Semina: Ciências Agrárias
ISSN: 1676-546X
semina.agrarias@uel.br
Universidade Estadual de Londrina
Brasil

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Semina: Ciências Agrárias, vol. 38, núm. 2, marzo-abril, 2017, pp. 671-681
Universidade Estadual de Londrina
Londrina, Brasil

DOI: 10.5433/1679-0359.2017v38n2p671

Agronomic characterization and responses to coffeeleaf rust in coffee progenies resistant to the gall nematode *Meloidogyne exigua*

Caracterização agronômica e reação à ferrugem de progênies de cafeeiro resistentes a *Meloidogyne exigua*

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Abstract

The aim of this study was to determine agronomic characteristics and responses to the coffee leaf rust fungus (*Hemileia vastatrix* Berk. et Br.) in coffee progenies resistant to the gall nematode *Meloidogyne exigua*. The experiment was conducted in December 2000 at Ouro Verde Farm (FazendaOuro Verde), located in the municipality of Campos Altos – Minas Gerais (MG). Ten $F_{3:4}$ progenies were evaluated. They were derived from crosses between CIFC 2570 Timor Hybrid selections and Catuaí cultivars known to be resistant to *M. exigua.* The Catuaí Vermelho IAC 99 cultivar served as a control. A randomized block design with three replicates was used. In total, there were thirty-three plots consisting of eight plants each. The following characteristics were assessed between the harvests of 2011/2012 and 2014/2015: (a) yield expressed as processed coffee bags $ha^{-1;}$ (b) rust incidence and severity; (c) vegetative vigor; (d) percentage of coffee fruits at the "cherry" stage; (e) percentage of floaters; (f) crown diameter; (g) percentage of coffee beans of size sieve 17 and higher; and (h) sensory analysis of the coffee beverage. The results indicated the following: (a) the H514-7-14-2, H514-7-4-5, H493-1-2-2, H514-7-16-3, H514-7-8-11, H518-2-10-1, and H514-5-2-4 progenies were the most productive; (b) all progenies showed promising resistance to coffee leaf rust; (c) all genotypes had the potential for specialty coffee production; (d) the H493-1-2-2 progeny showed resistance both to rust and the nematode, and has good potential for specialty coffee production; and (e) the yields of the H514-7-8-11, H518-2-10-1, H514-5-2-4, H514-7-16-3, H514-7-14-2, H514-7-4-5, and H493-1-2-2 progenies were significantly higher than that of the Catuaí IAC 99 control.
Key words: *Coffea arabica*; Timor Hybrid; Genetic Breeding; Yield.

Resumo

O objetivo deste trabalho foi disponibilizar informações de características agronômicas e reação à ferrugem de progênies de cafeeiro resistentes a *M. exigua*. O experimento foi instalado em dezembro de 2000, na Fazenda Ouro Verde, situada no município de Campos Altos – MG. Foram avaliadas 10 progênies $F_{3:4}$ oriundas do cruzamento entre seleções de Híbrido de Timor provenientes do CIFC 2570 e

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Received: Mar. 30, 2016 – Approved: Jan. 16, 2017

cultivares do grupo Catuaí, previamente selecionadas como resistentes a *M. exigua,* e a cultivar Catuaí Vermelho IAC 99 como testemunha. Utilizou-se delineamento de blocos ao acaso, com três repetições, totalizando 33 parcelas constituídas de oito plantas cada. Entre as safras 2011/2012 a 2014/2015 foram avaliadas as seguintes características: produtividade em sacas de café beneficiado ha^{-1}, incidência e severidade da ferrugem, vigor vegetativo, porcentagem de frutos no estádio "cereja", porcentagem de frutos chochos, diâmetro de copa, porcentagem de grãos peneira 17 e acima e análise sensorial de bebida. Diante dos resultados pode-se concluir que: as progênies H514-7-14-2, H514-7-4-5, H493-1-2-2, H514-7-16-3, H514-7-8-11, H518-2-10-1 e H514-5-2-4 são as mais produtivas; todas as progênies apresentam comportamento promissor para resistência à ferrugem do cafeeiro; todos os genótipos apresentam potencial para a produção de cafés especiais; a progênie H493-1-2-2 se mostra promissora apresentando resistência à ferrugem e ao nematóide além de apresentar bom potencial produtivo; e as progênies H514-7-8-11, H518-2-10-1, H514-5-2-4, H514-7-16-3, H514-7-14-2, H514-7-4-5 e H493-1-2-2 tiveram produtividade estatisticamente superior à testemunha Catuaí IAC 99.
Palavras-chave: *Coffea arábica.* Híbrido de Timor. Melhoramento. Produtividade.

