

'PITA-14': A Black Sigatoka-Resistant Tetraploid Plantain Hybrid with Virus Tolerance

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The Plantain and Banana Improvement Program (PBIP) of the International Institute of Tropical Agriculture (IITA) has developed plantain (*Musa* spp., AAB group) germplasm with resistance to black sigatoka (*Mycosphaerella fijiensis* Morelet) (Vuylsteke et al., 1993, 1995). However, most of these hybrids have shown susceptibility to virus diseases in multilocal trials in Africa (Ortiz, 1996). *Musa* can be affected by cucumber mosaic virus (CMV), banana bunchy top virus (BBTV), and banana streak virus (BSV) in several African countries (Dabek and Waller, 1990; Pasberg-Gaahl et al., 1996; Vuylsteke et al., 1996). These viruses reduce growth and vigor, resulting in poor yield due to small or absent bunches.

Several genomic clones from banana have DNA sequences that hybridize to BSV probes (B.E. Lockhart and N. Olszewski, Univ. of Minnesota, pers. comm.). This seems to suggest the integration of BSV sequences in the host genome (R. Hull, John Innes Centre, U.K., pers. comm.). IITA has considered that the most suitable short term strategy to control *Musa* viruses in Africa is the deployment of available field-tolerant symptomless genotypes. IITA has selected some high-yielding black sigatoka-resistant *Musa* hybrids that did not show virus symptoms during several years of cultivation in a location where viruses are

widespread. One tetraploid plantain hybrid which did not develop BSV or CMV symptoms in field trials at Onne, Nigeria, where it was developed, was 'PITA-14'.

Origin

'PITA-14' (tested as TMPx 7152-2) is a black sigatoka-resistant primary tetraploid ($2n = 4x = 44$) hybrid derived from the triploid ($2n = 3x = 33$) female-fertile French plantain 'Mbi Egome-1' of Nigeria. The male parent of this hybrid was the diploid ($2n = 22$) wild banana *Musa acuminata* subsp. *burmannicoides* 'Calcutta 4' from Burma (Myanmar). In addition to its black sigatoka resistance, this hybrid had shorter growth cycles than the plantain landraces and showed field tolerance to virus after several years of field testing at the IITA High Rainfall Station in Onne (southeastern Nigeria) (Plantain and Banana Improvement Program, 1995).

Sixty-six seeds were obtained after hand-pollination of an inflorescence of 'Mbi Egome-1' with pollen of 'Calcutta 4'. After in vitro germination (Vuylsteke et al., 1990), a tetraploid seedling (7152-2) was field-established in 1991, along with other euploid hybrids, in an early evaluation trial at Onne. 'PITA-14' was selected in 1992 for its black sigatoka resistance, good bunch characteristics (Fig. 1), large parthenocarpic fruit (Fig. 2), and improved ratooning (Plantain and Banana Improvement Program, 1993). 'PITA-14' was advanced to preliminary yield trials at Onne in 1993 (Plantain and Banana Improvement Program, 1994) and later to multiplication plots. The results obtained from this sequence of trials provided enough evidence for advanced testing by national programs elsewhere, and further cultivar release following each country's regulations. 'PITA-14' is being distributed worldwide in cooperation with the International Network for the Improvement of Banana and Plantain (INIBAP, France) of the International Plant Genetic Resources Institute (IPGRI, Italy).

Description and performance

'PITA-14' had similar bunch mass to 'Obino l'Ewai', a representative French plantain landrace, in the plant crop at Onne. However, in subsequent ra' ons, the 'PITA-14'

hybrid had significantly greater bunch mass than all plantain landraces (Table 1). Moreover, the significantly shorter cycle of 'PITA-14' resulted in higher yield potential over time ($18.7 \text{ t} \cdot \text{ha}^{-1} \cdot \text{year}^{-1}$) compared with the landrace ($12.8 \text{ t} \cdot \text{ha}^{-1} \cdot \text{year}^{-1}$). This shorter growth cycle was the result of regulated suckering behavior, which allowed more rapid ratooning. The suckers of this hybrid reached 80% to 100% of the height of its mother plant at harvest in both plant and ratoon crops (Table 1). Also, 'PITA-14' had yields similar to those of other previously registered TMPx plantain hybrids (Vuylsteke et al., 1993), when grown in multiplication plots with multispecies hedgerow alley cropping (data not shown).

