

Distribution and Diversity of Saprophytic, Mycorrhizal and Parasitic Higher Fungi in Kwangnung Experimental Forest in Korea¹

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光陵試驗林의 腐生性, 菌根性 및 寄生性 高等菌類의 分布와 多樣성에 關한 研究¹

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ABSTRACT

Higher fungi (Basidiomycetes) were collected from forest stands of Kwangnung Experimental Forest, Kwangnung, Kyonggido, during the summer and fall seasons of 1976, 1984, 1985 and 1986. A total of 257 species and varieties in 104 genera were identified. Saprophytic fungi accounted for 135 species in 75 genera while mycorrhizal fungi accounted for 120 species in 28 genera. Two parasitic species were collected and they were root parasites. Among the mycorrhizal species *Amanita*, *Russula*, *Lactarius*, and species in the Boletaceae were the dominant taxa. The mycorrhizal fungi appear to be an important component in the essential elements needed for forest management in Korea. A reevaluation of the higher fungi previously described in Korea was made and we report 77 higher fungi previously undescribed from Korea. This is from a single experimental forest and suggests that there are many unreported higher fungi which play an important role in Korean forests.

Key words: Ectomycorrhizal fungi, Fungal diversity, Saprophytic fungi.

要 約

1976年, 1984年, 1985年, 1986年の 7月부터 10月까지 京畿道 光陵에 있는 林業試驗場 中部支場의 試驗林에서 高等菌類를 採集하여 分類하였다. 總 104屬 257種의 擔子菌類를 同定하였는데, 其中 腐生菌이 75屬 135種으로써 全體種數의 52%를, 外生菌根菌이 28屬 120種으로써 47%를, 寄生菌이 1屬 2種으로써 1%를 點有하고 있었다. 菌根버섯중에서 광대버섯屬, 무당버섯屬, 젓버섯屬이 全體菌根버섯種數의 53%를(63種) 차지했으며, 이는 全體버섯種數의 25%에 該當한다. 위의 세 가지屬의 버섯들이 光陵試驗林의 優占種(屬)이라고 할 수 있다. 文獻調查結果 257種 中에서 韓國未記錄種이 77種에 달함을 發見하였다.

¹ 接受 9月 18日 Received on September 18, 1987

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INTRODUCTION

A large number of higher fungi inhabit forests in Korea and elsewhere. They play an important role in the various aspects of nutrient movement in the complex forest ecosystem. Saprophytic fungi facilitate decomposition of organic materials of plant origin, while symbiotic, mycorrhizal fungi actively participate in the nutrient absorption by host plants. Parasitic fungi may affect mortality of some trees, and subsequently direct the uncontrolled development of the forest. Relative abundance and diversity of these three groups of higher fungi are important in the subsequent stages of forest development. Fungal populations tend to increase with the increasing age of the forest stands. It has been routinely observed elsewhere (Miller, 1983) that diversity of fungal populations in a forest increases with increasing age and biomass as well as organic accumulation of the forest stand. Most Korean forests are relatively young in age, and in this aspect fungal diversity in these young forests is expected to be simpler than in older stands. In addition, the diversity should include different fungal species (Miller, 1983) as the stand ages. The importance of mycorrhizae in forest establishment, nutrient absorption and suppression of pathogens has been strongly recognized in recent years by many investigators (Harley and Smith, 1983). Unfortunately, distribution and diversity of ectomycorrhizal fungi in these forests have not been intensively investigated in Korea. Since survival and the rapid development of young trees rely on mycorrhizal symbionts, it is important to know which fungi are most important, and are required by a given tree species to enable it to reach maturity in the shortest possible time.

The objectives of the present study were to collect and classify higher fungi from well developed forest stands in Korea and to identify the diverse fungal components and the contribution of each to the growth of Korean forests. Cultures of the more important ectomycorrhizal species were made and

subsequent papers will record their importance in the survival and growth of specific Korean tree species.

MATERIALS AND METHODS

Kwangnung Experimental Forest is located in Kwangnung (Chigdong-ri, Sohumyon, Pochon-gun, Kyonggido) and is a part of the Central Branch Station of the Forest Research Institute. The Experimental Forest was established in the 1920's and includes sixty-year old forests of pure *Pinus koraiensis*, *Abies holophylla*, *Picea abies*, *Larix leptolepis*, *Juglans mandshurica*, *Quercus aliena*, a mixture of *Q. aliena* and *Q. serrata*, and *Betula platyphylla*, and mixed hardwood stands.

During the summer and fall seasons of 1976, 1984, 1985, and 1986, all of the higher fungi were collected from the forest stands mentioned above. Whenever possible, names of trees associated with the mushrooms were recorded to understand the physiological functions of particular fungi in various forest stands. Ectomycorrhizal fungi were especially recorded for their host trees. Physiological status of fungi was determined from literature citations (Miller, 1982) and by cooperative work in progress in the laboratory.

Macroscopic characteristics of mushrooms were observed in the field while they were fresh. Some microscopic features and chemical tests of the tissue were also recorded whenever necessary. The collected mushrooms were dried in a mushroom dryer at about 45-50°C with the heat source below the specimens and good ventilation. The dried mushrooms were deposited in the herbaria at the Institute of Agricultural Sciences, Rural Development Administration, Suwon and the Department of Biology, Virginia Polytechnic Institute and State University, Blacksburg, Virginia. Korean names of fungi were based upon compiled data (Anonymous, 1986.)

RESULTS AND DISCUSSION

Table 1 shows the list of higher fungi collected

Table 1. A list of higher fungi (Basidiomycetes) collected under various forest types during fruiting seasons of 1976, 1984, 1985 and 1986 in Kwangnung Experimental Forest.

