# UTILIZATION OF BLUE CRAB SCRAP COMPOST TO SUPPRESS *MELOIDOGYNE JAVANICA* ON TOMATO[†]

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ABSTRACT

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Three greenhouse experiments were conducted to determine the effect of compost made from a mixture of blue crab (*Callinectes sapidus*) scrap and cypress (*Taxodium distichum*) sawdust on the reproduction of the root-knot nematode, *Meloidogyne javanica*. Crab scrap compost was mixed with fine sand soil, placed in pots, and inoculated with nematode eggs. A tomato seedling was transplanted to each pot and grown for *ca.* 8 weeks. In two experiments comparing various concentrations of crab scrap compost, 10% or 20% (w/w) was required to significantly ($P \leq 0.05$) increase fresh root and foliar weight, and to decrease the root gall index and number of egg masses per plant compared to the control treatment. In a third experiment, raw crab scrap at 0.05% (w/w) was more effective in suppressing root galling and nematode reproduction than the crab scrap compost at 20% (w/w).

*Key words: Callinectes sapidus*, crab scrap compost, *Lycopersicon esculentum*, *Meloidogyne javanica*, nematode suppression, raw crab scrap.

RESUMEN

Rich, J. R. y C. H. Hodge. 1993. El uso de enmiendas de cangrejo para el manejo de *Meloidogyne javanica* en tomate. Nematrópica 23:1–5.

Se llevaron a cabo tres experimentos de invernadero para evaluar el efecto de una enmienda constituída por una mezcla de deshechos de cangrejo (*Caltinectes sapidus*) y aserrín de ciprés (*Taxodium distichum*) sobre la reproducción del nematodo agallador, *Meloidogyne javanica*. La enmienda de cangrejo fue mezclada con arena fina, colocada en macetas e inoculada con huevos de nematodos. Se transplantó en cada maceta una plántula de tomate. Después de 8 semanas se determinó el agallamiento en las raíces y la reproducción del nematodo. En dos experimentos comparando varias concentraciones de la enmienda de cangrejo, se requirió un 10% a 20% (p/p) para incrementar significativamente los pesos de las raíces y el follaje, y disminuir el índice de agallamiento de las raíces como el número de masas de huevos por planta, en relación al testigo. En un tercer experimento, deshechos de cangrejo fresco (sin compostar) de un 0.05% (p/p) fueron más eficaz que la enmienda de cangrejo de un 20% para disminuir el agallamiento y la reproducción del nematodo.

*Palabras clave:* enmienda de cangrejo, *Callinectes sapidus*, *Lycopersicon esculentum*, manejo de nematodos, *Meloidogyne javanica*, deshechos de cangrejo fresco.

## INTRODUCTION

Twenty-two processing plants in northwestern Florida process over 1.5 million kilograms of blue crab (*Callinectes sapidus*) annually (1). The disposal of processing wastes from these plants is problematic due to the increasingly high costs of the current practice of landfilling the material. Recently, an alternative method of disposal, composting, has been successfully tested in a pilot program and shows promise of becoming a standard practice for treating this waste product (3). Through composting, the crab scrap is

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transformed into a stable, nonputrescent material that could have agricultural applications similar to other currently available composted products.

Both composted and noncomposted organic materials have been added to soil since very early times to improve plant growth. Some of these materials have been shown to suppress plant-parasitic nematodes in soil, but their use in developed countries has been limited due to the availability of effective nematicides (8). With the cancellation or use restriction of several effective nematicides, there is renewed interest in organic soil amendments for nematode suppression. Products containing chitin, such as blue crab scrap, have been shown to suppress plant-parasitic nematode populations (4,6,7,9,10). The process of composting, however, breaks down complex molecules such as chitin. It is not clear, therefore, whether the composted blue crab scrap would result in nematode suppression similar to that achieved with chitin. The studies reported here were conducted to determine the effects of compost made from 44% blue crab scrap and 56% cypress (*Taxodium distichum*) sawdust on nematode reproduction and plant growth.

