

A Comparative Study on the Composition of Ectomycorrhizal Fungi in Pine and Poplar Stands

Kyung Joon Lee and Yang Sup Kim*

Institute of Forest Genetics, Suweon 170 and

**Institute of Agricultural Sciences, O.R.D., Suweon 170, Korea*

소나무林과 포플러林에 共生하는 外生菌根菌의 同定 및 比較

李 景 俊 · 金 養 燮

山林廳林木育種研究所 · *農村振興廳 農業技術研究所

Abstract: Ectomycorrhizal fungi in *Pinus rigida* × *taeda* and poplar stands (*Populus alba* × *glan-dulosa* and others) were collected in 1981 and 1982. A total of 39 mushrooms representing 15 genera were identified from the pine stand, and the major genera were *Amanita*, *Lactarius*, *Russula*, *Laccaria*, and *Boletus*. From the poplar stands 16 mushrooms representing 8 genera were identified and 13 of them were the same found in the pine stand. *Amanita*, *Russula*, *Laccaria*, and *Leccinum* are the major genera in the poplar stands. A single species of *Boletus* was found in large number in pine and poplar stands. *Lactarius* was not observed in the poplar stands, while *Leccinum* was not found in the pine stand. *Cantharellus lutescens* which has not been reported in Korea was collected in the pine stand.

Key words: Basidiomycetes, Ectomycorrhizal fungi, *Pinus rigida* × *taeda*, *Populus alba* × *glan-dulosa*, *Amanita*, *Lactarius*, *Russula*, *Laccaria*, *Boletus*, *Leccinum*, *Cantharellus lutescens*.

Ectomycorrhizal fungi are found in Basidiomycotina, Ascomycotina, Zygomycotina and Deuteromycotina (Miller, 1981). But most of ectomycorrhizal species belong to Basidiomycotina. Miller (1982) listed nine orders in Basidiomycotina which contained ectomycorrhizal fungi. The nine orders included 26 families and 74 genera in Basidiomycotina. The bulk of the species are found in the Agaricales, Russulales and Aphyllophorales.

Very few studies have been done on identification of ectomycorrhizal fungi in Korea, even though over 600 mushrooms have been reported in Korea. Lee *et al.* (1982) surveyed ectomycorrhizal fungi in a *Pinus rigida* × *taeda* stand. They identified 26 mushrooms from this pine stand during a six-month

period (June-November) in 1981. A total of 17 genera were represented in this study, and most commonly observed mushrooms belonged to the genera of *Russula*, *Lactarius*, *Boletus* and *Amanita*.

The objectives of present study were to supplement the previous survey of fungi in a *Pinus rigida* × *taeda* stand (Lee *et al.*, 1982), to identify ectomycorrhizal fungi in poplar stands, and to compare the composition of the fungal species between the two different forest types.

Materials and Methods

The study areas were a pine and poplar stands near the Institute of Forest Genetics in Suweon. The

* This study was supported by International Foundation for Science in Stockholm, Sweden.

pine stand was the same one used in the previous study (Lee *et al.*, 1982) and had both *Pinus rigida* and *P. rigida* × *taeda* at 24 years of age. The ground vegetation was described in the previous paper (Lee *et al.*, 1982).

Poplar stands included *Populus alba* × *glandulosa* at 12 years of age and a populetum at 23 years of age which were located near the Institute in Suweon. The study areas were visited daily from June to November in 1981 and from July to September in 1982. Mushrooms appearing on the forest floor were collected and identified. Mushrooms found on the tree trunk or apparently on the dead plant bodies or manure were not collected.

Results and Discussion

Even though special attention was given to avoid saprophytic fungi in our collection, some fungi were included by mistake in our survey. *Coprinus comatus* and *Lepiota luteus* which are saprophytic were incorrectly listed in our previous report (Lee *et al.*, 1982). For 1982 collection, *Trichlomopsis*, *Lycoperdon* and *Lepista* were originally included in our collection, but were deleted because of their saprophytic nature.

Table I shows the list of mushrooms collected in the pine stand in 1981 and 1982. A total of 39

Table I. List of mushrooms (potential ectomycorrhizal fungi) collected from the forest floor of a 24-year-old *Pinus rigida* × *taeda* stand in Suweon in 1981 and 1982.