Introduction

Cultivars of the Catuaí and Mundo Novo groups still constitute most of the coffee (*Coffea arabica*L.) plantations in Brazil (CARVALHO et al., 2009). Possessing high potential, vegetative vigor, and beverage quality, these cultivars have shown wide adaptability and phenotypic stability in different coffee regions of the country (ANDRADE et al.., 2013; BOTELHO et al., 2010a). Nevertheless, they are also susceptible to coffee leaf rust caused by the fungus *Hemileia vastatrix* Berk. et Br. (COSTA et al., 2007; PAIVA et al., 2010; DEL GROSSI et al., 2013) and to gall nematodes*Meloidogyne* spp.(BARBOSA et al., 2010; REZENDE et al., 2013). Currently, these pathogens are the main phytosanitary problems for coffee plants and cause serious economic losses to coffee growers (SILVA et al., 2006; GONÇALVES; PEREIRA, 1998; MUNIZ et al., 2009).

Genetic resistance is considered to be one of the most efficient, environmentally safe, and economically viable measures in the management of those pathogens (ALPIZAR et al., 2007; BOISSEAU et al., 2009; CARVALHO et al., 2012). The Timor Hybrid (TH), most likely a natural cross between *Coffea Arabica* and *C. canephora* Pierre ex A. Froehner, is a source of genetic material for the development of new cultivars (RODRIGUES JÚNIOR et al., 2004). It is resistant both to the causative agent of coffee leaf rust (COSTA et al., 2007) and the gall nematode (REZENDE et al., 2013).

Cultivars of the Catuaí group have been widely used in genetic breeding programs because they have desirable agronomic characteristics despite their susceptibility to major coffee pests and diseases. Crosses between Catuaí cultivars and TH have resulted in progenies that are agronomically superior to their parents and resistant to both *H. vastatrix* and *Meloidogyne exígua*Goeldi, 1887 (CARVALHO et al., 2008; REZENDE et al., 2013, 2014).

The objective of any breeding program is to produce cultivars with traits that exceed those of their predecessors. Thus, A cultivar can only have superior characteristics if it is has a combination of favorable phenotypes (RAMALHO et al., 2012). Current genetic breeding studies on coffee plants focus on other desirable characteristics such as uniform ripening, low percentage of floaters, superior beverage quality, high sieve, high vegetative vigor, multiple pathogen resistance, and high yields (MEDINA-FILHO et al., 2008).

The lack of data on the agronomic performance of new cultivars limits the adoption of this technology by agronomists and coffee growers (CARVALHO et al., 2012).

Material and Methods

The experiment was conducted in December 2000 at Ouro Verde Farm, situated in the municipality of Campos Altos, Minas Gerais, Brazil, at an altitude of 1,230 m and located at coordinates 19°41'47" S and 46°10'17" W. The average annual temperature is 17.6°C, with an average annual rainfall of 1,830 mm. The soil is characterized as Humic Yellow-Red Latosol, with clayey texture and flat terrain. It is infested with *M. exígua* phenotype E1 (Rm 1.5).

Ten $F_{3:4}$ progenies were assessed. They were derived from crosses between Catuaí group cultivars and CIFC 2570 Timor Hybrids, and were previously selected by Rezende et al. (2013, 2014) for their resistance to *M. exigua*. The Catuaí Vermelho IAC 99 cultivar was used as a susceptibility control (Table 1).

