FUMIGANT SYNERGIES; THE IMPORTANCE OF CHLOROPICRIN

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Given the importance of methyl bromide to Florida agriculture and diminishing supply of new production, it is imperative that the ways and means of reducing levels of methyl bromide usage in Florida agriculture continue to be evaluated. Mandated use of gas-tight, virtually impermeable plastic mulch film (VIF) in combination with methyl bromide formulations with increased chloropicrin content (i.e., 50% Mbr / 50% Chloropicrin and 30% Mbr / 70% Chloropicrin) has been proposed as a viable means of soilborne pest and disease control, and as a means of further reducing future CUE appropriations to Florida agriculture. The scientific basis for such efficacy claims regarding pest control synergies between methyl bromide and high proportions of chloropicrin (>50%) needs to be field validated under Florida conditions to substantiate claims of pest control efficacy and fumigant synergy. The primary objective of the studies reported herein was to evaluate lethal dosage and pest control synergies between different methyl bromide, methyl iodide and chloropicrin formulations, reduced application rates, and use of virtually impermeable or high barrier plastic mulch films.

LAKE ALFRED,FL: Two field microplot experiments were conducted in field microplots (95 l) at the Citrus Research & Education Center in Lake Alfred, FL during spring and fall 2006. The objectives of each experiment were to evaluate: **1)** single preplant applications of five formulations of methyl bromide chloropicrin, including 98/2, 67/33, 50/50, 30/70 and 100/0; **2)** two plastic mulch films including a standard low density polyethylene (Pliant LDPE) and virtually impermeable mulch (Black Bromostop VIF); and **3**) four soil fumigation application rates for control of the southern root-knot nematode, *Meloidogyne incognita*, and yellow nutsedge (*Cyperus escuelentus)*. For the LDPE treatments, methyl bromide chloropicrin application rates of 400, 350, 350 and 320 lb per treated acre were applied for the 98% methyl bromide and 2% chloropicrin, (98/2); 67% methyl bromide and 33% chloropicrin, (67/33); 50% methyl bromide and 50% chloropicrin, (50/50), 30% methyl bromide and 70% chloropicrin (30/70) formulations, respectively. Soil fumigation rates of 100, 75, and 50% of the maximum broadcast labeled rates were evaluated for each MBC formulation with LDPE mulch. Soil fumigation rates of 75, 50, and 25 % of the maximum broadcast labeled rates were evaluated for each MBC formulation with VIF mulch. Chloropicrin treatments of 100 and 200 lb/a with both LDPE and VIF mulch were also evaluated. For each VIF treatment, a black, 1.4 mil Klerk's Hytibar VIF mulch film was installed over the microplot prior to soil injection and left in place until planting. For each MBC formulation, a 50 lb, nitrogen pressurized cylinder was separately installed to the microdispensing system to obtain appropriate dosage for each MBC formulation.. All fumigant treatments were compared with a untreated control

Ruskin,FL: A single field experiment was conducted in a seep/drip irrigated commercial field near Ruskin, FL during spring 2006. The experiment consisted of two types of plastic mulch (HiLex HDPE vs. Canslit metalized), two formulations of methyl bromide/chloropicrin (67/33 and 50/50), and 4 rates of methyl bromide/chloropicrin As the commercial standard reference treatment, a black, HiLex® high density polyethylene mulch (1 mil, permeation constant (PC) to methyl bromide >200 g/m^2/hr) was sealed over the plant bed immediately following methyl bromide/chloropicrin application. Application rates for each formulation ranged from a low of 100 lb. of product per treated acre to 350 lb. in 50 lb. increments. Additional rates of the 50/50 formulation were included to cover the range from 75 lb. to 250 lb. in 25 lb. increments, but only under the Canslit metalized film since greater efficacy was anticipated with that film based on previous research. The high barrier mulch film used was metallic, highly methyl bromide impervious (1 mil, PC=<14 g/m^2/hr) Canslit mulch film. Separate untreated controls were included for dosage comparison with each mulch film. Data collected consisted of assessments of tomato plant vigor, mortality, yield, and counts of the number of nutsedge plants which emerged through the mulch film in 30 ft of row.

Results: Clearly the use of the Klerk's Hytibar VIF film provided much improved nutsedge control, a lower rates of methyl bromide chloropicrin application compared to LDPE mulch (Fig. 1). Effective nutsedge control with VIF was achieved with methyl bromide rates of 50 to 100 lb/a. Chloropicrin contributed little to methyl bromide for nutsedge or nematode control. With VIF, effective nutsedge control was not apparent at methyl iodide application rates less than 50 lb/a in the field microplots (Fig. 2). Again, chloropicrin was not observed to synergize methyl iodide or contribute to herbicidal efficacy at rates less than 140 lb/a.

