# VIF MULCHES, OPTIMIZED IRRIGATION AND TILLAGE PRACTICES FOR FUMIGANT USE IN FLORIDA STRAWBERRY

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The results presented herein derive from a USDA CSREES funded project entitled "*Grower field demonstration Trialing of Gas Impermeable plastic mulches, Reduced Rates of Soil Fumigants, and Optimized Irrigation and Cultural Practices*".

Soil moisture is well documented to limit radial diffusion of fumigant gases through its effects on blockage of soil air passage continuums. Optimal soil moisture conditions for preplant fumigations with Methyl iodide or 1,3-D (Telone) and Chloropicrin products have not been determined. To examine fumigant diffusion and soil retention of fumigant gases, a field moisture gradient was created using an established solid set overhead irrigation system and managing sprinkler run-time from one end of the field to the other by differentially and sequentially turning off sprinkler operation at 15-30 minute intervals. For studies conducted in 2008 and 2009, the differentially irrigated areas consisted of 2 separate plots of 10 plant rows and 6 soil moisture zones. After irrigation ceased, beds were then fumigated with either Telone C35 (35 gpta) or Midas 50/50 (175 lb/ta) in 2008, and either Telone C35 (35 gpta)or Pic-Clor 60 (300 lb/ta) in 2009, and fumigant soil gas concentrations monitored over a ten day period. Fumigant gas concentrations were measured with a MiniRae® 2000, portable VOC meter and GasTek® Trichloroethylene detector tubes immediately after soil injection and at daily intervals until near complete disappearance failed to detect meaningful differences in fumigant gas concentrations. For the studies, relative strawberry yield was estimated from whole plot enumerations and yield contributions from the number of large (>12"), medium (>8" to <12"), and small (<8") plants per 40 linear feet of plant row.

In 2008, no meaning differences in gas concentrations of either Telone C35 or Midas 50/50 were observed between the six different zones of the moisture gradient. Heavy rainfall occurring immediately after soil fumigation was observed to compromise established differences in soil moisture along the longitudinal field gradient. As a result of the unexpected rainfall, no differences in plant size distributions and relative strawberry yield were observed between the two fumigants and zones of the moisture gradient (Fig. 1). In 2009, significant differences in soil gas concentrations, plant size distributions, and that of

relative strawberry yield (Fig. 2) was observed between the 6 soil moisture zones and 2 preplant soil fumigant treatments which included Pic Clor 60 (300 lb/ta) and Telone C35 (22 gpta) with Pliant Blockade® VIF.

**VIF Mulches**: In two other separate studies, monitoring of soil gas concentration and persistence using a MiniRae® VOC meter was able to differentiate, relative to LPDE, the general retentiveness of four different gas impermeable plastic mulches (Filmtek, Cadillac, Olfinas, Pliant Blockade) to each of two fumigants, Telone C35 and Midas 50:50 (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 to 8 days. In these two studies, MiniRae® VOC PID-VOC monitoring was fairly accurate, and capable of differentiating between broad categories of mulch impermeability to the different fumigants.

**Soil Compaction**: To determine the cause for poor pest control efficacy after soil fumigation with methyl bromide or 1,3- D, field surveys of penetration resistances were conducted of problem fields. In each field surveyed, a compacted zone (traffic pan) was observed to occur between a soil depth of 1 to 3 inches below the soil level of the row middle and extended to a soil depth of 15 to 18 inches. In practical terms, the compaction zone appears to occur just below the depth of the deepest tillage operation / implement used within the field. The presence of the compacted zone is thought to reduce fumigant efficacy at depth, which dictates the time and degree to which various soilborne pests and pathogens ultimately recolonize the plant root system. Subsequently, for these CSREES funded studies, four field experiments were initiated during fall 2008 to assess the potential impact of the soil compacted zone (traffic pan) on fumigant movement of 1,3-dichloropropene in soil, and the performance of strawberry plants grown thereafter within the two different tillage regimes. Fumigant movement was evaluated in large scale field strip experiments conducted during August through September 2008 in four commercial strawberry fields near Plant City, Florida. Four treatments were evaluated in a complete randomized block design with 4 replications per treatment Telone C35 or Pic Clor 60 fumigant treatments were evaluated as an in-row application under a high barrier / VIF mulch film, injected 10 inches deep into the raised bed, and evaluated with and without deep chisel plowing as a tillage practice to destroy the subsurface compacted (traffic) soil layer. Appropriate blocks were either disked to depth of ca. 6 to 8 inches, while the other adjacent block was disked and chisel plowed to a depth of 12 to 14 inches and the soil within each block rolled 10 days prior to soil fumigant application. The subplots which were only disked were designed to leave the compacted traffic layer totally undisturbed. Ten days after tillage treatment, the plots were fumigated with Telone C35 (21 gpa) to an 8 to12" depth into bedded soil. The raised beds were then immediately covered with the highly gas impermeable Pliant Blockade® plastic mulch film.

