# Habitat Segregation and Cultural Preference of *Lampteromyces japonicus* and *Armillariella mellea.*

Osamu YAMAGUCHI* and Chiaki KOBAYASHI**
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Abstract

*L. japonicus* and *A. mellea* are the dominant mushroom species in summer-green forests dominated by *Fagus crenata* and *Quercus crispula* in Japan. Their preference to and specificity on host wood was examined in nature. Mushrooms of *L. japonicus* were found only on the dead trunks and branches of *F. crenata.* Those of *A. mellea* were found mainly around the withering trunks of *Q. crispula* and occasionally of *Q. serrata* or other deciduous trees. Chips of *F. crenata* and *Q. crispula* enhanced the growth of mycelia of these two mushroom species in a mycelial culture experiment. The former chips enchanced the growth of *L. japonicus* more efficiently, while the latter did that of *A. mellea.* These mycelia were innoculated to the lumbers of these two host trees. Nine point five grams in dry weight of fruit bodies of *L. japonicus* was produced on the lumber of 2910 grams in dry weight of *F. crenata.*

## Introduction

Biotic community is composed of three ecological members, plants as producers, insects and aminals as consumers, and fungi and bacteria as decomposers. In a mature ecosystem, they are organized in harmony guided by effective energy flow and material circulation. Therefore, a fine network of niche segregation is expected in an ecosystem in equilibrium state. In deciduous summer-green forests, the main producers are beechs of *Fagus crenata* Blume and oaks of *Quercus crispula* Blume. Usually the former is dominant over the latter. Mushrooms are quite popular in this sort of forests especially in autumn. Dominating ones are of *Lampteromyces japonicus* (Kawam.) Sing. and *Armillariella mellea* (Vahl. : Fr.) Karst. Some sorts of habitat segaration have been known so far. In this article, a survey of niche separation of these two fungi was done in nature, and their biological bases were examined under cultural experiments.

*Department of Biology Hyogo, University of Teacher Education, Yashiro, Hyogo 673-14
**Present address: Yagi Elementary School, Mihara, Mihara-Gun 656-04

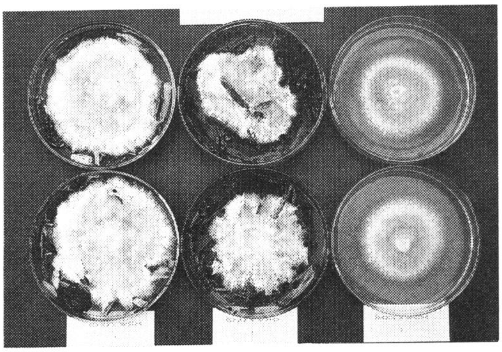
## Materials and Methods

From September of 1992 to September of 1993, mushrooms of *L. japonicus* and *A. mellea* were examined whether they grew on trunks of *F. crenata* or *Q. crispula* or the others in the summer-green forests of Mt. Hyonosen, Mt. Ooginosen and Valley Onzui in Hyogo Prefecture. The alutitudes are on 700 - 1200 meters above the sea level. They are all in the climax state in plant succession (Nakanishi et al., 1983).

The mycelial stocks of *L. japonicus* and *A. mellea* were constructed from the gills of freshly collected mushrooms at Mt. Hyonosen in October of 1991. They were kept in the Hamada's medium at 25℃ before use (see Kinugawa, 1988).

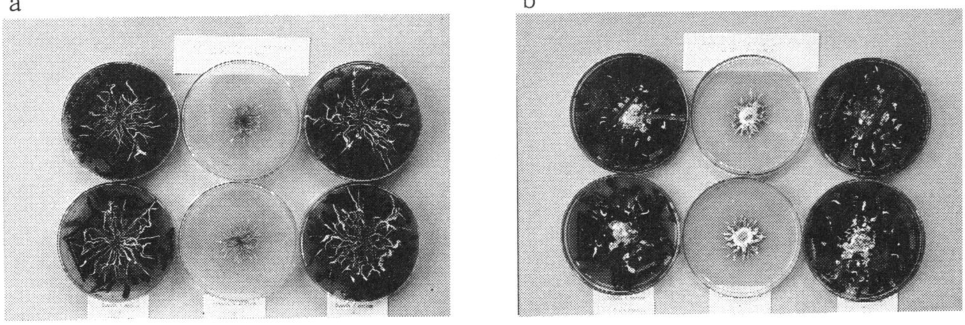
Experiments of mycelial growth were done by using 25 mililitters of the Hamada's medium adding 2.5 grams of the sterilized chips of *F. crenata* or *Q. crispula* in a petri dish. The dishes were kept in an incubator at 25°C for 7 days. After this period, the diameters of mycelial growth were measured by a ruler.

