × Deli material had a slower vertical growth rate than those of the two controls. Seven parents were identified in the four populations for their good general combining ability for the precocity and/or vascular wilt tolerance or the slow vertical growth rate. Prospects for utilization of these parents for the improvement of bunch production at the young age, the reduction of the vertical growth and the diversification of sources of vascular wilt tolerance of populations used in the reciprocal recurrent selection scheme were discussed.

Keywords: Agronomic traits, *Elaeis guineensis*, reciprocal recurrent selection.

INTRODUCTION

The genetic improvement of oil palm (*Elaeis guineensis* Jacq.) in Côte d'Ivoire is based on a reciprocal recurrent selection scheme. This breeding strategy, adopted on the La Mé station since 1957, uses two groups of populations with complementary production components (Meunier and Gascon, 1972). The Group A is characterized by palms with a small number of large bunches (Deli) and Group B, the La Mé and Yangambi populations (West Africa), includes palms with a large number of small bunches. This selection scheme is comprised of several successive breeding cycles. Each cycle includes progeny tests (Group A × Group B crosses) to identify the best parents, which were then recombined within each group to make up the improved populations or basic populations for the next cycle.

The implementation of this breeding strategy made it possible to perform a progression of 60 % on the oil yield in 50 years of selection (Durand-Gasselin *et al.*, 2009). However, this progress was accompanied by a reduction of the genetic base of populations used (CAO, 1995). This situation can hamper genetic progress in the long-term. To widen the genetic base and especially to enrich agronomic qualities of populations of breeding scheme, additional materials derived from surveys of wild oil palm groves and exchanges between research stations were introduced on the La Mé station (Meunier, 1969; Meunier, 1976). An evaluation of these populations in progeny tests starting from their crosses

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with acknowledged parents of breeding scheme was carried out (Adon *et al.*, 1998; Bakoumé *et al.*, 2001). The best parents of these populations were introduced into the improved populations of the two groups of selection scheme and will make it possible to ensure an important progress in the next breeding cycles. The Abak, Ahoada, Ayangba and Uli populations prospected in wild groves from Nigeria are comparable with Group B of breeding scheme (Adon *et al.*, 1993). They present a substantial variability in relation to the vascular wilt (which is the gravest oil palm disease in Africa), a good bunch and fruit quality, a good fluidity of oil and a substantial variability for the vertical growth. These populations can be useful for the enrichment of agronomic qualities of populations of Group B used in the breeding scheme. It is thus to take advantage of these qualities for oil palm breeding that palms originating from these populations were evaluated in crosses with Deli testers (Group A) of selection scheme.

MATERIALS AND METHODS

Planting material: Nigerian wild oil palm populations which were the subject of this study originated from Abak, Ahoada, Ayangba and Uli regions. They were introduced at the La Mé station in 1978 following a survey of wild oil palm groves carried out by the Malaysian Agricultural Research and Development Institute (M.A.R.D.I.) and the Nigerian Institute For oil palm Research (N.I.F.O.R.). They are comprised of progenies obtained by free fecundations of 21 *tenera* palms. Sixteen *tenera* palms were chosen in these various progenies on the basis of heritable characters (bunch number, percentage of pulp on fruit and vertical growth) to represent these populations. These trees were evaluated in progeny test starting from their crosses with 10 Deli palms used as testers (Table 1). These Deli testers were chosen in the second breeding cycle of selection scheme mainly for their good general combining ability (gca) for the oil yield. Thirty Nigeria × Deli progenies derived from the Abak × Deli, Ahoada × Deli, Ayangba × Deli and Uli × Deli crosses were used for the realization of this study.

Table 1. Crosses between palms chosen in Nigerian wild populations and Deli testers.

