USE OF VIRTUALLY IMPERMEABLE PLASTIC MULCHES (VIF) IN FLORIDA STRAWBERRY

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Many soilborne pests and diseases of Florida vegetable fields are controlled by soil treatments with different formulations of methyl bromide and chloropicrin. With the on-going phase-out and rising cost and scarcity of methyl bromide, it would be desirable to reduce the standard use rate, particularly when approved critical use exemptions may further restrict available amounts and possible allocation. During the period 2000 to 2004, seventeen strawberry field demonstration trials were conducted in grower fields in Plant City, FL to 1) evaluate the use of virtually impermeable mulch film (VIF) and the extent to which methyl bromide field application rates could be reduced, and 2) to compare crop growth and pest control efficacy with treatments utilizing standard dosage and low density polyethylene (LDPE) mulch film. In all trials, a formulation of 67percent methyl bromide and 33 percent chloropicrin was used as the fumigant standard for mulch film comparison. In a few instances, growers were unable and unwilling to significantly reduce methyl bromide use rates until a stable tractor speed could be established during the plastic laying operation. In these instances a reduced rate cannot be assumed. In all other trials, VIF was evaluated with methyl bromide use rate reductions of 25 to 67 percent and compared with a full grower standard use rate of 392 $kg \cdot ha^{-1}$ and LDPE mulch. Methyl bromide applications were always made via a single row bed press through 3 chisels per row (0.6 m; 24 inch wide bed) to a depth of 25-30 cm (10-12 inches) below the raised bed using nitrogen gas as the propellant. Soil injection flow rates were always calibrated via consideration of bed width, constant tractor speed, maximum flow meter capacity, and corresponding adjustment of proportionate flow.

In all trials, differences in plant growth, including comparisons of plant size, height, vigor, consistency, mortality, and or nematode and disease incidence and severity were evaluated on a periodic basis during the growing season. Other recorded observations often included the general appearance of individual plots and color and vigor ratings among treatments in the field for each site visit. Plant growth and weed density in at least 10 to 12 individual plots were always assessed when warranted, and paired for comparison between adjacent methyl bromide VIF and LDPE treated areas. In no trials or treatments were strawberry yields quantitatively assessed. Post season, each grower was asked to estimate any deviation in yield incurred with any reduced rate VIF treatment compared to that of standard dose LDPE treatment. In all trials, plant growth measurements were obtained via systematic examination of individual plants within subplots. Subplots were positioned within single rows, and conveniently identified as the areas between irrigation sprinklers spaced at 15 m (50 ft) intervals. Within each mulch type and fumigant treated area, strawberry plants were arranged in double rows with plants generally spaced 40 cm (15-16 inches) apart, equivalent to approximately 78 plants per subplot, and 6560 plants per hectare (16,200 plants per acre).

RESULTS AND DISCUSSION:
In no VIF treatment, at any location, was initial plant phytotoxicity observed in any newly planted strawberry stand or with performance of subsequent plant growth. Regardless of the time of assessment, no significant ($P \leq 0.05$) differences in strawberry plant crown diameters were ever observed in any VIF reduce rate treatment compared to the standard rate and LDPE mulch treatment (Table 1). In combination with VIF, methyl bromide chloropicrin use rate reductions of 20 to 66 percent produced no significant ($P \leq 0.05$) difference in the numbers of dead or decline plants per 15 m of row compared to standard use rate and LDPE . In all cases, the numbers of dead and decline plants marginally increased during the course of the season but no significant trends was ever observed between fumigant rate and mulch treatments. In most trials, strawberry plant mortality as attributable to strawberry anthracnose (*Colletotrichum gloeosporoides*). At three sites, yellow and purple nutsedge (*Cyperus esculentus* and *C. rotundus*) and or Carolina geranium (*Geranium carolinianum*) were the predominate weeds evaluated for pest control. At four demonstration site locations, superior ($P \leq 0.05$) weed control was achieved with reduced rates of methyl bromide under VIF compared to the full fumigant rate under LDPE (Table 1). At all other sites no differences in weed control was observed at any time between reduced rate and or mulch treatment. This would suggest that the VIF mulch retained lethal concentrations of methyl bromide for sufficient duration to achieve equivalent weed control with the standard rate and mulch treatment. The results of these studies indicated that, with VIF it was possible to reduce the rate of methyl bromide to 196 $kg \cdot ha^{-1}$ (175 lb/a) without a significant loss of weed control compared with methyl bromide applied at 392 $kg \cdot ha^{-1}$ under LDPE. These studies also repeatedly showed that methyl bromide application rates could be reduced as much as 50 percent without serious compromise to crop growth (and apparently of yield) if a significantly less permeable, VIF plastic mulch was used . In these trials, none of the grower cooperators indicated losses in strawberry yield with reduced rate VIF treatments.

