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The Interfruta Project and its Contribution to the Knowledge of Chestnut Moth (*Cydia splendana* Hubner) (*Lepidoptera: Tortricidae*) Dispersal and Infestation on Terceira Island, Azores

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Keywords: chestnut moth, *Cydia splendana*, monitoring, infestation percentage, flight curve

Abstract

The chestnut moth is one of the principal pests on Terceira Island affecting the quality of all chestnut production. Investigation work developed by the Interfruta II Project (a project of interregional cooperation among the three Atlantic regions: Azores, Madeira and Canaries) aims at increasing interest in fruit and the vineyard production in the three partner regions. The chestnut moth (*Cydia splendana* Hubner) (*Lepidoptera: Tortricidae*) is the only specie responsible for chestnut fruit damage.

The monitoring of this pest using Delta traps with sex pheromone revealed the adult abundance during the season. The higher activity period was between July and October, the months when the chestnut harvest begins.

A map of Terceira Island using a GPS and ArcGis 8.0 software was made showing the locality of all the chestnut production areas studied.

In the evaluated orchards, fruit damage reached its maximum of 38% at Terra Chã, 218 m of altitude and a southern exposure, and a minimum of 0% damage at Biscoitos, at about the same altitude but with a northern exposure. In both cases, the percentages of infestation were achieved by analyzing a sample of 2.500 chestnuts for each parcel of land.

INTRODUCTION

The chestnut fruit production culture in Europe started on the Mediterranean region, expanded through the center, West and then to the Azores, Madeira and Canaries Archipelagos (Ventura, 2005) (cit. Fernandes, 1987).

The chestnut presence in the Azores Islands dates back to the beginning of the XIX century, where this culture appears from 100 and 200 meters of altitude in places with some wind protection, deep and permeable soil (Fernandes, 1987) (cit. Ormonde, 1994).

The economic and social importance of this culture reached significant proportions on Terceira Island just as what happened in some regions of mainland Portugal and throughout Europe, where the culture was more extensive.

On Terceira Island, the areas with the greatest extent of this fruit production were, and still are, Terra Chã and its surroundings (S. Pedro, Posto Santo, S. Mateus and S. Bartolomeu).

In the northern part of the island it is still possible to find some isolated orchards of chestnut trees covering a wide area (Altares, Biscoitos, Quatro Ribeiras). In other localities chestnut production is only residual or has even ceased (Ormonde, 1994).

The chestnut moth is nowadays one of the principal pests on Terceira Island affecting the quality of chestnut production.

Because of this, some special attention has been given to *C. splendana* with the

goal of improving its control. The larvae develop inside the fruit and create small tunnels, leaving behind excrement. This type of larval activity causes the fruit economic depreciation making it unfit for human consumption.

The principal goals of this study were to: create a map of chestnut orchards; identify which were the species that were causing fruit damage; obtain adult flight activity for the species present; and make fruit damage evaluations caused by the larvae of this pest that affects the growing fruit.

MATERIAL AND METHODS

To create the chestnut orchard location map, a Garmin GPS was used to mark one point for each orchard and after that, making use of ArcGis 8.0 software, the output map came out as shown in Figure 1.

In the evaluated chestnut orchards, with the goal of finding out which one of the following three species: *Cydia splendana*, *Pammene fasciana* or *Cydia fagiglandana* were present on Terceira Island, Delta traps with a specific sex pheromone for each species from two different commercial houses (Econex and Biosani) were placed in the orchards. In the six chestnut orchards in the three evaluated zones (Terra Chã, Posto Santo and Biscoitos) one trap was positioned in each orchard for four months (July through October). The use of these traps could be considered for a mass trapping control against these pests. The capture records permitted us to know the chestnut moth flight pattern on Terceira Island that was, until now, unknown by the investigators as well by the farmers.

