

# Was the Silver Y Moth *Autographa gamma* (Lepidoptera: Noctuidae: Plusiinae) in South America?

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## Abstract

In this study we confirmed former records of *Autographa gamma* in South America by examining four individuals collected in different locations of Brazil and Uruguay. Species identity was established by examining male and female genitalia morphology. Some, but not all, location records are in the vicinity of cities with large seaports used for commercial trades of agricultural goods. Additionally, literature records indicate this species was using local hostplants. Furthermore, additional reports states that this species had large populations during the end of thirties decade but vanished after that without further justification. Here we discuss aspects related to a possible reintroduction of species in the future as a consequence of the increasing world trade business.

**Keywords:** invasive species, quarantine species, natural extinction sampling and detection, semilooper

## 1. Introduction

The introduction of pest species across continents is one of the main concerns of governmental pest control agencies, due to economic losses caused by alien species (Paini, Sheppard, Cook, De Barro, Worner, & Thomas 2016). The increasing world globalization and food trade raises the thread of invasions, especially to those countries dependent on agriculture (Early et al., 2016). Despite the worldwide efforts related to monitoring international food trade, recent pest species invasions are still being recorded. This is the case of noctuid species whose larvae defoliates several crop species of great economic importance (Hill & Gatehouse, 1992). For example, *Helicoverpa armigera* (Hübner, [1808]) has been recently reported and spread in America (Czepak, Albernaz, Vivan, Guimarães, & Carvalhais, 2013; Specht, Sosa-Gómez, Paula-Moraes, & Yano, 2013; Kriticos et al. 2015). Although it was reported in 2013 (Czepak et al., 2013) the examination of specimens deposited in entomological collections in Brazil revealed that *H. armigera* had already been present in Brazil since 2008 (Sosa-Gómez et al., 2016). Similarly, *Spodoptera frugiperda* (J.E. Smith, 1797) was recently recorded in Africa (Goergen, Kumar, Sankung, Togola, & Tamò, 2016), already causing severe damages to food production in this continent. These moths are known to develop different resistant strategies to chemical pesticides and transgenic plants, making them very difficult to control in the new habitat (Kergoat et al., 2012).

On the other hand, there are also historical cases when alien species went extinct after reported feeding in crop species outside its natural habitat range (Hoddle, 2006). Such reports deal sometimes with taxonomic problems when species identification is misleading. Thus, precise taxonomical identification of historical invasions is fundamental to estimate the likelihood of these species to reestablish in the same habitat after a new invasion event. In this communication, we confirm the historical records of the presence of silver Y moth *Autographa gamma* (Linnaeus, 1756) in South America (Biezanko & Freitas, 1938; Parseval, 1939; Redaelli, 1948; Biezanko, Bertholdi, & Baucke, 1949; Biezanko, Ruffinelli, & Carbonell, 1957; Bertholdi & Biezanko, 1950, 1951; Bertels, 1956; Costa, 1958; A. G. D. A. Silva, Gonçalves, Galvão, Gonçalves, Gomes, N. M. Silva, & Simoni, 1968; Specht & Corseuil, 1996) by studying the genitalia of specimens deposited in Brazilian museums.

## 2. Method

Aiming to confirm the literature records of *Autographa gamma* in South America, we searched for voucher specimens deposited in entomological collections nearby the species presence was originally reported. The scientific collections visited were: CAMB—Coleção Andréj Menschoy Bertels of the Embrapa Clima

Temperado; DZUP—Coleção Entomológica Pe. Jesus Santiago Moure, MECB—Museu Entomológico Ceslau Biezanko of the Universidade Federal de Pelotas (UFPeI); MRGC—Museu Ramiro Gomes Costa of the Fundação Estadual de Pesquisa Agropecuária do Rio Grande do Sul (FEPAGRO), and VOB—Collection of V.O. Becker. After finding specimens similar to *A. gamma* collected in South America, we dissected and compared male and female genitalia with specimens collected in Europe and Asia.

### 3. Results

After analyzing the moth collection from all these collections, we confirm the presence of four specimens of *A. gamma* deposited in the following Brazilian collections: 1) Penedo/Resende, Rio de Janeiro, Brazil, 7-XI-67, male (VOB); 2) Pelotas, Rio Grande do Sul, Brasil, C. Biezanko det., 16-VI-37, female without abdomen (MECB), 3) Pelotas, Rio Grande do Sul, Brasil, 25-II-1939, C. Biezanko det., female (MRGC); 4) Montevideo, Uruguay, M.A. Monné, no date, male (VOB).

