FIRST RECORDS OF THE SUBTERRANEAN TERMITES *Procornitermes striatus* (HAGEN) AND *Procornitermes triacifer* (SILVESTRI) (BLATTODEA, ISOPTERA, TERMITIDAE) IN MAIZE FIELDS IN ARGENTINA

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ABSTRACT

The genus *Procornitermes* is considered one the most important agricultural pest termites in South America. Here, the presence of *P. striatus* and *P. triacifer* on maize plants in Argentina is reported for the first time and the damages observed in the area are characterized. In May 2016, subterranean termites were detected in maize fields from Chaco province. They were identified as the aforementioned two species of the genus *Procornitermes*. The damages observed in the analyzed maize plants were concentrated in roots and at the stem base. The stems of affected plants were almost completely hollowed and many of the small diameter roots and rootlets had been cut and consumed or moved to the nests. These records reveal the presence of the subterranean *Procornitermes* termites in agricultural areas of Argentina and require future surveys to determine their abundance and potential impact on regional crops.

Keywords: Termites, *Procornitermes*, maize, Argentina

PRIMEROS REGISTROS DE LAS TERMITAS SUBTERRÁNEAS *Procornitermes striatus* (HAGEN) Y *Procornitermes triacifer* (SILVESTRI) (BLATTODEA, ISOPTERA, TERMITIDAE) EN CULTIVOS DE MAÍZ EN ARGENTINA

RESUMEN

El género *Procornitermes* ha sido mencionado entre las termitas plagas agrícolas más importantes de América del Sur. Aquí se comunica por primera vez la presencia de *P. striatus* y *P. triacifer* en plantaciones de maíz en Argentina y se caracterizan los daños observados en la zona. En mayo de 2016 se detectaron termitas subterráneas en lotes de maíz de la provincia del Chaco. Se identificaron los

insectos recolectados como pertenecientes a las dos especies mencionadas del género *Procornitermes*. Los daños observados en las plantas de maíz se concentraron en las raíces y en la base del tallo. Los tallos de las plantas afectadas estaban casi completamente ahuecados y muchas de las raíces y raicillas habían sido cortadas y consumidas o trasladadas a los nidos. Estos hallazgos revelan la presencia de termitas subterráneas del género *Procornitermes* en áreas agrícolas de Argentina y ponen de manifiesto la necesidad de futuros estudios para determinar su abundancia e impacto potencial en los cultivos regionales.

Palabras clave: Termitas, *Procornitermes*, maíz, Argentina

INTRODUCTION

The South American genus *Procornitermes* Emerson comprises five termite species of mainly subterranean habits distributed in open plant formations such as savannas and grasslands, but also in hydrophilic and xerophytic forests of Argentina, Bolivia, Brazil, Paraguay, and Uruguay (ARAUJO, 1977; CANCELLO, 1986; COLES DE NEGRET et al., 1982; CONSTANTINO, 1998, 2015; EMERSON, 1952; SILVESTRI, 1901, 1903; TORALES et al., 1997, 2005, 2008). *Procornitermes* belongs to the Syntermitinae subfamily comprising 18 neotropical genera characterized by soldiers with a frontal tube (nasus) of variable size at the end of which opens a wide frontal gland apical pore, and functional mandibles (CONSTANTINO & CARVALHO, 2011; ENGEL & KRISHNA, 2004; ROCHA et al., 2012). The cephalic capsule of *Procornitermes* soldiers is approximately rectangular or sub-rectangular, the frontal tube is conspicuous but short, not exceeding the postclypeus in dorsal view. The mandibles are moderately long with the outer margins curved inwards and teeth in the internal margin (CANCELLO, 1986; EMERSON, 1952; ROCHA et al., 2012). Some morphological and biological aspects would seem to indicate that the genus *Procornitermes* does not constitute a monophyletic group and possibly some species such as *Procornitermes araujoi* Emerson and *Procornitermes triacifer* (Silvestri) should be transferred to another genus in the future (CANCELLO, 1986; ROCHA et al., 2012).

