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REVIEW OF LITERATURE ON BIO-INTENSIVE PEST AND DISEASE MANAGEMENT (BIPM) MODULE IN SMALL CARDAMOM

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Abstract: Cardamom (Elettaria cardamomum Maton) known as the "Queen of Spices" originated in the Western Ghats of South India. It is one of the most highly priced and exotic spices in the world. The total world production of this spice is around 35,000 MT per annum and the largest producing country is Guatemala followed by India. Tanzania, Sri Lanka, EL Salvador, Vietnam, Laos, Cambodia and Papua New Guinea are the other cardamom growing countries. Cardamom is used for flavoring various food preparations, confectionary, beverages and liquors. It is also used for medicinal purpose, both in Allopathy and Ayurveda systems. The major consuming countries of cardamom are the Middle Eastern countries, India, Pakistan, European countries, the U.S and Japan. Middle Eastern countries such as Saudi Arabia and the United Arab Emirates, and South-East Asian countries such as India account for more than 60 % of the world's consumption. In India, Cardamom cultivation is confined mainly to the Western Ghats of Kerala, Karnataka and Tamil Nadu. Kerala accounts for 60% of the cultivation and production followed by Karnataka 30 % and Tamil Nadu 10 %. Idukki district in Kerala is the major cardamom producing area.

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Introduction

Small cardamom [Elettaria cardamomum (L .) Maton], the "Queen of Spices" enjoys a unique position in the International spices market, as one of the most sought after spices. It is indigenous to the southern stretch of evergreen forests of Western Ghats. In India, small cardamom is cultivated in the Southern States of Kerala, Karnataka and Tamil Nadu. Kerala accounts for 87 percent of the cultivation followed by Karnataka (8 percent) and Tamil Nadu (5 percent). The total area under small cardamom in India is estimated to be around 69,000 hectares (www.indianspices.com). Small cardamom is used for flavoring various food preparations, confectionery and beverages. It is also used for medicinal purpose, both in modern and indigenous systems of medicine.

The small cardamom of commerce is the dried fruit (capsule) of the plant, Elettaria cardamomum Maton. The genus belongs to the natural order Scitamineae, family Zingiberaceae under monocotyledons. It is basically a sciophytic plant/shade loving plant growing under shade in evergreen forests. Small cardamom plants mature in about 20 to 22 months after planting. Economic yield starts from third year of planting and it continues up to 8 to 12 years for high yielding varieties depending upon the level of management. Mysore, Malabar and Vazhukka are the three types of cultivars of small cardamom varieties and are highly location specific. In order to raise a small cardamom plantation, suckers or seedlings of high yielding varieties suitable to respective locations are to be used. If virus free production of planting material could be ensured, vegetative propagation through suckers is the best method. However, vegetative propagation has the inherent disadvantage of reducing genetic base of small cardamom. Traditionally, small cardamom plantations were raised from seeds.

Small cardamom is susceptible to diseases and pests. The crop loss is estimated to be approximately 20-40% of production due to various pests, diseases and weeds. Diseases alone can cause up to 50 percent of total loss if not managed properly. Small cardamom being an export-oriented spice crop, the responsibility of spices growers is to maintain sustainable yield and quality of produce.

The genus Elettaria

Cardamom belongs to the genus Elettaria, and species cardamomum (Maton). The genus name is derived from the Tamil word 'Elettari', meaning cardamom seeds. The genus comprises about six species (Mabberly, 1987), ofthese only E, cardamomum Maton occurs in India, and this is the only economically important species. E. ensal (Gaertn.) Abeywick (E. major Thaiw.), a native of Sri Lanka, is the closely related species ofE. cardamomum. It is a much larger and sturdier plant; and is known as the Sri Lankan (Ceylon) wild

cardamom, and its taste and flavour are far inferior to the true cardamom. The Malaysian species, E. longituba (Ridl.) Holtt., is a large perennial herb, with flowering panicles sometimes reaching a length ofover 3 m (Holttum, 1950). The related genera are Elettariopsis and Cyphostigma, both genera occur in Malaysia-Indonesia region

Origin and distribution

Cardamom is a native ofthe moist evergreen forests ofthe Western Ghats of southern India. It is cultivated extensively in the hills ofthe Western Ghats ofthe southern States: Kerala, Karnataka and Tamil Nadu at an elevation of 800-1300 m as an under crop in forest lands. Cardamom thrives well in areas receiving an average annual rainfall of 1500-4000 mm and a temperature range of 10-35°C (Korikanthimath, 2002).

