Determining the effect of different amounts of water on the physiology, yield and postharvest of avocado cv. Hass.

Determinación del efecto de distintas cargas de agua en la fisiología, rendimiento y post-cosecha de paltos cv. Hass.

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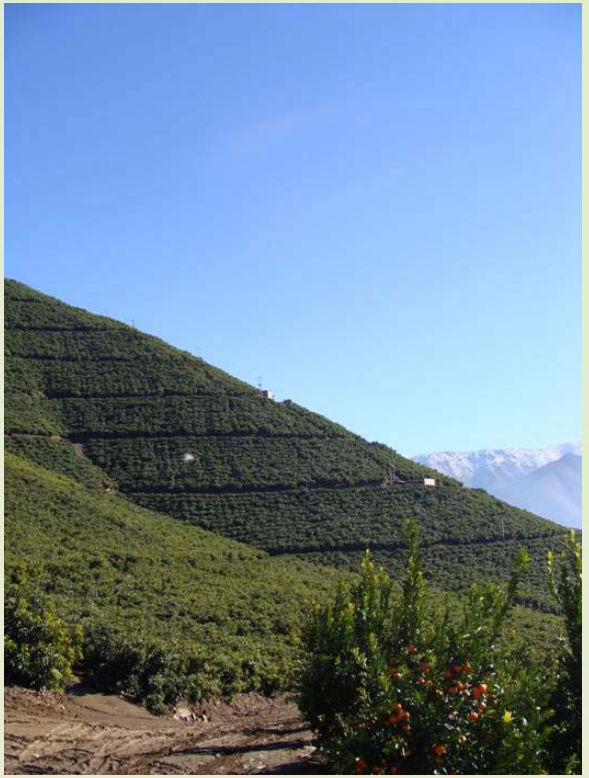
CAIRNS - AUSTRALIA

- The avocado industry in Chile is mainly exporter, demanding good fruit quality and post harvesting conditions.

- The avocado tree is highly sensitive to frost damage but also have a good adaptability to be planted in hill slopes; both are the reasons why Chilean avocado production have been expanded to hill slopes.

- During the last years the labor and electricity costs (used mainly to irrigation management) have significantly raised leading to high production costs which obligate to producers to reinforce crop management oriented to increase yield. The challenge is to increase production and/or reduce cost without affecting the fruit quality.

- High production cost plus serious drought events in the Chilean avocado production area make necessary to search new techniques to save water and electrical energy without affecting the fruit postharvest live and quality.



B&V Obras Eléctricas Ltda.

Variación Valor del kW-h

kW-H

Mes	Precio
Ene 06	32.762
Abr 06	36.358
Sep 07	46.667
Nov 07	53.053
Abr 08	71.564
May 08	68.972
Jun 08	68.972

Aumento en un 210%

- The avocado is an species able to outstay some water stress events; however a successful production depends on a good water availability (Schaffer y Whiley, 2002).

- Effects of the water stress in avocado:

  - Increment in the number of abortion of fruit after fruit set (Whiley et al., 1988; Whiley, 1994; Wolstenholme et al., 1990).
  - Reduction of the internal fruit quality (Bower and Cutting, 1988).
  - Reduction of growth of vegetative shoots and trunk (Kalmar and Lahav, 1977).
  - Reduction of the fruit size (Adato and Levinson, 1988; Michelakis et al., 1993).
  - Reduction of the fruit oil content (Lahav and Kalmar, 1977)
  - Reduction of yield (Richards et al., 1962; Lahav and Kalmar, 1977; Lahav and Whiley, 2002).

On the other hand:

- The excess of water in the root zone (clay or loam clay soils + low irrigation control) ⇒ effect on plant physiology, yield and fruit quality of avocado.

•Avocado tree is highly sensitive to low soil aeration :

•Reduction of leaf gas exchange (gs, T, A)
•Reduction of the leaf size
•Reduction of root and shoot growth.
•Severe abscission of leaves and fruit.

Stolzy et al., 1967, Ploetz y Schaffer, 1987, Schaffer et al., 1992; Schaffer, 1998, Schaffer y Ploetz, 1989; Schaffer et al., 1992; Schaffer and Whiley, 2002.

