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First record of *Dinarmus basalis* parasititing *Callosobruchus maculatus* on cowpea grains, in the state of Bahia

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ABSTRACT

The cowpea weevil (*Callosobruchus maculatus*) is the main post-harvest pest of the cowpea crop because it causes damage when it feeds on the grains during storage and, consequently, inflicts economic loss. Among the promising alternatives to the chemical control of the beetle in stored grains is the use of biological control by means of the parasitoid *Dinarmus basalis*. This parasitic relationship has been reported in several Brazilian states. This study aims to record the occurrence of this parasitoid associated with *C. maculatus* in stored cowpea grains in the municipality of Barra, in the São-Franciscano Valley Mesoregion of the state of Bahia. The stored grains were obtained of cowpea cultivars yield trials, conducted at the School Farm, belonging to the Federal University of Western Bahia (UFOB), located at the geographical coordinates of 11°04'53"S latitude and 43°11'08"W longitude. The experiments were installed in February 2023 and the harvests were carried out in April. The harvested grains were packed in transparent plastic bags and stored in a warehouse under ambient conditions. The presence of the parasitoid together with *C. maculatus* was observed during an inspection of the grains carried out in October 2023, around six months after harvest.

Keywords: *Vigna unguiculata*, Grain storage, Cowpea weevil, Biological control.

Primeiro registro de *Dinarmus basalis* parasitando *Callosobruchus maculatus* em grãos de feijão-caupi, no estado da Bahia

RESUMO

O caruncho (*Callosobruchus maculatus*) é a principal praga pós-colheita da cultura do feijão-caupi por causar danos ao se alimentar dos grãos durante o período de armazenamento e, consequentemente, gerar prejuízo econômico. Dentre as alternativas promissoras ao controle químico do caruncho em grãos armazenados está o uso do controle biológico por meio do parasitoide *Dinarmus basalis*. Essa relação de parasitismo vem sendo relatada em diversos estados do Brasil. Este trabalho visa registrar a ocorrência desse parasitoide associado ao *C. maculatus* em grãos armazenados de feijão-caupi no município de Barra, na Mesorregião do Vale São-Franciscano do Estado da Bahia. Os grãos armazenados foram obtidos de ensaios de produtividade de cultivares de feijão-caupi, conduzidos na Fazenda Escola, pertencente à Universidade Federal do Oeste da Bahia (UFOB), localizada sob as coordenadas geográficas de 11°04’53’’S de latitude e 43°11’08’’O de longitude. Os experimentos foram instalados em Fevereiro de 2023 e as colheitas realizadas no mês de Abril. Os grãos colhidos foram acondicionados em sacos de plástico transparente e armazenados em depósito sob condição ambiente. A presença do parasitoide juntamente com o *C. maculatus* foi constatada em inspeção dos grãos realizada em outubro de 2023, cerca de seis meses após a colheita.

Palavras-chave: *Vigna unguiculata*, Armazenagem de grãos, Caruncho, Controle biológico.

Cowpea, *Vigna unguiculata* (L.) Walp., originally from Africa, was introduced to Brazil in the 16th century, in the state of Bahia, by Portuguese settlers, from where it expanded throughout the country (Freire Filho, 1988). Its cultivation is mainly found in the Northern and Northeastern regions, on small farms, where it plays a significant socioeconomic role for the population due to its use as a high-quality nutritional food and also for generating employment and income (Freire Filho et al., 1999; Silva et al., 2018).

Historically, with the intensification of agriculture and the expansion of agricultural crops, some insect species found an abundant food supply, expanded their occurrence and came to be considered pests. According to Norris et al. (2003), there are two types of pests: the indirect pest, which attacks a part of the plant and indirectly affects the commercialized part; and the direct pest, which directly attacks the commercialized part, causing damage that devalues the final product. Consequently, both can cause economic losses.

For cowpea, the bruchid *Callosobruchus maculatus* (Fabricius, 1775) (Coleoptera: Chrysomelidae, Bruchinae) is the main post-harvest pest, being responsible for almost all losses occurring in the grains during storage (Freire Filho et al., 1999; Almeida et al., 2005; Oliveira et al., 2020). The presence of the pest in the grains can be directly verified by the presence of the insect, which is small, brown in color, with a lighter-colored "X" on the dorsal part of the forewings. It can also be indirectly verified by the presence of *C. maculatus* eggs, which appear as small whitish spots on the surface of the grains, or by rounded holes observed in the grains due to the exit of adult insects from the grain after the pupal stage (Silva and Athayde Sobrinho, 2019) (Figure 1).