## MATERIALS AND METHODS

Three greenhouse pot experiments were conducted using 'Homestead' tomato (*Lycopersicon esculentum* L.) inoculated with the Javanese root-knot nematode, *Meloidogyne javanica* (Treub) Chitwood. Experiments 1 and 2 were factorial designs with Experiment 1 replicated six times and Experiment 2 replicated eight times. In Experiment 1, one factor was blue crab scrap compost (3) at 0, 10, 20, and 100% (w/w) mixed with a fine sand soil (93% sand, 4% silt, 3% clay, < 1.0% organic matter, pH 5.7). The other factor was *M. javanica* applied at 0 or 10 000 eggs/pot. In Experiment 2, one factor was crab scrap compost at 0, 5, 10, 20, 40, 80, and 100% (w/w) and the other factor was *M. javanica* at 0 or 15 000 eggs/pot. In Experiment 3, treatments included soil alone, 0.05% (w/w) raw crab scrap, and 20% (w/w) crab scrap compost inoculated with *M. javanica* at 15 000 eggs/pot; each treatment was replicated six times.

Prior to experiment initiation, soil was fumigated with methyl bromide at 0.6 kg a.i./$m^3$. The crab scrap compost and soil were air-dried, then passed through a sieve with 0.3-mm-diam openings. The raw crab scrap was oven-dried, ground, and sieved as above. The treatment mixtures were placed in 10-cm-diam plastic pots in Experiment 1 and in 12.7-cm-diam pots in Experiments 2 and 3. Water was then added to bring the mixtures to field capacity, and pots were allowed 4, 6, and 13 days in Experiments 1, 2, and 3, respectively, before inoculation with nematode eggs. Eggs of *M. javanica* were extracted from 'Homestead' tomato roots using the sodium hypochlorite method (5). After inoculation, one tomato seedling was transplanted immediately into each pot in Experiments 1 and 3, and 8 days later in Experiment 2. Plants in experiments 2 and 3 were fertilized biweekly with 40 ml of a 60 g/L solution of 20-20-20 (N-$P_2O_5$-$K_2O$) for the duration of the experiments.

Pots were arranged on a greenhouse bench in a randomized complete block design, and tomato plants were allowed to grow 56, 59, and 60 days, respectively, in Experiments 1, 2, and 3. At experiment conclusion, fresh foliar weight, fresh root weight, and root gall index were recorded. Root gall index ratings were made on a 0–4 scale where 0 = 0%, 1 = 1–25%, 2 = 26–50%, 3 = 51–75%,

and 4 ≥ 76% of the root system galled. Plant roots then were stained in phloxine B and egg masses were counted (13).

## RESULTS

In Experiment 1, all levels of crab scrap compost significantly ($P \leq 0.05$) increased both foliar and root weights of tomato and reduced root gall indices compared to the control treatment (Table 1). Numbers of egg masses per plant similarly were reduced significantly by the 10, 20, and 100% crab scrap compost treatments. Comparatively little additional suppression of nematode reproduction was observed between the 20% and 100% compost levels.

In Experiment 2, significant increases in foliar weights were observed at the 20, 80, and 100% crab scrap compost levels as compared to the control treatment (Table 2). Fresh root weights were increased significantly at the 80 and 100% crab scrap compost level. Root galling and numbers of egg masses per plant were reduced significantly at 20% and higher levels of compost. Little additional suppression of nematode reproduction was observed at levels higher than 20% compost.

In Experiment 3, root weight was reduced significantly by both the raw crab scrap and crab scrap compost treatments while foliar weights were not affected (Table 3). The root gall index and number of egg masses per plant were significantly reduced by both the raw crab scrap and crab scrap compost treatment. The raw crab scrap treatment had significantly less root galling and fewer egg masses than the crab scrap compost treatment.

## DISCUSSION

Addition of crab scrap compost suppressed root galling and the number of egg masses per plant, and generally increased foliar tomato growth. A minimum of 10 to 20% crab scrap compost was needed to suppress root galling and egg mass production. These results and those of Experiment 3 indicate that, while crab scrap compost suppresses populations of *M. javanica*, it is much less effective than raw crab scrap. Effective nematode control with raw crab scrap at 0.05% (w/w) has been reported previously (4).

