GEORGIA VEGETABLE EXTENSION-RESEARCH REPORT 2008-2009

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THE UNIVERSITY OF GEORGIA
COOPERATIVE EXTENSION
Colleges of Agricultural and Environmental Sciences & Family and Consumer Sciences

GEORGIA VEGETABLE EXTENSION-RESEARCH REPORT 2008-2009

Edited by George E. Boyhan

The University of Georgia
College of Agricultural & Environmental Sciences
Cooperative Extension Service
Agricultural Experiment Station

Learning for Life

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SOUR SKIN DETECTION IN VIDALIA ONIONS USING HYPERSPECTRAL IMAGING

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Introduction

Sour skin is a common bacterial disease that can affect most onion varieties all over the world (Burkholder 1950; Sotokawa and Takikawa 2004). Because sour skin bacteria have an uncanny ability to survive in moist environments, it is one of the major threats to the sweet onion industry with up to 50% losses in some fields or storage rooms (Howard F. Schwartz 2008). Sour skin bacteria can enter the onion plant when onion tops are cut at harvest, or through other wounds caused by mechanical injuries in the neck area. Infection can also occur via rain splashing of infested soil or by contaminated irrigation water (Gitaitis 1994). Sour skin is often limited in a few inner bulb scales at the early stage, and infection can remain latent until the onion becomes mature (Howard F. Schwartz 2008). Therefore, it is difficult to identify sour skin symptoms from onion surface visually when the disease is in an early or latent stage. Currently, human visual inspection (HVI) is used by most onion-packing houses. Obviously, HVI cannot prevent onions with only internal infections from entering into controlled atmosphere (CA) storage rooms or fresh vegetable markets. In this research, a near-infrared hyperspectral imaging system was developed using a liquid crystal tunable filter (LCTF) and it was applied for sour skin detection in Vidalia onions. A number of preliminary experiments were conducted to test the efficacy of the hyperspectral imaging technology for sour skin detection.

Materials and Methods

Fifty medium size Vidalia sweet onions harvested in 2009 were purchased from two local grocery stores in Athens, Georgia. They were stored in room temperature (22 – 25^{o}C) for 3-6 days before they were tested. Two groups of onions containing 16 onions each were inoculated with a suspension of *B. cepacia* in sterile DI water. The concentration of inoculum used in the study was approximately 1 x 105- 1 x 106 colony-forming-units (CFU)/ml, which is sufficient to induce rot in one week at room temperature. Bacterial suspensions (1-1.5 ml) were infiltrated into bulbs under the first couple of layers at the root cap. Inoculated onions were put into plastic bags individually to avoid cross contamination and stored in an air-conditioned room (20 – 24^{o}C) during the period of testing.

Hyperspectral Imaging System

A near infrared reflectance hyperspectral imaging system was developed for this research. The system consisted of an InGaAs video camera (Model: SU320-1.7rt-

V/Rs170)(Sensors Unlimited, Princeton, NJ) with a spatial resolution of 320×240 pixels in the spectral range of 1000–1600 nm, a normal lens (Micro-Nikkor 55mm f/2.8, Nikon, Japan), a liquid crystal tunable filter (LCTF) (Model NIR 3)(Cambridge Research & Instrumentation, Cambridge, MA) covering a spectral range between 1000 nm and 1800 nm, a frame grabber (Model PX610 from formerly Imagenation, now CyberOptics Semiconductors, Beaverton, OR) for acquiring image data, and two tungsten halogen lamps as light sources (Model PHL300 from Regent Lighting Corp. Burlington, NC). To take transmittance images of sweet onions, onion bulbs were placed between the light source and the HSI imaging system.

In the hyperspectral transmittance test, two medium-sized onions were used. These onions were selected carefully to ensure that they were in good condition and represented normal, healthy onions in general. Onion bulbs were cut in half before scanning and only one half bulb of each onion was used in tests. In each test, the core of the half onion bulb was removed at the beginning. Then, the half bulb was scanned by hyperspectral transmittance imaging system. After each scan, one inner scale (layer) of the half bulb was removed and the bulb was re-scanned, until the bulb only had one inner scale.

In hyperspectral reflectance imaging tests, thirty-two onions were chosen at random and tested. These onions were divided into two groups with 16 onions in each group. All samples were labeled by sequential integer numbers using small paper tags sticking on the neck area of onion bulbs. The side of onion bulb with a paper tag was regarded as the front side, while opposite side was marked as the back side. In each test period (7 days), one group of onions were inoculated and tested. Before the inoculation, each of sixteen onions was scanned twice (front and back sides) as "healthy control onions" by the HSI reflectance imaging system. In one hour after the inoculation, all onions were re-scanned using the HSI system (on both sides) as the samples in "Day 0". In the subsequent 6 days, all onions were scanned once on two sides at every day until obvious sour skin symptoms were apparent on their surfaces. Once disease symptoms were observed, onions were cut in half from the neck to root, and outer layers were peeled away. Each half bulb on the front side of the onion after peeling was re-scanned to observe the infection occurring. Therefore, there were up to 15 HSI images total for each inoculated onion in the study. The onions of the second group were used to repeat the experiment following the same procedure as described above.

All hyperspectral images were preprocessed to obtain relative reflectance images. The white reference images were obtained by scanning a Spectralon panel (120mm×120 mm, from Labsphere, North Sutton, NH), which has up to 99% reflectance efficiency in the spectral range of this study (1000-1600 nm). Dark images were acquired by taking images when the lens was completely covered by its cap. The corrected reflectance image (IR) was calculated by subtracting dark images from raw images and white reference images and calculating their ratio.

Results and Discussion

A number of hyperspectral reflectance and transmittance imaging tests were conducted to explore useful image and spectral features for indentifying sour skin in sweet onions. The result from transmittance spectra indicated that the light source used in this study could penetrate three layers with good transmittance while the transmittance was significantly reduced with four layers or more. The hyperspectral reflectance tests proved that a sour skin infected region was darker than healthy flesh region, and the best contrast was observed in the spectral region of 1200-1300 nm as shown in Figure 1. Moreover, a better contrast between Vidalia sweet onion surface dry layer and inner fresh layers in HSI images was found in spectral region of 1400-1500 nm. These image features are useful for developing a pattern classifier based on image processing methods. Mean reflectance spectra from a sour skin infected area of HSI images of one sour skin onion also indicated that there was a significant difference sensed by HSI reflectance spectra in the spectral region of 1150-1280 nm when the onion was stored 3 days after being inoculated. The results of this study proved that the hyperspectral imaging technique is promising to be used to detect the sour skin in Vidalia sweet onion bulbs. Future work includes carrying out more tests to extract and select useful features, developing effective classification models to classify healthy and sour skin infected Vidalia sweet onions.

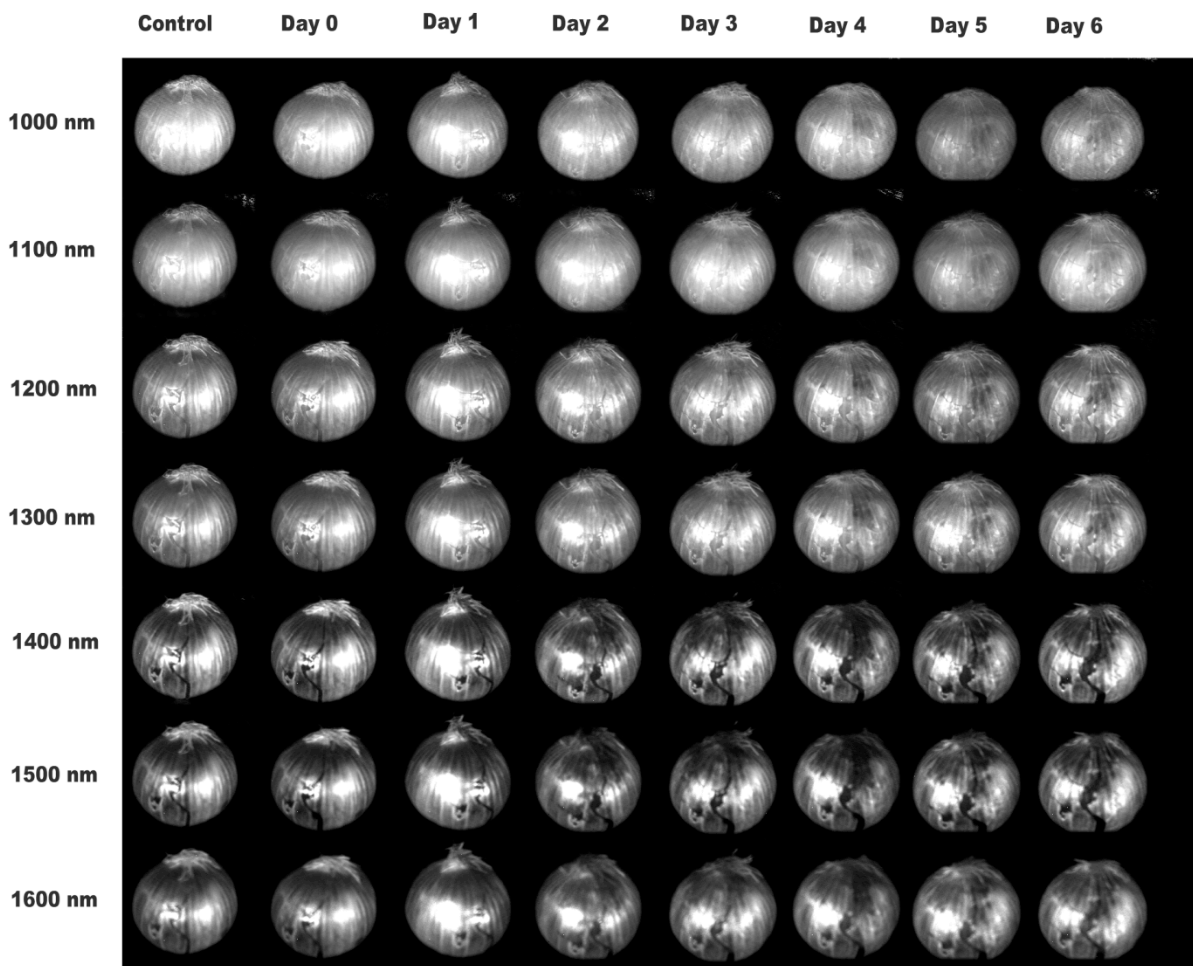

Fig. 1. Hyperspectral images of an onion at multiple wavelengths (1000-1600nm) on different days after inoculation (before inoculation, day 0, day 1 to day 6 after inoculation with sour skin inoculum)

Literature Cited

Burkholder, W. H. (1950). "Sour Skin, a Bacterial Rot of Onion Bulbs." Phytopathology, 40(1), 115-117.

Gitaitis, R. D. (1994). "Bacteriology results, 1993 onion trials." University of Georgia, College of Agriculture and Environmental Sciences, Cooperative Extension Service., Athens, Ga.

Howard F. Schwartz, S. K. M. (2008). Compendium of Onion and Garlic Diseases and Pests .

Sotokawa, N., and Takikawa, Y. (2004). "Occurrence of bacterial rot of onion bulbs caused by Burkholderia cepacia in Japan." J Gen Plant Pathol, 70, 348–352.

BELL PEPPER TOLERANCE TO DUAL MAGNUM APPLIED TOPICALLY

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Introduction

A Georgia Fruit and Vegetable Growers Association third party registration provides Georgia growers with a label for Dual Magnum (*S*-metolachlor) in bell pepper. This label currently allows preplant applications of Dual Magnum prior to transplanting bell pepper. Research has shown that preplant applications can occasionally reduce plant vigor when applied at high rates (≥14 fl oz) or during extremely cool moist environments. The objective of this study was to 1) determine the tolerance of bell pepper to topical applications of Dual Magnum and to 2) determine if sequential low rate applications of Dual Magnum would eliminate plant vigor concerns while providing improved weed control.

Materials and Methods

Two experiments were conducted during the spring of 2009 at the University of Georgia Ponder farm near Ty Ty, GA. Pic Chlor 60 at 21 GPA was applied over the trial area to remove nematodes and diseases. A factorial arrangement of treatments including three preplant herbicide options (no herbicide, Eptam 7 E at 3 pt/A, or Eptam 7 E at 3 pt/A plus Dual Magnum at 12 oz/A) and two topical herbicide options (no herbicide or Dual Magnum at 12 oz/A) were implemented across four replications (Table 1). Preplant herbicides were applied immediately before laying low density polyethylene mulch at 25 GPA while topical applications were made one to three weeks after transplanting at 15 GPA. Plot size was one raised 32 inch wide mulched bed with two rows of pepper by 20 feet in length and Aristotle bell pepper were transplanted two to three weeks after fumigating and applying preplant herbicides.

Soil for both studies included a Tifton sandy loam soil containing 88 to 92% sand and approximately 1% organic matter. Pepper stand, visual crop response, and weed emergence were measured throughout the season. Jumbo fruit from the entire plot were harvested for four consecutive weeks using a grower's harvesting crew.

Results and Discussion

Visual injury and pepper stand: Less than 5% visual reduction in pepper plant growth was noted throughout the season with any treatment (Table 1). Additionally, topical applications of Dual Magnum did not speckle or spot pepper leaves which is often observed with topical applications in other crops. Similar to visual injury, herbicide treatments did not impact plant stand (data not shown).

Broadleaf signalgrass and livid amaranth control: Plant populations from both of these weed species were light ranging from 3383 to 3700 plants per acre when herbicides were not applied (Table 1). These weeds are not capable of penetrating the mulch and only emerged from the plant hole. Eptam applied preplant only reduced weed emergence 17 to 38% at first harvest. Topical applications of Dual Magnum, without preplant applications, were more effective than Eptam by reducing weed emergence at least 70%. The signalgrass and amaranth that had emerged in the plant hole prior to the Dual Magnum application were not controlled as the herbicide only provides residual weed control. Combinations of Eptam plus Dual Magnum preplant provided complete weed control regardless of a Dual Magnum topical application.

Jumbo pepper fruit yield: Pepper were harvested four times during the season for Jumbo fruit only. Neither herbicide injury nor lack of weed control impacted yield (Table 1). It is likely that yield was not impacted by weeds because of the low number of plants per given area. In addition, as noted with the Dual Magnum POST application, most weeds emerged at least two weeks after transplanting providing the bell pepper with little early season weed competition.

Conclusions: Bell pepper are tolerant to topical applications of Dual Magnum. A more effective and less risky weed management program may be sequential low rate applications of Dual Magum such as 6 to 8 oz/A preplant followed by 10 to 12 oz/A applied topically within two weeks of transplanting.

Table 1. Bell pepper and weed response to Eptam and Dual Magnum herbicide systems.[1]

Preplant Herbicide Option[2]	Topical Herbicide Option[2]	Visual herbicide injury (%)		Broadleaf signalgrass (# plant/A)	Livid amaranth (# plant/A)	Jumbo pepper (4 harvests)
		3 WAP[3]	5 d POST[3]	At 1st harvest	At 1st harvest	lbs fruit/A
None	None	0 a	0 a	3383 d	3700 d	13,608 a
Eptam	None	3 a	0 a	2114 c	3071 c	13,808 a
Eptam + Dual Mag.	None	4 a	0 a	0 a	0 a	14,208 a
None	Dual Mag.	0 a	0 a	960 b	1110 b	13,949 a
Eptam	Dual Mag.	4 a	0 a	884 b	1110 b	12,517 a
Eptam + Dual Mag.	Dual Mag.	3 a	0 a	0 a	0 a	14,801 a

[1]Values within a column followed by the same letter are not different at $P = 0.05$. Data for injury and yield combined over locations. Weeds present at only one location.
[2]Preplant herbicide applications made immediately prior to laying low density polyethylene mulch and two to three weeks prior to transplant. Topical herbicide applications were made two to three weeks after transplanting.
[3]Abbreviations: 5 d POST = evaluation taken 5 days after topical Dual Magnum application; 3 WAP = evaluation 3 weeks after transplanting.

EFFECTS OF ADJUVANTS ON THE EFFICACY OF CORAGEN AND SYNAPSE AGAINST DIAMONDBACK MOTH IN CABBAGE

Cabbage - DBM - Coragen/Synapse +/- DyneAmic - Lang Farm, 2009

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Introduction

Coragen and Synapse are two new insecticides that have shown excellent control of caterpillar pests. Both products have been reported to perform better when mixed with a penetrating adjuvant. This test was conducted to evaluate the efficacy of these two products, with and without a adjuvant, against diamondback moth on cabbage.

Materials and Methods

A small plot efficacy trial was conducted in cabbage at the University of Georgia's Lang Farm in Tifton, Georgia. Plots measured one row (36 inches) by 19 feet. The test was established as a randomized complete block design with four replications. Insecticide treatments were applied on 29 April and 15 May, 2009. Applications were made with a CO_2 pressurized backpack sprayer (60 psi) in 40 gpa with 3 hollow-cone nozzles per row (one over-the-top; 2 on drops). Treatments evaluated were:

Coragen 1.67SC at 5 oz/ac with and without DyneAmic at 0.5% v/v,
Synapse 24WG at 2 oz/ac with and without DyneAmic at 0.5% v/v,
Radiant 1SC at 6 oz/ac (included as a standard),
And a non-treated Check.

Five randomly selected plants in each plot were visually searched on each sample date to determine insect densities. All caterpillars found were identified and counted. Diamondback moth was the predominant species and is the only one for which data is reported. Data were analyzed with the PROC ANOVA procedure of PC-SAS. Where significant differences were detected ($P<0.05$), means were separated with LSD ($P=0.05$).

Results:

All insecticide treatments tested provided good control of DBM. Following the first application there was a trend for both Coragen treatments and the Synapse+DyneAmic treatment to provide longer residual activity. This difference did not appear after the second application (DBM populations were in decline after the second application).

Table 1. Cabbage Efficacy Trial, Lang Farm, Tifton, Georgia, 2009.

Treatment	Number of Diamondback moth larvae per five plants										
	1 May	5 May	8 May	11 May	13 May	15 May	20 May	22 May	26 May	28 May	1 June
	2 DAT-1	6 DAT-1	9 DAT-1	12 DAT-1	14 DAT-1	16 DAT-1	5 DAT-2	7 DAT-2	11 DAT-2	13 DAT-2	17 DAT-2
Check	12.50 a	12.8 a	10.75 a	14.75 a	13.00 a	19.75 a	23.75 a	22.25 a	10.50 a	6.75 a	8.00 a
Radiant	1.50 b	0.75 b	4.25 bc	4.00 b	3.75 bc	9.75 b	3.25 b	4.25 b	2.50 b	1.25 b	1.25 b
Synapse	2.00 b	2.75 b	6.25 b	0.75 b	6.50 b	8.75 b	4.50 b	4.50 b	1.25 b	1.00 b	0.75 b
Synapse +DyneAmic	2.00 b	0.50 b	6.00 b	1.25 b	2.25 c	6.25 bc	5.75 b	3.50 b	0.25 b	0.00 b	0.50 b
Coragen	3.00 b	0.75 b	5.75 b	0.25 b	1.75 c	2.25 c	2.50 b	0.50 b	0.25 b	0.00 b	0.50 b
Coragen +DyneAmic	3.25 b	1.00 b	1.75 c	1.00 b	1.75 c	3.75 c	3.25 b	1.50 b	1.25 b	0.50 b	0.00 b

EFFICACY OF INSECTICIDE DRENCHES FOR MANAGEMENT OF SILVERLEAF WHITEFLY ON SNAP BEANS

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Introduction

In much of the snap bean production in Georgia, the silverleaf whitefly is an inconsistent pest and growers monitor populations and apply insecticides as needed. As this pest appears to becoming a more consistent pest of fall grown snap beans, there is a greater potential for preventive use of systemic insecticides. This test was conducted at the University of Georgia's Tifton Vegetable Park in Tifton, Georgia, to evaluate the efficacy of selected systemic insecticides applied as a row drench for control of silverleaf whitefly on snap beans.

Materials and Methods

Snap beans were direct seeded on single rows on 6 foot beds. Plots were a single row (treated as 36 inch rows) by 22 feet and were arranged in a randomized complete block with four replications. Insecticides evaluated were Admire Pro (at 7 oz/ac), Platinum (at 11 oz/ac), Venom (at 5 oz/ac), Coragen (at 5 oz/ac), and Durivo (at 11 oz/ac). All treatments, except Admire Pro, were evaluated as a single at-planting drench and as a delayed drench application. Admire Pro was evaluated only as an at-planting drench. A non-treated control was included for comparison.

At-planting applications were applied as a row drench on 26 August, 2009. After planting, the treatments were applied in 3 liters of water per plot in a roughly 4 inch band. The delayed applications were made in a similar manner on 10 September, 2009 (15 days after planting). Rates for all treatments were calculated based on area of the plot (36 inch row by 22 feet).

Whitefly nymph densities were monitored on five leaves selected from each plot on each sample date. Leaves were removed from the plants and taken to the laboratory for counts. Each leaf was placed under a dissecting scope and the nymphs in a single field (10X ocular, 20X magnification, circle of 15/32 inch diameter) on each leaf were counted. Nymphs were classified as small (assumed 1st and 2nd instar) or large (assumed 3rd and 4th instar). Unifoliate leaves were sampled on 11, 18 and 24 September. First trifoliate leaves were sampled on 25 and 30 September.

Whitefly adult emergence from treated leaves was also monitored as a measure of efficacy. Ten leaves were collected from each plot and held in paper bags to allow later instar nymphs to complete development and emerge. The bags were held long enough to allow emergence and death of the adults. Adult whiteflies in each bag were then counted. Counts of about 100 or less were directly counted under a dissecting scope. In plots with high numbers of emerging adults, the number of adults were estimated based on the volume of adults (aspirated and "compressed" in a pipette; 9445 adults per milliliter based on research by Sparks). Unifoliate leaves were sampled on 24 September. First trifoliate leaves were sampled on 30 September.

All Data were analyzed with the PROC ANOVA procedure of PC-SAS. Where significant differences were detected (P<0.05), means were separated with LSD (P=0.05).

Results and Discussion

Pest pressure was heavy during this trial. Because the insecticides evaluated are systemic, the eggs must hatch, nymphs emerge and feed before mortality can occur. Therefore, small nymphs (and total nymphs) are probably not a proper stage for evaluation as this would include nymphs which have not had adequate time for mortality. Therefore, this discussion is based on the large nymphs. In general, activity was detected only with the at-planting applications, with the exception of the delayed Venom application. All of the insecticides applied at-planting, except Admire, showed significant reductions through 29 days after application (24 Sept.). In the delayed applications, only Venom showed significantly reduced populations and only at 8 days after application (18 Sept.). Because of high variability, no significant differences were detected in adult emergence on either sample date. However, numerical trends on 24 September are similar to trends in the nymphs counts. The Venom, Coragen and Durivo at-planting and the Venom delayed application showed an obvious, but not statistically significant, reduction in adult emergence.

The at-planting applications appear to have worked better than delayed applications (Admire and Platinum probably worked well early, but played out earlier than the other insecticides because of more severe resistance; this assumption is supported by data from other trials). The fact that Venom worked better in the delayed application could be a result of quicker uptake. That said – the method of evaluation may have masked efficacy in the delayed applications. While the at-planting applications should have had insecticide distributed throughout the plant (it was present from planting), the delayed application may have effected distribution. At the time of the delayed application, the leaves ultimately sampled were already developed and may not have picked up as much insecticide as younger leaves. However, if this is the problem, it would also present a problem in commercial fields.

Snap bean insecticide drench trial, silverleaf whitefly, Tifton Vegetable Park, Tifton, Georgia, 2009.

Treatment	Application timing	Number of adults emerged per sample 24 Sept	30 Sept
Check		62.00 a	1005.30 a
Admire	at planting	55.25 a	2589.00 a
Platinum	at planting	26.75 a	725.00 a
Venom	at planting	3.75 a	1075.50 a
Coragen	at planting	3.50 a	522.30 a
Durivo	at planting	9.50 a	1442.30 a
Platinum	delayed	95.00 a	2344.50 a
Venom	delayed	12.25 a	1444.00 a
Coragen	delayed	44.00 a	1653.50 a
Durivo	delayed	85.75 a	2156.30 a
	Days after at-planting application	29	35
	Days after delayed application	14	20

Snap bean insecticide drench trial, silverleaf whitefly, Tifton Vegetable Park, Tifton, Georgia, 2009.

Treatment	Application timing	Number of SLWF large nymphs (3rd-4th instar) per 5 fields 11 Sept	18 Sept	24 Sept	25 Sept	30 Sept
Check		20.75 ab	39.00 a	135.75 a	45.75 a	65.00 a
Admire	at planting	26.25 a	50.25 a	114.50 a	17.50 a	66.50 a
Platinum	at planting	10.75 bc	2.75 b	33.75 bcd	27.50 a	35.25 a
Venom	at planting	8.00 c	1.00 b	12.00 d	5.50 a	22.50 a
Coragen	at planting	6.75 c	8.75 b	26.50 cd	26.50 a	50.50 a
Durivo	at planting	10.75 bc	3.00 b	32.50 cd	46.50 a	73.25 a
Platinum	delayed	27.00 a	46.25 a	97.25 abc	32.00 a	89.25 a
Venom	delayed	24.50 a	11.75 b	98.25 abc	10.25 a	48.00 a
Coragen	delayed	21.25 ab	39.75 a	105.00 ab	53.00 a	62.75 a
Durivo	delayed	24.50 a	43.50 a	110.00 a	33.25 a	63.00 a
Days after at-planting application		16	23	29	30	35
Days after delayed application		1	8	14	15	20

EFFICACY OF FOLIAR APPLIED INSECTICIDES FOR MANAGEMENT OF SILVERLEAF WHITEFLY ON SNAP BEANS

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Introduction

The silverleaf whitefly, *Bemisia tabaci*, has been a severe problem in fall snap bean production in recent years, with populations exceeding damaging levels in areas outside of the historic geographical pest range of this species within Georgia. For a variety of reasons, growers in these areas do not typically use systemic insecticides for management. This test was conducted at the University of Georgia's Tifton Vegetable Park in Tifton, Georgia, to evaluate foliar applied insecticides for efficacy against silverleaf whitefly on snap beans.

Materials and Methods

Snap beans were direct seeded into one row plots on 6 foot beds (insecticide treatments were applied as three foot rows). Plots were one row by 22 feet and were arranged in a randomized complete block design with four replications. Treatments were applied with a CO2 pressurized backpack sprayer (60 PSI) in 40 GPA of water, with 3 hollow-cone nozzles per row (one over-the-top, 2 on drops). Treatments were applied on 22 and 29 September, 2009. Treatments evaluated were:

Bifenthrin at 0.1 lb AI/ac tank mixed with Orthene 0.5 lb AI/ac
Movento at 4 and 5 oz/ac + MSO at 0.5%.
Knack at 8 oz/ac
Courier 40SC at 13.6 oz/ac
Venom at 4 oz/ac
Coragen at 5 oz/ac + MSO at 0.5%.
Requiem 25EC at 2 qts/ac
Assail 30SG at 4 oz/ac
Non-treated Check

Five plants were randomly selected in each plot on 1 Oct. for direct counts of whitefly nymphs. The first trifoliate was removed from each plant and taken to the laboratory for insect counts. Each leaf was placed under a dissecting scope and the nymphs in a single field (10X ocular, 20X magnification, circle of 15/32 inch diameter) on each leaf were counted. Nymphs were classified as small (assumed 1st and 2nd instar) or large (assumed 3rd and 4th instar).

Adult emergence from treated leaves was monitored after the second application. Leaves were collected from each plot and held in a paper bag to allow for late instar nymphs to complete development and for adults to emerge and die. All adults in the bag were then counted. If the number of adults was relatively small (< 150), the adults were directly counted. If adults were numerous, the number was estimated based on volume (9445 adults per milliliter based on research by Sparks). Ten trifoliate leaves were collected on 1 Oct. and 5 first trifoliate leaves were collected on 7 Oct.

Visual plot efficacy ratings were also conducted on 7 October. Five plants were pulled from each plot and visually examined. Based on the relatively populations of nymphs on these plants, plots were rated as follows:

0 = no control
1 = suppression of whitefly
2 = fair control (obvious suppression, but not adequate)
3 = good control
4 = excellent control

All data were analyzed with the PROC ANOVA procedure of PC-SAS. Where significant differences were detected (P<0.05), means were separated with LSD (P+0.05).

<u>Results and Discussion</u>

Pest pressure was heavy during this test. Within the nymph count data, emphasis is placed on late instar nymphs, as early instar counts (and thus total) includes individuals which may have recently hatched and not had sufficient exposure for mortality.

The trends across the various data are similar. In general, the best control was obtained with Movento followed by Knack and Courier. Knack has fairly high nymph counts and poor efficacy rating, however, this can be explained by its activity. It works primarily on eggs and last instar nymphs; thus nymphs are present in direct counts and efficacy ratings (based on nymph presence) but do not emerge (thus low adult emergence). Of the remaining insecticides, Venom provided significant suppression (but inadequate control) of large nymphs and emerged adults and was rated as fair control on plot ratings.

The lack of control with Bifenthrin+Orthene is likely a result of resistance. The lack of control with foliar neonicotinoid insecticides in snap beans has been noted previously.

Snap bean foliar insecticide trial, silverleaf whitefly, Tifton Vegetable Park, Tifton, Georgia, 2009.

Treatment	Number of nymphs per 5 fields on 1 Oct.			Number of emerged adults per sample		Efficacy rating
	Small nymphs	Large nymphs	Total nymphs	1 Oct.	7 Oct.	7 Oct.
Check	25.25 de	163.25 ab	188.50 ab	2207.8 a	2833.0 a	0.50 d
Bifenthrin	42.25 bcd	133.75 bc	176.00 abc	1342.8 ab	2715.3 a	0.50 d
Requiem	36.25 bcde	194.50 a	230.75 a	1511.0 a	2361.0 ab	0.50 d
Coragen	26.50 cde	129.25 bc	155.75 bcd	1334.0 ab	1254.8 bc	1.50 c
Assail	20.50 de	165.25 ab	185.75 ab	1912.5 a	2361.3 ab	0.75 d
Venom	81.75 a	80.00 cde	161.75 bcd	569.0 bc	506.5 c	2.38 b
Courier	50.25 bc	57.25 def	107.50 de	371.5 c	34.8 c	3.00 b
Knack	15.75 e	105.00 cd	120.75 cde	110.5 c	5.8 c	1.00 cd
Movento 4oz	32.75 bcde	24.25 ef	57.00 e	3.3 c	475.3 c	4.00 a
Movento 5oz	52.25 b	18.25 f	70.50 e	6.3 c	5.8 c	4.00 a
Days after first/second application		10/3		10/3	16/9	16/9

EFFICACY OF SOIL AND FOLIAR APPLIED INSECTICIDES AGAINST SILVERLEAF WHITEFLY IN SNAP BEANS

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Introduction

Silverleaf whitefly, *Bemisia tabaci*, is a severe pest of snap beans grown in the fall in some areas of south Georgia. It appears to be emerging as a more consitent pest in areas outside of historical problems. This test was conducted at the University of Georgia's Tifton Vegetable Park to evaluate the efficacy of insecticides against this pest.

Materials and Methods

Snap beans (variety: Nash) were direct seeded on 3 Sept. 2009 into single rows on 6 foot beds. Experimental plots were one row (treated as 3 feet) by 23 feet long and were arranged in a randomized complete block design with four replications. Treatments evaluated included soil applied insecticides and foliar applied insecticides. The soil applied insecticides were applied as a drench treatment on 5 Sept. Each plot was treated with the designated amount of insecticide applied in 3 liters of water poured in a four inch band along the row. After application of these insecticides, the entire test was watered with a roughly 12 inch band over the row with 50 gallons of water per 500 feet of row. Foliar applications were made on 19 and 26 Sept. and 2 and 10 Oct. (four weekly applications). Foliar applications were made with a CO_2 pressurized backpack sprayer (60 PSI) in 40 GPA with 3 hollow-cone nozzles per row (one over-the-top, two on drops). All foliar treatments included a tank mix with DyneAmic at 0.25% v/v.

Soil applied insecticides evaluated were: Venom 70SG at 6 oz/ac and Coragen 1.67SC at 5 oz/ac. Foliar applied insecticides were: Leverage at 3.5 oz/ac, Oberon 2 SC at 8.5 oz/ac, Movento at 5 oz/ac, Knack at 8 oz/ac, Assail 30SG at 4 oz/ac, Courier 40SC 13.6 oz/ac, Rimon at 12 oz/ac, and Bifenthrin 2EC at 6.4 oz/ac. A non-treated check was included for comparison.

Immature whitefly densities.

One leaf was selected from each of three randomly selected plants in each plot on each sample date. Leaves were selected based on age and potential for established immature whitefly populations (older leaves). Each leaf was examined under a stereo-microscope at15x magnification and a single field of view was counted for whitefly immature stages. Eggs, small nymphs (1^{st} and 2^{nd} instars) and large nymphs (3^{rd} and 4^{th} instars) were counted (some stages were not counted on some dates as age of the population on the selected leaf minimized the numbers of that stage).

Adult whitefly emergence. Infested leaves or plants were collected on three dates and held in paper bags for emergence of adults. On 8 Oct., ten first-trifoliate leaves were collected from each plot (unifoliate leaves were targeted, but miscommunication resulted in selection of trifoliate leaves). On 15 and 23 Oct., three plants were randomly selected from each plot and held for adult emergence. Leaves/plants were held long enough to allow for emergence and death of adults from the later instar nymphs present at the time of collection. The samples were then examined for adult whiteflies and the number of adults was counted or estimated for each sample. Where adult densities were low (less than 300), whiteflies were directly counted. Where densities were high, the adults were sucked into a pipette to determine volume and the numbers estimated based on 9445 adults per ml (based on published data).

Leaf damage from cucumber beetle adults was evident throughout the test. On 3 Oct., each plot was visually examined and the number of Aspots@ within the plot with obvious beetle feeding was counted.

All data were analyzed with the PROC ANOVA procedure of PC-SAS. Where significant differences were detected (P<0.05), means were separated with LSD (P = 0.05). Adult emergence data was analyzed as raw numbers and after data transformation (Log of X+1) to account for extreme variability in some treatments (particularly among treatments that did not provide excellent control).

Results and Discussion

Whitefly eggs.

No significant effects were detected in egg densities until after the 3rd application, when Knack had significantly more eggs than all other treatments including the Check. This is normal with this product as it prevents eggs from hatching and results in accumulation of eggs.

Small nymphs.

The soil applied drench treatments showed significant reductions in egg counts at 22 and 27 days after treatment (25 and 30 Sept.). Foliar treatments had relatively minor effects until after the 4th application (a few were significant after the second, but relatively minor reductions). On Oct. 14, only Movento, Knack, Courier and Oberon showed significantly lower small nymph densities than the Check.

Large nymphs.

Low populations and variability prevented detection of any differences after the first application. Coragen appeared to provide good suppression of populations through 33 days after application (6 Oct.). Among the foliar treatments, Leverage and Brigade actually resulted in increased densities after the 3rd application. Rimon, Oberon, Courier, Knack, and Movento reduced densities by the 4th application, with Courier and Movento showing significant reductions after the 2nd application.

Adult emergence.

Soil drench treatments did not show significant effects, but the first sample was collected 35 days after treatment. Mean separations of the transformed data (Log of X+1) indicate the best and longest suppression of adult emergence with Courier, Knack and Movento, followed by Rimon and Oberon. Assail separated from the Check on a single date, whereas, Leverage and Brigade were not significantly different from the Check.

Egg counts and small nymph counts appear to be poor indicators of efficacy for most of these products (possible exception of soil drench products). Whitefly populations were not evaluated soon enough to determine the efficacy and residual of the Venom soil drench, but Coragen did appear to provide significant reductions at least through 33 days after treatment. (Venom may have performed poorly, as did Assail - this effect on snap beans has been previously noted for neonicotinoid insecticides but can not be explained). The best control in this test was provided by Movento, Courier and Knack. Oberon and Rimon also showed significant reductions, but were not as consistent. Assail provided minimal control on snap beans (yet continues to work on squash). Leverage and Brigade provided no control (indicating probably pyrethroid resistance in the whitefly population).

Cucumber beetle adult feeding.

The greatest suppression of beetle feeding was seen with the pyrethroid insecticides (Brigade and Leverage [which contains baythroid]) and Assail, which were the only treatments significantly different from the Check.

Snap bean test, TVP, 2008.

Treatment	SLWF eggs per 3 fields of view			No. of beetle damaged spots per plot
	Unifoliate leaves		First trifoliate	
	25 Sept.	30 Sept.	6 Oct.	3 Oct.
	6 DAT-1	4 DAT-2	4 DAT-3	1 DAT-3
Check	118.00 a	68.50 a	102.50 b	13.50 ab
Knack	107.00 a	101.00 a	177.50 a	9.75 abc
Assail	135.33 a	90.25 a	92.50 bc	5.50 cde
Venom (soil)**	60.00 a	49.50 a	92.50 bc	15.00 a
Coragen (soil)**	45.33 a	67.00 a	77.50 bc	12.25 ab
Oberon	106.00 a	82.75 a	77.00 bc	10.50 abc
Courier	173.33 a	65.75 a	75.00 bc	8.75 bcd
Rimon	80.00 a	78.00 a	68.50 bc	11.50 ab
Brigade	117.33 a	89.50 a	67.50 bc	1.50 e
Movento	71.33 a	51.50 a	66.50 bc	11.25 ab
Leverage	116.67 a	60.00 a	53.00 c	4.00 de

Numbers within columns followed by the same letter are not significantly different (LSD; P=0.05).
** Days after treatment for the soil applied treatments were:
25 Sept. = 22 days
30 Sept. = 27 days
6 Oct. = 33 days

Snap bean test, TVP, 2008.

Treatment	SLWF small nymphs per 3 fields of view			
	Unifoliate leaves		First trifoliate	
	25 Sept.	30 Sept.	6 Oct.	14 Oct.
	6 DAT-1	4 DAT-2	4 DAT-3	4 DAT-4
Check	218.75 a	302.50 ab	153.00 a	116.00 a
Venom (soil)	73.25 c	112.75 e	164.50 a	125.00 a
Coragen (soil)	97.75 bc	56.75 e	132.00 a	129.00 a
Leverage	233.25 a	280.00 abcd	87.75 a	80.50 abc
Brigade	198.50 a	272.50 abcd	156.50 a	110.00 a
Assail	247.00 a	297.50 abc	150.00 a	87.50 ab
Rimon	178.75 ab	210.00 d	141.50 a	70.00 abcd
Oberon	209.25 a	215.00 cd	135.00 a	21.00 bcd
Courier	168.25 ab	297.50 abc	195.00 a	18.50 bcd
Knack	204.50 a	317.50 a	52.50 a	5.00 cd
Movento	183.00 a	222.50 bcd	100.25 a	0.00 d

Numbers within columns followed by the same letter are not significantly different (LSD; P=0.05).
** Days after treatment for the soil applied treatments were:
25 Sept. = 22 days
30 Sept. = 27 days
6 Oct. = 33 days
14 Oct. = 41 days

Snap bean test, TVP, 2008.

Treatment	SLWF large nymphs per 3 fields of view				
	Unifoliate leaves			First trifoliate	
	25 Sept.	30 Sept.	6 Oct.	6 Oct.*	14 Oct.
	6 DAT-1	4 DAT-2	4 DAT-3	4 DAT-3	4 DAT-4
Check	7.00 abc	27.50 abc	150.25 cd	22.00 a	205.75 ab
Venom (soil)	2.00 abc	17.25 bcd	118.50 cde	23.25 a	232.50 a
Coragen (soil)	0.00 c	0.25 d	13.50 f	9.25 a	81.00 cde
Leverage	8.25 ab	32.75 abc	262.50 ab	21.00 a	125.00 abcd
Brigade	8.00 ab	37.00 ab	262.75 a	49.50 a	175.00 abc
Assail	9.50 a	38.25 a	164.00 cd	45.25 a	105.25 bcde
Rimon	1.50 bc	25.00 abc	53.50 ef	17.00 a	74.75 cde
Oberon	2.00 abc	15.75 cd	77.25 def	57.00 a	41.50 de
Courier	1.00 bc	1.75 d	9.25 f	27.50 a	4.00 e
Knack	9.25 a	28.75 abc	172.25 bc	53.75 a	14.00 e
Movento	0.25 c	0.50 d	0.00 f	0.00 a	0.00 e

Numbers within columns followed by the same letter are not significantly different (LSD; P=0.05).
* Differences were detected at P=0.1
** Days after treatment for the soil applied treatments were:
25 Sept. = 22 days
30 Sept. = 27 days
6 Oct. = 33 days
14 Oct. = 41 days

Snap bean test, TVP, 2008.

