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In-vitro evaluation of selected fungicides against *Verticillium fungicola* in white button mushroom (*Agaricus bisporus*) cultivation

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ABSTRACT

A trial was carried out to evaluate effect of selected fungicides against *Verticillium fungicola* under *in-vitro* condition. Among all tested fungicides, Carbendazim was the only one which found best in least fungal growth (19.67 mm) and highest mycelium inhibition (78.15%) over control followed by Myclobutanil (35.00 mm and 61.11%, respectively).

Key words: *Agaricus bisporus,* fungicide, *Verticllium fungicola*

INTRODUCTION

White button mushroom (*Agaricus bisporus*) is an edible mushroom and very popular in all over the world. It is also called as 'Food of God' and also considered as vegetable meat. It contains vitamin B, D and K, and a very rich source of protein. In this mushroom, fat and cholesterol level is very low. Among all cultivated mushroom, it is one of the most popular and cultivated mushroom in world(Gbolagade*et al.*, 2006; Toker*et al.*, 2007 and Saiqa*et al.*, 2008).

In white button mushroom, many biotic and abiotic factors affects the crop yield, which include competitor moulds, nematodes, fungi, insects, bacteria and viruses. Many yield losses have been recorded in white button mushroom cultivation due to competitor moulds and fungi depending upon different regions (Gela, 1993; Khanna *et al.*, 2003 and Gea*et al.*, 2005).Dry bubble disease, caused by *Verticillium fungicola,* is one of the most important disease of mushroom. It was first reported from Scotland and later, from Chail and Taradevi (HP) in India. It is also called as La mole, brown spot and Verticillium disease. This disease

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is very common in all white button mushroom cultivated states like, Himachal Pradesh, Punjab, Uttaranchal, Haryana and Uttar Pradesh, due to which yield losses up to 90%, have been recorded (Seth *et al.,* 1973; Sharma, 1995 and Kerni*et al.,* 1997).

Keeping in view following problem, this experiment was carried out and main aim of this work was to check the efficacy of selected fungicides for the management of dry bubble disease.

MATERIALS AND METHODS

Present work was carried out at Department of Plant Pathology, SHUATS, Prayagraj (UP) during November-December, 2017. The cultures of *Verticillium fungicola* (ITCC No. 4909) was procured from Indian Type Culture Collection (ITCC), Division of Plant Pathology, IARI, New Delhi.

A total number of ten fungicides *viz.*, Carbendazim, Mancozeb, Zineb, Topsin-M, Bitertanol, Myclobutanil, Copper oxy-chloride, Captan, Chlorothalonil and Hexaconazole, were used against *Verticillium fungicola* at 10, 25, 50 and 100 ppm. For the present experiment, poison food technique was used. Twenty ml of PDA (Potato Dextrose Agar) was poured sterilized Petri dishes and later inoculated with 5 mm diameter mycelial cut from 5 days old cultures *V. fungicola*. Each treatment was replicated three times and Petri plates without any fungicide served as a control. Later, all the Petri plates were kept in incubator at 25±2^{o}C till the complete growth which was observed in control Petri plates. Per cent inhibition over control was calculated by using following formula:

$$\text{Mycelial Inhibition} = \frac{\text{Radial growth in control - Radial growth in treatment}}{\text{Radial growth in control}} \times 100$$

(Vincent, 1947)

RESULTS AND DISCUSSION

In present investigation, effect of selected fungicides were checked against *Verticillium fungicola,* causing dry bubble disease in mushroom, by using poison food technique and two parameters *viz.,* fungal mycelial growth and per cent inhibition over

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control, were checked. A total number of ten fungicides were used, out of which, Carbendazim was found best fungicide for the management of *V. fungicola.* The results of this study showed that minimum mycelial growth (19.67 mm) was obtained from Carbendazim at 100 ppm which was followed by Myclobutanil (35.00 mm) and Topsin-M (35.67 mm). For mycelial growth of *V. fungicola,* it was observed that growth of the pathogen varied with the increase in concentrations of used fungicides (10, 25, 50 and 100 ppm) (Table 1).

