Acta Biológica Colombiana
ISSN: 0120-548X
racbiocol_fcbog@unal.edu.co
Universidad Nacional de Colombia Sede Bogotá
Colombia

UNIVERSIDAD NACIONAL DE COLOMBIA
SEDE BOGOTÁ

ACTA BIOLÓGICA COLOMBIANA
http://www.revistas.unal.edu.co/index.php/actabiol

ARTÍCULO DE INVESTIGACIÓN / ORIGINAL RESEARCH PAPER

POPULATION FLUCTUATION OF *Empoasca* sp. (HEMIPTERA: CICADELLIDAE) IN A PHYSIC NUT CROP IN MATO GROSSO DO SUL

Fluctuación poblacional de *Empoasca* sp. (Hemiptera: Cicadellidae) en cultivos de piñón manso en Mato Grosso do Sul

Denisar Paggioli de CARVALHO[1], Harley Nonato de OLIVEIRA[2].

[1] Universidade Federal da Grande Dourados. Rodovia Dourados/Itahum, Km 12, CP 322, 79.804-970. Dourados, Brasil.

[2] Embrapa Agropecuária Oeste.. Rodovia BR 163, Km 253,6, CP 449, 79804-970. Dourados, Brasil.

For correspondence. biodenisar@hotmail.com

Received: 15th September 2014, **Returned for revision**: 1st April 2015, **Accepted**: 2nd June 2015.

Associate Editor: Geraldo Andrade-Carvalho.

Citation / Citar este artículo como: Carvalho DP, Oliveira HN. Population fluctuation of *Empoasca* sp. (Hemiptera: Cicadellidae) in a physic nut crop in Mato Grosso do Sul. Acta biol. Colomb. 2016;21(1):89-94. doi: http://dx.doi.org/10.15446/abc.v21n1.45111

ABSTRACT

Physic nut (*Jatropha curcas* L.) is an oilseed, semi-evergreen shrub or small tree of the Euphorbiaceae family, whose seeds contain oil that can be processed into a high quality biofuel. However, there have been reports of arthropods feeding from its leaves, including the green leafhopper *Empoasca* sp. (Hemiptera: Cicadellidae). The large numbers of this insect, observed in certain periods of the year in many regions of Brazil, are causing damage to the oilseed crops. This study aims at evaluating the fluctuation in green leafhopper population in a physic nut crop in Dourados, Mato Grosso do Sul, to assess possible correlations with rainfall, maximum, average and minimum temperatures. This evaluation was conducted between March 2011 and July 2012. The largest *Empoasca* sp. populations were recorded in May and June, 2011, and between February and May, 2012. No significant correlation was observed between the weather parameters analyzed and the fluctuation in the Hemiptera population, but there was a trend toward higher population density during the warmer and rainier months.

Keywords: *Jatropha curcas*, green leafhopper, rainfall, seasonality.

RESUMEN

El piñón manso (*Jatropha curcas* L.) es una oleaginosa de la familia Euphorbiaceae que se destaca por la producción de semillas cuyo aceite tiene características deseables para la producción de biocombustibles. Sin embargo, hay informes de algunos artrópodos que usan la planta como fuente de alimento, incluyendo la cigarrita verde *Empoasca* sp. (Hemiptera: Cicadellidae). La alta incidencia de este insecto se comprueba en varias regiones del Brasil, en ciertas épocas del año, causando lesiones a esta oleaginosa. El objetivo de este estudio fue evaluar la fluctuación de la cigarrita verde en una plantación de piñón manso en Dourados, Mato Grosso do Sul, y la búsqueda de posibles correlaciones con las precipitaciones y las temperaturas máximas, medias y mínimas. Esta evaluación se realizó entre los meses de marzo 2011 hasta julio 2012. Poblaciones mayores de *Empoasca* sp. se registraron en mayo y junio de 2011 y entre febrero y mayo de 2012. No hubo correlación entre los aspectos climáticos analizados y entre la fluctuación poblacional de los hemípteros, pero se observó una tendencia a una mayor densidad poblacional en los meses más cálidos y húmedos.

Palabras clave: cigarrita verde, *Jatropha curcas*, pluviosidad, sazonalidad.

