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Evaluation of yield performance and morphological characteristics of different strains of *Agaricus bisporus* (Lange) Sing

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Abstract

Mushrooms are being used since the time immemorial. Nowadays, mushrooms are popular valuable foods because they are low in calories, carbohydrates, fat, and sodium, they are also cholesterol-free. Besides, mushrooms provide important nutrients, including selenium, potassium, riboflavin, niacin, vitamin D, proteins, and fiber. All together with a long history as food source, mushrooms are important for their healing capacities and properties in traditional medicine. There are different kinds of edible mushrooms cultivated all over the world. Among them *Agaricus* is the most popular and accepted edible mushroom. *Agaricus bisporus* commonly known as white button mushroom belongs to phylum Basidiomycota. Mushrooms are the health food of the world keeping in its importance, the studies of growth behavior and yield potential of different strains (Delta, NBS-5, ICAF, A-15, and MC-465) were tested. Among various strains of *Agaricus bisporus*, strain Delta produced maximum mushroom yield and number of fruiting bodies i.e., 20.28 kg per q of compost and 104.00 respectively as compared to NBS-5, ICAF, A-15, and MC-465 strains, whereas minimum fruit body was observed in MC-465 (85.50) with 14.11 kg of production per 100 kg of compost. In the growth behavior, NBS-5 gave the highest body weight followed by the other strains. Maximum average body length and stripe was found in MC-465 strain of *Agaricus bisporus*.

Keywords: *Agaricus bisporus*, evaluation, growth behavior, mushroom, strains

Introduction

Mushrooms are part of fungal biota characterized by wonder. They comprise delicious, nutritionally rich, medicinally important, non-conventional source of human food. *Agaricus bisporus* commonly known as white button mushroom is an edible fungus belongs to phylum Basidiomycota. Mushrooms are the health food of the world. The indoor cultivation of *Agaricus bisporus* was however started in caves in France around 1810 (Vijay *et al.* 1988) [1]. It was first cultivated in India more than 3 decades ago, at Chambaghat, Solan. In India, mushroom cultivation has great potential due to favorable weather conditions, abundant cheaper agro wastes as well as cheaper availability of labour. Now a day's mushroom cultivation has been adopted by progressive farmers as a cottage industry, which not only provides them an additional source of income but they could also recycle the farm waste which was earlier sold by them at much low cost. *Agaricus bisporus* is one of the most acceptable edible fungi contributing 31.8% of total world mushroom production (Chang and Miles 2004) [2]. The three major mushroom producing countries are China, USA and Netherland which account for more than 60 per cent of the world production. Punjab has become one of leading states in white button mushroom production with 58000 tons/annum (Singh *et al.* 2011) [3].

Materials and Methods

Culture

The research work was carried out during two cropping years September 2020 and January 2021 and the parent culture of five strains of *Agaricus bisporus* (Lange) Sing. *viz.*, Delta, NBS-5, ICAF, A-15, and MC-465 were obtained from Mushroom Research and Training Centre (MRTC), G.B. Pant University of Agriculture & Technology, Pantnagar.

Preparation of spawn

The spawn was prepared at Mushroom Research and Training Centre (MRTC) Pantnagar,

using grains of wheat and by following standard method (Balazs and Kovacs, 1990) [4]. Healthy wheat grains were washed and boiled (grain: water, 1:25, w/v) to soften the seeds without damaging of the seed coat and the grains were allowed to dry on sieve overnight. Next day the mixing of boiled grains was done with calcium carbonate and calcium sulfate @ 3gm and 12gm per Kg wheat grains, respectively. Chemically mixed grains then placed in glass bottles and plugged with the help of nonabsorbent cotton. Prepared bottles of grains were sterilized by using autoclave (22 psi steam pressure, 121°C for 20 minutes). After sterilization bottles were shaken properly to avoid aggregation of grains. Next day, bits of 12-15 days old pure culture used for inoculation of grained bottles then bottles were shaken vigorously to spread the mycelium properly in bottle and after 10 days inoculated bottles were incubated at $25 \pm 1^\circ\text{C}$. It took 25 days for bottled grains to be entirely covered by mycelium. This is called master spawn. Master spawn was further used in preparation of commercial spawn.

Compost preparation

Agaricus bisporus (Lange) Sing., require a selective medium for its growth, therefore, synthetic compost was prepared by long method of composting according to formula given by Garcha and Kiran (1981) [5].

