

CHARACTERIZATION OF ‘HASS’ AVOCADO PROLEPTIC AND SYLLEPTIC SHOOT PROPORTION IN VALPARAISO REGION, CHILE

J. E. Salvo¹ and J. P. Martínez¹

¹: Instituto de Investigaciones Agropecuarias, Investigación y Desarrollo. Chorrillos 86, La Cruz, Region of Valparaíso, Chile. e-mail: jsalvo@inia.cl

Proleptic and sylleptic shoot development was studied to characterize canopy architecture of Hass avocado (*Persea americana* Mill.) in two provinces of Chile. Syllepsis and prolepsis rates at orchards with different ages were evaluated in Petorca and Quillota provinces in 2005-06 season. Forty trees were randomly selected to each orchard to this study. Number of branches, whose main shoots were proleptic or sylleptic types, was evaluated. Only branches that were accessible around the tree below 2 m high were considered. In general, it was observed that Quillota and Petorca display sylleptic rates lower than proleptic, and that there are differences in both shoot type ratio between these provinces as well. Moreover, it was observed that prolepsis rates increase at older age range. It was concluded that proleptic and sylleptic shoot proportion is a useful parameter to show differences among avocado orchards in this region as effect of age and location of the orchard. Further research is required to know how agronomic management may affect such differences.

CARACTERIZACIÓN DE LA PROPORCIÓN DE BROTES PROLÉPTICOS Y SILÉPTICOS DEL PALTO “HASS” EN LA REGIÓN DE VALPARAÍSO EN CHILE

J.E. Salvo¹ y J.P. Martínez¹

¹ Instituto de Investigaciones Agropecuarias, Investigación y Desarrollo, Chorrillos 86, La Cruz, V Región, Chile, teléfono: 56-33-312366. Correo electrónico: jsalvo@inia.cl

Se estudió el desarrollo de brotes prolépticos y silépticos para caracterizar la arquitectura del dosel del palto Hass (*Persea americana* Mill.) en dos provincias en Chile. Se evaluaron los porcentajes de silepsis y prolepsis en huertos de distintas edades en las provincias de Quillota y Petorca en la temporada 2005-2006. Cuarenta árboles fueron asignados al azar a cada huerto en este estudio. Se evaluó el número de ramas cuyo brote central era de tipo proléptico o siléptico. Sólo se consideró ramas accesibles alrededor del árbol a una altura no superior a 2 m. En general, se observó que Quillota y Petorca presentan un menor porcentaje de silepsis que de prolepsis, y que también existen diferencias en el porcentaje de ambos tipos de brotes entre estas provincias. Además, se observó que el porcentaje de prolepsis se incrementó con la mayor edad del huerto. Se concluye que la proporción de brotes prolépticos y silépticos es un parámetro útil para mostrar diferencias entre huertos de palto en esta región como efecto de la edad y ubicación del huerto. Más investigaciones son requeridas para conocer cómo el manejo agronómico puede afectar tales diferencias.

INTRODUCTION

Avocado (*Persea americana* Mill.) display proleptic and sylleptic shoot development (Halle, 1978). Proleptic shoots develop from dormant buds on one main shoot, and sylleptic shoots develop on another main shoot which do not have yet dormant buds. As a result proleptic shoot development occurs in two time steps: one for main shoot development and one for new proleptic shoot development. In contrast, sylleptic shoot development occurs simultaneously with its main shoot development (Halle, 1978). Avocado proleptic and sylleptic ratios change among localities (Thorp and Sedgley, 1993). However, there is not yet information about sylleptic and proleptic shoot development of 'Hass' Avocado in Chile. Therefore this study has the objective to characterize 'Hass' avocado proleptic and sylleptic ratios in two provinces of Valparaiso region in Chile.

