Effect of low temperature on fruiting body formation in *Pleurotus sajor-caju*

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Pleurotus sajor-caju (Fr.) Singer, was grown in three differnet temperature ranges viz., 17.0 to 25.0°C, 20.5 to 27,0°C, and 23.5 to 28.0°C using two substrates - paddy straw and paddy straw + arecanut leaf sheath (1:1 W/W). At the end of spawn run and subsequently at the end of each harvest air temperature was suddenly reduced by 2 - 3°C and maintained at this temperature for two days and again brought back to the original temperature. The sudden fall in temperature induced budding in the mushroom bags and peak harvest was obtained within 3-4 days from the day of low temperature treatment. Peak harvest was also achieved in mushroom bags of different age almost on the same day when they were subjected to low temperature treatment.

The ultimate goal of commercial mushroom culture is obtaining high as well as steady yield of mushrooms. All key factors for fruit body development and yield parameter in *Pleurotus* productoin are concentrated on the ecological factors: climate, microclimate and air conditioning (Zadrazil, 1978). The ideal temperature for spawn spread of *Pleurotus sajor-caju* (Fr.) Singer has been reported as 25-35°C and for fruiting 20-30°C (Chang & Miles, 1986). There is no report on the effect of sudden fluctuations in temperature on bud initiation and yileld of fruiting body of *Pleurotus*. Hence, preliminary investigations were carried out on the effect of low temperature on bud initiation and fruiting body formation.

MATERIALS AND METHODS

Effect of low temperature on cropping of *Pleurotus sajor-caju* grown in two substrates under three different temperature ranges:

P. sajor-caju was grown in two substrates viz., paddy straw + areca (*Areca catechu* L.) sheath (1:1 W/W) and paddy straw alone. The paddy straw was choped into pieces of 5-6 cm size and leaf sheath to a size of 3 cm x 6 cm. Then the paddy straw was soaked in water for 10 minutes and areca sheath 3 h. The excess water was drained off and the substrates were pasteurised in a steam chamber at 15 lb. pressure for 25 min. After steaming the substrates were spread, cooled and then given a thorough spray of carbendazim and formalin so as to achieve a concentration of 75 ppm and 500 ppm in the substrate respectively. The final moisture in the substrate was about 70 per cent. The substrates thus prepared were filled in high density high molecular polythene bags of 55 cm x 40cm size (100 guage) @ 3.75 kg per bag. Multilayered spawning technique was fqllowed using 2-3 per cent spawn per bag. After filling, the mouth of the bags were tied with rubber and incubated in special A.C. rooms with artificial light at three distinct temperature ranges. The maximum and minimum temperatures at the thre ranges were 19.0 $\pm$ 2°C & 23.0 $\pm$ 2°C, 22.5 $\pm$ 2.°C & 25.0 $\pm$ 2°C and 25.0 $\pm$ 2°C & 26.0 $\pm$ 2°C. At the end of the spawn run period the bags were kept open and watered daily once. Six days after opening, temperature was suddenly brought down by 2-3°C by running A.C. at a higher cooling capacity and maintained for two days. Thus the corresponding temperature ranges during this two days period were: 16.0$\pm$2°C to 20.5$\pm$1.5°C, 20.5$\pm$1.5°C to 22.5$\pm$1.5°C and 23.5$\pm$1.5°C to 25.5$\pm$1°C.

The first low temperature treatment was given during 24-25 days after spawning. Subsequent treatments were given 1-2 days after each harvest. Thus the subsequent treatments were given during 33-34, 41-42, 49-50, 56-57 and 64-65 days after spawning. The number of days taken for bud appearance and flushing were recorded in each bag. The weight of fresh fruiting bodies of each flush was also recorded. The maximum and minimum temperature inside the cropping rooms were recorded daily.

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Effect of low temperature on cropping of *P.sajor-caju* bags of different age:

This study was made as an additional observation during the earlier experiment. For this, paddy straw alone was used as a substrate to grow *P.sajor-caju*. the method of cultivation was same as that of the preveious experiment. Bags were filled in four batches with 4-5 days interval. The number of bagss were 42, 36, 84 and 36 in batch I, II, III & IV respectively. Bags of batch No. I and II were kept at a temperature range of 22.5±2°C to 25±2°C and batch No. III and IV were kept at a temperature range of 25±2°C to 26±2°C. These bags also received low temperature treatment whenever the temperature was reduced during the earlier experiment. As and when the flushes appeared the mushrooms were harvested batch-wise and weighed. Temperature and yield data were recorded.

