YELLOW NUTSEDGE CONTROL WITH METHAM-SODIUM IN TRANSPLANTED CANTALOUPE

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Cucurbit crops grown in the southeastern U. S. are typically transplanted on polyethylene covered seedbeds and much of the acreage is pre-plant fumigated with methyl bromide. Used in this fashion, methyl bromide controls an array of plant pests, including weeds. The major weeds targeted by methyl bromide fumigation are yellow nutsedge (*Cyperus esculentus* L.) and purple nutsedge (*Cyperus rotundus* L.). Uncontrolled perennial nutsedges can pierce and emerge through black polyethylene mulch, effectively competing with transplanted vegetable crops.

Methyl bromide has been shown to deplete stratospheric ozone and all uses are scheduled to be cancelled, with the exception of critical uses defined by the United Nations. Several alternatives to methyl bromide have been identified in vegetable crop transplant production. Metham-sodium was found to be equally effective as methyl bromide in controlling weeds, including yellow and purple nutsedge. Acceptable efficacy was achieved when metham-sodium was sprayed and incorporated with a modified a power-tiller.

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 yellow 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. These trials were conducted represent commercial cantaloupe production in the southeastern U. S. and had heavy natural infestations of yellow nutsedge (>50 plants/m^2).

The experimental design was a randomized complete block, with a factorial arrangement of treatments replicated four times. Treatments included all possible combinations of pre-plant fumigation interval (3-wk, 2-wk, and 1-wk before transplanting cantaloupe), metham-sodium rate (nontreated, 374 L/ha, and 747 L/ha), and seedbed mulching (bareground and black polyethylene mulch covered seedbeds).

Pre-plant 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 61 cm band and incorporate to a depth of 7.6 cm. 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 748 L/ha, compared to the registered rate of 701 L/ha, using a ground speed of 0.9 m/s and spray pressure of 166 kPa. The 374 L/ha metham-sodium rate was achieved by increasing ground speed to 1.8 m/s. Metham-sodium rates are hitherto referred to as ½x and 1x for 374 and 748 L/ha, respectively. Black polyethylene mulch, 1 mil thick and 61cm 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' cantaloupe were seeded in greenhouse trays. Seedlings were established in the field using a transplanter 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 1.8 m wide and 6.1 m long, with cantaloupe seedlings spaced 56 cm apart. Plots were sprinkler irrigated as needed, based on crop and meteorological conditions. Ethalfluralin plus glyphosate were applied to the entire experiment after transplanting for maintenance weed control in the row middles using a hooded sprayer. Excluding weed control, cultural practices and pest management decisions for transplanted cantaloupe were based on recommendations from the Georgia Cooperative Extension Service.

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 four-day intervals, depending on the continued presence of marketable fruits.

Results

Yellow nutsedge control. Over the three year term of this experiment, yellow nutsedge control was not affected by pre-plant fumigation interval (data not shown). However, yellow nutsedge control was affected by interactive effects of metham-sodium and seedbed mulching (Table 1). Metham-sodium at the ½x 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 ½x rate (59%). Interestingly, the ½x rate of metham-sodium with polyethylene mulch covered seedbeds controlled yellow nutsedge 84% compared 75% control from the 1x rate on bareground seedbeds, showing the importance of black polyethylene mulch in metham-sodium efficacy on yellow nutsedge.

Cantaloupe injury. Visual injury was not affected by seedbed mulching (data not shown). However, the interactive effects of pre-plant fumigation interval and metham-sodium rate affected cantaloupe injury (Table 2), although there was very little visual injury from metham-sodium during this three year study.

Cantaloupe yield. Total cantaloupe yield was affected by the interactive effects of pre-plant fumigation interval and metham-sodium rate. Maximum cantaloupe yields were in plots with 1x rate of metham-sodium applied either 1-wk or 2-wk before transplanting, which were also among the most efficacious treatment combinations on yellow nutsedge (Table 2). The lowest cantaloupe yields of all treatments evaluated were generally in the non-treated controls.

