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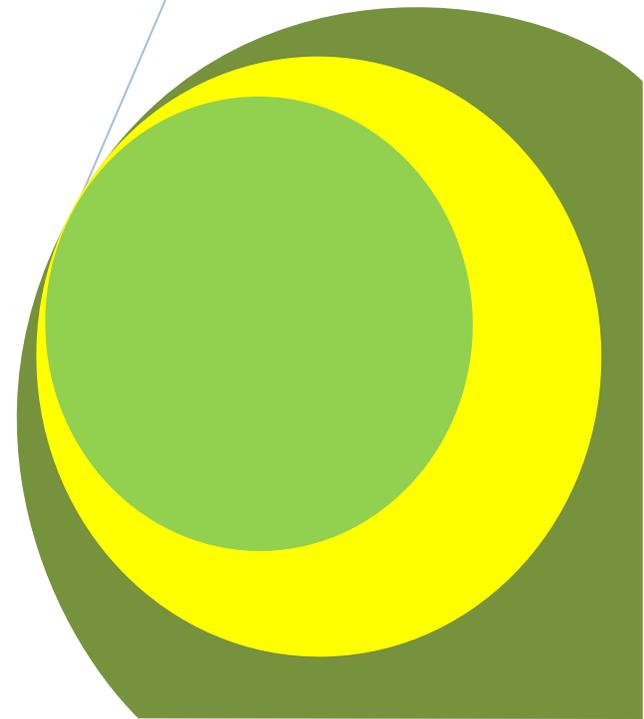
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## **Mango Leaf Gall Midge *Procontarinia Matteiana* (Kieffer & Cecconi) (Diptera, Cecidomyiidae) In Sudan**

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# Mango Leaf Gall Midge *Procontarinia Matteiiana* (Kieffer & Cecconi) (Diptera, Cecidomyiidae) In Sudan

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## ABSTRACT

This study was conducted to provide information on the distribution, life cycle and seasonal abundance of Mango leaf gall midge, *Procontarinia matteiiana* (Kieffer & Cecconi) in the Sudan. A total of 97 sites in all mango growing areas were surveyed. *P. matteiiana* infestation in all surveyed sites revealed that the insect was widely distributed with 100% infested trees in 84 sites, while 13 sites were found free of the infestation. Life cycle duration of *P. matteiiana* under field conditions showed high variation ranged from 1.5 to 8.4 months. *P. matteiiana* adults seem to be very active and coincide with the mango new flush. In El Molbus, North Kordofan State, two peaks of galls were reported in late September and late November. Abu Giebaha in South Kordofan State reported three peaks of galls in late of July, August and November. The study concluded that *P. matteiiana* is widely distributed in the Sudan and it expected to cause a serious loss in mango production in all infested areas.

**Keywords:** *Procontarinia matteiiana*, Mango and Sudan.

## INTRODUCTION

The Mango plant (*Mangifera indica* L.), has its origins in south-eastern Asia and India (Kwee and Chang, 1985). Mango is now cultivated throughout the tropical and sub tropical world including Sudan, for local and commercial fruit production. The total mango cultivated areas in Sudan in 2012 was 0.03 million hectares produced 0.64 million tons (Anony, 2012). Mango is infested with 250 species of plant-feeding arthropods. About 10% of these species produce galls on different parts of mango tree (Péna and Mohyuddin, 1997; Gagne and Medina, 2004; Raman *et al.*, 2009). The genus *Procontarinia* (Diptera: Cecidomyiidae) includes the most species, those that are inducing galls on mango ((Péna and Mohyuddin, 1997). *Procontarinia matteiiana* (Kieffer & Cecconi) was reported first in India in 1906 (Kieffer and Cecconi, 1906). Now, it is a common gall midge on mango in many counties such as Brazil, Kenya, South Africa, Oman, Indonesia and Iran (Srivastava, 1998; Askari and Radjabi, 2003). In Sudan, *P. matteiiana* was reported firstly in WadMedani in 2004. By the mid of July 2007 it was found in South and North Kordofan States (Mardi *et al.*, 2010). Satti (2011) stated that *P. matteiiana* is one of the alien insect species, believed that it was accidentally introduced to Sudan with the mango seedlings, e.g., cv. Tommy Atkins. In India *P. matteiiana* is an indigenous pest that attacks mango all- year- round with a peak population in September and April (Kaushik *et al.*, 2012). The economic implication of *P. matteiiana* in India in 1980s was alarming as it damaged about 36.75% of mango leaves (Jhala *et al.*, 1987). Also, significant damage to mango plants by the pest has been reported in Mauritius (Srivastava, 1998). According to Mardi *et al.* (2010), no studies were done on *P. matteiiana* distribution, biology and ecology under field conditions in Sudan. So, the current study was initiated with objective to study the geographical distribution, life cycle and seasonal abundance of *P. matteiiana* under field conditions in North and South Kordofan States, Sudan.

