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IMPACT OF PHYSICO-CHEMICAL PROPERTIES OF CASING SOIL ON SPOROPHORE DEVELOPMENT AND YIELD OF WHITE SUMMER MUSHROOM, *CALOCYBE INDICA* P&C

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ABSTRACT
Experiment was conducted to find out the effect of casing soil and their physico-chemical properties on pinhead initiation and productivity of *Calocybe indica*. Six casing soils viz Farm Yard Manure (FYM), Spent Compost (SC),Sandy Soil (SS), FYM +SC (1:2), FYM +SC (2:1)and FYM +SS+SC (2:1:1) were taken and each was sterilized with 4 per cent formalin solution. The casing soil prepared using FYM +SC+SS (2:1:1) took minimum average days (8) for pinhead initiation. The significantly higher yield (529.00 g/kg dry substrate) was obtained with FYM+SC (1:2). Sandy soil having slightly alkaline pH (7.05), low nitrogen content (2.68%), low phosphorus content (0.49%) and potassium content (0.44) had lowest yield (226.33 g/kg dry substrate) with minimum number of fruiting bodies (17).

INTRODUCTION

Agaricus bisporus (button mushroom) is the most widely cultivated and consumed mushroom species in India. *Calocybe indica* (milky mushroom) and *Pleurotus sajor-caju* (oyster mushroom) are high yielding mushrooms for which commercial cultivation technology has been released and is gaining popularity amongst the farmers (Mishra *et al.,* 2014). *Calocybe* commonly known as milky mushroom has become the third commercially grown mushroom in India after button and oyster mushrooms. Twenty species of this genus are known and four species including *C. indica* from India are known to be edible (Kaur and Sodhi, 2012). After spawn run, casing is an important operation in mushroom cultivation. Casing layer plays an important role in inducing fructification by changing vegetative phase to reproductive phase (Neelam *et al.,* 2014). Quality of casing soil and its physico-chemical properties affects the yield of mushroom as it stimulates the fruit body initiation and regulates the moisture, temperature and some other factors which determine the suitability of casing soils (Hayes and Shandilya 1977; Garcha, 1980; Gupta *et al.*, 2004; Bhatt *et al.,* 2007; Singh *et al.,* 2007). The best material for casing used universally is the 'peat moss' but in India due to unavailability of peat moss in desired quantity, well decomposed spent compost (Mentel, 1973) and farm yard manure (Hayes and Shandilya, 1977) are being used as casing materials by the growers. The best result have been reported when clay to clay loam soil, FYM, coir pith manure and spent compost are used alone or in the ratio of 1:1 (Shukla, 2008). However, limited availability and knowledge about casing soils and its physico-chemical properties resulted in low productivity of this mushroom in Northern India. The paper deals with the effect of different casing soils and its physico-chemical properties on fruiting bodies development and yield of *Calocybe indica*.

MATERIALS AND METHODS

Casing soil and its preparation

Six different casing formulations viz. Farm Yard Manure (FYM), Spent Compost (SC), Sandy Soil (SS), FYM+SC (1:2), FYM+SC (2:1), FYM+SC+SS(2:1:1) were used in the present study. The casing soils were prepared by thorough mixing of the selected casing soils in the proper ratio. Each casing soil was chemically sterilized with 4 per cent formalin solution @ 500 ml/cubic feet casing and covered with plastic sheet for 72 hours whereas untreated was kept as control.

Crop and yield

The substrate wheat straw was chemically sterilized. Spawning is done at the rate of 5% wet weight basis. The spawned substrate was filled in polythene bags of 60 × 40 cm size. Each bag contained 5 kg wet substrate. The temperature and relative humidity were kept 32-35ºC and 85-90 per cent, respectively, for spawn run. After complete spawn run, the bags were cased uniformly with above casing soils (2.5 cm thickness). Three replications were kept for each treatment.