The genus *Procornitermes* is considered one of the most important agricultural pest termites in South America, mentioning three species: *P. araujoi*, *P. triacifer* and *P. striatus* (Hagen), which are often found in the Brazilian Cerrado (CONSTANTINO, 2002; MILL, 1992). In Brazil, these species are detrimental to several crops, pastures and forestry systems (BERTI FILHO et al., 1993; CANCELLO, 1986; CONSTANTINO, 2002; ROULAND- LEFÈVRE, 2011; SILVA et al., 1968). In Uruguay, *P.*

striatus is mentioned as a common species whose subterranean nests make it difficult to prepare the agricultural land, but no reference is made to crop damage (ABER, 1995). For the remaining countries where the genus is present, no reports of its detection in agricultural areas have been found.

The aim of this communication is to report for the first time the presence of the termites *P. striatus* and *P. triacifer* attacking maize plants in Argentina, and to characterize in a preliminary way the damages produced by these insects in the area.

MATERIALS AND METHODS

The sampling was conducted in a 47 ha maize field (*Zea mays* L.) located in a farming area of the Independencia Department, Chaco Province, Argentina (26°45'47"S, 60°54'25"W) in May 2016. The field was surrounded by other maize, soybean and cotton crops. The maize plants were in the reproductive state of physiological maturity (R6), close to the harvest. In the selected lot, an exploratory sampling was carried out for the collection of termites. Six sampling points were randomly established within the field, separated from one another by distances of 20 m. At each point, ten plants were extracted and inspected for the presence of subterranean termites. A plant was considered to have been attacked when termites were observed and the damage was detected visually. The percentage of attacked plants was calculated. The termite samples were collected and fixed in 70% ethanol. Photographs of the observed damages were taken. In the laboratory, termites were identified using taxonomic keys and bibliography related to the genus *Procornitermes* (CANCELLO, 1986; CANCELLO & ROCHA, 2013; CONSTANTINO, 1999; EMERSON, 1952; ROCHA et al., 2012) as well as by comparisons with samples from the Argentinean Termite Collection (FACENAC) of the Facultad de Ciencias Exactas y Naturales y Agrimensura, Universidad Nacional del Nordeste (UNNE).

RESULTS AND DISCUSSION

When extracting several maize plants, termites were observed on their roots and inside the stems at the surface soil level. The percentage of attacked plants detected during the exploratory sampling varied from 0% to 20% at the six sampling points, with an average value of 11.67%. These values are considered as preliminary data and must be confirmed by further sampling in the area and surroundings.

The collected termites belong to two species of the genus *Procornitermes*: *P. striatus* and *P. triacifer*. In Argentina, the genus *Procornitermes* is widely distributed, since its presence has been recorded from natural ecosystems of Chaco, Corrientes, Formosa, Jujuy, La Rioja, Salta, Santa Fe,

Santiago del Estero and Tucumán provinces (BUCHER, 1974; CANCELLO, 1986; CUEZZO, 2005; EMERSON, 1952; ROISIN & LEPONCE, 2004; SILVESTRI, 1903; TORALES et al., 1997, 2005, 2008). However, these are the first records of *Procornitermes* spp. from agricultural areas of the country, causing damages to crops.

The two species detected (Figure 1A-D) can be distinguished mainly by different morphological characters of soldiers, such as the shape of the cephalic capsule, mandibles, labrum, postmentum and pronotum, as well as the number of the foretibia spurs and the length of the posterior tibia (CANCELLO, 1986; EMERSON, 1952). Also, the intestinal anatomy of workers has proved to be valuable for the interspecific differentiation of *Procornitermes* (CANCELLO & ROCHA, 2013; ROCHA & CONSTANTINI, 2015).

