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Prevention and control of garlic rot

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Abstract
Post-harvest diseases entail huge loses, and hence. It is not surprising that considerable effort has been directed towards the development of efficient methods for their control, although the disease caused by 'wound pathogens' can be avoided by proper harvesting handling and scientific storage but more often than not these precautions fail to provide desired level of disease control and hence additional precautions in the form of 'chemical precaution' become necessary. In fact, chemical protection is inseparable from an integrated control planning against many post-harvest diseases, for it reduces inoculum density, eradicates, inactivates or destroys the pathogens or cures the diseased entities.

Keywords: density, eradicates, wound pathogens

1. Introduction
Therefore, a number of chemicals whose efficacies in controlling various fungal infections are well known were tried against garlic diseases under study, both *in vitro* and i*n vivo*.

A. In vitro efficacy of the chemicals
In the present study nine fungicides and three antibiotics were tried *invitro*. Their efficacies were determined in terms of inhibition of radial growth of the pathogens following poisoned food technique.
In general the efficiency of the chemical was found to increase with increasing concentrations. Even at 100ppm concentration, the chemicals suppressed more than 50 percent radial growth of all the three pathogens (Table 1). Bavistin checked the complete growth of A. *ochraceus* at this concentration. A few others like agrimycin-100, benlate, blitox-50 and vitavax also attained this efficiency against the pathogen but at 2000 ppm concentration. Plantavax and difolatan were only slightly lesser effective as they too caused as much as 99.25+0.86 and 97.39+0.73% inhibition of the radial growth of this fungus Respectively.
The growth of F. moniliforme was also checked completely by 100ppm contration of bavistin and beniate and by 1000ppm concentration of agrimycin -100. Other fairly efficient chemical were aureofungin, difolatanPCNB, plantavax and vitavax which retardedm80.53+7.56, 95.42+1.61, 88.97+1.61,91.66+2.21 and 83.86+2.63%growth respectively. Dithane M-45 and dithane Z-78, although, did not suppress the growth considerably but the fungal growth was very diffused and sparse.

Table 1: vitro efficiency of the chemical against rot pathogens

chemicals	Conc. (ppm)	Aspergillus ochraceus		Fusarium moniliforme		Penicillium purpurogenum	
		Mean radial grdth beyond initial 7mm	percent inhibition	Mean radial grdth beyond initial 7mm	percent inhibition	Mean radial grdth beyond initial 7mm	percent inhibition
Antibiotics							
Agrymycin 100	100	16.0±2.58	76.11±3.86	14.5±3.41	84.40±3.67	6.5±0.47	73.21±1.44
	500	6.2±1.89	90.66±2.82	5.25±2.5	94.38±2.63	4.0±1.63	83.02±6.91
	1000	2.7±1.7	95.89±2.54	0	100.00±0.0	0	100.00±1
	2000	0	100.00±0.0	0	100.00±1	0	100.00±1
Roscilin	100	25.2±1.70	63.48±2.54	64.66±1.54	30.46±1.63	23.33±0.57	1.69±1.46
	500	24.53±1.28	63.37±1.91	63.66±3.05	31.51±3.28	21.66±1.15	8.18±4.89
	1000	21.66±2.08	67.65±3.10	60.66±2.51	34.76±2.70	20.66±2.51	12.42±10.66
	2000	14.0±3.06	79.1±5.38	52.33±5.13	40.72±5.51	19.33±3.21	18.07±13.61
Fungicides A. benzimidazoles							
Bavistin	100	0	100.00±0	0	100.00±0	0	100.00±0
	500	0	100.00±0	0	100.00±0	0	100.00±0
	1000	0	100.00±0	0	100.00±0	0	100.00±0
	2000	0	100.00±0	0/	100.00±0	0	100.00±0
Benlate							
	100	1.0±0	98.50±0	0	100.00±0	0	100.00±0
	500	1.0±0	98.50±0	0	100.00±0	0	100.00±0