Scientific Name	Korean Name	Associated Trees	Physiol. Status	Date of Collect.	Voucher Number
Agaricales					
Hygrophoraceae					
<i>Hygrophorus olivaceoalbus</i> (Fr. ex Fr.) Fr.	주름버섯목	QC.	sap	9-23-84	OKM21626, KYS219
<i>H. pratensis</i> (Pers. ex Fr.) Kummer	벗꽃버섯과	Ab.h.	?	10-4-84	OKM21823
<i>H. psittacina</i> (Sch. ex Fr.) Wuensche	이끼 벗꽃버섯	Juglans	?	7-15-84	KJL299
Amanitaceae					
<i>Amanita</i>	광대버섯과	Ab.h.+Pc.a.	myc	8-20-85	OKM22031, 21811, 22051
<i>A. agglutinata</i> (Berk. et Curt.) Sing.	큰주머니 광대버섯	Qc.a.	myc	8-23-85	KJL687
<i>A. cothurnata</i> Atk.	애 광대버섯	Ab.h.	myc	8-22-85	OKM22097, 21788, KYS241
<i>A. citrina</i> (Schaeff.) S.F. Gray	—	—	myc	9-22-84	OKM21614, 22106
<i>A. citrina</i> var. <i>alba</i> (Gill.) Gilb.	—	—	myc	9-23-84	OKM21631
<i>A. crocea</i> (Quel.) Sing.	—	Qc.a.	myc	8-5-84	KYS124
<i>A. echinocephala</i> (Vitt.) Quel.	—	Qc.	myc	7-15-84	KYS98
<i>A. farinosa</i> Schw.	애우산광대버섯	—	myc	8-22-85	KYS1227
<i>A. flavipes</i> Imai	노란대광대버섯	—	myc	8-21-85	OKM22042, KYS133
<i>A. griseofarinoso</i> Hongo	재빛가루광대버섯	Pn.k.	myc	8-20-85	OKM22017, 22062, 22105
<i>A. hemibapha</i> (Berk. et Br.) Sect.	달살버섯	Pc.a.	myc	8-21-85	OKM22040
<i>A. inaurata</i> Sect.	점막이 광대버섯	Pn.k.	myc	7-15-84	KJL293
<i>A. longistriata</i> Imai	진광대버섯 아세비	Pc.k.; Bt.	myc	7-15-84	—
<i>A. melleiceps</i> Hongo	파리버섯	—	myc	8-20-85	OKM22019, 22043
<i>A. pantherina</i> (DC. ex Fr.) Sect.	미귀 광대버섯	Pc.a.	myc	10-4-84	OKM21822, KYS384
<i>A. cf. phalloides</i> (Fr.) Sect.	알광대버섯	Pc.k.	myc	9-23-84	KJL449
<i>A. regalis</i> (Fr.)	—	Pc.k.; Ab.h.	myc	8-20-85	KJL606
<i>A. rubescens</i> (Pers. ex Fr.) Gray	붉은점막이 광대버섯	—	myc	9-23-84	OKM21651, KYS232
<i>A. spissa</i> complex (Fr.) Kummer	턱말이 광대버섯	Ab.h.	myc	7-15-84	KYS108
<i>A. spreata</i> Peck	우산버섯	—	myc	10-3-84	OKM21782, 21831
<i>A. vaginata</i> (Fr.) Vitt.	우산버섯	—	myc	8-5-84	KYS137
<i>A. vaginata</i> (Fr.) Quel. var. <i>vaginata</i> (Bull. et Fr.) Vitt.	—	Pn.k.	myc	—	—
<i>A. vaginata</i> (Fr.) Quel. var. <i>fulva</i> (Schff. ex) Pers.	고동색우산버섯	Ab.h.; Qc.	myc	-84	—

