

EFFECTS OF TIME OF DAY APPLICATION ON EMISSION OF CHLOROPICRIN

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Introduction

Minimizing buffer zones for fumigants such as chloropicrin is a major concern for vegetable producers in Georgia. One method to mitigate gas emission into the atmosphere is through the use of high barrier mulch films. Several different types of mulch films have been developed and will offer growers credits to reduce their buffer zones. There has been some observation that application time and tillage may also affect fumigant emissions. This experiment was conducted to determine the effects of application time of day and tillage prior to bed formation on gas emissions, in an effort to determine if more credits could be obtained through adopting varying cultural practices.

Materials and Methods

Plot land was chosen in the spring of 2009 for a soil type of sand which is comparable to soils used for commercial vegetable production in South Georgia. Three application times were selected for 8:00 am, 11:00 am and 3:00 pm. Plots were subdivided to be rototilled prior to bedding and not rototilled.

Pic Chlor 60 at 196 l/ha (21 gpa) (1,3-dichloropropene [40%] and chloropicrin [60%]) was applied on March 4, 2009 in 1.8 m by 15 m plots with 81 cm bed tops. Pic Chlor 60 was applied with a prebedder injecting fumigant 20 cm with injection three knives 28 cm apart. Next, the final bed was shaped and covered with black LDPE (1.25 mil) mulch film.

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 the above method. Soil samples were then sent to the University of Georgia Soils Lab for classification.

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.

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

Soil moisture content ranged from 6.2 to 7.5 % per dry weight of soil. Field capacity of the soil was determined to be 7.64% per dry weight of soil for sand. Soil temperatures at 8 inches averaged 63°F. The maximum and minimum temperature at 8 inches was 75 and 48°F.

The affect of tillage had an impact on the amount of off gassing from the mulch bed (Figures 2 and 3). Regardless of the time of day of application, gas emissions increased by 64 percent when the soil was rototilled prior to formation of the bed. The gas emission rate typically follows the daily rise and fall of temperature. Figures 4-6 illustrate the gas emission rate was the highest during the afternoon once the sunlight has warmed the soil and mulch. Fumigant emissions peaked on day one except for 11:00 AM rototilled application. This application peaked higher on day two. Table 1 presents total gas emissions for all application times and tillage. The lowest amount of gas emission occurred for 8:00 am with no prior tillage. The daily soil temperature at 20 cm ranged from 48F °C to 75F °C during the data collection period.

Conclusion

Results show that higher total gas emissions occurred for applications at 11:00 AM and 3:00 PM for rototilled and 11:00 AM nontillage. But rototilling the soil prior to bed formation tends to increase gas emissions.

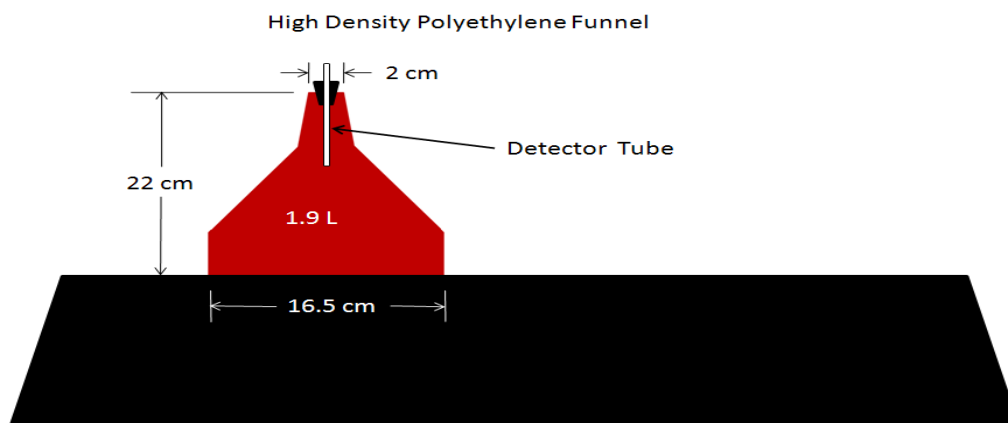


Figure 3. Schematic of fumigant sampling system.

