RETENTION AND EFFICACY OF DRIP APPLIED DIMETHYL DISULFIDE UNDER VIF AND TIF MULCHES

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The US EPA lists dimethyl disulfide (DMDS) as a methyl bromide (MBr) alternative under development in tomatoes(US EPA, 2009a). Totally impermeable film (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.

The major benefit of drip applied fumigants (chemigation) is that the worker safety requirement is lowered. This is due to the fact that less people are needed to fumigate (one person can fumigate an entire field instead of requiring the entire plastic laying crew). Drip applied DMDS uses an emulsifiable concentrate (EC) formulation.

Materials and Methods

Drip applied DMDS trials were conducted at the Virginia Tech Eastern Shore Agricultural Research and Extension Center in Painter, VA during the spring and fall of 2010. Treatments consisted of an untreated control under Blockade® VIF mulch, a standard rate (50 GPA) shank applied under VIF, a high chemigation rate (60 GPA) under VIF, a standard chemigation rate (50 GPA) under TIF, a reduced chemigation rate (40 GPA) under TIF, and an herbicide treatment (fomesafen preplant followed by halosulfuron post emergent).

All DMDS treatments utilized a 79:21 DMDS:chloropicrin formulation. The shank fumigated treatment was applied using a single row bed press 30 inches wide with three shanks. The chemigation treatments were applied through twin drip tapes with a half an acre-inch of irrigation. In the herbicide treatment, fomesafen was applied to the soil before the plastic mulch was deployed.

Halosulfuron was applied after nutsedge emerged through the plastic, before tomatoes were transplanted.

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 shank applied 50 GPA treatment under VIF was retained at the highest level for the longest period of time, followed by the drip applied 50 GPA rate under TIF, the 40 GPA rate under TIF, and the 60 GPA rate under VIF(Fig 1). The 40 GPA TIF treatment and the 60 GPA VIF treatment had similar retention levels. In the fall the drip applied 50 GPA rate under TIF was retained at the highest level followed closely by the shank applied 50 GPA rate under VIF, followed by the drip applied 40 GPA rate under VIF and 60 GPA rate under TIF (Fig 2). The plant back period was longer in the spring compared to the fall due to lower soil temperatures. During the spring the shank applied 50 GPA rate under VIF had reached safe plant back levels at 26 days after fumigation (80 ppm isobutylene). In the fall, all of the treatments had reached safe plant back levels by 15 days after fumigation($\leq$ 119 ppm isobutylene).

There were significant differences in yellow nutsedge control and disease incidence between the treatments. The herbicide treatment (0 plants/ft^2) and all the fumigant treatments (0 plants/ft^2) controlled yellow nutsedge better than the untreated control (8 plants/ft^2) (Table 1). The herbicide treatment had the worst disease incidence (48.5%) followed by the untreated control (15%) and all the DMDS fumigant treatments ($\leq$ 3.25 %). Reflex appeared to have caused injury to tomato plants and possibly made them more susceptible to disease.
There were significant differences in tomato fruit size and yield between the treatments. The untreated control (36,953 lbs/A) and all the fumigant treatments (46,101 – 50,607 lbs/A) produced more total marketable tomato yield than the herbicide treatment (19,476 lbs/A). There was no significant difference between fumigation treatments and the untreated control. 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

