

Phenology of *Apion oedorhynchum* LeConte, 1858 and the Attack on Seed of *Dalbergia palo-escrito*

Ricardo Guevara-Herrera¹, Pedro García-Ramírez², Santos Pérez Olivares¹, Cirenio Velasco Castillo¹, Cesar Jimenez Pelcastre¹, Raul Valentin Islas¹, and Sandra Iliana Torres Herrera³

1. Technological University of the Sierra Hidalguense, Mexico

2. Geographic Research and Solutions for the Environment, Mexico

3. Faculty of Forest Sciences, Durango State Juárez University, México

Abstract: *Dalbergia palo-escrito* presents reproduction problems when attacked by insects. In the present study was to evaluate the phenological stage of *Apion oedorhynchum* LeConte, 1858 that attacks the seed of *Dalbergia palo-escrito* in the locality of Coatitlamixtla, Xochicoatlán, Hidalgo de Soto, Mexico. Sixteen trees were selected with diameters from 6 cm to 18 cm and heights from 3 m to 17 m, within the altitudinal gradient (High, Medium and Low), these were marked with spray paints and numerical keys were added. The phenological stage of *Dalbergia palo-escrito* was monitored from the beginning of flowering to pod maturity. A total of 34 pods were collected. The life cycle of *Apion oedorhynchum* LeConte, 1858 in the pod of *Dalbergia palo-escrito* 3 months from egg laying to the adult stage.

Key words: phenological stage, *Apion oedorhynchum* LeConte, *Dalbergia palo-escrito*

1. Introduction

Dalbergia palo-escrito, a species endemic to a short segment of the Sierra Madre Oriental, is distributed in mesophyll mountain forest in the states of Hidalgo, Querétaro and San Luis Potosí [1]. Mexican populations of the *Dalbergia* genus are being affected by overexploitation, illegal trafficking, deforestation and fragmentation of their habitats [2]. In Mexico, *Dalbergia* species is traditionally used to make furniture, musical instruments and handicrafts [3]. *Dalbergia palo-escrito* has been reported to present serious reproductive problems, being attacked by pathogenic fungi [4-6]. One of the most important pests that attack seeds is the weevil of the family Brentidae, subfamily Apioninae [7], but the insect species that attack at the seed development stage is unknown.

Larvae of this subfamily Apioninae develop in the pericarp of fruits or seeds [8] of Fabaceae, Euphorbiaceae and other dicotyledons [9]. However, there are no studies reporting that *Dalbergia palo-escrito* is attacked by *Apion oedorhynchum* species LeConte, 1858 [7], suggests, that seeds of some *Dalbergia* genus, must be properly handled otherwise it considerably reduces their viability. Due to the scarce studies carried out to contribute to the solution of the problem, the present study was to evaluate the phenological stage of *Apion oedorhynchum* LeConte, 1858 that attacks the seed of *Dalbergia palo-escrito* in the locality of Coatitlamixtla, Xochicoatlán, Hidalgo de Soto.

2. Material and Methods

2.1 Study Area

The study was conducted in the property of the community of Coatitlamixtla, Xochicoatlán, Hidalgo

Corresponding author: Pedro García-Ramírez, Doctor; research areas/interests: species distribution, forest resources, and forest pests and diseases. E-mail: garp820203@gmail.com.

de Soto, Mexico (Fig. 1). The climate present is temperate humid (C(m)), with mean annual temperature between 12°C and 18°C, temperature of the coldest month between -3°C and 18°C and temperature of the hottest month below 22°C [10]. The

vegetation types present are mountain mesophilic forests and annual rainfed agriculture [11]. The altitudes above sea level at the sampling sites are from 1,290 meters to 1,303 meters [12].

