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Seasonal Population Fluctuations of *Dolichotetranychus floridanus* (Banks) (Acari: Tenuipalpidae) on Areca Palms of Kerala, India

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Abstract. A*reca catechu* L. is an economically important plantation crop in Kerala and is susceptible to infestation by the tenuipalpid mite *Dolichotetranychus floridanus*. This study investigated the seasonal abundance and feeding-associated damage of *D. floridanus* on arecanut in Kozhikode and Malappuram districts of North Kerala during 2022–2023 and 2023–2024. Monthly sampling of infested and uninfested nuts revealed peak mite abundance during July–August, with mean densities of 66 and 54 individuals per tepal in Kozhikode and Malappuram, respectively. Mite abundance was positively correlated with relative humidity and negatively correlated with temperature. Feeding caused tissue desiccation, epidermal deterioration, and surface cracking, with severe infestation associated with secondary fungal and bacterial infection and tissue rot. The findings highlight the seasonal dynamics and potential phytopathological significance of *D. floridanus* infestation in arecanut plantations of North Kerala.

Key words: *Areca catechu*, Tenuipalpidae, Stereo Zoom Microscope, *Dolichotetranychus floridanus*..

INTRODUCTION

Kerala occupies a unique geographical position in India, bordered by the Arabian Sea to the west and the Western Ghats to the east. Agriculture is a major sector of the states's economy, contributing approximately 8.30 % to its gross income (Grant Thornton Bharat, 2023). *Areca catechu* L. (Arecaceae) is an economically and culturally important plantation crop in Kerala, where its nuts are widely used for chewing as well as in religious and social ceremonies in India (Murthy, 1968).

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Kerala accounts for 22.47% of the total area under arecanut cultivation in India, and contributes 13.70% of national production (Karunakaran, 2016).

Over the past two decades, arecanut cultivation in Kerala has expanded with the adoption of improved varieties of areca palms, under changing agro-climatic conditions. Areca palms are attacked by a wide range of insect and non-insect pests that infest stems, leaves, inflorescences, roots and nuts of areca palms, at different growth stages. Among these, mites are considered serious pests, particularly in young plantations, where they damage leaves and nuts and become more active during hot weather conditions (Patel and Rao, 1958). All Tenuipalpid mites are phytophagous and feed on epidermal and sub epidermal tissues of leaves, stems and fruits (Beard et al. 2015). Apart from the direct feeding damage, many species of Tenuipalpid mites act as vectors of plant viruses that attack major horticultural crops (Kitajima et al. 1997).

Dolichotetranychus floridanus (Pineapple red mite) is an economically important mite tenuipalpid mite known to cause severe damages to its host plants (Rohrbach and Johnson, 2003). Although it primarily infests pineapple plants-causing stunted growth and reduced fruiting, especially in young plants – it is highly host-specific, similar to other flat mites. The present study identifies *A. catecheu* as a new host plant for *D. floridanus*. Information on this mite in India is limited; therefore, the present work aims to document its seasonal population dynamics and assess the severity of damage caused to arecanut in Malappuram and Thrissur districts of Kerala through qualitative evaluation during 2023 -2024.

MATERIALS AND METHODS

Mite infested arecanut samples were collected from ten geo referenced sites - five each in Kozhikode and Malappuram districts, Kerala, covering monsoon, winter and summer seasons, (June – May) to assess incidence, seasonal abundance and qualitative damage caused by mites. The sampling locations and their coordinates were Ramanattukara 11. 178 N, 75.865 E, Pantheerankavu 11.28N 75.78 E, Kunnamangalam 11.3046 N. 75.8777 E, Koduvally 11.32 N, 75.94 E, Mukkam 11.300 N, 75.975 E, Valluvambram 11.06 N, 75.93 E, Areekode 11.189 N, 76.225 E, Edavanna 11.212 N, 76.146 E, Malappuram 11.072 N, 76.074 E and Kondotty 11.111 N, 75.952 E.