Mycelial cultures were also tried in outdoor condition from May to December of 1992. The mycelia of *L. japonicus* and *A. mellea* were innoculated onto the sterilized woods, about 3000 grams in dry weight, of *F. crenata* and *Q. crispula* in plastic cases of 50×20×30 $cm^3$. The mycelial growth and formation of fruit body was monitored twice a week for the period.



◀Figure 1. Mycerial growth of *L. japonicus* at 25°C seven days after innoculation into the following media. Left: Hamada's medium with the wood chips of *F. crenata*. Center: Hamada's medium with the wood chips of *Q. crispula*. Right: Hamada's medium alone.

a b



▲Figure 2. Mycerial growth of *A. mellea* at 25°C seven days after innoculation into the following media. Left: Hamada's medium with the wood chips of *F. crenata*. Center: Hamada's medium alone. Right: Hamada's medium with the wood chips of *Q. crispula*. a: the reverse side of the cultured petri dish. Mycerial bundles are recognized easily. b: the front side of the cultured petri dish.

## Results

1. *Habitat segregation between L. japonicus and A. mellea in nature.*

A total of 26 mushroom colonies of *L. japonicus* was observed: 11 in Mt. Hyonosen and 15 in Mt. Ooginosen. All of them were on the decayed woods of *F. crenata*. None of the mushrooms was found on the woods of *Q. crispula*. On the contrary, a total of 17 mushroom colonies was observed for *A. mellea*. Out of them, 11 conolies were on the decayed woods of *Q. crispula*, 1 on *Q. serrata*, 1 on *Carpinus laxiflora*, and 1 on *Betula ermanii* in Mt. Oomine in Nara Prefecture, and 2 on unidentified broad-leaved woods. They were found on the ground adjacent to the woods. The mushrooms of *A. mellea* were never found on the wood of *F. crenata*. The mushrooms of *L. japonicus* were found in September or only early October. On the other hand, those of *A. mellea* were found in October and early Nobember. There was no coexistence of them on the same woods.

2. *The effect of wood chips on mycerial growth.*

The above observational results are indicative of the difference in preference to host woods. Mycerial growth was examined by using three kinds of media; the usual Hamada ' s medium, that one with the chips of *F. crenata*, and that one with the chips of *Q. crispula*. The small pieces of the cultured mycelia were innoculated onto the center of media, and were cultured at 25℃ for 7 days. The mycelial growth was measured by the diameter of the mycerial colony circle. The results are shown in Figures 1 and 2 and Table 1. The best growth rate of *L. japonicus* was found in the medium with the chips of *F. crenata*, and the second best was in the medium with the chips of *Q. crispula*. These wood extracts were significantly influential to the mycelial growth of these mushroom species. Especially, the wood chips of *F. crenata* accelerated the mycerial growth of *L. japonicus*. On the other hand, the best growth of *A. mellea* was found in the medium with the chips of *Q. crispula*. The second best was in the medium with the chips of *F. crenata*.

These results were statistically analyzed by analysis of variance. The results are shown in Table 2. The highly significant differences were found between the media and between the mushroom species. There is also a significant interaction between the media and specises. L. japonicus has a preference for the wood of *F. crenata*, and *A. mellea* has that for. *Q. crispula* in nature.

3. *Trial of fruit body formation in outdoor condition.*

The cultured mycelia were also innoculated into the sterilized woods of *F. crenata* and *Q. crispula*, and had been kept outdoor, especially under temperature condition. A spray of water was made one a week. A total of four possible combinations (2 x 2) was examined. Three of them were got haevy infection of other fungi, such as *Schizophillum commune* Fr. :Fr. However, the innoculated woods of *Q. crispula*, 2910 grams in dry weight, produced the five mushrooms of *L. japonicus* in the late of October. The sum of their dry weights was 9.5 grams.

Table 1. Effects of the wood chips of *F. crenata* and *Q. crispula* on the mycerial growth of *L. japonicus* and *A. mellea.*

