

EFFECTS OF HERBICIDE COATING ON FUMIGANT GAS EMISSIONS

Paul E. Sumner, Extension Engineer
Stanley Culpepper, Extension Weed Scientist
Tifton Campus University of Georgia
P.O. Box 748
Tifton, GA 31793
psumner@uga.edu

Introduction

Plastic mulches impregnated with herbicides to improve weed control in a vegetable plasticulture production system is a fascinating new technology currently being explored. The potential to improve weed control seems endless with this technology and grower adoption could be rapid. However, it is unknown what impact the mulch and herbicide impregnation process might have on fumigate emissions. This study was conducted to measure the amount of fumigant retained in the soil as well as allowed to pass through the mulch.

Materials and Methods

Plot land was chosen in the spring of 2009 for a soil type of loamy sand which is comparable to soils used for commercial vegetable production in South Georgia (Tifton sandy loam, 90% sand, 4% silt, 6% clay, ph 6.4, OM 1.0). Plots were tilled with a field cultivator and bedder prior to operation of the fumigation equipment. Plots were a randomized complete block design using Blockade and BIG mulch treatments.

Fumigant treatments included 1) PaladinTM, a mixture of dimethyl disulfide and chloropicrin (79:21), applied at 40 gpa or 2) Pic Chlor 60 (1,3-dichloropropene [40%] and chloropicrin [60%]) applied at 21 gpa. Both fumigants were applied with a prebedder injecting fumigants 8 inches deep with three knives 11 inches apart and covered immediately with mulch. Mulch options included Blockade film (1.25 mil) and BIG film (4 mil), an experimental technology with an herbicide applied to the side facing the soil surface. Applications were made on July 17, 2009 in 1.8 m by 20 m plots with 81 cm bed tops.

Soil samples of 365 cm³ were obtained from each plot with a soil probe (4.8 cm diameter by 20 cm deep). Gravimetric moisture content basis was determined for each sample by weighing the soil and placing the soil in a 105°C oven for 24 hours and reweighed. Next, the samples were evaluated for field capacity water content. Soil samples were placed on a ceramic plate. The sample is then saturated with water for 24 hours to equilibrate. The porous ceramic plate with saturated soil is pressurized to 1/3 bar of pressure. After 24 hours in this chamber, the moisture content in the soil was determined with above method.

Chloropicrin was measured with a gas detector pump (GASTEC GV100S) and a detector tube (Sensidyne #172S). An inverted HDPE funnel (1.9 L) with a rubber stopper measuring 16.5 cm in diameter fill opening by 22 cm high with a 2 cm drain was glued (silicon) to plastic mulch beds (Figure 1). Chloropicrin gas collected inside the funnels for a known period of time (1-10 minutes). After the known period, a 100 ml sample was drawn through the detector tube from the inside of the funnel by the gas detector pump. The chloropicrin detector tubes had a range of 0.05 – 16 ppm

Dimethyl disulfide and 1,3-dichloropropene was measured with a handheld volatile organic compound (VOC) monitor (MiniRae 2000) with a range of range of 0-10,000 ppm. Measurements were taken immediately after the chloropicrin inside the inverted funnel.

Samples of the accumulated gas inside the funnels were taken from 3 to 75 hours after application. Fumigants were measured in the funnels until no gases were detected.

Results and Discussion

Field capacity of the soil was determined to be 7.3%/dry weight of soil. Soil moisture content ranged from 5.8 to 7.9 %/dry weight of soil averaging 7%/dry weight of soil (96% field capacity).

Chloropicrin gas emissions were measured over a 55 hour period. Figures 2 and 3 is a graphical representation of the 55 hour collection period. The chloropicrin gas emission when Paladin was applied showed 31 percent reduction with the Blockade compared to the BIG film. On the contrary when applying Pic Chlor 60, the Blockade mulch had a 70 percent increase in chloropicrin emissions compared to BIG film.

Dimethyl disulfide gas emissions increased by 73 percent for the BIG film over Blockade Figures 4 and 5). 1,3-dichloropropene combined BIG film also emitted 30 percent more gas than Blockade mulch(Figures 6 & 7).

Concentration of dimethyl disulfide and 1,3-dichloropropene in the soil after application are shown in figures 8 and 9. The first 3 days after application the meter was unable measure the concentration for dimethyl disulfide (figure 8). Both dimethyl disulfide and 1,3-dichloropropene gas concentration within the bed declined as would be expected. The blockade mulch had higher concentrations of dimethyl disulfide than BIG film.

