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

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Introduction

Glucosinolates (GSL) are allelochemicals that occur throughout the agronocimically important Brassicaceae family. Glucosinolates break down into important chemicals that have demonstrated very good pest control activity. Two materials that may be of importance are methyl isothiocyanate (MITC) and alyl isothiocyanate (AITC). These materials are biologically active against fungi, nematodes, and weed seeds.

This study evaluates the effects of growing some of these Brassica spp. a season before tomatoes are grown, and evaluated for their effect on yield and pest control. The Brassica cover crop was planted fall 2004 followed by a planting of tomato in spring 2005.

Materials and Methods

The study was located at the Blackshank Farm, CPES, Tifton, GA. The area has a history of assorted vegetables. The area was prepared using all current University of Georgia Extension Service recommendations. Plots were arranged in randomized complete blocks consisting of single bed plots replicated five times. Each plot was 50 feet long and and 6 feet wide with 15 foot alleys.

Brassica crops were cabbage (cv. Bravo and Red Dynasty), broccoli (cv. Pacman), collards (cv. Top Bunch), mustard (cv. Florida Broadleaf), turnip (cv. Purple Top White Globe), rapeseed (cv. Dwarf Essex), raddish (cv. White Icicle), rutabaga, and carrot. The other treatments were bare fallow ground with and without a Vapam (50 gal/A) application after laying plastic, rye, and vetch. Brassicas were planted 8 October, 2004 with a monosem vacuum planter. On 28 February, 2005, Brassica crops were cut with a flail mower, fertilized (10-10-10) at a rate of 500 lb/a, and the plots were rototilled. Beds were shaped and all beds were covered with 1 mil black polyethylene with drip tape in the center of the bed approximately 1 in. deep. The following day, metam sodium was drip-applied at 37.5 gal/a on specified beds. Plastic covered plots were 50 feet long and 30

inches wide. Pathogen/pest sachets were buried in the plots immediately following plastic laying by making a small cut in the plastic, burying the sachets, and then taping up the plastic.

Tomato cv. BHN 640 seedlings were purchased from Lewis Taylor Farms in Tifton. A single plant was transplanted using a mechanical type transplanter, which cuts holes in the in the plastic just ahead of the planters in the center of the plastic bed adjacent to the drip tape on 29 March, 2005. Plant spacing was 12 inches. All plots were sprayed with Bravo (2 pt/A on 5, 11, and 21 April, 13, 20, and 27 May, and 17 and 24 June), Quadris (Azoxystrobin) (6 oz/A on 21 April), Quadris (Azoxystrobin)(10 oz/A on 10 May) for foliar diseases.

Stand counts and vigor ratings were done on 28 April, 2005 and 18 May, 2005. Plant vigor was rated on a scale of 1 to 10, 10 representing live and healthy plants and 1 representing dead plants.

Twelve soil cores, 2.5-cm-diam × 25-cm-deep, were collected from the center of each plot before planting Brassica's, at harvest of Brassica's, and at planting (31 March, 2005) and harvest (18 July, 2005) of tomatoes.. Nematodes were extracted from a 150-cm^3 soil sub-sample using a centrifugal sugar flotation technique. The extracted nematodes were then counted. On 24 May, 2005 an early root gall evaluation was done on few 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. The samples which were evaluated in the early root gall evaluation did not show significant galling; therefore, data from the entire field was not collected. Again following final harvest on 18 July, 2005 five plants per plot were evaluated for root galls using that same scale.

All tomato fruits were hand harvested from the 15 foot 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 three harvests, 16 and 27 June, and 5 July 2005.

Summary

Vigor rating ranged from a high of 9.2 on bare soil + Vapam to a low of 5.8 following rutabaga on April 28 and a high of 9.4 on bare soil and Vapam to a low of 7.4 on rapeseed on May 18 (Table 1). Stand counts were very consistent across treatments with no notable exceptions. Root gall ratings ranged from a low of 0.4 following bare fallow to a high of 4.4 occurring in the plots following the cabbage.

Marketable fruit ranged from a high of 409 per plot following carrot to a low of 236 per plot following bare fallow (Table 2). Weight of fruit per plot ranged from a high of 155 lb/plot following rutabaga and a low of 90 lb/plot following bare fallow. Both cull numbers and weights and total numbers of fruit and total weights fo fruit mirrored the results noted above under marketable yield (Table 2).

Fungal numbers of *Pythium irregulare* were low at planting and ranged from 8.8 CFU/g soil to a low of 0 CFU/g soil (Table 3). Fungal propagule numbers for *Fusarium*

solani were uniform across treatments ranting from 1968 to 5152 CFU/g soil. *Pythium irregulare* CFU/g soil ranged from a high of 7.2 to a low of 0 CFU/g soil at harvest. *Fusarium solani* propagule numbers remained in the same range as noted at planting time. The percent survival of *Rhizoctonia solani* colonies cultured from twenty beet seed per sachet ranged from a high of 55% in plots following bare soil to a low of 2.5% in plots following bare soil + Vapam (Table 3).