INTRODUCTION

Physic nut (*Jatropha curcas* L.) is a perennial shrub species belonging to the Euphorbiaceae family that is probably native to South America (Berry, 1929; Arruda *et al*., 2004). It is a fast-growing deciduous plant, which takes three–four years to reach reproductive age (which may extend to 40 years) that can reach a height of more than 5 meters, whose seeds contain oil that can be processed to produce a high-quality biodiesel fuel (Carnielli, 2003). Furthermore, the physic nut is also considered drought-tolerant and can adapt to low fertility soils (Islam *et al*., 2011; Dias, 2012).

In 2014, Brazil produced 3.4 billion liters of biodiesel (Ministério de Minas e Energia, 2015). There is a significant impact of social inclusion in this activity, which has generated 1.37 million wage labor throughout the production chain and 105,000 families benefited with the "National Program of Familiar Agricultural Strengthening" (Pronaf). (Tapanes *et al*., 2013)

However, the lack of technical and scientific knowledge about the physic nut culture hinders its large-scale use; therefore, further studies on its cultivation and industrial uses are necessary (Divakara *et al*., 2010). It must be highlighted that the physic nut has been researched and studied more for its chemical properties, as well as medicinal and biocidal uses, than its agronomic characteristics (Saturnino *et al*., 2005).

Arruda *et al*. (2004) reported that only few insects are capable of attacking physic nut crops, since the plant produces a caustic sap exudate as a defense mechanism against any plant damage. However, studies conducted by Silva *et al.* (2008) and Oliveira *et al*. (2010) have demonstrated the potential of some arthropods to damage this crop.

Empoasca sp., family Cicadellidae, order Hemiptera, is known as the green leafhopper, usually associated with bean (Naseri *et al*., 2009), citrus (Miranda *et al*., 2009), castor bean (Suganthy, 2011), potato (Lamp *et al*., 1994) and many other crops around the world, has been consistently found in physic nut crops. Saturnino *et al*. (2005) observed high infestation of Cicadellidae in areas planted with physic nut in northern Minas Gerais, where plants presented the characteristics symtoms of attack. In addition, the green leafhopper has also been reported in areas planted with *J. curcas* in Bahia (Carvalho *et al*., 2009), Rondônia (Costa *et al*., 2011), and six municipalities in Mato Grosso do Sul (Oliveira *et al*., 2010).

The green leafhopper, *Empoasca* sp., inserts its stylets into the plant and releases toxic substances present in the saliva into the plant vascular system, causing phytotoxicity, reducing crude proteins, fatty acids, and minerals, which, consequently, results in plant nutritional deficiency (Caetano *et al*., 1987). In addition, the continuous sap-sucking by the insects also causes clogging of the conducting vessels in the plants due to hypertrophy while the phloem cells reached by the stylet become disorganized and granulated (Hibbs *et al*., 1964; Nielsen *et al*., 1999). The physic nut plants infested with the sap-sucking leafhoppers become yellow while the leaves exhibit a slight curvature at the edges, as well as shriveling (Oliveira *et al*., 2010). Some species can transmit virus to other cultures (Haque and Parasram, 1973).

It is known that climatic factors such as rainfall and temperature have crucial importance in the population density of species, either in local or global scale. Be aware of the annual variations in population density of insect pests due to those variations is critical to make an effective decision-making and control in the Integrated Pest Management (IPM). Therefore, this study aims at evaluating the population dynamics of *Empoasca* sp. over time and seeking a possible correlation with the weather parameters in Dourados, Mato Grosso do Sul, Brazil.

MATERIALS AND METHODS

The study was conducted in a 12-ha area planted with physic nut with 3.0 × 2.0-m spacing in Dourados, with a sample area of 2.0 ha (22°05' S, 55°18' W; 484 m) in Mato Grosso do Sul, Brazil. According to Köppen (1948), the climate is Cwa (humid mesothermal), with rainy summers and dry winters, annual average rainfall of 1500 mm and a mean annual temperature of 22 °C. The daily records of maximum, minimum, and average temperatures (°C) and rainfall (mm) during the studied period were obtained from the data base of the weather station of Embrapa Agropecuária Oeste, in Dourados.

