Proceedings VI World Avocado Congress (Actas VI Congreso Mundial del Aguacate) 2007.
Viña Del Mar, Chile. 12 – 16 Nov. 2007. ISBN No 978-956-17-0413-8.

EVALUATION OF SOIL TREATMENTS TO PREVENT THE PROBLEM OF REPLANTING IN AVOCADO TREES

G. Reginato[1], C. Córdova[1] and J. Covarrubias[1]
[1] Facultad de Ciencias Agronómicas. Universidad de Chile. Santa Rosa 11315, Santiago. Chile. Correo electrónico: greginat@uchile.cl

An experiment was carried out near Cabildo, V Region, in order to determine and quantify the problem of avocado tree replanting in Chile. Six healthy trees from a declining yield orchard were removed. A 70-cm high berm was prepared. In November 2006 different soil fumigation treatments were applied: Methyl bromide; 1.3-dichloropropene (1.3-D); chloropicrin; and a mix of 1,3-D+chloropicrin. A control treatment without fumigation was also included. One month after fumigation, four 'Hass'/Mexicola trees were planted in each treatment. Irrigation and fertilization practices were the same for all treatments. Three months after planting, trunk diameter, tree height and leaf number were measured. Fumigation treatments showed 20-40% higher values than the control. Tree height was significantly lower in the control treatment compared to fumigation treatments (79.3 cm for the control and 108 cm average for fumigation treatments), with no differences among the fumigation treatments. These results indicate that avocado tree could be highly susceptible to the problem of replanting.
Keywords: replant disease, soil fumigants, 1,3-Dichloropropene, chloropicrin

EVALUACIÓN DE TRATAMIENTOS AL SUELO PARA PREVENIR EL PROBLEMA DE REPLANTACIÓN EN PALTOS

G. Reginato[1], C. Córdova[1] y J. Covarrubias[1]
[1] Facultad de Ciencias Agronómicas. Universidad de Chile. Santa Rosa 11315, Santiago. Chile. Correo electrónico: greginat@uchile.cl

Para determinar la presencia y magnitud de los problemas de replantación en palto, en un huerto de la V Región, Chile, se arrancaron 6 plantas sanas de un huerto adulto en declinación. Se preparó un camellón de 70 cm de altura y se establecieron, en noviembre de 2006, tratamientos comparativos de fumigantes de suelo. Estos fueron: Bromuro de metilo, 1,3-dicloropropeno (1,3 D), cloropicrina (Clor), la mezcla 1,3 D+Clor y testigo sin fumigar. La plantación se realizó un mes después de la aplicación, colocando 4 plantas 'Hass'/Mexicola por tratamiento. El manejo de riego y fertilización fue el mismo para todos los tratamientos. En marzo (3 meses después de la plantación), se evaluó el tamaño alcanzado por las plantas a través del diámetro de tronco, altura de plantas, y número de hojas. Se encontró que en todas las variables los tratamientos de fumigación obtuvieron valores entre un 20 y 40% superiores al testigo, aunque la diferencia sólo fue significativa para altura de plantas, con 79,3 cm el testigo, y 108 cm en promedio para los tratamientos de fumigación, entre los cuales no se apreciaron diferencias significativas. Este resultado indica que el palto sería una especie muy susceptible a problemas de replantación.

Palabras clave: replantación, fumigantes de suelo, 1,3 Dicloropropeno, cloropicrina

