CHLOROPICRIN AND INLINE LETHAL DOSE ON NUTSEDGE AND KNOTWEED UNDER IMPERMEABLE FILM

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Adoption of alternative fumigants and the drip fumigation technology by California strawberry growers has grown steadily in the past several years. Weeds that escape on the shoulders of the beds are sometimes problematic. The challenge is to push fumigants to the edge of the planting bed in a concentration sufficient to kill the weed propagules there. We have found that virtually impermeable films (VIF) reduce fumigant emissions, and weeding costs. However, does VIF have the potential to improve control of weeds on the hard to reach bed shoulders? We evaluated VIF at two commercial California strawberry field sites during the 2002-03 and 2003-04 productions seasons. Weed propagules were buried in the center and at the edge of the bed to measure the effect of VIF on fumigant distribution and soil pest control. The objective was to evaluate the weed control efficacy of chloropicrin (Pic) and InLine (1,3-D + Pic) under VIF and standard film.

Methods. Chloropicrin (Pic) and InLine were applied at 50, 100, 200, 300 and 400 lbs per acre in water through the drip irrigation system on Sept. 16, 2002 and Aug. 27, 2003 (Oxnard, CA), and on Oct. 1, 2002 and Sept. 24, 2003 **(**Watsonville, CA). The commercial standard, methyl bromide/chloropicrin (MbPic) was applied at 350 lb/A. Two types of tarp were used: standard polyethylene and VIF. Each treatment was replicated 4 times. Mesh bags containing yellow nutsedge (*Cyperus esculentus*) tubers, and knotweed (*Polygonum arenastrum*) seeds plus other species, were buried at 2-inch and 6-inch depths at the center and edge of the beds before fumigation and retrieved 2 to 3 weeks later, then tested for viability with tetrazolium. Strawberries were transplanted on Oct. 7, 2002 and Oct. 3, 2003 (Oxnard) and Oct. 25, 2002 and Oct. 20, 2003 (Watsonville). Cultivar 'Camarosa' was planted in all studies except Oxnard 2003, which used 'Plant Science 269'. Regression analysis was used to calculate the dose required to kill 90% of a weed propagule sample (GR_{90}).

Results and discussion. The data are reported in lbs active fumigant per acre injected in the drip tape, and not the fumigant dose at the location of the pest. GR_{90}s of both yellow nutsedge tubers and knotweed seeds were lower in the center of the beds than at the edge of the beds (data not shown). This is likely due to the fact that the fumigant concentrations are higher in the center of the bed than at the edge. Generally GR_{90}s for yellow nutsedge and knotweed were lower at the

2-inch depth than at the 6-inch depth (Tables 1 and 2). This reflects the fact that fumigant concentration was lower with increasing soil depth. Therefore, a higher fumigant concentration was required at the point of injection, so that a concentration high enough to kill weeds is achieved at a distance from the drip tape. In all experiments at the 6-inch depth, yellow nutsedge and knotweed GR_{90}s were lower under VIF than under standard film.

Fumigants are trapped at higher concentrations under VIF and maintained at higher concentrations for longer periods of time. For example, at Watsonville in 2002, chloropicrin soil concentration and nutsedge or knotweed viability were highly correlated, P=0.0003 and P=0.0265, respectively. In other words, high fumigant concentration equals low weed seed viability.

Because drip fumigation depends upon good lateral distribution for effective weed control, the increased retention of fumigants under VIF presumably helps disperse the fumigant laterally more than under the standard plastic. Better lateral distribution of fumigant results in more complete weed control. In contrast, under standard film, volatility losses to the air keep the overall concentration under the film lower than under VIF. Therefore, the probability that a weed on the edge of the bed will be exposed to a lethal dose of fumigant is less under standard film than under VIF.

Table 1. Inline and chloropicrin effect on nutsedge tuber viability at the edge of the bed, applied under VIF and standard film at Oxnard and Watsonville, CA. The data are GR_{90}s in lbs active ingredient per acre (+/-95% CI).

