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New Records of *Podontia quatuordecimpunctata* (L.) (Sineguelas Leaf Beetle) (Chrysomelidae: Galerucinae: Alticini) on *Spondias* spp. (Anacardiaceae) and Its Geographic Distribution in the Philippines

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***Podontia quatuordecimpunctata* (L.) or the "sineguelas" leaf beetle is reported from the Philippines. Red sineguelas (*Spondias purpurea* L.), golden apple or yellow sineguelas (*S. dulcis* Forst.), and hog plum or "libas" [*S. pinnata* (L.f.) Kurz.] are reported as host plants. However, feeding on *S. philippinensis* (Elm.) and *S. mombin* L. (hog plum are unverified. The current geographic distribution and pest status of *P. quatuordecimpunctata* are presented.**

Keywords: flea beetle, insect pest, leaf beetle, "sineguelas"

INTRODUCTION

Podontia quatuordecimpunctata (L.) 1767 has various common names: "ambara" defoliator (India), hog plum flea beetle (Bangladesh), "kedodong" beetle (Malaysia) or here as "sineguelas" leaf beetle (SLB); it is an introduced and economically important pest in the Philippines (Figures 1A and B). This is also the first record of the genus in the country. The pest is distributed in peninsular Malaysia, India, Nepal, Myanmar (Burma), Thailand, Laos, Cambodia, and Japan (Mohamedsaid 2004; Löbl and Smetana 2010; Minami *et al.* 2018). In Bangladesh, Hossain *et al*. (2004), Udin and Khan (2015), Rani *et al*. (2021), and Rahman *et al*. (2022) studied the pest.

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Unfortunately, the IBPGR (1986) misattributed the presence and the considerable damage inflicted by *Podontia 14-punctata* and *P. affinis* on the leaves of "ambarella" *S. dulcis* Forst. (syn. *S. cytherea* Sonn.) in Malaysia and Indonesia by citing Ochse and Bakhuizen van den Brink (1977) in his report. Further review revealed that there is no mention of the two insect pests on the paper. However, there is also considerable photo documentation posted on the iNaturalist (2022) website regarding the presence of *P. quatuordecimpunctata* in different parts of Indonesia, Borneo, and the Philippines. Scientists have apprehensions and appreciations of the accuracy of this web-based social media platform [Staines (2022), pers. comm.]. Also, Kalshoven (1981) reported *P. affinis* (Gröndal, 1808) in Indonesia, and Romantsov and Medvedev (2015) reported *P. flava* Baly, 1865 in

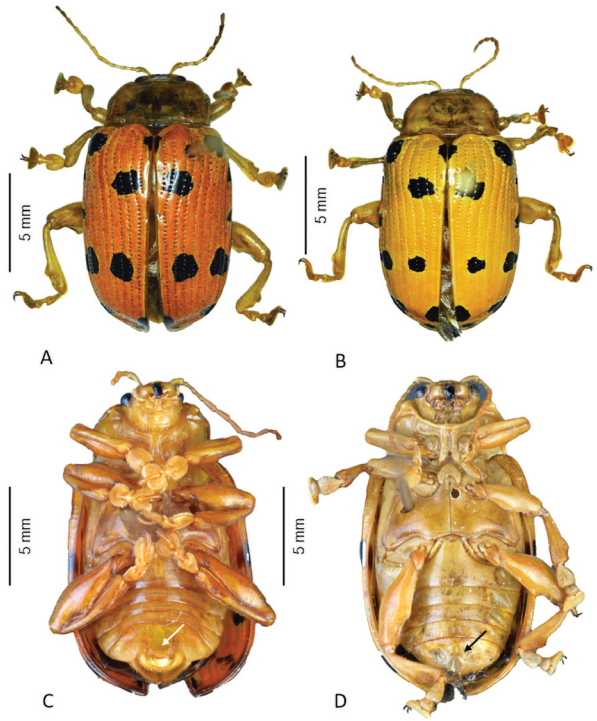


Figure 1. Sineguelas leaf beetle (SLB) (*Podontia quatuordecimpunctata* (L.), 1767); [A] habitus, dorsal aspect with orange elytra; [B] habitus, dorsal aspect, with yellow elytra; [C] habitus, ventral aspect of an adult male and showing the U-shaped genital opening; [D] habitus, ventral aspect of an adult female.

Borneo (Sarawak and Sabah) and *P. lutea* (Olivier, 1790) in Borneo.

In October 1895, Bateman collected specimens and sent them to the Indian Museum, which was reported in 1914 by Stebbing on hog plum [*Spondias pinnata* (L.f.) Kurz.] in Calcutta, India. There are previous reports of the insect on *S. pinnata* by Barlow (1900) and Maxwell-Lefroy (1909). Pierce (1917) listed *Podontia 14-punctata* in the United States Department of Agriculture's manual of dangerous insects likely to be introduced into the United States through importations from India as a defoliating beetle on rubber tree *Ficus elastica* Roxb. ex. Hornem (Moraceae). Recently, Prathapan and Chaboo (2011) provided an updated list of 12 host plants of this pest belonging to four different plant families: Anacardiaceae, Burseraceae, Lythraceae, and Moraceae. However, reports on plants other than *Spondias* spp. are unverified, especially those of maize (*Zea mays* L.) and sorghum (*Sorghum bicolor* (L.) Moench) (Poaceae) in Bangladesh (APPC 1987).

Peculiar to *Podontia* immature forms is that the larva covers its dorsum with feces. The species' dorsally-positioned anus and unique fecal covering behavior, according to Paterson (1943), represent complex characters supporting the monophyly of the Blepharida group.