The experimental design was randomized blocks with three replicates. There were a total of 33 plots consisting of eight plants each. The spacing between rows and plants was 4.0 × 0.8 m, respectively. Planting and management of the coffee plants were conducted according to the technical recommendations for the crop in the region. Except for coffee leaf rust and gall nematode control, chemical phytosanitary management was performed preventively or curatively depending on seasonal pest- and diseases occurrences.

Table 1. Genealogy of $F_{3:4}$ progenies and susceptible control assessed in the municipality of Campos Altos – Minas Gerais (MG).

Genotypes	F_1 crosses
H436-1-4-2	CV IAC 99 × TH UFV 442-42
H514-7-14-2	CA IAC 86 × TH UFV 440-10
H514-7-4-5	CA IAC 86 × TH UFV 440-10
H493-1-2-2	CV IAC 44 × TH UFV 446-08
H518-2-6-1	CV IAC 141 × TH UFV 442-34
H514-7-16-3	CA IAC 86 × TH UFV 440-10
H493-1-2-8	CV IAC 44 × TH UFV 446-08
H514-7-8-11	CA IAC 86 × TH UFV 440-10
H518-2-10-1	CV IAC 141 × TH UFV 442-34
H514-5-2-4	CA IAC 86 × TH UFV 440-10
Catuaí Vermelho IAC 99*	Mundo Novo × CaturraAmarelo

CA: Catuaí Amarelo; CV: Catuaí Vermelho; TH: Timor Hybrid.
*Cultivar used as susceptible control.

Four annual harvests (between 2011/2012 and 2014/2015) were conducted in July of each year, and coffee production in liters was assessed each time. Production was then approximated as yield in terms of 60-kg processed coffee bags ha^{-1} (YIELD). A mean yield of 480 liters of coffee at harvest was estimated for each 60-kg processed coffee bag (CARVALHO et al., 2009).

The assessments of rust incidence and severity were performed monthly from January to August of the 2011/2012 and 2012/2013 harvest years. Ten leaves were sampled from the third or fourth leaf pair on the middle third of both sides of each of the six central plants. A total of 60 leaves were sampled per plot. Incidence was expressed as a percentage and assessed by counting the total number of coffee leaves with sporulating pustules out of the 60 leaves collected. Severity was assessed using a five-point arbitrary diagrammatic scale (Cunha et al., 2001) in which the leaves with the smallest area occupied by lesions (<3%) are scored 1, and the leaves with the largest area occupied by lesions (25-50%) are scored 5. The percentages of disease incidence were transformed into areas under the curves of rust incidence and severity progress (AUCRIP, AUCRSP), according to criteria established by Shaner and Finney (1977).

The vegetative vigor of coffee plants was assessed for the harvests from 2011/2012 to 2014/2015. Plants were scored according to a ten-point arbitrary scale in which score 1 corresponds to plants with the poorest vegetative vigor and marked depletion symptoms, and ten corresponds to plants with excellent vegetative vigor, more leaves, and marked vegetative growth on productive branches (CARVALHO et al., 1979).

The percentage of coffee fruits at the "cherry" stage was assessed by counting the number of fruits per plot in a representative 300 mL sample. The percentage of floaters was assessed using the method proposed by Antunes Filho and Carvalho (1954), in which 100 coffee fruits at the cherry stage are placed in water, and those remaining on the surface are considered floaters. These assessments were performed in the 2011/2012, 2013/2014, and 2014/2015 harvests. Crown diameter was measured in July 2013 using the middle third of coffee shoots from the apices of the largest plagiotropic branches. This variable was expressed in centimeters.

The physical classification of coffee beans and the sensory analysis of coffee beverage were performed in the 2013/2014 and 2014/2015 harvests. Immediately after –harvest, fruits at the cherry- and buoy stages were separated by density difference using a water box fitted with a sieve. After separation, cherry coffee samples were hulled and approximately 5 L hulled cherry coffee was obtained. These samples were dried in sieves on a paved yard until the beans reached approximately 11.5% moisture. After drying, the samples were processed and sent to a laboratory for analysis.