The mode of action of chitin on nematodes has been hypothesized to be the production of ammoniacal nitrogen and enhanced chitinolitic fungal activity

Table 1. Influence of crab scrap compost on plant growth, root gall index, and egg masses on tomato plants 56 days after inoculation with 10 000 eggs of *Meloidogyne javanica* in greenhouse Experiment 1.

| Crab scrap compost[y] (%) | Fresh foliar weight[z] (g) | Fresh root weight (g) | Root gall index (0–4) | Egg masses per plant |
|---|---|---|---|---|
| 0 | 4.32 | 5.81 | 4.00 | 606 |
| 10 | 22.17* | 12.54* | 3.00* | 328* |
| 20 | 26.86* | 10.65* | 1.00* | 35* |
| 100 | 26.60* | 11.64* | 0.40* | 1* |

*Differs at $P \leq 0.05$ when contrasted to 0% level.

[y]Air-dried crab scrap compost mixed on weight for weight basis with an air-dried fine sand soil.

[z]No significant interaction of nematodes × crab scrap was observed; therefore, fresh foliar weight and fresh root weight data include pots with and without *M. javanica*.

Table 2. Influence of crab compost level on plant growth, root gall index, and egg masses on tomato plants 59 days after inoculation with 15 000 eggs of *Meloidogyne javanica* in greenhouse Experiment 2.

| Crab scrap compost[y] (%) | Fresh foliar weight[z] (g) | Fresh root weight (g) | Root gall index (0–4) | Egg masses per plant |
|---|---|---|---|---|
| 0 | 31.7 | 11.7 | 4.0 | 1 610 |
| 5 | 32.1 | 14.5 | 4.0 | 1 680 |
| 10 | 34.0 | 13.8 | 4.0 | 1 340 |
| 20 | 56.8* | 15.9 | 3.0* | 761* |
| 40 | 41.0 | 13.0 | 1.8* | 171* |
| 80 | 60.4* | 18.1* | 2.0* | 451* |
| 100 | 58.6* | 19.6* | 2.2* | 441* |

*Differs significantly ($P \leq 0.05$) when contrasted with 0% level.
[y]Air-dried crab scrap compost mixed on weight for weight basis with an air-dried fine sand soil.
[z]Fresh foliar and root weights are a combination of data from inoculated and non-inoculated plants.

(4,11,12). The depletion of nitrogenous compounds, degradation of chitin, and loss of microfloral substrates during composting (2) probably reduced the nematode suppressive characteristics of the crab scrap compost.

The 10% level of crab scrap compost represents an application rate of approximately 100 MT/ha, which may not be economical for nematode control in large scale agriculture. The crab scrap compost utilized in these tests had a C:N ratio of 24 with a nitrogen content of 0.36%. Data from these tests indicate that crab scrap compost has the same limitations for nematode control as many other materials containing high C:N ratios (8). Additions of large quantities of these materials have been found necessary to suppress nematode reproduction. The greatest potential for use of crab scrap compost for nematode suppression would seem to be in container grown plants and organic production systems. In these situations, high loading rates are normal practices.

The ability of crab scrap compost to increase organic matter, improve soil water retention and provide soil nutrients

Table 3. Comparative influence of raw crab scrap and crab scrap compost on tomato growth, root gall index, and egg mass production by *Meloidogyne javanica* in greenhouse Experiment 3.[x]

| Treatment[y] | Fresh foliar weight (g) | Fresh root weight (g) | Root gall index (0–4) | Egg masses per plant |
|---|---|---|---|---|
| Control | 14.4 a[z] | 11.5 a | 4.0 a | 218 a |
| Crab scrap compost (20%) | 20.1 a | 5.6 b | 2.2 b | 134 b |
| Raw crab scrap (0.05%) | 15.2 a | 7.6 b | 1.3 c | 21 c |

[x]Each plant inoculated with 15 000 nematode eggs and grown for 60 days.
[y]Air-dried crab scrap compost or raw crab scrap mixed on weight for weight basis with an air-dried fine sand soil.
[z]Waller-Duncan *k*-ratio *t*-test ($P \leq 0.05$).

may be more important than its ability to suppress nematodes. Further greenhouse and microplot tests need to be conducted to verify and extend results of these experiments.

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