生态学报 2007 27 (2007-06): 2325～2333 ISSN: 1004-616x CN: 44-1063/R

研究论文

云南松（*Pinus yunnanensis*）林外生菌根真菌的时空分布

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收稿日期 2006-6-5 修回日期 2007-2-1 网络版发布日期: 2007-6-25

摘要 2000年至2005年，调查了滇中及其附近云南松林下外生菌根真菌的生态分布，共采集、鉴定标本834号，计有27科39属211种（含变种、变型）。结果表明，红菇属（*Russula*）、牛肝菌属（*Boletus*）、乳菇属（*Lactarius*）、乳牛肝菌属（*Suillus*）、口蘑属（*Tricholoma*）、鸡油菌属（*Cantharellus*）和革菌属（*Thelephora*）等为云南松林下的主要外生菌根菌类群。它们的发生与分布受到气候（如：气温和降水）、植被（如：林龄、林地郁闭度和草本植被）、地形特征（如：海拔、坡向和坡度）、土壤条件（如：pH值、地表腐殖质和枯枝落叶层等）和人为干扰（比如：商业化采集、林木采伐、火烧和地表物清理）诸多因素的影响。总结为如下：(1）5a的调查结果显示，云南松外生菌根菌的分布表现出季节性变化的规律；其中以每年1、2、3月份的物种多样性为最低，雨季期间急剧增加，至中夏和秋末达到顶峰，种类最为繁多。(2）在海拔1500～2100 m，云南松外生菌根菌种类随着海拔的升高而逐渐增加，至顶峰后，又呈缓慢下降趋势。海拔因素不但对其物种多样性，而且对于类群的组成也具有重要的影响。特定的类群往往发生在特定海拔范围。(3）随着云南松林龄的增加，外生菌根菌呈现由少至多的演替过程。外生菌根菌多样性随云南松林生长而逐渐增加的演替方式，可能与宿主光合作用产物、根部分泌物和土壤条件的逐渐变化有关。(4）人类干扰是云南松外生菌根菌物种多样性和类群组成的主要负影响因子。大规模的商业化采集可破坏或枯竭地下菌丝体，打破各物种之间的竞争平衡，减少孢子释放影响资源再生能力，进而直接影响到子实体的产生。外生菌根菌物种多样性的减少趋势会随林木砍伐和火烧强度的增加而加剧。地表枯枝落叶层与杂草密度也会影响子实体的产生，其中枯枝落叶层的厚度与云南松外生菌根菌子实体的发生呈负相关性，而被紫茎泽兰覆盖的云南松林地内也很少会发现相应的子实体。

关键词 云南松；季节性变化；空间分布；真菌演替

分类号 Q143,Q938,Q948

Spatiotemporal distribution of ectomycorrhizal fungi in *Pinus yunnanensis* forests

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Abstract Ectomycorrhizal (EM) fungi from *Pinus yunnanensis* forests, a dominant vegetation type in central Yunnan and adjacent regions, were sampled from 2000-2005. A total of 834 mushroom collections representing 211 taxa in 39 genera and 27 families were obtained and identified. Of these, *Russula*, *Boletus*, *Lactarius*, *Suillus*, *Tricholoma*, *Cantharellus* and *Thelephora* were the dominant genera. Our ecological surveys indicate that EM fungal fruiting and distribution patterns are strongly affected by climate (e.g., air temperature and precipitation), vegetation (e.g., stand age, crown density and herbaceous vegetation), soil conditions (e.g., pH, litter and humus layers), topographic features (e.g., altitude, position and steepness of slopes), and human disturbance (e.g., commercial harvesting, logging, fire and residue removal).
The 4 primary findings were: (1) There was a consistent seasonal variation in the number of EM fungi associated with Pinus yunnanensis. Over the 5-year period, the lowest numbers of EM fungi were found during the winter months of January, February, and March. This number rose rapidly during the spring and peaked in mid and late summer. (2) The abundance, composition, and richness of EM fungi significantly increased with increasing altitude between 1500-2100 m, and then s

lightly decreased up to 2500 m. Usually a species was found only within a particular range of altit udes. (3) EM fungal richness increases as the host matures. The tendency is to find greater numbe rs of EM species associated with older *Pinus yunnanensis* stands. This increase in EM fungi wit h maturing of host stands may be related to changes in available photosynthate, root exudates an d soil conditions. (4) Human disturbance has a major negative impact on EM fungi species richnes s, abundance, and community composition. Large-scale harvesting directly affected the productio n of fruit bodies, either by damaging or exhausting mycelia, shifting competitive relations with othe r species, or by causing reproductive failure due to decreased spore production. EM fungi richnes s declined with increased fire severity and logging intensity. Both litter and humus layers and gras s density appeared to affect sporocarp production with litter depth and EM fungi sporocarp abun dance being negatively correlated. Sporocarps of EM fungi were scarce in *Pinus yunnanensis* st ands dominated by the grass *Eupatorium adenophorum*.

Key words *Pinus* *yunnanensis* _ seasonal variation _ spatial distribution _ fungal succession

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