Proc. Indian Acad. Sci. (Anim. Sci.), Vol. 94, No. 3, June 1985, pp. 295-301.

Behavioural response (feeding preference and dispersal posture) of *Aphis gossypii* Glover on brinjal crop

T K BANERJEE and D RAYCHAUDHURI

Department of Zoology, Calcutta University, 35 Ballygunge Circular Road, Calcutta 700019, India

Abstract. During late July to early August (kharif) and late November to late December (rabi), alates of *Aphis gossypii* Glover appear on the old leaves of the tender brinjal plants. Population build up is quite gradual with a sigmoid growth and the pest reaches peaks during late December (kharif) and late February (rabi) when plants become mature. In course of incidence they distribute from old to young to tender leaves and the aphid incidence on these leaves is always followed by the migration of alate immigrants. Thereafter, the aphid prefers mature tissues of the crop and in course of crop maturity its dispersing trend follows from old to the other leaves as well as plants in a sigmoid posture in a latero-angular spectrum.

Keywords. Brinjal; *Aphis gossypii*; sigmoid growth rate; matured tissue preference; latero-angular sigmoid dispersal contour.

1. Introduction

Aphids appear to have evolved the ability to profit from the environmental cues (*e.g.* mutual tactile stimulation, photoperiod, properties of different parts or ages of the host plant or of different plant species) to develop the morphs most suited to successful exploitation. They are found to disperse to the host plant as immigrant alates to exploit it if it is suitable and if not they tend to be away from there as emigrants. Thus the dispersive behaviour of alate migrants for better niche facilities is directly dependent on crop infestation. However, several factors for the development of the said form have been studied by several authors (Wadley 1923; Evans 1938; Dickson and Laird 1962; Johnson 1966; Lees 1967; Dadd 1968; Mittler and Kunkel 1971; Raccah *et al* 1971; Schaefers and Judge 1971; Ghosh and Mitra 1979; Rajagopal and Kareem 1979) in different species. Kennedy and Booth (1951) categorised the factors and flavour stimuli and nutrient stimuli to enhance alate migration. Muller and Unger (1951) also proposed a funnel-like locomotory path of alate immigrant of *Aphis fabae* Scop. in intercrop (*Vicia faba*) migration. The present study aims at gathering knowledge about the feeding preference and intracrop-dispersal posture of *Aphis gossypii* Glover on brinjal.

2. Material and methods

In a plot (20 m × 20 m) in Hooghly district (W.B.) twenty plants of brinjal (Krishnanagar cluster in kharif and Pusha purple long in rabi seasons) were planted. Observations were made on randomly selected three leaves (old, young and tender) per plant at 15 days interval. During observations adults and nymphs (3rd and 4th instars)

of both forms (alate and apterous) were separately counted along with the counting of colonies. Simultaneously the rate of infestation of plant and leaves were also recorded. Observations on kharif (1980–82) and rabi (1981–83) crops were recorded separately.

3. Results

3.1 *Incidence pattern*

The data on mean population (table 1) shows that after the initiation of colony aphids (*A. gossypii* Gl.) on brinjal plant followed a gradual increasing trend to reach the climax during late December (kharif) and late February (rabi). In both the seasons the aphid retained colony over the crop up to its harvest. Further, *A. gossypii* Gl. appeared on 2 month old hosts and the individuals in the population pyramid of the same increased with the rise of the host age (figures 1 C and F). Again, initiation of population was

Table 1. Kharif and rabi incidence of aphids and correlation coefficient between the increasing change of plant infestation with the decrease of alate adult incidence from old leaves.

Month	Incidence of aphid (%)	Incidence of alate immigrants (%)	Increasing change of infested plant (%) (x)	Decreasing change of alate adults (%) from old leaves (y)	Correlation coefficient (r) between x and y
Time			Kharif		
Jl_2	18·33	13·66	0	0	
A_1	57·77	18·94	8·35	8·33	
A_2	68·33	13·86	12·20	9·96	
S_1	113·88	10·22	3·35	+2·00	
S_2	98·33	4·16	−5·00	6·79	
O_1	126·66	4·11	5·00	+5·74	*
O_2	156·10	6·15	5·00	8·88	0·605
N_1	123·33	6·47	5·00	8·60	
N_2	199·99	10·87	1·65	3·98	
D_1	168·88	15·30	−3·30	3·52	
D_2	199·99	17·06	0·80	5·58	
			Rabi		
N_2	13·88	4·00	0	0	
D_1	71·11	13·98	10·00	35·77	
D_2	80·22	10·33	1·70	12.63	
J_1	108·33	20·54	1·30	+7·20	
J_2	151·66	11·40	7·00	+1·50	
F_1	188·88	9·21	3·35	7·63	**
F_2	247·22	8·90	3·35	15·19	0·689
M_1	244·99	9·75	1·65	0·05	
M_2	152·77	13·79	−10·00	4·79	
A_1	118·88	19·11	−5·55	4·95	
A_2	175·55	26·06	−0·55	2·91	

