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BRIEF REPORT: CONTROL MEASURES FOR THE *Mononychellus Tanajoa* (TETRANYCHIDAE) IN BRAZIL

[1]Felipe Fernando da Silva Siqueira, [2]Daniel de Carvalho Leite

[1]Programa de Pós-Graduação em Biologia Vegetal, Universidade Federal de Pernambuco, Av. Prof. Moraes Rego s/nº, Cidade Universitária, 50670-901, Recife, PE, Brazil.

[2]Associação Programa Um Milhão de Cisternas para o Semiárido, Articulação do Semiárido Brasileiro, Rua Nicaraguá, nº111, Espinheiro, CEP 52.020-190, Brasil.

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ABSTRACT

The cassava green mite, *Mononychellus tanajoa* Bondar (Acari: Tetranychidae), is a pest of considerable economic importance for cassava in Brazil, having a wide distribution in South America and in some African countries due to the abiotic conditions (high temperature, relative humidity low), which favor their infestation. Several tactics, such as biological control, selection of resistant cultivars, cultural practices and, eventually, chemical control, have been used to control *M. tanajoa*. In this context the objective of this work is to carry out a literature review on the control measures to the *M. tanajoa*. Based on the results found, it can be extrapolated to other cassava crop areas in other countries. Several strategies are used to control (i.e. cultural control, chemical control, extract of plants and biological control) the *M. tanajoa* it is difficult to say which is the best or most effective. For this we have to take into account not only the productivity, but also the conditions of the farmer and the type of environment. The best strategy then would be the *integrated pest control* allied to producer awareness with training courses and monitoring with the help of professionals.

Keywords: Cassava, cassava green mite, pest control, *integrated pest control*.

1. INTRODUCTION

The cassava *Manihot esculenta* (Crantz) is a species of the Euphorbiaceae family native to Brazil and distributed throughout the country (Valle, 2005). *M. esculenta* has high genetic variability and is cultivated in all regions, for the most diverse purposes (Ferreira *et al*., 2008). The world's largest producer of cassava is Nigeria with a production of 47,406,770 tons in 2013. With a

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production of 30,227,542 tons Thailand follows next, Indonesia (23,936,920) and Brazil (21,484,218) rank third and fourth in the world in cassava production (WordAtlas, 2017).

In Brazil the Northeast (34.7 %) and North (25.9 %) regions stand out as the main producers and consumers, and the production is essentially used in the food diet, in the form of flour (Embrapa, 2003). It is known the importance of cassava as a food crop, but few studies have been carried out to significantly increase its productivity. One of the main difficulties to increase its productivity is the pest management that attacks this crop (Cardoso-Júnior *et al*., 2005).

The cassava stands out as a source of energy in human and animal food, in the derivatives industry, and as a generator of direct and indirect jobs (Silva *et al*., 2007), being widely cultivated in the tropics , due to its great adaptability, mainly in the parallels 30 ° of Latitude North and South. Its cultivation can be realized, in conditions of high level of technology, as well as without the use of agricultural inputs, being the second alternative more used (Santana *et al*., 2008). In addition, the It is the food source of approximately 800 million people in the world, being considered the fourth source of carbohydrates in the tropics, losing only to rice, sugarcane and corn (Nassar, 2006). Roots are consumed in human and animal feeding, with per capita consumption of 70 kg/year. In addition to the flour, beijus, tapioca, starch and animal by-products, such as silage and hay, can be obtained from stalks, leaves and root residues (Santana *et al*., 2008; Alves *et al*., 2009).

Among the main agricultural pests that attack the cassava crop are the mites of the families Tetranychidae, Tenuipalpidae. Among the Tetranychidae we have: The cassava green mite (*Mononychellus tanajoa* Bondar), the spider mite (*Tetranychus urticae* Koch) and the red mite (*Oligonychus gossypii* Zacher), which has only been reported for Africa, having quarantine importance (Flechtmann and Moraes, 2008). In relation to the insects we have: The mandarová, (*Erinnys ello* Linnaeus) Lepidoptera: Sphingidae, termites and ants (Embrapa, 2003). Among all the agricultural pests that attack cassava culture the most important is *M. tanajoa*. This mite was described in Bahia, although it is found in all cultivated regions of Brazil, in other countries of South America and Africa. In Brazil severe damages are found in the Northeast region due to its dry climate, high temperatures and low relative humidity, conditions that favor infestation of these organisms, whose infestation begins with the upper part of the plants, attacking the buds and leaves (Flechtmann and Moraes, 2008), which is the result of the presence of a large amount of water in the soil.

