

ARTÍCULOS ORIGINALES

SPECIES OF THE BEETLE GENUS *ANTHONOMUS* GERMAR, 1817 (CURCULIONIDAE: CURCULIONINAE: ANTHONOMINI) OF QUARANTINE IMPORTANCE INTERCEPTED AT U.S. PORTS OF ENTRY

Allan H. Smith-Pardo. Entomologist. USDA-APHIS-PPQ, 389 Oyster Point Blvd., Suite 2, South San Francisco, CA. 94080. United States of America. allan.h.smith-pardo@aphis.usda.gov

Abstract

This paper presents a discussion on the taxonomy of weevils of the genus *Anthonomus* and presents diagnostic characters useful for the identification of adult and immature stages of the genus. In addition, I ran a search in the USDA's AQAS database for interceptions of species of *Anthonomus* of quarantine importance that have been intercepted at United States ports of entry. In total, six species of quarantine importance have been intercepted: *Anthonomus flavus*, *Anthonomus grandis*, *Anthonomus melanosticus*, *Anthonomus pomorum*, *Anthonomus rubi*, and *Anthonomus sisyphus*. Photographs and information on the origin and hosts of these interceptions are included.

Key words

Weevil, pest, crop, imported commodities, diagnostic character

Resumen

En este artículo se presenta una discusión acerca de la taxonomía de escarabajos- picudos del género *Anthonomus* y se presentan los caracteres diagnósticos para la identificación de estadios inmaduros y de adultos. Adicionalmente, se hizo una búsqueda de las intercepciones de especies del género *Anthonomus* de

importancia cuarentenaria en los EEUU que han sido interceptados en puertos de entrada. En total se han interceptado seis especies de importancia cuarentenaria de acuerdo a la base de datos AQAS del USDA: *Anthonomus flavus*, *Anthonomus grandis*, *Anthonomus melanosticus*, *Anthonomus pomorum*, *Anthonomus rubi* and *Anthonomus sisyphus*. Se incluyen además fotografías e información acerca del origen y los hospederos de estas seis especies.

Palabras clave

Picudo, plaga, cultivos, mercancías importadas, caracteres diagnósticos

Introduction

The genus *Anthonomus* has a cosmopolitan distribution. There are close to 500 described species, most of which are known from the New World, in particular, Mexico and Central America (where 172 species are known to occur).

The majority of host plants of this genus reported in the literature are in the families Asteraceae, Combretaceae, Cupressaceae, Euphorbiaceae, Fabaceae, Juglandaceae, Krameriaceae, Malpighiaceae, Malvaceae, Myrtaceae, Rosaceae, Rutaceae, Rhizophoraceae, Sapindaceae, Solanaceae, and Vitaceae.

The genus *Anthonomus* includes several species of agricultural importance, either as pests of crops [e.g. the boll weevil, *Anthonomus grandis*, which attacks cotton buds and flowers and has cost American cotton producers more than \$15 billion in yield losses and control efforts (K. Shea, In Literature, Dec. 2014); the strawberry blossom weevil, *Anthonomus rubi*, which feeds on

plants of the family Rosaceae and is an important pest of strawberry (*Fragaria x ananassa*) and raspberry (*Rubus idaeus*); and the pepper weevil, *Anthonomus eugenii*, which feeds on plants of the genus *Capsicum* and *Solanum*] or as biological control agents of invasive plants [e.g. *Anthonomus santacruzi*, used for the control of *Solanum mauritianum* (bugweed), an introduced weed of South American origin that is of quarantine importance in South Africa (Olckers, 2008)].

In the case of Colombia, there has been little work on pests in this genus. One of the few works is the one by Burke and Cross (1966), in which they describe a new species, *Anthonomus bisinuatus*, attacking cotton plantations in Departamento del Valle del Cauca.

Because of the enormous economic importance of some species (such as *A. grandis*), there have been several taxonomic works performed during over last 50 years, most of them describing new species (e.g., Burke 1962; Burke 1979; Burke, Clark & Cross 1984) and reviewing supraspecific taxonomic groups. However, to date, there is still not a clear consensus on the phylogenetic relationships among the species in this genus. The genus is badly in need of revision and the distinction of its species is difficult as a result..

