Agrotrópica 25(2): 93 - 96. 2013.
Centro de Pesquisas do Cacau, Ilhéus, Bahia, Brasil

DETERMINATION OF INCOMPATIBILITY ALLELES OF SCAVINA 6 (*Theobroma cacao* L.) CLONE IN FARM SELECTIONS

Milton Macoto Yamada[1], Wilson Reis Monteiro[1], Uilson Vanderlei Lopes[1], José Luis Pires[1], Basil G. D. Bartley[2], Ramon Figueiredo dos Santos[1]

[1]CEPLAC, Cocoa Research Center (CEPEC), Sector of Genetics, P.O. BOX 7, 45600-970, Itabuna, Bahia, Brasil. milton.yamada1@gmail.com. [2]*In Memorian*

The objective of this work was to determine the groups of self-incompatible clones that possess alleles of Scavina 6 (Sca 6), the main source of witches´broom resistance.This information is quite important because it is possible to determine which farm selections are more related to the Scavina clone. The clones used for determining the two phenotypic groups of incompatibility were TSA 656, TSA 654 (Sca6 x IMC 67), TSH565, TSH 516 (Sca 6 x ICS 1), Sca 6, Sca 12, IMC 67. The VB farms selections were crossed with two clones, each one with different Sca 6 incompatibility alleles (S_2 or S_3). Thirty pollinations were accomplished for each cross. It was determined that TSH 565 or TSH 516 belongs one group and TSA 656 or CEPEC 42 to different phenotypic group. The presence of Sca 6 alleles is confirmed in most of the farm selections studied (VB 184,VB 195,VB 276,VB 277,VB 430,VB 547,VB 549,VB 566,VB 1128,VB 1142).

Key words: *Theobroma cacao* L., compatibility, germplasm.

Determinação dos alelos de incompatibilidade de Scavina 6 (*Theobroma cacao* L.) nas seleções de fazendas. O objetivo deste trabalho foi determinar os grupos de clones que possuem os alelos de Scavina 6 (Sca 6). Isto é muito importante porque é possível determinar quais seleções de fazenda são mais relacionadas com o clone Scavina. Também determina a que grupo fenotípico pertence. Os clones usados para determinar os dois grupos fenotípicos de incompatibilidade foram TSA 656, TSA 654 (Sca6 x IMC 67), TSH 565, TSH 516 (Sca 6 x ICS 1), Sca 6, Sca 12, IMC 67. As seleções VB foram cruzados com dois clones, cada um com alelos diferentes de incompatibilidade de Sca 6 (S_2 ou S_3). Trinta polinizações foram realizadas para cada cruzamento. Foi determinado que TSH 565 ou TSH 516 pertence a um grupo e TSA 656 ou CEPEC 42 a diferente grupo fenotípico. A presença de alelos de Sca 6 está confirmada na maioria das seleções de fazendas (VB 184,VB 195,VB 276,VB 277,VB 430,VB 547,VB 549,VB 566,VB 1128,VB 1142)

Palavras-chave: *Theobroma cacao* L.,compatibilidade, germoplasma

Recebido para publicação em 21 de setembro de 2012. Aceito em 14 de agosto de 2013.

DOI: 10.21757/0103-3816.2013v25n2p93-96

Introduction

The Scavina 6 (Sca 6) and Scavina 12 (Sca 12) clones were the first sources of resistance to witches´ broom disease identified (Bartley, 1986). An undesirable fact related to the Scavinas is the transmission of the incompatibility alelles to their progenies, turning the descendent plants self-incompatible. Since most of resistant farm selections to witches´ broom disease derive from progenies of Scavinas (Yamada et al., 2009), it would be important to determine phenotypic incompatibility groups and also help to clarify their relationship with Scavina.

The genetic explanation for the self-compatibility in cacao was originally proposed by Knight and Rogers (1955) using Pa 7, Pa 35 and Na 32, as being sporophytic system controlled by a simple locus with 5 alleles in the following dominance order S1>S2=S3>S4>S5, being the same order in male or female side. The alleles S_2 and S_3 are independent action or co-dominant (Bartley, 2005). Later, Cope (1962) added two more independent loci, A and B. The A and B loci has been suggested by to author to affect the expression of self-incompatibility and together they produce one precursor substance of incompatibility. In the absence of that precursor substance, as in the case of aa or bb genotypes, the cacao trees are self-compatible. Still, based on Cope´s theory, self-compatible cacao trees can produce 25, 50 and 100% of non fusion of ovules depending on the alleles on he S locus . All possible combinations regarding these three loci are presented in Bartley and Cope (1973).