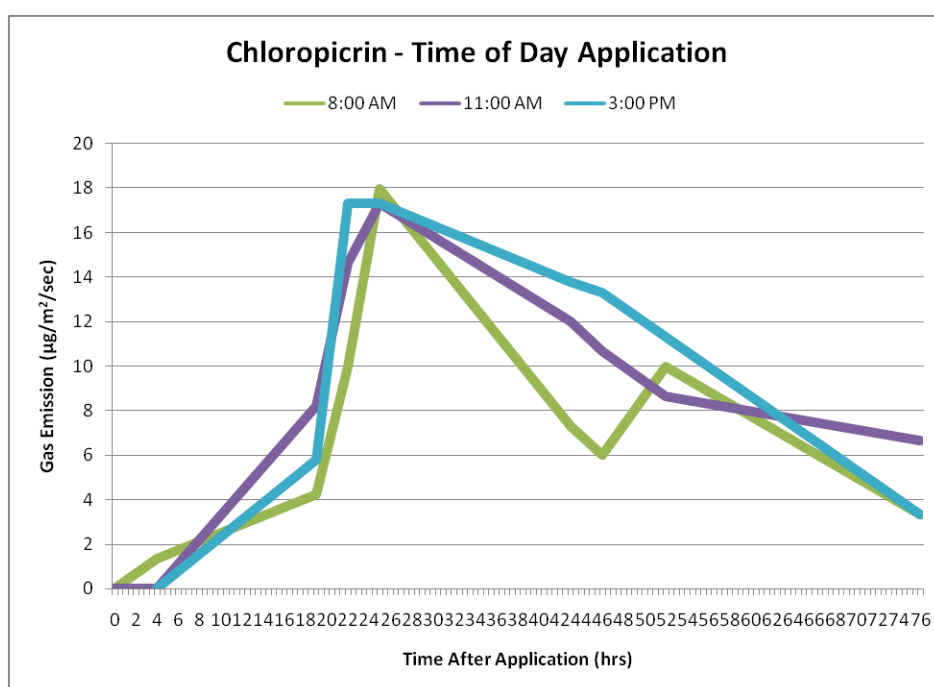


Figure 4. Chloropicrin release rates for various times of application during a day no field preparation. Spring 2009.

