

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

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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. This test evaluates the effect of Brassica species grown prior to pepper. The Brassica cover crop was planted during the winter 2004 followed by a planting of pepper in spring 2005. A second crop of zucchini is planned for summer 2005.

## **Materials and Methods**

The study was located at the horticulture farm, CPES, Tifton, GA. The area has a history of assorted vegetables and tobacco. The area was prepared using all current University of Georgia Extension Service recommendations. The plot design was a split plot design with fumigants as main treatments and a Brassica cover crop and fallow plots as sub-treatments. The test was a randomized complete block design consisting of single bed plots replicated four times. Each plot was 45 feet long and 6 feet wide with 10 foot alleys.

Brassica crops were, mustard (cv. Florida Broadleaf) and rapeseed (cv. Dwarf Essex). The other treatment was rye. Brassicas were planted 4 November, 2004 with a monosem vacuum planter. On 21 March, 2005, Brassica covers were cut with a flail mower, fertilizer (10-10-10 ) at a rate of 500 lb/A, and the plots were rototilled. Certain beds had the cover crops completely removed and were then 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 certain beds and at 75 gal/A on certain other beds. Plastic covered plots were 45 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.

Pepper cv. 'Stiletto' seedlings were purchased from Lewis Taylor Farms in Tifton. 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 5 April, 2005. Plant spacing was 12 inches. All plots were sprayed with Manex (Maneb) (1 qt/A on 11 April and 9 May) and Kocide (Copper Hydroxide) 4.5 LF (1 pt/A on 21 April and 2.6 pt/A on 20 and 27 May and 10, 17, 24, and 30 June) for foliar diseases, and Lannate (Methomyl) (1 pt/A on 11 and 21 April, 9 May, and 10, 17, 24, and 30 June), Phaser (Endosulfan) (1 pt/A on 20 May), and Pounce (Permethrin) (6 oz/A on 27 May) for insect control.

Stand counts were done on 6 and 24 May, 2005 and vigor ratings were conducted on 6 and 25 May. Plant vigor was rated on a scale of 1 to 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 (6 April, 2005) and harvest (19 July, 2005) of peppers. Nematodes were extracted from a 150-cm<sup>3</sup> soil sub-sample using a centrifugal sugar flotation technique. On 1 June, 2005 an early root gall evaluation was conducted on three 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 1 August, 2005 five plants per plot were evaluated for root galls using that same scale.

All pepper 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, 13 and 24 June, and 17 July.

### **Summary**

Vigor ratings on both 6 May and 25 May (Table 1) were generally high for all Brassica spp. with and without Vapam. The lowest vigor rating was recorded for rye cover, both biomass incorporated and removed. Interestingly, rye with Vapam had the highest yield. Stand counts were uniform ranging from 19.5 to 21.5 plants per plot on 6 May and 24 May.

Root gall ratings on pepper ranged from 0.3 to a high of 1.4 on 1 May, which are considered low. Root gall ratings on 1 August ranged from 3.2 to a high of 8.1. No trend in severity was observed with mustard with 75 gal/A Vapam having the highest root gall index.

Marketable number and weight per plot ranged from a high of 170.3 fruit per plot following mustard + Vapam (37.5 gal/A with biomass removed) and a low of 71.8 for rye untreated (Table 2), and 41.9 lb/plot and 16.1 lb/plot for the respective plots. A similar trend was noted for cull yield and total yield per plot. The addition of Vapam tended to increase yield of plots although not always significant.

Numbers of *Pythium irregulare* were uniformly low at planting but increased to a high of 28 CFU/g soil by harvest in one plot (Table 3). In general, *Pythium irregulare* were low throughout the test. *Fusarium solani* numbers ranged from a low 740 to a high of 5540 at planting. The population of *Fusarium solani* ranged from a low of 680 to a high of 13,160 at harvest. The highest numbers of fungi recovered corresponded to the highest yielding treatment, rapeseed + Vapam with biomass removed. The percent survival of *Rhizoctonia solani* ranged from a low of 25% to a high of 66.3%. There were not any trends in percent survival of *Rhizoctonia solani* even though Vapam was used with the Brassica crops.

