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NEMATODA

Use of slaughterhouse waste and tannery-based organic compost for the management of reniform nematodes

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HIGHLIGHTS

- the organic compost produced with slaughterhouse and tannery waste has potential for controling reniform nematodes.
- organic composts reduced the number of nematodes per gram of root and the reproduction factor.
- There was a reduction o height and dry mass of cotton shoots.
- It is required dose adjustments or improvements in its composition to reduce the risk of phytotoxicity.

ABSTRACT: A greenhouse experiment was carried out with the objective of evaluating the effect of increasing soil amendments (1, 3, 9, 15 and 30%, v/v) of organic compost produced from slaughterhouse waste and tannery residues on the reproduction of reniform nematodes and cotton development. The addition of organic composts to soil proportionately reduced the number of nematodes per gram of root and the reproduction factor. However, depending on the concentration of the compost, there was a reduction of height and dry mass of cotton shoots. We concluded that the organic compost produced with slaughterhouse and tannery waste has potential for controlling reniform nematodes, but requires dose adjustments or improvements in its composition to reduce the risk of phytotoxicity.

KEWWORDS: *Rotylenchulus reniformis*, *Gossypium hirsutum*, reproduction, control, organic farming, phytotoxicity.

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INTRODUCTION

Beef cattle production is a very important economic activity in Brazil. In 2012, more than 31 million animals were slaughtered[1]. As a consequence, about 900 tons of bovine rumen content – the main slaughterhouses waste – was generated[2, 3]. The use of such residue as a source of nutrients for agriculture could create value for what is now considered an environmental problem of the meat production chain, since these materials are often improperly discarded. Recently, bovine rumen content has been used as input for the production of organic fertilizers, which have been evaluated regarding their agronomic value[4, 5].

Different organic soil amendments have been proved to reduce the population density of plant parasitic nematodes and increase the productivity of various crops[6]. The mode of action of organic soil amendments in controlling nematodes is complex and depends on the type of compost[7]. However, most studies conducted so far suggest that the organic compounds or their degradation products are toxic to nematodes and stimulate antagonists in the soil[8]. Furthermore, the effects of organic compounds depend on the nematode species present in the soil[9].

The reniform nematode, *Rotylenchus reniformis* Linford and Oliveira, is a major problem for several crops worldwide, like cotton, soybean and muskmelon[10, 11, 12]. Due to the large number of susceptible

plant species and the few available resistant genotypes[13], the management of this nematode has been limited to the use of nematicides, when economically feasible. So, the use of organic residues as soil amendments could be an important management strategy[14].

The addition of municipal pruning residues (leaves, branches and grass), solid cattle manure and leaves, as well as residues of marigold, mustard or sunflower based-composts has been shown to reduce the population of *R. reniformis* in soil[15, 16, 17].

The present work was carried out with the objective of evaluating the effect of compost made from slaughterhouse and tannery wastes on the reproduction of reniform nematodes and development of cotton plants.

MATERIAL AND METHODS

The compost was produced using slaughterhouse wastes (rumen contents and fat), leather processing wastes (peeling products and scrap, before chromium treatment), vegetable waste, coal ashes from steam boilers, sawdust, basalt powder, phosphorite and talc, whose characteristics are presented in Table 1.

Varying concentrations (0, 1, 3, 9, 15 and 30% v/v) of the compost was added to the substrate (65.0% sand, 6.8% silt and 28.2% clay), previously disinfested by solarization, and the resulted mixtures were used to fill three-liter clay pots. One pre-germinated cotton seedling of cultivar "BRS Cedro" was transplanted to each pot.

After one week, each cotton plant was inoculated with 5 mL of an aqueous suspension of 1,000 eggs and vermiform specimens of *R. reniformis*. An equal number of cotton plants were maintained without inoculation. Ninety days after inoculation, the plants were evaluated for height, dry mass of shoots and multiplication of nematodes. The roots were separated from the substrate, gently washed in tap water and let dry for 20 minutes on paper towel before being weighed. Nematode extraction from roots followed Coolen & D'Herde[18]. Data on fresh root mass and nematode counts were used to estimate the number of nematodes per gram of root and the reproduction factor (RF = total number of nematodes in the root material at the end of the experiment/1,000). The experiment was a completely randomized design with eight replications per treatment in a 2 × 6 factorial setup (inoculated or not inoculated with nematodes x concentrations of compost). Data were subjected to analysis of variance and linear regression analysis.

RESULTS AND DISCUSSION

No significant interaction was observed between inoculation or not with the nematode and concentrations of the compost as far as cotton plant growth is concerned. There also were no significant differences between plants inoculated or not inoculated with the nematodes concerning the height and dry weight of shoots. On the other hand, significant differences were observed in plant height ($p < 0.01$), dry matter of shoots ($p < 0.01$), and nematode reproduction factor ($p < 0.01$) by different concentrations of compost in the substrate.

