

YELLOW NUTSEDGE CONTROL WITH METHAM-SODIUM IN TRANSPLANTED CANTALOUPE

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Introduction

Cucurbit crops grown in the southeastern U. S. are typically transplanted on polyethylene covered seedbeds and much of the acreage is preplant fumigated with methyl bromide (Doherty and Mizelle 2001). Used in this fashion, methyl bromide controls an array of plant pests, including weeds. The major group of weeds targeted by methyl bromide fumigation are yellow and purple nutsedge (Locascio et al. 1997). Uncontrolled perennial nutsedges can pierce and emerge through black polyethylene mulch (Chase et al. 1998; Gilreath et al. 1994, Webster 2005a, 2005b), effectively competing with transplanted vegetable crops.

Methyl bromide has been shown to deplete stratospheric ozone (Anonymous 1998) and all uses were scheduled to be cancelled in 2005 (Noling and Becker 1994; USDA 1999), with the exception of critical uses defined by the United Nations. Csinos et al. (1997, 2000) identified several alternatives to methyl bromide in vegetable crop transplant production. Their results showed that metham-sodium was equally effective as methyl bromide in controlling many cool- and warm-season weeds, including yellow nutsedge. Gilreath et al. (2004) showed that metham-sodium at 101 gal./A effectively controlled purple nutsedge in spring-transplanted bell pepper and improved yield compared to methyl bromide, with metham-sodium sprayed and soil-incorporated. Johnson and Webster (2001) modified a power-tiller, designed specifically for metham-sodium application, and successfully used the implement as part of a total weed management system in transplanted cantaloupe and watermelon (Johnson and Mullinix 2002).

While metham-sodium has been shown to be an acceptable weed control replacement for methyl bromide, questions remain about use in the southeastern U. S. regarding rates for perennial nutsedge control, time of application, and the need for polyethylene mulch to seal the fumigant. Therefore, studies were initiated in 2001 to refine the use of metham-sodium for yellow nutsedge control in transplanted cantaloupe.

Materials and Methods

Irrigated field trials were conducted from 2001 to 2003 at the Coastal Plain Experiment Station Ponder Farm near Tifton, GA. The soil was a Tifton loamy sand composed of 88% sand, 6% silt, and 6% clay, with 0.2% organic matter and pH 6.4. Sites where these trials were conducted represent commercial cantaloupe production in the

southeastern U. S. and had heavy natural infestations of yellow nutsedge (>50 plants/m²).

The experimental design was a randomized complete block, with a factorial arrangement of treatments replicated four times. Treatments included all possible combinations of preplant fumigation interval (3-wk, 2-wk, and 1-wk before transplanting cantaloupe), metham-sodium rate (nontreated, 40 gal./A, and 80 gal./A), and seedbed mulching (bareground and black polyethylene mulch covered seedbeds).

Preplant fumigation intervals were based on time prior to transplanting cantaloupe, with transplanting date being the same across the entire experiment. In each case, seedbeds were freshly tilled, sprinkler irrigated (1.2 cm), and weed-free at the time of treatment. Metham-sodium was applied with a specialized power tiller specifically designed to spray metham-sodium in a 24 in. band and incorporated to a depth of 3 in. (Johnson and Webster 2001). Non-diluted metham-sodium (Vapam HL®; AMVAC Chemical Corp., 4100 E. Washington Blvd., Los Angeles, CA 90023) was applied in these trials. The only means to control metham-sodium rate were to change ground speed of the sprayer/tiller or alter sprayer flow rate with nozzle-tip orifice or pressure adjustments. With these limitations, the metham-sodium calibrated rate was 80 gal./A, compared to the registered rate of 75 gal./A (Anonymous 2005), using a ground speed of 2.0 miles/hr and spray pressure of 24 lbs./in². The 40 gal./A metham-sodium rate was achieved by increasing ground speed to 4.0 miles/hr. Metham-sodium rates are hitherto referred to as ½x and 1x for 40 and 80 gal./A, respectively. Black polyethylene mulch, 1 mil thick and 24 in. wide, was spread in the appropriate plots immediately after each time of metham-sodium application using a mulch layer (Pro-Junior Series® mulch layer, Buckeye Tractor Company, P. O. Box 123, Columbus Grove, OH 45830).

