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Incidence of potato green aphid and *Liriomyza* sp. in radish plants grown on different levels of organic fertilizer

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Abstract. Radish is a short cycle horticultural product from family Brassicaceae. Between the insects found on radish leaves, potato green aphid (*Myzus persicae* Sulzer) is one of the main pests of this culture, causing economic damage. Synthetic fertilizers used in conventional crops can promote changes in the pattern of amino acids in plants, leading to a higher insect damage. The source of fertilization is one of the factors that could influence in the incidence of pests. The objective of the study was to evaluate the incidence of potato green aphid and other pests on radish plants grown with different doses of organic fertilizer. The experiment was carried under semi-field conditions, in Fortaleza (Ceará State). A completely randomized design was used, with six replicates. The treatments consisted of five doses of organic compost (0; 45; 60; 75; 90 $t.ha^{-1}$). For the population survey of pests and natural enemies, counts were made in three evaluations (7, 14 and 21 days after sowing). The counting data were subjected to deviance analysis using a generalized linear model (GLM). It was observed significant differences in the number of adults *M. persicae* in the treatments of 75 and 90 $t.ha^{-1}$. Presence of leafminer (*Liriomyza* sp.) was observed on plants without and with the lower doses of organic fertilizer. Even using organic fertilizers that promote a slower liberation of nutrients, high incidence of pests (Mainly *M. persicae*) was observed on radish plants.

Keywords: Agromizidae; Aphididae; Brassicaceae; Organic amendments; *Raphanus sativus*

Radish (*Raphanus sativus* L.) belongs to Brassicaceae family, and as other species also include in this botanic family, phytosanitary problems are constantly present (Filgueira 2005). Among the arthropod pests that are associated with species of Brassicaceae in general, aphids are the most common insects found on leaves, causing economic damage (Carvalho *et al*. 2002; Van Emden & Harrington 2007).

Aphids are reduced size arthropods, ranging in length from 1.5 to 2.5 mm (Van Emden & Harrington 2007). Usually, immigrant organisms are winged, in contrast to those who maintain the colony that do not have wings (Blackman & Eastop 2000). There are both direct and indirect losses caused by the caused attack of this insect, the direct damage is associated to the feeding habit, while the indirect losses are attributed to liberation of honeydew, causing the grown of opportunist plant pathogens on the leaves (Bass *et al*. 2014).

The potato green aphid, *Myzus persicae* Sulzer (Hemiptera: Aphididae), is an polyphagous pest that cause significant economic damage in several crops (Bass *et al*. 2014). Approximately 400 species distributed in more than 40 botanical families are listed as hosts of the *M. persicae* (Blackman & Eastop 2000). Its high capacity to adapt on different climatic conditions and, consequently, its wide distribution throughout the globe, makes the potato green aphid a severe pest, capable of transmitting more than 100 different types of viruses to plants (Van Emden & Harrington 2007).

In tropical conditions, *M. persicae* reproduces by thelytokous parthenogenesis (Bueno 2005). Thus, females generate new females in approximately 10 days, with the potential to generate approximately 80 individuals/female varying with the host plant and nutritional quality of the host (Petterson *et al*. 2007). In northeast of Brazil, the climatic conditions in addition to the biotic potential enhance infestations of *M. persicae*

Ventura *et al*. (2008) found a correlation between the imbalance nutritional status of the plant and incidence of pest-arthropods. One of the reasons of nutritional imbalance could be related to the type of fertilization which the plant is subjected, wich can promote biochemical and physiological changes (Atiyeh *et al*. 2000). Organic fertilizers benefit not only in plant growth, but also the edaphic fauna (including macro, meso and micro fauna), enhancing the biodiversity of beneficial organisms (Karbauskiene 2000; Berova & Karanatsidis 2009). Synthetic fertilizers used in conventional crops can promote changes in the pattern of amino acids in plants, leading to a higher insect damage (Lockeretz *et al*. 1981; Altieri 2003).

The objective of the study was to evaluate the incidence of potato green aphid and other pests on radish plants grown with different doses of organic fertilizer.

MATERIAL AND METHODS

The experiment was carried out in December 2016, under semi-field conditions, in Fortaleza (Ceará state, 03°47' S and 38°30' W). The location is classified as 'As' type, that is, Tropical with dry summer according to Köppen classification

(Alvarez *et al*. 2014). During the experiment, the average of air temperature was 29 °C, with variation between 23.2 °C and 31.8 °C, at minimum and maximum, respectively. The accumulated rainfall in the period was 28.8 mm.

A completely randomized design was used, with six replications, where each line with five plants was considered as one repetition. The treatments consisted of five doses of locally produced organic compost (0; 45; 60; 75; 90 $t.ha^{-1}$). A mix of cattle manure and leaves of *Anacardium* occidentale L. (Plantae: Anacardiaceae) were used to make the compost, with the following chemical characteristics: pH (H_2O) = 6.9; P (mg/dm^3) = 368.7; K (mg/dm^3) = 2,300; Ca ($cmol_c/dm^3$) = 10.9; Mg ($cmol_c/dm^3$) = 9.4; Zn (mg/dm^3) = 98; Fe (mg/dm^3) = 21.1; Mn (mg/dm^3) = 67.7; Cu (mg/dm^3) = 0.7; B (mg/dm^3) = 1.6. The organic fertilizer dosages established for each treatment were applied in three occasions, one in planting and the other two in coverage at 10 and 20 days after sowing (DAS). The compost was applied between the lines of cultivation. The experiment was conducted in n each experimental plot of 1 m^2 (1.0 x 1.0 m), five longitudinal lines were allocated, using spacing of 0.20 x 0.20 m. The working area consisted on the three central lines. No chemical or alternative methods of pest control were used. Weed control was made by removing the plants manually. Sowing was carried out with radish seeds of the cultivar 'Cometo' Top Seed®. Irrigations were made three times a day with micro sprinkler (60 L/h), aiming to replace the soil moisture lost by potential evapotranspiration throughout the day.