The study lasted from March 2011 to June 2012. Monthly, 40 yellow sticky traps were placed on 40 plants (one per plant), randomly selected within the area. Plants were about four years old. Sticky traps of dimensions 24.5 × 10 cm were tied to the plants at a height of approximately 1.5 m above the ground, following the methodology described by Miranda *et al*. (2009) and Oliveira *et al*. (2010) and for adult Cicadellidae sampling.

During the studied period, the traps remained in the field for a period of 15 days each month (approximate duration of nymphal stage of the insect) (Boiça Júnior *et al*., 2000). After this period, the traps were removed and kept in cold storage at 5 °C until the insects were manually counted under a stereoscopic microscope.

The possible influence of maximum, minimum, and average temperature and rainfall on the population density and seasonality of *Empoasca* sp. was evaluated by simple correlation index using the statistical program R (R Development Core Team, 2011).

RESULTS

A total of 201606 adult *Empoasca* sp. were captured in the area planted with physic nut during the 17-month study period, which corresponded to an average of 296.5 leafhoppers/trap/month. The highest individuals per trap averages were recorded in May 2011 (975), February

2012 (831), and April 2012 (1155) (Fig. 1a). Although leafhoppers were found every month of the study period, the number decreased between June and December (Table 1).

The results of this study showed no correlation between population dynamics and minimum, average, or maximum temperatures (Table 1). However, population decreased

Table 1. Correlation coefficient and probability between weather parameters and *Empoasca* sp. adult population in the physic nut crop, in Dourados, Brazil, from March 2011 to July 2012.

Climatic Factors	Correlation Coefficient	**Probability (*p*)**
Rainfall (mm)	r = -0.0012	*p* = 0.3515
Minimum temperature (°C)	r = 0.0496	*p* = 0.6667
Average temperature (°C)	r = -0.0412	*p* = 0.8754
Maximum temperature (°C)	r = -0.1127	*p* = 0.8502

*Significant correlation at $p < 0.05$.

