RETENTION AND EFFICACY OF DIMETHYL DISULFIDE UNDER VIRTUALLY AND TOTALLY IMPERMEABLE FILMS

Josh Freeman* and Theodore McAvoy. Virginia Polytechnic Institute and State University, Eastern Shore Agricultural Research and Extension Center, Painter, VA.

The US EPA lists dimethyl disulfide (DMDS) as a methyl bromide (MBr) alternative under development in tomatoes(US EPA, 2009a). Totally impermeable film mulch (TIF) utilizes a high barrier ethylene vinyl alcohol (EVAL) copolymer which is less permeable than nylon barrier layers common in virtually impermeable film mulches (VIF) (Chow, 2009). Vaporsafe® TIF mulch has been shown to increase retention of DMDS when compared with VIF mulch (Freeman et al., 2009). Benefits of mulches with increased fumigant retention are a reduction in the amount of fumigant needed for effective pest control, lower emissions, and a lowered buffer zone requirement. In fact, the US EPA has amended the re-registration eligibility decisions (REDs) to approve a 60% buffer zone reduction credit for MBr when applied under certain types of TIF (US EPA, 2009b). A potential drawback of TIF is that the plant back period may be increased. A research program has been developed to look at multiple aspects of reduced use rates of DMDS under Vaporsafe ® TIF mulch.

Materials and Methods

DMDS fumigant trials were conducted at the Virginia Tech Eastern Shore Agricultural Research and Extension Center in Painter, VA during the spring and fall of 2010. A 79:21 formulation of DMDS:chloropicrin fumigant was shank applied using a single row bed press 30 inches wide with three shanks. The treatments applied were an untreated control under TIF, a standard rate (50 GPA) under Blockade® VIF and TIF, a high rate (60 GPA) under VIF, and several reduced rates (20, 30, and 40 GPA) under TIF. The fall 2010 trial also included an untreated check under VIF.

Data Collection

Fumigant persistence, soil temperature, yellow nutsedge control, disease incidence, and tomato yield data were collected for these experiments. Fumigant persistence data was measured using a MiniRAE3000 volatile organic compound (VOC) meter. Soil temperature under the plastic was taken using a HOBO data logger. .Yellow nutsedge and disease incidence (dead/wilted plants) counts were taken from each plot at the end of the growing season. Tomatoes were harvested and graded at maturity.

Results and Discussion

In the spring trial the 40 GPA rate under TIF was retained at the highest level for the longest period of time (Fig.1). It is unclear why the 40 GPA rate was retained at a higher level than the 50 GPA rate under TIF. Perhaps there was a problem during fumigation application. During the fall experiment, the retention of DMDS under TIF showed a classical rate response (Fig 2). The standard application rate (50 GPA) was retained at the highest level for the longest period of time, while the reduced application rates (40, 30, 20 GPA) showed a stepwise decrease in retention levels and periods. The retention under VIF was very similar in both seasons for both rates (50 and 60 GPA) with the retention being slightly higher at the higher rate in most cases. The retention of DMDS under VIF at both rates (50 and 60 GPA) was somewhere between the lower fumigant rates (20 and 30 GPA) under TIF during both seasons. Therefore, it may be possible to decrease application rates by approximately 50% under TIF compared to VIF, while maintaining similar fumigant retention levels. The plant back period was longer in the spring compared to the fall due to lower soil temperatures. During the spring the plant back period was about 36 days for the 40 GPA treatment under TIF (average VOC reading =105 ppm isobutylene). In the fall the plant back period was only around 28 days for the 50 GPA treatment under TIF (average VOC reading = 122 ppm isobutylene).