In the laboratory, the coffee grains were physically classified by passing a 300 g sample through a set of sieves (17/64-19/64). The material retained on each sieve was weighed and the percentage of coffee beans sieve 17 and higher (17 HG) was calculated.

The sensory analysis of coffee beverage was performed by two qualified tasters using the method proposed by the Specialty Coffee Association of America (SCAA; LINGLE, 1986). Scores ranging from 0-10 points were assigned for each of the following traits: fragrance/aroma, uniformity, absence of defects, sweetness, flavor, acidity, body, finish, balance, and final. The sum of scores corresponded to the final score or classification of the coffee beverage and was used for statistical analysis. Coffees with a final score ≥ 80 points are considered specialty coffees, according to the SCAA method.

The analyses of variance (ANOVA) of YIELD, AUCRIP, AUCRSP, 17 HG and the final scores of the coffee beverage were performed using a temporal split-plot design (STEEL; TORRIE, 1980). The plots were the genotypes, and the subplots were the harvests. Before performing the ANOVA, the harvests (YIELD variable) were grouped into biennia (2011-2012 and 2013-2014) in order to reduce the effect of the biannuality of coffee plant production and to improve experimental accuracy (BOTELHO et al., 2010b). AUCRIP and AUCRSP data were transformed into $\sqrt{x+1}$.

The mean of the harvests was used in the analysis of vegetative vigor, percentage of coffee fruits at the cherry stage, percentage of floaters, and crown diameter. A significance of 5% probability was adopted for all characteristics assessed with the F test. When significant differences were detected, the means were grouped using the Scott-Knott test at 5% probability. The analyses were performed using SISVAR (FERREIRA, 2008).

Results and Discussion

Only genotype variation had a significant effect ($P \leq 0.05$) on yield. The absence of any significant interaction between genotypes and biennia shows that there is no difference in progeny performance throughout the harvests tested. Genetic materials have yield stability, which is highly desirable in genetic breeding programs (CUCOLOTTO et al., 2007; SILVA; DUARTE, 2006).

The H514-7-14-2, H514-7-4-5, H493-1-2-2, H514-7-16-3, H514-7-8-11, H518-2-10-1, and H514-5-2-4 progenies were the most productive, with yields ranging from 38.64 to 47.73 bags ha^{-1}, which surpasses the Catuaí Vermelho IAC 99 cultivar control (Table 2). The high potential of the progenies derived from crosses between Catuaí and Timor Hybrid has been reported by various authors (CARVALHO et al., 2008; REZENDE et al., 2014). These findings underscore the importance of continuing research on them.

Knowledge of the productive longevity of coffee is extremely important for researchers developing new cultivars since these plants are perennial crops. The progenies tested in this study have a productive lifespan of at least twelve years since the twelfth harvest was conducted in 2014 and the coffee plants still have high mean yields and vegetative vigor.

Table 2. Mean yield (YIELD) in processed coffee bags ha^{-1}(2011/2012, 2012/2013, 2013/2014 and 2014/2015 harvests), area under the coffee leaf rust incidence progression curve (AUCRIP), and area under the coffee leaf rust severity progression curve (AUCRSP; 2011/2012 and 2012/2013 harvest) of coffee genotypes evaluated in the municipality of Campos Altos – Minas Gerais (MG).

Genotypes	**YIELD**	**AUCRIP**[(1)]		**AUCRSP**[(1)]	
		11/12	**12/13**	**11/12**	**12/13**
H436-1-4-2	35.47 b	140 aA	160 aA	38 bA	30 aA
H514-7-14-2	38.64 a	0 aA	60 aA	0 aA	20 aA
H514-7-4-5	47.73 a	0 aA	160 aA	0 aA	35 aB
H493-1-2-2	44.24 a	0 aA	240 aB	0 aA	52 aB
H518-2-6-1	36.01 b	0 aA	40 aA	0 aA	20 aA
H514-7-16-3	42.02 a	0 aA	20 aA	0 aA	10 aA
H493-1-2-8	30.50 b	0 aA	180 aB	0 aA	35 aB
H514-7-8-11	43.71 a	0 aA	120 aA	0 aA	30 aB
H518-2-10-1	43.17 a	0 aA	20 aA	0 aA	10 aA
H514-5-2-4	39.97 a	50 aA	80 aA	17 bA	20 aA
Catuaí Vermelho IAC 99	31.94 b	6160 bB	1240 bA	284 cB	157 bA
CV (%)	15.38	57.32		47.95	