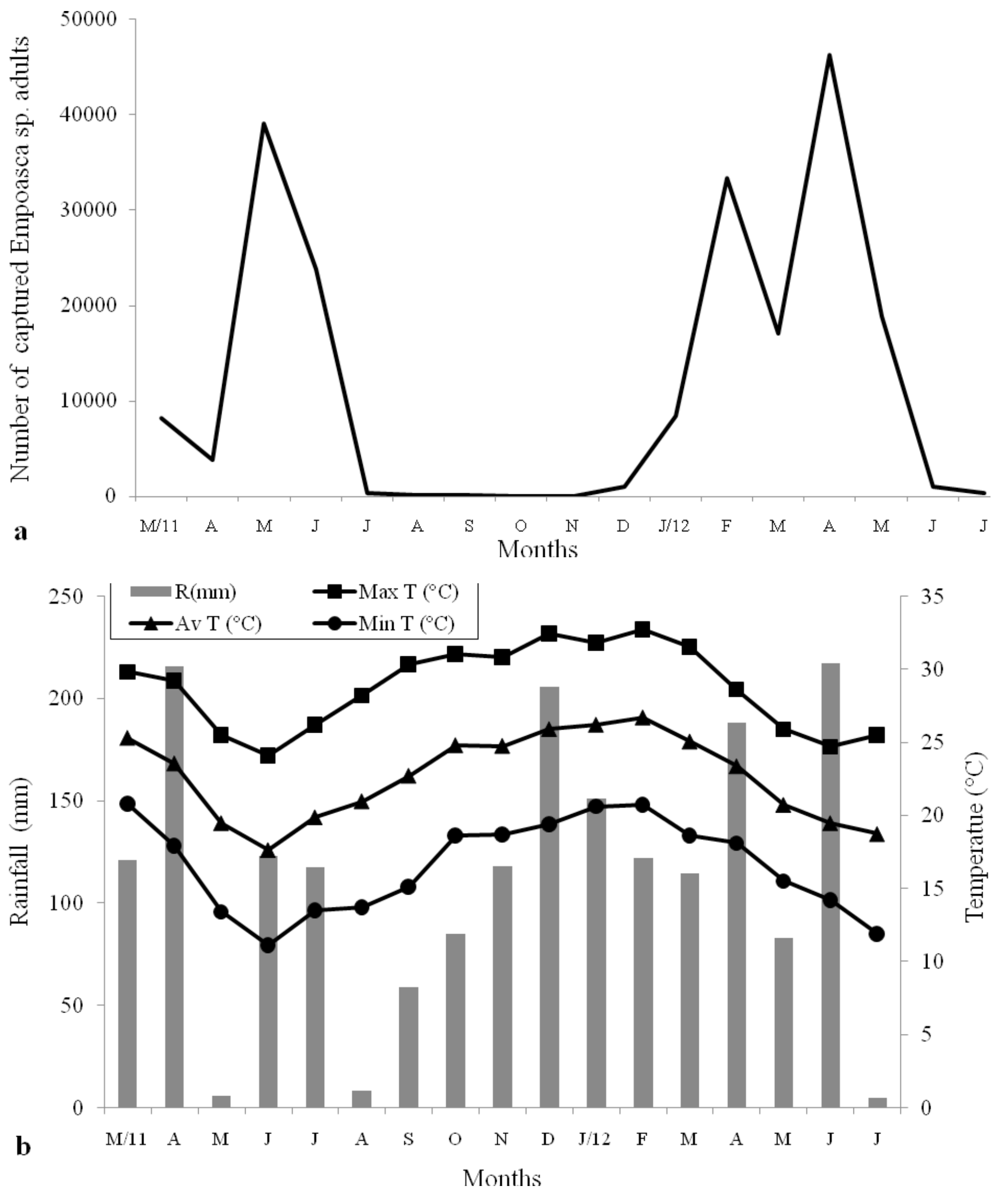

Figure 1. a. Adult *Empoasca* sp. population dynamics and b. maximum, minimum and average temperatures and rainfall recorded from March 2011 to July 2012 in a physic nut crop in Dourados region, MS, Brazil.

sharply from the beginning of the dry season, when the temperatures were the lowest (Fig. 1).

DISCUSSION

The population of *Empoasca* sp. increased significantly from April to May 2011, exhibiting a 10-fold increase in the number of adults in just one month. This sharp increase in the number of individuals coincided with the end of vegetative growth and early plant dormancy, when winter begins and the leaves fall completely. After this peak, the leafhopper population decreased sharply, probably due to leaf fall, and soon after complete defoliation, the insect population became low until the population growth resumed in January 2012 (Fig. 1a). In 2012, the population peaked between February and May, similar to the findings reported by Oliveira *et al*. (2010). However, the mean values found in the present study were 12 times higher than those observed by Oliveira *et al*. (2010) (706 against 59 individuals per trap), considering that the traps were in place for the same period. This difference could probably be due to plant developmental stage, since Oliveira *et al*. (2010) started with 1½-year-old plants, whereas, in the present study, the plants were almost four years old with more and larger leaves.

The low incidence of *Empoasca* sp. at the time of fall, when the plant is bare, could be due to the fact that most leafhoppers species feed preferably on these structures (Borror and Delong, 2011).

Santa-Cecilia *et al*. (2001) sampled leafhoppers in a coffee culture in Minas Gerais and reported that insect population started growing in October, unlike the present study. Moreover, the insect population started to decrease a little later. Probably the fact that the coffee does not lose its leaves during the dry season contributed to the early population increase and late population decline in comparison with the physic nut crop.

In another study, Yamamoto *et al*. (2002) observed the fluctuation of 14 species of Cicadellidae population in citrus crops in São Paulo. These authors recorded low population levels of these insects between January and mid-March, with no growth or declining trend, unlike the results of the present study, where population growth started in January. This difference is probably because the citrus seedlings used in the study by Yamamoto *et al*. (2002) were in the final stages of production during this period and possibly less attractive to the leafhoppers due to the pruning of seedlings. Nevertheless, both studies presented similar results regarding population decline period, which occurred early in the dry season, in May.

Although low temperatures do not affect directly the incidence of *Empoasca* sp., they interfere with the development of physic nut, causing the leaves to drop and consequently resulting in lack of food, as reported by Oliveira *et al*. (2010).