| Species / Medium | *Lampteromyces japonicus* (cm) |
|---|---|
| Hamada's medium | 6.4, 6.5, 6.1, 6.0, 6.0, 5.8, 6.1, 6.3, 6.7, 6.1, 6.4, 5.5, 5.5, 5.6, 5.2, 5.7, 5.7, 5.3, 5.8, 5.9, |
| | 5.9, 6.3, 5.4, 5.5, 5.6, 5.4, 4.9, 5.2, 5.3, 5.3, 5.8, 5.4, 5.6, 5.5, 5.5, 6.2, 5.8, 6.1, 6.4, 6.2, |
| Hamada's medium with *F. crenata* | 7.5, 7.4, 7.9, 7.4, 7.2, 8.1, 7.6, 7.5, 8.0, 8.0, 7.8, 7.2, 7.4, 7.0, 7.1, 6.1, 5.6, 6.1, 6.3, 6.1, |
| | 5.7, 6.2, 6.3, 5.6, 6.0, 6.6, 5.9, 5.8, 5.5, 6.4, 6.2, 6.2, 5.8, 6.0, 5.8, 6.3, 6.1, 6.3, 5.2, 5.4, |
| Hamada's medium with *Q. crispula* | 7.0, 7.2, 7.2, 7.3, 7.3, 7.7, 7.1, 6.9, 6.8, 6.5, 6.7, 6.7, 6.6, 6.2, 5.8, 5.7, 5.6, 5.7, 5.6, 5.2, |
| | 5.4, 5.8, 5.7, 5.8, 6.5, 5.5, 5.4, 6.1, 6.1, 6.0, 6.1, 6.1, 5.5, 6.4, 5.8, 6.0, 5.8, 5.6, 5.7, 5.6, |
| | *Armillariella mellea* (cm) |
| Hamada's medium | 2.3, 2.0, 3.8, 2.0, 2.2, 2.4, 1.9, 1.9, 3.0, 1.6, 1.5, 3.2, 2.1, 2.2, 3.1, 2.2, 1.8, 1.6, 2.6, 2.7, |
| | 3.5, 2.4, 4.1, 3.6, 2.3, 4.4, 3.7, 3.9, 4.6, 4.3, 1.1, 4.3, 3.5, 2.6, 4.4, 2.5, 2.5, 1.8, 2.3, 3.6, |
| Hamada's medium with *F. crenata* | 4.3, 4.0, 5.1, 4.3, 3.8, 2.1, 3.9, 3.6, 4.1, 4.3, 2.4, 3.3, 5.3, 4.9, 4.8, 4.9, 5.4, 3.1, 5.5, 5.0, |
| | 5.7, 5.0, 4.6, 4.0, 5.0, 4.1, 5.3, 6.1, 5.7, 4.6, 4.0, 5.0, 5.5, 5.3, 6.3, 5.1, 4.5, 5.7, 5.0, 6.0, |
| Hamada's medium with *Q. crispula* | 4.9, 5.7, 4.8, 3.9, 5.3, 4.7, 4.0, 4.5, 2.4, 4.3, 4.1, 4.5, 5.6, 6.5, 4.8, 5.8, 4.7, 4.6, 6.4, 4.8, |
| | 4.7, 4.9, 5.5, 5.0, 5.0, 4.8, 3.9, 5.5, 5.3, 5.7, 4.9, 4.2, 5.0, 6.4, 6.7, 6.3, 6.3, 6.1, 6.3, 6.7, |

Table 2. Analysis of variance in mycerial growth of *L. japonicus* and *A. mellea* in the media containing the wood chips of *F. crenata* or *Q. crispula.*

| Source of deviation | SS | DF | MS | F | P |
|---|---|---|---|---|---|
| Media (A) | 94.87 | 2 | 47.43 | 70.10 | $P<0.001^{***}$ |
| Fungi (B) | 242.15 | 1 | 242.15 | 357.85 | $P<0.001^{***}$ |
| Interaction (A×B) | 38.22 | 2 | 19.11 | 28.24 | $P<0.001^{***}$ |
| Error | 158.35 | 234 | 0.68 | | |
| Total | 533.59 | 239 | | | |

$^{***}$ Significant at 0.1% level.

## Discussion

The forests in which the mushroom survey was done are composed mainly of the trees of *F. crenata*. The second dominating tree is *Q. crispula*. In this sort of situation, the most dominant fungus seems to choice the former host tree. And the second dominant fungus seems to choice the second best host or the others in order to avoid fruitless competition. The detected habitat segregation is easily understandable between *L. japonicus* and *A. mellea*. *L. japonicus* seems to be dominating over *A. mellea* in these summer-green forests. They show an habitat segregation based on their preferences toward the host wood. The difference in the growth rate in mycerial cultures supplies the material evidences. The mycerial growth of *L. japonicus* was more enhanced with the aid of wood chips of *F. crenata* than of *Q. crispula*, and vice versa. The growth of *A. mellea* was accelerated by the aid of *Q. crispula*. However, *L. japonicus* still has the capacity of utilization of wood of *Q. csrispula* as a nutrient source. The present results supply an experimental evidence to the observation that mushroom diversity reaches to the maximum in climax forest (Iwabuchi, Sakai and Yamaguchi, 1994).

## References

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