EFFICACY OF METHYL BROMIDE ALTERNATIVES FOR VERTICILLIUM AND WEED MANAGEMENT IN TOMATOES

F. J. Louws[1], L. M. Ferguson[1], K. Ivors[1], J. Driver[1], K. Jennings[2], D. Milks[1], P.B. Shoemaker[1] and D.W. Monks[2].
Departments of [1]Plant Pathology and [2]Horticulture, North Carolina State Univ., Raleigh NC 27695

Introduction

Tomato production is an important source of income for many farms in North Carolina and the adjacent Southeastern States (GA, SC, TN, VA), accounting for $150 million in farm gate income. Up to 85% of this acreage is fumigated with methyl bromide to manage important soil borne pests and weeds. Important soil borne diseases include Verticillium wilt (VW), Fusarium wilt (FW), Southern bacterial wilt (SBW), Southern stem blight (SSB), and root knot nematodes (RN). In the case of North Carolina, VW and FW are major problems in the western (Mountain) production region and SBW, SSB, and RN are major issues in the eastern production region.

We have implemented a multifaceted approach to develop IPM-based approaches to manage soil borne pests. Components include proper diagnosis, the integration of cover crops, compost applications, crop rotation, site and water management, use of host resistance, fungicide and herbicide use, and soil fumigation. In this report we highlight recent research to manage weeds and Verticillium wilt of tomato in Western North Carolina. Most tomato cultivars have resistance to Verticillium race 1 but not race 2. Race 2 is a primary reason for fumigation on land with a history of intensive tomato production.

2003 TRIAL: **Objectives:** To evaluate pre-plant soil treatments as alternatives to methyl bromide for the management of soil borne pests, particularly plant pathogenic fungi such as *Verticillium dahliae*. Verticillium wilt can be quite severe in the mountains of North Carolina, limiting plant productivity. Previous studies indicated that no fumigant, including the highly effective biocide methyl bromide, can eradicate *V. dahliae.* Effective fumigants contribute to management of VW by killing inoculum in the rooting zone, delaying infection until late in the growing season. This allows plants to produce high tomato yields before they succumb to wilt.

Materials and Methods: The treatments outlined below were applied 5 Jun to 10 Jun in spring 2003 at the Horticultural Crops Research Station in Fletcher NC (Table 1). Standard management practices were used in the trial including foliar disease and insect management, fertilizer recommendations and staking and stringing of plots. Tomatoes were harvested weekly for a total of eight harvests. Harvest data were sorted into marketable categories; jumbo, extra large, large, medium and small and into cull fruit which includes damaged, misshapen or diseased fruit. We highlight total and marketable yields here (Table 1) and Verticillium incidence in the mid-season rating (Figure 1). All plots were hand-weeded in 2003.

Results: All treatments except InLine offered suppression of Verticillium wilt compared to plots not fumigated (Figure 1). Iodomethane and chloropicrin-based products shank applied and metam-sodium (drip and incorporated) offered control similar to MB. EC formulations of Iodomethane and chloropicrin compromised control of Verticillium wilt incidence. In terms of yield, several alternatives provided marketable yields similar to methyl bromide, including: Iodomethane shank applied (33:67v and 50:50), Telone-C35 and InLine, and metam sodium (drip-applied). Treatments not performing on par with methyl bromide were the chloropicrin applications, metam sodium incorporated in the bed, and the EC formulations of Iodomethane and chloropicrin. Non-fumigated plots had the lowest numerical yields.

2004 Trial: **Objectives:** To evaluate pre-plant soil treatments and herbicide products as alternatives to methyl bromide for the management of VW and weeds.

Materials and Methods: Two trials were initiated in the spring of 2004 (26 May – 2 Jun) and were done in cooperation with the IR-4 program for methyl bromide alternatives research. Trial 1 emphasized fumigant products and Trial 2 emphasized chloropicrin combined with various herbicides as compared to T-C35 and MB (data not shown). Verticillium wilt incidence, weed emergence, and crop yield data were collected. Dramatic flooding due to Hurricane Frances terminated the trial prematurely.