Likewise, leafhopper population densities were not influenced by either temperature or rainfall (Table 1). However, rainfall contributed to the recurrence of vegetative plant growth and provided abundant food resources for the leafhoppers (Fig. 1b).

From the second year after planting, the fruits of physic nut ripen and are harvested between December and July, in the Brazilian Midwest (Roscoe and Silva, 2007), coinciding with the population peak of *Empoasca* sp. observed in the present study. As a result, it is possible that the green leafhopper hinders the production of physic nut fruits in Mato Grosso do Sul. If the adult population peak occurs in February (as observed in this study, in 2012), the onset of economic damage might ensue from January (when large numbers of nymphs were seen on the leaves).

Thus, further studies on the occurrence and population dynamics of *Empoasca* sp. in this region as well as in other locations in Brazil, covering longer periods of data collection, are required for further and more detailed analysis of this insect population dynamics. The results may contribute to determine the extent of the economic losses brought by the green leafhopper to physic nut plantation and help define control strategies.

CONCLUSIONS

Empoasca sp. exhibited two population peaks, one between May and June 2011 and the other between February and May 2012. There was no correlation between the green leafhopper population density and maximum, average and minimum temperatures or rainfall throughout the study period.

ACKNOWLEDGMENTS

The authors are grateful to CAPES for granting the Masters scholarship, FINEP and FUNDECT for funding the research, and Embrapa Agropecuária Oeste for providing the infrastructure.

REFERENCES

Arruda FP, Beltrão NEM, Andrade AP, Pereira WE, Severino LS. Cultivo de pinhão manso (*Jatropha curcas* L.) como alternativa para o semiárido Nordestino. Rev Bras Oleag Fibrosas. 2004;8(1):789-799.

Berry EW. An eogene tropical forest in the Peruvian desert. Proc Natl Acad Sci USA. 1929;15(4):345–346.

Boiça Júnior Al, Muçouçah MJ, Santos TM, Baumgartner JG. Efeito de cultivares de fejoeiro, adubação e inseticidas sobre *Empoasca kraemeri* Ross & Moore, 1957 e *Bemicia tabaci* (Gennadius, 1889). Acta Sci Agron. 2000;22(4):955-961. Doi:10.4025/actasciagron.v22i0.2855

Borror DJ, Delong D. Introdução ao estudo dos insetos. 7 ed. Rio de Janeiro: Cengage Learning; 2011. p. 311.

Caetano W, Bertoldo N, Carlessi LR, Heineck MA, Eick VL. Teste de inseticidas no controle da cigarrinha verde *Empoasca kraemeri* (Ross & Moore, 1957) (Homoptera, Cicadellidae) na cultura do feijoeiro. Agron Sulriograndense. 1987;23(1):103-108.

Carnielli F. O combustível do futuro [Internet]. Boletim da Universidade Federal de Minas Gerais; 2003. Available from: https://www.ufmg.br/boletim/bol1413/quarta.shtml

Carvalho BCL, Oliveira EAS, Leite VM, Dourado VV. Informações técnicas sobre o cultivo do pinhão-manso no Estado da Bahia. 1 ed. Salvador: EBDA; 2009. 79 p.

Costa JNM, Pereira FS, Rocha RB, Santos AR, Teixeira CAD. Cigarrinha-verde *Empoasca* sp. (Hemiptera: Cicadellidae) em pinhão-manso no Município de Porto Velho, Rondônia [CD-ROM]. Brasília: Embrapa; 2011.

Dias LAS. Biofuel plant species and the contribution of genetic improvement. Crop Breed Appl Biotechnol. 2011;11(S1):16-26. Doi: 10.1590/S1984-70332011000500004

Divakara BN, Upadhyaya HD, Wani SP, Gowda CLL. Biology and genetic improvement of *Jatropha curcas* L.: a review. Appl Energy. 2010;87(3):732-742. Doi:10.1016/j.apenergy.2009.07.013

Haque SQ, Parasram S. *Empoasca stevensi*, a new vector of bunchy top disease of papaya. Plant Dis Rep. 1973;57(5):412-423.

