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Identification and seasonal fluctuations of the mango fruit fly in central Sudan

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ABSTRACT

Field surveys were carried out in Hantoub area, east of Wad Medani, Sudan, during the period from March 1998 to February 1999 to identify the prevailing species of mango fruit fly and to study their seasonal abundance and fluctuation, using yellow dome-shaped taps with attractants (cue-lure and methyl eugenol), and sticky yellow traps. Infestation level and the most susceptible stage of fruit maturity in four tested cultivars (Alphons, Baladi, Shendi and Abu samaka) were studied. The behaviour of the adult fly in the field was observed and the alternative host plants for the pest were also surveyed. The results revealed that Ceratitis cosyra (Walker) was the dominant species of fruit flies in the study area. The peak population of the fly was observed in the humid months of July and August. Alphons cultivar was the least susceptible while Shendi cultivar showed high susceptibility. The ripe stage of the fruit was the most preferred stage for infestation. Guava fruit represented the best alternative host for the pest

INTRODUCTION

Mango is considered as one of the most important fruit crops in the Sudan and leads the Sudanese exports of horticultural crops. Unfortunately, during the past few years, mango growers and exporters started to complain about mango fruit flies which caused considerable losses in mango production and quality and affected mango exports.

Singh (1960) stated that fruit flies form an important group of insects damaging mango fruits in the various mango growing areas of

the world and considered the pest to be of highly economic importance. Schmutterer (1969) found that the damage started with the ovipuncture made by the sharp long ovipositor of the fly, the larvae tunnelled into the fruits and gradually destroyed it. This was followed by rottening of the fruit caused by bacteria and fungi.

In many parts of Africa, mango fruit was infested by the species Ceratitis cosyra. Rendell et al. (1995) found that C. cosyra was the most common species of Ceratitis in mango orchards in Zimbabwe. Labuschayle et al. (1995) confirmed its dominance in a wide area in South Africa. In the Sudan, Deng (1990) reported C. cosyra for the first time in Khartoum area. Beije et al. (1995) found the same species infesting mango fruit in the Gash Delta in Eastern Sudan. However, no information is available about the mango fruit fly in the Gezira area.

Therefore, the objectives of this research are to identify the prevailing species; study the seasonal abundance; fluctuation and behaviour of the mango fruit fly in the field and survey the host plants for the pesto The objectives also included the determination of susceptibility of some mango cultivars for infestation and the most preferred stage of fruit maturity.

MATERIALS AND METHODS

Identification and seasonal abundance

Five mango trees from each of the tested cultivars Alphons, Baladi, Shendi and Abusamaka were randomly selected during 1998 and 1999 seasons. Sticky yellow traps (Horiver) and other types of traps made up of yellow plastic sheets (20 x 15 cm) and painted with glue (Tangle foot) were also used. Insect catches were recorded weekly for a whole year (March 1998 to February 1999) and total number was recorded. Two types of attractants: Cue-lure which is specialized in attracting the males of Dacus cucurbitae, and methyl-eugenol, which is specialized in attracting the males of oriental fruit fly (Dacus dorsalis) were used to monitor the existence of these species in the study area. The attractants were used in yellow dome-shaped traps distributed in the field.

Host preference and susceptible stage of fruit maturity

Ten trees from each tested cultivar were randomly selected. Six fruits of the same maturity stage were collected weekly from each tree. The fruit samples were examined and separated into infested and non infested fruits by visual signs of ovipunctures made by the females. Infested fruits were again counted and kept in the laboratory in rearing cages to follow the development of the eggs into the other stages and to identify the emerging adults.

Survey of the host plants

The study area was surveyed to identify plants which might host fruit flies. Random samples of the known host plants, such as guava (Psidiun guajava), Nabag (Zizyphus spina-christi), Ushar (Calotropis procera) and citrus (Citrus spry) fruits were collected and examined.

Regional surveys

Fruit samples were collected from different states which included Kassala, Gezira, Blue Nile, Sennar, Khartoum, South Kordofan and River Nile. The collected samples were separated into infested and non infested fruits. The infested fruits were taken to the laboratory for rearing to adult stage and the emerging flies were identified.

Behaviour of the fruit flies in the field

The number of ovipunctures per fruit as indicators of oviposition and the number of larvae per fruit were determined by dissecting the fruit samples using a magniifying lense. The different instars of the larvae harboured by the infested mango fruits were examined and their feeding behaviour was observed. The upper layer of the soil around mango frees, and the ground under the fallen infested fruits were examined in order to detect the pupation sites. Close observations were made on the diurnal movement of flies between trees, flowers, buds and infested fruits to determine the feeding habits and resting places of the adult stage of the pest.