Discussion

Yellow nutsedge control. These data show that yellow nutsedge was effectively controlled with metham-sodium when treated seedbeds are covered with black polyethylene mulch. Results from earlier studies suggest that rate, application method, and seedbed coverage affects purple nutsedge control using metham-sodium. Successful control of purple nutsedge in the earlier trials using metham-sodium requires the fumigant to be sprayed at the full rate, soil incorporated, and seedbeds covered with polyethylene mulch. Our results show that the same techniques will allow effective control of yellow nutsedge with metham-sodium.

Black polyethylene mulch alone suppressed yellow nutsedge in our trials. Yellow nutsedge control in nontreated plots covered with polyethylene mulch was 74%, which was similar to 75% control on bareground seedbeds treated with the 1x rate of metham-sodium (Table 1). Previous studies have demonstrated that yellow nutsedge is capable of penetrating opaque mulches, yet >89% of emerged yellow nutsedge shoots remain trapped beneath black polyethylene mulch. Our results suggest that the partial suppression of yellow nutsedge emergence by black polyethylene mulch may be a useful tool in an integrated yellow nutsedge management system 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 pre-plant 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, aggressively vining cucurbit crop like cantaloupe soon after applying polyethylene mulch gives cantaloupe 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.

Cantaloupe injury. Visual stunting from metham-sodium ranged from 0 to 3.6% (Table 2), which is inconsequential. Cantaloupe were transplanted three to eight weeks later than normal for the region. It is possible that the resulting warmer soil conditions may have allowed metham-sodium to dissipate quicker than if applied to cool soils earlier in the season. This may have lessened the chances for metham-sodium phytotoxicity on cantaloupe at the 1-wk and 2-wk applications.

Cantaloupe yield. When cantaloupe yields at individual harvest dates were considered, seedbed mulching was the only treatment variable of significance (Table 3). 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. Greater muskmelon yields were reported in North Carolina from polyethylene mulched seedbeds compared to bareground. This was attributed 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 from seedbed mulching was not due to warmer soil temperatures in mulched plots, but due to overall better yellow nutsedge control in mulched seedbeds compared to bareground seedbeds (Table 1).

Conclusion

These data show the value of metham-sodium and black polyethylene mulch as tools in an integrated yellow nutsedge management system 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 1-wk or 2-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. However, these data suggest that the registration can possibly be modified for earlier applications in temperate regions than those currently allowed, adding flexibility to metham-sodium use in transplanted cantaloupe.

Table 1. Effect of seedbed mulching and metham-sodium rate on yellow nutsedge control in transplanted cantaloupe; Tifton, GA, 2001-2003.[1]

Seedbed mulching	Metham-sodium rate[2]	Yellow nutsedge control
		(%)
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, 374 L/ha; 1x, 748 L/ha. Registered use rate for metham-sodium is 700 L/ha. 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]

Time of fumigation	Metham-sodium rate[2]	Visual injury	Total yield
		(%)	(no./ha)
3-wk pre-transplant			
	nontreated	0	9,860
	metham-sodium (½x)	3.6	12,380
	metham-sodium (1x)	0.7	11,770
2-wk pre-transplant			
	nontreated	0	11,100
	metham-sodium (½x)	0	13,620
	metham-sodium (1x)	0.4	15,970
1-wk pre-transplant			
	nontreated	0	12,050
	metham-sodium (½x)	1.1	11,380
	metham-sodium (1x)	1.8	16,310
LSD (0.05)		1.4	1,950

[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, 374 L/ha; 1x, 748 L/ha. Registered use rate for metham-sodium is 700 L/ha. 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]

	1st harvest	2nd harvest	3rd harvest	4th harvest	5th harvest	6th harvest	Total harvest
	-no./ha-						
Polyethylene covered seedbeds	3670	3450	3700	1720	970	750	14,260
Bareground seedbeds	2030	3490	2850	1660	550	600	11,180
LSD (0.05)	1130	ns	660	ns	390	ns	1050

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