Sampling sites were selected based on the presence of consistent arecanut cultivation. Samples were collected twice monthly from each locality. At each site, mature palms of uniform age were selected and infested nuts were identified based on visible symptoms of mite infestation. Random sampling was performed from *A. catecheu* plants. Collected samples were placed in labelled polythene bags and transported to the laboratory, for microscopic observation. In the laboratory, tepals from collected nuts were examined under a Zeiss Stemi DV4 stereo zoom microscope (Carl Zeiss, International). Data on incidence, relative abundance, population density, and nature of damage induced by *D. floridanus* were recorded. Infestation severity was assessed using two complementary approaches: mite density estimation and qualitative symptom categorization. Based on mean mite density per unit area, infestation severity was classified as low (< 10 mites cm^{-2}), moderate (12–30 mites cm^{-2}), or high (> 30 mites cm^{-2}).

Mites were gently removed from infested nuts using a camel hair brush and transferred to ten fresh tepals placed in culture cells prepared with water-soaked cotton in Petri dishes. Cultures were covered with black paper to provide a concealed environment, and two replicates were maintained for each set. Stock cultures were also maintained on field-collected arecanut tepals to ensure a continuous supply of developmental stages. Observations on feeding activity and symptom development were recorded at 24-hour intervals using a stereo zoom microscope.

Slide mounts of different life stages were prepared in Hoyer's medium for species confirmation and morphological examination. Species identification was carried out using a Carl Zeiss research microscope and confirmed with standard taxonomic keys and relevant literature. For seasonal population fluctuation studies, nut samples were collected fortnightly, and the number of each life stage present on individual tepals was recorded separately.

Studies on feeding biology

Qualitative assessment of damage potential

Qualitative assessment of feeding damage was conducted through repeated field and laboratory observations. Field-collected samples of mite-infested and uninfested arecanuts were examined microscopically to document progressive damage symptoms, including yellowing, greyish-brown patches, and surface cracking induced by different life stages of the mite. These observations were validated through concurrent microscopic examination of tepals maintained in laboratory stock cultures.

The extent of tissue damage caused by mite feeding was categorized into three visual symptom classes: mild, characterized by slight discoloration and pinpoint lesions; moderate, marked by brownish patches and early surface cracking; and severe, defined by epidermal necrosis, deep cracking of the nut surface, and evidence of secondary fungal invasion. Damaged or decayed tepals were replaced at two-week intervals, and observations were continued using fresh tepals.

RESULTS

Dolichotetranychus floridanus was found colonizing the concealed inner niches beneath the perianth of tender arecanuts, rather than the foliage, which is typical of most tenuipalpid mites. The study documented the seasonal population dynamics and damage caused by *D. floridanus* on areca palms in the study area. Infested nuts frequently exhibited shedding and a characteristic reddish discoloration adjacent to the perianth. The mites were slender and orange coloured, forming dense colonies in the concealed upper portion of tender nuts beneath the perianth (Fig. 1). Feeding activity of the mites resulted in a characteristic discoloration of the damaged area of nuts (Fig. 2).

Severe infestations were observed across localities in Kozhikode and Malappuram districts. Each damaged site harboured large colonies, often exceeding 30 individuals per unit area, including eggs, immature stages, and adults. The mites were soft-bodied and desiccated rapidly upon exposure to bright light. Active feeding was observed around the epicarp near the nut attachment region. The earliest visible symptom was the appearance of brown patches at the base of young nuts at the perianth level (Fig. 3). The inner surfaces of tepals showed

Table 1. Sesonal population density of *Dolichotetranychus floridanus* on areca palms of Malappuram district in 2022-2023

Month of sampling	AverageTemp (°C)/ Average RH (%)	Mean No.= Total no. of different life stages of mite / Total no. of tepals		
		Egg	Immature stages	Adult
June	26/80	20	22	12
July	25/82	23	30	16
August	26/81	24	33.4	18
September	30/70	18	20	14
October	27/77	16	18	14
November	27/81	15	18	12
December	28/77	15	18.2	12
January	28/76	12	14.4	10
February	30/75	8	12	8
March	30/70	6	6	6
April	33/65	2	4.4	3
May	35/65	2	2	3