Treatment	Number of SLWF adults emerged					
	Per 10 trifoliates		Per 3 plants			
	8 Oct. (6 DAT-3)		15 Oct. (5 DAT-4)		23 Oct. (13 DAT-4)	
	Adults	Log (X+1)	Adults	Log (X+1)	Adults	Log (X+1)
Check	289.75 ab	5.61 a	1794.5 abc	7.36 a	1652.8 abc	7.36 a
Venom (soil)	147.25 bcd	4.83 a	1959.8 ab	7.36 a	3329.3 a	7.71 a
Coragen (soil)	132.25 bcd	4.73 a	1265.0 abc	6.66 ab	1652.8 abc	7.32 a
Leverage	156.25 bcd	4.64 a	2550.3 a	7.32 a	1048.8 bc	6.62 a
Brigade	341.00 a	5.63 a	2314.0 a	7.55 a	2608.8 ab	7.22 a
Assail	77.75 cd	3.08 b	1818.3 abc	7.43 a	1251.8 bc	6.82 a
Rimon	122.50 bcd	4.69 a	354.3 bc	5.17 bc	79.8 c	4.38 b
Oberon	191.50 abc	4.91 a	308.5 bc	4.83 c	61.0 c	3.82 b
Courier	15.25 d	2.05 b	11.3 c	2.22 de	8.5 c	2.00 c
Knack	9.50 d	2.09 b	11.3 c	2.40 d	5.5 c	1.65 c
Movento	8.00 d	2.00 b	1.8 c	0.72 e	33.5 c	2.00 c

Numbers within columns followed by the same letter are not significantly different (LSD; P=0.05).
* Differences were detected at P=0.1
** Days after treatment for the soil applied treatments were:
8 Oct. = 35 days
15 Oct. = 42 days
23 Oct. = 51 days

EFFICACY OF INSECTICIDE DRENCHES AGAINST CATERPILLAR PESTS OF COLE CROPS

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Introduction

The caterpillar complex is the key arthropod pest of cole crops in Georgia. This complex consists primarily of diamondback moth, cabbage looper and imported cabbageworm. While these pests have historically been managed with foliar insecticides, a newly registered insecticide chlorantraniliprole, has shown good efficacy as a soil applied systemic insecticide. This active ingredient is available as a single product (Coragen) or as a pre-mix (Durivo; mixed with thiomethoxam). Another active ingredient (HGW86) being developed within this chemistry has shown similar promise. This test was conducted to evaluate the efficacy and residual control of caterpillar pests with these products applied as a transplant drench.

Materials and Methods

Collards were transplanted into single rows on six foot beds at the University of Georgia's Horticulture Farm in Tifton, Georgia. Plots were established in a randomized complete block design with four replications. Each plot was a single row with 12 plants. Plants were transplanted with a 1.5 foot in-row spacing to aid in pest monitoring; however, insecticide rates per plant were calculated based on the more common 12 inch in-row spacing. Treatments evaluated were: Coragen 1.67SC at 0.066, 0.088 and 0.1 lb AI/ac, HGW 86 (200g AI/l) at 0.066, 0.134 and 0.176 lb AI/ac, Platinum 2SC at 11 oz/ac, Durivo at 10.3 and 13 oz/ac, and two experimental products. Platinum was not expected to show activity against caterpillar pests, but was included because its active ingredient is contained in Durivo (combined with the active ingredient in Coragen). A non-treated control was included for comparison.

Insecticide rates were calculated on a per plant basis, with an assumed row spacing of 36 inches and an in-row spacing of 12 inches (14,520 plants per acre). The calculated dose was delivered in a 2 oz transplant water drench. Holes were punched for the transplants. A bare-root transplant was placed into the dry hole (container grown transplants were not available for this test) and the 2 ounce drench was applied on the roots and into the transplant hole. The hole was then closed. Plants were transplanted and treated on 30 April, 2008.

Insects were monitored through visual plant searches. Five randomly selected plants in each plot were visually examined and all caterpillars were identified and counted. Plot damage ratings were determined by visually examining all plants in each plot. Damage was rated on a 0 to 6 scale: 0 = no damage, 1 = light damage (feeding) on less than ½ of plants in the plot, 2 = light damage on > ½ of plants, 3 = moderate damage on < ½ of plants, 4 = moderate damage on > ½ of plants, 5 = heavy damage on < ½ of plants, and 6 = heavy damage on > ½ of plants.

All data were analyzed with the PROC ANOVA procedure of PC-SAS. Where significant differences were detected (P<0.05), means were separated with LSD (P = 0.05).

Results and Discussion

Experimental product 1 showed no systemic activity against caterpillars in this test. Platinum showed only minor activity against caterpillars and no effect on damage ratings, as was expected (platinum was included as a comparison with Durivo, which contains platinum as one of its active ingredients).

All of the remaining insecticide treatments showed excellent systemic activity against caterpillar pests, with almost no caterpillars detected in any of these treatments through 23 days after transplanting and only minor infestations in a few treatments at 27 days after transplanting. Further, damage ratings were below 2 for all but one of these treatments through 33 days after transplanting.

HGW 86 and Experimental product 2, 'played out' at about the same time, with significant caterpillar populations detected at 30 days after transplanting and obvious increases in damage ratings at 36 days after transplanting. HGW 86 did appear to show a rate effect. The Durivo and Coragen treatments provided longer residual control, with infestations less than one larvae per plant in most treatments through 33 days after transplanting. These treatments maintained damage ratings below or at 2 through 36 days after transplanting. The Coragen treatments maintained damage ratings below 3 through 47 days after transplanting. All Durivo and Coragen treatments showed significant effects on damage ratings at 61 days after treatment (end of the test), with the two higher rates of Coragen with only moderate damage.

Table 1. Collards - Transplant Drench Test - Hort Hill - 2008.

Treatment	Total number of caterpillars per 5 plants										
	9 May	14 May	20 May	23 May	27 May	30 May	2 June	5 June	9 June	13 June	18 June
	9 DAT	14 DAT	20 DAT	23 DAT	27 DAT	30 DAT	33 DAT	36 DAT	40 DAT	44 DAT	49 DAT
Check	0.75 a	1.75 a	3.75 a	3.25 a	8.00 a	22.0 a	34.5 a	17.75 a	17.25 a	26.50 a	15.50 a
Platinum	0.00 b	0.50 b	0.75 b	3.25 a	4.00 b	19.75 ab	27.75 a	16.50 ab	---	---	---
Exp. 1	0.00 b	2.50 a	5.25 a	4.00 a	3.00 bc	18.00 ab	27.50 a	16.75 ab	---	---	---
Exp. 2	0.00 b	0.25 b	0.00 b	0.00 b	0.75 cd	3.50 cd	10.0 b	7.75 cd	---	---	---
HGW0.066	0.00 b	0.00 b	0.25 b	0.00 b	0.50 cd	11.25 bc	12.5 b	9.25 bc	---	---	---
HGW0.134	0.00 b	0.00 b	0.00 b	0.00 b	0.00 d	6.25 cd	7.75 b	3.75 cd	---	---	---
HGW0.176	0.00 b	0.00 b	0.00 b	0.00 b	0.00 d	1.75 cd	8.75 b	4.25 cd	---	---	---
Durivo 10oz	0.00 b	0.00 b	0.00 b	0.00 b	0.00 d	1.25 d	0.50 b	0.75 d	3.25 b	3.00 b	6.50 b
Durivo 13oz	0.00 b	0.00 b	0.00 b	0.00 b	0.25 d	0.50 d	3.75 b	1.50 cd	3.25 b	7.50 b	4.75 b
Coragen0.066	0.00 b	0.00 b	0.00 b	0.00 b	0.00 d	0.50 d	0.50 b	1.25 cd	1.00 b	4.50 b	3.50 b
Coragen0.088	0.00 b	0.00 b	0.00 b	0.00 b	0.25 d	0.25 d	0.50 b	1.50 cd	3.25 b	2.00 b	4.00 b
Coragen0.100	0.00 b	0.00 b	0.00 b	0.00 b	0.25 d	0.00 d	0.75 b	1.75 cd	2.25 b	2.25 b	5.50 b

Table 2. Collards - Transplant Drench Test - Hort Hill - 2008.

Treatment	Plot damage rating (0 to 6)									
	30 May	2 June	5 June	9 June	13 June	16 June	19 June	23 June	26 June	30 June
	30 DAT	33 DAT	36 DAT	40 DAT	44 DAT	47 DAT	50 DAT	54 DAT	57 DAT	61 DAT
Check	4.25 a	5.00 a	6.00 a	6.00 a	6.00 a	6.00 a	6.00 a	6.00 a	6.00 a	6.00 a
Platinum	4.00 a	4.75 a	5.50 a	6.00 a	6.00 a	6.00 a	6.00 a	6.00 a	6.00 a	6.00 a
Exp. 1	4.13 a	4.50 a	5.63 a	6.00 a	6.00 a	6.00 a	6.00 a	6.00 a	6.00 a	6.00 a
Exp. 2	1.00 bc	1.88 bc	3.63 b	4.63 b	4.88 b	5.25 b	5.88 a	6.00 a	5.75 ab	5.75 a
HGW0.066	1.25 b	2.25 b	4.38 b	5.25 b	5.63 a	5.75 a	6.00 a	6.00 a	6.00 a	6.00 a
HGW0.134	0.25 d	1.50 bcd	3.13 c	3.75 c	4.75 b	5.25 b	6.00 a	6.00 a	6.00 a	6.00 a
HGW0.176	0.50 cd	0.75 de	2.25 d	3.38 cd	4.25 b	4.50 c	5.50 a	5.50 a	5.50 b	5.63 a
Durivo 10oz	0.88 bcd	1.25 cde	1.88 d	2.63 ef	3.13 c	3.75 d	4.50 b	4.38 b	4.88 c	4.75 b
Durivo 13oz	0.50 cd	0.75 de	1.63 d	2.88 de	3.13 c	3.25 de	3.63 c	3.88 bc	4.00 de	4.63 b
Coragen0.066	0.75 bcd	0.75 de	2.00 d	2.50 efg	2.50 cd	2.88 ef	3.50 c	3.75 c	4.25 d	4.38 b
Coragen0.088	1.00 bc	0.50 e	1.88 d	1.88 g	2.25 d	2.75 ef	3.25 c	3.50 c	3.63 ef	3.63 c
Coragen0.100	0.50 cd	0.75 de	1.50 d	2.13 fg	2.00 d	2.38 f	3.13 c	3.38 c	3.50 f	3.50 c

EFFECTS OF APPLICATION METHOD ON RESIDUAL CONTROL OF CATERPILLAR PESTS OF COLE CROPS WITH CORAGEN AND HGW86

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Introduction

Coragen has shown excellent activity against a variety of caterpillar pests in cole crops. It has shown long residual activity when applied as a drench treatment. HGW86 is a related product being developed by DuPont, the manufacturers of Coragen. This test was conducted to evaluate the residual control of these two products when applied as a drench treatment. Further, the effects of drench type on the residual control were evaluated.

Materials and Methods

A small plot trial was conducted in transplanted collards at the University of Georgia's Horticulture Farm in Tifton, Georgia. Collards were transplanted into single row plots (36 inch row spacing) with 12 plants per plot (18 feet). Plants were grown with a 1.5 foot in-row spacing to aid in monitoring of insects and damage; however, insecticide rates were calculated for a per plant basis with an assumed 1 foot spacing (common commercial plant spacing). The experimental design was a randomized complete block with four replications. Collards were transplanted on 9 June, 2009.
Insecticides evaluated were Coragen 1.67SC (at 3.5 and 5 oz/ac) and HGW86 20SC (at 6.75 and 13.5 oz/ac). Each treatment and rate were applied with three drench approaches: greenhouse drench, transplant drench, and a row drench. A non-treated control was included for comparisons.

In the greenhouse drench treatments, insecticides were applied in 1ml of water to the root ball of the transplants the day before transplanting (8 June, 2009). Rates per plant were calculated based on a 12 inch plant spacing (14520 plants per acre). For the transplant drench treatments, insecticides were applied in 4 oz of transplant water per plant. As with the greenhouse drench, rates per plant were based on a 12 inch spacing. The row drench treatments were applied in 3 liters of water per plot (attempting to simulate a drip application). The treatments were poured over the plants through a fanned hose nozzle in a narrow band (approximately 4 inches). Rates were based on the area of the plot (3 ft by 18 ft).

Insects were monitored on five randomly selected plants in each plot. Plants were visually searched on each sample date. All caterpillars were identified and counted.

Data are shown for total caterpillars per five plants. For damage ratings, all plants in each plot were visually examined. Those with moderate or severe damage (holes in leaves) were counted. All data were analyzed with the PROC ANOVA procedure of PC-SAS. Where significant differences were detected (P<0.05), means were separated with LSD (P=0.05).

Results and Discussion

Pest pressure was extremely light early and light to moderate through most of the test. Caterpillars did not exceed one per five plants in any treatment until 30 June (21 days after treatment [DAT]). From 30 June through 13 July (34 DAT), the transplant drench and greenhouse drench generally performed better than the row drench. By 20 July (41 DAT) caterpillar densities exceeded one per five plants in all but the high rate of Coragen transplant drench and the high rates of Coragen and HGW86 greenhouse drench.

Trends in damaged plant counts were very similar to those for insect counts. The row drench treatments appeared to begin "playing out" as early as 22 DAT (1 July). The transplant and greenhouse drench treatments maintained less than one damaged plant per plot through 35 DAT (14 July), with the exception of the low rate HGW86 transplant drench. By 42 DAT, only the HGW86 greenhouse drench treatments had less than one damaged plant per plot.

The transplant and greenhouse drenches consistently provided longer residual activity than the row drench. The row drench treatments appeared to provide less than 3 weeks of strong residual activity; whereas, the transplant drench and greenhouse drench appeared to provide excellent control through at least 35 DAT.

Table 1. Coragen/HGW86 drench methodology test, Horticulture Farm, Tifton, Georgia, 2009.

Treatment	Drench method	Number of caterpillars (all species) per 5 plants						
		19 June	24 June	30 June	6 July	13 July	20 July	27 July
		10 DAT	15 DAT	21 DAT	27 DAT	34 DAT	41 DAT	48 DAT
Check		0.00 a	0.50 a	3.75 a	2.25 abc	2.00 a	3.25 bcd	5.75 abc
Coragen 3.5oz	Row	0.00 a	0.00 a	2.75 abc	1.75 abcd	2.25 a	1.50 cde	4.00 bcde
Coragen 5oz	Row	0.00 a	0.00 a	1.00 cde	2.25 abc	1.50 ab	4.00 abc	5.50 bcd
HGW86 6.75oz	Row	0.00 a	0.25 a	3.25 ab	3.00 a	1.50 ab	6.00 a	3.25 bcde
HGW86 13.5oz	Row	0.00 a	0.00 a	2.00 abcd	2.75 ab	0.75 ab	4.00 abc	6.00 abc
Coragen 3.5oz	Transplant	0.00 a	0.00 a	0.50 de	1.00 bcd	0.00 b	2.00 cde	2.25 de
Coragen 5oz	Transplant	0.00 a	0.25 a	0.00 e	0.00 d	0.00 b	0.50 e	2.75 cde
HGW86 6.75oz	Transplant	0.00 a	0.00 a	0.25 de	1.25 abcd	0.25 b	5.50 ab	5.75 abc
HGW86 13.5oz	Transplant	0.00 a.	0.00 a	0.50 de	1.00 bcd	0.00 b	4.00 abc	9.00 a
Coragen 3.5oz	Greenhouse	0.00 a	0.00 a	1.50 bcde	0.50 cd	0.25 b	1.75 cde	3.75 bcde
Coragen 5oz	Greenhouse	0.00 a	0.00 a	0.00 e	0.00 d	0.75 ab	0.75 de	4.75 bcde
HGW86 6.75oz	Greenhouse	0.00 a	0.00 a	0.25 de	0.00 d	0.00 b	1.50 cde	6.25 ab
HGW86 13.5oz	Greenhouse	0.00 a	0.00 a	0.25 de	0.00 d	0.00 b	0.25 e	1.50 e

DAT = Days After Transplanting

Table 2. Coragen/HGW86 drench methodology test, Horticulture Farm, Tifton, Georgia, 2009.

Treatment	Timing of application	Number of plants with moderate or severe feeding damage				
		1 July	14 July	21 July	27 July	31 July
		22 DAT	35 DAT	42 DAT	48 DAT	52 DAT
13 Check		5.50 a	6.00 a	7.50 ab	10.25 ab	9.25 abcd
9 Coragen 3.5oz	Row	1.50 bcd	2.75 b	7.00 bc	10.50 ab	10.25 ab
10 Coragen 5oz	Row	1.75 bc	1.25 bcd	7.00 bc	9.25 abc	8.50 bcde
11 HGW86 6.75oz	Row	2.25 b	5.75 a	10.00 a	11.00 a	9.75 abc
12 HGW86 13.5oz	Row	1.25 bcd	2.75 b	8.00 ab	10.25 ab	10.75 a
5 Coragen 3.5oz	Transplant	0.25 cd	0.25 cd	4.00 de	6.75 cd	7.50 def
6 Coragen 5oz	Transplant	0.00 d	0.00 d	2.00 ef	6.25 d	5.75 fg
7 HGW86 6.75oz	Transplant	0.25 cd	2.00 bc	5.75 bcd	9.75 ab	10.00 abc
8 HGW86 13.5oz	Transplant	0.00 d	0.25 cd	4.75 cd	8.00 bcd	9.00 abcde
1 Coragen 3.5oz	Greenhouse	0.00 d	0.50 cd	4.75 cd	8.00 bcd	8.75 bcde
2 Coragen 5oz	Greenhouse	0.00 d	0.00 d	3.50 de	7.00 cd	7.25 ef
3 HGW86 6.75oz	Greenhouse	0.00 d	0.00 d	0.75 f	5.50 d	8.25 cde
4 HGW86 13.5oz	Greenhouse	0.00 d	0.00 d	0.25 f	1.75 e	4.75 g

DURIVO-CORAGEN DRENCH TEST – COLLARDS – HORTICULTURE FARM – 2009

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Introduction

A small plot trial was conducted to evaluate the efficacy and residual control of Durivo and Coragen, applied as a transplant drench and a row drench, against caterpillar pests of cole crops. This test was also intended to evaluate efficacy against whiteflies, but this pest did not appear in sufficient numbers until the test was near completion.

Materials and Methods

Plot size:

One row (36 inches) by 12 plants (planted with 1.5 foot in-row spacing).

Experimental design:

Randomized complete block design with 4 replications.

Treatments:

Durivo at 10.3 and 13 oz/ac applied as a Transplant Drench
Durivo at 10.3 and 13 oz/ac applied as a Row Drench
Coragen at 3.5, 5 and 7 oz/ac applied as a Transplant Drench
Coragen at 5 oz/ac applied as a Row Drench
Admire Pro at 7 oz/ac applied as a Transplant Drench
Non-treated Check

Application methods:

Transplant drench – designated treatment applied in 4 oz of water poured onto the rootball and into transplant hole. Rates were calculated based on the standard 1 foot in-row spacing (14520 plants per acre).

Row drench – designated treatment applied in 3 liters of water per plot. Poured on a roughly 4 inch band the length of the plot. Rates were based on area (36 inches by 18 feet).

Application date:

Plots were transplanted and treated on 29 July, 2009.

Insect counts:

Five randomly selected plants were visually examined in each plot on each sample date. All caterpillars observed were identified and counted.

Damaged plant counts:

All plants in each plot were visually observed for feed damage by caterpillars. All plants with moderate to severe feeding damage (obvious holes through leaves) were counted.

Statistical analyses:

Data were analyzed with the PROC ANOVA procedure of PC-SAS. Where significant differences were detected ($P<0.05$), means were separated with LSD ($P=0.05$).

Results and Discussion

Admire Pro provided no effect on caterpillar populations or feeding damage. This treatment was included as a standard for whitefly, which was not occur in sufficient populations for evaluation.

All of the Durivo and Coragen treatments provided good control of caterpillars and reductions in damage through roughly 30 days after treatment. The row drench treatments provided shorter residual control than the transplant drench treatments. Row drench treatments began “playing out” at 30 to 35 days after treatment; transplant drench treatments began “playing out” at over 40 days after treatment. Rate of product affected residual control, with higher rates providing longer residual: however, differences did not appear within the transplant treatments until after 45 days after treatment.

Overall, it appears that application method had a greater effect on residual control than rate.

Durivo-Coragen Drench Test, Horticulture Farm, Tifton, Georgia, 2009.

Treatment	Drench method	Number of larvae (all species) per 5 plants							
		6 Aug	13 Aug	19 Aug	26 Aug	31 Aug	3 Sept	8 Sept	15 Sept
		8 DAT	15 DAT	21 DAT	28 DAT	33 DAT	36 DAT	41 DAT	48 DAT
Check		0.00 a	0.00 a	0.25 a	4.00 b	8.25 a	9.50 a	13.25 a	88.00 a
Admire Pro	Transplant	0.00 a	0.00 a	0.75 a	5.75 a	7.25 a	10.75 a	15.50 a	85.25 a
Durivo 10.3 oz	Transplant	0.00 a	0.00 a	0.25 a	0.25 c	0.00 c	0.25 bc	0.50 de	14.75 c
Durivo 13oz	Transplant	0.00 a	0.00 a	0.00 a	0.00 c	0.00 c	0.00 c	0.00 e	9.25 c
Durivo 10.3oz	Row	0.00 a	0.00 a	0.00 a	0.50 c	2.75 b	3.25 b	9.50 b	83.25 a
Durivo 13oz	Row	0.00 a	0.00 a	0.25 a	0.00 c	2.00 bc	2.75 bc	5.50 c	70.25 ab
Coragen 3.5oz	Transplant	0.00 a	0.00 a	0.00 a	0.00 c	0.00 c	0.25 bc	0.50 de	51.75 b
Coragen 5oz	Transplant	0.00 a	0.00 a	0.00 a	0.00 c	0.00 c	0.00 c	0.50 de	13.25 c
Coragen 7oz	Transplant	0.00 a	0.00 a	0.00 a	0.00 c	0.25 bc	0.00 c	0.00 e	9.50 c
Coragen 5oz	Row	0.00 a	0.00 a	0.25 a	0.25 c	1.25 bc	2.50 bc	4.00 cd	83.50 a

Durivo-Coragen Drench Test, Horticulture Farm, Tifton, Georgia, 2009.

Treatment	Drench method	Number of plants per plot with moderate or severe feeding damage				
		24 Aug	27 Aug	7 Sept	11 Sept	16 Sept
		26 DAT	29 DAT	38 DAT	42 DAT	47 DAT
Check		6.75 b	7.25 b	10.75 a	11.00 ab	11.00 ab
Admire Pro	Transplant	9.25 a	9.50 a	11.75 a	12.00 a	12.00 a
Durivo 10.3 oz	Transplant	0.25 c	0.75 cd	0.75 d	1.75 de	9.00 c
Durivo 13oz	Transplant	0.25 c	0.50 cd	0.25 d	1.00 e	7.25 d
Durivo 10.3oz	Row	1.00 c	1.75 c	8.25 b	10.50 ab	11.75 a
Durivo 13oz	Row	0.75 c	1.00 cd	7.25 bc	10.25 bc	12.00 a
Coragen 3.5oz	Transplant	0.75 c	0.00 d	1.50 d	3.00 d	9.75 bc
Coragen 5oz	Transplant	0.25 c	0.25 d	1.00 d	0.75 e	9.25 c
Coragen 7oz	Transplant	0.50 c	0.25 d	0.75 d	1.00 e	6.25 d
Coragen 5oz	Row	0.25 c	0.75 cd	5.75 c	8.75 c	11.50 a

EFFICACY OF FOLIAR APPLIED INSECTICIDES AGAINST CATERPILLAR PESTS OF COLE CROPS

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Introduction

Caterpillars are the primary arthropod pest of cole crops in Georgia. These crops are attacked by a complex of caterpillars, with the primary species being diamondback moth, cabbage looper, and imported cabbageworm. This test was conducted to evaluate foliar applications of insecticides for efficacy against this complex of pests.

Materials and Methods

Collards were transplanted at the University of Georgia's Tifton Vegetable Park in Tifton, Georgia, with single rows on 6 foot beds. Plots measuring one row (treated as 36 inch rows) by 23 feet were arranged in a randomized complete block design with four replications. Insecticide treatments were applied with a CO2 pressurized back pack sprayer (60 PSI) in 40 GPA with 3 hollow-cone nozzles per row (one over the top; two on drops). Treatments were applied on 12 and 24 June, 2008. Treatments evaluated were: SpinTor (5 oz/ac), Radiant (5 oz/ac), Proclaim (3.2 oz/ac), Avaunt (3.5 oz/ac), Rimon (12 oz/ac), Alverde (16 oz/ac + Penetrator Plus at 0.5% v/v), Tesoro (6.4 oz/ac), Coragen (5 oz/ac) and Synapse (3 oz/ac). Coragen and Synapse were evaluated with and without a tank mix with DyneAmic (0.5% v/v). Sufactants have been reported to dramatically effect efficacy of these two products. A non-treated control was included for comparison.

For direct pest counts, five plants were randomly selected in each plot on each sample date and visually examined for caterpillar pests. All caterpillars were identified and counted. Analyses were conducted on the total numbers in each plot (number per five plants). Plot damage ratings were conducted starting at 3 weeks after the second application. Each plot was visually examined for feeding damage with emphasis placed on evaluation of feeding on the 'new' growth. Plots were rated on a 0 to 6 scale as follows: 0 = no damage, 1 = light damage on < ½ of plants, 2 = light damage on > ½ of plants, 3 = moderate damage on < ½ of plants, 4 = moderate damage on > ½ of plants, 5 = heavy damage on < ½ of plants, 6 = heavy damage on > ½ of plants. Acceptable control would be less than a 3, with less than 2 being very good control. A 4 or greater would represent poor control.

All data were analyzed with the PROC ANOVA procedure of PC-SAS. Where significant differences were detected ($P < 0.05$), means were separated with LSD ($P = 0.05$).

Results and Discussion

Cabbage looper numbers were extremely low, never exceeding 0.25 per 5 plants in any treatment until the last sample date (7 July) in which there was 1.00 per plot in the Tesoro treatment, 0.25 in the Synapse treatment and none in any other treatment. Thus, looper data is not discussed, but the numbers are included in the total caterpillar data.

Diamondback moth pressure was relatively light, but all insecticides tested showed good activity against this pest on the first sample date after each application (possible exception of Rimon on the first sample, with the mode of action explaining the delay in mortality).

The majority of pests in this test were Imported cabbageworm (ICW). All products generally provided good control of this pest after each application. Trends indicate good activity with most treatments through 7 to 9 days after application. By 9 to 11 days after treatment, Proclaim, Alverde, SpinTor and Tesoro showed trends for possible loss of residual activity.

Damage ratings were not conducted until 21, 24 and 27 days after the second application. Effects detected at this time should reflect both good control of the pest present and exceptional residual activity. Treatments that showed significant reductions, as compared to the check, across all three dates were Avaunt, Radiant, Coragen and Synapse. Addition of surfactant to Coragen and Synapse did not effect efficacy. Coragen and Synapse were the only treatments rated 4 or below and Coragen with surfactant was the only treatment rated below a 3. While this is not strong evidence, it does suggest that Coragen and Synapse provide longer residual activity than the other treatments, and that addition of the surfactant may aid in residual control.

Collards Efficacy Trial, TVP, Summer, 2008.

Treatment	Number of Diamondback moth larvae per 5 plants							
	16 June	19 June	23 June	26 June	30 June	3 July	7 July*	10 July
	4 DAT-1	7 DAT-1	11 DAT-1	2 DAT-2	6 DAT-2	9 DAT-2	13 DAT-2	16 DAT-2
Check	2.00 a	0.25 a	0.25 a	1.25 a	0.25 a	1.50 a	1.00 a	0.50 a
Rimon	1.25 ab	1.00 a	0.75 a	0.25 b	0.25 a	0.50 b	0.00 a	0.25 a
Proclaim	0.50 b	0.50 a	1.25 a	0.00 b	0.00 a	0.00 b	1.00 a	0.00 a
Avaunt	0.00 b	0.00 a	0.25 a	0.00 b	0.25 a	0.00 b	0.00 a	0.00 a
Alverde	0.00 b	0.00 a	1.00 a	0.00 b	0.00 a	0.25 b	0.50 a	0.00 a
SpinTor	0.25 b	0.25 a	1.25 a	0.00 b	0.00 a	0.00 b	0.00 a	0.00 a
Radiant	0.00 b	0.00 a	1.00 a	0.00 b	0.00 a	0.00 b	0.50 a	0.25 a
Tesoro	0.00 b	0.75 a	0.00 a	0.00 b	0.00 a	0.00 b	0.00 a	0.50 a
Coragen	0.25 b	0.00 a	0.50 a	0.00 b	0.00 a	0.00 b	0.00 a	0.00 a
Coragen+	0.00 b	0.00 a	0.00 a	0.00 b	0.00 a	0.00 b	0.00 a	0.00 a
Synapse	0.00 b	0.00 a	0.25 a	0.00 b	0.00 a	0.00 b	0.25 a	0.00 a
Synapse+	0.00 b	0.00 a	0.50 a	0.00 b	0.00 a	0.00 b	0.00 a	0.00 a

Number within columns followed by the same letter are not significantly different (P = 0.05).
* Differences were detected at P = 0.1.

Collards Efficacy Trial, TVP, Summer, 2008.

Treatment	Number of Imported cabbageworm larvae per 5 plants							
	16 June	19 June	23 June	26 June	30 June	3 July	7 July	10 July
	4 DAT-1	7 DAT-1	11 DAT-1	2 DAT-2	6 DAT-2	9 DAT-2	13 DAT-2	16 DAT-2
Check	0.50 a	1.75 a	7.25 a	8.75 a	3.75 a	3.25 a	0.75 a	0.25 a
Rimon	0.00 b	0.25 a	2.25 bc	2.00 b	0.00 b	0.25 a	0.50 a	0.25 a
Proclaim	0.00 b	0.50 a	8.50 a	0.00 b	0.00 b	0.25 a	1.50 a	0.25 a
Avaunt	0.00 b	0.75 a	1.75 bc	0.00 b	0.00 b	0.25 a	1.00 a	1.00 a
Alverde	0.25 ab	0.25 a	1.75 bc	0.00 b	0.00 b	3.00 a	0.50 a	0.00 a
SpinTor	0.00 b	0.75 a	5.75 ab	0.00 b	0.00 b	0.25 a	0.75 a	0.25 a
Radiant	0.00 b	0.25 a	3.75 abc	0.00 b	0.00 b	0.25 a	0.00 a	0.25 a
Tesoro	0.00 b	0.50 a	7.25 a	0.00 b	0.00 b	2.75 a	0.75 a	0.50 a
Coragen	0.00 b	0.00 a	2.25 bc	0.00 b	0.00 b	0.00 a	0.00 a	0.00 a
Coragen+	0.00 b	0.00 a	0.50 c	0.00 b	0.00 b	0.25 a	0.00 a	0.00 a
Synapse	0.00 b	0.00 a	3.75 abc	0.00 b	0.00 b	0.00 a	0.00 a	0.00 a
Synapse+	0.00 b	0.00 a	1.25 bc	0.00 b	0.00 b	0.00 a	0.25 a	0.00 a

Number within columns followed by the same letter are not significantly different (P = 0.05).

Collards Efficacy Trial, TVP, Summer, 2008.

Treatment	Total number of larvae per 5 plants							
	16 June	19 June	23 June	26 June	30 June	3 July*	7 July	10 July
	4 DAT-1	7 DAT-1	11 DAT-1	2 DAT-2	6 DAT-2	9 DAT-2	13 DAT-2	16 DAT-2
Check	2.75 a	2.25 a	7.50 ab	10.00 a	4.00 a	4.75 a	2.00 a	0.75 a
Rimon	1.50 ab	1.25 a	3.00 bcd	2.25 b	0.25 b	1.00 a	0.50 a	0.50 a
Proclaim	0.75 b	1.00 a	9.75 a	0.00 b	0.00 b	0.25 a	2.50 a	0.25 a
Avaunt	0.00 b	0.75 a	2.00 cd	0.00 b	0.25 b	0.25 a	1.00 a	1.00 a
Alverde	0.25 b	0.25 a	2.75 bcd	0.00 b	0.00 b	3.25 a	1.00 a	0.00 a
SpinTor	0.25 b	1.00 a	7.00 abc	0.00 b	0.00 b	0.25 a	0.75 a	0.25 a
Radiant	0.00 b	0.25 a	5.00 abcd	0.00 b	0.00 b	0.25 a	0.75 a	0.50 a
Tesoro	0.00 b	1.50 a	7.25 ab	0.00 b	0.00 b	2.75 a	0.75 a	2.00 a
Coragen	0.25 b	0.00 a	2.75 bcd	0.00 b	0.00 b	0.00 a	0.00 a	0.00 a
Coragen+	0.00 b	0.00 a	0.50 d	0.00 b	0.00 b	0.25 a	0.00 a	0.00 a
Synapse	0.00 b	0.00 a	4.00 bcd	0.00 b	0.00 b	0.00 a	0.25 a	0.25 a
Synapse+	0.00 b	0.00 a	1.75 d	0.00 b	0.00 b	0.00 a	0.25 a	0.00 a

Number within columns followed by the same letter are not significantly different (P = 0.05).
* Differences were detected at P = 0.1.

Collards Efficacy Trial, TVP, Summer, 2008.

Treatment	Plot damage ratings		
	15 July	18 July	21 July
	21 DAT-2	24 DAT-2	27 DAT-2
Check	5.75 a	5.63 a	5.75 a
Rimon	4.63 abc	4.88 ab	4.75 bc
Proclaim	5.38 ab	5.13 ab	5.50 ab
Avaunt	4.00 cd	4.25 bc	4.63 bc
Alverde	4.38 bcd	4.63 ab	5.25 ab
SpinTor	4.88 abc	4.75 ab	5.13 ab
Radiant	4.25 bcd	4.25 bc	4.63 bc
Tesoro	4.25 bcd	4.63 ab	5.13 ab
Coragen	3.38 d	3.38 cd	3.13 de
Coragen+	2.00 e	2.25 d	2.88 e
Synapse	3.75 cd	4.00 bc	3.88 cd
Synapse+	3.25 d	3.38 cd	3.38 de

Number within columns followed by the same letter are not significantly different (P = 0.05).

EFFICACY OF HGW86 APPLIED A ROW DRENCH IN COLLARDS FOR CONTROL OF CATERPILLAR PESTS

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Introduction

HGW86 is a diamide insecticide, related to Coragen, that is being developed by DuPont. It has shown good activity against caterpillar pests, both with foliar applications and with systemic activity through soil applications. This test was conducted at the University of Georgia's Horticulture Farm in Tifton, Georgia, to evaluate the efficacy of HGW86 applied as a greenhouse drench against caterpillar pests of cole crops. Initially this test was also intended to evaluate efficacy against whiteflies; however, this pest did not appear in sufficient numbers for potential evaluation until the end of the test when the treatments were losing efficacy and all treatments were overwhelmed.

Materials and Methods

Collards were transplanted into single row plots (36 inch rows), with 12 plants per plot (on a 1.5 foot in-row spacing). The experiment was conducted as a randomized complete block with four replications. HGW86 20SC was applied to the transplants prior to transplanting. Three rates were evaluated (6.75, 13.5 and 20.25 oz/ac), with the per plant rates calculated based on the standard row and plant spacings (14,520 plants per acre on 36 inch rows with a 1 foot in-row spacing). The HGW86 treatments were applied with a repeating pipette in 1 ml of water per plant applied directly to the root ball. Venom (at 5.6 oz/ac) and Durivo (at 12 oz/ac) were applied as transplant drenches. Rates were calculated based on standard plant spacings and were applied in 4 oz of water per plant, with the treatment poured onto the root ball and into the transplant hole. A non-treated control was included for comparison. The greenhouse drenches were applied on 29 July, 2009. Transplanting and the transplant drenches occurred on 30 July.

Five randomly selected plants were visually examined in each plot on each sample date to determine insect densities. All caterpillars observed were identified and counted. For damaged plant ratings, all plants in each plot were visually observed for feed damage by caterpillars. All plants with moderate to severe feeding damage (obvious holes through leaves) were counted. Data were analyzed with the PROC ANOVA procedure of PC-SAS. Where significant differences were detected ($P<0.05$), means were separated with LSD ($P=0.05$).

Results and Discussion

Venom showed no effect on caterpillar densities or feeding damage. This treatment was included as a standard for whiteflies, but this pest was not evaluated. Durivo and all rates of HGW86 showed excellent efficacy against caterpillar pests. Caterpillars were first detected in the lowest rate HGW86 treatment, but did not exceed one per 5 plants until 40 days after transplanting. The highest two rates of HGW86 and Durivo maintained excellent control through 35 to 40 days after transplanting. A clear rate effect was also obvious at 47 days after transplanting. The Durivo and HGW86 treatments also provided excellent suppression of plant damage, with less than one plant damaged per plot through 39 days after transplanting. A rate effect with HGW86 was also apparent in the plant damage counts at 43 and 48 days after transplanting, but all treatments contained significant damage at that point.

Table 1. HGW86 Collards Drench Test, Horticulture Farm, Tifton, Georgia, 2009.

Treatment	Drench type	Total caterpillars (all species) per five plants							
		5 Aug	11 Aug	18 Aug	25 Aug	31 Aug	3 Sept	8 Sept	15 Sept
		6 DAT	12 DAT	19 DAT	26 DAT	32 DAT	35 DAT	40 DAT	47 DAT
Check		0.00 a	0.00 a	1.25 a	3.00 a	6.50 a	8.25 a	10.25 a	70.00 a
Venom	Transplant	0.00 a	0.00 a	1.00 a	2.75 a	5.25 a	6.50 a	12.25 a	74.25 a
Durivo	Transplant	0.00 a	0.00 a	0.00 a	0.00 b	0.00 b	0.00 b	0.50 b	27.50 bc
HGW86 6.75oz	Greenhouse	0.00 a	0.00 a	0.00 a	0.00 b	1.00 b	1.00 b	2.25 b	40.25 b
HGW86 13.5oz	Greenhouse	0.00 a	0.00 a	0.00 a	0.00 b	0.00 b	0.00 b	0.25 b	16.5 c
HGW86 20.25oz	Greenhouse	0.00 a	0.00 a	0.00 a	0.00 b	0.00 b	0.00 b	0.00 b	10.75 c

DAT = Days after transplanting

HGW86 Collards Drench Test, Horticulture Farm, Tifton, Georgia, 2009.

Treatment	Drench type	Number of plants per plot with moderate or severe feeding damage				
		24 Aug	27 Aug	7 Sept	11 Sept	16 Sept
		25 DAT	28 DAT	39 DAT	43 DAT	48 DAT
Check		6.75 a	6.75 a	11.00 a	11.00 a	11.75 a
Venom	Transplant	7.25 a	8.00 a	11.25 a	11.00 a	11.25 ab
Durivo	Transplant	0.00 b	0.25 b	0.75 b	1.75 c	8.00 c
HGW86 6.75oz	Greenhouse	0.75 b	0.25 b	0.75 b	3.75 b	10.00 b
HGW86 13.5oz	Greenhouse	0.00 b	0.25 b	0.50 b	1.75 c	8.25 c
HGW86 20.25oz	Greenhouse	0.00 b	0.00 b	0.75 b	0.75 c	4.25 d

DAT = Days after transplanting

EFFICACY OF VOLIAM INSECTICIDES AGAINST CATERPILLAR PESTS OF COLLARDS AND EFFECTS OF POST-APPLICATION OVERHEAD IRRIGATION

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Introduction

Voliam xpress and Voliam flexi are pre-mix insecticides recently labeled by Syngenta. Both products contain chlorantraniliprole combined with thiamethoxam (Voliam flexi) or lambda-cyhalothrin (Voliam xpress). While both of these products are registered for foliar uses only, both chlorantraniliprole and thiamethoxam have systemic activity when applied in the soil. It is possible that an irrigation or rain event after of foliar application may not have the same adverse effect experienced with non-systemic insecticides. This test was conducted to evaluate the efficacy of Voliam express and Voliam flexi against caterpillar pests of cole crops and the influence of a simulated irrigation event shortly after application. A transplant drench with Durivo was included for comparison.

Materials and Methods

Collards were transplanted into single rows on six foot beds for this test, but were treated as a 3 foot row. Plots were 20 feet long and were established in a randomized complete block design with four replications. Insecticides evaluated were Voliam flexi 40WG (at 7 oz/ac) and Voliam xpress 1.25ZC (at 9 oz/ac). A row drench treatment with Durivo (at 13 oz/ac) was included as a standard for a systemic application. A non-treated check was included for comparison.

The Durivo row drench was applied in 3 liters of water per row in a 4 inch band on 30 July, 2009. Foliar applications of both Voliam products were made with a CO_2 pressurized backpack sprayer (60 psi) in 40 gpa, with 3 hollow-cone nozzles per row. Foliar applications, with and without post-application irrigation (wash-off), were made on 31 July and 25 August. Plots assigned to the "wash-off" treatments received overhead watering shortly after application. The first application wash was done with about 3 gallons or water per plot and the second application wash was done with 6 liters per row (both on a roughly 12 inch band over the plants).