Statistical analysis

Data collected was subjected to the appropriate transformation. The insect counts were transformed using the log (x + 12) scheme, while for the infestation data the square root of the arcsine percentage method was applied according to Gomez and Gomez (1993). The transformed data was then analyzed using analysis of variance and the means were subjected to comparison using Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Identification and seasonal abundance

Mango fruit were identified as follows:

(i) Mango fruit fly, Ceratitis cosyra (Walker) (Plate 1).

(ii) Mediterranean fruit fly, Ceratitis capitata (Weidemann) (Plate 2).

C. cosyra had been known as Pardalaspis cosyra (Walker), P. Parinarii (Hering), and Trypeta cosyra (Walker).

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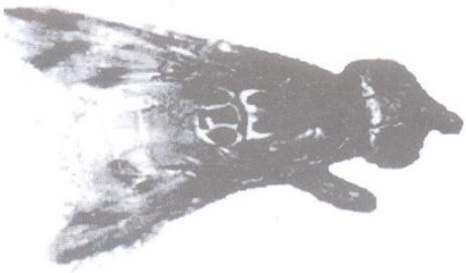

Plate 1. Adult fruit fly (*C. cosyra*)

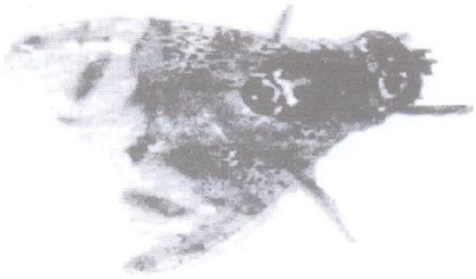

Plate 2. Adult fruit fly (*C. capitata*)

C. capitata had also been known as C. citriperda (Macleag), C, hispanica (DeBieme), Pardalaspis aspargi (Bezzi) and Tephritis Capitata (Weidemann) (White and Elson-Harris, 1992). Deng (1990) reported C. cosyra for the first time in Sudan. He stated that it was closely related to C capitata, especially in behaviour, biology and life cycle. The photograph of C cosyra (Plate 1) is typical to the description reported by White and Elson-Harris (1992) who stated that the species could be separated from most other species by its characteristic pattern of yellow bands and the three black areas in the apical half of the scutellum. Also, the male orbital setae are not expanded at the apex and the tibiae are not feathered.

In this study, C. cosyra was found to be the dominant species which attacked not only mango fruits (the main host), but also guava (P. guajava) which was found to be heavily infested. Ceratitis capitata, the main pest of guava in the Sudan (Eltahir, 1967), was found to emerge from the samples of guava in small numbers. This showed that C. cosyra might have displaced C. capitata apparently as a result of competition. The findings of many authors indicated the dominance of C cosyra. Rendell et al. (1995) stated that C. cosyra was the most common species of Ceratitis in mango orchards. Labuschagne et al. (1995) indicated its dominance in South Africa. However, C. cosyra had been recently recorded in Sudan (Deng, 1990) and may continue to build its population and disperse rapidly.

Population dynamics of C cosyra

A study of seasonal activity of C. cosyra, using sticky yellow traps, showed that the activity of the fly was largely dependent on the climatic factors such as temperature and relative humidity (Table 1: Figs. 1 and 2). The maximum number of flies were trapped in the humid months of July and August and the minimum numbers were trapped in March. The catches increased towards May due to the high relative humidity during May and then the number decreased again in June. The peak of the population was attained in July and August.

This peak sharply decreased after September, where low values were recorded in October, November, December and February 1999.

Table l. Total monthly count of mango fruit fly C. cosyra (transformed to log x + 12), temperature and relative humidity in Hantoub area (1998/1999).

Month	Total count (log x +12)*		Mean temperature (C^0)	Mean relative humidity (%)
March 1998	1.46	(17.0)	26.4	23
April	2.19	(143.0)	32.1	20
May	2.54	(337.0)	33.9	34
June	2.35	(210.0)	33.9	26
July	3.09	(1205.0)	30.0	71
August	3.01	(1015.0)	26.6	87
September	2.57	(360.0)	27.5	83
October	1.92	(72.0)	28.5	74
November	2.03	(95.0)	27.4	44
December	2.10	(114.0)	25.5	50
January 1999	2.14	(126.0)	23.7	54
February	2.09	(112.0)	29.8	41

* Actual values in parentheses.

