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SHORT REPORT

MOSQUITOES (DIPTERA: CULICIDAE) IN BAMBOO INTERNODES IN THE NORTHWESTERN REGION OF THE STATE OF RIO GRANDE DO SUL, BRAZIL

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ABSTRACT

Bamboo internodes can serve as a breeding ground for a diverse mosquito fauna, some with relative epidemiological importance. The goal of this study is to determine the mosquitoes´ species found in the bamboo internodes at the northwestern region of Rio Grande do Sul, Brazil. From September 2016 to August, 2017 immature forms of mosquitoes were collected from bamboos (*Bambusa* sp.), in the quarterly intervals (ten plants per collection) through 0.5 cm in diameter perforations on 40 internodes sides. After 30 days, the perforated internodes were cut out and their contents were taken to the laboratory where the immature forms of mosquitoes developed to adult stage were identified. A total of 367 immature forms of Culicidae were collected, however only 158 (43.1%) have developed to adult stage and were identified at a specific level. Eight species were identified: *Onirium personatum* (Lutz, 1904), *Sabethes aurescens* (Lutz, 1905), *Sa. intermedius* (Lutz, 1904), *Sa. purpureus* (Theobald, 1907), *Shannoniana fluviatilis* (Theobald, 1903), *Trichoprosopon pallidiventer* (Lutz, 1905), *Wyeomyia limai* (Lane & Cerqueira, 1942) and *Wyeomyia serratoria* (Dyar & Nuñez Tovar, 1927). Thus, the study showed the importance of this type of breeding in order to maintain the mosquito fauna in the wild areas in the studied region. The finding of the species *On. personatum* and *Sh. fluviatilis* was also reported for the first time in the State.

KEY WORDS: Fitotelmata, *Onirium*, Sabethini, *Shannoniana*, bamboo, mosquitoes.

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Mosquitoes are insects with high public health relevance since they are involved in the transmission of several pathogens to humans (Forattini, 2002). Many wild mosquitoes, specially from the *Sabethini* tribe which develop in *Phytotelmata* breeding sites (e.g. bamboos), participate as secondary vectors in the transmission cycle of important arboviruses, such as yellow fever, *Mayaro* and others (Vasconcelos, 2003, Caicedo et al., 2021).

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The mosquito fauna developed in breeding sites in which are formed by water storage in bamboo internodes has been studied in various regions of the world (Sunahara & Mogi, 1997), including Brazil (Zequi & Lopes, 2001). Some studies with artificially drilled bamboo internodes, simulating the action of insects that damage the sides of the internodes allowing the accumulation of water and then to be access by mosquitoes, have shown that the community of these dipterans that develops in this type of breeding can be very diverse, including species of epidemiological importance, such as *Aedes albopictus* (Skuse, 1894) (Müller et al., 2014).

In the State of Rio Grande do Sul in the extreme south of Brazil which has border with Argentina and Uruguay, records that the mosquito fauna that uses this type of breeding site are scarce (Marcondes et al., 2003). In studies with mosquitoes of bamboo internodes in the States of Santa Catarina (e.g. Marcondes et al., 2006) and Paraná (Zequi & Lopes, 2001), which are close by Rio Grande do Sul, the dominance of species of two genera, *Sabethes* and *Wyemyia*, was observed. So, the aim of this study was to determine the species of mosquitoes found in bamboo internodes in the northwestern of Rio Grande do Sul.

The study area is characterized by being a secondary forest of seasonal semideciduous forest, Atlantic Domain, with an area of 103 ha located in Pejuçara City, Rio Grande do Sul, Brazil (28°22´17.24" S; 53°41´45.42" W). From September 2016 to August 2017 immature forms of mosquitoes were collected on bamboos (*Bambusa* sp.), with quarterly intervals (ten plants per collection). Each plant received four lateral perforations (one per internode) with 0.5 cm in diameter (Marcondes & Mafra, 2003). Internodes located up to 1.20 m high were drilled. After 30 days, the perforated internodes were cut off and their contents were taken to the laboratory, where the mosquito larvae and pupae were allowed to develop in the water removed from the internodes until they turned adult mosquitos (Figure). The entire contents of the internodes were stored for 45 days in order to obtain larvae from eggs that eventually were in the water. Adults were preserved dry, fixed to triangles on entomological pins. Male genitalia were dissected and mounted for the identification. Adult mosquitoes were identified based on Lane (1953), Consoli & Oliveira (1994), Harbach & Peyton (2000) and Forattini (2002). All the material was deposited in the didactic collection of Federal Institute of Education, Science, and Technology of Farroupilha, at Panambi-RS. Genera were abbreviated according to Reinert (2009). The permanent license for collection, capture and transport of Culicidae in this study was obtained through the Biodiversity Authorization and Information System (SISBIO) with the number 52559-1, dated February 2nd, 2016 throughout Brazil.

