Olfactory response of cowpea aphid, *Aphis craccivora* Koch, to host odours and population of conspecifics

J. Jaba*, B. Haseena, S. Tripathy, A. C. Hosamani and Y. S. Amaresh

ABSTRACT

Cowpea, *Vigna unguiculata*, is an important food crop in many tropical regions. The cowpea aphid, *Aphis craccivora*, Koch is a key pest of the crop. Olfactometer experiments were conducted in the laboratory to study the influence of host odour and population of conspecifics on apterae and alatae of cowpea aphid *Aphis craccivora* Koch. Among the four different host plants tested, more number of alatae responded to the allomonal cues emanating from cowpea leaves (1.6,) followed by that from glyricidia (1.4), dolichos (0.4) and groundnut (0.4). Apterous morphs also responded more to cowpea (1.6) followed by dolichos (0.6) groundnut (0.4) and glyricidia (0.2). The maximum retention time recorded inside the olfactometer for alate morph was on cowpea (360 seconds) followed by glyricidia (300seconds).Apterous morph recorded maximum retention time on glyricidia (300seconds) followed by cowpea (240 seconds). In response to host odour perception, it was observed that cowpea was the most preferred host plant to *Aphis craccivora* followed by glyricidia. More number of alatae and apterae were attracted to cowpea leaves infested with the lowest population density of 10 aphids (3.2, 2.0) followed by 50 (1.6, 1.0), 100 (1.0, 0.6) and 150 (0.8, 0.4) respectively. This behaviour shows their non- preference to already infested leaves.

Key words: Olfactometer, aphid, crop pest, cowpea, host odour, conspecific population density

INTRODUCTION

Cowpea, *Vigna unguiculata*, is an important food crop in many tropical regions. In Kerala, cowpea is grown mainly as a vegetable crop. The cowpea aphid, *Aphis craccivora*, Koch is a key pest of the crop. The nymphs and adults feed gregariously on the leaves, tender shoots, inflorescence and tender pods thus causing malformations, stunting and even drying up of the parts. *A. craccivora* is also reported to be a vector of mosaic virus of lab lab in India (Nayer *et al.*, 1976). The host plant range of the cowpea aphid is limited to Leguminosae, and this species has a cosmopolitan distribution. The majority of herbivores insect species are very selective feeders that choose their host plant base on visual, mechanical, and chemical stimuli (Bernays, 1998). The alate *Aphis craccivora* are most responsible for finding new host. It is one of the relatively few aphid species with pest status in the tropics (Blackman and Eastop, 1984). Similarly, Sahayaraj and Kombiah (2009) have studied the olfactory response of banna weevil, *Odoiphorus longicollis* using the decayed banana pseudostem extracts. To understand the mechanism of aphid resistance in plants, investi gations are to be made on host plant relationship which would throw light on newer method of aphid management. In the present study, we test the host selectivity behaviour in response to plant volatiles and pest mediated semiochemicals by both morphs of *Aphis craccivora* in laboratory by using olfactometer experiments were conducted to investigate the role of odour perception by *A. craccivora* for host plant selection.

MATERIALS AND METHODS

The experiment was conducted in the laboratory using the laboratory reared aphids (*A. craccivora*) in a four arm olfactometer (Plate 1) designed and fabricated (Ranjith, 2007) in the Department of Entomology, College of Horticulture, Kerala Agricultural University, Vellanikkara, Thrissur. The kendall test used for statistical analysis for olfactometer experiment (Kendall, 1955). The laboratory reared *A. craccivora* was used for the study.

Mass culturing of *A. craccivora*

The stock culture of *A. craccivora* was maintained on potted cowpea plants covered by net cage of dimension 120cm diameter and 90cm .Cowpea plants were raised by sowing the seeds of variety Kanakamani (known to be susceptible to *A. craccivora*) once in three weeks. The plants were infested at two trifoliate leaf stages with ten

apterous adults of *A. craccivora* collected from the field on cowpea. The aphids multiplied rapidly in the absence of natural enemies. Adults of *A. craccivora* were collected from those plants for fresh infestation on another set of potted plants raised under net cage condition. The seedlings were irrigated daily in the morning. From heavily infested cowpea plant, using camel brush, aphids were dislodged into petri plate and used for laboratory experiments.

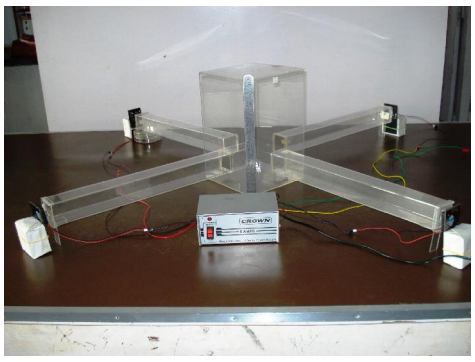

Plate 1. Four arm-olfactometer

Response of *A. craccivora* to different host plants

Twenty adult aphids were placed in the centre of olfactometer chamber. Two grams of fresh tender leaves each of cowpea and alternate hosts *viz.*, dolichos, groundnut and glyricidia were kept in four different arms of the olfactometer and air was passed over the host leaves using fan placed adjacent to each of the four arms of the olfactometer. Four hosts were exposed at the same time and the experiment was replicated five times. The number of alate aphids responding to different treatments was recorded at one hour interval and its retention time was also recorded. The experiment was carried out for four hours. Response of apterous and alate aphids was studied in separate experiments.