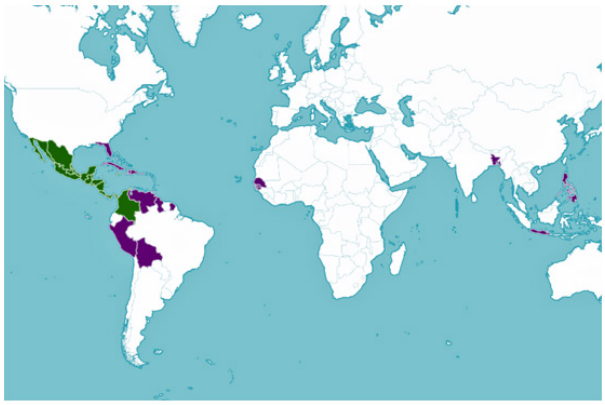
The biology of *P. quatuordecimpunctata* as an economically important pest was extensively studied on hog (plum) *S. pinnata* (=*S. mangifera* Willd.) and or *S. dulcis* in India (Corbett and Yusope 1921), Pramanik and Basu (1973), Sardar and Mondal (1983), and Singh and Misra (1989). Hossain *et al*. (2004) also studied the biology of the pest *S. pinnata* in Bangladesh. Deka and Kalita (1999, 2000a) studied the biology of the pest *S. pinnata* in Assam (northeast India) in the field and laboratory for seven months from April–October 1999 and under field conditions from 1999–2001. Prathapan and Chaboo (2011) provided a comprehensive list of the different natural enemies and recorded host plants. In addition, Deka and Kalita (1999) made several studies assessing foliage loss (2002b), distribution pattern of its larvae under natural conditions (2002c), seasonal incidence (2002d), its natural enemies (2003 and 2004), and the efficacy of different insecticides (2003) on *S. pinnata* in India. The phytochemicals of *S. pinnata* and *S. dulcis* in the regulation of nutritional ecology and population dynamics of the pest were studied by Roy (2015) in India. Udin and Khan (2015) determined the effects of different insecticides under laboratory and field conditions in Bangladesh. Khatun *et al*. (2016), determined the feeding, growth, and chemical control in Bangladesh. Rahman *et al*. (2022) made a sustainable pest management approach to mitigate the hog plum leaf beetle on *S. dulcis* in Bangladesh. Rani *et al*. (2021) studied the life history traits and food consumption and in a separate publication, the morphometrics of the pest on *S. pinnata* in Bangladesh.

"Sineguelas" (*Spondias purpurea* L.)

The Spanish plum (*Spondias purpurea* L.) or Mexican plum or "jocote" is native to tropical regions of North and Central America (Figure 2A). According to the Kew Royal Botanic Garden (2022), the fruit is native to Belize, Colombia, Costa Rica, El Salvador, Guatemala, Honduras, Jamaica, Mexico, Nicaragua, Panama, and southwest Caribbean and was introduced to the Bahamas, Bangladesh, Bolivia, Cayman Is., Cuba, Dominican Republic, Florida, French Guiana, Galápagos, Gambia, Guinea-Bissau, Guyana, Haiti, Java, Leeward Is., Peru, Philippines, Puerto Rico, Senegal, Trinidad-Tobago, Venezuela, Venezuelan Antilles, and Windward Is. (Figure 2B).

In the Philippines, different languages used different terms: "sineguelas" or "sirhuelas" (Tagalog), "saguelas" and "sarguelas" (Ilokano), "saraguelas" (Ibanag), "sereguelas" (Central Visayas), and "sireguelas" (Bicol). Sineguelas belongs to the cashew family Anacardiaceae and is a relative of cashew and mango. It became a pantropic species (naturalized throughout the tropics all

A



B

Figure 2. [A] Red sineguelas tree (*Spondias purpurea* L.); [B] global geographic distribution of sineguelas (*Spondias purpurea* L.). It is native to Central and Northern Americas (green) and introduced to other countries of the world (violet) [map courtesy of Kew Royal Botanic Garden 2022)].

over the world) and is widely grown for its edible fruits throughout the Philippines, where they are cultivated in low altitudes (Pancho and Gruezo 2006). The fruit has various names – red mombin, scarlet plum, hog plum, purple "mombin," "ciruela," and "huesito" in Venezuela; "ciruela," "iruela," and "traqueadora" in Panama; and "ciriguela," "cirguela," or "cirguelo" in Ecuador. The plant was brought to the Philippines by Spanish explorers from Central America in the last 400 years, and it was only in 2009 in San Miguel, Batangas City, and 2007 or 2008 in Brookes Point, Palawan that the leaf beetle pest was first observed and was presumed to be introduced in the country from South or Southeast Asia.

According to Pancho and Gruezo (2006), there are five species of the genus *Spondias* L. in the Philippines: *S. philippinensis* (Elm.), *S. purpurea* L. (red fruit variety), *S. mombin* L. (hog plum), *S. dulcis* Forst. (golden apple or yellow fruit variety), and *S. pinnata* (L. *f*.) Kurz. (hog plum). Sineguelas has been used for herbal medicine for thousands of years. Although much eaten, it is not considered a high-quality fruit, with a tendency to cause stomach aches when eaten in large quantities when semi-ripe. A compound isolated from fruit extract is lutein, which was reported to have antimicrobial and antimutagenecity potential. In a study of 84 plants screened for *in vitro* activity against five enterobacteria pathogenic to man, *S. purpurea* was one of 10 plants that showed the best antibacterial activity (Escober and Quero 2003). In the Philippines, Ragasa *et al*. (2001) identified antimicrobial compounds from the dried bark of *S. purpurea*, which tested positive against seven microorganisms. The sap or gum from the tree is used as glue and is combined with pineapple to make a treatment for jaundice. Sineguelas is also used for the treatment of tonsillitis and stomatitis in children (Ragasa *et al*. 2001).

