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Evaluation of new fungicides against the leaf blight disease of cardamom [*Elettaria cardamomum* Maton] in arecanut based intercropping system

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Abstract
Leaf blight of cardamom incited by the fungal pathogen *Colletotrichum gloeosporioides* (Penz.) has become a major and wide spread leaf disease in major cardamom growing regions of South India. Attempts were made to find out the best suitable fungicide for the management of leaf blight of cardamom in arecanut based intercropping system. Among the fungicides tested combination fungicide SAAF (carbendazim + mancozeb) @ 0.2 % and carbendazim @ 0.1 % are found to be more effective in cardamom leaf blight disease management fallowed by hexaconazole. The plants treated with SAAF (carbendazim + mancozeb) were consistently recorded less disease intensity consecutively for three years. Other fungicides propeconazole and difenconazole did not show better performance compared to SAAF (carbendazim + mancozeb) and carbendazim. The information generated from the study is useful in formulating effective and economical method of disease management.

Keywords: Leaf blight, Cardamom and New-generation fungicides.

Introduction
Small cardamom (*Elettaria cardamomum* Maton) the genus belongs to the natural order Scitamine, family *Zingiberaceae* under Monocotyledons, it is basically growing under shade in evergreen forest or inter cropping with some plantation crops. This crop is popularly called as "Queen of Spices" have greater and exceptional pose in the global spices market as one of the most important spice crop. India, Guatemala, Tanzania, Sri Lanka, Vietnam, Laos, Cambodia and Papua New Guinea are the major cardamom growing countries. Currently, Guatemala has emerged as world's largest producer of cardamom in the world. In India, cardamom is cultivated in southern states of Kerala, Karnataka and Tami Nadu. Cardamom is generally used for flavouring agent for various food preparations, confectionary, beverages and liquors. It is also used for medicinal purpose both in allopathy and ayurveda systems. In the Middle East countries, cardamom is mainly used for preparation of 'Gahwa' (cardamom flavoured coffee).

Cardamom plants suffer from various diseases and pest in different stages of its growth. Among the leaf diseases leaf blight/Chenthal disease is the most devastating, wide spread and economically important leaf disease of cardamom in most of the cardamom growing regions in India. The leaf blight of cardamom incited by fungal pathogen *Colletotrichum gloeosporioides* Penz. (George, 1976; Govindaraju, 1998) [3, 5] and it was first reported from Idukki district of Kerala state in India (George, 1977) [4]. This disease is commonly appears during the rainy season as well as in wet season, regular occurrence of this diseases is lead to cause annual economical yield loss of 7-13 percent (Praveena and Biju, 2012) [7]. The symptoms of the disease are initially manifests on the younger leaves as yellowish lesions which later coalesce together to form large blighted areas on the leaves. The affected area eventually dries up giving a burnt appearance to the plant (Praveena *et al*., 2012) [7]. Several fungicides have been recommended to manage this disease, however, considering the damages caused by this disease the study was undertaken to evaluate new-generation fungicides against leaf blight disease of cardamom in arecanut based intercropping system. The data generated from this study will be useful for development of new tool to an integrated disease management in

cardamom plantations.

Materials and Methods

Field experiments were carried out to evaluate the new-generation fungicides for cardamom leaf blight disease management in arecanut based cropping system. The trials were conducted in three consecutive disease seasons at Horticultural Research and Extension Station, Sirsi, UttaraKannada, Karnataka. The Research Station lies between 13^0- 55' and 15^0-31' North latitude and 74^0-9' and 75^0-10' East longitude and receives plentiful average rainfall around 2500 mm per annum, which supports diverse vegetation at different elevation and falls under IX agro-climatic zone of Karnataka. Experiment was carried out in four year old cardamom plants with three replication. The experiment includes recommended and new-generation fungicides viz., macozeb+carbendazem (SAAF), carbendazim (bavistin), difenconazole (score), hexaconazole (contaf), Propeconazole (Tilt) and untreated control plants were also maintained throughout the study. Treatments were imposed under the natural infection condition after the initiation of symptoms in the field. Three rounds of sprayings were carried out at on interval of 12 to 15 days and spraying was done by using high volume power operated mist blower. The disease intensity were recorded after each round of spraying by using 0 - 5 disease scoring scale based on the intensity of leaf spot and leaf deformation. 1 – No infection, 2 – Few spots + 10% infection of leaf area, 3 – Elongated spots + 25% infection of leaf area, 4 – Coalition of spots + 50% Infection of leaf area, 5 – Extensive spots + > 50% Infection of leaf area. The percent disease index (PDI) was calculated and the data was subjected to statistical analysis. Further, the progressive disease suppression (DS) at i^{th} (i = 0, 1, ……, n) round of spraying was calculated and expressed in percentage using the formula (Manju *et al*., 2002) [6]

$$DS_i = \frac{(DI_0 - DI_i)}{DI_0} \times 100$$

Where, DI_0 and DI_i are the average PDI scores at the initial stage (o^{th} day) and i^{th} day respectively.

