EVALUATION OF BRASSICA COVER CROPS FOR CONTROL OF SOILBORNE PEST AND DISEASES ON SUBSEQUENT SQUASH

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Introduction

Many plants in the *Brassicaceae* family produce glucosinolates naturally. Glucosinolates degrade into compounds such as methyl isothiocyanates (MITC) and allyl isothiocyanates (AITC).

Both MITC and AITC are lethal to soilborne pests such as nematodes and fungi. In fact, the common fumigant metham sodium degrades to MITC and then accounts for its activity as a soil fumigant. Since the Brassica species have been demonstrated to produce glucosinolates which degrade into MITC and AITC there is interest in determining if the growing a Brassica crop prior to another crop susceptible to soilborne pests would benefit from the rotation. Brassica spp. crops with and without Vapam and with and without methyl bromide were grown winter 2004 followed by a spring crop of eggplant and a fall crop of squash to evaluate their effects on yield quality and pests.

Materials and Methods

The study was located at the Blackshank Farm, CPES, Tifton, GA. Beds were installed in spring and a first crop of eggplant was grown from 29 April, 2005 to 22 July, 2005 (see previous report). Following eggplant, all beds that were fumigated (with methyl bromide or metam sodium) prior to the first crop were drip-fumigated with metam sodium (37.5 gal/A) on 1 August. Non-treated beds were sprayed with glyphosate to kill eggplant and plastic mulch was painted white.

Squash seedlings, cv. Prelude II, were purchased from Lewis Taylor Farms on 19 August. A single plant was transplanted using a mechanical type transplanter, which cuts holes in the plastic just ahead of the planters in the center of the plastic bed adjacent to the drip tape on 22 August. Plant spacing was 12 in.

Fertilizer on squash was added in the form of liquid fertilizer (4-0-8) injected through the irrigation tubing during the growing season. All squash plots were sprayed with Bravo 720 (Chlorothalonil) (2 pt/A on 26 August, 2, 9, 16, 23, and 30 September, and 7 October) for control of foliar diseases, and Phaser (Endosulfan) (1 qt/A on 26 August 2 and 30 September), Intruder (Acetamiprid) (4 oz/A on 9 September), and Lannate (Methomyl) (1 pt/A on 16 and 23 September and 7 October) for insect control.

Stand counts were made to record live plants on 30 August and plant vigor ratings were conducted on 8 September. Plant vigor was rated on a 1 to 10 scale, 10 representing live and healthy plants and 1 representing dead plants.

Twelve cores of soil, 2.5-cm-diam × 25-cm-deep, were collected from the center of each plot at planting of squash (22 August) and at harvest (13 October) of squash. Nematodes were extracted from a 150-cm^3 soil sub-sample using a centrifugal sugar flotation technique. The extracted nematodes were then counted. On 26 September an early root gall evaluation was conducted on four plants per plot using a 0 to 10 scale, whereby, 0 = no galls, 1 = very few small galls, 2 = numerous small galls, 3 = numerous small galls of which some are grown together, 4 = numerous small and some big galls, 5 = 25 % of roots severely galled, 6 = 50 % of roots severely galled, 7 =75 % of roots severely galled, 8 = no healthy roots but plant is still green, 9 = roots rotting and plant dying, 10 = plant and roots dead. Again following final harvest on 12 October ten plants per plot were evaluated for root galls using that same scale.

All squash fruits were hand-harvested from the 15-ft center area of each bed (15 plants per plot). Each harvest was separated into marketable and cull fruits, counted, and weighed. There were a total of five harvests,15, 20, and 27 September, and 4 and 11 October.

All data collected was analyzed with an analysis of variance (P = 0.05) and means were separated using LSD.

Summary

Vigor of squash ranged from a high of 7.3 following turnip + Vapam to a low of 2.0 following turnip (Table 1). Stand counts were uniform across the trial with the number of plants ranging from 24.8 to 20.5. Root gall ratings on 26 September were moderate to low and ranged from a high of 5.6 following turnip to a low of 0.8 following turnip + Vapam (no biomass). Root gall indices were higher on 12 October ranging from a high of 8.0 in mustard (with and without biomass) and a low of 1.2 in mustard + Vapam (Table 1).

Marketable yield numbers were generally highest in plots treated with Vapam and lowest in non-treated plots of turnip, mustard, and rye (Table 2). Both cull data and total yield showed similar trends.

