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SCIENTIFIC PAPER

Rhizophagous insects associated to turfgrass varieties in the Varadero Golf Club, Matanzas, Cuba

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ABSTRACT: A study was conducted in order to determine the main species of rhizophagous insects associated to the turfgrass varieties in the Varadero Golf Club (Matanzas, Cuba). During 2010-2015 root samples from the turf of varieties Bermuda grass 328 and tifdwarf (hybrids obtained from *Cynodon dactylon* (L.) Pers x *Cynodon transvaalensis* Burt-Davy) were evaluated, which were extracted through a hole-cutting device. In them the main associated rhizophagous insects were collected and the lesions were identified and described. Thirteen insect species were found, corresponding to five orders and eight families, which were found in all the game areas (except in the rough); the taxa with higher incidence belonged to the orders Hemiptera and Coleoptera. Due to the affectations they caused on the turf of both hybrids the burrower bugs *Dallasiellus varaderensis* Marrero and Mayorga, *Tominotus inconspicuus* Froeschner and the true weevils *Sphenophorus* sp. (1) and *Sphenophorus* sp. (2) stood out; proving their potential as pest insects of the turf in Cuba for the grasses of the *Cynodon* genus, because the root affectations caused chlorosis, burns and localized death of the turfgrass in the Varadero Golf Club. As a result of the inventory conducted the recording, for the first time, of the two species of the *Sphenophorus* genus stands out. It is recommended to identify the *Sphenophorus* species and to include them, along with *D. varaderensis* and *T. inconspicuus*, in the available list of the insect species associated to turfgrasses in the country.

Keywords: Bermuda grass 328, chlorosis, plant pests, tifdwarf

INTRODUCTION

Pests in golf courses constitute an important component in these ecosystems worldwide, especially if they affect the roots of the turfgrass species that make them up, because such noxious agents conspire against the aesthetics of the courses and the possibilities of playing with the required quality.

In Cuba, taking the above-stated facts into consideration, with the constitution of the Turfing Services Program of the Pastures and Forages Research Station Indio Hatuey (EEPFIH) a full-cycle research and turfing services area was consolidated, of great acceptance in the tourism and sports sector of the country; which allowed a technology-based turfgrass industry to emerge (Blanco *et al.*, 2010).

This program generated an integral technology, which included the selection of turfgrass varieties, the substratum preparation, planting, establishment (irrigation, fertilization, weed and fungi control),

negative selection of weeds and mowing (Hernández, 2010); likewise, the studies related to the abiotic and biotic stress factors that affect the available turfgrass accessions have been given priority (López *et al.*, 2013).

Based on the phytosanitary observations previously conducted in the Varadero Golf Club –considered, among the three courses existing in the country, as the most attractive choice for international tourism–, the criteria expressed by Ordaz *et al.* (2014) regarding the affectation of the aesthetics and sustainability of turfing by rhizophagous pests in Mexico, the need of professional training as part of the National Program of Golf Courses for the construction of new courses (Martínez, 2015), and the insufficient entomological studies published (Martínez, 2004; León and Marrero, 2008; Marrero *et al.*, 2012), the objective of this research was to determine the

main species of rhizophagous insects associated to the turfgrasses in the Varadero Golf Course.

MATERIALS AND METHODS

Study area and geographical location

The study was conducted at the Varadero Golf Club, 18-hole golf course located north of the Hicacos peninsula (23° 04' N and 81° 17' W), in the Varadero beach, Matanzas province.

Sampling of rhizophagous insects and taxonomic identification

During 2010-2015 collections were made of the insects associated to the turfgrasses, called varieties: Bermuda grass 328 and tifdwarf (hybrids obtained from *Cynodon dactylon* (L.) Pers x *Cynodon transvaalensis* Burt-Davy), established in the different game areas (tee, green, fairway and rough).

A completely randomized design was used and, through the methodologies proposed by Martínez (2004) and by Held and Potter (2012), the game areas, holes, sand traps and sandlots, and reproduction areas of the varieties for the turfgrass replacement were sampled every 15 days.

Edaphic samples were taken, of 15,0 cm of diameter and 10,6 cm of depth, with a hole-cutting device (figs. 1a and 1b); while from the roots with lesions caused by insects and from the soil the rhizophagous insects were collected with the aid of entomological pins (fig. 1c) and of a small metallic shovel, according to the recommendation made by Juang-Horng (2015).