RESULTS

Effect of low temperature on bud appearance of *P.sajor-caju*

The details of bud appearance of *P.sajor-caju* grown in paddy straw + areca leaf sheath and paddy straw alone are given in Table 1. Buds started appearing 2-3 days after each treatment irrespective of the three temperature ranges and the two substrates used. Though the low temperature induced budding, it was not uniform in all the bags. But these bags also produced buds in the subsequent low temperature treatment. The fruiting bodies could be harvested 2 days after bud emergence. In case of paddy straw + areca leaf sheath the average number of flushes per bag was 2.08 and in paddy straw alone it was 2.25 during 70 days cropping period. The sudden fall in temperature induced budding in the mushroom bags and peak harvest was obtained within 3-4 days from the last day of treatment. Paddy straw bags maintained at a temperature range of 19.0±2°C - 23±2°C gave the highest yield with a biological efficiency of 53.3 per cent followed by paddy straw + areca leaf sheath at 22.5±2 to 25.0±2°C reaching a biological efficiency of 42.7 per cent (Table 2). However, the cropping in paddy straw was over in 61 days compared to 69 days in paddy straw + areca leaf sheath. The salient finding was the induction of budding by low temperature treatment and thus the synchronization of peak harvest irrespective of the substrate and the room temperature.

Effect of low temperature on flushing pattern of *P.sajor-caju* bags of four different age.

Irrespective of age of bags and room temperature all the batches exhibited peak harvest 5-7 days after low temperature treatment and flushing pattern was uniform (Fig.1). However, the first flush was delayed in all the four batches. The first flush appeared in all the four batches on the same day irrespective of the age. Though the first flush appeared simultaneously, the bags filled earlier stopped producing fruiting bodies earlier. the first batch which received the treatment on 14th day gave the minimum average yield of 167 g per bag, whereas the average yield of fresh fruiting bodies per bag was 226, 280 and 275 g in II, III and IV batches respectively.

DISCUSSION

'Cold shock' to the substratum has been recommended to improve induction of the first flush of *Pleurotus ostreatus* (Vessey & Toth, 1970; Stanek & Rysava, 1971). The present study revealed that low temperature treatment to the substrates during *Pleurotus sajor-caju* culture induced budding in mushroom bags. It also helped in synchronizing the harvest in the mushroom bags of different ages. But when the treatment was given during the spawn run period the first flush was delayed. When cold shock treatments were given on 1st, 2nd and 8th day after casing in *A. bisporus*, the initiation of buds was delayed (Flegg, 1972). Flegg (1980) has also reported the possibility of temperature induced synchronization of sporophore production in *A. bisporus*. One of the authors (Moorthy, V.K. - unpublished) found that spraying of chilled water (10-15°C) also could induce the sprophore formation in *P.sajor-caju*. In general, it has been observed that the mushroom bags maintained at identical conditions did not produce flushes uniformly in all the bags. Thus one of the major problems observed in *Pleurotus* cultivation is the variation in the time of flushing as well as the number of flushes and total yield. Such variation in flushing was also observed in the present study, inspite of low temperature treatments. The results of the present studies on the effect of low temperature on *P.sajor-caju* culture call for

Table 1. Effect of low temperature on bud appearance of *P.sajor-caju* grown in two substrates at three different temperature ranges

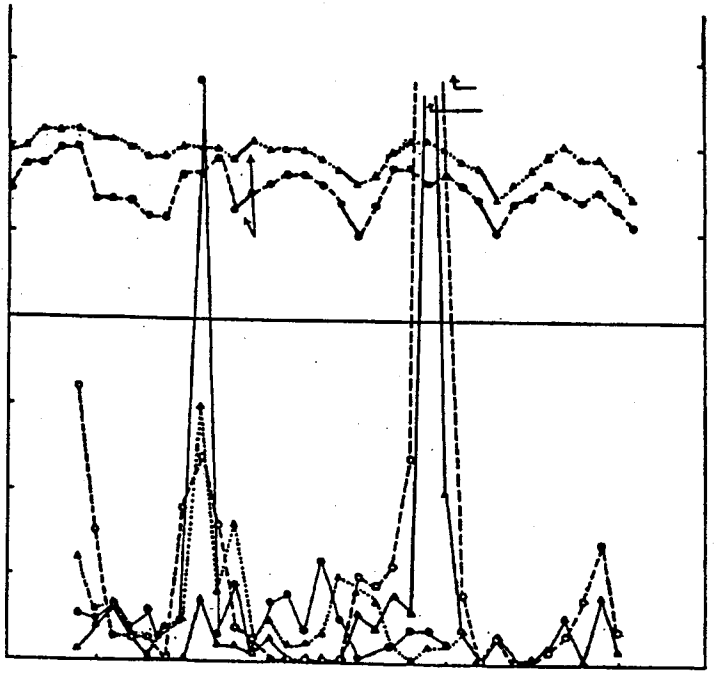
Normal Temperature	Low Temperature	Day of low temperature treatment	Days of bud appearance	
			Paddy straw + Areca leaf sheath	Paddy straw alone
19.0±2 - 23.0±2°C	16.0±2 - 20.5±1.5°C	24, 25	27	27 - 28
		33, 34	38	
		41, 42		45
		49, 50	51	
		56, 57	59	
		64, 65	67	
22.5±2 - 25.0±2°C	20.5±1.5 - 22.5±1.5°C	24, 25	27 - 29	27
		33, 34		38
		41, 42	49	45
		49, 50		54
		56, 57		
		64, 65		
25.0±2°C - 26,0±2°C	23.5±1.5 - 25.5±1°C	24, 25		
		33, 34	36	36 - 39
		41, 42	45 - 50	45 - 47
		49, 50	52 - 53	51
		56, 57		
		64, 67		

