

EVALUATION OF CREOLE CULTIVARS OF AVOCADO (*Persea* spp) FROM THE COLECTION OF INIA-CENIAP IN VENEZUELA

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The collection of avocado from National Center of Agricultural Research (INIA-CENIAP, by its Spanish acronym) is kept in the experimental Field in Maracay, Aragua State, Venezuela: Height of 450 m.a.s.l., annual rain average of 1018.4 mm, seasonal behaviour, humid period (June-November) and dry period (December - April), and 1354.4 mm of potential evapotranspiration (ET). The annual insolation was of 6.2 hours, characterized by a maximum (March) and a minimum (June). In forty three types of creoles, morphologic descriptors of plant, leaves and fruit were applied. In this work, description of plant and fruit is emphasised. Thirty-one types were classified within the Guatemalan x Antillean group (G x A), 7 in group G and 5 in A. Fifty percent of G x A had an irregular growing habit and 25% verticillate, 59% belong to floral group 'B' and 41% to the 'A' group. The fruits were between medium-to-big sizes in 81% of these cultivars with pear-shaped form or pear-shaped oblong (70.3%). The predominant colour in the fruit is green in different tints, 80% displayed smoothly or slightly rough skin with yellow to greenish-yellow pulp. The Guatemalan group had irregular habit growth, semi-elliptical or circular canopy, and medium to large fruits. In the West-Indian group the habit growth is verticillate or irregular, semi-elliptical canopies and medium sized trees. Medium-large to large fruits, pear-shaped or oblong, green yellowish either dark, some bright ones with medium thickness of skin. By its characteristics, 'Figueroa' has great possibilities of having large-scale commercial use.

Key words: Descriptors, multivariate, race

EVALUACION DE CULTIVARES CRIOLLOS DE AGUACATE (*Persea* spp) EN LA COLECCIÓN DEL INIA-CENIAP EN VENEZUELA

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La colección de aguacate del INIA-CENIAP es mantenida en el Campo experimental en Maracay, Edo. Aragua, Venezuela. Altura de 450 msnm, precipitación promedio anual de 1018,4 mm, comportamiento estacional, con un período húmedo (junio-noviembre) y un período seco (diciembre – abril) y 1354,4 mm de evapotranspiración potencial (ETo). La insolación anual fue de 6,2 horas caracterizada por un máximo (marzo) y un mínimo (junio). Cuarenta y tres tipos clasificados como criollos se les aplicó descriptores morfológicos de planta, hoja, flor y fruto. En este trabajo se hace énfasis en los descriptores de planta y fruto. Treinta y un tipos fueron clasificados dentro del grupo guatemalteco x antillano (G x A), 7 grupo G y 5 A. Cincuenta por ciento de los G x A tuvieron hábito de crecimiento irregular y 25% verticilado, 59% pertenecen al grupo floral 'B' y 41% al 'A'. El fruto fue de mediano a grande en 81% de estos cultivares de forma piriforme o piriforme oblonga (70,3 %), el

color predominante en el fruto es el verde en diferentes tonalidades, el 80% presentaron cáscara lisa o ligeramente rugosa con pulpa amarilla a amarilla verdosa. El grupo guatemalteco tuvo hábito de crecimiento irregular, copa semi elíptica circular, frutos medianos a grandes. En el grupo antillano el hábito es verticilado o irregular, copas semi elíptica y portes medianos. Frutos Medianos-grandes a grandes, piriformes u oblongos, verdes amarillentos u oscuros algunos lustrosos con espesor de la cáscara mediano. Por sus características, se destaca 'Figueroa' con posibilidades de uso comercial a gran escala.

Palabras claves: Descriptores, multivariado, razas

1. Introduction

The avocado in Venezuela occupy a surface of 12.000ha located mainly in Yaracuy, Carabobo, Sucre and Miranda states with a production of 48.483. In great part of Venezuelan production areas exist a heterogeneous distribution of population or big diversity in size, shape and fruit color, this due that the development was as associated crop and by seed (Avilan *et al* 1980). In recent monocrop systems, the cultivars commonly used are Pollock, Choquette, Winslowson or dry box and Nelan or CENIAP-4 among others (Avilian *et al* 1997). The production levels are generally low ($< 4,5 \text{ tn ha}^{-1}$) and the problems of disease with the scare adoption of technologies influence in the low income and productivity of the crop. In the breeding plan of the crop collects in the production areas of promising Creoles cultivars graft) which were grouped according its probable origin taken as a base the characteristics that identify the races. This work it is the continuation of the analysis of morphologic descriptions of leave, flower, seed and tree to determine which of them contribute more in the grouping and to be more precise in the classification of Creole types.