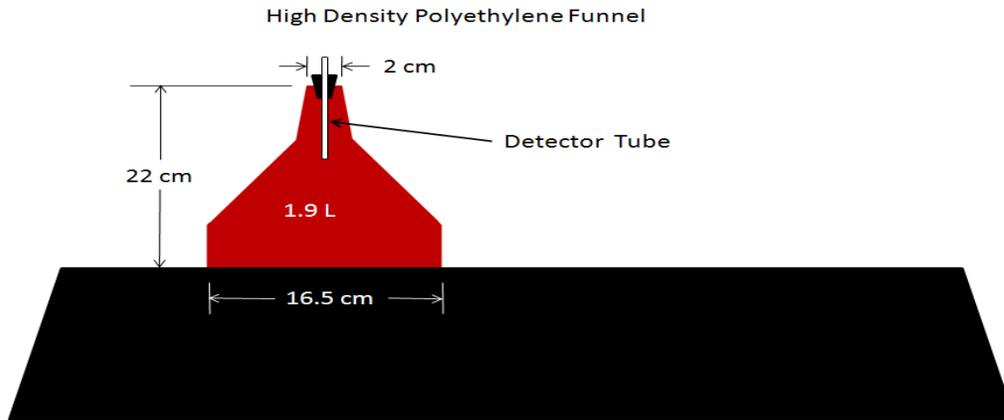


Figure 9. Schematic of fumigant sampling system.

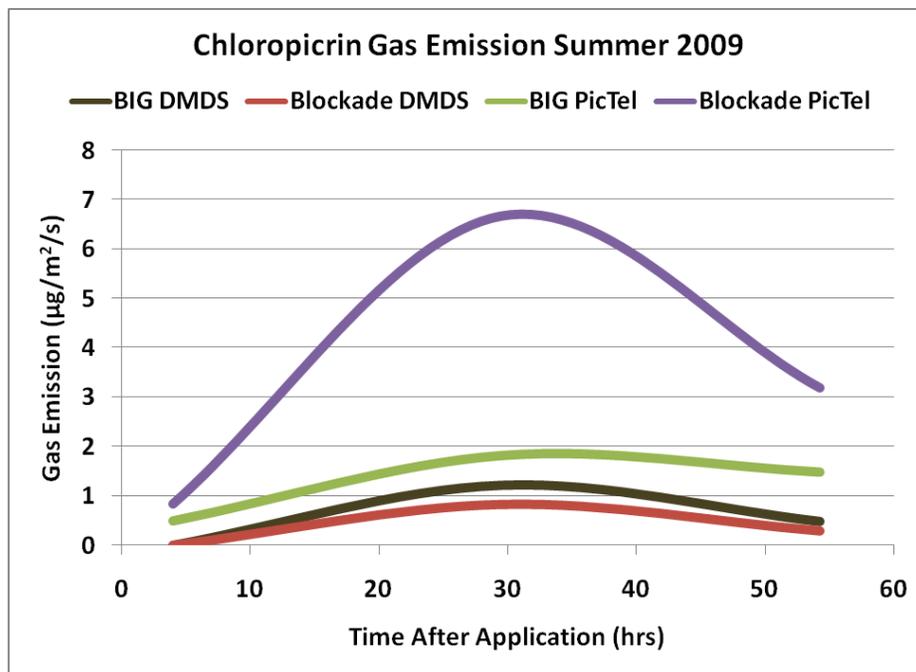


Figure 2. Gas emission for chloropicrin comparing BIG and Blockade mulch films, Summer 2009