For the population survey of pests, counts were made in three evaluations (7, 14 and 21 days after sowing), for this, a fully expanded leaf was analyzed in each of the plants present in the three central lines of each plot, totaling 15 plants evaluated per treatment. Only adults were considered in the count to provide a better perception of population growth, taking in consideration that not all nymphs reach adult stage. The evaluations were made in one cycle of radish production. The counting data were subjected to deviance analysis using a generalized linear model (GLM), the means being compared by the Tukey test (p = 0.05) using the software SAS (SAS Institute 2002). A pearson's correlation study between the presence of *M. persicae* and other pests was also performed.

RESULTS AND DISCUSSION

The potato green aphid was already present at the first evaluation (7 DAS), but no significant effect of the treatments on the number of adults of *M. persicae* was found (Table 1). Only at 21 DAS the average adult density of *M. persicae* in the plants was statistically significant. The organic fertilizer doses of 75 and 90 $t.ha^{-1}$ provided the greatest infestations of green aphids.

The incidence of leafminer fly *Liriomyza* sp. (Diptera: Agromizidae) was also observed in *R. sativus.* Plants that did not receive organic fertilizer were more attacked by leaminers, with about 33% of plants infested. A negative correlation between the incidence of *M. persicae* and *Liriomyza* sp. was obtained by the Pearson's correlation coefficient (-0.88). Possibly, this fact may be related to a competition between these pest arthropods on the host. No natural enemies associated with *M. persicae* or *Liriomyza* sp. were found in the evaluations.

Due to the absence of tactics for control potato green aphid on the plants, the infestation possibly started in the first days after germination, with the arrival of winged females to start the colony. In case of plants from Brassicaceae family, the glycosinolate sinigrine, substance naturally produced by several species of Brassicaceae, favors the host's encounter by aphids (Nault & Styer 1972; Pinchersky & Gershenzon 2002).

The period of nymph-adult of *M. persicae* on *R. sativus* is about 13 days (Hong *et al*. 2019). Therefore, estimating the beginning of the infestation close to 7 DAS, a significant increase in the population would only be achieved at least 17 DAS without presume possible arrivals of other winged forms attracted by intraspecific communication chemicals. It was observed that in *Rhopalosiphum padi* L. (Hemiptera: Aphididae) winged females are attracted by aggregation pheromones released by other winged females already present in the host plant (Pickett & Glinwood 2007). Therefore, both the generation time and intra-specific communication between individuals may have led to a greater abundance of *M. persicae*, resulting in a significant difference both between treatments and in relation to the evaluation dates at 21 DAS.

In a study made by Michelotto *et al*. (2005) it was verified that at a temperature of 30 °C, there was no reproduction of *M. persicae* in eggplant (*Solanum melogena* L.) as host. The temperature values during the experiment period were always close to 30 °C, with an increase on pest population over time. The divergences in terms of the results obtained in the present study in comparison to Michelotto *et al*. (2005) may come from both the difference in relation to the host plant and population of *M. persicae*.

Plants submitted to the highest doses of organic fertilizer showed the highest levels of infestation by *M. persicae* but no incidence of other pests. The greater availability of nutrients for plants may have generated a higher concentration of free amino acids, providing greater nutritional quality for the green aphid, thus contributing to its population increase. In general, free amino acids directly favor the development of the green aphid, which reduces its generation time and, consequently, increases its speed of plant colonization (Bortoli *et al*. 2005).

In organic production systems, where soil fertilization is made with organic amendments, the availability of nutrients for plants can be considered as slower compared to synthetic fertilizers. However, according to the results obtained in the study, higher doses of organic fertilizers promote higher incidence of *M. persicae* in radish plants. Further research must be done with more cycles of production of radish to reinforce the results obtained.

Table 1. Averages of adults of *Myzus persicae* (Hemiptera: Aphididae) and incidence of *Liriomyza* sp. (Diptera: Agromizidae) at 7, 14 e 21 days after sowing (DAS) in radish plants submited to different levels of organic fertilizer.

Doses ($t.ha^{-1}$)	7 DAS	14 DAS	21 DAS	*Liriomyza* sp.
0	0.4 ±0.42 Aa	5.1 ± 2.67 Aa	21.5 ± 4.21 Ab	Present
45	0.3 ± 0.19 Aa	2.8 ± 1.13 Aa	24.1 ± 9.42 Ab	Present
60	0.4 ± 0.29 Aa	7.1 ± 2.86 Aa	20.9 ± 10.21 Ab	Absent
75	1.4 ± 0.75 Ba	6.9 ± 2.17 Ba	60.1 ± 10.81 Aa	Absent
90	2.5 ± 0.88 Ba	16.1 ± 3.50 Ba	74.3 ± 12.48 Aa	Absent

Lower case letters compare columns and upper case letters compare lines. Means followed by the same letter do not differ statistically by the Tukey test at the 5% level of significance.

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