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ORIGINAL ARTICLE

Post-Harvest Disease Management of Sweet Potato Tubers (*Ipomoea batata* Lamk.) by Using Fungicides

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ABSTRACT

Several workers have reported both physical and chemical treatments to control post harvest decay in fruits and vegetables. Prevention and reduction in disease depends on the effectiveness of a treatment in checking growth of decay causing organisms. Efforts have also been made to evaluate the effect of certain chemical factors for the control of tuber's rot during storage. The efficacy of different fungicides can be determined by linear growth, radial growth and mycelial dry weight methods. The fungicide found effective against pathogens in in vitro conditions were used for the control of disease development under in vivo trials as prophylactic treatments. The disease development and growth of mycoflora were observed at regular intervals. Ten fungidices viz., Alliette, Benonyl, Bavistin, Carbendazin, Fentin acetate, Fytolan, Mencozab, Phenyl Thiourea, Thiopharate methyl and Tricyclazole were selected for screening to know their efficiency against rot causing pathogens of sweet potato tubers. Effective fungicides were, Cardendazin, Mencozab and Benomyl. There were further screened by mycelial dry weight and colony diameter measurement methods. It was concluded from the studies that Carbendazin was able to inhibit the growth of Aspergillus nidulans var. acristatus, Cladosporium cladosporioides and Penicillium meleagrinum at 200 ppm conc. in broth media.

Key words: *Sweet potato, Post harvest disease, Fungi, Fungicide in vivo, in vitro.*

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INTRODUCTION

Ipomoea batatas Lamk. (fam. Convulvulasae) commonly known as "Sweet potato" is one of the important cultivated crops of India. It is grown practically in all the states and rank third among tuber crops. It is widely cultivated throughout the tropical and in some parts of temperate regions.

Ipomoea batatas is grown as annual herbaceous vine producing succeeded tuberous roots. The sweet potato is largely attacked in the fields by several fungi, bacterial, and viral diseases, which reduce the yield of underground tubers. Some of the important fungal diseases are, leaf spot caused by *Cercospora batatae*, White blister caused by *Ceratocystic fimbriata* (Lu and Feng, 1988), Rhizopus rot caused by *Cystopus ipomoeae panduratae* (Anonymous, 1950). Black rot caused by *Rhizopus stolonifer* (Sinha and Prasad, 1986) and Collar rot caused by *Sclerotium rolfsii* (Sivaprakash and Kandaswamy, 1983 and Kareppe, 1991) and Scap disease caused by *Sphaceloma batatas* (Bajit and Gapasin, 1987 and Paningbaton, 1987).

A number of other pathogenic forms are also known which caused high damage to the tubers in fields, market and storage in post harvest conditions. These are *Alternaria*

capsiciannui, *Cladosporium cladosporiodes, Colletotrichum capsici* (Gehlot, Praveen and Purohit, 2001), *Corynespora cassicola, Helminthosporium euphoribiae, Fusarium oxysporum f. batalas* (Sarbhoy *et al.,* 1986 and Dohroo and Parmar, 1989), *Rhyzoctonia soloni, Penicillum digitatum, Myrothecium roridum, Arthrinium phaseospermum, Stemphylim botryosum* (Ravichandra and Sullia, 1983), *Fusarium solani* (Campbell and Collins, 1987) and *Streptomyces ipomoea* (Clark and Mathews, 1987).

The crop is attacked annually by these pathogen during cultivation in the fields. The process of spoilage of tubers remain continue even after the harvesting of the crop till the storage.

Management of disease has been done by different workers for checking the disease and the improvement of quantity and quality of tubers. Thankappan (1991) mentioned disease management of sweet potato by using technological, integrating flexible combinations such as field sanitation, disease free plantation material, tolerant or resistant varieties, improved cultural practices, biological control, soil solarization and avoiding disease favourable season.