No. of bags in each temperature range : 4

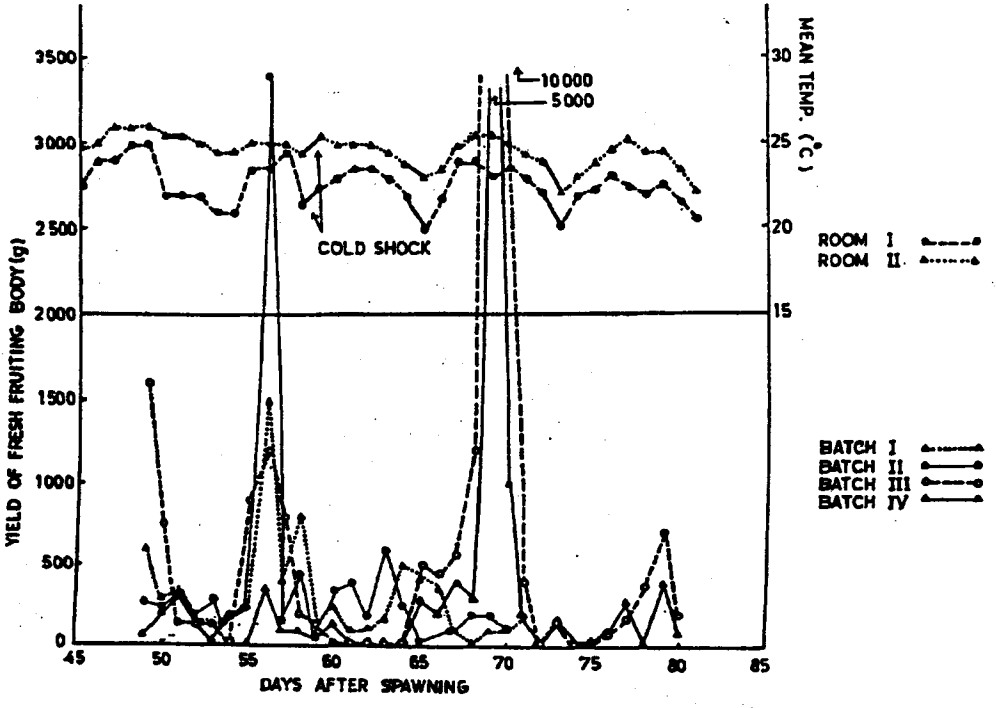
Table 2. Effect of low temperature on yield of fresh fruiting bodies of *P.sajor-caju* grown in two substrate at three different temperature ranges

Normal temperature	Low temperature	Substrates	*Average yield(g)	Biological efficiency(%)
19.0±2 - 23±2°C	16.0±2 - 20.5±1.5	Paddy straw + Areca leaf sheath	325	34.6
		Paddy straw alone	500	53.3
22.5±2 - 25.0±2°C	20.5±1.5 - 22.5±1.5°C	Paddy straw + Areca leaf sheath	400	42.7
		Paddy straw alone	350	37.3
25.0±2 - 26.0±2°C	23.5±1.5 - 25.0±1°C	Paddy straw + Areca leaf sheath	325	34.6
		Paddy straw alone	269	28.7

* Average of 4 bags
Dry weight of the substrate per bag 937.5 g.



EFFECT OF COLD SHOCK ON FLUSHING PATTERN OF P. sajor-caju BAGS OF FOUR DIFFERENT AGE AT TWO DIFFERENT TEMPERATURE RANGES



detailed investigations on similar aspects to induce bud initiation and early harvest of mushrooms with high yield.

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