EPPO Datasheet: *Anthonomus grandis*

Last updated: 2024-02-28

IDENTITY

Preferred name: *Anthonomus grandis*
Authority: Boheman
Taxonomic position: Animalia: Arthropoda: Hexapoda: Insecta: Coleoptera: Curculionidae: Curculioninae
Common names: Mexican cotton boll weevil, boll weevil, cotton boll weevil, thurberia weevil
view more common names online...
EPPO Categorization: A1 list
view more categorizations online...
EU Categorization: A1 Quarantine pest (Annex II A)
EPPO Code: ANTHGR

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Notes on taxonomy and nomenclature

Three forms or subspecies of boll weevils (*Anthonomus*) have been described, although only two subspecies have been validated by integrative taxonomy (Alvarado *et al*., 2017). The most economically important is the Southeastern American boll weevil, *Anthonomus grandis grandis*. Another subspecies is *Anthonomus grandis thurberiae*. The third form, the Mexican boll weevil, has intermediate morphological characters (Burke *et al.*, 1986, Roehrdanz, 2001). However, all forms are morphologically similar, which makes practical identification difficult, especially because when *A. grandis thurberiae* is reared on cultivated cotton or artificial diets, it tends to lose diagnostic morphological traits that allow distinction from *A. grandis grandis* (Burke *et al*., 1986). Recent studies have confirmed that populations found in cotton growing areas in South America are closely related to the Eastern lineage (*Anthonomus grandis grandis*) (Raszick *et al.*, 2021).

This datasheet provides data on the economically important species *Anthonomus grandis grandis.*

HOSTS

The principal host of *A. grandis grandis* is cotton, including *Gossypium barbadense*, *G. hirsutum* and wild *Gossypium* spp. (*Gossypium arboreum* and *Gossypium herbaceum*). Marginal reproduction has also been observed on the ornamental *Hibiscus syriacus* (Parrott *et al.*, 1966). Feeding and foraging on pollen have been reported on a number of different hosts from a number of plant families (Hardee *et al.*, 1999; Jones and Coppedge, 1999).

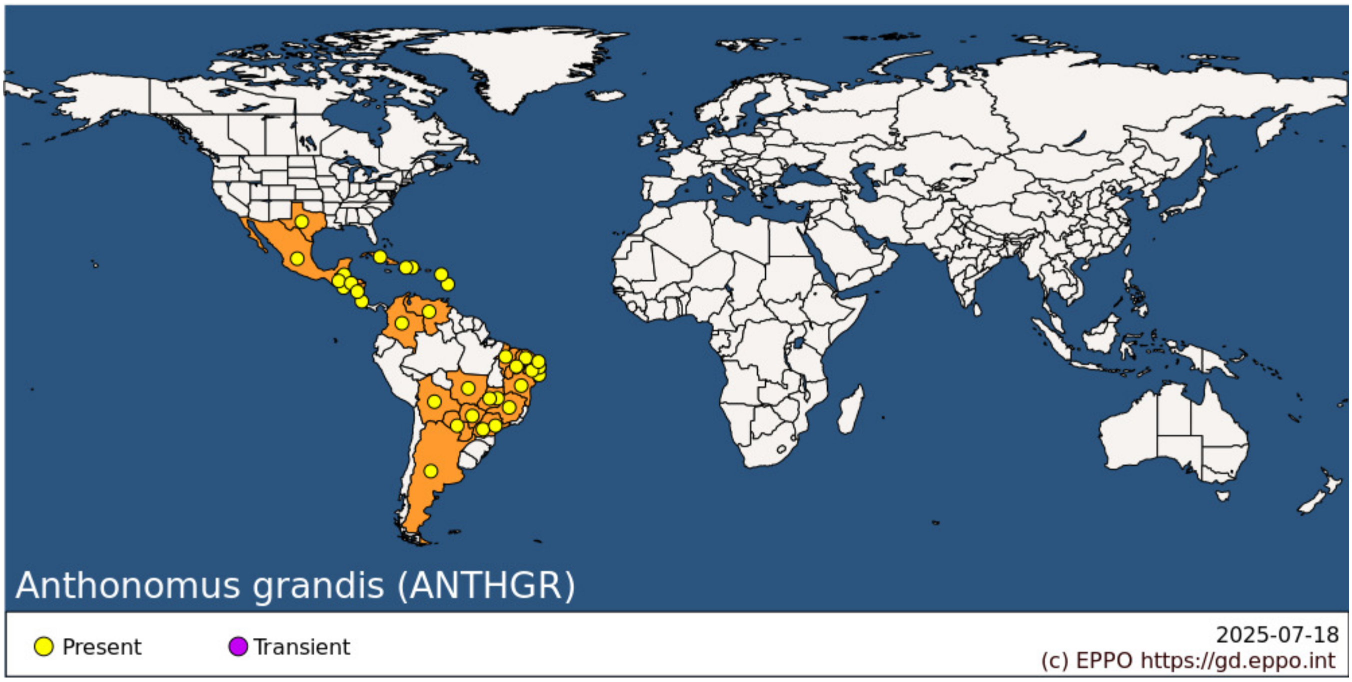
In the EPPO region, cotton is the only host to be considered. Wild Malvaceae might be attacked and act as reservoirs.

