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Behavioral responses of banana aphid, *Pentalonia nigronervosa* (Coq.) to host plant extracts

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Abstract
Banana aphid, *Pentalonia nigronervosa* (Coq.) is an important pest of banana and causing economic damage due to transmission of Banana Bunchy Top Virus. A difference in the infestation pattern of banana aphid has been recorded among the cultivars of banana. In order to find out the role of host plant responses in the aphid infestation, the host and host extracts were evaluated by behavioural assays. Olfactometry studies of host indicated a maximum attraction of 40% in cvs Karpuravalli and least preference was noted as 16.7% in Saba and Njalipoovan. The solvent extracts demonstrated a maximum aphid attraction of 36.7% in cv. Karpuravalli and a minimum attraction of 10% in Saba.

Keywords: Banana Pest, Aphid, *Pentalonia nigronervosa*, Olfactometry, Behavioral assay

Introduction
The banana (Musa spp.) is widely regarded as the most significant fruit crop in tropical and sub-tropical countries [1-3]. It is among the economically viable fruit crops that the average person can easily acquire. Banana and plantains are affected by a number of pests [4]. Among them, banana aphid (*Pentalonia nigronervosa)* (Hemiptera: Aphididae) is an important sucking pest posing threat to the banana production to some cultivars of banana as vector of Banana Bunchy Top Viral (BBTV) disease [5-7]. It is recognised as one of the world's most dangerous banana diseases. The disease is characterized by stunting, leaf chlorosis, and rosetting, and a cessation of fruiting. Studies have demonstrated that several elements including climatic condition, vector life stage, and plant access period has role in BBTV transmission [8]. BBTV disease is a devastating disease that caused huge loss in different countries including India and it seriously affected the states of Andhra Pradesh, Maharashtra, Tamil Nadu and Kerala.

Olfaction is the most important sensation for insects and it helps them to locate their host plants [9]. Insects have highly sensitive and selective senses of smell, allowing them to distinguish between numerous volatile molecules [10-12]. Insect's behavioral assays are usually designed to measure attraction for feeding or oviposition in relation to their host plants or specific chemistry. Olfactometers are a valuable tool for studying insect olfaction. Knowledge of insect olfactory detection mechanisms could provide a basis for developing insect control initiatives. Hence the present study was designed to assess behavioral responses in *P. nigronervosa* to *musa* cultivars.

Material and methods
Insect culture
Banana aphids were collected from the field and raised on newly established banana plants in laboratory (Fig. 1). The culture was maintained at 27±1.0^{0}C. RH 60% with photoperiod of 16:8 (Light: Dark) hours.

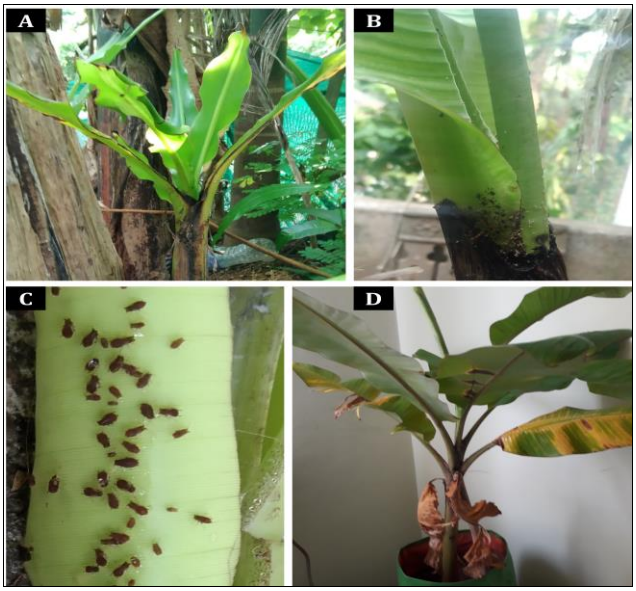

Fig 1: BBTV infected banana plant in the field (A), Banana aphids on the plant Leaf (B, C) and Banana aphids reared on banana plant in the Laboratory (D).