Infestation of grains with bruchids can occur in the field, before harvest, through eggs, larvae or adults present in the bean pods, and continue multiplying in the stored grains. Alternatively, it can happen during storage when healthy grains from the field are infested by insects present in the warehouses. This occurs when preventive control measures are not adopted (Oliveira et al., 2020). Oviposition occurs on the grain surface, and the larvae colonize and feed inside, causing damage to the embryonic axis and/or the cotyledons. In grains, this damage results in weight loss, reduced nutritional value and decreased product hygiene due to the presence of excrement, eggs and insects (Almeida et al., 2005; Prasanthi et al., 2017). In seeds, it can lead to abnormal seedling germination and emergence or seed death (Dongre et al., 1996; Melo et al., 2010).

Chemical control is the most used method for controlling bruchids, particularly through fumigation, which has been a common practice for disinfesting stored grains. However, due to the non-compliance with correct practices, the application of sub-dosages and the disregard for the product's withholding period, it is observed that there is more harm than benefit in ecological, economic and social terms (Almeida et al., 2006; Melo et al., 2012; Prasanthi et al., 2017).

Alternative methods to the chemical control of bruchids in stored grains are being studied, such as the use of botanical insecticides (Almeida et al., 2006; Hedjal-Chehheb et al., 2013; Sousa Neto et al., 2019), identification of resistant cultivars (Sousa et al., 2016; Medeiros et al., 2017; Silva et al., 2021) and the use of biological control with parasitoids. Various parasitoids from the family Pteromalidae (Hymenoptera) have been associated with *C. maculatus* worldwide, with five species distributed among the genera *Dinarmus*, *Theocolax* and *Lariophagus* (Van Huis, 1991). The species *Dinarmus basalis* (Rondani, 1877) is an important biological control agent of stored product pest insects and parasitizes various genera of Bruchinae (Coleoptera: Chrysomelidae), as well as Apionidae, Brentidae and Dermestidae (Marsaro Júnior et al., 2013).

Figure 1. Cowpea grains showing eggs and exit holes of *Callosobruchus maculatus*

It is a solitary ectoparasitoid of the last larval stages or pupae of *C. maculatus*. The cycle from egg-laying to adult emergence of the parasitoid is 11 days for males and 12 days for females, with a longevity of 7 and 16 days for males and females, respectively. The species is quite prolific with a pre-oviposition period of 1 day and an oviposition period of approximately 16 days, during which a fertilized female produces 106 offspring of both sexes, while an unfertilized female produces 43 males (Ohashi et al., 1993).

Using *C. maculatus* as the host, Mondedji et al. (2002) found that *D. basalis* females live an average of 32.6 ± 1.6 days, lay an average of 136.5 ± 55.2 eggs, parasitize 132.7 ± 53.9 hosts and also that the generation time and population doubling time are 22.5 days and 4.3 days, respectively. Ouedraogo et al. (1996) report that climatic conditions, namely temperature and humidity, influence the population growth of this parasitoid and the parasitism rate on *C. maculatus*.

The biological control of weevils through the introduction of *D. basalis* adults is efficient and results in higher quality cowpea seeds at the end of storage (Ouedraogo et al., 1996; Sanon et al., 1998). According to Amevoin et al. (2007), the introduction of the parasitoid should occur at the beginning of storage, and the quantity to be introduced should consider the initial infestation rate of the seeds by the weevils. These authors found that grains infested with the parasitoids have weight losses of less than 10%, while non-infested grains showed losses of around 30%.

In Brazil, the occurrence of the parasitoid *D. basalis* associated with *C. maculatus* has been reported in the states of Santa Catarina (Lima, 1942), Pará (Ohashi et al., 1993), Roraima (Marsaro Júnior et al., 2013), São Paulo (Costa et al., 2007), and in the semi-arid region of Rio Grande do Norte (Costa et al., 2023). This scientific note aims to report, for the first time, the occurrence of the parasitoid *D. basalis* associated with *C. maculatus* in cowpea in the Mesoregion of the São Francisco Valley in Bahia, Brazil.

