USDA CSREES: METHYL BROMIDE TRANSITIONS IN FLORIDA STRAWBERRY 2008-10

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This USDA CSREES project was funded during 2008-10 to demonstrate and improve the performance and consistency of next-best chemical alternatives to methyl bromide in large scale, grower field demonstration trials in Florida strawberry. Alternative chemicals evaluated within these trials include individual and or combined uses of chloropicrin, and 1, 3-dichloropropene with use of appropriate herbicide(s). A diversity of drip fumigants were also evaluated for pest control efficacy, strawberry yield enhancement, and as a potential risk mitigation tactic to reduce buffer zone distances and overall personal protective equipment requirements which were being proposed by EPA. Secondary objectives were to evaluate the feasibility of using two drip tapes per bed rather than one to enhance efficacy and yield of methyl bromide chloropicrin and of other different drip applied fumigants; and use of a high barrier, semi-impermeable mulch film to reduce emissions and soil fumigant field application rates and to compare crop yield and pest control efficacy of methyl bromide alternatives.

Methods: Two grower field studies focused on a co-application approach of different fumigants, herbicides, and other alternative tactics to achieve pest control efficacy and crop growth response similar to that of methyl bromide. Among the sites, chisel applied soil treatments included broadcast equivalent methyl bromide (67%) chloropicrin (33%) (320lb/ta) ± VIF mulch, methyl bromide (50%) chloropicrin (50%) (288 – 320 lb/ta), in addition to the drip applied Telone Inline (35 gpta) were evaluated with either one or two drip tapes per bed at the Florida Strawberry Growers Association (FSGA) Research and Education farm in Dover, FL ; and at Ferris Farms, Floral City, FL. At all field locations, the highly gas retentive Pliant Blockade was installed immediately after methyl bromide chloropicrin application. All fumigants were applied with commercial grower equipment. Calibration procedures were followed at each experiment location. Certified applicators and pesticide label requirements for buffers, posting, rates of use, personal protective equipment requirements, etc., were closely followed.

At all farm locations, beds measured 30 inches wide, 10 inches in height, with rows spaced on 4 foot centers. Actual per acre fumigant use rates represent 62.5% of the broadcast or reported per treated acre (ta) rates expressed above. At FSGA and Ferris, bare root 'Festival' transplants from Canadian nurseries were planted between 4 to 5 weeks following fumigant treatment. At the Florida Pacific farm Atlantis and Sanibel were planted. Water and nutrients were supplied to each plant row with Netafim or TTape (0.22 gpm/100 ft or 0.45 gpm/

100 ft row; or 0.40 gpm/100 ft row) on at least a daily/ twice daily basis (unless sufficient rainfall occurs) for much of the season. Fertigation rates were seasonally defined based on crop growth stage. Fertilization rates were generally based on a near field equivalent of 225 lbs NPK per acre per season. Other pest and disease control measures were maintained primarily on both a prophylactic and as needed basis.

Assessments of plant growth were made as appropriate during the course of the season to characterize differences in plant size, health, and vigor. Strawberry fruit were harvested (lb/plot or lb/row) and numbers of individual flats (8 lb/flat and 10,890 ft/a) were determined on a 2 to 3 day basis from early December generally through March or April. Following chemical treatment, weed densities were monitored and recorded on a periodic basis to determine any differences in weed control between fumigant treatments. An untreated control was not included as a replicated treatment for comparison at Florida Pacific or Ferris Farms. All treatments were arranged within their respective experimental areas as a completely randomized block design with 4 replications per treatment. Plot sizes varied from 2 to 12 rows or 0.06 to 0.4 acres among the different grower farm locations.

Some of the experiments described herein involved taking soil VOC measurements of a number of soil fumigants, under a variety of plastic mulch films of differing permeability, at different locations across the mulch covered plant bed. Samples were taken at various times (1-7 days) following fumigant application using a 6 inch long perforated soil sampling probe. Actual bed locations included bed center, midway, and bed shoulder. For most field studies, mean VOC concentrations per fumigant treatment and bed location were averaged from at least 5 to as many as 16 random measurements within each fumigant treatment and experimental field location. For these studies, peak concentration measurements from the MiniRAE 2000 over a 30 second sampling period were used to characterize soil atmosphere gas concentrations, retention characteristics of different plastic mulches over time, as well as relative differences in cross bed, gas phase movement of the different fumigants with time.