Nigerian wild populations		Deli testers of the second cycle of breeding scheme									
	Parents	LM 3038 D	LM 3047 D	LM 3257 D	LM 4441 D	LM 4564 D	LM 5662 D	LM 5960 D	LM 5970 D	LM 5971 D	LM 5972 D
ABAK	LM 11209 T	X									X
	LM 11211 T							X		X	
	LM 11212 T		X	X							
ULI	LM 11214 T		X	X							
	LM 11215 T									X	
	LM 11216 T					X					X
	LM 11217 T				X		X	X			
AHOADA	LM 11218 T										X
	LM 11219 T							X		X	
	LM 11221 T					X			X		
	LM 11222 T		X			X	X				
AYANGBA	LM 11223 T		X								
	LM 11224 T						X	X	X		
	LM 11225 T					X					
	LM 11226 T										X
	LM 11227 T			X						X	

X: cross between Nigerian parent and Deli tester.

The LM 2 T × DA 10 D and LM 2 T × DA 115 D progenies of the 1st breeding cycle of selection scheme were used as controls. These Deli × La Me hybrids were largely diffused in the village and industrial groves in Côte d'Ivoire.

Study site: This study was laid on the La Mé station of the National Center of Agronomic Research. It is located in withdrawal of the Gulf of Guinea (5° 26' N; 3° 50' W; 23 m). This station is located in ombrophilous zone of forest, under an equatorial climate of transition. This climate is characterized by four seasons. The two seasons of rains are dominant (March-June and September-November) and are intercalated by two dry seasons (December-February and July-August). The last 15 years of the station were characterized by an average annual pluviometry of 1600 mm, an average hydrous deficit of 307 mm and a monthly average temperature of 27 ° C.

Experimental design: All palms of various progenies (32 on the whole) were planted according to a block of Fisher with 6 replications. Each experimental unit is comprised of 12 palms (either 72 palms per progeny). These palms were planted in 1996 at the standard density of 143 palms per hectare after felling of an old palm grove.

Parameters measured

Bunch production components: The bunch production was observed palm by palm for 7 years from the start of bearing (3 years after planting). Bunches were collected on each tree at a frequency from 2 to 3 times per month. The bunch number (BN) and total bunch weight (TBW) were recorded with each harvest. These observations cumulated on each crop year made it possible to determine the average bunch weight (ABW). The bunch production components of the first 3 years (3 to 5 years) correspond to the young age and the following 4 years (6 to 9 years) the adult stage.

Vertical growth rate: The height of stem (H) was measured at 9 years on each straight and healthy palm, starting from the axil of frond 33 to the ground level. The vertical growth rate was calculated from the formula of Jacquemard (1980):

$$Vc = H / (N - P0)$$

Vc: vertical growth rate (cm/year)

N: tree age expressed in years and tenths of years

P0: the age of imaginary take off from the soil of leaf 33 of an oil palm, after which the speed of growth is constant (estimated at 3.5 years).

Vascular wilt susceptibility: Each progeny was represented by 160 seedlings arranged in main plots of 20 seedlings in 8 blocks. The preparation of the inoculum, its application in the pre-nursery at 2-leaf stage and the identification of wilt-infected plants were carried out according to the method of Renard *et al*. (1972). However, the stock monospore 179 was used for the preparation of the inoculum. The assessment of vascular wilt susceptibility of each progeny was carried out starting from its index (I) which was derived from the following formula:

$$I = \frac{P.100\ wilt - infected\ plant\ of\ a\ progeny}{P.100\ wilt - infected\ plant\ in\ all\ progenies\ in\ the\ test} \times 100$$

The wilt index of each parent (Ip) was obtained starting from the mean index of progenies of this latter. The wilt index of each Nigerian × Deli material (Im) was obtained starting from the mean index of all its progenies. A progeny, a parent or a Nigerian × Deli material with wilt index less than 100 is known as tolerant to vascular wilt. It is susceptible in the contrary case.

Statistical analyses: The descriptive statistics parameters (average and coefficient of variation) and analyses of variance followed by the test of mean comparisons of Newman and Keuls to the risk of 5% (Dagnelie, 1998) were used on parameters measured to compare various Nigerian × Deli materials to the two controls. The cross design used in this study is an incomplete factorial with several Nigerian parents crossed only once. Moreover, Deli testers who were used in the various crosses are not all identical of a Nigerian parent to another. Aware of these situations it is not possible to compare statistically general combining abilities of Nigerian parents. Thus, for a given character, a classification of performances of progenies was carried out in order to identify parents having good general combining ability. The classification was applied after the test of Newman and Keuls to the risk of 5 %. The analyzes were carried out with the Genstat software 10.1 (Lawes Agricultural Trust, 2007).