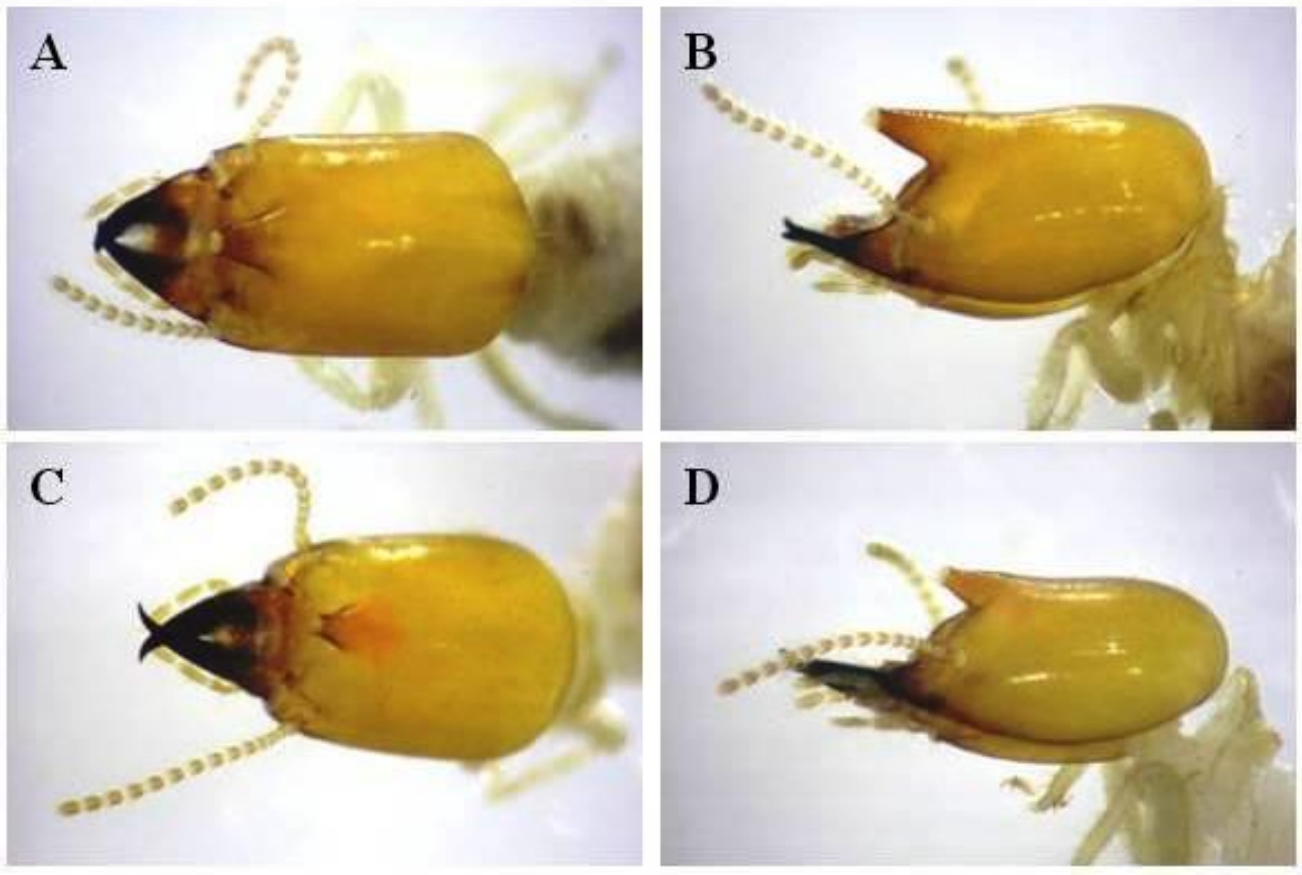

Figure 1 A-D. Head of *Procornitermes* soldiers found at maize field. *P. striatus*: A: dorsal view, B: lateral view. *P. triacifer*: C: dorsal view, D: lateral view. Chaco/ Argentina, 2016.

Neither during the inspection of the corn field nor during the excavations could be observed nests of these termites. Their finding is difficult and often fortuitous, since the nests of *P. striatus* are

completely subterranean and polycalic, with a particular structure consisting of several chambers with seven to ten inner cells communicated to each other (EMERSON, 1952; SILVESTRI, 1903). On the other hand, the nests of *P. triacifer* have not been described (CANCELLO & ROCHA, 2013).