Besides India, cardamom is cultivated commercially in Sri Lanka, Papua New Guinea, Tanzania and in Guatemala. Till 1980, India was the world's largest producer of cardamom, but oflate Guatemala has emerged as a keen competitor in the international spice market. Now about 90% of global trade in cardamom is the contribution from Guatemala (Gowda, 2012). The cardamom growing regions ofSouth India lies within 8° and 30° N latitudes and 75° and 78° 30_ E longitudes. These areas lie on both sides -the windward and leeward - ofthe Western Ghats which acts as a climatic barrier ofthe monsoon trade winds, thereby determining the spatial distribution ofrainfall. The rainfall pattern differs among the cardamom growing regions located in Kerala, Karnataka and Tamil Nadu (Nair et al., 1991).

Cardamom description

Cardamom is a herbaceous perennial with branched underground rhizome, which gives offseveral erect leafy shoots. The leaves are distichous, dark green, lanceolate with an acuminate apex, lightly pubescent or glabrous below (25-90 X 5-15 cm) and have sheathing leafbases. Inflorescence usually borne separately on a prostrate (or erect or semi erect) panicle with a stalk up to 40 cm (or more in certain cases) in length. Bracts are lanceolate, acute glabrous, rather persistent but becoming fimbriate with age (2-3 x 0.8-1 cm). Cincinni many flowered. Bracteoles up to 2.5 cm long, tubular, mucronate, glabrous. Calyx up to 2 cm long, 2- or obscurely 3-lobed, lobes mucronate. Corolla tube about as long as calyx; lobes 1-1.5 cm long, rounded at the apex, the dorsal tube widest. Labellum white in colour with violet streaks, obovate, obscurely 3-lobed, narrowed at the base. Lateral staminodes inconspicuous, subulate. Anther sessile, with about 1 cm long, parallel theca; connective prolonged into a short, entire crest. The flowers are self-sterile. Fruit is a capsule, creamy-white, oblong or more or less globose, shortly beaked, three-sided capsule with a fibrous, papery and longitudinal wrinkled pericarp (Madhusoodanan et al, 2002)

Essential oil of cardamom is the source for its aroma and flavour. As early as 1908 there were reports that cardamom oil contained terpinene, sabinene, limonene, 1, 8-cineole, a-terpineol, a-terpinyl acetate, terpinen-4-yl formate and acetate and terpinen-4-ol (Guenther, 1975). The characteristic odour and flavour ofcardamom is determined by the relative composition ofthe components ofvolatile oil. Researchers have shown that a low 1, 8-cineole and high a-terpinyl acetate content can enhance the total flavour quality ofthe Indian cardamom.

Cytology

According to Gregory (1936) the basic chromosome number of cardamom is x=12 and 2n=48, indicating a balanced tetraploidy. This was further confirmed by the reports ofRamachandran (1969) and Sudharshan (1989). However, Chandrasekhar and Sampath Kumar (1986) observed variation in number as well as in morphology of chromosome ofvar. Mysore and var. Malabar and concluded that aneuploidy as well as structural alterations in chromosome has contributed to the varietal differentiation. According to them, from a karyological standpoint, var. Mysore stands at a higher rank in the evolutionary ladder.

Disease Management:

Management ofKatte disease depends mainly on the use ofhealthy planting material. Cardamom being propagated vegetatively, the infected material serves as the primary source ofinfection from which the disease is further spread by viruliferous vectors. As titre ofthe virus, seasonal variations, age, resistance and susceptibility of the genotype affects symptom expression, visual diagnosis of viral diseases cannot be employed as a fool proof criterion for identification ofthe infected plants (Biju et al., 2010). Thus, it is necessary to develop a proper diagnostic tool for identification and production ofdisease free planting material

Periodic surveillance ofthe plantation and removal ofinfected plants are also necessary (Venugopal, 1995). The removed plants are to be destroyed either by fire or by burying them underground at a depth of 3 ft and this practice should be done once in 3 months (Deshpande et al, 1972). Another important strategy for the management of the disease spread is controlling the vector population. Because of concealed placement ofthe aphid colonies in the older parts ofthe plant, the possibilities of direct access to contact and indirect contact with systemic insecticides are less (Rajan et al, 1989). Sometimes, the insecticide application may disturb the sluggish vectors and prompt them to take frequent migrations from infected plants resulting in faster spread. Thus, insecticides are ineffective in preventing the disease spread.