RESULTS AND DISCUSSION

Characteristics of various Nigerian × Deli materials

Bunch production components: The various Nigerian × Deli materials were characterized at young age and the adult period by a small number of large bunches compared to the two controls (Table 2). The Abak × Deli, Ahoada × Deli and Uli × Deli materials had at young age, bunch productions (total bunch weight) higher than that of LM 2 T × DA 10 D control.

Table 2. Bunch production components of the two controls and various Nigerian × Deli materials

Type of materials	n	Young âge (3-5 years)						Adult period (6-9 years)					
		BN		ABW		TBW		BN		ABW		TBW	
		μ	cv	μ (kg)	cv	μ (kg/tree)	cv	μ	cv	μ (kg)	cv	μ (kg/tree)	cv
LM 2 T × DA 10 D		14.24		3.38		46.45		11.59		9.70		110.34	
LM 2 T × DA 115 D		16.49		4.24		67.61		11.64		10.61		121.70	
Abak × Deli	6	11.99	12.98	4.76	10.24	54.57	10.43	7.87	11.58	12.11	8.59	92.15	5.83
Ahoada × Deli	8	10.10	30.54	5.32	9.85	50.45	24.50	6.69	23.35	14.13	11.21	89.29	13.57
Ayangba × Deli	8	9.84	22.59	4.27	4.43	40.50	20.47	7.22	18.74	12.53	9.10	87.24	9.78
Uli × Deli	8	11.50	10.69	4.85	12.02	53.87	8.32	7.71	16.82	12.94	15.80	94.58	5.86

n : number of progenies ; BN : bunch number ; ABW : average bunch weight ; TBW : total bunch weight ; μ : mean ; cv : coefficient of variation

The precocity of these materials is mainly due to their large bunches. Their additional bunch production range from 9 to 18 % compared to this control. The precocity of these materials seems to be a specific characteristic to Nigerian populations. Indeed, similar results were observed with improved populations of N.I.F.O.R. derived from Aba and Calabar regions. Therefore, these wild populations constitute a trump for the improvement of the bunch production at young age of planting material to provide to village and industrial groves. Unfortunately, the high production of young age tumbled at adult period because of the important reduction in the bunch number produced by these materials compared to the two controls. The low bunch production of these materials ranged from 84 and 86 % of LM 2 T × DA 10 D control and 76 to 78 % of LM 2 T × DA 115 D control. These results show that the low bunch productions to the adult stage which characterize various Nigerian wild populations were observed into Nigerian × Deli materials. They are similar to results observed by Adon *et al*. (1998) and Bakoumé *et al*. (2001) on wild populations from Angola and Côte d'Ivoire (Yocoboué). However, the substantial variability between progenies of these various materials made it possible to carry out an effective selection on this character. Indeed, 16 progenies derived from all Nigerian × Deli materials were not statistically different from the LM 2 T × DA 10 D control (Table 3) which is a reference for the bunch production of first cycle crosses and even of 2nd cycle. These performances are promising for not yet improved populations and make it possible to hope for progress on this character in the next breeding cycles of these various populations.

Vertical growth rate: Ayangba × Deli material was characterized by a slower vertical growth rate than those of the two controls (Table 4). The Abak × Deli, Ahoada × Deli and Uli × Deli materials were characterized by vertical growths higher than those of the two controls. A substantial variability was observed between progenies of Ayangba × Deli material; what made it possible to identify 4 progenies with growth significantly slower than those of the two controls (Table 5). According to Adon *et al*. (1993) Nigerian wild populations are divided into two groups in relation to the vertical growth of LM 2 T × DA 10 D control which is already acknowledged for its moderate vertical growth. The group with substantial vertical growth represented by Abak and Ahoada populations and the group with slow growth comprised of Ayangba and Uli populations. The vertical growths which characterize the Abak, Ahoada and Ayangba populations were thus observed in their progenies. On the other hand, the slow growth of Uli population was not observed in Uli × Deli material. The vertical growth being heritable (Noiret and Gascon, 1967), Ayangba population therefore effectively transmitted slower vertical growth to its progenies. Thus, this population constitutes a trump for the increase in the economic life span of planting material to provide to village and industrial groves. The substantial vertical growth of Uli × Deli material can be explained by the fact that the majority of parents chosen in the Uli population have relatively high growths since Deli testers used are known to transmit moderate growth.