During the spring all the fumigant treatments controlled broadleaf weeds, grasses and diseases better than then untreated control (Table 1). Except for the 60 GPA under VIF treatment (0.4 plants/ft^2), DMDS controlled nutsedge (0 – 0.2 plants/ft^2) better then the untreated control (0.51 plants/ft^2). It is important to note that nutsedge counts were very low in the untreated plots, therefore differences may have been seen when weed pressure is greater. Nutsedge was controlled better by 50, 40, and 30 GPA of DMDS under TIF (0 – 0.03 plants/ft^2) than 60 GPA under VIF (0.4 plants/ft^2). All the fumigant treatments except the 30 GPA under TIF treatment controlled broadleaves better than the 20 GPA under TIF treatment. There were significant differences in tomato fruit size and yield between the treatments. (Table 2). With regard to total marketable fruit, all the DMDS treatments (23,389 – 36,316 lbs/A) increased yields compared to the untreated control (7,738 lbs/A). The 20 and 30 GPA treatments under TIF (32,126 – 36,316 lbs/A) increased yields compared to both DMDS treatments under VIF (23,389 – 24,436 lbs/A). The 20 GPA rate under TIF treatment (36,316 lbs/A) produced higher yields than the 40 GPA rate under TIF (27,273 lbs/A). The fall efficacy and yield data will be presented in November. Data generated in the spring of 2010 indicates that it may be possible to significantly reduce fumigant use rates while maintaining efficacy, however, weed pressure was low in this trial. Fumigant reduction capacity under TIF will remain unclear until more trial data is accumulated when pressure from yield limiting factors is high.

Literature Cited

Chow, E. 2009. An update on the development of TIF mulching films. Proc. 2009 Annual International Research Conference on Methyl Bromide Alternatives

and Emissions Reductions.
http://www.mbao.org/2009/Proceedings/050ChowEMBAO2009.pdf

Freeman, J., S. Rideout, and A. Wimer. 2009. DMDS retention by totally impermeable film and its effectiveness for tomato production. Proc. 2009 Annual International Research Conference on Methyl Bromide Alternatives and Emissions Reductions.
http://www.mbao.org/2009/Proceedings/053FreemanJDMDS%20TIF%20MBAO.pdf

USEPA. 2009a. Methyl bromide alternatives.
http://www.epa.gov/ozone/mbr/alts.html

US EPA. 2009b. Amended reregistration eligibility decision for methyl bromide (soil and non-food structural uses). Pg 60.
http://www.regulations.gov/search/Regs/home.html#documentDetail?D=EPA-HQ-OPP-2005-0123-0716

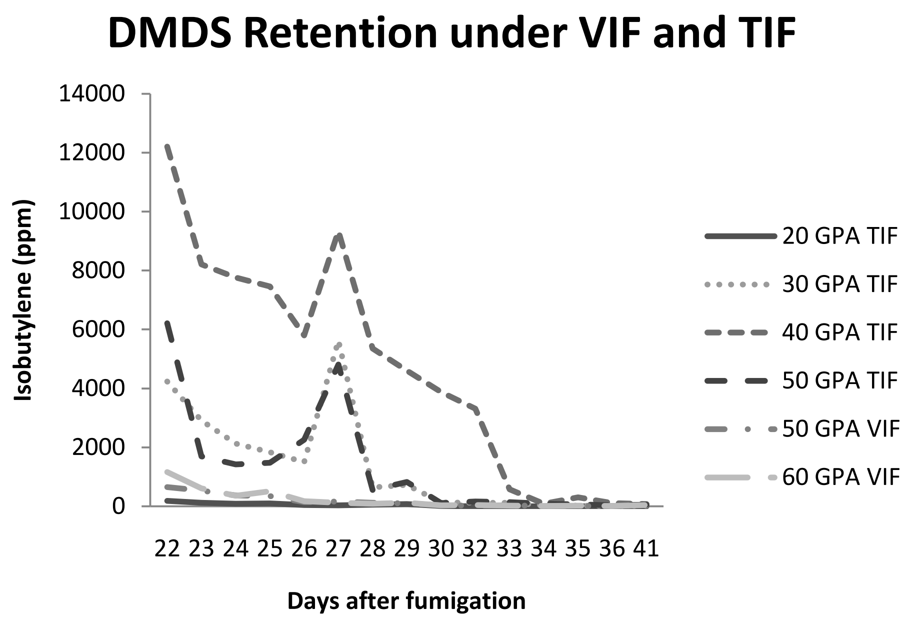

Fig 1. Dimethyl disulfide retention under VIF and TIF mulches. Experiments were performed during the spring of 2010 at the Eastern Shore Agricultural Research and Extension Center in Painter, VA.