## MATERIALS AND METHODS

### Geographical distribution:

This survey was conducted on mango new leaves that had emerged in October 2011, to study the geographical distribution of *P. matteiiana*. A total of 97 sites were selected randomly from all mango grown states across the

country. Three orchards were chosen randomly from each site. Five mango trees were selected at random basis from each orchard. From each tree, ten branches were chosen randomly to calculate the mean infestation percentage. The mean number of galls per leaf was also recorded in 10 random selected leaves from each site.

### Life cycle:

This study was carried out at El Molbus, North Kordofan State, Sudan (Lat: 13 01 08 N, long: 30 14 50 E alt 547 m) to study the field life cycle of *P. matteiana*. Twenty healthy mango seedlings with newly developed leaves were placed in mango- infested orchard for 24 hours, so the adult could lay eggs on the new leaves of seedlings. The seedlings were placed in a field cages until signs of oviposition appeared on the leaves. Leaves from infested seedlings were tagged in the same cages. The tagged leaves were inspected daily for developmental stages of *P. matteiana*.

### Seasonal abundance:

This study was conducted from January 2011 to December 2013, at El Molbus, North Kordofan State and Abu Giebaha, South Kordofan State, Sudan. The study was conducted on the largest distributed Sudanese grown mango cultivar "Kitchiner". Ten mango trees with new flush were selected randomly every 15 days. From each tree, ten new leaves were picked randomly at about 1.5 m height above the ground. The percentage of infested leaves and the number of galls per leaf were counted.

## RESULTS

### Geographical distribution:

*P. matteiana* infestation in all surveyed sites revealed that the insect was widely distributed with 100% infested trees in 84 sites. The rest of the surveyed sites were free of the infestation (Table 1). The results showed that South Kordofan, North Kordofan, West Kordofan, Sennar, Blue Nile, South Darfur and West Darfur States recorded 100% mean number of infested branch per mango tree, while the lowest infestation was recorded in Gezira State. Of the 13 surveyed States, five had means above 300 galls per mango leaf, namely South Kordofan, West Kordofan, Sennar, South Darfur and West Darfur States. The other six of infested States had mean number of galls per leaf ranged between 97 and 261. Gedarif State recorded 97 galls per leaf as the lowest mean (Table 1).

**Table 1: Surveyed sites, mean infestation percentage of trees and branches, and the mean number of gall/leaf in the mango economic production states, Sudan, 2011.**

State	No. of surveyed sites	Mean infested trees/site (%)	Mean infested branches/tree (%)	Mean number. of gall/ leaf
South Kordofan	22	100	100	362
North Kordofan	7	100	100	261
West Kordofan	4	100	100	317
Sennar	6	100	100	359
Blue Nile	30	100	100	256
Kassala	3	100	68	122
Gedarif	3	100	54	97
Gezira	3	100	52	112
South Darfur	3	100	100	364
West Darfur	3	100	100	372
Khartoum	4	0.0	0.0	0.0
River Nile	4	0.0	0.0	0.0
Northern	5	0.0	0.0	0.0
Total	97	1000	752	2622
Mean	-	76.92308	57.8	201.7