INTRODUCTION

Replant problem (RP) is common in fruit trees and researchers around the world have well documented it in deciduous fruit trees. On the other hand RP has not been properly quantified in evergreen fruit trees, especially for avocado trees. Then, RP is not generally considered when orchards or trees are replanted in an existing orchard, condition that leads to reduced growth of replanted trees. Besides to poor growth, leaf yellowing and early growth cessation are commonly described as replant problem symptoms. According to McKenry (1999), who has done research for stone fruit trees and grapevines, RP is an interaction of four factors: reject component (specifically of the species); physical and chemical soil problems; pests or diseases; and nutrition deficiencies. Reject component is not related to the effect of a specific chemical compound, as it is in the case of allelopaty, and it would be caused by microbes that grow and persist over root residues. The effect of pests and diseases is not a specific effect, because the organisms (nematodes for grapes and stone fruit trees) generally reported are not specific to a plant species. In avocado trees *Phytophthora cinnamomi* and *Verticillium dahliae* are well recognized as cause of tree failure when trees are replanted (Allen, 2004; Goodall and Zentmyer, 1987), however, growers experience is that growth of replanted trees is not satisfactory even though no disease symptoms are present. Physical and chemical soil component are referred to salts, herbicides or other compounds accumulation in the soil, or soil structure alteration as compaction. Actinomycetes are considered the causal organism of pome fruit trees replant problem, especially for specific apple replant disease (SARD), even though these organisms have not been identified. For peach trees, Brown *et al*. (2002) partially explained replant problems with the effect of the fungi *Aspergillus*, *Cylindrocarpon* and *Fusarium*. According to McKenry, nematodes would be very important in RP of grapes. One of the most important characteristic of RP is its specificity and persistence, being as long as decades (Hoestra, 1994). Response to soil fumigant treatments is another important characteristic. Treatments consistently control RP, whatever its origin may be. This also allows to quantify and to determine the origin of the problem, when tree growth comparison are done between different soils treatments, as it is when comparing broad spectrum fumigants against nematicides, fungicides or nutrition treatments.

Since 2003, supported by a FIA (Fundación para la Innovación Agraria) grant, the Universidad de Chile has been evaluated RP for several fruit species. Tree growth difference as high as fivefold have been found in apple trees when grown on fumigated and non fumigated soil (Reginato and Córdova, 2005), threefold tree growth has been found in grapevines (Reginato and Córdova, 2004), and twofold in peaches and cherry trees (Reginato *et al.*, 2005). The objective of this work was to determine and to quantify the replant problems in avocado trees.

MATERIALS AND METHODS

In November 2006, in an avocado grove, located in Bartolillo, 5th Region, Chile, a trial was established. Six healthy adult trees were pulled out in the orchard which was in a yield declining stage. According to the current planting trend, a ridge 2.5 m width at the base, 1 m width at the top and 0.8 m height was built. On top of this ridge, 20 plants were randomly assigned to different soil fumigation treatments. Treatments were: methyl bromide (MB) (970 kg/ha), 1,3-dichloropropene (1,3-D) (400 kg/ha), chloropicrin (C) (300 kg/ha), a mix 65% 1,3-D 35% C (400 kg/ha) and a non fumigated control. Fumigants were injected 0.2-0.7 m deep with a hand injector system. MB was tarp sealed right after injection for a week with a polyethylene film. Planting was done one month after fumigation. Four Hass/Mexicola trees per treatment were planted.

At planting, trunk diameter, tree height and leaf number were recorded. Water and fertilization management were the same for all treatments. Three and six months after planting, in March and June 2007, trees were also evaluated. In June, a 20 leaves sample was taken to determine leaf size and a leaf area meter (CI-203 model, CID Inc. USA) was used to do this. Also, leaf colour was measured with a portable device (CCM-200 model, Opti-Science, USA). Analysis of variance (ANOVA) and LSD test with significance level $P<0.05$ were performed.

RESULTS AND DISCUSSION

Trunk cross sectional area (TCSA) linearly increased during the evaluation period. Three months after planting, tree TCSA on MB and 1,3-D treated soil was 46% higher than Control (Fig. 1). C + 1,3-D mix was in between those treatments. Six months after planting (June, 2007), TCSA on all fumigation treatments was 52% higher than the Control.

Tree height showed clearly differences between fumigated treatments and Control just 3 months after planting (Fig. 2), with no differences among fumigation treatments. Control trees practically stopped their growth in autumn while trees from fumigated soil kept growing, becoming 50% taller than Control trees in June.