Wheat straw - 1000 kg

Wheat bran - 150 kg

Urea - 18 kg

Gypsum - 35 kg

Wheat straw was spread over the cemented platform. Water was sprinkled over the straw by pipe and frequently turned by forks till sufficient moisture was absorbed. Wetting of straw was continued up to 48 hours. After two days, required quantities of different materials viz., urea and wheat bran except gypsum were thoroughly moistened with water and heap was made. The prepared mixture was filled in the rectangular blocks (moulds). While filling the blocks materials were slightly pressed on the sides and kept loose in the centre. The compost was decomposed by total seven turning and each turning was done at 3 days interval. Gypsum was mixed during 3rd turning and at each turning, water should be sprinkled to make up the loss of moisture content due to evaporation.

Spawning

Process of mixing spawn with compost is termed as spawning. The mixing of compost and spawn was done @ 1 kg grain spawn per quintal compost and spawned compost filled in polythene bags (60 x 60cm size) @ 10 Kg per bag.

Spawn run

The spawned bags were kept in the crop room for spawn run. Spawn run is the spread of mycelium of the mushroom throughout the compost. During spawn run, in crop room the temperature and relative humidity ranged between 20-24 °C and 85-95%, respectively.

Preparation and treatment of casing mixture

By mixing of 2 years old FYM (Farm Yard Manure) and 2 years old spent mushroom compost in 1:1 ratio, casing mixture was prepared. Formaldehyde (4%) was used for the treatment of casing mixture. Then mixture was covered with polythene sheet for 48 hours.

Casing

After complete spawn run a layer of casing mixture was used to cover the surface of compost. The bags were opened and 5 cm thick casing mixture was applied to the surface of the spawn run compost.

Watering

Water was sprayed regularly 2 times per day after casing for good case run and growth of fruiting bodies.

Case run

Case run is the growth of mushroom mycelium through the casing mixture. The environmental conditions for case run were similar to spawn run.

Cropping and harvesting

During cropping season (fruit body growth and development) temperature and relative humidity ranged between 16-20°C and 80-90%, respectively. Pinheads (initial of fruit body) matured within 3 - 4 days of its initiation. Mature fruiting bodies of the mushroom were harvested at button shaped stage. Mushrooms, after maturation, were harvested by holding the fruiting body between forefinger and thumb, and rotating in clockwise or anticlockwise direction and the soiled stem portion was cut with sharp edged knife.

Results and Discussion

Evaluation of high yielding strains of *Agaricus bisporus* (Lange) Sing

An experiment was carried out for five strains of *Agaricus bisporus* were evaluated for yield performance given in table 1. The highest yield were obtained from strain Delta with an average 20.28 kg/100 kg of compost followed by NBS-5 (20.05 kg/q) further other strains, ICAF (17.11 kg/q), A-15 (16.28 kg/q), and MC-465 (14.11 kg/q) gave minimum yield over all strains. Maximum number of fruiting body were produced in strain Delta with an average 104.00 per ten kilogram of compost followed by strain NBS-5 (99.00), ICAF (92.0), A-15 (88.00) however minimum number of fruiting body was produced in MC-465 with an average of 86.0 per ten kilogram of compost. The average fruiting body weight was observed to be significantly higher in case of strain NBS-5 with an average fruit body weight of 20.50 gm followed by strain Delta (19.50 gm), ICAF (18.50 gm) and A-15 (18.50 gm), and minimum of MC-465 (16.50 gm).

Table 1: Yield performance of different strains of *Agaricus bisporus* (Lange) Sing

Strains	Number of fruiting body /10 kg of compost*	Yield* (Kg/q of compost)
Delta	104.00	20.28
NBS-5	99.00	20.05
ICAF	92.50	17.11
A-15	88.00	16.28
MC-465	85.50	14.11
S.Em. ±	0.48	0.07
CD 5%	1.52	0.24

The present study showed that confirmative results with finding of Kushwaha *et al.* (2006) [6] had been observed yield potential of different six strains of *Agaricus bisporus* (S-649, S-46, U-3, Pant-52, and Pant-215) were evaluated for yield performance in terms of the number and weight of fruiting bodies at room temperature. The highest number of fruiting

bodies (2161/100kg of compost) was recorded for U-3 followed by S-649 and Pant -215.

