Prepared by CABI and EPPO for the EU under Contract 90/399003

Data Sheets on Quarantine Pests

Anthonomus grandis

IDENTITY

Name: *Anthonomus grandis* Boheman
Taxonomic position: Insecta: Coleoptera: Curculionidae
Common names: Boll weevil (English)
Anthonome, charançon américain de la capsule (French)
Mexikanischer Baumwollkapselkäfer (German)
Notes on taxonomy and nomenclature: The species is segregated by several adult characteristics into:

a) *A. grandis grandis*: South-eastern boll weevil.
b) *A. grandis thurberiae*: Thurberia boll weevil.
c) Intermediates: Mexican boll weevil.

Bayer computer code: ANTHGR
EPPO A1 list: No. 34
EU Annex designation: II/B

HOSTS

The principal host of *A. grandis grandis* is cotton, including *Gossypium barbadense*, *G. hirsutum* and wild *Gossypium* spp. There is also significant reproduction of boll weevils in nature on a number of wild malvaceous hosts, including weeds. Marginal reproduction has also been observed on the ornamental Hibiscus syriacus. *A. g. thurberiae* mainly feeds on the wild *Gossypium thurberi* but also on cultivated cotton. For more information see Cross *et al.*, 1975.

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

GEOGRAPHICAL DISTRIBUTION

A. grandis is indigenous to Central America (probably originating in southern Mexico and Guatemala) and spread into the USA (Burke *et al.*, 1986), where it was first recorded in Texas in 1898, and into the Caribbean. It has since spread to all cotton-growing areas of the USA and recently to Brazil.
EPPO region: Absent.
Africa: One or two records appearing in the literature are unconfirmed.
North America: *A. g. grandis* occurs (or has occurred) in south-eastern USA (Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, Missouri, North Carolina (eradicated), Oklahoma, South Carolina, Tennessee, Texas, Virginia (eradicated)) and north-eastern Mexico. *A. g. thurberiae* occurs or has occurred in south-western USA (Arizona, California (eradicated)) and north-western Mexico; intermediates occur in the rest of Mexico. As the boll weevil eradication programme continues in the USA (see Pest significance), it may become possible to remove more of the above states of the USA from the list.

Central America and Caribbean: *A. g. grandis* occurs in El Salvador, Haiti and the Dominican Republic, while other populations in Central America (Belize, Costa Rica, Guatemala, Honduras, Nicaragua) and Caribbean (Cuba) are intermediate between the two subspecies.
South America: *A. g. grandis* occurs in Argentina, northern Colombia, Ecuador, Paraguay and Venezuela, and since 1983 in Brazil. It is under eradication in São Paulo.
EU: Absent.
Distribution map: See IIE (1993, No. 12).

BIOLOGY

Under favourable conditions, the life cycle of *A. g. 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. Negligible oviposition occurs before diapause, but diapausing females about 30 days old often become reproductive. In Texas, peak emergence of overwintered adults occurs in mid-May. They feed on developing cotton foliage and the females lay eggs singly in cotton flower buds. In cases of high weevil populations and shortages of buds, two or more eggs may be laid in one bud; however, this is of minor significance since only one weevil matures in a flower.

Late in the season, eggs are laid both in flower buds and in young bolls. Eggs hatch in 3-5 days; 50-51 h is the minimal time for egg development at 30°C. The larvae feed for 7-12 days inside the flower or boll and then pupate. This stage lasts 3-5 days. The emerging adults cut their way out of the flowers or bolls and after feeding for 3-7 days they mate. The females begin egg-laying within 20 min of mating, depositing one egg per hour in daylight. Successive multiple matings occur, the females being attracted by a male pheromone.

A. g. grandis migrates and hibernates in forest litter or on various malvaceous hosts, including volunteer and regrowth cotton in warmer areas. *A. g. thurberiae* has never been found in litter, but diapauses as an unfed adult and remains trapped in the larval cell in the wild host (*Thurberia thespesioides*) until the summer rains (100-175 mm) free it. On this host, *A. g. thurberiae* has only one small and one major generation per year. The Mexican boll weevil (intermediate form) survives in larval cells in cotton bolls, but adults have also been found overwintering in suitable litter.

Total developmental periods recorded in the laboratory were 17 and 88 days for the Mexican boll weevil and 17.5 and 72.5 days for *A. g. thurberiae* at 30 and 15°C, respectively. For both forms, a temperature of 35°C prolonged the developmental period; in Arizona, high temperatures during June-August were reported to suppress boll weevil populations.