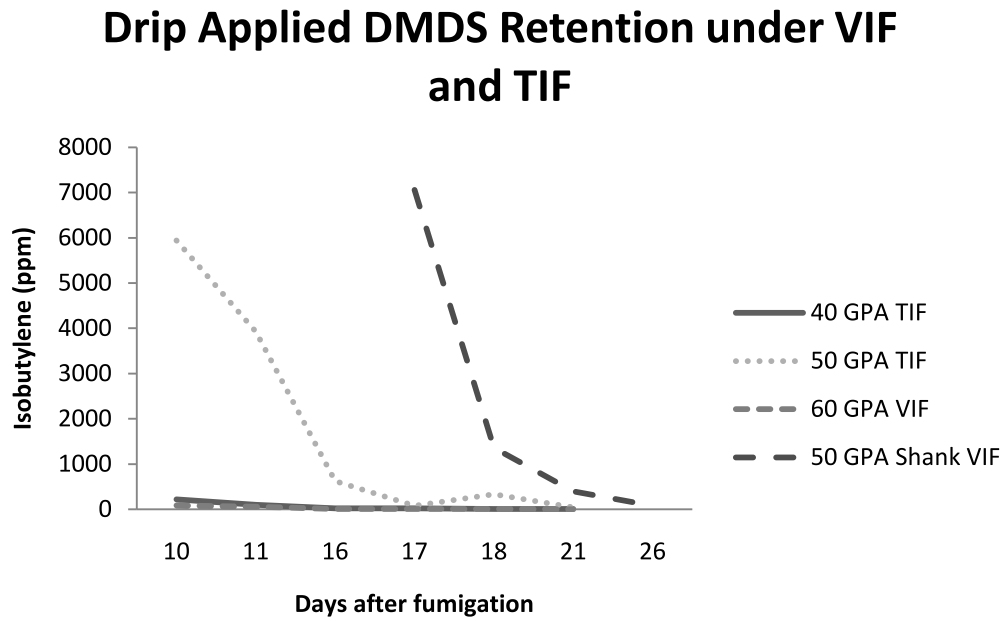

Fig 1. Drip applied dimethyl disulfide retention under VIF and TIF mulches. Experiments were performed during the spring of 2010 at the Eastern Shore Agricultural Research and Extension Center in Painter, VA.

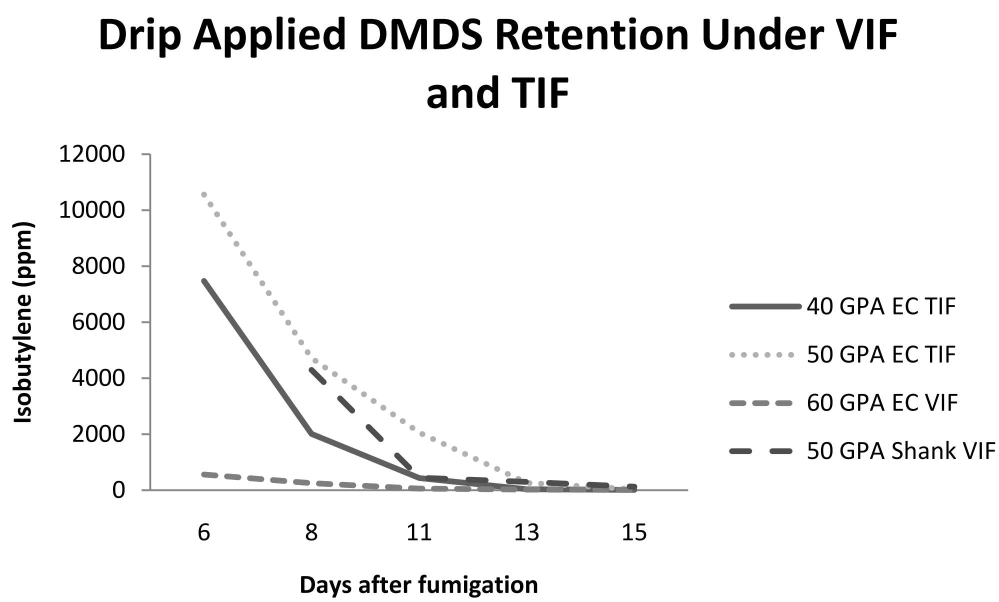

Fig 2. Drip applied dimethyl disulfide retention under VIF and TIF. Experiments were performed during the fall of 2010 at the Eastern Shore Agricultural Research and Extension Center in Painter, VA

Table 1. Yellow nutsedge and disease incidence data from drip applied dimethyl disulfide fumigant trials conducted in Painter, VA during the spring of 2010. Diseases include fusarium crown rot and southern blight.

Treatment	Nutsedge/ft^2	% Disease Incidence
Untreated	7.98 a[z]	15 b
40 GPA TIF	0 b	3.25 c
50 GPA TIF	0 b	0.75 c
60 GPA VIF	0 b	2.5 c
50 GPA Shank VIF	0 b	0.75 c
Fomesafen/Halosulfuron	0 b	48.5 a

[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 drip applied dimethyl disulfide fumigant trials conducted at the Eastern Shore Agricultural Research and Extension Center in Painter, VA during the spring of 2010.

		Yield (lbs/A)		
Treatment	Medium	Large	X-Large	Total Marketable
Untreated	4308 b[z]	8936 cd	23710 bc	36953 a
40 GPA TIF	3388 b	11489 bc	35731 a	50607 a
50 GPA TIF	3951 b	14302 b	30692 ab	48947 a
60 GPA VIF	4120 b	14193 b	30982 ab	49295 a
50 GPA Shank VIF	9045 a	20939 a	16117 cd	46101 a
Fomesafen/Halosulfuron	2505 b	6679 d	10291 d	19476 b

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