Data plotted here, mean of three years' observation.
* Significant at 1%.
** Significant at 5%.

mostly restricted to the old leaves and within a short period, aphid incidence could be traced on old, young and tender leaves. In course of aphid incidence on the old leaves it was marked with a gradual decrease whereas it was reverse on the young leaves. But on the tender leaves no such trend could be traced though there was a relatively higher incidence on it just prior to the harvest. Interestingly, the old, young and tender leaves had higher incidence values during early, middle and late sessions of the crops respectively in both the seasons but in no case incidence on old leaves could be surpassed by the others.

Another interesting feature was the incidence of the alate adults which could be marked with a higher percentage during early and late sessions of the crop seasons. The incidence of the said morph was relatively lower during the mid session. Like the trend of aphid incidence, the higher values of alate adults were marked successionally on old, young and tender leaves during early, middle and late sessions of the crop respectively (figures 1A and D; figures 2 B and E).

3.2 *Growth rate*

The growth curves (figures 1 B and E) show a modified sigmoid form where the upper asymptote level was marked during late November (kharif) and late February (rabi) when the plants were fully mature (5–7 months old).

3.3 *Infestation percentage*

Maximum incidence of *A. gossypii* Gl. infested plants and leaves in maximum frequencies (figures 2 A and D). Furthermore, the leaf infestational trend was distributed from old to young to tender leaves in course of its incidence (figures 2 C and F). Again it could be seen (table 1) that decrease of alate immigrant incidence from old leaves positively correlated (r = 0·605/kharif and 0·689/rabi) with the increase of plant infestation.

4. Discussion

It has often been shown that the aphids (*A. gossypii* Gl.) favour winter with low temperature and optimum rh (Bodenheimer and Swirski 1957; Agarwala and Raychaudhuri 1979; Roy and Behura 1979). Here too the aphids showed abundance on

---

Figures 1 A–F. Preferential behaviour of aphid to the host tissues. **A, D.** Population distribution on different leaves **B, E.** sigmoid (s-shaped) population growth form and **C, F.** population pyramid of *Aphis gossypii* Gl. in kharif and rabi crops of brinjal. These show that the aphids always favour the mature tissues of the brinjal crop.

Figures 2 A–G. Intra crop dispersal-trend of aphid (*Aphis gossypii* Gl.) on brinjal. **A, B.** Incidence of aphid on the crop in relation to plant and leaf infestation. **C, D.** Distribution of alate adult at the different levels of the leaves. **E, F.** Rate of infestation of different leaves during pest incidence. These suggest that the aphids tend to be dispersed from old to young to tender leaves. **G.** Model showing intra crop dispersal contour of aphid (*Aphis gossypii* Gl.) in brinjal.

