THE CULTIVATION OF SHIITAKE MUSHROOMS IN PAPUA NEW GUINEA

By F. Arentz, Forest Pathologist, Forest Research Station, Bulolo

INTRODUCTION

The Shiitake mushroom occurs naturally in South East Asia, Papua New Guinea and Australia. It is a favourite food in Asia and North America. It has been cultivated in Japan for many centuries and is now also cultivated in China, Taiwan, Korea, Thailand, India and Bhutan. There is a large world trade in dried Shiitake mushrooms, and demand is starting to exceed supply. So there would be a ready market for any Shiitake mushrooms grown commercially in Papua New Guinea. Mushrooms also have potential as a source of high quality protein for people in Papua New Guinea. Fresh mushrooms contain 3-4% protein and the dried product contains 30-50% protein. In addition Shiitake mushrooms are reported to have medicinal value.

This article outlines the work carried out in Papua New Guinea on mushroom cultivation. Also, the technique for Shiitake mushroom cultivation is set out.

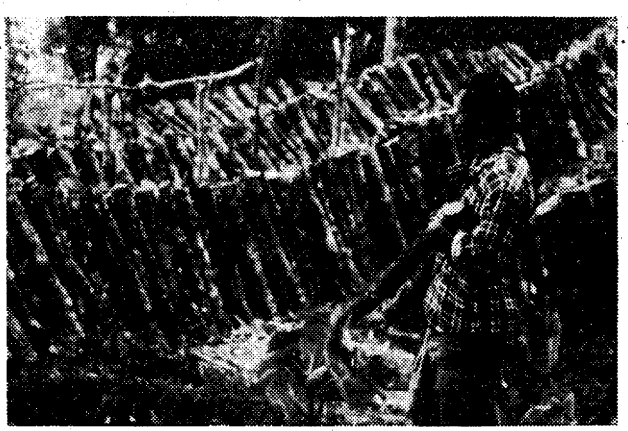
THE SHIITAKE MUSHROOM IN PAPUA NEW GUINEA

In Papua New Guinea, trials started in 1974 to see whether Shiitake mushrooms could be cultivated under our conditions. The first trial was set up at Bulolo, in the Morobe Province. The results showed that the daily temperatures were too hot to produce a high quality mushroom. Other trials were then set up in the Southern Highlands Province where conditions are more suitable for the cultivation of Shiitake mushrooms.

In 1979 NPEP funding was obtained from the National Government to build a laboratory and house at Mendi. In addition a full-time Mushroom Project Officer was recruited and, after an initial training period at Bulolo, he was placed at Mendi. A small mushroom production area was established outside Mendi, but this was later destroyed in tribal fighting. Before the production area was destroyed, dried Shiitake mushrooms harvested there were being sold in Port Moresby for K10/kilo.

Through lack of funds no further work has been done in Papua New Guinea on setting up Shiitake mushroom growing on a commercial basis.

In 1983 an FAO mushroom expert came to Papua New Guinea to examine the possibilities of growing Shiitake mushrooms commercially in Papua New Guinea. His report was very optimistic. He suggested that Shiitake mushroom cultivation was ideally suited for the more economically depressed areas of the Highlands of Papua New Guinea. On the basis of this report the Southern Highlands Department of Forests has now submitted a NPEP request for funds for 1986.



Wayong Nangi, Mushroom Project Officer, in the raising yard at Kolunda, near Mendi