Scientific name	Korean name	Period of collection	
		1981	1982
<i>Amanita agglutinata</i> (Berk. et Curt.) Sing.	큰주머니광대버섯	Aug.	Aug.
<i>Amanita farinosa</i> Schw.	애우산광대버섯	Jul.	Jul.
<i>Amanita longistriata</i> Imai	긴골광대버섯아재비	—	Aug.
<i>Amanita melleiceps</i> Hongo	파리버섯	Jul.	Aug.
<i>Amanita spissacea</i> Imai	뱀겜질광대버섯	Jul.	Aug.
<i>Amanita vaginata</i> (Fr.) Vitt.	우산버섯	Jul.	Aug.
<i>Amanita vaginata</i> (Fr.) Quél. var. <i>fulva</i> (Fr.) Gill.	고동색우산버섯	—	Aug.
<i>Amanita vaginata</i> (Fr.) Vitt. var. <i>puncta</i> (Cleland & Cheel) Gilbert	큰우산버섯	—	Aug.
<i>Lactarius gerardii</i> Peck	애기젓버섯	Jul.	Aug.
<i>Lactarius glaucescens</i> Crossl.	푸른유액젓버섯	Jul.	Aug.
<i>Lactarius subvellereus</i> Peck	털젓버섯아재비	Jul.	—
<i>Lactarius subzonarius</i> Hongo	당나귀젓버섯	Aug.	—
<i>Lactarius volemus</i> (Fr.) Fr.	젓버섯	Jul.	Aug.
<i>Russula adusta</i> (Fr.) Fr.	흑갈색무당버섯	—	Aug.
<i>Russula bella</i> Hongo	수원무당버섯	Jul.	Aug.
<i>Russula cutefracta</i> Cooke	청버섯	—	Aug.
<i>Russula flavida</i> Frost et Peck	노랑무당버섯	—	Aug.
<i>Russula foetens</i> (Fr.) Fr.	갈대기무당버섯	Jul.	Aug.
<i>Russula lepida</i> Fr.	줄각무당버섯	Jul.	Aug.
<i>Russula nigricans</i> (Bull.) Fr.	질구버섯	Jul.	Aug.
<i>Russula pseudodelica</i> Lange	흰무당버섯아재비	Jul.	Aug.
<i>Russula sororia</i> Fr.	회갈색무당버섯	—	Aug.
<i>Russula vesca</i> Fr.	조각무당버섯	—	Aug.

Lee and Kim: Composition of Ectomycorrhizal Fungi

<i>Russula virescens</i> (Zanted.) Fr.	기와버섯	Jul.	—
<i>Laccaria amethystina</i> (Fr.) Berk. et Br.	자주줄각버섯	—	Aug.
<i>Laccaria laccata</i> (Fr.) Berk. et Br.	줄각버섯	Jul.	—
<i>Laccaria vinaceoavellanea</i> Hongo	색시줄각버섯	—	Aug.
<i>Fhyloporus bellus</i> (Mass.) Corner	노란길민주름버섯	Jul.	Aug.
<i>Inocybe fastigiata</i> (Fr.) Quél.	술담버섯	Jul.	Aug.
<i>Hebeloma</i> sp.	미기록속	Jul.	—
<i>Cantharellus cibarius</i> Fr.	파꼬리버섯	Jul.	—
<i>Cantharellus lutescens</i> Fr.	한국미기록종	—	Aug.
<i>Thelephora terrestris</i> Fr.	사마귀버섯	Jul.	—
<i>Tylophilus neofelleus</i> Hongo	제주쓴맛그물버섯	—	Aug.
<i>Boletus rubellus</i> Krombh.	붉은그물버섯	Jul.	—
<i>Pulveroboletus ravenellii</i> (Berk. et Curt.) Murr.	갓그물버섯	—	Aug.
<i>Gyroporus castaneus</i> (Fr.) Quél.	흰둘레그물버섯	Jul.	—
<i>Scleroderma lycoperdoides</i> Schw.	점박이어리알버섯	Jul.	—
<i>Pisolithus tinctorius</i> (Pers.) Coker et Couch	도래발버섯	Aug.	Sep.

different mushrooms representing 15 genera were identified. *Tylophilus* and *Pulveroboletus* were noticed in 1982 only. The genus *Hebeloma* has not been reported in Korea, but we observed two different species of *Hebeloma* in this study. Unfortunately, we were unable to identify them by species names. *Cantharellus lutescens* has not been reported in Korea and should be listed as a new species. The major mushrooms in this pine stand were *Amanita*, *Lactarius*, *Russula*, *Laccaria*, and *Boletus* which have world-wide distribution and also been well known for their mycorrhiza formation.

