

## Research Note

# Insect pests of *Theobroma cacao* (Malvaceae) in the Peruvian Amazon

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Cocoa (*Theobroma cacao* L) has become one of the main crops in Peru. Insect pests cause substantial reduction in cocoa production in the Peruvian Amazon. This study sampled for the presence of insect pests over 6 years; 31 species were observed, seven of these were most abundant: *Xylosandrus compactus*, *Cyclocephala putrida*, *Carmenta foraseminis*, *Horiola picta*, *Toxoptera aurantii*, *Steirastoma breve*, *Dysmicoccus brevipes*, and two were new reported pests: *Cyclocephala putrida* and *Tetrataenia surinama*.

**Keywords:** Cocoa, pests, inventory, agroforestry, flooding

Cocoa (*Theobroma cacao* L) has become one of the main crops in Peru. In the last 10 years cocoa production increased at an average annual rate of 15.6%; in 2018 the production was 135,300 t (Ministerio de Agricultura y Riego del Gobierno Peruana-MINAGRI 2019). The plant is attacked by insect pests at all stages of growth, some of which have posed serious problems. For example *Carmenta foraseminis* Eichlin (Lepidoptera: Sesiidae) infests green and half-ripened fruits, damaging up to 62% of the cobs (Delgado et al. 2017) and *Xylosandrus compactus* Eichhoff (Coleoptera: Curculionidae) infests up to 42% of nursery plants (Delgado and Couturier 2017). The objective of this study was to provide a list of insects pests of cocoa in the Peruvian Amazon, which due to their presence, need continuous monitoring.

## Materials and methods

The study was carried out from 2012 to 2018 in 32 cocoa plot size of 1 – 1.5 ha in the Peruvian Amazon at altitudes ranging from 64 – 1150 m above sea level. Intensive sampling was conducted in monocrop plantations,

plantations in agroforestry systems arranged for cultivation and traditional systems. Most plots were in non-flooded soils, with a small number in soils submerged underwater for 4 - 5 months every year. Insects observed on the structures of plant organs were collected manually using entomological nets. Immature insects were taken to the entomology laboratory of the Research Institute of the Peruvian Amazon to be reared to adults for identification.

## Results and discussion

The study recorded 31 most frequently occurring species of insects in cocoa plantations: five Coleoptera, five Hemiptera, 11 Homoptera, two Hymenoptera, seven Lepidoptera, and one Orthoptera (Table 1). The seven most abundant insect species recorded in the survey were: *Xylosandrus compactus*, *Steirastoma breve* Sulzer (Coleoptera: Cerambycidae), *Cyclocephala putrida* Burmeister (Coleoptera: Scarabaeidae), *Carmenta foraseminis*, *Horiola picta* (Coquebert) (Homoptera: Membracidae), *Toxoptera aurantii* (Boyer) (Homoptera:

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Aphididae) and *Dysmicoccus brevipes* (Cockerell) (Homoptera: Pseudococcidae). A number of reported insects are described as classic cocoa pests (Mendes et al. 1988; Babin 2018; Bagny et al. 2018), some in Peru (Castillo 2013); while other species for example *X. compactus* and *C. Foraseminis*,

were recently described as cocoa pests in Peru (Delgado and Couturier 2017; Delgado et al. 2017). Both *C. putrida* and *Tetrataenia surinama* (Linnaeus) (Orthoptera: Acrididae) were first reported as pests associated with this crop.

Table 1. List of the most frequent insect pests of cocoa crops in the Peruvian Amazonia