Background

- Irrigation management is necessary under the crop conditions of avocado in Chile.

- The soil moisture highly depends on the irrigation rate and volume of the applied water; thus a lack or excess of water in the soil not only depends on the soil physical characteristics but also in the irrigation management.

- In the central zone of Chile, a study is carried out with the objective of determine the response of “Hass” avocado trees to different amounts of water, in terms of the plant physiology, yield, fruit quality and postharvest condition.

- In this presentation partial results obtained from the first year of the study will be presented.

Experimental site and plant material:

- 6-years-old "Hass" avocado orchard planted in hill slope (15-20%). 6x4 mt.
- Location: Panquehue. 32º48'45.6", W 70º49'13.4".
- Soil: coluvial, loam sandy soil, 1 m deep, high amount of stones

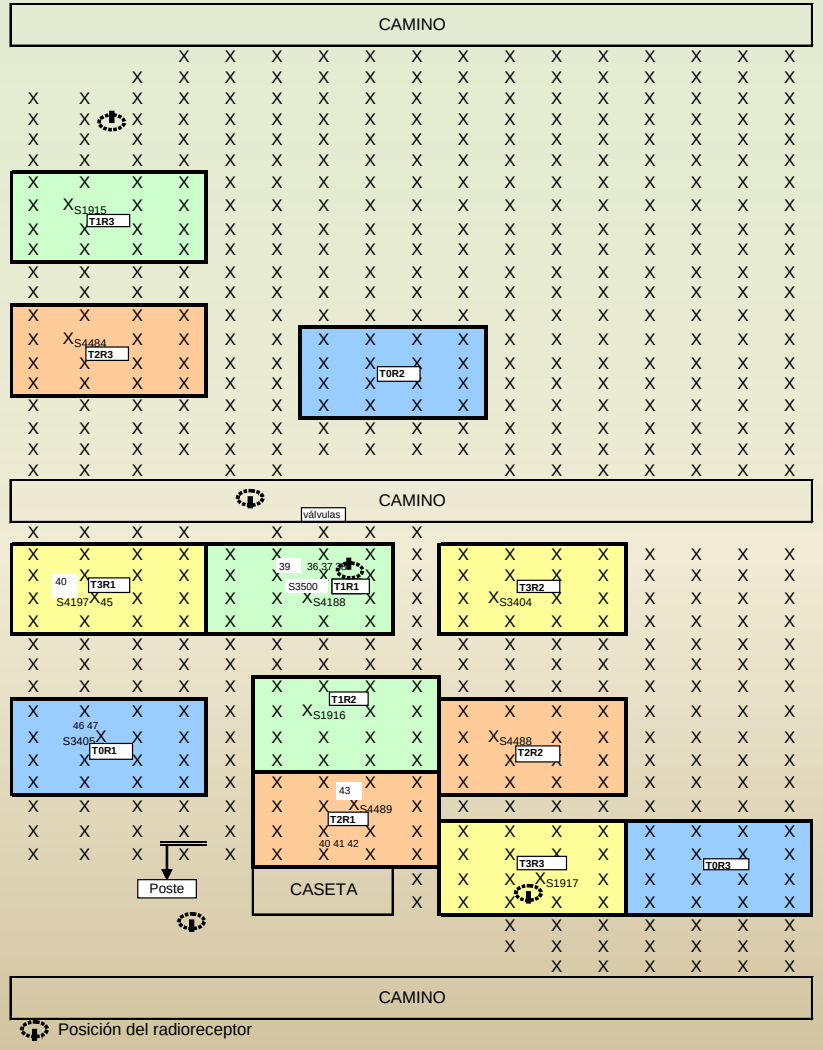
Treatments:

- T0: 110% ETo (35 L/h emitters)
- T1: 65% ETo (20 L/h emitters)
- T2 : 77% ETo (28 L/h emitters)
- T3 : 132% ETo (47 L/h emitters)

* Same irrigation time than T0; all emitters are micro sprinklers.
* Treatments applied during the entire study period.

- **Experimental design**

Completely Randomized Design; 3 replications. Each experimental Unit is conformed by 16 trees.