Table II shows the list of mushrooms collected in the poplar stands in 1981 and 1982. A total of 16 different mushrooms representing eight genera were identified in 1982. Collection of mushrooms in the poplar stands in 1981 was not complete, because we failed to visit daily the stands in 1981. Therefore, the mushrooms not observed in 1981 in poplar stands do not necessarily indicate their absence in 1981. *Amanita*, *Russula*, *Laccaria*, and a single species of *Leccinum* and of *Boletus* were the major mushrooms in the poplar stands.

Composition of mushrooms in the pine and poplar stands were similar in general. Of the 16 mushrooms collected in the poplar stands, 13 mushrooms were also found in the pine stand. Three species exclu-

sively found in the poplar stand were *Amanita inaurata*, *Russula senecis*, and *Leccinum aurantiacum*. *Leccinum* was absent in the pine stand, but abundantly found in the poplar stands in 1982 and appeared to be one of the major species in the poplar stands. *Lactarius* was absent in the poplar stands, while five species of *Lactarius* were abundantly found in the pine stand.

After comparing the pine with the poplar stands, it is concluded that *Amanita*, *Russula*, *Laccaria* and *Boletus* are the major genera commonly associated with both pine and poplar. *Inocybe*, *Gyroporus* and *Tylophilus* are minor genera commonly associated with pine and poplar. *Lactarius* was not observed in the poplar stands, while *Leccinum* was not found in the pine stand.

Present study suggested that at least 42 mushrooms were associated with pine and poplars in Suweon area. The list of ectomycorrhizal fungi should be expanded in the future, because the number of mushrooms listed in the present study appears to be small compared with foreign literature. For example, Zak (1973) stated that over 100 mycorrhizal fungi were associated with *Pseudotsuga menziesii* in U.S.A. Ogawa (1977) observed 62 mycorrhizal fungi in a mixed stand of *Tsuga-Betula-Abies*. The number of ectomycorrhizal fungi on the earth is not well

Table II. List of mushrooms (potential ectomycorrhizal fungi) collected from the forest floor of 12-year-old *Populus alba* × *glandulosa* stands and a populetum in Suweon in 1981 and 1982. Collection of mushrooms in 1981 was not complete.

Scientific name	Korean name	Period of collection	
		1981	1982
<i>Amanita agglutinata</i> (Berk. et Curt.) Sing.	큰주머니광대버섯	Aug.	Aug.
<i>Amanita inaurata</i> Secr.	점박이광대버섯	—	Aug.
<i>Amanita longistriata</i> Imai	긴골광대버섯아재비	—	Aug.
<i>Amanita melleiceps</i> Hongo	파리버섯	—	Aug.
<i>Amanita vaginata</i> (Fr.) Vitt.	우산버섯	—	Aug.
<i>Amanita vaginata</i> (Fr.) Quél. var. <i>fulva</i> (Fr.) Gill.	고동색우산버섯	—	Aug.
<i>Russula bella</i> Hongo	수원무당버섯	Jul.	Aug.
<i>Russula pseudodelica</i> Lange	흰무당버섯아재비	Jul.	Aug.
<i>Russula senecis</i> Imai	흙무당버섯	—	Aug.
<i>Laccaria amethystina</i> (Fr.) Berk. et Br.	자주줄각버섯	—	Aug.
<i>Laccaria vinaceoavellanea</i> Hongo	색시줄각버섯	—	Aug.
<i>Inocybe fastigiata</i> (Fr.) Quél	솔땀버섯	—	Aug.
<i>Leccinum aurantiacum</i> (Bull.) S.F. Gray	등색겉껍이그물버섯	—	Aug.
<i>Gyroporus castaneus</i> (Fr.) Quél.	흰둘레그물버섯	Jul.	Aug.
<i>Boletus rubellus</i> Krombh.	붉은그물버섯	Jul.	Aug.
<i>Tylopilus</i> sp.	쓴맛그물버섯속	—	Aug.

known. However, Marx (1977) estimated that over 2,100 ectomycorrhizal fungi exist in North America alone. Of the about six hundred mushrooms identified in Korea, many of them belong to families and genera which are completely or almost completely ectomycorrhizal. Future studies will broaden our knowledge on the identity of mushrooms associated with specific tree hosts as mycorrhizal fungi. Such knowledge is essential for application of ectomycorrhizal research to enhancement of forest productivity through manipulation of symbiosis between the fungi and tree hosts as demonstrated by Koo *et al.* (1982).