Before the introduction of *P. quatuordecimpunctata*, there was no known major pest of sineguelas in the Philippines except for some problems with fruit flies (OCVAS, unpublished report). Gabriel (1997) reported 10 minor insect pests of red sineguelas (*S. purpurea*). Tree trunks and branches were attacked by two longhorn beetles (Coleoptera: Cerambycidae) species *Niphonoclea albata* (Neuman) and *N. capito* Pascoe. Several insect species were also reported feeding on sineguelas shoots and leaves: "salaguinto" (*Anomal*a sp.; Coleoptera: Scarabaeidae: Rutelinae), a slug caterpillar (*Thosea philippina* Holloway; Lepidoptera: Limacodidae), bagworm (*Amatissa cuprea* Moore; Lepidoptera: Psychidae), and three species of tussock caterpillars [*Euproctis varians* (Walker), *Lymantria lunata* (Stoll), and *Metanastria hyrtaca* Cramer; Lepidoptera: Lymantriidae].

Hog plum (*Spondias pinnata*) is more prevalent in the Bicol region and is an alternative host of SLB (Figure 3). Local names of the plant are "lannu" or "lanu" (Cagayan); "libas" (Bataan, Tayabas, Capiz, Iloilo, Cotabato, and Zamboanga), and "lubas" or "libas" (Bicol) (Florido and Cortiguera 2003). The tree is native to India, Burma (Myanmar), Indonesia, southern China, Thailand, and throughout Malesia to the Solomon Islands. Its wood is suitable for the manufacture of matchsticks, matchboxes, boxes, and crates (Florido and Cortiguera 2003). Leaves are also used as feed for cattle in Batangas and goats in Iloilo.

Economic Significance

The Department of Agriculture–Regional Crop Protection Center (DA-RCPC) IV-A-CALABARZON first monitored the presence of SLB in Laiya, San Juan, Batangas in August 2016 and Agoncillo in 2017 [Sandoval and Manzanilla (2016, 2017, unpublished report)]. The second author tentatively identified the pest as a chrysomelid beetle by submitting it for confirmation with an expert [Calcetas (2016, unpublished notes)]. The specimen

Figure 3. Foliage of hog plum or "libas" [*Spondias pinnata* (L.)].

was sent for identification to Dr. Charles Staines, the world expert on hispines and other Chrysomelidae at the Smithsonian Institution, Washington, DC, USA. A much earlier detection was by Ms. Marilyn Gico of San Miguel, Batangas City, who has been engaged in the harvesting and marketing of sineguelas since 1995. She attested that the beetle and larvae were first observed in May 2009. The orange larvae often fall on her face while she harvested sineguelas fruits. They did not control SLB until the advent of the pandemic when the population and damage reached economic levels. A similar sighting report was made in Balacan, Brookes Point, Palawan from 2007–2008 by Mr. Raffy Tumines. He narrated that he used to climb and eat sineguelas fruits on top of the tree at the back of their house and this is the first time he encountered the adults and the larvae. Ebora *et al.* (2017, unpublished report) reported the pest from Bulsa, San Juan, Batangas as *Podontia* sp. Feeding damage was described, and the life cycle was studied [Ebora *et al.*, BPI-CPD, Manila (2017, unpublished report)]. In 2019, three years after its reported introduction in 2016, SLB reached outbreak levels in fruit farmers in San Miguel, Batangas City, which is considered the largest producer. Based on the latest survey conducted by the OCVAS, Batangas City, 10 *barangays* are dependent on sineguelas as the major source of livelihood. The sineguelas fruit industry in this part of the country started as a booming business in the 1970s, and many of the old trees in the area are 30–50 years old. Currently, there are 14,537 trees of singuelas that are managed by 296 farmers in 10 *barangays* of Batangas City within the slopes of Mt. Banoi [OCVAS (2021, unpublished report)]. In Mexico, the fruit is an important source of income for many small growers in the states of Jalisco, Nayarit, Puebla, Sinaloa, Chiapas, and Yucatan (Garcia and Bernal 1998).

A farmer's forum and consultation session was held on 29 Aug 2019. Before the introduction of SLB, a typical sineguelas tree can yield an average of PHP 3,000 (USD 52.91) worth of fruits every other day for 30 days – based on the sineguelas fruit farm gate price of PHP 1.00 (USD 0.017) per fruit. Therefore, a farmer with 100 sineguelas trees per hectare earns PHP 90,000 (USD 1,587.30) pesos per month. However, after three years of SLB infestation in the area, resulted in a loss of approximately 70% (PHP 2,000 or USD 35.27) was reported by the majority of the farmers interviewed. Before, there were 12 cargo jeeps fully loaded with sineguelas fruits leaving Batangas City daily for Manila – but after the infestation, only a single jeep is needed (OCVAS, unpublished report). To manage SLB chemical insecticides (mostly Cypermethrin) were occasionally sprayed several times to prevent damage to the developing fruits [Acuzar (2022, pers. comm.)].

There are no reports in the literature on SLB on either mango, cashew, or "pili" (Bursearceae: *Canarium ovatum* Engl.). However, the threat of this invasive species to these and other plants is possible. Therefore, a detection survey SLB on major islands of the country, as well as determining their current geographic distribution and survey of different host plants, are vital in the development of suitable control and management strategies.

MATERIAL AND METHODS

Survey

A nationwide detection survey was conducted from May 2021–November 2022 to determine the presence and status of SLB, survey potential host plants, and access other important pests of sineguelas. Forty (40) beetle specimens were examined with 20 males and 20 females. They were collected using an insect nylon net or manually handpicked and killed using 80% ethyl alcohol. Adult specimens were preserved and pinned and deposited at the DA-RCPC-IVA and BPI-LBNCRDPSC (Los Baños National Crop Research, Development, and Production Support Center) collections. Voucher specimens were also deposited at the UPLB-MNH (University of the Philippines Los Baños Museum of Natural History).

