Estimation of Genetic Parameters in *Coffea canephora* Var. Robusta

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Abstract

Coffea robusta

Cercospora

C. canephora

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Introduction

Cofee belongs to the family, *Rubiaceae* and the genus *Cofea* L. which comprises over 104 species that have been identiẐed so far. Commercial cofee production relies mainly on two species, *Cofea arabica* L. (63%) and *Cofea canephora Pierre* (36%). *C. arabica* is a natural allotetraploid (2n=4X=44), and is self-fertile [1]. Whereas, other species are diploid (2n=22) and generally self-incompatible. T e cup quality made from *C. canephora* is generally regarded as inferior to that made of *C. arabica*. However, *C. canephora* does not need to grow at high altitude, requires less care to grow because it is hardier,

variance of the prediction error is minimal, the functions of the prediction are not always estimable and, depending on the degree of data unbalancing, the values of some genotypes may be used overestimated [16]. Whereas, the mixed models equation described by Henderson [17] introduced changes in the estimation of variance components and breeding values [18]. This method consists basically the predication of genetic values considered random to the unequal number of subclasses and to coefficients of relatedness of genotypes [19].

Since the prediction of genetic values of superior materials is one of the main problems in the breeding of any species, once it requires the true values of variance components, the use of more sophisticated methods, such as BLUP, allows obtaining better estimates for these parameters [20]. This approach takes into account the treatment effects as random, which enables to carry out the genotypic selection instead of the phenotypic one [21,22] and their implications in plant selection is presented by several authors in the literature [20]. Ramalho et al. [23] also emphasize the advantages of the application of BLUP in the improvement of Arabica coffee. This methodology has been used by other authors in various crops such as corn, rice, sugar cane among others. However, there are few reports in the literature of the use of this methodology in the selection of individual plants of *Coffea canephora* species. Hence, the objective of this study was to estimate genetic parameters and identify the existing variability among *C. canephora* specie using the mixed model methodology.

Materials and Methods

Plant materials

A total of 52 Robusta variety were used for this study which are maintained at the Coffee Germplasm Collection of EPAMIG (Empresa de Pesquisa Agropecuária de Minas Gerais)/UFV (Universidade Federal de Vicosa) at Oratorios, Minas Gerais, Brazil. The trail was established as a randomized complete block design with 5 replications and one plant per plot was used.

Data collection

Data on 11 quantitative traits recorded on tree basis include vegetative vigor, reaction to rust, reaction to cercospora, number of ortotropics branches, number of plagiotropics branches, plant height, canopy diameter, stalk diameter, fruit maturity, fruit size and production of fruits.

Vegetative vigor average plant scored by the general appearance of the plant, observi□s, and on

$^2 = \frac{^2}{^2 + ^2 + ^2 + ^2 + ^2}$:Coe f cient of determination of interaction e f ects

^{2} =genotypic variance

^{2} =block variance

^{2} =Permanente variance

^{2} =genotype × measurement variance

^{2} =residual variance

Accuracy was calculated using the following equation:

$= \sqrt{^2}$

where ^{2} =heritability at the average level of genotypes

$^2 = \frac{^2}{^2 + ^2 + ^2 + ^2}$

Selection Index was calculated using the following equation Smith and Hazel [24].

I=b1 × 1+b2 × 2 … bm × m=b'x (6.2)

Where;

Xi=an observation on the i th trait and bi is the selection index coe f cient (or weight) for that trait. In vector notation: b'=[b1, b2 , … , bm] and x'=[x1 , x2 , … , xm].

Economic Weight: estimated from Statistics of the experimental data and the genetic variation coe f cient (CV_g%) as a reference, which directly proportional to the available genetic variance, which express the proportionality between the characters and it is dimensionless [25].

Results

Estimation of genetic and phenotypic parameters

T e highest coe f cients of genetic variation obtained were 14.27%, 17.39%, and 19.49% for fruit size (TFr), number of plagiotropics branches (NRPla) and number of Ortotropicos branches (NRort) respectively indicating the relative importance of these traits for the improvement of these variety (Table 1).

Parameter	VIG	FER	CER	NROrt	NRPla	APL	DCO	DCA	MAT	TFR	PROD
Vg											
Vbloc											
Vgm											
Vperm											
Ve											
Vf											
h2g											
R											
C2bloc											
C2gm											
C2perm											
CVg(%)											
CVe(%)											
rgmed											
Accuracy											
Mean											

Ve=Residual variance, Vf=phenotypic variance, h2g=broad sense heritability, r=coe f cient of individual repeatability, C2gm= coe f cient of determination of general combining abilities in pop, C2perm=Coe f cient of determination of permanents e f ects, rgmed=genotypic correlation across the measurements, Vig=Vigor of the plant, Fer=reaction to rust, Cer=reaction to cercospera, NROrt=number of Ortotropics branches, DCA=diameter of stem, MAT=fruit maturity, NRPla=number of plagiotropics branches, Apl=plant height, Dco= canopy diameter, TFr=fruit size, Prod.=production of fruits.

On the other hand, relatively highest residual coe f cient of variation (CV%) of 125.32%, 45.688%, 36.578%, 23.50% and 26.269% were observed for yield, number of plagiotropicos branches (NRPla), number of Ortotropicos branches (NRort), Cercospors and Vigor, respectively for Robusta. For Robusta variety, the highest phenotypic variance of 1018.85, 674.9, 623.2146, and 222.7696 were obtained for canopy diameter (Dco), plant height, yield (Sac/ha) and plagiotropicos branches (NRPla), respectively. T e genetic correlation across measurements (accuracy) over years (r_{gmed}) ranged from 0.1938 for yield (Sac/ha) to 0.8682 for Cercospora (Table 2).

Traits	VIG	FER	CER	NROrt	NRPla	APL	DCO	DCA	MAT	TFR	PROD	
VIG												
FER												
CER												
NROrt												
NRPla												
APL												
DCO												
DCA												
MAT												
TFR												
PROD												
Eco. Wt												

and concluded that the vegetative attributes that contributed most to increased productivity were the length of plagiotropic branches, plant height and stem diameter.

For Robusta variety, yield was positively and signiŹcantly correlated with vigor, NRPLa, APL, DCO and DCA, which suggests that yield per