2. Materials and Methods

The study was made taking as it bases the results of the characteristics of 43 entrances (Table 1), referring to the tree, leaf, flowers, fruits and seeds, established by application of 40 morphologic descriptors (Avilán and Rodriguez, 1997).

Each entry is constituted by three trees like minimum, propagated vegetative using grafted prongs and in a common rootstock, planted in the collection of cultivars of the National Centre of agricultural Research (CENIAP-INIA), Maracay, Venezuela.

The data were analysed using the Infostat program applying calculations of frequency, analysis of main components and conglomerates.

The orchard is located in the region North center of the country ($10^{\circ}17' \text{ N}$, $67^{\circ}37' \text{ W}$), characterized as Tropical Dry Forest, that has general climatic limits a precipitation average of 1018.4 mm annual, seasonal behaviour, with a

humid period (June-November) and a dry period (December-April), presents 1354.4 mm of potential evapotranspiración (Eto), an annual average temperature between 24 °C. and 26 °C, the annual insolation was of 6.2 hours characterized by a maximum in March and a minimum in June.

The collection this located to an elevation of 450 m.o.s. in soils with good physical training conditions of medium natural fertility, classified within the Entisol Order (Ewel and Madriz, 1968).

Table 1 List of creoles cultivars of avocado in the collection from Bank of Germoplasm- CENIAP

Cultivars	Race
Zulia-2	Guatemalean x antillean (GXA)
Santa Ana	G x A
Esparta	G x A
Lujo	G x A
Ceniap-1	G x A
Santa Cruz	G x A
Figueroa	G x A
Araira-1	G x A
CTB	G x A
Ceniap-11	G x A
Adolfo	G x A
CM-1	G x A
Herrera	G x A
Guacara Morado	G x A
María	G x A
Pedro	G x A
Ortega	G x A
Ceniap-5	G x A
Toledo	G x A
Ceniap-6	G x A
Ricardo-2	G x A
Santa Clara	G x A
Lozada	G x A
Calidad	G x A
Ceniap-7	G x A
Nora	G x A
Ceniap-10	G x A
Evangelista	G x A
Palomino	G x A
Ceniap-14	G x A
Alcenio	A
Araira-2	A
Moya	A
Catire	A
Ceniap - 13	A

Araira FM	G
Vargas	G
Celia	G
Ceniap-2	G
Ceniap-12	G
Secundino	G
Concepción	G

3. Results and Discussion

3.1. Characteristics in hybrid Creoles G x A

Thirty types were classified within this group, the greater diversity in the description, based on the greater number of frequency groups, was: form of the fruit, colour of the rind, form of the canopy, forms of the seed, form of lóculo of the seed, chalazae colour, nature of episperm, nature of cotyledon, colour of panicle, colour of lenticels and forms of the leaf.

Fifty percents had habit of irregular growth and verticillate 25%, 59% belong to the floral type 'B' and 41% to 'A', the fruit were of medium to great in a 81% of pear-shaped form or pear-shaped oblong (70,3%), 80% presented smooth or slightly rough rind with yellow colour to greenish yellow.

3.2. Characteristics in the Antillean Creoles

Five types corresponded to this group, the greater diversity was in the descriptors: Size and forms of the fruit, type of peduncle, consistency of the rind, adhesion of the rind, lenticels of the rind, form of the canopy, tree dimensions of the plant, weight of the seed, colour of tegmen, forms of the chalazae, nature of episperm, nature of cotyledon and colour of lenticels. Verticillate growing habit or irregular growth, canopy semi elliptical or medium, great to medium-great fruits, pear-shaped either oblong, of yellowish or dark green colour, some bright with thickness of the rind medium. 60% belong to the floral group 'B'.

3.3. Characteristics in the Guatemalan Creoles

Seven types were located in this group, the greater diversity was in the descriptors: form of the fruit, colour of the rind, form of the canopy, forms of the seed, colour of cotyledon, colour of the rind and form of the leaf. Irregular growth habit, canopy semi elliptical and medium tree dimensions, 71% belong to the floral group 'B'.