Means followed by the same lowercase letter in columns and uppercase letter in rows, within each variable, are not significantly different from each other according to the Scott-Knott test at the 5% significance level.
[(1)] Non-transformed means

The genotypes and the genotype × harvest interaction had a significant ($P \leq 0.05$) effect on the area under the curve of rust incidence progression (AUCRIP) and the area under the curve of rust severity progression (AUCRSP). It has been reported that coffee rust is strongly affected by annual crop loads and environmental conditions (COSTA et al., 2006; MEIRA et al., 2008, 2009). This explains the interaction between genotype and harvest year.

The control cultivar, Catuaí Vermelho IAC 99, was very susceptibility to the pathogen and showed high disease incidence and severity in both harvests according to the mean AUCRIP and AUCRSP (Table 2). All progenies showed low AUCRIP and AUCRSP values for both harvests and therefore have the potential for resistance to coffee rust. The presence of the coffee rust resistance allele in progenies of the Timor Hybrid germplasm has already been demonstrated by various authors (COSTA et al., 2007)

Horizontal resistance is a disease control measure that is highly desired by researchers because it is both durable and efficient against multiple strains of a specific pathogen. Table 2 shows that no progeny had high resistance to nonsporulating rust. Intermediate disease incidence in progeny is important. Progeny with horizontal resistance cannot be selected from those without disease incidence, since the latter most likely have vertical or specific resistance which, according to Botelho et al. (2010 b), masks the expression of horizontal resistance. Costa et al. (2007) also proposed the existence of quantitative or horizontal resistance when studying Catimor (Caturra × Timor Hybrid) progeny. They showed that the Timor Hybrid could be used as source of vertical and/or horizontal resistance in genetic breeding programs aimed at preparing rust-resistant cultivars.

In other studies, intermediate resistance was observed in cultivars derived from Timor Hybrid including Oeiras MG 6851, Tupi IAC 1669-33, Sabiá 398, Arapongas MG1, IPR 99, Acauã (DEL GROSSI et al., 2013) and IPR 108 (SERA et al., 2010). The authors reported that vertical resistance occurred after the loss of complete resistance and was seen in new rust races.

Grossi et al. (2013) report that some cultivars in northern Paraná derived from the Timor Hybrid, including Tupi IAC 1669-33, have partial resistance to rust. In the same study, the authors also mention other cultivars derived from the Timor Hybrid that have complete rust resistance: Catiguá MG 1, Catiguá MG 2, IAPAR 59, IPR 98, IPR 104, Palma II, Paraíso H-419-10-6-2-5-1, Paraíso H-419-10-6-2-10-1, Paraíso H-419-10-6-2-12-1, Pau Brasil MG 1, and Sacramento MG 1.

Sera et al., (2010) reported that the Iapar 59, IPR 97, IPR 98, IPR 104, and IPR 105 cultivars have complete resistance to the rust race populations present at the Agronomic Institute of Paraná (Instituto Agronômico do Paraná – IAPAR). They assessed twelve new coffee cultivars developed by the IAPAR and derived from the Catuaí group and the Timor Hybrid. The authors also stated that about 75% of the IPR 99, IPR 101, IPR 102, and IPR107 cultivars are entirely resistant and are most likely heterozygous for this trait.