To monitor insect densities, five randomly selected plants were visually examined for insects in each plot on each sample date. All caterpillars were identified and counted. For damaged plant counts, all plants in each plot were visually examined. Those with moderate or severe feeding damage (obvious holes through the leaves) were counted in each plot. Data were analyzed with the PROC ANOVA procedure of PC-SAS. Where significant differences were detected ($P<0.05$) means were separated with LSD ($P=0.05$).

Results and Discussion

The Durivo drench treatment maintained insect counts below 1 per 5 plants through 28 days after application and provided statistically similar control to the foliar treatments throughout the test (up to 36 days after the drench application). Durivo provided suppression of damage through 28 days after drenching. The foliar treatments and the foliar+washoff treatments performed similarly throughout the test. Pest pressure was light following the first application until 24 days after application, when all the foliar treatments provided a non-statistical suppression of insect counts. Following the second application, all four treatments provided good control through 10 days after application (last counts taken). Damaged plant counts did not show much affect from the foliar treatments as damage was already present prior to the second application (however, all four treatments did show numerical increases by 13 days after the second application; other data has shown similar trends for foliar applications of chlorantraniliprole). The wash-off treatments did not hurt efficacy of the foliar treatments, but did not appear to have the residual activity of the Durivo drench (based on numerical differences in damage on 24 and 27 Aug).

Voliam wash-off test, collards, Horticulture Farm, Tifton, Georgia, 2009.

Treatment	Number of caterpillars (all species) per 5 plants							No. damaged plants per plot		
	5 Aug	11 Aug	17 Aug	24 Aug	27 Aug	1 Sept	4 Sept	24 Aug	27 Aug	7 Sept
Check	0.00 a	0.00 a	0.00 a	5.00 a	2.75 a	10.25 a	9.50 a	5.25 a	6.00 a	9.75 a
V. flexi	0.00 a	0.00 a	0.25 a	1.75 a	0.25 b	0.50 b	0.00 b	2.50 ab	3.50 a	5.00 c
V. xpress	0.00 a	0.00 a	0.25 a	1.25 a	0.00 b	1.00 b	0.00 b	3.75 a	5.00 a	5.25 bc
V. flexi+wash	0.00 a	0.00 a	0.00 a	1.50 a	0.00 b	0.50 b	0.50 b	4.25 a	3.00 a	5.00 c
V. xpress+wash	0.00 a	0.00 a	0.00 a	3.00 a	0.00 b	0.25 b	1.50 b	5.50 a	5.50 a	7.75 ab
Durivo drench	0.00 a	0.00 a	0.00 a	0.25 a	0.50 b	3.75 b	1.50 b	0.50 b	1.25 a	6.50 bc
DAT foliar	5	11	17	24	2	7	10	24	2	13
DAT drench	6	12	18	25	28	33	36	25	28	39

RESIDUAL CONTROL OF CATERPILLAR PESTS WITH FOLIAR APPLIED CORAGEN AND SYNAPSE WITH AND WITHOUT DYNEAMIC

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Introduction

Coragen and Synapse have shown excellent control of caterpillar pests of cole crops when applied as foliar applications. Some experiments suggest that the initial activity and residual control of these products may be enhanced with adjuvants that aid in penetration of the leaf surface. This test was conducted to evaluate the effects of a penetrating surfactant on the efficacy and residual activity of these two insecticides. HGW86 is an insecticide of similar chemistry being developed. It was included in this test for comparison.

Materials and Methods

A small plot trial was in collards transplanted at the University of Georgia's Horticulture Farm in Tfiton, Georgia. Experimental plots were on row (36 inches) by 22 feet. The test was conducted as a randomized complete block with four replications. Insecticides evaluated were Coragen 1.67SC (5 oz/ac), Synapse 24WDG (3 oz/ac), and HGW86 10SE (13.5 oz/ac). Coragen and Synapse were applied with and without addition of DyneAmic (0.5% v/v). HGW86 was applied with DyneAmic, and the water for this treatment was buffered (Ph below 7) prior to mixing. Anon-treated check was included for comparison. All insecticide treatments (with and without adjuvant) were applied on a 7 and 14 day schedule. Plots on a 7 day schedule were treated four times (2, 9, 15 and 23 July, 2009) and those on the 14 day schedule were treated twice (2 and 15 July, 20090). Applications were made with a CO_2 pressurized backpack sprayer (60 psi) in 40 GPA, with three hollow-cone nozzles per row (one over the top, 2 on drops).

Five randomly selected plants in each plot were visually searched on each sample date for caterpillars. All caterpillars were identified and counted. For damage ratings, all plants in each plot were visually observed for feeding damage. All plants with moderate or severe damage (obvious holes through leaves) were counted. Data were analyzed with the PROC ANOVA procedure of PC-SAS. Where significant differences were detected ($P<0.05$), means were separated with LSD ($P=0.05$).

Results and Discussion

Both the caterpillar counts and the damage counts show similar trends. The 7 day application schedule provided better control than the 14 day schedule for all insecticide treatment. Caterpillar counts and damage showed good control from 4 to 8 days after an application (irrespective of timing) and showed a numerical (and often statistical) increase at 12 or 13 days (or more) after an application. Statistical suppression of insects and damage was seen for longer periods (up to 20 days), but increases were obvious by 12 to 14 days. Addition of DyneAmic did not consistently affect efficacy or residual activity of either product.

While some research has shown dramatic increase in efficacy with addition of a penetrating surfactant to both Coragen and Synapse, that did not occur in this test. The surfactant did not consistently effect initial efficacy or residual control. Residual control of these products when applied as a foliar application has been reported as 10 to 14 days. In this test, residual control appeared to be within that range, but less than 14 days.

Table 1. Coragen/Synapse surfactant test, collards, Horticulture Farm, 2009.

Treatment	Application frequency	Number of caterpillars (all species) per 5 plants						
		8 July	14 July	22 July	28 July	31 July	4 Aug	6 Aug
		Days after last treatment (7 & 14 day schedule)						
		6 & 6	5 & 12	7 & 7	5 & 13	8 & 16	12 & 20	14 & 22
0 Check		3.50 a	1.75 a	3.50 a	7.75 a	15.25 a	13.75 a	4.75 a
21 Coragen	14 days	0.50 b	1.50 ab	0.50 b	2.00 bc	8.50 bc	9.25 b	5.00 a
22 Coragen+Dyneamic	14 days	0.00 b	0.25 c	0.00 b	3.00 bc	3.75 cd	4.00 cde	2.25 abcd
23 Synapse	14 days	0.50 b	1.75 a	0.50 b	2.50 bc	5.50 bcd	5.75 bcd	4.00 ab
24 Synapse+Dyneamic	14 days	0.00 b	0.75 bc	0.00 b	5.00 ab	10.75 ab	7.25 bc	2.50 abcd
25 Hgw86+Dyneamic	14 days	0.00 b	0.75 bc	0.00 b	3.00 bc	5.50 bcd	8.00 bc	3.50 abc
1 Coragen	7 days	0.50 b	0.25 c	0.25 b	1.00 c	2.00 d	2.00 de	2.25 abcd
2 Coragen+Dyneamic	7 days	0.00 b	0.00 c	0.00 b	0.00 c	0.00 d	1.50 e	0.50 d
3 Synapse	7 days	0.25 b	0.25 c	0.25 b	1.50 bc	2.50 cd	4.25 cde	1.50 bcd
4 Synapse+Dyneamic	7 days	0.00 b	0.00 c	0.00 b	0.00 c	1.25 d	1.75 de	1.25 bcd
5 Hgw86+Dyneamic	7 days	0.00 b	0.00 c	0.00 b	0.00 c	0.25 d	1.00 e	1.00 cd

Table 2. Coragen/Synapse surfactant test, collards, Horticulture Farm, 2009.

Treatment	Application frequency	Number of plants per plot with moderate or severe feeding damage				
		27 July	31 July	4 Aug	7 Aug	14 Aug
		Days after last treatment (7 & 14 day schedule)				
		4 & 13	8 & 17	12 & 21	15 & 24	22 & 31
0 Check		7.75 a	8.25 a	9.25 a	9.50 a	9.50 a
21 Coragen	14 days	4.50 b	5.00 b	8.75 a	10.00 a	9.75 a
22 Coragen+Dyneamic	14 days	2.75 c	3.25 b	7.25 a	8.00 ab	8.75 a
23 Synapse	14 days	3.00 bc	4.25 b	8.00 a	8.50 a	9.00 a
24 Synapse+Dyneamic	14 days	2.50 c	4.25 b	7.75 a	9.50 a	10.00 a
25 Hgw86+Dyneamic	14 days	1.75 cd	4.50 b	9.00 a	9.75 a	9.75 a
1 Coragen	7 days	0.50 de	0.25 c	2.25 b	5.50 c	8.25 a
2 Coragen+Dyneamic	7 days	0.25 de	0.00 c	1.00 bc	2.50 de	7.75 a
3 Synapse	7 days	0.25 de	0.50 c	2.50 b	6.25 bc	8.25 a
4 Synapse+Dyneamic	7 days	0.00 e	0.25 c	2.25 b	4.50 cd	8.50 a
5 Hgw86+Dyneamic	7 days	0.00 e	0.00 c	0.00 c	2.00 e	7.00 a

EFFICACY OF FOLIAR APPLIED INSECTICIDES FOR CONTROL OF SILVERLEAF WHITEFLY IN CUCUMBERS

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Introduction

The silverleaf whitefly, *Bemisia tabaci*, is a key pest of cucurbit crops grown in the Fall in South Georgia. Severity of this pest problem in some areas requires use of multiple insecticides for management. This test was conducted at the University of Georgia's Tifton Vegetable Park in Tifton, Georgia, to evaluate the efficacy of foliar applied insecticides against the silverleaf whitefly in cucumbers.

Materials and Methods

Cucumbers for the test were grown on white plastic mulch (6 foot row spacing) with a one foot in-row spacing. Plots were a single row by 22 feet, with four replications of each treatment in a randomized complete block design. Treatments evaluated were:

Brigadier at 5 oz/ac
Movento at 4 and 5 oz/ac + MSO at 0.5% v/v
Venom at 4 oz/ac
HGW 86 10SE at 13.5 and 20.5 oz/ac + MSO at 0.5% v/v (also buffered below pH 7 with 1ml/3000ml)
Coragen at 5 oz/ac + MSO at 0.5% v/v
Requiem 25EC at 2 qts/ac
Non-treated Check

Foliar applications were made with a CO2 pressurized backpack sprayer (60 psi), in 40 GPA of water, with 3 hollow-cone nozzles per bed (broadcast arrangement, 18 inch nozzle spacing). Application dates were 22 and 29 September and 8 October, 2009. The more detailed evaluations were conducted prior to the third application.

Direct whitefly nymph counts were conducted on 2 October. Five plants were randomly selected in each plot. The third true leaf was removed from each plant and taken to the laboratory for insect counts. The third leaf was selected based on presence of older nymphs. Each leaf was placed under a dissecting scope and the nymphs in a single field (10X ocular, 20X magnification, circle of 15/32 inch diameter) on each leaf were counted. Nymphs were classified as small (assumed 1st and 2nd instar) or large (assumed 3rd and 4th instar).

Whitefly adult emergence from treated leaves was determined following the second application. Leaves were collected from each plot and held in a paper bag to allow for late instar nymphs to complete development and for adults to emerge and die. All adults in the bag were then counted. If the number of adults was relatively small (< 150), the adults were directly counted. The adults were numerous, the number was estimated based on volume (9445 adults per milliliter based on research by Sparks). Five leaves were sampled on Oct. 2 (the same leaves used for nymphs counts). On 7 Oct., the five leaves used in the efficacy ratings were used.

A visual efficacy rating was conducted on 7 October. Five plants were visually examined in each plot. Runners were picked up and the 3rd to 6th leaves from the crown were examined to determine the leaf with the most late instar nymphs (ended up as 4th or 5th leaf). This leaf was also picked for adult emergence. Based on the relatively populations of nymphs on these leaves, plots were rated as follows:

0 = no control
1 = suppression of whitefly
2 = fair control (obvious suppression, but not adequate)
3 = good control
4 = excellent control

Following the third application, sooty mold ratings were conducted. On 23 October, it was obvious that differences existed in sooty mold deposits on the white plastic beneath the plots. All plants were cut and removed to make observations easier. Plots were rated as follows:

1 = very little sooty old, primarily around crown of plants (good to fair control)
2 = light and spotty distribution (also good to fair control)
3 = even distribution but much less sooty mold than 5 (obvious suppression, but inadequate)
4 = even distribution with slightly less sooty mold than a 5
5 = heavy and even (worst plots)
0.05).

All data were analyzed with the PROC ANOVA procedure of PC-SAS. Where significant differences were detected (P<0.05), means were separated with LSD (P=0.05).

<u>Results and Discussion</u>

Pest pressure was heavy in this test. Brigadier and Requiem did not provide significant suppression of silverleaf whitefly. The lack of control with Brigadier is likely a result of pyrethroid resistance in the whitefly. Coragen, Venom, Movento and HGW86 generally provided good to excellent control with few significant differences in whitefly nymph counts, adult emergence or sooty mold ratings. The efficacy ratings did indicate better control with Movento, which is supported by numerical trends in the other data.

Cucumber – Silverleaf whitefly foliar insecticide test, Tifton Vegetable Park, Tifton, Georgia, 2009.

Treatment	Number of nymphs per 5 fields, 2 Oct.			Efficacy rating, 7 Oct.	Adults emerged per sample		Sooty mold rating, 23 Oct.
	Small nymphs	Large nymphs	Total nymphs		2 Oct.	7 Oct.	
Check	64.50 a	163.25 a	227.75 ab	0.25 c	2006.8 a	5950 a	4.50 a
Brigadier	93.25 a	148.25 a	241.50 a	0.00 c	2054.0 a	7320 a	4.75 a
Requiem	63.00 a	123.75 a	186.75 ab	0.13 c	1383.8 a	5667 a	4.25 a
Coragen	77.75 a	21.50 bc	99.25 cd	3.25 b	42.8 b	78 b	2.50 b
Venom	133.25 a	20.00 bc	153.25 bc	3.38 ab	95.5 b	123 b	2.00 b
Movento 4oz	57.75 a	53.75 b	111.50 cd	3.00 b	101.8 b	121 b	1.75 b
Movento 5oz	78.25 a	24.25 bc	102.50 cd	3.25 b	31.0 b	125 b	2.00 b
HGW86 13.5oz	55.00 a	28.00 bc	83.00 cd	4.00 a	6.3 b	5 b	1.50 b
HGW86 20.5oz	61.00 a	6.25 c	67.25 d	4.00 a	6.5 b	26 b	1.50 b
Days after second application		3		8	3	8	24
Days after third application							15

EFFICACY OF CONCURRENT AND SEQUENTIAL APPLICATIONS OF CORAGEN AND NEONICOTINOID INSECTICIDES APPLIED AS DRENCH TREATMENTS FOR MANAGEMENT OF SILVERLEAF IN SQUASH

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Introduction

The silverleaf whitefly is a key pest of cucurbit crops grown in the fall in South Georgia. This pest produces severe silverleaf symptoms in squash at relatively low pest densities. The neonicotinoid insecticides have served as the cornerstone of management for this pest for over a decade. Coragen is a new diamide insecticide that has shown promise for management of this problem. With two chemistries available that provide systemic protection of the crop, the question arises whether these chemistries should be used together or sequentially. If used sequentially, the best order of chemistries needs to be identified. These tests were conducted to address these questions for direct seeded squash production in South Georgia.

Materials and Methods

Two similar small plot trials were conducted at the University of Georgia Horticulture Farm in Tifton, Georgia. Squash (var. Destiny III) was direct seeded for both test, with the first test planted on 14 August and the second on 22 September, 2008. Experimental plots were established as one row (36 inch beds) by 25 feet, with four replications in a randomized complete block design. Treatments evaluated were the same for both tests. Treatments involved an application of insecticide shortly after planting, followed by either no insecticide or an additional application of insecticide 19 days after the first application. Application dates were 15 Aug. and 3 Sept. in the first test, and 24 Sept. and 13 Oct. in the second test. Treatments evaluated were:

Coragen at 5 oz/ac - single application after planting
Platinum at 11 oz/ac - single application after planting
Admire Pro at 7 oz/ac - single application after planting
Venom at 5 oz/ac - single application after planting
Coragen + Platinum - single application after planting
Coragen + Admire Pro - single application after planting
Coragen + Venom - single application after planting
Coragen fb Platinum - first product applied after planting, 2nd product 19 days later
Coragen fb Admire Pro - first product applied after planting, 2nd product 19 days later

Coragen fb Venom - first product applied after planting, 2nd product 19 days later
Platinum fb Coragen - first product applied after planting, 2nd product 19 days later
Admire Pro fb Coragen - first product applied after planting, 2nd product 19 days later
Venom fb Coragen - first product applied after planting, 2nd product 19 days later
Venom fb Venom - first product applied after planting, 2nd product 19 days later
Coragen fb Coragen - first product applied after planting, 2nd product 19 days later
Non-treated Check

Insecticide rates were calculated based on a three foot row spacing, with product per acre applied in an over-the-row drench. The product was applied in three liters of water per plot on a roughly four inch band. After all treatments in a replication were applied, the entire replication was watered over-the-row (roughly 6 inch band) with a transplanter at about 50 gallons per 500 foot or row. The over-the-row watering was applied within 10 to 15 minutes of the drench application.

Efficacy of insecticides was determined by monitoring plots for silverleaf symptoms. Each plot was examined visually and rated on a 0 to 6 scale as follows:

0 = No silverleaf symptoms in plot
1 = silverleaf light and spotty
2 = silverleaf light and evenly distributed
3 = moderate spots within the plot
4 = silverleaf moderate and evenly distributed
5 = heavy spots of silverleaf
6 = silverleaf heavy and evenly distributed

All data were analyzed with the PROC ANOVA procedure of PC-SAS. Where significant differences were detected ($P<0.05$), means were separated with LSD ($P=0.05$).

Results and Discussion

For ease of discussion, onset of moderate symptoms (rating of 3 or greater) will be used as an indicator of treatment efficacy decline.

Neonicotinoid insecticides and Coragen alone.

All of these products delayed onset of silverleaf symptoms in the first test (2 Sept.); however, Admire Pro and Platinum (applied alone or as the first application in a sequential treatment) were not significantly different from the Check when silverleaf first appeared at moderate to heavy levels in the second test (17 Oct.). Venom did slightly delay onset of moderate symptoms as compared to the other neonicotinoids. Coragen provided longer residual control than any of the neonicotinoid insecticides.

Neonicotinoid-Coragen Combination treatments.

The combination treatments appeared to provide little benefit over the Coragen alone treatment. Addition of Venom did delay onset of moderate symptoms by 4 days as compared to Coragen alone.

Neonicotinoid treatments followed by Coragen.

The second drench with Coragen following the neonicotinoid insecticides appeared to have suppressive effects, but not to the degree of the early Coragen applications. These treatments appeared to slow the development of silverleaf symptoms as compared to the neonicotinoids alone, but did not provide adequate suppression.

Coragen treatments followed by neonicotinoids.

These treatments appeared to provide the most likely scenario for commercial use. The Coragen appeared to provide good initial suppression, with the neonicotinoid extending suppression. The efficacy of these combinations tended to following that of the individual neonicotinoid, with Venom following Coragen providing the best suppression of silverleaf.

Coragen-Coragen and Venom-Venom treatments.

The Venom followed by Venom treatment performed extremely well in the first test, but not as well in the second. The Coragen followed by Coragen treatment appeared only moderately better than the Coragen alone. The second application appeared to have less suppressive activity, similar to results with the neonicotinoid followed by Coragen treatments.

These data support the previous indications of neonicotinoid resistance in silverleaf whitefly in South Georgia. These data and others indicate excellent activity of Coragen against silverleaf whitefly when used in a preventative manner. Results are much less dramatic in a rescue situation. Coragen applied at the first signs of silverleaf is too late for maximum benefit.

Sequential applications of Coragen followed by the neonicotinoid insecticides appears to be the best approach under conditions of this test (direct seeded, etc.). Coragen can be applied early (prior to any symptoms) and the neonicotinoids applied as symptoms first appear (the neonicotinoids activity is rapid enough to allow for a >reactive= application). Additional work is needed to evaluate these treatments for squash grown from transplants.

Table 1. Coragen - Neonicotinoid Drench Test I, Horticulture Farm, Tifton, Georgia, 2008.

Treatment	Silverleaf Rating (0 to 6)							
	2 Sept	5 Sept	8 Sept	11 Sept	15 Sept.	19 Sept.	22 Sept.	25 Sept.
	18 DAT-1	21 DAT-1	24 DAT-1	27 DAT-1	31 DAT-1	35 DAT-1	38 DAT-1	41 DAT-1
	18 DAT-1	2 DAT-2	5 DAT-2	8 DAT-2	12 DAT-2	16 DAT-2	19 DAT-2	22 DAT-2
Check	5.00 a	6.00 a	6.00 a	6.00 a	6.00 a	6.00 a	6.00a	6.00 a
Admire	2.00 b	3.63 bc	5.75 a	5.88 a	6.00 a	6.00 a	6.00 a	6.00 a
Platinum	1.63 bc	3.25 bcd	5.50 a	5.75 ab	6.00 a	6.00 a	6.00 a	6.00 a
Venom	1.25 bc	2.63 de	4.25 b	4.88 bc	5.75 a	5.75 ab	5.88 ab	6.00 a
Coragen	0.00 e	0.00 f	1.50 d	2.75 d	3.63 c	5.13 abc	5.25 abc	6.00 a
Coragen+Admire	0.00 e	0.00 f	0.88 de	2.00 de	3.25 c	4.88 bcd	5.63 ab	6.00 a
Coragen+Platinum	0.00 e	0.00 f	0.50 ef	1.38 ef	3.25 c	4.63 cd	4.50 cd	6.00 a
Coragen+Venom	0.00 e	0.00 f	0.13 ef	0.75 fgh	2.25 de	3.38 ef	3.88 d	4.75 cd
Admire fb Coragen	1.88 b	3.75 b	5.38 a	5.38 ab	4.63 b	5.25 abc	5.50 ab	5.75 ab
Platinum fb Coragen	1.38 bc	2.75 cde	4.00 b	4.00 c	3.00 cd	4.125 de	5.00 bc	5.50 abc
Venom fb Coragen	1.00 cd	2.38 de	2.50 c	2.63 d	2.13 e	3.13 f	3.75 d	4.50 d
Coragen fb Admire	0.00 e	0.00 f	0.38 ef	1.50 ef	3.13 c	4.63 cd	5.25 abc	5.88 a
Coragen fb Platinum	0.25 de	0.00 f	0.00 f	0.13 gh	1.13 f	2.00 g	2.50 e	3.00 e
Coragen fbVenom	0.00 e	0.00 f	0.00 f	0.00 h	0.13 g	0.13 h	0.25 f	0.38 f
Venom fb Venom	1.00 cd	1.88 e	2.88 c	2.50 d	1.00 f	0.13 h	0.13 f	0.25 f
Coragen fb Coragen	0.00 e	0.25 f	0.50 ef	1.00 fg	2.00 e	3.13 f	4.00 d	5.00 bcd

Table 2. Coragen - Neonicotinoid Squash Drench Test II, Horticulture Farm, Tifton, Georgia, 2008.

Treatment	Silverleaf Rating (0 to 6)					
	14 Oct.	17 Oct.	22 Oct.	27 Oct.	31 Oct.	5 Nov.
	20 DAT-1	23 DAT-1	28 DAT-1	33 DAT-1	37 DAT-1	42 DAT-1
	1 DAT-2	4 DAT-2	9 DAT-2	14 DAT-2	18 DAT-2	23 DAT-2
Check	0.63 a	4.75 a	5.75 a	6.00 a	6.00 a	6.00 a
Admire	0.38 ab	4.75 a	5.50 a	6.00 a	6.00 a	6.00 a
Platinum	0.13 bc	4.50 a	5.88 a	6.00 a	6.00 a	6.00 a
Venom	0.00 c	2.88 bc	5.00 a	5.75 ab	5.75 a	5.88 ab
Coragen	0.00 c	1.75 cde	2.75 cdef	3.63 efg	4.00 bc	4.25 def
Coragen+Admire	0.00 c	1.25 de	2.25 defg	3.00 fgh	3.13 cd	3.75 efg
Coragen+Platinum	0.00 c	1.38 de	3.38 cd	3.63 efg	3.88 bc	4.38 cdef
Coragen+Venom	0.00 c	0.63 e	1.25 g	2.13 h	3.00 cd	3.38 g
Admire fb Coragen	0.25 bc	4.38 a	4.88 ab	4.88 bc	5.00 ab	5.13 bc
Platinum fb Coragen	0.13 bc	3.63 ab	5.00 a	4.63 cd	5.00 ab	4.88 cd
Venom fb Coragen	0.00 c	2.38 bcd	3.63 bc	4.00 cde	4.13 bc	4.50 cde
Coragen fb Admire	0.00 c	0.88 e	1.63 fg	2.38 h	2.63 d	3.63 fg
Coragen fb Platinum	0.00 c	1.13 de	2.00 efg	3.00 fgh	3.13 cd	3.75 efg
Coragen fbVenom	0.00 c	0.75 e	1.25 g	1.13 i	1.25 e	2.50 h
Venom fb Venom	0.00 c	1.75 cde	3.13 cde	3.88 def	4.13 bc	4.38 cdef
Coragen fb Coragen	0.00 c	1.75 cde	2.50 cdefg	2.75 gh	2.63 d	3.38 g

EFFICACY OF CORAGEN, VENOM AND HGW86, APPLIED AS ROW DRENCHES AND VIA DRIP CHEMIGATION, FOR MANAGEMENT OF SILVERLEAF IN SQUASH

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Introduction

Silverleaf whitefly can be severe pests of cucurbit crops in the fall in Georgia. Squash is a favored host of this pest. The newly developed diamide insecticides with systemic activity, Coragen and HGW86, have shown promise for management of this pest. This test was conducted at the University of Georgia's Tifton Vegetable Park in Tifton, Georgia, to evaluate these products against silverleaf whitefly in squash. Venom was included as a whitefly standard insecticide and as a check for neonicotinoid resistance.

Materials and Methods

Squash (var. Destiny III) was direct seeded on 3 Sept. 2008 in single rows on six foot beds. Experimental plots were established as single rows (treated as 3 foot rows) by 21 feet, with four replications in a randomized complete block design. Treatments evaluated were:
HGW86 20SC (200 g AI/l) at 0.066, 0.134, and 0.176 lb AI/ac applied at-planting, Coragen SC at 5 oz/ac applied at-planting, Venom 70SG at 5 oz/ac applied at-planting, Coragen SC (1.67 lb AI/gal) at 0.044, 0.066, and 0.088 lb AI/ac applied through drip chemigation, and Venom 70SG at 5 oz/ac applied through drip chemigation. A non-treated control was included for comparison.

At-planting application were intended to simulate a drip cehmigation, but were applied as a direct row drench. Each plot had insecticide applied over the row in 3 liters of water in a four inch band. After application, the entire test was watered over-the-row with a transplant rig at about 50 gallons per 500 foot of row. The Aat planting@ application was actually made on 8 Sept (5 days after planting, but pre-emergence).

Drip applications were made with a manifold set up to treat four plots at a time. The four lines from the manifold were attached to 21 foot sections of drip tape. The four drip lines were set next to the row of each replication of a treatment and all four plots were treated at once. The line was pressurized (irrigation turned on) and checked for leaks (ran for about 5 minutes). The treatment was injected (in 3 liters of water; about 5 minutes to inject) with the irrigation running, and the irrigation was then run for an additional 10 to 15 minutes to flush the lines. Drip applications were applied on 9 and 23 Sept. (all four drip treatments). On 7 Oct., the third applications of Coragen at 0.044 and 0.066 lb AI/ac treatments were made.

Plots were monitored periodically for silverleaf symptoms. Each plot was examined visually and rated on a 0 to 6 scale as follows: 0 = No silverleaf symptoms in plot, 1 = silverleaf light and spotty, 2 =

silverleaf light and evenly distributed, 3 = moderate spots within the plot, 4 = silverleaf moderate and evenly distributed, 5 = heavy spots of silverleaf, 6 = silverleaf heavy and evenly distributed. All data were analyzed with the PROC ANOVA procedure of PC-SAS. Where significant differences were detected ($P<0.05$), means were separated with LSD ($P=0.05$).

Results and Discussion

All insecticide treatments suppressed (or delayed) silverleaf, with only minor symptoms in any treated plot at 13 to14 days after the initial treatment (22 Sept). The Venom drench at planting and the lowest rate of HGW86 (also at planting) showed light silverleaf symptoms by 17 days after treatment and moderate to severe symptoms at 21 days. The Coragen drench and higher rates of HGW86 showed the first significant symptoms at 21 days after treatment. The drip applications extended the activity with Venom (as compared to the Venom drench). Drip applications of Coragen did not show clear rate effects; although, the highest rate was consistently rated with slightly less symptoms.

Table 1. Coragen/HGW86 Drip-Drench Test, TVP, Tifton, Georgia, 2008.

Treatment	Application method	Silverleaf Rating (0 to 6)						
		22 Sept.	25 Sept.	29 Sept.	3 Oct.	8 Oct.	14 Oct.	17 Oct.
		14 DAD*	17 DAD	21 DAD	25 DAD	30 DAD	36 DAD	39 DAD
		DADr2 =>	2	6	10	15	21	24
		DADr3 =>				1	7	10
Check		5.25 a	6.00 a	6.00 a	6.00 a	6.00 a	6.00 a	6.00 a
HGW86 0.066	Drench	0.13 c	2.00 bc	4.75 a	5.75 ab	5.75 ab	6.00 a	6.00 a
HGW86 0.134	Drench	0.00 c	0.50 de	3.25 b	4.75 abc	5.38 abc	5.50 ab	5.63 ab
HGW86 0.176	Drench	0.00 c	0.63 de	2.75 bc	4.38 cd	5.13 abc	5.25 ab	5.25 abc
Coragen	Drench	0.00 c	0.13 e	2.50 bc	4.63 bc	5.38 abc	5.38 ab	5.63 ab
Venom	Drench	0.00 c	2.75 b	5.38 a	6.00 a	6.00 a	5.75 a	5.88 a
Coragen 0.044	Drip (3x)	0.25 bc	1.38 cd	2.63 bc	4.13 cde	4.38 cd	4.88 bc	4.75 cd
Coragen 0.066	Drip (3x)	0.00 c	1.13 cde	2.38 bc	4.00 cde	4.75 bcd	4.88 bc	4.88 bcd
Coragen 0.088	Drip (2x)	0.13 c	0.75 de	1.50 c	3.00 e	4.00 d	4.13 c	4.13 de
Venom	Drip (2x)	0.50 b	1.50 cd	2.50 bc	3.13 de	3.75 d	4.13 c	3.75 e

DAD = Days after drench application (subtract one for days after first drip application).
DADr2 = Days after second drip application (for all drip treatments).
DADr3 = Days after third drip application (Coragen 0.044 and 0.066 only).

EVALUATION OF DRENCH AND FOLIAR INSECTICIDE APPLICATIONS FOR SUPPRESSION OF SILVERLEAF IN SQUASH

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Introduction

The silverleaf whitefly, *Bemisia tabaci*, is a key pest of cucurbit crops grown in the fall in Georgia. Systemic insecticides, applied at or shortly after planting or transplanting, are a key component of whitefly management. Insecticide resistance has been detected with some of these products. This test was conducted at the Tifton Vegetable Park to evaluate insecticidal suppression of silverleaf in squash with preventive applications of systemic insecticides. In addition, two foliar insecticides were evaluated for efficacy and potential effects of rain or irrigation shortly after application.

Materials and Methods

Squash (var. Destiny III) was direct seeded for this test, with one row per six foot bed. Experimental plots were one row (treated as a 36 inch row) by 23 feet, with four replications in a randomized complete block design.

Drench treatments evaluated were Durivo (13 oz/ac), Venom (6 oz/ac), Admire Pro (10.5 oz/ac), Platinum (11 oz/ac), and Coragen (6.5 oz/ac). Foliar treatments evaluated were Voliam Flexi 40WG (7 oz/ac) and Voliam Xpress 1.25ZC (9 oz/ac). Foliar treatments were evaluated with and without an overhead "wash-off" applied shortly after application.

Drench treatments were applied as an over-the-row drench in three liters of water per plot immediately after planting (19 Sept.). Foliar treatments were applied with a CO_2 pressurized backpack sprayer (60 psi), in 40 GPA, with three hollow cone nozzles per row (one over-the-top, 2 on drops). The foliar treatments without the wash-off were applied on 30 Sept. and 8 Oct., 2009. The wash-off treatments were applied a single time on 30 Sept. After application, each wash-off plot was watered over the row with three liters of water to attempt to wash the treatment into the root zone. No silverleaf was observed on the day of the wash off treatment (the foliar treatments, with and without wash-off, were applied prior to any silverleaf symptoms).

All plants in each plot were visually observed for silverleaf ratings. Plots were assigned a rating as follows:

0 = no silverleaf

1 = light silverleaf on less than half of the plants in the plot
2 = light silverleaf on more than half the plants in the plot
3 = moderate silverleaf on less than half of the plants in the plot
4 = moderate silverleaf on more than half the plants in the plot
5 = heavy silverleaf on less than half of the plants in the plot
6 = heavy silverleaf on more than half the plants in the plot

All data were analyzed with the PROC ANOVA procedure of PC-SAS. Where significant differences were detected ($P<0.05$), means were separated with LSD ($P=0.05$).

Results and Discussion

Pest pressure was heavy at the beginning of this test and dropped off near the end. All drench treatments reduced or delayed silverleaf development. Admire showed the shortest residual, with moderate silvering at 20 days after treatment (6 Oct.); however, all of the drench treatments had signs of moderate silvering by 23 days after treatment. (9 Oct.). Admire and Platinum showed severe silvering by 26 days after treatment, while the remaining drench treatments never reached a full 6 ratings (possibly due in part to reduced pest pressure).

While both foliar insecticides reduced silverleaf symptoms, Voliam flexi provided better suppression than Voliam xpress. Comparison of the foliar and wash-off treatments are difficult (foliar applied twice, wash-off a single time), but it is apparent that the wash-off did not harm performance.

Squash - Silverleaf management test, Tifton Vegetable Park, Tifton, Georgia, 2009.

Treatment	Silverleaf ratings						
	6 Oct.	9 Oct.	12 Oct.	15 Oct.	19 Oct.	23 Oct.	28 Oct.
Check	4.25 a	5.88 a	6.00 a	6.00 a	6.00 a	6.00 a	6.00 a
Admire Pro	3.00 c	5.50 a	6.00 a	6.00 a	6.00 a	6.00 a	6.00 a
Platinum	1.63 d	4.88 ab	6.00 a	6.00 a	6.00 a	6.00 a	6.00 a
Venom	0.75 d	2.88 de	4.75 b	5.13 ab	5.13 ab	5.63 ab	5.63 ab
Coragen	0.75 d	3.63 cd	4.13 bc	4.63 ab	4.50 bc	4.88 abc	4.75 bc
Durivo	1.25 d	3.63 cd	4.13 bc	4.38 b	4.25 bc	4.50 bc	4.50 bc
Voliam flexi	1.25 d	2.25 ef	1.63 d	0.75 c	0.00 d	0.75 e	0.75 e
Voliam xpress	4.00 ab	5.13 ab	4.38 bc	4.13 b	3.63 c	4.13 c	3.75 c
V. Flexi + wash-off	1.38 d	1.38 f	0.75 d	0.75 c	1.13 d	2.00 d	2.25 d
V. Xpress + wash-off	3.25 bc	4.13 bc	3.25 c	4.50 b	4.75 abc	4.88 abc	5.50 ab
Days after transplanting	20	23	26	29	33	37	42
Days after foliar app.	6	1	4	7	11	15	20
Days after wash-off	6	9	12	15	19	23	28

FIELD EVALUATION OF CHLOROPICRIN AND DIMETHYL DISULFIDE FUMIGATION

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Introduction

Liquid fumigants have been used for many years in the production of vegetables in the Southeast. The fumigant of choice has traditionally been methyl bromide. Price and availability is limiting methyl bromide use in Georgia. Alternative fumigants have been tested to give similar effects as methyl bromide. Dimethyl disulfide mixed with chloropicrin (79:21) is one alternative.

Minimizing buffer zones is a major concern for vegetable producers in Georgia. Current buffer zones for application of fumigants such as chloropicrin have endangered vegetable production in Georgia as it is known today. Current research on fumigant release rates have been evaluated on small plots basis. This experiment will be for a large plot size to determine the rate of gas emission from low density polyethylene (LDPE) and Blockade mulch films.

Methods and Materials

Three individual plots were selected of approximately 1 acre in size. Plots were more than 1 mile apart. Two fields (Altman and Davis) were classified as loamy sand and the other sand (Rigdon). All three fields were had cotton planted the previous year. Fumigants were applied on February 7 at 12:30 PM to Altman, 3:15 PM to Davis and 5:30 PM to Rigdon field sites. Paladin™ a mixture of dimethyl disulfide and chloropicrin (79:21) was applied at 75 gpa with a prebedder injecting fumigants 8 inches deep with three knives 11 inches apart. Next, Vapam at 75 gpa was applied 4 inches deep with coulter knives 4 inches apart on a pre-shaped bed and covered with the mulch film. The final bed was pressed and covered with a white on black LDPE (1.25 mil) mulch film.

Soil samples of 365 cm^3 were obtained from each plot with a soil probe (4.8 cm diameter by 20 cm deep). Gravimetric moisture content basis was determined for each sample by weighing the soil and placing the soil in a 105°C oven for 24 hours and then reweighing. Next, the samples were evaluated for soil field capacity. Soil samples (7.6 cm diameter by 15 cm deep) were collected before any tillage operation for field capacity analysis. Soil samples were placed on a ceramic plate. Each sample was saturated with water for 24 hours to equilibrate. The porous ceramic plate with saturated soil was pressurized to 1/3 bar of pressure. After 24 hours in this chamber, the moisture content in the soil was determined with the above method. Soil samples were finally sent to the University of Georgia Soils Lab for classification.

Chloropicrin was measured with a gas detector pump (GASTEC GV100S) and a detector tube (Sensidyne #172S). An inverted HDPE funnel (1.9 L) with a rubber stopper measuring 16.5 cm in diameter fill opening by 22 cm high with a 2 cm drain was glued (silicon) to plastic mulch beds (Figure 1). Chloropicrin gas collected inside the funnels for a known period of time (1-10 minutes). After the known period, a 100 ml sample was drawn through the detector tube from the inside of the funnel by the gas detector pump. The chloropicrin detector tubes had a range of 0.05 – 16 ppm.

Dimethyl disulfide was measured with a handheld volatile organic compound (VOC) monitor (MiniRae 2000) with a range of range of 0-10,000 ppm. DMDS measurements were taken immediately after the chloropicrin inside the inverted funnel.

Samples of the accumulated gas inside the funnels were taken from 3 to 130 hours after application.

Results and Discussion

Field capacity of the soil for each site was determined as follows: Atlman, 8.3; Davis, 11.8 and Rigdon, 6.8 %/dry weight of soil. Soil moisture content at time of fumigation for each filed was Altman, 6.4; Davis, 7.6 and Rigdon, 5.5 %/dry weight of soil. Percent field capacity for each field was Altman, 77; Davis, 65 and Rigdon, 80 percent. At the time of fumigant application Davis field had large clods in the upper 2-4 inches of bed.

The measured results of the chloropicrin and dimethyl disulfide are shown in figures 2 and 3. All showed similar gas emission patterns. A spike was observed for each field site at 40 hours after application. Funnels were being attached at the same location and the mulch films were showing fatigue. This could contribute the excessive values obtained during the sampling period. Once noted, sample location was changed each time a gas sample was measured for the remainder of the test.

Figures 4 and 5 illustrate the accumulated gas emission for the entire test for chloropicrin and dimethyl disulfide. The amount of chloropicrin emission (figure 4) was reduced at the Blockade mulch Altman field site by 63 percent compared to the LDPE mulch Davis field. Loamy sand soil type of Davis field reduced chloropicrin gas emission by 12 percent compared to sand soil type of Rigdon field. There were similar trends for the dimethyl disulfide emission (figure 5) was reduced by 9 percent when Blocakde mulch (Altman field) compared to the LDPE for same soil type.

Changing soil types showed more reduction of 16 percent when comparing loamy sand (Davis Field) to sand (Rigdon field).

This field test showed as prior test have shown a VIF plastic mulch type film will reduce gas emissions.

