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Relations Among the Components of Avocado Seedlings (*Persea americana* Mill.)

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1. Seed Size Components Summary

Evaluating avocado seeds originating from the criollo (Mexican race) and cultivars Fuerte and Hass, the following conclusions were reached: (1) the mean seed size (all of its characteristics) increased from criollo to Hass; (2) the mean range of days to shoot emergence for criollo was 56.4-68.6, Fuerte 63.1-70.9, Hass 67.2-96 days; and this range correlated with the major residual dry matter content of the cotyledons; (3) the fresh residual weight of the cotyledons, estimated after the shoots reached 5, 15, and 45 cm, was higher than the seed size at the time of sowing; (4) the dry weight of the cotyledons diminshed with increase in shoot size; (5) the degree of hydration of the cotyledons (g $H_2O \cdot g^{-1}$d.m.) increased with rise of shoot size in all three types of avocado seeds.

Introduction

Nurseries as well as orchard tree size and tree establishment are controlled by the rootstock characteristics. The vigor and final tree size depend upon the rootstock race as well as the species. Large variation in seedling characters was found in wild Guatemalan, Mexican, West Indian (*P. americana* Mill.) and in chinini (*P. schiedeana* Nees.) as reported previously (Borys *et al,* 1985, 1987).

The seed sources for the wild type of avocado are gradually disappearing, and no specific plantations of seed production exist to cover the nursery needs. Thus, some nurseries use any seed source available for avocado propagation. The aim of this paper is to present the results of evaluation of the differences among seedling characteristics produced from seeds of two cultivars and one criollo type of avocado belonging to *P. americana* Mill. The first part includes the characteristics of seeds.

Material and Methods

Seeds from open pollination were collected from criollo type (Mexican race), Fuerte, and Hass in the area of Tacambaro, Michoacan. Only sound seeds of normal appearance were used, after heat treatment according to

the procedure of Durbin (1957). The experiment was conducted in the glasshouse at the University of Chapingo (19°29' N latitude and 98°53' longitude E; 2250 m above sea

level). A total of 135 plants was evaluated. Seeds were planted in river sand previously washed with tap water, treated with methyl bromide, using black polyethylene bags 40 cm in height and 20 cm in diameter; one seed was planted per bag. Three populations of seeds for three stages of shoot size (5, 15, and 45 cm) were tested. For each, 15 plants were used. One plant constituted an experimental unit. Commercial complete inorganic nutrient solution (Floraphil) was applied at a rate of 1 g per liter of H_2O at each irrigation. Insects were controlled using tobacco extract or Temic, when it was necessary. The roots were washed with water and preserved in 5% of formaldehyde until respective measurements. The seeds' weights were determined after heat treatment and without seed covers. The cotyledons' residual fresh and dry mass were determined at time of harvesting; dry mass after drying for 48 hours in forced oven at 60°C. Data produced were analyzed using SAS system. The averages were compared using Tukey test at 0.05.

Results and Discussion

Seed Size. The criollo seeds were smaller; the largest seeds tended to be produced by the cv. Hass. The data in Table 1 indicate the possibility of size overlapping among all three types tested. The results support field observations and opinions widely held that avocado types of cultivars belonging to the Mexican race produce small seeds, Guatemalans larger, and West Indians the largest (Borys, 1987; Lopez-Jimenez and Borys, 1989). The intermediate seed size of Fuerte expresses the hybrid nature of that cultivar (Guatemalan x Mexican), and seed of the Hass, the Guatemalan race.

Shoot Emergence. The shoot emergence from seeds of various sizes was previously studied, and the presence of a positive correlation between their characters was noted. Hernandez (1980), relating days needed to shoot emergence, found a very small correlation with seed mass (0.179 and 0.312 for the Mexican and West Indian races, respectively). The respective seed sizes ranged from 9 to 49.6 g.

In the present study, there appeared to be a general negative correlation between the seed size and days needed to shoot emergence (Tables 1 and 2). However, in the calculated correlations for both characters for each sample and avocado type, only two positive values per nine cases tested were found (Table 8). Dominated positive correlations between days to emergence and cotyledons residual dry mass. This indicates that those seeds which had slowly started to metabolize their resources needed more days to germinate. One should point to the high value of these correlation coefficients.

Cotyledon Size. The seeds germinated increased slightly their fresh weight due to rise of water content. Both the fresh mass and the residual linear size of cotyledons show similar differences between avocado types (Tables 3, 4). The interesting feature of cotyledons is the maintenance, even a slight increase, in their fresh mass. The emergence period was rather long (Table 2). This occurred although the dry mass of these cotyledons dropped substantially (Table 5). Significant differences among seed types in fresh and dry mass content at 5 and 15 cm shoot size are evident, with no significant differences present when the emerged shoot reached 45 cm in height. There was no or low decrease in fresh mass, but a very marked drop in dry matter content

with the increase in shoot size. Thus, water is substituting the dry matter constituents of cotyledons (Tables 5, 6).

Table 1. Seed size of three types of avocados.

Sample	Criollo (g)	Fuerte (g)	Hass (g)
1	21.2 b	26.8 b	39.7 a
2	27.7 c	29.9 b	39.5 a
3	23.2 a	27.4 a	28.8 a
Mean	22.0	28.0	35.7

Table 2. Days after sowing to shoot emergence.