Host list: *Abutilon*, *Cienfuegosia drummondii*, *Cienfuegosia rosei*, *Gossypium arboreum*, *Gossypium aridum*, *Gossypium barbadense*, *Gossypium davidsonii*, *Gossypium harknessii*, *Gossypium herbaceum*, *Gossypium hirsutum*, *Gossypium laxum*, *Gossypium lobatum*, *Gossypium sp.*, *Gossypium thurberi*, *Gossypium turneri*, *Hampea nutricia*, *Hampea rovirosae*, *Hibiscus syriacus*

GEOGRAPHICAL DISTRIBUTION

Anthonomus grandis grandis is present across cotton growing areas in the Americas (South, Central, and North). From Mexico, the species spread into the United States of America in 1892, with the first report in the Lower Rio Grande Valley, Texas (Brazzel *et al.*, 1996). It has since spread throughout the cotton growing area in the USA before the initiation of an eradication programme in the 1970s (Perkins, 1980; Raszick, 2021). Due to the success of the eradication programme, *A. grandis grandis* has been eradicated from 98% of the cotton growing region in the USA (USDA, 2022).

The weevil is present throughout Central America. In South America, *A. grandis grandis* has been reported in Venezuela (1949), Colombia (1951) (Scataglini *et al.*, 2000), Brazil (1983) (Barbosa *et al.*, 1983), Paraguay (1991), Argentina (1984), and Bolivia (1999) (Stadler and Buteler, 2007).



North America: Mexico, United States of America (Texas)
Central America and Caribbean: Belize, Costa Rica, Cuba, Dominican Republic, El Salvador, Guatemala, Haiti, Honduras, Martinique, Nicaragua, Saint Kitts and Nevis
South America: Argentina, Bolivia, Brazil (Alagoas, Bahia, Ceara, Distrito Federal, Goias, Maranhao, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Paraiba, Parana, Pernambuco, Piaui, Rio Grande do Norte, Sao Paulo), Colombia, Paraguay, Venezuela

BIOLOGY

The post-embryonic development of the boll weevil undergoes three larval instars, the pupal stage, the pre-emergent adult stage, and finally, the adult stage. When feeding on large flower buds, developmental times for larva, pupa, and pre-emergent adult stages last, on average, 7.7, 2.0, and 4.2 days, respectively, at 25°C (Greenberg *et al.*, 2005a).

Females start laying eggs after reaching reproduction maturation (?3-4 days old). Females puncture the cotton fruiting structures to lay their eggs, usually one egg per structure. However, there can be more than one egg per structure, especially in late developing bolls (Neves *et al.*, 2013). Oviposition punctures form small protrusions and differ from feeding punctures, which are small, uncapped holes. Despite the plasticity in laying eggs on flower buds, flowers, and bolls, females prefer to lay eggs on larger flower buds (5.5 to 8.0 mm) (Showler, 2005). One female can lay seven to 11 eggs per day for up to 21 days (Lloyd, 1986), depending on the female age, availability of flower buds, and environmental conditions. Egg incubation lasts, on average, 2.1 days at 25°C (Greenberg *et al.*, 2005a), with the larvae showing developed head capsules and appendices seen through the chorion near the hatching time.

After completing development, the larvae moults and becomes a pupa inside a cell located inside infested buds and bolls. This structure will protect the adults formed, until they emerge from this structure (which may fall to the ground or remain on the plant).

A. grandis grandis can migrate long distances and it can disperse short distances. It hibernates in forest litter or on various malvaceous hosts, including regrowth cotton in warmer areas.