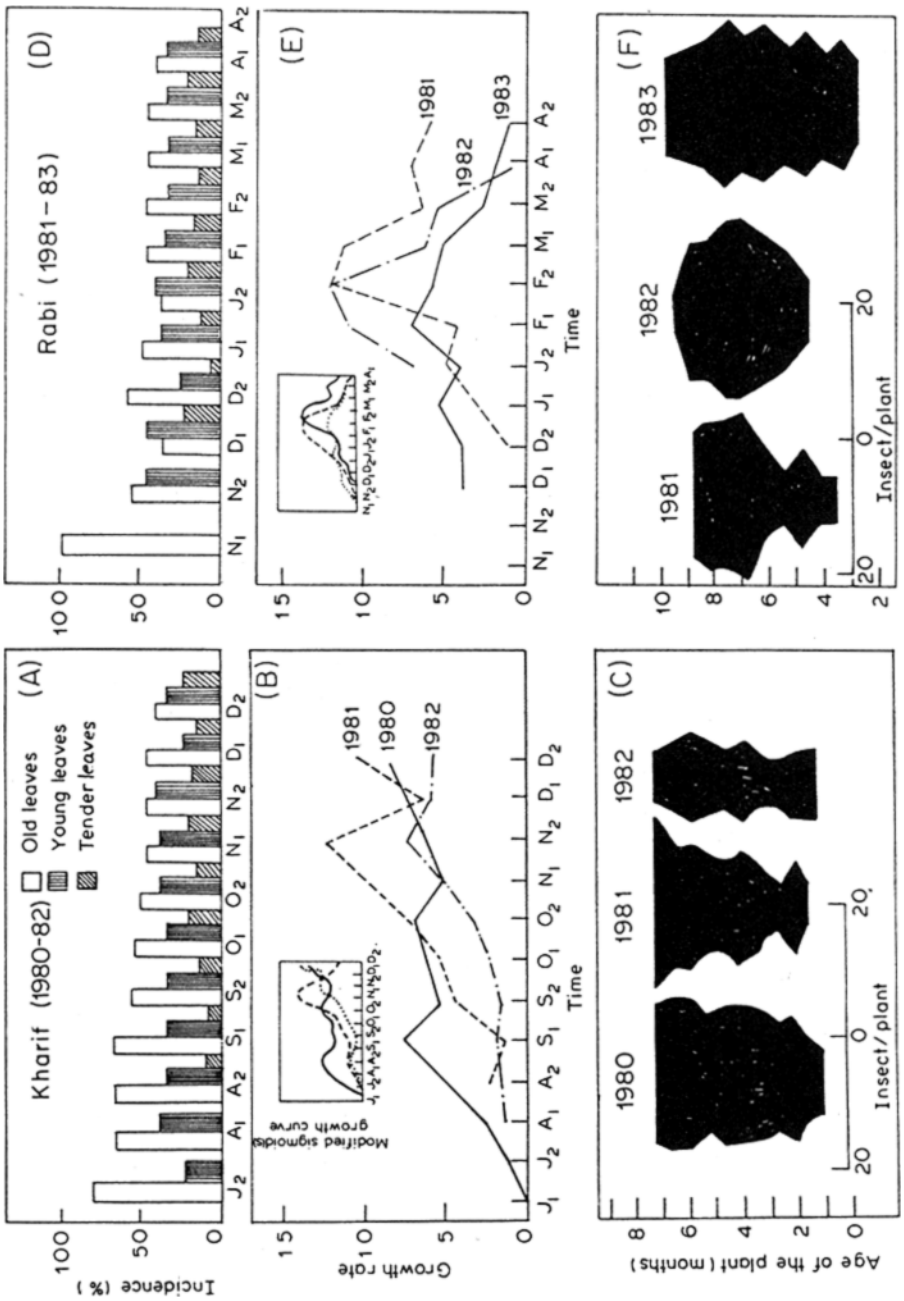

Figure 1. For caption, see page 297.