According to recent work by Soto, Jones & Reyes (2013), the genus *Anthonomus* can be distinguished from other genera in the tribe Anthonomini by a combination of the following characters: rostrum slender and longer than length of pronotum with scales limited to basal half of length; eyes moderately large, diameter slightly or much greater than

rostrum at base; antennal funiculus with 6 or 7 articles; lateral rostral groove directed toward middle of eye; pronotum with postero-median sides; tarsal claw with stout tooth arising from the base; procoxae contiguous or, if separated, then profemur with a large and triangular tooth; profemur approximately 1.5 times wider than metafemur and profemoral tooth usually with shallow to deep anterior emargination; protibia usually straight; mesocoxae separated by distance more than one-fourth the width of one coxa; mesotrochanter triangular (*Anthonomus* subgenus *Anthonomorphus* males have a trapezoidal mesotrochanter); elytra not strongly convex and apical sides rounded, lacking a transverse basal patch of black scales, and elytral elevations mostly absent or limited to odd-numbered interstriae.

For species recognition, Burke (1962) refers to the median lobe (mostly dorsal aspect) of the male genitalia of *Anthonomus* as a very useful character for separating related species as well as for assigning species to subgenera and groups.

Materials and methods

I performed an ad-hoc, unrestricted search of interceptions of species of the genus *Anthonomus* at U.S. Ports of Entry in the AQAS database of the USDA (as of December 17th, 2014). The results of this search were then sorted and filtered by species, origin, host, and date of interception using the filter tool of MS Excel.

Photographs of the diagnostic characters and the species of quarantine importance were taken using a Nikon SMZ 1500 dissecting microscope with

a Nikon Digital Sight DS-Fi2 camera. Series of photographs were processed using the Elicon Focus V. 5.3 software (Helicon Soft Ltd.) and edited using Photoshop Elements 10 (Adobe).

Results

The ad-hoc search of the AQAS database rendered a total of more than 4,800 interceptions of the genus at U.S. ports of entry since 1984. Of all the interceptions, 3,732 were considered to be reportable (however, of the total of 3,732, approximately 3,670 interceptions were reportable because they were only identified to the generic level, either because they were immature stages (most of them) or because there were no comparable specimens in the USNMNH collections).

A total of 58 reportable interceptions were identified to species. These species are *Anthonomus flavus*, *Anthonomus grandis*, *Anthonomus melanostictus*, *Anthonomus pomorum*, *Anthonomus rubi*, and *Anthonomus sisyphus*.

The origins of the reportable species intercepted and the associated commodities (and possible hosts), both derived from the AQAS database, are as follows: *A. flavus* (four interceptions) were from the Caribbean (two from Puerto Rico and one from the Dominican Republic, all associated with fruits of *Malpighia glabra* -Acerola (Malpighiaceae)) and Mexico (one interception with seeds of *Zea mays* -Corn (Poaceae)); *A. grandis* (38 interceptions) were mostly from Mexico (34, most associated with seeds of *Gossypium hirsutum*, some with seeds of *Zea mays*, a few with fruits of *Musa paradisiaca* and one *Physalis* sp. or with leaves of *Medicago sativa* or *Coriandrum*

sativum) and one for each of the following countries: Guatemala (with fruits of *Cucumis melo*), Costa Rica (with seeds of *Gossypium hirsutum*), and Colombia (with leaves of *Ocimum basilicum*); *A. melanosticus* (only one interception from Mexico on leaves of *Origanum majorana*); *A. pomorum* (three interceptions, one from each of the following European countries: Switzerland, on stems of *Malus domestica*; Italy, on leaves of *Apium graveolens*; and Poland, on a plant of *Picea pungens*); *A. rubi* (only one interception from the Netherlands associated with flowers of *Astilbe* sp.); and for *A. sisyphus*, all the interceptions (11) came from Mexico, mostly associated with herbs (*Artemisia dranunculus*, *Mentha arbenses*, *M. officinalis*, *Ocimum basilicum*, *Origanum vulgare*, and *Rosmarinus officinalis*) and one interception in a fruit of *Prunus avium*.

Diagnostic characters used for the identification of different stages of the genus *Anthonomus*:

Adults:

Head:

Rostrum slender, longer than length of pronotum (Fig. 1a), and with scales limited to basal half of its length (Fig. 1b).

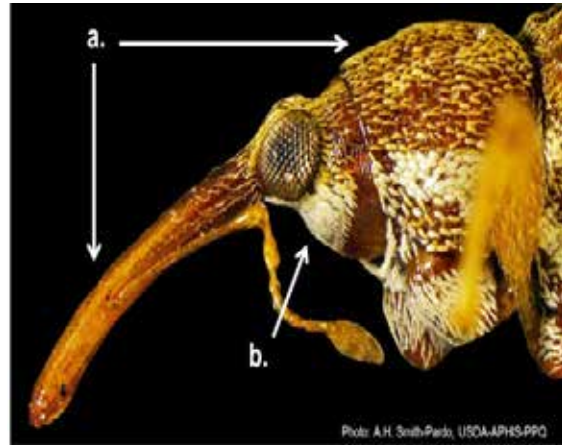


Figure 1. Head and prothorax of *Anthonomus* sp. showing: a. rostrum (beak) longer than pronotum, b. scales limited rostrum's basal half.