Digital photos of SLBs and their damage symptoms were taken, and dead specimens of different life stages were also collected and preserved along with other associated arthropod pests of sineguelas and natural enemies. In addition, notes on the possible dates of introduction and the extent of infestations were gathered from fruit farmers and traders, government agencies and officials, agricultural technicians, and researchers from different research facilities around the country.

Imaging

Color images of habitus and other morphological characters of the different stages of SLB and associated arthropods were taken using a Nikon®-D7110 DSLR (24.71 megapixels) digital camera equipped with a Nikon Micro 40 mm or 150 mm 1:2.8G lenses and mounted on a microscope arm track stand. The camera was attached to a Mac® computer and remotely controlled with a mouse using Helicon Remote® software. Time-lapse photography functions at predetermined intervals while manually adjusting the microscope's coarse and fine adjustment knobs. This is to hasten the process and prevent unnecessary movement when pressing the camera's shutter button. Lighting was provided by several units of light-emitting diode (LED) ring lights and LED bulbs mounted on a movable study lamp and covered with a Pixco® camera flash diffuser for maximum lighting. Afterward, digital photographs were tethered using Helicon Remote® (ver. 3.9.12 M) and combined using Helicon Focus® (ver. 7.7.4) stacking software and then digitally enhanced, cropped, and cleaned from any unwanted blemishes using Windows-based Adobe Photoshop Elements 2020® and stored in a TIFF format.

The acronyms used are as follows:

DA-BPI-CPMD	Department of Agriculture, Bureau of Plant Industry, Crop Pest Management Division, San Andres, Malate, Manila
DA-BPI-LBNCRDPSC	Department of Agriculture, Bureau of Plant Industry–Los Baños National Crop Research, Development and Production Support Center, BPI Economic Garden, Timugan, Los Baños, Laguna
DA-BPI-LGNCRDPSC	Department of Agriculture, Bureau of Plant Industry–La Granja National Crop Production Research Development and Production Support Center, La Granja, La Carlota, Negros Occidental
DA-RCPC-IVA	Department of Agriculture, Regional Crop Protection Center, Marawoy, Lipa City, Batangas
DA-RFO-IVA	Department of Agriculture, Regional Field Office–IVA-CALABARZON, Marawoy, Lipa City, Batangas
DA-RFO-IVB	Department of Agriculture, Regional Field Office-IVB-MIMAROPA, Camilmil, Calapan City, Oriental Mindoro
DOST-PCAARRD	Department of Science and Technology–Philippine Council for Agriculture, Aquatic, and Natural Resources Research and Development, Paseo de Valmayor, Timugan, Economic Garden, Los Baños, Laguna
OCVAS	Office of the City Veterinary and Agricultural Services, Bolbok, Batangas City

RESULTS AND DISCUSSION

"Sineguelas" Leaf Beetle [*Podontia quatuordecimpunctata* (L.)]

The SLB is a robust and brightly colored flea beetle. The antenna has 11 segments, the head and pronotum are yellow and the elytra are either salmon pink, orange, or yellow and with yellow legs. However, after death, the salmon pink elytra turn orange while the yellow elytra turn to cream. There are 14 collective black, irregularly

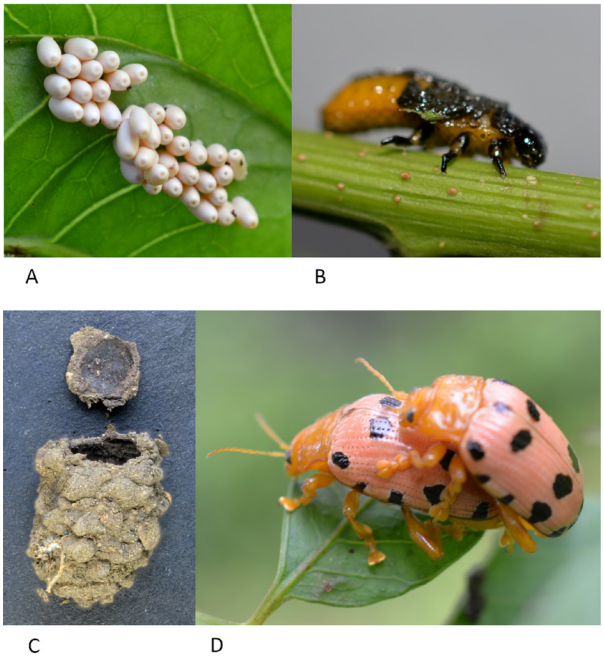


Figure 4. Sineguelas leaf beetle (SLB) [*Podontia quatuordecimpunctata* (L.), 1767)]; [A] egg cluster; [B] larva; [C] pupal case; [D] adults mating.

rounded spots on the elytra, thus arriving with the name *quatuordecimpunctata* or an old abbreviated name of *Podontia 14-punctata.* Counting the individual black spots, there are 9–10 on each elytron for a total of 18–20 spots for both males and females. There are five levels of spots: two spots on the anterior, two spots on the apical third, one spot on the medial, two spots on the basal third, and two to three spots on the basal part. The spot in the middle at the basal part is sometimes attached to the spot adjacent to the sutural margin and sometimes individually separated from it. There are also ten distinct longitudinal punctured striae on each elytron. The male has a U-shaped genital opening at the last abdominal ventrite (Figure 1C), whereas the female has none (Figure 1D). Also, the III and IV abdominal ventrites are C-shaped on males and nearly straight on females.

