RHIZOPOGON (RHIZOPOGONACEAE): HYPOGEOUS FUNGI IN EXOTIC PLANTATIONS FROM THE STATE OF SÃO PAULO, BRAZIL[1]

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RESUMO – (*Rhizopogon* (Rhizopogonaceae): fungos hipógeos em plantações exóticas no Estado de São Paulo, Brasil). Um estudo sobre o gênero *Rhizopogon*, associado com raízes de árvores exóticas no Estado de São Paulo (Brasil), foi realizado de Janeiro/1999 até Setembro/2000. Três espécies foram identificadas: *R. luteolus* Fr., *R. roseolus* Corda sensu A. H. Smith e *R. rubescens* Tul. Este é o primeiro registro de *R.. luteolus* e *R.. roseolus* para o Brasil.

Palavras-chave – Gasteromycetes, falsas trufas, taxonomia, ectomicorríza

ABSTRACT – (*Rhizopogon* (Rhizopogonaceae): hypogeous fungi in exotic plantations from the State of São Paulo, Brazil). A survey on the genus *Rhizopogon*, associated with roots of exotic trees in State of São Paulo (Brazil), was undertaken from January /1999 to September/2000. Three species were identified: *R. luteolus* Fr., *R. roseolus* Corda sensu A. H. Smith and *R. rubescens* Tul. This is the first report of *R. luteolus* and *R. roseolus* from Brazil.

Key words – Gasteromycetes, false truffles, taxonomy, ectomycorrhiza

Introduction

The Brazilian hypogeous gasteroid fungi have received scant attention from collectors in the past and have not been adequately collected. Few specimens in the herbaria have been sufficiently studied or even not.

Rhizopogon Fr. & Nordh. is an ectomycorrhizal genus (Mikola, 1969; Zak, 1971; Miller, 1986; Molina & Trappe, 1994) characterized by basidiomata whose gleba have small irregular and sinuous chambers that are and far from a bolete in appearance. However, Bruns et al. (1989) and Martin et al. (1998) presented the bolete genus *Suillus* and suggested that a change in a few developmental genes with strong selection pressure of a hypogeous habitat would lead to rapid morphological divergence.

From Brazil *Rhizopogon* is represented by *R. fuscorubens*, *R. nigrescens*, *R. rubescens*, *R. vulgaris* and *R. zelleri* (Giachini et al., 2000). The objetive of this study was to expand the

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knowledge of Basidiomycetes in Brazil, particularty the gasteroid forms.

Materials and methods

In the rainy seasons of 1999 and 2000 specimens of *Rhizopogon* were collected from plantations of *Pinus*, at the following areas: "Estação Ecológica de Itirapina" (2,300.00 ha, 22°28'-22°30S and 48°17'-48°19'W); "Reserva Ecológica de Jataí" (4,532.18 ha, 21°33'-21°37'S and 47°45'-46°51'W); "Reserva Biológica de Moji Guaçu" (343, 42 ha, 22°15'-22°16'S and 47°08'-47°-12'W), all in the State of São Paulo. Tree species composition of the plantations include *Pinus radiata* D. Don and *Pinus taeda* L. Climatic conditions are of the AW type according to the Köppen System.

Hand-cut sections of fresh and dried material were mounted in Melzer's reagent, 3% KOH, water or cotton blue for microscopical examination (Singer, 1986). Permanent slides were made using PVL resin (Alcohol Polyvinilic and Lactophenol), according to Trappe & Schenck (1982).

The mycorrhizal observations were accomplished by using the methods mentioned by Zak (1971) and Zak & Bryan (1963). Color terms in parenthesis are those of Kornerup & Wanscher (1978). The material is preserved at the Herbario do Estado Maria Eneyda P. K. Fidalgo (SP), abbreviated according to the Index Herbariorum (Holmgren et al., 1990).