The monthly catches continued to decrease in the same trend during January and February 1999. The high population of the insect during the months of July and August was due to the high relative humidity, which encouraged the rapid emergence of adults. These results were supported by Hanna (1947) who obtained the peak of medfly population during the rainy season in early July to September. Deng (1990) found that the highest population of medfly was in August and decreased gradually towards January. Wong and Mc Innis (1985) reported that the abundance of medfly throughout the year depended on climatic conditions as well as the kind of fruits available.

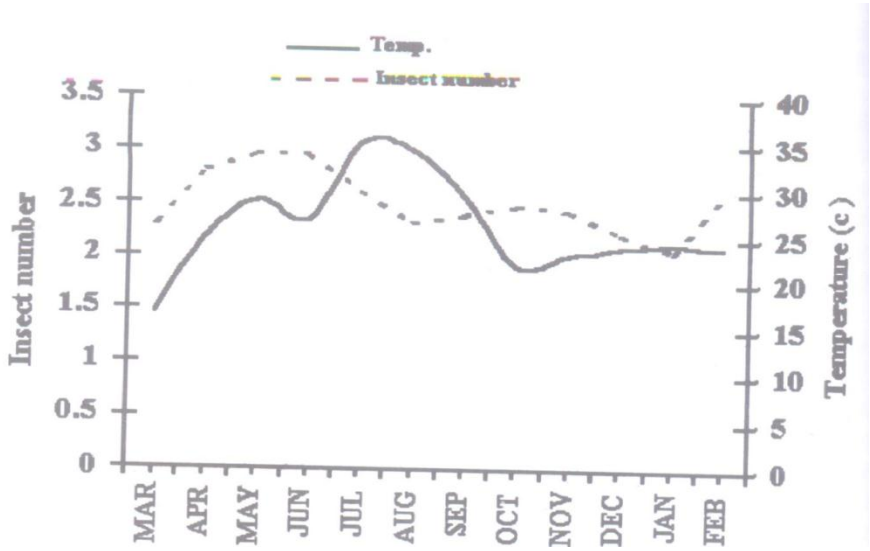

Fig. l. The relationship between number of mango fruit fly (C. cosyra) count and temperature (Hantoub area 1998/99).

Cultivar preference and susceptible stage of fruit maturity

Table 2 shows that Shendi cultivar was the most susceptible among the mango cultivars under test, Baladi came in the second rank followed by Abusamaka. Alphons was found to be the least Susceptible cultivar. This variation in the susceptibility of the different cultivars was attributed to the differences in the chemical composition of these cultivars. Shendi and Baladi cultivars had high sugar contents and low acidity and were, therefore, preferred by the pest. However, Alphons and Abusamaka had low sugars and high acidity. Additionally, Alphons ripened during the time when the most preferred cultivars, i.e., Shendi and Baladi were at the ripe stage and, hence, it escaped severe infestation. The reason behind the high susceptibility of Abusamaka cultivar to infestation in the field, although its chemical characteristics were not preferred by the pest, was due to the time of its maturity which coincided with the peak of the pest population in

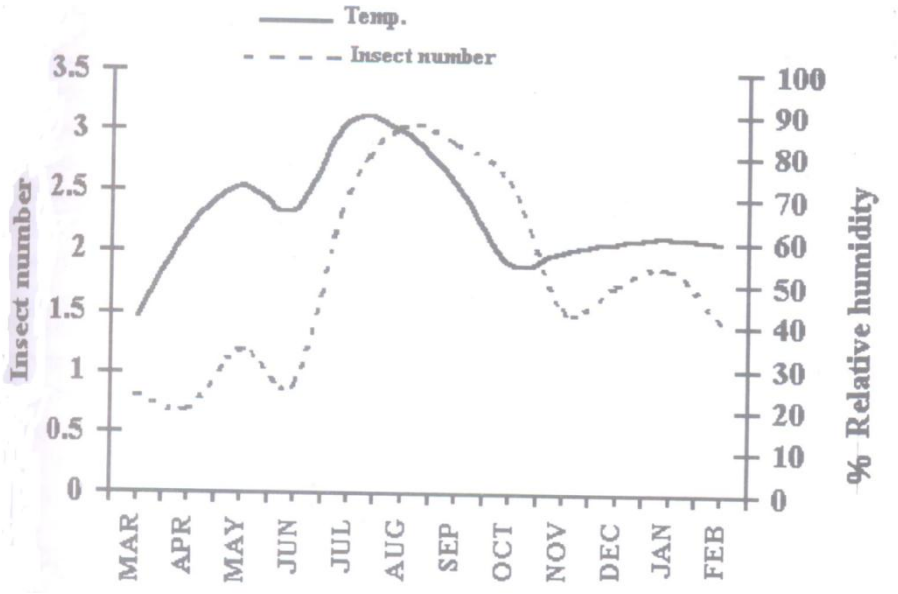

Fig.2s The relationship between number of mango fruit fly (C. cosyra) count and relative humidity (Hantoub area 1998/99).

