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THE MOUNTAIN AVOCADO OF COSTA-RICA. *PERSEA AMERICANA* VAR. *COSTARICENSIS*, A NEW SUB-SPECIES

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SUMMARY

In a study of Avocado genetic resources, the related species were explored in Costa Rica. It was found in this country that the native avocado population and its botanical relatives are unique and differ from those known from northern countries. One unique item is the mountain avocado of Costa Rica, hereby described as a new sub-species-*Persea americana* var. Costaricensis.

This is an abundant type of avocado, distributed in elevation between 1200 and 2000 m. above sea level. The fruit characteristics separate it from other known sub-species: it is much smaller than West Indian (*P. americana* var. Americana), and Guatemalan (*P. americana* var. Guatemalensis) avocados, it has skin like the West Indian avocado in its pale green color, soft leathery texture, medium thickness and peelability, but a seed like the Guatemalan avocado in its oblate form and smooth surface. The possibility of being hybrid of the above mentioned two "races" discussed and contradicted.

Key Words: avocado, Costa Rica, germplasm, Persea *americana*

BACKGROUND

The avocado genetic resources are located mainly in those parts of the world where destruction of native vegetation has reached an advanced stage. Many avocado relatives that were described in the literature about 20-30 years ago are no longer available.

In order to rescue these endangered species, and to enable further breeding research, a wide scale project has been operated since 1989 with the participation of Latin American, German and

Israeli scientists (Ben-Ya'acov et al. 1992). The stages included in the project are: exploration, collection, propagation, conservation and evaluation of many accessions, having wide diversity. The evaluation includes horticultural traits and a study of the DNA characteristics (Bufler and Ben-Ya'acov, 1992).

In Costa Rica, unique examples of avocado and its relatives were found, one of which is described in this article for the first time.

METHODS

In Costa Rica, one of the. countries included in the study of the avocado genetic resources, the program has included the following activities;

1. A general study of the ecological conditions in different regions.

2. A study of the flora based on the literature and herbariums.

3. Exploration trips.

4. Collection of representative accessions as well as material from outstanding trees.

5. Propagation and conservation.

6. Evaluation study

During the years 1990-1994 exploration trips were arranged in Costa Rica, and more than 60 accessions were collected as seeds, graftwood and germinating plants. The material was propagated and conserved in gene pools in Costa Rica (Wilson Botanical Garden), in Mexico (CICTAMEX) and in Israel (Volcani Center). Leaves from different accessions were collected, treated by the recommended methods and examined for DNA characteristics by the RFLP method (Bufler and Ben-Ya'acov, 1992).

RESULTS

Description of the mountain avocado of Costa Rica

This is an abundant type of avocado tree, mostly distributed among the elevations of 1200 to 2000 m. above sea level. It is called by the local people "Aguacate de Monte" or "Aguacate de Montana" and even "Aguacatillo". These names are commonly used for different avocado types and their relatives, but the last name is used in Mexico for other species and not for the *Persea americana*; it means that the fruit is very small and useless.

The tree

The trees are big, and sometimes very big, depending on their age. Most of its characteristics are typical of the avocado (Kopp, 1966; Bergh, 1975, 1992).

The leaves

They are of various forms, but usually smaller than those of the Guatemalan and West Indian avocado. They lack the anise smell which the Mexican avocado often has (Bergh and Ellstrand 1986).

The flowers

The flowers are also typical to avocado but emerge along the whole length of the twigs. The blooming season is in November-December, and the fruit ripens in September.

The fruit

The fruit is round and small, often very small about 4 cm in diameter (Fig. 1). We also found trees with pyriform fruits, mostly a little bigger in size. The typical fruit has a very small amount of flesh and its quality is poor. The fruits of the typical round type are not considered edible because of their poor quality, but some of the pyriform type taste better.

The fruit skin is leathery and easy to peel, and its color is pale green and shiny, so that it is very much like the West Indian avocado skin.

The seed

The seed is relatively big, round to oblate in form, and its surface is smooth, so that it is very much like the Guatemalan avocado seed. In few cases, we found rosy to red seeds (Fig. 2). The seeds are frequently used as a rootstock source.

Twenty accessions which we consider typical of the Costa Rican mountain avocado are described in Table 1. Leaves from three typical trees were analyzed for their DNA characteristics by the restriction length fragment polymorphism (RFLP) method and these were found to be different from those of any known avocado group (Ben-Ya'acov et al, 1992; Bufler and Ben-Ya'acov, 1992).

DISCUSSION

There is no doubt that the avocado type hereby described belongs to the species *Persea americana.* This species is botanically divided into varieties also called races or sub-species (Bergh, 1975, 1992; Bergh and Ellstrand, 1986; Kopp, I966;). But the mountain avocado of Costa Rica could not be considered as belonging to one of the known races, especially because its fruit skin and flesh quality are nearer to those of the West Indian avocado (*Persea americana* var. *Americana)* while the seed form and surface are nearer to the Guatemalan avocado (*Persea americana var. Guatemalensis*).