The Sca 6 has S_2S_3 alleles and they are independent S_2=S_3 (Cope, 1962; Terreros et al., 1983). Being S_2 and S_3 independent alleles it is not possible to use Sca 6 to test the groups that possess any of these two alleles, because in both cases the crossing with Sca 6 would be incompatible. Therefore, this clone cannot serve as control to separate phenotypic groups. In order to do that Sca 6 descendants carrying only one of the alleles (either S_2 or S_3, not both) should be used, as described in this study.

Since the introduction of the witches´ broom in the region in 1989 (Pereira et al.,1989) thousands of trees have been selected on farmer fields (Lopes et al., 2003). As the main source of resistance used in the production of hybrid varieties planted in those fields is the Scavina, some of those selections likely derives of those clones. However, there is a large phenotypic variation (pod shape, color, plant size among others) among them and so their relationship with Scavina is not obvious. It would be important to determine among the farm selections that originated from Sca 6 the ones that have inherited one of these two S alleles of Sca 6. The farm selections that have none of those two incompatibility alleles of Sca 6 have great chance of being descendant either from other clones also regarded as distinct resistance source to witches' broom disease or from progenies not directly derived from Sca 6 (Yamada et al., 2009).

The objective of this work was to determine the groups of self-incompatible clones that possess each of the allele of incompatibility present in Scavina 6.

Materials and Methods

The clones used for determining the two phenotypic groups of incompatibility were TSA 656,TSA 654 (Sca6 x IMC 67), TSH565, TSH 516 (Sca 6 x ICS 1), Sca 6, Sca 12, IMC 67. The farms selections VB 184, VB 195, VB 276, VB 277, VB 430, VB 547, VB 549, VB 566, VB 1128 and VB 1142 were crossed with two clones, each one with different Sca 6 incompatibility alleles (S_2 or S_3).

Thirty pollinations were accomplished for each cross and the setting was based on the criterion established by Yamada et al. (1982). Clones or crosses that presented setting above 5% were considered compatible and when that value observed was close to this percentage the pollinations were repeated.

Results and Discussion

The cross between TSA 656 and TSA 654 indicated that they have different alleles of incompatibility, because they were compatible (data not shown). The clone Sca 6 is incompatible when it is crossed with a group of clones that has S_2 alleles and also incompatible with clones having the S_3 allele (Table 1).Then, the Sca 6 has alleles S_2=S_3, meaning co-dominance for these two alleles, as found before (Terreros et al.,1983; Cope,1962). However, both TSA clones were compatible with IMC 67, but incompatible with Sca 6 (Table 1). Therefore, the alleles S_2 and S_3 are dominant

in relation to S alleles of IMC 67. These results demonstrated that Sca 6 can be used to identify the progeny origin, but not to identify the S_2 and S_3 groups, as shown in the cross with TSA 654 and 656 that has different alleles (Table 1). When it is not necessary to identify the phenotypic group, the test can be performed only with Sca 6. The cross between Sca 6 and Sca 12 is incompatible (data not shown), indicating that they have at least one allele in common.

Other incompatible cross was TSA 656 and CEPEC 42 (Table 1), indicating they belong to the same group. The clone TSH 565 and TSH 516 belong to the same group while CEPEC 42 to another group (Pinto and Pires, 1998). The clones TSA 656 and TSH 565 have different dominant S alleles because their cross was compatible (Table 1). Also, this different alleles was demonstrated in crosses with farm selections, denoted as VB series (Table 2) These ten VB selections were incompatible when crossed with TSA 656 or TSH 565, except, VB 547 that was compatible with both. These results indicated that for a great proportion of farm selections the source of resistance comes from Scavina, what matches with previous investigations using molecular markers (Yamada and Lopes ,1999; Yamada et al., 2009). And even for those clones did not cluster with Scavina in those studies, as for example VB 184, which was suspect as being a different source of resistance (Faleiro,F.G. et al., 2004), in this work, it was incompatible with TSA 656, indicating ancestry of Scavina. Maybe it is a farm selection that was selected within an open-pollinated cacao population, where Sca 6 and other clones genetically distant were present in the pedigree, causing no cluster in the diversity studies. All previous studies have demonstrated great genetic diversity in the farm selections (Faleiro, F.G. et al., 2004; Faleiro, A.S.G. et al., 2004), what is quite desirable for genetic breeding purposes.

