

EFFICACY OF 1,3-DICHLOROPROPENE PLUS CHLOROPICRIN REDUCED RATES UNDER TWO DIFFERENT TARPS AGAINST NEMATODES, PATHOGENS AND WEEDS

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One of the major concerns in tree nursery production is the control of parasitic nematodes. California phytosanitary regulations require pre-plant fumigation or an intense soil and root sampling for nematode inspection must be conducted before nursery stocks planting materials can be certified and sold. Failure to pass such inspection would lead to disapproval of certification for stock commercialization causing major economic losses. In addition, the susceptibility of some nursery stocks to soilborne pathogens, such as *Phythium* spp., *Verticillium* spp., and *Fusarium* spp., and vulnerability to weed competition are other important problems that need to be addressed in tree nursery production.

Telone C35 is a mixture of 1,3-dichloropropene (1,3-D) and chloropicrin (CP) currently registered in California as pre-plant soil fumigant to control nematodes, soilborne pathogens and weeds. However, 1,3-D and CP are restricted by township caps and buffer zone requirements because of their volatile organic compound emissions. Thus, there is a pressing need to investigate alternative methods that would reduce emissions and concurrently provide effective control of nematodes, pathogens, and weeds in tree nursery production systems.

OBJECTIVES:

- 1) Evaluate the efficacy of reduced Telone C35 rates followed by standard high density polyethylene tarp (PE) or a Totally Impermeable Film (TIF) on plant parasitic nematodes, soilborne pathogens and weeds.
- 2) Determine the ñconcentration timeò (CT) values at different soil depths of 1,3-D and CP under PE, TIF and bare soil.

STUDY METHODS: Field experiments were conducted in fall 2009 and 2010 at the San Joaquin Valley Agricultural Sciences Center, near Parlier, CA. The field had a Hanford sandy loam soil. In both years, the experiment was arranged as a split-block design. The whole-plot factor was Telone C35 rate and the split-plot factor was tarp types. All treatments were replicated three times. In 2009, plots consisted of either 4 or 6.5 m wide by 3 m long. Plots were randomly assigned to receive Telone C35 treatments at full pre-plant fumigation rate (605 kg/ha), ¾ rate (454 kg/ha), or ½ rate (303 kg/ha). A non-fumigated control was included for comparison. Bags containing citrus nematodes (*Tylenchulus semipenetrans*) were buried at 15, 30, 60, and 90 cm soil depth prior to fumigation. Fumigants were applied to a 46 cm depth using a conventional

Telone rig with shanks spaced 51 cm apart (TriCal, Inc.; Hollister, California). Immediately after fumigation, PE or TIF (VaporSafe™, 3.2 m wide, 1 mil [0.025 mm] thickness, clear, Raven Industries, Sioux Falls, SD, USA) was installed to each Telone C35 application rate. The PE tarp was installed in a single operation whereas two sheets of TIF were glued together and installed using a Noble plow rig with the application shanks removed. Two weeks after fumigation (WAF) the tarps were removed and soil samples were taken for nematode evaluation. Bags containing citrus nematodes that were buried before fumigation were recovered and nematode survival was evaluated. Weed emergence and biomass production were also determined several months after fumigation.

In 2010, the experiment was slightly modified from the 2009 methods. Specifically, individual plot size was increased to 11.6 m wide by 4.5 m long. Nematode bioassay bags containing citrus nematode infested soil were buried together with bags containing galled tomato roots and highly infested with root-knot nematodes (*Meloidogyne incognita*). Telone C35 was applied at full (605 kg/ha), ½ (303 kg/ha), and ¼ (151 kg/ha) rate. At four WAF, plastic tarps were removed and data on nematode, soilborne pathogens, and weed control were evaluated. The CT values of 1,3-D and CP under PE, TIF and bare soil were measured at 0, 5, 15, 25, 35, 45, 55, 70, 85 and 100 cm soil depth.

RESULTS: Nematodes: In the 2009 trial, full rate and ¾ rate (which chemical analysis indicated that it had similar pesticide concentrations in soil as the full rate) of Telone C35 provided 100% control of pin nematodes (*Paratylenchus* spp.) at 30, 60, 90 and 120 cm soil depths when evaluated 2 WAF with both tarp types tested. The Telone C35 ½ rate provided 100% pin nematode control at 30, 60 and 90 cm soil depth whereas 96 and 98% at 120 cm soil depth with PE and TIF tarp, respectively. Additionally, there were no pin nematodes detected 0 to 60 cm soil depth 16 WAF in all three rates tested and two different tarps. Citrus nematodes were controlled 100% at 15, 30, 60 and 90 cm soil depths in the two trials (2009 and 2010) with all rates and both tarps with one exception. The only case where living citrus nematodes were detected was at 15 cm soil depth in the 2010 trial where ¼ rate was applied under PE. In the 2010 trial, all root-knot nematodes inside the tomato roots that were buried at 90 cm soil depth were controlled 100% by all treatments.

Soilborne pathogens: In the trial 2010, there were no differences at 15 cm soil depth in the efficacy of Telone C35 at any rate with both tarps against all the soilborne pathogens evaluated. However, Telone C35 was more effective against *Pythium* spp. and *Verticillium* spp. than *Fusarium* spp. For example, full and half rate of Telone C35 provided 100% control of *Pythium* spp. and *Verticillium* spp. under both tarps whereas only around 20% control of *Fusarium* spp.

Weeds: Significant interactions on rates by tarp types for weed count and biomass data were not detected for both years. A total of six and nine broadleaf weed species were observed in 2009 and 2010, respectively. Total broadleaf and grass weed populations were reduced in all Telone C35 treatments in both years. Further, PE and TIF tarps significantly reduced weed density in both years but no differences were observed between PE and TIF.

Soil gas data: In the 2010 trial, the chemical analysis revealed that the CT of Telone C35 varied among depth. The highest CT values of 1,3-D and CP were obtained between 35 and 70 cm soil depth. In particular, the maximum CT of 1,3-D was 1,665 ug/cm³ and of CP was 972 ug/cm³ both at 55 cm soil depth. The full rate under TIF achieved higher average CT values of both chemicals than the full rate with bare soil or with PE. In addition, the combination of full rate with bare soil had generally higher CT values of 1,3-D and CP through all the soil profile than the two reduced rates evaluated under TIF.

CONCLUSIONS: In this study, PE and TIF did not affect the efficacy of reduced 1,3-D and CP rates against nematodes, soilborne pathogens, and weeds. Telone C35 reduced rates were highly effective against plant parasitic nematodes resulting generally in a control that would comply with current California phytosanitary regulations for nursery stock production. However, higher soilborne pathogen incidence was encountered in the reduced rate treatments compared to full rates under both tarp types. This situation suggests that fumigant concentrations at reduced rates may be sufficient for adequate nematode control in sandy soil conditions but is not enough for the control of some soilborne pathogens such as *Fusarium* spp.