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The bagging of *Annona crassiflora* fruits to control fruit borers

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ABSTRACT. The objective of this work was to evaluate the use of plastic bags to protect the fruits of *Annona crassiflora* (Annonaceae) against *Cerconota* sp. (Lepidoptera: Oecophoridae). As protection against this fruit-boring insect, 100 fruits were enclosed in plastic bags. Another 100 fruits were not bagged. The fruits were selected from the following five ranges of diameters: 1 = 0.5 – 1.99; 2 = 2.00 – 3.99; 3 = 4.00 – 7.90; 4 = 8.00 – 11.90; and 5 = 12.00 – 16.00 cm. The bagged fruits of various diameters were attacked less frequently by the pest. The bagged fruits with a diameter of less than two cm were not attacked. The percentage of fruits attacked and the number of larvae/fruit increased as the diameter of fruits increased in both treatments. The bagged fruits initially less than two cm in diameter showed the greatest final diameter and height.

Keywords: araticum, *Cerconota* sp., plastic bag, cultural control.

Ensacamento de frutos de *Annona crassiflora* contra broqueadores de frutos

RESUMO. O objetivo deste trabalho foi avaliar o efeito do ensacamento dos frutos de *Annona crassiflora* (Annonaceae) no controle de *Cerconota* sp. (Lepidoptera: Oecophoridae). 100 frutos foram ensacados com saco plástico e 100 não ensacados em cada uma das cinco categorias de diâmetro: 1 = 0,5 – 1,99; 2 = 2,00 – 3,99; 3 = 4,00 – 7,90; 4 = 8,00 – 11,90 e 5 = 12,00 – 16,00 cm. Os frutos ensacados com sacos plásticos, nos diferentes diâmetros, apresentaram-se menos broqueados. Os frutos ensacados com menos de dois cm de diâmetro não foram broqueados. Observou-se aumento na percentagem de frutos broqueados bem como no número de brocas/fruto broqueado com o aumento na categoria do diâmetro de frutos nos diferentes tratamentos. Os frutos ensacados com menos de dois cm de diâmetro apresentaram maiores diâmetros e alturas de frutos.

Palavras-chave: araticum, *Cerconota* sp., saco plástico, controle cultural.

Introduction

The culture of “araticum”, *Annona crassiflora* (Mart.) (Annonaceae), is very important in the Brazilian savanna, especially in the northern region of Minas Gerais, where the collection of the fruits of this plant and of *Caryocar brasiliense* (Camb.) (Caryocaraceae) represents an important source of income for the local communities (ALMEIDA et al., 1998; FERNANDES et al., 2004; LEITE et al., 2006, 2007, 2009, 2011; MELO et al., 2002). The fruit pulp of the *Annona crassiflora* contains 1.28% protein. Approximately 80% of the fatty acids are monounsaturated. Saturated fatty acids constitute 16% of the total, and polyunsaturated fatty acids constitute 4% of the total (ALMEIDA et al., 1998). The primary monounsaturated, saturated, and polyunsaturated fatty-acid constituents are oleic acid, palmitic acid,

and linolenic acid, respectively. The fruits have a high total sugar content (56.4%) and a low tannin content (0.38%) The fruits also contain vitamin C (ALMEIDA et al., 1998). However, fruit collectors in northern Minas Gerais report that attacks on fruits by insect pests have often harmed the region's level of production.

Among the fruit-boring insects known or suspected to be associated with *A. crassiflora*, *Bephratelloides pomorum* (Fabricius, 1908) (Hymenoptera: Eurytomidae) and *Cerconota anonella* (Sepp, 1830) (Lepidoptera: Oecophoridae) are considered the main pests of the Annonaceae (BROGLIO-MICHELETTI; BERTI FILHO, 2000; BROGLIO-MICHELETTI et al., 2001; SILVA et al., 2006).

The use of waxed-paper or translucent plastic bags to protect the fruits when they are still small from attacks by fruit-boring insects is one of the oldest and most effective control practices (FAORO,

2003; ROSA, 2002; SÃO JOSÉ et al., 1997). A number of studies have demonstrated the effectiveness of these control tactics in preventing the attacks of fruit borers on other Annonaceae, such as *A. muricata* L. (BROGLIO-MICHELETTI; BERTI FILHO, 2000; BUSTILLO; PEÑA, 1992; CARNEIRO; BEZERRIL, 1993; MANICA, 1994; McCOMIE, 1987).

Given the scarcity of scientific reports on insects associated with *A. crassiflora*, the objectives of this study were to identify the borer(s) of fruits in the northern region of Minas Gerais and to evaluate the effect of bagging on fruits of different sizes to identify an alternative control method for producers and gatherers of this plant.