Results and Discussion:

At Florida Pacific in 2008, highest strawberry yields were observed with the DMDS + Chloropicrin (21% V/V) (60gpta) + LDPE mulch treatment for both cv Sanibel and Atlantis (Figures 1,2). Use of the highly impermeable Pliant Blockade VIF was not observed to improve strawberry yields of either variety at Florida Pacific. In the two mulch trials, VOC monitoring of soil gas concentration and persistence of Telone C35 (35gpta) and Midas 98/2 (100lb/ta) was able to differentiate, relative to LPDE, the general retentiveness of different gas impermeable plastic mulches to each of two fumigants (Figures 3,4). Regardless of fumigant, LDPE mulch films were always characterized as the least retentive of the mulches evaluated, with fumigants generally dissipating completely from

soil within 7 days of soil application. PID-VOC monitoring was also fairly accurately, capable of differentiating between broad categories of mulch impermeability to the different fumigants.

At FSGA, treatment comparisons consisted of shank and drip applied fumigants during fall 2009-10. Shank applied fumigants consisted of methyl bromide chloropicrin 50/50 (320 lb/ta), Pic Clor 60 (300 lb/ta) and two rates of Telone C35 (35 and 42 gpta). Telone InLine (42 gpta) was drip applied into strawberry beds with one (0.45 g/min/100 ft) or two (each 0.225 g/min/100 ft) drip tapes per bed. Compared to the untreated control, highest (P=0.05) strawberry yields were observed with Telone C35 (35 gpta) and PicClor 60 (300 lb/ta) (Fig. 5). At Ferris Farms, no significant differences in strawberry yields (cv Festival) were observed between fumigant treatments season long (Fig. 6). Treatment comparisons of five preplant soil fumigant treatments included methyl bromide chloropicrin 50/50 (288 lb/ta) + VIF plastic mulch film, DMDS + 21% Chloropicrin (60gpta) + VIF, DMDS + 21% Chloropicrin EC (60gpta) + VIF; Midas 50/50 (175 lb/ta)+VIF, and Telone C35 (35gpta) + LDPE on strawberry yield (lb/a) at Ferris Farms in Floral City, FL during Fall 2009 - Spring 2010.

KEY POINTS:

$ In these trials, PID-VOC monitoring was able to confirm and differentiate, relative to LDPE, broad categories of gas impermeability among plastic mulches to different fumigants.

$ The extraordinarily cold winter in Dover and Floral City, FL during 2009 - 2010 resulted in a significant reduction of approximately 45% from average strawberry crop yields from the previous year.

$ In these trials, most alternative fumigants evaluated produced yields which were statistically equivalent to that of methyl bromide chloropicrin. Coformulated fumigants such as PicClor 60, Telone C35, and DMDS+PIC proved to be effective for maintaining strawberry crop productivity.

Fig 1. Comparison of four preplant soil fumigant treatments, including methyl bromide chloropicrin 67/33 (320 lb/ta) with VIF or in combination with LDPE plastic mulch film, DMDS +PIC (60gpta) LDPE and VIF, PicClor 60 (250 lb/ta) LDPE and VIF, and PicClor 60 (300 lb/ta) LDPE and VIF on strawberry yield (lb/a) in Dover, FL during Fall 2009 - Spring 2010. (LDPE-low density polyethylene film;VIF-Pliant Blockade 1.25ml). Florida Pacific 2008-09. cv Atlantis.