Figures 1 and 2 show the data from the number of nematodes per gram of root and reproduction factor of *R. reniformis*, due to the addition of increasing concentrations of the organic compost in the substrate. Nematode reproduction was affected by compost soil amendment. The reduction in the number of nematodes per gram of root ranged from 22.4 to 97.3%. The nematode reproduction factor decreased from 59.9 to 99.0%, depending on the different compost concentrations. In both cases, exponential models best fit the data on compost effect on nematode reproduction. However, the addition of the compost to the soil caused a negative effect on cotton plants, characterized by reduced height (14.8 to 45.1%) and dry mass of shoots (12.6 to 62.8%), as presented in Figures 3 and 4.

Table 1. Chemical and fertility features of the organic compost produced from slaughterhouse waste and tannery.

pH	C:N	M. O.	Ca	Mg	P	K	N	Na	S	Cu	Zn	B
		---------- dcg / kg ----------								-------- mg / kg --------		
8.0	6.20	37.44	8.79	1.23	4.78	0.20	2.95	0.30	0.94	18.69	62.01	54.15

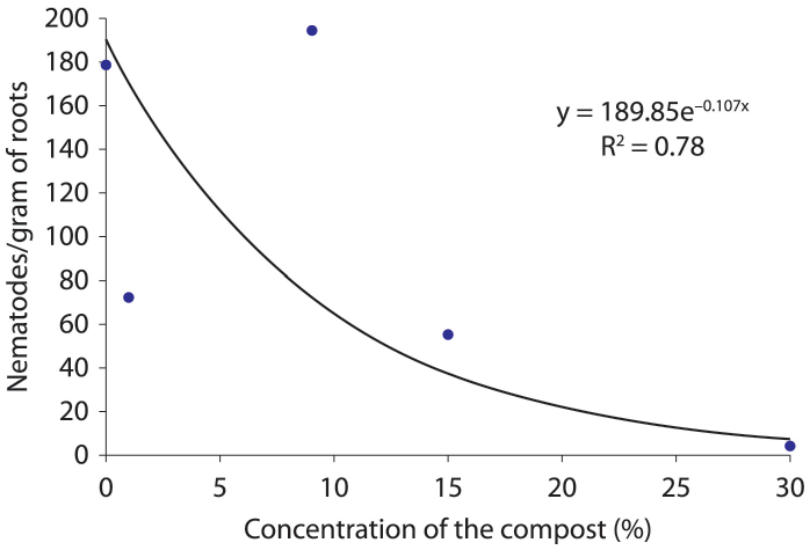

Figure 1. Number of nematodes per gram of cotton roots as affected by concentrations of the compost in the substrate.

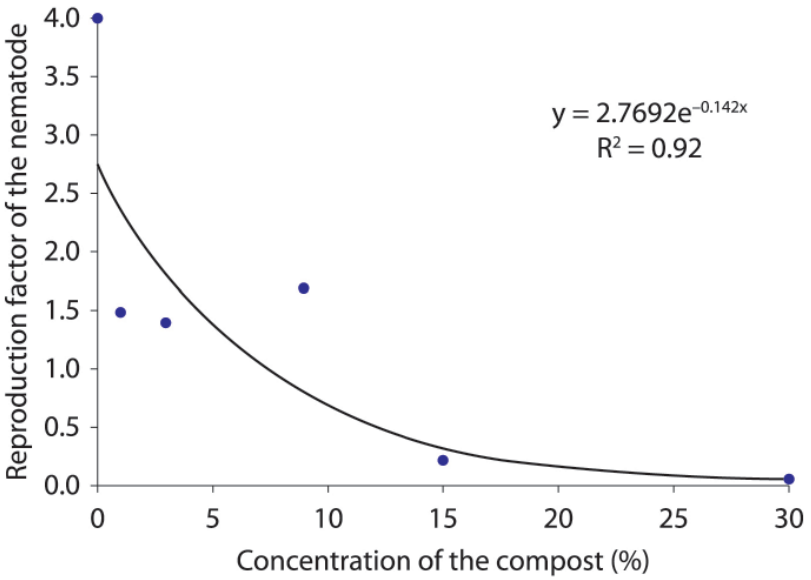

Figure 2. Reproduction factor of *Rotylenchulus reniformis* as affected by concentrations of the compost in the substrate.