Post harvest disease management of sweet potato tuber were reported by Moyer (1982) include seed selection, crop rotation and hygiene, adequate sanitation, curing and washing. Another type of treatment known as hot water dips for the control of pathological decay in sweet potatoes were reported by Scriven, Ndunguru and Wills (1991). Dipping Yam tubers in 1.0% sodium hypochloride or wood ash slurry was effective in controlling weight loss and tuber root for 5 months or treatment with Benlate (benomyl) or thiabendazole (Nnodu and Nwankiti, 1988).

The studies include effect of certain chemical factors for the control of tuber's rot during storage. The efficiency of different fungicides can be determined by linear growth (Fires, 1973), radial growth and mycelial dry weight methods (Davies *et al*., 1948). These methods were followed as suggested by Darby (1960) for the disease management.

The fungicide found effective against pathogens in *in vitro* conditions were used for the control of disease development under *in vivo* trials as prophylactic treatments. The disease development and growth of myflora were obsened at regular intervals. As evident from the literature that the crop's important from economical point of view. In our country heavy losses are incurred due to poor storage practices.

MATERIALS AND METHODS

DISEASE MANAGEMENT:

To prevent storage decay and deterioration fungicidal treatment has been suggested by many workers. Various techniques were used, which were based on bioassay. The calculated doses of fungicide were incorporated in the medium and the growth responses of organism were observed. This method is also described as poisoned food technique in literature.

1. Determination of Efficiency of Fungicides:

The efficiency of fungicides was tested by the following methods:

(a) Colony Diameter Measurement: In all 10 fungicides i.e., Alliette, Benomyl, Bavistin, Carendazim, Fentin acetate, Fytolan, Mencozab, Phenyl thiourea, Thiophanate methyl, Tricyclazole fungicides were used in this method for the preparation of stock solution of fungicides, 1.0 g of fungicide was dissolved in 100 ml of sterilized distilled water to prepare a solution of 10,000 ppm. From this stock solution 50, 100, 150, 200, 250, 500 ppm solutions were prepared. For each conc. 0.025, 0.05, 0.075, 0.10, 0.12 and 0.25 ml of fungicidal solution were added respectively in each 50 ml of sterilized medium to get the above mentioned concentrations. Four replicates of each concentration were taken. These dishes were inoculated aseptically with the spore suspension of test fungi and incubated

at 28±1ºC temperature. The observation for fungal growth was made after 7 days by measuring the diameter of colony. This method was successfully used by Fires (1943).

(b) Mycelial Dry Weight Method: Stock solution of fungicide was prepared by dissolving 1 gm of fungicide in 100 ml of sterilized distilled water. For mycelial dry weight method the different concentration i.e. 50, 100, 150, 200, 250 and 500 ppm were prepared by adding 0.025, 0.05, 0.075, 0.10, 0.12 and 0.25 ml of stock solution in each 50 ml of sterilized Czapek's Dox broth medium contained in 250 ml Erlenmeyer flask as mentioned in previous method. The medium was inoculated with spore suspension of test fungi and incubated at 28±1ºC for 7 days. Control sets were also prepared without addition of any fungicide in the medium. After incubation period, the growth was measured in terms of dry weight of mycelium as detailed earlier. Mycelium dry weight method was successfully used for the valuation of efficacy of various fungicides and chemicals by Darby (1960).

2. APPLICATION OF FUNGICIDES IN VIVO:

The effective fungicide was applied by dip treatment on the tubers (Foister, 1940 and Ainsworth, 1968) and subsequent inoculation of each rot causing fungus by Knife injury method as suggested by Tandon and Mishra (1969). Tubers were dipped in effective conc. i.e., 200 ppm solution of fungicides and after evaporation of surface solution, injury were made with the help of Knife and then inoculation was made by spraying homogeneous spore suspension of each fungus on tuber surface. After one hour when tuber was dried, the inoculated tubers were placed in pre-sterilized paper bags and incubated at 28 ± 1ºC temperature for 7 days. The development of rot by each fungus was observed. Control in that fungicidal treatment was also maintained simultaneously.