In these trials, chisel plowing was observed to locally but significantly reduce soil penetration resistance via changes in soil bulk density. Chisel plowing did not however

appear to reduce penetration resistances midway between adjacent chisel plows spaced 12 inches apart. Based on comparison of 1,3-D gas concentrations at two soil depths, downward diffusion of Telone II was significantly restricted by the soil compacted layer. In most fields, no differences were observed in plant size distribution or in relative strawberry yields observed between shallow disked or chisel plowed treatments (Table 1). These results suggest that new, even deeper tillage / application methods will be required to destroy problems of soil compaction and thereby improve overall nematode control, particularly in deeper soil horizons, and also improve crop yield response consistency.

KEY POINTS

- MiniRae® PID-VOC monitoring was able to confirm and differentiate, relative to LDPE, broad categories of gas impermeability among plastic mulches to different fumigants. This information provides assistance to growers in need of selecting an impermeable mulch film to retain fumigants in soil and improve pest control efficacy and strawberry yield.

- The use of chisel plowing strawberry field soil to reduce soil bulk density and penetration resistance to a soil depth of 12 to 14 inches appeared to be insufficient to elicit an improvement in strawberry plant size distribution and relative strawberry yield.

Table 1. Influence of chisel plowing soil to a depth of 14- inches prior to soil fumigant application and bed formation on the average numbers of small (<8”), medium (>8<12”), and large (>12’’ canopy diameter) plants per 48 ft or strawberry plant row. Relative yield is calculated as increasing contribution in yield, relative to large plants within the respective treated areas. Dover FL ; Fall 2008-Spring 2009.

| Treatment / rate | Tillage Treatment | No. Plants per 48 linear feet of row | | | | Relative Yield |
|---|---|---|---|---|---|---|
| | | Small | Medium | Large | Dead | |
| **Alexander Farm** | | | | | | |
| Telone C35 35 gpTa + LDPE | Chisel plow | 0.27 a | 7.92 b | 69.34 a | 1.47 a | 0.9268 a |
| Telone C35 35 gal/Ta + LDPE | No Chisel plow | 0.58 a | 10.95 a | 66.77 b | 0.70 b | 0.9134 a |
| **Sapp Farm** | | | | | | |
| Pic Clor 60 240 lb/ta +LDPE | Chisel plow | 10.48 a | 18.46 a | 50.85 a | 17.21 a | 0.6347 a |
| Pic Clor 60 240 lb/ta +LDPE | No Chisel plow | 10.75 a | 22.96 a | 44.58 a | 18.71 a | 0.5992 a |
| **Chancey Farm** | | | | | | |
| Telone C35 35 gpTa + LDPE | Chisel plow | 0.18 a | 3.25 a | 93.13 a | 0.45 a | 0.9766 a |

| | | | | | | |
|---|---|---|---|---|---|---|
| Telone C35<br>35 gpTa + LDPE | No Chisel plow | 0.08 a | 2.40 a | 93.80 a | 0.72 a | 0.9791 a |
| **Brown Farm** | | | | | | |
| Telone Inline 35gpta<br>2 tapes /bed + LDPE | Chisel plow | 1.72 a | 15.58 a | 53.64 a | 1.06 a | 0.8537 a |
| Telone Inline 35 gpta<br>2tapes /bed + LDPE | No Chisel plow | 1.89 a | 15.00 a | 53.86 a | 1.25 a | 0.8533 a |
| | | | | | | |

Fig. 1 Comparison of 6 soil moisture zones and 2 preplant soil fumigant treatments, including Midas 50/50 (175 lb/ta) and Telone C35 (22 gpta) with Pliant Blockade VIF and relative strawberry yield estimated from enumeration and yield contributions from the number of large (>12"), medium (>8" to <12"), and small (<8") plants per 40 linear feet of plant row at FSGA, Dover, FL. 2008-09.

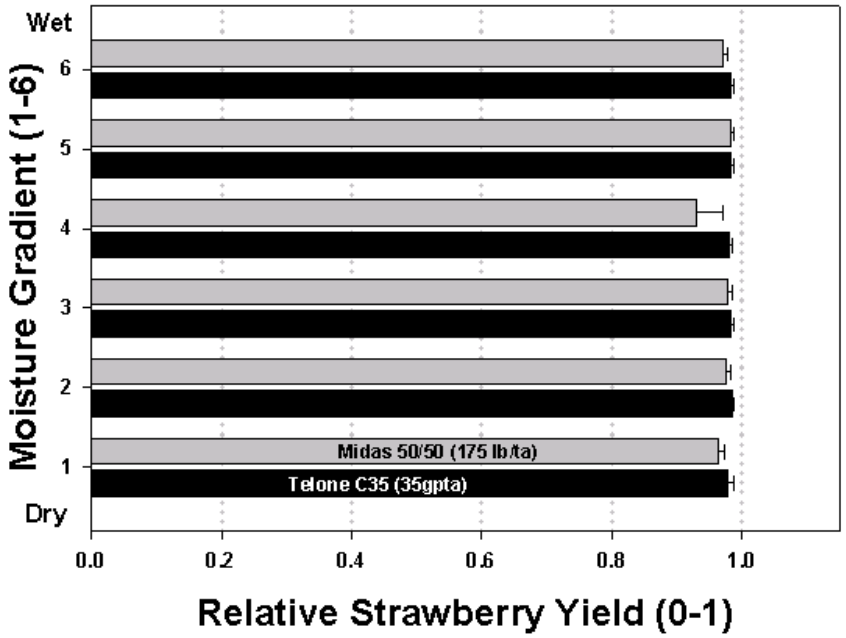


Fig. 2 Comparison of 6 soil moisture zones and 2 preplant soil fumigant treatments, including Pic Clor 60 (300 lb/ta) and Telone C35 (22 gpta) with Pliant Blockade VIF and relative strawberry yield estimated from an enumeration and yield contributions from the number of large (>12"), medium (>8" to <12"), and small (<8") plants per 40 linear feet of plant row at FSGA, Dover, FL. 2009-10.