Vegetative vigor was relatively high and ranged from 6.96 for Catuaí Vermelho IAC 99 to 8.79 for H493-1-2-2 (Table 3). Thus, there is significant genotype adaptability because high vegetative vigor is positively correlated to better adaptation of the cultivar to the growth environment (SEVERINO et al., 2002). Carvalho et al. (2008) and Rezende et al. (2014) also obtained vegetative vigor ratings in the progeny of crosses between Catuaí and Timor Hybrid cultivars that were similar to, or greater than those derived from Catuaí cultivars.

Two of the progeny performed best in terms of cherry-stage fruit harvest, with yield ranging from 52.92% to 62.59% (Table 3). They were superior to the other three progeny as well as the control. These results corroborated the findings of Rezende et al. (2014).

A high percentage of floaters in coffee plants is a serious deficiency and directly affects processed coffee yield. This anomaly is apparently linked to physiological, environmental, and especially genetic factors (FERREIRA et al., 2013; MENDES et al., 1960). Table 3 shows two groups with this trait. The lowest means ranged from 2.67% to 7.33%.

Varieties that produce nearly ninety percent mature fruit are suitable for coffee researchers since most commercial cultivars yield almost that amount of normal fruit according to Carvalho et al. (2006). Even the progeny with the highest percentage of floaters are in the range considered optimal for this characteristic (Table 3).

The percentages of floaters found in this study corroborate the data of Rezende et al. (2014), who obtained similar values when they assessed progeny from previous years. Therefore, the genetic control hypothesis, suggested by Mendes et al. (1960), explains this phenomenon.

Table 3. Vegetative vigor means (2011/2012, 2012/2013, 2013/2014 and 2014/2015 harvests), percentage of coffee fruits at the cherry stage, percentage of floaters (2011/2012, 2013/2014 and 2014/2015 harvests), and crown diameter (2013/2014 harvest) of coffee genotypes assessed in the municipality of Campos Altos – Minas Gerais (MG).

Genotypes	Vigor	Cherry (%)	Floater (%)	Crown diameter (cm)
H436-1-4-2	7.83 a	52.92 a	11.89 b	158.78 b
H514-7-14-2	8.00 a	60.83 a	9.67 b	175.61 b
H514-7-4-5	7.50 a	46.64 b	4.78 a	188.00 a
H493-1-2-2	8.79 a	59.20 a	4.22 a	189.29 a
H518-2-6-1	7.75 a	58.49 a	7.33 a	194.44 a
H514-7-16-3	8.13 a	62.59 a	4.44 a	183.44 a
H493-1-2-8	7.84 a	57.16 a	10.44 b	171.11 b
H514-7-8-11	7.71 a	44.39 b	5.78 a	188.00 a
H518-2-10-1	8.29 a	54.06 a	2.67 a	174.33 b
H514-5-2-4	8.13 a	48.83 b	5.11 a	151.78 b
Catuaí Vermelho IAC 99	6.96 a	43.06 b	4.22 a	169.00 b
Mean	7.90	53.47	6.41	176.71
CV (%)	7.47	15.05	47.94	6.49

Means followed by the same letter in columns are not significantly different from each other according to the Scott-Knott test at the 5% significance level.

There were two groups with respect to crown diameter. The group with the largest diameter consisted of five progeny ranging from 183.44 to 194.44 cm, and the group with the smallest diameter also included five progeny as well as the control. Their crown diameters ranged from 151.78 to 175.61 cm (Table 3). As a rule, genotypes with smaller crown diameters so that the spacing between rows and plants can be reduced and the number of plants per hectare and, by extension, the yield per area, can be increased (PEREIRA et al., 2011).

When researchers assess and select coffee plants, they seek an idiotype with, among other characteristics, high yield and a large proportion of high sieve beans (FERREIRA et al., 2005). In general, increased grain size increases processed batch uniformity and directly affects the physical appearance of the product. This is particularly desirable for use in espresso machines (FERREIRA et al., 2013). There were three grain size groups. H493-1-2-2 was the best progeny with 55.17% of its coffee beans retained in sieves 17 and higher (Table 4). This value is fifteen percent higher than that of the control. Thus, genetic material may potentially increase coffee sales. These results corroborate the findings of Rezende et al. (2014), who also demonstrated that this progeny has promising characteristics of agronomic interest.

