

Efficacy of Methyl-eugenol as Male Attractant for *Dacus dorsalis* Hendel (Diptera: Tephritidae).

A. GHANI IBRAHIM and A. GHANI HASHIM

Department of Plant Protection, Faculty of Agriculture, Universiti Pertanian Malaysia,
Serdang, Selangor, Malaysia

Keywords: Methyl eugenol; Fruitfly; *Dacus dorsalis*; Carambola Orchard.

RINGKASAN

Dacus dorsalis ialah spesies lalat buah yang terbanyak (99.8%) di dusun belimbing besi. Tahap populasi didapati berkorelasi ($r = 0.56$) dengan kadar hujan. Buah belimbing mula diserang apabila umur meningkat 29 hari. Kajian di makmal tentang daya penarik methyl eugenol terhadap tiga spesies lalat buah menunjukkan tidak terdapat perbezaan yang bererti diantara *Dacus dorsalis* dan *D. umbrosus* tetapi perbezaan yang bererti ($P < 0.05$) didapati diantara kedua-duanya dengan *D. cucurbitae*. Methyl eugenol juga didapati mempunyai daya penarik yang kuat terhadap lalat buah dewasa *Dacus dorsalis* yang dara berumur lebih daripada 20 hari.

SUMMARY

Dacus dorsalis Hendel is the predominant species of fruit-fly (99.8%) found in a carambola orchard. Population level was found to be correlated ($r = 0.56$) with rainfall. Infestation of fruits began 29 days after fruit set. Laboratory studies show that among the three species of fruitflies tested for attractiveness to methyl eugenol, male of *D. dorsalis* and *D. umbrosus* showed no significant difference but both are significantly different ($p < 0.05$) with *D. cucurbitae*. Virgin adult males of *D. dorsalis* more than 20 days old were greatly attracted to methyl eugenol.

INTRODUCTION

The tephritids are destructive pests of both tropical and subtropical fruits. There are approximately 4000 known species within the family Tephritidae (Christenson and Foote, 1960). The most serious pests of agricultural crops are *Dacus dorsalis* Hendel which are injurious to fleshy fruits like carambola (*Averrhoa carambola*), guava (*Psidium guava*), mango (*Mango indica*) and papaya (*Carica papaya*). Hardy (1973) reported that *D. dorsalis* are widely distributed in the tropics. Several workers have described in detail the biology of *D. dorsalis*. (Shah *et al*, 1948; Janjuna, 1948). In Peninsular Malaya, Corbett (1928) first recognised the importance of *D. dorsalis* as a major insect pest of orchards. Biological studies of this particular pest conducted in Malaysia were those by Miller (1940), Ibrahim and Kudom (1978) and Ibrahim and Mohamad (1978).

In the field, the abundance of *D. dorsalis* is due to many factors such as climate and host-

plants. For example, temperatures influence the reproductive rate of the adult fruit-fly (Lee, 1976). In Malaysia the temperature and relative humidity are relatively constant throughout the year. Rainfall has its seasonal pattern but the effect of rain on the pest population is little known.

Various methods have been adopted in controlling fruit-flies, among which, are the use of specific chemical attractants. Methyl eugenol, an attractant, is being used extensively for controlling *D. dorsalis*. Its usefulness was realised when Howlett (1915) recognized methyl eugenol as one of the main constituents of citronella oil which then attracted *D. diversus* and *D. zonatus*. To-day, methyl eugenol has been extracted from diverse plants. (Kawano *et al*, 1968; Fletcher *et al*, 1975 and Shah and Patel, 1976). The use of methyl eugenol for annihilation of *D. dorsalis* was successfully adopted by Steiner (1952). Ever since then, various formulations of methyl eugenol and insecticides have been tried under different climatic conditions.

Key to authors' names: Ibrahim, A.G. and Hashim, A.G.

(Cunningham *et al*, 1978). The use of methyl eugenol has an advantage in that insect pests could be eradicated from an area with the minimum amount of insecticides (Steiner *et al*, 1965). In Malaysia, the attractant has been used on a limited scale.