	1000	1.0±0	98.50±0	0	100.00±0	0	100.00±0
	2000	0	100.00±0	0	100.00±0	0	100.00±0
B. Copper compound							
Blitox -50	100	29.2±10.77	56.14±16.08	50.5±6.45	45.69±6.94	15.5±1.91	34.31±8.11
	500	9.75±4.11	85.44±6.13	42.5±8.10	54.29±8.71	23.25±3.86	43.85±16.36
	1000	1.25±0.5	98.13±2.24	28.7±14.5	74.08±15.92	7.5±4.12	68.21±17.4
	2000	0	100.00±0	24.5±14.73	63.65±15.83	3.0±1.63	87.28±6.91
C. Heterocyclic nitrogenous compound							
Difolatan	100	9.75±2.62	85.44±3.92	22.0±3.91	76.33±4.21	14.0±2.0	40.67±8.47
	500	6.25±0.92	90.66±1.42	10.75±1.10	88.43±1.83	7.0±3.55	70.33±15.08
	1000	2.25±0.95	96.65±1.43	6.25±1.5	93.27±1.61	2.7±0.5	88.31±2.13
	2000	1.75±0.5	97.35±0.73	4.25±1.5	95.42±1.61	1.75±0.5	92.58±2.12
D. Sulphur compounds							
Dithan z-78	100	28.0±4.08	58.20±6.09	62.25±13.5	33.06±14.21	21.75±0.95	7.83±4.05
	500	27.25±2.34	59.32±0.99	34.5±4.5	0	0	0
	1000	27.75±2.87	61.56±4.28	42.4±2.02	54.40±2.17	19.0±1.15	19.48±4.89
	2000	22.00±2.70	67.16±4.04	32.5±9.88	64.92±10.78	17.0±2.58	27.96±10.93
Dithan z-78	100	28.0±4.08	58.20±6.09	62.25±13.5	33.06±14.21	21.75±0.95	7.83±4.05
	500	27.25±2.34	59.32±0.99	34.5±4.5	0	0	0
	1000	27.75±2.87	61.56±4.28	42.4±2.02	54.40±2.17	19.0±1.15	19.48±4.89
	2000	22.00±2.70	67.16±4.04	32.5±9.88	64.92±10.78	17.0±2.58	27.96±10.93
E. Benzen compound							
PCNB	100	16.25±2.36	75.74±3.52	49.25±4.78	47.04±5.14	23.75±0.95	1.27±1.06
	500	16.75±4.7	74.99±7.14	39.75±3.20	57.12±3.56	19.75±0.95	16.31±4.05
	1000	8.5±2.08	87.80±2.38	35.0±1.63	62.36±1.75	16.25±0.95	31.14±4.05
	2000	4.0±1.82	94.02±2.72	10.25±1.5	88.97±1.61	11.25±0.95	52.32±4.05
F. Oxathins							
Plantavax	100	16.5±1.36	75.37±2.85	66.25±5.67	28.76±6.10	20.0±1.63	15.24±6.91
	500	12.25±0.95	81.71±1.43	49.0±2.44	47.30±2.63	17.0±1.47	27.96±5.99
	1000	6.25±1.25	90.66±1.87	22.5±3.10	75.8±3.34	14.2±1.5	39.16±6.35
	2000	0.5±0.57	99.25±0.86	7.75±2.06	91.66±2.21	1.0±0.81	95.16±3.46
vitavax	100	5.5±2.51	91.71±3.75	56.37±5.05	39.37±5.43	20.0±1.63	15.24±6.91
	500	3.0±0.81	95.51±1.22	26.25±5.90	71.77±6.35	15.75±1.89	33.25±8.02
	1000	1.5±0.57	97.64±0.75	19.25±1.70	79.29±1.83	13.8±0.97	41.52±4.14
	2000	0	100.00±0	15.0±2.44	83.86±2.62	10.75±0.95	54.44±4.05
Control		67.0±8.94	-	93.00±0	-	23.6±5.13	-

Beniate, bavistin and dithane M-45 checked the growth of P. Purpurogenum completely even at 100 ppm concentration. Agimycin-100 was equally effective but at 1000 ppm concentration. Blitox-50, difilatan and plantavax too impaired the growth of this fungus to an extent of 87.28± 6.91, 92.58 ± 2.12 and 95.16± 3.46 percent, respectively. In cases of bavistin and benlate and fungal discs were apparently fresh, but still the growth of the fungus was completely checked. Brown colored zone was also observed around the disc in case of bavistin.

Table 2: effects of pre-inoculation treatments of the fungicides on incidence and intensity or rots produced by the pathogens.

Fungicides	**Aspergillus Disease Incidence**		**Ochraceous Rot**		**fusarium disease incidence**		**moniliforme Rot**		**Panicillium disease incidence**		**Purpurgenum Rot**	
	%I	**%In**	**%Rot**	**%In**	**%I**	**%In**	**%Rot**	**%In**	**%I**	**%IN**	**%Rot**	%IN
Bavistine (200 ppm)	100	-	8.25	84.82	60	40	3.42	90.13	40	60	5.982	76.47
Benlate (200 ppm) control	100	-	18.52	65.94	50	50	10.38	70.07	00	100	00.0	100.0
Control (inoculated)	100	-	54.38	-	100	00	34.71	00.0	100	00	25.424	0
(inoculated out Treatment)												
	slight				slight				slight			
	yellow				yellow				yellow			
Control (injured Uninoculated)	-	-	Browning of margins of injury	-	-	Browning of margins of injury	-	-	Browning of margins of injury	-	-	

An average of 2 replicates of 10 cloves each. %I=percent incident, %in=per cent inhibition, %Rot=percent Rot

B. In vivo efficacy of fungicides

Bavistin and benlate were found most effective in checking the growth of the pathogens in vitro. Therefore, 200 ppm concentration, double to in vitro does to compensate losses in treatment, was used for both pre and post-inoculation treatments.