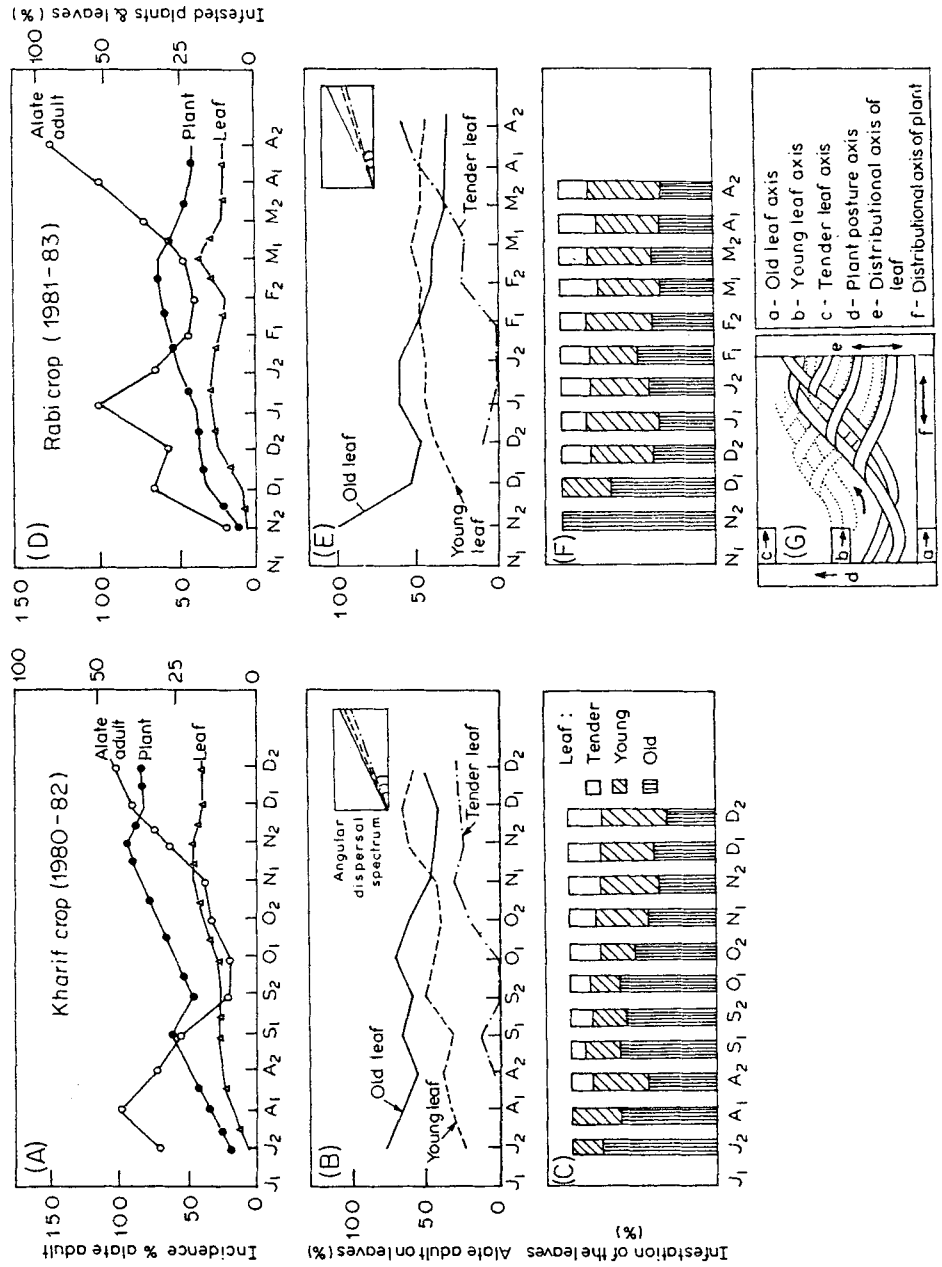

Figure 2. For caption, see page 297.

mature brinjal plants. Nevertheless, the forms of population pyramids diverged towards old age, as they were active during that period. Again, the trends of aphid incidence (colony as well as alate immigrants) from old to young to the tender leaves and the retention of the same over old leaves during harvest reflect a behavioural affinity of the aphids towards the older hosts. Furthermore, the higher growth rate with sigmoid form on the old plants during late session, indicates the host status where the aphids find normal situation in which population size deviates less from the asymptote (Odum 1971). This could be placed as a supplementary factor for the former reflection. Again to pay emphasis over aphid-host interaction in relation to matured tissues several factors including emergence of largest veins (Gibson 1972), intermittent water stress (Wearing 1972), nitrogen saturation (van Emden *et al* 1969) have been referred. Moreover, Turner (1971) found that the growth of *A. gossypii* Gl. was haltered in the absence of methionine. Though the present study does not deal with any of these factors, it is obvious that the aphid prefer to feed on older tissues rather than the young or tender.

Based chiefly on alate incidence and the relative infestation of the plants by them the speculation has often been advanced that the initiation of aphid colony is being made by the alate adults. Subsequently, factors like feeding competitiveness (Ghosh and Mitra 1979), crowding effect (Mittler 1973) and reduced moisture content of the host (Ratanlal 1951) enhance aphid incidence thereby increasing the rate of host infestation. But it is obvious that throughout the season alate persisted in all the leaves though the relative percentage varied during different periods. It is noteworthy that in the observation, the preabundance of alate adults led the abundance of aphids in general along with the peak percentage of infestation. It is quite clear from the correlation between the decrease of alate immigrant incidence and increase of plant infestation, that the aphids tried to avail latero-angular dispersal than vertical or irregular. Thus the projectile of alate percentage on different leaf level, a sigmoid dispersal contour (Wolfenbarger 1946; Odum 1971) appears (figures 2 B, E and G).

Acknowledgements

The authors thank Dr M R Ghosh and B C K V V Kalyani for constructive suggestions and Mr S N Basu for the drawings.