In a field experiment in which different amounts of compost from plant pruning waste (leaves, branches and grass), with pH 7.7 and C:N ratio 4.2:1, were added to soil cultivated with barley, Renčo et al.[17] observed a significant reduction of the population density of *R. reniformis*, proportional to the compost concentration. Generally, lower C:N composts, as that used in the present study (Table 1), promote the control of nematodes[14], due to the production of ammonia during the decomposition of organic residues in the soil, because of their high nitrogen contents[19]. On the other hand, this same low C:N ratio could be responsible for the observed phytotoxic effects, as a consequence of an insufficient amount of carbon in the substrate, interfering in the use of available nitrogen by soil microbes. As a rule, the range of C:N ratio most suitable to obtain control of nematodes without causing phytotoxicity varies from 14 to 20[20]. Thus, good strategies to obtain the benefits of using the organic compost made from slaughterhouse and tannery waste for the control of the reniform nematodes without risks of causing phytotoxicity could be the use of lower but still efficient concentrations (Figures 1 and 2), and/or the addition of carbon sources to the compost to increase its C:N ratio.

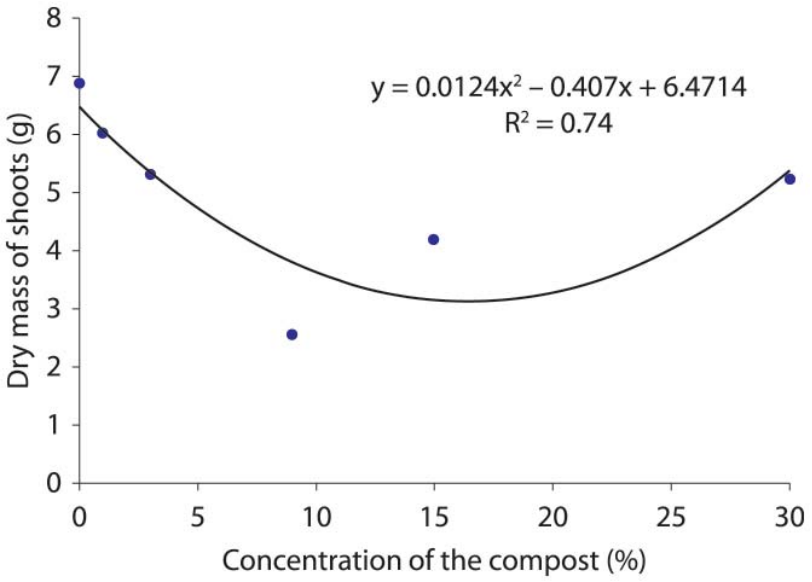

Figure 3. Dry mass of cotton plants shoots 90 days after inoculation with the reniform nematode as affected by concentrations of the compost in the substrate.

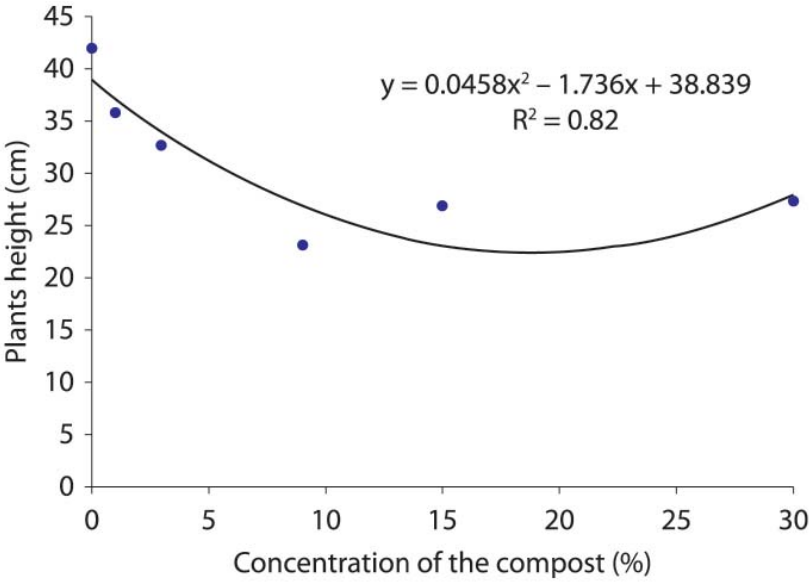

Figure 4. Height of cotton plants 90 days after inoculation with the reniform nematode as affected by concentrations of the compost in the substrate.

CONCLUSIONS

In conclusion, the application in the soil of organic compost based on slaughterhouse and tannery waste has potential for reniform nematode management, helping to reduce the use of chemical pesticides and also the disposal of polluting wastes.

REFERENCES

1. Instituto Brasileiro de Geografia e Estatística – IBGE. Sistema IBGE de Recuperação Automática. Banco de Dados Agregados [online]. Rio de Janeiro: IBGE; 2013 [cited 2013 Jun 3]. Available from: http://www.sidra.ibge.gov.br/.
2. Melo GCB, Torres A Fo, Abreu LR, Dias LC, Beirigo EA, Scherer D. Resíduos sólidos em indústrias de abate frigorífico. In: Instituto de Ciência e Tecnologia em Resíduos e Desenvolvimento Sustentável – ICTR. Abstracts of the Congresso Brasileiro de Ciência e Tecnologia em Resíduos e Desenvolvimento Sustentável; 2004; Florianópolis, Brazil. Florianópolis: ICTR; 2004. p. 3555-67.