- Soil moisture:
  - Monitoring devices: Capacitance probes (FDR). Discrete (Diviner 2000) and continuous (Enviroscan, Decagon) measurements at 3 different soil deeps.

- Trunk shrinkage, dilatation and growth rate. Electronic dendrometer (Phytech Co.)

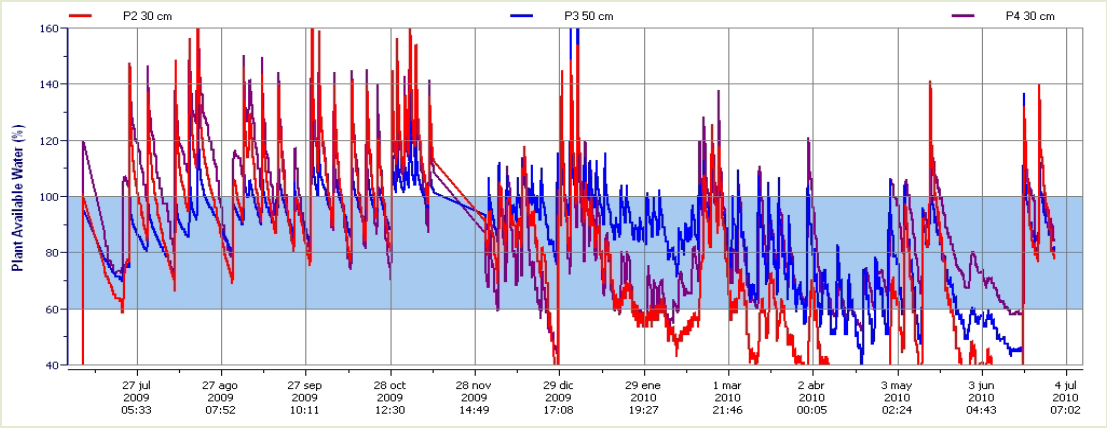
- Chlorophyll content: SPAD (Minolta). After harvesting period.
- Trunk diameter: after harvesting period.
- Yield: evaluated from 16 trees per replication. Harvest time when orchard was released for exportation.
- Fruit quality: fruit size, % oil, dry matter content, firmness.
- Post harvest conditions: firmness after ship simulation on cold storage (5°C) at the post harvest laboratory at INIA la Platina (Santiago, Chile). 25, 35 and 45 days.

Applied water

Period	Eto (mm/day)	Etc (mm/day)	Applied water (m^3 ha^{-1})			
			T0	T1	T2	T3
Oct2009 Oct2010	1520.4	1137.1	16,741	8,167	11,841	20,008
% Eto			110%	65%	77%	132%

Eto = Reference ET, Etc = Crop ET

To



T1

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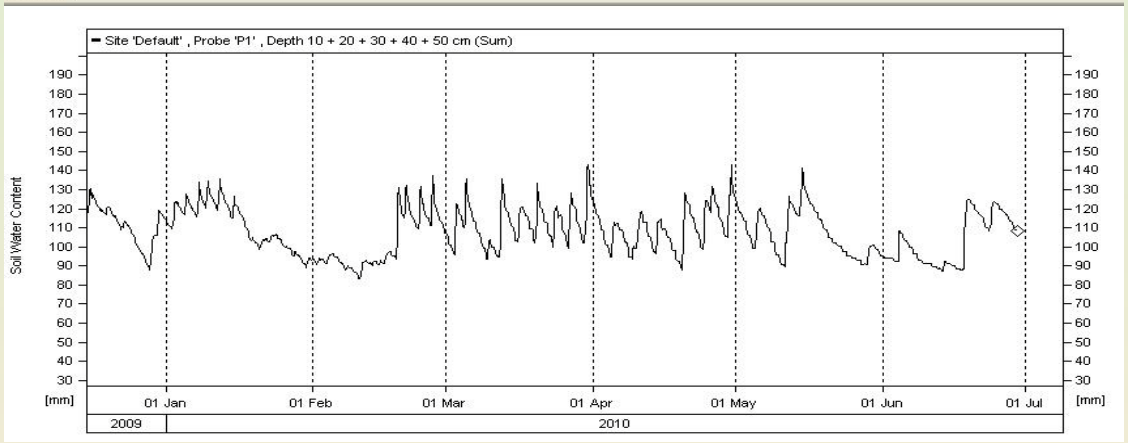

