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Information on Resource-related Events

- Oct. 28 (Sat) 9:00–11:00 *Progress in Fertilization Techniques of Rats* at TERRSA Hall at Kyoto TERRSA (Kyoto Citizen's Amenity Plaza, Shinmachi Kujo Minami-ku, Kyoto, Japan)

Detailed information is available at <http://www.nbrp.jp/index.jsp>



Introduction to Resource Center No. 11

Fungus/Mushroom Resource and Research Center

Fungus/Mushroom Resource and Research Center,
 Faculty of Agriculture, Tottori University
 Hiroshi Otani, Director
 Nitaro Maekawa, Professor



[1] Fungi such as mushrooms are a gold mine of genetic resources

Fungi constitute a separate kingdom in the biological classification system and comprise an extremely massive group that includes yeasts, molds, and mushrooms. The number of species belonging to this kingdom is presumed to be a million or more. Fungi attract attention because of their diverse functions; they play an extremely important role in maintaining the natural ecosystem and participate in environmental conservation by decomposing plants and animals. Fungi also form symbiotic relationships with plants in which they help them by exerting growth-promoting effects, increasing their tolerance against environmental stresses, and by purifying environmental pollutants. In addition, mushrooms are widely consumed as a health food due to their excellent nutritional value. Recently, the medicinal properties of mushrooms represented by their immunoactive, antioxidative, antimutagenic, and anticoagulant effects have attracted a great deal of interest. Thus, fungi such as mushrooms are a repository of genetic resources with undiscovered beneficial ingredients and functions, although this field has not been studied adequately.

[2] Establishment of the resource center



The relationship between Tottori prefecture and mushrooms was initiated when Osamu Tsuneda, a graduate from the Tottori Agricultural College, (a predecessor to the Faculty of Agriculture, Tottori University), established National Mushroom Society (later known as the Foundation of Japan Mushroom Center) in 1947. Subsequently, the Tottori Mycological Institute was founded in Japan in 1959 as an exclusive general research institute for mushrooms, with extensive research being conducted in the fields of taxonomy, ecology, genetics, physiology, breeding, and cultivation of mushrooms.

Additionally, Tottori University established a collaboration with the Tottori Mycological Institute at its Graduate School of Agriculture (Master's program) and the United Graduate School of Agricultural Sciences (Doctoral program) in 1999 and has been energetically conducting collaborative research on mushrooms. Through these achievements, the Faculty of Agriculture established the Fungus/Mushroom Resource and Research Center in 2005; the Center is aimed at strengthening the cooperation with the Tottori Mycological Institute, facilitating the accumulation and conservation of genetic resources of fungi with a central focus on mushrooms, and providing specialization in advanced and fundamental researches for elucidating the biological functions of mushrooms by using these genetic resources. The center started with three research sections: Environmental Ecology, Molecular Genetics, and Functional Development. The Research Section of Genetic Resource Evaluation and Conservation was newly established through a grant from the Ministry of Education, Culture, Sports, Science and Technology (Fig. 1). The Research Section of Functional Development is an endowed section established by Tottori prefecture and is aimed at establishing new industries and rejuvenating the existing local industries.

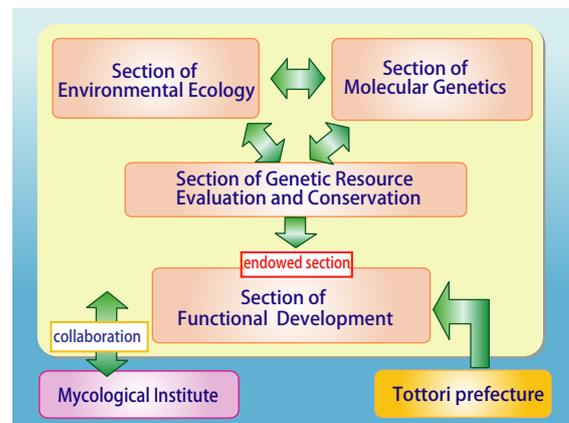


Fig. 1. Organization of Fungus/Mushroom Resource and Research Center

[3] Conducted researches



The Fungus/Mushroom Resource and Research Center promotes the expansion of genetic resources by further collecting and preserving genetic resources of mushrooms in addition to the core resources that were obtained from the Fungi Research Institute. Taxonomically, most species of mushrooms belong to Basidiomycota or Ascomycota in the kingdom Fungi, and approximately 20,000 species in 1,000 genera are known to exist. Among these, approximately 3,000 species have been reported in this country.

Currently, the center preserves approximately 1,000 species with a focus on the genetic resources that were collected primarily from various areas within the country. Although this institute ranks high in the world in terms of the number of species preserved as genetic resources of mushrooms, the actual number is less than 20% of the species that are presumably distributed in the country (6,000–10,000 species).

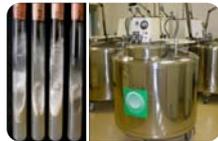
Thus, the Research Section of Environmental Ecology collects a large number of mushroom species from various regions within the country (Fig. 2), conducts taxonomic research on fungi with a focus on domestic mushrooms, elucidates the regional flora by analyzing the diversity of species, and acquires genetic resources (isolated strains) of each mushroom species. Concurrently, it conducts research related to the elucidation of the ecological functions of mushrooms.