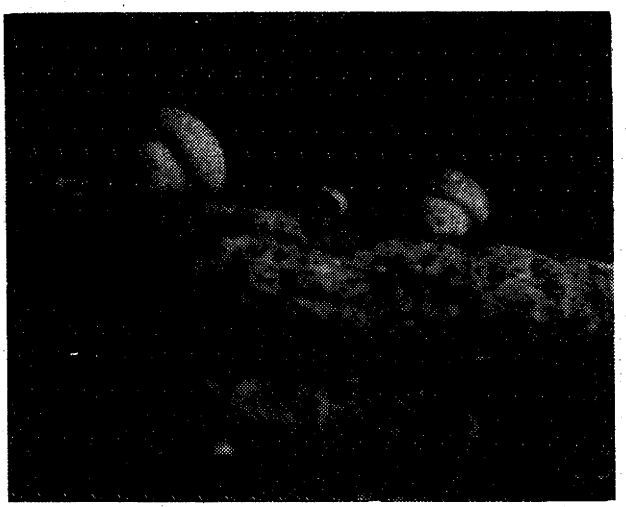
Research work being carried out now is aimed at comparing the productivity of different strains of Shiitake mushroom grown under different climatic conditions.

It is expected that the commercial production of Shiitake mushrooms in Papua New Guinea will involve both the Government and the villager. The Government will be responsible for:

- the production and distribution of inoculum;
- buying the mushrooms from the grower;
- the drying and marketing of the product.

The villager will be responsible for:

- cutting the logs on which Shiitake mushrooms are grown;
- the inoculation of the logs;
- maintenance of the logs;
- harvesting the Shiitake mushrooms.



Shiitake mushrooms just beginning to fruit on an oak log

THE SHIITAKE MUSHROOM

The Shiitake mushroom has a light brown or reddish brown cap, with a white to pale yellow margin, and a reddish brown centre. The margin of the cap sometimes has small flattened scaly marks. The gills (on the under-side of the mushroom) are white. Mushrooms range from about 40 to 120 mm in diameter. The flesh of the cap and stipe (special name for the stem of a fungus) is white, with a slightly acid taste and a faint but distinct garlic-like taste and smell. Although Shiitake mushrooms can be eaten fresh, they taste better if they have been dried.

TREES SUITABLE FOR USE AS BED LOGS

The Shiitake mushroom grows on the dead wood of oak and beech trees. These trees are members of the family Fagaceae which includes the genera *Nothofagus* (beech), *Lithocarpus* and *Castanopsis* (oak). All of these trees are common in the forests of the Highlands of Papua New Guinea. The bark of these species contains chemicals which cause the Shiitake mushrooms to grow, so that only trees of the family Fagaceae are suitable as bed logs. It is important that trees to be used for growing Shiitake mushrooms are handled carefully so as to cause as little bruising and tearing of the bark as possible. If the bark is removed from the log, the Shiitake mushrooms will not grow.

Trees of oak or beech are cut up into log lengths of 1.0 to1.5 metres. At any site all logs should be the same length. Because the logs have to be moved during the growing cycle only small logs of less than 20 cm in diameter are used. Both the trunk of the tree and branches greater than 5 cm diameter can be used. Logs which contain a lot of decayed wood, or logs which have large branch stubs are not suitable. Cut the logs with a saw or chainsaw. This will leave smoother ends on the logs, and reduces the possibility of the logs being decayed by other fungi.

