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Effect of pre-and postharvest treatments with calcium compounds on the incidence of postharvest fruit rots of mango

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Effects of pre- and postharvest treatments with calcium nitrate and calcium chloride on the incidence of *Colletotrichum gloeosporioides* Penz. and *Diplodia natalensis* Pole Evans causing postharvest rot of mango fruits was studied by artificial inoculation on the Gangetic plains of West Bengal, India. *In vitro* study showed that both calcium nitrate and calcium chloride at different doses have significantly reduced the linear growth of *C. gloeosporioides* and *D. natalensis*, but calcium chloride was better than calcium nitrate and maximum inhibition of growth of the two pathogens occurred at 10000 ppm of calcium. Preharvest treatment showed that the percentage of fruit rot due to the two pathogens was lowest after 9 days of storage when calcium nitrate and calcium chloride were sprayed thrice @ 10000 ppm and 5000 ppm of calcium respectively, but calcium chloride was more effective than calcium nitrate at a common dose of 5000 ppm of calcium irrespective of the number of spray used. Postharvest treatment by vacuum infiltration also showed that the two test chemicals significantly reduced the fruit rot incidence after 9 days of storage, but calcium chloride was better than calcium nitrate and both the chemicals were most effective at 5000 ppm of calcium.

Key words : *Colletorichum gloeosporioides, Diplodia natalensis,* postharvest rot, mango

INTRODUCTION

Anthracnose and *Diplodia* stem end rot caused by *Colletotrichum gloeosporioides* Penz. and *Diplodia natalensis* Pole Evans, respectively, are the two major postharvest diseases of mango (*Mangifera indica* L.) in India which cause appreciable damage to the ripe fruits in storage (Tandon, 1967) and ultimately reduce the market value and affect the mango export (Pathak and Srivastava, 1967). Some workers have reported the beneficial effects of pre- and postharvest applications of calcium compounds against postharvest decay of different fruits caused by various groups of pathogens in storage (Sharples and Johnson, 1977 ; Singh *et al.*, 1981 ; Conway, 1982 ; Siddique *et al.*, 1989). But knowledge on this aspect is scanty in respect of *C. gloeosporioides* and *D. natalensis* of mango. The present study was, therefore, undertaken.

MATERIALS AND METHODS

The study was undertaken at the Postharvest Research Laboratory in collaboration with the Plant Pathology Research Laboratory of Bidhan Chandra Krishi Viswavidyalaya (BCKV), Kalyani during the months from March to June for a period of three successive years. From an ecological point of view the existing weather conditions in the Gangetic plains at Kalyani are conducive for the development of anthracnose and *Diplodia* stem end rot on mango fruits (Banik, 1995).

A susceptible variety of mango fruit (var.Himsagar) was included in the present study. The soil of the experimental orchard was alluvial with an average pH 6.5. The age group of mango trees varied from 15 to 20 years. Normal agronomic practices were followed and no plant protection measure was undertaken during the entire fruit

season.

The two pathogens *C. gloeosporioides* and *D. natalensis* were isolated from the affected fruits of var. Himsagar on potato dextrose agar (PDA) at 29±1°C. Pathogenicity of the two pathogens was confirmed by inoculating the mature fruits of var.Himsagar in each fruit season. The different calcium compounds used in the experiments were calcium nitrate and calcium chloride. The different experiments related to the fruit rot incidence in storage were : (1) effect of preharvest spray of calcium compounds on the incidence of the two fruit rot diseases and (2) effect of postharvest treatment with calcium compounds by vacuum infiltration on the incidence of the two fruit rot diseases. The other experiment under the *in vitro* condition was on the (3) effect of different calcium compounds on the linear growth of the causal pathogens.