The eggs are white and oblong and measure about an average length and diameter of 1.82 x 0.85 mm. They are laid mostly on the abaxial surface of the leaf (Figure 4A). The immature and mature larvae and adults voraciously feed on the young shoots and young and tender leaves (Figure 4B). In severe cases, it can defoliate the whole tree in India and Bangladesh (Corbett and Yusope 1921; Deka and Kalita 2002b; Rani *et al*. 2021). According to Deka and Kalita (2002b), the larvae prefer to feed on the young and tender leaves of *S. dulcis* and *S. pinnata* in India. The larva typically covers its body with its feces to serve as a defense mechanism against vertebrate and invertebrate predators (Figures 4B and 6A–C). Additionally, this fecal coat acts as a deterrent against predatory ants (Vencl and Morton 1998; Vencl *et al*. 1999). The larva pupates in the soil, thus creating a pupal case out of regurgitated soil particles and mud (Figure 4C). The adults were occasionally observed mating for long hours and falling to the ground when alarmed (Figure 4D).

Hosts of SLB in the Philippines

The most abundant host of SLB in the country is the Spanish plum or sineguelas (*Spondias purpurea*) since they are widely cultivated in Batangas, Pangasinan, Cagayan de Oro, Iloilo, and as a fence or an ordinary backyard fruit tree around the country compared to other related species (Figures 5A–B and 7). Heavy infestation and extensive defoliation of sineguelas foliage, mostly on young shoots and leaves, were observed in different parts of the country. All of the *S. purpurea* trees visited and monitored in different parts of the country were infested. Currently, a study on the biology, population dynamics, and employment of different integrated pest management strategies is underway through a two-year collaborative project spearheaded by DA-RFO-IVA-CALABARZON and DA-BPI-LBNCRDPSC and funded by the DOST-PCAARRD.

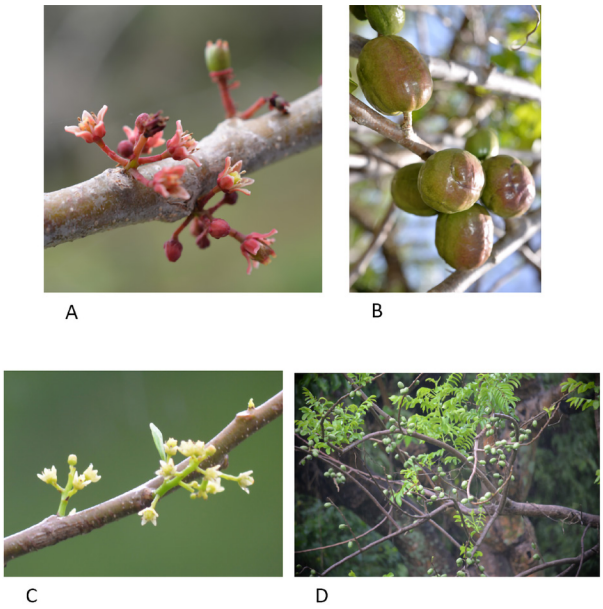


Figure 5. Red sineguelas tree (*Spondias purpurea* L.).[A] flowers; [B] fruits; Yellow Sineguelas tree (*Spondias dulcis* Forst.); [C] flowers;[D] fruits.

The golden apple, yellow mombin or locally known as "yellow sineguelas" (*Spondias dulcis*), is more common in Ilocos Norte and is less prevalent and less preferred by farmers in other parts of the country since the fruits are less sweet, faster to ripen, less firm, and with low

market value (Figures 5C and D). This is in contrast to red mombin – which is sweeter, takes longer to ripen, is much firmer, and with higher market value. Red sineguelas has red flowers and red to maroon fruits when ripe or mature compared to yellow sineguelas with yellow flowers and green fruits when ripe. The trees monitored in Pagudpud, Ilocos Norte were free from SLB at the time of monitoring (December 2021) (Figure 7). Since there are numerous records of SLB infesting *S. dulcis* in India and Bangladesh it is only a matter of time before the trees will be infested. The vendor interviewed by the team near Bangui Wind farm, Bangui, Ilocos Norte noted the extensive infestation of the "orange beetle" and "orange worm" in different parts of the province where sineguelas are extensively grown. However, to prolong the shelf life of the fruit and maintain its freshness it is recommended to refrigerate them inside the vegetable compartment [Calcetas (2022, unpublished notes)].

SLB also feeds in great numbers on hog plum or "libas or lubas" (*S. pinnata*). In the Philippines, they are less planted compared to the two above species. They are more prevalent in the Bicol region. Its local names are "lannu" or "lanu" (Cagayan), "libas" (Bataan, Tayabas, Capiz, Iloilo, Cotabato, and Zamboanga), and "lubas" or "libas" (Bicol) (Florido and Cortiguera 2003) (Figure 7). The young shoots and leaves are used as filling for fish cooked in coconut milk called "sinanglay," whereas the young leaves are dried and used in the preparation of "laing," a very popular Bicolano dish, and also used as an alternative souring agent for fish and other delicacies (Florido and Cortiguera 2003; Nicolas 2022, pers. comm.). Leaves are also used as feed for cattle in Batangas and goats in Iloilo. However, in the Philippines, they are less planted compared to the other species. The fruits are seldom used or eaten in the country since it's too sour unlike in India and other countries, wherein according to Mondal and Amin (1990), its fruits are edible, delicious, and sources of vitamin C and carotene. Probably, they are different varieties of the plant.

Other than these hosts there are no other crops or plants that SLB feeds on. They are just sometimes seen resting or mating on top of weeds, grasses, and other crops planted within the area after falling from the tree top or as newly emerged adults from pupal cases.

Feeding Damage of SLB on *Spondias purpurea*

The newly hatched larva or neonate immediately feeds on the foliage of young shoots and young leaves of sineguelas. They can only scrape the upper surface of the leaf and fail to create holes, whereas much older larvae can directly create feeding holes and can voraciously defoliate the plant (Figures 6A and B). Larvae and adults were also observed in the field to feed on the developing and mature sineguelas fruits (Figure 6C). Adults are also voracious foliage feeders (Figure 6D).

