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EVALUATION OF CALCIUM PHOSPHITE; MAGNESIUM PHOSPHITE AND POTASSIUM PHOSPHITE IN THE CONTROL OF *Phytophthora cinnamomi* IN HASS AVOCADO TREES (Persea americana Mill) GROWN IN CONTAINER

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In an experimental Hass avocado (*Persea americana* Mill) located at the Experimental Station of the *Pontificia Universidad Católica de Valparaiso*, Valparaiso, Chile, a study was carried out intending to determine the effects of phosphites on the development of *Phytophthora cinnamomi*, in avocado trees grown in containers.

From August, 2005 to November, 2006 measurements were carried out tending to explain the photochemical yield of photosystem II, number of leaves and density of roots. The results indicate that the phosphites stimulated a high rate production of leaves in the plants and these with a high quantum yield of the photosystem II, besides presenting density of roots higher than that of the controls with *Phytophthora* inoculation and without chemical control.

EVALUACIÓN DEL FOSFITO CÁLCICO, POTÁSICO Y MAGNÉSICO EN EL CONTROL DE *Phytophthora cinnamomi* EN PALTOS (*Persea americana* Mill) CV. HASS PLANTADOS EN CONTENEDOR

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En un huerto experimental de paltos (*Persea americana* Mill) cv. Hass, ubicado en la Estación Experimental La Palma de la Pontificia Universidad Católica de Valparaíso, sector La Palma, Región de Valparaíso, Chile, se realizó un estudio cuyo propósito fue determinar los efectos de los fosfitos sobre el desarrollo de *Phytophthora cinnamomi*, en paltos cultivados en contenedores. Desde agosto de 2005 a noviembre de 2006 se realizaron mediciones tendientes a dilucidar el

rendimiento fotoquímico del fotosistema II, número de hojas, densidad de raíces. Los resultados indican que los fosfitos estimularon la producción de hojas en alta tasa en las plantas y éstas con un alto rendimiento cuántico del fotosistema II, además de presentar mayor densidad de raíces que los testigos con inoculación de *Phytophthora* y sin control químico.

INTRODUCTION

Phytophthora cinnamoni Rands is the main disease problem on avocados (*Persea americana* Mill) planted in Chile. The main symptoms affect young roots seriously, causing a progressive decay and finally a reduction on fruit production and quality.

The main control strategy tries to address through an integrated management covering rootstock selection, irrigation management, biological control and chemical control.

Phosphites and their salts (generally phosphorous acid neutralized with potassium hydroxide) are used on many crops as a fertilizer and preventive of *Phytophthora* problems.

The aim of this study is to evaluate the efficacy of different salts of phosphites on the prevention of *Phytophthora* problems and to analyze the agronomical efficiency on avocado plants.

METHODOLOGY

Study was conducted in Estación Experimental La Palma, in the Facultad de Agronomía de la Pontificia Universidad Católica de Valparaíso.

1. Vegetal Material

We used 50 avocado trees variety Hass on a rootstock *mexicola*, on 45 L containers on a 4 x 2 meters disposal. Irrigation system was pressurized with drip irrigation 4 L/hour distanced 2 meters from each other.

2. Treatments

The substrate was a clay-loam soil, previously disinfected with vapor so that to suffer a later inoculation (depending on each treatment) with isolates of *Phytophthora* from necrotic roots of avocados cv. Hass with symptoms of the disease.

On Table 1 you can see products and doses applied:

Table 1. products and doses applied:

Product name	Phosphite content (P_2O_5 % w/w)	Other elements (% w/w)	Doses
Codaphos Ca	16 %	5 % CaO	0,3%
Codaphos K	30 %	20 % K_2O	0,3%
Codaphos Mg	40 %	10 % MgO	0,2%

More technical information on products is available at Sustainable Agro Solutions, S.A., Spain (www.greencareby-sas.com).

Products were applied foliar. Treatments were repeated each 60 days.

A Complete randomized design was used; with 6 treatments and 8 replications (other products rather than phosphites were also used). Quantitative data was analyzed using ANOVA and comparison on treatments' means was analyzed with Duncan Test. The significance level was 5%.

Table 2. Teatments:

T0= Not inoculated with *Phytophthora cinnamoni*.
T1= Inoculated with *P. cinnamoni*.
T2= Inoculated with *P. cinnamoni* and applied with calcium phosphite (Codaphos Ca).
T3= Inoculated with *P. cinnamoni* and applied with potassium phosphite (Codaphos K).
T4= Inoculated with *P. cinnamoni* and applied with magnesium phosphite (Codaphos Mg).