MATERIALS AND METHODS

Study was done on thirteen 'Hass' avocado orchards in Quillota and Petorca provinces. Orchards were located between 32.4°S 71.9°W and 32.9°S 71.2°W geographic positions, and they were separated in three age groups: three to five years old, six to ten years old, and eleven or more years old. Proleptic and sylleptic module percentage was evaluated in forty randomly assigned trees in each orchard. Module name describes main shoot branch development type, and this module may include additional proleptic or sylleptic shoots. Measurements were done in August, September and November of 2006 year, this period match with spring season in south hemisphere. Modules that were accessible around the tree between 1 to 2 m height were counted walking with one meter steps around the tree. Data was analyzed with two factor factorial design, in which age main effect, location main effect and interaction effect were simultaneously evaluated. Temperature (°C) and relative humidity (%) was registered each five minutes along 2006 year in four representative points with data loggers HOBO H08-032-08 and software Boxcar Pro. Data were analyzed with General Linear Model procedures (GLM) of the SAS statistical program (SAS Inst., Inc., Cary, N.C.) to test orchards age and location effects on sylleptic and proleptic avocado shoot development. Duncan mean separation procedure was done at 0.05 probability level.

RESULTS

Temperature and relative humidity. Annual average temperature was 15 °C on 2006 year, with an absolute maximum of 37 °C and an absolute minimum of -1 °C. Besides, annual relative humidity average was 78 %. It was not detected significant differences on average temperature by month among four evaluation points (Figure 1). However, average minimum temperature by month was 3.97 °C in Petorca and 5.51 °C in Quillota, which are different at probability level of 0.07.

Proleptic and sylleptic shoot development. Data show that proleptic shoot development differences between Petorca (60.7%) and Quillota (71.2 %) provinces are very significant (P value ≤ 0.001). Results also point out that sylleptic shoot development in younger orchards (51.4%) is bigger than sylleptic shoot development in older orchards (22.93%). Consequently proleptic shoot development increases as soon orchard become old.

However, significant interaction between age and location factors was detected (P value ≤ 0.0001), so age effect is not the same at different locations (Table 1).

DISCUSSION AND CONCLUSION

Proleptic shoots ratio is higher than sylleptic shoot ratio in central zone of Chile. Besides, orchard age and location affect proleptic and sylleptic module development. However, age effect is not the same in both provinces due significant interaction between both factors. This study show that younger orchards display more amount of sylleptic development, then as orchard age the amount of proleptic development increases. This tendency was shown in Petorca and Quillota, but response was different for both localities. Proleptic development in Quillota is bigger than proleptic development in Petorca at younger orchards, as soon orchards become old such differences decrease, and differences are not detected at more than ten years old orchards.

This work shows that proleptic shoot development is bigger than sylleptic shoot development in Valparaiso region (32.7°S 71.6°W). Thorp data (Thorp and Sedgley, 1993) for younger avocado trees in Melany (26.51°S 152.15°E) and data for adult orchards in Somis (34.17°N 119.03°W) at California also show this development pattern (unpublished data). Climate of both provinces were study to explain proleptic and sylleptic development differences. However, temperature and relative humidity analyses did not show differences in north –south transect of evaluate zone in 2006 year. There were not differences for annual average temperature or for annual average relative humidity measured at both provinces. However, it was possible to detect differences on minimum temperature by month. Sylleptic shoot development for Petorca was bigger than sylleptic shoot development for Quillota just at young trees, and minimum month average temperature on Petorca was 1°C lower than minimum month average temperature on Quillota. Thorp also show that sylleptic shoot development is bigger than proleptic shoot development on young trees in Mc Laren valley (32,12°S 138,32°E) (Thorp and Sedgley, 1993). Annual average temperature in this place is lower than annual average temperature in Valparaíso, Somis and Melany on about 6°C. However, to assign a role for cold temperature to explain more sylleptic developmental on young trees is controversial, because prolepsis is associated to bud pre-formation, which occurs on cold climates, and syllepsis develops new lateral shoots without bud pre-formation. Besides, some species of *Cinnamomun* genus, which belong to Lauraceae family together with *Persea* genus, display sylleptic and proleptic shoot development as well. Nitta and Osawa show that proleptic shoot development on *Cinnamomun* genus increases at bigger latitude, and they explain that the amount of available energy for photosynthesis is lower at bigger latitude (Nitta and Ohsawa, 2001). Despite we did not measure energy availability; our data are consistent with a latitude effect on proleptic and sylleptic shoot development of young ‘Hass’ avocado. It is concluded that orchard age and location influence avocado shoot development. This approach is useful to investigative avocado orchard status at different ages and to evaluate its premature aging. More research is required to determinate agronomic management useful to change these developmental patterns.

