

STUDIES ON THE FIELD HABITS OF ADULT MELON FRUIT FLY DACUS (STRUMETA) CUCURBITAE, COQUILLET

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Abstract. There are 15 plants on which the adult flies perches. Activities of the female fly in the host field was maximum during 10.00-11.00 a.m., but consistently minimum on the resting sites and was vice versa in the early morning and late evening hours. This indicated female movement. Feeding habits of the adults in nature were also studied.

Fruit flies belonging to the family Tephritidae (Diptera) cause considerable damage to the cucurbitaceous vegetables. Latif *et al.*⁹ estimated a minimum loss of about four million rupees on account of fruit fly damage to cucurbits in Pakistan.

In Sind, two species of fruit flies namely the melon fruit fly *D. cucurbitae* Coq., and the Ethiopian fruit fly *D. (Didacus) ciliatus*, Loew., have been reported by Moiz *et al.*¹¹ damaging cucurbits. Studies made from 1960 to 1963 on their abundance showed predominance of the former species at Tandojam.^{1-3, 10} Application of the insecticides on the cucurbitaceous vines has been advocated as an effective method of controlling the melon fly at Lyallpur by Latif *et al.*⁹ Holdaway³ also believed that spraying with DDT would bring complete mortality of the *cucurbitae* attacking tomatoes and cucurbits in Hawaii. As against these recommendations, Nishida and Bess,⁵ however, accounted that the residual toxicity of DDT dust and sprays on the crop could not be relied on to prevent oviposition and subsequent damage because bulk of the fly population rested on other plants adjacent to the treated ones. They also succeeded in bringing down the infestation to only 3% in Hawaii by the application of insecticides on the rows of maize grown along the border of the host field as against 65% attack in the photo dusted with 3% insecticides.

Because of such conflicting recommendations on the control of *D. cucurbitae*, it was felt necessary to study the field habits of the adult melon fly under local conditions, with a view to evolve measures of control suited to this region. Studies were made at Tandojam from 1961 onwards to record: (i) activities of the adult melon fly after their emergence in the host field; (ii) plants preferred for rest and refuge; (iii) population of adults on refuge providing plants at different hours of the day; (iv) population of the adult flies in the host field at different hours of the day; (v) sex proportion on the resting plants and in the host field; and (vi) feeding habits of the adult flies in nature.

Material and Methods

The pupae were dug out from soil beneath the rotten fruits of cucurbits and were kept at a depth of about 1 inch at a selected site under more or less

the same conditions as in site. Observations on the emergence of the flies were recorded daily at these spots from 7.00 to 12.00 noon, since most of the emergence took place between these hours. Activities of the imagines were recorded until they left the site of emergence and got lost.

To find out the plants preferred by the adult flies for rest and refuge, their presence was looked for on all the low growing vegetations, shrubs and trees growing at Tandojam. Search was made especially in the early morning hours when the flies were less active and remained congregated under the leaves of the refuge-providing plants. Having known such plants, records on the population of the melon fly adults were taken at these spots from 6.30 and then at hourly intervals from 7.00 to 18.00 hr. Males and females were recorded separately.

The data thus obtained were statistically analysed using LSD test.

Intensive field surveys were carried out to find out the natural food of the adult flies. Observations were also made on the activities of the flies in different situations to record their feeding on plant secretions as well as on insect excretions.

Results

Activities of the Adult Melon Flies After Their Emergence in the Host Field. The young adults climb on the cucurbit vines or clods of soil to rest after their emergence. In sunny mornings, the flies pass the resting period on the underside of the cucurbitaceous leaves for about 10-30 min during which they move their wings up and down and occasionally rub them with their fore and hindlegs. Short flights are then initiated followed by longer ones and generally they leave the host fields and got lost.

The flies generally disappeared from the host fields in between 1930.2—3111.6 sec or 32 min and 10.2 sec to 51 min and 51.6 sec after their emergence (Table 1).

Plants Preferred for Rest and Refuge. Adult melon flies have been found perching on the following plants which were not beyond 180 m distance from the cucurbitaceous fields: *Cassia fistula* Linn.; *Ricinus communis* Linn.; *Cardia myxa* Linn.; *Mangifera indica* Linn.; *Psidium guajava* Linn.;

TABLE 1. A.O.V. FOR TIME TAKEN FROM EMERGENCE OF THE ADULTS TO THEIR BEING LOST (SEC).