### Life cycle:

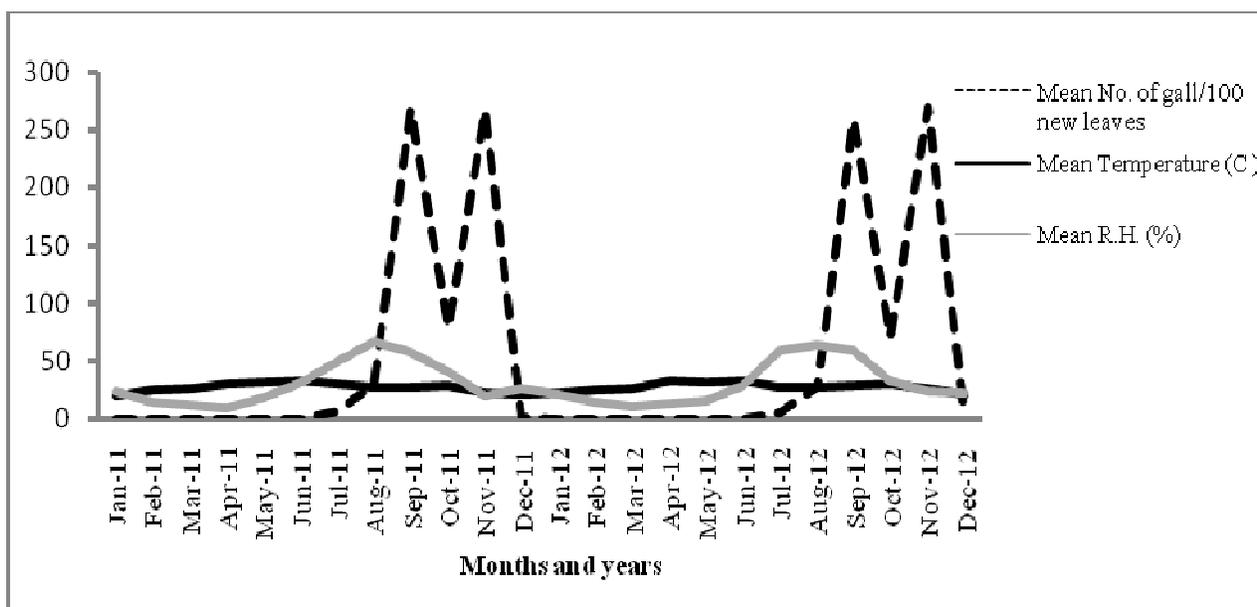
Eggs of *P. matteiana* were laid on the underside or rarely on the upper site of mango new leaves. The oviposition sites were marked with a reddish small spots. On hatching larvae penetrated leaves and started forming galls. The new developed galls were light green, increased in size and gradually became hard and concave at oviposition site. The mean duration of the life cycle was  $46.203 \pm 0.27$  days when eggs were laid in mid of August and  $53.755 \pm 0.00$  days when laid in 1<sup>st</sup> October. The mean duration of the life cycle of eggs laid in late November recorded  $253.60 \pm 0.20$  days (Table 3).

**Table 2: Duration of *P. matteiana* life cycle and its relation to date of eggs laying under field conditions in El Molbus, North Kordofan State, Sudan**

Date of eggs laying	No. of eggs observed	Mean duration (egg-adult) $\pm$ SE (days)
15 <sup>th</sup> August	1000	$46.203 \pm 0.27$
1 <sup>st</sup> October	1000	$53.755 \pm 0.00$
26 <sup>th</sup> November	1000	$253.60 \pm 0.20$

### Seasonal abundance:

Throughout the period of the study, in ElMolbus site, appearance of *P. matteiana* galls on mango new leaves in the field started with the starting of rainy season in mid July. It was increased as it reached its peak in late September. Second peak was observed in late November (Fig 1). In AbuGiebaha site, the incidence of galls on new leaves was observed in few numbers in first June, when the rain started in south Kordofan State. Three peaks of *P. matteiana* galls were recorded in the late of July, August and November (Fig 2).



**Fig 1: Seasonal abundance of *P. matteiana* galls on new mango leaves in relation to the mean temperature and relative humidity in the field from Jan, 2011 to Dec, 2012 in ElMolbus, North Kordofan State, Sudan.**

