EVALUATION OF XRC-245 AS A SOIL FUMIGANT FOR FLORIDA VEGETABLES

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Introduction

Florida vegetable growers rely on combinations or successive application of 1,3-dichloropropene (1,3-D), chloropicrin (Pic), or metam potassium for soil-borne pest control. These fumigant combinations generally do not control the same spectrum of pests as was observed with methyl bromide-chloropicrin combinations nor do they move as readily through the soil. As a result, pest management costs and complexity have continued to increase following the loss of methyl bromide. There remains a need for alternative fumigants that move readily through the soil, control a broad spectrum of pests, and are economically viable.

XRC-245 is an alternative fumigant that has been evaluated for use in vegetables for several years. Three experiments were conducted in 2019 at the Gulf Coast Research and Education Center (27°N, 82°W) in Balm, Florida to determine the: 1) efficacy of various XRC-245 rates when applied with 150 lbs of chloropicrin, 2) efficacy of 350 lbs of XRC-245 when applied with various rates of chloropicrin, and 3) efficacy of XRC-245 when applied in conjunction with various other registered fumigants. The soil type at the site was a Myakka fine sand (Sandy, Siliceous Hyperthermic Oxyaquic Alorthod) with a pH of 6.0, 1.5% organic matter and 98, 1, and 1 % sand, silt, and clay, respectively. The field used for the experiment had a history of purple nutsedge (*Cyperus rotundus* L.) infestation.

Methods

Each experiment was conducted as a randomized complete block design with four blocks. Plot size was 75 feet of a single raised bed. Beds were spaced 5 feet apart and were 32 inches wide at the base. Beds were shaped and fumigated in January 2019. XRC-245 was applied as a gas through a single drip tape buried 1 inch deep with emitters every foot. All other fumigants except K-Pam were applied with a standard fumigant rig (Kennco Manufacturing, Ruskin, FL) equipped with three backward swept shanks set to evenly distribute fumigant at the base of the 8 inch tall bed. K-Pam was applied with the same fumigant rig equipped with six shanks set to evenly distribute fumigant at 4 inches deep within the raised bed. All beds were covered with TIF plastic mulch. Tomatoes (cv. Charger) were transplanted in the center of the bed with 2 foot spacing between plants on March 4, 2019. Tomatoes were irrigated, fertilized, and managed for foliar pests as per industry standards in the region.

Yellow nutsedge tubers were buried in mesh bags in the center of the bed prior to fumigation. The bags were retrieved and the number of tubers that sprouted counted 14 days after fumigation. The number of purple nutsedge shoots that punctured the TIF mulch was also counted within the plot at transplant, mid-season, and harvest. Tomatoes were rated for damage and vigor using a 0-100 scale. The height of five plants per plot was measured 14 and 28 days after transplant. Ten tomato plants per plot were harvested from each plot and all fruit was graded prior to weighing as small (<5.5 cm diameter), medium (5.5 cm < diameter <6.5 cm), large (6.5 cm < diameter <7 cm) or extra large (>7 cm).

Buried bags with a known concentration of *Fusarium oxysporum* f. sp. *lycopersici* race 3 (FOL) were buried immediately prior to fumigation with XRC-245 in some experiments. Three grams of sand inoculated corn meal were placed in each bag and the bags were buried 4 inches deep in the center of the bed. Levels of viable FOL were monitored by plating serial dilutions onto semi selective media (Komada's or Malachite Green).

Results

<u>Evaluation of XRC-245 Mixtures</u>
A variety of fumigant mixtures that included XRC-245 were evaluated (Table 1). None of the fumigant treatments evaluated differed in terms of tomato damage, vigor, height or total yield (data not shown).

All fumigants controlled 100% of yellow nutsedge tubers that were buried in the plots. All fumigant treatments except K-Pam reduced purple nutsedge shoot density by almost 100% compared to the nontreated control (Table 2) and this trend persisted throughout the season.

<u>Pic100 Reduction Effects in Cominbation with XRC-245 on Tomato Safety and Weed Control</u>
Crop tolerance and pest management of 350 lbs/acre of XRC-245 combined with 0, 50, 100, 125, or 150 lbs/acre of chloropicrin was compared to a nontreated control, 150 lbs/acre chloropicrin or 275 lbs/acre of Pic-Clor 60. None of the fumigant treatments evaluated differed in terms of tomato damage, vigor, height or fruit yield (data not shown).