In summary, the results of the 17 grower field demonstration trials indicated no significant loss of pest control efficacy, of reduced crop growth or plant size, or of apparent crop yield as reported by the grower when applications rates of methyl bromide were reduced as much as 25 to 50% **when** reduced rates were accompanied by the use of the VIF mulch. At many of the demonstration sites, problems were incurred during the plastic laying operation, in that tractor speeds needed to be reduced as low as 2 to 3 mph, rather than 4 to 5 mph, to properly install the plastic. Since the VIF plastics are not embossed, they have a tendency to slip from under the rear press wheels during installation causing stoppages in the plastic laying operation. Since the VIF mulch lack 'stretch' characteristics, utilizing marginally wider spool widths of plastic than typically used have improved laying characteristics in the field. There is also no question that these new VIF mulches will be more expensive (2x) in terms of material and labor costs to install, but use of VIF plastic mulches may become more cost effective as methyl bromide availability decreases and pricing increases in future years, and as growers acquire neccessary skills in which to lay them. Clearly, growers intent on using VIF in the future will have to adapt to change by acquiring a more patient and problem solving attitude to utilize the new technology. It should also be recognized that these slower tractor speeds can also create a flow metering problem for accurate, uniform dispensing of methyl bromide; thereby requiring some possible changes in application equipment.

Table 1. Summary of seventeen strawberry field demonstration trials during Fall 2000 through Fall 2004 evaluating reduced soil application rates of methyl bromide (Mbr) chloropicrin used concurrent with virtually impermeable plastic mulch film (VIF) on subsequent plant growth, mortality, and pest control efficacy.

Farm Location	MBr Formulation used	Percent Rate Reduction	No. Dead / 15 m row	No. Decline / 15m row	Weed Density / 15 m row	Crown Diameter (cm)
Fall 2000						
1 RYF	67/33	0	0.640	0.325	0.737	0.425
2 DREC	67/33	50	ns [2]	ns	ns	nvd
3 CHF	67/33	50,100	0.281	0.441	0.001	0.001
4 SMcD	98/0	0	ns	ns	ns	nvd [1]
5 MBF	98/2	0	--	--	0.508	0.379
6 SFF	67/33	50	ns	ns	ns	nvd
7 RCF	67/33	50	ns	ns	0.662	nvd
Fall 2001						
8 AHF	67/33	30,50	0.648	0.867	0.340	0.327
9 JSF	67/33	50,66	0.238	0.557	0.056	0.262
10 BPF	67/33	50	ns	ns	0.011	nvd
11 NFF	67/33	20,40	--	--	0.006	0.118
Fall 2002						
12 JSF	67/33	50	ns	ns	0.347	0.664
13 JHF	67/33	40	0.606	0.543	ns	nvd
14 REF	67/33	50	0.389	0.717	0.808	nvd
Fall 2003						
15 JSF	67/33	45	0.804	0.559	0.371	nvd
16 RBF	67/33	25	0.292	0.156	ns	0.500
17 AHF	67/33	50	0.587	0.441	0.001	0.623

[1]NVD- General observation recorded for site visit to indicate no visual difference between rate and mulch treatments apparent.

[2]NS- not statistically significant (probabilities could not be calculated), with no recorded incidence for measured plant parameter.