The present study was conducted to evaluate the effectiveness of methyl eugenol in attracting fruit-flies, especially *D. dorsalis*. This behavioral study in relation to the development of the carambola fruits and rainfall pattern would be useful in the integrated control of *Dacus species*.

MATERIALS AND METHODS

Field and laboratory studies were conducted to assess the efficacy of methyl eugenol on fruit flies. A trial was conducted in a carambola orchard *ca.* 1.5 ha at Serdang Baru, Selangor. The experimental site was *ca.* 1500 m² situated almost in the centre of the orchard. The trees of ten years old were in the fruit bearing stage. Laboratory trials were conducted in room at ambient temperature ($28^{\circ} \pm 2^{\circ}\text{C}$).

Trial 1: Field trapping of *Dacus spp.*

This study was initiated on 16th May 1978 for a period of nine months. Plastic traps (10cm \times 10cm) with circular openings measuring 2.4 cm in diameter at both ends were used for trapping the fruit-flies. This round hole trap design was adopted for they were effective in trapping fruit-flies. (Ibrahim *et al*, 1979). A total of nine traps were placed at strategic positions in the orchard (Fig. 1). Each

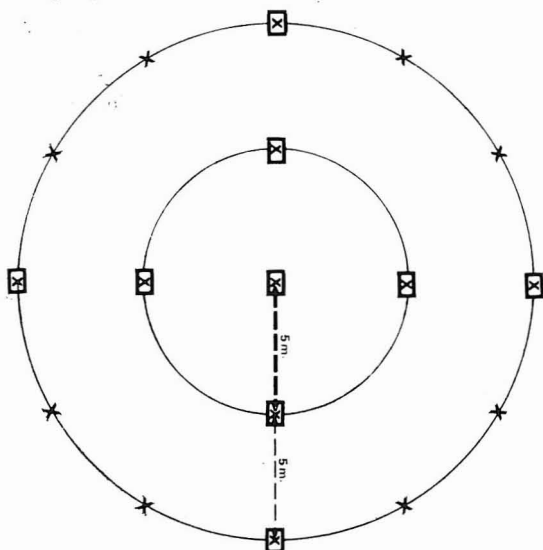


Fig. 1: Placement of traps containing baits in the experiment plot of Carambola orchard. X is the plant.

trap was baited with a mixture of 0.5 ml methyl eugenol, 0.5 ml of Malathion EC 80 and 2 ml of sucrose solution soaked in cotton rolls. The traps were hung to the branches of trees at a height of *ca.* 1.2 m from the ground. At the chosen height, there was no effect on capture of fruit flies (Hooper and Drew, 1979). Collection of the fruit flies and recharging of the poisoned baits were made every 4th day between 4 - 5 pm. The flies were sexed and identified.

Trial II: Laboratory studies

Three different species of fruit-flies viz: *D. dorsalis*, *D. cucurbitae* Coq and *D. umbrosus* Fabr were reared from infested fruit of carambola, cucumber and jack-fruits. The third instars larvae were allowed to pupate in nylon-meshed cages (82 cm \times 66 cm \times 66 cm) filled with sand to a depth of 5 cm. The newly emerged adults were provided with water, sugar solution (10%) and protein hydrolysate. Thirty male fruit-flies of the same species which had been kept in captivity with females for ten days were tested for their response to methyl eugenol. A total of 90 male flies belonging to three different species were released in a perspex cage (1m \times 1m \times 1m). A small trap (8 cm \times 12 cm) of similar shape to the field trap was used in each cage. The trap was baited with three drops of methyl eugenol, one drop of Malathion and 1 ml of sucrose solution. Recordings were made at hourly intervals for four consecutive hours on all the tested species of the fruit flies.

In a further trial to evaluate the stage of adult *D. dorsalis* attracted to methyl eugenol, the fruit-flies were reared using artificial diet (Tanaka *et al*, 1969). Twenty virgin male flies of varying ages of 4, 8, 12, 16 and 20 days were placed in separate cages containing methyl eugenol solution, malathion and sucrose solution. The number of flies caught in the traps were recorded at hourly intervals for four hours. Both laboratory trials were replicated four times using the Completely Randomized Design. The results were analysed and the means were separated by the Duncan Multiple Range Tests.

