

First report of *Rhizopogon roseolus* in Iran

Received: 12.11.2016 / Accepted: 28.12.2016

Samad Jamali✉: Assistant Prof., Department of Plant Protection, College of Agriculture, Razi University, Kermanshah, P.O. Box 6715685438, Iran (jamali454@yahoo.com)**Pablo Alvarado**: Researcher, ALVALAB, C/ La Rochela 47, E-39012 Santander, Cantabria, Spain

Rhizopogon is a hypogeous fungal genus that grows in an ectomycorrhizal symbiosis mostly with members of the *Pinaceae* family and its worldwide distribution correlates with natural and exotic *Pinaceae* forests. In Iran, *Rhizopogon* species have received scant attention from collectors in the past and have not been adequately collected. Few older studies, report the presence of *R. luteolus* (Saber 1999), and *R. vulgaris* in Iran (Ershad 2009). However, the accuracy of the species identification merely on the basis of morphological features is questionable. *Rhizopogon roseolus* is common in northwestern United States USA (Coker & Couch 1928, Harrison & Smith 1968). So far, it has been reported from, Finland (Schulmann 1955), Chile (Garrido 1986), Brazil (Baseia & Milanez 2002), Poland (Iwanski *et al.* 2006), Spain (Dominguez-Nunez *et al.* 2013) and New Zealand. In this study, seven specimens associated with roots of *Pinus eldarica* based on morphological and molecular characteristics were examined. Basidiocarps were hypogeous, globose, subglobose or irregular with different sizes (up to 10 cm in diam.) (Fig. 1A). Peridium was smooth and orange. Gleba was white to olive (Fig. 1B). Fresh mature basidiocarp not reacting in iodine. The basidia were club-shaped and $15\text{--}20 \times 6\text{--}8 \mu\text{m}$ (Fig. 1C). Columella absent and paraphyses about $12\text{--}18 \times 5\text{--}9 \mu\text{m}$ (Fig. 1D). The basidiospores ellipsoidal, smooth, hyaline, $6\text{--}8 \times 3\text{--}4 \mu\text{m}$, often contain two guttulae inside and falsely septate (Fig. 1E). All DNA sequences of *Rhizopogon* (accession numbers: KP202698 to KP202700) showed 100% homology with valid sequences previously identified and deposited in GenBank. Phylogenetic trees constructed based on ITS sequences showed that, all Iranian specimens are in the same branch in a clade with *R. roseolus* reported from other authors (Fig. 2). *Rhizopogon roseolus*, *R. Burlinghamii*, and *R. vulgaris* form distinct clades which were well-supported by bootstrap value (78% MP). This is the first report of *R. roseolus* and its host plant from Iran.

Voucher specimens are deposited in the Culture Collection of the Ministry of Jihad-e-Agriculture ("IRAN") located at the Iranian Research Institute of Plant Protection, Tehran, Iran (IRAN-16730F).

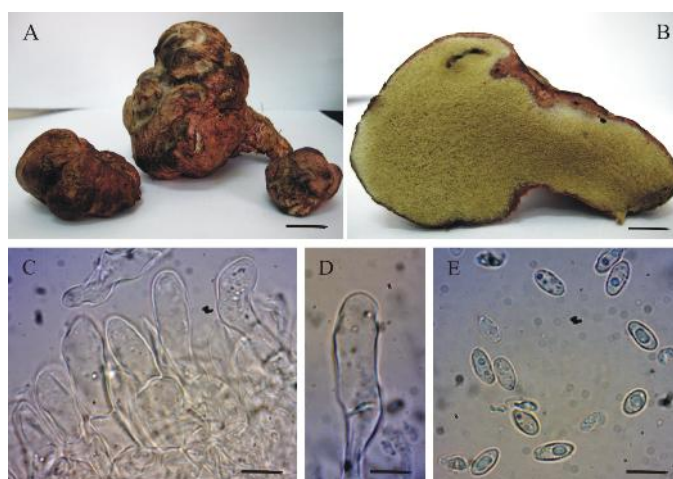


Fig. 1. *Rhizopogon roseolus*: A. Basidiocarp in different size, B. Cross section of basidiocarp, C, D. Basidium and Paraphyse, E. Basidiospores (Bars = 1 cm in A, B and 10 μm in C–E).