in the absence of the other favourable cultivars. The ripe stage was found to be the most susceptible stage to infestation as shown in Table 3 followed by the mature green and lastly the immature stage. This was probably due to the high sugar content and low acidity of ripe fruits. Both the yellow colour and the strong aroma of the ripe stage act as additional factors which attract the fruit flies. Prokpy (1978) found that the yellow colour was the most attractive to the fruit flies while the mature green and the immature stages were less preferred by the fruit fly, due to the high acidity and low sugar content. Moreover, the green colour was not attractive to the flies.

Table 2. Effect of mango cultivar on infestation by mango fruit fly, C. cosyra (1998/1999).

Cultivar	Infestation (%)
Alphons	10.02 c
Baladi	34.64 ab
Shendi	39.57 a
Abusamaka	30.64 b
SE +	02.14
C.V.	29.08

Means with different letters in the same column are significantly different according to Duncan's Multiple Range Test.

Table 3. Effect of stage of maturity of mango fruit on infestation by mango fruit fly C. cosyra (1998/1999).

Stage	Infestation (%)
Immature	15.19 c
Mature green	26.47 b
Ripe	44.02 a
SE +	1.86
C.V.	29.08

Means with different letters in the same column are significantly different according to Duncan's Multiple Range Test.

Regional surveys

Results of examining mango fruit samples which were collet collected from different parts of Sudan (data not shown) indicated that mango fruits in these areas were infested only by C. cosyra. From this regional survey, it appeared that the pest was distributed throughout the area of the central region of Sudan. Hill (1983) stated that the species had been recorded in South and East Africa. The pest might have invaded the country from the eastern and southern boundaries and then spread inside the country.

Survey of the host plants

Host plants in the study area were surveyed to monitor the population of C. cosyra. The results were obtained from the trapped adults, and the rearing of the immature stages of the pest from the

infested mango fruits up to the adult stage. They indicated that the mango fruit was the main host for the pest. Hill (1983) and Deng (1990) also stated that the mango was the main host of C. cosyra. In this study, guava (Psidiun guajava), which had been reported as the main host of C. capitata in Sudan (Eltahir, 1967) was found to be an alternative host for C. cosyra which was observed to migrate to guava trees when mango fruits were not available in the orchards. The sweet taste and strong aroma of guava fruit perhaps rendered it an excellent alternative to mango fruit. Mc Donald and Mc Innis (1985) stated that the host properties affected the flies acceptance and preference for ovipositiono The adult flies of C cosyra were never observed to emerge from the other known fruit fly host plants such as Nåbag and citrus, even under artificial infestation. This might be due to certain characteristics of these host plants, which resulted in high mortality rate of the immature stage of the pesto Similar results were reported by Back and Pemberton (1981) who attributed the high mortality rate of the immature stage in citrus fruits to the large number of oil glands in the rind.

Behaviour of C cosyra in the field (observational studies)

Oviposition

Oviposition was observed to take place in the upper and middle zones of the fruits. This confirmed the observation of Deng (1990) who stated that the female medfly oviposited predominantly near the fruit navel and the middle sides. This was probably due to the fact that these parts of the fruit ripened before the stem end, so it become more preferred by the flies. The number of ovipunctures per fruit in the field ranged between I to 20. This variation in the number of ovipunctures could be explained by the fact that sometimes more than one female oviposited in the same fruit.

Larval behaviour

Infested fruits in the field were found to harbour a large number of larvae which could be as many as 100 maggots per fruit in different instars. This was due to the high number of eggs, which were deposited by several females at different times.

Ripe fruits harboured the highest number of larvae, while, immature fruits were almost free of larvae. This was probably due to the lack of tendency of female insects to oviposit their eggs in

immature fruits, or due to the high mortality rates of the early instars because of the adverse chemical effects of the immature fruits which discouraged larval development. Pupation was observed to take place in the soil, and inside fallen fruits.

Observation on the adults

Adult fruit flies were observed to feed on damaged mango and guava fruits. In addition, C cosyra was seen migrating to guava tree when mango fruits were not available in the orchards.

CONCLUSIONS

Since the ripe stage is the most susceptible stage for infestation, it is recommended to harvest mango fruits at the mature green stage Orchard sanitation by collecting and burning infested fruits is very important to prevent early pest outbreaks in the following season Also, strict quarantine measures are essential to prevent entry of infested fruits to pest free areas. More research work is needed to explore ways and means for controlling the mango fruit fly.

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