There is high mortality rate in weevil populations interseason. About 95% of the hibernating adults die. Furthermore, heat, dry weather, natural enemies, and birds help materially to check rapid multiplication. Without such natural interference, the offspring of a single pair of boll weevils could amount to several million in one season. Under favourable conditions, the life cycle of A. grandis grandis is completed in 17-21 days, and as many as seven generations may develop in a year in the extreme southern part of the Cotton Belt in the USA.

DETECTION AND IDENTIFICATION

Symptoms

Although adult weevils can feed on leaves and petioles, they only lay eggs on reproductive structures (Showler, 2007). Therefore, adults are commonly found in the flower buds and bolls protected by the bracts and in the centre of open flowers during warmer hours and are rarely seen on other parts of the plants. Because adults are not easily seen in the field, in the absence of the insect, the occurrence is assessed through damaged reproductive structures (buds, flowers, and bolls). As adults prefer flower buds over bolls for feeding and oviposition, they are most often seen in flower buds, especially the large (5.5-8.0 mm diameter) as well as the medium (3.0-5.4 mm diameter) sizes. Feeding and oviposition cause punctures at the base of flower buds, flowers, and bolls.

The bracteoles of oviposited flower buds spread out and turn yellow, and five to nine days after infestation, they turn brown and fall off (Silva *et al.*, 2015; Showler and Cantú, 2005).

Oviposited small bolls (up to one week after anthesis) also fall off. Older infested bolls, containing larvae and pupae, remain on the plants and open irregularly or do not open. Signs of adults feeding on plants terminal shoots and young leaves can be seen before the flowering stage. After moulting into adults, weevils leave fallen or retained structures through exits hole.

Morphology

Egg

Eggs are slightly elliptical, opaque 1 mm long (Leigh *et al.*, 1996).

Larva

A. grandis grandis larvae are C-shaped, legless, white to cream-colored, have a brown head, and strong mandibles. They can grow up to 13 mm long when fully developed.

Pupa

The pupae are 6-8 mm long, white to cream-colored, and resemble adults with visible legs, eyes, and mouthparts. According to Anderson (1968), female pupae can be distinguished from male pupae by the presence of a pair of lobes present near the anal opening in females, which are absent in males.

Adult

The adult is 5 to 8 mm long, with body weight varying as a function of food availability during the larval stage, reaching up to 20 mg (Greenberg *et al.*, 2005b). Larger adults, up to 24 mg, occur when larvae develop on bolls than on flower buds. The adult has a long, slender rostrum bearing the pair of antennae geniculate (=elbowed) nearer the tip than the base. The mouthparts are at the end of the rostrum. Two larger and one smaller spine are easily seen on the inner side of the femur of the front legs.. Eyes are large, convex, and sloping dorsally, in front at the base of the rostrum. Adults vary from brownish-red when recently molted to the adult stage to near black with aging. The pronotum and elytra are covered by dense, whitish pubescence. The male rostrum is less smooth than that of females and has more pits, pores, and scales. The female rostrum is usually larger and flatter than the male's (Soto and Reyes, 2014).

The posterior edge of the last tergite of the male (8th tergite), is notched in males and not in females (comparative pictures available at Agee, 1964; Sappington and Spurgeon 2000).

Detection and inspection methods

Visual examination of cotton plants is used to survey for *A. grandis grandis* but it can be difficult in large cotton fields, plants with dense foliage, and dense fruiting structures. In addition to the cryptic development the weevils as described above, adult boll weevils exhibit thanatosis (death feigning) when disturbed. At high levels of infestation, adults can be seen on the upper parts of the plants during the warmer hours of the day.

Anthonomus grandis grandis can be detected by using traps containing sex-and-aggregation pheromones. Traps containing rubber septum impregnated with pheromone are widely used to catch weevils when dispersing. Different tools have been tested, combining pheromones as an attractant and glue to hold the attracted weevils, or pheromone and the surface treated with an insecticide.

Despite the high efficacy of these tools in attracting and capturing weevils in certain circumstances, the efficacy of traps can be reduced due to the competition with the abundance of host and food availability and females inside the field. Kairomones have been incorporated in the mix with the aggregation pheromones to attempt to increase effectiveness (Magalhães *et al.*, 2016).