3. Pacheco JW, Yamanaka HT. Guia técnico ambiental de abates (bovino e suíno). São Paulo: CETESB; 2006. 98 p. 1 CD-ROM.
4. Roscoe R, Nunes WAGA, Sagrilo E, Otsubo AA. Aproveitamento agrícola de resíduos de frigorífico como fertilizante orgânico sólido. Dourados: Embrapa Agropecuária Oeste; 2006. Boletim de pesquisa e desenvolvimento, 35.
5. Nunes WAGA, Menezes JFS, Benites VM. Uso de compostos orgânicos produzidos a partir de resíduos da agropecuária como fertilizantes na cultura de milho. Abstract of the 3rd Simpósio Internacional sobre Gerenciamento de Resíduos Agropecuários e Agroindustriais; 2013; São Pedro, Brazil. São Pedro: SBERA; 2013. CD-ROM.
6. Muller R, Gooch OS. Organic amendments in nematode control: an examination of the literature. Nematropica. 1982;12(2):319-26.
7. Akhtar M, Malik A. Roles of organic soil amendments and soil organisms in the biological control of plant-parasitic nematodes: a review. Bioresource Technology. 2000;74(1):35-47. http://dx.doi.org/10.1016/S0960-8524(99)00154-6.
8. Duncan LW, Noling JW. Agricultural sustainability and nematode integrated pest management. In: Barker KR, Pederson GA, Windham GL, editors. Plant and nematode interactions. Madison: American Society of Agronomy; 1998. p. 251-87.
9. McSorley R, Stansly PA, Noling JW, Obreza TA, Conner JM. Impact of soil organic amendments and fumigation on plant-parasitic nematodes in a southwest Florida vegetable field. Nematropica. 1997;27(2):181-9.
10. Starr JL. Cotton. In: Barker KR, Pederson GA, Windham GL, editors. Plant and nematode interactions. Madison: American Society of Agronomy; 1998. p. 359-79.
11. Moura RM, Pedrosa EMR, Guimarães LMP. Nematoses de alta importância econômica da cultura do melão no Estado do Rio Grande do Norte, Brasil. Fitopatologia Brasileira. 2002;27(2):225. http://dx.doi.org/10.1590/S0100-41582002000200020.
12. Dias WP, Asmus GL, Silva JFV, Garcia A, Carneiro GES. Nematoides. In: Almeida AMR, Seixas CDS, editors. Soja: doenças radiculares e de hastes e inter-relações com o manejo do solo e da cultura. Londrina: Embrapa Soja; 2010. p. 173-206.
13. Robinson AF, Inserra RN, Caswell-Chen EP, Vovlas N, Troccoli A. Rotylenchulus species: identification, distribution, host ranges, and crop plant resistance. Nematropica. 1997;27(2):127-80.
14. Rodríguez-Kábana R. Organic and inorganic nitrogen amendments to soil as nematode suppressants. Journal of Nematology. 1986;18(2):129-34. PMid:19294153.
15. Akhtar M, Mashkoor Alam M. Effect of Crop Residues Amendments to Soil for the Control of Plant-Parasitic Nematodes. Bioresource Technology. 1992;41(1):81-3. http://dx.doi.org/10.1016/0960-8524(92)90102-4.
16. Akhtar M. Plant growth and nematode dynamics in response to soil amendments with neem products, urea and compost. Bioresource Technology. 1999;69(2):181-3. http://dx.doi.org/10.1016/S0960-8524(98)00158-8.
17. Renčo M, Sasanelli N, Salamún P. The effect of two compost soil amendments, based on municipal green and penicillin production wastes, on plant parasitic nematodes. Helminthologia. 2009;46(3):190-7. http://dx.doi.org/10.2478/s11687-009-0035-6.
18. Coolen WA, D'Herde CJ. A method for the quantitative extraction of nematodes from plant tissue. Ghent: State Nematology and Entomology Research Station; 1972. 77 p.
19. Ferraz S, Freitas LG, Lopes EA, Dias-Arieira CR. Manejo sustentável de fitonematoides. Viçosa: Ed. UFV; 2010. 304 p.
20. Rodríguez-Kábana R, Morgan-Jones G, Chet I. Biological control of nematodes: soil amendments and microbial antagonists. Plant and Soil. 1987;100(1-3):237-47. http://dx.doi.org/10.1007/BF02370944.