FACILITATING ADOPTION OF ALTERNATIVES TO METHYL BROMIDE IN CALIFORNIA STRAWBERRIES

S. Fennimore*[1], H. Ajwa[1], S. Shem-Tov[1], Krishna Subbarao[1], Frank Martin[2], Greg Browne[3], Susanne Klose[1]
[1]University of California, Davis, Salinas, CA 93905
[2]USDA-ARS, Salinas, CA 93905
[3]USDA-ARS, Davis, CA 95616

Summary. The main goal of this project is to facilitate the adoption of methyl bromide (MB) alternative fumigants and to evaluate novel soil disinfestation methods with heat and non-fumigant chemicals for control of key pests in California strawberries. This project will demonstrate which combinations of fumigants applied at reduced rates under impermeable and semi-permeable tarps can sustain strawberry production in commercial fields. The combined strategy of reduced fumigant rates and increased retention, may allow for continued use of alternative fumigants despite increasingly more stringent regulations on fumigant use. This proposal will test and demonstrate non-fumigant methods to control key soil pests by heat (soil solarization plus steam), non-fumigant chemicals, and natural products. The ultimate goal of this research is to develop alternative pest management practices for the California strawberry industry that eliminates the need for methyl bromide, by developing cost-effective treatments that control soil pests and allow profitable strawberry production to continue.

Introduction. California strawberry growers have made great strides towards the phase out of MB as about half of the acreage now uses MB alternative fumigants for soil disinfestation. However, regulatory constraints such as township caps for 1,3-D (Telone, Inline) usage and buffer zones are slowing further adoption. This project is divided into two portions: 1) reducing fumigant emissions with virtually impermeable film (VIF) and semi-impermeable film (SIF), 2) evaluation of non-fumigant methods of soil disinfestation. The specific objectives are:

1. Evaluate reduced rates of alternative fumigants applied by drip fumigation under VIF and SIF in combination with metam sodium (sequential application).
2. Conduct on-farm demonstration trials in buffer zones (60 to 300 ft) using reduced rates of fumigant applied by drip fumigation under VIF.
3. Determine relative fumigant retention under tarps for treatments used in objective 2.
4. Evaluate and demonstrate promising non-fumigant treatments and "soft" chemical alternatives.
5. Demonstrate to growers the performance of key alternative fumigants so that they can make informed decisions during the transition to alternative fumigants.

Fumigant emissions reductions.

Drip Fumigation Research: Two research projects will be conducted in Oxnard and Watsonville in the 2007-08 season to compare five fumigant treatments, three plastic mulches, and two sequential application treatments (Table 1). Experiments will be

carried out as a split-split plot design, arranged in a randomized complete block, replicated four times. The main factor will be the fumigant treatment, split between the sequential application treatment (with or without metam sodium) and further split between the three mulches (VIF, SIF, HDPE). Data collection will include survival of selected pests in buried bags, and in-season data such as weed densities and biomass, hand weeding time, and marketable and total strawberry yields.

Table 1. Drip fumigation treatments applied with and without metam sodium under three films.

Treatments	**Rate*** lb/acre	**Metam sodium** 30 GPA	**Film type**
1-6. Chloropicrin (Pic)	150	+/-	VIF, SIF, HDPE
7-12. InLine (62% 1,3-D: + 33% Pic)	200	+/-	VIF, SIF, HDPE
13-18. Pic60-EC (60% Pic + 35% 1,3-D)	150	+/-	VIF, SIF, HDPE
19-24. Midas (33% iodomethane + 67% Pic)	150	+/-	VIF, SIF, HDPE
25. Methyl bromide/Pic (67% MB + 33% Pic)	300	-	HDPE
26-31. Untreated control	0	+/-	VIF, SIF, HDPE

* Rate per treated bed area.

Commercial demonstration project: The demonstration project will consist of six drip fumigation trials. Plot size will consist of approximately one acre for each chemical applied under two plastic types (HDPE and VIF). Two or more fumigants (Table 2) will be tested against growers' commercial fumigation practice. The on-farm demonstration projects will be conducted in the buffer zone (or within 60 to 300 ft from property line) on commercial fields in three main production regions near Watsonville, Santa Maria, and Oxnard.

Table 2. Drip fumigation treatments – two or more treatments for each demonstration project.

Treatment*	**Rate** (lb/acre)
1. Chloropicrin (Pic)	150
2. InLine (62% 1,3-D + 33% Pic)	200
3. Pic60-EC (60% Pic + 35% 1,3-D)	150
4. Midas-EC (33% iodomethane + 67% Pic)	150
5. Methyl bromide/Pic (50% MB + 50% Pic)	150
6. Untreated control	---

* Each treatment will be applied to one acre under Standard HDPE and VIF. These treatments will be compared to standard fumigation practice by the collaborating grower.

Heat and Low-Risk Chemical Research:

Treatments to be tested (Table 3) include an untreated control and MB/Pic 67:33 at 350 lbs/A as the commercial standard. Raised beds will be established and prepared as finished seed beds with starter fertilizer and drip irrigation tape installed. For treatment 3, two plastic steam distribution lines with emitters at 4-inch spacing will be installed no more than 12-inches apart in the bed at a depth of 4 inches, with the objective of effectively heating the top 6 inches of soil. In The Netherlands the use of tubing to distribute steam is called "drain steaming". Basically we are proposing to adapt the Dutch drain steaming methods to our local production systems in strawberry.

Additional treatments to be tested are listed in Table 3. In these trials, beds will be 52 to 68 inch wide bed by 20 ft long. The treatments will be arranged in a randomized complete block replicated four times and data will be subjected to analysis of variance. This study will be repeated twice at either the California Strawberry Commission Research facilities (MBA) in Watsonville or at the USDA-ARS Research Station (Spence Farm), Salinas, CA.

Table 3. Non-fumigant soil disinfestation treatments to be tested in strawberry.

Treatment*	**Rate**	**Temperature**
1. Untreated	0	
2. MBPic 67:33	350 lb/ac	
3. Steam/ solarization		70°C – 20 minutes
4. Muscador	2000 lb/ac	
5. Brassica seed oil	TBA	
6. Acrolein	400 lbs/ac	
7. Furfural	600 lbs/ac	
8. Fludioxamil + Ridomil	TBA	
9. Stabilized Urea	400 lbs/ac	
10. Enzone (CS_2)	200 lbs/ac	