Results and Discussion

Feasibility of new-generation systemic fungicides in cardamom leaf blight disease management is presented the Table 1. The results of the study indicated that the spraying of combination fungicide SAAF (macozeb + carbendazim) @ 2g/l found to be more superior to previously recommended fungicide carbendazim and other new-fungicides tested. The cardamom clumps treated with SAAF recorded the final percent disease intensity of 10.50, 9.30, and 11.40 respectively during first, second and third disease season. The clumps treated with recommended fungicide carbendazim recorded the disease intensity of 12.50, 10.00 and 13.30 percent respectively for three consecutive disease seasons, followed by hexaconazol (contaf) showed positive response towards the disease management and recorded disease intensity of 18.80, 19.60 and 19.40 percent respectively for first, second and third disease season. The clumps treated with other fungicides showed lesser response over the leaf blight disease management and recorded comparatively higher disease intensity ranging from 23.00 to 31.30 percent in all the three disease seasons tested.

Comparative disease suppression after individual rounds of spraying is presented in Fig.1. A combination fungicide SAAF @ 2g/l showed higher rate of disease suppression in all the three season. SAAF is a fungicide that contains both contact as well as systemic action, by virtue of its systemic nature, chemical penetrates and move into the plant system and it helps to distribution on the surface, consequently, showing better disease control (Vyas, 1993) [10] and it also expected to protects the emerging younger leaves from the initial infection. Use of SAAF in cardamom plantation is more advisable and beneficial than the contact/systemic single fungicides recommended, because of it is an evident that regular and repeated use of systemic/contact fungicides could lead to development of resistance in the pathogen. This can be handled safely by using efficient fungicides either in mixture or alternatively for effective disease management (Del, 1980) [1]. The disease is more aggressive in mid monsoon period and field population of the pathogen is also varied from period to period. Hence the periodical monitoring of pathogen development, distribution, virulence and pathogen population is also essential for disease management since (Sung Kee Hong, 2008) [9].

Table 1: Evaluation of new fungicides for the management of leaf blight of cardamom under arecanut based intercropping system

Sl. No.	Treatments	Dosage (% a.i)	Disease intensity (%)		
			Season 1	Season 2	Season 3
1	Mancozeb+carbendazim (SAAF)	0.2	10.50	9.30	11.40
2	Carbendazim (Bavistin)	0.1	12.50	10.00	13.30
3	Difenconazole (Score)	0.1	24.40	23.50	23.00
4	Hexaconazol (Contaf)	0.1	18.80	19.60	19.40
5	Propeconazole (Tilt)	0.1	25.50	24.50	24.50
6	Control	Unsprayed	30.50	29.6	31.30
CD (P<0.05)			3.64	2.89	3.24

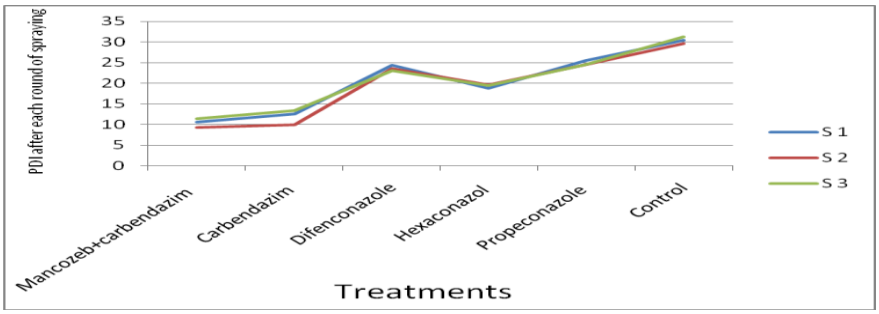

Fig 1: Cardamom blight disease suppression after individual rounds of spraying of Fungicides.

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