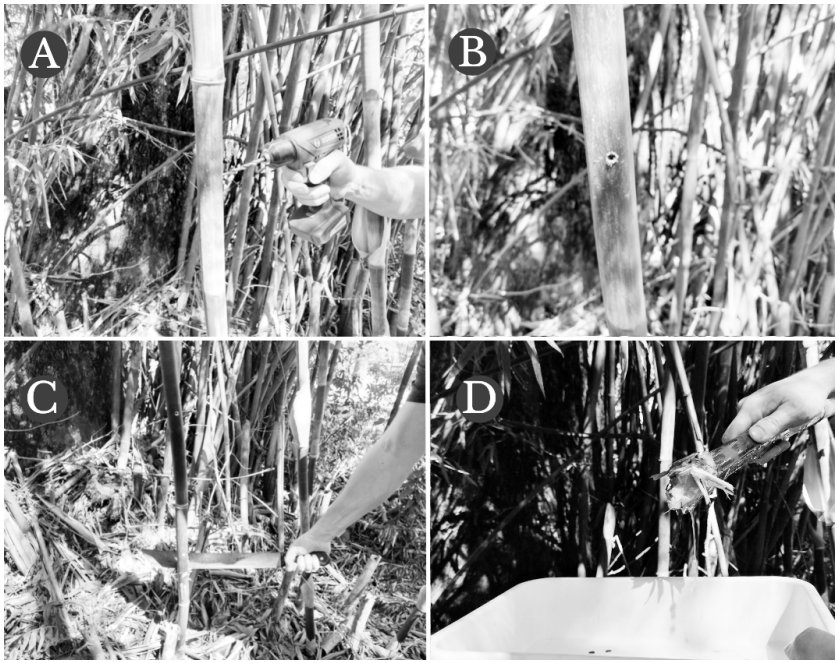

Figure. Procedures for collecting immature mosquitoes from bamboo internodes. A. Drilling the lateral side of the internodes with an electric drill. B. Side hole with 0.5 cm in diameter. C. Cutting the bamboo internode to remove the water. D. Water removal to transport later to the laboratory.

A total of 367 immature forms of Culicidae were collected, however only 158 (43.1%) developed to adults and they were identified at the specific level. The mean (±standard deviation) of immatures found per internode from the bamboo sample was 2.3 (±3.8). The number of immatures per internode ranged between zero and nine. From the 160 internodes analyzed throughout the study, mosquito larvae or pupae were found in 66 (41.2%). The species recorded were: *Onirium personatum* (Lutz, 1904) (2), *Sabethes aurescens* (Lutz, 1905) (93), *Sa. intermedius* (Lutz, 1904) (1), *Sa. purpureus* (Theobald, 1907) (17), *Shannoniana fluviatilis* (Theobald, 1903) (6), *Trichoprosopon pallidiventer* (Lutz, 1905) (23), *Wyeomyia limai* Lane & Cerqueira (1942) (4) and *Wy. serratoria* (Dyar & Nuñez Tovar, 1927) (12).

The species richness recorded in this study was probably underestimated, since only 43.1% of the immature forms of mosquitoes captured have developed to adults and were identified as species. Lozovei (2001) observed in her study thirteen species of mosquitoes that developed in internodes of perforated bamboo. Zequi & Lopes (2001), in a similar study, found ten mosquito taxa. This high mortality of specimens in the immature

phase may be related to the natural conditions of the breeding site that were not reproduced properly in the laboratory. The breeding site formed in the internodes of bamboos in the natural environment certainly has a dynamic of nutrients supply and water that were not reproduced in the plastic containers used for mosquitoes breeding in the laboratory. Müller et al. (2009) obtained immatures of *Sa. aurescens* from bamboo internodes that were reared in the laboratory with a lower mortality (21.3%).

From the eight species identified in this study, six of them had already been recorded for the State of Rio Grande do Sul (Cardoso et al., 2005; Gomes et al., 2009; Cardoso 2010). However, this is the first record of *On. personatum* and *Sh. fluviatilis* for the State. The occurrence of these species had already been reported in other Brazilian States and in other South American countries (Marchi et al., 2010).

Onirium personatum is a species whose immature forms had already been found to develop in bamboo internodes and also in bromeliads (Müller et al., 2014). *Sabethes aurescens*, a species that typically uses bamboo internodes to lay their eggs, has a long period of larval development, and its larvae may eventually prey on other mosquito larvae that inhabit the same breeding site (Laporta & Sallum, 2014). *Sa. intermedius* and *Sa. purpureus* are usually found developing in bamboo internodes, but have also been observed in tree hollows (Marcondes et al., 2006; Mangudo et al., 2014; Muller et al., 2014). Lozovei (2001) noted that *Sh. fluviatilis* and *Tr. pallidiventer* are species that may colonize bamboo internodes containing water with different physicochemical conditions, from clean water to water with decaying organic matter. *Wyeomyia limai* is considered one of the most abundant species in breeding sites formed by perforated bamboo internodes in southern Brazil (Marcondes et al., 2006). Medeiros-Sousa et al. (2020) found *Wyeomyia* immatures sawmill in internodes of perforated and broken bamboo, in bromeliads and in artificial breeding sites. In addition, they observed a preference of the species for breeding sites containing water with a pH lower than 3.0.

Among the eight species recorded, only *Sa. intermedius* (Wanzeller et al., 2014) and *Tr. pallidiventer* (Souza-Lopes et al., 1975) had potentially pathogenic agents isolated, however, the vector capacity of such species has not yet been proven. Bamboo internodes in the wild environment are breeding grounds with a high mosquito diversity, however few species have been proven of medical importance (Bastos et al., 2021).

Even with a small number of mosquitoes identified to a specific level, this study demonstrated that bamboo internodes enable the maintenance of some species of mosquitoes in the wild areas in the northwestern region of Rio Grande do Sul. The possible epidemiological role of these species in disease-causing agents in humans' transmission and other animals must be elucidated in future studies.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest to disclose.

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