There is extremely high mortality in weevil populations. About 95% of the hibernating adults die; heat, dry weather, insect parasites and predators 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.

For more information, see Anon. (1962), Cross (1973).

DETECTION AND IDENTIFICATION

Symptoms

The early stage of attack is recognizable by a small puncture (either egg or feeding puncture) at the side of the flower bud. The bracteoles subsequently spread out, and buds turn brown and fall off. In later attacks, flowers turn yellow and fall to the ground, as do small bolls. Punctured large bolls usually remain on the plant, but will be of poor quality.

For more information, see Anon. (1962), Cross (1973).

Morphology

Larva

White and legless.

Adult

Elongated oval weevil, grey-brown to almost black, measuring about 5 mm without the rostrum, which is 3 mm long and round. The upper side of the elytra is pale, marked by fine parallel lines and moderately densely clothed with smooth hairs. All femora, and especially the front pair, are provided with a strong tooth on the inner side.

MEANS OF MOVEMENT AND DISPERSAL

Especially in arid areas, thermal convection may disperse flying adult weevils for long distances; up to 72 km has been recorded. In central Texas, greatest dispersal occurs from mid-August to September. In international trade, boll weevils may be carried with cotton seeds or bolls, with raw cotton and various cotton products (see Phytosanitary measures).

PEST SIGNIFICANCE

Economic impact

Since its entry into Texas in the 1890s from Central America, the boll weevil has destroyed and reduced the quality of several billion dollars' worth of cotton, over 3 million ha. In the 1970s, USA cotton producers lost 200 million US$ or more annually; suppression costs an additional 75 million US$ annually; in fact, nearly one third of all pesticides applied to crops in the USA are used to control this pest. Azinphos-methyl and parathion-methyl have been the two most widely used insecticides, together, more recently, with pyrethroids.

Control

In a comprehensive review of cotton insect management in the USA (Ridgway *et al.*, 1983), two main control strategies are developed, together with the supporting technology: field-by-field management in relation to economic thresholds; area-wide population reduction, with the possibility of eradication. The management strategy relies on trapping with the pheromone grandlure (Benedict *et al.*, 1985). This is done early in the season to time the first insecticide applications (Henneberry *et al.*, 1988). Trapping is also used to suppress low-level boll weevil populations (Leggett *et al.*, 1988). An Optimum Pest Management Trial was carried out in Mississippi in 1978-1980, and provided a thorough test of available technology for suppression of *A. grandis* during the period of diapause entry in late summer and autumn. Release of sterile males is an important new technique in boll weevil suppression (Haynes & Smith, 1989; Villavaso *et al.*, 1989). Other elements of the control strategy (Cross, 1973; Davich, 1976) include biological control utilizing natural parasites, predators and pathogens, resistant cultivars, and suppression of possible overwintering sites (e.g. cotton regrowth).

A Pilot Boll Weevil Eradication Experiment in the south Mississippi area in 1971-1973 was followed by a Weevil Eradication Trial in North Carolina in 1978-1980 to test the feasibility of eradicating the boll weevil with available techniques. Since then, the US Boll Weevil Eradication Project has conducted successful eradication programmes in California, North Carolina and Virginia. By 1990 it had been extended to Arizona, Florida and parts of Alabama and Georgia, as well as north-western Mexico. An area-wide suppression programme has also successfully mobilized massive resources in Nicaragua (Swezey & Daxl, 1988).

Publications on boll weevil control are numerous, including the following recent reviews: Lloyd (1986), Pencoe & Phillips (1987), Fisher (1989).

Phytosanitary risk

A. grandis is listed as an A1 quarantine pest by EPPO (OEPP/EPPO, 1979), and also has quarantine significance for APPPC, IAPSC and CPPC. This is clearly justified by the massive economic importance of the pest in the Americas, and the problems which arise in its control. *A. 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 boll weevil could survive the low winter temperatures of the Central Asian cotton-growing areas of the former USSR. For many years, the boll weevil 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

EPPO recommends (OEPP/EPPO, 1990) that cotton-growing countries should prohibit importation of seeds or bolls of cotton from countries (or states in the USA) where *A. grandis* occurs. Raw cotton from the same origin (including waste fabric, waste cotton, cotton seed cake, meal, bags that have been used as a container for lint or any form of unmanufactured cotton) should be fumigated (with phosphine or methyl bromide; FAO, 1983). There is no obvious pathway from EPPO countries not producing cotton to those mainly concerned about the pest, so no special measures are recommended for them except to list *A. grandis* as a quarantine pest (OEPP/EPPO, 1990).