'PITA-14' exhibited high levels of partial resistance to black sigatoka disease as measured by the youngest leaf spotted (Vakili, 1968). 'PITA-14' retained nearly twice the number of functional leaves without black sigatoka spotting as did the susceptible plantain landraces (Table 1) in both plant and ratoon crops. The resistance of this hybrid to black sigatoka, which increases available photosynthetic leaf area and source/sink ratio, explained its significantly longer fruit filling time and larger fruit size relative to those of the French plantain landraces.

'PITA-14' is one of the few black sigatoka-resistant plantain hybrids that have not shown virus symptoms in multiplication plots at Onne, i.e., virus incidence was always 0% (Plantain and Banana Improvement Program, 1995). Other tetraploid plantain hybrids showed high susceptibility to either BSV or CMV, with virus incidence ranging from 10% to 90% in the rainy season, when conditions are most conducive to expression of virus symptoms at Onne (BBTV does not occur at this station). In vitro shoot-tip cultures were reinitiated from field-grown plants and sent to INIBAP for virus-indexing. The virus indexing center at the Queensland Department of Primary Industry (QDPI, Australia) virus-tested the in vitro stocks sent by INIBAP. Plants were visually inspected and indexed by ELISA for CMV and BBTV at 4 and 6 months after potting up. Partially purified minipreps were also examined by electron microscopy and BBTV, BSV and CMV were not detected. Virus symptoms were not observed on any plants of this hybrid (J.E. Thomas, QDPI, Australia, pers. comm.).

'PITA-14' has a lax bunch, which promotes the development of large fruit (Fig. 2). This hybrid is female-fertile, has pendulous bunches with deciduous neutral flowers, and an imbricated male bud. 'PITA-14' has been advanced for testing in multilocal trials at IITA stations in Nigeria and Uganda and is available for international distribution from INIBAP.

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, 'PITA-14' cannot be patented or registered for restricted release. A limited number of virus-

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Fig. 1. Black sigatoka-resistant tetraploid plantain hybrid 'PITA-14' (center), obtained from crossing the triploid susceptible French plantain 'Mbi Egome-1' (left) with the highly resistant wild diploid banana 'Calcutta-4' (right). The bunch of 'PITA-14' weighed 22 kg, while the bunch of its maternal parent weighed 13.5 kg.



Fig. 2. Fruit of the second hand of plantain hybrid 'PITA-14' (right) and its maternal plantain parent 'Mbi Egome-1' (left). Average fruit length in the second hand was 25 cm and 23 cm for the hybrid and its maternal parent, respectively. Marker is 15 cm.

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. hands	No. fruits	Fruit length (cm)	Fruit girth (cm)
<i>Plant crop</i>											
Tetraploid plantain hybrid (TMPx)											
'PITA-14'	239	278	12	12	243	116	8.0	6	79	20	11
Triploid plantain landraces											
'Agbagba'	262	300	10	6	160	95	5.9	5	20	26	15
'Bobby Tannap'	346	272	6	4	142	82	4.2	6	63	15	11
'Obino l'Ewai'	303	311	9	7	113	98	9.1	7	75	20	13
LSD _{0.05}	36	18	2	2	13	46	1.8	1	10	2	1
<i>Ratoons</i>											
Tetraploid plantain hybrid (TMPx)											
'PITA-14'	96	332	12	10	270	118	12.4	7	99	22	12
Triploid plantain landraces											
'Agbagba'	177	325	9	5	178	84	5.3	6	19	24	15
'Bobby Tannap'	205	292	8	6	160	94	8.0	6	78	17	12
'Obino l'Ewai'	---	328	9	7	161	97	8.6	7	71	19	13
LSD _{0.05}	38	14	1	1	37	8	1.4	0.5	9	1	1

indexed stocks are available from INIBAP 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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