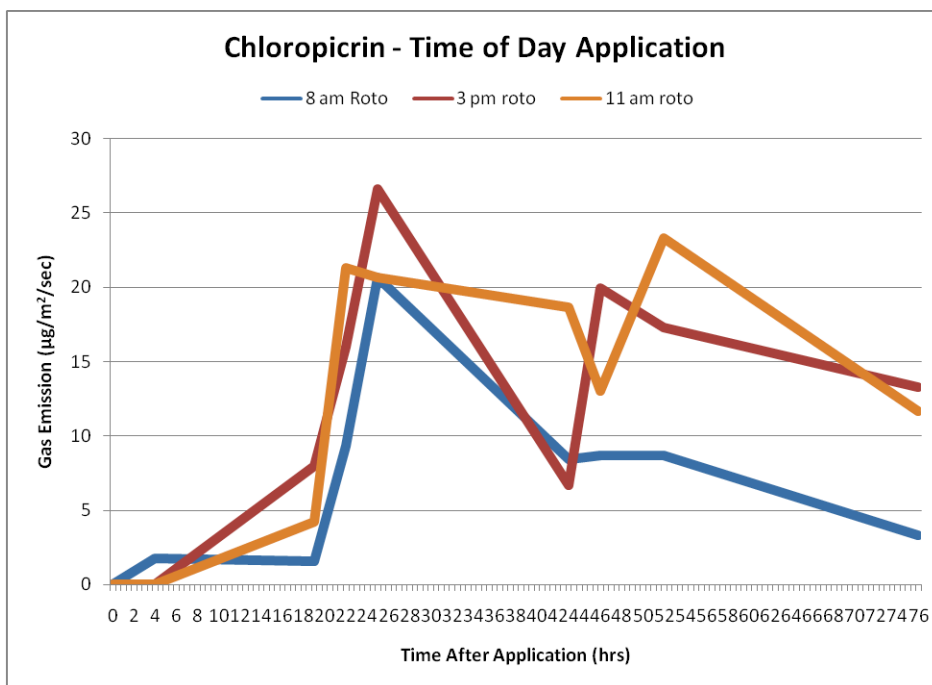


Figure 5. Chloropicrin release rates for various times of application during a day. Rototilled prior to bed formation. Spring 2009.

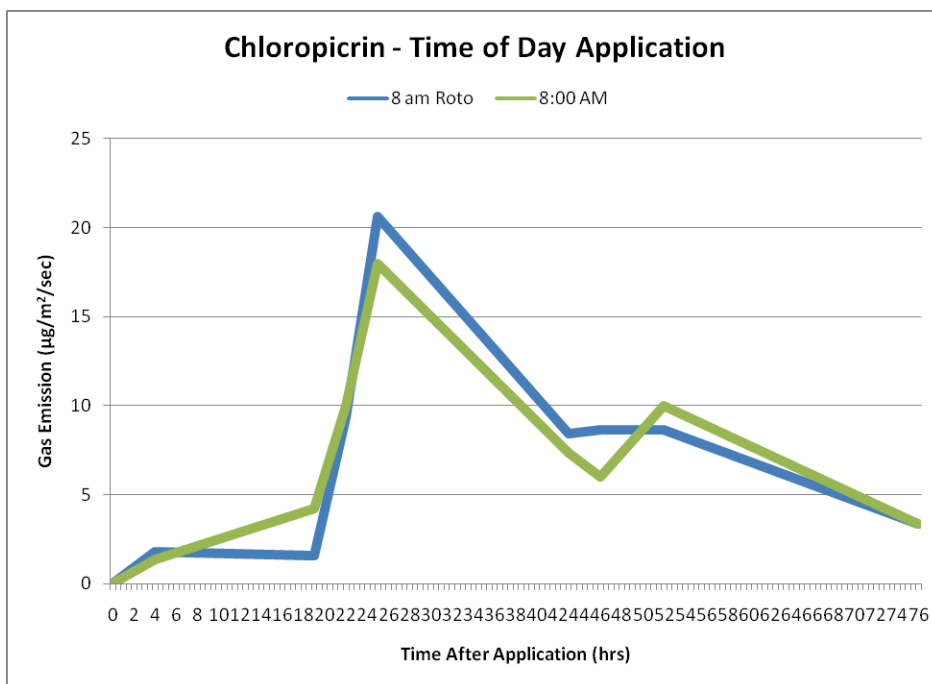


Figure 6. Chloropicrin release rates for 8:00 am application. Spring 2009.