In terms of leaf number, in March, trees from fumigated soil (Figure 3) had more leaves than those from non fumigated soil, but they were joined in two groups, trees from methyl bromide and 1,3-D had more leaves than those from chloropicrin and C + 1,3-D mix. In June only numerical differences were detected among trees from different fumigation treatments, but all of them showed more leaves than Control trees.

No significant differences in leaf size were detected (Figure 4), even though a similar trend to other growth variables is apparent. High variability due to different age leaves at the time of sampling could partially explain this lack of significance.

Tree leaf area in June was estimated for every tree from leaf number and average leaf size (Figure 5). Trees from methyl bromide, 1,3-D were almost threefold the leaf area than those from non fumigated soil, C + 1,3-D mix was around twofold, and there was only a numerical difference between chloropicrin and control trees. Leaf colour was not different among treatments, with a mean value of 52.8 (Figure 6).

TCSA showed a significant and positive relationship with leaf number and tree leaf area, with R^2 values of 0.85 and 0.77, respectively.

CONCLUSIONS

Only after six months of development after planting, the results lead to conclude that avocado trees are significantly affected by replant problems. A symptom associated to avocado replant problem is the generalized decrease of growth, affecting mainly growth rate and leaf number, with minor effects on leaf size and nil on foliage colouration. The growers might be confused by the normal aspect of the foliage in order to determine the real problem that is affecting growth depressed trees in replanted groves.

ACKNOWLEDGEMENT

This work was funded by Fundación para la Innovación Agraria, Chile. Grant FIA-PI-C-2003-1-A-010

LITERATURE CITED

Brown, G., T. Trout, and R. Bulluck. 2002. Cultural Control and Etiology of Replant Disease of Prunus spp. Final Report. http://www.sarep.ucdavis.edu/grants/reports/mebr/ browne/browne.html

Hoestra, H. 1994. Ecology and pathology of replant problems. Acta Horticulturae 363:1-10.

McKenry, M. 1999. The replant problem. Catalina publishing. Fresno, USA. 124p.

Reginato, G., C. Córdova, and C. Mauro. 2005. Rootstock and management practices evaluation to avoid cherry replant disease in Chile. 5th Internacional Cherry Symposium. June 6-10, 2005. Bursa, Turkey (Abstract).

Reginato, G. y Córdova, C. 2004. Grapevine replant. Replant fruit trees Newsletter Nº2. www.replantacion.cl

Reginato, G. y Córdova, C. 2005. Apple trees replant. Replant fruit trees Newsletter Nº3. www.replantacion.cl

Figures

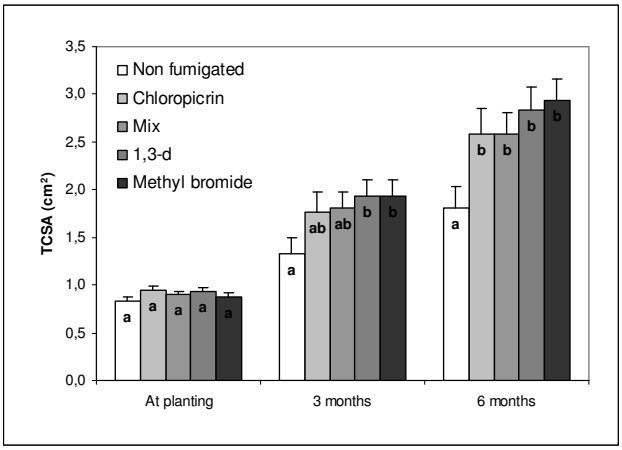

Fig. 1. Trunk cross sectional area of recently planted avocado trees (TCSA) and after 3 or 6 months of growing in differently treated soil. Means with different letters are significantly different (LSD, 5%), bars indicate SE.