Significant differences ($P \leq 0.05$) were detected among the final scores of the sensory analyses of coffee beverage for the genotypes and the genotypes × harvests interaction. Two groups were found in the 2013/2014 harvest. Scores ranged from 84.14 to 87.50 for the superior group, and from 79.67 to 83.35 for the inferior group. Conversely, there were three groups in the 2014/2015 harvest. Scores ranged from 83.75 to 87.58, 82.17 to 83.08, and 78.67 to 80.33 for the superior, intermediate, and inferior groups, respectively. The H518-2-6-1 and H514-7-16-3 progeny are noteworthy because they produced superior coffee beverage in both harvests tested (Table 4).

Table 4. Percentage of coffee beans classified as sieve 17 and higher (17 HG), and final scores from the sensory analysis of coffee beverage according to SCAA criteria of coffee genotypes assessed in the municipality of Campos Altos – MG. 2013/2014 and 2014/2015 harvests.

Genotypes	17 HG (%)	Final Score (beverage)		
		13/14	14/15	Mean
H436-1-4-2	20.83 c	84.92 aA	78.67 cB	81.79 b
H514-7-14-2	32.50 b	84.17 aA	82.50 bA	83.33 b
H514-7-4-5	31.00 b	81.58 bA	82.92 bA	82.25 b
H493-1-2-2	55.17 a	84.58 aA	83.08 bA	83.83 a
H518-2-6-1	31.00 b	85.92 aA	85.83 aA	85.88 a
H514-7-16-3	19.83 c	87.50 aA	83.83 aB	85.67 a
H493-1-2-8	37.17 b	83.25 bA	84.67 aA	83.96 a
H514-7-8-11	12.08 c	82.50 bA	80.33 cA	81.42 b
H518-2-10-1	34.83 b	82.75 bA	82.17 bA	82.46 b
H514-5-2-4	38.33 b	79.67 bB	83.75 aA	81.71 b
Catuaí Vermelho IAC 99	40.50 b	81.25 bB	87.58 aA	84.42 a
Mean	32.11	83.46 A	83.21 A	83.34
CV (%)	20.85	2.10		

Means followed by the same lowercase letter in columns and uppercase letter in rows are not significantly different from each other according to the Scott-Knott test at the 5% significance level.

In coffee plant breeding, the Timor Hybrid generates cultivars with a substantial amount of *C. canephora* genetic material which may reduce the quality of coffee beverage obtained from newer cultivars (BERTRAND et al., 2008). Nevertheless, we did not observe this effect since all genotypes except for H436-1-4-2 and H514-5-2-4 scored higher than 80 points in both harvests. Therefore, according to SCAA criteria, they have potential for specialty coffee production. Various authors have also found high quality coffee potential in progeny derived from the Timor Hybrid (CHALFOUN et al., 2013; PEREIRA et al., 2008, 2010), which underscores the value of this germplasm in breeding programs aimed at specialty coffee production and pathogen resistance.

Conclusions

The H514-7-14-2, H514-7-4-5, H493-1-2-2, H514-7-16-3, H514-7-8-11, H518-2-10-1, and H514-5-2-4 progenies had significantly higher yields than that of the Catuaí IAC 99 control.

All progenies show promising resistance to coffee leaf rust

All genotypes could be used in specialty coffee production.

The H493-1-2-2 progeny shows resistance both to coffee leaf rust and to the gall nematode and has good yield potential.

Acknowledgments

The authors thank the following for their financial support: the National Council for Scientific and Technological Development (Conselho Nacional de Desenvolvimento Científico e Tecnológico – CNPq), the Coffee Research Consortium (Consórcio Pesquisa Café), the Minas Gerais State Research Foundation (Fundação de Amparo à Pesquisa do Estado de Minas Gerais- Fapemig), Coordination for the Improvement of Higher Education Personnel (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – CAPES), and the National Institute of Science and Technology (Instituto Nacional de Ciência e Tecnologia – INCT).

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