Description: Wingspan length 3.9 mm in female and 4.1 mm in males, similarly to specimens found in Europe (Ronkay, Ronkay, & Behounek, 2008). General pattern of wing markings and coloration is similar on both sexes (Figure 1). The male genitalia present a lamella-shaped valva with a truncated apex. Also, the edeago presents a large spine at the base of the vesica, which distinguishes it from *Autographa californica* (Speyer, 1875), a sibling species that occurs in North America (Lafontaine & Poole, 1991). Furthermore, part of vesica clothed by several small spines, besides the leedle-like cortunto. The female genitalia present distinct sclerotizations both in bursa duct and in the anterior lobe of corpus bursae. Both genitalia match with those of other specimens collected in Italy and Belgium (DZUP) and with illustrations provided by Lafontaine and Poole (1991) and Ronkay et al. (2008).



Figure 1. *Autographa gamma*: A. Female dorsal and ventral view; B. Female dorsal and ventral view



Figure 2. *Autographa gamma* genitalia: Above left: posterior view of male genitalia; below left: lateral view ofedeago; right: posterior view of female genitalia

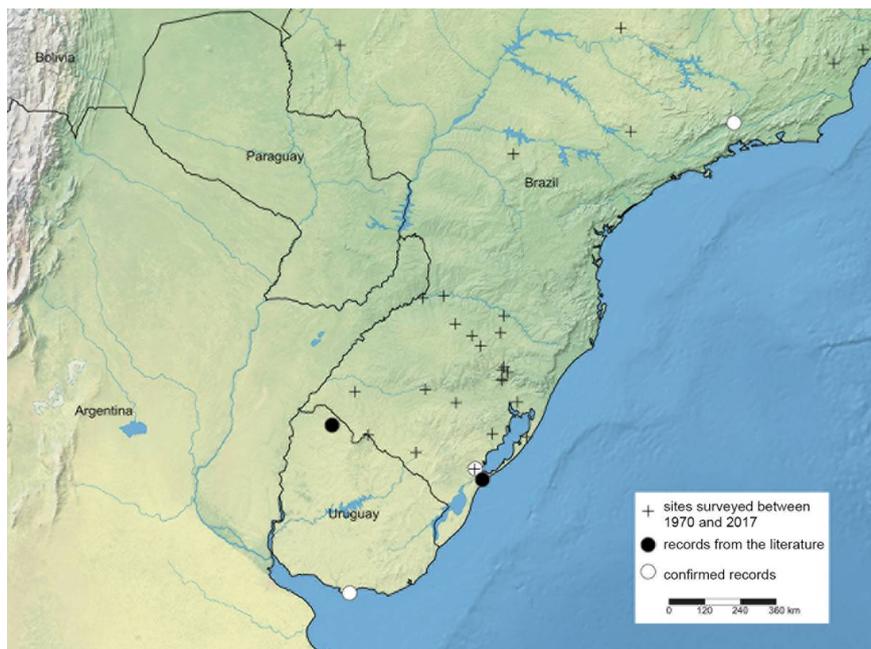


Figure 3. *Autographa gamma* historical distribution in South America. White spots represent places where specimens has been collected and remain preserved in Brazilian museums; black spots represent places where the literature indicates that specimens collected and crosses represent sites sampled since the 1970s without any record until 2017

#### 4. Discussion

The first bibliographical record of *A. gamma* in South America is that from Biezanko and Freitas (1938), who mentioned it to be an eminent threat to Brazilian agriculture due to several specimens captured in the field. However, since they did not provide genitalia drawings nor a taxonomic description or diagnoses, its true identity was still suspicious. Here, we found several additional evidences to support that *A. gamma* was present

in South America, at least in the cities of Rio de Janeiro, Pelotas (Brazil) and Montevideo (Uruguay). In addition to the sites where voucher specimens were found, the literature records it also in Arroio Tres Cruces, Artigas, Uruguay (Biezanko et al., 1957) and in the city of Rio Grande, Rio Grande do Sul, Brazil. Therefore, the species was not only present in South America but also had wide geographical distribution. During our visit at MECB, we found an unpublished manuscript of C. Biezanko reporting detailed information about the species. C. Biezanko mentions in this document that Dr. W. T. M. Forbes, Cornell, N. Y., USA confirmed himself the identification of *Plusia gamma*, quoting: “Your *Plusia gamma* have surprised me very much. They are in fact *gamma* as you thought, and it must be an introduction from Europe. I have compared the genitalia with specimen I caught in France and also with our northern *P. californica*, which is supposed to be a race of *gamma*. In fact, yours are true *gamma*, while *californica* is a little different”. Further, Biezanko mentioned that *A. gamma* was common in Pelotas and in the surrounding areas until the beginning of 1960s.