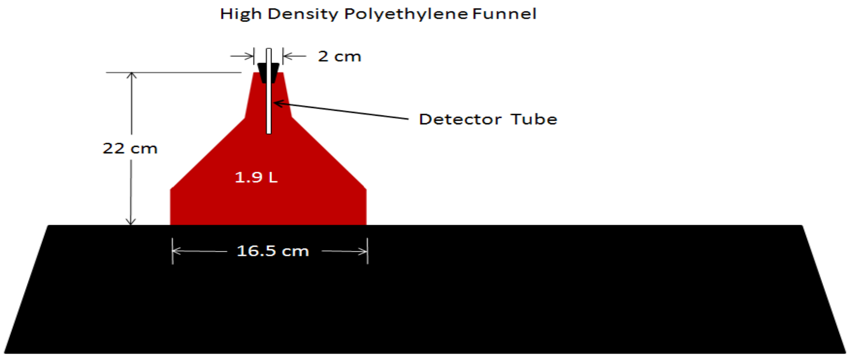

Figure 1. Schematic of fumigant sampling system.

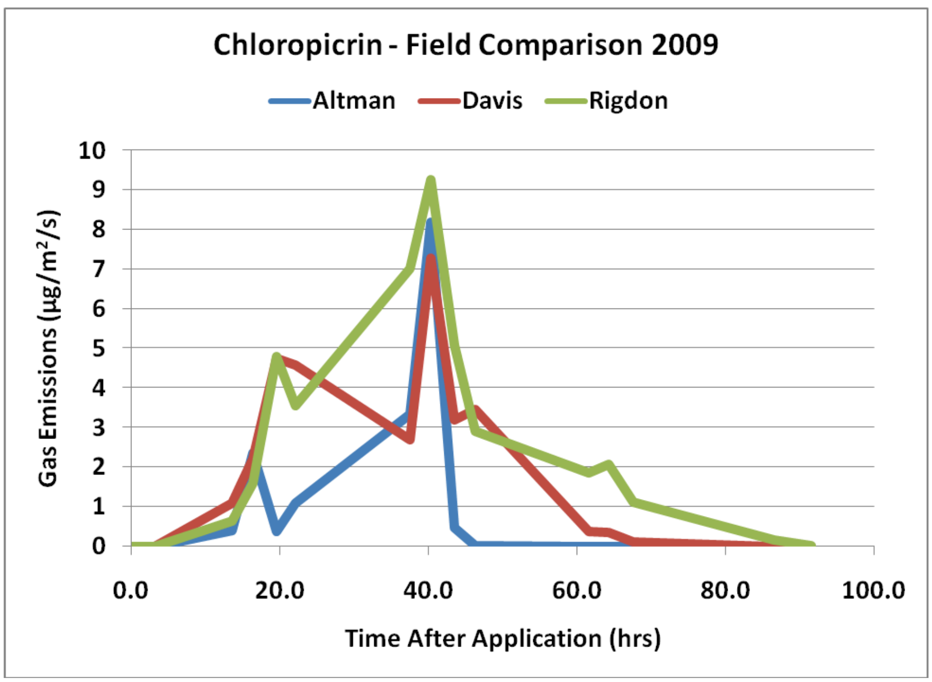

Figure 2. Chloropicrin gas emissions for three field sites Spring 2009.

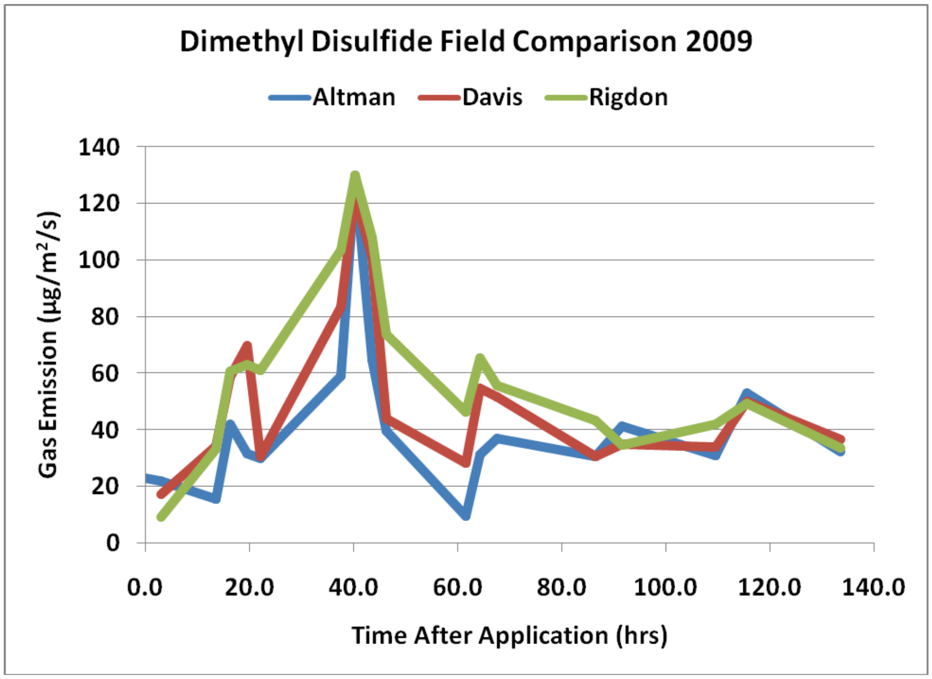

Figure 3. Dimethyl disulfide gas emissions for three field sites Spring 2009

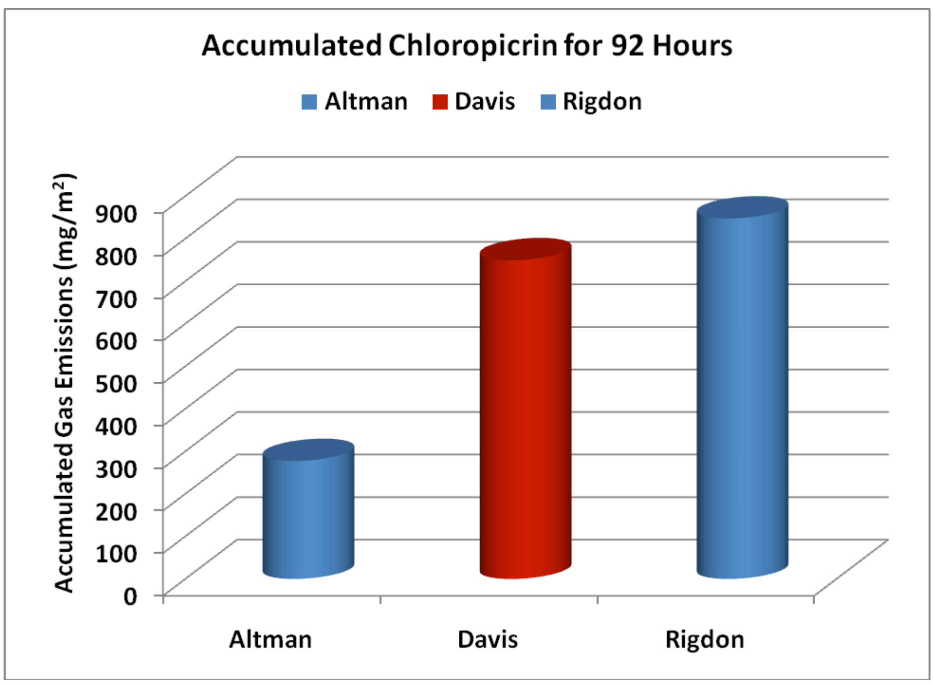

Figure 4. Accumulated chloropicrin gas emission for three field sites Spring 2009.

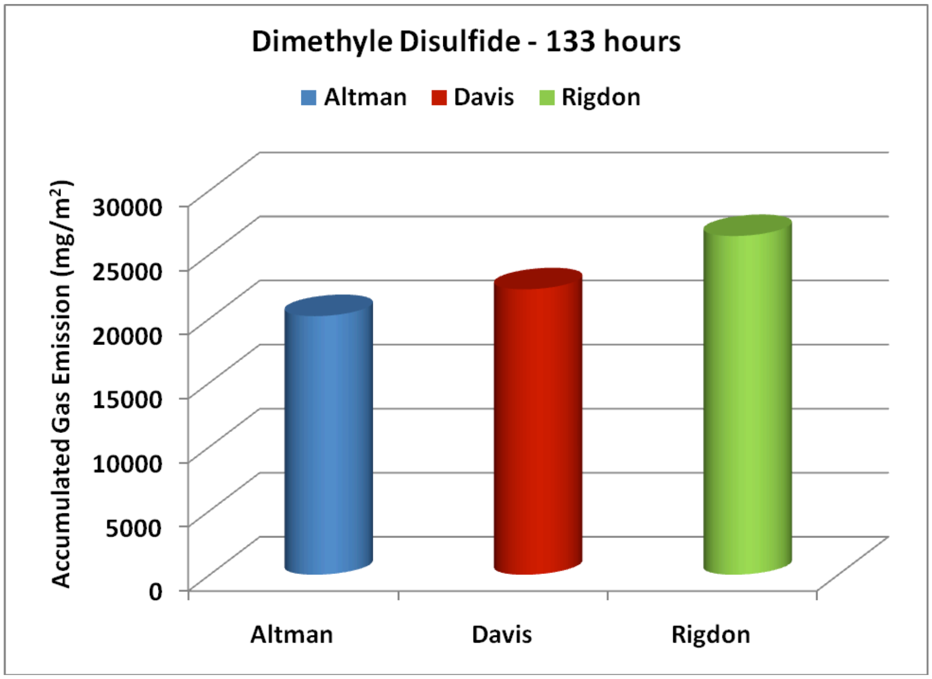

Figure 5. Accumulated dimethyl disulfide for three field sites Spring 2009.

CHLOROPICRIN AND DIMETHYL DISULFIDE GAS EMISSIONS RELATED TO SOIL MOISTURE CONTENT

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Introduction

Liquid fumigants have been used for many years in the production of vegetables in the Southeast. The fumigant of choice has traditionally been methyl bromide. Price and availability is limiting methyl bromide use in Georgia. Alternative fumigants have been tested to give similar effects as methyl bromide. Dimethyl disulfide mixed with chloropicrin (79:21) is one alternative.

Minimizing buffer zones is a major concern for vegetable producers in Georgia. Current buffer zones for application of fumigants such as chloropicrin have endangered vegetable production in Georgia as it is known today. The effect of moisture on reducing emissions from mulched beds as a means of further reducing buffer zones has been questioned. This experiment will determine the effects of moisture on gas emission from low density polyethylene (LDPE) mulch film.

Materials and Methods

Plot land was chosen in the fall of 2008 for two soil types (loamy sand and sand) which is comparable to soils used for commercial vegetable production in South Georgia. Four moisture content strategies were super imposed on to each soil type. The moisture content of the soil was altered by placing 0, 1, 2, or 3 drip irrigation tubes on the surface of the bed area. Beginning one week prior to fumigation, the plots were irrigated once a day for 1 hour. Irrigation tubing was removed the day of fumigation. Plots were tilled with a field cultivator and bedder prior to operation of the fumigation equipment.

Fumigants were applied on July 17 at 9:00 AM to both soil types in 1.8 m by 15 m plots with 81 cm bed tops. Dimethyl disulfide mixed with chloropicrin (79:21) was applied with a prebedder injecting fumigants 20 cm deep with three knives 28 cm apart. Application rates were chloropicrin 16.14 g/m^2 and dimethyl disulfide 38.93 g/m^2. Next, the final bed was pressed and covered with a white on black LDPE (1.25 mil) mulch film.

Soil samples of 365 cm^3 were obtained from each plot with a soil probe (4.8 cm diameter by 20 cm deep). Gravimetric moisture content basis was determined for each sample by weighing the soil and placing the soil in a 105°C oven for 24 hours and then reweighing. Next, the samples were evaluated for soil field capacity. Soil samples (7.6 cm diameter by 15 cm deep) were collected before any tillage operation for field capacity analysis. Soil samples were placed on a ceramic plate. Each sample was saturated with water for 24 hours to equilibrate. The porous ceramic plate with saturated soil was pressurized to 1/3 bar of pressure. After 24 hours in this chamber, the moisture content in the soil was determined with the above method. Soil samples were finally sent to the University of Georgia Soils Lab for classification.

Chloropicrin was measured with a gas detector pump (GASTEC GV100S) and a detector tube (Sensidyne #172S). An inverted HDPE funnel (1.9 L) with a rubber stopper measuring 16.5 cm in diameter fill opening by 22 cm high with a 2 cm drain was glued (silicon) to plastic mulch beds (Figure 1). Chloropicrin gas collected inside the funnels for a known period of time (1-10 minutes). After the known period, a 100 ml sample was drawn through the detector tube from the inside of the funnel by the gas detector pump. The chloropicrin detector tubes had a range of 0.05 – 16 ppm.

Dimethyl disulfide was measured with a handheld volatile organic compound (VOC) monitor (MiniRae 2000) with a range of range of 0-10,000 ppm. DMDS measurements were taken immediately after the chloropicrin inside the inverted funnel.

Samples of the accumulated gas inside the funnels were taken from 3 to 55 hours after application. Fumigants were measured in the funnels until no gases were detected.

<u>Results and Discussion</u>

Soil moisture content was determined for each plot per soil type. Plots were categorized into 5, 6, 7, 8, 9 and 10% moisture content. Field capacity of the soil was determined to be 9.6% for loamy sand and 7.6% for sand on a dry basis.

The amount of chloropicrin passing through LDPE was reduced by 84% for loamy sand and 72 % for sand when moisture was increased 6 to 10% MC (Figures 2 and 3, Tables 1 and 2). The gas emission increased to 79 % when comparing soil moisture 5% to 10%. The gas emission rate typically follows the daily rise and fall of temperature as noted in figures 2 and 3. The gas emission rate was the highest during the afternoon once the sunlight has warmed the soil. Fumigant emissions peaked on the first day. The daily soil temperature at 20 cm ranged from 22°C to 40°C during the data collection period.

Dimethyl disulfide was evaluated for gas being emitted from the surface of the LDPE plastic mulch based on moisture content of the soil in the raised bed. Figures 4 and 5, Tables 3 and 4 show the results of the data collected. When moisture content of soil increased the amount of DMDS fumigant being released decreased similar to chloropicrin. The gas emission was reduced by 42.6 % when soil moisture increased to 10% for both soil types.

This study showed that increasing moisture levels in the soil will significantly reduce the amount of chloropicrin or dimethyl disulfide being released to the environment.

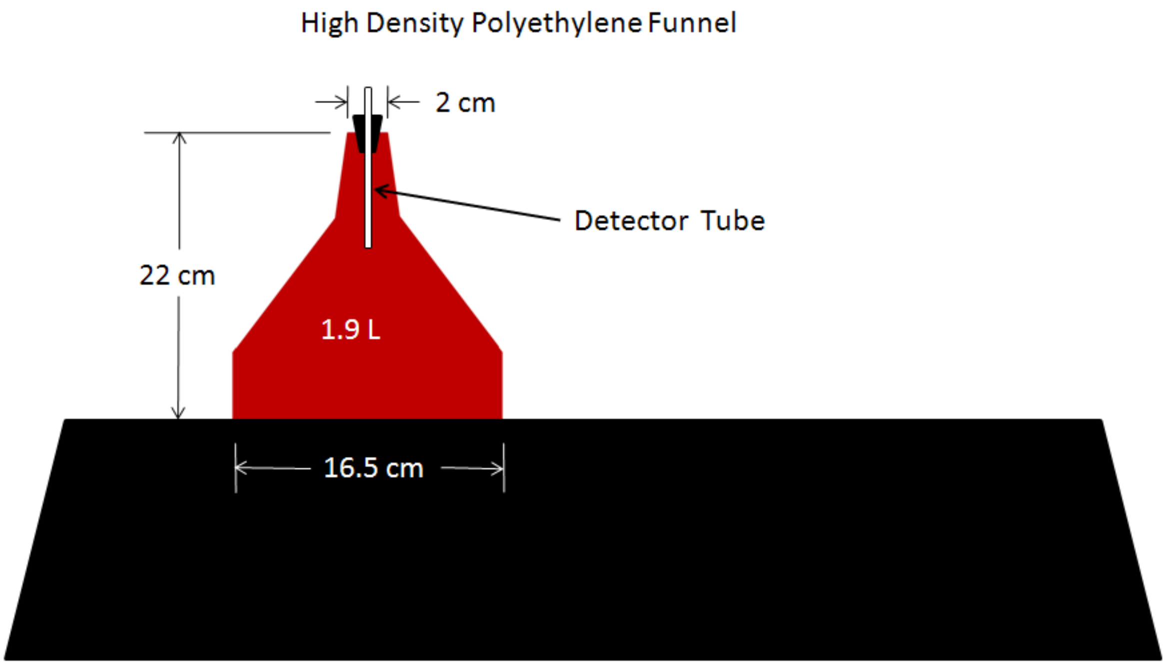

Figure 1. Schematic of fumigant sampling system.

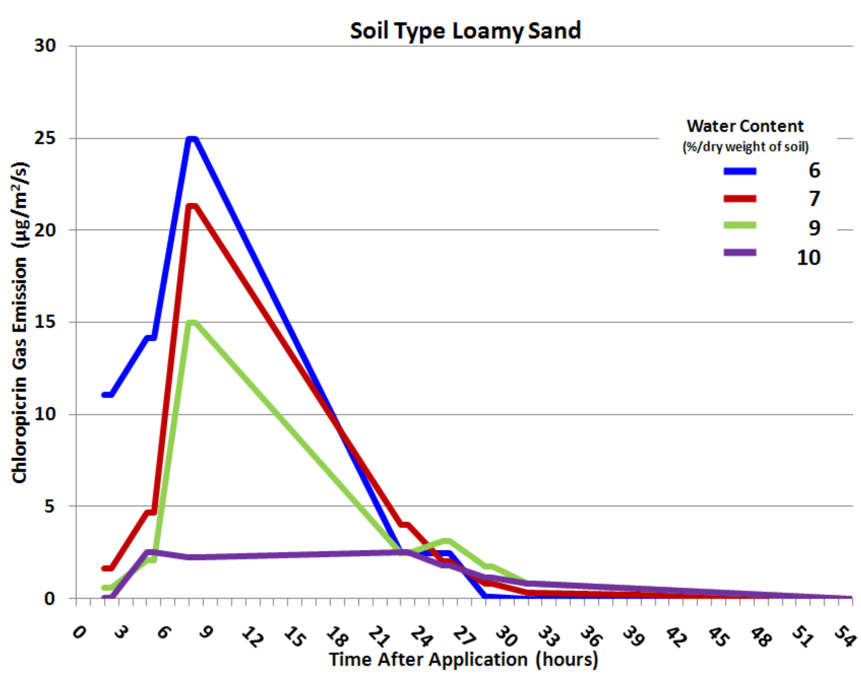

Figure 2. Comparison of chloropicrin gas emission with soil moisture content through LDPE plastic mulch loamy sand. Fall 2008.

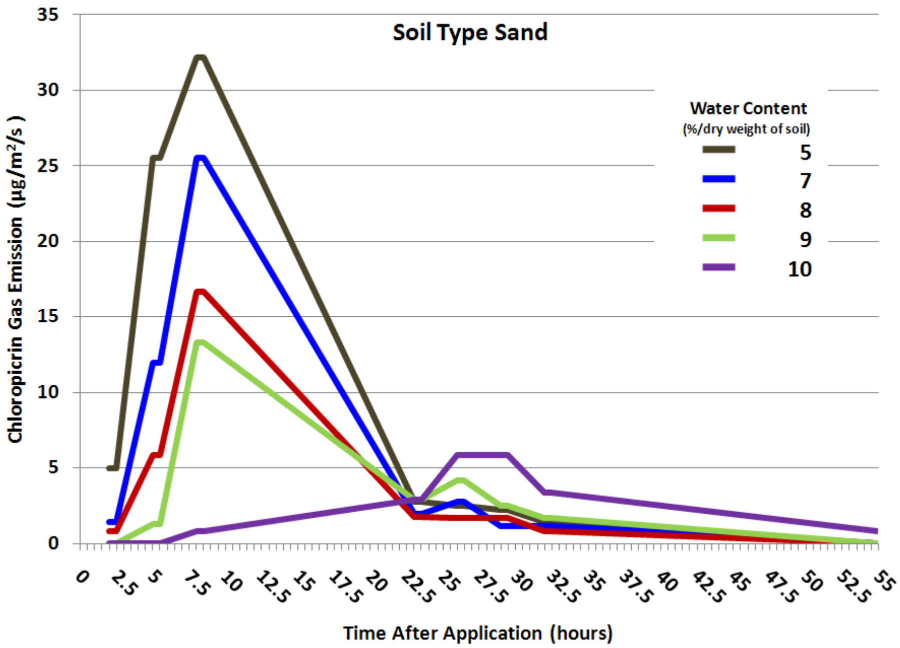

Figure 3. Comparison of chloropicrin gas emission with soil moisture content through LDPE plastic mulch sand. Fall 2008.

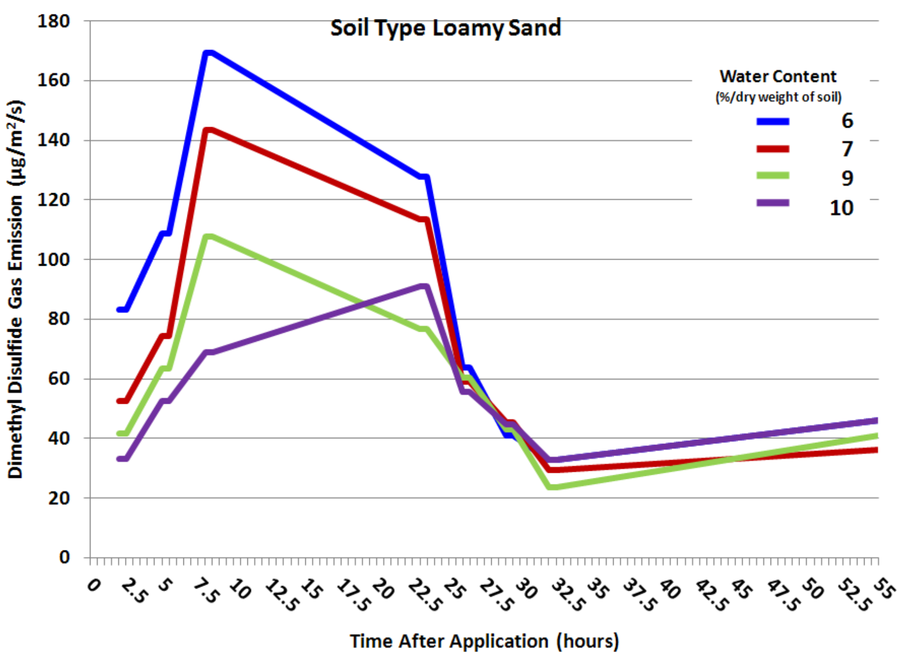

Figure 4. Comparison of dimethyl disulfide gas emission with soil moisture content through LDPE plastic mulch loamy sand. Fall 2008.

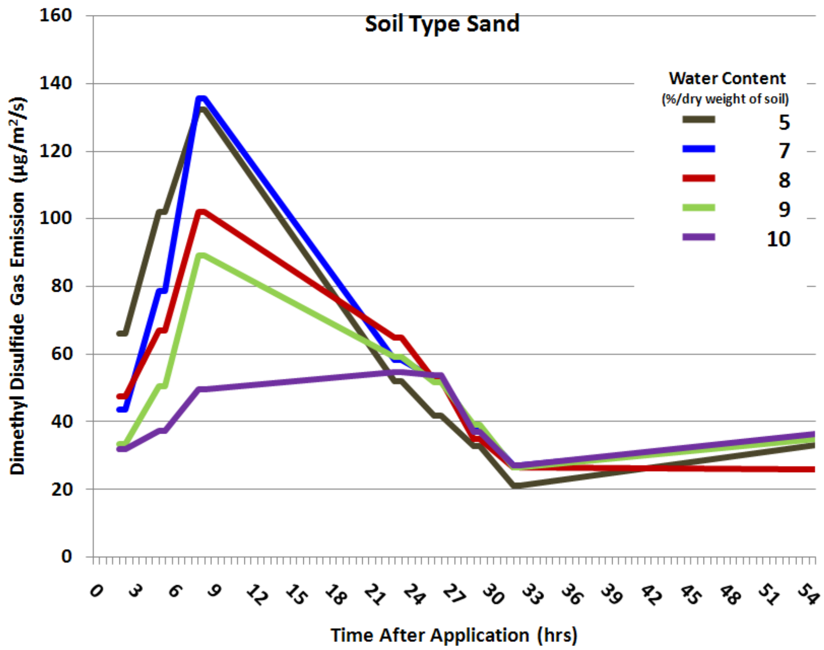

Figure 5. Comparison of dimethyl disulfide gas emission with soil moisture content through LDPE plastic mulch sand. Fall 2008.

Table 1. Reduction in total chloropicrin gas emission for loamy sand soil type. Ponder Fall 2008.

Soil Moist (%)	Field Capacity (%)	Total Emission (mg/m^2)	Reduction - 6% Base (%)	Reduction - 7% Base (%)	Reduction - 9% Base (%)
6	65	1868			
7	77	1489	20.3		
9	88	1115	40.3	25.1	
10	105	293	84.3	80.3	73.7

Table 2. Reduction in total chloropicrin gas emission for sand soil type. Ponder Fall 2008.

Soil Moist (%)	Actual Field Capacity (%)	Total Emission (mg/m^2)	Reduction - 5% Base (%)	Reduction - 7% Base (%)	Reduction - 8% Base (%)	Reduction - 9% Base (%)
5	67	2542				
7	86	1907	25.0			
8	104	1240	51.2	34.9		
9	114	1096	56.9	42.5	11.6	

10	136	531	79.1	72.1	57.2	51.5

Table 3. Reduction in total dimethyl disulfide gas emission for loamy sand soil type. Ponder Fall 2008.

Soil Moist (%)	Field Capacity (%)	Total Emission (mg/m^2)	Reduction - 6% Base (%)	Reduction - 7% Base (%)	Reduction - 9% Base (%)
6	65	17207			
7	77	14494	15.8		
9	88	11470	33.3	20.9	
10	105	9874	42.6	31.9	13.9

Table 4. Reduction in total dimethyl disulfide gas emission for sand soil type. Ponder Fall 2008.

Soil Moist (%)	Field Capacity (%)	Total Emission (mg/m^2)	Reduction - 5% Base (%)	Reduction - 7% Base (%)	Reduction - 8% Base (%)	Reduction - 9% Base (%)
5	67	12980				
7	86	13363	-3.0			
8	104	10999	15.3	17.7		
9	114	9976	23.1	25.3	9.3	
10	136	7444	42.6	44.3	32.3	25.4

EFFECTS OF TIME OF DAY APPLICATION ON EMISSION OF CHLOROPICRIN

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Introduction

Minimizing buffer zones for fumigants such as chloropicrin is a major concern for vegetable producers in Georgia. One method to mitigate gas emission into the atmosphere is through the use of high barrier mulch films. Several different types of mulch films have been developed and will offer growers credits to reduce their buffer zones There has been some observation that application time and tillage may also affect fumigants emissions. This experiment was conducted to determine the effects of application time of day and tillage prior to bed formation on gas emissions, in an effort to determine if more credits could be obtained through adopting varying cultural practices.

Materials and Methods

Plot land was chosen in the spring of 2009 for a soil type of sand which is comparable to soils used for commercial vegetable production in South Georgia. Three application times were selected for 8:00 am, 11:00 am and 3:00 pm. Plots were subdivided to be rototil prior to bedding and not rototilled.

Pic Chlor 60 at 196 l/ha (21 gpa) (1,3-dichloropropene [40%] and chloropicrin [60%]) was applied on March 4, 2009 in 1.8 m by 15 m plots with 81 cm bed tops. Pic Chlor 60 was applied with a prebedder injecting fumigant 20 cm with injection three knives 28 cm apart. Next, the final bed was shaped and covered with black LDPE (1.25 mil). mulch film.

Soil samples of 365 cm^3 were obtained from each plot with a soil probe (4.8 cm diameter by 20 cm deep). Gravimetric moisture content basis was determined for each sample by weighing the soil and placing the soil in a 105°C oven for 24 hours and reweighed. Next, the samples were evaluated for field capacity water content. Soil samples were placed on a ceramic plate. The sample is then saturated with water for 24 hours to equilibrate. The porous ceramic plate with saturated soil is pressurized to 1/3 bar of pressure. After 24 hours in this chamber, the moisture content in the soil was determined with the above method. Soil samples were then sent to the University of Georgia Soils Lab for classification.

Chloropicrin was measured with a gas detector pump (GASTEC GV100S) and a detector tube (Sensidyne #172S). An inverted HDPE funnel (1.9 L) with a rubber stopper measuring 16.5 cm in diameter fill opening by 22 cm high with a 2 cm drain was glued (silicon) to plastic mulch beds (Figure 1). Chloropicrin gas collected inside the funnels for a known period of time (1-10 minutes). After the known period, a 100 ml sample was drawn through the detector tube from the inside of the funnel by the gas detector pump. The chloropicrin detector tubes had a range of 0.05 – 16 ppm.

Samples of the accumulated gas inside the funnels were taken from 3 to 75 hours after application. Fumigants were measured in the funnels until no gases were detected.

Results and Discussion

Soil moisture content ranged from 6.2 to 7.5 % per dry weight of soil. Field capacity of the soil was determined to be 7.64% per dry weight of soil for sand. Soil temperatures at 8 inches averaged 63°F. The maximum and minimum temperature at 8 inches was 75 and 48°F.

The affect of tillage had an impact on the amount of off gassing from the mulch bed (Figures 2 and 3). Regardless of the time of day of application, gas emissions increased by 64 percent when the soil was rototilled prior to formation of the bed. The gas emission rate typically follows the daily rise and fall of temperature. Figures 4-6 illustrate the gas emission rate was the highest during the afternoon once the sunlight has warmed the soil and mulch. Fumigant emissions peaked on day one except for 11:00 AM rototilled application. This application peaked higher on day two. Table 1 presents total gas emissions for all application times and tillage. The lowest amount of gas emission occurred for 8:00 am with no prior tillage. The daily soil temperature at 20 cm ranged from 48F °C to 75F °C during the data collection period.

Conclusion

Results show that higher total gas emissions occurred for applications at 11:00 AM and 3:00 PM for rototilled and 11:00 AM nontillage. But rototilling the soil prior to bed formation tends to increase gas emissions.

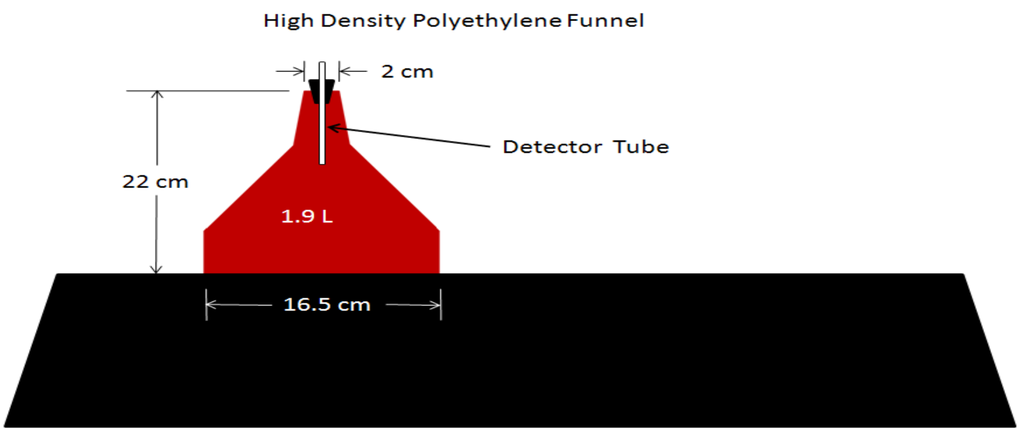

Figure 3. Schematic of fumigant sampling system.

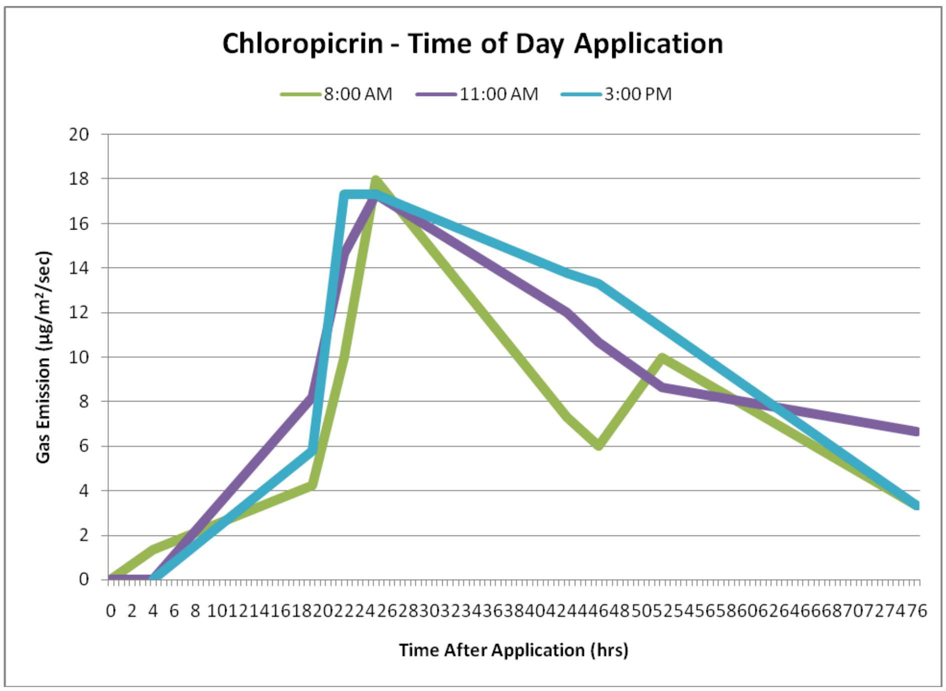

Figure 4. Chloropicrin release rates for various times of application during a day no field preparation. Spring 2009.

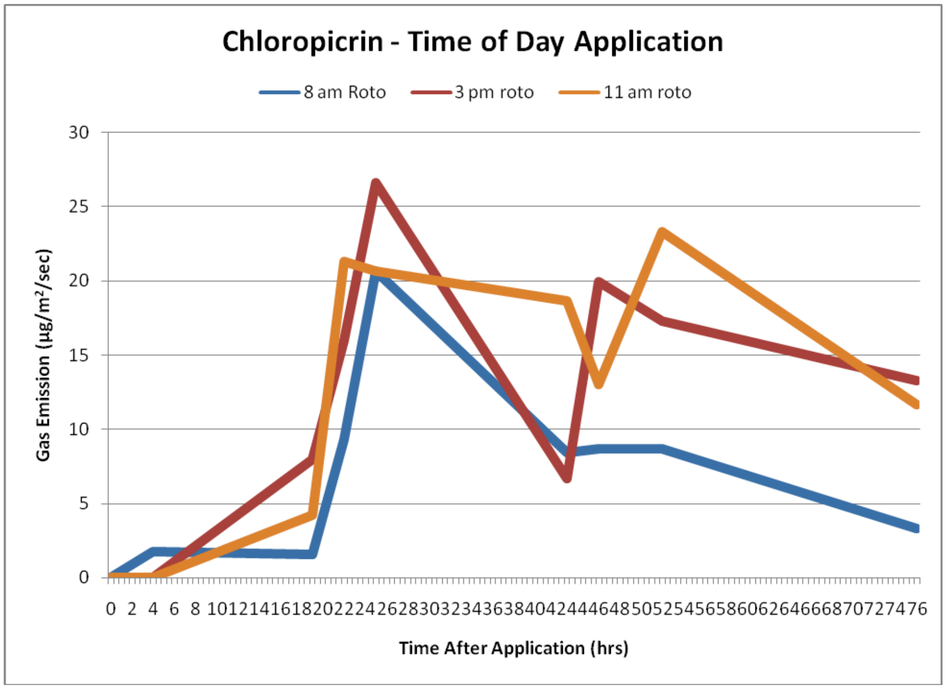

Figure 5. Chloropicrin release rates for various times of application during a day. Rototilled prior to bed formation. Spring 2009.

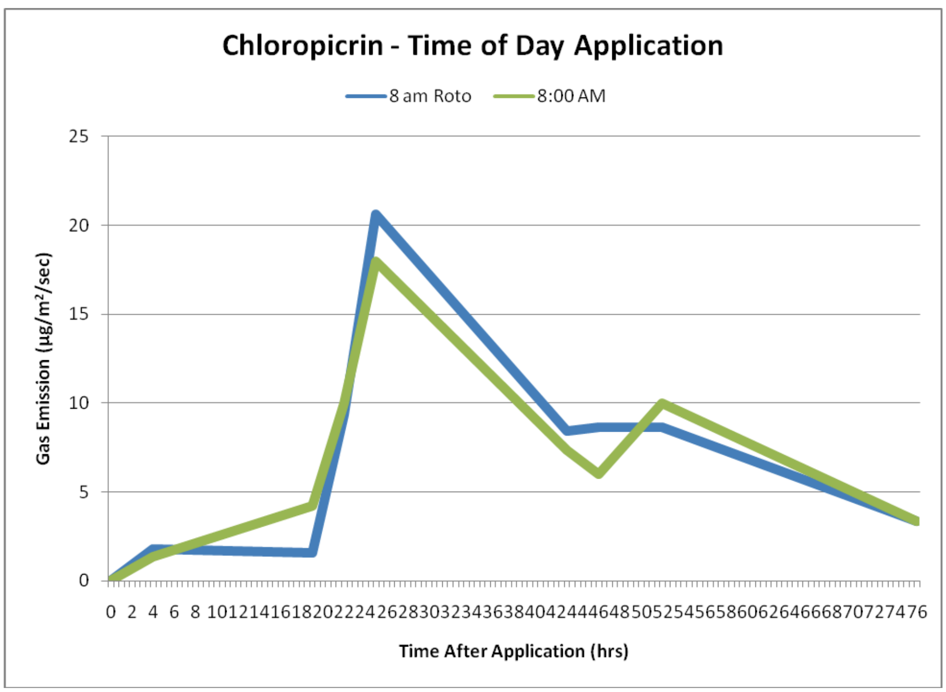

Figure 6. Chloropicrin release rates for 8:00 am application. Spring 2009.

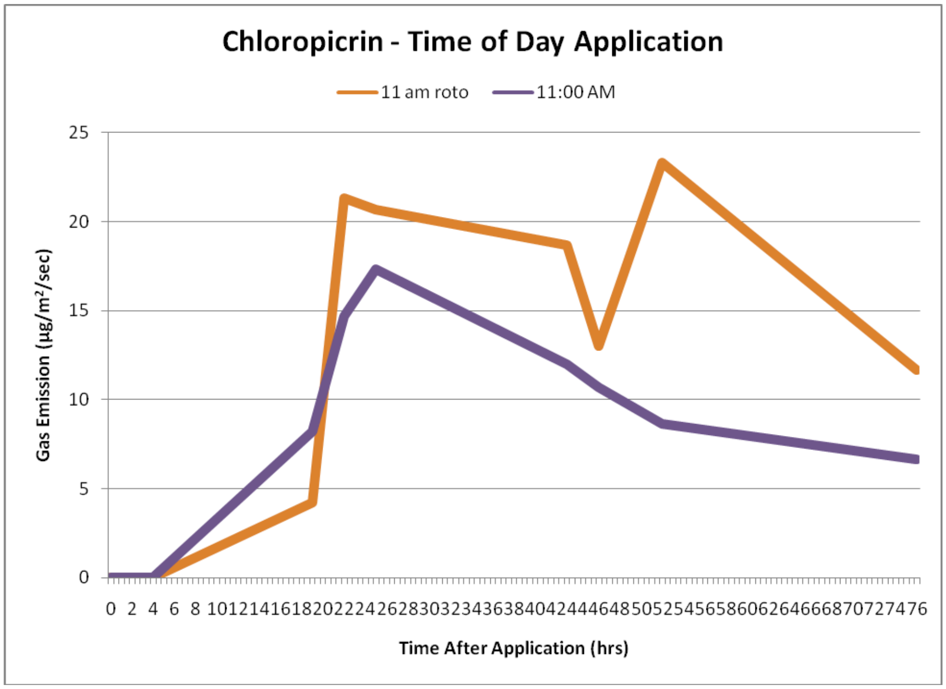

Figure 7. Chloropicrin release rates for 11:00 am application. Spring 2009.