Source of variation	d. f.	S. S.	M. S.	F. ratio	Remarks
Time	4	894827.6667	223706.916675	3.82	x
Month	5	5371704.5667	1066340.91334	18.19	†
Error	20	1172280.934	58614.0467		
Total	29	7438812.9667			

(x) significant

† Highly significant

S. E. for time mean 98.83

S. E. for month mean 108.2719

Time	T ₃	T ₁	T ₂	T ₄	T ₅	
mean	2558.0	2505.83	2498.33	2404.67	2078.0	
Sig. 5%	—————					
Month mean	Sept. 3111.6	Aug. 2772.4	July 2455.0	June 2183.6	May 2001.0	Apr. 1930.2
Sig. 5%	—————					
1%	—————					
c. f.,	174093612.00 ;	TSS,	7438812.9667 ;	RM,	894827.4667 ;	
MSS,	5371704.5607 ;	ERRORS,	1172280.9340			

Carica papaya Linn.; *Citrus paradisi* Macfad.; *Citrus grandis* Hassk.; *Grewia asiatica* Linn.; *Solanum melongena* Linn.; *Eucalyptus* Spp.; *Gossypium hirsutum* Linn.; *Ficus carica* Linn.; *Zea mays* Linn.; and *Vigna sinensis* Linn.

C. fistula, *R. communis* and *C. myxa* were the most preferred perching plants of the melon fly adults. The flies, however, were found in all the cases congregated on the lower surface of the leaves. On a single leaf of *C. fistula* as many as 96 flies were recorded during November 1962 at 8.00 hr.

The total fly population on refuge-providing plants was restricted to only few leaves where they were observed sitting on the same leaves day after day. On disturbance, the flies left the resting site, but again congregated under the same leaves after some time even if better shady plants existed elsewhere on the same leaves. The first congregation of the flies on few leaves may be due to their gregarious instinct. It is possible that some odour is left by these flies which causes repeated build up of the fly population upon the same leaves.

Adult flies, while congregating on the resting plants remained busy either in disturbing other flies by probing with their proboscis or in vomiting out droplets of liquid which was readily retaken through their mouth parts. Regular cleaning of their wings with their forelegs was observed to be a common feature. Copulation on the resting plants could not be observed even at dusk.

Population of the Adults on the Resting Plants at Different Hours of the Day. The total numbers of

the adults counted on the resting plants at different hours of the day during July–November have been analysed (Table 2).

The population on the refuge providing plants is highest in the morning up to 8.00 hr followed by the evening after 17.00 hr. (Table 2). From 9.00 to 11.00 hr the number of adults decreased considerably. However, it is slightly high from the minimum from 12.00 to 14.00 hr and it again decreases from 14.00 to 16.00 hr.

Population of the Adults in the Host Field at Different hr of the Day. Population counts were made in the host field at one-hour intervals from 7.00 to 18.00 hr in the fields of *Luffa aegyptiaca*, Mill.; *L. acutangula*, Roxb.; *Cucumis melo* var: *utilissimus*, Roxb.; *Momordica charantia*, L.; *Citrullus vulgaris* var: *fistulosus* stock.; *Lagenaria vulgaris* Serr. The counts were taken by sweeping for about 10 min (Table 3).

The population in the host field is generally highest at about 11.00 hr and increases again after 15.00 hr, but with low curve of population at 13.00 hr. (Table 3). Before 9.00 and after 17.00 hr the population reaches the lowest levels.

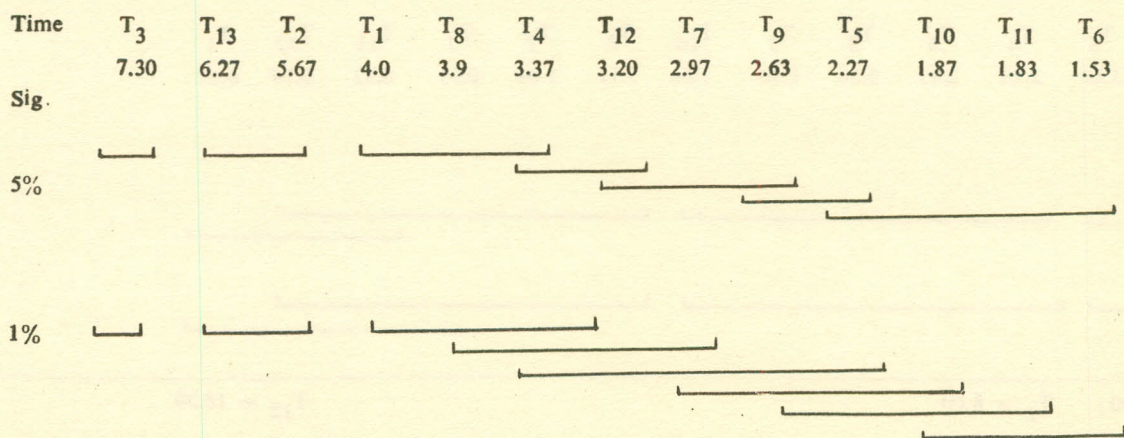
Sex Proportion of Adults Collected from the Host and the Resting Plants at Different Hours of the Day. While taking population counts, the number of males and females were recorded separately both on the resting plants as well as in the host fields. The analysed data is presented in Table 4 and Table 5, respectively.