Shoot Size (cm)	Criollo	Fuerte	Hass
5	68.6 a	59.4 b	67.2 a
15	56.4 c	63.1 b	96.0 a
45	67.5 a	70.9 a	72.4 a
Mean	64.2	64.5	78.5

Due to the relatively high drop of dry mass and constant or low change in water content of cotyledons, the hydration of cotyledons was rising strongly (Table 7). One wonders about the function of such a high degree of hydration of the cotyledons at the time when the shoots are reaching 45 cm in height. It is possible that the cotyledons serve as an emergency reservoir of water for rapidly expanding shoot components. At least, these

data indicate that the cotyledons do not serve only as a reservoir for energy and building components. The importance of high water content of cotyledons for shoot growth should be evaluated in the near future. It seems that there is a constituent in residual dry mass that controls the velocity of shoot emergence.

Taking into account the number of days to shoot emergence, which is of interest to nurserymen, one should conclude that the criollo and Fuerte types presented similar characteristics. Hass seeds will require a longer period to produce shoots, thus increasing the cost of nursery management.

Table 3. Residual fresh mass of cotyledons at the shoot size of emerged avocado plants.

Shoot Size (cm)	Criollo (g)	Fuerte (g)	Hass (g)
5	24.7 b	30.3 b	44.2 a
15	20.7 c	33.9 b	42.4 a
45	24.6 a	29.5 a	30.5 a
Mean	23.3	31.3	39.0

Table 4. Residual length of cotyledons at the shoot size of emerged avocado plants.

Shoot Size (cm)	Criollo (mm)	Fuerte (mm)	Hass (mm)
5	24.7 b	30.3 b	44.2 a
15	30.5 a	31.1 a	30.1 a
45	30.4 ab	34.6 a	28.7 b
Mean	28.6	32.0	34.4

Table 5. Residual dry weight of cotyledons at the shoot size of emerged avocado plants.

Shoot Size (cm)	Criollo (g)	Fuerte (g)	Hass (g)
5	7.9 b	10.7 b	15.9 a
15	5.3 b		11.3 a
45	3.3 a	4.6 a	4.1 a
Mean	5.5	8.7	10.4

Table 6. Water content of cotyledons at the shoot size of emerged avocado plants.

Shoot Size (cm)	Criollo (g)	Fuerte (g)	Hass (g)
5	16.6 b	19.6 b	28.3 a
15	15.4 c	23.2 b	31.0 a
45	21.3 a	24.9 a	26.4 a
Mean	17.7	22.6	28.5

Table 7. Hydration of dry matter of cotyledons at the shoot size of emerged avocado plants.

Shoot Size	Criollo	Fuerte	Hass
(cm)	(g $H_2O \cdot g^{-1}$ d.m.)		
5	2.32 a	1.89 ab	1.79 b
15	3.10 a	2.23 b	2.90 a
45	7.38 a	5.58 b	6.72 ab
Mean	4.27	3.23	3.80

Table 8. Correlation of days to shoot emergence with seed size at time of planting and days to shoot emergence with residual dry mass of cotyledons at the shoot size of emerged plants.

Shoot Size	Criollo	Fuerte	Hass
(cm)	Days to shoot emergence (y); and seed size (x)		
5		0.524[x]	
15			
45	0.619[x]		
	Days to shoot emergence (y); and residual dry mass of cotyledons (x)		
5	0.929[x]	0.953[x]	
15		0.754[x]	0.808[x]
45	0.926[x]	0.738[x]	0.842[x]

x) Significant at 5% level.

Literature Cited

Borys, M. W., J. L. Barrera-Guerra, J. Luna-Lopez. 1985. Some root characteristics of avocado (*Persea americana* Mill.) seedlings of the West Indian and Guatemalan races. Calif. Avocado Soc. Ybk. 69: 111-122.

Borys, M. W., J. L. Barrera-Guerra, H. Mendez-Martinez. 1987. Roots system of seedlings of *Persea americana* Mill. Mexican race and *Persea schiedeana* Nees. chinini. Rivista di Agricultura Subtropicale a Tropicale 81: 137-146.

Durbin, R. D. 1957. Hot water treatment of avocado seed for eradication of *Phytophthora cinnamomi.* Plant Dis. Rptr. 41: 678-680.

Flores Meza, D., L. Vite Cisneros, M. W. Borys. 1988. Laterals distribution on the principal root in avocado seedlings (*Persea americana* Mill.). Calif. Avocado Soc. Ybk. 72: 237-242.

Hernandez, M. M. 1980. Compatibilidad y vigor en injertos entre razas de aguacate *(P. americana* Mill.) y chinini *(P. Schiedeana* Nees.). Tesis M. C., Colegio de Postgraduados, Chapingo, México.

López Jiménez, A., M. W. Borys. 1989. Evaluación de algunas características en semillas y plántulas de aguacate (*Persea americana* Mili, razas mexicana, antillana, y guatemalteca). III Congreso Nac., Soc. Mexicana de Ciencias Hortícolas, Oaxtepec, México. Programa y Memoria de Resúmenes p. 36.