Scientific Name	Korean Name	Associated Trees	Physiol. Status	Date of Collect.	Voucher Number
<i>Amanita</i>					
<i>vaginata</i> (Fr. Quel. var. <i>strangulata</i>	흰알 광대버섯	Pc.k.	myc	8-22-85	KJL659
<i>verna</i> (Bull. ex Fr.) Pers. ex Vitt.	흰가시광대버섯		myc	7-15-84	KYS
cf <i>virgineoides</i> Bas	독우산광대버섯	Ab.h.	myc	8-22-85	OKM22094
cf <i>virosa</i> Secr.			myc	8-20-85	OKM22024, KYS136
Lepiotaceae					
<i>Cystolepiota</i>	갓버섯과		sap	8-23-85	KYS1245
<i>sistrata</i> (Fr.) Sing.	두엄갓버섯		sap	7-22-76	KYS
<i>Lepiota</i>	애꽃갓버섯		sap	7-22-76	KYS
<i>L.</i>	밤색갓버섯		sap	9-22-84	OKM21608
<i>L.</i>	갈색고리갓버섯		sap	8-21-85	OKM22064
<i>L.</i>	고양이갓버섯		sap	9-22-84	OKM21615
<i>L.</i>	여우갓버섯		sap	8-20-85	OKM22033
<i>L.</i>			sap	8-20-85	OKM22030
<i>Macrolepiota</i>	갓버섯	Hd.	sap	8-24-85	KJL701
<i>procera</i> (Fr.) Sing.	갓버섯아재비	Qc.	sap	8-23-85	OKM22101
<i>M.</i>			sap	8-21-85	KJL647
Russulaceae					
<i>Russula</i>	무당버섯과		myc	9-22-84	OKM21603, KYS207
<i>adusta</i> (Pers. ex Fr.) Fr.	홍갈색 무당버섯	Ab.h.	myc	7-22-76	KYS
<i>aurata</i> Fr.	박하무당버섯	Pn.k.	myc	9-22-84	OKM21602, KYS206
<i>albonigra</i> (Kromb.) Fr.	수원무당버섯	Pn.k.	myc	10-3-84	OKM21793
<i>bella</i> Hongo	푸른주름무당버섯	Pc.k.	myc	10-3-84	KYS339
<i>delica</i> Fr.	애기 무당버섯	Pc.a.	myc	8-20-85	OKM22022
<i>densifolia</i> (Secr.) Gill.	냄새 무당버섯		myc	7-22-76	KYS
<i>emetica</i> (Fr.) S.F. Gray	노랑 무당버섯		myc	7-22-76	KYS
<i>flavida</i> Frost et Peck	갈매기 무당버섯		myc	8-23-85	OKM22107
<i>foetens</i> (Fr. ex Pers.) Fr.	붉은 무당버섯	Pn.k.	myc	10-3-84	OKM21780, KYS359
cf <i>integra</i> L. ex Fr. ss R. Mre.	밀짚 무당버섯	Pn.k., Pc.k.	myc	9-22-84	OKM21593, 22092, KYS205
<i>laurocerasi</i> Melzer	졸자 무당버섯		myc	7-22-76	KYS
<i>lepidia</i> Fr.	연보라 무당버섯		myc	7-22-76	KYS
<i>lilacea</i> Quel.		Pn.k.	myc	9-23-84	OKM21632
cf <i>minutula</i> Vel.		Ab.h.	myc	10-4-84	OKM21824
<i>nigricans</i> Fr.	전구버섯		myc	7-22-76	KYS
cf <i>pulchella</i> Borszcov	색바른 무당버섯	Qc.	myc		

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<i>Russula pseudodelicata</i> (?) Lange	흰무당버섯 아재비		myc	8-21-85	OKM22058, 22066
<i>R. cf. roseacea</i> Pers. ex S.F. Gray	송각무당버섯	Ab.h.	myc	9-22-84	OKM21604
<i>R. rosea</i> Quel.	-	Pn.k.	myc	9-22-84	OKM21605
<i>R. sanguinea</i> (?) (Bull. ex St. Am.) Fr.	혈색무당버섯	Pn.k.	myc	8-21-85	OKM22050
<i>R. senecis</i> Imai	홍무당버섯		myc		
<i>R. sororia</i> (Fr.) Romeli. ss Bond.	회갈색무당버섯	Pn.k.; Ab.h.	myc	9-22-84	OKM21600, 21799, KYS204
<i>R. violeipes</i> Quel.	자주빛무당버섯	Ab.h.; Pn.k.	myc	7-22-76	KYS
<i>R. virescens</i> (Zanted) Fr.	기와버섯		myc	8-21-85	KJL649
<i>Lactarius camphoratus</i> Fr.	민맛버섯	Lx.l.	myc	8-21-85	OKM22056
<i>L. gerardii</i> Peck	애기젓버섯		myc	8-23-85	OKM22110
<i>L. cf. glaucescens</i> Crossland	푸른유액젓버섯		myc	10-3-84	OKM21790, KYS375
<i>L. cf. griseus</i> Peck	-		myc	10-3-84	OKM21787
<i>L. hatsudake</i> Tanaka	젓버섯 아재비	Ab.h.+Pc.a.	myc	10-3-84	OKM22023
<i>L. hygrophoroides</i> Berk. et Curt.	넓은갓젓버섯	Pn.s.	myc	8-20-85	OKM21775
<i>L. cf. lepidothus</i> Smith et Hesler	-		myc	10-3-84	OKM22034
<i>L. lignyotus</i> Fr.	갓빛햇대젓버섯	Ab.h.	myc	8-20-85	OKM22034
<i>L. piperatus</i> (Scop. ex Fr.) Gray	곶털이		myc	8-23-85	OKM22103
<i>L. deliciosus</i> (L. ex Fr.)	맛젓버섯	Ab.h.	myc	10-5-84	OKM21828, KYS369
S.F. Gray var. <i>japonicus</i> Kawam.	-				
<i>L. subdulcis</i> (Pers. ex Fr.) S.F. Gray	-	Ab.h.	myc	9-22-84	OKM21599
<i>L. subvelereus</i> Peck	털젓버섯 아재비	Ab.h.	myc		
<i>L. subzonarius</i> Hongo	당귀젓버섯				
<i>L. velereus</i> (Fr.) Fr.	새털젓버섯		myc	8-22-85	OKM22090
<i>L. volemus</i> (Fr.) Fr.	배젓버섯	Ab.h.+Pc.a.	myc	8-20-85	OKM22028
Tricholomataceae					
<i>Armillariella mellea</i> (Fr.) Karst.	송이과		par	7-15-84	KJL294
<i>A. tabescens</i> (Fr.) Sing.	뿔나무버섯		par	7-22-76	KYS
<i>Calocybe cf. alpestris</i> (Britz.) Sing.	뿔나무버섯부치		sap	9-23-84	OKM21636
<i>C. carnea</i> (Bull. ex Fr.) Donk	-	Pc.k.	sap	10-3-84	OKM21783
<i>C. ionides</i> (Bull. ex Fr.) Donk	-		sap	10-3-84	OKM21788
<i>C. candidans</i> (Fr.) Kummer	비단빛깔패기버섯		sap	8-5-84	KYS7
<i>C. gibba</i> (Fr.) Kummer	후갈래기버섯	Hd.	sap	8-22-85	OKM22088, KJL671
<i>C. odora</i> (Fr.) Quel.	하늘색깔패기버섯	Ab.h.	sap	9-22-84	KJL400
<i>C. tuba</i> (Fr.) Gill.	비단빛깔패기버섯		sap	10-3-84	OKM21795, KYS237