The numbers of root knot nematode collected at planting ranged from 0 to 25 nematodes per 150 cc soil. Rye cover had the highest level of root knot nematode both with biomass added to the soil and biomass removed (Table 4). All other nematodes were generally low across all treatments.

**Table 1. Effect of Brassica Spp. on Root Knot Nematode and Plant Vigor and Counts on ‘Stiletto’ Peppers, Spring 2005**  
**Tifton, GA**

Treatment <sup>a</sup>	Application Rate (gal/A)	Vigor Rating (0-10) <sup>b</sup>		Stand Counts <sup>c</sup>		Gall Ratings (1-10) <sup>d</sup>	
		May 6	May 25	May 6	May 24	May 1	Aug. 1
1 Mustard + Vapam	37.5	7.6abcde	7.6cde	20.5ab	20.5abc	0.3c	6.6abcd
2 Rapeseed + Vapam	37.5	7.8abcde	7.6cde	21.0ab	20.3abc	0.6bc	3.2e
3 Rye + Vapam	37.5	7.9abcd	8.4abc	19.5b	19.8bc	0.8abc	7.7ab
4 Mustard + Vapam	75.0	7.9abcd	8.1bcd	20.5ab	20.5abc	0.7abc	8.1a
5 Rapeseed + Vapam	75.0	7.9abcd	8.1bcd	20.8ab	20.5abc	0.7abc	7.0abc
6 Rye + Vapam	75.0	8.6a	9.4a	20.3ab	20.3abc	0.3c	7.1abc
7 Mustard		7.0cdef	6.5efg	20.0ab	20.0abc	1.2ab	6.0abcd
8 Rapeseed		6.8def	6.9e	20.8ab	20.8abc	1.0abc	6.6abcd
9 Rye		6.0f	5.5g	20.0ab	19.8bc	1.4a	6.0abcd
10 Mustard + Vapam	37.5	8.3ab	8.4abc	20.8ab	20.8abc	0.8abc	6.4abcd
11 Rapeseed + Vapam	37.5	6.6ef	6.8ef	20.8ab	20.8abc	0.8abc	4.4de
12 Rye + Vapam	37.5	7.5abcde	8.3abc	21.5a	21.3ab	1.0abc	5.1cde
13 Mustard + Vapam	75.0	7.9abcd	8.8abc	20.5ab	20.5abc	0.7abc	6.9abc
14 Rapeseed + Vapam	75.0	8.0abc	8.8abc	19.8ab	19.8bc	0.5bc	6.3abcd
15 Rye + Vapam	75.0	8.6a	9.3ab	21.5a	21.5a	0.3c	5.5bcde
16 Mustard		7.0cdef	6.6efg	20.5ab	20.3abc	1.3ab	7.1abc
17 Rapeseed		7.3bcde	7.0de	19.5b	19.5c	1.4a	6.0abcd
18 Rye		6.6ef	5.6fg	19.8ab	19.8bc	1.1abc	5.3cde

- 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 1-9 had the biomass incorporated into the soil and treatments 10-18 had the biomass removed from the soil prior to bed preparation.
- 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 6 and 25 May .
- c. Counts of live plants were taken on 6 and 24 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 on 1 May and 1 August.