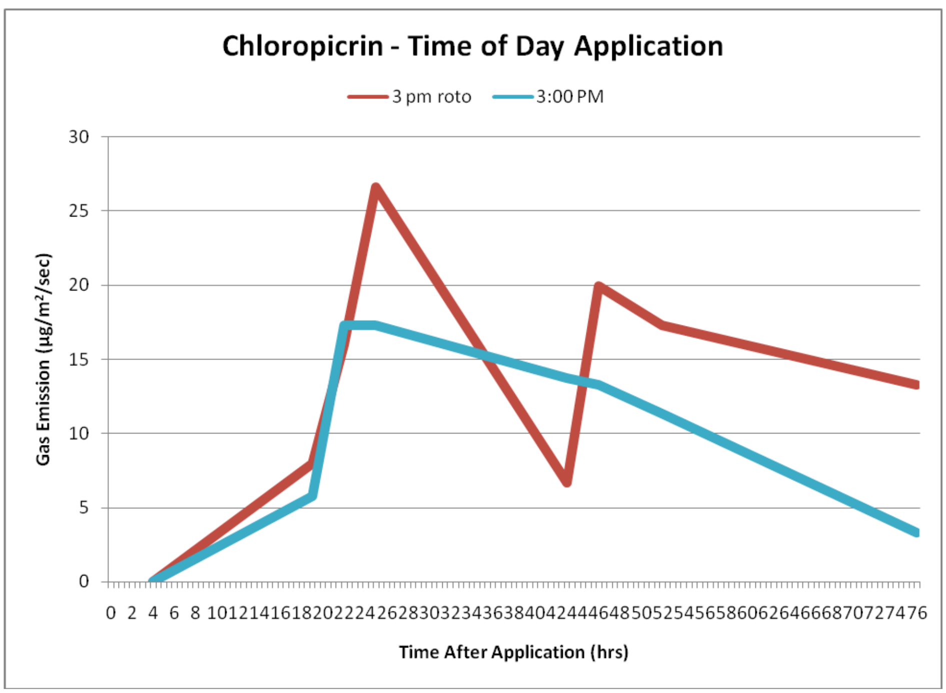

Figure 8. Chloropicrin release rates for 3:00 pm application. Spring 2009.

Table 1. Reduction in total chloropicrin gas emission for sand soil type based on application time and tillage. Spring 2009.					
Application Time	Tillage	Total Flux (mg/m^2)	[1]Time of Day Reduction - None (%)	[2]Time of Day Reduction – Rototilled (%)	Tillage Reduction (%)
8:00 AM	Rototilled	3831		55.2	
8:00 AM	None	3773	20.4		1.6
11:00 AM	Rototilled	8125		5.0	
11:00 AM	None	4741			41.7
3:00 PM	Rototilled	8551			
3:00 PM	None	3978	16.1		53.5
[1] – Calculation based on 11:00 AM application. [2] – Calculation based on 3:00 PM application.					

EFFECTS OF HERBICIDE COATING ON FUMIGANT GAS EMISSIONS

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Introduction

Plastic mulches impregnated with herbicides to improve weed control in a vegetable plasticulture production system is a fascinating new technology currently being explored. The potential to improve weed control seems endless with this technology and grower adoption could be rapid. However, it is unknown what impact the mulch and herbicide impregnation process might have on fumigate emissions. This study was conducted to measure the amount of fumigant retained in the soil as well as allowed to pass through the mulch.

Materials and Methods

Plot land was chosen in the spring of 2009 for a soil type of loamy sand which is comparable to soils used for commercial vegetable production in South Georgia (Tifton sandy loam, 90% sand, 4% silt, 6% clay, ph 6.4, OM 1.0). Plots were tilled with a field cultivator and bedder prior to operation of the fumigation equipment. Plots were a randomized complete block design using Blockade and BIG mulch treatments.

Fumigant treatments included 1) Paladin^{TM,} a mixture of dimethyl disulfide and chloropicrin (79:21), applied at 40 gpa or 2) Pic Chlor 60 (1,3-dichloropropene [40%] and chloropicrin [60%]) applied at 21 gpa. Both fumigants were applied with a prebedder injecting fumigants 8 inches deep with three knives 11 inches apart and covered immediately with mulch. Mulch options included Blockade film (1.25 mil) and BIG film (4 mil), an experimental technology with an herbicide applied to the side facing the soil surface. Applications were made on July 17, 2009 in 1.8 m by 20 m plots with 81 cm bed tops.

Soil samples of 365 cm^3 were obtained from each plot with a soil probe (4.8 cm diameter by 20 cm deep). Gravimetric moisture content basis was determined for each sample by weighing the soil and placing the soil in a 105°C oven for 24 hours and reweighed. Next, the samples were evaluated for field capacity water content. Soil samples were placed on a ceramic plate. The sample is then saturated with water for 24 hours to equilibrate. The porous ceramic plate with saturated soil is pressurized to 1/3 bar of pressure. After 24 hours in this chamber, the moisture content in the soil was determined with above method.

Chloropicrin was measured with a gas detector pump (GASTEC GV100S) and a detector tube (Sensidyne #172S). An inverted HDPE funnel (1.9 L) with a rubber stopper measuring 16.5 cm in diameter fill opening by 22 cm high with a 2 cm drain was glued (silicon) to plastic mulch beds (Figure 1). Chloropicrin gas collected inside the funnels for a known period of time (1-10 minutes). After the known period, a 100 ml sample was drawn through the detector tube from the inside of the funnel by the gas detector pump. The chloropicrin detector tubes had a range of 0.05 – 16 ppm

Dimethyl disulfide and 1,3-dichloropropene was measured with a handheld volatile organic compound (VOC) monitor (MiniRae 2000) with a range of range of 0-10,000 ppm. Measurements were taken immediately after the chloropicrin inside the inverted funnel.

Samples of the accumulated gas inside the funnels were taken from 3 to 75 hours after application. Fumigants were measured in the funnels until no gases were detected.

Results and Discussion

Field capacity of the soil was determined to be 7.3%/dry weight of soil. Soil moisture content ranged from 5.8 to 7.9 %/dry weight of soil averaging 7%/dry weight of soil (96% field capacity).

Chloropicrin gas emissions were measured over a 55 hour period. Figures 2 and 3 is a graphical representation of the 55 hour collection period. The chloropicrin gas emission when Paladin was applied showed 31 percent reduction with the Blockade compared to the BIG film. On the contrary when applying Pic Chlor 60, the Blockade mulch had a 70 percent increase in chloropicrin emissions compared to BIG film.

Dimethyl disulfide gas emissions increased by 73 percent for the BIG film over Blockade Figures 4 and 5). 1,3-dichloropropene combined BIG film also emitted 30 percent more gas than Blockade mulch(Figures 6 & 7).

Concentration of dimethyl disulfide and 1,3-dichloropropene in the soil after application are shown in figures 8 and 9. The first 3 days after application the meter was unable measure the concentration for dimethyl disulfide (figure 8). Both dimethyl disulfide and 1,3-dichloropropene gas concentration within the bed declined as would be expected. The blockade mulch had higher concentrations of dimethyl disulfide than BIG film.

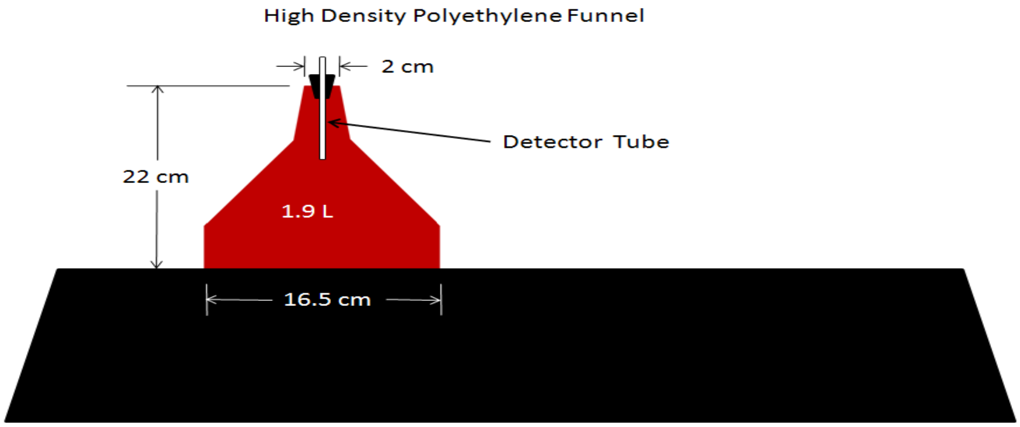

Figure 9. Schematic of fumigant sampling system.

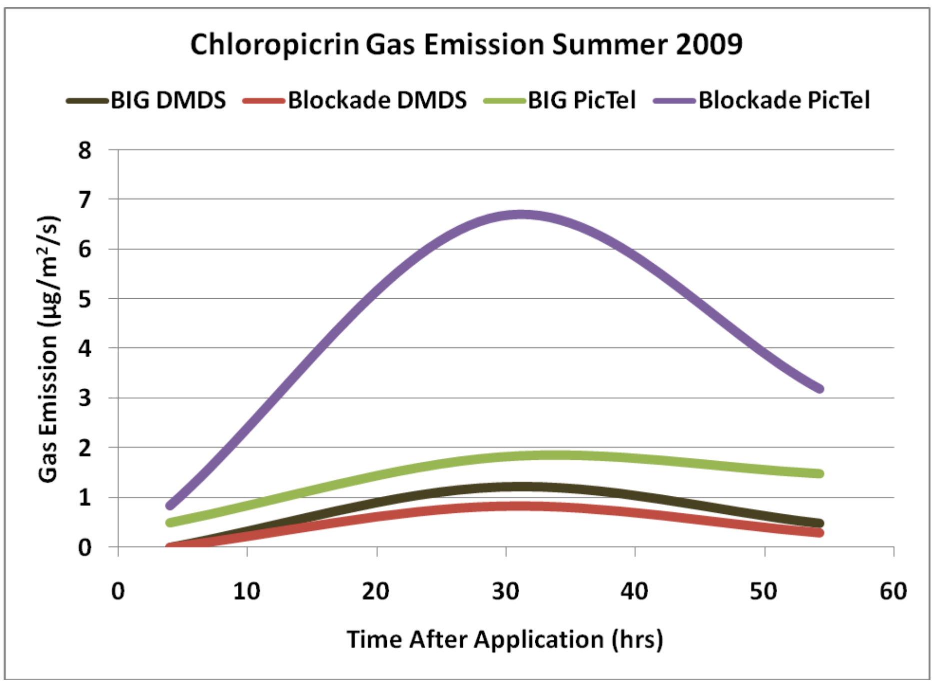

Figure 2. Gas emission for chloropicrin comparing BIG and Blockade mulch films, Summer 2009

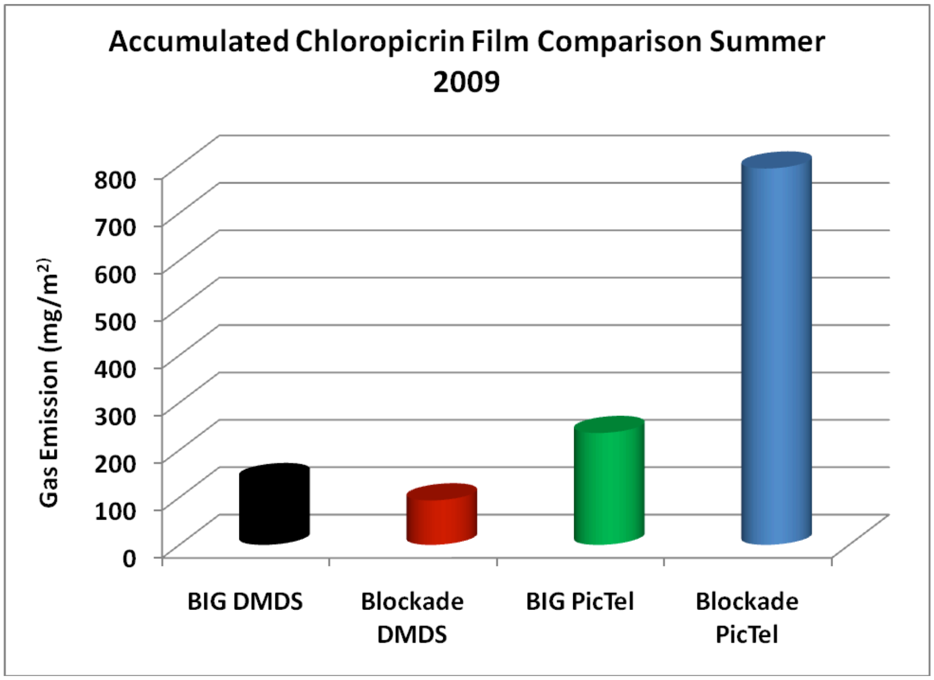

Figure 3. Accumulated gas emission for chloropicrin BIG and Blockade mulch film comparison, Summer 2009.

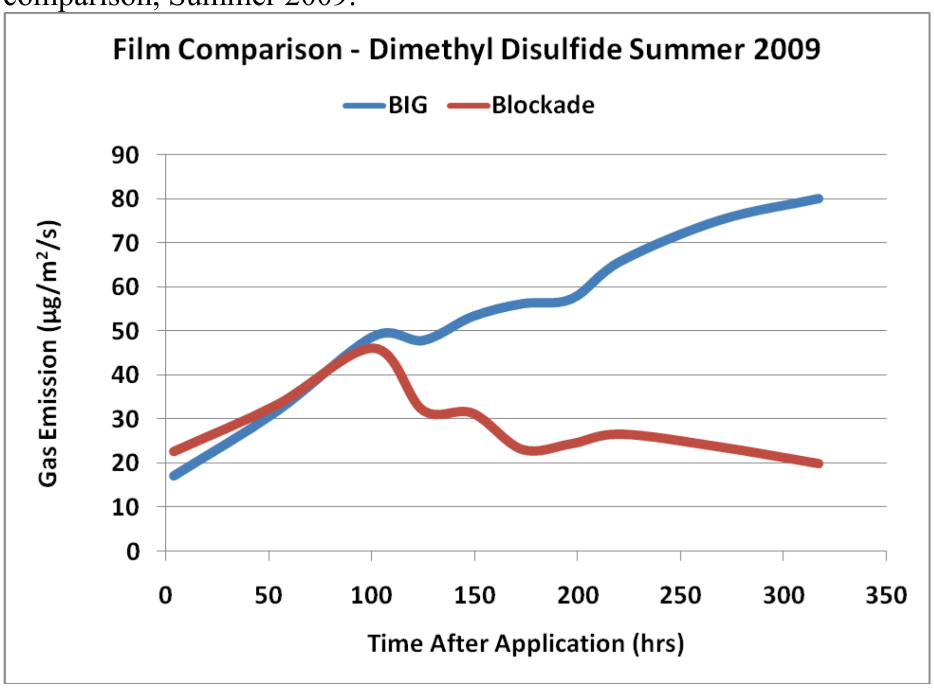

Figure 4. Gas emission for dimethyl disulfide comparing BIG and Blockade mulch films, Summer 2009.

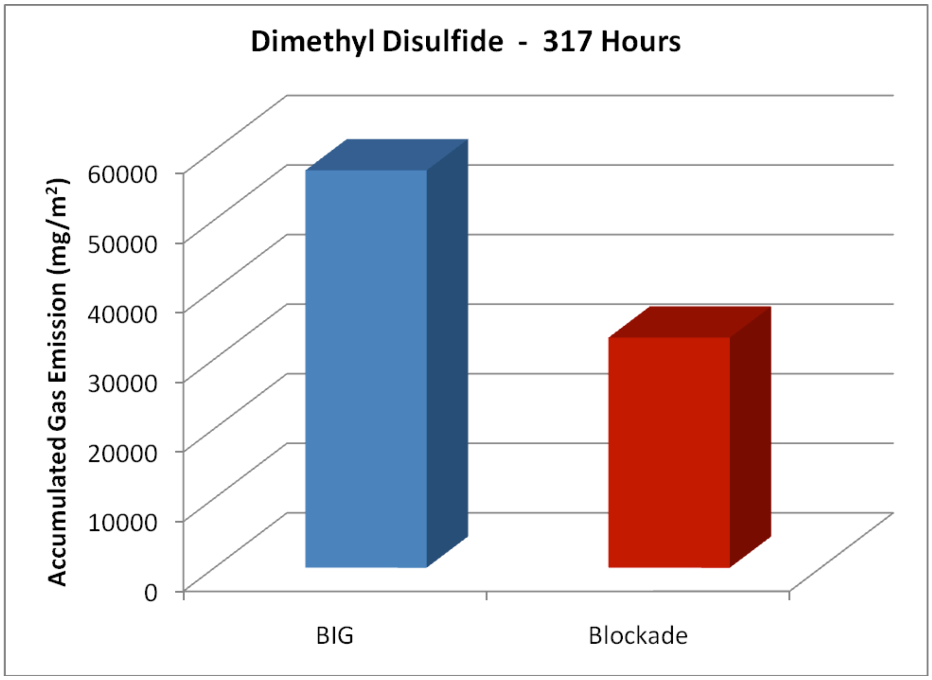

Figure 5. Accumulated gas emission for dimethyl disulfide BIG and Blockade mulch film comparison, Summer 2009.

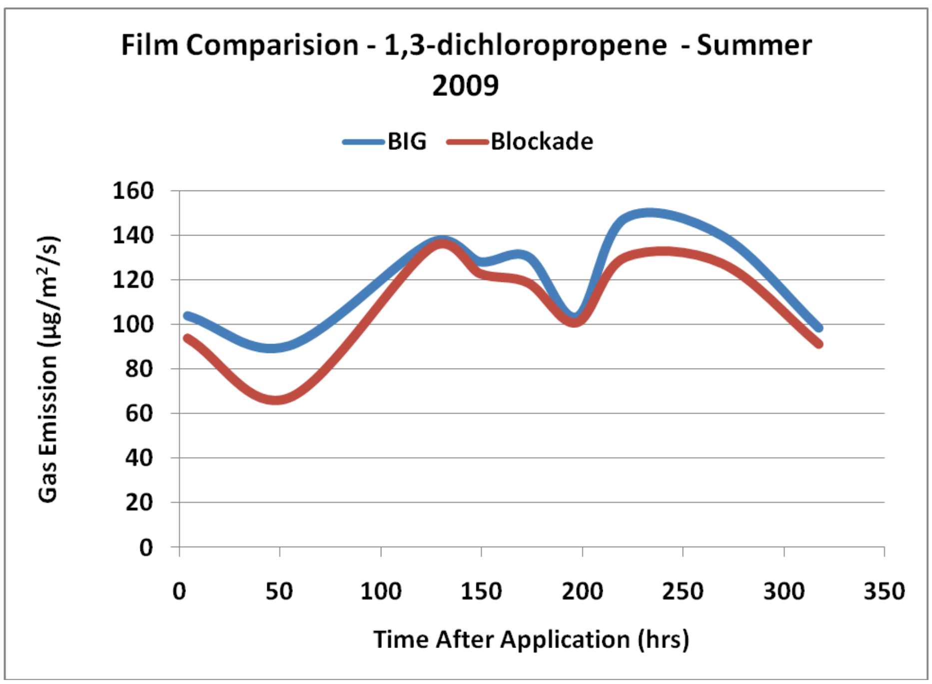

Figure 6. Gas emission for 1,3-dichloropropene combination, comparing BIG and Blockade mulch films, Summer 2009.

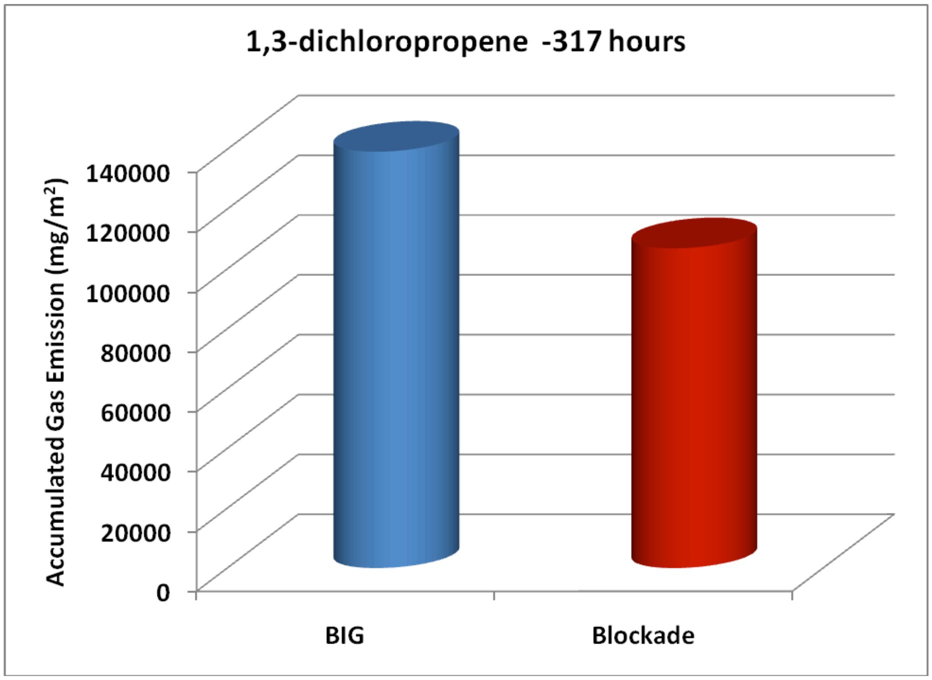

Figure 7. Accumulated gas emission for 1,3-dichloropropene combination BIG and Blockade mulch film comparison, Summer 2009.

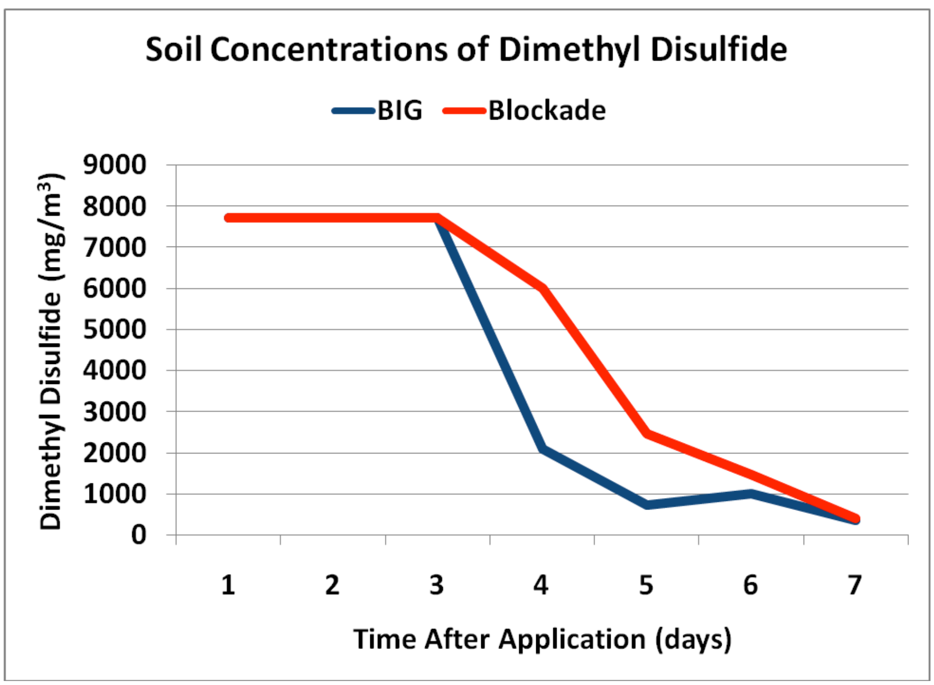

Figure 8. Concentration of dimethyl disulfide in the soil. Days 1-3 readings were off scale of meter (MiniRae 2000), Summer 2009.

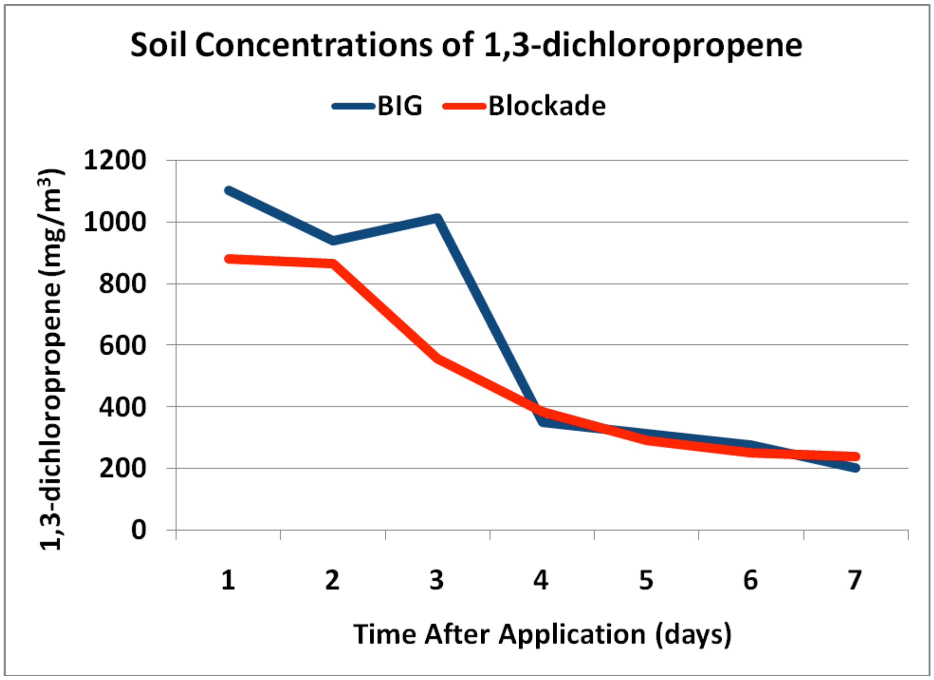

Figure 9. Concentration of 1,3-dichloropropene in the soil. Summer 2009.

EFFECTS OF MOISTURE ON GAS EMISSIONS 2009

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Introduction

In order to prepare a good firm plant bed for vegetable production adequate soil moisture is important. The Coastal Plains of Georgia has soil types that ranged from a deep sand to a loam. Soil fumigants have been used extensively in commercial raised mulch bed systems for vegetable production. These fumigants when placed in the soil in a liquid form will volatilize at soil temperatures above 40°F. Once in the gases form the fumigant will occupy pores space and treat soil particles for diseases, insects and weeds. The longer the fumigant gas comes in contact with theses pest the better control can be achieved by the fumigation process. A test was conducted to determine the effect of soil moisture content on gas emissions with a Blockade and LDPE mulch covering for commercial raised bed vegetable production.

Materials and Methods

Plot land was chosen in the spring of 2009 for a soil type of loamy sand which is comparable to soils used for commercial vegetable production in South Georgia. Soil moisture levels were selected to have relative dry and wet moisture content. Prior to bedding soil moisture was estimated with a 10HS Soil Moisture Sensor and a ProCheck meter, Decagon Devices, Inc. Figure 1 was used to convert meter readings to a percent moisture/dry weight of soil measurement. Plots were random design using Blockade and LDPE mulch treatments. Plots were tilled with a field cultivator and bedder prior to operation of the fumigation equipment.

Pic Chlor 60 at 196 l/ha (21 gpa) (1,3-dichloropropene [40%] and chloropicrin [60%]) was applied on February 18, 2009 in 1.8 m by 15 m plots with 81 cm bed tops. Pic Chlor 60 was applied with a prebedder injecting fumigant 20 cm with injection three knives 28 cm apart. Next, Vapam at 701 l/ha (75 gpa) was applied 10 cm (4 in) deep with coulter knives 10 cm (4 in) apart on a pre-shaped bed and covered with the mulch film.

Soil samples of 365 cm^3 were obtained from each plot with a soil probe (4.8 cm diameter by 20 cm deep). Gravimetric moisture content basis was determined for each sample by weighing the soil and placing the soil in a 105°C oven for 24 hours and reweighed. Next, the samples were evaluated for field capacity water content. Soil samples were placed on a ceramic plate. The sample is then saturated with water for 24 hours to equilibrate. The porous ceramic plate with saturated soil is pressurized to 1/3 bar of pressure. After 24 hours in this chamber, the moisture content in the soil was determined with above method.

Chloropicrin was measured with a gas detector pump (GASTEC GV100S) and a detector tube (Sensidyne #172S). An inverted HDPE funnel (1.9 L) with a rubber stopper measuring 16.5 cm in diameter fill opening by 22 cm high with a 2 cm drain was glued (silicon) to plastic mulch beds (Figure 2). Chloropicrin gas collected inside the funnels for a known period of time (1-10 minutes). After the known period, a 100 ml sample was drawn through the detector tube from the inside of the funnel by the gas detector pump. The chloropicrin detector tubes had a range of 0.05 – 16 ppm.

Telone and Vapam combination was measured with a handheld volatile organic compound (VOC) monitor (MiniRae 2000) with a range of range of 0-10,000 ppm. Measurements were taken immediately after the chloropicrin inside the inverted funnel.

Samples of the accumulated gas inside the funnels were taken from 3 to 75 hours after application. Fumigants were measured in the funnels until no gases were detected.

Results and Discussion

Field capacity of the soil was determined to be 8.0 %/dry weight of soil. Soil moisture content was determined for each plot. Plots were categorized into wet (8.2%/dry weight of soil) (103 % field capacity) and dry (6.7%/dry weight of soil) (82 % field capacity) moisture contents.

Chloropicrin gas emissions were compared for moisture content and mulch cover. Figure 3 and 4 show chloropicrin emission comparison for Blockade and LDPE mulch for dry and wet soil moisture regimes. The blockade decreased chloropicrin emissions by 70 percent (dry soil) and 72 percent (wet soil) compared to LDPE. Comparing soil moisture with LDPE increasing soil moisture by 1.5 percent decreased chloropicrin gas emission by 30 percent (figure 5). Also, comparing soil moisture with Blockade mulch, emissions were reduced by 35 percent (figure 6).

Telone II and Vapam was evaluated for gas being emitted from the surface of the LDPE and Blockade plastic mulch based on moisture content of the soil in the raised bed. Figures 7 and 8 compare mulch type for dry and wet soil moisture content. The blockade decreased emissions by 8 percent (dry soil) and 11 percent (wet soil) compared to LDPE. When moisture content of soil increased, the amount of Telone II and Vapam combination fumigant being released increased by 2 percent with LDPE mulch and decreased by 6 percent for Blockade mulch (figures 9 and 10).

The gas emission rate typically follows the daily rise and fall of temperature. The gas emission rate was the highest during the afternoon once the sunlight has warmed the mulch and soil. The daily soil temperature at 20 cm ranged from 11°C to 15°C during the data collection period.

This study showed that increasing moisture levels in the soil will significantly reduce the amount of chloropicrin being released to the environment but had little effect on Telone II and Vapam combination for the time period examined.

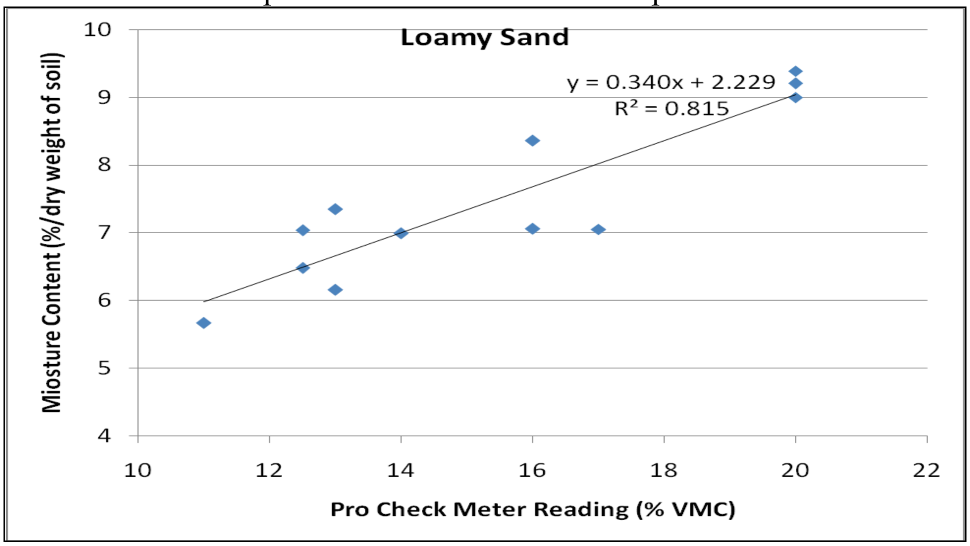

Figure 10. Gravimetric moisture content of loamy sand soil type using Decagons ProCheck and 10HS soil moisture sensor.

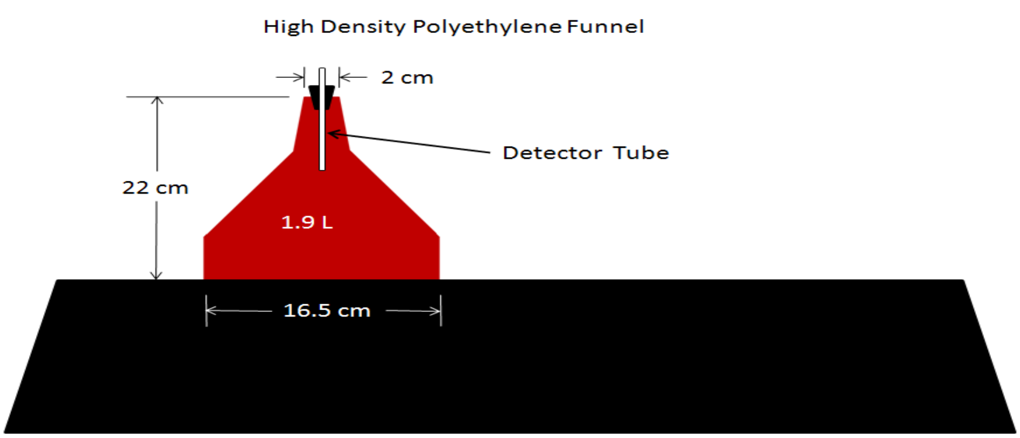

Figure 11. Schematic of fumigant sampling system.

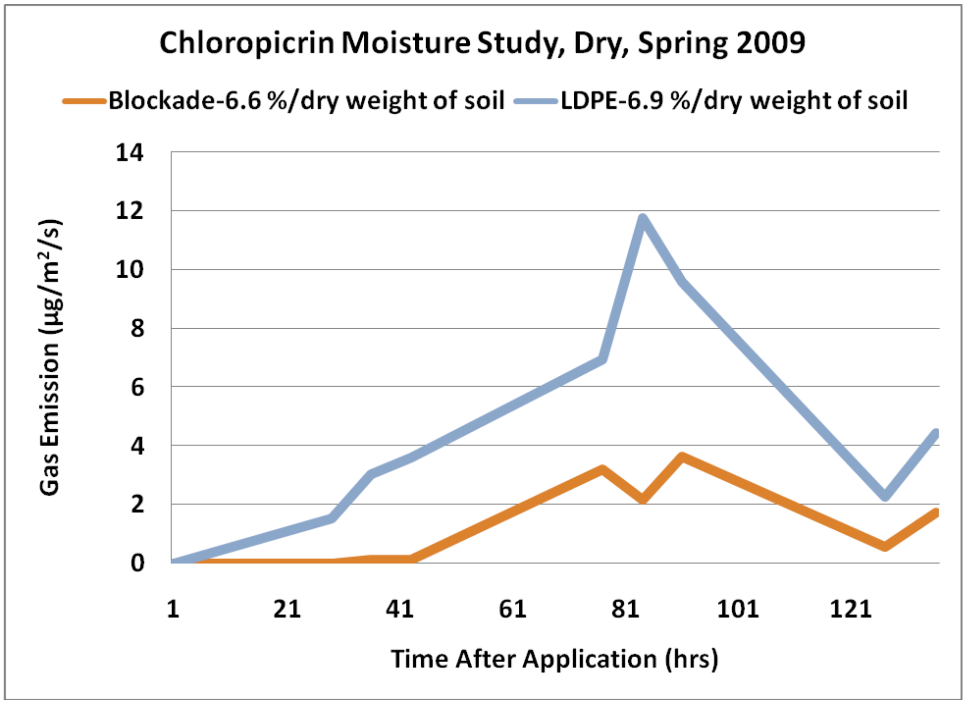

Figure 12. Chloropicrin gas emission comparison for Blockade and LDPE in dry loamy sand.

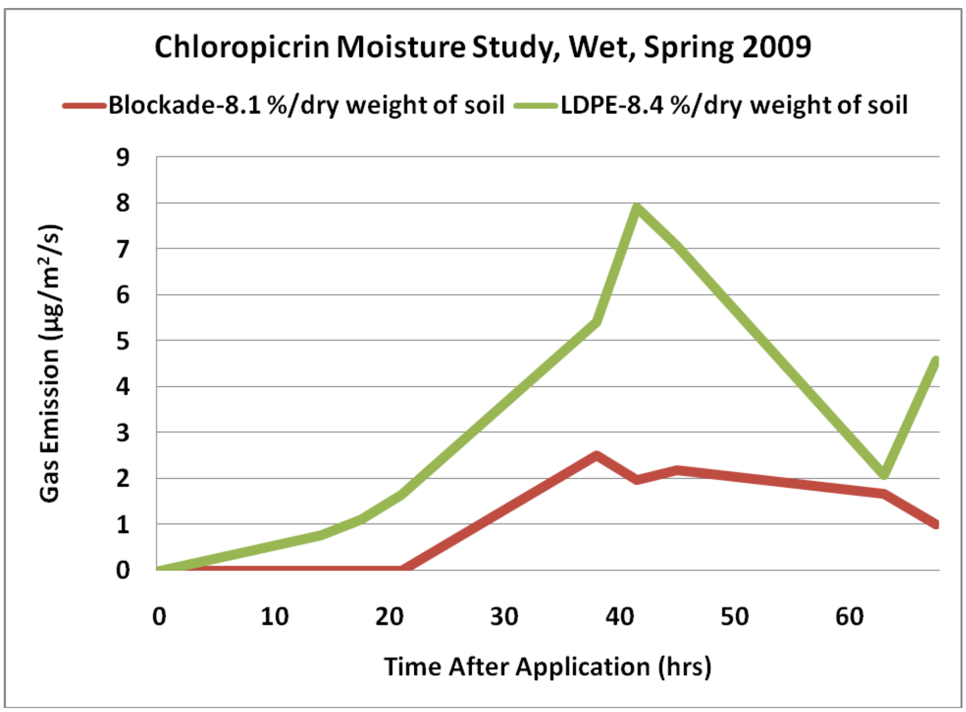

Figure 13. Chloropicrin gas emission comparison for Blockade and LDPE in wet loamy sand

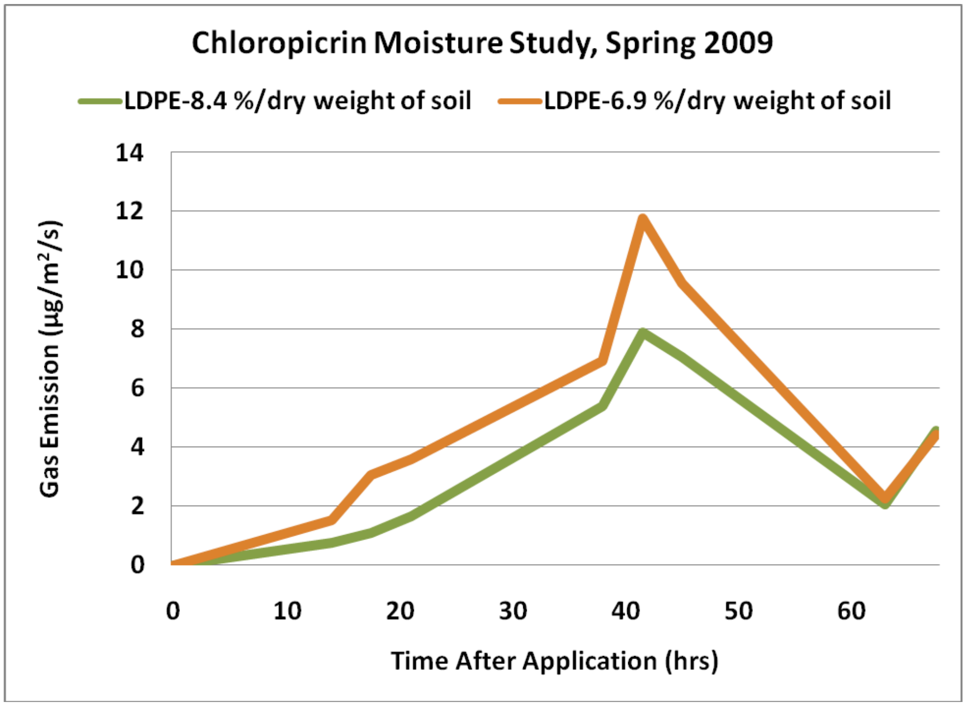

Figure 14. Chloropicrin gas emission comparison for wet and dry beds for LPDE mulch.

