

Bio-efficacy of potassium phosphonate against nut rot disease of areca nut (*Areca catechu* L.) in the northern Karnataka of India

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Abstract: *Phytophthora arecae*, a causal agent of nut rot disease (*koleroga*) of areca nut (*Areca catechu* L.) is one of the major fungal pathogens affecting the crop in the northern Karnataka of India. The estimated loss associated with this disease extends up to 60%. In the endemic regions of India, the disease occurs immediately after the onset of the monsoon rains (June) and prevails till mid-August due to congenial weather conditions. For the effective management of this devastating disease, potassium phosphonate was tried during June and July 2013-2014 at the farmer's fields. The results revealed that potassium phosphonate applied at the rate of 6.0 ml/L has reduced the per cent disease incidence (PDI) in areca nut (PDI=19.5%), where the results were on par ($p>0.05$) with metalaxy MZ applied at 2.0 g/L (PDI=16.81%) and Bordeaux mixture applied at 1% (w/v; PDI=18.84%). However, potassium phosphonate at 3.0 ml/L (PDI=43.10%) and 4.5 ml/L (PDI=39.45%) was not effective in reducing the PDI. The maximum PDI of 52.87% was recorded in unsprayed control plots. The highest yields of 26.42 q/h was recorded from the plots sprayed with metalaxy MZ at 2.0 g/L, which is in par ($p>0.05$) with potassium phosphonate applied at 6.0 ml/L (24.76 q/ha) and Bordeaux mixture at 1% (25.12q/ha). The lowest yield (12.48 q/ha) was recorded from the control (unsprayed) plots.

Keywords: Areca nut, *Phytophthora arecae*, nut rot disease (*koleroga*), potassium phosphonate

Introduction

Areca nut (*Areca catechu* L.), popularly known as betel nut, is an important plantation crops in India. This crop is being grown in an area of 0.38 m ha with an annual production of 0.48 mt in major cities such as Karnataka, Kerala, Assam, Maharashtra, West Bengal and Tamilnadu of India (Jose *et al.*, 2008). India leads in the cultivated extent and production of areca nut and also in average yields of the crop. Other main countries growing areca nut are Bangladesh, Sri Lanka and Malaysia. In Karnataka of India, Uttara Kannada is one of the major areca nut growing districts and the estimated production is 16,700 mt from an area of 12,290 ha. Although India has attained self-sufficiency in this crop, *koleroga* (nut rot) caused by *Phytophthora arecae* is the major production constraint in areca nut (Rather *et al.*, 1982).

This disease occurs during the south west monsoon season and results in heavy dropping of nuts from bunches and the death of the palms at advanced

stages (Kamath, 1953; Sastry, 1982). The previous records on crop losses due to nut rot varied from 10-90%, and due to bud rot the crop losses is about 15% (Coleman and Rao, 1918).

The disease is characterized by sudden heavy shredding of immature nuts, which lies scattered near the base of the palms. On closer observations of the nuts, dark coloured white lesions are seen near the perianth. The control measures suggested by the previous workers to control the disease comprised of either providing covers made out of areca nut leaf sheaths (*kotte*) or dried grass (*karada*) to areca nut bunches or spraying Bordeaux mixture (1% w/v) to the bunches 2-3 times (Narasimhan, 1922). However, the covers could either dislodged or be damaged by heavy winds or deteriorate during the rains in the monsoon resulting rainwater percolation into bunches providing favorable condition for *Phytophthora* infection. In case of Bordeaux mixture sprays, the difficulty lies with use of calcium carbonate and copper sulphate of various qualities and difficulties in application during the rains. Spraying with Bordeaux mixture followed by covering bunches with polythene has also been suggested in the recent past as a better technique to manage the disease however, being time-consuming and laborious nature of the activity has failed in acceptance by farming communities. Hence, identification of chemicals that has both fungicidal properties and providing nutrition to be used immediately after the occurrence of the disease to minimize the yield losses was considered important to control the disease as well as to promote crop growth. The present study was undertaken to evaluate the bio-efficacy of a new molecule potassium phosphonate (Phosfik 8[®]) in managing *koleroga* of areca nut in the endemic region of Uttara Kannada district in India.

Materials and Methods

Farmers plot at Bilaghi village of Siddapur Taluk of Uttara Kannada district in India was selected for the experiment during *kharif* 2013-2014, which was situated in valleys with thick perennial trees on both sides. The humidity during the rainy season was almost 100% and the gardens were prone to *koleroga* infestation during the previous years. The experiment was conducted in a randomized complete block design (RCBD) with seven treatments and three replicates. The plot size was 13 m X 8 m with spacing of 1.2 m X 1.2 m. In each treatment 20 palms were considered for observations. During the south west monsoon (*kharif*) of 2013-2014, the field experiment was laid out to investigate the efficacy of various concentrations of potassium phosphonate (Phosfik 8[®]). Prophylactic spray with Bordeaux mixture (1%) and market sample of potassium phosphonate applied at 3%, metalaxyl MZ at 0.2% was also used (Table 1).