**Table 2. Effect of Brassica Spp. on Yield of ‘Stiletto’ Pepper, Spring 2005 Tifton, GA.**

Treatment <sup>a</sup>	Application	Marketable Yield/Plot		Cull Yield/Plot		Total Yield/Plot		
		Rate (gal/A)	Number <sup>b</sup>	Weight (lb) <sup>c</sup>	Number <sup>d</sup>	Weight (lb) <sup>e</sup>	Number <sup>f</sup>	Weight (lb) <sup>g</sup>
1 Mustard + Vapam	37.5		129.0bcdefg	33.2abcd	43.0cde	7.7bcdef	172.0cde	40.9abc
2 Rapeseed + Vapam	37.5		169.0ab	37.8ab	51.8abcd	8.2bcde	220.8ab	45.9a
3 Rye + Vapam	37.5		164.5abc	38.7ab	44.0cde	8.4bcde	208.5abc	47.1a
4 Mustard + Vapam	75.0		123.0defg	29.5bcde	45.0cde	8.6bcde	168.0cdef	38.1abc
5 Rapeseed + Vapam	75.0		127.3cdefg	30.3abcd	47.8bcd	8.9bcd	175.0bcde	39.2abc
6 Rye + Vapam	75.0		111.8efgh	28.8bcde	58.5abc	15.6a	170.3cde	44.4a
7 Mustard			93.8gh	22.2def	26.5efg	4.9defg	120.3gh	27.1cde
8 Rapeseed			112.5efg	23.9cdef	26.8efg	5.5defg	139.3defg	29.3bcde
9 Rye			71.8h	16.1f	16.5g	3.3fg	88.3h	19.4e
10 Mustard + Vapam	37.5		170.3a	41.9a	37.0def	6.5cdefg	207.3abc	48.3a
11 Rapeseed + Vapam	37.5		132.8abcdefg	28.1bcdef	37.3de	6.4cdefg	170.0cde	34.5abcd
12 Rye + Vapam	37.5		135.5abcdef	33.4abcd	44.0cde	8.4bcde	179.5bcd	41.7ab
13 Mustard + Vapam	75.0		115.0efg	28.1bcdef	66.5ab	11.0b	181.5bcd	39.0abc
14 Rapeseed + Vapam	75.0		163.0abcd	35.4abc	67.5a	10.2bc	230.5a	45.6a
15 Rye + Vapam	75.0		139.3abcde	30.8abcd	46.3cd	9.3bcd	185.5abcd	40.1abc
16 Mustard			95.8fgh	23.2def	26.3efg	4.1efg	122.0fgh	27.3cde
17 Rapeseed			103.8efgh	24.0cdef	26.8efg	4.4efg	130.5efgh	28.4bcde
18 Rye			93.8gh	18.0ef	18.3fg	2.7g	112.0gh	20.6de

- 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 1-9 had the biomass incorporated into the soil and treatments 10-18 had the biomass removed from the soil prior to bed preparation..
- b. The fruit from each individual plot that was considered to be marketable and showed no symptoms of disease was separated and counted on 13 and 24 June and 14 July.
- c. The fruit was collected separately by each plot and the fruit considered marketable and non-diseased was weighed on 13 and 24 June and 14 July.
- d. The fruit from each individual plot that was considered to be non-marketable and diseased was separated and counted on 13 and 24 June and 14 July.
- e. The fruit was collected separately from each plot and the fruit considered non-marketable and diseased was weighed on 13 and 24 June and 14 July.
- f. The number of marketable and non-marketable fruit were totaled for each plot on 13 and 24 June and 14 July.
- g. The weight of marketable and non-marketable fruit were totaled for each plot on 13 and 24 June and 14 July.

**Table 3. Effect of Brassica Spp. on Fungal Soil Populations (CFU/g soil) on ‘Stiletto’ Pepper, Spring 2005 Tifton, GA.**