Results: Telone-C35, Chloropicrin Plus, Chloropicrin alone, Chloropicrin combined with K-Pam, and MB clustered closely with regard to a low numerical incidence of VW (Table 2). Only T-C35 was superior to the non-fumigated plots. Wilt incidence progressed with the season and disease levels were low to moderate just prior to the flood. It may have been possible that disease levels would have progressed and generated more dramatic treatment differences among treatments.

All fumigants except Chloropicrin alone or Chloropicrin Plus offered weed control comparable to MB and these were all comparable to hand-weeded plots and superior to the non-weeded control (Table 2). In Trial 2, T-C35 suppressed weed populations equivalent to hand-weeded plots (data not shown). Likewise, chloropicrin combined with pre-emergent (on pre-formed beds prior to covering with plastic) applications of Sulfentrazone, Dual, Goal or K-Pam offered weed control comparable to the hand-weeded control (data not shown). The primary weeds in both trials were summer annuals, particularly pigweed.

SUMMARY: Shank application of products with a high content of chloropicrin offered the best control of Verticillium wilt. T-C35 offered good VW and weed suppression. Weed management was enhanced in chloropicrin treated plots with the use of herbicides or K-Pam.

Table 1A. Effect on yield of pre-plant soil treatments and application rates employed at Fletcher NC 2003.

Pre-plant Treatment		Rate (broadcast equiv)	Total lb/A[z]	Marketable lb/A[z]
Methyl bromide: chloropicrin (67:33)		400 lbs/A	64747 a	56338 a
Iodomethane: chloropicrin (33:67)		300 lbs/A	64583 ab	54133 ab
Telone-C35 shank		35 gal/A	63371 abc	54064 ab
Metam sodium drip		75 gal/A	60821 abcd	51766 abc
Iodomethane: chloropicrin (50:50)		240 lb/A	60972 abc	51500 abcd
InLine TC35 drip		35 gal/A	58334 abcdef	48957 abcde
Chloropicrin (99%)		150 gal/A	57631 bcde	48259 bcde
Chloropicrin Plus (75%)		256 lbA	57003 cdef	48001 bcde
Metam sodium (spray/till)		75 gal/A	59484 abcd	47650 bcde
Iodomethane: chloropicrin (33:67) EC formulation		300 lbs/A	53893 def	44262 cde
Tri clor EC		200 lbs/A	52478 ef	43717 de
Control			50288 f	41564 e

[z]Values with a common letter are not significantly different from one another based on Fisher's Protected LSD (P=0.05).

Figure 1: Verticillium wilt incidence in the mid-season (21 Aug 2003). Values with a common bar are not significantly different from one another based on Fisher's Protected LSD (P=0.05).