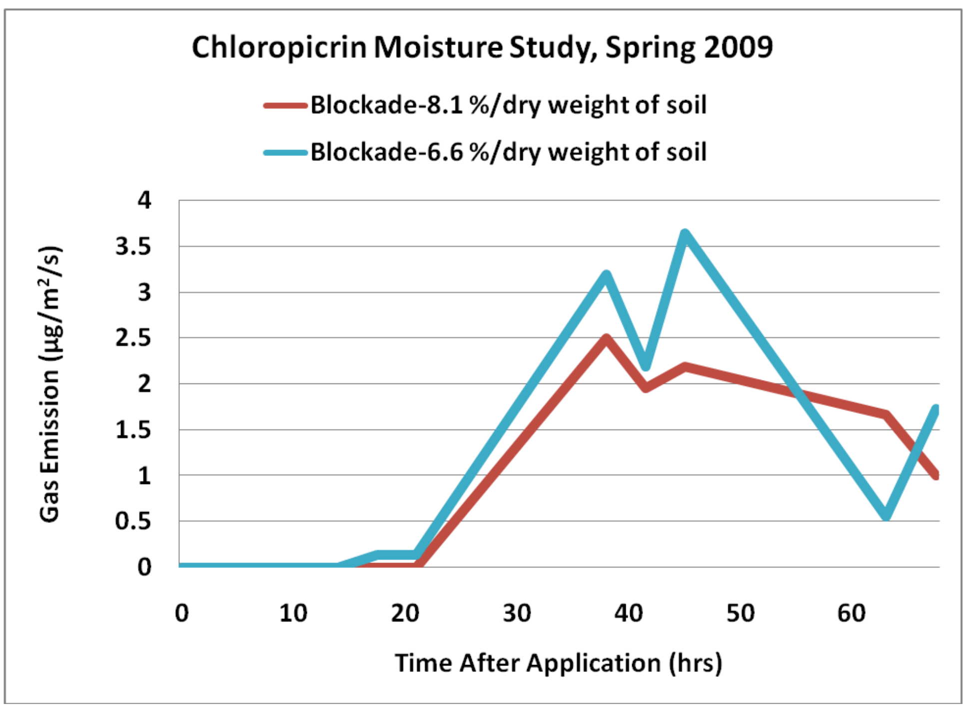

Figure 15. Chloropicrin gas emission comparison for wet and dry beds for LPDE mulch.

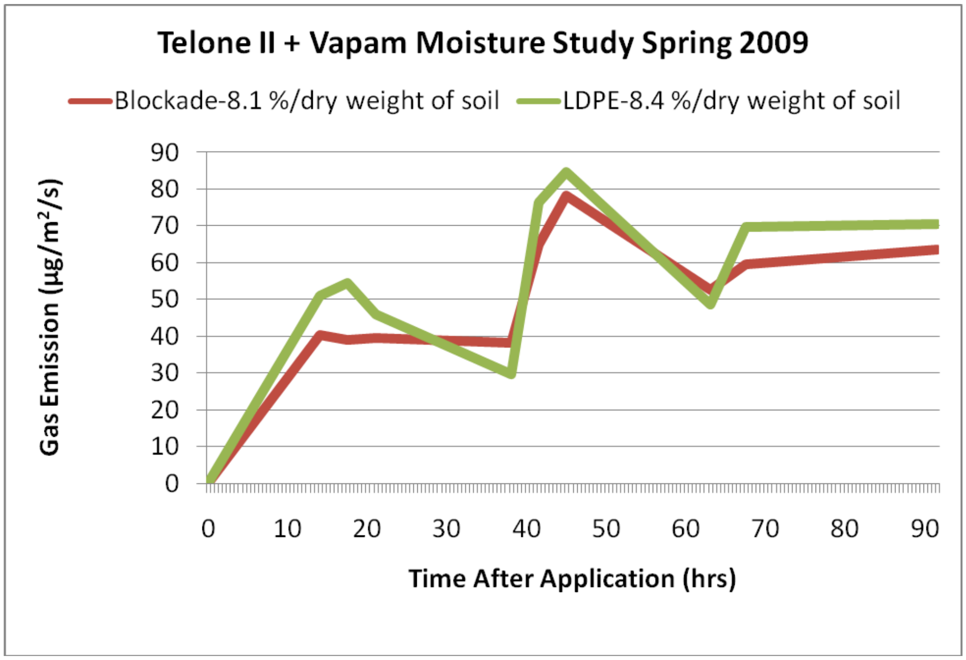

Figure 16. Telone II and Vapam combination gas emission comparison for Blockade and LDPE in dry loamy sand.

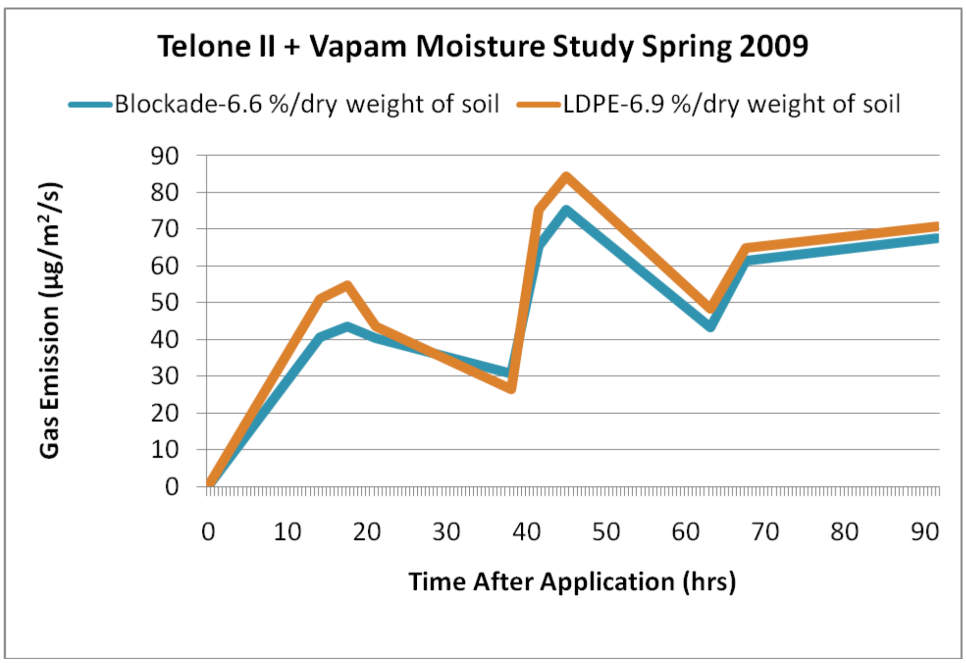

Figure 17. Telone II and Vapam combination gas emission comparison for Blockade and LDPE in wet loamy sand.

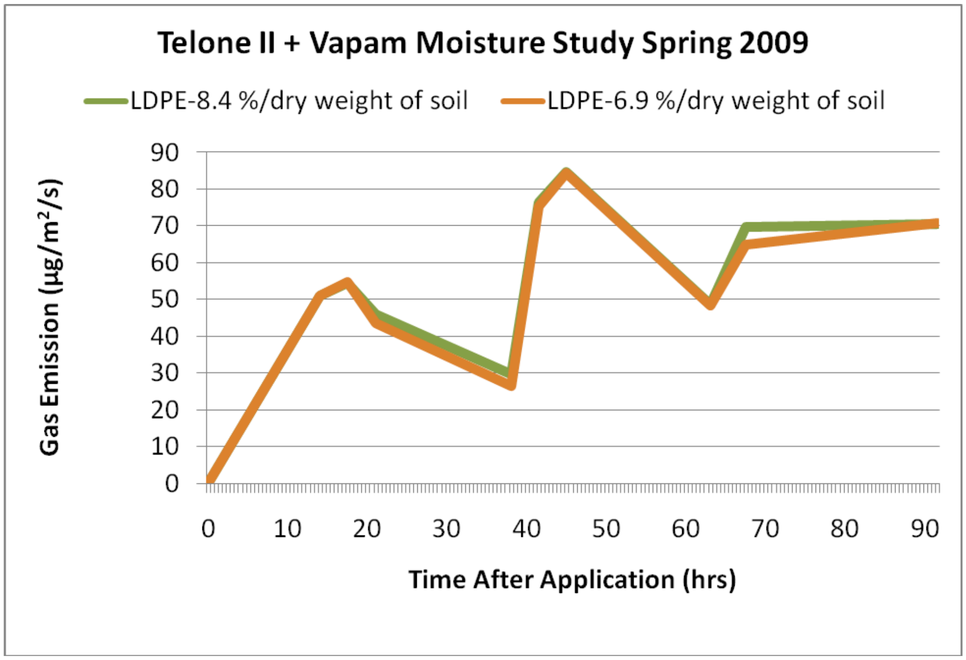

Figure 18. Telone II and Vapam Combination gas emission comparison for wet and dry beds for LPDE mulch.

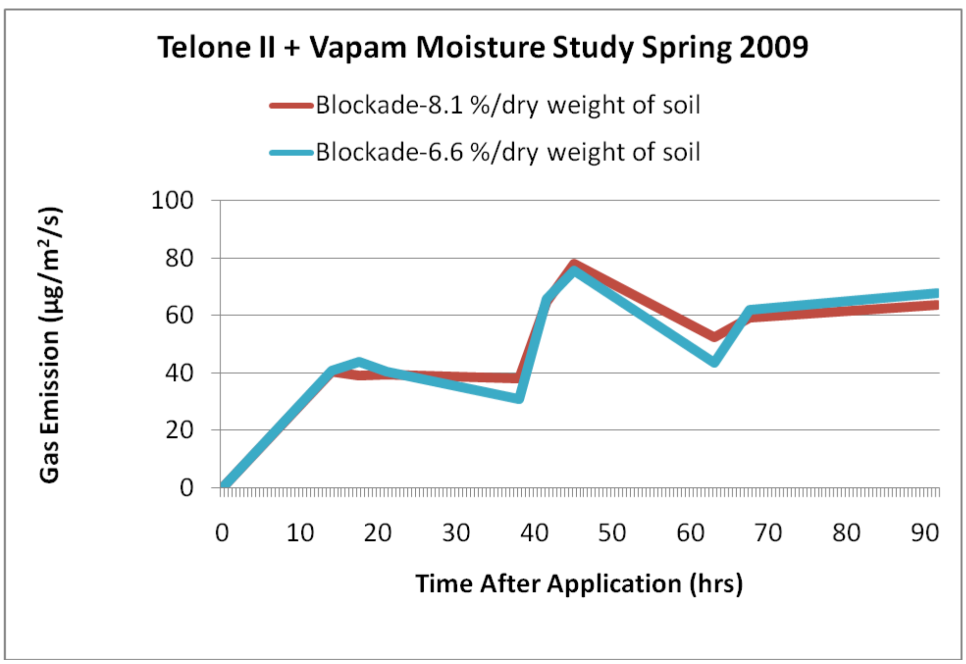

Figure 19. Telone II and Vapam Combination gas emission comparison for wet and dry beds for Blockade mulch.

MULCH EFFECTS ON FUMIGANT GAS EMISSIONS

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Introduction

EPA has proposed significant buffers between fumigated bareground fields and residences or occupied buildings; however, the distances that are proposed appear to be unrealistic for commercial vegetable production in Georgia. Current proposed buffer restrictions for the use of the 3-WAY in plasticulture range from 200 to 400 feet while this same fumigant program would have a buffer restriction exceeding 1450 feet in bareground production. Fumigant use in bareground production would be eliminated by these buffer restrictions!

Research was conducted in the fall of 2008 to investigate the amount of chloropicrin and dimethyl disulfide emission from bareground fumigation in a raised bed.

Materials and Methods

Plot land was chosen in the fall of 2008 for a soil type of sand which is comparable to soils used for commercial vegetable production in South Georgia. Plots were random design using LDPE, VIF and bareground mulches. Plots were tilled with a field cultivator and bedded prior to operation of the fumigation equipment.

Paladin™ a mixture of dimethyl disulfide and chloropicrin (79:21) was applied at 75 gpa with a prebedder injecting fumigants 8 inches deep with three knives 11 inches apart on September 8, 2008 in 1.8 m by 15 m plots with 81 cm bed tops.

Soil samples of 365 cm^3 were obtained from each plot with a soil probe (4.8 cm diameter by 20 cm deep). Gravimetric moisture content basis was determined for each sample by weighing the soil and placing the soil in a 105°C oven for 24 hours and reweighed. Next, the samples were evaluated for field capacity water content. Soil samples were placed on a ceramic plate. The sample is then saturated with water for 24 hours to equilibrate. The porous ceramic plate with saturated soil is pressurized to 1/3 bar of pressure. After 24 hours in this chamber, the moisture content in the soil was determined with above method.

Chloropicrin was measured with a gas detector pump (GASTEC GV100S) and a detector tube (Sensidyne #172S). An inverted HDPE funnel (1.9 L) with a rubber stopper measuring 16.5 cm in diameter fill opening by 22 cm high with a 2 cm drain was glued (silicon) to plastic mulch beds(Figure 1). Chloropicrin gas collected inside the funnels for a known period of time (1-10 minutes). After the known period, a 100 ml sample was drawn through the detector tube from the inside of the funnel by the gas detector pump. The chloropicrin detector tubes had a range of 0.05 – 16 ppm.

Dimethyl disulfide was measured with a handheld volatile organic compound (VOC) monitor (MiniRae 2000) with a range of range of 0-10,000 ppm. DMDS measurements were taken immediately after the chloropicrin inside the inverted funnel.

Samples of the accumulated gas inside the funnels were taken from 3 to 50 hours after application. Fumigants were measured in the funnels until no gases were detected.

Results and Discussion

Average soil moisture content for this experiment was 5 %/dry weight of soil. The field capacity of sand soil type was 5.4 %/dry weight of soil therefore the soil was at 92% field capacity when the test was started. Figure 2 illustrates the temperature cycle occurring during the test on a typical bed. Soil temperatures at a depth of 8 inches averaged 87°F and ranged a minimum of 79 to a maximum of 96°F.

Chloropicrin gas emissions are shown in figure 3 for LDPE, VIF and bareground. The VIF mulch reduced chloropicrin emission by 80 percent over LDPE. Also bareground had a reduction of 40 percent compared to LDPE.

Dimethyl disulfide gas emission for the test is graphed in figure 4 for LDPE, VIF and bareground. Gas emission reduction for using VIF compared to LDPE was 52 percent. The bare ground has a reduced gas emission of 48 percent. Figure 5 shows the final concentration of dimethyl disulfide in the soil 49 hours after application. Concentration of dimethyl disulfide was 3.8 time higher than under VIF than LDPE.

The results from this experiment shows the need for more research to be conducted on gas emission in bare ground production before regulations are imposed that will eliminate bare ground production.

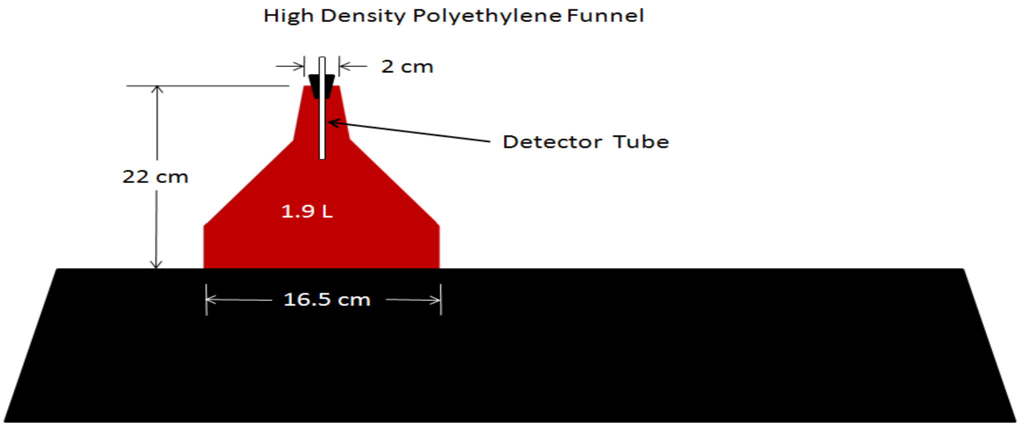

Figure 20. Schematic of fumigant sampling system.

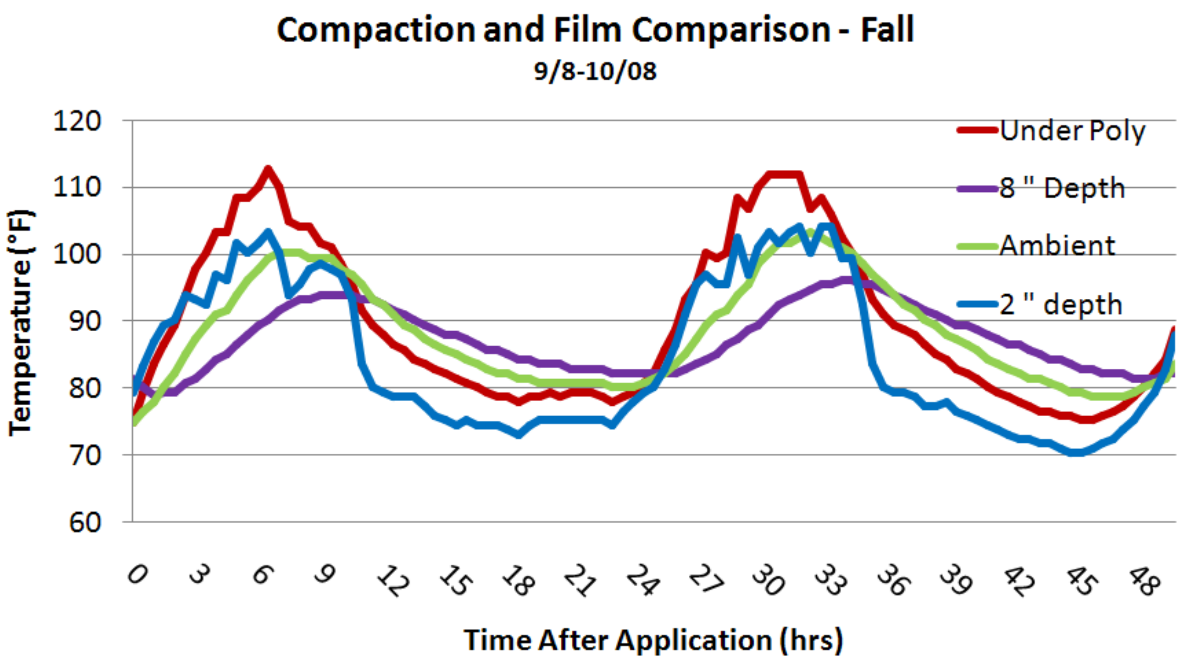

Figure 2. Temperature profile for under poly, 2 inch, 8 inch and ambient during the mulch tests. September 2008.

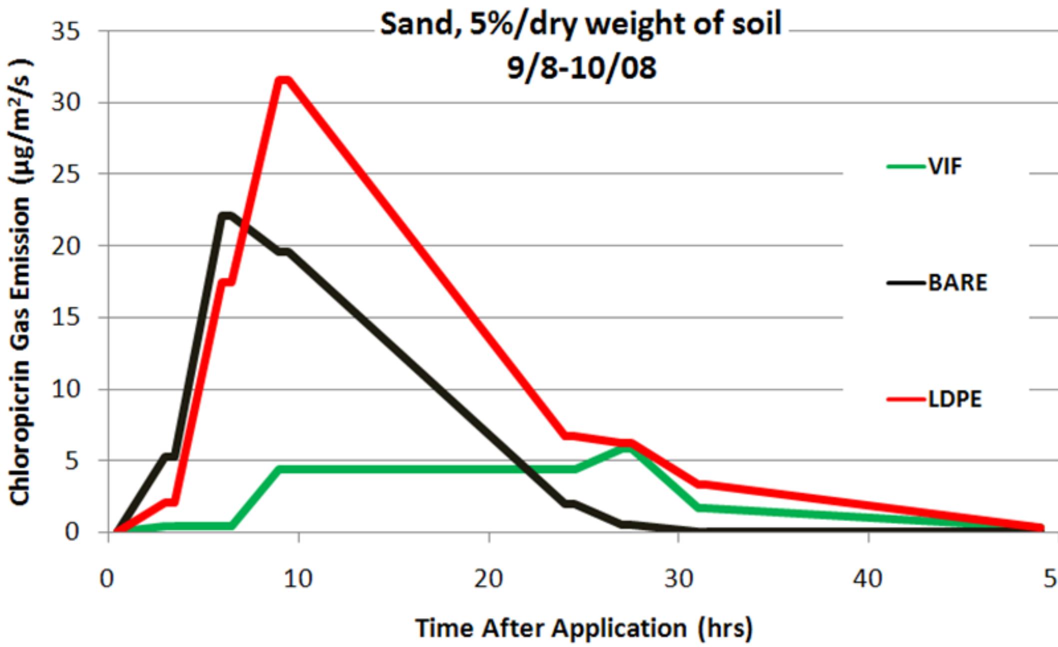

Figure 3. Comparing chloropicrin gas emissions on bare ground and mulch raised beds. September 2008.

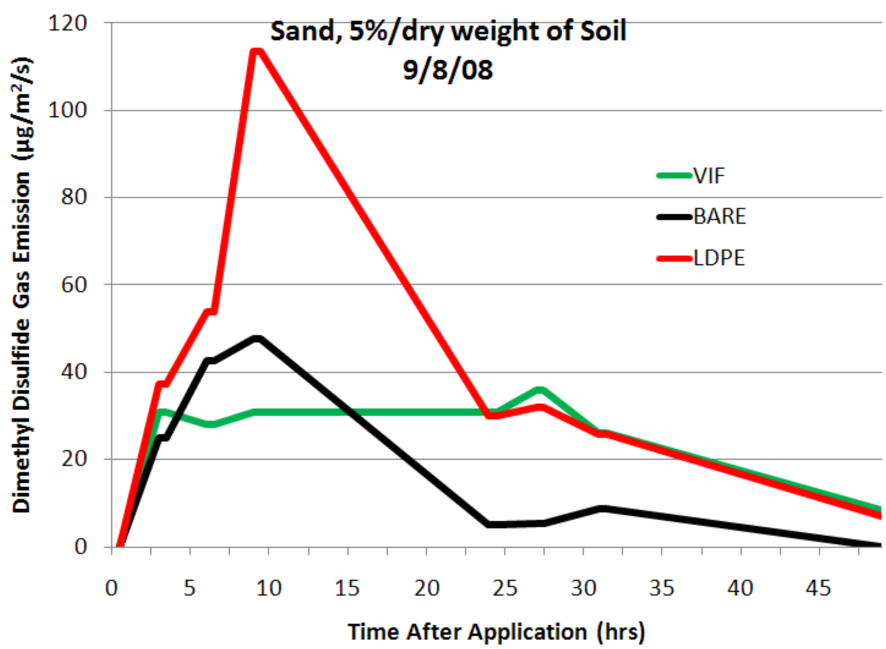

Figure 4. Comparing dimethyl disulfide gas emissions on bare ground and mulch raised beds. September 2008.

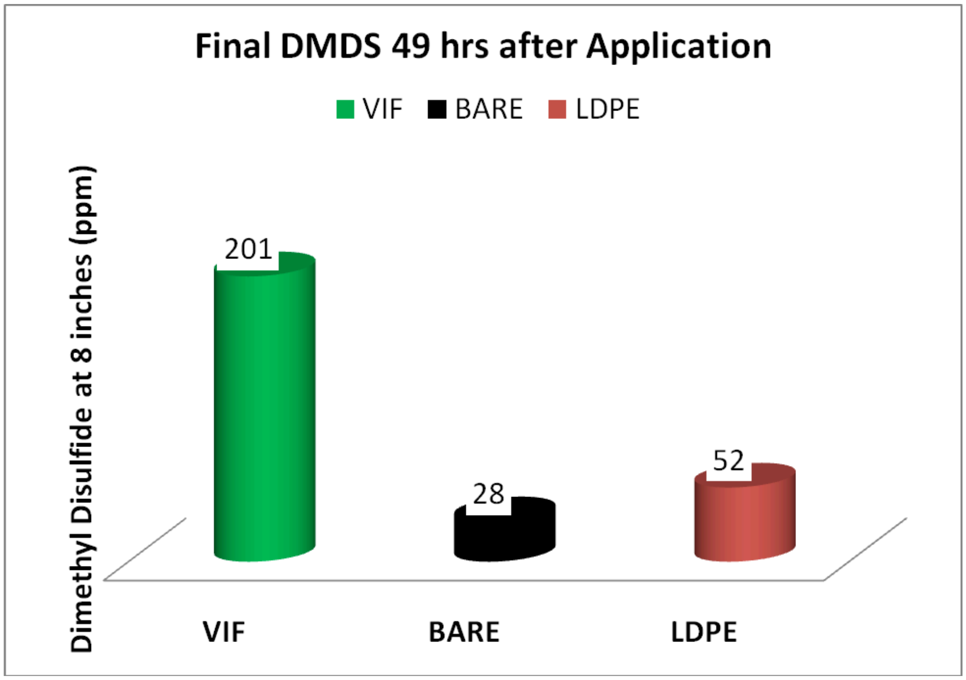

Figure 5. Dimethyl disulfide concentrations at 8 inches soil depth. September 2008.

SOIL COMPACTION EFFECTS ON FUMIGANT GAS EMISSIONS

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Introduction

Chloropicrin fumigant gas will be the controlling factor for buffer zone (distance from public and private habitat) restrictions in commercial vegetable production. Buffer zones are being discussed that could reduce the amount of land available to produce commercial vegetables. All liquid fumigants used today in commercial vegetable production have chloropicrin as a component. Chloropicrin is usually injected into the soil where it permeates the soil and kills soil-borne pests. Chloropicrin is a clear, colorless, nonflammable oily liquid with strong, sharp, highly irritating odor and a strong lacrimator. A lacrimator is gas that makes the eyes fill with tears but does not damage them. The high vapor pressure of 23.8 mm Hg @ 25°C of chloropicrin suggests that volatilization is the route of dissipation. Direct photolytic degradation ($t^1/_2$ <8 hrs) of chloropicrin is the primary route of dissipation in the atmosphere, which suggests it is not a significant threat to deplete the ozone layer. However, if chloropicrin remains in soil, it also degrades in soil with half-lives ranges from 4.5 to 10 days with CO_2 being the terminal breakdown product.(EPA, 2007.)

It is theorized that the closer the soil particles are together (soil compaction), the gas fumigant would stay in the soil profile longer. An experiment was setup to measure the amount of chloropicrin and DMDS fumigants released on two different soil compactions.

Materials and Methods

Plot land was chosen in the fall of 2008 for a soil type of sand which is comparable to soils used for commercial vegetable production in South Georgia. Plots were random design using LDPE mulch. Plots were tilled with a field cultivator and bedded prior to operation of the fumigation equipment.

Paladin™ a mixture of dimethyl disulfide and chloropicrin (79:21) was applied at 75 gpa with a prebedder injecting fumigants 8 inches deep with three knives 11 inches apart on September 8, 2008 in 1.8 m by 15 m plots with 81 cm bed tops. Next, LDPE mulch was applied with a plastic layer. The compaction of the bed was obtained by adjusting the top link on the plastic laying machine. The top link was set at 27.5 (ideal bed preparation setup) and 28.0 inches (more compact bed) in length. Soil compaction was measured with a Pocket Penetrometer modified with a ½ inch foot on various section of the bed.

Soil samples of 365 cm^3 were obtained from each plot with a soil probe (4.8 cm diameter by 20 cm deep). Gravimetric moisture content basis was determined for each sample by weighing the soil and placing the soil in a 105°C oven for 24 hours and reweighed. Next, the samples were evaluated for field capacity water content. Soil samples were placed on a ceramic plate. The sample is then saturated with water for 24 hours to equilibrate. The porous ceramic plate with saturated soil is pressurized to 1/3 bar of pressure. After 24 hours in this chamber, the moisture content in the soil was determined with above method.

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Results and Discussion

Average soil moisture content for this experiment was 5 %/dry weight of soil. The field capacity of sand soil type was 5.4 %/dry weight of soil therefore the soil was at 92% field capacity when the test was started. Figure 2 illustrates the temperature cycle occurring during the test on a typical bed. Soil temperatures at a depth of 8 inches averaged 87°F and ranged a minimum of 79 to a maximum of 96°F.

Chloropicrin gas emissions on LDPE covered beds at two compaction settings are shown in figure 3. When the top link was extended to create a firmer bed, gas emissions was reduced by 20 percent. Dimethyl disulfide gas emission reduced by 9 percent when the top link was lengthened to increase bed density(figure 4).

This experiment shows that compaction can affect how fumigant gas is being emitted from the mulch bed.

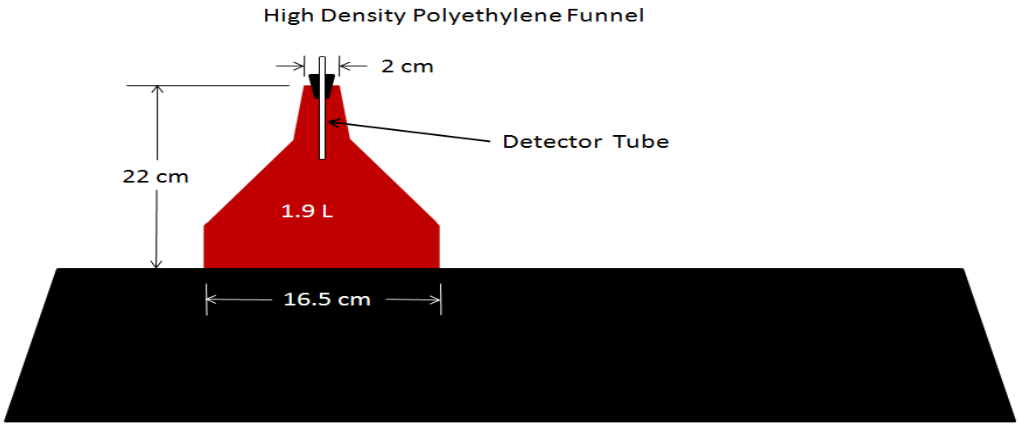
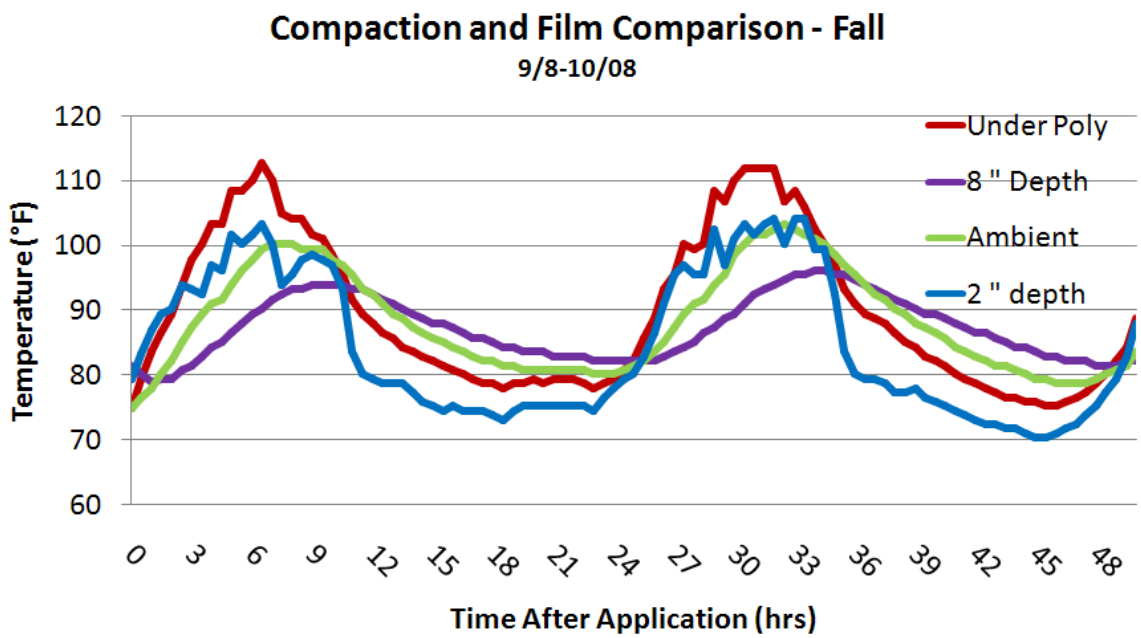


Figure 21. Schematic of fumigant sampling system.



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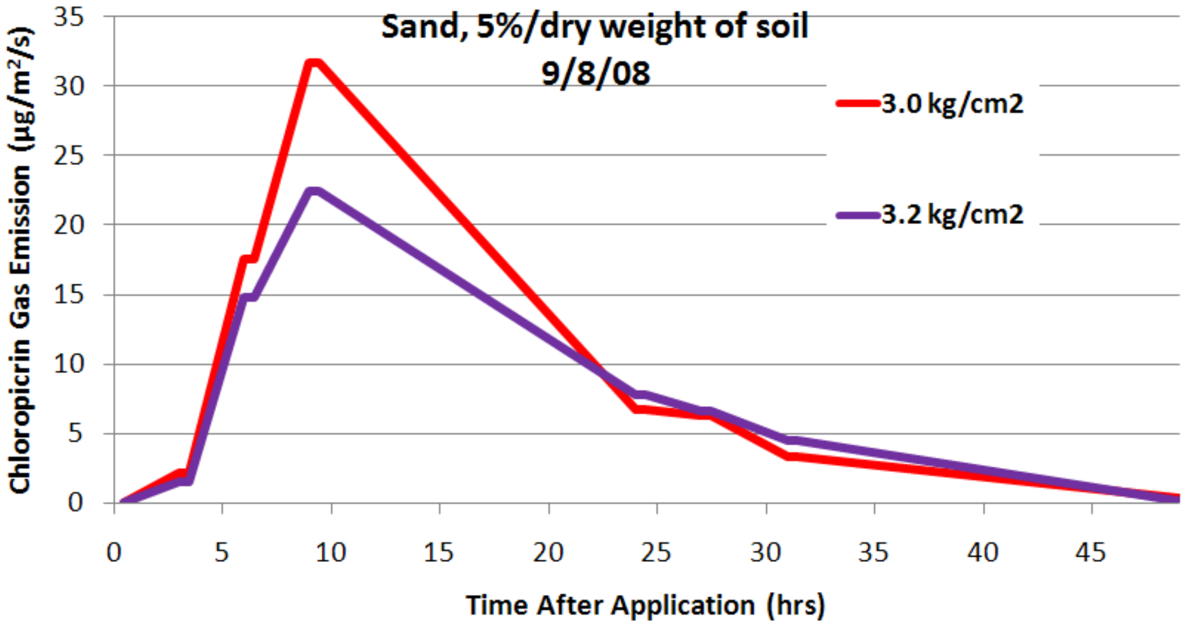

Figure 3. Chloropicrin gas emission on LDPE plastic mulch for two compactions settings. September 2008.

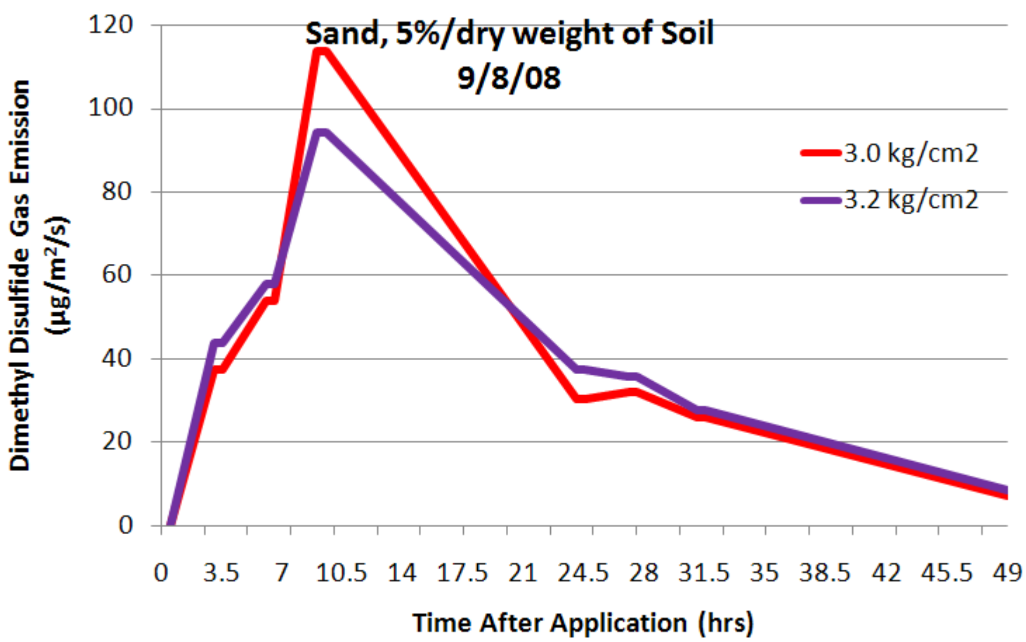

Figure 4. Dimethyl disulfide gas emission on LDPE plastic mulch for two compactions settings. September 2008.

EFFECTS OF TIME OF DAY APPLICATION ON EMISSION OF CHLOROPICRIN

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Introduction

Minimizing buffer zones for fumigants such as chloropicrin is a major concern for vegetable producers in Georgia. One method to mitigate gas emission into the atmosphere is through the use of high barrier mulch films. Several different types of mulch films have been developed and will offer growers credits to reduce their buffer zones There has been some observation that application time and tillage may also affect fumigants emissions. This experiment was conducted to determine the effects of application time of day and tillage prior to bed formation on gas emissions, in an effort to determine if more credits could be obtained through adopting varying cultural practices.

Materials and Methods

Plot land was chosen in the spring of 2009 for a soil type of sand which is comparable to soils used for commercial vegetable production in South Georgia. Three application times were selected for 8:00 am, 11:00 am and 3:00 pm. Plots were subdivided to be rototil prior to bedding and not rototilled.

Pic Chlor 60 at 196 l/ha (21 gpa) (1,3-dichloropropene [40%] and chloropicrin [60%]) was applied on March 4, 2009 in 1.8 m by 15 m plots with 81 cm bed tops. Pic Chlor 60 was applied with a prebedder injecting fumigant 20 cm with injection three knives 28 cm apart. Next, the final bed was shaped and covered with black LDPE (1.25 mil). mulch film.

Soil samples of 365 cm^3 were obtained from each plot with a soil probe (4.8 cm diameter by 20 cm deep). Gravimetric moisture content basis was determined for each sample by weighing the soil and placing the soil in a 105°C oven for 24 hours and reweighed. Next, the samples were evaluated for field capacity water content. Soil samples were placed on a ceramic plate. The sample is then saturated with water for 24 hours to equilibrate. The porous ceramic plate with saturated soil is pressurized to 1/3 bar of pressure. After 24 hours in this chamber, the moisture content in the soil was determined with the above method. Soil samples were then sent to the University of Georgia Soils Lab for classification.

Chloropicrin was measured with a gas detector pump (GASTEC GV100S) and a detector tube (Sensidyne #172S). An inverted HDPE funnel (1.9 L) with a rubber stopper measuring 16.5 cm in diameter fill opening by 22 cm high with a 2 cm drain was glued (silicon) to plastic mulch beds (Figure 1). Chloropicrin gas collected inside the funnels for a known period of time (1-10 minutes). After the known period, a 100 ml sample was drawn through the detector tube from the inside of the funnel by the gas detector pump. The chloropicrin detector tubes had a range of 0.05 – 16 ppm.

Samples of the accumulated gas inside the funnels were taken from 3 to 75 hours after application. Fumigants were measured in the funnels until no gases were detected.

Results and Discussion

Soil moisture content ranged from 6.2 to 7.5 % per dry weight of soil. Field capacity of the soil was determined to be 7.64% per dry weight of soil for sand. Soil temperatures at 8 inches averaged 63°F. The maximum and minimum temperature at 8 inches was 75 and 48°F.

The affect of tillage had an impact on the amount of off gassing from the mulch bed (Figures 2 and 3). Regardless of the time of day of application, gas emissions increased by 64 percent when the soil was rototilled prior to formation of the bed. The gas emission rate typically follows the daily rise and fall of temperature. Figures 4-6 illustrate the gas emission rate was the highest during the afternoon once the sunlight has warmed the soil and mulch. Fumigant emissions peaked on day one except for 11:00 AM rototilled application. This application peaked higher on day two. Table 1 presents total gas emissions for all application times and tillage. The lowest amount of gas emission occurred for 8:00 am with no prior tillage. The daily soil temperature at 20 cm ranged from 48F °C to 75F °C during the data collection period.

Conclusion

Results show that higher total gas emissions occurred for applications at 11:00 AM and 3:00 PM for rototilled and 11:00 AM nontillage. But rototilling the soil prior to bed formation tends to increase gas emissions.

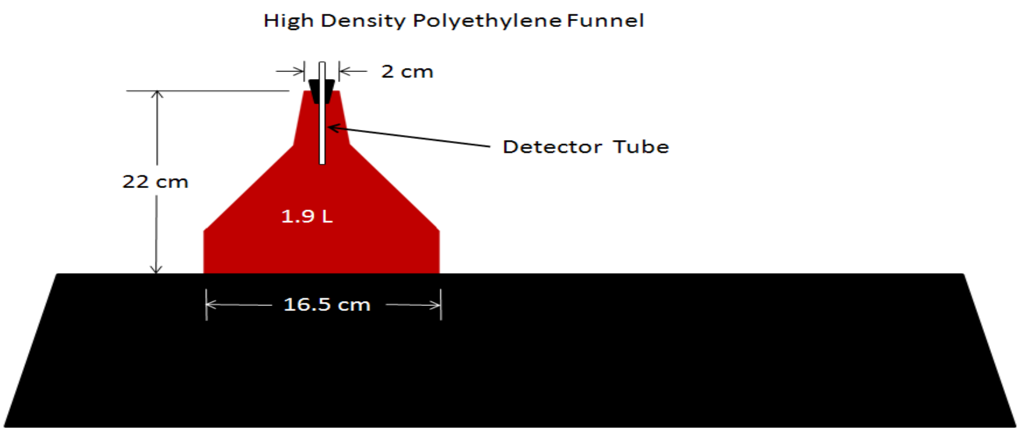

Figure 22. Schematic of fumigant sampling system.