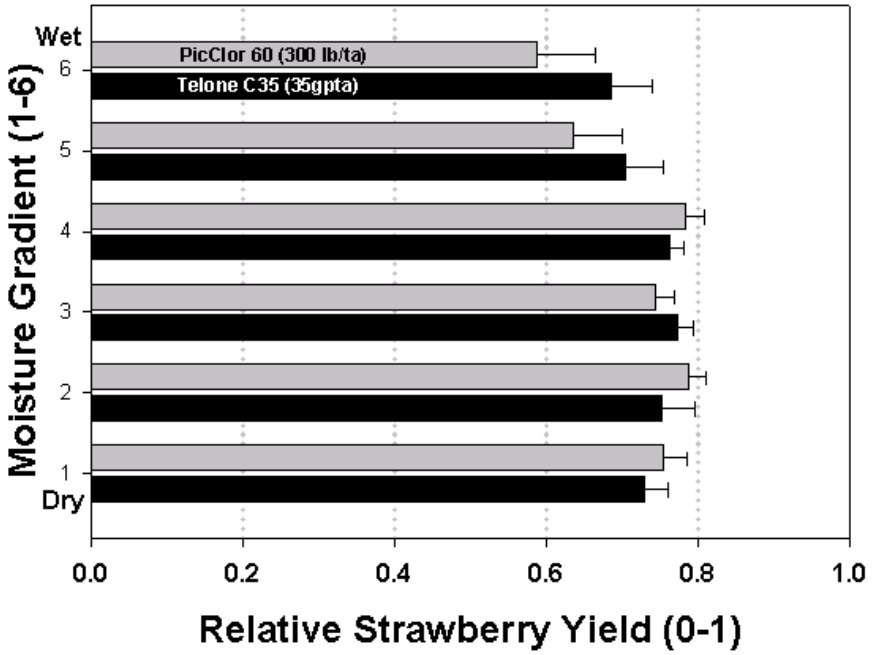

Fig. 3. Soil air concentrations of Midas 98/2 (100 lb/ta), expressed as parts per million (PPM) isobutylene one to seven days post application, under five different plastic mulch films. Measurements acquired with a MinRae® 2000 PID VOC meter. Dover, FL Fall 2008

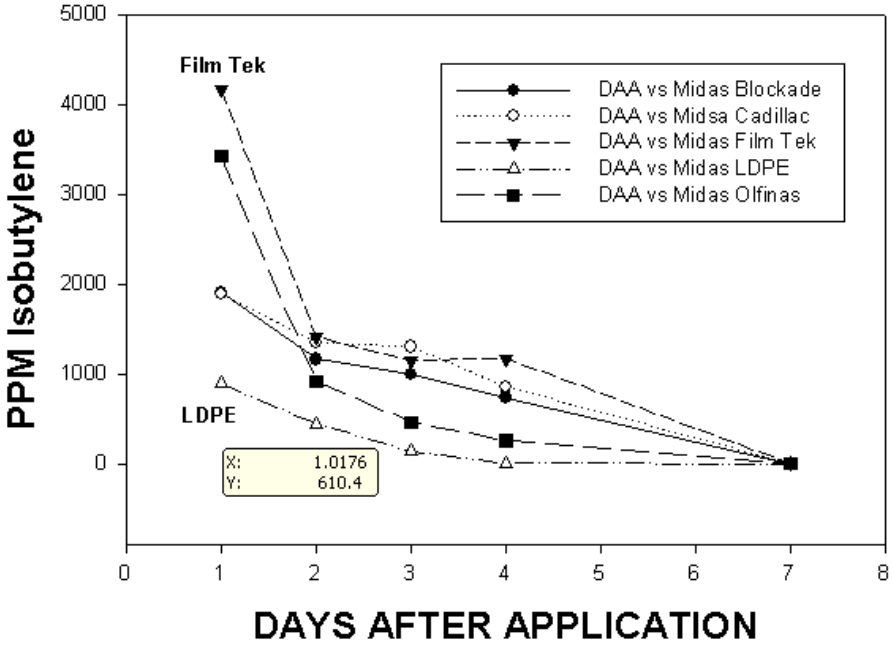


Fig. 4. Soil air concentrations of Telone C35 (35 gpa), expressed as parts per million (PPM) isobutylene one to seven days post application, under five different plastic mulch films. Measurements acquired with a MinRae® 2000 PID VOC meter. Dover, FL Fall 2008