In natural environments, *Procornitermes* spp. individuals are generally detected in soil-related microhabitats and near the ligno-cellulosic materials which they consume inside their nests or in subterranean galleries, on fallen logs and branches, litter, bromeliads or under stones or dung. They have also been detected inside nests of *Constrictotermes* Holmgren termites (CANCELLO, 1986; CUEZZO, 2005; EMERSON, 1952; TORALES et al., 2005, 2008).

With respect to the diet of different *Procornitermes* species, they are included in the intermediate feeding-group of termites or soil-wood interface feeders (CONSTANTINO, 2015; ROISIN & LEPONCE, 2004), also among wood feeders (*P. araujoi*, *P. triacifer*) or litter feeders (*P. araujoi*, *P. triacifer*) (ROCHA & CONSTANTINI, 2015). In natural environments, the feeding substrates consumed by these termites are living or dead plant material located underground, with a tendency to consume well-decomposed material. *P. striatus* and *P. triacifer* also consume cattle and equine excrements. *P. araujoi* also seems to be able to occasionally forage in the open field to collect decaying grasses (CANCELLO, 1986; COLES DE NEGRET & REDFORD, 1982; EMERSON, 1952; TORALES et al., 1997, 2005).

The damages observed in the analyzed maize plants were concentrated in the subterranean portions and at the stem bases. When extracting the attacked plants, numerous individuals of the worker and soldier castes of *Procornitermes* spp. were detected on the roots and inside the partially hollowed stems. The main roots, stems and some basal leaves of the affected plants had their surfaces partially chewed and covered by soft consistency constructions made by workers with material taken from the topsoil (Figure 2 A, B).

Many of the small diameter roots and rootlets had been cut and consumed or moved to the nests. The stems were almost completely hollowed, so they were dry and brittle, detaching easily. In the inner tissues it was possible to recognize the marks produced by the worker mandibles by gnawing them (Figure 2C). Close to some plants, at the soil surface level, many galleries and subterranean cells were excavated by termites to reach them (Figure 2D). As observed in the field, each one of the two termite species invaded exclusively a plant, since both were not seen in a same specimen of maize. However, in one case, the distance between plants occupied by different species was very short, less than 0.5 m.