Venugopal (1999) identified 17 disease escapes as source ofresistance to mosaic disease by screening 134 disease escapes collected from the hot spots ofthe disease from Appangala, Pallakere and

Madenadu ofKodagu District, Karnataka and Salkeri ofUttara Kannada District, Karnataka. After further evaluation ofthese 17 collections, three lines were identified viz., Natural katte Escape (NKE) 9, NKE 12 and NKE 19 with mosaic resistance combined with good capsule characters (Venugopal, 1999). The collection NKE 9 was later released by Indian Institute ofSpices Research, Kozhikode, Kerala, as the katte resistant variety IISR-Vijetha, The variety is also known to be high yielding with a yield potential of 979 kg/ha.

The disease is confined to some endemic pockets in Karnataka (Venugopal and Govindaraju, 1993; Govindaraju et al, 1994). It was first observed in Hongadahalla which is the hot spot area ofthis disease. Later it was reported from Kodagu, Hassan and Uttara Kannada Districts ofKarnataka (Venugopal, 1995; Venugopal, 2002; Biju and Bhat, 2012). The plants infected with kokke kandu decline rapidly and the yield reduction is to the extent of 62-84% in the first year ofpeak crop (IISR, 1997). So far, there is no report ofkokke kandu disease from Kerala.

The disease is transmitted through cardamom aphid, P. caladii in a semipersistent manner (IISR, 1996) or persistent manner (Anand et al., 1998) and not by mechanical or other means. Incubation period range from 22-128 days and a single viruliferous aphid can transmit virus to plants ofall stages. The etiology ofthe associated virus is not yet deciphered. Electron microscopic observations using crude and clarified sap revealed the presence offlexuous particles with dimension 710 - 740 x 12 nm (IISR, 1997). A few isometric particles were also observed in the partially purified preparations ofleafsheath ofinfected cardamom (IISR, 2002). Enzymelinked immunosorbent assay (ELISA), indicated that it could be a member ofPotyvirus group (Venugopal et al., 1997b).

Cardamom necrosis/Nilgiri necrosis disease was first noticed in Nilgiris, Tamil Nadu and hence the disease is also known by its place of origin, Nilgiri necrosis (Anonymous, 1985). At present, the disease is known to occur only in a few pockets in Kerala and Tamil Nadu with very low incidence of0.1 to 1% (CPCRI, 1985). Thus the disease is of less significance at present. Infected plants show typical variegated symptoms on leafwith characteristic slender to broad radiating light and dark green stripes on the lamina. Distortion of leaves, tillers and stunting are other common symptoms. Infected plants become unproductive within the same year ofinfection. All the types of cardamom cultivars are susceptible to the disease (Sridhar, 1988).

Chlorotic streak disease caused by Banana bract mosaic virus (BBrMV) is a new and emerging disease ofcardamom (Siljo et al, 2012). The disease is characterized by continuous or discontinuous chlorotic streak along the veins and midrib. For long this virus was known to be associated with banana only. A detailed study ofthis disease was undertaken in this work.

Biological properties that have much relevance to the detection ofviruses are symptoms, host range and mode oftransmission (Mukhopadhyay, 2010). Symptoms on plants are the primary criteria for characterizing a disease. Many factors such as virus strain, host plant cultivar/variety, time ofinfection, and the environment influences the symptom expression (Matthews 1980), thus, symptoms alone cannot be taken as a sole criteria for virus identification (Walkey, 1985). The symptoms may also be a result of the combined infection ofmany viruses, or different viruses can cause same symptoms or sometimes the plants may not express any symptoms. Specific plant viruses are known to infect a unique combination ofplant species, and this phenomenon is known as the “HostRange” ofthe virus (Mukhopadhyay, 2010). Some viruses have a very wide host range such as Tobacco rattle vims (400 plant species belonging to 50 different plant families), Cucumber mosaic virus (1200 plant species belonging to 100 different plant families), etc. whereas some are having a very narrow host range {Watermelon mosaic virus 1 infects plants belonging only to the plant family Cucurbitaceae). This was the only approach available for virus identification during the 1920s and 1930s and is still applied in the identification ofnew isolates in most laboratories around the world. But conflicting results may be obtained in tests done in different laboratories with the same virus isolate because of differences in environmental conditions, or use ofdifferent cultivars or genetic lines ofthe same plant species (Mukhopadhyay, 2010).

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