In this experiment, all the fungicides used, more or less significantly inhibited the fungal growth of *V. fungicola* at all used concentrations. Out of all ten used fungicides, highest mycelium inhibition of *V. fungicola* was observed with Carbendazim, which was 78.15% at 100 ppm concentration. It was followed by Myclobutanil (61.11%) and Topsin-M (60.37%). Least mycelium inhibition of *V. fungicola* over control was observed with Mancozeb (25.93%).

Table 1: Effect of selected fungicides on mycelial growth (mm) of *Verticillium fungicola* under*in-vitro* condition

Fungicides	**Mycelial growth (mm)***				
	Concentrations				
	10 ppm	**25 ppm**	**50 ppm**	**100 ppm**	**Mean**
Control	90.00	90.00	90.00	90.00	90.00
Carbendazim	47.67	40.00	31.67	19.67	34.75
Mancozeb	85.00	79.67	73.00	66.67	76.08
Zineb	81.00	76.33	67.00	59.00	70.83
Topsin-M	57.67	50.67	43.33	35.67	46.83
Bitertanol	60.67	55.00	47.00	36.33	49.75
Myclobutanil	57.00	50.00	41.67	35.00	45.92
Copper oxy-chloride	83.33	74.67	64.67	54.33	69.25
Captan	83.33	78.33	66.33	58.67	71.67
Chlorothalonil	81.00	76.33	66.33	55.67	69.83
Hexaconazole	79.00	69.00	61.00	56.00	66.25
Mean	73.24	67.27	59.27	51.54	

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	CD (0.05)	S.E(d)±
Fungicides	1.285	0.645
Concentrations	0.775	0.389
Fungicides × concentrations	2.570	1.291

*****Average of 3 replications

Later, it was found that with the increase of concentrations of fungicides (10 to 100 ppm), growth of *V. fungicola* varied subsequently (Table 2).

Dry bubble disease is a most important disease of white button mushroom, due to which many yield losses of mushroom have been recorded from different mushroom growing areas of the world. Many fungicides have been suggested by several authors and scientists for the management of this disease. For the best management of the disease, many experiments have been done against *V. fungicola* under *in-vitro* conditions to evaluate best fungicide. We need to do more research to find out maximum benefits of fungicides and their doses (Challen and Elliott, 1985; Clift and Terras, 1991; Chalaux*et al.*, 1993 and Abosriwil and Clancy, 1999).

Table 2:Effect of selected fungicides on inhibition of mycelium growth (%) of *Verticillium fungicola*

Fungicides	Per cent inhibition over control*				
	Concentrations				
	10 ppm	**25 ppm**	**50 ppm**	**100 ppm**	**Mean**
Control	0.00	0.00	0.00	0.00	0.00
Carbendazim	47.04	55.56	64.82	78.15	61.39
Mancozeb	05.56	11.48	18.89	25.93	15.46
Zineb	10.00	15.19	25.56	34.44	21.30
Topsin-M	35.93	43.70	51.85	60.37	47.96
Bitertanol	32.59	38.89	47.78	59.63	44.72
Myclobutanil	36.67	48.11	53.70	61.11	49.90
Copper oxy-chloride	7.41	17.04	28.15	39.63	23.06
Captan	7.41	12.96	26.30	34.82	20.37
Chlorothalonil	10.00	15.19	26.30	38.15	22.41
Hexaconazole	12.22	23.33	32.22	37.78	26.39

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Mean	18.62	25.85	34.14	42.73	
	CD (0.05)		**S.E(d)±**		
Fungicides	1.682		0.845		
Concentrations	1.014		0.510		
Fungicides × concentrations	3.364		1.690		

*****Average of 3 replications

In this experiment, Carbendazim was found best fungicide for management of *V. fungicola* under *in-vitro* condition at 100 ppm, which inhibit maximum mycelium growth of tested pathogen as compared to other fungicides. Gea*et al.*, (2005) and, Bhatt and Singh (2002) also reported same result which are similar to the result of present study. There is no adverse effects are found on *Agaricus bisporus* due to Carbendazim, as it was used at high concentrations. This result was accordance with the findings of many authors (Jandaik*et al.*, 1978 and Thapaand Raina, 1989)..

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