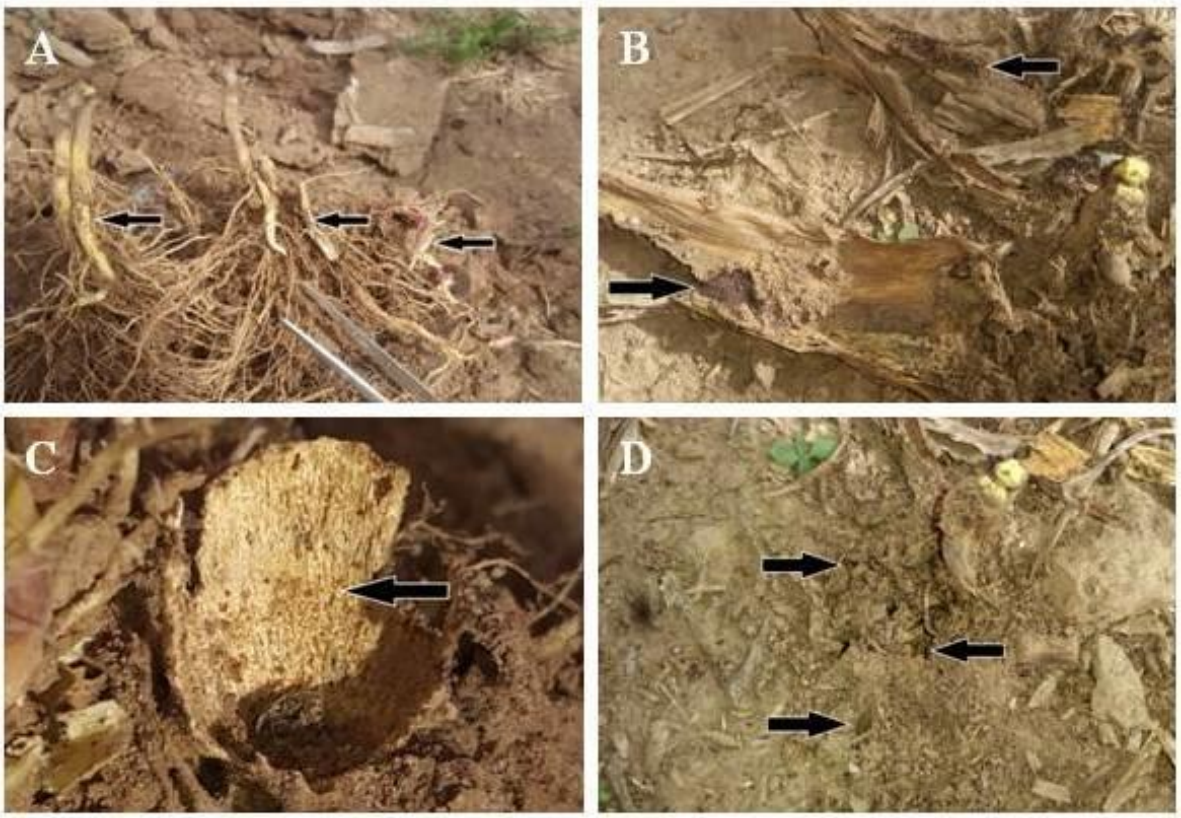

Figure 2A-D. Damage by *Procornitermes* spp. to maize plants (arrows). A: gnawed stems and roots, B: leaves with earth constructions, C: hollowed stem with marks of the worker mandibles, D: subterranean gallery openings next to the attacked plants. Chaco/ Argentina, 2016.

According to several reports, both termite species produce significant damages to different crops in Brazil. *P. striatus* attacks roots of maize, pineapple (*Ananas comosus* [L.] Merr), rice (*Oriza sativa* L.), coffee (*Coffea arabica* L.), sugarcane (*Saccharum* spp.), asparagus (*Asparagus officinalis* L.) and recently implanted young specimens of *Eucalyptus* spp. in the Brazilian states of Minas Gerais and Rio Grande do Sul. *P. triacifer* causes significant damage to maize roots, roots and young plants of upland rice, as well as to coffee, *Eucalyptus* spp., sorghum (*Sorghum bicolor* [L.] Moench) and wheat (*Triticum aestivum* L.) seedlings in the states of São Paulo and Goiás (AGROFIT, 2011; BERTI FILHO et al., 1993; CANCELLO, 1986; CONSTANTINO, 2002; CZEPAK et al., 1993; FERREIRA, 1998; SILVA et al., 1968). In sugarcane, although *P. triacifer* has been cited as causing damage to the stems, an intensive study in cane fields of São Paulo catalogs this species as infrequent (BERTI FILHO et al., 1993; JUNQUEIRA et al., 2015). It has also been mentioned damaging elephant grass (*Pennisetum purpureum* Schum.), pangola grass (*Digitaria decumbens* Stent.) and rice replant grains (CANCELLO, 1986). In soybean (*Glycine max* [L.] Merril), *P. triacifer* consumes roots causing planting lines to fail, as well as

deterioration and even death of young plants and sometimes attacks its aerial organs (MOREIRA & ARAGÃO, 2009).

The third species of the genus mentioned as agricultural pest (*P. araujoi*) was not detected in Argentina. In the Brazilian states of Goiás, Minas Gerais and São Paulo it attacks roots, seedlings and rice paddies as well as vegetable and *Eucalyptus* spp. roots (BERTI FILHO et al., 1993; CONSTANTINO, 2002; CZEPAK et al., 1993; FERREIRA, 1998; SILVA et al., 1968). It is also indicated as a pineapple, coffee and asparagus pest (AGROFIT, 2011). *P. triacifer* and *P. araujoi*, together with *Syntermes molestus* (Burmeister) are present in most of the Brazilian Cerrado upland rice lots and they are one of the main causes of insecticides use for seed treatments in those areas (FERREIRA et al., 2007; SILVA et al., 2012).

CONCLUSION

The detections reported here and the damages observed to maize plants in the Chaco province reveal the presence of subterranean termites of the genus *Procornitermes* in agricultural areas of Argentina and the results of the preliminary sampling require further research to determine accurately their abundance and potential impact on regional crops.