T2

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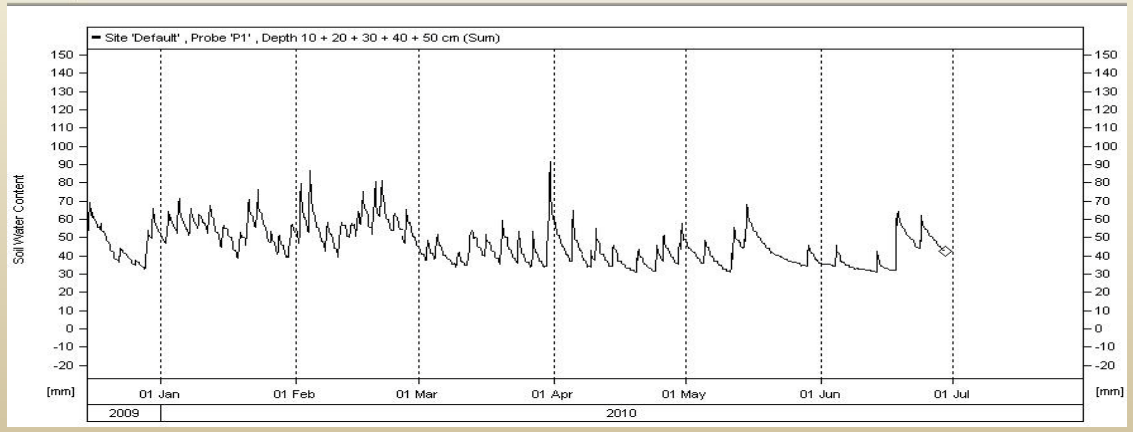