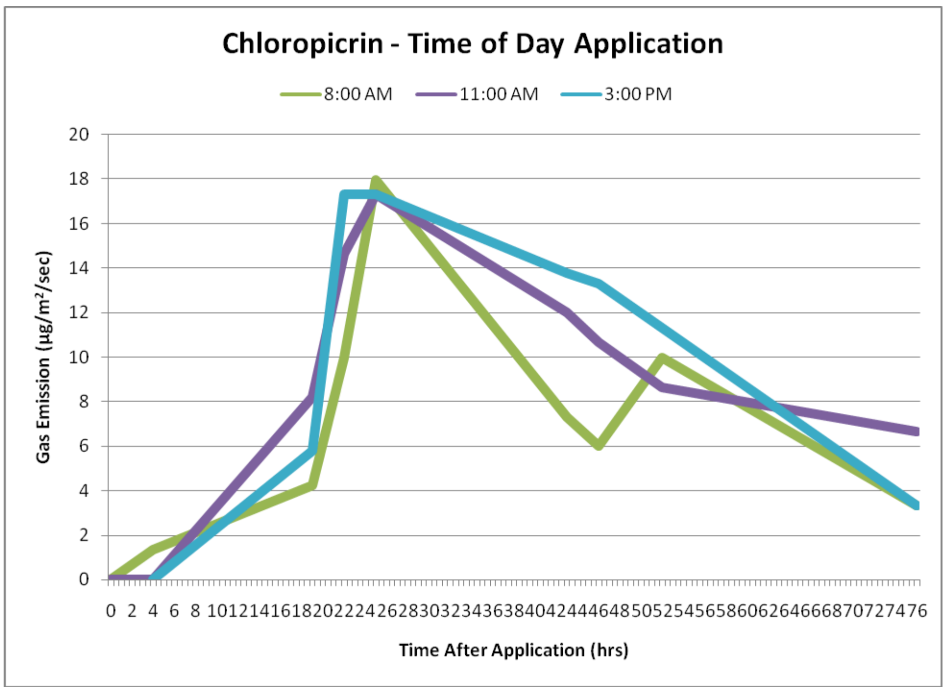

Figure 23. Chloropicrin release rates for various times of application during a day no field preparation. Spring 2009.

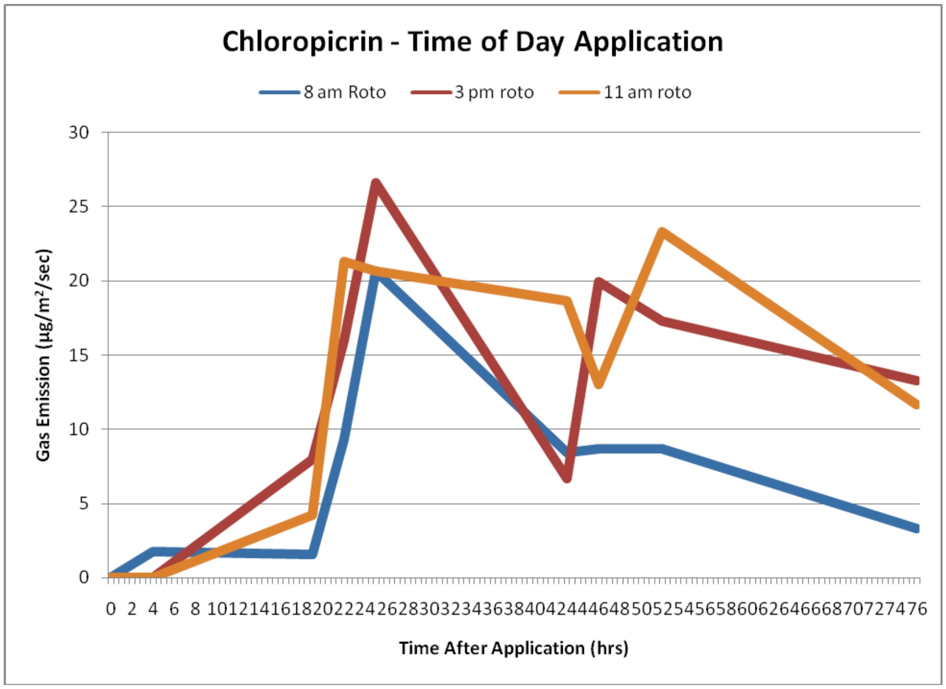

Figure 24. Chloropicrin release rates for various times of application during a day. Rototilled prior to bed formation. Spring 2009.

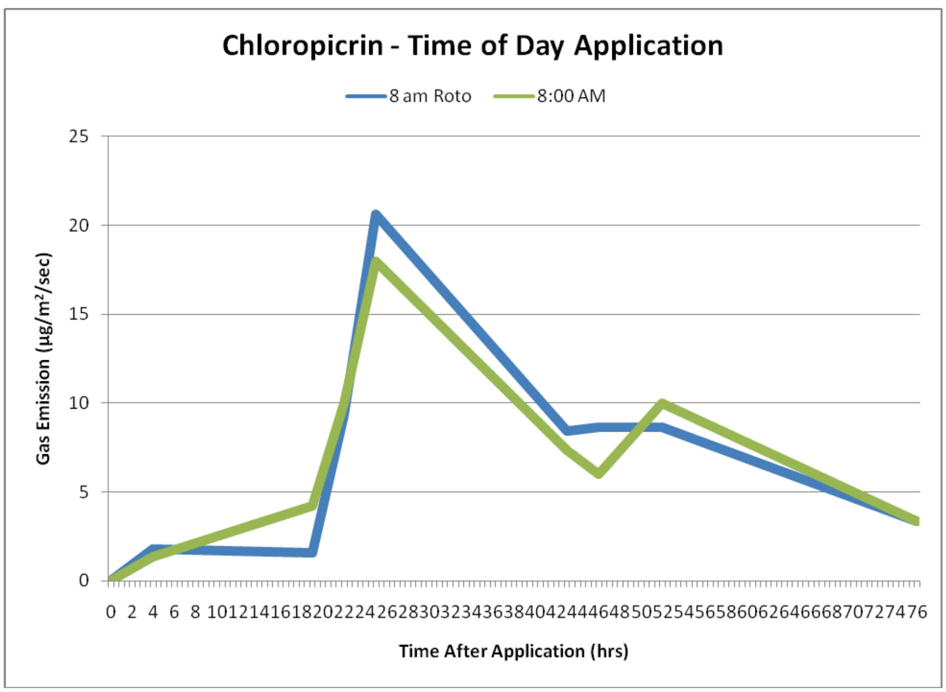

Figure 25. Chloropicrin release rates for 8:00 am application. Spring 2009.

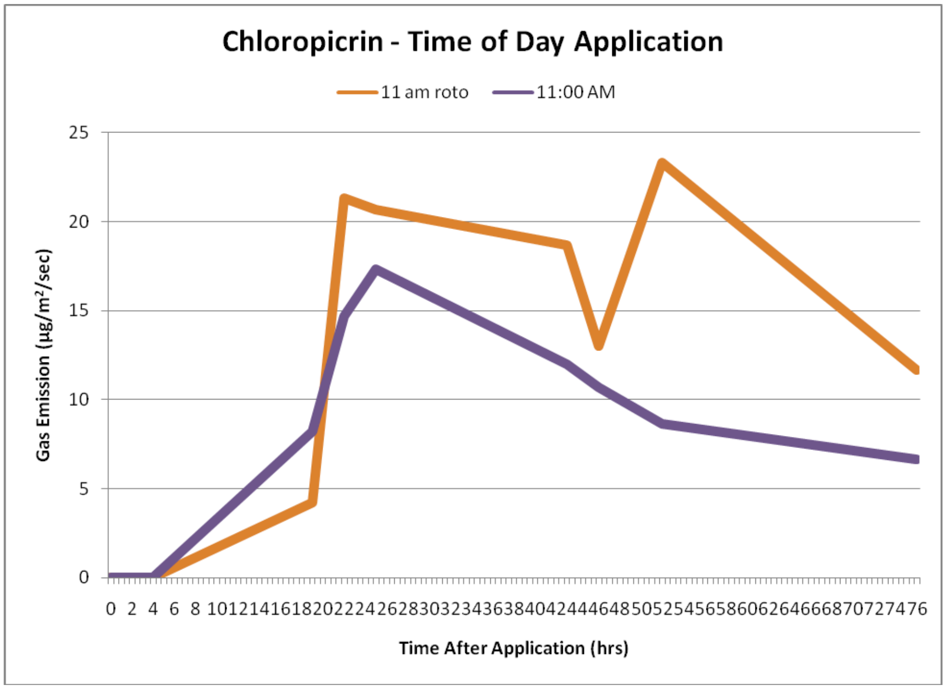

Figure 26. Chloropicrin release rates for 11:00 am application. Spring 2009.

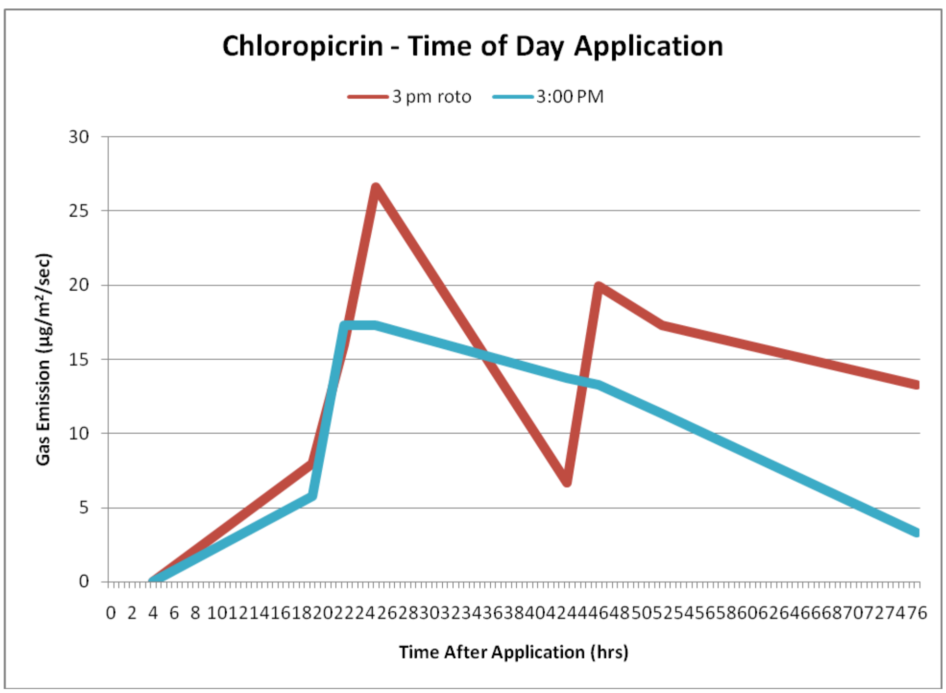

Figure 27. Chloropicrin release rates for 3:00 pm application. Spring 2009.

Table 1. Reduction in total chloropicrin gas emission for sand soil type based on application time and tillage. Spring 2009.					
Application Time	Tillage	Total Flux (mg/m^2)	[1]Time of Day Reduction - None (%)	[2]Time of Day Reduction – Rototilled (%)	Tillage Reduction (%)
8:00 AM	Rototilled	3831		55.2	
8:00 AM	None	3773	20.4		1.6
11:00 AM	Rototilled	8125		5.0	
11:00 AM	None	4741			41.7
3:00 PM	Rototilled	8551			
3:00 PM	None	3978	16.1		53.5

[1] – Calculation based on 11:00 AM application. [2] – Calculation based on 3:00 PM application.

SWEET CORN IRRIGATION SCHEDULING PROJECT 2009

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Abstract

Farmers in Southwest Georgia have developed their own irrigation strategies for high yield and high grade sweet corn production. Little to no research has been done on systematic irrigation scheduling or water use efficiency in commercial sweet corn. In 2008 and 2009 a randomized complete block study with four replications was established at the C. M. Striping Irrigation Research Park (SIRP) to test for yield and grade under nine different irrigation treatments. Treatments were designed to evaluate an irrigation scheduling computer program and water use efficiency. The project team customized an evapotranspiration (ET) based computer program (KanSched) for work in commercial sweet corn irrigation. With the modified KanSched software and soil moisture sensors the project team was able to accurately predict the irrigation decisions of typical sweet corn growers. This "modified KanSched" irrigation treatment was compared to a "farmer standard" treatment for accuracy verification. Additionally, we compared the "farmer standard" irrigation treatment (comparable to commercial sweet corn irrigation) against seven other treatments using more and less irrigation water. Data from research conducted at SIRP indicates a positive response in yield and grade to increasing amounts of irrigation. However, water use efficiency appears to increase at a decreasing rate as total irrigation amounts increase. Data includes yield, quality, irrigation amounts and timing, soil moisture and ET reference inputs. With this data set we were able to investigate the yield and quality implications of alternative irrigation strategies.

Introduction

In 2007, sweet corn was produced on 25,816 acres in Georgia making it the number one vegetable crop in the State by acreage comparison. 93% of sweet corn production is irrigated. Most of the crop is in South Georgia with 80% coming from Decatur, Mitchell, Miller and Seminole Counties. These counties are located in the Lower Flint River Basin where farmers are being encouraged to improve irrigation application and water use efficiency. For the most part sweet corn producers have relied on self-taught irrigation methods to successfully grow a high yielding and high quality crop. For many reasons producers are now more interested in irrigation management tools to better understand soil moisture dynamics and crop water use. Producers are increasing their irrigation management efforts to save on pumping costs and water use while insuring high yields and quality. Producers are also interested in objective irrigation management tools to create continuity in irrigation strategies from field to field and year to year. Continuity and record keeping would allow producers to better evaluate their irrigation management and better train irrigation managers. The County Extension Agents listed above have been studying irrigation scheduling on sweet corn for the past three years. They have worked closely with farmers and agricultural consultants to merge irrigation scheduling software with soil moisture sensor data to develop an objective irrigation management tool for Georgia sweet corn production. The public software is designed to monitor the root zone soil water balance and schedule irrigation events using evapotranspiration (ET) data. The Watermark sensor is an electrical resistance type sensor, read by data logging equipment, which converts the electrical resistance reading to a calibrated reading of Centibars of soil water tension. When used together these two tools provide more useful and reliable information then when used separately. Additionally, the County Agents have worked with wireless data transmission. They recognize that on today's hectic farm, wireless communication techniques have a real place and can turn good information into timely information. Gathering soil moisture sensor data means a trip to the field which can oftentimes be delayed or forgotten when schedules get busy. With wireless data transfer, the sensor information is much more likely to be used and relied on when making daily irrigation decisions. The County Agents have experience with both manual and wireless data transmission and feel the future of irrigation scheduling will definitely include advanced forms of soil moisture data transmission. To address these issues the Project Team developed the following objectives to work on in 2009.

1. Evaluate irrigation scheduling software for sweet corn
2. Compare a standard sweet corn irrigation treatment to seven other irrigation treatments using more and less irrigation water
3. Test the effectiveness of wireless communication equipment and remote soil moisture sensors in sweet corn.

Materials and Methods

The project included developing and testing an irrigation scheduling tool, comparing irrigation treatments and testing wireless communication equipment and remote soil moisture sensors at three locations.

Irrigation Scheduling Software

A computer program (KanSched) was modified for sweet corn irrigation scheduling in the sandy to sandy loam soils of Southwest Georgia. KanSched is free public software, available from Kansas State University and is adaptable to many crops. Essentially, the program is an ET based soil moisture calculator. For the calculator to work well, options on crop growth, soil properties, root dynamics, irrigation system performance etc. must be correctly modified. After initial field setup, the grower inputs a daily reference ET (evapotranspiration), rainfall and irrigation in the Budget Sheet (Diagram 1). The reference ET is readily available from the Georgia Automated Weather Network.

KanSched then generates a Water Chart (Diagram 2) to track changing soil moisture, the dotted green line. The dotted red line is a soil moisture threshold called "Managed Allowed Deficit" (MAD). Farmers manage irrigation amounts and intervals to keep soil moisture above the MAD threshold. The irrigator is allowed to change the MAD level to suit his management style.

Irrigation Treatments

A randomized complete block study with four replications and nine treatments was designed and installed at SIRP for 2008 and 2009. Plot size was 24' by 55'. Buffers surrounded all plots to insure the integrity of irrigation treatments. The variety planted was Passion, a commercial sweet corn sh2 yellow variety. Fertilizer was applied in a manner consistent with commercial sweet corn production using pre-plant, starter and multiple sidedress applications. Planting dates were around April 10th each year to have a timed harvest just before July 4th. The irrigation treatments varied at two critical stages, rapid vegetative growth (early season) and reproductive growth (late season). The treatments that remained constant from 2008 to 2009 were:

Irrigation Treatment/ Name	**Early crop stage amount or trigger**	**Late crop stage amount or trigger**
1.	.75" per week	.75" per week
2.	.75" per week	1.5" per week
3.	1.5" per week	.75" per week
4. KanSched 50% MAD	50% soil moisture deficit	50% soil moisture deficit
5. Farmer Standard	1.5" per week	1.5" per week
6. KanSched 30% MAD	30% soil moisture deficit	30% soil moisture deficit
7.	.75" per week	2.25" per week
8.	1.5" per week	2.25" per week

There were two other treatments not reported in these results. In 2008, a dryland treatment yielded zero and was not repeated for 2009. In its place was a KanSched treatment that changed from a 50% MAD early season to a 30% MAD late season. This treatment did well and will be repeated next year.

Remote Moisture Sensors and Locations

Location #1 at SIRP used a linear irrigation system on 3 acres of land and 36 randomized plots to carry out work in all three objectives. Locations #2 and #3 were separate 20 acre commercial sweet corn plantings. Nozzles on standard farm irrigation pivots were retrofitted with shutoff valves and variable rate controllers to allow 2-3 fewer irrigation applications on small replicated plots for comparisons to the producer's normal irrigation management. Wireless communication systems and soil moisture sensors were installed at SIRP and both commercial sweet corn fields. This allowed evaluation of the equipment under rugged farm conditions and study of the enhanced usefulness of 24/7 soil moisture data retrieval. Irrigation managers were trained in data transfer, irrigation software and soil moisture sensor data interpretation.

Results and Discussion

Data from 2008 and 2009 were helpful in all of the Sweet corn Irrigation Project objectives.

Irrigation Scheduling Tool

After two years of modifications, the program KanSched appears to be useful for scheduling sweet corn irrigation. KanSched did a good job of predicting when commercial growers would irrigate in 2008. In 2008 & 2009 KanSched treatments were very close in irrigation amounts and timing as compared to a "farmer standard" treatment.

The program allowed modifications for a fast developing vegetable crop like sweet corn to be modeled. Crop development and harvest is dependent on growing degree days, therefore adjustments to crop stage and coefficients were taken into account for various planting dates. Soil water holding capacities were kept standard according to type. Root zone management was set at 20 inches because of a shallower, less robust root system as compared to field corn. Also, at final cultivation, growers throw soil to the base of the stalk effectively altering the root zone. The soil properties and managed root zone determine soil water storage amounts at field capacity (solid blue line) (Diagram 2) and at the permanent wilting point (solid red line). One of the most effective modifications was the MAD level. Most row crop irrigators use a 50% managed allowed deficit (MAD) threshold. As plant available water declines, farmers "manage irrigation effort" to stop the decline at 50% plant available water. For sweet corn, this MAD level is too high; most growers see moisture stress in the plants before reaching the 50% MAD threshold. This is especially true for later spring plantings that are grown during the normally hot, dry month of June. A MAD threshold of 30-35% was much better at predicting when growers would initiate irrigation.

Without rain, the amount of irrigation is roughly the same between the two levels of MAD. The irrigation intervals for a 30% MAD are shorter than for a 50% MAD; but, irrigation amounts needed to bring soil moisture back to field capacity are less. However, since the 50% MAD allows for longer intervals, the chance of rain recharge is greater, usually resulting in less irrigation. When irrigation is necessary, KanSched calculates how much water is necessary to recharge the managed root zone back to field capacity.

Graph 1 shows average irrigation totals for 2008 and 2009. The 30% MAD treatment had similar irrigation totals to the farmer standard treatment. The farmer standard treatment attempts to duplicate how commercial sweet corn growers irrigate. In reality this is nearly impossible because of variables in soil type, planting dates, fertilizer strategies, and plant populations. There are other factors that could force growers to use more or less water than what our farmer standard treatment prescribed. The 50% MAD treatment resulted in less irrigation than the farmer standard because of rainfall delaying and canceling several applications. Rain forecasting was not a factor in irrigation treatment decisions.

The 30% MAD threshold seems to be a good, objective scheduling tool for commercial sweet corn growers. With this modified KanSched program, growers can be more consistent in their irrigation decisions from year to year. KanSched is fairly easy to use and update during the growing season. It gives specific information on current soil moisture and can make projections based on weather forecasts. Continuity and record keeping would allow producers to better evaluate their irrigation management and better train irrigation managers.

Irrigation Treatments

The eight irrigation treatments carried out at SIRP for 2008 and 2009 were done to verify the accuracy and usefulness of KanSched and to compare quality and yield for various water amounts and timing. The total irrigation amounts, yield and quality data show that the KanSched program is an effective way to schedule sweet corn irrigations. Statistics have not been run on the data but Graph 1 seems to indicate very little difference in yield when comparing the farmer standard and KanSched treatments. Yield was determined by measuring plant populations, pulling a sample box in each plot, and grading 20 ears for each plot. Federal-State inspectors graded each plot to determine a percent US grade fancy. Additionally all ears harvested from each plot were measured for length and girth. The size of sweet corn ears plays an important role in crate selection, grade and shipping cost. There was one treatment that showed negative effects from untimely irrigation. Treatment seven on average, used 1-2 inches more irrigation water than the KanSched treatments, but yielded 10 – 30 boxes per acre less. This extra irrigation was applied mainly during the reproductive stage of the crop. The early season irrigation for treatment seven was more limited by design and apparently caused yield reducing stress during that stage, especially during the 2008 year.

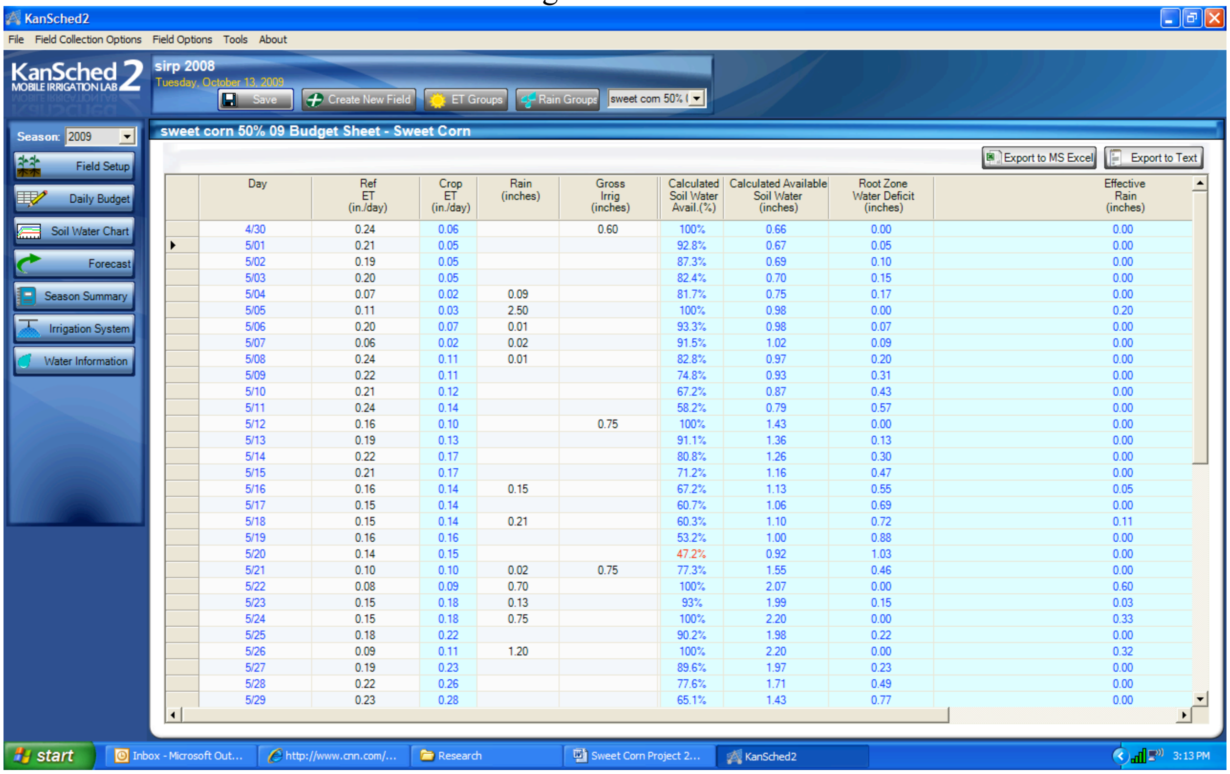
When looking at quality, Graph 2 shows there was little difference in either 2008 or 2009 between the farmer standard and the KanSched 30% treatment. The 50% treatment also did well in quality, coming in just behind the farmer standard on a two year average. From a water efficiency standpoint, Graph 3 shows a classic “law of diminishing returns” pattern. While yields generally climbed as irrigation rates increased, they did not have as much effect on yield as seen at the lower irrigation rates. In other words, yields increased at a decreasing rate as additional irrigation amounts were applied. Graph 4 looks at the farmer’s bottom line, or the average revenue adjusted for irrigation cost. Here, both KanSched treatments are comparable to the farmer standard and even the highest irrigation treatment. Irrigation costs were based on the total amount of water applied and the number of irrigation applications per treatment. Costs were based on an electric irrigation system. Average irrigation costs for the KanSched 50% MAD averaged $47 per acre for the two years, while treatment eight averaged $68 per acre. Adjusted revenue was based on yield and adjusted for the irrigation costs per acre. Revenues were calculated assuming that all boxes were sellable at $7.50 per box. The treatment with the highest adjusted revenue was treatment eight with $3,708 per acre. The KanSched 30% MAD was next with $3,682 per acre.

Preliminary analysis of the ear size data indicates a distinct relationship to irrigation. Limited irrigation treatments three and seven had the smallest ears on average for 2009. Crate size is an important consideration to growers and shippers as they harvest and transport sweet corn to market. Ear size can also have an impact on marketability. Growers tend to want a moderate size ear that is nice in appearance but takes up less room in a crate. More precise irrigation scheduling might enable growers to manage for optimum ear size having a positive impact on revenue.

Remote Moisture Sensors

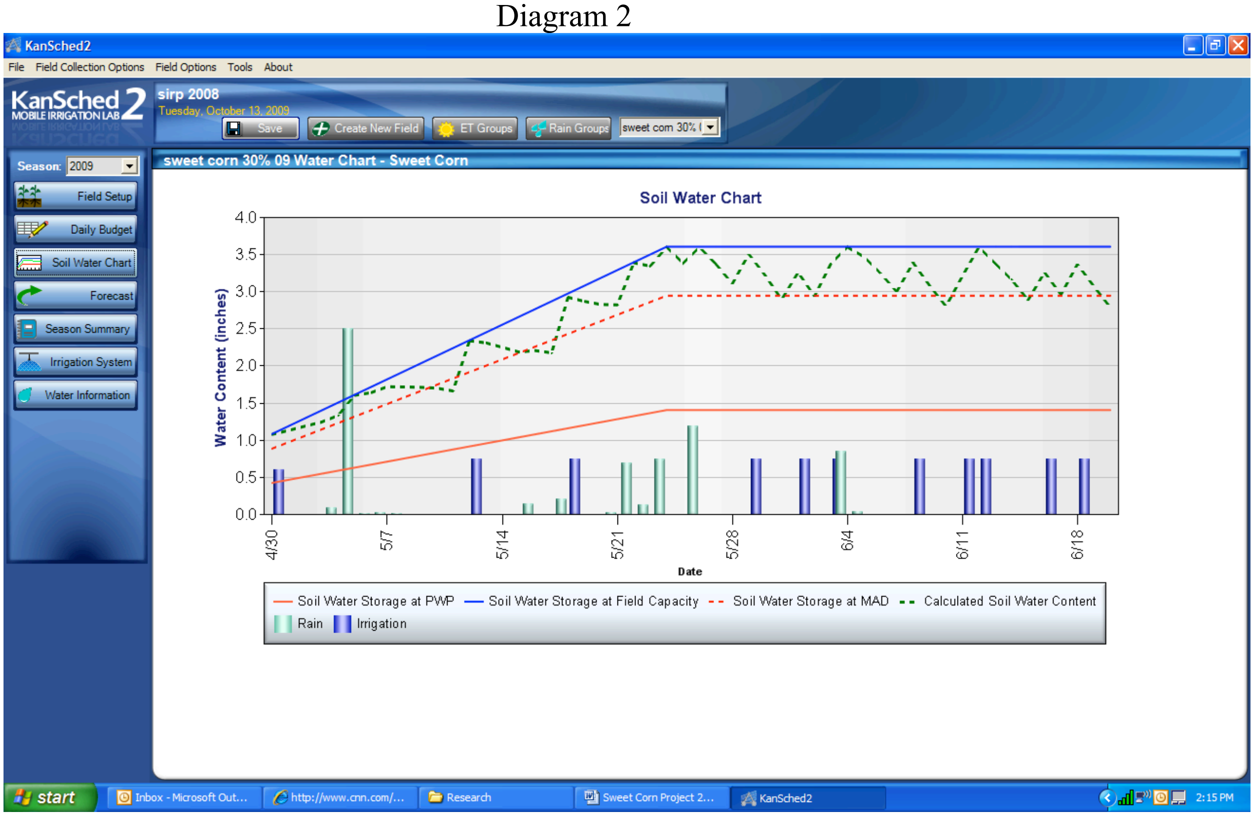
Moisture sensors were installed in two commercial sweet corn fields and in plots at SIRP. Cell and telemetry communications equipment was set up to send the soil moisture and rainfall data to a web portal. Access to the data via the web allowed the Project team and farmers to use the data more often and understand the impact of rain and irrigation on soil moisture. Data retrieved from these sensors also helped calibrate KanSched and insure the model was correct. Diagram 3 is an example of a one week view of five remote sensors and how they reacted to rainfall. The top graph is color coded to give soil moisture status in the top 12 inches. The green zone is above field capacity therefore gravity forces will quickly pull excess moisture out. Crop stress is minimized in the yellow zone and the red zone is where plants start to suffer. Farmers were educated to make irrigation decisions based on these zones. When irrigation was necessary application rates were adjusted to fully recharge the yellow zone without going into the green. The bottom graph is useful in determining how deep an irrigation or rainfall event percolates through the soil profile. Cooperating farmers saw the value of the sensors; but, were sometimes frustrated by the "learning curve" necessary to interpret the data. Reliability of the sensors can also be an issue. The project team experienced several ways that sensors and or the communication equipment can malfunction. Another challenge is the considerable time spent installing and maintaining the equipment. Remote moisture sensors will be utilized more often in the future as farmers adapt, prices come down and reliability improves. Sensors will help fine tune irrigation decisions leading to better yields and possible water and energy savings.

Diagram 1

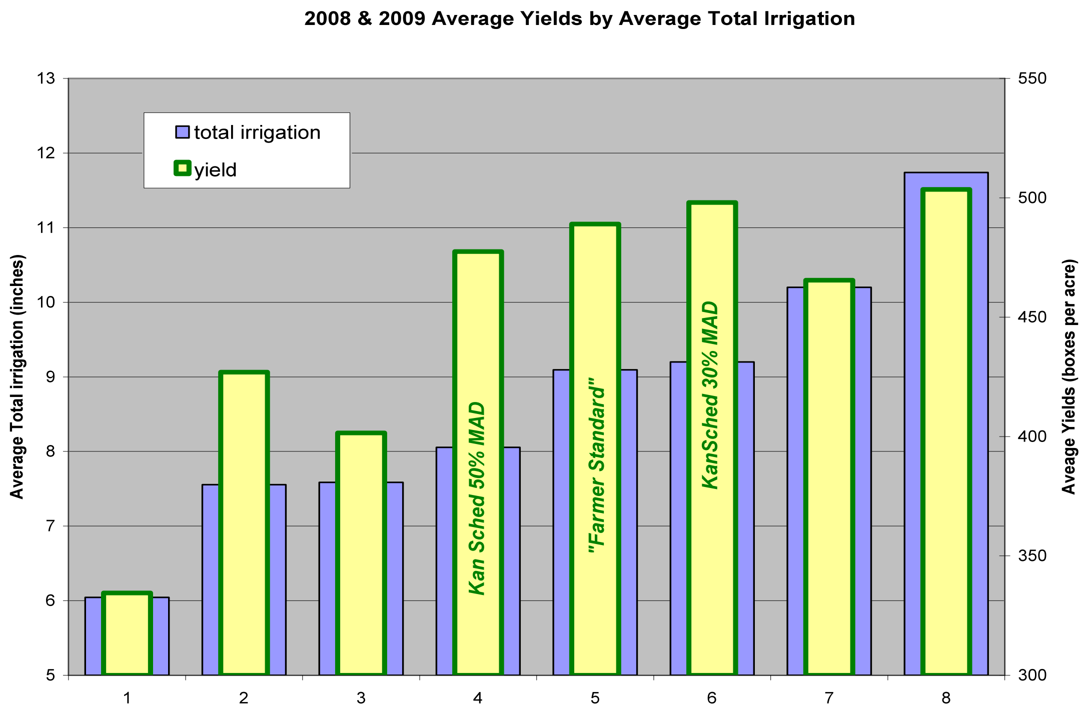


Day	Ref ET (in./day)	Crop ET (in./day)	Rain (inches)	Gross Irrig (inches)	Calculated Soil Water Avail.(%)	Calculated Available Soil Water (inches)	Root Zone Water Deficit (inches)	Effective Rain (inches)
4/30	0.24	0.06		0.60	100%	0.66	0.00	0.00
5/01	0.21	0.05			92.8%	0.67	0.05	0.00
5/02	0.19	0.05			87.3%	0.69	0.10	0.00
5/03	0.20	0.05			82.4%	0.70	0.15	0.00
5/04	0.07	0.02	0.09		81.7%	0.75	0.17	0.00
5/05	0.11	0.03	2.50		100%	0.98	0.00	0.20
5/06	0.20	0.07	0.01		93.3%	0.98	0.07	0.00
5/07	0.06	0.02	0.02		91.5%	1.02	0.09	0.00
5/08	0.24	0.11	0.01		82.8%	0.97	0.20	0.00
5/09	0.22	0.11			74.8%	0.93	0.31	0.00
5/10	0.21	0.12			67.2%	0.87	0.43	0.00
5/11	0.24	0.14			58.2%	0.79	0.57	0.00
5/12	0.16	0.10		0.75	100%	1.43	0.00	0.00
5/13	0.19	0.13			91.1%	1.36	0.13	0.00
5/14	0.22	0.17			80.8%	1.26	0.30	0.00
5/15	0.21	0.17			71.2%	1.16	0.47	0.00
5/16	0.16	0.14	0.15		67.2%	1.13	0.55	0.05
5/17	0.15	0.14			60.7%	1.06	0.69	0.00
5/18	0.15	0.14	0.21		60.3%	1.10	0.72	0.11
5/19	0.16	0.16			53.2%	1.00	0.88	0.00
5/20	0.14	0.15			47.2%	0.92	1.03	0.00
5/21	0.10	0.10	0.02	0.75	77.3%	1.55	0.46	0.00
5/22	0.08	0.09	0.70		100%	2.07	0.00	0.60
5/23	0.15	0.18	0.13		93%	1.99	0.15	0.03
5/24	0.15	0.18	0.75		100%	2.20	0.00	0.33
5/25	0.18	0.22			90.2%	1.98	0.22	0.00
5/26	0.09	0.11	1.20		100%	2.20	0.00	0.32
5/27	0.19	0.23			89.6%	1.97	0.23	0.00
5/28	0.22	0.26			77.6%	1.71	0.49	0.00
5/29	0.23	0.28			65.1%	1.43	0.77	0.00

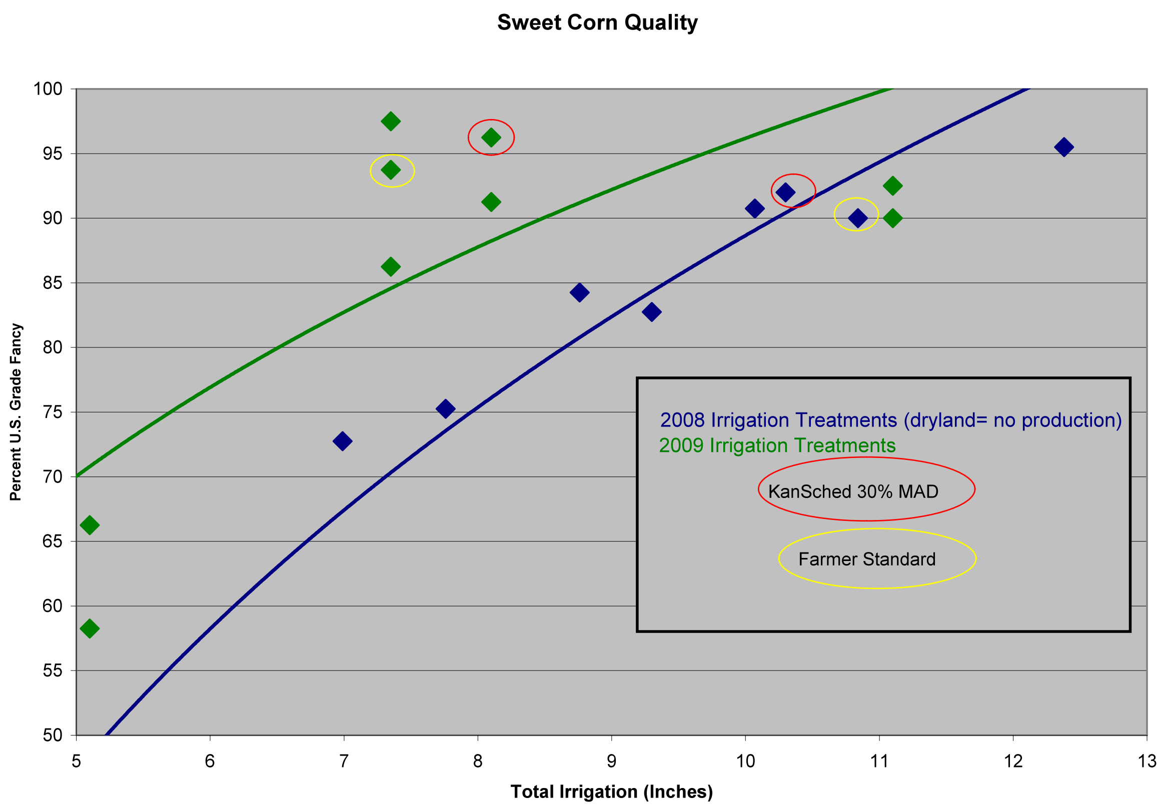
Diagram 2



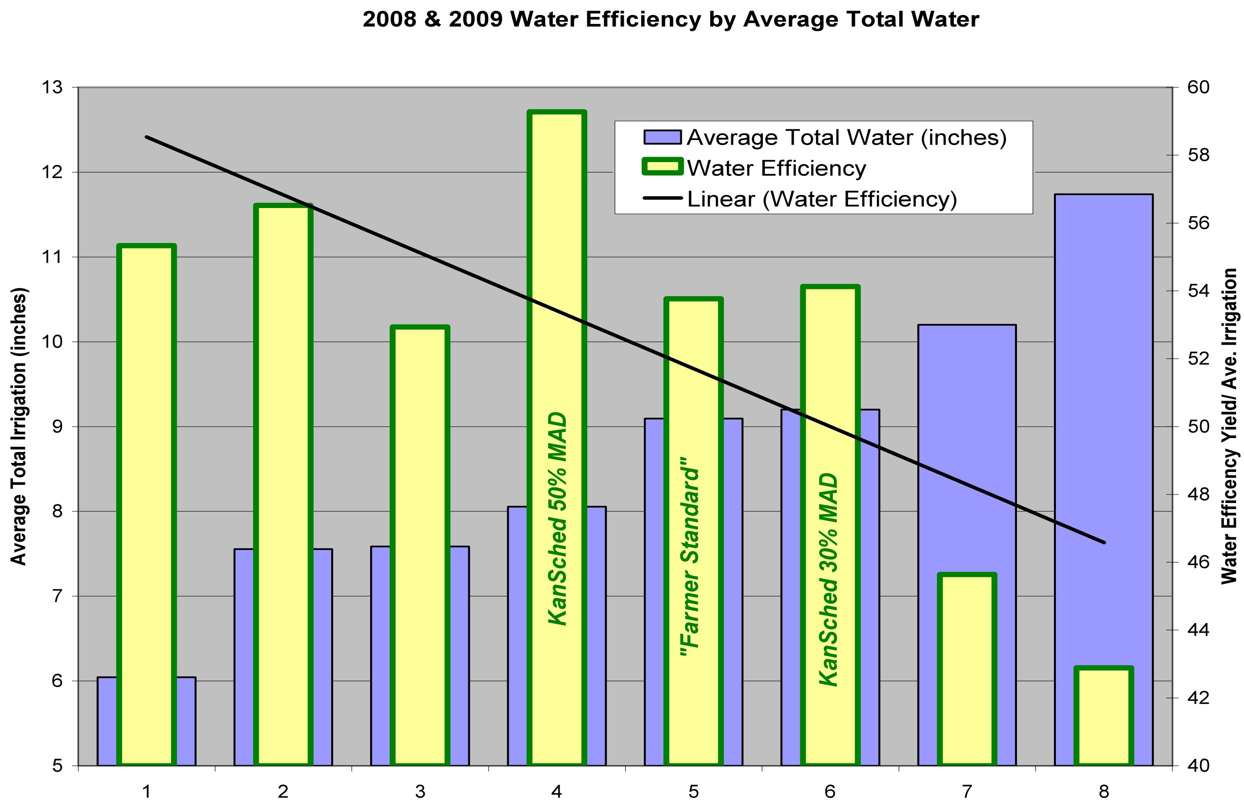
Graph 1


2008 & 2009 Average Yields by Average Total Irrigation
total irrigation
yield
Kan Sched 50% MAD
"Farmer Standard"
KanSched 30% MAD
Average Total irrigation (inches)
Avearge Yields (boxes per acre)
13
12
11
10
9
8
7
6
5
550
500
450
400
350
300
1
2
3
4
5
6
7
8