References

Agarwala B K and Raychaudhuri D N 1979 Biotic potential of weeds in respect of *Aphis gossypii* Gl. infesting some economic plants in Kalimpong, West Bengal; *Indian Agric. Sci.* **23** 25–29

Bodenheimer F S and Swirski E 1947 Studies on the physical ecology of the wooly apple aphis (*Eriosoma lanigerum*) and its parasite *Aphelinus mali* in Palestine; *Bull. Agric. Exp. Sta. Rehovot.* **41** 20

Dadd R H 1968 Dietary aminoacids and wing determination in the Aphid *Myzus persicae*; *Ann. Entomol. Soc. Am.* **61** 1201–1210

Dickson R C and Laird E F 1962 Green peach aphid populations on desert sugarbeats; *J. Econ. Entomol.* **55** 501–504

Evans A C 1938 Physiological relationships between insects and their host plant I. Effect of chemical composition of the plant on reproduction and production of winged forms in *Brevicoryne brassicae* L; *Ann. Appl. Biol.* **8** 49–64

Gibson R W 1971 The resistance of three Solanum species to *Myzus persicae*, *Macrosiphum euphorbiae* and *Aulocorthum solani* (Aphididae: Homoptera); *Ann. Appl. Biol.* **68** 245–251

Ghosh M R and Mitra A 1979 Population of *Lipaphis erysimi* (Kalt) on mustard and radish; *Proc. Symp. aphids. Zoo. Soc. Orissa* Bhubaneswar pp. 1–440

Johnson B 1966 Wing polymorphism in aphids. III. The effect of temperature and photoperiod. *Entomol. Exp. Appl.* **9** 301–313

Kennedy J S and Booth C O 1954 Host alternation in *Aphis fabae* Scop; *Ann. Appl. Biol.* **41** 88–106

Lees A D 1967 The production of apterous and alate forms in aphid *Megoura viciae* Buckton with reference to the role of crowding; *J. Insect Physiol.* **13** 289–318

Mittler T E and Kunkel H 1971 Wing production by grouped and isolated apterae of the aphid *Myzus persicae* on artificial diet; *Entomol. Exp. Appl.* **14** 83–92

Mittler T E 1973 Aphid polymorphism as affected by diet. In *Perspectives in aphid biology* (ed.) A D Lowe (Auckland New Zealand: Ent. Soc. New Zealand) pp. 65–75

Mueller H J and Unger K 1951 Uber die ursachen der unterschiedlichen Resistenz von *Vicia faba* L. gegenuber der Bohnenblattlaus Doralis fabae Scop; *Zuechter* **21** 1–30, 76–89

Odum E P 1971 *Fundamentals of Ecology* (London: W B Saunders Company) 1–574

Rattanlal 1957 Effect of water content of aphid and their host plants on the appearance of alatae; *Indian J. Entomol.* **17** 52–62

Raccah B, Tahori A S and Applebaum S W 1971 Effect of nutritional factors in synthetic diet on increase of alate forms in *Myzus persicae*; *J. Insect Physiol.* **17** 1385–1390

Rajagopal S and Abdul Kareem A 1979 Studies on certain factors affecting alatae production green peach aphid; *Proc. Symp. on aphids* (ed.) B K Behura (Bhubaneswar: Zoological Society of Orissa) pp. 17–22

Roy D K and Behura B K 1979 Seasonal variation in the population of *Aphis gossypii* Gl. on brinjal; *Proc. Symp. on aphids* (ed.) B K Behura (Bhubaneswar: Zoological Society of Orissa) pp. 60–64

Schaefers G A and Judge F D 1971 Effect of temperature, photoperiod and host plant on alasy, polymorphism in the aphid *Chaetosiphon fragaefolii*; *J. Insect. Physiol.* **17** 365–69

Turner R B 1971 Dietary aminoacid requirements of the cotton aphid, *Aphis gossypii* Gl. the sulphur containing aminoacids; *J. Insect Physiol.* **17** 2451–2456

Van Emden H F, Eastop V F, Hughes R D and Way M J 1969 Ecology of *Myzus persicae*; *Ann. Rev. Entomol.* **14** 197–270

Wadley F M 1923 Factors affecting the production of alate and apterous forms of *Myzus persicae*; *Ann. Entomol. Soc. Am.* **16** 279–303

*Wearing C H 1972 Selection of Brussels Sprouts of different water status by apterous and alate *Myzus persicae* and *Brevicoryne brassicae* in relation to age of leaves; *Entomol. Exp. Appl.* **15** 139–154

*Wolfenberger D O 1946 Disperson of small organism; *Am. Midl. Nat.* **35** 1–152