Another main goal of this study was the evaluation of all the fruit damage caused by the chestnut moth larvae. Therefore, a 2500 chestnut sample was collected at each chestnut orchard (50 chestnuts on the ground under 50 trees in each parcel). After that, in the laboratory, those fruits were opened using a knife, and they were observed to get a value concerning their infestation percentages (Fig. 3.)

RESULTS AND DISCUSSION

The moths caught from the chestnut moth traps with the three different pheromones were identified by the Biology Department of the Madeira University. They reached the conclusion that only one of the three species was present, *C. splendana*.

Analysing the *C. splendana* adults captures according to the different altitudes in the three areas studied (Fig. 4), we can verify that the greatest adult captures were in the orchards with southern exposure. The greatest number were collected at the Posto Santo parcel (260 m), with more than 100 adult captures during the four months of the survey. It is also important to record that in this chestnut parcel the owner does not undertake cultural procedures such as clearing the fallen fruits on the soil, which could limit the *C. splendana* populations.

In the Biscoitos area, beyond the high altitude of that place (192 m), because it is exposed to the North, only two adults were captured. In the orchard situated at the lowest altitude (153 m), Terra-Chã, was the place where the highest adult captures (83 adults). In the high and medium altitude areas the captures were less than 10 adults. So the data obtained point to a distribution of chestnut moth regarding the altitude and they were mostly in the areas with a south exposure (Fig. 4).

From the adult captures obtained in the Delta pheromone traps, it was possible to know the flight pattern of this pest. The *C. splendana* adults are present from the middle of June with an increase of their populations until the middle of October, the time when the highest *C. splendana* adult captures were registered (Fig. 5). So, because of these results it is possible to say that those pheromone delta traps should be put into the chestnut parcels in the beginning of June and should only be removed at the end of October (Fig. 5), the season when the collecting of chestnut fruits begins. Applying this strategy it is possible to prevent or decrease the fruit infestation percentage caused by the chestnut moth that in Terra-Chã production area reached above 40%. This situation, when we reach such an infestation percentage (40%), could be dangerous and contributes effectively to a decrease in the real revenue of the producers from these areas, with the

loss of almost half of the collected chestnut fruits. The differences registered among the different altitudes studied could also be connected with the different microclimatic areas that often appear in these production parcels. That is the only explanation because the cultural practices implemented by the producers were almost identical in both studied areas.

At Terra-Chã at the lower altitude the damage level of 40% (C1) is greater than the infestation percentage found in the other two higher altitude orchards, medium with 30% (C2) and highest altitude had only 20% (C5) (Fig. 6). At Biscoitos, where two adults were captured in the pheromone delta traps, in the fruit larvae survey no chestnut was found with *C. splendana* (Fig. 6).

From all this survey investigation work, it was possible to conclude that *C. splendana* nowadays is an important key pest in the chestnut orchards because of the fruit damage that it causes and it decreases the income of most chestnut producers from Terceira Island.

The solution to this problem in terms of control measures against this important chestnut pest could be simple and could follow two different ways: the application of cultural and biotechnical measures. The first involves clearing fallen fruits from the production parcels and even making some superficial tillage of the soil (10 to 15 cm deep) in the winter or spring as a way of exposing the pupae to the rigorous climatic conditions and because of that, inducing a higher percentage of. A second way of dealing with this pest could be the use of pheromone delta traps, as a mass capture method that has no impact on the beneficial insect fauna present in the orchards and may contribute to the effective population *C. splendana* reduction on Terceira Island.

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To all the chestnut producers involved in this work that permitted access and the collecting of all the needed fruits used in the infestation percentage determination during all this work.

To the Junta de Freguesia from Terra-Chã, and in particular to its Mayor as an associated partner in this INTERFRUTA II project for all the facilities given in the direct contact with all the producers and support given to all the proposed work.