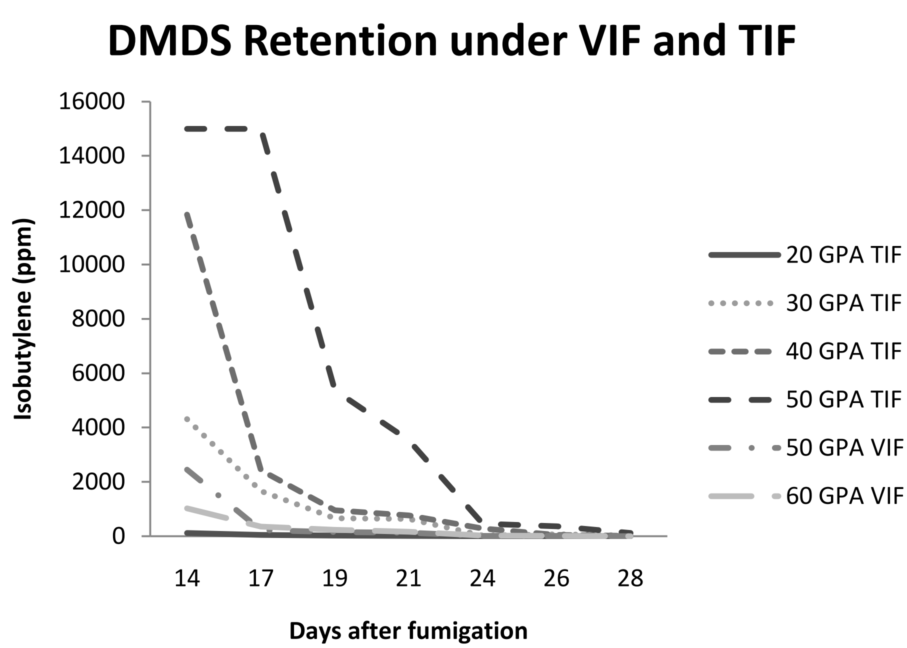

Fig 2. Dimethyl disulfide retention under VIF and TIF. Experiments were performed during the fall of 2010 at the Eastern Shore Agricultural Research and Extension Center in Painter, VA

Table 1. Weed and disease incidence data from dimethyl disulfide fumigant trials conducted in Painter, VA during the spring of 2010. Weeds are categorized as yellow nutsedge, broadleaves (common lambsquarters and carpetweed) and grasses (crabgrass and goosegrass). Diseases include fusarium crown rot and southern blight.

	Weeds/ft^2			% Disease Incidence
Treatment	Nutsedge	Broadleaves	Grasses	
Untreated TIF	0.51 a[z]	0.05 a	0.025 a	42 a
20 GPA TIF	0.16 bc	0.03 b	0.003 b	4 b
30 GPA TIF	0.03 c	0.013 bc	0 b	15 b
40 GPA TIF	0.02 c	0.003 c	0 b	12 b
50 GPA TIF	0 c	0.003 c	0 b	5 b
50 GPA VIF	0.2 bc	0 c	0 b	10 b
60 GPA VIF	0.4 ab	0.008 c	0 b	12 b

[z] Means not followed by the same letter are not significantly different at $P \leq 0.05$ by Duncan's multiple range test.

Table 2. Tomato yield data from dimethyl disulfide fumigant trials conducted at the Eastern Shore Agricultural Research and Extension Center in Painter, VA during the spring of 2010.

	Yields (lbs/A)			
Treatment	Medium	Large	X-large	Total Marketable
Untreated TIF	2069 c[z]	2819 c	2850 e	7738 d
20 GPA TIF	4243 abc	14899 a	17159 a	36316 a
30 GPA TIF	5161 ab	11780 ab	15186 ab	32126 ab
40 GPA TIF	5911 a	11453 ab	9910 cd	27273 bc
50 GPA TIF	5506 ab	12542 ab	12590 bc	30637 abc
50 GPA VIF	3213 bc	9468 b	11755 bcd	24436 c
60 GPA VIF	5439 ab	10297 b	7653 d	23389 c

[z] Means not followed by the same letter are not significantly different at $P \leq 0.05$ by Duncan's multiple range test.