Hibbs ET, Dahlman DL, Rice RL. Potato foliage sugar concentration in relation to infestation by the potato leafhopper, *Empoasca fabae* (Homoptera: Cicadelidae). Ann Entomol Soc Am. 1964;57(5):233–244. Doi:10.1093/aesa/57.5.517

Islam AKMA, Yaakob Z, Anuar M. *Jatropha*: A multipurpose plant with considerable potential for the tropics. Sci Res Essays. 2011;9(13):2597-2605. Doi:10.5897/SRE10.611

Köppen W, editor. Climatologia com um estúdio de los climas de la tierra. Fondo de Cultura Economica; 1948. p. 168-171.

Lamp WO, Nielsen GR, Danielson SD. Paterns among host plants of potato leafhopper, *Empoasca fabae* (Homoptera: Cicadellidae). J Kans Entomol Soc. 1994;67(4):354-378.

Ministério de Minas e Energia. Boletim mensal dos combustíveis fósseis n°85. Departamento de Combustíveis Renováveis; Brasília: Secretaria de Petróleo, Gás Natural e Combustíveis Renováveis; 2015. p. 1-6.

Miranda MP, Lopes JRS, Nascimento AS, Santos JL, Cavichioli RR. Levantamento populacional de cigarrinhas (Hemiptera: Cicadellidae) associadas à transmissão de *Xylella fastidiosa* em pomares cítricos do litoral norte da Bahia. Neotrop Entomol. 2009;38(6):827-833. Doi:10.1590/S1519-566X2009000600017

Naseri B, Fathipour Y, Talebi AA. Population density and spatial distribution pattern of Empoasca decipiens (Hemiptera: Cicadellidae) on different bean species. J Agric Sci Technol. 2009;11(3):239-248.

Nielsen GR, Fuentes C, Quebedeaux B, Wang Z, Lamp WO. Alfalfa physiological response to potato leafhopper injury depends on leafhopper and alfalfa developmental stage. Entomol Exp Appl. 1999;90(3):247-255. Doi:10.1023/A:1026406920507

Oliveira HN, Silva CJ, Abot AR, Araújo DI. Cigarrita verde em cultivos de *Jatropha curcas* en el Estado de Mato Grosso do Sul, Brasil. Rev Colomb Entomol. 2010;36(1):52-53.

R Development Core Team. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria; 2011. Available from: http://www.R-project.org/

Roscoe R, Silva CJ. Pinhão-manso não faz milagres, mas é boa opção para o biodiesel. Agrianual 2008: Anuário da agricultura brasileira; 2007. p. 43-45.

Santa-Cecilia LV, Gonçalves-Gervásio RCR, Souza B, Torres AF, Reis PR, Souza JC. Flutuação populacional e análise faunística de cigarrinhas que ocorrem em cafeeiros no Sul do Estado de Minas Gerais. In: Simpósio Brasileiro de Pesquisa dos Cafés do Brasil, 2, 2001, Vitória. Vitória: Anais, Embrapa Café; 2001. p. 1951-1955.

Saturnino HM, Pacheco DD, Kakida J, Tominaga N, Gonçalves T. Cultura do pinhão-manso (*Jatropha curcas* L.). Informe Agropecuário. 2005,26(229):44-78.

Silva PHS, Castro MJP, Araújo ECA. Tripes (Insecta: Tripidae) associados ao pinhão-manso no Estado do Piauí, Brasil. Rev Bras Ol Fibros. 2008;12(3):125-127.

Suganthy M. Field screening of promising castor cultures against capsule borer, *Conogethes punctiferalis* and leafhopper, *Empoasca flavescens*. Madras Agric J. 2011;98(4-6):178-179.

Tapanes NC, Aranda DAG, Perez RS, Cruz YR. Biodiesel no Brasil: matérias primas e tecnologias de produção. Acta Sci Tech. 2013;1(1):119-125.

Yamamoto PT, Roberto SR, Pria Junior WD, Felippe MR, Freitas EP. Espécies e flutuação populacional de cigarrinhas em viveiro de citros no Município de Mogi-Guaçu, SP. Rev Bras Frutic. 2002;24(2):389-394. Doi:10.1590/S0100-29452002000200023