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<i>Clitocybula abundans</i> (Peck) Singer	-	Pn.k.	sap	9-22-84	OKM21597
<i>Collybia alkaliivirens</i> Singer	-		sap	9-22-84	OKM21606, KYS210
<i>C. confluens</i> (Pers. ex Fr.) Kummer	밀버섯		sap	9-23-84	KYS
<i>C. dryophila</i> (Bull. ex Fr.) Kummer	애기버섯		sap	9-22-84	OKM21607
<i>C. subsulphurea</i> Peck	-		sap	8-22-85	OKM22084
<i>Cystoderma carcharias</i> (Pers. ex Secr.) Fayod	-	Ab.h.	sap	9-22-84	OKM21618, KYS211
<i>C. cf. fallax</i> Smith et Singer	-		sap		OKM21835, KYS246
<i>Hohenbuehelia</i> sp.	호헨부엘버섯속		sap	8-21-85	OKM22046
<i>Laccaria amethystina</i> (Bolt. ex Hooker) Murr.	자주줄각버섯	Ab.h.; Qc.	myc		
<i>L. laccata</i> (Scop. ex Fr.) Cke.	줄각버섯	Ab.h.	myc	9-22-84	OKM21609, 21773, 22093, KYS345
<i>L. vinaceoavellanea</i> Hongo	색시줄각버섯		myc	8-22-85	OKM22067
<i>Lepista irina</i> Fr.	-			9-22-84	KJL412
<i>L. nuda</i> (Fr.) W.G. Smith	민각주방망이버섯		sap	10-5-84	OKM21829
<i>Lentinus ponderosa</i> group	-		sap	7-15-84	KJL296
<i>Lyophyllum connatum</i> (Schm. ex Fr.) Sing.	-		sap	10-3-84	OKM21768, KYS338
<i>Marasmiellus candidus</i> Bolt. ex Fr.	-		sap	8-24-85	OKM22121, KYS1864
<i>Marasmius epiphyllus</i> (Pers. ex Fr.) Fr.	-		sap	8-24-85	OKM22123
<i>M. fulvoferrugineus</i> Gill.	-		sap	8-24-85	OKM22122
<i>M. maximus</i> Hongo	큰낙엽버섯		sap	9-23-84	OKM21641
<i>M. scorodonius</i> (Fr.) Fr.	-		sap	8-22-85	OKM22071
<i>M. siccus</i> (Schw.) Fr.	애기낙엽버섯		sap	7-22-76	KYS
<i>Melanoleuca melaleuca</i> (Pers. ex Fr.) Murr.	잔디베짚버섯	Ab.h.	sap	10-4-84	OKM21798, KYS370
<i>Mycena adonis</i> (Bull. ex Fr.) S.F. Gray	-		sap	9-24-84	OKM21667
<i>M. fibula</i> (Fr.) Kühn.	이끼애주름버섯		sap	7-1-84	KYS3
<i>M. galericulata</i> (Scop. ex Fr.) S.F. Gray	풍나물애주름버섯		sap	9-23-84	OKM21655, 21850
<i>M. pura</i> Pers. ex Fr.	맑은애주름버섯		sap	9-22-84	KJL420
<i>Oudemansiella mucida</i> (Fr.) Hoehnel	끈적끈적라미버섯		sap	9-22-84	KJL410
<i>O. renati</i> Clc.	-		sap	8-23-85	OKM22112
<i>Panellus stipticus</i> (Bull. ex Fr.) Karst.	부채버섯		sap	9-24-84	OKM21666, 21669
<i>Pleurotus ostreatus</i> (Jacq. ex Fr.) Kummer	느타리버섯		sap	8-23-85	OKM22111
<i>Resupinatus rhacodium</i> (Berk. et Curt.) Sing.	-		sap	9-21-86	KYS2015
<i>Tricholoma atroscamosum</i> (Chev.) Sacc.	-	Ab.h.	myc	10-4-84	OKM21796, KYS363
<i>T. inamoenum</i> (Fr. ex Fr.) Kummer	-	Pn.k.	myc	9-23-84	OKM21649, KYS236
<i>T. pardinum</i> Quel.	-	Ab.h.	myc	9-22-84	OKM21620