Response of *A. craccivora* to conspecific population density on cowpea

Twenty adult aphids were placed in the centre of olfactometer experiment chamber. In the four arms, cowpea leaf infested with different densities of apterous aphids *viz.*, 10, 50, 100 and 150 were kept and air was passed over them by fans placed adjacent to each of the four arms of the olfactometer. The number of aphids responding to different treatments was recorded at one hour interval and its retention time was also recorded. The whole experiment was carried out for four hours and replicated five times. Response of apterous and alate aphids was studied in separate olfactometer experiments.

RESULTS

Among the host plants tested, cowpea (1.6) was found to be more attractive to the alates of *A. craccivora* followed by glyricidia (1.4), dolichos (0.4) and groundnut (0.4) (Table 1). Apterous morphs also responded more to cowpea (1.6) followed by dolichos (0.6) and groundnut (0.4). The maximum retention time recorded for alate morphs was on cowpea (360seconds) followed by glyricidia (300 seconds). But apterous morphs recorded maximum retention time on glyricidia (300seconds) followed by cowpea (240 seconds) The results of the experiment showed that, when different host plants *viz.*, glyricidia, cowpea, dolichos and groundnut were tested for their preference by *A. craccivora*, highest response was found towards cowpea followed by glyricidia.

Table 2. Response of *Aphis craccivora* to different densities of aphid population

Aphid Population	Alate		Apterous	
	Responded		Responded	
	Mean number	Mean rank score	Mean number	Mean rank score
10	3.2	3.63	2	4.0
50	1.6	2.50	1	2.67
100	1	2.0	0.6	2.00
150	0.8	1.88	0.4	1.33

* Ranking based on Kendall's test

In the olfactometer, the retention time was also recorded more on cowpea leaves.

Among the different densities of aphid population tested (Table 2) maximum response was found towards 10 aphids (3.2, 2.0) followed by 50 aphids (1.6, 1.0), 100 aphids (1.0, 0.6) and 150 aphids (0.8, 0.4) in both alate and apterous

Table 1. Response of *Aphis craccivora* to different host plant odours

Host plant	Apterous				Alate			
	Responded		Retention		Responded		Retention	
	Mean number	Mean rank score	Time (Seconds)	Mean rank score	Mean number	Mean rank score	Time (Seconds)	Mean rank score
Glyricidia	0.2	2.75	300	3.80	1.4	3.00	300	3.20
Cowpea	1.6	3.00	240	3.10	1.6	3.20	360	3.80
Dolichos	0.6	2.25	180	2.00	0.4	2.00	180	1.80
Groundnut	0.4	2.00	60	1.10	0.4	2.00	120	1.20

* Ranking based on Kendall's test

morphs respectively. The attracted aphids were retained in the treatments throughout the experiment. Aphid population density was found to have significant influence in attracting other aphids to the plant. Both apterous and alate responded more towards cowpea leaf with lower density of 10 aphids.

DISCUSSION

Most studies on the response of alate and apterous aphids to distant host plants have been based on olfactometer test. The olfactometers evaluate the importance of volatile semiochemicals in the host finding process, independently of visual stimuli. In Kerala, cowpea is the major host for *A. craccivora* in the field and glyricidia is reported as its major alternate host (Reji, 1995). Hence, the aphids were more attracted to their most preferred host cowpea followed by the major alternate host glyricidia. Pettersson *et al.* (1998) reported that both morphs of *A. craccivora* showed more response to cowpea leaves than the *Vicia faba* and oat leaves in an olfactometer. The significantly higher proportion of individuals of *Myzus persicae* were observed on tobacco than the less preferred host of sugar beet by Vargas *et al*. (2009). Seven days old decayed pseudostem having the attractant property towards the banana weevil, *Odoiphorus longicollis* (Sahayaraj and Kombiah, 2009)

High concentration of alarm pheromone at higher population density of aphids would ward off other aphids. Attraction to low density of aphids on cowpea leaves might also be due to the higher quality of food available at feeding site at low population density as compared to higher population. (Araya and Fereres, 1991; Thirakhupt and Araya, 1992). The results obtained are in confirmation with Petterson *et al*. (1998). They showed that the apterous *A. craccivora* was attracted to both alate and apterous as long as the group in the odour consisted of 10 individuals but they were repelled by bigger groups. This is a natural adaptation to colonise fresh leaves or those with least population of conspecifics, so as to avoid intraspecific competition.

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