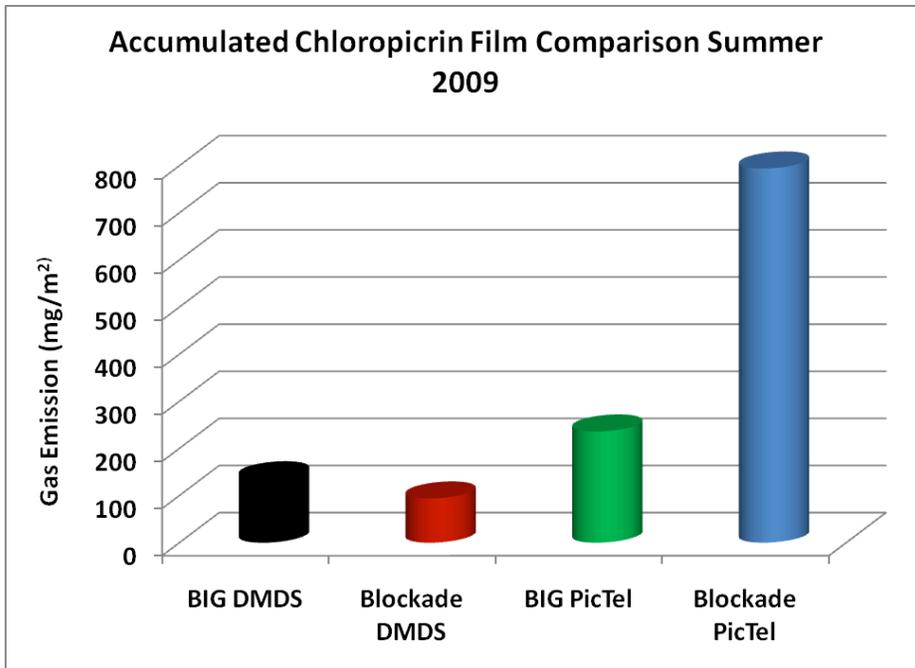


Figure 3. Accumulated gas emission for chloropicrin BIG and Blockade mulch film comparison, Summer 2009.

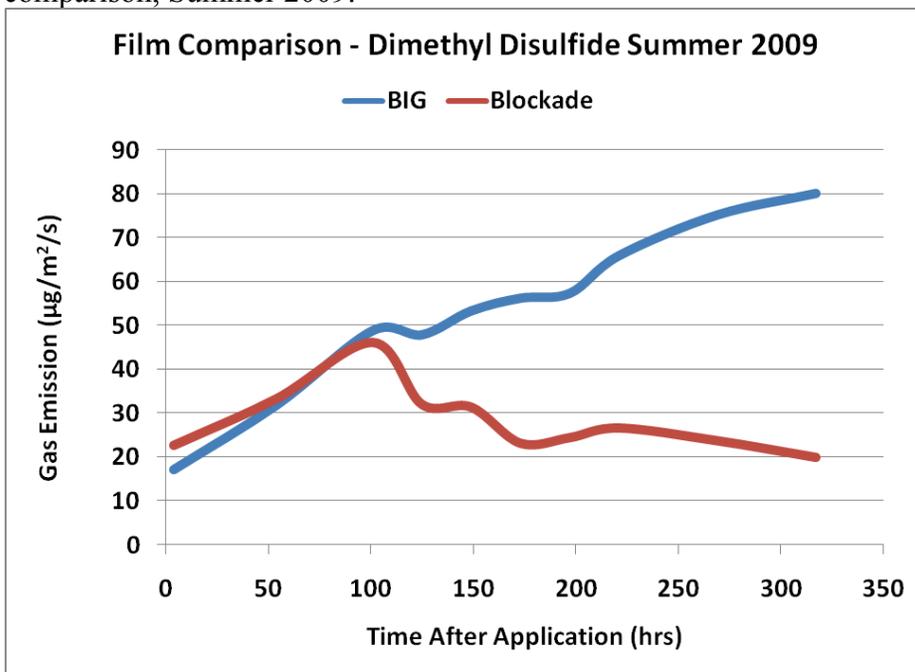


Figure 4. Gas emission for dimethyl disulfide comparing BIG and Blockade mulch films, Summer 2009.

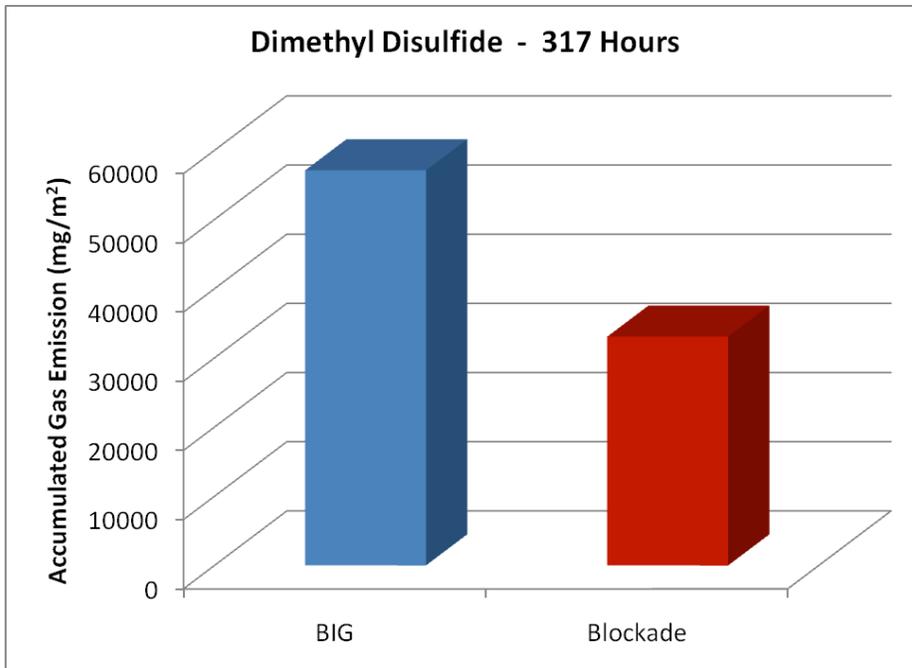


Figure 5. Accumulated gas emission for dimethyl disulfide BIG and Blockade mulch film comparison, Summer 2009.