Based on the results of the Ruskin field study, it was apparent that the Canslit metalized film was superior to HiLex HDPE for nutsedge control with either formulation or rate of methyl bromide. Using a 50/50 blend appears to be an acceptable method of reducing methyl bromide consumption while still maintaining nutsedge control and crop production. The methyl bromide rate "breaking point" for nutsedge control varied with the film used. A porous film like the HiLex HDPE appears to require rates of 300 lb. per treated acre or more, while a highly retentive film like Canslit metalized or any of the VIF products can achieve acceptable nutsedge control with rates as low as 100 lb. of product per treated acre.

Key Points:

1) Superior control of yellow or purple nutsedge at reduced application rates of methyl bromide or methyl iodide and chloropicrin was achieved only with the low permeability, high barrier VIF or metalized mulches.
2) Based on these results, Chloropicrin was observed to contribute little, either directly or synergistically with other fumigants for control of nematodes or yellow or purple nutsedge. These data would suggest that potential importance of fumigant synergy only with disease control.
3) Decisions to include Chloropicrin within a fumigant formulation should be driven by pest incidence, potential efficacy and synergy, and not as a filler at reduced cost.

Fig. 1. Contour of yellow nutsedge (*Cyperus escuelentus*) survivorship (%) of following soil fumigation with various rates of application of methyl and chloropicrin and use of either low density plastic mulch (LDPE) or virtually impermeable film (VIF) mulch in field microplots. Lake Alfred, FL Fall 2006.

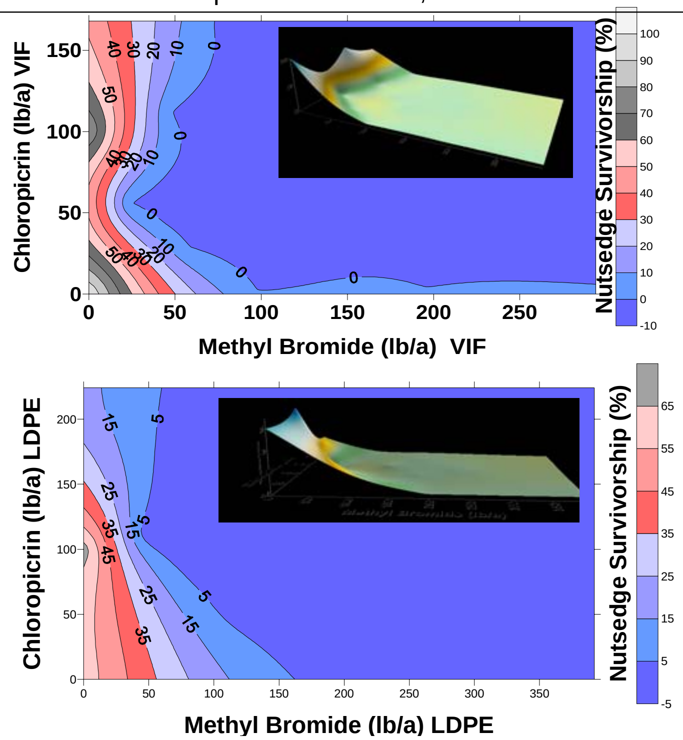

Fig. 2. Contour of yellow nutsedge (*Cyperus escuelentus*) survivorship (%) following soil fumigation with various rates of application of methyl iodide and or chloropicrin and use of virtually impermeable film (Klerk VIF) in field microplots. Lake Alfred,FL Fall 2006. Insert depicts 3D response surface

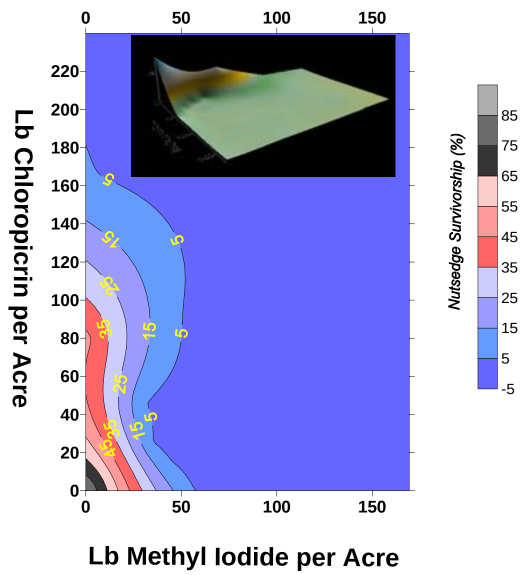

Fig. 3. Contour of yellow and purple nutsedge (Cyperus spp.) survival following soil fumigation with various application rates of methyl and chloropicrin and use of either high density polyethylene plastic mulch (LDPE) or high barrier, gas impermeable Canslit metalized mulch film. Ruskin, FL Spring 2006.