TABLE 2. A.O.V. FOR POPULATION OF THE ADULT MELON FLIES ON THE RESTING PLANTS.

Sources of variation	d. f.	S. S.	M. S.	F. ratio	Probability against F value
Time (T)	12	1171.40	97.6167	43.46*	34311138×10^{-63}
Month (M)	4	182.8564	45.7141	20.35*	$1337342277 \times 10^{-23}$
Sex (S)	1	32.1614	32.1614	14.32*	0.000191544
T × M	48	853.0103	17.7710	7.91*	$1228496655 \times 10^{-38}$
T × S	12	88.3036	7.3586	3.28*	0.000199545
M × S	4	6.2205	1.5551	N.S.	
T × M × S	48	267.6461	5.5760	2.48*	0.000002627
Error	260	584.0000 ¹	2.2462	—	—
Total	389	3185.600	—	—	—

S. E. for time mean. 0.27

*. Highly significant

T₁ = 6.30; T₂ = 7.00; T₃ = 8.00;T₁₃ = 18.00

The population of females is high in the morning hours up to 8.00 hr, but declines from 9.00 to 11.00 hr. (Table 4). With a slight rise after 12.00 noon, it again decreases from 14.00 and continues up to 16.00 hr. From 17.00 hr onwards the population of the females again increases.

The population of males is high at 8.00 hr but decreases onwards up to 17.00 hr and reaches the level, close to female population again in the evening hours at 18.00 hr.

The population of females was mostly high all the day long, but quite significant during 9.00 - 12.00 noon. After slight decrease, the female population again had a sharp increase from 14.00 - 16.00 hr. During early morning and late evening hours the population of the adults was comparatively very low, showing that the flies move out from the host fields.

Natural Food of the Adult Melon Flies. Plants of

cowpeas, *V. Sinensis*, growing almost 100 m on south west of the nearest cucurbit plots, attracted maximum number of melon fly adults. Flies were found to feed in a competitive manner on the exudates of the gland present at the base of the floral bud during September—November.

Besides, the adults were also found feeding on the gummy exudates oozing out from the stem of eucalyptus plants, situated 200 m north west of host field.

In the month of January and February, the adult flies were observed feeding in large numbers on the honeydew exudates of aphids attacking *Brassica juncea* Coss; *B. compestris* Var: *dichotoma* Linn.; *Luffa aegyptiaca*; and *L. acutangula*.

Discussion and Conclusion

Dacus cucurbitae Cog. and *D. ciliatus* Loew. are responsible for severe losses to cucurbits in Sind, of

TABLE 3. A. O. V. FOR POPULATION OF ADULTS IN THE HOST FIELD AT DIFFERENT HOURS OF THE DAY.

Sources of variation	d.f.	S. S.	M. S.	F. ratio	Probability against F value
Time (T)	11	220.1757	20.0160	19.61*	10282×10^{-15}
Month (M)	6	199.7857	33.2976	32.62*	$7168812988 \times 10^{-34}$
Sex (S)	1	46.5030	46.5030	45.56*	249107×10^{-15}
T × M	66	355.9282	5.3929	5.28*	$1682990584 \times 10^{-27}$
T × S	11	37.2470	3.3861	3.32*	0.000377808
M × S	6	9.8095	1.6349	1.60 N.S.	
T × M × S	66	59.1905	0.8968	N.S.	
Error	168	171.5000	1.0208	—	
Total	335	1100.1399	—	—	

S. E. for time mean. 0.19

* Highly significant

Time	T ₅	T ₄	T ₆	T ₉	T ₃	T ₁₀	T ₈	T ₂	T ₇	T ₁₁	T ₁₂	T ₁
Mean	3.29	2.25	2.11	2.04	1.96	1.66	1.11	1.04	0.93	0.82	0.79	0.32

Sig

5%												
1%												

T₁ = 7.00; T₂ = 8.00T₁₂ = 18.00

TABLE 4. NUMBER OF MALES AND FEMALES ON THE RESTING PLANTS AT DIFFERENT HOURS OF THE DAY. (FOR A.O.V. REFER TABLE 2, S. E. FOR SEX MEAN, 0.11)

