Proc. 11th New Zealand Geothermal Workshop 1989

USE OF GEOTHERMAL FLUID FOR CULTIVATION OF SHIITAKE MUSHROOMS

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Abstract

Shiitake (Lentinus edodes) is one of the edible fungi grown in the Fujian province, China. The mushrooms were able to be grown all year round in soils which were heated by geothermal fluids in greenhouses. The time of cultivation was less than two months; the mushrooms take eight to eleven months to mature. Three crops were gathered in two and a half months. The yield was 13.5-kg per square meter and was 22.6% more than that produced in a natural climate. The geothermally-heatedgreenhousesproduce a better quality, cheaper product

Introduction

Shiitake (Lentinus edodes) requires a range of temperatures for growth. The mycelium grows at 24-26°C while the main growth is from 8-15°C. The lower temperature is required to stimulate mature growth. If the temperature was constant at about 25°C throughout the growth cycle, or if it was highly variable, the Shiitake mushroom would not grow. In winter, mycelium growth and nutrient accumulation is slow, because the air temperature is low. So temperature is an important factor for Shiitake mycelium and main plant growth. If the temperature can be varied, the mushroom growth cycle can be reproduced. Geothermal fluids can be used to control indoor temperature for the production of high yielding, better quality mycelium growth and plant development. In this artificially controlled environment, the period of cultivation of the Shiitake mushroom is shortened.

Materials and methods

Geothermal conservatory condition:

The greenhouses are built with steel and concrete. They are 24 meters square and 3.5 meters high. There are double glass windows for maintaining temperatures. Steel tubes and smng film radiators were installed in the glasshouses. Electromagnetic valves control the flow of hot water to the glasshouses.

Test organism: Shiitake (Lentinus edodes) strain.

Culture:

Shiitake spawn mushrooms were germinated on sawdust. After the mycelium grew in the sawdust, the material was pressed into bricks where dimensions are a square chi (1 chi^2 = 1.196 ft^2) by 5 centimeters high and weigh 1.8 kg.

Mature mushroom growth:

The bricks were divided into six groups; there were five trials per group:

(a) Heating group:

The brick spawns were put into glasshouses and heated to 22°C for 3 days; they were then moved to growing rooms and heated to 8-12°C until maturity.

(b) Heating + ΔT group:

After the Shiitake bricks grew for 3 days at 22°C, they were transferred from the heating room to the maturing room which was at 22°C during the day and 8-12°C at night. Here, the mushrooms grew at temperatures above 10°C (i.e. the difference between day and night temperature) until maturity.

(c) Heating + soaking group:

After the bricks were heated for 3 days, they were soaked in cold water (8°C) for 12 hours, and put in a growing room at 8-12°C until maturity.

Table 1. The yields of the test groups

Groups	first trial (g/chi^2)	second trial (g/chi^2)	third mal (g/chi^2)	total (g/chi^2)	rate of increase	bio-efficiency
(a)	519	597	233	1349	10.3	74.9
(b)	599	621	210	1430	16.9	79.4
(c)	568	574	321	1463	19.6	81.3
(d)	608	651	241	1500	22.6	83.3
(e)	549	457	217	1223		67.9

The yield of each group is an average of five repeated trials.

(d) Heating + soaking + ΔT group:

After heating for 3 days, the bricks were immersed in cold water for 12 hours; they were then moved to a maturing room.

(e) Control:

In this group, the Shiitake bricks produced mushrooms at room temperature.

Test results

Comparison of the yields for each group

This experiment showed that the yield of each test group was higher than the control group; the yields of groups a, b and c were 10.3%, 16.9% and 19.6% respectively higher than the control group. Group d produced the highest yield of 22.6% (Table 1).

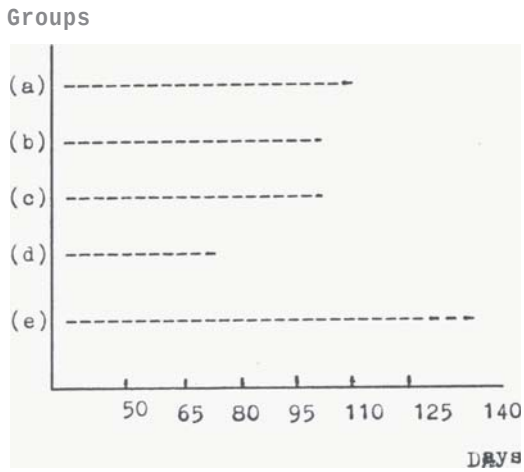

Fig. 1. Yield time for the set quota of 1.5 kg/chi

Comparison of int(rcropping with test groups:

In order to compare the yield with the maturing period, the number of maturing days were added after the yield of each group reached 1.5 kg per chi2 (see Figure 1).

The results indicate that the cultivation period of the second and third flushing for each of the four test groups was shorter than the control group. The time to reach a set quota (1.5 kg/chi2) was 75 days for test group (d), 115 days for p u p (a) and 105 days for groups (b) and (c). The control group took 135 days to reach the set quota. These results show that temperature affects the harvest period of the Shiitake mushroom.

Conclusion and discussion

The test results showed that after the first time the mushrooms were picked, the Shiitake mycelium required a rest period. Heating was required during winter so that the Shiitake mycelium would grow better and the residue would decompose more quickly in order to provide a substrate for the next growth. After heating to 22°C, the substrate was then cooled to 8-12°C by soaking with cold water. The Shiitake mushrooms developed from vegetative growth stage to the reproductive stage again. A wide variation in day and night temperatures demonstrated that the mycelium were stimulated to grow into mature mushrooms. In the group d experiment where the soil was heated and soaked and subjected to fluctuating temperatures from day-time to night-time, the yields of the second and third growths were the highest. The time taken from pressing the Shiitake bricks to gathering mushrooms was two and a half months. The control group took four and a half months to produce the set quota of 1.5 kg/chi2. The use of geothermal fluids in greenhouses shortens the cultivation period to two months.

References

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