

'BITA-3': A Starchy Banana with Partial Resistance to Black Sigatoka and Tolerance to Streak Virus

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The International Institute of Tropical Agriculture (IITA), through its Plantain and Banana Improvement Program (PBIP) and its East and Southern Africa Regional Center, is developing improved plantain and cooking banana (*Musa* spp. L.) germplasm with pest and disease resistance, high and stable yield, and acceptable fruit quality (Vuylsteke et al., 1997). A major constraint to *Musa* production in Africa has been black sigatoka, a leaf spot disease caused by the fungus *Mycosphaerella fijiensis* Morelet. More recently, the banana streak virus (BSV) has been identified as another major threat to plantain and banana production and to safe movement of germplasm (Jones, 1994).

Most plantain hybrids (TMPx) previously registered by IITA (Vuylsteke et al., 1993, 1995) have proved to be susceptible to BSV in sub-Saharan Africa (Ortiz, 1996). This prompted IITA to select germplasm with resistance or tolerance to both black sigatoka and BSV. One such selection is 'BITA-3' (tested as TMBx 5295-1), an F₁ banana hybrid with 44 chromosomes (2n = 4x). 'BITA-3' produces heavy bunches with many large fruit. 'BITA-3' is being distributed worldwide with the cooperation of the International Network for the Improvement of Banana and Plantain

(INIBAP, France) of the International Plant Genetic Resources Institute (IPGRI, Italy).

Origin

'BITA-3' is a tetraploid starchy banana hybrid with low partial resistance to black sigatoka disease. Additionally, this hybrid has always been devoid of virus symptoms in early or preliminary yield trials at the IITA High Rainfall Station in Onne (southeastern Nigeria) (Plantain and Banana Improvement Program, 1995), where both BSV and cucumber mosaic virus (CMV) have been observed. 'BITA-3' is a hybrid from the interspecific cross 'Laknau' × 'Tjau Lagada'. 'Laknau' is a female-fertile AAB starchy banana that closely resembles plantains (Stover and Simmonds, 1987). Because 'Laknau' produces 2n (= 3x = 33) eggs and sets seed upon hand pollination, it was suggested for use in breeding new cooking bananas (Rowe, 1984). 'Tjau Lagada' is an AA diploid banana having a long bunch with many hands.

An inflorescence of 'Laknau' was hand pollinated with pollen of 'Tjau Lagada' and produced two seeds. These seeds were cultured in vitro using embryo culture (Vuylsteke et al., 1990) and one tetraploid hybrid seedling (initially designated 5295-1) was obtained. This hybrid was selected at Onne in the 1991–92 season from an early evaluation field trial, based on its high-yielding bunch with many large fruit (Fig. 1). It was advanced to a preliminary yield trial at Onne in 1993, which ended in 1996 after the harvest of the plant crop and two ratoon cycles.

Description and performance

'BITA-3' had a significantly ($P < 0.05$) greater bunch mass than two common plantain landraces tested at Onne (Table 1). It had a bunch mass similar ($P > 0.05$) to TMBx 612-74, a high-yielding, black sigatoka-resistant cooking banana hybrid derived from the cultivar Bluggoe (Ortiz et al., 1995). Also, TMBx 612-74 has a short cycle, i.e., some of its followers had emerging bunches before the harvest of the mother plant, shortening the growth cycle in the ratoon (Table 1). However, TMBx 612-74 has not been registered by IITA because of its somatic instability, owing perhaps to mixoploidy (Plantain and Banana Improvement Program, 1996). 'BITA-3', despite its longer growth cycle, has greater yield potential (18.6 t·ha⁻¹·year⁻¹) than 'Obino l'Ewai' (12.8 t·ha⁻¹·year⁻¹), a representative French plantain landrace from Nigeria (Swennen et al., 1995).

'BITA-3' had 78% of leaves without black sigatoka spots at flowering, while the plantain landraces showed only 50% to 67% of healthy leaves, as calculated from the ratio of youngest leaf spotted (–1) over number of standing leaves, both scored at time of flowering (Table