RESULTS AND DISCUSSION

During the period of nine months (May 1978 to January 1979) the total number of fruit-flies caught was 36,035. The dominant fruit flies were the males of *Dacus dorsalis*. (Table 1). Though *D. pedestris* (Bezzi) are known to attack carambola fruits the dissection of the female genitalia failed to show their presence in the traps. The number of female flies caught was

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extremely low. This finding was similar to that of Steiner *et al.*, (1965) who showed that methyl eugenol rarely attract females. Besides *D. dorsalis*, the other two species caught were *D. umbrosus* and *D. cucurbitae*, though the last two species were significantly ($P < 0.05$) few in number.

TABLE 1

Fruit flies, *Dacus* spp attracted to methyl eugenol in Carambola orchards from 16.4.1978 - 19.1.1979

Species	Sex	Total Nos	Av. catch/trap/month
<i>D. dorsalis</i>	Male	35,959	500.47
	Female	76	
<i>D. umbrosus</i>	Male	26	0.38
	Female	2	
<i>D. cucurbitae</i>	Male	5	0.13
	Female	5	

Analysis showed that there was no significant difference in response to methyl eugenol in the laboratory between ten-day-old males of *D. dorsalis* and *D. umbrosus*; but, when compared to *D. cucurbitae*, their attraction to methyl eugenol was found to be significantly different (Table 2). The percentage of *D. dorsalis*, *D. umbrosus* and *D. cucurbitae* caught were 43.3%, 47.5% and 4.2% respectively. The higher catch of *D. dorsalis* in the field could be due to their abundance in the open for the laboratory study showed *D. dorsalis* and *D. umbrosus* were equally attracted to methyl eugenol. The smaller number of *D. umbrosus* caught could possibly be due to the plant specificity since this species is not known to attack carambola but is specific to *Artocarpus* spp. Less than 50% of the total number of flies from each species were attracted to methyl eugenol even after four hours. Dissection of the male flies showed them to have well developed testes which suggests that a considerable number of flies are indifferent to methyl

eugenol. This suggestion conforms with that of Umeya *et al.*, (1973).

The fruit-flies showed marked seasonal fluctuations with the peak periods in September and early December following fruit-set (Fig. 2). Bateman (1973) reported an increase of fruit fly population at the onset of fruit ripening. After all the fruits had been bagged, there was a decline in the population. This could possibly be due to absence of fruits for oviposition which subsequently resulted in a reduced fly population in the field. Observation of fruits in the field showed that the fly oviposited as early as 29 days after fruit set. The flies prefer to oviposit on ripe fruits but in their absence they oviposit on green fruits. Lee (1976) found similar results with young papaya fruits.

The relationship between total catch and rainfall was found to positively correlated ($r = 0.56$). The population was observed to be significantly high ($P < 0.05$) only after continuous daily rainfall. Lee (1976) observed a similar pattern when a sunny day precedes several cold and wet days.

The placing of the traps also influences the amount of fruit-flies caught. Traps placed at the periphery of the orchard had higher counts than those placed in the centre. This suggests that peripheral traps had better access to wind movement and methyl eugenol is capable of attracting flies at a distance of 0.6 km. (Steiner, 1952).

The attraction of *D. dorsalis* to methyl eugenol is relative to the age of the flies (Table 3). The attraction was greatest when the flies were 20 days old. Since methyl eugenol is a sex attractant, it will attract flies of a specific physiological age. Umeya *et al.*, (1973) observed that male fruit flies were not attracted to methyl eugenol until the ninth day, suggesting that

TABLE 2

Laboratory study showing cumulative number of fruit flies attracted to methyl eugenol

Dacus species	Tot. no of flies caught within:				
	1 hr.	2 hr.	3 hr.	4 hr.	%
<i>D. dorsalis</i>	29	38	46	52	43.3 a
<i>D. umbrosus</i>	38	45	49	57	47.5 ab
<i>D. cucurbitae</i>	1	3	4	5	4.2 c

Means followed by the same letters are not significantly different at 5% level as determined by Duncan's Multiple Range Test.