Graph 2


Sweet Corn Quality
2008 Irrigation Treatments (dryland= no production)
2009 Irrigation Treatments
KanSched 30% MAD
Farmer Standard
Percent U.S. Grade Fancy
Total Irrigation (Inches)
100
95
90
85
80
75
70
65
60
55
50
5
6
7
8
9
10
11
12
13

Graph 3



Graph 4

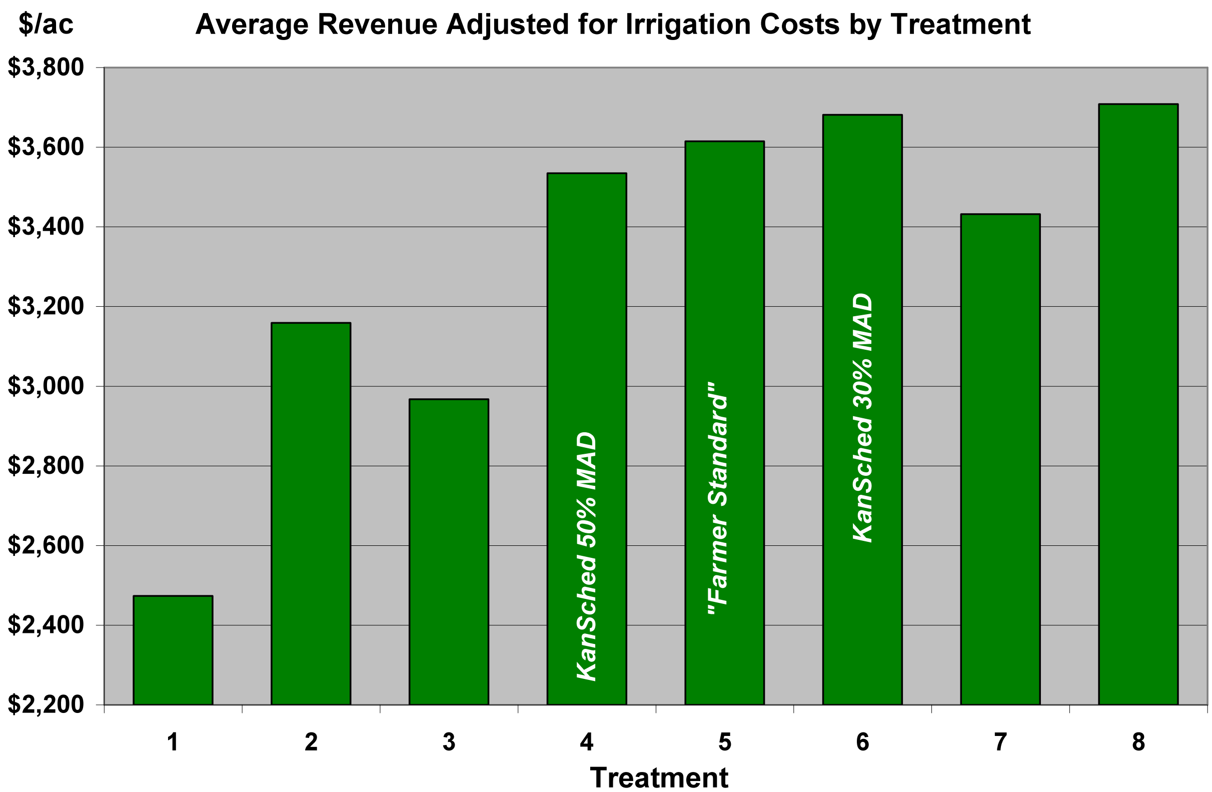
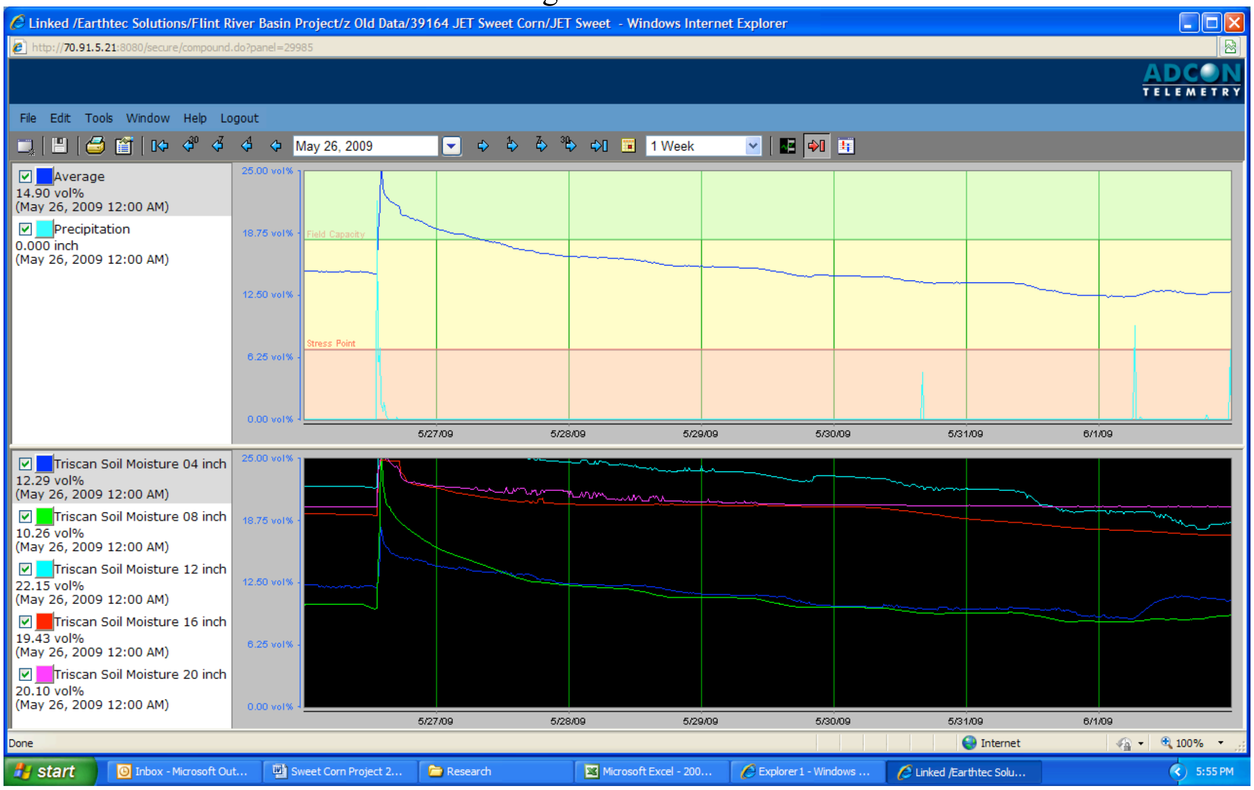


Diagram 3


Linked /Earthtec Solutions/Flint River Basin Project/z Old Data/39164 JET Sweet Corn/JET Sweet - Windows Internet Explorer
File Edit Tools Window Help Logout
May 26, 2009
1 Week
Average
14.90 vol%
(May 26, 2009 12:00 AM)
Precipitation
0.000 inch
(May 26, 2009 12:00 AM)
25.00 vol%
18.75 vol%
12.50 vol%
6.25 vol%
0.00 vol%
Field Capacity
Stress Point
5/27/09
5/28/09
5/29/09
5/30/09
5/31/09
6/1/09
Triscan Soil Moisture 04 inch
12.29 vol%
(May 26, 2009 12:00 AM)
Triscan Soil Moisture 08 inch
10.26 vol%
(May 26, 2009 12:00 AM)
Triscan Soil Moisture 12 inch
22.15 vol%
(May 26, 2009 12:00 AM)
Triscan Soil Moisture 16 inch
19.43 vol%
(May 26, 2009 12:00 AM)
Triscan Soil Moisture 20 inch
20.10 vol%
(May 26, 2009 12:00 AM)
Done
Internet
100%
start
5:55 PM

EVALUATION OF PUSH PLANTERS FOR SMALL PLOT WORK

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Introduction

Small scale plot work is done at a variety of locations both at research centers and on-farm. Sowing seed in these small plots is often accomplished with a small push planter. These planters are easy to transport and use. They are, however, not the precise seeder, but will often suffice for this type of work.

A popular push planter that can be used, which is also popular among home gardeners is the Earthway push planter (Figures 1 & 2). This planter relies on a series of notched plates to handle different sized seed and account for different spacing. Another such push planter is from Jang Automation headquartered in South Korea (Figure 3).

The objective of this study was to evaluate these two planters with a variety of different sized seed. Seed sizes ranged from small (carrots and onions) to large (beans, sweet corn, squash, and cucumbers).

Materials and Methods

The study was conducted at the Vidalia Onion and Vegetable Research Center in Lyons, GA. The experimental design was a randomized complete block design with each experimental unit 10 ft. in length. A single row of each vegetable seed was sown with each planter in each experimental unit.

The two planters used were an Earthway Planter model 1001-B and a Clean Seeder AP1 (Jang Automation Co., LTD, Cheongju-city, South Korea). Each was used according to manufacturer's directions for the specific seed.

The varieties used in this study were 'Goliath' beans, 'Passion' sweet corn, 'Dixie' squash, 'PX14710830' cucumber, 'Tasty Peel' carrots, and 'Candy Ann' onion. To plant beans with the Earthway planter, plate 1002-14 (beans, sm. Peas) was used and the depth gauge was set to 0.75 inches. For sweet corn plate 1002-4 (sweet corn) was used and the depth was set to 1 inch. The squash seed was also planted with plate 1002-4. The cucumber seed was planted with plate 1002-22 (beets, okra, sw. chard) and the depth was set at 0.75 inches. Carrots were also sown with plate 1002-22 with the depth set at 0.5 inches. Finally the onion seed were sown with plate 1002-5 (radish-med, leek, asparagus, spinach) and the seed depth was 0.5 inches.

The gears used on the Jang seeder were number 14 on the front and number 29 for the rear cog for all seed planted. The 6 slot A seed roller was used for beans, corn, squash and cucumber. For carrots the 6 slot AA seed roller was used. Finally the 12 slot Y roller was used for onion seed.

Seed were sown on 10 April 2008 and the data was collected on 29 April 2008. Data collected consisted of stand counts for each seed type on a randomly selected 18 inch length of row for each planter in each experimental unit.

Paired t-tests were calculated between the seeders for each seed type. The probability of a significant difference between each seeder for each seed type was calculated.

Results and Discussion

There were no differences in stand count for beans, sweet corn, squash, or cucumbers (Table 1). There was insufficient stand with the carrots to ascertain any difference between the planters. There was a significant difference in stand count for onions between the Jang and Earthway planters. Although it is not evident in the data, the Earthway appeared to do a better job with larger seed while the Jang did a better job with small seed (Figures 4 & 5).

A thorough evaluation of the Earthway planter for small research work has been done by Parish and Bracy (2004) where they evaluated all of the plates in a variety of configurations where some slots were blocked to improve overall seed spacing. They found the Earthway to be adequate for a variety of purposes including for small research, demonstration and home garden use particularly where overall mean spacing is desirable and uniformity of spacing is less so.

The Jang planter used a small tray with holes to determine the proper seed roller to use to properly singulate the seed. In addition the sprockets used with the chain mechanism can be changed to affect seed placement. The Jang planter is a more sturdy piece of equipment then the Earthway and this is reflected in the price, which is approximately $375.00. This in comparison to an Earthway that can be purchased for about $75.00.

For more information about the Jang planter visit their website at:

http://www.jangauto.com/

In addition to this, a video of the operation of the Jang planter can be found on You Tube at:

http://www.youtube.com/watch?v=6eWwUXRIZ38&feature=related

In conclusion, this study was too small to reliably determine which of these planters is better. Both will probably get the job done, but don't expect too much. Neither of these is a commercial precision planter, but then again neither costs that much either.

Literature Cited

Parish, R.L. and R.P. Bracy. 2004. Recommendations for effective use of a garden seeder for research plots and gardens. HortTechnology 14:257-261.

Table 1. Stand count comparison between Jang Automation and Earthway seeders.

Vegetable	JAC[z]	Earthway	Paired ttest
	(Stand count/18 inches)		Probibility
Beans	2.5	3.3	0.644
Sweet corn	4.0	5.0	0.727
Squash	4.5	6.5	0.834
Cucumber	14.8	19.5	0.744
Carrot	-	-	-
Onion	21.5	0.0	0.045

[z]Jang Automation Company


Figure 1. Earthway push planter.


Figure 2. Various plates used the Earthway planter.

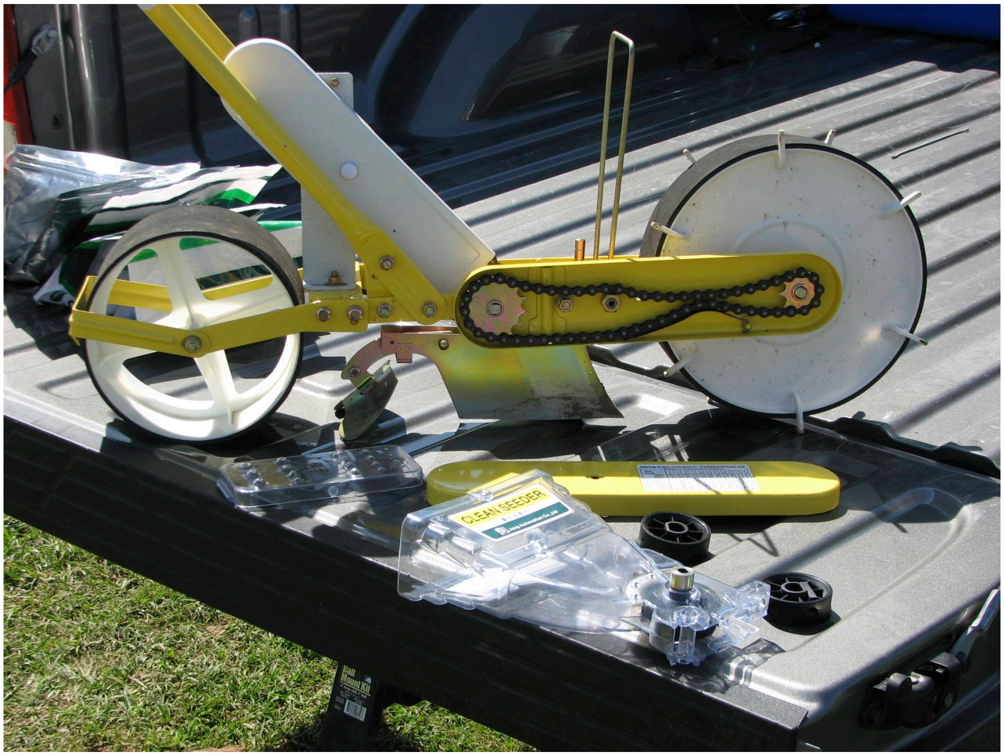

Figure 3. Jang Automation Clean Seeder AP1.


Figure 4. Onion seed – Earthway used on the left of the stake and Jang seeder used on the right.


Figure 5. Squash seed – Earthway used on the left of the stake and Jang seeder used on the right.

EVALUATION OF WATERMELON FERTILIZATION PRACTICES

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Introduction

Watermelons are an important crop in Georgia with over 20,000 acres in production representing almost $120 million in farm gate value (Boatright and McKissick, 2009). Watermelons were produced in 78 counties in 2008, however, over half the production was in just eight counties located in southwestern Georgia. These counties include Berrien, Cook, Crisp, Dooly, Tift, Turner, Wilcox, and Worth.

Watermelon fertilization is important particularly on the sandy loam soils of south Georgia. Growers have a wide range of fertilizers, methods of applications and rates to choose from. This study was to evaluate two application methods, broadcast versus banded, five fertilizer rates from 0-200 lbs/acre nitrogen (N), and three different sources of fertilizer including potassium nitrate (KNO_3), urea ammonium nitrate (UAN), and urea.

Materials and Methods

Land preparation and transplanting followed University of Georgia Cooperative Extension Service recommendations. The experimental design was a randomized complete block design with three replications. Plants were grown according to University of Georgia Cooperative Extension Service recommendations. This was a factorially arranged experiment with three factors, fertilizer application method, N rate, and N source.

Application methods included broadcast and banded fertilizer application. Nitrogen rates included 0, 50, 100, 150, 200 lbs/acre. Finally the nitrogen sources were KNO_3, UAN, or urea. Fruit were harvested at maturity and weighed individually. The fruit were segregated into three size classes and culls. Fruit below 15 lbs in size were considered culls, with the remainder in 15-19 lbs, 19-23 lbs, or greater than 23 lbs.

Data were analyzed with ANOVA using Stata 11.0 computer software. Each factor and all interactions were evaluated and the probabilities of significance reported.

Results and Discussion

Overall the results were not unexpected. As fertilizer rate increased there was a significant reduction in the amount of cull fruit as well as an increase in fruit in the >23 lb size class. (Table 1). There was also an increase in total yield as the fertilizer rate increased with the highest yields around 150-200 lbs/acre N.

The only other significant finding was a difference in the amount of culls based on N source. It is unclear why this would be so, but there were significantly more culls with KNO_3 then with urea.

In conclusion, there were no surprises with these results. As expected increasing N rate from 0-200 lbs/acre resulted in increased yield. Neither application method or N source had appreciable effects on watermelon yield.

Literature Cited

Boatright, S.R. and J.C. McKissick. 2009. 2008 Georgia farm gate vegetable report. College of Agr. and Environ. Sci. Rpt. AR-09-02.

Table 1. Evaluation of fertilizer source, application method, and fertilizer rate on total and graded yield of watermelons.

	Culls[z]	Size 1[z]	Size 2[z]	Size 3[z]	Total[y]
			(lbs/acre)		
Application Method					
Broadcast	9,099	11,099	17,720	49,533	77,499
Banded	6,215	9,490	14,234	52,281	75,397
Nitrogen rate (lbs/acre)					
0	13,279	13,983	23,798	20,706	58,487
50	8,848	11,730	16,766	40,109	67,954
100	6,217	9,745	13,680	47,993	71,419
150	5,894	7,947	11,748	69,166	87,326
200	7,381	10,255	18,968	56,427	85,080
Nitrogen source					
KNO_3	8,649	9,338	16,179	50,840	75,507
UAN	7,684	11,877	15,829	45,756	72,967
Urea	6,378	9,829	15,954	56,142	81,105
Probabilities					
Application method (AM)	0.629	0.180	0.722	0.905	0.870
Nitrogen rate (NR)	0.045	0.154	0.657	0.000	0.001
Nitrogen source (NS)	0.042	0.674	0.701	0.650	0.451
AM x NR	0.429	0.267	0.799	0.974	0.978
AM x NS	0.801	0.700	0.215	0.315	0.682
NR x NS	0.105	0.420	0.646	0.607	0.702
AM x NR x NS	0.316	0.900	0.163	0.258	0.738

[z]Culls < 15 lbs, Size 1 ≥ 15 & < 19 lbs, Size 2 ≥ 19 & ≤ 23 lbs, Size 3 > 23 lbs.

[y]Total yield includes sizes 1, 2, & 3 as calculated from original data.

EVALUATION OF SELECT WATERMELON VARIETIES, 2009

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Introduction

Watermelons are an important crop in Georgia with over 20,000 acres in production representing almost $120 million in farm gate value (Boatright and McKissick, 2009). Watermelons were produced in 78 counties in 2008, however, over half the production was in just eight counties located in southwestern Georgia. These counties include Berrien, Cook, Crisp, Dooly, Tift, Turner, Wilcox, and Worth.

This report is a subset of varieties evaluated in Georgia that are part of a larger evaluation throughout the Southeast. The purpose of the larger study is to evaluate a diverse collection of varieties for their performance characteristics over a wide region of production. This report focuses on a subset of varieties and reports yield, graded yield, and fruit characteristics. Included in this report are three experimental varieties from Shamrock Seed Company, Salinas, CA.

Materials and Methods

This experiment was conducted at the Watermelon Research Field in Crisp County just outside Cordele, GA. Land was prepared according to University of Georgia Cooperative Extension Service recommendations and 50 lbs/acre of N, P, & K were tilled in on 24 March 2009 prior to planting. Plastic mulch and herbicide were applied on 9 April 2009. Finally watermelon seedlings were transplanted on 23 April 2009.

There were 43 entries in the trial, which was arranged in a randomized complete block design with 4 replications. Each experimental unit or plot consisted of 7 plants with an in-row spacing of 2 ft. The plot size was 15 x 11 ft. except for the Shamrock entries where the plot size was 20 x 11 ft.

Plots were maintained according to University of Georgia Cooperative Extension Service recommendations. Seventy-five lbs/acre of additional N and K were sidedressed on 1 June 2009.

Watermelons were harvested three times as fruit matured on 10, 16, 29 July 2009. Each melon was weighed individually from each experimental unit. Three fruit from each plot were cut to assess hollow heart incidence and severity. In addition, flesh from the heart of each cut melon was used to determine soluble solids (% sugar) with a handheld refractometer.

Data were analyzed with ANOVA using Stata 11.0 computer software. The coefficient of variation (CV), which is the standard deviation divided by the mean was calculated as was Fisher's Protected Least Significant Difference (LSD) at the 5% probability. Fisher's Protected LSD requires an overall significance level prior to calculating the LSD.

Results and Discussion

Total yield ranged from 23,329 – 92,873 lbs/acre. The highest yielding varieties were SSC 2417, SSC2290, and SSC 2225, all of which had yields above 80,000 lbs/acre. These entries represent hybrid seedless advanced lines from Shamrock Seed.

The lowest yielding varieties are all older open-pollinated varieties that are generally not grown commercially anymore. 'Mickylee' is a small icebox type melon that was developed at the University of Florida. 'King & Queen' is also a small to medium sized watermelon that is referred to as an overwintering watermelon in some catalogs. Overwintering a watermelon is a novel idea, but probably impossible in any practical sense. Unlike pumpkin and winter squash, watermelon have a sweet flesh that breaks down quickly. 'Sugar Baby' and 'Black Diamond' have rinds that are dark green almost black in color. 'Black Diamond' is no longer produced commercially, but 'Sugar Baby' is still occasionally grown for local markets. The last among the five poorest yielding varieties is 'Peacock WR-60'. 'Peacock WR-60' according to some seed catalogs has a dark rind with a blocky shape with fruit usually in the 25-30 lb range. In this study most of its fruit was in the 15-23 lb range.

There are several entries in this trial that are standards for that particular type of fruit. In most cases these seed are still available from catalogs that cater to homeowners or small growers. In addition, most feed & seed stores that sell seed in bulk would carry these varieties. These would include 'Jubilee', which is an oblong melon with a light green color and a dark green stripe. 'Allsweet' is also an oblong melon, but it has a dark green rind with a light yellow/green stripe. The flesh of 'Allsweet' is dark red. Another standard oblong watermelon is 'Charleston Gray', which has a light green rind. This light green color in watermelon fruit is often referred to as a 'gray' melon. Finally, 'Crimson Sweet' is a round melon with a stripe pattern similar to 'Jubilee'.

Varieties with an 'F_1' designation after the name indicate they are hybrid varieties. Hybrids represent a specific type of seed production in which highly uniform inbred lines are crossed and the seed from this cross are sold to growers. The seed for this type of variety has to be recreated every year. Growers who try to save the seed will find that the variety does not breed true-to-type. To obtain the same performance growers have to go back to the seed company and buy the seed. Such varieties often perform better than their parents and are usually very uniform from one plant to next particularly for harvesting.

The yields reported in table 1 are broken out into four different size classes from less than 15 lbs to greater than 23 lbs. Most commercial watermelons would be in either the 15-19 or 19-23 lb size classes. The majority of production in Georgia is now seedless varieties, which include the three entries (SSC) from Shamrock Seed. There is, however, still a significant amount of seeded production particularly for local markets.

A new class of watermelons that has been developed in the last several years are mini- or palm melons. These are usually in the 3-5 lb range and are seedless. They are almost a single serving watermelon and probably better positioned as competing with cantaloupes. None of the entries in this trial are of this type.

Finally, a couple of other entries of note include ‘NC Giant’ and ‘AU-Jubilant’. ‘NC Giant’ is a popular variety grown to produce giant watermelon (100+ lbs). This is usually accomplished by selecting an appropriate variety such as ‘NC Giant’ and then growing it in particular fertile soil, heavily amended with compost and fertilizer. Finally only one fruit is allowed to develop on the plant to insure maximum fruit size. ‘AU-Jubilant’, which did well in this trial with yield just below the top three entries, is an open-pollinated jubilee type watermelon. It was developed at Auburn University and with its sister line, ‘AU Producer’, a crimson sweet type melon, were particularly popular when first introduced.

The percent sugar ranged from 8.4 to 11.7% with the Shamrock varieties having the highest sugar content. ‘SSC 2417’ with 11.7% sugar did not, however, differ statistically from ‘Crimson Sweet’ or ‘Starbright F1’ with 10.8% sugar. Most of the low sugar varieties are older open-pollinated varieties. The USDA requires an average sugar content of 10% or better for graded watermelons.

Hollow heart was a relatively minor occurrence in this trial with variety results ranging from 0-1.2 on a 0-4 scale with 0 no hollow heart and 4 severe hollow heart. The greatest amount of hollow heart was in ‘Congo’ with a rating of 1.2, which was significantly lower than the highest possible rating.

In conclusion, this trial evaluated a wide range of open-pollinated and hybrid varieties most of which have been around for quite some time. The results of the multi-year regional trials will be an interesting addition to our understanding of watermelon variety performance when it is completed.

Literature Cited

Boatright, S.R. and J.C. McKissick. 2009. 2008 Georgia farm gate vegetable report. College of Agr. and Environ. Sci. Rpt. AR-09-02.

Table 1. Watermelon variety trial results, Crisp County, 2009.

Variety	Size 1[z]	Size 2[z]	Size 3[z]	Size 4[z]	Total yield[y]	Sugar (%)	Hollow heart[x]
	(lbs/acre)						
Starbright F_1	1,757	7,768	8,393	40,874	58,489	10.8	0.4
Stars-N-Stripes F_1	2,570	5,721	10,919	30,928	48,162	10.6	0.6
AU - Jubilant	842	3,543	14,142	56,788	73,327	9.9	0.6
Calhoun Gray	1,481	2,236	10,861	31,857	45,878	9.6	0.0
Charleston Gray	828	3,398	14,055	53,259	70,561	10.4	0.3
King & Queen	9,932	8,973	6,737	3,325	27,809	9.0	0.1
Desert King	2,759	6,011	8,334	38,086	53,923	8.8	0.2
Jubilee	0	1,249	1,321	41,455	39,844	10.2	0.5
Sangria F_1	1,742	9,162	19,283	28,721	58,191	11.4	0.2
Fiesta F_1	5,271	7,071	18,310	11,805	41,632	10.2	0.3
Royal Flush F_1	1,220	10,900	24,316	36,648	72,996	10.9	0.2
Mickylee	17,076	6,708	1,481	0	23,329	10.0	0.3
Crimson Sweet	900	4,487	20,372	33,483	59,036	10.8	0.0
Allsweet	1,800	6,766	5,750	36,619	49,974	10.7	0.4
Black Diamond	2,178	4,661	13,838	13,315	31,316	8.4	0.0
Georgia Rattlesnake	1,278	0	3,775	33,222	34,550	9.6	0.0
Graybelle	24,902	11,209	2,730	0	37,017	10.4	0.1
Congo	16,901	8,518	7,163	4,356	36,212	9.7	1.2
NC Giant	0	0	4,429	66,574	68,510	9.0	0.2
Regency F_1	2,614	11,006	23,159	34,514	67,252	11.3	0.1
Peacock WR-60	6,592	15,827	5,503	4,850	32,592	10.5	0.0
Sugar Baby	29,766	2,352	0	0	31,029	9.2	0.1
SSC 2290	7,373	6,599	19,700	58,098	90,703	11.5	0.2
SSC 2417	18,829	23,947	22,128	23,904	88,566	11.7	0.8
SSC 2225	11,445	14,092	27,824	40,130	92,873	11.5	0.0
Coefficient of variation	88%	74%	64%	51%	20%	6%	-
Fisher's Protected LSD (p=0.05)	8,497	7,656	10,653	21,067	3,975	0.9	0.5

[z]Size 1 < 15 lbs, Size 2 ≥ 15 & < 19 lbs, Size 3 ≥ 19 & ≤ 23 lbs, Size 4 > 23 lbs.
[y]Total yield differs from the sum of size yields because of rounding and back-transformation from a square root transformation.
[x]Hollow heart: 0-5, 0-no hollow heart, 5-severe hollow heart.

EVALUATION OF CONTROLLED ATMOSPHERE STORAGE OF PUMPKINS

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Introduction

Controlled atmosphere (CA) storage of fruits and vegetables has been shown to be effective with several commodities. Vidalia onion growers have used this technology to extend the availability of their onions. Pumpkins cannot be reliably produced in the Southeast for fall markets because of the high pressure of aphid transmitted viruses. The University of Georgia has developed a virus resistant pumpkin, 'Orange Bulldog', but it is a related species, not the standard pumpkin type.

CA storage may be an opportunity to grow standard pumpkins in the spring/summer and have them available for fall sales. The objective of this study was to evaluate several pumpkin varieties for storage under CA and ambient conditions.

Materials and Methods

Sixteen fruit (4 from each replication) of 10 pumpkin varieties were collected from a variety trial at the Vidalia Onion and Vegetable Research Center on 9 Aug. 2007. Eight of the fruit for a specific variety were held under ambient conditions while 8 fruit were placed in CA storage with 3% O_2, 5% CO_2, 50°F, and 60% relative humidity.

Pumpkins were held in CA until 1 Oct. 2007 when they were removed and evaluated for marketability and disease damage. Pumpkins held under ambient condition were periodically evaluated and rotten fruit disposed of. Pumpkins were evaluated into one of three classes, 1-marketable, 2-some fruit damage, and 3-unmarketable.

Data collected were evaluated with non-parametric Mann-Whitney and Kruskal-Wallis tests.

Results and Discussion

CA stored pumpkins stored significantly better than those stored under ambient conditions (Table 1). The presented data does not convey how dramatic the difference was. Almost all of the pumpkins stored under ambient conditions rotted before the CA pumpkins were evaluated. There are some problems with CA storage with fungal growth appearing around and on the pumpkin stem. It may be possible to surface sterilize this area prior to CA storage with either alcohol or chlorine solution.

There were no differences among the varieties stored under CA conditions (Table 2). Pumpkins stored under ambient conditions, did show differences between the varieties with 'Orange Bulldog' having the lowest value rating.

In conclusion, CA storage of pumpkins shows promise as a method for growers in Georgia to have pumpkins available for fall markets. It is probably not economic for such facilities to be used exclusively for pumpkins, but the large number of CA facilities in the Vidalia onion growing region could be used to store pumpkins as an added revenue source.

Table 1. Effect on controlled atmosphere on pumpkin storage.

Treatments	Evaluation^{z}
Controlled atomsphere	1.8
Ambient conditions	2.2
Mann-Whitney Test	0.000

^{z}Evaluation: 1-Marketable, 2-some damage, 3-unmarketable

Table 2. Pumpkin variety evaluation with and without controlled atmosphere storage.

	Evaluation^{z}	
Variety	Ambient conditions	Controlled atmosphere
PMK-06-04	2.4	1.6
PMK-02-03	2.0	1.5
PMK-06-02	2.1	1.5
PMK-06-01	2.9	1.5
PMK-06-05	2.0	2.1
Gold Medal F1	2.6	2.0
Red Eye	2.0	2.0
Gold Challenger	2.3	2.3
Alladin	2.3	1.9
Orange Bulldog	1.8	1.9
Kruskal-Wallis Test	0.013	0.205

^{z}Evaluation: 1-Marketable, 2-some damage, 3-unmarketable

PUMPKIN GERMPLASM AND VARIETY EVALUATION

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Introduction

Pumpkins are an unimportant crop in Georgia. There were only 458 acres of pumpkins produced in Georgia in 2008 (Boatright and McKissick, 2009). This was due to the high incidence of insect transmitted virus diseases that affect pumpkins. Most of the production is in north Georgia where an aggressive program of insect and disease control can result in a successful crop. In south Georgia even with such an aggressive program success is not always possible.

Insect transmitted virus diseases are very difficult to control. The aphids that transmit these diseases transmit them in a non-persistent manner, which means as soon as the insect probes the tissue the virus is transmitted. This means even with 90+% control of the insect vector, there can be enough insects remaining to infect the crop. Aphid populations continue to build throughout the spring and summer so for fall crops such as pumpkins, which are highly susceptible to these viruses production is acutely difficult.

Increased disease resistance in pumpkins would help a fall pumpkin industry grow in Georgia. To this end 'Orange Bulldog' pumpkin was released several years ago and has been offered for sale in Georgia. This work continues with goals of releasing a larger pumpkin with more uniformity and consistent coloring. To this end, the objective of this study was to evaluate advanced germplasm for yield and uniformity. In addition, several commercial pumpkin varieties were evaluated in this study.

Materials and Methods

Pumpkin seed of selected advanced lines as well as the commercial varieties were sown in a commercial potting mix in the greenhouses at the Horticulture Farm in Watkinsville, GA on 2 July 2009. Seedlings were transplanted by hand to a field prepared according to University of Georgia Cooperative Extension Service recommendation, which had 750 lbs/acre of 10-10-10 preplant incorporated.

Plants were set out with a 12-ft between-row and a 6-ft in-row spacing on 16-17 July 2009. There were 44 lines in the trial that consisted of 11 commercial varieties, including 'Orange Bulldog' and 33 advanced germplasm lines. The experiment was arranged in a randomized complete block design with three replications. There were 8 plants per experimental unit. An additional 750 lbs/acre of 10-10-10 fertilizer was applied 4 weeks after transplanting. Plots were harvested on 29 September 2009 at which time the total number and weight was recorded for each plot. In addition, the degree of uniformity was determined between fruit from each plot. The variability index was 1-9 with 1 indicating a high degree of uniformity and 9 a high degree of variability. The variability index was transformed with a square root transformation prior to analysis and the results were back transformed to their original units. Finally photographs were taken of fruit from each harvested plot for future assessment and selection.

Results and Discussion

The highest yielding entry in the trial was '18-4-3' with 30,187 lbs/acre (Table 1, Figure 1). It had a relatively high variability index at 7.0 with an average fruit weight of 21 lbs. The highest yielding commercial variety was 'Dependable' from Abbott & Cobb with 11,344 lbs/acre. This points out the problem that this breeding program is trying to address and that is the relatively poor performance of commercial pumpkins in Georgia. It should be pointed out that no insecticides or fungicides were used in this trial so that the performance of the breeding material could be assessed. Commercial varieties can perform satisfactorily in north Georgia if a conscientious spray program is followed. In south Georgia even with such a spray program success is not guaranteed every year.

The lowest variability index among the UGA lines was with '18-4-2', which had a variability index of 4.2 (Figure 2). This was, however, not statistically different from most of the other entries.

This evaluation trial will be used to select material for selfing and making crosses in the greenhouse. The primary focus of the breeding program going forward is produce a variety with a larger size than 'Orange Bulldog' as well as having greater uniformity for size and color.

Literature Cited

Boatright, S.R. and J.C. McKissick. 2009. 2008 Georgia farm gate vegetable report. College of Agr. and Environ. Sci. Rpt. AR-09-02.

Table 1. Evaluation of advanced pumpkin germplasm & commercial pumpkins for yield, number of fruit, and variability.

Entry	Source	Yield (lbs/acre)	Yield (No./acre)	Variability Index[z]	Pre-Trial Color	Postharvest Comments
18-6-1	UGA	16,096	807	6.0	Orange	
11-4-2	UGA	15,957	1,109	7.3	Red	
11-4-3	UGA	11,369	706	4.9	Orange	
1-4-4	UGA	26,935	1,865	6.2	Red	Good color
17-3-1-2	UGA	18,011	1,311	4.9	Red	
5-3-A-2-1	UGA	21,830	756	5.5	Red	
19-1-4	UGA	16,272	756	5.6	Orange	
17-3-2	UGA	20,078	706	5.3	Orange	
18-4-3	UGA	30,187	1,437	7.0	Orange	
19-1-5	UGA	19,032	882	4.8	Red	
11-4-6	UGA	26,456	1,059	5.5	Orange	
5-3-3	UGA	17,003	756	4.6	Orange	
11-4-1	UGA	14,331	1,084	6.0	Red	Good
5-3-5	UGA	10,487	630	5.0	Ghost	
18-4-2	UGA	22,940	908	4.2	Orange	Colby Jack
8-1-5	UGA	20,368	857	5.9	Orange	
15-1-1	UGA	25,095	1,286	5.6	Orange	
19-1-2-4	UGA	21,440	1,386	5.9	Orange	
18-5-2	UGA	21,427	983	6.0	Orange	
Magic Wand	Harris Moran	7,247	580	2.6	Orange	
15-1-2	UGA	19,058	1,034	6.3	Red	
11-4-6	UGA	20,734	1,286	6.0	Red	Good color
11-2-3	UGA	16,713	807	6.0	Green	
5-3-A-1	UGA	16,776	857	4.9	Orange	
1-4-2	UGA	14,054	882	7.0	Orange	
5-3-1	UGA	19,259	933	5.9	Orange	
11-2-4	UGA	25,763	1,109	5.9	Orange	Some green
Dependable	Abbott & Cobb	11,344	857	3.3	Orange	
11-2-2	UGA	21,440	933	5.9	Red	Large
5-3-4	UGA	16,612	958	7.3	Orange	
5-3-2	UGA	12,982	681	5.3	Red	
OB Offtype	UGA	17,091	1,386	5.9	Orange	
11-2-1	UGA	14,835	832	5.9	Orange	
Magical	Abbott & Cobb	4,512	479	2.6	Orange	Very poor yield
Magician	Harris Moran	8,735	882	3.7	Orange	
11-2-5	UGA	27,528	1,185	8.3	Orange	
Warlock	Harris Moran	3,970	340	2.5	Orange	Severe sunscald
Charmed	Abbott & Cobb	7,953	832	2.9	Orange	

Gladiator	Harris Moran	3,945	303	4.5	Orange	
Magic Lantern	Harris Moran	7,285	655	2.6	Orange	
Field Trip	Harris Moran	4,538	1,260	1.3	Orange	
Aladdin	Harris Moran	10,083	681	1.6	Orange	
1-1-4-2	UGA	22,209	1,008	6.7	Red	
Orange Bulldog	UGA	10,020	1,185	4.4	Orange	Direct seeded late
	Coefficient of Variation	32%	29%	31%		
	LSD (p=0.05)	8,480	448	2.7		

[z]Variability Index: 1-9, 1-uniform, 9-highly variable

Figure 1. ’18-4-3’, highest yielding entry in the trial.

Figure 2. ’18-4-2’, highest degree of uniformity among advanced germplasm entries.