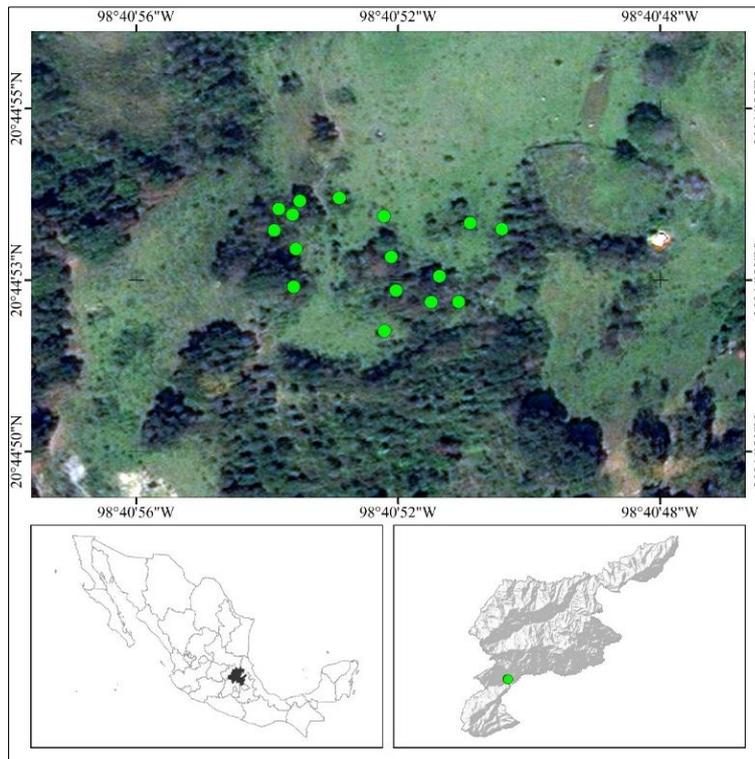


Fig. 1 Location of trees in the study area.

2.2 Sampling

A directed sampling was carried out. Sixteen trees were selected with minimum diameters of 6 cm to 18 cm and heights from 3 m to 17 m, within the altitudinal

gradient (High, Medium and Low), these were marked with spray paints and numerical keys were added (Fig. 2).



Fig. 2 (a) Numerical marking and (b) low altitudinal tree marking.

2.3 Monitoring

The phenological stage of *Dalbergia palo-escrito* was monitored from the beginning of flowering (February) to pod maturity (July), a branch was selected in the four latitudinal sectors: north, east, south and west; and the presence or absence of the insect during seed development was recorded (Table 1).

2.4 Collection

We manually collected 3 to 5 pods per monitoring, with a total of 34 pods, from March 20 to July 17, 2017 (Table 2) and placed in paper bag, labelled with tree numbering and geographic location. They were then transferred to the environmental laboratory of the Universidad Tecnológica de la Sierra Hidalguense

(UTSH) to analyze and discard orifice in the pods. Once analyzed, a longitudinal cut was made to evaluate under the stereoscopic microscope, the state of the seed and determine the development and state (larva, pupa, adult insect) of the insect. Subsequently, some photographs were taken as evidence.

Table 1 Distribution of monitoring from February to July 2017.

Year	Months	Days	Elapsed time	Monitoring
2017	February	06 y 13	7	2
		20 y 27	7	2
2017	March	06 y 20	14	2
2017	April	03 y 25	22	2
2017	May	08 y 22	14	2
2017	June	07 y 13	6	2
2017	July	17	34	1

Table 2 Pod collection record in *Dalbergia palo-escrito* trees.

Tree	Tree Section	Flower	Pod	20 March	3 April	25 April	8 May	22 May	7 June	13 June	17 July	Total of pods
1	B	p	p	1	1	1	1	1	1	2		8
2	M	p	p								1	1
3	B	p	s/p									
4	M	p	s/p									
5	A	p	s/p									
6	B	p	p	2	1	2	1	1	2	1		10
7	B	p	s/p									
8	M	p	s/p									
9	B	p	p	2	1	2	1	1	2	2	1	12
10	M	p	s/p									
11	A	p	s/p									
12	B	p	s/p									
13	B	p	s/p									
14	B	p	s/p									
15	M	p	s/p									
16	A	p	p								3	3

Where Sec. = Section, B = Low, M = Medium, A = High, p = presence and s/p = no presence.

Once the stage and development of the insect had been identified, they were placed in flasks and then transferred to a Petri dish to be sent to the National Center for Risk Evaluation and Phytosanitary Alert (CNERyAF), located in Ciudad Guzmán, Jalisco, Mexico, for taxonomic identification.

2.5 National Center for Risk Evaluation and Phytosanitary Alert

At the CNERyAF, insect specimens were checked in Petri dishes containing 70% alcohol to avoid over-drying the insect so that they would not break, and

only a few were checked dry to observe the coloration of the mushrooms. The taxonomic keys of Refs. [13] and [14] were used. Reagents such as 10% potassium hydroxide (KOH) for genitalia extraction and 10% acidified water were prepared. The mounts were made in glycerin to be able to manipulate the movement of the structures and to observe them in different positions. The determination of the insects was complicated mainly due to the lack of knowledge of many species of the subfamily and the difficult distinction between genera, where many times the species have been grouped according to their close kinship.

3. Results and Discussion

The flowering period of *Dalbergia palo-escrito* was from February 27 to March 06, 2017, however, by March 06, trees were found with pods present (Fig. 3b).

Of the 5 pods collected in the trees (one, six and nine) on March 20, 2017, insect hosts were found in larval stage, on the other hand, no embryo development stages were found inside the pods (Fig. 4).