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<i>Tricholoma sejunctum</i> (Fr.) Quél.	쓴송이	Qc.a.	myc	8-22-85	KJL671
<i>T. terreum</i> (Schaef ex Fr.) Kummer	-	Ab.h.	myc	10-4-84	OKM21797, KYS364
<i>Tricholomopsis platyphylla</i> (Fr.) Sing.	넓은솔버섯		sap	7-1-84	KYS2
<i>Xeromphalina campanella</i> (Fr.) Kuhner et Maire	이끼갈이버섯		sap	7-15-84	KJL297
<i>X. kauffmanii</i> A.H. Smith	-		sap	9-23-84	OKM21646
Volvariaceae					
<i>Volvariella hypopithys</i> (Fr. ex Karst.) Mos.	비단털버섯과		sap	9-23-84	OKM21637, KYS227
<i>V. pusilla</i> var. <i>pusilla</i> (Pers. ex Fr.) Sing.	요정풀버섯		sap	8-24-85	KJL697
<i>Pluteus nanus</i> (Pers. ex Fr.) Kummer	-		sap	8-23-85	OKM22109
Rhodophyllaceae					
<i>Cladopus byssisedum</i> (Fr.) Gill.	외대버섯과		sap	8-20-85	OKM22020
<i>C. depluens</i> (Fr.) Gill	-	Ab.h.+Pc.a.	sap	8-21-85	OKM22061
<i>Entoloma clypeatum</i> (L. ex Fr.) Kummer	-	Pc.k.	myc		
<i>E. coelestinus</i> (Fr.) Quél. var. <i>violacens</i> (Kauffm.) A.H. Smith	군청색외대버섯	Qc.a.	myc	8-5-84	KJL301
<i>Nolanea murraili</i> Berk et Curt.	노란꼭지버섯		sap	8-19-76	KYS
<i>N. salmoneus</i> (Peck) Sing	붉은꼭지버섯		sap	8-19-76	KYS
Bolbitiaceae					
<i>Agrocybe cf. firma</i> (Peck) Kuhner	소풍버섯과		sap	9-22-84	OKM21625, KYS229
<i>Conocybe lactea</i> (Lange) Metrod	노란종버섯		sap	7-15-84	KJL298
<i>C. tenera</i> (Schaef. ex Fr.) Kuhner	종버섯	Ab.h.	sap	10-4-84	OKM21807, KYS373
<i>Descolea flavoannulata</i> (Vass.) Horak	노란턱돌버섯	Ab.h.;Qc.	myc	9-22-84	OKM21598, 21616
Cortinariaceae					
<i>Cortinarius cf. flexipes</i> Fr.	관적버섯과		myc	9-23-84	OKM21629
<i>C. pseudosaior</i> Lange	-	conifer	myc		
<i>C. cf. varicolor</i> Quél.	가지색관적버섯아세비	Ab.h.	myc	10-4-84	OKM21825, 21832, KYS390
<i>C. cf. vibratilis</i> (Fr.) Fr.	자주관적버섯	Pn.k.	myc	9-23-84	OKM21647
<i>Gymnopilus spectabilis</i> (Fr.) A.H. Smith	갈황색미치광이버섯	Qc.	myc	10-4-84	OKM21817, KYS377
<i>Inocybe calamistrata</i> (Fr.) Gill.	털실땀버섯	Qc.a.	sap	9-23-84	OKM21627
<i>I. cincinnata</i> (Fr.) Quél.	골슴미리땀버섯	Pn.s.	myc	8-20-85	OKM22027
<i>I. cf. dulcamara</i> (A. et S. ex Pers.) Kummer	-		myc	10-3-84	OKM21784, KYS347
<i>I. fastigiata</i> (Schaeff. ex Fr.) Quél.	솔땀버섯	Qc.l.	myc	10-5-84	OKM21847, KYS401

	Scientific Name	Korean Name	Associated Trees	Physiol. Status	Date of Collect.	Voucher Number
Paxillaceae						
<i>Paxillus</i>	<i>curtisii</i> Berk. ap Berk et Curt	우단버섯과	Pn.k.	sap	8-21-85	OKM22039
<i>Phylloporus</i>	<i>bellus</i> (Mass.) Corner	노란길린그물버섯		myc	8-21-85	OKM22041
Crepidotaceae						
<i>Crepidotus</i> sp.		귀버섯과 귀버섯속		sap	8-24-85	OKM22125
Agaricaceae						
<i>Agaricus</i>	<i>placomyces</i> Peck.	주름버섯과 주름버섯아재비		sap	7-22-76	KYS
A.	<i>semotus</i> Fr.	—		sap	9-24-84	OKM21662
A.	<i>sibicolor</i> (Vitt.) Peck.	담황색주름버섯		sap	8-21-85	OKM22063
A.	cf <i>subrutilescens</i> (Kauff.) Hot. et Stuntz	진갈색주름버섯		sap	8-22-85	OKM22068, KYS1207
<i>Melanophyllum</i>	<i>echinatum</i> (Roth ex Fr.) Sing.	잔피막혹주름버섯		sap	8-20-85	KYS1181
Strophariaceae						
<i>Naematoloma</i>	<i>fasciculare</i> (Fr.) Karsten	독청버섯과		sap	9-22-84	OKM21601, 21772
N.	<i>fasciculare</i> (small) (Fr.) Karsten	노란다발버섯	Ab.h.	sap	8-23-84	OKM22108
N.	<i>sublateritium</i> (Fr.) Karst	노란다발버섯 개암버섯		sap	10-3-84	KYS25
<i>Pholiota</i>	<i>limonella</i> complex (Peck) Sacc.	—		sap.	9-23-84	OKM21639
P.	<i>adiposa</i> (Fr.) Quél.	검은비늘버섯		sap	9-23-84	KJL441
<i>Stropharia</i>	<i>aeruginosa</i> (W. Curt. ex Fr.) Quél.	독청버섯		sap	10-3-84	OKM21767, KYS349
S.	<i>rugosoannulata</i> Farlow ex Murr.	독청버섯아재비	Ab.h.	sap	9-22-84	OKM21624
Gomphidiaceae						
<i>Chroogomphus</i>	<i>sibiricus</i> (Sing.) O.K. Miller	못버섯과	Pn.k.	myc	9-23-84	OKM21628
Coprinaceae						
<i>Coprinus</i>	<i>disseminatus</i> (Fr.) S.F. Gray	먹물버섯과		sap		
C.	<i>plicatilis</i> (W. Curt. ex Fr.) Fr.	고깔먹물버섯		sap	10-5-84	OKM21843, KYS399
<i>Psathyrella</i>	<i>hydrophila</i> (Bull. ex Merat) Mre.	좀밀먹물버섯		sap	10-3-84	OKM21777
P.	<i>gracilis</i> (Fr.) Quél.	나람쥐늑물버섯 가느대늑물버섯		sap	10-5-84	KYS7
Boletaceae						
<i>Boletus</i>	<i>badius</i> Fr.	그물버섯과	Lx.l.;Qc.	myc	9-22-84	OKM21617
B.	<i>bicolor</i> Peck	밤꽃그물버섯	Ab.h.;Bt.	myc	8-22-85	KJL709