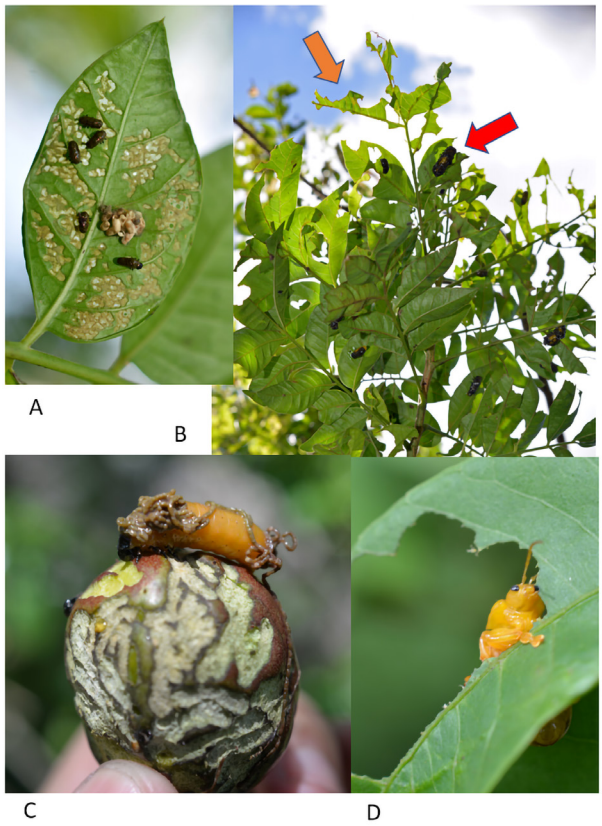


Figure 6. Feeding damage symptoms of sineguelas leaf beetle (SLB) (*Podontia quatuordecimpunctata* (L.), 1767)*;* [A] neonate larvae; [B] different larval instars; [C] feeding damage of larva on sineguelas fruit; [D] adult beetle feeding on foliage.

Geographic Distribution of SLB in the Philippines

Luzon. The geographic distribution and the extent of SLB infestation in the Philippines were determined, and the different sineguelas-producing provinces in the country were identified (Figure 7). SLB was first sighted with certainty in 2009 by Ms. Marilyn Gico together with her husband and mother-in-law of San Miguel, Batangas City who have been engaged in the harvesting and marketing of sineguelas since 1995. The earliest massive infestation report was in Laiya, San Juan, Batangas in August 2016 in San Miguel, Batangas City, and in Agoncillo in 2017. SLB was observed in Lemery, Calatagan, and Lobo. Batangas City is a major hub for different oil refineries in the country and a major shipping port to South Asia and Southeast Asian countries; thus, this is the most plausible cause of the pest's accidental introduction. A study on natural history, biology, ecology, and population dynamics was conducted in Batangas in 2021–2022 (unpublished report 2022).

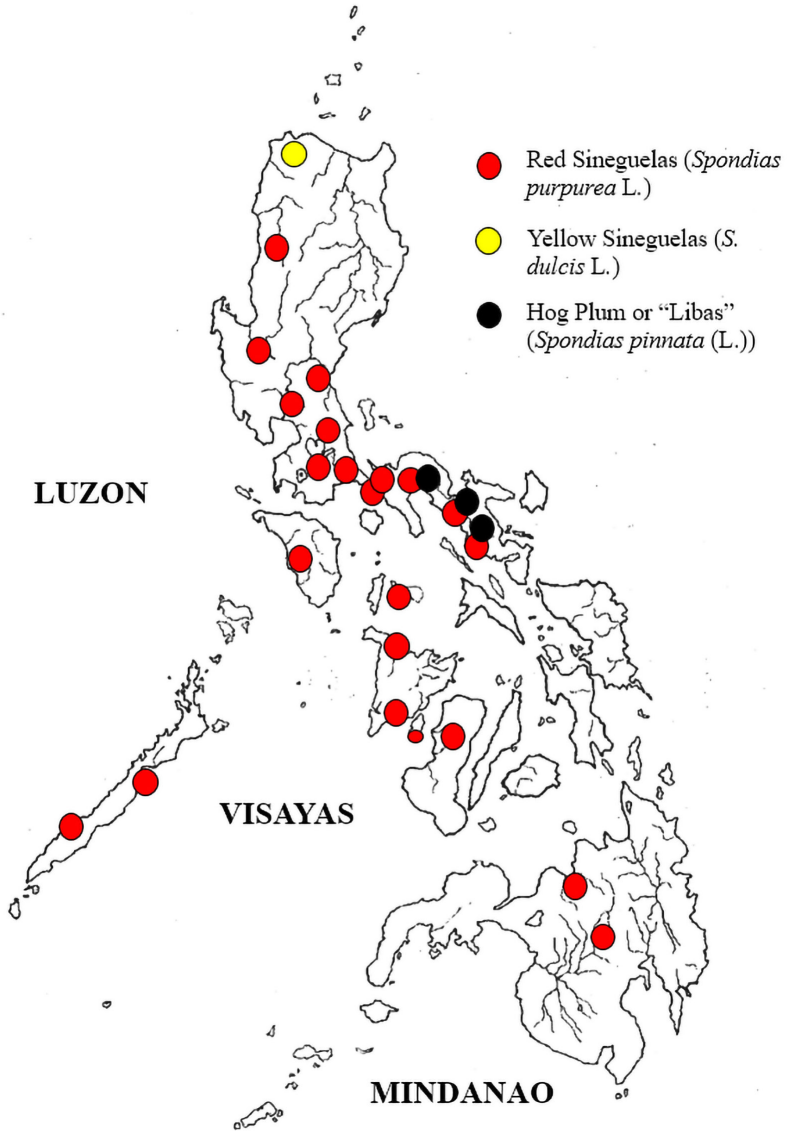


Figure 7. Infestation of sineguelas leaf beetle (SLB) (*Podontia quatuordecimpunctata* (L.), 1767) on red sineguelas (*Spondias purpurea* L.) (red circle), yellow sineguelas (*S. dulcis* Forst.) (yellow circle), and hog plum or "libas" (*S. pinnata* (L.)) (black circle) in the Philippines. Map courtesy of Dr. Sheryl A. Yap of IWEP-UPLB, Los Baños, Laguna, unpublished thesis 2004.