Table 3. Classification in homogeneous groups of bunch productions at the adult stage of progenies of various Nigerian × Deli materials.

Progenies	TBW (6-9 years) (kg/tree)	Homogeneous groups	Type of materials
LM 2 T × DA 115 D	121.70	a	Control
LM 2 T × DA 10 D	110.34	b	Control
LM 11222 T × LM 4564 D	106.19	b c	Ahoada × Deli
LM 11223 T × LM 3047 D	102.86	b c d	Ayangba × Deli
LM 11218 T × LM 5972 D	102.59	b c d	Ahoada × Deli
LM 11214 T × LM 4441 D	101.28	b c d	Uli × Deli
LM 11212 T × LM 3047 D	99.35	b c d e	Abak × Deli
LM 11222 T × LM 3047 D	98.88	b c d e f	Ahoada × Deli
LM 11216 T × LM 4564 D	98.05	b c d e f	Uli × Deli
LM 11209 T × LM 3038 D	97.64	b c d e f	Abak × Deli
LM 11217 T × LM 5960 D	96.86	b c d e f g	Uli × Deli
LM 11227 T × LM 3257 D	96.30	b c d e f g	Ayangba × Deli
LM 11222 T × LM 5662 D	96.02	b c d e f g	Ahoada × Deli
LM 11216 T × LM 5972 D	95.77	b c d e f g h	Uli × Deli
LM 11217 T × LM 4441 D	95.28	b c d e f g h	Uli × Deli
LM 11214 T × LM 3257 D	93.66	b c d e f g h i	Uli × Deli
LM 11217 T × LM 5662 D	93.36	b c d e f g h i	Uli × Deli
LM 11212 T × LM 3257 D	92.32	b c d e f g h i	Abak × Deli
LM 11209 T × LM 5972 D	91.49	c d e f g h i	Abak × Deli
LM 11211 T × LM 5971 D	88.60	c d e f g h i	Abak × Deli
LM 11224 T × LM 5960 D	86.71	d e f g h i	Ayangba × Deli
LM 11225 T × LM 4441 D	86.56	d e f g h i	Ayangba × Deli
LM 11211 T × LM 5960 D	85.70	d e f g h i	Abak × Deli
LM 11224 T × LM 5662 D	85.44	d e f g h i	Ayangba × Deli
LM 11215 T × LM 5971 D	82.38	e f g h i	Uli × Deli
LM 11227 T × LM 5971 D	82.36	e f g h i	Ayangba × Deli
LM 11224 T × LM 5970 D	81.59	e f g h i	Ayangba × Deli
LM 11219 T × LM 5960 D	81.56	e f g h i	Ahoada × Deli
LM 11221 T × LM 5970 D	80.03	f g h i	Ahoada × Deli
LM 11221 T × LM 4564 D	78.58	g h i	Ahoada × Deli
LM 11219 T × LM 5971 D	77.50	h i	Ahoada × Deli
LM 11226 T × LM 5972 D	76.11	i	Ayangba × Deli

TBW: total bunch weight; Values followed by the same letter are not statistically different.

Table 4. Vertical growth rate of the two controls and various Nigerian × Deli materials

Type of materials	n	Vc (cm/year)	cv
LM 2 T × DA 10 D		36.34	
LM 2 T × DA 115 D		37.62	
Abak × Deli	6	45.21	5.45
Ahoada × Deli	8	43.12	4.72
Ayangba × Deli	8	33.58	16.71
Uli × Deli	8	39.56	7.08

n: number of progenies;
Vc: vertical growth rate;
cv: coefficient of variation.