Treatment <sup>a</sup>	Application Rate (gal/A)	At Planting Peppers <sup>b</sup>		At Harvest Peppers <sup>c</sup>		Pepper Sachets <sup>d</sup>
		<i>P. irregulare</i>	<i>F. solani</i>	<i>P. irregulare</i>	<i>F. solani</i>	<i>R. solani</i>
1 Mustard + Vapam	37.5	0.0a	3280abcd	5.0bc	2420b	32.5bc
2 Rapeseed + Vapam	37.5	1.0a	3880abcd	10.0abc	4700ab	40.0abc
3 Rye + Vapam	37.5	0.0a	3340abcd	7.0bc	3340b	55.0ab
4 Mustard + Vapam	75.0	0.0a	1660bcd	0.0c	6640ab	30.0bc
5 Rapeseed + Vapam	75.0	0.0a	740d	1.0c	4480ab	46.3abc
6 Rye + Vapam	75.0	0.0a	1140cd	15.0abc	2000b	27.5bc
7 Mustard		1.0a	2720abcd	6.0bc	5520ab	28.8bc
8 Rapeseed		1.0a	4860abc	0.0c	4740ab	35.0abc
9 Rye		0.0a	1840abcd	4.0bc	1140b	51.3abc
10 Mustard + Vapam	37.5	0.0a	4640abc	21.0ab	1260b	47.5abc
11 Rapeseed + Vapam	37.5	0.0a	5540a	0.0c	1160b	30.0bc
12 Rye + Vapam	37.5	1.0a	2420abcd	6.0bc	680b	25.0bc
13 Mustard + Vapam	75.0	2.0a	3020abcd	10.0abc	5740ab	41.3abc
14 Rapeseed + Vapam	75.0	0.0a	1180dc	28.0a	13160a	20.0c
15 Rye + Vapam	75.0	0.0a	820d	3.0bc	1440b	66.3a
16 Mustard		0.0a	4600abc	2.0bc	1320b	40.0abc
17 Rapeseed		0.0a	5140ab	5.0bc	3660b	32.5bc
18 Rye		2.0a	3100abcd	1.0c	3160b	50.0abc

- 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 1-9 had the biomass incorporated into the soil and treatments 10-18 had the biomass removed from the soil prior to bed preparation.
- b. The at plant soil sample as taken on 6 April.
- c. The at harvest soil sample was taken on 19 July.
- d. Percent survival of *Rhizoctonia solani*.

**Table 4. Effect of Brassica Spp. on Populations of Plant-Parasitic Nematodes at Planting of ‘Stiletto’ Peppers, Spring 2005 Tifton, GA.**

Treatment <sup>a</sup>	Application Rate (gal/A)	Plant Parasitic Nematodes / 150 cc soil <sup>b</sup>				
		Root-knot	Stubby	Sting	Ring	Tylenchus
1 Mustard + Vapam	37.5	2.5b	0.0b	0.0c	0.0b	5.0a
2 Rapeseed + Vapam	37.5	5.0ab	0.0b	0.0c	0.0b	0.0a
3 Rye + Vapam	37.5	0.0b	0.0b	5.0abc	2.5b	0.0a
4 Mustard + Vapam	75.0	10.0ab	0.0b	1.3c	47.5a	2.5a
5 Rapeseed + Vapam	75.0	20.0ab	0.0b	1.3c	7.5b	0.0a
6 Rye + Vapam	75.0	15.0ab	0.0b	13.8a	5.0b	0.0a
7 Mustard		1.3b	0.0b	1.3c	3.8b	0.0a
8 Rapeseed		5.0ab	0.0b	0.0c	0.0b	0.0a
9 Rye		25.0a	0.0b	3.8bc	7.5b	0.0a
10 Mustard + Vapam	37.5	12.5ab	0.0b	1.3c	0.0b	0.0a
11 Rapeseed + Vapam	37.5	7.5ab	0.0b	8.8abc	0.0b	5.0a
12 Rye + Vapam	37.5	5.0ab	1.3a	7.8abc	5.0b	0.0a
13 Mustard + Vapam	75.0	10.0ab	0.0b	5.0abc	0.0b	0.0a
14 Rapeseed + Vapam	75.0	17.5ab	0.0b	12.5ab	2.5b	0.0a
15 Rye + Vapam	75.0	7.5ab	0.0b	0.3c	7.5b	0.0a
16 Mustard		6.3ab	0.0b	1.3c	30.0ab	5.0a
17 Rapeseed		10.0ab	0.0b	0.0c	5.0b	0.0a
18 Rye		17.5ab	0.0b	1.3c	2.5b	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.

b. The at plant soil sample was taken on 6 April. Root-knot Nematode (*Meloidogyne* spp.); Stubby Root Nematode (*Paratrichodorus* spp.); Sting Nematode (*Belonolaimus longicaudatus*); Ring Nematode (*Mesocriconea* spp.); *Tylenchus* spp.