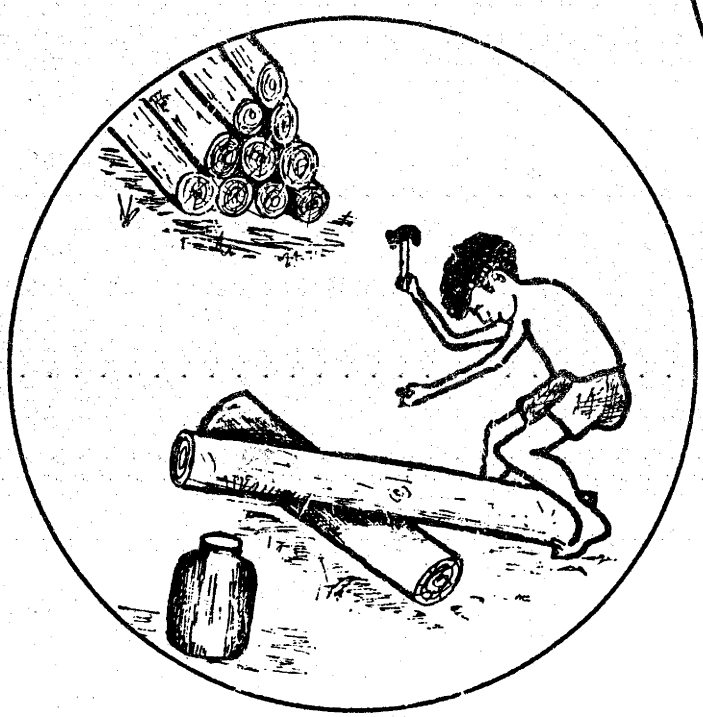
INOCULATING LOGS

The logs are assembled at the growing site and are inoculated 2 to 3 weeks after cutting. By 'inoculate' we mean that the Shiitake fungus is implanted into the logs.

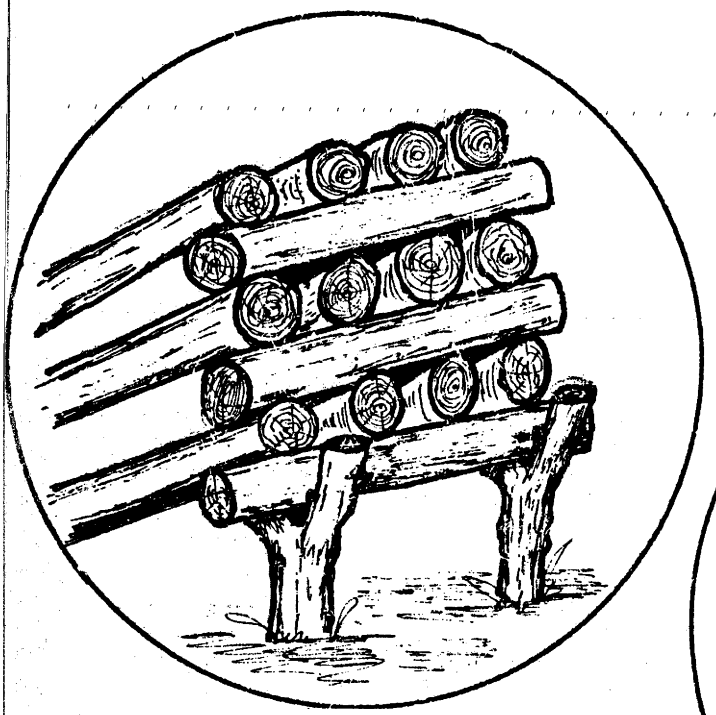
Holes 13 mm in diameter and 20 mm deep are drilled into the logs using an electric

