

A METHOD OF GROWING THE LOTUS-MUSHROOM (VOLVARIA SP.)*

By SUP VATNA,

*Department of Biology, Chulalongkorn University.**Bangkok.*

INTRODUCTION.

The purpose of this work was to find the conditions best suitable to the growth of our common edible mushroom. Mushroom growing in other countries has been done successfully on a commercial scale for some time past, but in Siam the people depend almost entirely upon what nature gives them. Some attempts are being made at the present, mostly by Chinese, to grow them in sufficient quantity to supply the needs of the hotels, but unfortunately most of these growers do not possess the necessary knowledge to ensure their success or to be able to enlarge their business to any extent. Some Siamese have imported spawn from England or America, but they have not succeeded and never will succeed in growing them, since those spawn belong to *Agaricus campestris*, the field mushroom, which requires a fairly uniform temperature of about 60°F. for its natural growth and fructification.

The method of growing mushrooms by the Chinese in Bangkok is crude, but fairly practical for the present state of demand. The method is probably imported from China and is based upon the known fact that one usually finds these mushrooms growing where there is a heap of lotus-seed husks left to decay, and that they grow better if the husks were left together with other rubbish material. Hence the Chinese mushroom grower will in the first place try to find a suitable quarter which was once a rubbish heap, but has undergone decomposition to its final stage. He then levels the surface and next makes some crude boxes without bottom or top, and even the sides are not entirely closed as they are made up of small

* These experiments were made possible mainly by a research fund of the Rockefeller Foundation and partly by help from the Biology Department.

* Read before a meeting of the Natural History Section, February 19th, 1936.

pieces of board nailed at a little distance from each other; in fact the box can be anything made out of any material, because the main purpose is to keep the husks together. These boxes, which should not be larger than 60 × 60 cm. and a height of about 40 cm., are then placed about 150 cm. apart in all directions, so that there will be a space in the middle for a narrow walk and a small area at the sides of the boxes for the mushrooms to grow. As the next step the sides of the box and the bottom (which in this case is the ground) are lined with a thick layer of straw, and then the lotus-seed husks are put in. After this, the top part of the boxes as well as the spaces between them are all covered with straw, and the process of preparation for the crop is finished. The bed which is in the open will now be watered about twice a day until the mushrooms appear.

There are some obvious disadvantages in this method of the Chinese growers. First, to find a suitable place with a large area for the purpose is not an easy matter, and when the soil is exhausted he has to move to some other places; second, he cannot control the moisture of the bed. Especially in the rainy season a bed of this kind will be almost useless, because of the fact that the bed will be too wet for a proper growth; third, the production per surface area is small; and fourth, the amount of lotus-seed husks to be used is so large that often the supplies run short.

The results of investigations now to be described will show how to avoid the above disadvantages.

SUITABLE QUARTERS.

As regards quarters, it is best to have indoor beds so that they can be run throughout the year without the interruption of the rainy season, or they can be in the open, provided that they can be covered when it rains. The place selected must be high enough to prevent flooding by rains and high tides during the months of September, November and December. The bed should not exceed 100 cm. in width to have it within reach when gathering, but the length can be as long as desired and 25 cm. will be high enough. The four walls can be made out of boards, whereas the bottom part may be the soil solidly packed or wood or cement,

MANURE AND ITS CURING.

The best manure for growing *Volvaria* is fresh horse dung, preferably from hard working horses. This can be obtained from the different Chinese livery stables and the lotus-seed husks are on sale in the vicinity of Wat Mahan. The horse dung must be piled under cover and packed rather firmly, and left there for about 3 to 5 days; after that turn the pile inside out every 2 or 3 days, so that all parts will undergo equal fermentation. During this period it must be watched carefully to see that the manure is not too dry; if so, sprinkle a little water over it but not too much. From time to time the temperature of the pile must be taken, to see the progress of fermentation. At first, it will be found that the temperature rises steadily, but later on it will begin to drop. When the temperature drops to about 40° C. the manure is ready to be mixed with one-fourth to one-third by volume of the lotus-seed husks, or the manure can be put right into the bed, then the husks spread over thinly on every 3 cm. thickness of manure. The manure in the bed must be pressed together firmly, so that moisture and heat will remain constant. The total thickness of the manure in the bed should be about 20 cm. After this leave it as it stands for a few days, but in the mean time take temperature every day, to see if there is any further rise; if there is, leave it until it drops. If the manure is well cured and no rise occurs, the bed is ready for spawning.

SPAWN AND SPAWNING THE BEDS.