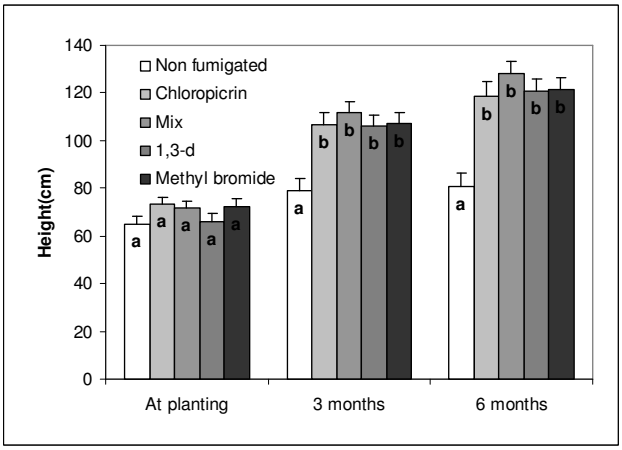

Fig. 2. Tree height of recently planted avocado trees and after 3 or 6 months of growing in differently treated soil. Means with different letters are significantly different (LSD, 5%), bars indicate SE.

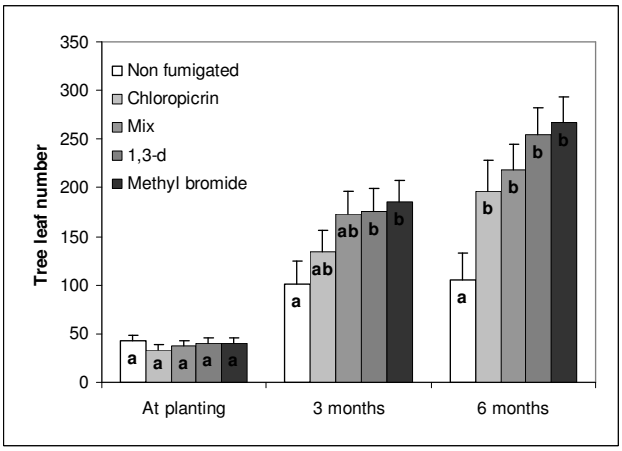

Fig. 3. Leaf number of recently planted avocado trees and after 3 or 6 months of growing in differently treated soil. Means with different letters are significantly different (LSD, 5%), bars indicate SE.

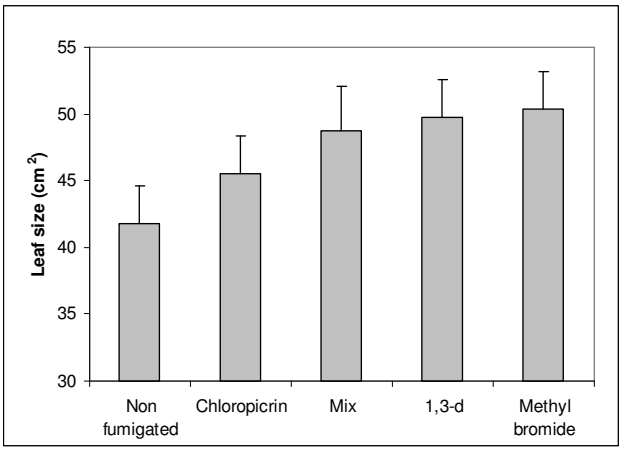

Fig. 4. Mean leaf size of avocado trees after 6 months of growing in differently treated soil. Bars indicate SE.

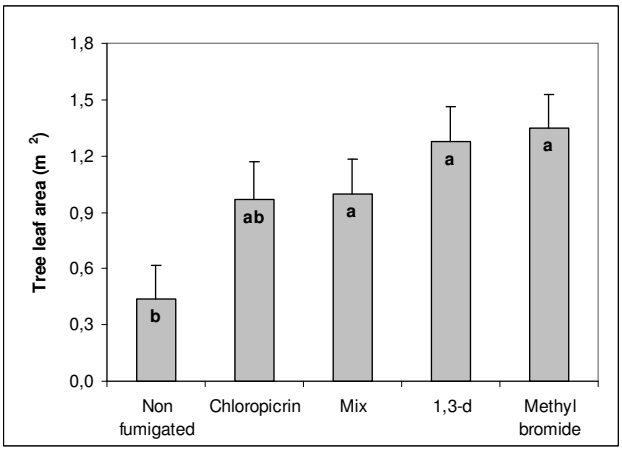

Fig. 5. Tree leaf area of avocado trees after six months of growing in differently treated soil. Bars indicate SE.

