RETENTION OF BROADCAST-APPLIED FUMIGANTS WITH IMPERMEABLE FILM IN STRAWBERRY

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Summary. Field studies were conducted to evaluate the potential for virtually impermeable films (VIF) to increase fumigant retention, improve weed control and improve strawberry yields in broadcast fumigation. Broadcast-applied treatments made by a commercial applicator were methyl bromide/chloropicrin (MBPic) at 350 lbs/A and Telone II (1,3-D) at 15 GPA co-injected with chloropicrin at 200 lbs/A. Both fumigant treatments were tarped with VIF and standard film. Assessments made were weed control, fruit yield and fumigant concentration under the film. No differences were observed between the films in terms of weed control, fruit yield or MBPic retention. However, VIF does appear to increase retention of 1,3-D compared to standard film.

Introduction. We have found that the use of VIF in drip fumigation systems, normally improves weed control compared to standard film and that strawberry yields are sometimes higher than with the use of standard film. We set out to conduct research to determine if similar benefits could be achieved with VIF using available commercial broadcast fumigation technology.

Materials and methods. Eight field studies were conducted on commercial farms in the 2004-05 and 2005-06 seasons (Table 1). California locations were Oxnard, Pajaro (Watsonville), Santa Maria, and Spence (Salinas) USDA Farm. Applications made by a commercial applicator were: MBPic 67:33 at 350 lb ai/A and Telone II (1,3-D) at 15 gallons/A co-injected with chloropicrin at 200 lbs/A. The two fumigant treatments were applied under both standard and VIF tarps. VIF was glued by inserting a narrow strip of plastic between the two VIF layers which allowed the glue to dry in 2004-05 and by direct gluing in 2005-06. Treatments were replicated twice and arranged in a randomized complete block. Fumigant concentrations under the film were monitored for about one week after application. Fumigant gas concentration samples from charcoal tubes were analyzed in the lab with a gas chromatograph mass spectrograph. Weed biomass and hand weeding times were monitored as were fruit yields. Weed and yield data were subjected to analysis of variance. Factors considered in the analysis were fumigant concentration under the film, fumigant treatment, and the interaction term. Fumigant concentration data were fitted to a first order degradation function in Sigma plot.

Table 1. Location, soil type, fumigation date, strawberry variety and transplant date for eight broadcast fumigation VIF studies conducted in 2004-05 and 2005-06.

Location	Soil type	Fumigation date	Variety	Plant date
Oxnard	Sandy loam	Sept. 1, 2004	Plant Sci. 269	Oct. 7-8, 2004
Santa Maria	Sandy loam	Aug. 23, 2004	Diamante	Nov. 9, 2004
Pajaro	Loam	Aug. 10, 2004	Not disclosed	Nov. 23, 2004
Spence	Sandy loam	Sept. 15, 2004	Diamante	Nov. 22, 2004
Oxnard	Sandy loam	Sept. 9, 2005	Agoura	Oct. 12, 2005
Santa Maria	Sandy loam	Sept. 3, 2005	Albion	Nov. 12, 2005
Pajaro	Loam	Sept. 22, 2005	Not disclosed	Oct. 29, 2005
Spence	Sandy loam	Aug. 17, 2005	Diamante	Nov. 25, 2005

Results. The weed control and yield data indicate that there was no clear advantage for VIF tarp in these studies. Weed biomass, hand weeding time and fruit yields all were about the same for MBPic and 1,3-D whether they were applied under VIF or standard tarp (Tables 2 to 7). VIF film did not increase retention of MBPic relative to standard film (data not shown). However VIF film does appear to improve the retention of 1,3-D (Figures 1 and 2).

Table 2. Season-long weed biomass (lb/A) in broadcast fumigation trials conducted at four California locations in 2004-05.

Fumigant	Tarp	Oxnard	Pajaro	Santa Maria	Spence
		------------------------ biomass (lb/A) ------------------------------			
MBPic	standard	193	40.1 a	234	247.3
MBPic	VIF	170	14.7 b	87	432.7
Telone + Pic	standard	307	5.6 b	270	399.7
Telone + Pic	VIF	107	41.3 a	284	256.3
		ANOVA			
Fumigant trapping		ns	ns	ns	ns
Fumigant		ns	ns	ns	ns
Interaction		ns	0.03	ns	0.02

Table 3. Season-long weed biomass (lb/A) in broadcast fumigation trials conducted at four California locations in 2005-06.

Fumigant	Tarp	Oxnard	Pajaro	Santa Maria	Spence
		------------------------- biomass (lb/A) -----------------------------			
MBPic	standard	23.0	0.0	71.4	1207
MBPic	VIF	14.5	1.3	65.1	1740
Telone + Pic	standard	26.8	10.0	60.0	589
Telone + Pic	VIF	18.5	0.7	81.8	602
		ANOVA			
Fumigant trapping		ns	ns	ns	ns
Fumigant		ns	ns	ns	0.015
Interaction		ns	ns	ns	ns

Table 4. Season-long weeding times (hours/A) in broadcast fumigation trials conducted at four California locations in 2004-05.