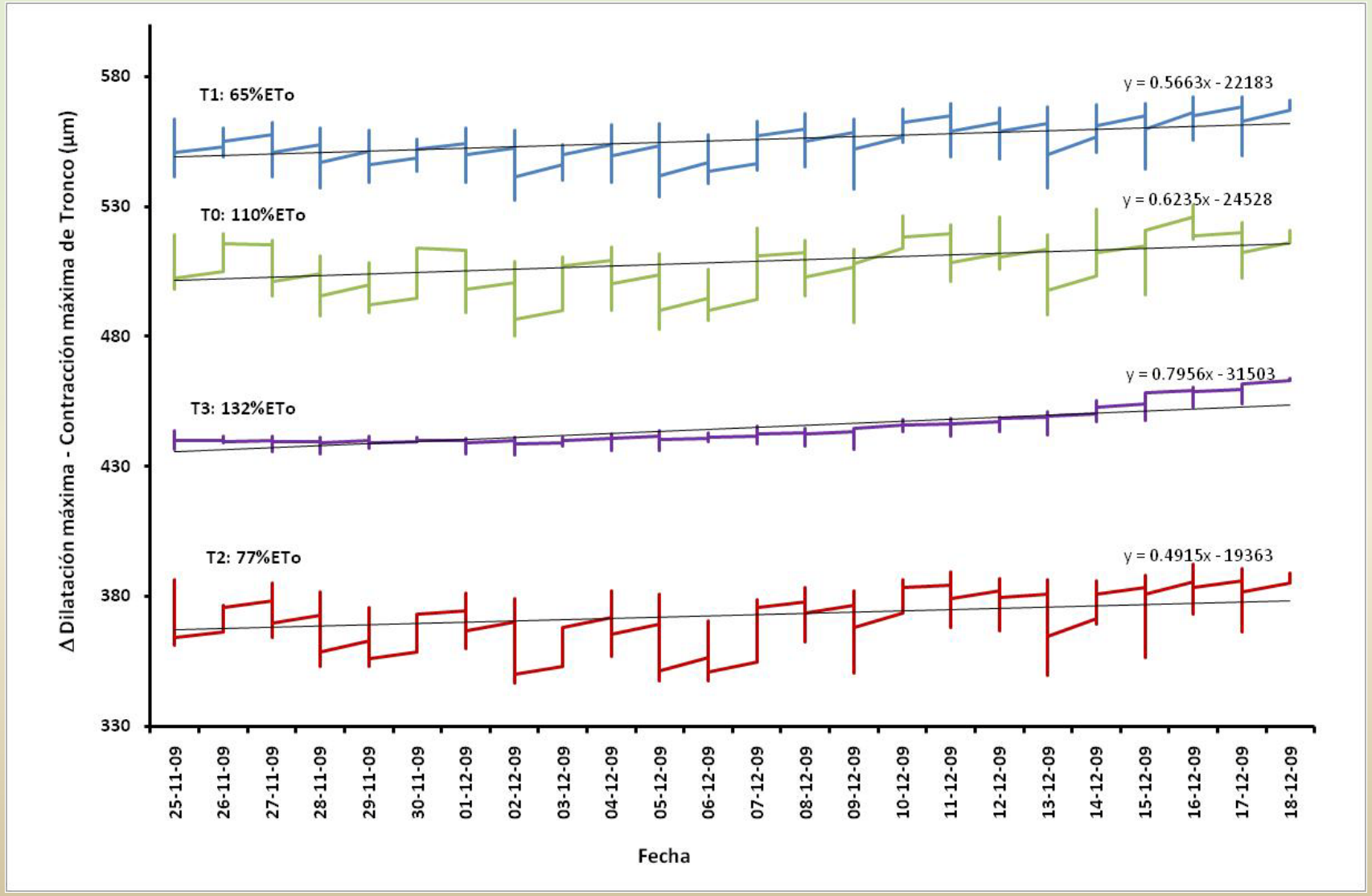
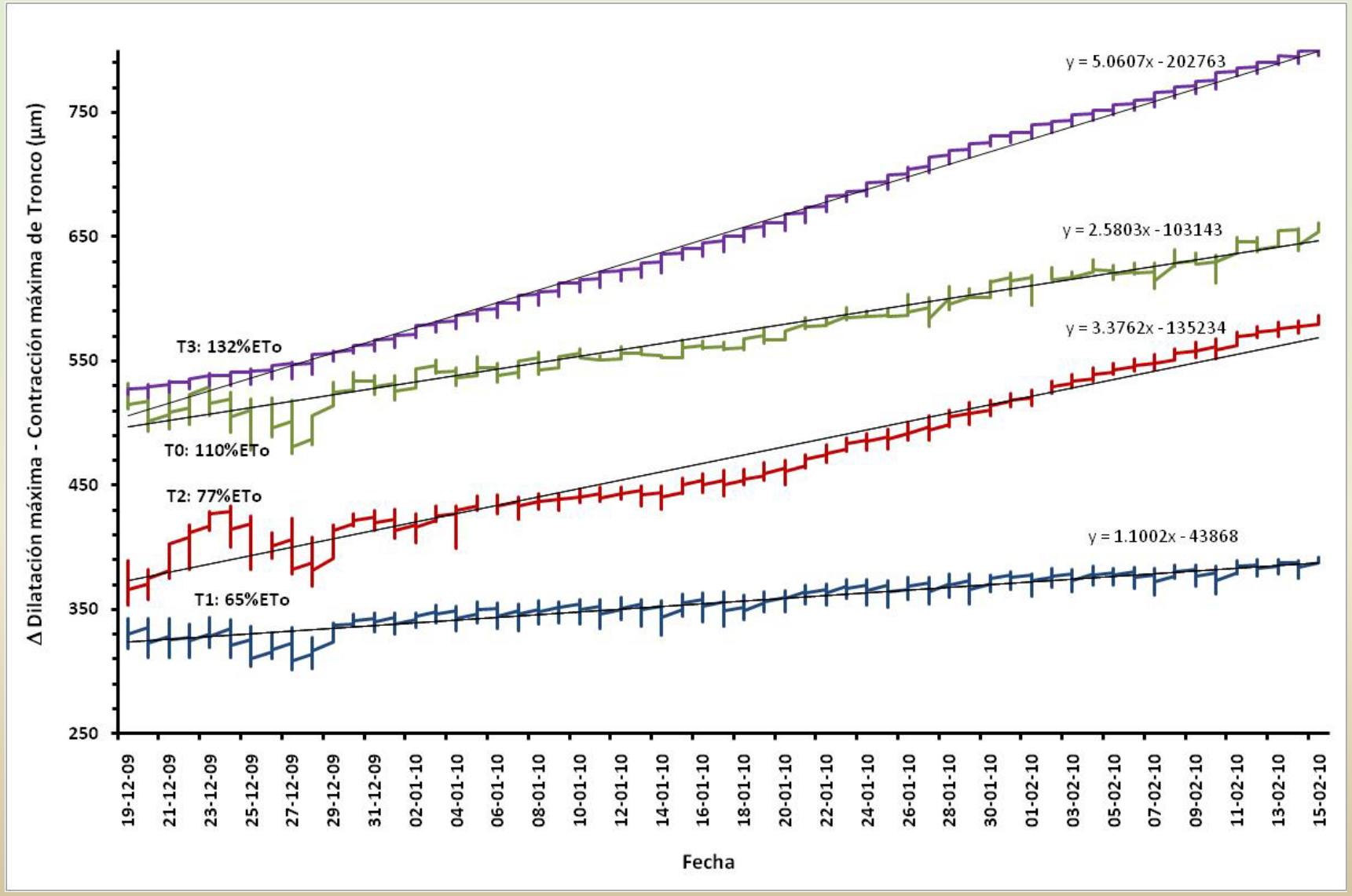