Spawn, or mycelium, is the vegetative part of the mushroom plant. It can be grown easily enough in the first place from the spores of the mushroom. Once the mycelia are obtained it is only necessary to transfer them to the prepared medium, to get a sufficient quantity for spawning the beds.

The surface of the bed is now dug up to the depth of about 3 cm. at points 20 cm. apart in all directions. Then a small portion of the spawn is put in those pits and the surface is levelled and pressed down again. That done, cover the bed with dry grass or straw and moisten the cover with water. After that preparation there is left only to see that the bed does not become too dry; usually a

small amount of water once a day is enough to keep it uniformly moist. About 10-20 days after the introduction of the spawn, there will appear on the surface of the bed small buttons which develop into young mushrooms ready for use in 4-5 days. The crop will last for about 2 months.

DISCUSSION.

What has been described deals only with the practical side of mushroom growing. A scientific mind certainly will want to question many points, some of which the author cannot even guess. The name "lotus-mushroom" (เห็ดบัว) as commonly used, is in itself rather misleading. This mushroom does not have to depend solely on the decomposition products from the lotus-seed husks to grow. It can be grown out of the horse manure alone, provided that it is sterilized to kill all other mycelia before spawn is added. The author tried many experiments to grow this mushroom on ordinarily-cured horse manure alone, and never succeeded; in one experiment this sort of bed was tried and over a month elapsed without any sign of fructification. Then in the hope of re-using the horse manure in the usual way he dumped into the bed about one-third by volume of the lotus-seed husks and thoroughly mixed them together, but did not have the time to come to it soon again. After about 10 days it was reported that mushrooms had come up in great profusion, and he then saw that every one of them was so dry that the volva, or envelopes, cracked open instead of being gently torn open in the usual way when the bed is moist enough. In this instance, it was rather strange that the same horse manure could be made to yield mushrooms only in the presence of lotus-seed husks, even without an adequate amount of moisture.

In nature, this mushroom is also grown in the rainy season, around the base of any old stack of straws, and that is why the farmers call this same mushroom "straw mushroom" (เห็ดฟาง). Once also the author saw this mushroom grow near the dead stump of a banana tree. Out of these facts it can at least be concluded that there is some sort of affinity between the mycelia of *Volvaria* and the decomposition products from lotus-seed husks and straw. There-

fore, the Chinese have been using the best of materials, i.e., both the straw and the lotus-seed husks, for their mushroom culture.

The fact that the Chinese can grow mushrooms without the use of spawn can probably be explained. The first start is the most difficult for them, since they have to depend upon the presence of either the spores or the mycelia of the mushroom on the straw or on the lotus-seed husks. If those straws or husks happen to be free from the germinating agent, that investment will be a loss, but as they usually start out with at least a hundred boxes of the kind mentioned in the beginning, if one or two of the boxes happen to have the spores, the developing mycelia will spread to supply every bed, so in this way the growth is usually a success. A home grower often suffers on account of his small start, because one or two of those beds might not have the spores at all. If once the grower has succeeded, then he is insured of his future success, for now he already has the mycelia on the boards of his boxes, so that when food, heat and moisture are present, they will immediately spread and a harvest is obtained.

With the spawn to start his culture, a home grower who dislikes to handle horse manure can make use of humus soil as a substitute. In the first place he will have to prepare a sort of frame and then put this humus soil, preferably mixed with some cut grass, in the bed to the depth of about 20 cm., patted down fairly firmly. On this bed place any old bottomless tin can about 40 cm. in diameter. In the middle of the can stand a piece of hollow bamboo stem about 40 cm. high, and around this bamboo stem pour down the lotus-seed husks to the height of about 35 cm. If the bed is large, several of the tin cans should be used and placed at about 50 cm. apart in all directions. After the lotus seed husks are put in, the bed is next covered entirely with straw, also including the tin cans. The bed is now watered once or twice daily, according to whether it is moist or dry. After 2-3 days when the husks have slightly decayed, a small amount of spawn is dropped into the hollow of the bamboo stem, and after 2-3 weeks there should be mushroom buttons developing on the soil around the tin can.

On account of the fact that the practical raising of this mushroom at present requires something from the lotus-seed husks, and because the husks are rather scarce, therefore the next problem seems to be to find some cheap chemical substitute for them, or some way of killing mycelia naturally present in the horse manure so that the use of the autoclave can be avoided. Also the raising of spawn needs to be simplified for the ordinary grower of mushrooms. These two points are the subjects of further investigation.

I wish to thank heartily Dr. A. G. Ellis, who with his help and stimulation has made this little work what it is.