ALTERNATIVES TO METHYL BROMIDE STUDIES IN GAINESVILLE: SUMMARY 2001-2008

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The data of several previous papers were reanalyzed and summarized for visual interpretations. The focus and primary objectives of the studies were reduction of emissions of pre-plant fumigants for bedded-soil production systems, and detailed measurements and descriptions of *subsurface* distribution of fumigants in the target treatment zone. The focus of this presentation will be on fumigant emission reductions governed by tarps and soil, not with treatment efficacy or crop yield.

Fumigants and comparisons included: (i) Telone II [1,3-dichloropropene, 1,3-D]; (ii) Telone C35 (1,3-D with 35% chloropicrin, CP); (iii) In-Line (emulsified drip formulation); (iv) Vapam (metam sodium, precursor of methyl isothiocyanate or MITC); (v) Methyl Bromide (with CP). Application methods included: (i) chisel-shank injection; (ii) Yetter coulter injection; (iii) drip tube with emulsified formulations. Bedded-soil covers included: (i) non-tarped bare soil; (ii) low-density polyethylene film (PE), (iii) virtually impermeable film (VIF). The focus is on VIF vs. PE for emissions reduction and fumigant retention.

The first two studies were conducted in microplots, partly buried black tubs 130 cm long X 100 cm wide X 60 cm deep. The Microplot #1 study was conducted in Gainesville in 2001. The soil was Arredondo fine sand with two soil organic carbon (SOC) contents: (i) yard waste compost (YWC)-amended soil (1.0 to 1.4% SOC) and (ii) un-amended soil (0.4% SOC). Three soil water content conditions were: (i) ”Air Dry”; (ii) ”Near Field Capacity”; (iii) “Near Saturation”. Tarps were tucked in to about 6-inch depths at the edge of tubs. Telone II (1,3-D) was injected by 30 cm needle at 8 points 15 cm apart along centerline in each microplot at a rate equivalent to 200 kg/ha (18 gal/acre). Emissions were measured using passive capture pans at 1, 5, 29, 53, 77, 101 hours after injection.

We compared total cumulative emissions of 1,3-D from VIF plots vs. non-tarped (bare) soil tubs with both YWC-amended and un-amended soil. The ratio of emission VIF/bare soil was 0.11; thus, VIF clearly reduced emissions of 1,3-D. The YWC-amended soil had slightly lower emissions than un-amended soil due to either greater soil organic matter or slightly higher water content. Although data are not shown, “Near saturation” soil had little fumigant movement or

emissions, indicating that 1,3-D (low vapor pressure fumigant) was trapped by water-filled pore space.

The Microplot #2 study was conducted in Gainesville from March 4 to April 29, 2002 in two steps. Conditions of soil, soil organic carbon, and soil water contents were similar. Telone C35 was injected by the same technique. We compared cumulative emissions of 1,3-D and chloropicrin from PE covered soil tubs compared with bare soil, 96 hours after injection. We show emissions from only *un-amended* soil with *pooled air dry & field capacity data.* Emissions of either chloropicrin or 1,3-D through the PE film covered soil was virtually the same as emissions from the non-tarped bare soil. This indicates that the PE film was very porous to these fumigants. Also, possibly that the bare soil bed was compacted.

Results of the two microplot studies indicate that VIF film can potentially decrease emissions of 1,3-D through bedded rows to about 10 percent of that by PE covered rows or bare soil.

Field Studies at UF/IFAS Plant Science Research Unit, Citra, FL were conducted on raised-bed plasticulture systems with drip irrigation, with beds 36 inches wide and 8 to 9 inches tall. Soil was Arredondo fine sand. Beginning June 4, 2001, the first study was emission of 1,3-D from field beds with bare soil (non-tarped) or covered with PE or VIF. Emission were measured at the top of the bed or at the edge of the bare non-tarped middle. Emissions rates and cumulative totals from the beds ranked as VIF cover < PE cover < bare non-tarped soil bed. Only minor emissions of 1,3-D were found at the edges of bare middles. Also, VIF promoted deeper dispersion and more uniform distribution (data not shown).

The next field study compared MITC emissions from emulsified metam sodium applied as (i) spray & rototill broadcast; (ii) one drip tube; or (iii) two drip tubes. Findings at 0.3 h after application were: Emissions rank—by film: VIF << PE < bare non-tarped soil. Emissions rank—by method: one drip tape < two drip tapes << broadcast application. MITC emissions were low after first day (data not shown). Cross-bed coverage of MITC seemed inadequate based on nutsedge prevalent along edge of beds. Conclusion: Low vapor pressure = low dispersion.

The next field study beginning on August 6, 2003 compared emissions from chisel versus Yetter Avenger coulter injection of CP and 1,3-D. Metallic polyethylene (MPE) or VIF films were used. Coulter injection decreased emissions. As usual, VIF decreased emissions.

The next field study beginning on February 28, 2004 compared methyl bromide emissions from bedded rows of VIF and PE tarped plots, and from non-tarped middles. Methyl Bromide:CP (67/33) was applied with conventional chisel injection. Cumulative emissions were calculated from emission measurements at 0.5, 4, 20, 44, 68, and 92 hours after application.

Findings:

- VIF plots: Only 2% came through the film but 98% came from the bare middle. *Clearly, VIF is a barrier. High vapor pressure = high dispersion to the middles.*
- PE plots: 76% came through the film and 24% came from the bare middle. *Clearly, PE is porous.*

In other words:

- VIF Plots: Of the applied MBr, less than 1% was emitted through VIF, whereas 16% was diverted and came through the bare non-tarped middles.
- PE Plots: Of the applied MBr, 21% was emitted through PE film and only 7% came from the bare middle.

Speculations:

- Perhaps *FULL FIELD TARPING WITH VIF* could make overall retention of MBr more successful.
- For a number or reasons, full field tarping with VIF would not be desirable for most of Florida plasticulture.
- Hypothetical question: Could emissions reduction technology have been developed years ago to the extent that methyl bromide could have been continued as a preplant soil fumigant? Maybe, maybe not.
- Nevertheless, fugitive as well as naturally-occurring methyl bromide would still be an ozone-depleting substance.