Available online at www.sciencedirect.com
ScienceDirect
Crop Protection 26 (2007) 867–871
Crop Protection
www.elsevier.com/locate/cropro

Yellow nutsedge (*Cyperus esculentus*) control with metham-sodium in transplanted cantaloupe (*Cucumis melo*)

W.C. Johnson III*, B.G. Mullinix Jr.

Research Agron., USDA-ARS and Agric. Res. Statistician, Coastal Plain Exp. Sta., Tifton, Ga 31793-0748, USA

Received 21 August 2006; accepted 21 August 2006

Abstract

Irrigated field trials were conducted from 2001 to 2003 in Tifton, Georgia at the Coastal Plain Experiment Station to determine the optimum combination of pre-plant fumigation interval, metham-sodium dose, and seedbed mulching for yellow nutsedge control in transplanted cantaloupe. The trial evaluated all possible combinations of pre-plant fumigation intervals (1-wk, 2-wk, or 3-wk before transplanting), three metham-sodium doses (nontreated, 374, and 748 l/ha), and seedbed mulching (bareground or black polyethylene mulched seedbeds). Metham-sodium sprayed and soil incorporated at 374 and 748 l/ha effectively controlled yellow nutsedge when seedbeds were covered by black polyethylene mulch, with minimal fumigant phytotoxicity. In contrast, yellow nutsedge control from metham-sodium was reduced when seedbeds were not mulched. Cantaloupe treated either 1-wk or 2-wk before transplanting with metham-sodium at 748 l/ha yielded greater than other treatment combinations. Black polyethylene mulch increased cantaloupe yield when averaged across all possible combinations of pre-plant fumigation intervals and metham-sodium doses, due primarily to improved yellow nutsedge control over bareground seedbeds.
Published by Elsevier Ltd.

Keywords: Metham-sodium; Methyl bromide alternatives; Yellow nutsedge

1. Introduction

Cucurbit crops grown in the southeastern US are typically transplanted on polyethylene covered seedbeds and much of the acreage is pre-plant 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 nutsedge (*Cyperus esculentus* L.) and purple nutsedge (*Cyperus rotundus* L.) (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, b), effectively competing with transplanted vegetable crops.

Methyl bromide (bromomethane) 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 (methylcarbamodithioic acid) was equally effective as methyl bromide in controlling many cool- and warm-season weeds, including yellow nutsedge. Gilreath and Santos (2004) showed that metham-sodium at 945 L/ha effectively controlled purple nutsedge in spring-transplanted bell pepper (*Capsicum frutescens* L.) 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 (*Cucumis melo* L.) and watermelon [*Citrullus lanatus* (Thunb.) Mansf.] (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 US

*Corresponding author. Tel.: +1 229 386 3172; fax: +1 229 386 3437.
E-mail address: cjohnson@tifton.usda.gov (W.C. Johnson III).

0261-2194/$ - see front matter Published by Elsevier Ltd.
doi:10.1016/j.cropro.2006.08.010

regarding doses 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.

2. 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 (fine-loamy, kaolinitic, thermic Plinthic Kandiudults), composed of 88% sand, 6% silt, and 6% clay, with 0.2% organic matter and pH 6.4. These sites represent commercial cantaloupe production in the southeastern US 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 dose (nontreated, 374, 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 (Johnson and Webster, 2001). Non-diluted metham-sodium (Vapam HL®, containing 0.51 kg/L metham-sodium. AMVAC Chemical Corp., 4100 E. Washington Blvd., Los Angeles, CA 90023) was applied in these trials. The only means to control metham-sodium dose 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 dose was 748 L/ha, compared to the registered dose of 701 L/ha (Anonymous, 2005), using a ground speed of 0.9 m/s and spray pressure of 166 kPa. The 374 L/ha metham-sodium dose was achieved by increasing ground speed to 1.8 m/s. Metham-sodium doses are hitherto referred to as $\frac{1}{2}x$ and $1x$ for 374 and 748 L/ha, respectively. Black polyethylene mulch, 1 mil thick and 61 cm 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 (Seminis Inc., 2700 Camino del Sol, Oxnard, CA 93030-7967) were seeded in greenhouse trays (Speedling® Incorporated, P. O. Box 7220, Sun City, FL 33586-7220). Each tray contained 128 cells and each cell was 3.8 × 3.8 cm in dimension. 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 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 (0.6 kg ai/ha) plus glyphosate (1.1 kg ai/ha) were applied to the entire experiment after transplanting for maintenance weed control in the row middles using a hooded sprayer that treated a band 71 cm 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 0–100 (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.

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 dose, and seedbed mulching on yellow nutsedge control, visual injury, and cantaloupe yield. Means were separated using Fisher's Protected LSD ($P \leqslant 0.05$).

3. Results

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

3.1. 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 dose and seedbed mulching (Table 1). Metham-sodium at the $\frac{1}{2}x$ and $1x$ doses controlled yellow nutsedge 84–85%, respectively, when seedbeds were covered with black polyethylene mulch. However, on bareground seedbeds the $1x$ dose of metham-sodium was more effective (75%) in controlling yellow nutsedge than metham-sodium at the $\frac{1}{2}x$ dose (59%). Interestingly, the $\frac{1}{2}x$ dose of metham-sodium with polyethylene mulch covered seedbeds controlled yellow nutsedge 84% compared 75% control from the $1x$ dose on bareground seedbeds, showing the