Table 1. Results of compatibility reaction of the cross-pollinations

Clone	Male parent	
Female parent	TSA 654	TSA 656
IMC 67	C	C
Sca 6	I	I
TSH 565		C
TSH 516		C
CEPEC 42	C	I

Table 2. Testing the cross-compatibility reaction of farm selections using TSH 565 and TSA 656

Clone	Male parent	
Female parent	TSH 565	TSA 656
VB 184	C	I
VB 195	I	C
VB 276	C	I
VB 277	I	C
VB 430	C	I
VB 547	C	C
VB 549	I	C
VB 566	I	C
VB 1128	C	I
VB 1142	I	C

I = Incompatible C = Compatible

Conclusions

-The clones TSH 565 and TSH 516 carry one of the S alleles of Sca 6 and TSA 656 and CEPEC 42 the other.

-The phenotypic groups of incompatibility can be determined for any self-incompatible farm selections by cross-pollinating them with TSH 565 or TSH 516 and TSA 656 or CEPEC 42 .This information is very important for cacao farmers when using the recommended varieties for planting. The Scavina alleles are present in most of farm selections studied.

Literature Cited

BARTLEY, B. G. D. 1986. Cacao, *Theobroma cacao*. In: Breeding for durable resistance in perennial crops. Rome, FAO.130p.

BARTLEY, B. G. D. 2005.The genetic diversity of Cocoa and its utilization. Cambridge, USA. CABI Publishing. 341p.

BARTLEY, B. G. D.; COPE, F. W. 1973. Practical aspects of incompatibility in *Theobroma cacao*.L. In : Seminar of Agricultural Genetics for Latin America, Maracay, 1969. Proceedings, New York, John Wiley & Sons. pp. 109-134.

COPE, F. W. 1962. The mechanism of pollen incompatibility in *Theobroma cacao* L. Heredity 17:157-182.

FALEIRO, A. S. G. 2004. Variability in cocoa selected by producers for resistance to witches´ broom based on microsatellite markers. Crop Breeding and Applied Biotechnology 4 (3):290-297.

FALEIRO, F. G. et al. 2004. Genetic diversity of cocoa accessions selected for resistance to witches' broom disease based on RAPD Markers. Crop Breeding and Applied Biotechnology 4(1): 12-17.

KNIGHT, R.; ROGERS, H. H. 1955. Incompatibility in *Theobroma cacao* L. Heredity 9: 69-77.

LOPES, U. V. et al. 2003. On farm selection for witches´ broom resistance in Bahia, Brazil - a historical retrospective. In International Cocoa Research Conference,14th. Accra Ghana. Proceedings. Cocoa Producer´s Alliance. pp 1001-1006.V.2.

PEREIRA, J. L. et al. 1989. Primeira ocorrência de vassoura-de-bruxa na principal região produtora de cacau do Brasil. Agrotrópica (Brasil) 1 (1):79-81.

PINTO, L. R. M. ; PIRES, J. L. 1998. Seleção de plantas de cacau resistentes a vassoura de bruxa. Ilhéus, BA. CEPLAC/CEPEC. Boletim Técnico n0 181.

TERREROS, J. R.; CHAVARRO, G.; OCAMPO, R. F. 1983. Determinación de los genotipos de incompatibilidad o compatibilidad en varios clones de cacao (*Theobroma cacao* L.). El Cacaotero Colombiano (Bogotá) 24:27-37.

YAMADA, M. M.; LOPES, U. V. 1999. Paternity analysis of cacao trees selected for resistance to witches' broom disease in plantations. Agrotrópica (Brasil) 11(2):83-88.

YAMADA, M. M.; BARTLEY, B. G. D.;de CASTRO,C.T.; MELO G. R. P. 1982 Herança do fator compatibilidade em *Theobroma cacao* L. Relações fenotípicas na familia PA (Parinari). Revista Theobroma (Brasil) 12 (3): 163-167.

YAMADA, M. M. et al. 2009. Parent pair analysis of cacao trees selected in farms for resistance to *Moniliophthora perniciosa* using microsatellites. Agrotrópica (Brasil) 21(2):123-126.

●