Sex	Males		Females										
Mean	3.89		3.31										
Sig. 5%													
1%													
S. E. for T × S = 0.39													
T × S Mean	T ₁	T ₂	T ₃	T ₄	T ₅	T ₆	T ₇	T ₈	T ₉	T ₁₀	T ₁₁	T ₁₂	T ₁₃
Males	3.53	5.27	7.27	3.93	2.87	2.13	3.47	4.53	3.13	2.53	2.60	3.67	5.60
Females	4.47	6.07	7.33	2.80	1.67	0.93	2.47	3.27	2.13	1.20	1.07	2.73	6.93
Difference	-0.94	-0.80	-0.06	+1.13	+1.20	+1.20	+1.0	+1.26	+1.00	+1.33	+1.53	+1.14	-1.33

TABLE 5. NUMBER OF MALES AND FEMALES IN THE HOST FIELD AT DIFFERENT HOURS OF THE DAY.
(FOR A.O.V. REFER TABLE 3. S. E. FOR SEX MEAN, 0.08)

	Sex													
	Mean		Males						Females					
			1.92						1.18					
			Sig. 5%						Sig. 5%					
			1%						1%					
S. E. for T × S mean = 0.27														
T × S	T ₁	T ₂	T ₃	T ₄	T ₅	T ₆	T ₇	T ₈	T ₉	T ₁₀	T ₁₁	T ₁₂		
Means														
Males S ₁	0.29	1.07	1.64	1.37	2.14	1.64	0.79	0.79	1.36	1.43	0.64	0.70		
Females S ₂	0.36	1.00	2.29	2.93	4.43	2.57	1.07	1.43	2.71	2.50	1.00	0.79		
Difference	+ 0.13	- 0.07	+ 0.65	+ 1.36	+ 2.29	+ 0.93	+ 0.28	+ 0.64	+ 1.34	+ 1.07	+ 0.36	—		

which the former is regarded as the more important species. The field habits of the former species were therefore studied at Tandojam (Sind) to ultimately find out suitable control measures.

It was observed that the melon fly remains for a very short time in the host field after emergence, from about 32 to 52 min. On leaving the host fields they take rest and refuge on 15 different plants growing in the vicinity of the cucurbitaceous fields. Ebeling *et al.*⁵ Nishida and Bess¹⁵ and Nishida¹³ have reported about a dozen plant species which provide perching places to melon fly adults in Hawaii. In India, the flies rest on castor (*R. communis*); guava (*P. guajava*) and citrus varieties¹⁴ Gupta⁶ casually observed them resting on *Mangifera Indica* in India. Castor, as reported earlier, is the only plant recorded providing rest and refuge to adults in Pakistan (Sind), Hawaii and India.

Population counts on the resting plants indicate low numbers of females during 9.00 – 12.00 noon and again after 15.00 – 17.00 hr. High population with almost equal numbers of male and female during evening and early morning hours indicate the come back of the female adults from the host fields. This notion gets more support from the data of sex proportion as recorded from the host field at different hours of the day. The population of the adults is negligible before 9.00 but increases afterwards until evening, but again decreases after 17.00 hr. The role played by the female movement, therefore, apparently affords changes in the population levels on either places, namely host field and the resting sites. These results mostly coincides with those of Nishida and Bess¹⁵ except that they observed maximum activity of adults at 15.00 – 18.00 hr. whereas the maximum activity period at Tandojam seems to be from 10.00 – 11.00 hr. The difference might be due to the ecological variation between Hawaii and Tandojam.

Exudates of cowpeas have been found to be the natural food of *D. cucurbitis*. Excretion of aphids (*Lipaphis erysimi*, Kalt.) attacking brassica and cucurbits served as another natural food of adult melon flies. This observation confirms the earlier records of Back and Pemberton,⁴ who reported melon fly adults feeding on the honeydew excretions of various homopterous insects. In India, Narayanan and Batra,¹² also reported that the honeydew of aphids attacking *Solanum melongena* Linn. served as a source of food for *D. cucurbitae*.

Since the adult melon flies rests on the surrounding vegetation for most of the time, the application of insecticides to the cucurbit vines is of doubtful value. The flies could better be controlled by the application of insecticides on the surrounding vegetation which provide rest and refuge to the adult melon flies. The habit of regurgitation while browsing on the plants may add to the effectiveness of contact and stomach insecticides.

R. communis, a preferred plant for rest and refuge could better be used as a border crop of the cucurbitaceous fields for the purpose of treatment with insecticides having long residual toxicity to gain effective control of melon fly in Sind.

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