RESULTS

Ten fungicides viz. Allette, Benomyl, Bavistin, carbendazin. Fentin acetate, Fytolan, Mencozas, Phenyl thiourea, Thiophanta methyl and Tricyclazole were screened at 250, 500 and 1000 ppm (Table - 1).

Table 1: Screening of fungicides against various fungal species by poisoned food technique

S.No.	Fungicides	Fungicidal concentration in ppm		
		250	500	1000
1.	Alliette [Fosetyl A1]	+	+	+
2.	Benomyl [Methyl-1- (butylcarbamoyl) benzimidazole]	-	-	-
3.	Bavistin [2-(Methoxy-carbamoyl) benzimadazole]	+	+	+
4.	Carbendazin [Methyl-2- benzimadazole carbamate]	-	-	-
5.	Fentin acetate [Triphenyltin acetate]	+	+	+
6.	Fytolan [Copper oxychloride]	+	+	+
7.	Mencozab [Zinc ions and Mangenese ethylene bisdi thiocarbamate]	-	-	-
8.	Phenyl thiourea [Phenyl thiocarbamide]	+	+	+
9.	Thiophonate methyl [1, 2, bis (methoxycarbonyl-2- thiureido) Benzene]	+	+	+
10.	Tricyclazole [1, 2, 3 trizole]	+	+	+

Czapek's Dox Agar Medium + = growth present
- = growth absent Temperature = 28 ± 1ºC
Incubation period = 7 days

Only 3 fungicides out of ten were found effective i.e., Carbendazim, Mencozab and Benomyl. Their efficiency was further confirmed by measuring mycelial dry weight of the

pathogens against doses. All the test fungi showed variable growth in fungicides incorporated in Czapek's Dox broth medium at different concentrations.

The results obtained from radial growth of mycelium are shown in Table- 2: *Aspergillus nidulans var, Acristatus* showed 3.00 mm, *Cladosporium cladosporioides* 2.1 mm radial growth of mycelium at 150 ppm when treated with Carbendazim Carbendazim was found effective at 200 ppm conc. which completely checked the growth of pathogens.

Table 2: Relative efficiency of selected fungicide (Colony diameter measurement)

S.No.	Fungicide	Concentration (im ppm)	Radial growth of fungi in mm.		
			***Aspergillus nidulans* var. acristatus**	***Cladosporium cladospiorioides***	***Penicillium meleagrinum***
1.	Carbendazin [Methyl 2-benzimidazole carbomate]	50	9.1	6.2	7.2
		100	6.4	5.0	4.1
		150	3.0	2.1	-
		200	-	-	-
		250	-	-	-
		500	-	-	-
2.	Mencozab (Zinc ions and Mangenese Ethylene bisdithiocarbonate)	50	14.2	11.9	12.0
		100	10.3	7.5	8.6
		150	8.4	4.2	5.3
		200	6.1	-	-
		250	5.0	-	-
		500	1.1	-	-
3.	Benomyl [Methyl-1-(butyl carbamoyl) benzimidazole]	50	18.0	15.2	19.1
		100	13.5	10.5	15.3
		150	10.5	8.6	10.1
		200	4.6	6.2	7.7
		250	-	3.0	6.2
		500	-	-	-
4.	Control	0.0	21.0	19.2	22.1

Temperature = 28±1ºC Duration = 7 days

Table 3: Relative efficiency of selected fungicide (mycelial dry weight method)

S.No.	Fungicide	Concentration (im ppm)	Mycelial dry weight in mg.		
			Aspergillus nidulans var. acristatus	**Cledosporium cladosporioides**	**Penicillium meleagrinum**
1.	Carbendazin [Methyl 2-benzimidazole carbomate]	50	220	200	100
		100	200	100	50
		150	100	40	-
		200	-	-	-
		250	-	-	-
		500	-	-	-
2.	Mencozab (Zinc ions and Mangenese Ethylene bisdithiocarbomate)	50	200	100	200
		100	180	20	100
		150	150	10	50
		200	120	-	-
		250	100	-	-
		500	50	-	-
3.	Benomyl [Methyl-1-(butyl carbamoyl) benzimidazole]	50	300	200	310
		100	250	150	300
		150	150	100	200
		200	100	80	100
		250	-	50	40
		500	-	-	-
4.	Control	0.0	310	300	400