Fumigant	Tarp	Oxnard	Pajaro	Santa Maria	Spence
		time (h/A)			
MBPic	standard	13.5	6.7	19.2	11.7
MBPic	VIF	12.5	5.4	17.9	1.9
Telone + Pic	standard	13.2	6.7	22.4	15.0
Telone + Pic	VIF	12.7	6.1	23.1	20.3
		ANOVA			
Fumigant trapping		ns	ns	ns	0.03
Fumigant		ns	ns	ns	ns
Interaction		ns	ns	ns	ns

Table 5. Season-long weeding times (hours/A) in broadcast fumigation trials conducted at four California locations in 2005-06.

Fumigant	Tarp	Oxnard	Pajaro	Santa Maria	Spence
		time (h/A)			
MBPic	standard	4.7	1.6	18.9	46.5
MBPic	VIF	4.0	1.8	15.4	58.9
Telone + Pic	standard	5.2	2.4	15.6	22.7
Telone + Pic	VIF	4.5	1.9	25.7	22.9
		ANOVA			
Fumigant trapping		ns	ns	ns	ns
Fumigant		ns	ns	ns	0.006
Interaction		ns	ns	ns	ns

Table 6. Season-long marketable fruit yields in broadcast fumigation trials conducted at four California locations in 2004-05.

Fumigant	Tarp	Oxnard	Pajaro	Santa Maria	Spence
		yield (g/plant)			
MBPic	standard	581.5	861.2	1474.4	853.1 a
MBPic	VIF	575.0	880.4	1511.6	756.7 b
Telone + Pic	standard	533.0	890.7	1440.8	752.0 b
Telone + Pic	VIF	496.4	868.4	1476.5	829.3 ab
		ANOVA			
Fumigant trapping		ns	ns	ns	ns
Fumigant		ns	ns	ns	ns
Interaction		ns	ns	ns	0.01

Table 7. Season-long marketable fruit yields in broadcast fumigation trials conducted at four California locations in 2005-06.

Fumigant	Tarp	Oxnard	Pajaro	Santa Maria	Spence
		yield (g/plant)			
MBPic	standard	411.8	672.4	768.6 b	323.7
MBPic	VIF	428.8	714.3	802.1 a	355.2
Telone + Pic	standard	373.4	622.0	801.8 a	355.6
Telone + Pic	VIF	368.3	661.7	753.8 b	364.2
		ANOVA			
Fumigant trapping		ns	ns	ns	ns
Fumigant		ns	ns	ns	ns
Interaction		ns	ns	0.002	ns

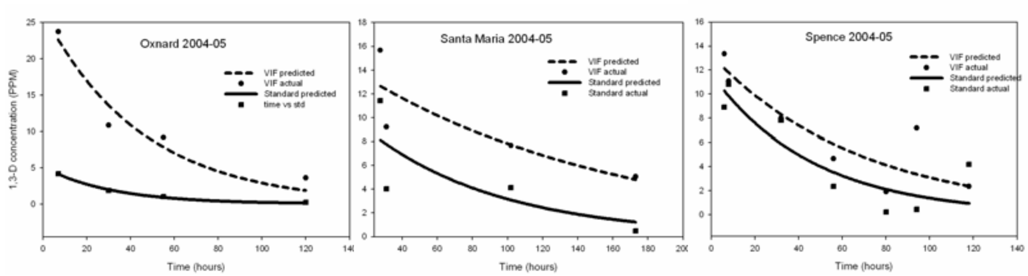

Figure 1. 1,3-D concentrations under standard film and VIF in the Oxnard, Santa Maria and Spence studies in 2004-05. The 1,3-D concentrations were fitted to first order degradation functions. Actual observed 1,3-D concentrations and predicted concentrations are plotted.

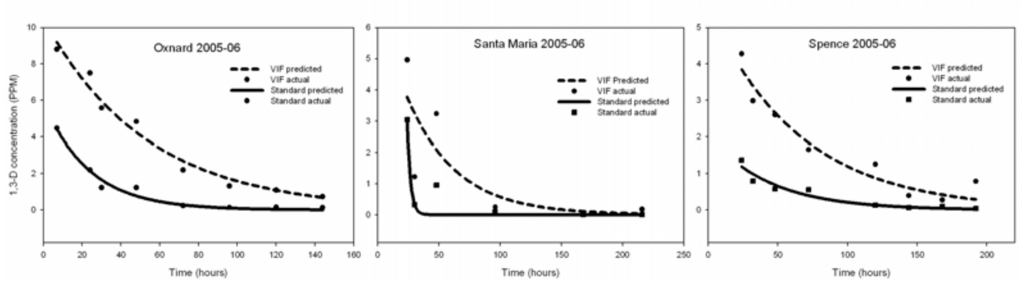

Figure 2. 1,3-D concentrations under standard film and VIF in the Oxnard, Santa Maria and Spence studies in 2005-06. The 1,3-D concentrations were fitted to first order degradation functions. Actual observed 1,3-D concentrations and predicted concentrations are plotted.

Discussion. The weed control and fruit yields did not indicate any advantage for VIF over standard film. VIF does appear to be increasing retention of 1,3-D in the first 60 hours after application (Figure 1), but did not increase the retention of MBPic. VIF or a similar impermeable or semi-permeable film should be pursued to determine if this could lead to reduced 1,3-D emission on a commercial scale.