For studying the effect of preharvest spray the test fruits were sprayed separately with calcium nitrate @ 5000 ppm and 10000 ppm of calcium and with calcium chloride @ 2500 ppm and 5000 ppm of calcium in three different sprays i.e., single, double and triple. For single spray the test fruits were sprayed once 10 days before harvest while for double spray at 20 days and 10 days before harvest, and for triple spray at 30 days, 20 days and 10 days berore harvest. Treated fruits were harvested after 10 days of the last spray on third week of May and were brought to the laboratory. Harvested fruits were cleaned by means of dry soft cloth, and after surface sterilization by absolute alcohol those were inoculated with the individual fungal spore suspension (0.5 ml/fruit) using hypodermic needle and were stored following the method described by Banik (1995). Disease incidence in the respective case was recorded on percentage basis (% fruit rot) after 9 days.

For postharvest treatment mature fruits were harvested on third week of May. After washing and air drying the fruits were treated with both calcium nitrate and calcium chloride @ 2500 ppm and 5000 ppm of calcium following vacuum infiltration method that lasted for 2.5 minutes under 250 mm pressure of Hg. Treated fruits were then inoculated with the individual fungal suspension and were stored similarly as in the case of previous experiment. Disease incidence was recorded after 9 days similarly as before.

Variation of storage temperature in respect of the experiments stated above ranged from 27° to 37°C while the humidity varied from 56% to 87%. Each treatment contained 15 fruits with 4 replications. For comparison, control was kept by inoculating fruits without any treatment of calcium.

Effects of calcium nitrate and calcium chloride on mycelial growth of *C. gloeosporioides* and *D. natalensis* were studied by using different concentrations of calcium (2500 ppm, 5000 ppm, and 10000 ppm) on PDA medium. For this purpose, the requisite amount of the test chemicals was added per litre of sterilized PDA cooled to 45°C to provide respectively the requisite concentrations. Twenty millilitre of this medium was then aseptically poured in each of the 10 cm sterilized petriplates and were seeded at the centre with 6 mm disc of the fungal pathogens. The plates were incubated at 29+1°C and linear growth of *C. gloeosporioides* and *D. natalensis* was recorded respectively after 5 days and 7 days.

RESULTS AND DISCUSSION

Effect of preharvest spray on fruit rot incidence

From the data presented in Table 1 it appears that both calcium nitrate and calcium chloride highly reduced the fruit rot incidence caused by *C. gloeosporioides* and *D. natalensis* in storage irrespective of the dose and number of spray used. Incidence of fruit rots gradually decreased with increase in the dose of calcium and number of spray used. Percentage of fruit rot was lowest when both calcium nitrate and calcium chloride were applied thrice @ 10000 ppm and 5000 ppm of calcium respectively. But the incidence of *C. gloeosporioides* was much less that *D. natalensis* irrespective of the dose of calcium and number of spray used. However, calcium chloride was better than calcium nitrate in reducing the fruit rot incidence at a common dose of 5000 ppm of calcium irrespective of the number of spray used.

Effect of postharvest vacuum infiltration on fruit rot incidence

Data presented in Table 2 show that both calcium nitrate and calcium chloride significantly reduced the incidence of fruit rots caused by *C. gloeosporioides* and *D. natalensis* in storage

irrespective of the dose used. However, calcium chloride was more effective than calcium nitrate. Fruit rot incidence gradually decreased with increase in the dose of calcium and the chemicals were most effective at 5000 ppm of calcium. Although there was a significant reduction on the incidence of *D. natalensis* but the pathogenic effect remained fairly high.

Table 1 : Effect of preharvest spray with calcium compounds on the incidence of *C. gloeosporioides* and *D. natalensis* on mango fruits in storage[a]

Calcium compound	Dose of calcium (ppm)	Number of spray	Fruit rot (%) by *C. gloeosporioides*		*D. natalensis*	
			Original value	Transformed value[b]	Original value	Transformed value[b]
Calcium nitrate	5000	One	15.30	23.03	30.00	33.21
	10000	One	10.80	19.15	27.00	31.30
	5000	Two	10.50	18.91	24.00	29.55
	10000	Two	9.20	17.66	20.00	26.32
	5000	Three	7.60	15.89	15.00	23.05
	10000	Three	4.40	12.06	5.00	13.34
Calcium Chloride	2500	One	8.60	17.05	30.00	33.21
	5000	One	6.70	15.08	20.00	26.56
	2500	Two	7.40	15.78	25.00	29.99
	5000	Two	5.30	13.27	19.00	26.07
	2500	Three	4.70	12.52	18.00	25.10
	5000	Three	4.80	11.19	11.00	19.36
Untreated (control)			45.50	42.42	55.00	47.87
SE (mean)				± 0.09		± 0.44
CD (P = 0.05)				0.20		1.02