Order: family/ species	Affected part	Order: family/ species	Affected part
Coleoptera: Cerambycidae		Homoptera: Coccidae	
<i>Steirastoma breve</i> Sulzer, 1776	S	<i>Saissetia oleae</i> (Olivier, 1791)	Fr, P
<i>Psapharochrus lateralis</i> Bates, 1861	S	Homoptera: Membracidae	
Coleoptera: Curculionidae		<i>Horiola picta</i> (Coquebert, 1801)	Fr, P
<i>Xylosandrus compactus</i> Eichhoff, 1875	S	<i>Cyphonia clavata</i> (Fabricius, 1787)	Fr, P
<i>Conotrachelus humeropictus</i> Fiedler, 1940	Fr, Se	<i>Bolbonota globosa</i> Fairmaire, 1846	Fr, P
Coleoptera: Scarabaeidae		Homoptera: Pseudococcidae	
<i>Cyclocephala putrida</i> Burmeister, 1847	S, R	<i>Dysmicoccus brevipes</i> (Cockerell, 1893)	S, R, Fr, P
Hemiptera: Berytidae		<i>Dysmicoccus neobrevipes</i> (Beardsley, 1859)	S, R, Fr, P
<i>Parajalysus andinus</i> Horvath, 1905	L	Hymenoptera: Formicidae	
Hemiptera: Coreidae		<i>Atta cephalotes</i> (Linnaeus, 1758)	L
<i>Zoreva</i> sp	Fr	<i>Atta sexdens</i> (Linnaeus, 1758)	L
Hemiptera: Miridae		Lepidoptera Geometridae	
<i>Monalonion dissimulatum</i> Distant, 1883	Fr	<i>Oxydia</i> sp	L
Hemiptera: Pentatomidae		Lepidoptera: Limacodidae	
<i>Antiteuchus tripterus</i> Fabricius, 1787	S, Fr	<i>Sibine nesea</i> Stoll, 1781	L
<i>Antiteuchus</i> sp	S, Fr	<i>Sibine fusca</i> Stoll, 1781	L
Homoptera: Aleyrodidae		Lepidoptera: Sesiidae	
Unidentified	L	<i>Carmenta foraseminis</i> Eichlin, 1995	Fr, Se
Homoptera: Aetalionidae		<i>Carmenta theobromae</i> (Busck, 1910)	Fr
<i>Tropidaspis</i> sp	Fr, P	Lepidoptera: Stenomatidae	
Homoptera: Aphididae		<i>Anadasmus porinodes</i> Meyrick, 1915	Fr
<i>Toxoptera aurantii</i> (Boyer, 1841)	F	<i>Stenoma cecropia</i> Meyrick, 1916	L
<i>Aphis gossypii</i> Glover, 1877	F, L	Orthoptera: Acrididae	
Homoptera: Cercopidae		<i>Tetrataenia surinama</i> (Linnaeus, 1764)	L
<i>Clastoptera globosa</i> Fowler, 1897	F		

F: flower, Fr: fruit, L: leaf, P: peduncle, R: root, S: stem, Se: seed.

Several pest species were found in plots established in soils submerged underwater for 4-5 months. To survive underwater environments, these insects have developed strategies, which include simple flight migrations to the greenwood, as observed in hemiptera *Parajalysus andinus* Horvath (Hemiptera: Berytidae), *Monalonion dissimulatum* Distant (Hemiptera: Miridae); or

horizontal movement towards high areas following the flood level as observed in *Atta* spp. A more complex strategy consists of physiological modifications, as observed in the weevil of the camu camu fruit *Conotrachelus dubiae* O'Brien and Couturier (Delgado et al. 2014), a species of the same genus of cocoa fruit weevil, of the *Conotrachelus humeropictus* Fiedler.

## Major pests

*Xylosandrus compactus* (Eichhoff, 1875)  
(Coleoptera: Curculionidae)

This very small insect is known as the cocoa twig borer. It is 1.8 mm long, females are intense black and males are light brown. The female bores into the twig of the plant, where she establishes a gallery for breeding. From the entrance hole upwards the leaves dry out, infected twigs and stems die and break easily by the wind or a slight mechanical action. It was recently reported as a cocoa pest in the Peruvian Amazonia (Delgado and Couturier 2017). The greatest infestations occur in high humidity nurseries, infesting up to 47% of the seedlings. This pest is widespread throughout the Amazonia and is found in compacted and flooded soils.

*Cyclocephala putrida* Burmeister, 1847  
(Coleoptera: Scarabaeidae)

The adult *C. putrida* is a yellow to intense brown beetle approximately 1.30 cm in length. The eruciform larva is 2.5 cm long, white coloured with a brown head. The larva lives in soils to an average depth of 4.3 cm and feeds on roots, mainly of young plants. Larvae use production residues of plots or crop remnants to protect themselves from the sun. The main crop problems occur in nurseries. This insect has been reported in compacted and flooded soil. In flooded soil, plantations as much as 60 larvae/m<sup>2</sup> have been noted (authors observations).