Afterwards, the samples were transferred to the Laboratory of Entomology of the University of Matanzas for their observation under a Novel

stereomicroscope, in order to capture digital images (with a Sony coupled photographic camera, 7.0 megapixels) which would facilitate their identification through the diagnostic traits and with the aid of dichotomous keys (Froeschner, 1960; Mayorga and Cervantes, 2006; Ordaz *et al.*, 2014), and they were then preserved in essay tubes with alcohol at 70 %.

RESULTS AND DISCUSSION

In the samplings 13 species of rhizophagous species were found, belonging to five orders and eight families. Hemiptera and Coleoptera were the taxa with the highest number of species, represented by five and four, respectively; and besides they had incidence on all the game areas, except in the rough (table 1).

During December, 2010, the burrower bug *Dallasiellus varaderensis* was found, species which appeared in all the turf areas of the golf game (except in the rough) and showed high mobility in the soil profiles; which was conditioned by the oval shape of the body, the modified head with dense setigerous punctures in the juga and tylus, as well as robust legs and tibiae armed with strong spines. In the field samplings nymphs and adults were found, on the surface as well as at depths between 3 and 40 cm; the insect fed on the roots and caused leaf chlorosis in both turfgrass varieties, and this affectation indicates its potential to become a turfgrass pest in Cuba.

The above-described morphological adaptations of *D. varaderensis* provide the insect with powerful excavating habits in the sandy substratum of the golf course, which allow them to reach the deepest roots and extract the plant juices. The burrower bugs dig constantly and move at remarkable depth, which sometimes makes it difficult to find them.

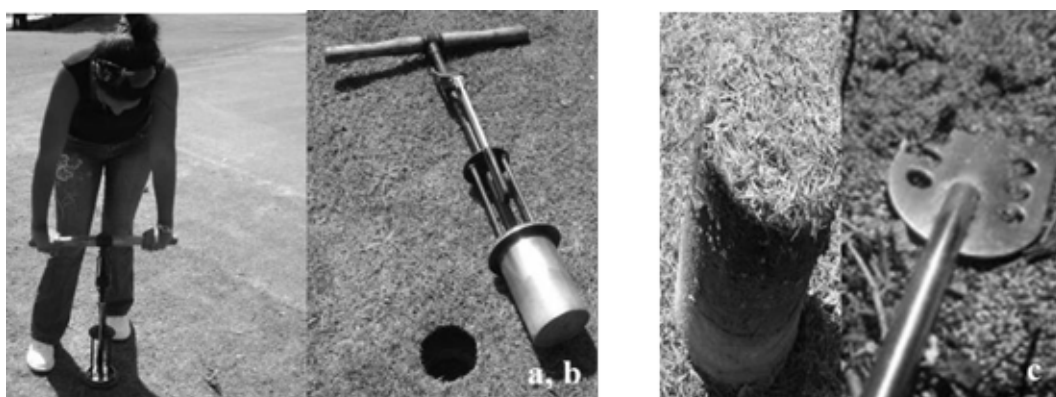


Figure 1. a,b. Proceeding with the hole cutter; c. Collection of rhizophagous insects.

Table 1. List of rhizophagous insects associated to the turfgrass of the Varadero Golf Club, during the experimental period.

Insect species (common name)	Taxonomic classification (Order: Family)	Area where they were collected (turfgrass variety and hole number)
<i>Dallasiellus varaderensis</i> Marrero and Mayorga (burrower bug)	Hemiptera: Cydnidae	Tee, green, fairway, sand traps (Bermuda grass 328 and tifdwarf; holes 10, 14, 17).
<i>Dallasiellus scitus</i> (Walker) (burrower bug)		
<i>Tominotus communis</i> Uhl. (burrower bug)		
<i>Tominotus inconspicuus</i> Froeschner (burrower bug)		
<i>Antonina graminis</i> Mask. (mealybug)	Hemiptera: Pseudococcidae	Tee, green, fairway (Bermuda grass 328; holes 14, 17).
<i>Sphenophorus</i> sp. (1)** (weevil)	Coleoptera: Curculionidae	Green, tee and sand traps (Bermuda grass 328 and tifdwarf; holes 10, 14, 17).
<i>Sphenophorus</i> sp. (2)** (weevil)		
<i>Phyllophaga</i> sp.* <i>Dyscinetus</i> sp.*	Coleoptera: Scarabaeidae	Green (Bermuda grass 328 and tifdwarf; holes 10, 14, 17).
<i>Conoderus</i> sp. (wireworm)	Coleoptera: Elateridae	Green (Bermuda grass 328; holes 14, 17).
<i>Neocurtilla hexadactyla</i> Perty* (northern mole cricket)	Orthoptera: Gryllotalpinidae	Tee, green, sand lots, área for turfgrass (Bermuda grass 328 and tifdwarf; holes 14, 17).
<i>Eyrocotis lacernata</i> Cab.	Blattodea: Blattidae	Sand traps (Bermuda grass 328; holes 10, 17).
<i>Dorymyrmex</i> sp.* (leafcutter ants)	Hymenoptera: Formicidae	Tee, green, sand traps (Bermuda grass 328 and tifdwarf; holes 10, 17).