Host plant extracts

A freshly collected banana midrib was taken from four-month-old earthern potted plant. Host plant extracts were prepared by soaking 100g of cut pieces of banana midrib of different cultivars in HPLC grade Dichloromethane (DCM) solvent overnight. The supernatant solution was filtered and collected in a 100ml round bottom flask and reduced to 1 ml by rotary evaporator.

Four-way olfactometer bioassay

The response of *musa* spp. and its solvent extract were tested against aphids with a four-armed olfactometer. The olfactometer consists of a central area for releasing the insects and it is connected to the four arms. Each arm was connected via Silicon tube to headspace chamber containing the odor source. A pressure controlled vacuum pump and activated carbon filter were used. The bioassay studies were conducted using fourth instar nymph. For each assay, aphid nymph (n=10) was introduced into the release portion, and they were observed for 10 min using a stopwatch and replicated four time. The test aphids were kept for 2 hours of starvation. A piece of whatman filter paper with 5% concentration host plant extract samples, 5gm of banana mid rib or the control (fresh air) was placed into the headspace units. Aphids entering an arm within this time were considered 'responders'. The number of aphids in the treatment and control sides of the olfactometer was recorded. The entire experiments have carried out in a dark room at 27±1°C.

Results and discussion

The olfactory responses of banana aphids towards selected cultivars depicted that the response of aphids towards the solvent extract or the fresh midrib varies widely (Table 1). In the behavioral bioassay using 4-way olfactometer, the olfactory response of banana aphid to different cultivars depicted that the maximum number of aphids was attracted in Karpuravalli (40%). All other cultivars showed less preference when tested the midrib as host plant with the least preference (16.7%) in Saba and Njalipoovan. Similarly, the dichloromethane of cultivar Karpuravlli attracted a maximum number of aphids (36.7%) followed by Nendran (3.3%) and minimum number of aphids was recorded in Saba (10%). The cultivars such as Monthan, Njalipoovan, Chenkadali, Rasthali and Nendran were having similar aphid attraction in both DCM extract of Midrib and Fresh banana Midrib. This kind of behavioural studies using the banana aphids are very limited. Some of the previous studies has reported the behavioural responses of the banana stem borer (*Odoiporus longicollis*) [13-16].

Table 1: Response of banana aphid to banana host and host plant extract by four way olfactometery

Name of the Cultivar	% attraction of adult aphids on banana midrib	
	DCM extract of Midrib	Fresh banana Midrib
Karpuravalli	36.7^{a}	40.0^{a}
Robusta	23.3^{abcd}	30.0^{ab}
Monthan	20.0^{bcde}	20.0^{bc}
Virupakshi	13.3^{cdef}	20.0^{bc}
Njalipoovan	16.7^{cdef}	16.7^{bcd}
Chenkadali	26.7^{abc}	26.7^{ab}
Rasthali	23.3^{abcd}	23.3^{ab}
Nendran	33.3^{ab}	33.3^{ab}
Poovan	20.0^{bcde}	26.7^{ab}
Saba	10.0^{def}	16.7^{bcd}
DCM	6.7^{ef}	0.0^{d}
Control	3.3^{f}	3.3^{cd}
CD value at 5%	14.566	16.848

Mean followed by the same letter (s) in a vertical column is (are) not significant at the 5% level as per the Duncan Multiple Range Test (DMRT).

Conclusion

The present study revealed that the host plant and host plant extracts of banana cv. Karpuravalli has the maximum ability to attract banana aphid *P. nigronervosa.* The volatile chemicals emanating from the plant extract may act as cue. Therefore, identification of the volatile components of the attractive plants will help to elucidate the attractant and develop an effective lure to monitor the incidence of banana aphid *P. nigronervosa*.

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