LITERATURE CITED

Hallé, F., R.A. Oldelman, and P.B. Tomlinson. 1978. Tropical trees and forest - an architectural analysis. Springer, Berlin, pp.441

Nitta, I. and M. Ohsawa. 2001. Geographical transition of sylleptic/proleptic branching in three *Cinnamomum* species with different bud types. *Annals of Botany* 87, 35-45

Thorp, T.G. and M. Sedgley. 1993. Architectural analysis of tree form in a range of avocado cultivars. *Scientia Horticulturae* 53, 85-98

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Table 1. Proleptic (PSM) and Sylleptic (SSM) Shoot Module number in 'Hass' avocado trees in commercial orchards in Petorca and Quillota provinces of Valparaiso region.

	Petorca				Quillota			
	PSM		SSM		PSM		SSM	
Age	(%)	SE	(%)	SE	(%)	SE	(%)z	SE
3 -5 years old	31,2 a	2,3	68,8 c	2,3	65,9 b	1,3	34,1 a	1,3
6-10 years old	68 b	1,3	32 b	1,3	68,3 b	1,1	31,7 a	1,1
> 10 years old	75,6 c	1,1	24,5 a	1,1	79,5 a	1,2	20,6 b	1,2
P value ^z ≤	0.001		0.001		0.001		0.001	

^zSignificant differences among age factor (P value ≤ 0.05)

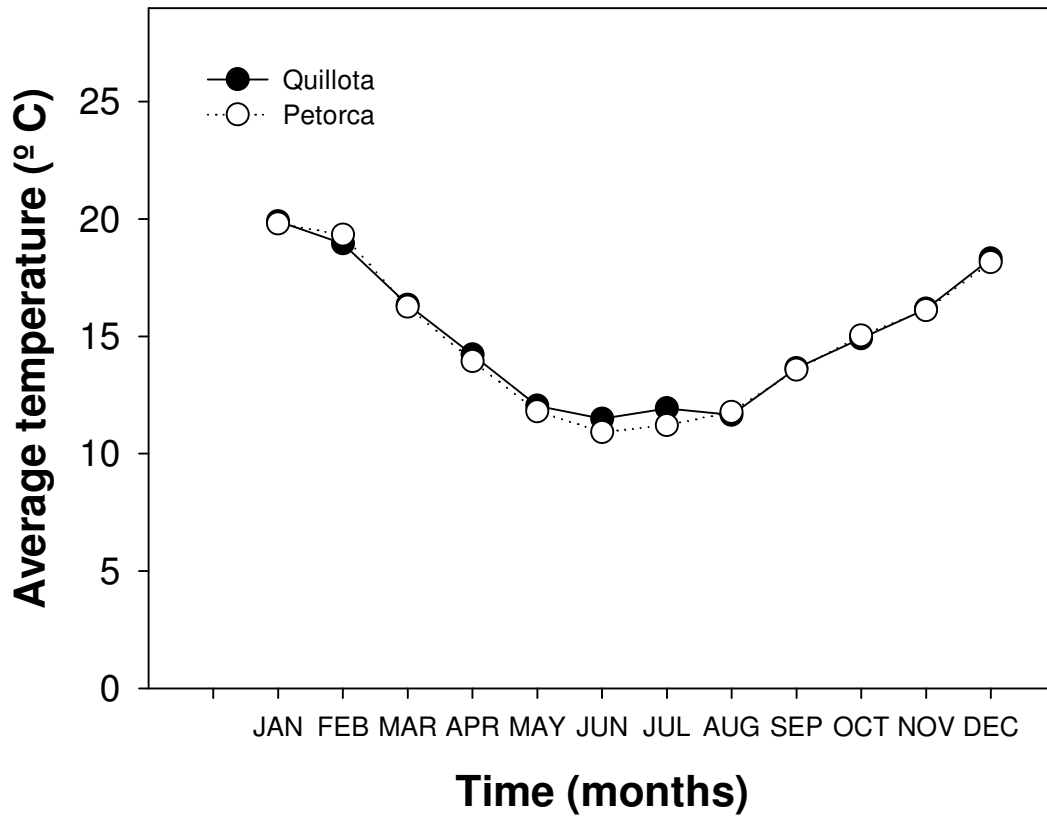


Figure 1. Average temperatures of 2006 year in Quillota and Petorca provinces.