Scientific Name	Korean Name	Associated Trees	Physiol. Status	Date of Collect.	Voucher Number
<i>Boletus erythropus</i> (Fr. ex Fr.) Pers.	붉은태그물버섯	Qc.	myc	8-21-85	KJL641
<i>B. fraternus</i> Peck	—		myc	8-21-85	OKM22054
<i>B. laetissimus</i> Hongo	피꼬리그물버섯		myc	8-14-86	KYS1867
<i>B. pulverulentus</i> Opat.	밤꽃그물버섯	Pn.k.	myc	8-21-85	OKM22055
<i>B. submentosus</i> Fr.	산그물버섯	Ab.h.+Pc.a.	myc	10-5-84	OKM21837, KYS394
<i>Gyroporus castaneus</i> (Bull. ex Fr.) Qué.	흰물매그물버섯	Qc.	myc		
<i>Leccinum extremorientale</i> (Vass.) Sing.	저지절편이그물버섯	Ab.h.	myc		
<i>L. aurantiacum</i> (Bull. ex St. Am.) S.F. Gray	등색절편이그물버섯	Bt.	myc		OKM22021, 22118
<i>Strobilomyces confusus</i> Sing.	덜귀신그물버섯	Pc.a.	myc	8-20-85	OKM22026
<i>Suillus bovinus</i> (Fr.) Kuntze	황소비단그물버섯		myc	6-7-86	KYS1646
<i>S. granulatus</i> (L. ex Fr.) Kuntze	젓비단그물버섯	Pn.k.	myc	9-22-84	OKM21613, 21659
<i>S. grevillei</i> (Klotzsch) Sing.	큰비단그물버섯	Lx.	myc	10-3-84	OKM21794
<i>S. pictus</i> (Peck) Smith et Thiers	솜황곰비단그물버섯	Pn.k.	myc	9-22-84	OKM21592, 22059, 22120, KYS257
<i>S. sibiricus</i> (Sing.) Sing.	—	Pn.k.	myc	9-22-84	OKM21623, 21591, 21658, KYS203
<i>Tyloplitis alboater</i> (Schw.) Murr.	용담쓴맛그물버섯		myc	9-23-84	OKM21652
<i>T. neofelleus</i> Hongo	세주쓴맛그물버섯	Ab.h.	myc		
<i>T. cf. plumbeoviolaceus</i> (Snell et Dick) Sing.	—	Ab.h.	myc	8-21-85	OKM22044
<i>T. cf. rubrobrunneus</i> Mazzer et A.H. Smith	—	Pc.a.	myc	8-20-85	OKM22025
<i>T. Virens</i> (Chiu) Hongo	녹색쓴맛그물버섯	Hd.	myc	8-22-85	OKM22087
<i>Xerocomus chryseniteron</i> (St. Amans) Qué.	마른산그물버섯	Ab.h.	myc	8-14-86	KYS1892
Aphylliphorales					
Cantharellaceae					
<i>Cantharellus cibarius</i> Fr.	피꼬리버섯과				
<i>C. friesii</i> (?) Qué.	피꼬리버섯				
<i>C. minor</i> Peck	—				
<i>Craterellus cornucopioides</i> (L.) Pers.	애기쇠꼬리버섯	Ab.h.	myc	8-22-85	OKM22082
<i>Gomphus floccosus</i> (Schw.) Sing.	뽕나무잎버섯		myc	10-3-84	OKM21770
	나팔버섯		myc	9-22-84	OKM21610, 21612
	—		myc	9-22-84	KJL415
	—		myc	10-4-84	OKM21813, 22049, 22070, KYS244
Telephoraceae					
<i>Thelephora palmata</i> (Scop.) Fr.	갈뚝버섯과	Qc.	myc	8-21-85	KJL644
	단풍시마귀버섯				
Clavariaceae					
<i>Lentaria byssiseda</i> Corner	국수버섯과		sap	10-4-84	OKM21820, KYS374