Table 1: Effect of casing soil on yield of *Calocybe indica*

Casing soil	Pinhead initiation (d)	No. of fruiting body	Yield (g/kg dry substrate)	Wt/fruit body (g)	Biological efficiency (%)
Farm Yard Manure(FYM)	10	24.00	476.33	19.84	47.6
Spent Compost (SC)	10	30.33	457.66	15.08	45.7
Sandy Soil (SS)	10	17.00	226.33	13.31	22.6
FYM + SC (1:2)	11	45.33	529.00	11.66	52.9
FYM + SC (2:1)	12	21.00	426.00	20.28	42.6
FYM + SC + SS(2:1:1)	8	22.66	481.00	21.22	48.1
CD (p = 0.05)	1.09	2.58			

Table 2: Physico-chemical properties of casing soil

Casing soil	pH	Electrical conductivity(Deci-simen^{-1})	Nitrogen(%)	Phosphorus(%)	Potassium(%)
FYM	6.34	164.16	4.25	0.97	0.49
SC	6.41	194.91	3.66	0.66	0.66
SS	7.05	210.41	2.68	0.49	0.44
FYM + SC (1:2)	6.25	227.74	3.88	0.90	0.64
FYM + SC(2:1)	6.23	144.57	4.1	0.86	0.58
FYM + SC + SS (2:1:1)	6.31	196.07	2.74	0.62	0.60

FYM = Farm Yard Manure, SC = Spent compost, SS = Sandy Soil

During the cropping period, 28-32^{0}C temperature and 90-95 per cent relative humidity were maintained by spraying of the water thrice a day. The yield data was recorded for a period of 42 days and calculated on the basis of fresh mushrooms harvested per kg dry substrate from each bag.

Evaluation of physico-chemical properties

Dried soil sample (10g) was dissolved in 20 ml of distilled water. After stirring with a glass rod, pH was measured using pH-meter. pH of the different casing mixtures were taken at the time of casing. For measurement of electrical conductivity, the soil particles were allowed to settle down in water and after that electrical conductivity was measured in EC-meter. The casing soil samples were passed through a 0.2 mm sieve for estimation of nitrogen (N) content in Kjeltec 2300 auto-analyzer (Foss Pvt. Ltd). For estimation of Phosphorus (P) and Potassium (K), sieved samples were digested with a mixture of nitric acid and perchloric acid in the ratio of 10:4 (v/v) on hot plates sand bath. After complete digestion, samples were cooled at room temperature and appropriately diluted. The P content was estimated by the ammonium molybdate method (Olsen and Sommers, 1982) and the K content by flame photometry (Jackson 1973).

Statistical analysis

Statistical analysis of data was done using appropriate programme. In order to compare the effect of different casing mixtures simple CRD was used. Critical difference (CD) calculated at 5 per cent level of significance were used for comparison of difference between the treatment means.

RESULTS AND DISCUSSION

All the six casing mixtures analyzed for physico-chemical and nutritional properties were evaluated for their effect on production and productivity of *Calocybe indica*. Maximum yield was recorded from FYM+SC (1:2) (529.00 g/kg dry substrate, BE 52.9%) followed by FYM + SC +SS, 2:1:1 (481.00g/kg dry substrate), FYM (476.33 g/kg dry substrate), however, lowest yield was recorded from sandy soil (226.33 g/kg dry substrate) (Table 1). The number of fruiting bodies were maximum in FYM + SC, 1:2 (45.33) and lowest number of fruiting bodies were recorded from sandy soil (17) (Table 1). Sandy soil having slightly alkaline pH (7.05), low nitrogen content (2.68%), low phosphorus content (0.49%) and potassium content (0.44) had lowest yield with minimum number of fruiting bodies (Table 1 and 2). It clearly demonstrated that higher nitrogen and phosphorus content in the casing soil resulted in increased yield of *Calocybe indica* while potassium showed variable results. FYM was having pH 6.34 and it decreased when spent compost was added to it while increased when sandy soil was added. However, electrical conductivity of spent compost was higher as compared to FYM alone. It clearly reflected that slightly acidic pH and low electrical conductivity favoured the yield in case of *Calocybe indica* (Table 2).

The growth of mushroom is affected by acidity/alkalinity. Hawker (1966) indicated that acidic pH is favourable for mushroom cultivation but Allison and Kneebone (1962) indicated alkalinity for the same purpose. However, Kumar *et al.,* (2006) found neutrality as more favourable. Bhatt et al., (2007) found that pH of casing mixture varied from 6.2-7.1 and Kumar *et al.,* (2006) reported maximum mycelial growth of *A. bitorquis* at pH 7.0. Visscher (1976) suggested higher pH of casing soil because of the higher incidence of *Trichoderma* with low casing pH. Shandilya and Hayes (1987) concluded that decrease in number of pin-heads is almost proportional to increased conductivity. Watson (1973) showed that a large proportion of nitrogen in liquid medium could be taken-up by mycelium as long as phosphorus was not limiting. The results of present investigations are almost in accordance with earlier reports and slight difference in results may be due to change in casing mixtures and crop.

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