SHANK DESIGNS AND SOIL SURFACE TREATMENTS ON 1,3-D EMISSIONS IN A NURSERY FIELD TRIAL

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Introduction:

In California, tree and grapevine field nurseries must meet the CDFA requirements for nematode-free planting stock. Telone II (1,3-D) is the only methyl bromide alternative currently accepted by the CDFA's Nursery Stock Nematode Certification program (CDFA, 2008). However, 1,3-D emissions contribute to volatile organic compounds (VOCs) impacting air quality. Hence, VOC regulations will likely impact the future use of this alternative.

Fumigant emissions can be controlled through application methods and post fumigation surface treatments. When used in nurseries, 1,3-D is normally broadcast applied with a conventional Telone rig (40 cm injection depth with shanks spaced 51 cm apart) and covered with HDPE tarps or retreated with additional 1,3-D or another fumigant several weeks later. An alternative shank design (the Buessing shank with injection depths at 40 and 66 cm with shanks spaced 61 cm apart) has been proposed for increasing efficacy at deeper soil depths and for reducing 1,3-D emissions (Hanson et al., 2007; McKenry et al., 2003). Several surface treatments including various types of tarps and soil moisture management have been proposed for further reductions in 1,3-D emissions from fumigated fields. For example, tarping soil surface with HDPE reduced emissions of 1,3-D and CP under moist soil conditions, while VIF effectively reduced emissions under both dry and moist soil conditions, and post-fumigation water applications have shown effectiveness on emission reductions (Gao and Trout, 2007).

The objective of this study was to evaluate the combined effects of shank designs and soil surface treatments on 1,3-D emissions and soil gaseous fumigant concentration in a simulated perennial crop nursery.

Materials and Methods:

A field trial was conducted during October 2-12, 2007 at the University of California Kearney Agricultural Center near Parlier, CA. The tested soil is a Hanford sandy loam (coarse-loamy, mixed, superactive, nonacid, thermic Typic Xerorthents). Soil moisture at fumigant application was 5.1-6.6% (w/w) throughout 1-m soil profile. The experiment was designed as a randomized complete block with 0.1 ha plots. The shank designs included conventional shank and Buessing shank and each shank consisted of four post-fumigation soil treatments, i.e., water seals, HDPE tarping, VIF tarping, and bare soil. The water seals were applied at 3 hr (12 mm), 12 hr (5 mm), 24 hr (4 mm), and 48 hr (4 mm) after fumigant injection. HDPE or VIF film was installed immediately after fumigant injection. Fumigant emissions were sampled for 10 d by dynamic active flux chambers. Fumigant in the soil gas-phase was also sampled during the trial.

Results and conclusion:

No differences in the measured emission flux were observed between the two different shank injections. However, the Buesssing shank spacing was 61 cm and the dynamic chamber covered 51 cm centered above shank injection line. This resulted in about 20% area not covered by the chamber where lower emissions were expected. Thus the measured emissions might be slightly higher than actual for the treatments with Buessing shank injections.

Following fumigant injection, the emission peak in bare soil plots occurred at 30 h. Water seals had high emission peak occurred after water applications (48 h later). The peak flux of HDPE treatments occurred at similar time to the bare soil plots but was reduced by approximately half compared to bare soils. The emission flux of VIF treatments was substantially lower than other treatments.

Corresponding to the flux values, the cumulative emission loss was similar between the two fumigant injection methods for the same surface treatment. Among the soil surface treatments, total emission loss was highest from bare soils, reduced ~30% by water seals, 50% by HDPE tarp, and >90% by VIF.

Fumigant concentrations in the soil gas-phase were slightly higher in the Buessing shank treatments compared to the conventional shank, particularly in lower depths. This difference became marked when tarping soil surface with HDPE and especially with VIF.

Results from this field trial indicate that the Buessing shank with the current design may not reduce 1,3-D emissions but can enhance its concentration in soil gas phase and its distribution in soil profile especially to lower depths that may improve fumigation efficacy compared to the conventional shank. Tarping with VIF achieves the best fumigant emission reduction. Post-fumigation water seals resulted in low emissions only during the water application period.

References:

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