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Figures

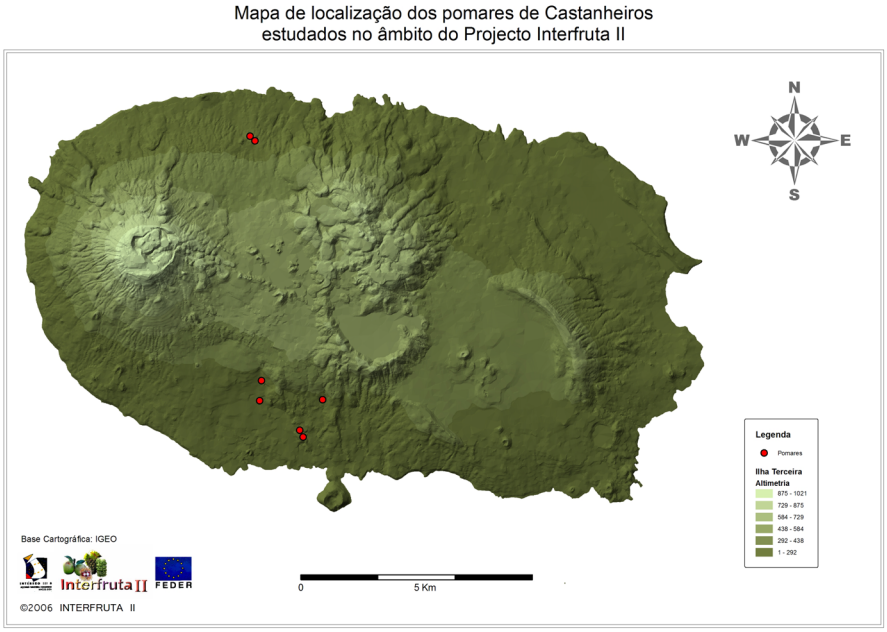

Fig. 1. Location map of the evaluated chestnut orchards on Terceira Island.

Fig. 2. Delta trap with the specific sexual pheromone.

Fig. 3. Fruit damage laboratory evaluation process.

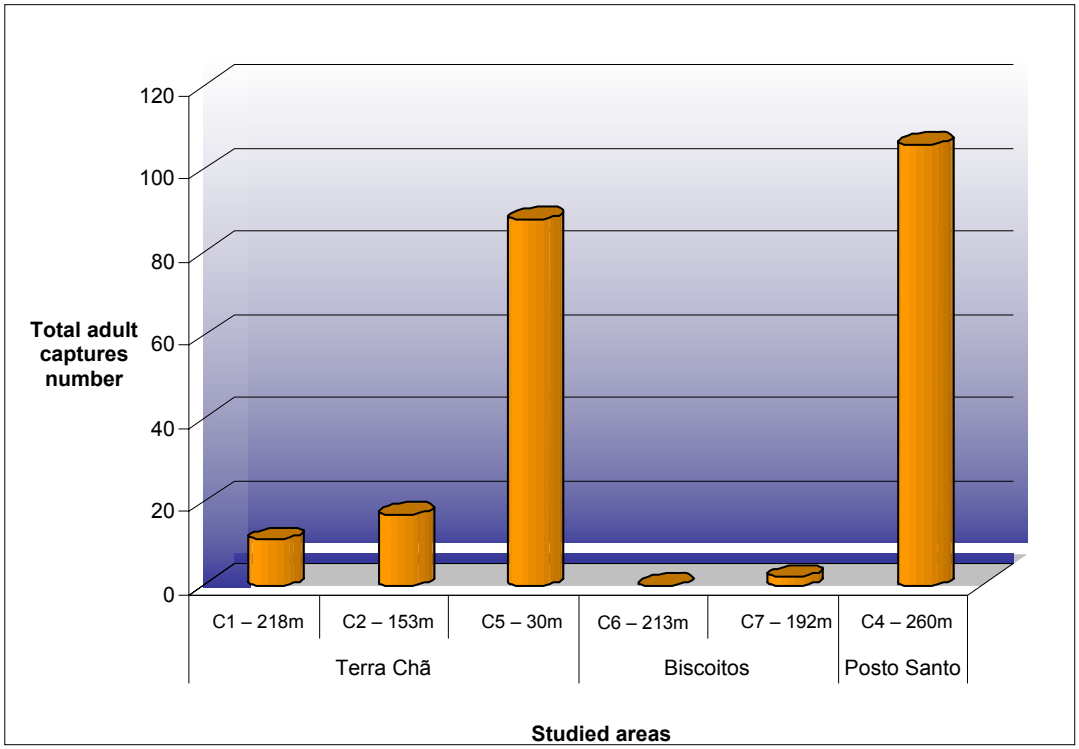

Fig. 4. Total *C. splendana* adult captures in the three studied chestnut production areas on Terceira Island.