Trunk growth rate, contraction and dilatation.



Trunk growth rate, contraction and dilatation.



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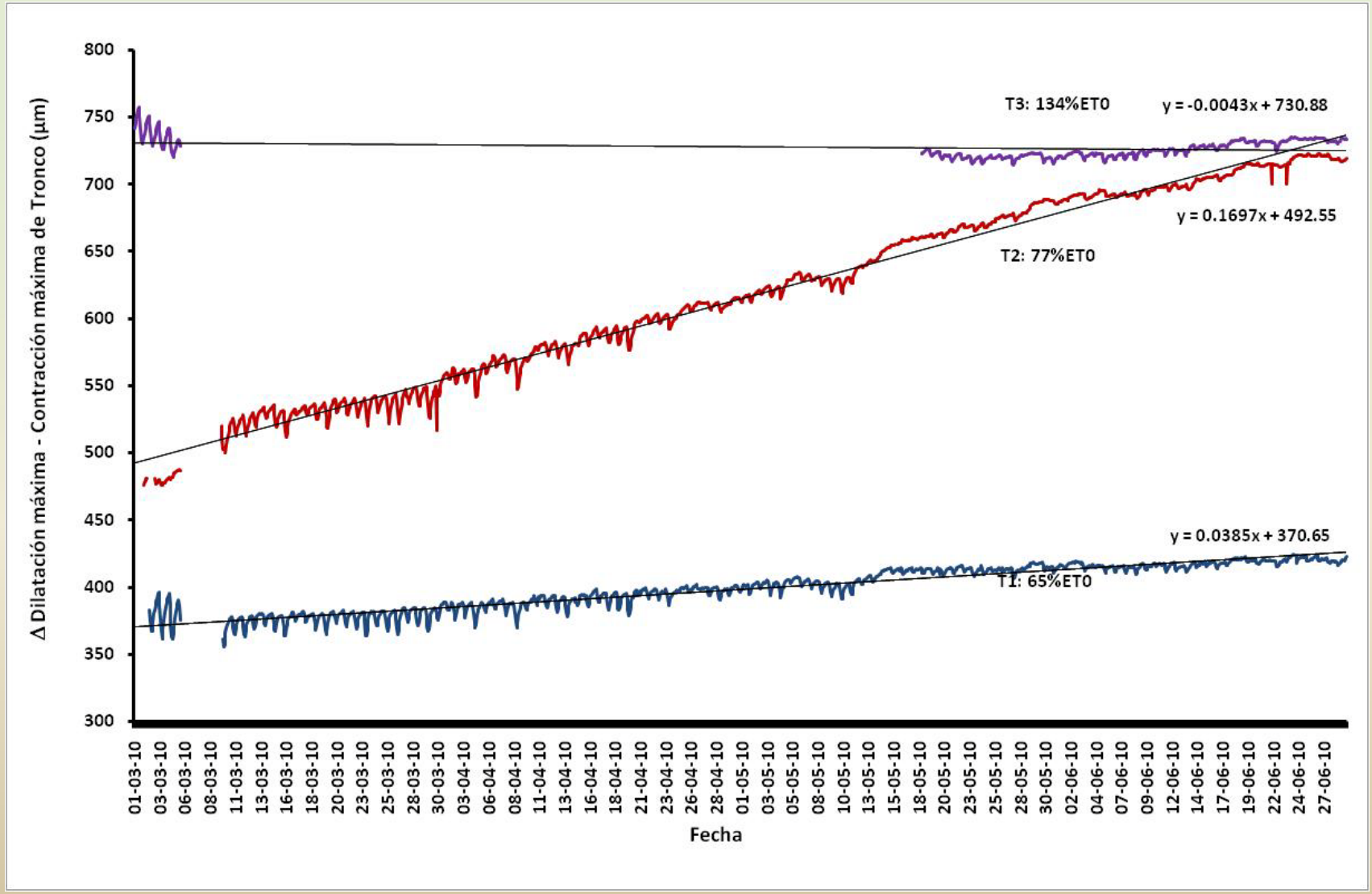