In South America, where the boll weevil is liable to spread to new areas, networks of pheromone traps are being established along the Paraguay-Brazil border to intercept the pest (Whitcomb & Marengo, 1986).

BIBLIOGRAPHY

Anon. (1962) The boll weevil; how to control it. *Farmers' Bulletin, US Department of Agriculture* No. 2147, 12 pp.

Benedict, J.H.; Urban, T.C.; George, D.M.; Segers, J.C.; Anderson, D.J.; McWhorter, G.M.; Zummo, G.R. (1985) Pheromone trap thresholds for management of overwintered boll weevils. *Journal of Economic Entomology* **78**, 169-171.

Burke, H.R.; Clark, W.E.; Cate, J.R.; Fryxell, P.A. (1986) Origin and dispersal of the boll weevil. *Bulletin of the Entomological Society of America* **32**, 228-238.

Cross, W.H. (1973) Biology, control and eradication of the boll weevil. *Annual Review of Entomology* **18**, 17-46.

Cross, W.H.; Lukefahr, M.J.; Fryxell, P.A.; Burke, H.R. (1975) Host plants of the boll weevil. *Environmental Entomology* **4**, 19-26.

Davich, T.B. (1976) *Boll weevil suppression, management and elimination technology. Proceedings of a conference, February 13-15, 1974, Memphis, Tennessee*, iv + 172 pp. Southern Region, ARS, US Department of Agriculture, New Orleans, USA.

FAO (1983) International plant quarantine treatment manual. *FAO Plant Production and Protection Paper* No. 50, pp. 143-144. FAO, Rome, Italy.

Fisher, R.W. (1989) The influence of farming systems and practices on the evolution of the cotton-boll weevil agroecosystem in the Americas - a review. *Agriculture, Ecosystems and Environment* **25**, 315-328.

Haynes, J.W.; Smith, J.W. (1989) Evaluation of a new method of sterilizing boll weevils by dipping in a diflubenzuron suspension followed by irradiation. *Journal of Economic Entomology* **82**, 64-68.

Henneberry, T.J.; Meng, T.; Bariola, L.A. (1988) Boll weevil: grandlure trapping and early-season insecticide applications in relation to cotton infestations in Arizona. *Southwestern Entomologist* **13**, 251-259.

IIE (1993) *Distribution Maps of Pests, Series A* No. 12 (2nd revision). CAB International, Wallingford, UK.

Leggett, J.E.; Dickerson, W.A.; Lloyd, E.P. (1988) Suppressing low level boll weevil populations with traps: influence of trap placement, grandlure concentration and population level. *Southwestern Entomologist* **13**, 205-216.

Lloyd, E.P. (1986) The boll weevil: recent research developments and progress towards eradication in the USA. In: *Agricultural Zoology Reviews* (Ed. by Russell, G.E.), Vol. 1, pp. 109-135. Intercept, Newcastle upon Tyne, UK.

OEPP/EPPO (1979) Data sheets on quarantine organisms No. 34, *Anthonomus grandis*. *Bulletin OEPP/EPPO Bulletin* **9** (2).

OEPP/EPPO (1990) Specific quarantine requirements. *EPPO Technical Documents* No. 1008.

Pencoe, N.L.; Phillips, J.R. (1987) The cotton boll weevil: legend, myth, reality. *Journal of Entomological Science* Supplement 1, 30-51.

Ridgway, R.L.; Lloyd, E.P.; Cross, W.H. (1983) *Cotton insect management with special reference to the boll weevil*, *USDA Agriculture Handbook* No. 589. US Department of Agriculture, Beltsville, USA.

Swezey, S.L.; Daxl, R.G. (1988) Area-wide suppression of boll weevil populations in Nicaragua. *Crop Protection* **7**, 168-176.

Villavaso, E.J.; Roberson, J.L.; Seward, R.W. (1989) Effectiveness of sterile boll weevils against a low-density population in commercially grown cotton in northcentral Mississippi. *Journal of Economic Entomology* **82**, 472-476.

Whitcomb, W.H.; Marengo, R.M. (1986) Use of pheromones in the boll weevil detection and control program in Paraguay. *Florida Entomologist* **69**, 153-156.