Table 1. Treatment structure

Serial No.	Treatments	Dosage (ml/L)	Application Time & Method
1	Potassium phosphonate-8	3.0	The first spray was given immediately after the onset of the disease and subsequent spray at 30 days interval using gutter sprayer. Used at 45 days interval.
2	Potassium phosphonate-8	4.5	
3	Potassium phosphonate-8	6.0	
4	Potassium phosphonate-8 (market sample)	3.0	
5	Metalaxyl MZ 68WP	2.0	
6	Bordeaux mixture	1%	
7	Control	---	

Per cent Disease Index (PDI) for *Koleroga* of Areca nut

In each micro plot, five palms were randomly selected and graded for *koleroga* using 1-6 scale as given by Sastry and Hegde (1987; Table 2).

Table 2. Grading scale of *koleroga* (nut rot disease)

Grades	Description
1	1-10% nut fall from bunches
2	11-25% nut drop
3	26-50% nut drop
4	51-75% nut drop + spread of the disease to bunch stalk
5	76-100% nut drop + spread of the disease to the main stalk of the bunch
6	Crown death

The PDI was calculated using Equation 1

$$\text{Per cent Disease Index} = \frac{\text{Sum of Numerical ratings}}{\text{Total No. of plants} \times \text{Maximum grade}} \times 100 \quad \text{Equation 1}$$

The PDI and yields per palm were recorded and later analyzed by using standard statistical methods. The yields were converted in to q/ha.

Results and Discussion

The results revealed that potassium phosphonate applied at the rate of 6.0 ml/L (T₃) significantly reduced the *koleroga* incidence in areca nut (19.48% $p < 0.05$; Table 2) and has found on par with metalaxy MZ at 2 g/L (T₅; 16.81%) and Bordeaux mixture at 1% (T₆; 18.84%). The market sample of potassium phosphonate (Akomin[®]) applied at 3.0 ml/L showed a PDI of 36.18%. However, potassium phosphonate applied at 3.0 ml/L (43.4%) and 4.5 ml/L (39.45%) was

inferior in reducing the PDI. The maximum PDI of 52.87% was recorded in the control (T7).

Table 2. Evaluation of Potassium phosphonate against *koleroga* in areca nut

No.	Treatments	Per cent disease incidence (PDI)			Yield q/ha
		Before spray	After I spray	After II spray	
1	Potassium phosphonate-8 at 3.0 ml/L	13.0 (21.13)*	25.21 (30.13)	43.40 (41.21)	15.88
2	Potassium phosphonate-8 at 4.5 ml/L	12.58 (20.79)	26.96 (31.24)	39.45 (38.94)	17.76
3	Potassium phosphonate-8 at 6.0 ml/L	12.18 (20.44)	15.60 (23.26)	19.48 (26.21)	24.76
4	Potassium phosphonate-8 at 3.0 ml/L (market sample)	15.50 (23.19)	27.48 (31.63)	36.18 (36.99)	18.59
5	Metalaxyl MZ at 2.0 g/L	13.14 (21.30)	13.28 (21.39)	16.81 (24.20)	26.42
6	Bordeaux mixture at 1%	12.48 (20.70)	16.21 (23.73)	18.84 (25.70)	25.12
7	Control	13.16 (21.30)	28.19 (32.08)	52.87 (46.66)	12.48
	SEm+**	1.01	1.07	1.11	1.12
	CD (p=0.05)***	NS	3.19	3.31	3.28

*Values in parenthesis are angular transformed values; ** standard error of the means; ***Critical difference

The highest yield of (24.76 q/ha) was recorded in the plots sprayed with potassium phosphonate at 6.0 ml/L (T3), which is in par ($p>0.05$) with 26.42 q/ha in the plots sprayed with metalaxy MZ at 2.0 g/L (T5) and Bordeaux mixture at 1% (T6; 25.12 q/ha). The lowest yields of 12.48q/ha was recorded in the untreated plots (T7) plots.

Among the various concentrations of potassium phosphonate evaluated, application of the chemical at the rate of 6.0 ml/L has significantly reduced the PDI and increased the yields. This is an agreement with Hegde and Mesta (2014) who reported that in cocoa, spraying with potassium phosphonate at 6.0 ml/L and drench at 4.0 ml/L has reduced the incidence of pod rot caused by *P. theobromae*. Phosphonate fungicides have been found to inhibit several key enzymes needed for growth and development of *P. palmivora*. It is also opined that the combined application of *Trichoderma harzianum* + potassium phosphonate significantly reduces the populations of *Phytophthora* causing foot rot of black pepper (Anon, 1997). It is assumed that the mode of action of potassium phosphonate did not involve killing the fungus directly rather it involved in a stimulation of the plants natural chemical and physical defenses against disease (Jahagirdar *et al.* 2000). However, spraying with metalaxyl MZ at

2.0 g/L and Bordeaux mixture at 1% was in par with the potassium phosphonate. Ramachandran and Sarma (1985) reported that the systemic fungicide metalaxyl (Ridomil[®], Matco 8-64[®]) and Fosetyl Al (Aliette[®]) both as foliar spray and soil drenching were effective against *P. capsici* in the field conditions. Similar results have been reported on the efficacy of metalaxyl against *Phytophthora* infections in black pepper (Sastry 1982; Anon 1986). This may be due to the reduced number of secondary inoculum due to the antispore activity of this fungicide there by restricting the rapid secondary spread of the disease.

The results conclude that two sprays at monthly intervals with potassium phosphonate (Phosfik 8) at the rate of 6.0 ml/L was effective in managing *koleroga* (nut rot disease) of areca nut.

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