Three weeks before transplanting, 'Vienna' (Semini Inc., 2700 Camino del Sol, Oxnard, CA 93030-7967) cantaloupe were seeded in greenhouse trays (Speedling® Incorporated, P. O. Box 7220, Sun City, FL 33586-7220), each tray containing 128 cells and each cell being 1.5 in. by 1.5 in. Seedlings were established in the field using a transplanter (Kennco Manufacturing Inc., P. O. Box 1149, Ruskin, FL 33575) that simultaneously cut holes in the polyethylene mulch and transplanted seedlings in one row centered on the finished seedbed. Cantaloupe were transplanted into the field on 4 May 2001, 29 April 2002, and 3 June 2003. Plots were 6 ft. wide and 20 ft. long, with cantaloupe seedlings spaced 22 in. apart. Plots were sprinkler irrigated as needed, based on crop and meteorological conditions. Ethalfluralin (0.5 lb ai/A) plus glyphosate (1.0 lb ai/A) were applied to the entire experiment after transplanting for maintenance weed control in the row middles using a hooded sprayer that treated a band 28 in. wide. Excluding weed control, cultural practices and pest management decisions for transplanted cantaloupe were based on recommendations from the Georgia Cooperative Extension Service (Boyhan et al. 1999).

Visual estimations of yellow nutsedge control and crop injury were taken early-season (3 wk after transplanting) each year on a scale of 0 to 100 (compared with the nontreated control, where 0 = no weed control or crop injury and 100 = complete weed control or crop injury). Visual estimates of yellow nutsedge control were based on the presence of yellow nutsedge in the finished seedbed, including yellow nutsedge emerging

through the polyethylene mulch and present in transplant hole. Yields were measured by harvesting mature fruits from the entire plot at multiple intervals, depending on the continued presence of marketable fruits. The number and weight of cantaloupe fruits were recorded by harvest date.

Data were analyzed using a mixed-model analysis. Degrees of freedom were partitioned to test singularly and in combination the effects of time of treatment, metham-sodium rate, and seedbed mulching on yellow nutsedge control, visual injury, and cantaloupe yield. Means were separated using Fisher's Protected LSD ($P \leq 0.05$).

Results and Discussion

Data analysis showed nonsignificant year effect for all parameters. Therefore, all data are pooled across years.

Over the three year term of this experiment, yellow nutsedge control was not affected by preplant fumigation interval (data not shown). However, yellow nutsedge control was affected by interactive effects of metham-sodium rate and seedbed mulching (Table 1). Metham-sodium at the $\frac{1}{2}x$ and $1x$ rates controlled yellow nutsedge 84 to 85%, respectively, when seedbeds were covered with black polyethylene mulch. However, on bareground seedbeds, the $1x$ rate of metham-sodium was more effective (75%) in controlling yellow nutsedge than metham-sodium at the $\frac{1}{2}x$ rate (59%). Interestingly, the $\frac{1}{2}x$ rate of metham-sodium with polyethylene mulch covered seedbeds controlled yellow nutsedge 84% compared 75% control from the $1x$ rate on bareground seedbeds.

These results demonstrate effective yellow nutsedge control with metham-sodium when used in conjunction with black polyethylene mulch. There have been conflicting reports of the efficacy of metham-sodium for perennial nutsedge control in cropping systems using black polyethylene mulch. For example, Gilreath et al. (1994) soil-injected metham-sodium to spring transplanted pepper and the resulting purple nutsedge control was poor. In the same trial, metham-sodium was sprayed and incorporated with a power-tiller to fall-seeded cucumber and purple nutsedge control was excellent. Purple nutsedge was also effectively controlled in later trials where metham-sodium was sprayed and incorporated with a power-tiller (Gilreath et al. 2004). However, the metham-sodium rate evaluated was 101 gal./A compared to the registered rate of 75 gal./A (Anonymous 2005). Locascio et al. (1997) reported poor (32 to 56%) control of purple nutsedge with sprayed and incorporated metham-sodium at 32 gal./A. Metham-sodium sprayed at a full-rate and incorporated did not effectively control purple nutsedge in turfgrass sod production (Unruh et al. 2002). The seedbed in this trial was sealed with a soil-roller after treatment, but the treated area was otherwise uncovered during the fumigation period. It appears that metham-sodium efficacy is largely dependent on matching rate and application technique with the targeted pest. When used for perennial nutsedge control, metham-sodium should be sprayed the full rate, simultaneously incorporated with a power-tiller, and treated areas immediately covered by black polyethylene mulch.