[a] Results are an average of observations for three years
[b] Transformed values were calculated through the process of angular transformation

Table 2 : Effect of postharvest treatment with calcium compounds by *C. gloeosporioides* and *D. natalensis* on mango fruits in storage[a]

Calcium compound	Dose of calcium (ppm)	Fruit rot (%) by *C. gloeosporioides*		*D. natalensis*	
		Original value	Transformed value[b]	Original value	Transformed value[b]
Calcium nitrate	2500	32.53	30.20	35.40	36.51
	5000	23.20	28.79	26.50	30.98
Calcium chloride	2500	24.60	29.73	33.30	35.24
	5000	21.80	27.83	25.40	30.26
Untreated (control)		45.50	42.42	66.70	54.76
SE (mean)			± 0.06		± 0.56
CD (P = 0.05)			0.18		1.68

[a] Results are an average of observations for three years
[b] Transformed values were calculated through the process of angular transformation

Effect on linear growth

Table 3 show that both calcium nitrate and calcium chloride at different doses of calcium significantly reduced the linear growth of *C. gloeosporioides* and *D. natalensis* in culture. But calcium nitrate, in general, was better than calcium chloride irrespective of the doses used. Mycelial growth of the two pathogens gradually decreased with increase in the doses of calcium and the maximum inhibition of growth occurred at 10000 ppm.

From the results of the present study it also appears that preharvest spray with both calcium nitrate and calcium chloride, in general, was more effective than postharvest application in reducing the effects of both *C. gloeosporioides* and *D. natalensis* of mango in storage and calcium chloride in this regard was better than calcium nitrate. The investigations made by different workers also suggest that preharvest treatments with calcium compounds were more effective in the control of postharvest decay and maintaining the fruit quality in storage. Sharples and Johnson (1977) demonstrated that orchard spray with different calcium compounds was found more effective for reducing the incidence of *Gloeosporium perennas* of mango in storage, while Siddique *et al.* (1989) reported that preharvest application of calcium chloride and calcium nitrate decreased spoilage in ber fruit (*Zyziphus mauritiana* Lank.). Singh *et al.* (1981), however, obtained reduced rate of disease development in guava fruits by postharvest dipping in different concentrations of calcium nitrate.

Table 3 : Effect of calcium compounds on linear growth of *C. gloeosporioides* and *D. natalensis* on PDA medium

Calcium compound	Dose of calcium (ppm)	*C. gloeosporioides* Linear growth (mm)	*D. natalensis* Linear growth (mm)
Calcium nitrate	2500	68.8	68.3
	5000	62.4	58.5
	10000	58.3	31.0
Calcium chloride	2500	77.6	72.4
	5000	61.5	67.5
	10000	59.7	46.7
Control (without any does of calcium)	88.0	76.5	
SE (mean)		± 0.09	± 0.08
CD (P = 0.05)		0.20	0.19

It may be further noted that calcium nitrate, in general, was better than calcium chloride for the inhibition of growth of both *C. gloeos/orioides* and *D. natalensis in vitro*. But calcium chloride was more effective than calcium nitrate in reducing the incidence of both *C. gloeosporioides* and *D. natalensis in vivo*. The results indicate that growth of the both fruit rot pathogens of mango in response to calcium nitrate and calcium chloride *in vitro* has no direct relation with the disease incidence *in vivo*. Better action of calcium chloride than calcium nitrate against disease development in the present case might be attributed due to greater uptake of calcium from calcium chloride by the test fruits. This phenomenon was reported by Scott and Wills (1977, 1979) who observed that vacuum infiltration with calcium chloride solution increased the calcium content of apple fruit. Lidster *et al.* (1978) also reported that both pre- and postharvest treatments of apple fruits with 4% calcium chloride solution significantly increased the calcium level and decreased the break down of stored fruits.

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