Temperature = 28±1ºC Duration = 7 days

Table 4: In vivo application of fungicide to control pathogens

S.No.	Fungi	Concentration of Cardendazim in ppm			
		100	150	200	Control
1.	*Aspergillus nidulans var. acristatus*	+	+	-	+
2.	*Cladosporium cladosporioides*	+	+	-	+
3.	*Penicillum meleagrinum*	+	-	-	+

+ = growth present - = growth absent
Temperature = 28±1ºC Duration = 30 days

At 150 ppm concentration of *Mencozab Aspergillus nidulans var. acristatus* showed 8.4, *Cladosporium cladosporioides* 4.2 and *Penicillium melagrinum* showed 5.3 mm growth. *Mencozab* completely inhibited the growth of *Cladoporium cladosporioides* and *Penicillium meleagrinum* at 200 ppm. It was found less effective against *Aspergillus nidulans var. acristatus* and showed 1.1 mm growth at 500 ppm concentration (Table 2).

At 200 ppm concentration of *Benomyl Aspergillus nidulans var. acristatus* showed 4.6, *Cladosporium cladosporioides* 6.2 and *Penicillium meleagrinum* 7.7 mm growth. Benomyl suppressed the growth of *Aspergillus nidulans var. acristatus* at 250 ppm and *Cladosporium cladosporioides, Penicillium meleagrinum* at 500 ppm concentration.

As 50 ppm concentration of Carbendazim, *Aspergillus nidulars var. acristatus, Cladosporium cladosporioides, Penicillium meleagrinum* showed 220, 200 and 100 mg of mycelial growth, respectively at 100 ppm concentration *Aspergillus nidulans var. acristatus* showed 200, *Cladoporium cladosporioides* 100 and *Penicillium meleagrinum* 50 mg of mycelial growth. *Aspergillus nidulans var. acristatus* and *Cladosporium cladosporioides* showed 100 and 40 mg of mycelium at 150 ppm concentration while growth of *Penicillum meleagrinum* was completely inhibited at 150 ppm concentration Carbendazim was found effective at 200 ppm concentration for all test fungi (Table- 3).

Mencozab was less effective than carbendazim. At 50 ppm concentration of this fungicide *Aspergillus nidulans var. acristatus* showed 200 mg. *Cladosporium cladosporioides* 100 mg and *Penicillium meleagrinum* 200 mg of mycelium on dry weight basis. At 100 ppm concentration *Aspergillus nidulans var. acristatus, Cladosporium cladosporioides, Penicillium meleagrinum* showed 180, 20 and 100 mg growth respectively. At 150 ppm concentration *Aspergillus nidulans var. acristatus* and *Cladosporium cladosporioides* only 150 and 10 mg growth was seen. When treated with *Benomyl Penicillium meleagrinum* showed 200 mg growth while *Aspergillus nidulans var. acristatus* and *Cladosporium cladosporiodes* showed less growth. *Aspergillus nidulans var. acristatus, Cladosporium cladosporioides* and *Penicillum meleagrinum* showed 200, 100 and 80 mg of growth respectively. Only *Cladosporium cladosporioides* and *Penicillum meleagrinum* showed 50 and 40 mg growth at 500 ppm concentration (Table- 3).

The result indicated that out of 3 fungicides one was highly effective against rot causing pathogens.

The *in vivo* effect of Carbendazim was studied to check the growth of mycoflora on sweet potato tubers by dip treatment. The result is expressed in Table- 2. The treated and inoculated tubers were kept for 30 days. Mycelial growth was present at 100 ppm and 150 ppm concentration of Cardendazim, but 200 ppm concentration was found effective to control growth of *Aspergillus nidulans var. acristatus, Cladosporium cladosporioides* and *Penicillium meleagrinum* Table- 4.

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