Results and discussion

Descriptions of the species

Rhizopogon luteolus ***Fries & Nordholm, Symbolae Gasteromycetum 1: 5, 1815, emended Tulasne, Giornal Botanica Italiana 2, 57, 1844.*** Fig. 1. Basidiomata up to 5-6 cm broad, subglobose, surface fibrilose with lateral rhizomorphs, peridium brownish yellow (KW 5F7); gleba white to olive, columella absent, paraphyses about 9-10 x 3-4 µm; basidia 6-spored 18-20 x 5-6 µm, basidiospores elliptic to pyriform, smooth, 5-6 x 3 µm, light brown, containing two guttulae inside.

Habitat: Hypogeous under exotic forests trees, aggregated with roots.of *Pinus radiata*.

Material examined: **BRAZIL, São Paulo**: Município de Luís Antônio, Estação Ecológica de Jataí, 17/III/1999, I. G. Baseia 365 (SP307523); Município de Moji Guaçu, Reserva Biológica de Moji Guaçu, 04/II/2000, I. G. Baseia 419 (SP307524); Município de Itirapina, Estação Ecológica de Itirapina, 08/IX/2000, I. G. Baseia 673 (SP307525).

Additional material examined: (donated to SP Herbarium): **SCOTLAND**: det. Dring, D. M., 09/IX/1963, (SP107411).

Distribution: USA (Coker & Couch, 1928; Smith & Zeller, 1966), Australia (Cleland, 1935; Cunningham, 1944), South Africa (Bottomley, 1948), United Kingdom (Hawker, 1954), Finland (Schulmann, 1961), Canary Islands (Eckblad, 1975), China (Liu, 1984), Chile (Garrido, 1986), Iran (Saber, 1997), Belgique (Moyersoen & Demoulin, 1996)

Remarks: *Rhizopogon luteolus* is characterized by the color and size of the basidiomata, as well as the fibrilose surface with lateral rhizomorphs. It differs from *R. rubescens* mainly by its lateral rhizomorphs and the size of basidiospores and paraphyses.

The basidiomata of this species were found aggregated with roots of *Pinus radiata* exhibiting ectomycorrhizal association observed through the microscopic analysis and the presence of the mantle and Hartig net. This evidence was also mentioned by Mikola (1969), who found the same association between these species from New

Key of the species

1	Peridium surface reddish brown, basidiomata up to 1-1.5 cm broad; basidiospores hyaline ..... **Rhizopogon roseolus**
1'	Peridium surface brownish yellow, basidiomata up to 3-4 cm broad; basidiospores pale brown 2
2	Basidiomata surface with lateral rhizomorphs; basidiospores 9-10 x 2.5-3 mm, paraphyses 9-10 x 3-4 mm ..... **Rhizopogon luteolus**
2'	Basidiomata surface with basal rhizomorphs; basidiospores 6-9 x 3-4 mm, paraphyses 15-20 x 2-3 mm ..... **Rhizopogon rubescens**

Zealand. In Brazil, large scale reforestation is being carried out with both softwood and hardwood species, including *Pinus radiata*, a tree native from the California coast (Garrido, 1986), probably *R. luteolus* had the same origin. This is the first record of *R. luteolus* from Brazil.

Rhizopogon roseolus Corda sensu A. H. Smith, Mem. N. Y. Bot. Gard. 14(2), p. 90, 1966.

Fig. 2 Basidiomata up to 2-3 cm broad, globose, subglobose or irregular, surface rugose with scattered lateral rhizomorphs, peridium greyish orange (KW 5B3); gleba white to olive, columella absent, paraphyses about 12-18 x 5-9 µm; basidia 6-spored 15-20 x 6-8 µm, basidiospores oblong to elliptic, smooth, 6-8 x 3-4 µm, hyaline, often containing 2 guttulae inside and falsely septate.

Habitat: Hypogeous under exotic tree where it was found aggregated with roots.of *Pinus taeda*.