All West Indian avocado fruits are much bigger in size than the one described here, and so are most Guatemalans. Some primitive Guatemalans have small fruits, but they have much thicker and harder shell than the Costa Rican type.

Our conclusion is that this avocado from Costa Rica does not belong to any known race or botanical variety and is not a hybrid.

The reasons why it could not be a hybrid are:

1. The two parent candidates do not grow in the region. Of the three important varieties of the avocado, the Mexican and Guatemalan could not be found in Costa Rica, and the West Indian is present, but in lowland areas only.

2. The Costa Rican type is native to the region and has its own variable population.

3. The small size and poor quality of the fruits could not be a result of hybridization among big ger fruited types.

4. The basic characteristics of possible parent races are absent in the Costa Rican type (Kopp, 1966; Williams, 1977).

We came to the conclusion, supported by the results of the DNA analysis that the Costa Rican mountain type is a new variety. In recent years, the tendency has been to eliminate separation among the groups involved in the *Persea* genus, subgenus *Persea,* and to leave only *P. schiedeana* as a separate species from *Persea americana* (Bergh, 1992; Bergh and Ellstrand 1986; Scora and Bergh, 1992). According to this classification, eight groups would be recognized as sub-species, to which there will now be added one more sub-species, var. *Costaricensis* belonging to the species *Persea americana.*

The existence of the mountain avocado of Costa Rica has previously been mentioned in the literature. Typical of botanical surveys of flora, the surveys made in Costa Rica (Burger and van der Werff, 1990; Skutch, 1971) did not mention inter-specific differences. Popenoe (1927, 1935), Schroeder (1977) and Zentmyer and Schieber (1976) were dealing more specifically with the variable *Persea americana* and *Persea* spp. which were found in their exploration trips in Costa Rica, but they also did not describe the type which is the subject of this paper.

The Pacific coastal area of Costa Rica and neighboring countries was considered as the origin of the West Indian avocado (Storey et al, 1986). We found many intermediate trees between the mountain type and the West Indian avocado on the Western slope of the mountains. May we suggest that the mountain Costa Rican avocado is an ancestor of the West Indian race, rather than its offspring. Further DNA analysis will either confirm or contradict this hypothesis.

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Table 1: Genetic material of the mountain type avocado collected in Costa Rica.

No	Name	Collection Place	Conserved in Gene pool			Notes
			1	2	3	
1	San Rafael	Coronado			G(2)	In RFLP test, found to be different from any known avocado
2	Las Nubes 1	Coronado				In RFLP test, found to be different from any known avocado
3	Las Nubes 3	Coronado	G			
4	Las Nubes 5	Coronado	G			
5	Monteverde 11	Monterverde	G			Very small fruit, known as "Aguacatillo"
6	Monteverde 15	Monteverde	G,S			Very small fruit, known as "Aguacatillo"
7	Lecheria	Passo Ancho				In RFLP test, found to be different from any known avocado
8	Freddy 2	Poas de Aseri	G	S(2)		Very small fruit
9	Freddy 3	Poas de Aseri	G,S			
10	Freddy 4	Poas de Aseri	G,S		S	Rosy seed
11	Freddy 5	Poas de Aseri	G,S		S	
12	Freddy 7	Poas de Aseri	G,S		S	Pyriform fruit
13	Freddy 15	Poas de Aseri	G,S			Red seed
14	Rojas	Coronado	G,S			The fruit is pyriform, nice and edible
15	Get Shemani	Heredia	G			
16	Carisal 1	Alejuela	G			From a huge tree that was cut back
17	La Cima 1	De Copey	G,S	S		Nice, but small pyriform fruit
18	La Cina 2	De Copey	G,S	S		Nice, but small pyriform fruit
19	La Brisas	Zarcero		S		
20	Solis	Zarcero		S		

Legend: (1) Gene pool - 1-CICTAMEX Mexico, 2-Wilson Botanical Garden, Costa Rica, 3-ARO, Volcani Center, Israel.
(2) Propagated as G-Graftwood, S-Seeds

Figures

Fig. 1. A typical inflorescence of the mountain avocado of Costa Rica.

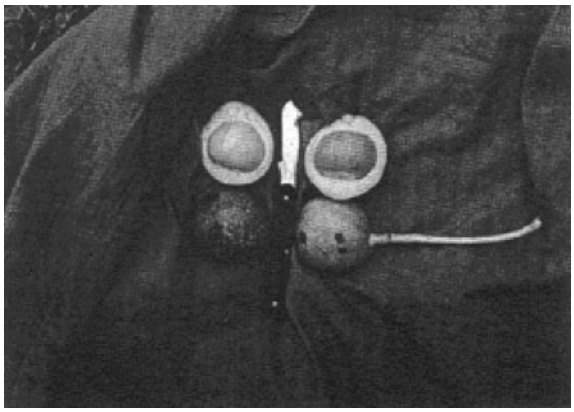

Fig. 2. A typical rounded fruit and leaves of the mountain avocado.