Morphological characteristics of different strains of *Agaricus bisporus* (Lange) Sing

Morphological characteristics of different strains were given in table 2 that maximum average body weight was observed in NBS-5 (21.0 gm) followed by Delta (19.00 gm), ICAF (18.0 mm), A-15 (17.0 gm) and minimum average body weight was observed in MC-465 (26.00 mm), maximum average body length was observed in MC-465 (40.67 mm) followed by ICAF (39.00 mm), A-15 (38.0 mm), Delta (37.0 mm) and minimum average body length was observed in NBS-5 (16.00 gm), whereas maximum average pileus

diameter was observed in NBS-5 (40.00 mm) followed by Delta (38.00 mm), ICAF (37.00 mm), A-15 (35.0 cm), however minimum width of pileus was observed in MC-465 (34.00 mm). Maximum average thickness of cap was observed in NBS-5 (19 mm) followed by Delta (18.0 mm), ICAF (16.50 mm), A-15 (15 mm), and minimum in MC-465 (14.0 mm) moreover average maximum weight of pileus was observed in NBS-5 (17.0 mm) followed by Delta (15.50 mm), ICAF (14.50 mm), A-15 (14.00 mm), and minimum were taken in MC-465 (13.00 mm). Maximum average stripe length was observed in MC-465 (26.0 mm) followed by A-15 (22.00 mm), ICAF (21.00 mm), NBS-5 (19.00 mm) and minimum average stripe length was observed in Delta (20.00 mm).

Table 2: Morphological characteristics of different strains of *Agaricus bisporus* (Lange) Sing

Strains	Avg. body weight (gm)	Avg. body length (mm)	Avg. Pileus diameter (mm)	Avg. thickness (mm)	Avg. Pileus weight (mm)	Avg. stripe length (mm)
Delta	19.00 ± 0.29	37.00 ± 0.29	38.00 ± 0.58	18.00 ± 0.35	15.50 ± 0.29	20.00 ± 0.40
NBS-5	21.00 ± 0.35	26.00 ± 9.41	40.00 ± 0.35	19.00 ± 0.12	17.00 ± 0.29	19.00 ± 0.35
ICAF	18.00 ± 0.17	39.00 ± 0.29	37.00 ± 0.23	16.50 ± 0.29	14.50 ± 0.87	21.00 ± 0.58
A-15	17.00 ± 0.46	38.00 ± 0.58	35.00 ± 0.46	15.00 ± 0.40	14.00 ± 0.40	22.00 ± 0.52
MC-465	16.00 ± 0.52	40.67 ± 0.83	34.00 ± 0.75	14.00 ± 0.46	13.00 ± 0.12	26.00 ± 0.64
S.Em. ±	0.37	4.23	0.50	0.34	0.46	0.50
CD 5%	1.19	13.33	1.59	1.08	1.47	1.60

Thus, it can be conclude from above results that maximum average body length and stripe length was observed in MC-465 but have lowest body weight, pileus diameter, thickness and stripe length. Maximum body weight was observed in NBS-5 strain of white button mushroom with maximum pileus diameter, thickness and pileus weight but have lowest body and stripe length. This results showed that confirmative results with finding of Prakasam *et al.* (2008)^[7]. reported that Cultural and morphological variations of seven strains of *Agaricus bisporus* (CM-1, CM-5, CM- 10, Delta, S-130, S-140 & X-13) and a strain (NCB-13) of *Agaricus bitorquis* were studied on the basis of growth on MEA medium, synthetic compost and casing soil, and different characters of their fruiting body. Strain S-130 showed maximum growth on MEA medium, compost and casing soil whereas NCB-13 produced higher fruit body weight and stipe width. Lesser stipe length and maximum pileus diameter were observed in strain Delta. Maximum pileus thickness was observed in CM-5. Kumar *et al.* (2017)^[8] studied the growth behavior and yield potential of different strains (U-3, Delta, A-15, NCS-459, NCS-465 and Portbella) and found that the average fruiting body weight was observed to be significantly higher in case of strain Portbella (12.00 gm). In the growth behavior, U-3 gave the best performance followed by the other strains. Maximum average length, width of stalk and average width, length of cap was observed in Portbella followed by A-15, U-3, Delta, NCS-459 and minimum was observed in NCS-465.

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