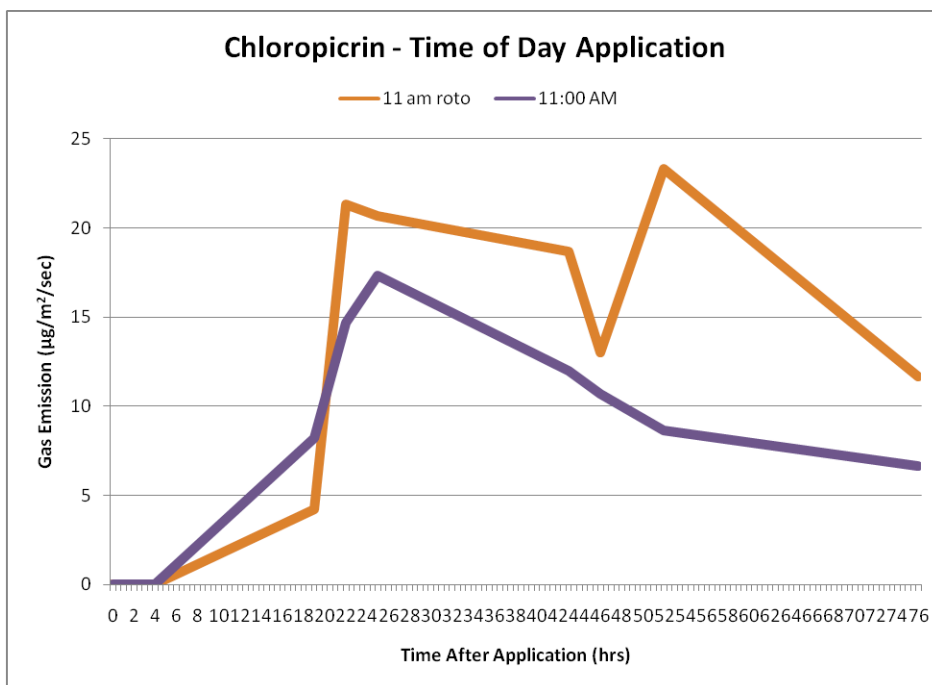


Figure 7. Chloropicrin release rates for 11:00 am application. Spring 2009.

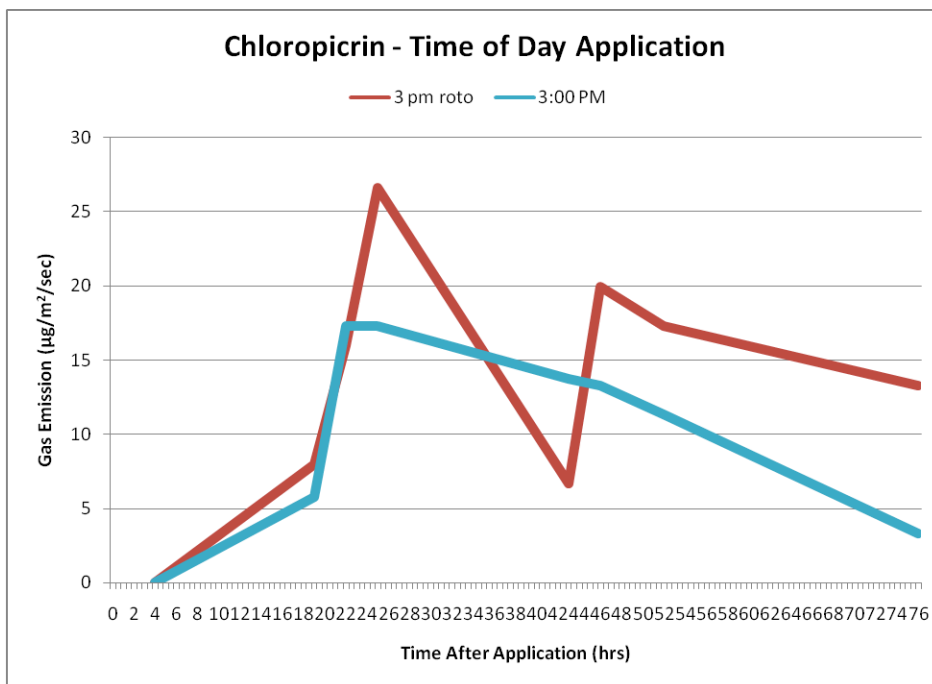


Figure 8. Chloropicrin release rates for 3:00 pm application. Spring 2009.

Table 1. Reduction in total chloropicrin gas emission for sand soil type based on application time and tillage. Spring 2009.					
Application Time	Tillage	Total Flux (mg/m ²)	¹ Time of Day Reduction - None (%)	² Time of Day Reduction – Rototilled (%)	Tillage Reduction (%)
8:00 AM	Rototilled	3831		55.2	
8:00 AM	None	3773	20.4		1.6
11:00 AM	Rototilled	8125		5.0	
11:00 AM	None	4741			41.7
3:00 PM	Rototilled	8551			
3:00 PM	None	3978	16.1		53.5
¹ – Calculation based on 11:00 AM application. ² – Calculation based on 3:00 PM application.					