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ARBUSCULAR MYCORRHIZAL FUNGI AND NEMATOFAUNA IN MANGO PLANTATIONS (*Mangifera indica* L. 'TOMMY ATKINS') PRODUCED ORGANICALLY OR CONVENTIONALLY IN THE SAN FRANCISCO VALLEY, BRAZIL

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ABSTRACT

Mango tree is the second most cultivated fruit tree in San Francisco Valley. Nematodes and the arbuscular mycorrhizal fungi (AMF) have important roles in the soil can be used to assess its quality. Purpose of this work is to evaluate the nematofauna and AMF in organic and conventional mango plantations. Collection was performed in: organic, conventional farming and Caatinga. The amount of bacteriovoros, omnivores and *Helicotylenchus* was lower, while fungivores were higher in the conventional cultivation area. Mycorrhizal colonization and density of AMF spores did not differ between areas. Organically grown mango area was less affected by the type of management.

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INTRODUCTION

The mango (*Mangifera indica* L.) belongs to the Anacardiaceae family, having an Asian origin. It is an edible species, being marketed worldwide.The consumption of this fruit can be both fresh and processed in the form of jellies, sweets, ice cream, juices.In the San Francisco Valley region, in the Brazilian semiarid region, mango stands out as the second most cultivated fruit tree, with most of its production destined for the foreign market (Silva and Correia, 2004). Brazil is the ninth world producer, having 62 thousand hectares of planted area. The states of Brazil that stand out as exporters of mango are: Bahia, Pernambuco, Rio Grande do Norte, San Paulo, Minas Gerais (IBGE, 2018). Since the São Francisco Valley is located in the states of Bahia and Pernambuco, the Petrolina-Juazeiro pole stands out, where the harvest is made all year round, due to the use of the floral induction method (Almeida *et al*., 2000). Arbuscular mycorrhizal fungi (AMF) belong to the phylum Glomeromycota (Tedersoo *et al*., 2018).These form a symbiotic mutualistic association with most terrestrial plants, with the main benefit of increasing the absorption of macro and micronutrients by the host plant, among which P has been extensively studied and in exchange the plant provides photosynthates for the AMF. These fungi increase the growth of plants, including fruit trees, as observed in mango trees (Mohandas, 2012), sweet passion fruit (Silva *et al*., 2004), sugar apple (Coelho *et al*., 2012), as well as helping to reduce biotic and abiotic stresses suffered by vegetables (Campos *et al*., 2017; Beltrano and Ronco, 2008). Another important point, related to the mycorrhizal association, is that the AMF are considered indicators of soil quality, so evaluation of their activity or presence may be related to soil conditions. Nematodes belong to the phylum Nematoda, are wormlike, live in aquatic environments and films of water in the soil. Nematodes from the free-living soil are grouped according to the trophic group into: Bacteriovores; Fungivores; Omnivores and Carnivores (Bongers and Bongers, 1998). They participate in the food chain, being involved in nutrient cycling. In this way, these nematodes are regulators of microbial communities (Yeates, 2003). Bacterivores and fungivores are secondary consumers, while omnivores and carnivores are considered tertiary consumers (Mulder *et al*., 2003).

Tabela 1. Quantity of nematodes (100 ml of soil), percentagem of mycorrhizal colonization (MC) and density spores(DS) of arbuscular mycorrhizal fungi (50 g of soil)from areas with organic or conventional cultivation of 'Tommy Atkins' mango and caatinga area

Areas	Bacteriovorus	Fungivores	Omnivores	*Helicotylenchus*	MC (%)	DS
CC	37 b	42 a	8 c	69 b	79 a	42 a
OC	277 a	37 ab	233 a	187 a	80 a	69 a
C	186 a	5 b	121 b	131 ab	73 a	62 a

CC= Conventional Cultivation; OC= Organic Cultivation; C= Caatinga. Averages followed by the same letter, in the column, do not differ by the Tukey 5%

Some soil nematodes are plant parasites and are called phytoparasites. Nematodes are indicators of soil functioning (Bongers and Bongers, 1998). Several factors influence the structure of soil nematode communities such as: soil type (Cadet *et al*., 2003), agricultural practices (Zhang *et al*., 2012), significant correlation was observed between agricultural ecosystems and the nematode community (Mulder *et al*., 2003).Thus, field studies demonstrate that relationships between soil nematode biodiversity and ecosystem functioning are priority investigations (Mulder *et al*., 2003), which may indicate changes in certain areas, so the use of free-living nematodes assessment is a valuable tool for determining soil quality. Therefore, these two organisms can be used as indicators of soil quality either by identifying species or by evaluating these organisms in the soil. Several studies show differences related to these organisms in different areas (Campos, 2009; Pen- Mouratov *et al*., 2004). Thus, the hypothesis of this work is that the quantity or type of these organisms in the soil differ between areas of organically grown mango from those cultivated conventionally, since areas of conventional production receive chemical inputs, while areas of organic plantations do not receive, which are replaced by organic fertilizers and natural pesticides. Thus, the objective of this work is to evaluate nematofauna and AMF in organic and conventional mango plantations 'Tommy Atkins'. A collection was carried out in three areas: organic 'Tommy Atkins' mango cultivation, conventional 'Tommy Atkins' mango cultivation and Caatinga area close to the cultivation areas in the Santa Helena Community located in Juazeiro –BA. Thirty soil samples (0-30 cm deep) were collected in the projection of the hose canopy, 10 samples in each area. The soil samples were packed in plastic bags and transported to LACACSSF (Laboratory of Agricultural Cultures and Caatinga in the Submediate San Francisco) at UPE *Campus* Petrolina for nematode and AMF evaluation.