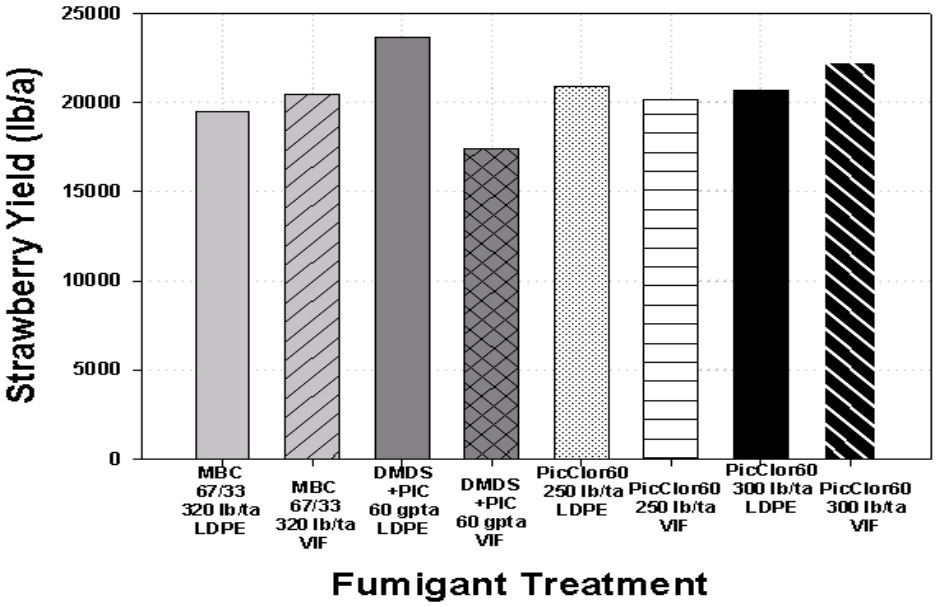

Fig 2. Comparison of four preplant soil fumigant treatments, including methyl bromide chloropicrin 67/33 (320 lb/ta) with VIF or in combination with LDPE plastic mulch film, DMDS +PIC (60gpta) LDPE and VIF, PicClor 60 (250 lb/ta) LDPE and VIF, and PicClor 60 (300 lb/ta) LDPE and VIF on strawberry yield (lb/a) in Dover, FL during Fall 2009 - Spring 2010. (LDPE-low density polyethylene film;VIF-Pliant Blockade 1.25ml). Florida Pacific 2008-09. cv Atlantis.

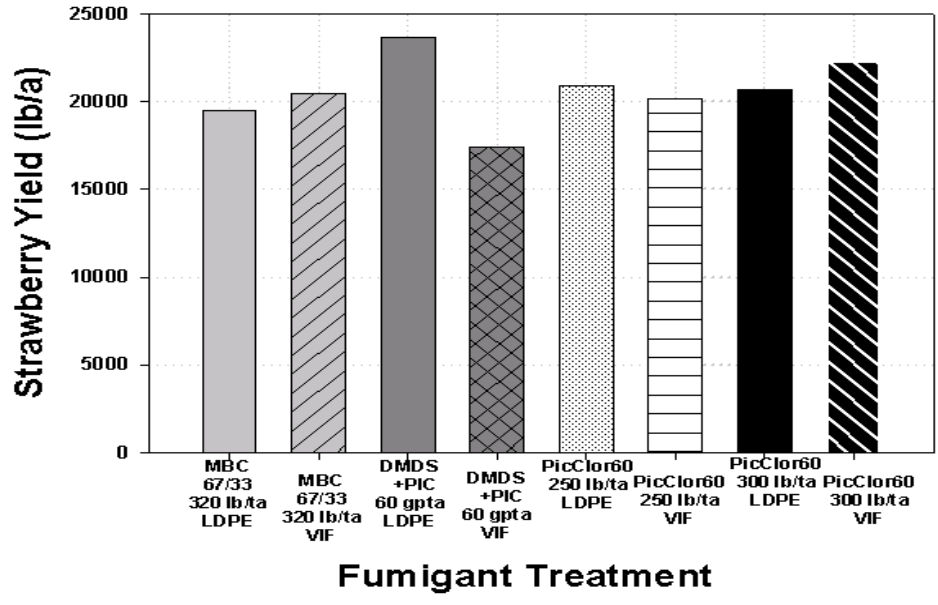

Fig. 3. Soil air concentrations of Midas 98/2 (100 lb/ta), expressed as parts per million (PPM) isobutylene one to seven days post application, under five different plastic mulch films. Measurements acquired with a MinRae® 2000 PID VOC meter. Dover, FL Fall 2008