Fungal colony forming units (CFU) for *Pythium irregulare* were absent at planting and harvest for all treatments (Table 3). Those receiving Vapam generally had the lowest populations of *Fusarium solani* at planting and at harvest, with the exception of mustard + Vapam which had a high of 1060.0 at planting and a high of 400.0 at harvest (Table 3).

Root knot nematode numbers at planting ranged from a high of 327.5/150 cc of soil in plots following rye + Vapam (this treatment had been treated with methyl bromide before planting of the spring crop of eggplant) and a low of 0 following turnip + Vapam (no biomass), mustard + Vapam (no biomass), and rye + Vapam (not treated with methyl bromide prior to the spring crop of eggplant). Vapam treated plots tended to have lower populations than non-Vapam treated plots (Table 4). Other nematodes species numbers were low and demonstrated no trends.

Root knot nematode numbers at harvest ranged from a high of 437.5/150 cc soil

in rye + Vapam (no biomass) (previously treated with methyl bromide before planting of the spring crop) and low of 2.5/150 cc soil in turnip + Vapam (Table 5). Generally plots treated with Vapam were lower than those not treated with the exception of the plot of rye + Vapam that had been treated with methyl bromide prior to the planting of the spring crop of eggplant. All other nematode species were low in number at planting and were zero at harvest.

Table 1. Effect of Brassica Spp. and Other Cover Crops on Root Knot Nematode and Plant Vigor and Stand Counts of 'Prelude II' Squash, Fall 2005 Tifton, GA.

Treatment[a]	Application Rate (gal/A)	Vigor Rating (0-10)[b] Aug. 30	Stand Counts[c] Aug. 30	Gall Ratings (1-10)[d] Sept. 26	Oct. 12
1 Turnip		2.0e	22.8ab	5.6a	6.8ab
2 Mustard		3.1de	23.3ab	5.1a	8.0a
3 Rye		6.0ab	22.5ab	3.4abc	6.8ab
4 Turnip + Vapam	37.5	7.3a	23.0ab	0.9d	1.9d
5 Mustard + Vapam	37.5	5.1abcd	22.5ab	1.2cd	1.2d
6 Rye + Vapam	37.5	7.3a	23.5ab	0.8d	2.9cd
7 Rye +Vapam[e]	37.5	5.3abcd	22.8ab	5.1a	7.4ab
8 Turnip		2.4e	24.8a	5.0a	5.2bc
9 Mustard		3.6bcde	22.5ab	4.5a	8.0a
10 Rye		3.5cde	21.5ab	3.8ab	6.4ab
11 Turnip + Vapam	37.5	5.9abc	20.5b	0.8d	2.7cd
12 Mustard + Vapam	37.5	5.0abcd	24.3a	1.8bcd	3.1cd
13 Rye + Vapam	37.5	6.8a	23.8ab	1.6bcd	2.4d
14 Rye + Vapam[e]	37.5	4.0bcde	23.5ab	3.8ab	7.8a

a. Data are means of five replications. Means in the same column followed by the same letter are not different (P = 0.05) according to LSD. Treatments 1-7 had the biomass incorporated into the soil and treatments 8-14 had the biomass removed from the soil prior to bed preparation before planting of the spring crop of eggplant.

b. Vigor was done on a scale of 1-10 with 10 = live and healthy plants and 1 = dead plants and an average was taken of vigor for 8 September.

c. Counts of live plants were taken on 30 August.

d. Gall ratings were done on a scale of 0-10 with 10 = dead plant and roots and 0 = no galls and a healthy plant. An average was taken of the gall ratings for 26 September and 12 October.

e. Treatments 7 and 14 were previously treated with methyl bromide (300 lbs/A) before planting of the spring crop of eggplant.

Table 2. Effect of Brassica Spp. and Other Cover Crops on Fruit Numbers and Yield of 'Prelude II' Squash, Fall 2005 Tifton, GA.