The number of root-knot nematode recovered from plots at planting was zero (Table 4). Both stubby root nematodes and *Tylenchus* spp. were present, but in low levels. All nematodes counted at planting were very low and no great differences were seen among treatments (Table 5).

Table 1. Effect of Brassica Spp. and Other Cover Crops on Root Knot Nematode and Plant Vigor and Stand Counts of 'BHN 640' Tomato, Spring 2005 Tifton, GA.

Treatment[a]	Vigor Rating (0-10)[b]		Stand Counts[c]		Gall Ratings (1-10)[d]
	April 28	May 18	April 28	May 18	July 18
1 Cabbage Bravo	7.2bc	8.4abc	26.2a	10.4b	4.4a
2 Cabbage Red Dynasty	6.6bc	7.9abc	26.4a	11.0ab	4.4a
3 Broccoli Pacman	6.2bc	8.0abc	27.0a	11.2a	1.2b
4 Collards Top Bunch	7.2bc	8.6abc	26.6a	10.8ab	0.5b
5 Mustard Fl. Broadleaf	6.5bc	7.6c	26.0a	11.0ab	0.5b
6 Turnip Purple Top White Globe	6.9bc	8.4abc	26.4a	11.0ab	3.0ab
7 Rapeseed Dwarf Essex	6.5bc	7.4c	26.2a	11.0ab	1.1b
8 Radish White Icicle	7.1bc	8.5abc	26.4a	10.8ab	0.4b
9 Rutabaga	5.8c	7.7bc	26.0a	11.0ab	0.5b
10 Carrot	7.8ab	9.2ab	26.6a	11.2a	0.7b
11 Bare Fallow	6.8bc	7.8bc	26.2a	11.0ab	0.4b
12 Rye	7.3bc	8.1abc	26.6a	10.8ab	1.5ab
13 Vetch	7.3bc	8.6abc	26.6a	11.0ab	3.5ab
14 Bare Fallow + VAPAM (50 gpa)	9.2a	9.4a	26.4a	10.8ab	0.7b

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.

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 28 April and 18 May .

c. Counts of live plants were taken on 28 April and 18 May.

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 18 July. This gall rating was taken after the final harvest. When the roots were examined before harvest, there was no significant difference among treatments in root galling.

Table 2. Effect of Brassica Spp. and Other Cover Crops on Fruit Numbers and Yield of 'BHN 640' Tomato, Spring 2005 Tifton, GA.

Treatment[a]	Marketable Yield/Plot		Cull Yield/Plot		Total Yield/Plot	
	Number[b]	Weight (lb)[c]	Number[d]	Weight (lb)[e]	Number[f]	Weight (lb)[g]
1 Cabbage Bravo	345.2abcd	125.3abcd	106.4ab	41.3a	451.6ab	166.6abc
2 Cabbage Red Dynasty	278.8cde	109.8cd	104.8ab	40.9a	383.6bc	150.7abcd
3 Broccoli Pacman	305.4bcde	128.4abcd	91.4ab	31.4a	436.8ab	159.8abcd
4 Collards Top Bunch	329.4abcde	112.8bcd	103.2ab	35.5a	432.6ab	148.3bcd
5 Mustard Fl. Broadleaf	331.6abcde	123.4abcd	98.4ab	39.0a	430.0ab	162.3abcd
6 Turnip Purple Top White Globe	324.4abcde	146.1abc	105.6ab	43.9a	430.0ab	190.0ab
7 Rapeseed Dwarf Essex	381.2ab	147.8abc	78.6b	27.4a	459.8ab	175.3abc
8 Radish White Icicle	320.0abcde	119.4abcd	131.4a	42.9a	451.4ab	162.3abcd
9 Rutabaga	370.4abcd	154.7a	88.4ab	34.2a	458.8ab	189.2ab
10 Carrot	409.0a	144.7abc	115.2ab	41.0a	524.2a	185.6abc
11 Bare Fallow	236.6e	90.0d	85.4ab	29.0a	322.0c	118.9d
12 Rye	274.4de	112.9bcd	100.4ab	31.6a	374.8bc	144.4dc
13 Vetch	373.8abc	151.2a	117.8ab	43.1a	491.6a	194.3a
14 Bare Fallow + VAPAM (50 gpa)	305.0bcde	117.8abcd	128.4a	37.8a	433.4ab	155.6abcd

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.
b. The fruit from each individual plot that was considered to be marketable and showed no symptoms of disease was separated and counted on 16 and 27 June and 5 July.
c. The fruit was collected separately by each plot and the fruit considered marketable and non-diseased was weighed on 16 and 27 June and 5 July.
d. The fruit from each individual plot that was considered to be non-marketable and diseased was separated and counted on16 and 27 June and 5 July.
e. The fruit was collected separately from each plot and the fruit considered non-marketable and diseased was weighed on 16 and 27 June and 5 July.
f. The number of marketable and non-marketable fruit were totaled for each plot on 16 and 27 June and 5 July.
g. The weight of marketable and non-marketable fruit were totaled for each plot on 16 and 27 June and 5 July.

Table 3. Effect of Brassica Spp. on Soil Populations of Pythium, Fusarium, and Rhizoctonia (CFU/g soil) on 'BHN 640' Tomato, Spring 2005 Tifton, GA.