Fumigant	Location	Season	Depth	VIF	Standard
			----- inches -----	---------- lbs active/Acre ----------	
Inline	Oxnard	2003-04	2	359.6 (328.3, 399.4)	439.9 (385.1, 518.9)
Inline	Oxnard	2003-04	6	202.9 (184.3, 225.9)	329.4 (297.0, 371.6)
Chloropicrin	Oxnard	2003-04	2	326.3 (298.7, 360.9)	475.2 (426.1, 541.0)
Chloropicrin	Oxnard	2003-04	6	262.7 (240.9, 289.5)	425.1 (381.4, 483.7)
Inline	Watsonville	2002-03	2	187.5 (175.9, 201.2)	400.4 (374.7, 431.1)
Inline	Watsonville	2002-03	6	341.5 (324.1, 361.5)	833.3 (728.7, 983.8)
Chloropicrin	Watsonville	2002-03	2	166.5 (155.8, 179.1)	299.3 (281.8, 319.8)
Chloropicrin	Watsonville	2002-03	6	269.7 (256.7, 284.6)	750.3 (659.2, 878.7)
Inline	Watsonville	2003-04	2	92.4 (81.1, 106.0)	228.7 (209.7, 251.8)
Inline	Watsonville	2003-04	6	81.6 (69.8, 97.6)	1039.8 (778.5, 1657.2)
Chloropicrin	Watsonville	2003-04	2	64.5 (56.4, 74.6)	189.9 (171.3, 212.9)
Chloropicrin	Watsonville	2003-04	6	180.5 (160.9, 205.7)	189.7 (169.2, 216.0)

Table 2. Inline and chloropicrin effect on knotweed seed viability at the edge of the bed, applied under VIF and standard film at Oxnard and Watsonville, CA. The data are GR_{90}s in lbs active ingredient per acre (+/-95% CI).

Fumigant	Location	Season	Depth	VIF	Standard
			----- inches -----	---------- lbs active/Acre ----------	
Inline	Oxnard	2002-03	2	206.8 (196.5, 218.8)	468.5 (451.6, 488.0)
Inline	Oxnard	2002-03	6	339.8 (327.7, 353.5)	1462.8 (1204.0, 2038.0)
Chloropicrin	Oxnard	2002-03	2	357.3 (343.7, 372.7)	603.3 (568.6, 645.2)
Chloropicrin	Oxnard	2002-03	6	601.0 (569.1, 639.4)	963.3 (854.4, 1119.8)
Inline	Oxnard	2003-04	2	272.7 (255.1, 293.6)	408.2 (386.9, 433.0)
Inline	Oxnard	2003-04	6	416.1 (397.8, 437.1)	683.5 (637.4, 740.2)
Chloropicrin	Oxnard	2003-04	2	426.0 (406.8, 448.1)	517.6 (492.0, 547.6)
Chloropicrin	Oxnard	2003-04	6	517.3 (492.1, 546.7)	683.4 (639.7, 737.8)
Inline	Watsonville	2002-03	2	38.9 (32.7, 46.6)	137.2 (124.9, 152.3)
Inline	Watsonville	2002-03	6	133.8 (121.7, 148.7)	842.8 (711.2, 1051.1)
Chloropicrin	Watsonville	2002-03	2	118.5 (105.4, 134.4)	258.3 (233.7, 289.5)
Chloropicrin	Watsonville	2002-03	6	385.4 (356.6, 420.6)	826.2 (695.0, 1034.7)
Inline	Watsonville	2003-04	2	138.3 (131.4, 146.6)	331.2 (319.2, 344.9)
Inline	Watsonville	2003-04	6	251.9 (237.3, 269.2)	809.9 (711.5, 965.8)
Chloropicrin	Watsonville	2003-04	2	164.6 (156.8, 173.8)	304.2 (294.7, 315.1)
Chloropicrin	Watsonville	2003-04	6	413.3 (394.8, 435.3)	666.2 (614.8, 734.6)