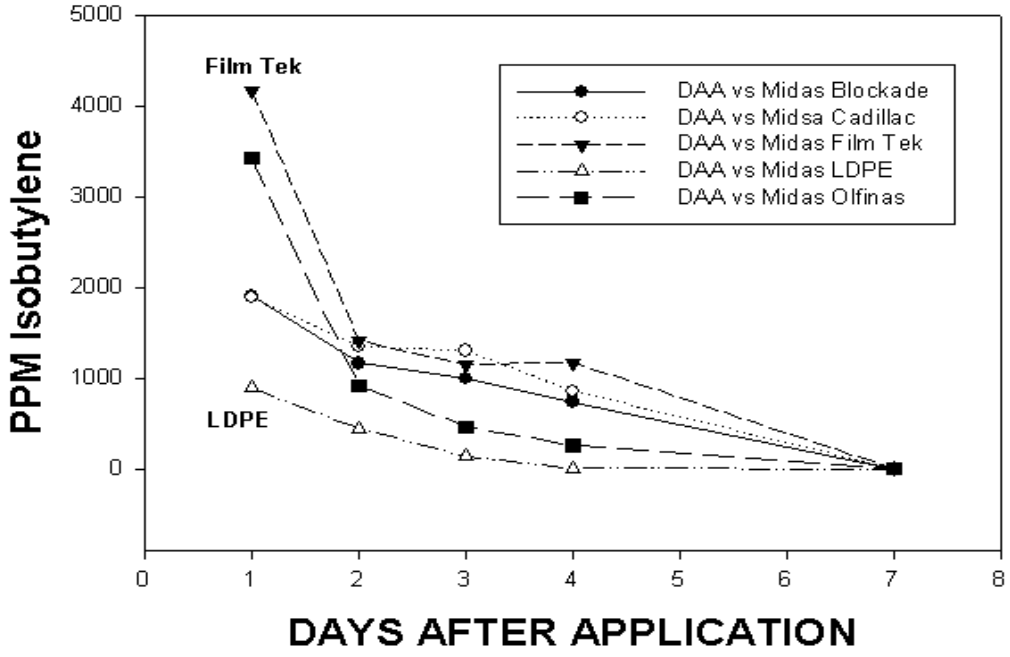

Fig. 4. Soil air concentrations of Telone C35 (35 gpa), expressed as parts per million (PPM) isobutylene one to seven days post application, under five different plastic mulch films. Measurements acquired with a MinRae® 2000 PID VOC meter. Dover, FL Fall 2008