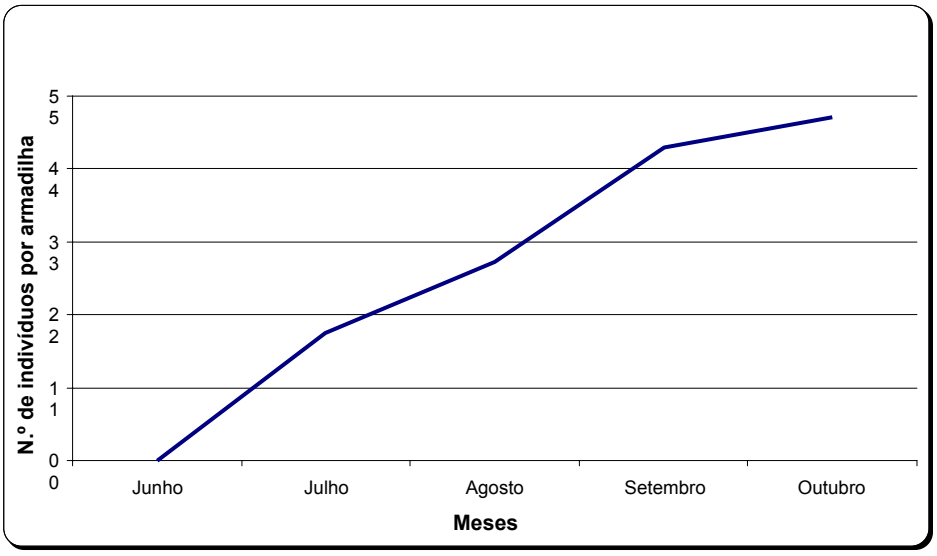

Fig. 5. Monthly *C. splendana* adult captures in 2006.

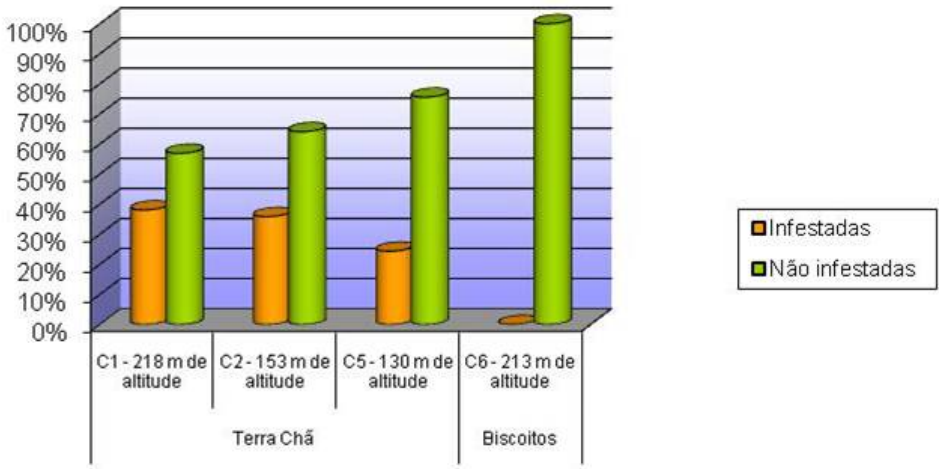

Fig. 6. Infestation percentage registered in chestnut fruits caused by *C. splendana* larvae in the two studied areas on Terceira Island.