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REFERENCES

ABER, A. 1995. Termites (Isoptera) que causan infestación en Uruguay. *In*: BERTI FILHO, E.; FONTES, L. R. **Alguns aspectos atuias da biologia e controle de cupins,** Piracicaba: FEALQ, p. 165-168.

AGROFIT. 2011. **Sistemas de agrotóxicos fitossanitários**. Available in: <http://extranet.agricultura.gov.br/agrofit_cons/principal_agrofit_cons>. Accessed: 15 sept/16).

ARAUJO, R. 1977. **Catálogo dos Isoptera do Novo Mundo,** Rio de Janeiro: Academia Brasileira de Ciências. 92 p.

BERTI FILHO, E.; MARICONI, F. A. M.; WILCKEN, C. F. 1993. **Manual de pragas em florestas: cupins ou térmitas,** Piracicaba: IPEF/SIF. 56 p.

BUCHER, E. H. 1974. Observaciones ecológicas sobre los artrópodos del bosque chaqueño de Tucumán. **Revista de la Facultad de Ciencias Exactas Físicas y Naturales (N.S.) Biología**, Córdoba, v. 1, p. 35-122.

CANCELLO, E. M. 1986. Revisão de *Procornitermes* Emerson (Isoptera, Termitidae, Nasutitermitinae). **Papéis Avulsos de Zoologia**, São Paulo, v. 36, n. 19, p. 189-236.

CANCELLO, E. M.; ROCHA, M. M. 2013. Comparative morphology of the digestive tube in species of *Procornitermes* Emerson (Isoptera, Termitidae, Syntermitinae). **Deutsche Entomologische Zeitschrift**, Berlin, v. 60, n. 2, p. 147-153.

COLES DE NEGRET, H. R.; REDFORD, K. H. 1982. The biology of nine termite species (Isoptera: Termitidae) from the cerrado of Central Brazil. **Psyche**, Cambridge, v. 89, n. 1-2, p. 81-106.

CONSTANTINO, R. 1998. Catalog of the living termites of the New World (Insecta: Isoptera). **Arquivos de Zoologia**, São Paulo, v. 35, n. 2, p. 135-230.

CONSTANTINO, R. 1999. Chave ilustrada para a identificação dos géneros de cupins (Insecta: Isoptera) que ocorrem no Brasil. **Papéis Avulsos de Zoologia**, São Paulo, v. 40, n. 25, p. 387-448.

CONSTANTINO, R. 2002. The pest termites of South America: taxonomy, distribution and status. **Journal of Applied Entomology**, Berlin, v. 126, n. 7-8, p. 355-365.

CONSTANTINO, R. 2015. **Cupins do Cerrado**, Rio de Janeiro: Technical Books Editora. 167 p.

CONSTANTINO, R.; CARVALHO, S. H. 2011. *Paracurvitermes*, a new genus of Syntermitinae (Isoptera: Termitidae). **Sociobiology**, Feira de Santana, v. 57, n. 2, p. 377-388.

CUEZZO, C. 2005. Citas nuevas de Isoptera para el Chaco semiárido argentino. **Revista de la Sociedad Entomológica Argentina**, La Plata, v.64, n. 1-2, p. 106-108.

CZEPAK, C.; FERREIRA, E.; NOGUEIRA, S. B. 1993. Identificação e quantificação de cupins rizófagos na cultura do arroz de sequeiro. **Pesquisa Agropecuária Brasileira**, Brasilia, v. 28, p. 871-875.

EMERSON, A. E. 1952. The neotropical genera *Procornitermes* and *Cornitermes* (Isoptera, Termitidae). **Bulletin of the American Museum of Natural History**, New York, v. 99, n. 8, p. 475-540.

ENGEL, M. S.; KRISHNA, K. 2004. Family-group names for termites (Isoptera). **American Museum Novitates**, New York, v. 3423, p. 1-9.

FERREIRA, E. 1998. **Manual de identificação de pragas do arroz**, Goiás: EMBRAPA- CNPAF, 110 p.