Trunk contraction and dilatation difference.

Treatment	Δ (Trunk max. Dilatation – Trunk max. shrinkage), µm		
	Nov-Dic 2009	Dic 2009-Feb 2010	Mar-Jun 2010
T0	22.2 ± 1.03	15.4± 1.23	No info.
T1	20.6 ± 1.07	19.5 ±0.73	8.6 ± 0.52
T2	23.2 ± 1.45	17.3 ± 1.19	9.2 ± 0.63
T3	6.4± 0.43	9.4± 0.27	6.5 ± 1.51

(Medias ± SE).

Chlorophyll leaf level (SPAD) and Transversal Trunk Area (ATT)

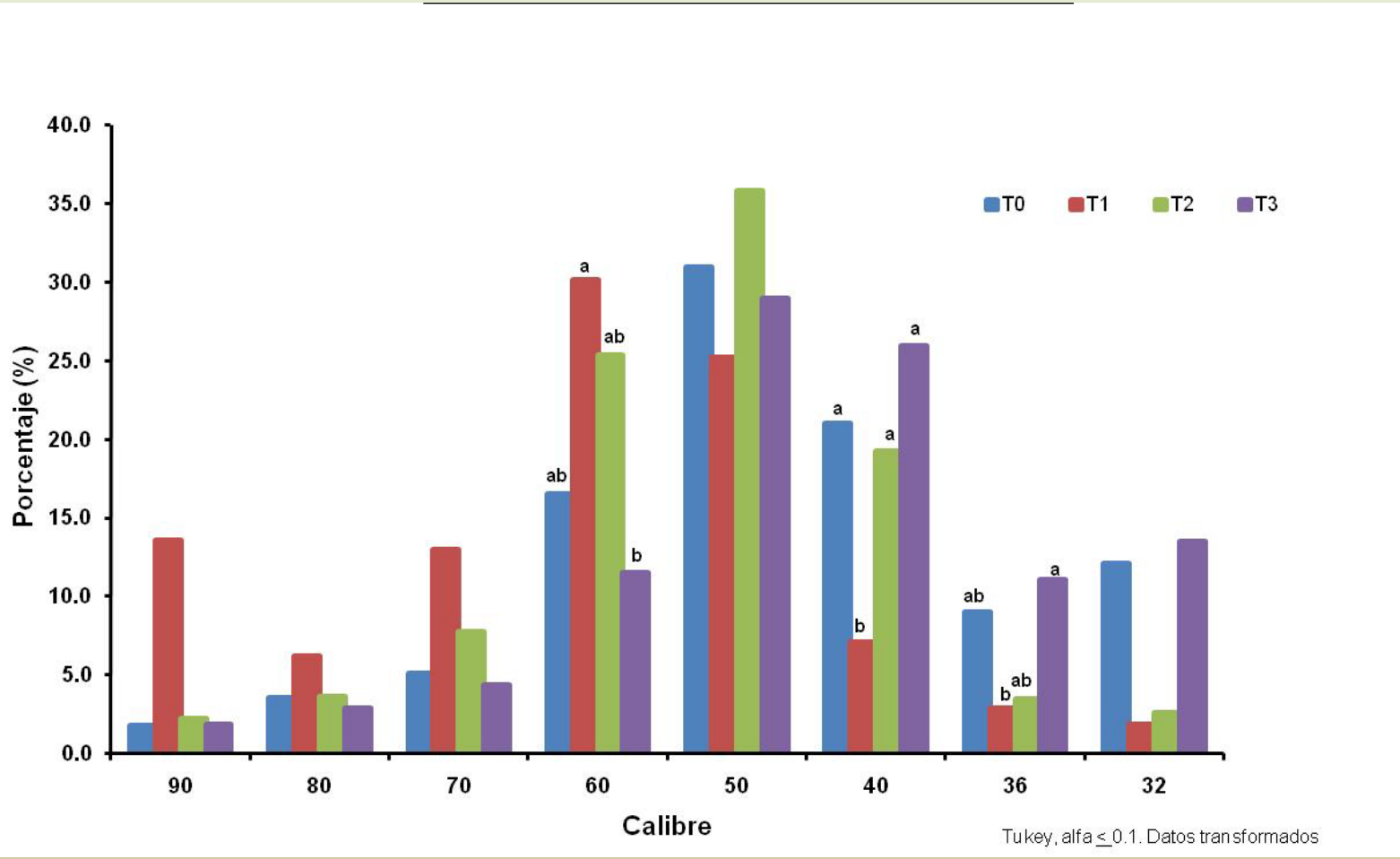
	SPAD index	ATT (cm^2)
T0	60.2a	5873.7a
T1	69.4a	6679.5a
T2	57.6a	6386.5a
T3	59.4a	5970.0a