1. *Felling of trees*

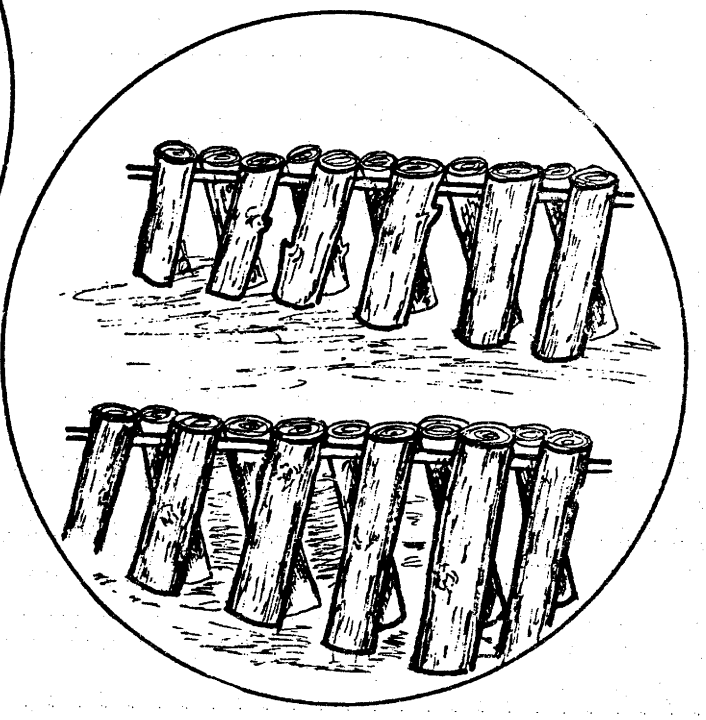
2. *Cutting of logs into lengths*



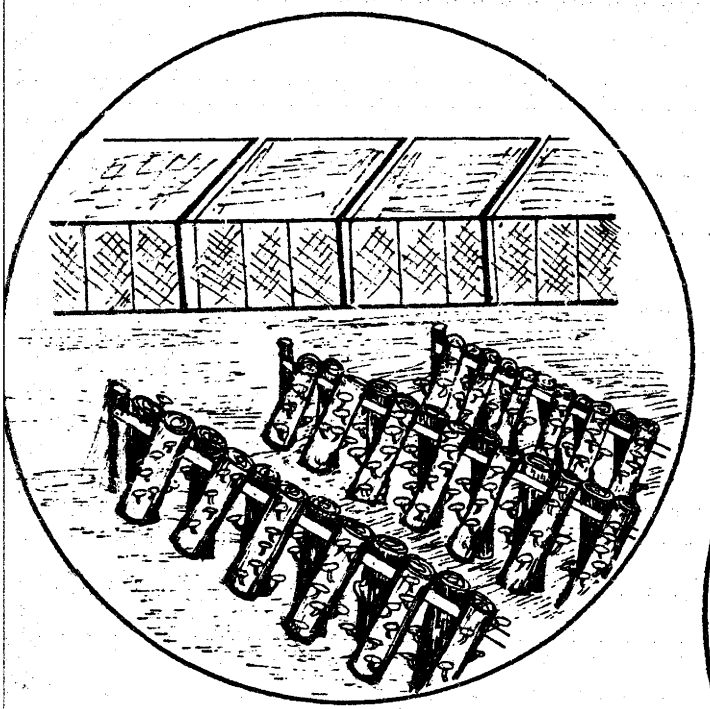
3. *Inoculating logs with pellets of wood containing the fungus*



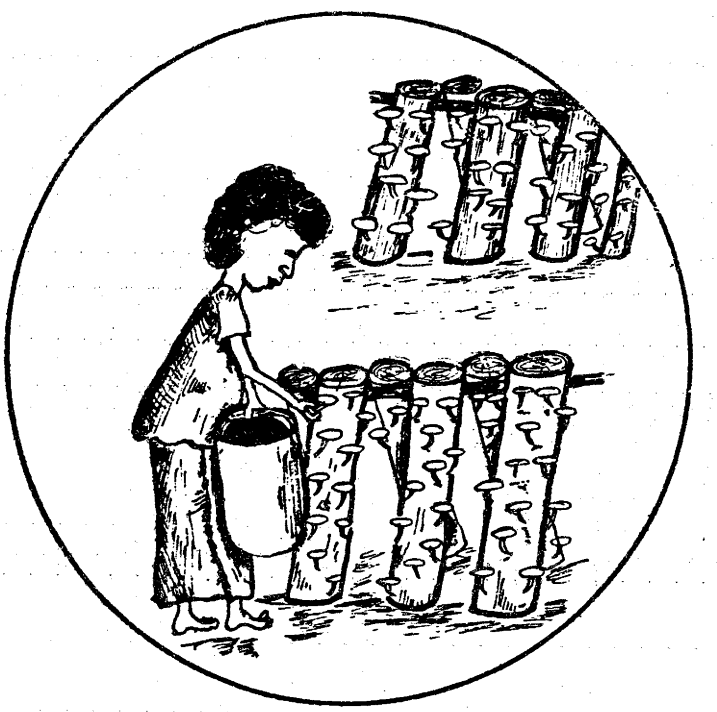
4. *Laying of 'bed logs'.*



5. *Position of logs in raising yards*



6. *Fruiting of Shiitake mushrooms*



7. *Harvesting of Shiitake mushrooms*

drill. Electricitv for the drill may come from the main supply or a portable generator. The first row of holes is drilled with the holes about 20 cm apart along the log, starting 5 cm from one end of the log. The next row of holes is made 5 to 7 cm further around the circumference, with the holes midway between the holes in the first row. If a 1 metre log is used then there will be 4 holes in the first row, and 3 in the second. This sequence is followed right around the log. It is important that no dirt or litter gets into the drilled holes.