Several practices have been used to control *M. tanajoa*, among them biological control, selection of resistant cultivars, cultural practices and chemical control. According to Veiga (1985) he reported the control of *M. tanajoa* with the use of chemical products in the state of Pernambuco,

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although the use of chemical products is not very profitable for the producer (Bellotti *et al*., 1999). Undesirable effects on humans, animals and plants (Igbedioh, 1991).

Therefore, the objective of this work is to demonstrate the practices that are being used in Brazil for the control of the cassava green mite *M. tanajoa*. We hope that this review will serve as a support for students of agricultural entomology, farmers, for decision making in pest control and the public interested in the subject.

2. MATERIAL AND METHODS

2.1 RESEARCH SOURCE

We performed a literature search of scientific published articles found in the databases: Scopus (https://www.scopus.com), Google Scholar (http://scholar.google.com.br), Scielo: (http://www.scielo.org), Periódicos da capes (http://www.periodicos.capes.gov.br), thesis and books; Where they served as the basis for the preparation of this review. Where a bibliographic survey of the main techniques used for the control of *M. tanajoa* and its importance for the cassava crop was carried out. All found articles were analyzed in order to evaluate if they really address to propose of this review.

3. RESULTS

3.1 Importance of *M. tanajoa* for cassava crops

The cassava green mite is a key pest of cassava in Brazil and Africa due to abiotic conditions (elevated temperature, low relative humidity) factors that favor its infestation in cassava plantations (Rêgo *et al*., 2013). This pest passes through the stages of egg, larva, protoninfa, deutoninfa, and adult. The adult female measures approximately 0.4 mm in length. Proto-chrysalis, deuto-chrysalis and telo-chrysalis are periods of immobility, in which morphological and physiological changes related to phase changes occur. The egg to adult period lasts on average 11.5 days at 25ºC. The oviposition period is approximately 16 days, with the posture being about five eggs/per female/per day (Boaventura *et al*., 2012).

Yaninek (1989) tested the development of *M. tanajoa* at five different temperatures, and concluded that the best temperature for the development of this mite was 31ºC, demonstrating that these organisms prefer high temperatures. In the Southeast region the mite rarely causes damage. In the state of Pernambuco (northeast region), this mite has caused losses of up to 51% in root production (Yaninek, 1989; Gonçalves *et al*., 2001; Flechtmann and Moraes, 2008). The injuries can be observed in all the leaves of the plant, with predominance in the apical region, being able to cause low growth, yellow spots, deformities of the limb, tanning, reduction in the

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growth of the internodes and fall of the same ones. Very attacked plants lose the leaves of the upper region, the stems die progressively from top to bottom, culminating with their death (Flechtmann and Moraes, 2008).

3.2 Control measures

M. tanajoa due to its economic importance for the cassava crop in Brazil, several practices were created for its control in order to try to reduce its damages to the cassava crop (see below).

3.2.1 Cultural Control

An alternative for the control of *M. tanajoa* would be the time of planting of cassava, that is, that the sowing season was at the beginning of the rainy season. Thus, the relative air humidity in the area would be high in this way, making *M. tanajoa* infestation difficult, since it prefers low levels of relative humidity (Yaninek, 1989; Gonçalves *et al*., 2001). In this way when it arrived at the rainy period the plant would already be with a good growth, thus would increase the chances so that it can survive by *M. tanajoa* damages. Other measures to be adopted would be the burning of the regions of the attacked plant (Flechtmann, 1985), destruction of host plants, periodic inspections in the culture, destruction of crop residues (Embrapa, 2003).

3.2.2 Resistant Cultivars

In Brazil, of the 1,196 cassava accessions evaluated in four ecosystems of the northeastern region, some genotypes with cassava green mite tolerance were identified, whose behavior varied according to the evaluation site (Fukuda *et al*., 1996). According to Boaventura *et al*., (2009) the genotype *Manihot peruviana* (Müll. Arg) presented resistance to *M. tanajoa* because it presents low oviposition rate in leaves. Farias *et al*., (2007) identified 24 promising hybrid resistance against to *M. tanajoa*, and the *Manihot flabellifolia* plants presented the best indexes.

High levels of resistance have been identified in Northeast cassava germplasm. However, most of the accesses identified as resistant have been shown to be agronomically inferior, indicating the need for a work of genetic improvement in the sense of associating resistance with yield and root quality (Fukuda *et al*., 1996).