Nucleotide sequences from a segment of the mitochondrial cytochrome C oxidase subunit I (COI) gene can be used to separate *A. grandis grandis* from *A. grandis thurberiae* (Barr *et al.*, 2013; Alvarado *et al.*, 2017).

PATHWAYS FOR MOVEMENT

In international trade, boll weevils may be carried with cotton seeds or bolls, with raw cotton and various cotton products (EFSA, 2017). Additionally, ornamental Malvaceae plants for planting (e.g. *Hibiscus* spp.) may be a pathway for movement though it should be noted that only marginal reproduction is shown (Parrott *et al.*, 1966).

Natural dispersal can occur through flight and walking. The dispersal of adults right after emergence from fallen buds is predominantly achieved by walking to reach the base of nearby plants. In arid areas, thermal convection may disperse flying adult weevils over long distances. In central Texas, the greatest dispersal occurs from mid-August to September.

PEST SIGNIFICANCE

Economic impact

Boll weevil has been one of the most important pests on cotton in the USA (Schwartz, 1983; Williams, 1997). Since its entry into Texas (USA) in the 1890s, *A. grandis grandis* destroyed and reduced the quality of several billion USD worth of cotton, in an area of over 3 million ha. In the 1970s, USA cotton producers lost 200 million USD or more annually with suppression costing an additional 75 million USD annually; in fact, nearly one third of all pesticides applied to crops in the USA in the 1970s were used to control this pest.

Nowadays, *A. grandis grandis* is largely under control in the USA, though the pest still causes significant economic damage to cotton in South America (Burbano-Figueroa *et al.*, 2021).

Control

Suppressing *A. grandis grandis* populations requires the adoption of different control tactics of Integrated Pest Management in the cotton crops. Their efficacy and use depend on the production system adopted from low- to high-input conventional cropping systems. Preventive tactics can be applied field-by-field but these have more efficacy when applied regionally. These are cultural control practices aimed at avoiding pest infestation. Collecting and destroying fallen fruiting structures in small fields can reduce population growth (Neves *et al.*, 2013). Furthermore, trap crops established by seeding a strip of cotton plants earlier on the border of the definitive fields can detect infestation so that the grower can take localized curative control, reducing the number of future generations. Other measures, such as the adoption of adequate row spacing (Paim *et al.*, 2021) and suitable planting dates (Santos *et al.*, 2023), good control of cotton volunteer plants reduce the overall pest populations that can cause outbreaks.

Other control measures could include:

- Biotechnological control: transgenic Bt-cotton has been tried but not successfully obtained up to date; likewise, the use of the sterile insect technique (SIT) has been developed; use of pheromones (e.g. the aggregation pheromone grand lure) for mass-trapping is the most applied tool to detect boll weevil populations at the beginning of cultivation (when the cotton plants do not have reproductive structures).
- Biological control: conservation biological control; inundative biological control with the entomopathogenic fungus *Beauveria bassiana*, mass release of the parasitoid *Catolaccus grandis* (Hymenoptera: Pteromalidae).
- Chemical control: use of different pesticides is the most common curative tactic (Torres *et al.*, 2022), often timed according to captures in pheromone traps, and applied after reaching 3-5% flower bud infestation with up to five applications, spaced 5 days to kill all adults as they emerge.
- Use of less preferred cultivars.

Phytosanitary risk

A. grandis grandis is essentially a subtropical pest, so that the cotton-growing area at greatest risk in the EPPO region would be the Mediterranean zone. It is questionable whether the weevil could survive the low winter temperatures of the Central Asian cotton-growing areas. For many years, *A. grandis* was confined in the USA to the more humid regions of the south, where there were significant amounts of summer rainfall. It was assumed that the insect could not survive in the hot, arid regions of the south-west. In the early 1950s, however, it gradually moved westward into some of these formerly unoccupied areas, and this further confirms the risk to Mediterranean countries.

PHYTOSANITARY MEASURES

Appropriate measures may include that cotton growing countries in the EPPO region can source seed or bolls of cotton from an area free from the pest (Pest Free Area). Raw cotton from the same origin (including waste fabric, waste cotton, cotton seed cake, meal, and bags that have been used as a container for lint or any form of unmanufactured cotton) can be treated in such a way that the material will be free from the pest. See EPPO (2018) for fumigation of cotton and cotton products.

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Datasheet history

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Database. The sections on 'Identity', ‘Hosts’, and 'Geographical distribution' are automatically updated from the database. For other sections, the date of last revision is indicated on the right.

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