To evaluate the groups of nematodes, 100 ml of soil was processed according to Jenkins (1964) and the nematodes obtained were quantified under a microscope and grouped according to the trophic group in: Bacteriovores; Fungivores; Omnivores and Carnivores (Bongers and Bongers, 1998), or when phytonematodes identified at the gender level. To assess mycorrhizal colonization, the roots were separated from the soil, washed, clarified with 10% KOH and stained with Trypan Blue (0,05%) (Phillips and Hayman, 1970) and the percentage of mycorrhizal colonization was assessed according to Giovanneti and Mosse (1980). To assess the spore density, these were counted in a channeled plate under a stereomicroscope, after processing 50g of soil (Jenkins, 1964; Gerdemam and Nicolson, 1963).The data were submitted to analysis of variance and the means compared by the Tukey test ($P < 0.05$) using the Statistica program (Statsoft, 1997). Values in number were transformed log x + 1 and in percent to arcosene x / 100. There was a statistical difference between the areas studied for most of the evaluated nematode parameters. The number of bacteriovorus and omnivorous nematodes was lower in the conventionally cultivated mango area (Table 1). The reduction in the amount of bacteriovorous and omnivorous nematodes in the conventional area may be related to the addition of chemical inputs, which alters the soil, modifying its characteristics and probably reducing the amount of bacteria that are the food source of bacteriovores and can also be ingested by omnivores. The amount of bacteriovorus is usually higher in soils that receive organic fertilizer (Thoden *et al*., 2011).Another factor is related to nutrient availability, according to Mulder *et al*. (2009) this can directly influence the size of the communities and the links between them, this availability of nutrients may have been lower in the conventional area. The amount of fungivorous nematodes was higher in the area of conventionally cultivated mango in relation to Caatinga (Tabela 1). Probably the reduction in the other trophic groups of nematodes (bacteriovorus and omnivorous) in this area it may have made more resources available for fungivores, which could thus have a larger population. Mondino *et al*. (2009) consider that the type of soil management can influence nematodes, as verified in the present study, causing imbalance in the nematode population. Renco and Kovacik (2012) observed an increase in the amount of bacteriovorus and fungivores when pig manure was applied to the soil.

The only phytonematode found in the three areas was of the genus *Helicotylenchus*(Table 1). This phytonematoid was in greater quantity in the area of organically grown mango compared to the conventionally cultivated area.Probably the plants in the organic area were more showy allowing the multiplication of this nematode. In addition, the organic fertilizer added to these areas usually contains several organisms, including nematodes and AMF, thereby bringing in new nematode populations. Campos (2009) observed a high amount of this phytonmatode in an area of semi-organic cultivation of guava. No carnivorous nematodes were found in the collected areas, indicating that they all suffer some interference, in the case of the Caatinga this interference is anthropic due to the proximity of the cultivation areas. In general, carnivores are at the top of the food chain, being found in lesser quantities, however, in some areas it may not be present, precisely due to the managements that are carried out in areas of conventional and organic cultivation, and in the anthropized Caatinga. Regarding the parameters related to mycorrhizal fungi, the type of cultivation (organic or conventional) did not affect mycorrhizal colonization or spore density, so there was no statistical difference between treatments (Table 1). The percentage of mycorrhizal colonization varied between 74 to 79% and the spore density of AMF varied between 40 to 60 spores in 50 grams of soil. Similar to that observed by Pereira (2019) in mango tree submitted to green manure. While Govindan *et al*. (2019) observed a greater amount of AMF spores in the various varieties collected in various mango orchards in India. Thus, taking into account the results obtained in relation to nematodes, the organically cultivated mango area was similar to the Caatinga area, which is the control area, therefore, it can be considered that the organically cultivated mango area was less affected by the management and introduction of monoculture than the conventionally cultivated mango area, since, in general, less nematodes were observed in this area. However, the AMF showed no difference between the areas, proving to be a fragile tool. Thus, it is important that soil quality assessments consider more than one parameter, in order to strengthen the results obtained and consequently generate more reliable conclusions.

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