As far as the environmental factors are concerned, temperature seems to play a vital role in the growth of the mushrooms. Styer (1928) found that the maximum yield of mycelial growth could be obtained at 30°C with Agaricus campestris. In the early period, it was generalised that mushrooms are restricted to 25-28°C for mycelial yield and fruit-body formation. This was further supported by the findings of Humfeld and Sugihara (1952) who reported that A. campestris had an optimum temperature of 25°C for mycelial growth. But Jennison et al (1955) were of the view that this assumption can be held valid for only a few cases, though Merulius americanus, one of their test organisms grew well at 25°C. Fries (1956) reported that for the mycelial growth of Coprinus fimetarius 35-40°C was the most suitable. A study of the temperature effect on the growth of Volvariella dilligia by Rangaswami (1956) reveals that the vegetative growth was promoted at 35°C. The effect of temperature on mycelial growth had been reviewed by Cochrane (1958) and Deverall (1965). Litchfield et al (1963) reported that three species of Morchella had an optimum temperature of 25°C for mycelial growth. Volz (1969) concluded that the incubation temperatures of the Agaricales
tested were identical for both mycelial growth and fruit-body formation. Chang and Chu (1969) recorded 35°C as optimum temperature for the mycelial growth of *Volvariella volvacea*. Ward (1971) concluded that the transference of a low temperature basidiomycete to high temperature might result in the cease of the mycelial growth. Sattler (1975) investigated the temperature dependent growth of the different mushrooms by varying the nitrogen sources and their concentrations. Jandaik and Kapoor (1975) opined that 25, 35 and 40°C were the optimal temperatures for the best mycelial yield of *Pleurotus sajor-caju*, *P. pistillaris* and *P. inquinans* respectively. The effect of temperature and incubation period on the protein content of *Pleurotus ostreatus* and *Coprinus aratus* was studied by Jauhri et al (1978). The mycelial production of *Lyophyllum decastes* was studied by Nagaso and Yoshikawa (1978) and found that 25°C was the optimum for the best mycelial production. For *Lentinus edodes*, the maximum increase in biomass was achieved at 25°C, although intensive growth was found at 35°C (Brodziak 1980). Hong et al (1981) found that the optimum temperatures were 25-30°C and 25°C for *Agaricus bitorquis* and *Pleurotus ostreatus* respectively. According to Kosaric and Nabuo (1981) 25-28°C temperature was the most appropriate for maximum vegetative growth of most of the tested mushrooms. The best mycelial growth of *Flammulina velutipes* was obtained at a temperature range of
25-28°C (Gavrilova and Garibova 1982). For Pleurotus membranaceus and Saccorhyton connunctum, Sarwal et al (1982) observed that 24°C and 14 days incubation period and 28°C and 10 days incubation period respectively were optimal for mycelial production. Fermor (1982) reported that Agaricus macrosorum has most rapid growth at 24-27°C though maximum temperature for growth was 30°C. Martin (1983) opined that at 24°C, Agaricus campestris had maximum mycelial yield. The temperature range of 25-35°C was the optimum for mycelial yield of Agaricus trisulphuratus, Rhodocybe subgilia and Agrocybe praecox (Rao 1983).

An attempt as such has been made to determine the optimal temperature for the best biomass production of the test-fungus Tricholoma crassum (Berk) Sacc. under submerged conditions.

MATERIALS AND METHODS

Test-organism:

The culture of the test-organism T. crassum (Berk) Sacc. was maintained by regular subculturing in PDA slants (peeled potato (decoction), 400g; glucose, 25g; agar, 20g; and distilled water to 1000 ml). The glucose-casein hydrolysate basal medium of Lilly and Barnett (1951) was modified
and used as the basal synthetic liquid medium.

**Culture vessels:**

Erlenmeyer flasks (250 ml) cleaned with sulphuric acid and potassium dichromate solution, carefully washed with tap water and distilled water, were used in the experiment.