3. Evaluation

The measured characteristics were the following ones:

- Nº of total leaves. Measurements were realized periodically.
- Photosynthetic efficiency through the chlorophyll fluorescence. Was realized with a fluorimeter Pulse-amplitude-modulate-fluorometer MINI PAM.
- Root density. Measured on soil samples extracted with a 1 liter cylinder, registering data as root fresh weight per volume of extracted soil.

RESULTS

1. Number of leaves

The number of leafs per plant is heavily influenced by the application of phosphites if we compare them with inoculated and not treated plant. (see Table 3).

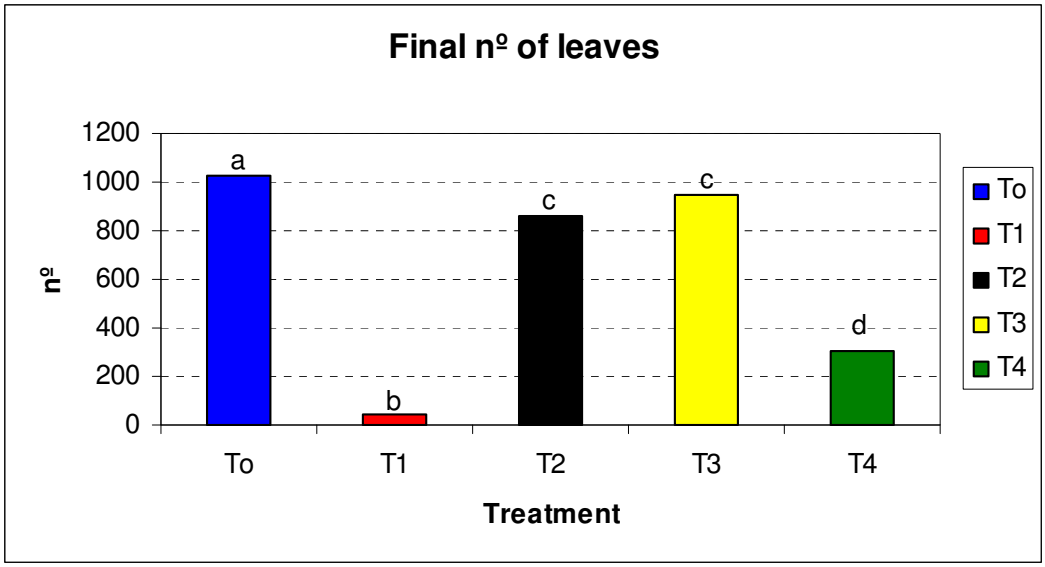

Figure 1. Number of final leaves on each treatment: Different letters on each treatment indicate statistical differences (Duncan, P<0,05).

Besoain et al (2005) already mentioned that plants affected by *Phytophthora* reduce their number of leaves and have less foliar area index compared with non inoculated plants. Those symptoms should also be directly related with the reduction or damage of young roots.

2. Chlorophyll fluorescence

The value of photosynthetic yield is shown as monthly average valued during all the season. (see Figure 2).

The values differ significantly among treatments with respect to inoculated non treated plants. There are differences among treatments, although non statistical difference has been shown.