Eyes moderately large, with their diameter slightly or much greater than rostrum at base (Fig. 2)

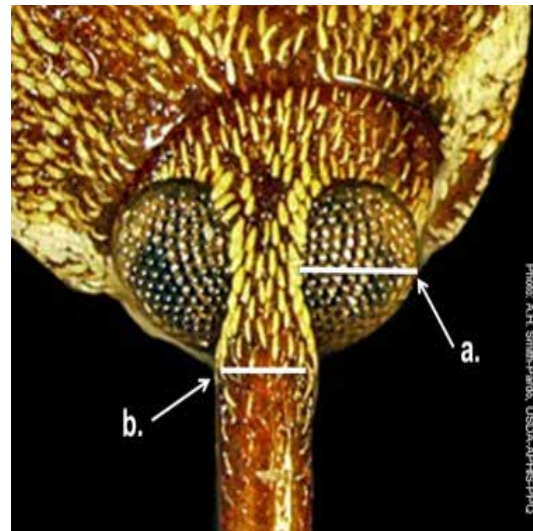


Figure 2. Head and part of rostrum and prothorax of *Anthonomus* sp. showing compound eyes' diameter (a) greater than base of rostrum (beak) (b)

Antennal funiculus with six or seven articles (Fig. 3)



Figure 3. Head and part of prothorax of *Anthonomus* sp. showing the antennal funiculus (in this case, with six segments).

Lateral rostral groove directed toward middle of compound eye (Fig. 4)



Figure 4. Head and part of prothorax of a specimen of *Anthonomus* sp. showing the lateral rostral groove (arrow).

Thorax

Legs:

Tarsal claws with stout teeth arising from the base (Fig. 5a) and forelegs with procoxae contiguous or, if separated, then profemur with a large, triangular tooth (Fig. 5b); profemur, if 1.5 times wider than metafemur, then profemoral tooth usually with shallow to deep emargination anteriorly; protibia usually straight.

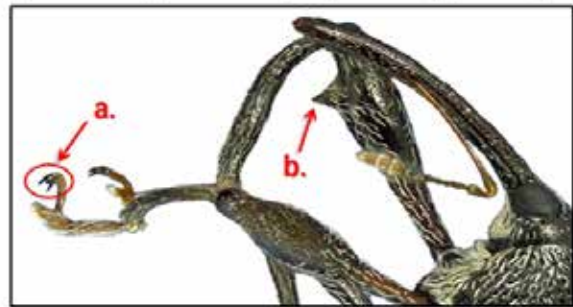


Figure 5. Head and front legs of *Anthonomus* sp., showing the tarsal claws (a) and the profemur with triangular tooth (b).

Mesocoxae separated by distance more than one-fourth the width of one coxa; mesotrochanter triangular (*Anthonomus* subgenus *Anthonomorphus* males have a trapezoidal mesotrochanter).

Wings with elytra not strongly convex (Fig. 6a), with their sides rounded toward the apex (Fig. 6b), and lacking a transverse basal patch of black scales; elytral elevations mostly absent or limited to odd-numbered inter-striae (Fig. 6c).



Figure 6. Photograph of elytra (lateral view) of *Anthonomus* sp.

Genitalia:

Examination of the genitalia requires dissection but it is useful for the separation of species. In particular, the shape of the median lobe of the male genital capsule is often used for separating related species as well as for assigning species to subgenera and species groups (Fig. 7, arrows).

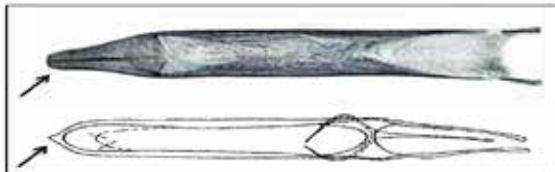


Figure 7. Male genital capsule of two species of *Anthonomus*. Top: photograph modified from Clark (1987); bottom: diagram modified from Hong (2001).

Immature:

Head capsule usually with four pairs of frontal setae (usually lacks f2) (Fig.8a) and anus located sub-terminally (i.e., not at the end of the body) (Fig. 8b, arrow).