Treatment[a]	Application	Marketable Yield/Plot		Cull Yield/Plot		Total Yield/Plot	
	Rate (gal/A)	Number[b]	Weight (lb)[c]	Number[d]	Weight (lb)[e]	Number[f]	Weight (lb)[g]
1 Turnip		24.8de	10.5cde	0.5b	0.7bc	25.3fg	11.2fg
2 Mustard		28.5de	11.0cde	2.8ab	1.9bc	31.3defg	12.9ef
3 Rye		38.8bcd	18.0bc	4.5a	2.1bc	43.3bcde	20.1abcde
4 Turnip + Vapam	37.5	57.3a	26.6a	2.0ab	1.2bc	59.3a	27.8a
5 Mustard + Vapam	37.5	46.8ab	17.9bc	2.8ab	1.8bc	49.5abc	19.7abcde
6 Rye + Vapam	37.5	50.5ab	22.1ab	2.3ab	0.4c	52.8ab	22.4abc
7 Rye +Vapam[h]	37.5	28.3de	11.2cde	3.0ab	1.5bc	31.3defg	12.7efg
8 Turnip		16.5e	4.2e	0.5b	0.5bc	17.0g	4.7g
9 Mustard		22.8e	8.8de	3.0ab	4.5a	25.8fg	13.4def
10 Rye		30.8cde	12.5cd	4.5a	2.6ab	35.3cdef	15.1cdef
11 Turnip + Vapam	37.5	43.3abc	17.8bc	2.5ab	1.5bc	45.8abcd	19.3bcdef
12 Mustard + Vapam	37.5	45.5ab	20.7ab	1.5ab	0.5bc	47.0abc	21.3abcde
13 Rye + Vapam	37.5	46.5ab	22.2ab	2.0ab	1.4bc	48.5abc	23.6ab
14 Rye + Vapam[h]	37.5	27.8de	11.8cde	1.8ab	0.9bc	29.5efg	12.7efg

a. Data are means of five replications. Means in the same column followed by the same letter are not different (P = 0.05) according to LSD. Treatments 1-7 had the biomass incorporated into the soil and treatments 8-14 had the biomass removed from the soil prior to bed preparation before planting of the spring crop of eggplant.

b. The fruit from each individual plot that was considered to be marketable and showed no symptoms of disease was separated and counted on 15, 20, and 27 September, 4 and 11 October.

c. The fruit was collected separately by each plot and the fruit considered marketable and non-diseased was weighed on 15, 20, and 27 September, 4 and 11 October.

d. The fruit from each individual plot that was considered to be non-marketable and diseased was separated and counted on 15, 20, and 27 September, 4 and 11 October.

e. The fruit was collected separately from each plot and the fruit considered non-marketable and diseased was weighed on 15, 20, and 27 September, 4 and 11 October.

f. The number of marketable and non-marketable fruit were totaled for each plot on 15, 20, and 27 September, 4 and 11 October.

g. The weight of marketable and non-marketable fruit were totaled for each plot on 15, 20, and 27 September, 4 and 11 October.

h. Treatments 7 and 14 were previously treated with methyl bromide (300 lbs/A) before planting of the spring crop of eggplant.

Table 3. Effect of Brassica on Soil Populations of Pythium, Fusarium, and Rhizoctonia (CFU/g soil) on 'Prelude II' Squash, Fall 2005 Tifton, GA.

Treatment[a]	Application	At Planting Squash[c]		At Harvest Squash[d]	
	Rate (gal/A)	P. irregulare	F. solani	P. irregulare	F. solani
1 Turnip		0.0a	3080.0a	0.0a	740.0a
2 Mustard		0.0a	1060.0b	0.0a	560.0ab
3 Rye		0.0a	1420.0ab	0.0a	420.0abc
4 Turnip + Vapam	37.5	0.0a	360.0b	0.0a	80.0bc
5 Mustard + Vapam	37.5	0.0a	1060.0b	0.0a	400.0abc
6 Rye + Vapam	37.5	0.0a	240.0b	0.0a	200.0bc
7 Rye +Vapam[b]	37.5	0.0a	0.0b	0.0a	0.0c
8 Turnip		0.0a	1720.0ab	0.0a	420.0abc
9 Mustard		0.0a	1000.0b	0.0a	280.0abc
10 Rye		0.0a	840.0b	0.0a	480.0abc
11 Turnip + Vapam	37.5	0.0a	420.0b	0.0a	40.0c
12 Mustard + Vapam	37.5	0.0a	360.0b	0.0a	160.0bc
13 Rye + Vapam	37.5	0.0a	360.0b	0.0a	20.0c
14 Rye + Vapam[b]	37.5	0.0a	60.0b	0.0a	20.0c

a. Data are means of five replications. Means in the same column followed by the same letter are not different (P = 0.05) according to LSD. Treatments 1-7 had the biomass incorporated into the soil and treatments 8-14 had the biomass removed from the soil prior to bed preparation before planting of the spring crop of eggplant.

b. Treatments 7 and 14 were previously treated with methyl bromide (300 lbs/A) before planting of the spring crop of eggplant.

c. The at plant soil samples were taken on 22 August.

d. The at harvest soil samples were taken on 13 October.