3.2.3 Chemical Control

As reported by Veiga (1985) the chemical control of the *M. tanajoa* proved to be quite effective for the state of Pernambuco. However, chemical control is considered uneconomic, due to the long crop cycle, the low returns and the limited resources of the producers, most of whom are small producers (Bellotti *et al*., 1999). In addition, there is a possibility of adverse effects resulting from the use of these products, such as population reduction of natural enemies and

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development of resistant mite lines (Igbedioh, 1991), damages to the environment, soil, water and food (Sachs, 2008). In addition, there is an increase in suicide cases, due to the people who apply these pesticides, due to their easy access to the product (Gunnell and Eddleston, 2003). An alternative would be to use aqueous extracts of plants, for being more feasible and causing no, or practically no damage to the environment.

3.2.4 Aqueous plant extracts

Regarding the use of aqueous extracts of plants in Brazil there is still no registered plant product. But there are some works, with extracts of Nim *Azadirachta indica* (A. Juss.), Indian Carnation *Syzigium aromaticum* (L.). Whose products have shown acaricidal action for immatures of *M. tanajoa*. Also to studies with Cinnamon *Melia azedarach* (L.). In addition, the Nim extracts are more efficient as acaricide (Gonçalves *et al*., 1999; Gonçalves *et al*., (2001). Native plants of Caatinga dry forest has been used as the *Croton blanchetianus*, *Myracrodruon urundeuva* and *Ziziphus joazeiro* were used, in which were immersed in cassava leaf discs (3.5 cm diameter). The extracts at all concentrations (1, 5, 10, 15, 20 and 25%) resulted in a decline in the pest population. The concentrations of 20 and 25% of the extracts resulted in the highest percentage mortality of the pest. All extracts in concentrations of 15, 20 and 25% for adult females were repellents to *M. tanajoa* (Siqueira *et al*., 2014).

Plant extracts would be a good choice for the control of these mites because the cost is more feasible and because it presents selectivity for the natural enemies (Spollen and Isman, 1996), but for this it would be necessary more researches in this area. Continuity of this field study will not only provide a light for pest control, but an alternative less harmful to the environment.

3.2.5 BIOLOGICAL CONTROL

Predator mites of the Phytoseiidae family are considered the most effective natural enemies for the control of pest mites, mainly for the Tetranychidae family (Flechtmann and Moraes, 2008). In relation to the control of *M. tanajoa*, some Phytoseiidae species are being used to control this pest in Brazil and Africa: *Neoseiulus idaeues* (Denmark & Muma), *Amblydromalus manihoti* (Moraes), *Typhlodormalus aripo* (De Leon) (Flechtmann and Moraes, 2008). This project is bringing benefits to the farmer (Bellotti *et al*., 1999).

Another organism that is being used to control *M. tanajoa* is the entomopathogenic fungi of several genera. Being the most important species of the genus *Neozygites*. Some species of this fungus are being used in biological control as: *Neozygites tanajoa* for the control of *M. tanajoa* both in Brazil and in Africa (Agboton *et al*., 2009) and *Neozygites floridana*. Other species of fungi have also been reported for the control of *M. tanajoa*, these being of minor importance *Aspergilus* sp., *Fusarium* sp. (Yaninek, 1996; Chandler *et al*., 2000).

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4. CONCLUSIONS

Innumerable strategies are used to control the cassava green mite *Mononychellus tanajoa* (Bondar) (Acari: Tetranychidae), it is difficult to say which is the best or most effective. For this we have to take into account not only the productivity, but also the conditions of the farmer (i.e. financial support) and the type of environment.

- Cultural control should be used and consists of practices that makes it harder the population development of the pest and delay its dispersion.

- Chemical control proves to be quite effective for pest control in general, but its cost is high for smallholders without thinking about the risks to the environment, and to man himself.

- An alternative would be the use of natural products (i.e. extracts of plants), but for this we have to increase the research in this area and divulge them to the producers.

- Biological control is a good alternative to keep mite populations at low levels that do not cause damage to production, but for this we have to break paradigms regarding this type of control.

The best strategy then would be the union of all of them (Cultural Control, Resistant Cultivars, Chemical Control and Biological Control). What is known as integrated pest management (IPM), also known as *integrated pest control* (IPC). Allied to producer awareness with training courses and monitoring with the help of professionals.

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