SLB was recently observed on sineguelas in the other three provinces of Southern Tagalog – Laguna (Los Baños in 2021), Rizal (Tanay in 2020 and Angono in 2022), and Quezon (Lopez in 2022). It was also observed in Tiaong, Quezon on "libas" (*S. pinnata*) (Bihis 2022, pers. comm.). These provinces are bordered by the Sierra Madre Mountain, the largest and longest mountain range in the country. The beetles were first observed by local fruit farmers and traders in 2019 on sineguelas in Central Luzon in Floridablanca and Porac, Pampanga, and in 2020 in Bani and Manaoag, Pangasinan. These fruits were transported to Manila or sold around the premises of the famous church in Manaoag according to local traders. In the north of Luzon, SLB was monitored on several trees of red sineguelas planted near the seashore in Sta. Maria, Ilocos Sur. However, the golden apple or yellow sineguelas (*S. dulcis*), which are commonly planted in the coastal barangay of Pagudpud, Ilocos Norte were free from the pest during the time visit in April 2022.

A trip to the flat plain on the island of Sta. Lucia, Sablayan, Occidental Mindoro in December 2021 confirmed its presence in the area. SLB was first sighted on sineguelas in 2020 according to local farmers. According to them, their sineguelas fruits are much sweeter, tastier, and less attacked by fruit flies due to their drier climate. The

majority of sineguelas trees planted in the province are red or maroon according to local farmers (*S. purpurea*).

A survey for SLB in the Bicol region in August 2022 showed at present in abundant numbers of red sineguelas in Lupi, Camarines Sur (northern part of the province and region; mountainous) and in Pio Duran, Albay (eastern coastal part of the province and region). Surprisingly, some of the trees monitored in Pio Duran did not have feeding damage and with no beetles found, whereas a few kilometers away from the same coastal *barangay*, SLB was abundant with distinct feeding damage observed. The high winds of the sea toward the coast may have prevented adults from migrating to these uninfested trees, and it clearly shows a recent introduction of the pest in the area. The pest was also sampled on hog plum (*S. pinnata*) in Pili, Camarines Sur (southern part of the province and region; flat plain). The hog plum is famous in the region since they are used as a souring agent for "bulalo" or meat broth and fish delicacies (Nicolas 2022, pers. comm.). Severe infestation of the pest was observed, even though the leaves of the plant are much larger, thicker, and waxier compared to both the red and yellow sineguelas.

The pest was reported in the remote province of Romblon in July 2022; it seriously affected the harvest of a 5.0-hectare sineguelas farm in Brgy. Tugdan, Alcantara, Romblon (Mercene 2022, pers. comm.). Based on an interview with local farmers, the pest has been causing damage on the remote island since 2017 and is considered the third earliest record of the pest in the country. Most likely, the pest was transported to the island *via* the "Roro (roll-on-roll-off) shipping routes." A similar scenario on the accidental transport of rice black bug [*Scotinophora sorsogonensis* Barrion *et al*. (Hemiptera: Pentatomidae)] from Calamba, Laguna to Romblon through the use of rice hay on the trade and transport of mallard duck *via* the same shipping route [Calcetas (2007; unpublished RCPC report)].

Palawan. A recent report by an entomologist of DA-RCPC-MIMAROPA and personnel in charge of pest and disease occurrences in Palawan confirmed the presence of SLB in the southern part of the island of Ipilan, Brookes Point, which is closest to Malaysia and mainland Asia and in San Manuel and San Pedro, Puerto Princesa City [Mercene and Bauzon (July 2022, pers. comm.)]. A survey in October 2022 confirmed a moderate infestation in Balacan, Brookes Point, and a severe infestation in Salugon, Brookes Point. According to Mr. Celso Lactaotao of Salugon, his two sineguelas trees produced approximately 100 kg of the fruits before the introduction of SLB in 2020; however, after its infestation, he incurred a 100% yield loss. He sells his produce in Bataraza Public Market and harvests the fruits by using a black net laid around the tree and manually handpicking them. In the nearby *barangay* of Sarasa, Brookes Point, Gabriel Flores – a meat vendor – first observed the pest in 2019. Ms. Raquel Badenas of the coastal barangay of Balacan, Brookes Point first observed SLB in 2019, she even recalls that the larvae oftentimes crawl into their houses. A *Beauveria* sp. infected adult was collected in the area. Interestingly, Raffy Tumines of Balacan recalled that he first observed the pest sometime in 2007–2008 since he frequently climbed the tree to manually harvest and eat the fruit. This is similar to an earlier claim of Ms. Marilyn Gico of San Miguel, Batangas City, who also harvested the fruit by herself in 2009.