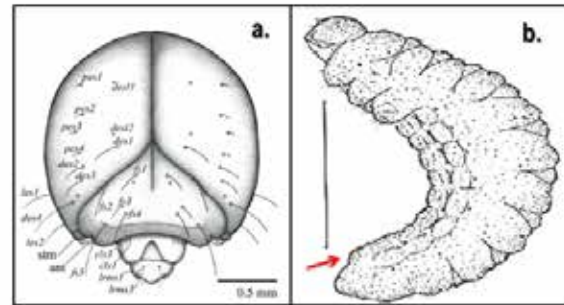


Figure 8. *Anthonomus* larval morphology: a. Head capsule in frontal view, modified from De Cassia Bená & Vanin (2013); b. Habitus in lateral view, modified from University of Florida (UF/IFAS) (2014).

Abdominal segments with three dorsal folds (Figs. 9a and 9b, arrows).

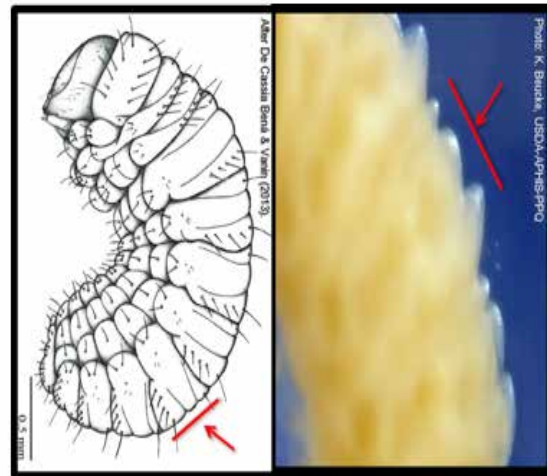


Figure 9. Immature of *Anthonomus* sp. a. Illustration of lateral habitus of larva (modified from De Cassia Bená & Vanin, 2013). b. Photograph of part of the larval abdomen (lateral view).

Below, I present photographs of the male and female of the six species of quarantine importance intercepted at U.S. ports of entry with some information

on distribution and hosts (figs 10-20). All of these species (with the exception of *A. grandis*) are not yet known to be present in Colombia and could be considered to be of quarantine importance in this country as well.

Anthonomus flavus Boheman

Distribution: Brazil, Guadeloupe Island, and introduced in Florida.

Hosts: Flower buds and fruits of *Malpighia* spp. and probably other Malpighiaceae (Stegmaier & Burke, 1974).

Interceptions at U.S. ports of entry: four interceptions: Puerto Rico (2), Dominican Republic (1), and Mexico (1).



Figure 10. Adult female of *Anthonomus flavus*. top left- lateral habitus, top right- dorsal habitus, bottom left lateral view of head and prothorax, bottom right dorsal view of head and prothorax and fore femur.



Figure 11. Adult male of *Anthonomus flavus*. top left- lateral habitus, top right- dorsal habitus, bottom left- lateral view of head and prothorax, bottom right- dorsal view of head and prothorax and fore femur.

Anthonomus grandis Boheman

Distribution: Originally from Mexico and Guatemala, also found in Texas (USA), Central and South (Argentina, Brazil, Colombia, and Venezuela) America, and the Caribbean.

Hosts: Malvaceae: *Gossypium* spp, *Cienfuegosia* spp., *Thespesia* spp., and *Hampea* spp.

Interceptions at U.S. ports of entry: 38 interceptions: Mexico (35), Colombia (1), Costa Rica (1), and Guatemala (1).



Figure 12. Adult female of *Anthonomus grandis*. top left- lateral habitus, top right- frontal view of head and prothorax and close view of forelegs, bottom left- lateral view of head and thorax, bottom right- dorsal habitus.



Figure 13. Adult male of *Anthonomus grandis*. top left- lateral habitus, top right- dorsal habitus, bottom left- lateral view of head and thorax, bottom right- frontal view of head and prothorax.

Anthonomus melanostictus Champion

Distribution: Central America (Panama & Nicaragua) and Mexico (PestID).

Hosts: Malvaceae.

Interceptions at U.S. ports of entry:
Mexico (1).



Figure 14. Adult female of *Anthonomus melanostictus*. top left- dorsal habitus, top right- ventral habitus, bottom left- lateral habitus, bottom right- dorsal habitus.

Anthonomus pomorum Linnaeus

Distribution: Mostly Palearctic in distribution (Europe and parts of Asia). Also present in Algeria.