FERREIRA, E.; BARRIGOSSI, J. A. F.; SILVA, J. D.; STONE, L. F.; MOREIRA, J. A. 2007. Fatores influenciando o ataque de cupim rizófago em plantio direto de arroz de terras altas. **Pesquisa Agropecuária Tropical**, Goiás, v. 37, n. 3, p. 176-181.

JUNQUEIRA, L. K.; GONÇALVES, E. R.; TEIXEIRA, L. M. C. 2015. Termite communities in sugarcane plantations in Southeastern Brazil: an ecological approach. **EntomoBrasilis**, Vassouras, v. 8, n. 2, p. 105-116.

MILL, A. 1992. Termites as agricultural pests in Amazonas, Brazil. **Outlook on Agriculture**, London, v. 21, n. 1, p. 41-46.

MOREIRA, H. D. C.; ARAGÃO, F. D. 2009. **Manual de pragas da soja**, Campinas: FMC, 144 p.

ROCHA, M.; CONSTANTINI, J. 2015. Internal ornamentation of the first proctodeal segment of digestive tube of Syntermitinae (Isoptera, Termitidae). ***Deutsche Entomologische Zeitschrift**, Berlin, v.* 62, n. 1, p. 29-44.

ROCHA, M. M.; CANCELLO, E. M.; CARRIJO, T. F. 2012. Neotropical termites: revision of *Armitermes* Wasmann (Isoptera, Termitidae, Syntermitinae) and phylogeny of the Syntermitinae. ***Systematic Entomology**, London, v.* 37, n. 4, p. 793-827.

ROISIN, Y.; LEPONCE, M. 2004. Characterizing termite assemblages in fragmented forest: A test case in the Argentinian Chaco. **Austral Ecology**, Windsor, v. 29, p. 637-646.

ROULAND- LEFÈVRE, C. 2011. Termites as pests of agriculture. *In*: Bignell, D.E.; Roisin, Y.; Lo, N. **Biology of Termites: a Modern Synthesis,** Netherlands: Springer, p. 499-517.

SILVA, A. G.; GONÇALVES, C. R.; GALVÃO, D. M.; GONÇALVES, A. J.; GOMES, J.; DO NASCIMENTO SILVA, M.; DE SIMONI, L. 1968. **Quarto catálogo dos insetos que vivem nas plantas do Brasil. Seus parasitas e predadores**, Rio de Janeiro: Ministério da Agricultura, 906 p.

SILVA, H. M. R.; ALVES, T. M.; BARRIGOSSI, J. A.; PINHEIRO, V.; DA SILVA, J. G.; COBUCCI, T.; LACERDA, M. C.; SILVA, J. F. 2012. Compactação de sulco de plantio e inseticidas no controle de cupins rizófagos em arroz de terras altas. *In*: **Anais do Congresso de Pesquisa, Ensino e Extensão CONPEEX,** Goiás: Universidade Federal de Goiás, p. 8797-8801.

SILVESTRI, F. 1901. Nota preliminare sui Termitidi sud-americani. **Bolletino dei Musei di Zoologia ed Anatomia Comparata della Reale Università di Torino**, Turin, v. 16, p. 1-8.

SILVESTRI, F. 1903. Contribuzione alla conoscenza dei Termitidi e Termitofili dell' America Meridionale. **Redia**, Firenze, v. 1, p. 1-234.

TORALES, G. J.; LAFFONT, E. R.; ARBINO, M. O.; GODOY, M. C. 1997. Primera lista faunística de los isópteros de la Argentina. **Revista de la Sociedad Entomológica Argentina**, La Plata, v. 56, n. 1-4, p. 47-53.

TORALES, G. J.; LAFFONT, E. R.; GODOY, M. C.; CORONEL, J. M. 2005. Update on taxonomy and distribution of Isoptera from Argentina. **Sociobiology**, Chico, v. 45, n. 3, p. 853-886.

TORALES, G. J.; CORONEL, J. M.; GODOY, M. C.; LAFFONT, E. R.; ROMERO, V. 2008. Additions to the taxonomy and distribution of Isoptera from Argentina. **Sociobiology**, Chico, v. 51, n. 1, p. 31-47.

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