CROP BREEDING AND APPLIED BIOTECHNOLOGY

CULTIVAR RELEASE

IAC 125 RN – A dwarf coffee cultivar resistant to leaf rust and root-knot nematode

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Abstract: *IAC 125 RN was derived from a cross between the coffee cultivar Villa Sarchí and the Hibrido de Timor CIFC 832/2. The coffee trees are short and resistant to races 1 and 2 of the nematode Meloidogyne exigua and to all races of coffee rust, Hemileia vastatrix, present in Brazil. Brazil.*

Key words*: Coffea arabica, Hemileia vastatrix, Meloidogyne exigua, plant resistance.*

INTRODUCTION

Coffee rust, caused by the fungus *Hemileia vastatrix*, is the main disease of arabica coffee, and is widely disseminated in the main coffee-producing regions of Brazil and other countries. The root-knot nematode *Meloidogyne exigua* has a more restricted distribution, but the damages it causes to coffee trees is severe, mainly in plantations on sandy soils. With regard to rust control, the efficiency of chemical pesticides is satisfactory, but limited in the management of plant nematodes. In addition, their use directly increases the production costs of the crop. Cultivars resistant to both biotic agents play an important role in reducing costs and increasing competitiveness. Cultivar IAC 125 RN was developed by the Agronomic Institute of Campinas (IAC) and is resistant to all coffee rust races currently present in Brazil and to races 1 and 2 of the nematode *M. exigua*. This study describes the main morphological, technological and agronomic characteristics of this cultivar.

BREEDING PROCESS

Cultivar IAC 125 RN, bred by the pedigree method, was derived from the Costa Rican cultivar Villa Sarchí crossed with the Híbrido de Timor CIFC 832/2, at the Research Center for Coffee Rust in Oeiras, Portugal, in 1967. This latter in turn is native to East Timor, derived from a natural cross of the species *C. arabica* and *C. canephora*, probably followed by backcrossing with *C. arabica* (Bettencourt 1973). Híbrido de Timor trees have at least five major resistance genes to coffee rust, known as S_H5, S_H6, S_H7, S_H8, and S_H9 (Bettencourt et al. 1980, Bettencourt and Fazuoli 2008).

Seeds of the F_1 hybrid CIFC H361/4 were registered at the Agronomic Institute of Campinas as IAC 1669, in 1971. A progeny of 27 F_2 coffee trees was planted in a progeny test, in Campinas, SP, Brazil. The yield and other agronomic and technological characteristics were evaluated for eight years (1974 – 1981). One of

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the F_2 plants, coffee tree IAC 1669-13, with fresh green leaves was selected, especially in function of the high production of large red-dark fruits, exceptional vegetative vigor, short size, medium to large screen size, and rust resistance.

Fruit production and adaptation of the coffee trees in generation F_3 were evaluated in Varginha, MG, between 1987 and 1992. From the best coffee tree, F_3 seeds were harvested to study the F_4 generation in a field experiment, installed in Patrocínio, MG. The coffee trees in the F_4 generation were evaluated in relation to size, fruit production and vegetative vigor. The designation IAC 1669-13 was maintained between the F_3 and F_5 generations.

In 2000, a trial of F_5 generation coffee progenies was planted in Patrocínio, MG, and cultivated for five years under irrigation. The plants were evaluated for fruit production and other agronomic and technological characteristics and considered exceptional. From 2004 on, several observation fields and trials were established in the State of Minas Gerais and in Campinas, Mococa, Gália, Ribeirão Corrente, Franca, Marília, and Piraju, in the State of São Paulo.

In 2005, coffee trees in the F_5 generation were selected to study resistance to the nematode *Meloidogyne exigua* in the F_6 progenies. The results of the analyses (Tables 1 and 2) indicated a high resistance level, respectively, to races 1 and 2 of this nematode.