Table 2. Seasonal population density of *Dolichotetranychus floridanus* on areca palms of Malappuram district in 2023-2024

Month of sampling	AverageTemp (°C)/ Average RH (%)	Mean No.= Total no. of different life stages of mite / Total no. of tepals		
		Egg	Immature stages	Adult
June	29/75	22	18	12
July	27/80	34	20	20
August	27/85	48	28	26
September	28/80	20	16.2	22
October	27/85	16	10	12
November	26/85	14	10	12
December	25/85	12	8	10
January	29/80	12	6	8
February	28/75	10	4	10
March	29/75	6	2	8
April	29/70	3	2	8
May	34/65	3.6	2	6

Table 3. Seasonal population density of *Dolichotetranychus floridanus* on areca palms of Kozhikode district in 2022 - 2023

Month of sampling	AverageTemp (°C)/ Average RH (%)	Mean No.= Total no. of different life stages of mite / Total no. of tepals		
		Egg	Immature stages	Adult
June	30/75	14.4	15.6	13.2
July	34/65	34.5	19.2	15.6
August	28/70	60.9	33.3	32.7
September	27/75	8.4	14	10
October	27/80	10	14	10
November	30/75	6	8.5	9
December	28/80	6	6.6	8
January	27/85	4	8.5	6
February	25/85	6	4	6
March	27/80	6	4	4
April	29/80	2	2	2
May	29/78	4.4	0	2

Table 4. Seasonal population density of *Dolichotetranychus floridanus* on areca palms of Kozhikode district in 2023 - 2024

Month of sampling	AverageTemp (°C)/ Average RH (%)	Mean No.= Total no. of different life stages of mite / Total no. of tepals		
		Egg	Immature stages	Adult
June	27/81	18	16	10
July	25/85	22	28	16
August	26/82	23	32	18
September	30/75	16	20	14
October	28/77	16	21.4	14.4
November	27/81	14	18.2	12
December	27/79	14	18	12
January	28/75	12	14.4	10
February	30/70	8	12	8
March	32/68	4	6	6.2
April	33/65	2	4.4	3
May	35/65	2	1.2	2

longitudinal reddish, blister-like, corky deformities and irregular cracks caused by mite feeding. As damage progressed, these discoloured areas expanded, the epidermis cracked, and deep fissures occasionally developed (Fig. 4). Severe infestation resulted in shrivelling and premature shedding of developing nuts, which, upon removal of the perianth, revealed abundant orange, dust-like mites.

Mite population build-up was initiated during periods of increased humidity between June and May over two consecutive years. Population density peaked between July and August, with approximately 40–70 active and inactive stages per tepal (Tables 1 and 2). A decline in population began in late October and continued through May, with the lowest densities (<10 mites/cm²) recorded during March, April, and May (Tables 1 and 2). High population densities (>30 mites/cm²) were observed from the third week of June to the end of August, with peak abundance during July–August.

Adult females laid eggs on the inner surfaces of the nut tepals (Fig. 6). Eggs and immature stages were orange-red and commonly occurred in colonies. Larvae possessed three pairs of legs, while nymphs had four pairs. Adult females were larger and darker red than males. Seasonal variation in mite abundance appeared to be influenced by the availability of young, tender green nuts, which were predominantly present during July and August. Additionally, the concealed habitat beneath the tepals protected mite populations from rainfall, facilitating uninterrupted development and population increase.

DISCUSSION

Historically, this mite was first reported from pineapple in Florida (Banks, 1900) and has since been consistently described as a monospecific, gregarious species associated exclusively with pineapple (Beard et al., 2014; Castro et al., 2022; Poli, 1991). It has been reported from all major pineapple-growing regions worldwide (Baker & Pritchard, 1956; Elder, 1988). Prabheena and Ramani (2015) suggested a notable shift in host utilization, indicating that *D. floridanus* is not restricted to pineapple and can successfully exploit arecanut palms as an alternative host. This highlights the species' potential for multi-host infestation, particularly in plantation crops such as areca palm.