1. Pre- inoculation treatments

Pre-inoculation chemical dip of the healthy cloves was given 3-4 hours before inoculation. % incidence and amount of rot produced was determined 15 days after inoculation (table 2).

All the cloves inoculated by A. ochraceus developed rotting symptoms (100% incidence) in spite of treatments with the fungicides. But the amount of rot produced was reduce to 8.25 and 18.25 % following treatments with bavistin and benlate, respectively, as against 54.38 % in control. The chemicals demonstrated greater influence on F. moniliforme by way of retarding its disease incidence (40 to 50 %) and intensity (70-90 %). P. purpurogenum was still more sensitive to these fungicides particularly to benlate as it failed to initiate any rot on any of the cloves treated with this chemical.it, however, managed to infect 40 % of the cloves treated with bavistin and produced on an average 5-9.8 % rot on them.

Table 3: Effect of post- inoculation treatments of the fungicides on disease development.

Treatments Days After Inoculation	Aspergillus Disease incidence		Ochraceous Rot		Fusarium disease incidence		Moniliforme Rot		Panicillium disease incidence		Purpurgenum Rot	
	%I	%In	%Rot	%In	%I	%In	%Rot	%In	%I	%IN	%Rot	
Bavistin												
A.2nd day	100	100	00	100	00	100	00	100	00	100		
B.7th day	100	00	36.741	4.44	100	00	19.43	100	00	13.697	46.12	
Benlate												
A.2nd day	00	100	00	100	00	100	00	100	00	100	00	100
B.7th day	100	00	26.409	51.43	100	00	20.00	44.39	100	00	15.975	37.16
Control (inoculated	100	00	54.383	-	100	00	34.71	-	100	00	25.424	
With out Treatment)												
	slight				slight				slight			
	yellow				yellow				yellow			
Control (injured Uninoculated)	-	-	Browning of margins of injury	-	-	Browning of margins of injury	-	-	Browning of margins of injury	-	-	

%I= per cent incidence, %In= per cent inhibition, % Rot=per cent Rot.

Table 4: Treatments of bulbs and gunny bags with the chemical for preventing spread of the diseases in storage.

	December, 1983				February, 1984			
	Spraying of chemical on bulb surface		Dipping in chemical of gunny bags		spraying of chemical on bulb surface		dipping the gunny bags in chemical	
	%	%	%	%	%	%	%	%
	Disease incidence	inhibition over control	Disease incidence	inhibition over control	Disease incidence	inhibition over control	Disease incidence	inhibition over control
A.ochraceus								
A. Treated	16.66	81.06	63.33	28.03	30.00	69.35	43.33	52.90
B. Control	88.00	-	88.00	-	92.00	-	92.00	-
F.moniliforme								
A. Treated	10.00	86.11	60.00	16.66	23.33	72.22	53.33	36.51
B. Control	72.00	-	72.00	-	84.00	-	84.00	-
P. purpuroqenum								
A. Treated	22.33	70.83	73.33	8.33	40.00	53.48	60.00	30.23
B. Control	80.00	-	80.00	-	86.00	-	86.00	-

2. Post- inoculation treatments

Both bavistin and benlate were used 48 hours and days after inoculation of the pathogens separately. % inhibition of disease incidence and amounts of rots produced by each pathogen over control were calculated and (Table3). Advent of the chemicals in contact with host and pathogen simultaneously within 48 hours of inoculation resulted in non-appearance of the diseases up to 15 days of inoculation in all cases, thereby showing hundred per cent control (Table3). But the treatments, given after 7 days of inoculation brought about only limited success in terms of either disease intensities or incidences. All the treated cloves got infections (100 % incidence) in this case, irrespective of the chemical used and pathogen inoculated. Bavistin could check 34.44, 44.03 and 46.12 % rot produced by A. ocheaceus, F. moniliforme and P. purpurogenum, respectively. Almost similar degree of influence i.e., 51.43,44.39 and 37.16 per cent was evident in cases of beniate treatment in respective cases.

3. Spraying of fungicide on bulb surfaces and dipping of gunny bags in chemical

Bavistin, when sprayed on bulb surface was found more effective than dipping of the gunny bags in this chemical in controlling the % disease incidence of the during storage (Table 4). The former treatments lowered the incidence of the disease by 70.83 to 86.11 % even two months after the treatments while the latter reduced the incidence by only 8 to 28 per cent during this period. The effectiveness of the former remained quite high (53 to 72 %) even after 4 month of treatment (in February). The latter too improved its performance by bringing about 30-52 % inhibition of the rot diseases. The effectiveness of the chemical was more

pronounced in case of F. moniliforme followed by that in cases of A. ochraceus and P. purpurogenum in decreasing order. However, the bulbs in all the bags were dried, withered and disfigured with loss of ‘garlic smell. These were also found infested with insects, mites and larvae, though their infestation was lowered in treated ones in comparison to control. Prevention and control were made by singh and nevi (2000) [3], Kapoor (2008) [1], sharma and khan (2012) [2].

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