In Rio Grande do Sul State, Silva et al. (1968) recorded *A. gamma* larvae feeding on: Apiaceae: Parsley—*Petroselinum crispum* (Mill.) Nyman ex A.W. Hill; Brassicaceae: Collard—*Brassica oleracea* L. var. *viridis* L.; Cabbage—*Brassica oleracea* var. *capitata* L.; Chenopodiaceae: Chard—*Beta vulgaris* L. ssp. *cicla* (L.) W.D.J. Koch; Beet—*Beta vulgaris* L.; Spinach—*Spinacia oleracea* L.; Fabaceae: Bean—*Phaseolus vulgaris* L.; Pea—*Pisum sativum* L.; Clover—*Trifolium incarnatum* L.; Sainfoin—*Onobrychis viciifolia* Scop.; Serradela—*Ornithopus sativus* Brot.; Linaceae: Flax—*Linum usitatissimum* L.; and Solanaceae: Potato—*Solanum tuberosum* L. Therefore, there is enough evidence to support the species was not only present by occasional records, but certainly established populations in Southern South America during this period. Elsewhere, *A. gamma* is known as a destructive and migratory insect that feeds on more than 311 plant species throughout Europe and Asia (Noma et al., 2010). Consequently, it is currently included in the quarantine list of the United States under the status of high invasive risk (Noma et al., 2010). In this country, the silver-Y moth has been intercepted in more than 130 imported plants samples, most commonly on cut flowers exported from the Netherlands (USDA-APHIS, 2010) and the possible establishment of this species determined structured surveys of its occurrence using pheromones in approximately 20 US states through the USDA’s Cooperative Agricultural Pest Survey (CAPS) program (Zink, Tembrock, Timm, & Gilligan, 2018).

On the other hand, several evidences suggest its local extinction after the 1970s Biezanko’s unpublished appointments reported that the larvae could not be found in the region. Several Noctuid systematical samplings (Figure 3) have been conducted in Southern South America, recording several species of Plusiinae, except for *A. gamma* (Tarragó, Carvalho, & Link, 1975; Link, 1977; Silveira-Neto, Monteiro, Zucchi, & Moraes, 1995; Specht & Corseuil, 2002; Specht, Teston, Di Mare, & Corseuil, 2005; Zenker, Botton, Teston, & Specht, 2010; Specht et al., 2013). These samplings were sometimes performed monthly, during more than one year, suggesting that a major collecting effort was taken during the last four decades without any additional record. Intriguingly, *A. gamma* populations are also declining in Netherlands and in the Great Britain (Fox et al., 2013; Ellis, 2016), and the reason justifying this decline is still debated among effects of strong deleterious nitrogen deposits, immigration rates reduction, and global changes (Wallis de Vries & Van Swayy, 2006; Ellis, 2016).

We are therefore convinced of the extinction of this species due to the bibliographical reports that mention the absence of larvae and adults from the 1970s and recent exhaustive collections throughout the area of occurrence without finding a single specimen. Henceforth, knowing the past occurrence of this species in Brazil allows us to consider an especial carefulness and improvement of control practices of national imported food to avoid its possible reintroduction. Thought we do not know the specific reason why this species has vanished, the amount of records both from deposited specimen and literature between the 30’s to the 70’s, in distant locations in South America, associated with crop species, suggests that this species is likely to be reintroduced, thus becoming a serious threat to several types of economically agricultural goods (USDA-APHIS, 2010; Zink et al., 2018). Therefore, all southern South American countries that share similar climate and crop species production (such as Brazil, Uruguay and Argentina) should also focus their interception quarantine services on specific species target, once the establishment of noctuid species in a new continent could be followed by a prompt geographical dispersal and population outbreaks (Kriticos et al., 2015; Georgen et al., 2016). *A. gamma* is known to be a primate migrant in the Palearctic thus ranging practically all parts of Europe including a wide variety of habitats and climate conditions (Ronkay et al., 2008). Therefore, its interception in South America should be carefully monitored once its establishment could generate additional concerns to the food production in the southern part of the continent.

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