Table 4. Effect of Brassica Spp. on Populations of Plant-Parasitic Nematodes at Planting of 'Prelude II' Squash, Fall 2005 Tifton, GA.

Treatment[a]	Application Rate (gal/A)	Plant Parasitic Nematodes at Planting/ 150 cc soil[b] Root-knot	Stubby	Sting
1 Turnip		15.0b	5.0a	0.0a
2 Mustard		15.0b	2.5a	0.0a
3 Rye		15.0b	0.0a	2.5a
4 Turnip + Vapam	37.5	7.5b	0.0a	0.0a
5 Mustard + Vapam	37.5	2.5b	0.0a	0.0a
6 Rye + Vapam	37.5	0.0b	0.0a	0.0a
7 Rye +Vapam[c]	37.5	327.5a	0.0a	0.0a
8 Turnip		7.5b	0.0a	0.0a
9 Mustard		35.0b	5.0a	2.5a
10 Rye		37.5b	5.0a	0.0a
11 Turnip + Vapam	37.5	0.0b	0.0a	0.0a
12 Mustard + Vapam	37.5	0.0b	2.5a	0.0a
13 Rye + Vapam	37.5	2.5b	0.0a	0.0a
14 Rye + Vapam[c]	37.5	47.5b	0.0a	0.0a

a. Data are means of four replications. Means in the same column followed by the same letter are not different (P = 0.05) according to LSD. Treatments 1-7 had the biomass incorporated into the soil and treatments 8-14 had the biomass removed from the soil prior to bed preparation before planting of eggplant.

b. The at plant soil samples were taken on 22 August. Root-knot Nematode (*Meloidogyne* spp.); Stubby Root Nematode (*Paratrichodorus* spp.); Sting Nematode (*Belonolaimus longicaudatus*).

c. Treatments 7 and 14 were previously treated with methyl bromide (300 lbs/A) before planting of the spring crop of eggplant.

Table 5. Effect of Brassica Spp. on Populations of Plant-Parasitic Nematodes at Harvest of 'Prelude II' Squash, Fall 2005 Tifton, GA.

Treatment[a]	Application	Plant Parasitic Nematodes at Planting/ 150 cc soil[b]		
	Rate (gal/A)	Root-knot	Stubby	Sting
1 Turnip		42.5cd	0.0a	0.0a
2 Mustard		135.0bcd	0.0a	0.0a
3 Rye		95.0bcd	0.0a	0.0a
4 Turnip + Vapam	37.5	2.5d	0.0a	0.0a
5 Mustard + Vapam	37.5	12.5d	0.0a	0.0a
6 Rye + Vapam	37.5	10.0d	0.0a	0.0a
7 Rye +Vapam[c]	37.5	267.5abc	0.0a	0.0a
8 Turnip		295.0ab	0.0a	0.0a
9 Mustard		135.0bcd	0.0a	0.0a
10 Rye		27.5d	0.0a	0.0a
11 Turnip + Vapam	37.5	32.5cd	0.0a	0.0a
12 Mustard + Vapam	37.5	27.5d	0.0a	0.0a
13 Rye + Vapam	37.5	7.5d	0.0a	0.0a
14 Rye + Vapam[c]	37.5	437.5a	0.0a	0.0a

a. Data are means of four replications. Means in the same column followed by the same letter are not different (P = 0.05) according to LSD. Treatments 1-7 had the biomass incorporated into the soil and treatments 8-14 had the biomass removed from the soil prior to bed preparation before planting of eggplant.

b. The at harvest soil samples were taken on 13 October. Root-knot Nematode (*Meloidogyne* spp.); Stubby Root Nematode (*Paratrichodorus* spp.); Sting Nematode (*Belonolaimus longicaudatus)*.

c. Treatments 7 and 14 were previously treated with methyl bromide (300 lbs/A) before planting of the spring crop of eggplant.