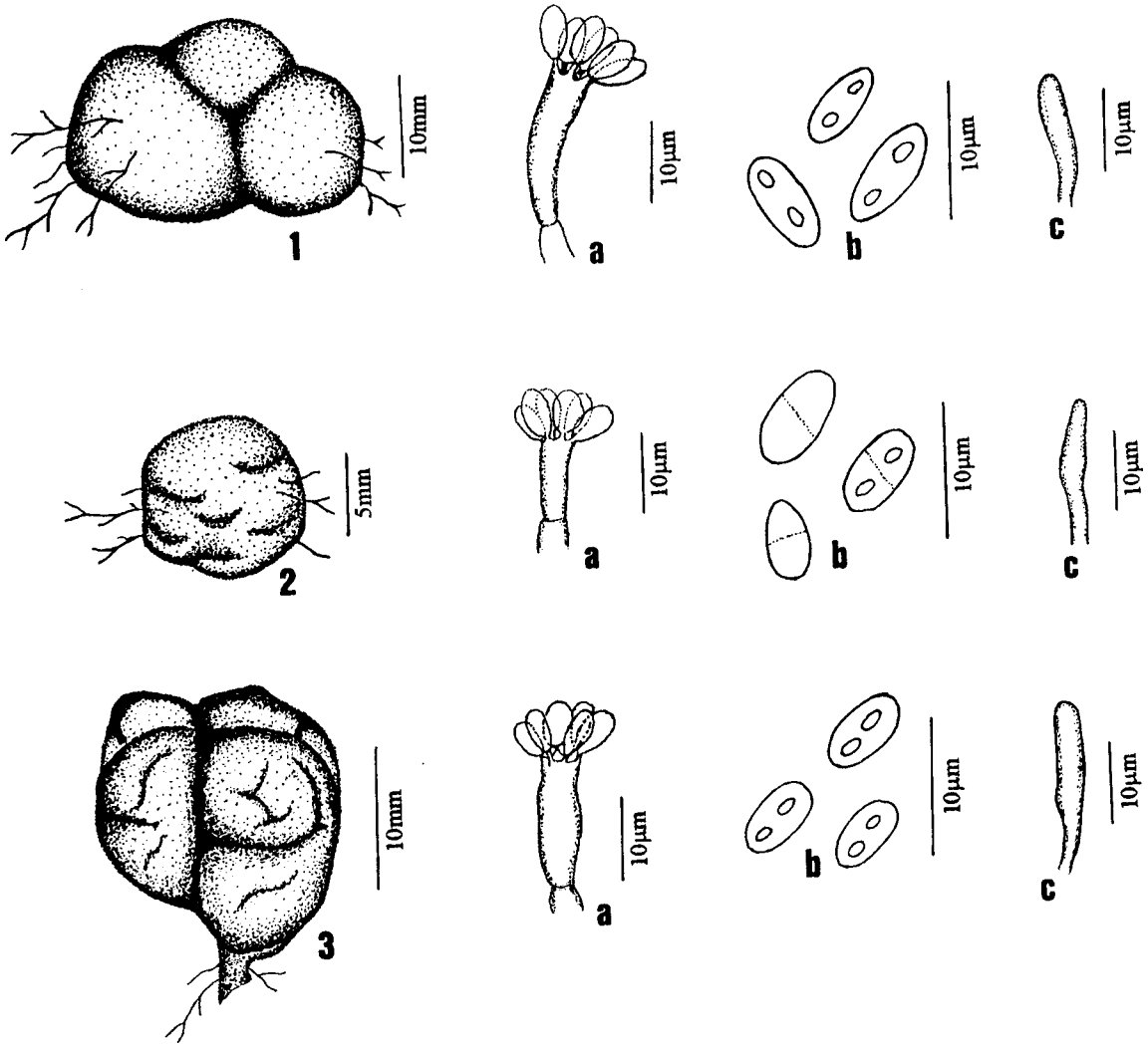
Material examined: **BRAZIL, São Paulo**: Município de Moji Guaçu, Reserva Biológica de Moji Guaçu, 31/I/1999, I. G. Baseia 312 (SP307526).