The stored grains in which the parasitoid *D. basalis* associated with *C. maculatus* was identified were obtained from cowpea cultivar evaluation experiments conducted at the School Farm, belonging to the Federal University of Western Bahia (UFOB), located in the municipality of Barra, Westernern Bahia region, situated at the geographical coordinates of 11°04'53"S latitude and 43°11'08"W longitude. The climate type is characterized as BSh (hot semi-arid), according to the Köppen-Geiger classification (Beck et al., 2018), with an average annual temperature and rainfall of 25.7 °C and 649 mm, respectively.

The experiments were set up in February 2023 with harvests carried out in April. The grains of each cultivar were separately packed in transparent plastic bags and stored in a warehouse under natural conditions of temperature, light and relative humidity. Possible fluctuations of these variables in the storage environment occurred according to the environmental variations characteristic of the municipality during the time of the year adopted. The presence of the parasitoid along with *C. maculatus* was observed during a grain inspection conducted in October 2023, about six months after the harvest. The presence of the pest and the parasitoid was observed in grains of seven cultivars: BRS Carijó, BRS Imponente, BRS Itaim, BRS Juruá, BRS Paraguaçu and BRS Tapaihum.

To identify the species of the weevil, ten specimens were collected from the mass of cowpea grains. From the specimens analyzed, the species was confirmed to be *Callosobruchus maculatus* (Fabricius, 1775) (Coleoptera: Chrysomelidae, Bruchinae) according to Faroni and Sousa (2006). The hymenopterans were collected and sent for identification to the Biological Institute of the São Paulo Agency of Agribusiness Technology. From the specimens analyzed, it was found to be the parasitoid *Dinarmus basalis* (Rondani, 1877) (Hymenoptera: Pteromalidae) (Figure 2).

Figure 2. Specimen of *Dinarmus basalis*, female

The genus was determined according to Bouček and Heydon (1997), while the species was determined according to Rasplus (1989). The *D. basalis* specimens (nine females and two males) sent for identification were deposited in the "Oscar Monte" Collection of Entomophagous Insects at the Biological Institute, located in Campinas, São Paulo State, in the Biological Control Laboratory, under the reference number IB-CBE-S-889, under the care of curator Valmir Antonio Costa. More details of the parasitoid can be observed in Figure 3. In view of the above and local findings, new observations in cowpea crops and stored grains should be carried out with the aim of deepening knowledge about the natural infestation and association between the two species, as well as studies to evaluate the potential and efficiency of *D. basalis* in the control of *C. maculatus*.

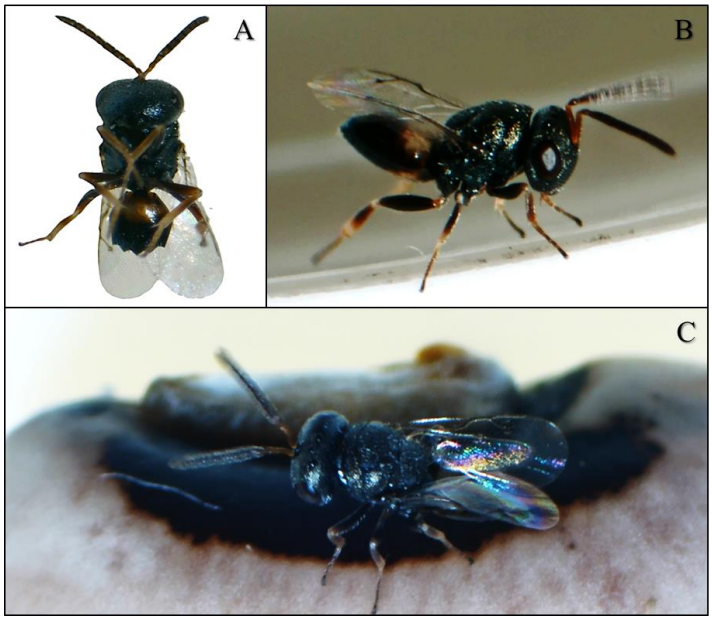

Figure 3. Specimen of *Dinarmus basalis*, male (A); adult of *D. basalis* seen under a magnifying glass (B); parasitoid in the cowpea seed halo (C).

Authors' Contribution

Adérico Júnior Badaró Pimentel cultivated cowpea, obtained and collected specimens of the pest and parasitoid. Ana Elizabete Lopes Ribeiro and Romenique da Silva de Freitas identified the woodworm species. Valmir Antonio Costa and Daniéla Cristina Calado identified the parasitoid species. All authors contributed to writing the manuscript.

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