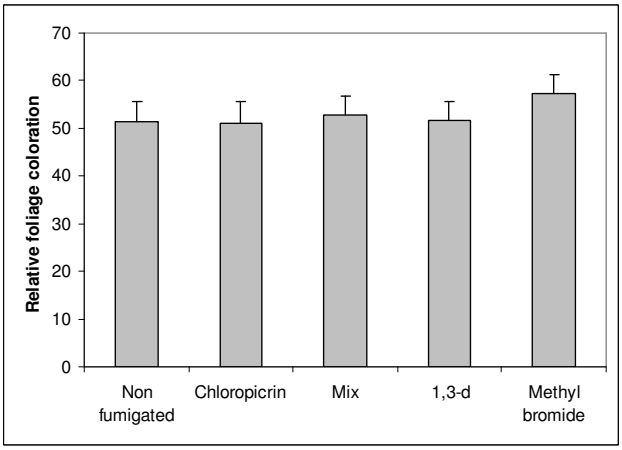

Fig. 6. Leaf colour of avocado trees after six months of growing in differently treated soil. Measured with device CCM-200, Opti-Science, USA.

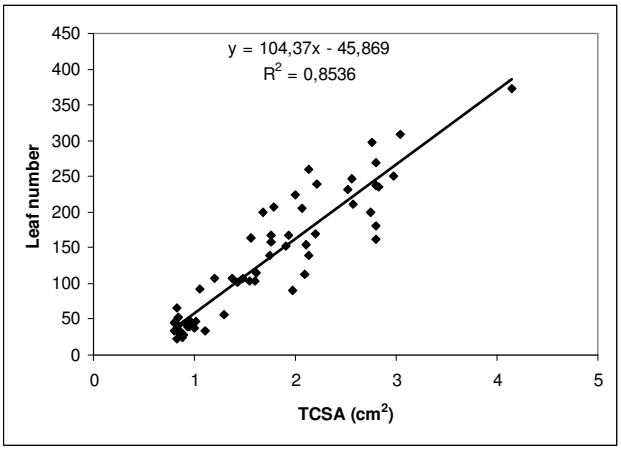

Fig. 7. Leaf number as a function of TCSA for young avocado trees. Function obtained with measures at planting, and 3 and 6 months after it.

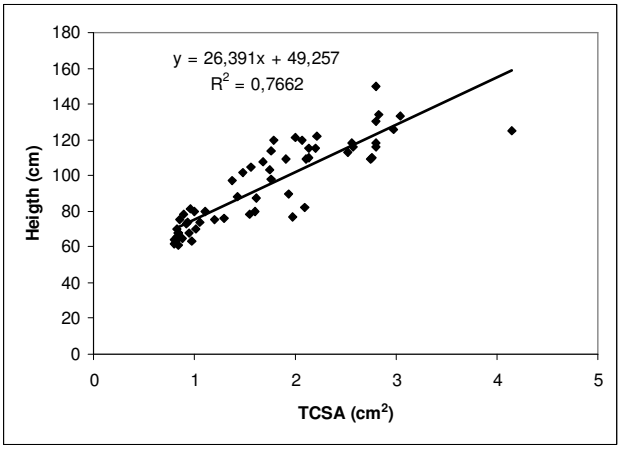

Fig. 8. Tree height as a function of TCSA for young avocado trees. Function calculated with measures at planning, and 3 and 6 months after it.