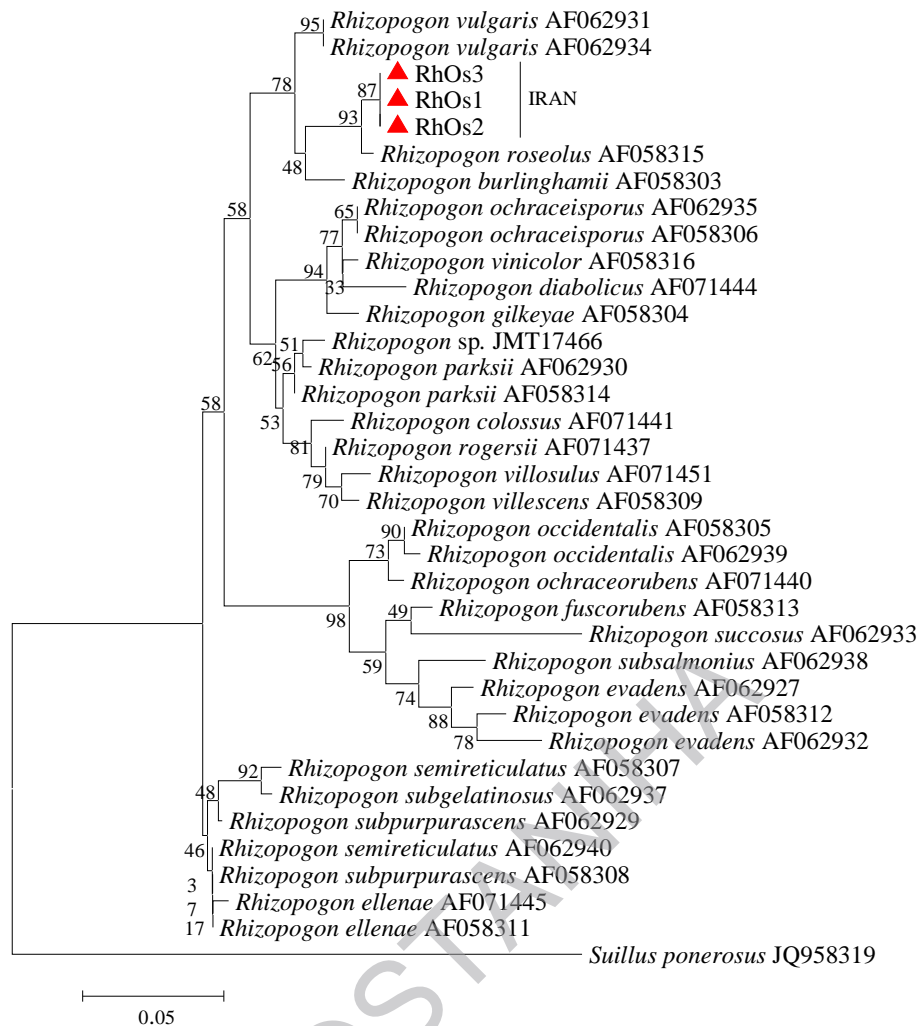


Fig. 2. Maximal Parsimony phylogram generated in Mega from the alignment of 36 combined ITS1, 5.8S subunit, and ITS2 regions of the genomic ribosomal RNA sequences of *Rhizopogon* species using Kimura 2 parameter method (Kimura 1980) with complete deletion gap handling and 1000-replication bootstrapping. The triangles refer to *Rhizopogon roseolus* specimens in Iran.

نخستین گزارش از *Rhizopogon roseolus* در ایران

دریافت: ۱۳۹۵/۰۸/۲۲ / پذیرش: ۱۳۹۵/۱۰/۰۸

صمد جمالی✉: استادیار قارچ‌شناسی، دانشکده کشاورزی، دانشگاه رازی، کرمانشاه، ایران (jamali454@yahoo.com)

یابلو آلوارادو: محقق مؤسسه تحقیقاتی آلوالب، سانتاندر، اسپانیا

خلاصه

Rhizopogon یک قارچ زیرزمینی است که به صورت قارچ-ریشه خارجی در همزیستی با اغلب اعضای تیره کاج (*Pinaceae*) بوده و پراکنش جهانی آن همسو با جنگل‌های کاج است. در ایران، مطالعات کمی در خصوص *Rhizopogon* صورت گرفته و اطلاعات اندکی در مورد این قارچ در دسترس است. در مطالعه حاضر، هفت نمونه *Rhizopogon* که همراه با ریشه گونه گیاهی *Pinus eldarica* بودند، براساس خصوصیات مورفولوژیکی و مولکولی مورد بررسی قرار گرفتند. بر این اساس، تمام نمونه‌های دنبل دروغین *Rhizopogon* همراه با ریشه این گونه گیاهی متعلق به جنس *Rhizopogon* بودند. توالی دی.ان.ای. نمونه‌های *Rhizopogon* ۱۰۰ درصد همولوژی با نمونه‌های معتبر ثبت شده در بانک ژن داشتند. درخت فیلوژنتیکی ترسیم شده براساس توالی‌های جداکننده نسخه‌برداری شده داخلی (آی.تی.اس.)، نشان داد که تمام نمونه‌های تحت بررسی با نمونه‌های معتبر مربوط به گونه *Rhizopogon roseolus* در یک شاخه با ضریب اطمینان بالا قرار گرفتند. این نخستین گزارش از وجود این گونه و میزبان آن در ایران است.

References

- Baseia, I.G. & Milanez, A.I. 2002. *Rhizopogon* (*Rhizopogonaceae*): Hypogeous fungi exotic plantations from the state of Sao Paulo, Brazil. *Acta Botanica Brasilica* 16(1): 55–59.
- Coker, W.C. & Couch, J.N. 1928. *The Gasteromycetes of the Eastern United States and Canada*, Chapel Hill. The University of North Carolina Press. 512 pp.
- Dominguez-Núñez, J.A., Saiz, M., Calderon, C. & Saiz de Omeñaca, J.A. 2013. Physiological effects of *Rhizopogon roseolus* on *Pinus halepensis* seedlings. *Forest Systems* 22(3): 568–572.
- Ershad, D. 2009. *Fungi of Iran*. Ministry of Jihad-e-Agriculture. 531 p.
- Garrido, N. 1986. Survey of ectomycorrhizal fungi associated with exotic trees in Chile. *Nova Hedwigia* 43: 423–442.
- Harrison, K.A. & Smith, A.H. 1968. Some new species and distribution records of *Rhizopogon* in North America. *Canadian Journal of Botany* 46: 881–889.
- Iwanski, M., Rudawska, M. & Leski, T. 2006. Mycorrhizal associations of nursery grown Scots pine (*Pinus sylvestris* L.) seedlings in Poland. *Annals of Forest Science* 63: 715–723.
- Kimura, M. 1980. A simple method for estimating evolutionary rates of base substitutions through comparative studies of nucleotide sequences. *Journal of Molecular Evolution* 16: 111–120.
- Saber, M. 1997. *Rhizopogon luteolus*, a new record for Iran. *Iranian Journal of Plant Pathology* 33: 73–74.
- Schulmann, O. 1955. *Pilzstudien in Finnland*. *Karstenia* 3: 17–68.

ROSTANIHA