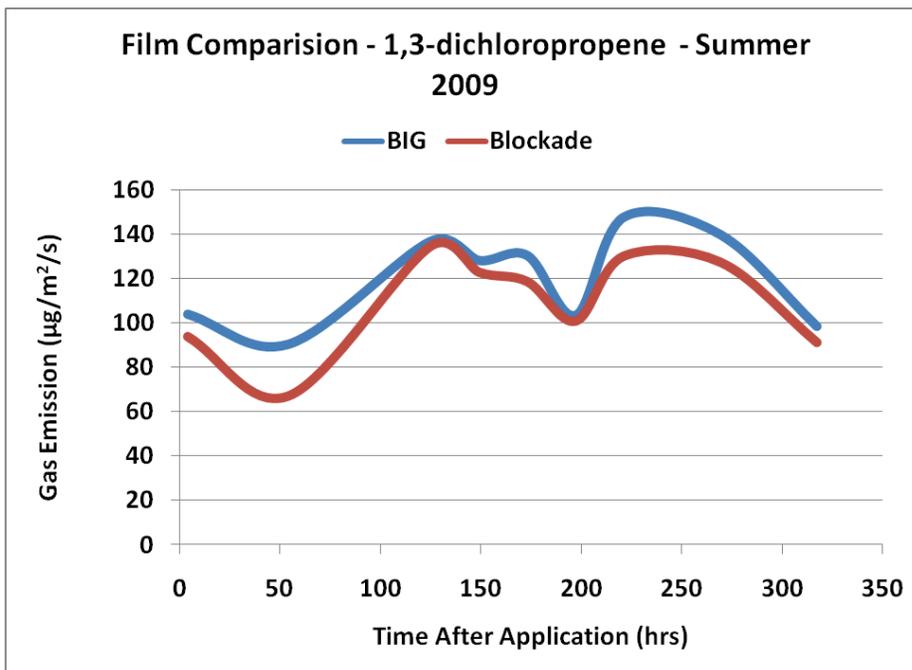


Figure 6. Gas emission for 1,3-dichloropropene combination, comparing BIG and Blockade mulch films, Summer 2009.

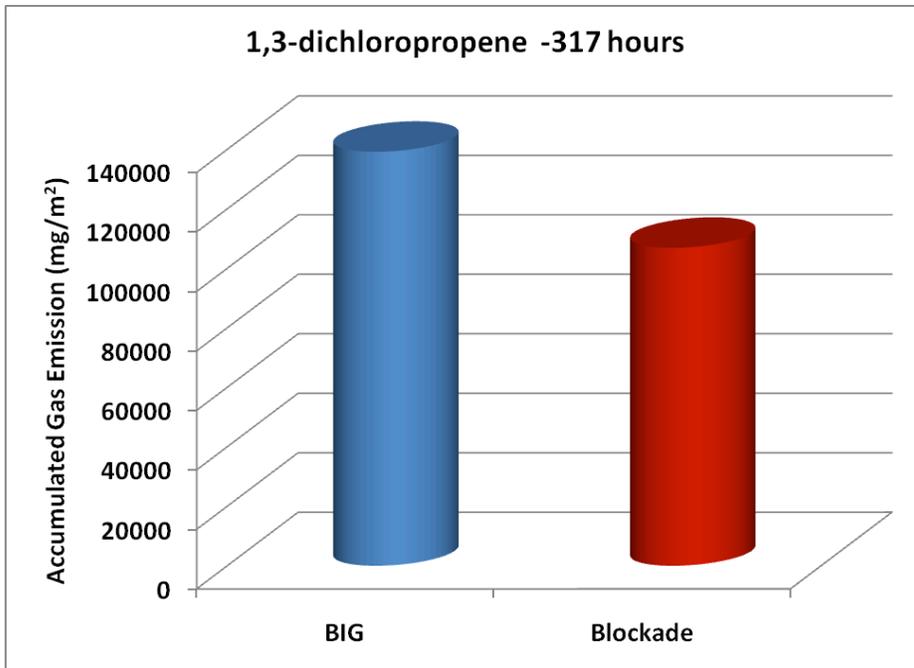


Figure 7. Accumulated gas emission for 1,3-dichloropropene combination BIG and Blockade mulch film comparison, Summer 2009.

