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RESEARCH ARTICLE

Influence of *Pseudomonas putida* on the yield of *Agaricus bisporus* (Lange) Imbach

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ABSTRACT

In cultivation of button mushroom [*Agaricus bisporus* (Lange) Imbach], casing layer that is nutritionally deficient to compost is believed to trigger the fruit body formation and this is conducted by the bacterial community residing in casing layer. Therefore, relationship between different concentrations (1 x 10^4, 1 x 10^6, 1 x 10^8, 1 x 10^{10}, 1 x 10^{12}) of bacterial inoculants (*Pseudomonas putida*) and yield of *Agaricus bisporus* were determined. Available data showed a significant difference in yield in respect to concentration of bacterial inoculant added. In addition, concentration 1x 10^8cfu/ml was found to be high yielding concentration, which took minimum case run period together with higher biological efficiency compared to other.

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INTRODUCTION

Mushroom science is a discipline concerned with the principles and practices of mushroom cultivation. *Agaricus bisporus* is the most cultivated species of edible mushroom and it is the most popular cultivar among the artificially grown fungi of the world that contributes about 31.8% to the global mushroom cultivation and 85% of the total produce in india(Angrish *et al.*, 2003). In commercial mushroom cultivation, it is necessary to cover the vegetative growth of *Agaricus bisporus*, which takes place in the compost (consisting of composted straw and other plant derived materials), with a layer of soil and FYM or various combination of similar materials. Among these, use of farm yard manure (FYM) as a casing medium for mushroom cultivation has been vogue in Indian subcontinent because of its easy availability and non-availability of peat moss generally used for casing in Europe and USA. The application of these materials, termed the casing layer, is essential for initiation of Basidiomata (Eger, 1972; Flegg *et al.*, 1985). Bacteria present in casing layer considerably influence the growth and morphogenesis of *Agaricus bisporus* production. It supports beneficial microbial populations that release growth stimulating substances which are reportedly involved in stimulating the initiation of pinheads. Several reports are available on the beneficial effects of casing soil microbes, especially *Pseudomonas putida* and *Alcalgenes faccalis*, on *Agaricus bisporus* (Rainey Cole, 1990).

This work describes the role of population density of *Pseudomonas putida* in the production of *Agaricus bisporus*.

MATERIAL AND METHODS

Cultivation of *Agaricus bisporus* :

Long method of composting (LMC) was adopted using the method proposed by Mantel and Agarwal (1972) using newly harvested wheat straw. The formulation given by G. B. Pant University of Agriculture and Technology, Pantnagar, Uttrakhand, India (Singh and Mishra, 2006) was modified depending on the availability of ingredients locally.

Spawn was procured from Department of Plant Pathology, Chandra Shekher Azad University of Agriculture and Technology, Kanpur (U.P). Having completed the composting process, thorough spawning was done @75g/10 kg compost. The spawned compost weight 7kg was filled in the bags at Mushroom Crop Room, Department of Plant Protection, Sam Higginbotom Institute of Agriculture, Technology & Sciences, Allahabad. Room temperature, condition of spawn run of each bag recorded separately.

A mixture of FYM and garden soil in the proportion of 2:1 was used as casing mixture. The mixture was pre- treated with 2% formalin two weeks before to eliminate undesirable microorganisms. Casing was done at a thickness of 2-3 cm and again bags were kept in the dark crop room. The temperature and relative humidity were maintained at 14- 18^{0}C and 80-90%, respectively. Temperature during cropping, time taken to complete case run, relative humidity in the crop room and number of days to pinhead initiation were recorded.

Inocula preparation :

The culture of bacterial inoculum (*Pseudomonas putida*) was procured from Division of Plant Pathology, Indian Agricultural Research Institute, New Delhi, India.

Inocula were prepared by growing the selective strains in King·s B broth medium. After incubation at 30^{0}C for 72h, the densities of culture were determined. Then cultures were diluted further in King·s B broth until final bacterial cell numbers were $1x10^4$,$1x10^6$,$1x10^8$,$1x10^{10}$,$1x10^{12}$cells/ml . Bacterial suspension (77ml/bag) was sprayed in different treatments at the time of casing. The harvesting began when buttons were fully-grown (but not yet open), and total harvest was recorded in each bag. Biological efficiency (BE) of the compost was calculated using the following formula (Gupta and Sharma, 1994) :

$$BE\% = \frac{\text{Total weight of fresh mushroom harvested}}{\text{Dry weight of substrate}} \times 100$$

RESULTS AND DISCUSSION

The results of this study showed that there was close relation between population density of *Pseudomonas putida* in the casing soil and yield of *Agaricus bisporus* (Table 1).

Concentrations inoculated in casing soil,$1x10^8$cfu/ml recorded significantly superior over all concentrations, required minimum average number of days(13.4) for mycelium run in casing soil, highest yield (1.268kg/bag) and highest biological efficiency(27.806%) followed by $1x10^{10}$,$1x10^{12}$,$1x10^6$ and $1x10^4$cfu/ml as compared to control. Number of days for mycelium run increased with the incensement ($1x10^{10}$,$1x10^{12}$cfu/ml) of inocula concentration and also with decreasement ($1x10^6$,$1x10^4$cfu/ml) of inocula concentration.

Mushroom yield dramatically increased in concentration of $1x10^8$cfu/ml but decreased with increasement of concentration ($1x10^{10}$, 1x1012cfu/ml) and also with decreasement of concentration ($1x10^6$, 1x104cfu/ml).

Biological efficiency of compost prepared by LMC ranged between 13-28%. Highest biological efficiency was recorded in bags where concentration inoculated $1x10^8$cfu/ml

Fig. 1 : Control bag

Fig. 2 : Treated bag with *Pseudomonas putida* (10^8cfu/ml)

Table 1 : Effect of bacterial inoculant (*Pseudomonas putida*) on the number of days required for mycelium run on yield and biological efficiency of *Agaricus bisporus*

Concentration	Av. No. of days	Yield (kg/bag)	BE(%)
Control	17.20	0.316	8.391
1×10^{12}cfu/ml	15.00	0.698	17.868
1×10^{10}cfu/ml	14.60	0.756	19.128
1×10^8cfu/ml	13.40	1.268	27.806
1×10^6cfu/ml	15.20	0.575	16.478
1×10^4cfu/ml	15.60	0.492	13.776
CD at 5%	0.719	0.184	3.149

* Average of replications

(27.806) followed by $1x10^{10}$, $1x10^{12}$, $1x10^{6}$ and $1x10^{4}$ as compared to control. This indicates that the biological efficiency of compost can be improved by inoculation of *Pseudomonas putida* in the casing mixture (Table 1 and Fig. 1 and 2). These results are in accordance with the earlier work of Hossein *et al.* (2011), which reported the role of bacterial and cynobacterial culture on growth and yield of *Agaricus bisporus*.

Conclusion :

In cultivation of *Agaricus bisporus*, casing soil is major element. Population of *Pseudomonas* in the casing layer on which the mushroom fruit body develops is very important. It is concluded that inoculation of *Pseudomonas putida* in casing soil in $1x10^{8}$cfu/ml concentration is very efficient for increasing the yield and biological efficiency (BE) of compost.

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