(ANOVA; Waller-Duncan Test, P ≤0.05).

Yield and fruit size

	Average yield per tree (Kg)	
T0	14.8	b
T1	32.1	ab
T2	37.1	a
T3	26.3	ab

(ANOVA; Tukey Test, P ≤0.05).



(Data transformed to normality distribution; ANOVA; Tukey Test, P ≤0.05).

Fruit quality after harvest

	Average Weight (g)	% Oil	% Dry Matter	Firmness day 0 (Lb)
T0	257.4 ab	12 a	28.1 a	61 a
T1	218.67 b	11.9 a	28 a	62.5 a
T2	243.37 ab	11.8 a	27.7 a	61.3 a
T3	265.7 a	9.1 a	23.2 a	61.6 a

(ANOVA; Waller-Duncan Test, P ≤0.05).

Fruit firmness after 25, 35 and 45 days of cold (5°C) storage.

	Firmeza día 25 (Lb)	Firmeza día 35 (Lb)	Firmeza día 45 (Lb)
T0	53.3 a	38.8 a	6.17 b
T1	55.7 a	34.5 a	18.1 a
T2	55.1 a	27.6 a	12.8 ab
T3	47.8 a	31.5 a	15.7 ab

(ANOVA; Waller-Duncan Test, P ≤0.05).

Conclusions

- As effect of the treatments there were observed differences in trunk contraction and growth rate patterns.
- However chlorophyll content and trunk transversal area after harvest did not show differences.
- Yield, fruit size and characteristics of the fruit after harvest and shipping simulation did show significant differences among treatments.
- Regarding yield, increased performance was observed in the trees for the T2 treatment (77%Eto), while control trees (T0) had a significantly lower production.
- Regarding fruit size, the fruit size distribution of T1 showed a higher proportion of lower size fruit compared with T3; also, the average weight of fruit taken from T1 was significantly lower than T3.

- The postharvest behavior of fruit showed differences in firmness measured after 45 days of simulated shipping; treatment T0 has significantly lower fruit firmness.

- Withholding water until 77% of the Eto did not affect negatively the yield, fruit quality and post harvest life during the first year of study.

- Thus, the preliminary results presented in this work showed that applying the 77% of the ETo during 11 months is a good alternative for water reduction without affecting production or fruit quality of “Hass” avocado.

Acknowledgments

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¡¡¡¡Gracias por su atención!!!!