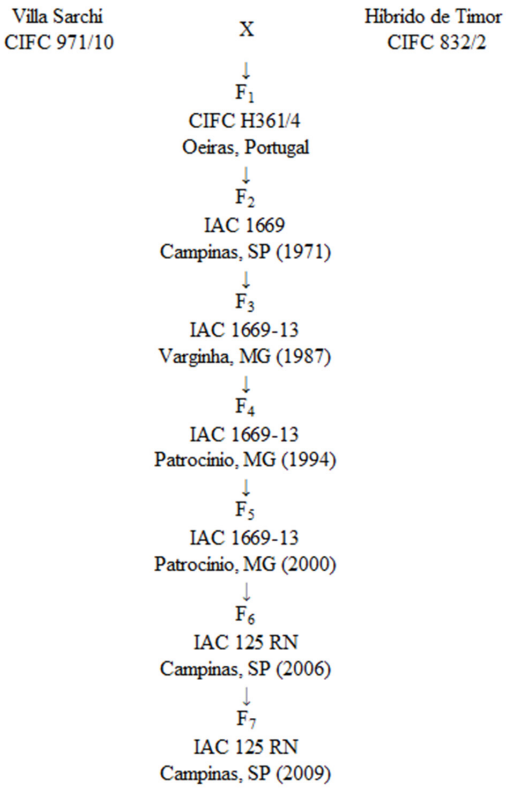

Figure 1. Genealogy of cultivar IAC 125 RN of *Coffea arabica* with indication of the location and year of evaluation of the progenies selected by the pedigree method.

The F_6 coffee trees were evaluated in 2006, at the IAC Experimental Center in Campinas, SP, and in the Polo Nordeste of the São Paulo Agency of Agribusiness Technology (APTA) in Mococa, SP, and in 2008, at the IAC Experimental Center in Campinas, SP. The F_7 generation was evaluated as of 2009, at the Central Experimental Center of IAC, in Campinas. From the generation F_6 onwards, the already quite regular plant population was denominated IAC 125 RN (Fazuoli et al. 2006, 2007). The genealogy of cultivar IAC 125 RN is detailed in Figure 1.

Table 1. Resistance of cultivar IAC 125 RN to the nematode *Meloidogyne exigua,* race 1[1]

Cultivar	IG[2]	Classification	NERS[3]	NE (g root^{-1}) [4]	FR	Classification
Catuaí Vermelho IAC 144	4.6	Susceptible	5,550	2,649.5	1.12	Susceptible
IAC 125 RN	0.5	Resistant	100	51.5	0.02	Resistant

[1] Race determined in tests with differential hosts, which are pathogenic to coffee and not pathogenic to tomato, and by isoenzymatic analysis with esterase phenotype E1; [2] GI= Gall index. On a 0 - 5 scale proposed by Taylor and Sasser (1978). Plants with GI£ 2 are resistant; [3] NERS = Number of eggs in the root system. Mean of four plants with GI£ 2; [4] NE g root^{-1} = Number of eggs per gram of root. Mean of four plants with GI£ 2. Evaluation carried out in a greenhouse experiment with 20 replications. Plants inoculated on 3/16/2005 and evaluated on 7/13/2005, with inoculum consisting of 5000 eggs and J2 juveniles per pot of 300 mL.

Table 2. Resistance of cultivar IAC 125 RN to the nematode *Meloidogyne exigua,* race 2[1]

Cultivar	IG[2]	Classification	NERS[3]	NE g root^{-1} [4]	FR	Classification
Catuaí Vermelho IAC 144	4.1	Susceptible	1,047	2,585.3	2.10	Susceptible
IAC 125 RN	0.0	Resistant	25	16.4	0.01	Resistant

[1] Race determined in tests with differential hosts, which are pathogenic to coffee and not pathogenic to tomato, and by isoenzymatic analysis with esterase phenotype E1; [2] GI= Gall index. On a 0 - 5 scale proposed by Taylor and Sasser (1978). Plants with GI£ 2 are resistant; [3] NERS = Number of eggs in the root system. Mean of four plants with GI£ 2; [4] NE g root^{-1} = Number of eggs per gram of root. Mean of four plants with GI£ 2. Evaluation carried out in a greenhouse experiment with 20 replications. Plants inoculated on 3/16/2005 and evaluated on 7/13/2005, with inoculum consisting of 5000 eggs and J2 juveniles per pot of 300 mL.

PERFORMANCE

Cultivar IAC 125 RN was evaluated in field trials in regions suited for *C. arabica* cultivation in the states of São Paulo and Minas Gerais. Experimental data of F_6 progenies cultivated with and without irrigation are listed in Tables 3 and 4, respectively. Important differences were observed in the development and production of cultivars IAC 125 RN and Catuaí Vermelho IAC 144. In an experiment under irrigation, in Patrocínio, Minas Gerais, at a spacing of 3.68 x 0.5 m, the mean yield of cultivar IAC 125 RN, during the first five harvests, was 66 bags ha^{-1} $year^{-1}$ of green coffee. The annual yields in the period were, respectively, 91, 50, 89, 50, and 50 bags ha^{-1} $year^{-1}$ of green coffee. In Patos de Minas, MG, the mean yield of the cultivar IAC 125 RN during the first three harvests was 60 bags ha^{-1} $year^{-1}$ of green coffee (Table 3). At both sites, the mean yield of the control cultivar Catuaí Vermelho IAC 144 was 40 bags ha^{-1} $year^{-1}$ of green coffee. Under non-irrigated cultivation, the mean yield of cultivar IAC 125 RN varied between 33.1 to 59.4 bags ha^{-1} $year^{-1}$ of green coffee (Table 4). At the same sites, the yield of the experimental control, Catuaí Vermelho IAC 144, ranged between 31 and 36.4 bags ha^{-1} $year^{-1}$ of green coffee.