The log is now ready for inoculating. Shiitake fungus inoculum, or spawn, is grown in glass or plastic bottles full of small rod-shaped pieces of oak wood about 13 mm diameter and 15 to 20 mm long, and a small amount of sawdust, wheat-bran, and chemicals to make the fungus grow faster. The rod-shaped pieces of inoculum are taken from the bottle and gently hammered into the drilled holes until the top of the plug is level with the bark of the log. The plug is then coated with a layer of vaseline or petroleum jelly.

Care should be taken to ensure that the logs are kept as clean as possible. If the logs are muddy there is a high risk that other fungi will grow in them. It is also important that the person inoculating the logs has clean hands and a clean hammer. Weed fungi (that is, species of fungi other than Shiitake mushrooms) are the biggest cause of the failure of Shiitake mushrooms to grow well.

LAYING

After inoculation the 'bed logs' are placed in a laying yard in an area where the Shiitake fungus will be able to grow quickly through the wood. It is important that this place should be shaded, with gentle air movement, and be well drained. Direct sunshine is unsatisfactory as the fungus stops growing when the temperature is above 30°C. The amount of shade should be 50 to 70%. The edge of the forest is more suitable than an undisturbed forest. During periods of dry weather it may be necessary to lightly water the logs.

The logs are stacked in their laying sites with single logs laid crosswise to increase ventilation, as shown in drawing number 4 on page 63. The logs remain in this position until the sapwood has been fully colonised by the Shiitake fungus. The logs should be turned around once a month to prevent uneven drying and splitting of the bark.

RAISING AND CROPPING

When the sapwood is completely colonised, the logs are suitable for cropping. This may take from 4-10 months depending on the climate, the type of wood and the strain of Shiitake mushroom used. The progress of colonisation of the sapwood can be followed from changes in the bark colour. The bark becomes darker as the Shiitake mushroom grows through the sapwood underneath. When ready, the logs are transferred to a cooler, moister, shadier site as the best temperature for mushroom formation is lower than that for vegetative growth, and the moisture content of the wood needs to be higher than required for vegetative growth. In the raising yard the logs are in an almost upright position against a single support, as shown in drawing number 5 on page 63.

Oak logs in the raising yard at Kolunda, near Mendi

Under ordinary weather conditions 2 to 5 crops of Shiitake mushrooms a year will

develop once fruiting has begun. Logs will last for 3 to 5 years. Logs should be harvested daily when fruiting takes place. The mushrooms should be picked, including the stem, when the veil (i.e. the 'skin' around the under-side of the mushrooms) has just broken and while the mushrooms are still convex (rounded).

DRYING

Shiitake mushrooms are best dried in hot air driers, starting at 30°C, and increasing the temperature by 1-2°C per hour until a temperature of 50°C is reached. Mushrooms collected in wet weather need to be dried more slowly than those collected in dry weather. Usually drying takes 12-13 hours. Finally they are heated at 60°C for 1 hour to enhance the flavour and appearance.

In Papua New Guinea the relatively high temperatures cause the Shiitake mushrooms to develop quickly and to have relatively thin caps. This means that we will only be able to produce dried mushrooms of quality lower than those produced in countries with cold climates.

FURTHER INFORMATION

Further information on Shiitake mushroom growing can be obtained from:

The Senior Forest Pathologist,
Forest Research Station,
P.O. Box 134,
Bulolo,
Morobe Province