Hosts: *Malus domestica* (apple) and *Pyrus communis* (European pear).

Interceptions at U.S. ports of entry: Switzerland (1), Italy (1), and Poland (1).



Figure 15. Adult female of *Anthonomus pomorum*. top left- dorsal habitus, top right- lateral habitus, bottom left- lateral view of head and prothorax, bottom right- frontal view of head and prothorax and forelegs.



Figure 16. Adult male of *Anthonomus pomorum*. top left- dorsal habitus, top right- dorsal view of head and prothorax,

bottom left- lateral habitus, bottom right- lateral view of head and prothorax.

Anthonomus rubi Herbst

Distribution: Europe, Asia, and North Africa.

Hosts: Flowers and fruits of the Rosaceae, in particular, strawberry (*Fragaria x ananassa* Duchesne) and raspberry (*Rubus idaeus* L.).

Interceptions at U.S. ports of entry: Netherlands (1).



Figure 17. Adult female of *Anthonomus rubi*. top left- dorsal habitus, top right- dorsal view of head and prothorax, bottom left- lateral habitus, bottom right- lateral view of head and prothorax.



Figure 18. Adult male of *Anthonomus rubi*. top left- dorsal habitus, top right- frontal view of head and prothorax, bottom left- lateral habitus, bottom right- lateral view of head and prothorax.

Anthonomus sisyphus Clark

Distribution: Mexico, Central America (Mexico, El Salvador, Nicaragua, Costa Rica, and Panama), and the Caribbean (Puerto Rico and Dominican Republic).

Hosts: Multiple plants in the families Leguminosae, Malpighiaceae, and Rubiaceae (see Clark 1987 for a complete list)

Interceptions at U.S. ports of entry: Mexico (11) (all on herbs).



Figure 19. Adult female of *Anthonomus sisyphus*. top left- lateral habitus, top right- dorsal view of head and prothorax, bottom left- lateral view of head and prothorax, bottom right- dorsal habitus.



Figure 20. Adult male of *Anthonomus sisyphus*. top left- lateral habitus, top right- frontal view of head and prothorax, bottom left- lateral view of head and thorax, bottom right- dorsal habitus.

Acknowledgements

I would like to thank Mrs. Kyra Metz (Entomologist, USDA-APHIS-PPQ) for arranging the loan of specimens from the Entomology Collection at Texas A&M University, Dr. Kyle Beucke (Entomologist, USDA-APHIS-PPQ) for his comments and for reviewing the original manuscript, Mr. Arthur Berlowitz (officer in charge at the USDA-APHIS-PPQ, Plant Inspection Station in South San Francisco) for his continuous encouragement of our work, and finally Dr. Sergio Orduz (chief editor of this bulletin) for his invitation to participate with this contribution.

Literature cited

Anderson RS. 2002. Curculionidae. In: Arnett R, Thomas M, Skelley P (Eds) American Beetles. Polyphaga: Scarabaeoidea through Curculionoidea. CRC Press LLC, Boca Raton. Pp 722-815.

Burke H. 1962. Studies on the genus *Anthonomus* in North America and Central America (Coleoptera: Curculionidae): some new and little known species from Mexico. *The South Western Naturalist* 7(3-4): 202-210.

Burke H. 1979. New species of Mexican and Central American *Anthonomus* (Coleoptera: Curculionidae). *The South Western Naturalist* 4(3): 201-208.

Burke H, Cross W. 1966. A new species of *Anthonomus* attacking cotton in Colombia, with a revision of the taxonomy of *Anthonomus vestitus* (Coleoptera: Curculionidae). *Annals of the Entomological Society of America* 59(5): 924-931.

Burke H, Clark W, Cross W. 1984. Larvae and pupae of the *Anthonomus* subgenus *Anthonomorphus* Dietz, *A. grandis* Boheman and *A. hunter* Burke & Cate (Coleoptera: Curculionidae). The Southwestern Entomologist 9(1): 84-90.

Kissinger D. 1964. Curculionidae of America North of Mexico. A key to the Genera. Taxonomic Publication, South Lancaster Massachusetts, 143p.

Olckers T. 2008. *Anthonomus santacruzii* Hustache (Curculionidae), a new biological control agent for bugweed, *Solanum mauritianum* Scopoli, in South Africa, poses no risks to cotton production. African Entomology 16(1): 137-139.

Soto M, Jones R, Reyes P. 2013. A key to the Mexican and Central America Genera of Anthonomini (Curculionidae, Curculioninae). Zookeys 260: 31-47.