Black polyethylene mulch suppresses yellow nutsedge. Yellow nutsedge control in nontreated plots covered with polyethylene mulch was 74%, which was similar to 75% control in bareground seedbeds treated with the $1x$ rate of metham-sodium (Table 1).

Previous studies have demonstrated that while yellow nutsedge is capable of penetrating opaque mulches (Chase et al. 1998; Gilreath et al. 1994, Webster 2005a, 2005b) , yet >89% of emerged yellow nutsedge shoots remain trapped beneath black polyethylene mulch (Majek and Neary 1991; Webster 2005b). These results suggest that the partial suppression of yellow nutsedge emergence by black polyethylene mulch may be a useful tool in yellow nutsedge management in transplanted cucurbit crops.

An additional observation was made in nontreated plots covered with black polyethylene mulch. Early-season yellow nutsedge control was 84% in nontreated plots using black polyethylene mulch applied within 1 wk of transplanting, which was similar to the 86% nutsedge control from covered plots treated with the 1x rate of metham-sodium at the same preplant fumigation interval (data not shown). In contrast, yellow nutsedge control in nontreated plots was 72 and 65% when black polyethylene mulch was applied 2 wk and 3 wk before transplanting, respectively. Transplanting a rapidly growing, aggressive cucurbit crop like cantaloupe soon after applying polyethylene mulch gives cantaloupe vines the opportunity to cover the seedbed before yellow nutsedge emergence through black polyethylene mulch. This could be of significant value in cropping systems where fumigation or herbicide treatment is not possible, such as organic crop production.

Visual injury was not affected by seedbed mulching (data not shown). The interactive effects of preplant fumigation interval and metham-sodium rate affected cantaloupe injury (Table 2), although there was very little visual injury from metham-sodium application during this three year study (Table 2). Metham-sodium applications as soon as 1 wk before transplanting caused <2% visual injury. Applications 2-wk prior to transplanting were even less injurious; <1% visual injury. There was an unexplained abnormality in data from ½x rate of metham-sodium applied 3 wk before transplanting, with <4% visual injury to cantaloupe compared to <1% visual injury from the 1x rate. It should be noted that cantaloupe were transplanted at a later date than normal for the region and the resulting warmer soil conditions may have allowed metham-sodium to dissipate quicker than if applied to cooler soils earlier in the season. This may have lessened the chances for metham-sodium phytotoxicity at the 1 wk and 2 wk applications.

Total cantaloupe yield was affected by the interactive effects of preplant fumigation interval and metham-sodium rate. Total cantaloupe yield, whether expressed as fruit number or weight, reflected the treatment combinations that effectively controlled yellow nutsedge (Table 2). Maximum cantaloupe yields were in plots with 1x rate of metham-sodium applied either 1 wk or 2 wk before transplanting. The lowest cantaloupe yields of all treatments evaluated were in the non-fumigated controls.

When cantaloupe yields (no./ha) at individual harvest dates were considered, seedbed mulching was the only treatment variable of significance (Table 3). Similar results were seen for cantaloupe yield expressed as kg/ha (data not shown). When averaged over times of fumigation and metham-sodium rates, black polyethylene mulch increased transplanted cantaloupe yield an average of 28% over production on bareground seedbeds in three of six harvest dates and total yield. Bonanno and Lamont (1987) reported greater muskmelon yield in North Carolina from polyethylene mulched seedbeds

compared to bareground. They attributed the yield increase to the polyethylene mulch warming the seedbed when average temperatures were nearly normal for the location. However, there was no yield difference when average temperatures were higher than normal, negating the soil warming advantages of polyethylene mulch. In our trials, cantaloupe were transplanted later than normal for the region and temperatures were correspondingly warmer compared to normal transplanting dates. Therefore, we believe that the 28% yield increase in our trials to seedbed mulching appears to be due to overall better yellow nutsedge control in black polyethylene mulched seedbeds compared to bareground seedbeds (Table 1).