3.4. Multivariate analysis

The first run with all the used variables showed few groups with too many individuals by group, the contributions in the table of self values of the vectors by variable were reviewed and those with low individual contribution in the component discarded. The variables selected (16) for the second analysis

were: Size of the fruit (F1), Form of the fruit (F2), Form of the apex of the fruit (F4), Position of the apex of the fruit (F5), Type of pedicel (F8), colour of the rind (F9), lenticels of the rind (F14), Form of the canopy of the tree (C2), dimensions of the tree (C3), Weight of the seed (S2), adhesion of the seed (S3), form of lóculo, (S4), occupation of lóculo of the seed (S5), nature of cotyledon (S11), Colour of panicle (I1), forms of the apex of the leaf (H4), size of petiole (H6).

The accumulated proportion of the 3 first components improve from 0.33 to 0.44 in the second analysis, the cophenetic correlation stayed in 0.90 and could be separated better the groups in cluster.

In the figure 1 the vectors of each variable and the location of each variety according to their relation with them appear. From of the analysis of the graph a first grouping of the cultivars can be established as shows in table 2.

Figure 1 Analysis of main components in a group of descriptors in creoles avocados from Venezuela

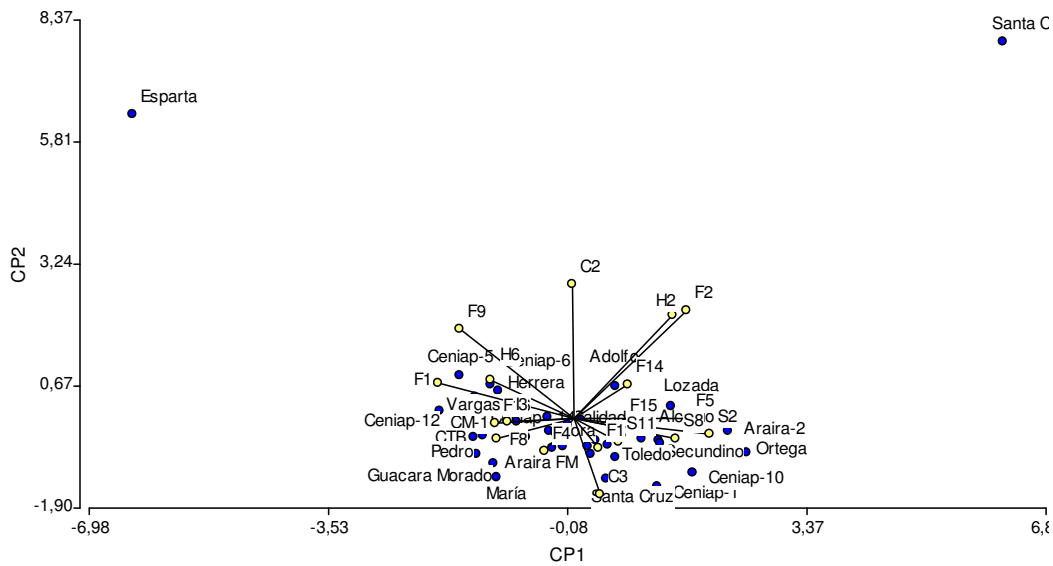


Table 2. Groups of cultivars according to the variables that they contribute to the main component

Variety	Vectors related
Esparta, Ceniap-5, Ceniap-6, Herrera, Vargas, Ceniap-12, CM-1, CTR, Ceniap-14, Pedro, Guacara Morado, María, Araitha FM, Esparta	Size of the fruit (F1) Form of apex (F4), type of pedicel (F8), Colour of the rind (F9), Form of the scar (F16), size of petiole (H6)
Santa Cruz, Ceniap-1, Ceniap-10, Toledo, Secundino, Ortega, Araitha-2, Alcenio, Lozada,.	Dimensions of the plant (C3), adhesion to rind (F12), Lenticels of the rind (F14), size of the scar (F15), weight of the seed (S2), form of chalazae (S8), nature of cotyledon (S11),
Adolfo, Santa Clara,	Form del apex (H2), Size of fruit (F2), Form of the canopy (C2),
Ceniap-11, Ricardo-2, Concepción, Figueroa, Palomino, Nora, Moya, Santa Ana, Calidad.	Towards the center of the graphic

In the Figure 2 are five groups derived from the analysis of conglomerates, 5 groups deriving themselves from the cut in distance 1. It emphasizes group 5, Avilan and col. report to `Santa Ana`, and `Santa Clara` as cultivars with good used potential for scion according to its excellent characteristics like percentage of pulp, green colour of the rind, with exception of clear Santa, and amount of fruits. Another group to consider is the 4, the most numerous, grouped the majority of the G x A, which include `Guacara`, `Figueroa` and `Santa cruz` equally potential for scions by its medium to great fruit among other characteristics.