Scientific Name	Korean Name	Associated Trees	Physiol. Status	Date of Collect.	Voucher Number
<i>Clavaria</i>		Bt.	myc	8-22-85	KJL670
<i>Ramaria</i>			myc	8-14-86	KYS1875
<i>Sparassis</i>			sap	8-23-85	KJL688
<i>Sparassis</i> sp. nov.	꽃송이버섯속		sap	8-21-85	OKM22060
Polyporaceae					
<i>Bjerkandera</i>	구멍장이버섯과		sap	8-22-85	OKM22100
<i>Coltricia</i>	활버섯		sap	8-14-86	KYS1877
<i>Coltricia montagnei</i> var. <i>greenii</i> Fr.	—		sap	10-3-84	OKM21792, KYS356
<i>Coriolus consors</i> (Berk.) Imaz.	송곳니 구름버섯		sap	10-5-84	OKM21840
<i>Daedalea confragosa</i> Bolt. ex Fr.	—		sap	8-23-85	OKM22116
<i>Ganoderma lucidum</i> (Ley. ex Fr.) Karst.	부노초		sap		
<i>G.</i> <i>neojaponicum</i> Imaz.	일본영지		sap		
<i>Gloeoporus dichrous</i> (Fr. ex Fr.) Bres.	검푸른구멍장이버섯		sap	8-24-85	OKM22126
<i>Laeioporus sulphureus</i> (Fr.) Bond et Singer var. <i>miniatus</i> (Jungb.) Imaz.	붉은덕다리버섯				
<i>Lenzites betulina</i> (L. ex Fr.) Fr.	조개껍질버섯		sap	10-5-84	OKM21839
<i>Microporus affinis</i> (Fr.) Kuntze	메꽃버섯부치		sap	8-23-85	OKM22113, 21640
<i>M.</i> <i>flabelliformis</i> (?) (Fr.) Kuntze	부채메꽃버섯	Pn.k.	sap	8-21-85	KJL630
<i>Oxyporus populinus</i> (Fr.) Donk	—		sap	10-4-84	OKM21816, KYS368
<i>Porodisculus pendulus</i> (Schw.) Murrill	—		sap	8-22-85	KYS1223, OKM22086
<i>Polyporus varius</i> Pers. ex Fr.	—		sap	8-22-85	KJL667
<i>Polyporellus brumalis</i> (Ders. ex Fr.) Karst.	—		sap	10-5-84	KYS5
<i>Pycnoporus cinnabarinus</i> (Fr.) Karst.	—		sap	8-23-85	KYS1236
<i>P.</i> <i>coccinea</i> (Fr.) Karst.	—		sap	9-27-86	KYS2052
<i>Trametes mollis</i> (Sommerf.) Fr.	주걱송편버섯		sap	10-3-84	OKM21786, KYS360
<i>Trichaptum bifforme</i> (Klotz.) Murr.	—	Qc.	sap	10-5-84	OKM21841
<i>Tyromyces chioneus</i> (Fr. ex Fr.) Karst.	—		sap	10-5-84	OKM21842, KYS396
<i>T.</i> <i>lacteus</i> (Fr.) Murr.	—		sap	8-23-85	OKM22114
Phylacteriaceae					
<i>Haploporus suaveolens</i> (L. ex Fr.) Donk	—		sap	10-5-84	OKM21838, KYS4
Hydnaceae					
<i>Hericium erinaceum</i> (Bull. ex Fr.) Pers.	타수염버섯과		sap	9-24-84	OKM21671
<i>H.</i> <i>ramosum</i> (Bull. ex Merat) Let	노루궁뎅이	Ab.h.	sap	9-24-84	OKM21664

Scientific Name	Korean Name	Associated Trees	Physiol. Status	Date of Collect.	Voucher Number
<i>Hydnetum</i> sp.	—	—	myc	8-23-85	OKM22117
<i>Hydnum albidum</i> Peck	흰덕수염버섯	P.c.k.	myc	9-23-84	OKM21654
<i>Steccherinum ochraceum</i> (Pers. ex Fr.) S.F. Gray	바늘버섯	—	sap	9-23-84	OKM21657, KYS238
Corticiaceae					
<i>Merulius tremellosus</i> Schrad. ex Fr.	고약버섯과	—	sap	10-5-84	OKM21834, KYS398
<i>Stereum hirsutum</i> (Willd.) Fr.	아교버섯 꽃구름버섯	—	sap	9-27-86	KYS2056
Mucronophoraceae					
<i>Cryptoderma cirrinum</i> Imazeki	진흙버섯과 기와층버섯	—	sap	9-24-84	OKM21670
Gasteromycetes					
Phalliales					
<i>Pseudoecolus schellenbergiae</i> Sumstine	말뚝버섯목	—	sap	10-4-84	OKM21800
<i>Phallus impudicus</i> Pers.	새발버섯	—	sap	10-5-84	OKM21837
<i>P. rugulosus</i> (Fisch.) Kunze	말뚝버섯	—	sap	7-22-76	—
<i>Dicetophora indusiata</i> (Pers.) Fisch. var. <i>aurantiaca</i> Kobayashi	붉은말뚝버섯	—	sap	—	—
<i>Kobayasia nipponica</i> (Kobay.) Imai et A. Kawam.	분홍 망태버섯 흰편뿔버섯	—	myc	7-1-84	KYS8
Lycoperdales					
<i>Gyvastrum cf. coronatum</i> Pers.	말뚝버섯목	—	sap	8-20-85	OKM22098
<i>G. minimum</i> Schw.	—	—	sap	10-4-84	OKM21805
<i>G. saccatum</i> (?) Fr.	—	—	sap	8-20-85	OKM22026
<i>Cubaria craniiformis</i> (Schw.) Fr.	발징버섯	—	sap	9-24-84	OKM21672
<i>Lycoperdon mammaeforme</i> Pers.	비늘말뚝버섯	Ab.h.+P.c.a.	sap	8-20-85	OKM22018
<i>L. marginatum</i> (?) Vitt.	—	—	sap	8-20-85	OKM22037
<i>L. perlatum</i> Pers.	말뚝버섯	P.c.k.; Ab.h.	sap	7-15-84	KJL295
<i>L. perlatum</i> Pers. var. <i>foetidum</i>	—	Hd.	sap	8-22-85	KJL669
<i>L. pyriforme</i> Pers.	좁말뚝버섯	—	sap	5-6-86	KYS1614
<i>L. pusillum</i> Batsch ex Pers.	애기말뚝버섯	Pn.k.	sap	8-21-85	KJL642
Sclerodermatales					
<i>Astrea hygrometricus</i> (Pers.) Morgan	어리알버섯목 민지버섯	—	myc	7-22-76	KYS