These data show the value of metham-sodium and black polyethylene mulch for yellow nutsedge control in transplanted cantaloupe. Superior yellow nutsedge control and cantaloupe yield performance is provided by a 1x rate of metham-sodium sprayed and incorporated with a power-tiller, with seedbeds covered with black polyethylene mulch. Using this treatment combination, metham-sodium applied 2 wk or 3 wk before transplanting effectively controlled yellow nutsedge, was not overly injurious to cantaloupe, and provided the greatest cantaloupe yield of all treatment combinations. The metham-sodium registration does not allow for crop seeding/transplanting earlier than 3 wk after treatment due to potential for crop injury (Anonymous 2005). However, these data suggest that the registration can possibly be modified for earlier applications than those currently allowed, adding flexibility to metham-sodium use in transplanted cantaloupe.

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Table 1. Effect of seedbed mulching and metham-sodium rate on yellow nutsedge control in transplanted cantaloupe; Tifton, GA, 2001-2003.¹

<u>Seedbed mulching</u>	<u>Metham-sodium rate²</u>	<u>Yellow nutsedge control</u> (%)
Polyethylene covered seedbeds	nontreated	74
	metham-sodium (½x)	84
	metham-sodium (1x)	85
Bareground seedbeds	nontreated	8
	metham-sodium (½x)	59
	metham-sodium (1x)	75
LSD (0.05)		11

¹ All data are averaged across years and time of metham-sodium fumigation.

² Non-diluted metham-sodium applied with a modified power-tiller and sprayer. Rates: ½x, 40 gal./A; 1x, 80 gal./A. Registered use rate for metham-sodium is 75 gal./A. Sprayer calibration was achieved by altering ground speed. The limited ability to calibrate application equipment spraying non-diluted metham-sodium resulted in slightly different rates from those registered.

Table 2. Effect of time of fumigation and metham-sodium rate on cantaloupe injury and total yield; Tifton, GA, 2001-2003.¹

<u>Time of fumigation</u>	<u>Metham-sodium rate²</u>	<u>Visual injury</u>	<u>Total yield</u>	
		(%)	(no./A)	(lb./A)
3-wk pre-transplant				
	nontreated	0	3,990	27,350
	metham-sodium (½x)	3.6	5,010	35,440
	metham-sodium (1x)	0.7	4,770	33,460
2-wk pre-transplant				
	nontreated	0	4,490	31,210
	metham-sodium (½x)	0	5,510	39,980
	metham-sodium (1x)	0.4	6,470	46,860
1-wk pre-transplant				
	nontreated	0	4,480	35,080
	metham-sodium (½x)	1.1	4,610	32,460
	metham-sodium (1x)	1.8	6,600	47,300
LSD (0.05)		1.4	790	13,130

¹ All data are averaged across years and seedbed mulching.

² Non-diluted metham-sodium applied with a modified power-tiller and sprayer. Rates: ½x, 40 gal./A; 1x, 80 gal./A. Registered use rate for metham-sodium is 75 gal./A. Sprayer calibration was achieved by altering ground speed. The limited ability to calibrate application equipment spraying non-diluted metham-sodium resulted in slightly different rates from those registered.

Table 3. Effect of seedbed mulching on cantaloupe yield; Tifton, GA, 2001 - 2003.¹

	<u>1st harvest</u>	<u>2nd harvest</u>	<u>3rd harvest</u>	<u>4th harvest</u>	<u>5th harvest</u>	<u>6th harvest</u>	<u>Total harvest</u>
	------(no./A)-----						
Polyethylene covered seedbeds	1,490	1,400	1,500	700	390	300	5,770
Bareground seedbeds	820	1,410	1,150	670	220	240	4,530
LSD (0.05)	460	ns	270	ns	160	ns	430

¹All data are averaged across years, time of fumigation, and metham-sodium rates.