Material and methods

The study was conducted at the "Olhos D'Água" rural community (Latitude: 16° 53 '45.2 "S Longitude: 43° 53' 21.6" W, altitude: 990 m), which is located 30 km from the Institute of Agrarian Sciences, Federal University of Minas Gerais (ICA/UFGM), Montes Claros, Minas Gerais State, Brazil, from 2006 through 2008. The study was requested by the producers, who had been observing production losses caused by the pests of *A. crassiflora*. The producers asked for a practical and inexpensive control method that would be feasible under their modest financial circumstances.

The fruits were enclosed in transparent plastic bags with a capacity of 5 L (35 cm wide and 50 cm long) with two small holes at the base to allow aeration of the fruit. Alternatively, Kraft paper bags with a 5 L capacity were used. Both types of bags were tied with cord cotton.

For this experiment, 100 trees with a high production of fruit were selected. The experimental unit was represented by 300 fruit. In all, 100 fruits were bagged with transparent plastic bags, 100 fruits with Kraft paper bags, and 100 were not bagged (control) in each of the following five diameter categories (20 fruits in each category): 1 = 0.5 - 1.99 cm; 2 = 2.00 - 3.99 cm; 3 = 4.00 - 7.90 cm; 4 = 8.00 - 11.90 cm; and 5 = 12.00 - 16.00 cm on the selected trees.

The diameter and height of each fruit were measured weekly with a ruler. Also on a weekly basis, we evaluated the effectiveness of treatments by counting the number of infected fruits and the number of insects inside the fruits of each category (diameter).

The damaged fruits were collected and taken to the Insectarium G.W.G. Moraes of the ICA/UFGM. The fruits were packed in plastic pots covered with white cloth and placed in an incubator (temperature 25°C) to allow the emergence of insects. The insects were identified by Dr. Camargo Amábilio (Embrapa Cerrados). The data were analyzed with an ANOVA and a Tukey test with a 5% significance level.

Results and discussion

The fruit-boring insects found by the study were identified as *Cerconota* sp. (Lepidoptera: Oecophoridae). The genus *Cerconota* includes important pests of other Annonaceae (JUNQUEIRA et al., 1996; BROGLIO-MICHELETTI; BERTI FILHO, 2000).

The bagging of fruits using Kraft paper bags was not effective because the bags were not rain-resistant. During the fruiting period of *A. crassiflora*, the paper bags on all experimental plots were ripped or torn open (data not shown). However, the fruits bagged with transparent plastic bags showed fewer attacks by the borers than the control (Figures 1 and 2). This difference was observed for fruits of all the diameters investigated. These findings agree with the results of a study by Broglio-Micheletti et al. (2001) that verified the efficiency of fruit bagging with plastic bags and perforated plastic bags for controlling insect borers in the fruit of *A. muricata*.

The bagged fruit less than two cm in diameter were not attacked by *Cerconota* sp., whereas 5% of the non-bagged fruit were attacked by this pest (Figure 1). The entire crop of *A. crassiflora* fruit was lost if the fruits were not bagged. When the fruits reached the harvesting stage, 100% of them had already been attacked by the borers. On average, 11 caterpillars of *Cerconota* sp. were observed per fruit (Figure 1).

Oliveira et al. (2001) investigated the control of the seed borer *B. pomorum* in the fruits of *A. muricata* and found that the fruits should be bagged soon after the flower petals fall. For *A. crassiflora*, bagging is not necessary when the petals drop, but the fruits should be bagged when they are less than two cm in diameter. Broglio-Micheletti and Berti Filho (2000) observed that fruits of *A. muricata* bagged with microperforated plastic bags were attacked 25% less frequently by *C. anonella* than fruits treated only with the insecticide Triflumuron.

We observed an increase in the percentage of damaged fruits and of larvae in the fruits as the fruit diameter increased in the different treatments (Figure 1). This observation suggests that oviposition had occurred on the fruits that were previously attacked. To avoid this problem, a recommended practice is the destruction of fruits damaged by this pest because adults continue to emerge from the fruits, even after the fruits have fallen to the ground (BROGLIO-MICHELETTI et al., 2001).

The bagged fruit with an initial diameter of below two cm showed larger final diameters and heights

compared with the control (Figure 2a). The final size (diameter and height) of the bagged fruit that were more than two cm in initial diameter did not differ significantly from that of the control (Figure 1).

Oliveira (1998) found that the presence or absence of bagging did not produce a statistically significant difference in the weight of bunches of bananas. These authors observed that the effectiveness of bagging for increasing production may depend on the location where the crop is grown. The only general consensus is that bagging significantly improves the external appearance of the banana fruit.