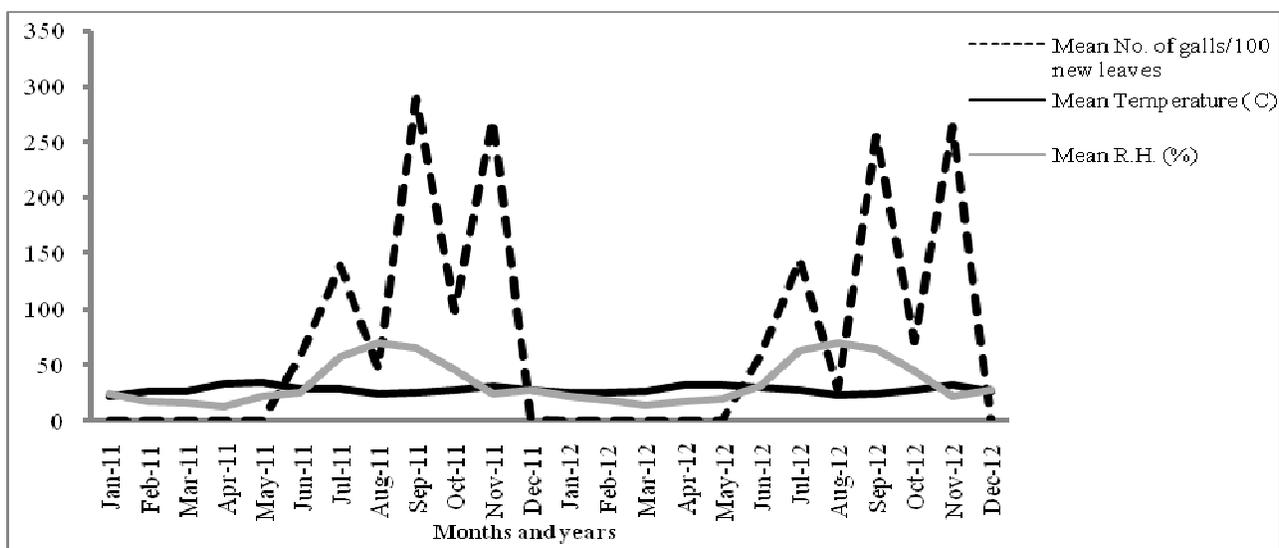


Fig 2: Seasonal abundance of *P. matteiana* galls on new mango leaves in relation to the mean temperature and relative humidity in the field from Jan, 2011 to Dec, 2012 in AbuGiebaha, South Kordofan State, Sudan.

## DISCUSSION

In the Sudan, *P. matteiana* was reported in Gezira, North and South Kordofan States (Mardi *et al.*, 2010). Results of the current study showed wide spread of *P. matteiana* in (76.9%) mango growing areas, covering ten states. In the northern parts of the country, where annual rainfall under 200mm, mango cultivations were free of infestation.

In this study, gall flies seem to be very active in the field coincides with a new flush of mango leaves. The larvae of *P. matteiana* are observed to have confined themselves in galls on leaves. Pupation took place in the same galls. The same observations have also been reported by Gupta (1952), Botha and Kotzé (1987), and Askari and Bagheri (2005). *P. matteiana* life cycle under field conditions showed high variation ranged from 1.5 to 8.4 months. This variation may attributes to the date of eggs laying and its relation to the relative humidity. This finding agreed with Botha and Kotzé (1987), who reported that variation in life cycle period ranged from 3 to 7 months in South Africa. In north India, Gupta (1952) observed three generations in a year in north India; the larval period of the first generation lasts for about 2-12 months. Since there are overlapping broods, the adults emerge and females oviposit in a continuous cycle.

During the present study at ElMolbus, North Kordofan State, annually, two peaks of galls per new mango leaves were observed in late September and late November. This result is in line with Grové *et al.* (2002) who found that the gall flies are very active during November to April with two peaks in February and April in South Africa. This result is also similar to observations of Kaushik *et al.* (2012) who observed two generations in India; first in April and second in September. In AbuGiebaha, South Kordofan State three peaks of galls per new mango leaves were recorded in July, September and November of the year. This result agrees with Gupta (1952) who reported three generations per year in north India. This study showed that the galls formation was enhanced with high humidity. So, the larval and pupal survival capacity was improved. Similar result is reported by Askari and Bagheri (2005), Mardi *et al.* (2010) and Grové *et al.* (2002).

In conclusion, it seems *P. matteiana* is widely distributed in most mango growing areas in Sudan. The duration life cycle recorded high variations under field conditions, ranged between 1.5 to 8.4 months. It has two peaks of galls abundant in North Kordofan during late September and late November. South Kordofan recorded three peaks of galls abundant during the late of July, August and November.

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