Morphological Characteristics of *Mycogone perniciosa* causing Wet Bubble Disease of Button Mushroom (*Agaricus bisporus*) and Assessment of Factors Affecting Disease Development and Spread

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INTRODUCTION

- Mushroom culture represents the only major process in biotechnology which successfully converts various lignocellulosic, agricultural, industrial, forestry and horticultural wastes or their by-products into proteins.
- Mushrooms contains 19-35% protein on dry weight basis, having 70-90% digestibility. Mushrooms are also good source of minerals and B complex group vitamins like thiamine (B1), riboflavin (B_2), niacin and biotin.
- Mushrooms possess various anticancer, antitumour, anticholesteral, immunomodulating and antioxidative properties and are currently used as dietary supplements.
- Wet bubble disease is severe impediment in the profitable cultivation of white button mushroom (*Agaricus bisporus* L.). It is incited by an important and cosmopolitan fungal pathogen, *Mycogone perniciosa* Magn. which is responsible for frequent crop failures in Kashmir valley.
- The mycoparasite parasitizes the fruit bodies/sporophores and/or growing mycelium and causes variable yield losses depending upon the stage of infection, amount of inoculum and the prevailing ecological factors inside the production rooms.
- The disease was found prevalent in varying proportions in all the districts and locations across seasons in the valley.

Objective

- To investigate Morphological and cultural characteristics of *M. perniciosa* isolated from button mushroom (*Agaricus bisporus*).
- To assess the factors affecting the development and spread of the disease.

MATERIAL AND METHODS

Morphological characters of the isolated pathogen

- The morphological characteristics of the causal organism on host and in artificial culture were studied in the laboratory. The important characters studied were the cultural characters such as mycelial colour and growth and the morphological characters such as shape, size, colour and septation of hyphae, conidiophores, conidia and chlamydospores.

Assessment of factors responsible for disease development and spread

Survival of Pathogen

✪ Contaminated compost ✪ Contaminated casing soil:
✪ Spent compost as inoculum source ✪ Casing material

Spread of Pathogen

✪ Water splash ✪ Air currents ✪ Flies

Salient Findings

- The isolated fungus produced copious flocculent mycelium and the colour of colonies changed from white to pale brown and finally dark brown after 12-14 days of incubation at 24±1°C.
- The maximal radial growth (90 mm) was recorded on malt extract agar medium after 15 days, followed by potato dextrose agar (75.5 mm) and compost extract agar (72.0 mm).
- Microscopic examination of pathogen reveals that the mycoparasite was both inter and intra-cellular. The conidiophores were erect, long and verticillately branched. Conidia were oval, single, 2-celled and thin walled.
- The pathogen was successfully re-isolated when admixed with the compost at 6th, 7th or 8th turnings i.e. on 22nd, 25th and 29th day of composting with a pile temperature of only (0-30 °C).
- The pathogen was also present in viable form in all the test samples of casing mixture in varied populations.
- The pathogen was continuously present in samples from spent compost of diseased trays.
- It was also observed that only the garden soil and the spent compost carried the wet bubble pathogen in populations varying each year. The peat soil, virgin soil,
- farm yard manure and sand did not yield any *M. perniciosa* propagules during both the years.

CONCLUSION

In light of the present investigations, it can be deduced that:

- White button mushroom cultivation in Kashmir valley in primarily in the hands of resource-poor growers. The prevalence of unhygienic conditions in and around the mushroom farms and lack of pasteurization facility result in recurrence of wet bubble and other mould diseases causing heavy economic losses to these growers. The disease can be managed at farmer's field levels by providing pasteurized compost and casing material and adhering to farm sanitation.

Table 1: Isolation of *M. perniciosa* incorporated in compost at different stages of composting.

Pathogen incorporation stage	Temperature of pile (°C)	Isolation status
Stacking (0 day)	0-30	–
1st turning (6th day)	65-70	–
2nd turning (10th day)	65-70	–
3rd turning (13th day)	65-70	–
4th turning (16th day)	60-65	–
5th turning (19th day)	50-55	–
6th turning (22nd day)	40-45	+
7th turning (25th day)	30-35	+
8th turning (29th day)	25-30	+

\+ = Successful isolation
– = Pathogen could not be isolated

Table-2 : Population of *Mycogone perniciosa* in different casing materials during 2008 and 2009

Casing material	*M. perniciosa* population (cfug^{-1} casing mixture)	
	Spring 2008	Autumn 2009
Peat soil	–	–
Garden soil	2×10^4	5.5×10^2
Virgin soil	–	–
Spent compost	4.5×10^4	3.5×10^2
Farmyard manure	–	–
Sand	–	–

– =Not isolated

Table-3: Number of *Mycogone perniciosa* colonies developed on PDA plates exposed to air currents of different velocities at different distances

Air current velocity	Distance from inoculum source					Mean
	20 cm	40 cm	60 cm	80 cm	100 cm	
High (7 meters/sec.)	15.67	11.33	7.00	1.00	0.00	**7.00[a]**
Medium (5 meters/sec.)	9.33	3.67	2.00	0.00	0.00	**3.00[b]**
Low (2 meters/sec.)	2.67	1.33	0.33	0.00	0.00	**0.87[c]**
Mean	**9.22[A]**	**5.44[B]**	**3.11[C]**	**0.33[D]**	**0.00[E]**	
	SE±			**CD(p=0.05)**		
Distance	0.53			1.08		
Speed	0.41			0.83		
Distance x Speed	0.91			1.87		

*****Figures are the number of *M. perniciosa* colonies

Table-4 : Per cent *Agaricus bisporus* sporocarps infected with *Mycogone perniciosa* after release of different populations of sciarid flies fed on diseases sporocarps

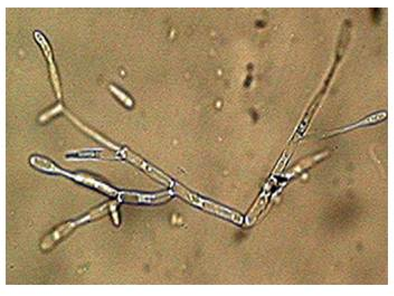
Acquisition time (minutes)	Sciarid fly population					Mean
	10	20	50	75	100	
30 min	5.33*	8.33	11.00	18.00	19.00	**12.33**
60 min	12.00	15.67	16.67	23.00	29.67	**19.40**
90 min	16.67	25.00	35.00	37.33	42.67	**31.33**
120 min	27.00	31.33	42.00	46.67	52.00	**39.80**
	15.25	**20.08**	**26.16**	**31.25**	**35.83**	
	S.E±			**CD(p=0.05)**		
Fly population (FP)	1.09			2.20		
Acquisition time (AT)	0.97			1.97		
Pop. x Time (FP x AT)	2.18			4.40		

***** Figures are the per cent infected sporocarps

Symptom development after inoculation

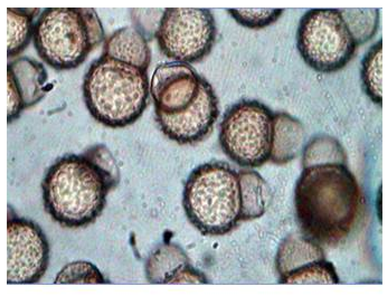
Mycelial growth on MEA

Dual culture of *Mycogone perniciosa* and *Agaricus bisporus*



Sub-verticillate to verticillate conidiophores

Terminal chlamydospore



Bi-cellular chlamydospore