*They are builders of edaphic mounds.

** New record of potentially noxious insect for the turfgrasses of the *Cynodon* genus.

In this regard it is stated that these rhizophagous insects can cause a marked physiological stress in several economically important hosts, bring about severe affectations in the root system and also represent potential plant pathogen vectors (Marrero *et al.*, 2012).

In the case of the species *Dallasiellus scitus*, Grillo (2012) reported it as very rare. In this study it prevailed in the sand traps of hole 10, where there was litter of *Ficus elastica* Roxb and fruits of *Guaiacum sanctum* Lim. reported as host plants of the insects of the *Dallasiellus* genus by Marrero *et al.* (2012).

With the performance of systematic edaphic samplings in the Varadero Golf Club the re-appearance of *D. varaderensis* during 2013-2015 could

be proven, with a higher appearance of nymphs and adults in holes 10, 14 and 17 of the green. Such findings indicate that the insect found, in this ecosystem, favorable edaphoclimatic conditions for its reproduction; besides, according to the described affectations, the potential danger of this species as pest for the turfgrass varieties evaluated in this study is imminent.

On the other hand, in 2013 another burrower bug (*Tominotus inconspicuus*) was found, associated too to the roots of the hybrids, which was first reported in the country by Rodríguez (2013); and its presence is confirmed to be possible, because according to Froeschner (1960) and Vivan *et al.* (2013) it is a species that is framed in the neotropical region in ecosystems of Brazil and Argentina, among others, and affects different economically important crops.

The appearance of this species of the Cydnidae family in the Varadero Golf Club could be motivated by the coastal characteristics of the ecosystem. In this regard, Mayorga and Cervantes (2006) reported the finding of several species of the burrower bugs in coastal ecosystems of Veracruz, Mexico.

Likewise, it is considered that the island condition of Cuba and the flow of tourists to the Varadero Golf Club could also condition the appearance of new insect species, similarly to what occurred in the Island of Guam, with marked flow of tourists; in that site five species of burrower bugs were notified by Lis and Zack (2010).

On the other hand, several ecological hypotheses also support the appearance of pest-causing organisms in turfs due to the closeness of Cuba to several Caribbean islands and to Florida, which largely conditions the effectiveness of insect colonization in the coastal zones. This is due to the fact that they have high flying capacity and an accelerated dispersal rate, and their dissemination can be favored by the winds and sea currents, as well as by the sustained increase of commercial and touristic exchange, which in turn favors the accidental introduction of exotic insects that do not have natural enemies in the country (Pérez, 2012).

Regarding the other insects that were captured (the orthopteran, the Blattodea species, the mealybug and the coleopterans), they were found in both hybrids and in all the game areas of the course, with the exception of the rough.

From them two *Sphenophorus* species, (genus undetermined), commonly called weevils, stood out, whose taxonomic characteristics confirmed with the corresponding dichotomous key allowed to discern that they were two new records of potentially

noxious insects for the turfgrasses of the *Cynodon* genus, according to the reports of previous studies conducted in the country. These insects showed a size of 8-11 mm and remarkable morphological differences, among them the thoracic and elytral patterns, the quantity and arrangement of the elytra, and the size of the punctures (figs. 2a and 2b).

During their feeding activity they caused chlorosis, localized death in certain zones of the turf and formation of edaphic mounds (fig. 2c), which showed the noxious potential of these insect species, because they affected the aesthetics of the turf and it also constitutes a limitation to develop the golf game with quality.

According to the report by León (2009), these rhizophagous insects are an important part of the maintenance costs of golf courses in Mexico, and several *Sphenophorus* species represent a phytosanitary problem and constitute economically important pests of the turf.