Vascular wilt susceptibility: Abak × Deli material was tolerant to vascular wilt (Table 6). All progenies of this material were tolerant to this cryptogamic disease. These results show that the Abak population is a source of vascular wilt tolerance since the transmission of tolerance factors is primarily additive (Meunier *et al.*, 1979) and Deli testers are diversified (tolerant and susceptible). The Ahoada × Deli and Ayangba × Deli crosses were susceptible to this disease. In spite of their susceptibility, vascular wilt tolerant progenies were observed in these two types of materials.

Table 5. Classification in homogeneous groups of vertical growth rate of progenies of various Nigerian × Deli materials.

Progenies	Vc (cm/year)	Homogeneous groups	Type of materials
LM 11224 T × LM 5960 D	26.99	a	Ayangba × Deli
LM 11224 T × LM 5662 D	28.23	a	Ayangba × Deli
LM 11225 T × LM 4441 D	29.63	a	Ayangba × Deli
LM 11224 T × LM 5970 D	29.67	a	Ayangba × Deli
LM 2 T × DA 10 D	36.34	b	Control
LM 11216 T × LM 4564 D	36.68	b c	Uli × Deli
LM 11227 T × LM 3047 D	36.79	b c d	Ayangba × Deli
LM 11217 T × LM 4441 D	37.09	b c d e	Uli × Deli
LM 11227 T × LM 3257 D	37.13	b c d e f	Ayangba × Deli
LM 2 T × DA 115 D	37.62	b c d e f g	Control
LM 11214 T × LM 3257 D	37.82	b c d e f g h	Uli × Deli
LM 11227 T × LM 5971 D	37.90	b c d e f g h	Ayangba × Deli
LM 11216 T × LM 5972 D	38.05	b c d e f g h	Uli × Deli
LM 11214 T × LM 4441 D	39.60	b c d e f g h i	Uli × Deli
LM 11222 T × LM 3047 D	40.39	b c d e f g h i	Ahoada × Deli
LM 11215 T × LM 5971 D	40.52	b c d e f g h i	Uli × Deli
LM 11221 T × LM 4564 D	40.89	b c d e f g h i	Ahoada × Deli
LM 11217 T × LM 5662 D	41.68	b c d e f g h i j	Uli × Deli
LM 11212 T × LM 3257 D	42.18	c d e f g h i j	Abak × Deli
LM 11226 T × LM 5972 D	42.30	d e f g h i j	Ayangba ×Deli
LM 11222 T × LM 4564 D	42.59	e g h i j	Ahoada × Deli
LM 11218 T × LM 5972 D	42.77	g h i j	Ahoada × Deli
LM 11219 T × LM 5960 D	43.23	h i j k	Ahoada × Deli
LM 11212 T × LM 3047 D	43.44	i j k	Abak × Deli
LM 11209 T × LM 5972 D	44.04	i j k	Abak × Deli
LM 11222 T × LM 5662 D	44.07	i j k	Ahoada × Deli
LM 11221 T × LM 5970 D	44.68	i j k	Ahoada × Deli
LM 11217 T × LM 5960 D	45.02	i j k	Uli × Deli
LM 11209 T × LM 3038 D	46.66	j k	Abak × Deli
LM 11219 T × LM 5971 D	46.87	j k	Ahoada × Deli
LM 11211 T × LM 5960 D	47.15	j k	Abak × Deli
LM 11211 T × LM 5971 D	48.28	k	Abak × Deli

Table 6. Vascular wilt susceptibility of various Nigerian × Deli materials.

Type of materials	n	Im	Number of progenies with wilt index	
			< 100	≥ 100
Abak × Deli	6	75	6	0
Ahoada × Deli	5	101	2	3
Ayangba × Deli	8	106	4	4
Uli × Deli	8	99	4	4

n: number of progenies

Im: Wilt index of Nigerian × Deli material

General combing ability of Nigerian parents

Precocity (bunch production at the young age): The ranking of bunch production at young age of progenies shows that the LM 11212 T parent of the Abak population, LM 11214 T of the Uli population and LM 11222 T of the Ahoada population provide in crosses with Deli testers, good precocities (Table 7). The progenies of these parents produce on average between 24 and 35 % more than LM 2 T × DA 10 D control. These parents constitute a trump for the improvement of the bunch production at the young age of populations used in the breeding scheme. **Vertical growth rate:** The ranking of the vertical growth rate of progenies shows that the LM 11224 T parent of Ayangba population provide slow vertical growths in crosses with its Deli partners (Table 8). The progenies of this parent have a reduced average growth of 22 % compared to LM 2 T × DA 10 D control and of 25 % compared to LM 2 T × DA 115 D control.