Treatment[a]	At Planting Tomatoes[b]		At Harvest Tomatoes[c]		Tomato Sachets[d]
	P. irregulare	F. solani	P. irregulare	F. solani	R. solani
1 Cabbage Bravo	1.6abc	2832ab	2.4ab	3168ab	50.0a
2 Cabbage Red Dynasty	4.0abc	2944ab	1.6ab	2608ab	40.0abc
3 Broccoli Pacman	3.2abc	3376ab	3.2ab	2752ab	40.0abc
4 Collards Top Bunch	0.0c	2608ab	2.4ab	2624ab	33.8abc
5 Mustard Fl. Broadleaf	0.8bc	2864ab	2.4ab	5072a	37.5abc
6 Turnip Purple Top White Globe	8.8a	2768ab	6.4a	3376ab	17.5cd
7 Rapeseed Dwarf Essex	0.8bc	3168ab	3.2ab	3216ab	20.0bcd
8 Radish White Icicle	8.0ab	3680ab	0.0b	2592ab	53.8a
9 Rutabaga	4.0abc	1968b	2.4ab	2496ab	35.0abc
10 Carrot	0.0c	3680ab	7.2a	4896a	42.5abc
11 Bare Fallow	5.6abc	2864ab	1.6ab	1920b	55.0a
12 Rye	3.2abc	4292ab	1.6ab	3200ab	48.8ab
13 Vetch	2.4abc	5152a	3.2ab	3376ab	33.8abc
14 Bare Fallow + VAPAM (50 gpa)	0.0c	1744b	1.6ab	1088b	2.5d

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.

b. The at plant soil sample was taken on 31 March.

c. The at harvest soil sample was taken on 18 July.

d. 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. Percent survival of *Rhizoctonia solani.*

Table 4. Effect of Brassica Spp. on Populations of Plant-Parasitic Nematodes at Planting of 'BHN 640' Tomatoes, Spring 2005 Tifton, GA.

Treatment[a]	Plant Parasitic Nematodes / 150 cc soil[b]		
	Root-knot	Stubby	Tylenchus
1 Cabbage Bravo	0.0a	18.0bc	6.0b
2 Cabbage Red Dynasty	0.0a	13.0bc	24.0a
3 Broccoli Pacman	0.0a	6.0c	8.0ab
4 Collards Top Bunch	0.0a	8.0c	20.0ab
5 Mustard Fl. Broadleaf	0.0a	26.0bc	6.0b
6 Turnip Purple Top White Globe	0.0a	25.0bc	4.0b
7 Rapeseed Dwarf Essex	0.0a	18.0bc	8.0ab
8 Radish White Icicle	0.0a	7.0c	4.0b
9 Rutabaga	0.0a	16.0bc	18.0ab
10 Carrot	0.0a	16.0bc	8.0ab
11 Bare Fallow	0.0a	5.0c	4.0b
12 Rye	0.0a	46.0ab	20.0ab
13 Vetch	0.0a	74.0a	10.0ab
14 Bare Fallow + VAPAM (50 gpa)	0.0a	11.0bc	6.0b

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.

b. The at plant soil sample was taken on 31 March. Root-knot nematode (*Meloidogyne* spp.); Stubby root nematode (*Paratrichodorus* spp.); *Tylenchus* spp.

Table 5. Effect of Brassica Spp. on Populations of Plant-Parasitic Nematodes at Harvest of 'BHN 640' Tomatoes, Spring 2005 Tifton, GA.

Treatment[a]	Plant Parasitic Nematodes / 150 cc soil[b]			
	Root-knot	Stubby	Ring	Tylenchus
1 Cabbage Bravo	0.0b	0.0c	2.0ab	0.0b
2 Cabbage Red Dynasty	6.0ab	2.0c	0.0b	0.0b
3 Broccoli Pacman	0.0b	2.0c	0.0b	0.0b
4 Collards Top Bunch	0.0b	4.0bc	0.0b	0.0b
5 Mustard Fl. Broadleaf	2.0ab	0.0c	0.0b	0.0b
6 Turnip Purple Top White Globe	12.0a	0.0c	0.0b	0.0b
7 Rapeseed Dwarf Essex	0.0b	6.0bc	2.0ab	0.0b
8 Radish White Icicle	2.0ab	4.0bc	4.0a	0.0b
9 Rutabaga	2.0ab	16.0a	2.0ab	0.0b
10 Carrot	2.0ab	12.0ab	0.0b	0.0b
11 Bare Fallow	2.0ab	2.0c	0.0b	0.0b
12 Rye	2.0ab	0.0c	0.0b	4.0a
13 Vetch	12.0a	12.0ab	0.0b	0.0b
14 Bare Fallow + VAPAM (50 gpa)	6.0ab	6.0bc	0.0b	0.0b

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.

b. The at harvest soil sample was taken on 18 July. Root-knot Nematode (*Meloidogyne* spp.); Stubby Root Nematode (*Paratrichodorus* spp.); Ring Nematode (*Mesocriconema* spp.); *Tylenchus* spp.