According to some locals, there are numerous sineguelas trees in Puerto Princesa City but due to increasing urbanization and development, most of them were cut down. This same scenario was also encountered in Guimbal, Iloilo. Mr. Renato Venturillo of San Manuel, Puerto Princesa City has 20–30-year-old trees and first observed SLB presence in 2019, he sells the fruit on their fruit stand in the city market at PHP 100.00 per 100 pieces or PHP 1.00 per fruit. The pupal case in the area is brownish since the soil is generally dark brown in color. Mr. and Mrs. Perry and Emma Padalapat also of San Manuel used to prune their sineguelas trees to control or manage the pest; thus, plenty of new shoots and beetle larvae of different stages were observed on the tree since the production of young leaves favors the growth and development of young larvae. He also noted that they first observed SLB sometime in 2014–2015. Before the infestation, they harvested four full paint pail containers of sineguelas fruits, which is approximately 16 kg per container; however, now they can only harvest one container full of fruit. The date coincides with the first pest-reported outbreak in 2016 in San Miguel, Batangas City.

These findings support our earlier hypothesis that SLB in Palawan must have been introduced on the island by a route different from the introduction in Batangas City. The proximity of the islands of Mindanao and Palawan to other Asian countries is a constant threat and avenue for the accidental crossing and introduction of pests between the continent and our island country through the shipping industry. According to the Philippine Ports Authority and the National Plant Quarantine and Services Division (NPQSD) in Brookes Point, there is a trip from the port to Tawi-Tawi, which is a 14-hour trip by small boat. However, trips to the nearby island of Banggi (Pulau Banggi), Sabah, Malaysia, and other nearby foreign lands are all illegal, undocumented, and unauthorized. New findings suggest that there is a parallel introduction of the pest in Batangas City and the island of Palawan, most probably by ship.

Visayas. According to sineguelas farmers and fruit traders of San Miguel and Sto. Nino, Batangas City, Iloilo province is the next largest exporter of fruit in the greater Manila area and their main competitor, for they deliver the fruits by airplane and also with the superior quality

of their produce. Traders from Iloilo make sure that their fruits are uniformly ripe and reddish to be high-priced and competitive compared to fruits from mainland Luzon, which are less uniform in color and maturity. From 06–07 Sep 2022, the team visited Iloilo province; there are six towns with large plantations of sineguelas – Guimbal, Miagao, San Joaquin, Igbaran, Tubungan, and Badjangan [Guimbal Agricultural Technicians (2022, pers. comm.)]. Ms. Rosalina Barrion of Sta. Rosa, Guimbal is one of the several traders of the fruit, and the highway street where she lived in the same area in the province is where the fruits are retailed along with Madras thorn or locally known as "kamatsile" [*Pithecellobium* dulce (Roxb.) Benth.] (Fabaceae) and "duhat" [*Syzygium cumini* (L.) Skeels] (Myrtaceae) during its fruiting season. As a trader, she was able to sell to retailers approximately 10 sacks of the fruit every other day starting in April. SLB was first observed in these areas during the nascent period of the COVID-19 pandemic (2020–2022) according to some farmers and traders. Unfortunately, some of the trees in the coastal *barangay* of Guimbal will be cut down to give way to some infrastructure projects. Another notable insect pest of sineguelas in Iloilo, according to locals are June beetles or "salagubang," which are mostly *Leucopholis* spp. (Coleoptera: Scarabaeidae: Melolonthinae) based on the descriptions and illustrations that were shown to them. They are abundant during May and June in the area. However, Numancia, Aklan is the largest producer of sineguelas in Aklan [Guimbal Agriculture Technicians (2022, pers. comm.)]. The SLB was also present in the neighboring province of Camanci, Batan, Aklan, and this was confirmed by Mr. Glenn Tabasa, whose friend in the area sent digital photos [Tabasa (2021, pers. comm.)]. SLB was also monitored on the island of Guimaras on the same date as the first observation in Iloilo [Yonder (2021, pers. comm.)]. SLB was similarly observed in the adjacent island of Negros Occidental, which is the sugarcane capital of the Philippines and planted few sineguelas trees. It was monitored inside the vicinity of the BPI-LGNCRPSC, La Granja, La Carlota City, and was first observed in 2021 by local farmers and officials of the research station [Discaya (2022, pers. comm.)]. The majority of the trees planted in these provinces are red sineguelas.

Mindanao. The personnel of DA-RCPC-IVA who visited and underwent training in the mountainous areas of RCPC-X, Malaybalay, Bukidnon photographed and were amazed by insect specimens inside a large insect display glass top box arranged in a heart-shaped fashion in the mini museum of the center. Close inspection of the main author on the photographs revealed that they are SLB [Marasigan and Perez (2018, pers. comm.)]. Mr. Tito Manigos collected the beetles in 2018 on a red sineguelas tree planted in front of his house in an exclusive urban subdivision in Cagayan de Oro City [Guzman and Manigos (2021, pers. comm.)]. This largest southern island of Mindanao is much closer to Borneo and Indonesia, where the pest is known to be present.

DISCUSSION AND CONCLUSION

This is the first record of the genus and species *Podontia quatuordecimpunctata* in the Philippines and also the first record of *Spondias purpurea* as host plant of the pest. Currently, the beetle was observed feeding on *Spondias purpurea*, *S. dulcis*, and *S. pinnata*, and there is no record yet of the pest on *S. philippinensis* and *S. mombin*. However, the search for other alternate host plants is still ongoing. Based on our recent survey the pest is present in all major islands of the country except for yellow sineguelas area of Pagudpud, Ilocos Norte. However, the presence of several research studies on the biology, ecology, and integrated pest management in India and Bangladesh on *S. dulcis* made it evident that only time will tell for how long SLB will need to reach the northern tip of the province. SLB was able to spread from Batangas City to different islands of the country through shipping routes and multiply rapidly on even irregularly distributed sineguelas trees but failed to establish on plants other than members of the genus *Spondias*. However, the parallel introduction of the pest on the island of Palawan and some parts of Mindanao provinces is most likely through Sabah, Malaysia, or Indonesia *via* a shipping route from the island of Banggi and other interisland routes.

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