Table 7. General combining ability for bunch production at the young age of Nigerian parents.

Nigerian wild populations	Nigerian parents	Deli testers	TBW 3-5 years (kg/tree)	Ranking TBW
Abak	LM 11209 T	LM 3038 D	57.70	8/30
		LM 5972 D	51.60	17/30
	LM 11211 T	LM 5960 D	45.21	21/30
		LM 5971 D	59.10	5/30
	LM 11212 T	LM 3047 D	59.68	4/30
		LM 3257 D	55.75	10/30
Uli	LM 11214 T	LM 3047 D	60.98	3/30
		LM 3257 D	57.58	7/30
	LM 11215 T	LM 5971 D	53.07	12/30
	LM 11216 T	LM 5972 D	52.26	15/30
		LM 4564 D	56.89	9/30
	LM 11217 T	LM 5662 D	46.68	20/30
		LM 5960 D	53.06	13/30
		LM 4441 D	50.47	18/30
Ahoada	LM 11218 T	LM 5972 D	52.52	14/30
	LM 11219 T	LM 5960 D	39.46	24/30
		LM 5971 D	51.78	16/30
	LM 11221 T	LM 5970 D	36.05	27/30
		LM 4564 D	36.44	26/30
	LM 11222 T	LM 3047 D	65.49	1/30
		LM 5662 D	58.08	6/30
		LM 4564 D	65.12	2/30
Ayangba	LM 11223 T	LM 3047 D	53.28	11/30
	LM 11224 T	LM 5662 D	37.14	25/30
		LM 5960 D	32.40	29/30
		LM 5970 D	31.91	30/30
	LM 11225 T	LM 4441 D	43.69	22/30
	LM 11226 T	LM 5972 D	33.03	28/30
	LM 11227 T	LM 3257 D	50.42	19/30
		LM 5971 D	42.15	23/30

TBW: total bunch weight.

Table 8. General combining ability for vertical growth rate of Nigerian parents.

Nigerian wild populations	Nigerian parents	Deli testers	Vc (cm/year)	Ranking Vc
Abak	LM 11209 T	LM 3038 D	46.66	27/30
		LM 5972 D	44.04	23/30
	LM 11211 T	LM 5960 D	47.15	29/30
		LM 5971 D	48.28	30/30
	LM 11212 T	LM 3047 D	43.44	22/30
		LM 3257 D	42.18	17/30
Uli	LM 11214 T	LM 3047 D	39.60	12/30
		LM 3257 D	37.82	9/30
	LM 11215 T	LM 5971 D	40.52	14/30
	LM 11216 T	LM 5972 D	38.05	11/30
		LM 4564 D	36.68	5/30
	LM 11217 T	LM 5662 D	41.68	16/30
		LM 5960 D	45.02	26/30
		LM 4441 D	37.09	7/30

Cont…

Ahoada	LM 11218 T	LM 5972 D	42.77	20/30
	LM 11219 T	LM 5960 D	43.23	21/30
		LM 5971 D	46.87	28/30
	LM 11221 T	LM 5970 D	44.68	25/30
		LM 4564 D	40.89	15/30
	LM 11222 T	LM 3047 D	40.39	13/30
		LM 5662 D	44.07	24/30
		LM 4564 D	42.59	19/30
Ayangba	LM 11223 T	LM 3047 D	36.79	6/30
	LM 11224 T	LM 5662 D	28.23	2/30
		LM 5960 D	26.99	1/30
		LM 5970 D	29.67	4/30
	LM 11225 T	LM 4441 D	29.63	3/30
	LM 11226 T	LM 5972 D	42.30	18/30
	LM 11227 T	LM 3257 D	37.13	8/30
		LM 5971 D	37.90	10/30

Vc: vertical growth rate.