The fat content also was analyzed by the author and reveals that although in these cultivars they present low values (6,9 - 7,7%), for the Venezuelan market does not affect much since the majority preference by flavour of the population is in types like the Pollock and Choquette that have lower levels (5%). Amongst cultivars of greater fat content are `Araitha FM`, `Adolfo` and `Ortega`, located in group 4, 5 and 2 respectively. This last one has been verified with good behaviour against soil borne fungi and it is had predicted to prove like pattern in semi commercial fields.

4. Conclusions

According to the analysis altogether the separation Venezuelan Creoles cultivars is based more on characteristics of the fruit and canopy by on those of seed and leaf.

Exist the possibility of regrouping several cultivars of the Antillean raze due its

dispersion in the different groups from the multivariate analysis

The resulting grouping of the analyses maintained in groups near `Santa Ana` and `Santa Clara` as well as `Figueroa` and `Guacara`, cultivars with potentiality of use for Venezuela

5. References

AVILÁN, L; F. LEAL Y M RODRÍGUEZ. Cultivares de Aguacate Venezolanos. En: Frutales para México. Contribuciones del Caribe y Surdeàrica. Capitulo 18 Pág. 153- 160.

AVILÁN, L; E. ESCALÁNTE; F. LEAL Y M. FIGUEROA. 1980. Áreas potenciales para el desarrollo de diferentes especies frutícolas en el país. I Aguacate, *Agronomía Tropical* 30(1-6):105-113.

AVILÁN, L; F. LEAL Y D. BAUTISTA. 1997. El Aguacatero, principios y técnicas para su producción. Caracas. Venezuela. Espasande Editores. S.R.L. 380p.

AVILAN R. L. Y RODRÍGUEZ M. 1997. Descripción y evaluación de la colección d aguacates (*Persea spp*) del CENIAP. Maracay, Venezuela. Fondo Nacional de Investigaciones Agropecuarias. Centro Nacional de Investigaciones Agropecuarias. IICA/CreA/PROCIANDINO/FRUTEX. 92p (Serie A No 12)

EWEL, L Y J. MADRIZ. 1968. Zonas de vida de Venezuela. Memoria explicativa sobre el mapa ecológico. Caracas. Ministerio de Agricultura y Cría. Editorial Sucre. 265p.

GALAN V Y D. FERNÁNDEZ. Evaluación de la población local de aguacates antillanos de la isla de Gomera. Madrid. Instituto Nacional de Investigaciones Agrarias. Serie: Producción Vegetal No 56. 1983.

MONTENEGRO H. Contribuceao para o estudio pomologico de abacateiro. Piracicaba. Tese Escola Superior de Agricultura Luis de Qeiros. Universidade de Sao Paulo. 1956 92p.

LIZANA L. Y LUZA. Caracterización de la fruta de paltos (*Persea americana Mill*) de la raza americana cultivados en Chile. *Proceedings American Society for Horticultural Science. Tropical Region* 23:113-118. 1079

PENNOCK W.; T. SOTO; K. ABRAMS; R. GANDIA; A. PEREZ Y G. JACKSON. Variedades selectas de aguacates de Puerto Rico. *Boletín* No 172. 1963 59p.

RHODS, A. ; S. MALO; C. CAMPBELL ANS S. CRAMER A. Numerical taxonomic study of the avocado (*Persea Americana Mill*) *Journal American Society Horticultural Sciences* 96 (3) 391-395. 1991.

SALAZAR, R.; D. RIOS Y R. TORRES 1972. Selección de variedades de aguacate (*Persea americana Mill.*) en Colombia. *Revista ICA.* 6(4): 357-379

Figure 2. Conglomerate analysis of groups of descriptors in creoles avocados from Venezuela