Sphenophorus parvulus Gyllenhal, *Sphenophorus venatus* Say and *Sphenophorus phoenicenis* Chittenden have been reported as important pests in turfs of sports and recreational areas in the United States and Canada. *S. venatus* is a prevailing species in golf courses and its damage is severe on the turf, because the larvae weaken and destroy the root system and cause plant desiccation (death) shaped as large spots, which are easily detached in different parts of the course (called dry spots) and cause problems in the cutting and management of turfgrass. In addition, this insect can remain in the soil for two or three years, which clearly shows its status as key pest (Woodruff, 2010).

Although *S. venatus* was reported in 1951 for the Bahamas, the Dominican Republic and Cuba,



Figure 2. Adults of: a: *Sphenophorus* sp. (1), b: *Sphenophorus* sp. (2). c: edaphic mounds and localized detachment of the turfgrass caused by them.

the records that detail the localities and hosts infested by this true weevil in the country are still scarce. According to the report by Martínez (2004), there were no records that notified its finding in the turf of the Varadero golf course.

On the other hand, Acuña (2010) reported that the subspecies *Sphenophorus venatus vestitus* Chittenden is considered the most abundant and damaging true weevil in the golf courses of the United States, which is directly related to the fact that more than 80 % of the weevil adults collected in four courses of Florida belonged to the species *S. venatus*. Its larvae, by feeding on the roots, cause burn-like leaf lesions and damage more than 40 % of the turfgrass foliage; they also cause considerable affectations on the dry weight of the roots and the total weight of the turfgrass. In the last two decades the populations of this rhizophagous species have remarkably increased in the golf courses of Florida.

Ordaz *et al.* (2014) also found severe damage by *S. venatus* in *C. dactylon* in several golf courses of Mexico. Meanwhile, Krischik and Ascerno (2016) observed affectations by *S. parvulus* similar to the ones described in this research, and emphasized that in the turfgrass areas infested by this weevil a fast chlorosis appears and finally the turfgrass turns straw-colored.

Professionals and greenkeepers of golf courses in Puerto Rico have sometimes indicated that the soil coleopterans have been confused with burrower bugs, and that the damage caused by *S. venatus* can be masked with symptoms of leaf burns due to inadequate management of fertilization, for which they recommended a systematic monitoring of the populations of this pest. On the other hand, Blake (2014) emphasized the need of knowing how to identify the edaphic insects that infest the turfgrass in golf clubs, knowing how to find them, having a basic knowledge of their biology and understanding the different available management options.

It should be stressed that in the Varadero Golf Course the species of rhizophagous insects (table 1), and particularly burrower bugs and weevils, find favorable conditions to be developed and increase their populations. The affectation caused by these insect species and their potential noxiousness along with the other rhizophagous insects reported in this study may represent a limiting factor for the turfgrass aesthetics and the quality of the golf game.

The above-mentioned aspects indicate the need to be alert in the country with all the potential pests that could appear in the turfgrasses of the *Cynodon*

genus, taking into consideration the proposal of increasing the number of golf courses in Cuba.

CONCLUSIONS

As a result of the inventory performed 13 species of phytophagous insects were found, belonging to five orders, with higher representation of species in Hemiptera and Coleoptera. The record, for the first time, of the two species of the *Sphenophorus* genus, stands out. Likewise, the noxious potential as pest, for the turfgrasses Bermuda grass 328 and tifdwarf, of the burrower bugs *D. varaderensis* and *T. inconspicuus*, is ratified; which, together with the root affectations, cause chlorosis, burns and localized death of the turfgrass in the Varadero Golf Club.

RECOMMENDATIONS

According to the economic-social importance of golf courses for Cuba and the scarce information about the impacts caused by rhizophagous pests of turfgrass, it is necessary to organize training activities for their recognition in the course and their timely detection, as well as for the evaluation of sustainable management alternatives to be incorporated in the Integrated Turfgrass Pest Management Program.

Collections of adults of *Sphenophorus* sp. (1) and (2) should be conducted to increase the availability of male individuals and obtain the specific identity from the genitalia description. In addition, it is suggested to include *D. varaderensis*, *T. inconspicuus* and *Sphenophorus* sp. (1) and (2) in the available list in the country of the insect species associated to the turfgrasses Bermuda grass 328 and tifdwarf.

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