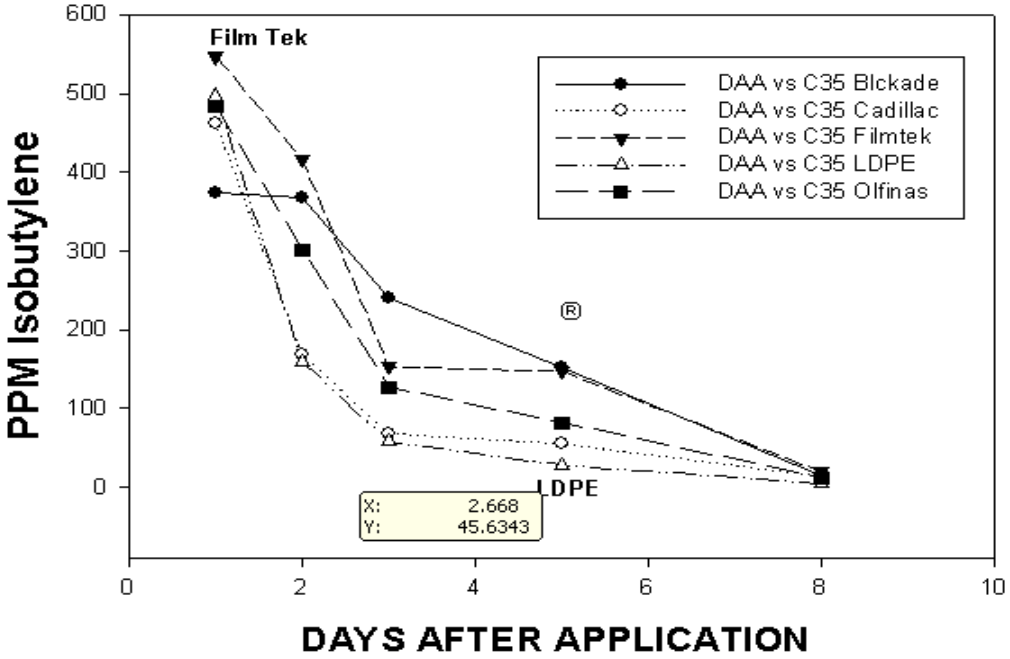

Fig. 5. Comparison of shank and drip applied fumigant treatments on strawberry yields at the Florida Strawberry Growers Association Farm, Dover, Fl, 2009-10. Shank applied fumigants consisted of methyl bromide chloropicrin 50/50 (320 lb/ta), Pic Clor 60 (300 lb/ta) and two ratesof Telone C35 (35 and 42 gpta). Telone InLine (42 gpta) was drip applied into strawberry beds with one (0.45 g/min/100 ft) or two (each 0.225 g/min/100 ft) drip tapes per bed.

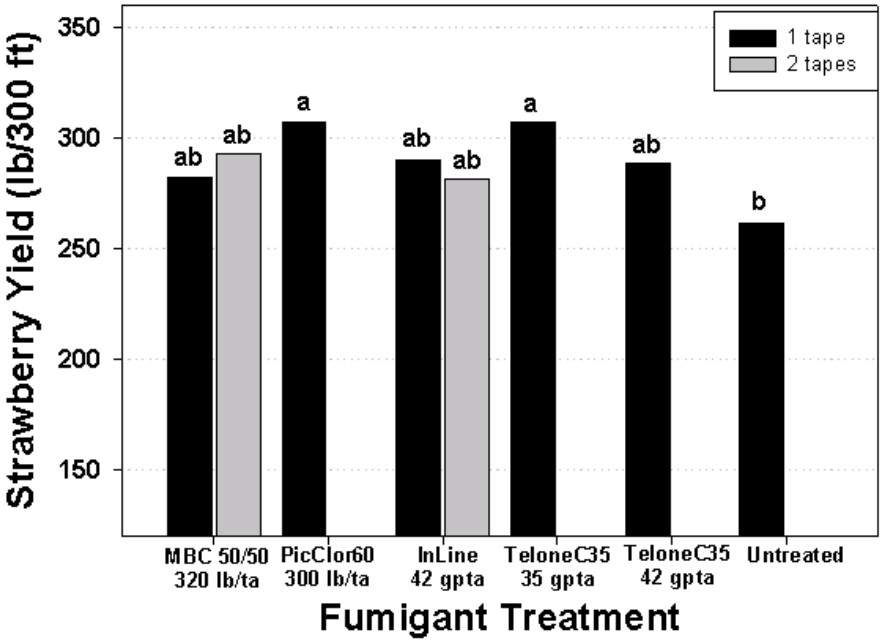

Fig 6. Comparison of five preplant soil fumigant treatments, including methyl bromide chloropicrin 50/50 (288 lb/ta) + VIF plastic mulch film, DMDS + 21% Chloropicrin (60gpta) + VIF, DMDS + 21% Chloropicrin EC (60gpta) + VIF; Midas 50/50 (175 lb/ta)+VIF, and Telone C35 (35gpta) + LDPE on strawberry yield (lb/a) at Ferris Farms, Floral City, FL during Fall 2009 - Spring 2010. (LDPE-low density polyethylene film;VIF-Pliant Blockade 1.25ml). cv Festival.