Fig. 2. Genetic resources of mushrooms are collected particularly from subtropical areas that have remained rarely investigated. *Cymatoderma lamellatum* (upper left), *Daedaleopsis tenuis* (upper right), and *Ganoderma boninense* Pat. (lower left) are distributed in Ryukyu and Ogasawara islands in the country. *Calocera viscosa* (lower right) mainly grows on a touchwood of conifers.

We aim to preserve the fungal genetic resources on the world's largest scale both quantitatively and qualitatively by accumulating information on genetic resources of various strains collected at the Research Section of Genetic Resource Evaluation and Conservation, and constructing databases of these resources that has large amounts of information on each genetic resource. To achieve this goal, we are conducting fundamental research on the separation and culture of a variety of genetic resources including those of mushrooms that are difficult to culture. Furthermore, we have developed a freeze-preservation method using liquid nitrogen; this enables the stable long-term preservation of the genetic resources of the collected strains. (Fig. 3)

Fig. 3. Left: Cultured genetic resources of mushroom strains. Right: Genetic resources from mushrooms are preserved in a freeze-preservation container under liquid nitrogen after gradual freezing in a programmable freezer.



Another significant goal of the center is the application of the collected and preserved genetic resources to various fundamental and applied research fields. Fungi, including mushrooms, possess numerous functions. Some fungi are useful for human consumption, whereas others cause diseases in plants, animals, or insects. In addition, some fungi are capable of decomposing harmful chemicals or synthesizing beneficial substances. Research Section of Molecular Genetics investigates fungi that exhibit useful functions and targets to elucidate such functions at the molecular level by using instrumental analyses and methods based on molecular biology and molecular genetics and develop technologies to utilize them.

Among the various researches, the Research Section of Functional Development has attempted to further environmental conservation by harnessing the potential of mushrooms for decomposition of harmful and persistent chemicals, particularly dioxins. Moreover, the section conducts research on developing a technology for the artificial infection of plants with general-purpose mycorrhizal fungi for effective and inexpensive development of mycorrhiza (tissues in which roots are replaced by fungi for absorbing water and nutrients) even under natural conditions. This may promote the growth of plants and endow or enhance water-stress tolerance (drought resistance) in them (Fig. 4). The section has also undertaken the development of plantation technology by exploiting the symbiotic relationship between fungi and plants, enhancing the production of mycorrhizal edible fungi, proliferation of rare plant species through preservation, and establishment of a technique to revive Satoyama (Japanese traditional rural landscape) by the advanced use of fungi.



Fig. 4. Left: A seedling of *Pinus densiflora* in which *Suillus granulatus*, a mycorrhizal fungus, was inoculated has been extracted from a flowerpot after several months of growth. Rampant white hyphae of *Suillus granulatus* cover the root filaments. Right: Mycorrhiza of *Suillus granulatus* formed on the roots of *Pinus densiflora*. The dichotomous "Y"-shape is a characteristic feature of mycorrhiza in pines.

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"Google Webmaster Tools"



Recently, due to the improved performance of search engines, an increasing number of users access websites pertaining to their requirements by searching each time without bookmarking the websites. Hence, website administrators who aim to increase the number of visitors are encouraged to display their sites among the top-ranked search results. Therefore, search engine optimization (SEO) is required for each search site. For that reason, Google has released a website (<http://www.google.com/webmasters/>) termed "Google Webmaster Central" for site administrators.

This site includes the tool "Google Webmaster Tools", which was originally called "Google Sitemaps". This tool is employed by users to register their sites on the Google index. It analyzes the results of search queries with regard to a user's site and the keywords that appear on these sites; therefore, it can be used as a service to evaluate the overall status of the user's site.



Please open a Google account if you do not already have one, for it is a prerequisite to use "Google Webmaster Tools" (<http://www.google.com/webmasters/sitemaps/>). Once logged in, the users should type the URL of their site in the "Add Site" field on the Google Webmaster Central site to include their sites in the Google index. The added sites will be included in the user's account. Next, the "Verify your site" step should be completed. This is conducted so that Google can confirm that the account owner is an authorized administrator of the site.

Next, "sitemap.xml" file should be created to ensure that the user



Google Webmaster Tools

can avail of all the services provided by "Google Webmaster Tools". There are several ways to create the file; however, it can be easily created by using the program "GsiteCrawler" (<http://gsitecrawler.com/>). Once constructed, "sitemap.xml" file is uploaded to the user's site and added from "Sitemaps" to "Google Webmaster Tools".

Thus, the process is completed. Consequently, useful information such as the last date when a Googlebot accessed the user's site and whether the website has been deleted from the search index due to violation of the Google policy can be obtained.

Further, after updating the website, "sitemap.xml" file should be recreated and reuploaded to "Google Webmaster Tools".

- Reference: <https://www.google.com/webmasters/sitemaps/>

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(Genetic Informatics Laboratory,
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Editor's Note: An article regarding mushrooms, which are timely for autumn, the season of the pleasures of the table has been submitted by the recently established Fungus/Mushroom Resource and Research Center. It was several years ago when I knew that the Tottori Mycological Institute was established approximately 50 years ago and is an internationally highly acclaimed institute. Fungi have been extensively researched in fields ranging from basic to applied sciences and are essential genetic resources for the life sciences. The Fungus/Mushroom Resource and Research Center was recently established in Tottori University, and research has been initiated by eight researchers of four divisions. Fungal research is a highly promising research field in that Japan is at the forefront of this research. I thank Dr. Otani and Dr. Maekawa for their contributions despite their busy schedules. (Y.Y.)

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