LOW PERMEABLE TARPS REDUCE EMISSIONS FROM DRIP-APPLIED INLINE IN A STRAWBERRY FIELD TRIAL

Ruijun Qin[1,2], Suduan Gao[1], Husein Ajwa[2]

[1] USDA-ARS, San Joaquin Valley Agr. Sci. Ctr., Parlier, CA. [2] University of California, Davis, CA

Introduction: Preplant soil fumigation with methyl bromide was used for broad spectrum pest control in strawberry production. 1,3-dichloropropene (1,3-D) and chloropicrin (CP) are important alternatives since the phase out of methyl bromide. However, these alternatives are subject to rapid emission and contribute volatile organic compounds (VOCs) to impairment of air quality. Plastic tarps are often used over raised beds in strawberry field. Low permeability films can retain fumigants under the tarp to improve efficacy and minimize volatilization losses. Post fumigation water seals were found to reduce fumigant emission effectively. The objective of this study was to determine the effectiveness of three different tarps over the raised-beds and applying water in furrows to reduce 1,3-D and CP emission in a strawberry field trial.

Materials and Methods: A field trial was conducted during Sept. 12-20, 2007, near Oxnard, CA in a sandy loam soil. Four treatments were tested including (1) Polyethylene tarp (over the raised-beds) (PE), (2) PE plus water seal in furrows following fumigant injection (PE/water), (3) Virtually impermeable film tarp (VIF), and (4) Semi-impermeable film tarp (SIF). The field for each treatment was 0.4 ha and consisted of 24 beds. Each bed was 104 m long, 107 m wide and 30 cm high. The distance from bed center-to-center was 162 cm. The furrow width was 55 cm and the area of furrow was 35% of the total field area. The treated fields were separated from each other by more than 283 m to avoid cross contamination and prepared by cooperating growers following standard strawberry production practices. Two high flow drip tapes (4.77 L m^{-1} h^{-1}) per bed were buried at 3-cm soil depth and 46 cm apart. InLine (60.8% 1,3-D and 33.3% CP) was drip-applied at 340 kg ha^{-1} over 3.3 h (including flushing for 20 min after fumigation). Immediately following the InLine application, 6 mm of water was applied through sprinklers for 1 hr to furrows of PE/water. Fumigant emissions from 2 beds and 2 furrows in each field were monitored for 8 d following fumigant injection using dynamic flux chambers. Air samples under the tarp and above soil surface were collected to determine 1,3-D and CP concentration. Air temperature and soil temperature were also measured during the trial.

Results: Similar pattern of the emission fluxes from the beds were found for all four fields (Fig. 1). Emission flux was highest immediately following the fumigant application (~3.5 h after fumigant injection began) because of the shallow depth of drip tapes for delivering the fumigant. After the emission peaks, the emission flux decreased significantly with time although the flux followed a daily diurnal variation pattern corresponding to temperature changes. The highest emission flux occurred in PE tarped fields compared to the low permeable film tarped fields. The emission rates of 1,3-D were generally higher than that of CP. There were little differences in emission peaks of both fumigants between the PE and PE/water fields. The peak emission flux from furrows was lower than 10% of that from beds for all four fields.

The cumulative emission losses from beds in the VIF and SIF tarped fields were 60-66% for 1,3-D and 55-59% for CP of the loss from the PE tarped field (Fig. 2 & Fig. 3). PE/water field showed slightly lower cumulative emissions compared to PE field. The furrows had very low emission losses (< 1% of loss from beds for both fumigants) for all four fields. As a result, the water application to furrows in the PE tarped field did not illustrated further emission reductions.

Fumigant concentrations under the VIF tarp were substantially higher than the PE and SIF tarped fields throughout the whole trial (Fig. 4). Although there were some variations, fumigant concentrations under the tarps were similar in PE fields and SIF field.

Conclusion: The results indicate that low permeable tarps especially the VIF significantly reduce fumigant emissions when the fumigant is drip-applied to raised beds. The VIF tarp retained higher fumigant concentration in the soil that can benefit fumigation efficacy. Emissions of 1,3-D and CP were mainly through the beds from drip-applied fumigants and the results confirmed our previous observations that emissions from furrows were almost negligible with the current field bed designs in strawberry fields. Thus, emission reductions need to focus on the tarp quality over beds.