Scientific Name	Korean Name	Associated Trees	Physiol. Status	Date of Collect.	Voucher Number
Tulostomatales					
<i>Calostoma japonicum</i> P. Henn.	(송장버섯목) 연지버섯		sap	7-22-76	KYS
Heterobasidiomycetes					
<i>Dacryopinax spathularia</i> (Schw.) Martin	이담자관목		sap	8-21-85	KJL653
<i>Calocera viscosa</i> (Pers. ex Fr.) Fr.	허버섯		sap	8-20-85	OKM22038
<i>Protodactalea hispida</i> Imazeki	동황색끈적싸리버섯		sap	8-22-85	OKM22086
<i>Tremella foliacea</i> Fr.	꽃흰목이		sap	9-22-84	KJL406
Abbreviations:					
Qc.	<i>Quercus</i>	Pc.k.	<i>Picea koratensis</i>		
Ab.h.	<i>Abies holophylla</i>	Bt.	<i>Betula</i>		
Pc.a.	<i>Picea abies</i>	Hd.	Hardwood		
Qc.a.	<i>Quercus aliena</i>	Lx.1.	<i>Larix leptolepis</i>		
Pn.k.	<i>Pinus koratensis</i>	Pn.s.	<i>Pinus strobus</i>		

in 1976, 1984, 1985, and 1986 from the Kwangnung Experimental Forest. The higher fungi are listed by the classification system used by Imazeki & Hongo (1970) and Miller (1972). A total of 257 species and varieties of Basidiomycetes in 104 genera were identified. Korean names of some fungi are not listed in Table 1 because these fungi appear to be newly reported from Korea. Most fungi in the large mycorrhizal genera of *Amanita*, *Russula*, and *Lactarius* were recorded previously, while many or all of the species in *Calocybe*, *Cystoderma*, *Marasmius*, *Tricholoma*, *Volvariella*, *Claudopus*, and *Geastrum* have not been recorded in Korea. A member of our team (OKM) collected *Chroogomphus sibiricus* (Sing.) O. K. Miller for the first time in Korea. According to one of us (OKM) a species of *Sparassis* collected on August 21, 1985 (OKM 22060) seems to be a previously undescribed species and the fungus is under study at the present time.

Table 2 summarizes the diversity of three types of higher fungi. Among the total of 257 species of higher fungi, 135 species in 75 genera were saprophytic while 120 species in 28 genera were ectomycorrhizal. Two species of root parasites of hardwoods, *Armillariella mellea* and *A. tabescens* were collected. More Basidiomycete root parasites may be found but the general health of the trees would indicate that they are not abundant. Saprophytic fungi accounted for 52% of the total species collected.

The most commonly collected ectomycorrhizal fungi belonged to *Amanita* (22 species & 2 varieties), *Russula* (24 species), *Lactarius* (15 species), *Tri-*

Table 2. Diversity of saprophytic, mycorrhizal and parasitic higher fungi collected in 1976, 1984, 1985 and 1986 in Kwangnung Experimental Forest.

Taxon	Physiological Function			Total
	Saprophytic	Mycorrhizal	Parasitic	
No. of genera	75	28	1	104
No. of species	135	120	2	257

choloma (5 species), *Laccaria* (3 species), *Inocybe* (4 species), *Boletus* (7 species), *Suillus* (5 species), and *Cantharellus* (3 species). Among the 120 ectomycorrhizal species and varieties *Amanita*, *Russula*, and *Lactarius* alone accounted for 53% of the total mycorrhizal species or 25% of the total Basidiomycetes collected in Kwangnung area.

There have been few records on the distribution of higher fungi in the Kwangnung Experimental Forest and the surrounding area. The most detailed investigations were reports by Lee and Lee (1957, 1958, 1959). They reported a total of 168 higher fungi from this area during a three year study. Their list of higher fungi did not appear to be exhaustive. For example, they listed only five species of *Amanita* and four species of *Lactarius* and eleven species of *Russula*. Due to many differences in classification system between their list and our present report, it is difficult to compare differences in distribution of fungal populations between the two studies.

Distribution of mycorrhizal fungi in some pure forest stands has been studied by Lee and Kim (1985, 1986). They collected 133 ectomycorrhizal species in 38 genera from 8 different types of pure forest stands in 9 locations. The most diversified fungal flora was observed from *Pinus densiflora* stands, while *Larix leptolepis* had simplest flora (Lee and Kim, 1985). In the present study in Kwangnung Experimental Forest, 120 mycorrhizal species in 28 genera were identified. This number appears to be quite high, considering the fact that these 120 mycorrhizal species were collected from a single locality. The diversified mycorrhizal flora in Kwangnung suggested that the forests in Kwangnung at the age of about 60 years have developed into a complex forest ecosystem with abundant symbiotic associations between fungal flora and host trees. The general health and vigor of the trees suggests that this is not only a necessity for tree nutrition but a normal situation in Korean forests. It is necessary to maintain the deep duff and stable organic horizons which are vital to the maintenance of the necessary mycorrhizal symbionts.

ACKNOWLEDGEMENTS

We wish to acknowledge the support of KOSEF (Korea Science and Engineering Foundation) and NSF (National Science Foundation, USA). We also wish to thank the staff of Kwangnung Experimental Forest for all their support. Lastly, we wish to thank Hope Miller for her assistance in the field in Korea and editing and typing the manuscript.

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