Additional material examined: (donated to SP Herbarium): **ESTONIA**: det. Parmasto E., 07/VII/1960 (SP61313)

Distribution: USA (Coker & Couch, 1928; Zeller, 1939; Smith & Zeller, 1966; Harrison & Smith, 1968), Finland (Schulmann, 1955), Chile (Garrido, 1986).

Remarks: This species is close to *R. rubescens* in several morphological characters; some authors (Moyersoen & Demoulin, 1996) lists *R. rubescens* as a synonym of *R. roseolus*. However, in our opinion and following Smith & Zeller (1966), there are sufficient characters to segregate these taxa. The color of the reddish brown peridium surface and small size of basidiomata are some peculiar characteristics of the Brazilian specimens.

The basidiomata of this species grow solitary, and aggregated with roots of *Pinus taeda*, an exotic conifer having North American origin introduced in cerrado biome. Probably *R. roseolus* had the same origin. This symbiotic relationship was confirmed by rhizomorphs aggregated with the conifer roots and through microscopic analysis with the presence of the mantle and Hartig net. Mikola (1969) also found the ectomycorrhizal association between *R. roseolus* with *Pinus radiata* and another undetermined species of *Pinus* from Australia, New Zealand, South Africa, Nigeria and Trinidad. This is the first report of *R. roseolus* from Brazil. ***Rhizopogon***



Figs. 1-3. 1. Rhizopogon luteolus; a. basidioma; b. basidiospores; c. paraphyse. Figure 2. Rhizopogon roseolus; a. basidioma; b. basidiospores; c. paraphyse. Figure 3. Rhizopogon rubescens; a. basidioma; b. basidiospores; c. paraphyse.

rubescens Tulasne, Giornal Botanica Italiana 2, 58, 1844. Fig. 3. Basidiomata up to 3-4 cm broad, globose to subglobose, surface fibrilose with basal rhizomorphs, peridium brownish yellow (KW 5F7); gleba white to olive brown, columella absent, paraphyses about 15-20 x 2-3 µm; basidia 6-spored 10-15 x 5-6 µm, basidiospores elliptic to ovate, smooth, 9-10 x 3-3.5 µm, hyaline to yellowish, containing two guttulae inside, and often falsely septate.

Habitat: Hypogeous under exotic forest trees, aggregated with roots.of ***Pinus radiata***.

Material examined: **BRAZIL, São Paulo**: Município de Luís Antônio, Estação Ecológica de Jataí, 02/III/1999, I. G. Baseia 621 (SP307527).

Additional material examined: (donated to SP Herbarium): **FRANCE, Briançonnais**: det. Kofler L., 21/VII/1958(SP61508).

Distribution: USA (Coker & Couch, 1928; Smith & Zeller, 1966; Harrison & Smith, 1968), Australia (Cleland, 1935; Cunningham, 1944), United Kingdom (Hawker, 1955), Chile (Garrido, 1986), Finland (Eckblad & Lange, 1992), Belgique (Moyersoen & Demoulin, 1996), Brazil (Giachini et al., 2000).

Remarks: This species can be characterized by the size of basidiomata, basidiospores and paraphyses. It differ from *R. luteolus* and *R. roseolus* mainly by the rhizomorphs in these cited species, whereas in *R. rubescens* the rhizomorphs have a basal localization.

Basidiomata of *R. rubescens* were found aggregated with roots of *Pinus radiata* exhibiting ectomycorrhizal association with the presence of the mantle. Both, mantle and Hartig net were observed.

This is a common and widespread hypogeous conifer associate (Garrido, 1986; Miller, 1986; Molina & Trappe, 1994, Giachini et al., 2000), found not only with *Pinus*, but also with *Abies*, *Picea*, *Pseudotsuga*, *Tsuga* and *Quercus* (Molina & Trappe, 1994). Ectomycorrhizae were synthesized in vitro on *Pinus radiata* and *P. sylvestris* (Molina & Trappe, 1994) and *Larix laricina* (Sampson & Fortin, 1988).

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