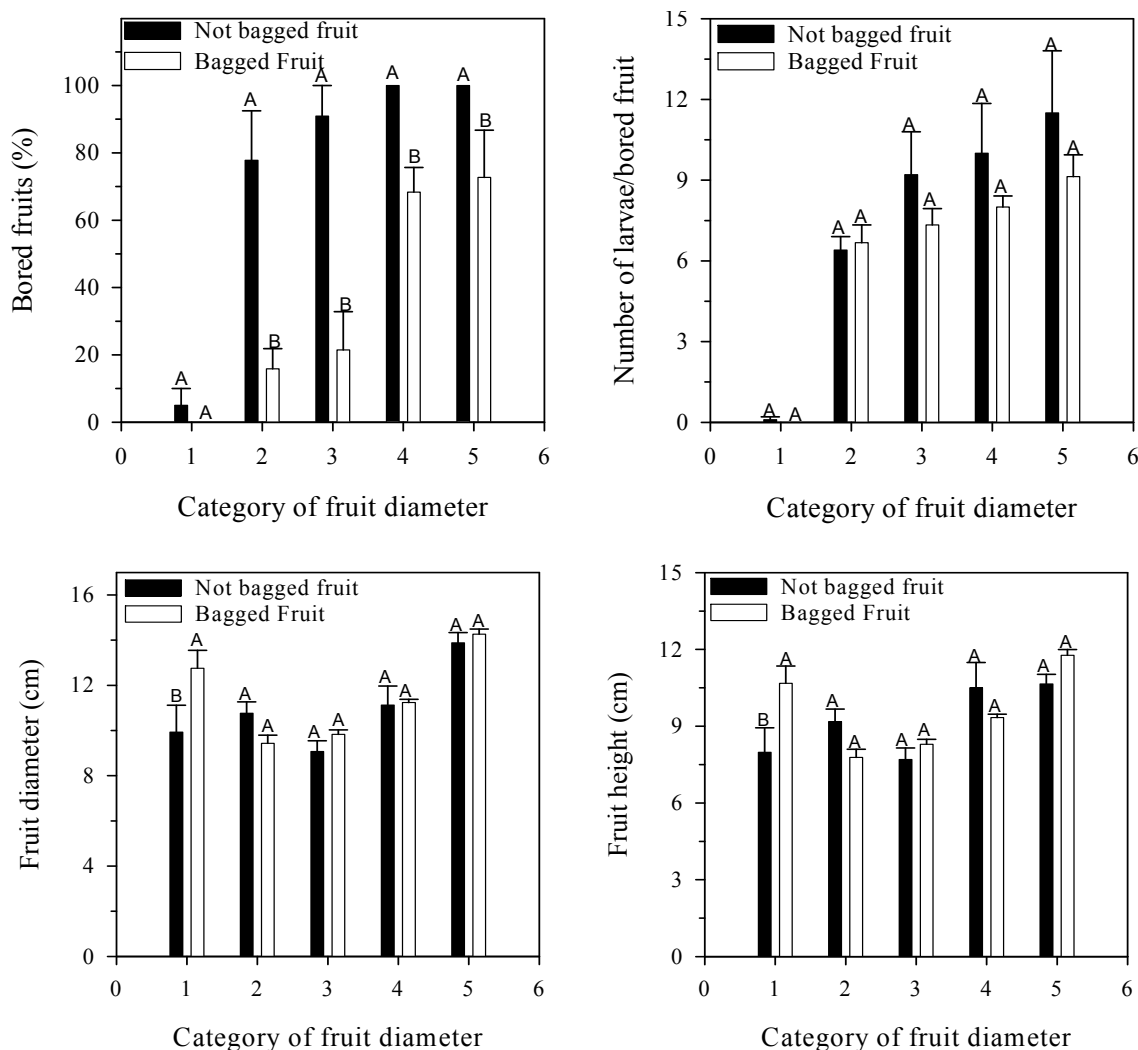


Figure 1. Effects of bagging fruits of *Annona crassiflora* to control the fruit borer *Cerconota* sp. Final diameter (cm) and height of fruit (cm) for different initial categories of fruit diameter (1 = 0.5 – 1.99; 2 = 2.0 – 3.99; 3 = 4.0 – 7.9; 4 = 8.0 – 11.9; and 5 = 12.0 – 16.0 cm). Montes Claros, Minas Gerais State. The averages, which are identified by the same letter in the histogram pairs, do not differ significantly (Tukey test, $p < 0.05$).



Figure 2. Fruit less than two cm in diameter (A); bagged fruit (B); undamaged fruit (bagged fruit) (C), and damaged fruit (not bagged fruit) (D).

Conclusion

The fruit-boring insect was identified as *Cerconota* sp. (Lepidoptera: Oecophoridae). The fruits of *A. crassiflora* should be bagged when they are less than two cm in diameter with a transparent plastic bag.

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