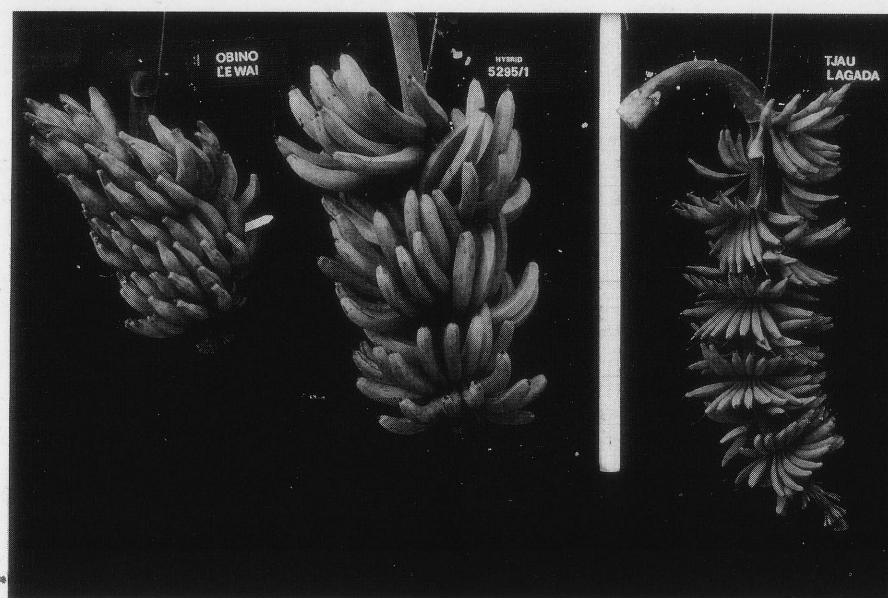


Fig. 1. Tetraploid banana hybrid 'BITA-3' (center), obtained from crossing the triploid starchy banana 'Laknau' with the diploid banana 'Tjau Lagada' (right). The bunch of 'BITA-3' (or TMBx 5295-1) weighed 18 kg, and had 8 hands of long fruit (27 cm). This bunch outyielded that of the medium French plantain landrace 'Obino l'Ewai' (left). 'Tjau Lagada' (right) shows a medium-size bunch (9 kg) bearing 10 hands with many small fruit (12 cm).

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Table 1. Growth and yield characteristics of *Musa* hybrids and landraces evaluated at Onne, Nigeria (1993–96).

Clone	Days to flowering	Plant height (cm)	Standing leaf count (no.)	Youngest leaf spotted (no.)	Tallest sucker height (cm)	Days for fruit filling	Bunch mass (kg)	No. of hands	No. of fruits	Fruit length (cm)	Fruit girth (cm)
<i>Tetraploid starchy banana hybrid (TMBx = 'Laknau' x AA)</i>											
'BITA-3'	340	318	9	8	125	88	13.1	7	91	24	13
<i>Tetraploid cooking banana hybrid (TMBx = 'Bluggoe' x AA)</i>											
612-74	148	324	14	12	256	136	12.9	6	77	18	15
<i>Plantain landraces</i>											
'Agbagba'	226	310	10	6	168	90	5.7	6	20	25	15
'Obino l'Ewai'	322	318	9	7	134	97	8.8	7	73	19	13
LSD _{0.05}	26	11	1	1	29	8	1.1	0.3	7	1	1

1). 'BITA-3' has not shown virus symptoms under natural inoculum pressure at Onne, although it has been field-grown along with BSV-susceptible hybrids since the early 1990s (Plantain and Banana Improvement Program, 1995, 1996). Note that reliable methods are not yet available for testing plantain or banana genotypes against BSV under controlled conditions. Field screening, which evaluates either escape, difficulty to infect, or resistance/tolerance when infected, remains the only option. Nevertheless, when in vitro shoot-tip cultures of 'BITA-3', reinitiated from field-grown plants, were tested by the virus indexing center at the Queensland Department of Primary Industry (QDPI), Australia, no *Musa* virus was detected (David Jones, INIBAP, pers. comm.).

Among the banana hybrids developed at IITA, 'BITA-3' has the largest fruit, with fruit length similar to that of the preferred False Horn plantain 'Agbagba' (Table 1). Fruit size is considered a key quality trait (Vuylsteke et al., 1997), especially by West African consumers. Results from taste panels of a Nigerian dish called "dodo" (fried ripe fruits) at Onne showed that fruit of 'BITA-3' was preferred by 38% of the panelists when compared to that of the plantain 'Agbagba', and by 40% of the panelists when compared with the fruit of the registered hybrid TMPx 2796-5 (Plantain and Banana Improvement Program, 1995). These results are very encouraging, since the cooking banana cultivar 'Cardaba' has become accepted by plantain farmers and consumers in southeastern Nigeria (Ferris et al., 1994; Plantain and Banana Improvement Program, 1995). Fruit of 'Cardaba' were never accepted by more than 15% of the panelists when compared to those of the plantain landraces, when used in "dodo" making.

Additional features of 'BITA-3' include female fertility, a lax pendulous bunch with deciduous neutral flowers, long pedicels, and an imbricated male bud. This hybrid exhibits slow sucker development and a relatively longer plant maturation period, requiring some 100 d more to flower than the plantain landrace 'Agbagba'. It has been advanced for testing in multilocal trials at IITA stations in Nigeria and Uganda (Plantain and Banana Improvement Program, 1996).

Availability

IITA shares germplasm with partners in developed and developing countries under the agreement that this material will not be licensed for commercial purposes. Hence, 'BITA-3' cannot be patented or registered for restricted release. 'BITA-3' is available for international distribution through INIBAP, which maintains a limited number of virus-indexed stocks in the form of in vitro shoot-tip cultures or rooted plantlets. Requests should be sent to the Director, INIBAP, Parc Scientifique Agropolis, 34397 Montpellier Cedex 5, France; e-mail: INIBAP@CGNET.COM. Recipients are asked to give appropriate recognition of the germplasm source if it is used in developing a new germplasm, parental line, or cultivar.

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