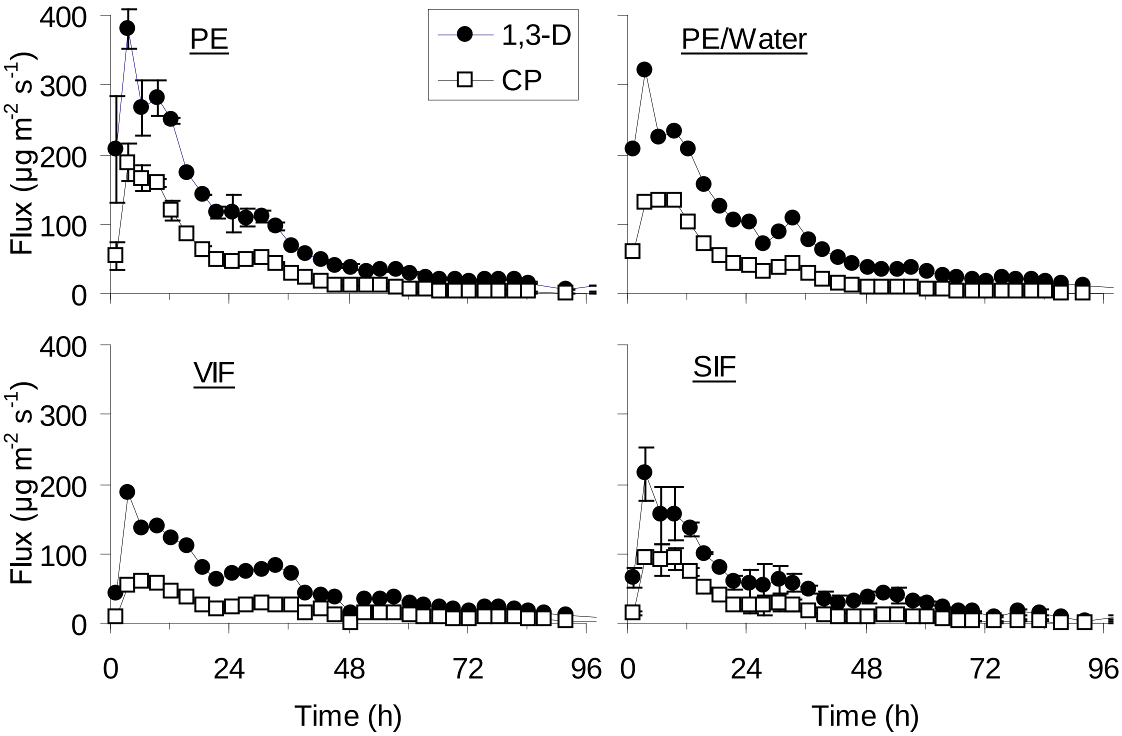

Fig. 1. Emission flux of 1,3-D and CP measured from top of the beds in Oxnard strawberry field trial. Error bars are the standard deviation of the mean (n=2).

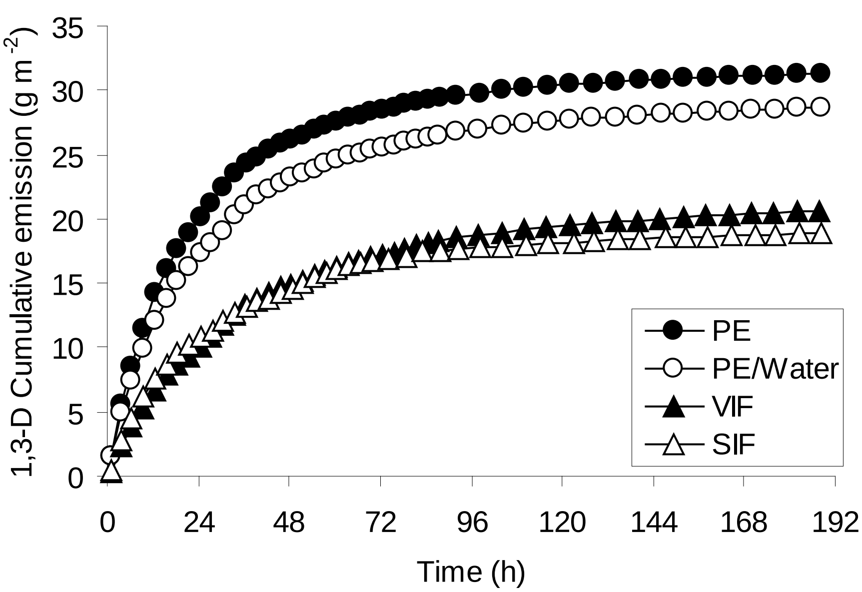

Fig. 2. 1,3-D cumulative emission (g m^{-1}) from the beds in Oxnard strawberry field trial.