The two controls belonging to Deli × La Mé material which is regarded as a reference for the slow vertical growth (Cochard *et al.*, 1993), the LM 11224 T parent thus constitute an important trump for the increase in the economic life span of the planting material to provide to the village and industrial groves. Its use could also make it possible to reduce the growth of populations used in the selection scheme, in particular Yangambi and Nigerian populations (Group B) which belong to ecotypes with substantial vertical growth of the breeding program.

Vascular wilt susceptibility: The LM 11209 T, LM 11211 T, LM 11212 T parents of the Abak population, LM 11214 T of the Uli population and LM 11223 T of the Ayangba population were tolerant to vascular wilt (Table 9). In crosses with susceptible (LM 3038 D) or fairly tolerant Deli testers (LM 3047 D, LM 3257 D and LM 5971 D), these parents provided tolerant progenies to this cryptogamic disease. Vascular wilt tolerance of these 5 parents constitutes a major trump being able to justify their introduction into the breeding scheme. Indeed, their exploitation will be able to make it possible to diversify sources of vascular wilt tolerance of populations of Group B used in the breeding scheme and to create variability in the type of seeds (currently Deli × La Me type) destined for zones affected by the disease. As for the LM 11217 T, LM 11222 T and LM 11227 T parents, they were susceptible to vascular wilt. Even in crosses with tolerant (LM 5960 D) and fairly tolerant (LM 3047 D, LM 5971 D) Deli testers, these parents provided progenies susceptible to this disease.

Table 9. Wilt susceptibility of Nigerian parents.

Nigerian wild populations	Nigerian parents	Deli testers	Deli testers indices	Progenies indices (I)	Nigerian parents indices (Ip)
ABAK	LM 11209 T	LM 3038 D	128 (3-8)	61	76
		LM 5972 D	86 (8-2)	90	
	LM 11211 T	LM 5960 D	80 (8-2)	78	75
		LM 5971 D	101 (6-3)	71	
	LM 11212 T	LM 3047 D	97 (13-15)	90	74
		LM 3257 D	104 (37-227)	57	
ULI	LM 11214 T	LM 3047 D	97 (13-15)	90	85
		LM 3257 D	104 (37-227)	80	
	LM 11215 T	LM 5971 D	101 (6-3)	86	86
	LM 11216 T	LM 5972 D	86 (8-2)	100	88
		LM 4564 D	80 (5-1)	76	
	LM 11217 T	LM 5662 D	99 (7-6)	102	120
		LM 5960 D	80 (8-2)	106	
		LM 4441 D	114 (1-2)	151	

Cont…

AHOADA	LM 11218 T	LM 5972 D	86 (8-2)	86	86
	LM 11219 T	LM 5960 D	80 (8-2)	83	94
		LM 5971 D	101 (6-3)	105	
	LM 11221 T	LM 5970 D	102 (2-3)	-	
		LM 4564 D	80 (5-1)	-	
	LM 11222 T	LM 3047 D	97 (13-15)	123	116
		LM 5662 D	99 (7-6)	108	
		LM 4564 D	80 (5-1)	-	
AYANGBA	LM 11223 T	LM 3047 D	97 (13-15)	40	40
		LM 5662 D	99 (7-6)	91	
	LM 11224 T	LM 5960 D	80 (8-2)	71	93
		LM 5970 D	102 (2-3)	116	
	LM 11225 T	LM 4441 D	114 (1-2)	100	100
	LM 11226 T	LM 5972 D	86 (8-2)	80	80
	LM 11227 T	LM 3257 D	104 (37-227)	197	174
		LM 5971 D	101 (6-3)	151	

CONCLUSION

Nigerian wild populations present interesting characteristics for the oil palm breeding. In crosses with Deli testers, Abak, Ahoada and Uli populations provided good bunch production at the young age to their progenies. The Abak population is a source of vascular wilt tolerance. As for the Ayangba population, it constitutes a source of reduction of the vertical growth of planting material to provide to villager and industrial plantations. On the basis of the interesting characteristics, 7 parents were retained in the 4 wild populations for their good general combining ability. Their utilization could make it possible to guarantee the reduction of the vertical growth, diversification of sources of vascular wilt tolerance and the improvement of the bunch production at the young age of populations used in the breeding scheme.

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