Based on the experimental data, IAC 125 RN cultivars are recommended for regions indicated for arabica coffee in the

Table 3. Mean yield, in bags of green coffee ha^{-1} $year^{-1}$, of cultivar IAC 125 under irrigated cultivation

Location	Harvests	Cultivar	
		IAC 125 RN	Catuaí Vermelho IAC 144
Patrocínio, MG	5	66.0	40.0
Patos de Minas, MG	3	60.0	40.0

Table 4. Mean yield in bags of green coffee ha^{-1} $year^{-1}$ of cultivar IAC 125 under rainfed cultivation

Location	Harvests	Cultivar	
		IAC 125 RN	Catuaí Vermelho IAC 144
Mococa, SP	3	59.4	36.4
Campinas, SP	3	35.5	31.0
Patos de Minas, MG	3	40.0	35.0
Campinas, SP	6	33.1	34.7

Table 5. Morphological, technological and agronomic traits of the cultivar IAC 125 RN with the respective descriptions

Characteristics	Descriptions[1]
Size (tree height)	Short (=IAPAR 59)
Canopy radius	Short (=IAPAR 59)
Canopy architecture	Cylindrical (=Catuaí)
Internode length	Short (=IAPAR 59)
Intensity plagiotropic branching	From medium (=Mundo Novo) to high (=Catuaí)
Young leaf color	Green (=Catuaí)
Leaf length	Between short and long
Leaf width	Between narrow and large
Leaf shape	Oval
Undulation of the leaf margin	Medium wavy (=Mundo Novo)
Color of ripe fruits	Red
Fruit shape	Oblong (=Mundo Novo)
Fruit size	Between medium (=Mundo Novo) and large (=Acaiá)
Bean length	Between medium (=Mundo Novo) and long (=Acaiá)
Bean width	Between medium (=Mundo Novo) and large (=Catuaí)
Maturation cycle	Early
Rust resistance[2]	High resistance
Nematode resistance	*Meloidogyne exiua* races 1 and 2
Reaction to Brown Eye Spot[3]	Susceptible
Cup quality	Similar or superior to Catuaí

[1] IAPAR 59, Catuaí, Mundo Novo and Acaiá are Brazilian cultivars of *Coffea arabica*; [2]*Hemileia vastatrix Berkeley* and Broome; [3]*Cercospora coffeicola Berkeley* and Cooke.

states of São Paulo and Minas Gerais, in areas with no record of marked drought. The cultivar is particularly adequate for irrigated cultivation.

OTHER TRAITS

Cultivar IAC 125 RN has large beans with a mean screen size of 17.4. The percentage of flat, peaberry and elephant beans is, respectively, 90.2%, 8% and 1.8%. Young leaves are green. The plant size is short and the fruits are large and dark red, with early maturation. Canopy height and diameter are slightly smaller than in cultivar Catuaí Vermelho IAC 144. The coffee trees are nutrient-demanding and have a good cup quality. Cultivar IAC 125 RN is resistant to all *Hemileia vastatrix* rust races currently found in Brazil, and to races 1 and 2 of the nematode *Meloidogyne exigua*. It is susceptible to coffee leaf miner *(Leucoptera coffeella)*, coffee berry borer *(Hypothenemus hampei)* and to brown-eye spot *(Cercospora coffeicola)*. Other morphological, technological and agronomic characteristics of the cultivar IAC 125 RN are listed in Table 5.

SEED MAINTENANCE AND DISTRIBUTION

Cultivar IAC 125 RN was registered by the IAC in the National Register of Cultivars (RNC) on April 18, 2012 (Registration no. 28587) and protected by the National Plant Protection System (SNPC) on November 7, 2014 (Certificate no. 20150081). The names IAC 1669-13, IBC 12, Tupi RN IAC 1669-13, and Uva were used as synonyms of cultivar IAC 125 RN during the experimental phase of selection, as mentioned in the protection and registration processes. The IAC and the Polo Nordeste Paulista are responsible for the production of genetic seeds.

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