The pods collected from tree one, six and nine, on April 03 and 25, 2017, hosts of the insect were found in larval stage (Fig. 5a) [1], reported the flowering of *Dalbergia palo-escrito* in the months of February and April, unlike this study, for the month of April, the trees sampled were found with formed pods.



Fig. 3 (a) Flowering and (b) developing pods of *Dalbergia palo-escrito*.

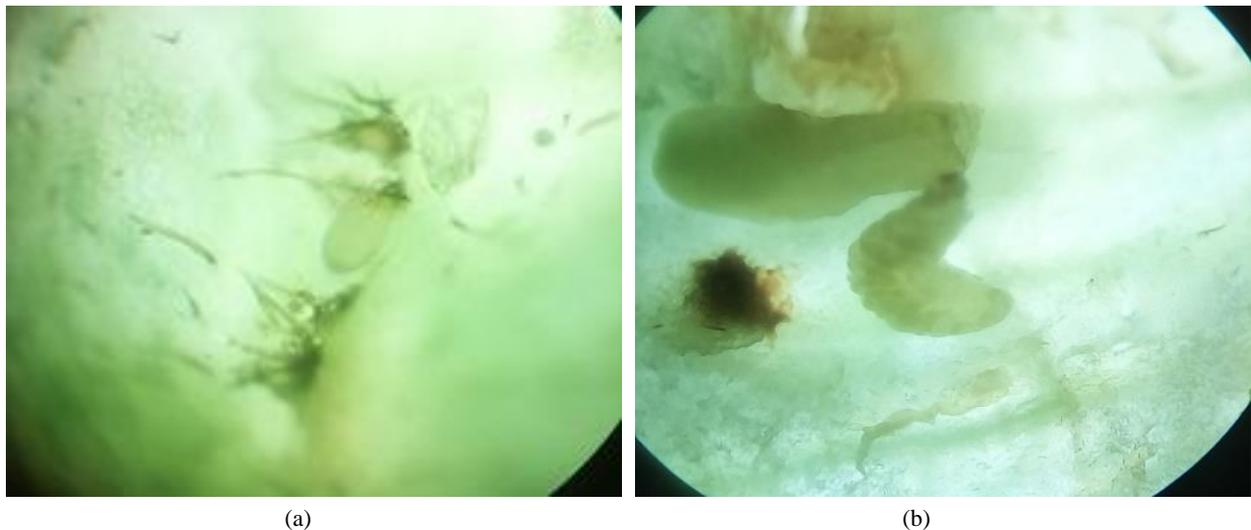


Fig. 4 (a) Small eggs and (b) larvae of insects in pods of *Dalbergia palo-escrito*.



Fig. 5 (a) Larval stage and (b) pupa of insects in pods of *Dalbergia palo-escrito*.



Fig. 6 *Apion oedorhynchum* LeConte 1858 in adult stage in pod of *Dalbergia palo-escrito*.

In the pod collections of May 08 and 22, 2017, the insect was observed in pupal stage, it is worth mentioning that the development was observed with the naked eye, inside the environmental laboratory of the UTSH (Fig. 5b).

The results showed that, for day 07, June 13 and July 17, 2017, of the 15 collected pods of *Dalgerbia palo-escrito*, none presented developed seeds, however, in this period, the adult stage development of the insect was found.

Taxonomic identification of Apion oedorhynchum LeConte 1858 at the CNERyAF

Derived from the detailed analysis and with the support of laboratory information, it was obtained that

according to Bouchard et al. (2011) [15] and using the keys of Curculionidae subfamily Apioninae of North and Central America (1968) [14]. Curculionidae subfamily Apioninae of North and Central America. Taxonomic Publications, South Lancaster, Massachusetts, the following taxonomic classification was obtained.

- Family: Brentidae
- Subfamily: Apioninae
- Supertribe: Apionitae
- Tribe: Apionini
- Subtribe: Apionina
- Genus: Apion
- Species: *Apion oedorhynchum* LeConte, 1858

Kissinger G. D. (1989) [14] mentions that this species hibernates on epiphytic plants of oak close to fields of cicadas, however, during the collection no agricultural crops were observed and the damage is direct on the seed of palo escrito (*Dalbergia palo-escrito*).

Seed predation of *Dalbergia palo-escrito* is by beetles, high levels of seed abortion have been recorded in some species, which has an impact on low recruitment in natural populations [16].

Studies on pollination and other biotic interactions are scarce, there is no demographic information and the conservation status of *Dalbergia palo-escrito* populations is unknown.

4. Conclusion

According to the selected trees of *Dalbergia palo-escrito* in the community of Coatitlamixtla, Xochicoatlán, Hgo. to determine the phenology of *Apion oedorhynchum* LeConte, 1858 and to specify the cycle that passes in larval stage to later emerge in adult stage. It was determined that *Apion oedorhynchum* LeConte, 1858 synchronizes its life cycle according to the fruiting stage of *Dalbergia palo-escrito*.