All fumigant treatments except chloropicrin alone controlled all buried yellow nutsedge tubers (data not shown). At planting, Pic-Clor 60, and treatments with XRC-245 plus >50 lbs / acre of chloropicrin reduced nutsedge emergence to 0. This trend tended to continue throughout the season. By season end, Pic-Clor 60 and XRC-245 alone did not control nutsedge as effectively as XRC-245 combined with chloropicrin.

<u>Effect of XRC-245 Rate Reduction in Combination with Chloropicrin on Tomato Safety and Weed Control</u>
Crop tolerance and pest management with 350 lbs/acre of XRC-245 combined with 0, 50, 100, 125, or 150 lbs/acre of chloropicrin was compared to a nontreated control, 150 lbs/acre chloropicrin or 275 lbs/acre of Pic-Clor 60. None of the fumigant treatments evaluated differed in terms of tomato damage, vigor, height or fruit yield (data not shown).

Nearly 100% of all buried yellow nutsedge tubers and purple nutsedge shoots were controlled by all XRC-245 rates (Table 3). Broadleaf weeds but not grasses emerging in the planting holes was equally reduced by all fumigant treatments compared to the nontreated control.

Fusarium data will be presented at the meeting. Overall, we conclude that XRC-245 over a range of rates when combined with Chloropicrin or other fumigants will control yellow and purple nutsedge and will reduce broadleaf and grass weeds when present.

Table 1. Treatment list for evaluation of sulfuryl fluoride when applied alone and in combination with other fumigants at Balm, FL, in 2019.

Name designation	Rate	Application
Nontreated	N/A	N/A
Pic60	275 lb/acre	shank
XRC-245 + Pic	350+150 lb/acre	gas + shank
XRC-245 + Kpam	350 lb+40 GPA	gas + drip
XRC-245 + Telone	350lb + 15 GPA	gas + shank
XRC-245	350 lb/acre	gas
Pic100	150 lb/acre	shank
Kpam	40 GPA	drip
Telone II	15 GPA	shank
Paladin Pic-21	40 GPA	shank

Table 2. Nutsedge densities piercing the plastic mulch within the bed in response to XRC-245 when applied alone and in combination with other fumigants at Balm, FL, in 2019.

Treatment	Nutsedge density		
	Planting	Midseason	Harvest
		No. m^{-2}	
Nontreated	19 a	20 a	11 ab
Pic60	0 c	0 bc	0 c
XRC-245+ Pic	0 c	0 c	0 c
XRC-245 + Kpam	0 bc	0 bc	1 bc
XRC-245 + Telone	0 c	0 c	0 c
XRC-245	1 b	2 b	2 bc
Pic100	0 c	0 c	0 c
Kpam	7 a	21 a	29 a
Telone	0 c	0 bc	0 c
Paladin Pic-21	0 c	0 c	0 c
P value	<0.0001	<0.0001	<0.0001

*Values are transformed (or back-transformed) least square estimates. Different letters within the medium category column indicate a significant difference using Tukey's honestly significant difference (α=0.05).

Table 3. The effect of fumigant treatments on weed control at the Gulf Coast Research and Education Center in 2019. The yields in each size category is a combination of two harvests.

Name	SF	Pic100	Purple nutsedge	Yellow nutsedge
	lb/acre	lb/acre	#/m[2]	#/m[2]
Nontreated	0	0	9.4 a	14.0 a
Pic-Clor 60	0	0	3.0 b	0 b
XRC-245+Pic	50	150	0.1 b	0 b
XRC-245+Pic	100	150	0 b	0 b
XRC-245+Pic	200	150	0.1 b	0 b
XRC-245+Pic	300	150	0 b	0 b
XRC-245+Pic	400	150	1.4 b	0 b

[1]The Paladin Pic combination consisted of 40% chloropicrin and 60% dimethyl disulfide.
[2]Means within the same column followed by different letters are significantly different at $p<0.05$