*Steirastoma breve* Sulzer, 1776 (Coleoptera: Cerambycidae)

The adult ashy colour beetle ranges in size from 2.0 - 2.5 cm. The last-instar larva is slightly larger than the adult, creamy-white coloured with brown head. It feeds on the bark of stems and branches of the plants where it causes damage. Depending on the location of the damage, it can kill the plant; otherwise, it

can weaken the branches and stems, making them susceptible to getting torn in windy conditions or leaving them exposed to microorganisms. *S. breve* is widely distributed throughout Peruvian Amazonia. Its presence in flooded soils has not been reported.

*Dysmicoccus brevipes* (Cockerell, 1893)  
(Homoptera: Pseudococcidae)

This parthenogenetic insect is known as the floury or pineapple mealybug. The adult female is 3 mm long. It is covered by white cotton-like secretions with same colour appendages around the body. The insect is sessile and feeds on the sap of the plant. They live in colonies in symbiotic association with the ant of the genus *Solenopsis*, which feeds on the sugary exudates (honeydew) secreted by the mealybug. In return, the ants transport the eggs and small insects to other locations and also provide protection of the colonies using dirt. It has been observed that the presence of the insect in fruits increases during flood seasons.

*Toxoptera aurantii* (Boyer de Fonscolombe, 1841) (Homoptera: Aphididae)

This small species is known as black citrus aphid. It is 1.1 - 2.0 mm long with an oval body, black or reddish brown coloured and transparent wings. It lives on the underside of the tender leaves, inflorescence and in the newly formed fruits, from which it extracts a large amount of sap. The leaves harden and slightly deform, small fruits fall off or grow with some difficulty. A high degree of damage to inflorescences results in them bending, deforming and finally drying out. Abundant honeydew is excreted, promoting the growth of sooty mold. Colonies in inflorescences can have 700 individuals, including nymphs and adults. It is widespread in the Amazonia and is found in compacted and flooded soils.

*Carmenta foraseminis* Eichlin, 1995  
(Lepidoptera: Sesiidae)

This pest, locally known as the cocoa pod borer, has great economic interest for the crop. This small butterfly is 1.78 - 1.98 cm long. Its body is black with yellow abdominal bands, delimiting each segment and a black scale tuft on the apical part of the male's abdomen. Transparent wings have black scales on the edges. The larva has a white to slightly yellowish body, with a visibly dark brown head which is somewhat narrower than the thorax. The larvae feed on fruit placenta, mucilage and seeds damaging green fruits aged 2 months or in maturing process or matured. CCN-51 and TSH-565 cocoa clones have the highest levels of infestation, reaching up to 62% (Delgado et al. 2017). The larvae entrance hole also favours the entrance of pathogens such as *Phytophthora* sp and *Monilia* sp. Since sunlight is weak in the plantation, due to a lack of cocoa tree pruning and there is an excess of trees shading the crops, the insect population has increased. This pest was found throughout the Peruvian Amazonia where cocoa is grown, at altitudes exceeding 360 m above sea level and was not reported in flooded soils. Delgado et al. (2017) and Fachin et al. (2019) studied the importance of environmental factors on population levels of this pest; according to Delgado et al. (2017), 62% of fruits were infested by *C. Foraseminis*.

*Horiola picta* (Coquebert, 1801) (Homoptera: Membracidae)

Adult insects range in size from 6 - 7 mm in length. They are brown and black with several white lines. They are abundant at the level of peduncle and young fruit, which makes it wither and dry. These insects are protected by a layer of dirt made by ants, in return *H. picta* produces honeydew that serves as food for ants. They were found in all areas visited, including compacted and flooded soils.

## Conclusion

Cocoa is a crop of great importance for Peru and is one of the most exported agricultural products. The crop has a diversity of insect pests, several of which cause significant losses to production. *C. foraseminis* deserves special attention, as this insect is distributed in all regions where cocoa is grown; the management of *C. foraseminis* should be focused on finding resistant clones, allowing entry of sunlight to the plantation, developing pruning management to eliminate infested fruits and providing education to producers.

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