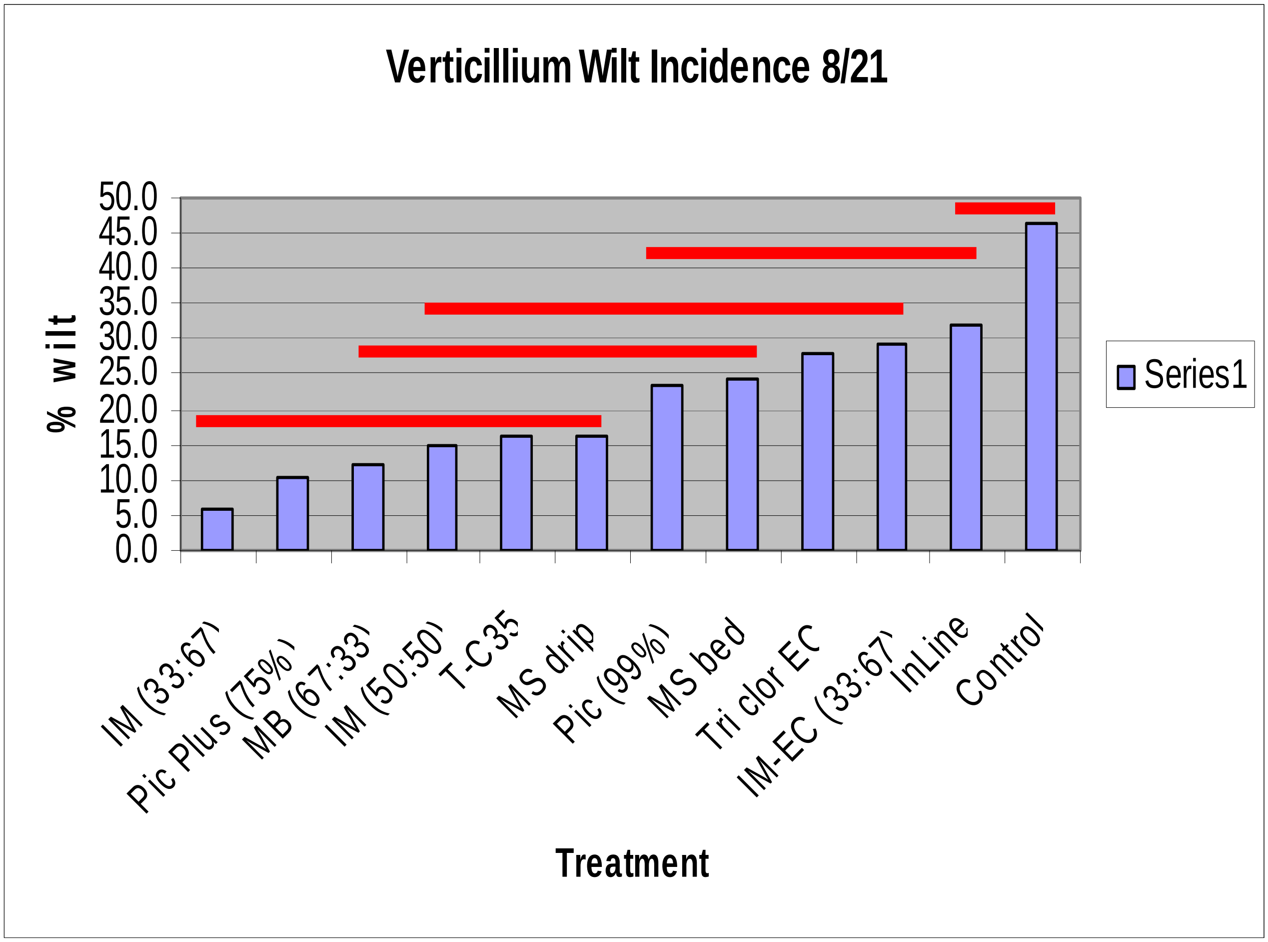

Table 2. Verticillium wilt incidence and weed counts as affected by pre-plant soil treatments employed at Fletcher NC 2004.

Pre-plant Treatment	Rate (broadcast equiv)	Verticillium wilt incidence (%) (4 Sep)		Total weed count/ sq. m 19 Jul		19 Aug	
Propozone (Drip applied)	60 gal/A	37.1	bcde	0.3	a	0.0	bc
Methyl bromide: chloropicrin (67:33)	400 lbs/A	29.3	abcde	0.5	a	0.0	a
SEP 100	75 lbs a.i./A	41.5	de	0.5	a	0.8	a
Propozone (Shank applied)	60 gal/A	34.7	bcde	1.0	a	2.5	a
Control (hand-weeded)	---------------	41.0	cde	2.5	a	3.0	a
Telone-C35	35 gal/A	17.4	a	5.5	a	5.8	a
Chloropicrin (99%) + K-Pam (7 days later)	150 lb/A 75 gal/A	25.7	abcde	14.3	ab	12.5	ab
Chloropicrin (99%)	150 lb/A	24.2	abc	27.8	bc	26.5	bc
Chloropicrin Plus (75%)	256 lbA	22.4	ab	36.8	c	34.8	c
Control (non-weeded)	---------------	38.6	bcde	37.8	c	25.0	bc

Values with a common letter are not significantly different from one another based on Fisher's Protected LSD (P=0.05).