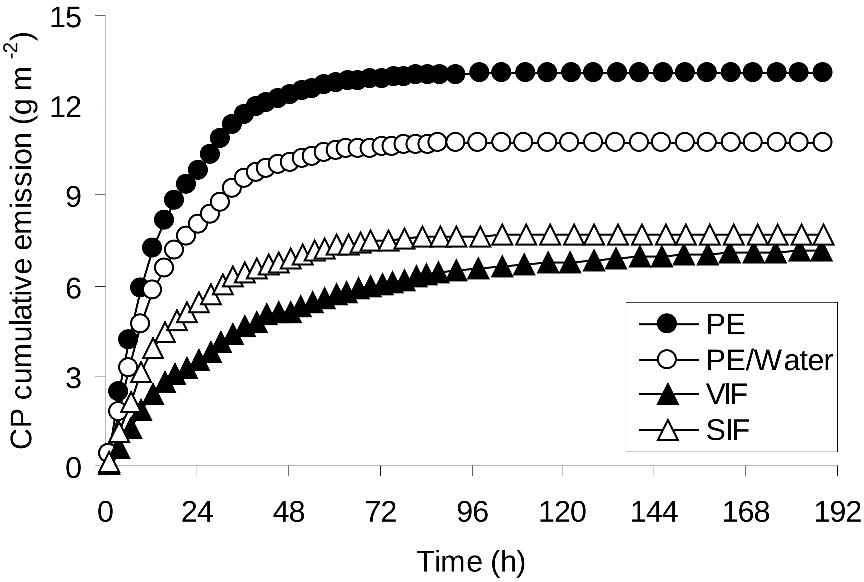

Fig. 3. CP cumulative emission (g m^{-2}) from the beds in Oxnard strawberry field trial.

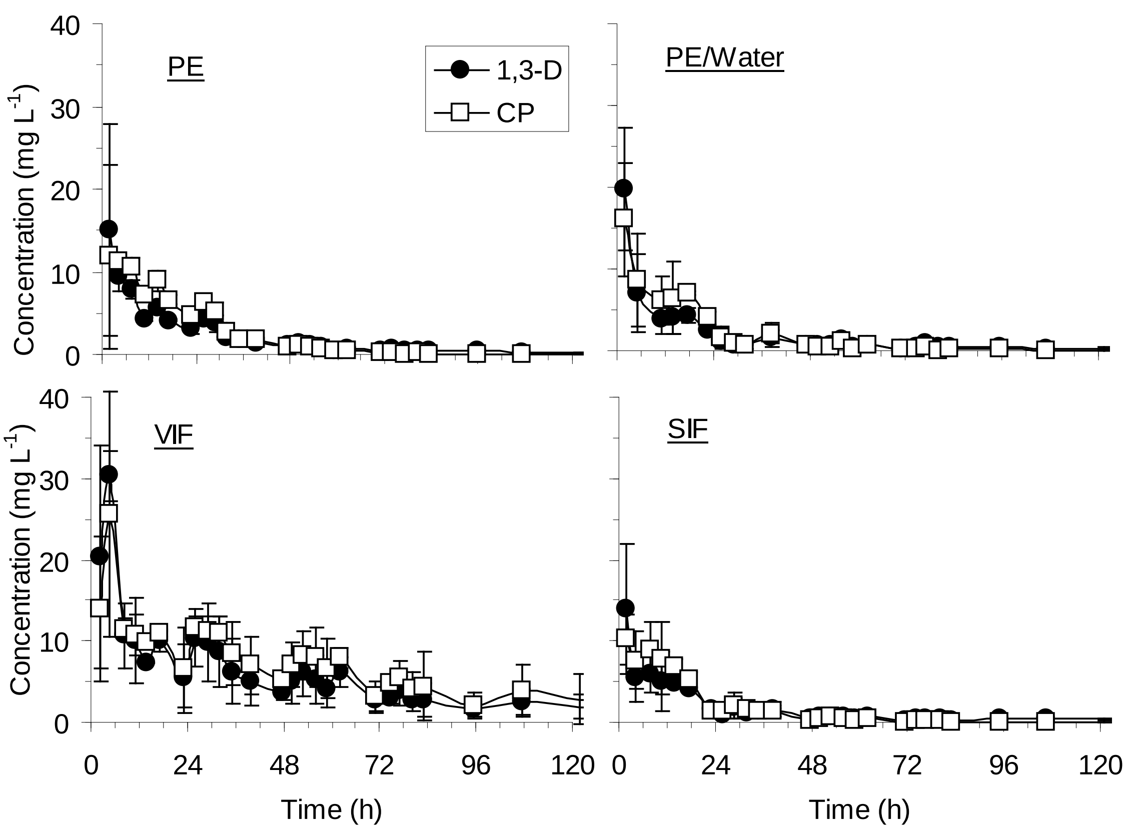

Fig. 4. Concentration of 1,3-D and CP measured under the tarp and above soil surface. Error bars are the standard deviation of the mean (n=2).