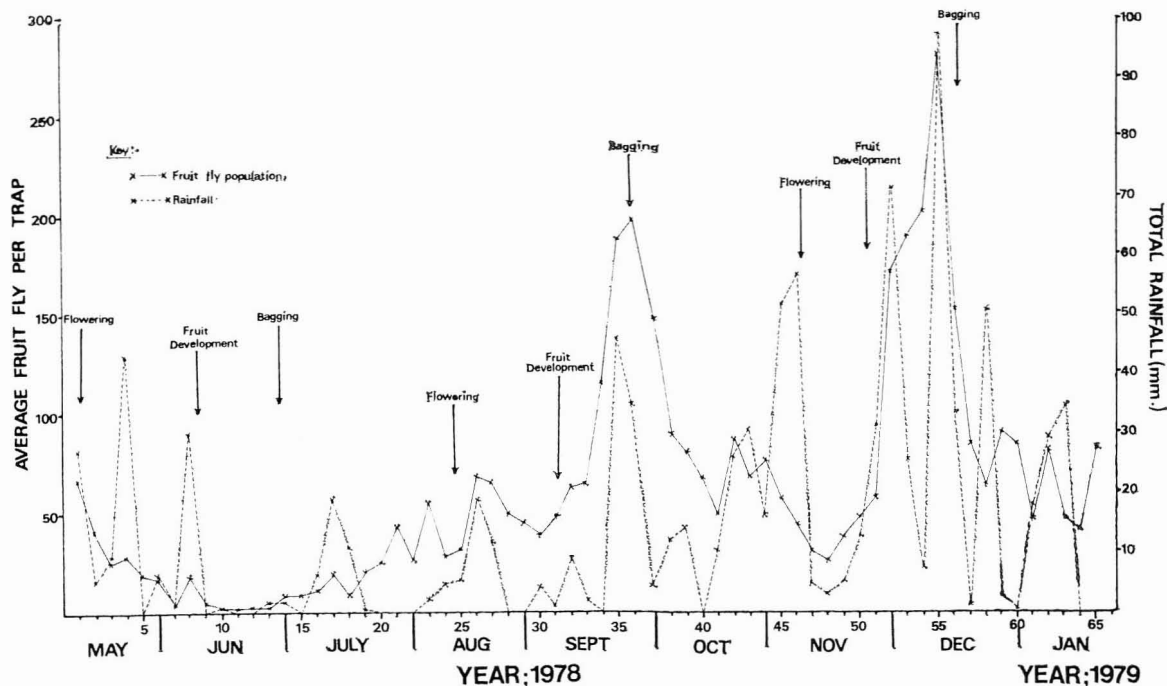


Fig. 2: Fluctuations of fruitfly population in relation to tree phenology and rainfall.

TABLE 3

Laboratory study showing cumulative numbers of virgin *D. dorsalis* attracted to methyl eugenol

Age (days)	n	Tot. No. of flies caught within:				
		1 hr.	2 hr.	3 hr.	4 hr.	
4	80	4	5	5	5	6% a
8	80	4	8	0	0	10% ab
12	80	14	21	25	25	31% c
16	80	38	44	47	47	58% d
20	80	67	71	72	72	90% e

Means followed by the same letters are not significantly different at 5% level as determined by Duncan's Multiple Range Test.

sexual maturity may play a prominent role. The knowledge of physiological ages of flies which are responsive to the attractant is important in a control programme where sex attractants are used.

CONCLUSION

Dacus dorsalis is the main pest of carambola fruits. The fruit-fly population positively correlated ($r = 0.56$) with the total amount of rainfall. The limited number of female flies in the field traps using methyl eugenol failed to indicate the

presence of *D. pedestris*. The laboratory studies showed varying responses of fruit-flies to methyl eugenol. Male of *D. dorsalis* and *D. umbrosus* were equally attracted to the sex attractant but *D. cucurbitae* was less attracted to the chemical. Evidently, with virgin males of *D. dorsalis* the response to the attractant increased with the age of the flies.

ACKNOWLEDGEMENT

The authors wish to express their sincere thanks to Messrs Abd. Rahman Mohamad and M. Subramanian for their assistance in the field.

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(Received 19 June 1980)