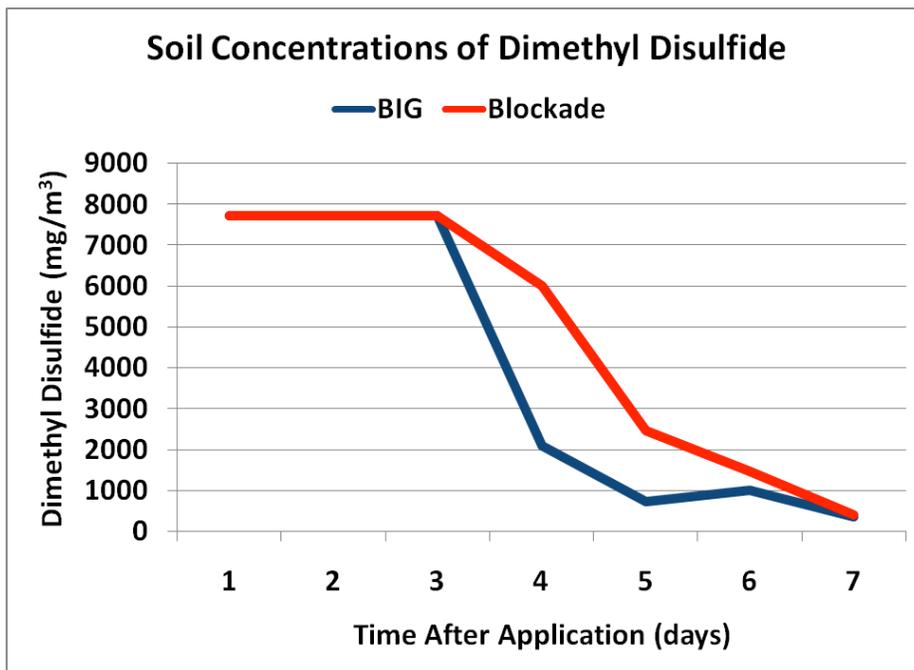


Figure 8. Concentration of dimethyl disulfide in the soil. Days 1-3 readings were off scale of meter (MiniRae 2000), Summer 2009.

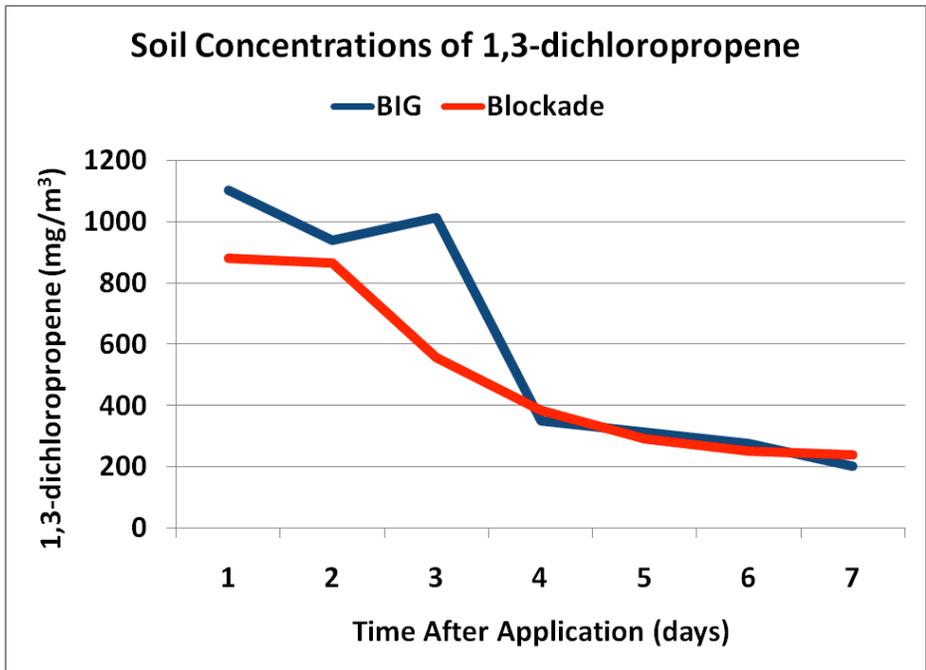


Figure 9. Concentration of 1,3-dichloropropene in the soil. Summer 2009.