Seasonal population dynamics of *D. floridanus* on areca differed from patterns previously reported in pineapple. While pineapple plantations typically show peak mite abundance during summer months, areca nuts recorded maximum infestation during the rainy season (July–August), moderate populations in December, and very low numbers during summer. This pattern appears closely linked to the availability of young tender nuts, which are present mainly during the monsoon. Because the mites reside inside the tepals, rainfall does not significantly reduce their populations.

Feeding activity on the epidermal tissue of areca nuts caused drying, cracking, and discoloration, resembling the symptoms reported in pineapple. The punctures created by mite feeding facilitated secondary infections by fungal and bacterial pathogens, contributing to tissue decay and deformation (Akamine et al., 2005; Jeppson et al., 1975; Sanches & Zem, 1978; Seeman et al., 2017). These findings underscore the economic relevance of *D. floridanus* as an emerging pest in areca plantations.

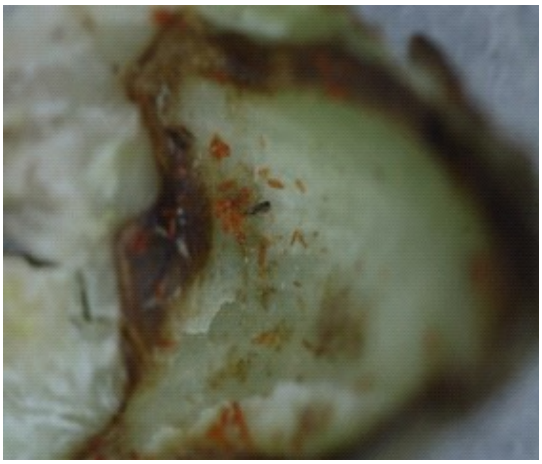

Fig: 1. Inner side of infested tepal of *A. catechu* showing the colony of *D. floridanus*.

Fig: 2. Characteristic discolouration on the damaged area.

Based on these findings, future research should consider:

1.Host Range Expansion

Evaluating the potential of *D. floridanus* to infest other palm species or plantation crops.

2.Environmental and Phenological Influences

Long-term ecological studies to understand how climate and nut development stages regulate seasonal population fluctuations.

3.Mite–Pathogen Interaction

Identifying fungal and bacterial pathogens associated with mite-induced injuries to determine the severity of disease complexes.

4.Economic Impact Assessment

Quantifying nut loss, quality deterioration, and fall rates to estimate economic damage in areca plantations.

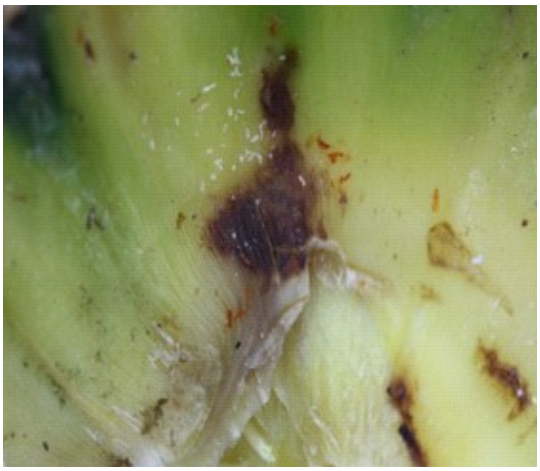

Fig:3. Development of brown patch at the base of the nut.

Fig: 4. Infested nuts showing the cracks and dried up regions.

CONCLUSION

Present investigation shows that the *D. floridanus* mites have wide distribution in Kerala and is a major cause of economic damage to areca nut plantations. The findings highlight the urgent need for the development of effective integrated pest management (IPM) strategies to mitigate its impact. Owing to the absence of an outer cuticle, *D. floridanus* is highly sensitive to environmental fluctuations and its population dynamics are strongly influenced by microclimatic factors (Jeppson *et. al*., 1957; Perring *et. al*., 1984). Hence, the species preferentially occupies concealed microhabitats that provide relatively stable conditions and protection from environmental variability.

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