Apion oedorhynchum LeConte, 1858 lives on plants adjacent to *Dalbergia palo-escrito*, once it begins to flower, the female makes a hole in the tender tissue of the pod, near the developing seed where she deposits one to two eggs, giving rise to an inconspicuous protuberance. When the larvae hatch, they penetrate to the seed and feed on it. The *Dalbergia palo-escrito* pod is monosperm and serves the larva as an incubator. Once the larva devours the seed, it remains at rest until it becomes a pupa and then an adult insect.

Therefore, the life cycle of *Apion oedorhynchum* LeConte, 1858 in the pod of *Dalbergia palo-escrito* is 3 months from egg laying to its adult stage, at the end of its metamorphosis it emerges from the pod and flies to surrounding plants and waits 9 months until the new flowering of *Dalbergia palo-escrito*.

References

- [1] J. Rzedowski and L. I. Guridi-Gomez, El palo escrito, árbol de madera preciosa-una nueva especie mexicana de *Dalbergia* (Leguminosae, Papilionoideae), *Acta Botanica Mexicana* (4) (1988) 1-8.
- [2] M. Gual-Díaz and A. Rendón-Correa, *Bosques mesófilos de montaña de México: diversidad, ecología y manejo*, México D.F.: Comisión Nacional para el Conocimiento y Uso de la Biodiversidad, 2014.
- [3] A. Cervantes, J. Linares and E. Quintero, An updated checklist of the Mexican species of *Dalbergia* (Leguminosae) to aid in its conservation efforts, *Revista Mexicana de Biodiversidad* 90 (2019).
- [4] E. L. Webb and S. Y. Hossain, *Dalbergia* sissoo mortality in Bangladesh plantations: correlations with environmental and management parameters, *Forest Ecology and Management* 206 (2004) (1-3).
- [5] A. Shukla, Resistance of *Dalbergia sissoo* to *Fusarium solani* f. sp. *dalbergiae*, *Forest Pathology* 38 (2008) (6) 410-418.
- [6] A. Kumar, R. Luna, A. Bhatt and S. Dobhal, Genotypic X environmental interactions and growth performance in different clones of *Dalbergia sissoo* (Roxb.), in: *Memory XIII World Forestry Congress*, 18-23 Oct. 2009.
- [7] B. Knoblauch, Estudio ecológico, silvícola y de utilización del Granadillo, in: *Dalbergia tucurensis* J. D. Smith, *bosques latifoliados de Honduras*, El Zamorano, Honduras, 2001, p. 44.
- [8] M. A. Alonso-Zarazaga, *Apionidae* (Coleoptera). *Biodiversidad, taxonomía y biogeografía de artrópodos de México: hacia una síntesis de su conocimiento*, Vol. 4, 2004, pp. 691-699.
- [9] J. J. Morrone, Biodiversidad de Curculionioidea (Coleoptera) en México, *Revista mexicana de biodiversidad* 85 (2014) 312-324.
- [10] Instituto Nacional de Estadística y Geografía (INEGI), Conjunto de Datos Vectoriales del Continuo Nacional de Efectos Climáticos Regionales escala 1: 250 000, en formato digital, México, 2019.
- [11] Instituto Nacional de Estadística y Geografía (INEGI). Guía para la interpretación de cartografía: uso del suelo y vegetación: escala 1:250, 000: serie VI, Instituto Nacional de Estadística y Geografía. México, 2014, p. 204.
- [12] Instituto Nacional de Estadística y Geografía (INEGI), Continuo de Elevaciones Mexicano 3.0, available online at: <https://www.inegi.org.mx/temas/relieve/continental/#Map> a (20 de mayo de 2021)
- [13] R. Jr. Arnett, M. Thomas, J. Frank and P. Skelleyand, *American Beetles, Volume II: Polyphaga: Scarabaeoidea through Curculionioidea*, CRC Press LLC, Boca Raton, 2002.

- [14] G. D. Kissinger, Apionidae from North and Central America, Part 1: Notes on the classification of the Apion subgenus Trichapion Wagner with description of new species from the United States of America (Coleoptera), *Insecta Mundi*. (1989) 271-287.
- [15] P. Y. B. A. E. D. Bouchard, M. A. Alonzo-Zarazaga, C. H., A. F., N. Lyal and A. B. Smith et al., Family-group names in Coleoptera (Insecta), *Zookeys* 88 (2011) 1-972.
- [16] A. Cervantes Maldonado, La conservación del granadillo en México: una carrera contra el tiempo, *CONABIO. Biodiversitas* 128 (2016) 6-11.