**Growth medium:**

The modified glucose-casein hydrolysate basal medium of Lilly and Barnett (1961) was used here. The medium was prepared and distributed as 50 ml per flask in the culture vessels, tightly plugged with non-absorbent cotton wool and sterilized at 15 p.s.i for 15 minutes.

**Preparation of inoculum:**

A small portion of the actively growing mycelium from agar slant of the test fungus was aseptically transferred to a sterile 250 ml Erlenmeyer flask containing 50 ml of the basal medium and was incubated at (30°C ± 0.5°C) room temperature on a shaking incubator (120 r.p.m) for 7 days in complete darkness. After the incubation period, the mycelial mass was aseptically fragmented into small pieces with the help of a Waring blender. The fragmented mycelium was washed several times with distilled water to remove any trace of the medium and then suspended in a phosphate buffer medium (pH 5.5) for 24 hours to overcome the shock encountered
during blending. One ml of the mycelial suspension was used as the inoculum.

**Inoculation and incubation:**

Each of the flask was inoculated with 1.0 ml of the cell suspension of the mycelium of the test fungus and incubated in a shaking incubator (at 120 r.p.m) in complete darkness at room temperature (30°C), 20, 25, 35 and 40°C respectively, for 14 days. Sufficient number of flasks were incubated to yield 3 replicates of each set.

**Harvesting and measurement of growth:**

After the incubation period, the mycelia were harvested by filtration through a tarred filter paper (Whatman No. 1) using a Buchner funnel. The filtered mycelia were washed repeatedly with distilled water to remove any trace of the medium and dried at 60°C in an oven for 24 hours. After drying, the mycelia were kept in a vacuum desiccator and weighed in a chemical balance (Sartorius). The dry weight of the mycelia thus obtained was taken as an index of growth.

**RESULTS AND DISCUSSION**

The experimental data are given in Table 1 and Text-fig. 1.
Table 1: Data (Mean)* showing the effect of different temperatures on the growth (g/l) of the mycelia of *Trichoderma crassum* (Berk.) Sacc. under submerged conditions

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>Dry weight of mycelium (g/l)</th>
<th>S.E.</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>NG</td>
<td>-</td>
</tr>
<tr>
<td>25</td>
<td>$0.900 \pm 0.021$</td>
<td>$\pm 0.014$</td>
</tr>
<tr>
<td>30</td>
<td>$1.080 \pm 0.028$</td>
<td>$\pm 0.018$</td>
</tr>
<tr>
<td>35</td>
<td>$0.720 \pm 0.024$</td>
<td>$\pm 0.016$</td>
</tr>
<tr>
<td>40</td>
<td>NG</td>
<td>-</td>
</tr>
</tbody>
</table>

* Values are averages of 3 replicates. NG = Negligible growth.
Text-fig. 1: Graph showing the effect of different temperatures on the growth (g/l) of the mycelia of *T. crassum* (Berk.) Sacc. under submerged conditions.
NEGLIGIBLE GROWTH

TEMPERATURE (°C)

DRY WEIGHT OF MYCELium (g/l)

0 0.2 0.4 0.6 0.8 1.0 1.2

20 25 30 35 40

TEMPERATURE (°C)

Text fig 1
Results presented in Table 1 reveal that the test-organism prefers to grow at 30°C and the mycelial yields were followed at 25°C, 35°C. Growth was completely retarded at 40°C and at 20°C. (No measurable growth was recorded in both cases).

So from the above results it can be concluded that the test-organism prefers 30°C for growth, as in case of other temperate mushrooms. At lower and higher temperatures there was no growth. Since this mushroom prefers a temperature range of 25-35°C for growth, the transference of this test fungus to a higher temperature i.e. at 40°C might have ceased the growth, a fact which is substantiating the conclusion of Ward (1971). However, these results, contradict the results of Nag Chowdhuri (1977) who indicated that another species of Tricholoma, T. gigantum, yielded best mycelial growth as well as protein at 25°C. The results coincide with the findings of Rao (1983) who indicated that the optimum temperature for the fungi tested ranged from 25-35°C.

REFERENCES