要 約

水原近處에 있는 리기테다소나무림과 포플리(은사시나무)림의 林床으로부터 1981年 6月末부터 11月初까지 그리고 1982年 7月初부터 9月末까지 外生菌根을 形成하는 버섯을 採取하여 그 分布를 究明하고 두 林分의 菌種의 相異點을 比較하였다. 소나무림에서는 15屬 39

種을 究明하였으며, 가장 흔한 屬은 *Amanita*, *Lactarius*, *Russula*, *Laccaria*이었다. 포플리林에서는 8屬 16種을 分類하였으며, 이 중 13種은 소나무림에서도 採取된 同一菌種이었으며, 가장 흔한 屬은 *Amanita*, *Russula*, *Laccaria*, *Leccinum*이었다. *Boletus*는 두 林分에서 한 菌種(붉은 그물버섯)만이 確認되었다. *Lactarius*는 포플리林에서 觀察되지 않았으며, *Leccinum*은 소나무림에서 觀察되지 않았다. 1982年度 採集中 韓國未記錄種인 *Cantharellus lutescens*를 소나무림에서 採取하여 確認하였다.

References

Cooke, W.B. (1881~1891): *Illustrations of British Fungi*. Vol. 1-8. 1198 plates. Williams and Norgate, London.
 Coker, W.C. and A.H. Beers (1974): *The Boleti of North Carolina*. 95pp. Dover Publ. Inc. New York
 Imazeki, R. and T. Hongo (1957): *Coloured Illustrations of Fungi of Japan*. Hoikusha Publ. Co., Japan. 181pp.

Lee and Kim: Composition of Ectomycorrhizal Fungi

- Imazeki, R. and T. Hongo (1965): *Coloured Illustrations of Fungi of Japan*. Vol. II Hoikusha Publ. Co., Japan. 238pp.
- Imazeki, R., T. Hongo and K. Tubaki (1970): *Common Fungi of Japan in Color*. Hoikusha Publ.Co., Japan. 175pp.
- Ito, I. (1959): *Mycological Flora of Japan*. Vol. II. No. 5, 647pp. Yokendo Ltd. Tokyo
- Koo, C. D., K.J. Lee, and K.B. Yim (1982): Growth stimulation of pines by artificial inoculation with mycorrhizal fungus, *Pisolithus tinctorius*. *J. Korean For. Soc.* 55:22.
- Lee, K.J., C.D. Koo, and Y.S. Kim (1982): Identification of ectomycorrhizal fungi in a *Pinus rigida* × *taeda* stand. *Kor. J. Mycol.* 10:21.
- Lincoff, G.H. (1981): *Simon & Schuster's Guide to Mushrooms* (ed. G. H. Lincoff). Simon and Schuster Publ., New York. 512pp.
- Marx, D.H. (1977): The role of mycorrhizae in forest production. *TAPPI Conference Papers*, Ann. Meet. Feb. 14-16, 1977. Atlanta. Georgia. 151-161.
- McIlvaine, C. and R.K. Macadam (1973): *One Thousand American Fungi*. Dover Publ. Inc., New York 729pp.
- Miller, O.K. Jr. (1972): *Mushrooms of North America*. E.P. Dutton Publ. New York 368pp.
- Miller, O.K. Jr. (1981): Taxonomy, morphology, and distribution of mycorrhizae. In *Mycorrhizal Associations and Crop Production* (eds. R.F. Myers, R.F. Bartha, and W. Busscher). 5-13p. New Jersey Agric. Exp. Sta. Res. Rep. No. R04400-01-81
- Miller, O.K. Jr. (1982): Taxonomy of ecto- and ectendomycorrhizal fungi. In *Methods and Principles of Mycorrhizal Research* (N.C. Schenck, ed.) Amer. Phytopathol. Soc. 91-101.
- Ogawa, M. (1977): Ecology of higher fungi in *Tsuga diversifolia* and *Betula ermani*-*Abies mariesii* forests of subalpine zone. *Trans. Mycol. Soc., Japan* 18:1.
- Pegler, D.N., and T.W.K. Young (1971): *Basidiospores Morphology in the Agricales*. Beih. Nova Hedwigia 35, Verlag von J. Cramer
- Singer, R. (1975): *The Agricales in Modern Taxonomy*. 3rd ed. 912pp. Vaduz. J. Cramer Press
- Smith, A.H. (1957): *The mushroom Hunter's Field Guide*. 197pp. Univ. Mich. Press, Ann Arbor, Mich.
- Smith, A.H. (1968): *The Cantharellaceae of Michigan*. Michigan Botanist Vol. 7, f. 10. 143.
- Zak, B. (1973): Classification of ectomycorrhizae. In *Ectomycorrhizae* (eds. G.C. Marks and T.T. Kozlowski) Academic Press, New York, Chapter 2: 43-78.

<Received January 30, 1983>