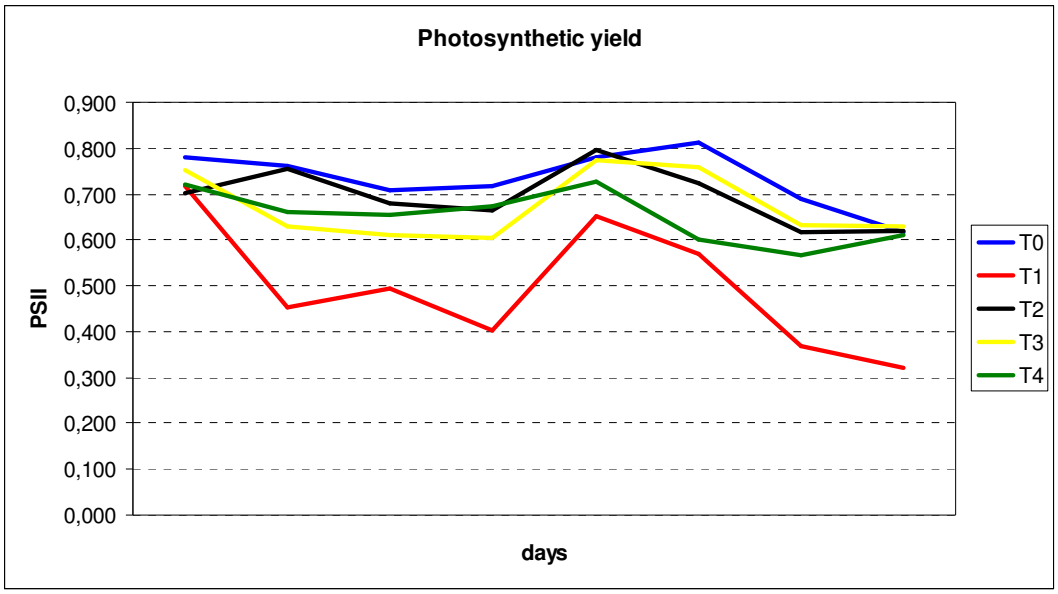

Figure 2. Photosynthetic Yield.

According to Santa Maria (2001), difference shown is important and more than enough to affect the normal plant functions, affecting its agronomical behavior and productivity.

3. Root density

Results indicate that phosphite application is effective, presenting in some treatments levels near the healthy plants (see Figure 3).

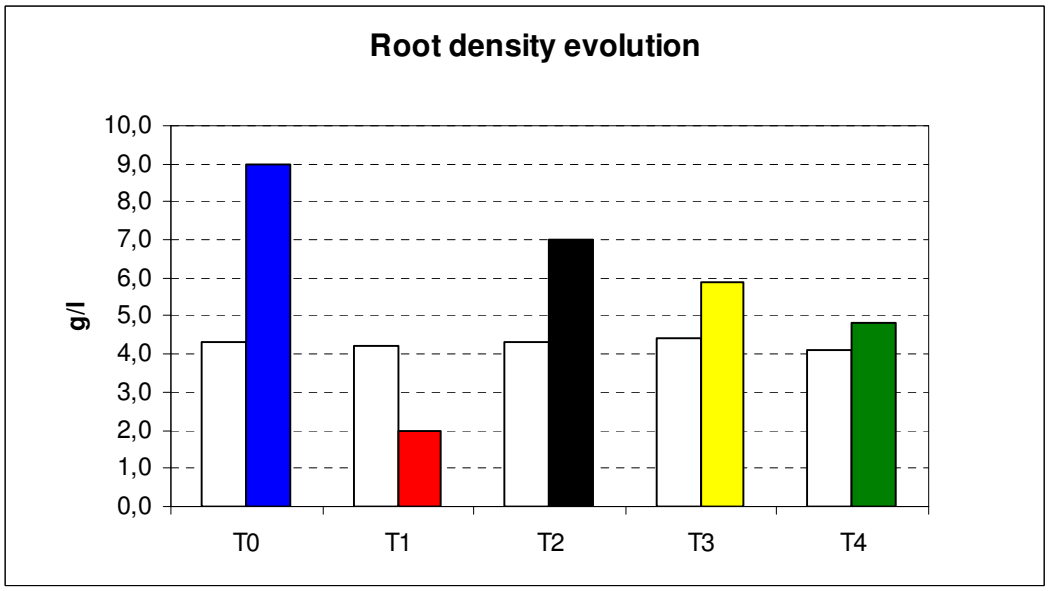

Figure 3. Root density differential growth: On white is shown the initial root fresh weight, and with colors the end value.

A good and healthy root system is really important on a crop like avocado. As this crop is characterized for having a root system very superficial, extensively suberized and quite inefficient on water absorption due to lack of root hairs (Salgado and Toro, 1998; Whiley, Chapman and Saranah, 1988; Kriedman,

1986). That makes avocado plants very sensible to water excess or scarcity (Sterne, Kaufman and Zentmeyer, 1977).

On my opinion this result suggest that continuous applications of phosphites can help on preventing Phytophthora attacks and event help on recovering root density of affected plants, specially with calcium and potassium phosphite. Some works even suggest that one application on spring would be enough (López, Pérez and García, 1998; Bender, 1996).

The evolution of root system on inoculated and non treated plants gets worse along the season, which agrees with results published by Zentmyer, Menge and Ohr (1994), who conclude than decay is increasing along the season and can even cause the death of affected trees.

RESULTS

1. Foliar applications of phosphites have a positive control effect on *Phytophthora ciannamoni* in infected avocado trees.
2. There are differences among phosphite salts used, but all of them improve effectiveness on control of *Phytophthora* and agronomical performance with respect to infected plants.
3. Agronomical performance of infected trees improves significantly with the application of phosphites. Number of leaves, photosynthetic activity and root density improves significantly with respect to non treated infected plants.
4. It is important to continue on evaluating doses and application moments and systems (irrigation) in order to adjust and include phosphite application on an Integrated Management on Avocados.

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