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Short Communication

Food plants and temperature dependent mortality of *Aphis craccivora* (Hemiptera: Aphididae)

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ABSTRACT
Aphis craccivora (Hemiptera: Aphididae) is a serious polyphagous pest on several agricultural plants in North East Bihar. Economically important four host plants viz., *Phaseolus sinensis*, *Lablab purpureus*, *Vigna radiate*, and *Vigna mungo* were used in the experiment. During the experiment, food plant and temperature-dependent mortality was found in *A. craccivora*. The highest mortality of *A. craccivora* was recorded on *V. mungo* (17.54%) followed by *V. radiata* (11.52%), *L. purpureus* (6.27%) and *P. sinensis* (4.18%) during November. Similarly, highest mortality was also recorded on *V. mungo* when studied during December, January, and February respectively. However, the effect of temperature was also recorded significantly. The highest and lowest mortality of *A. craccivora* was recorded 49.31% at (9.24±0.703 ºC) and 17.54% at (19.96±0.13 ºC) on *V. mungo* respectively. The significant variation was recorded when reared on different food plants in different months ($F1=24.15$, $F2=29.72$; $P< 0.05$). The highest mortality of *A. craccivora* shows the unsuitability of food plants and environmental factors.
Keywords: *Aphis craccivora*, Mortality, Food plants, Temperature, Humidity

INTRODUCTION
Aphids (Hemiptera: Aphididae) are small polymorphic soft-bodied hemipteran bugs. They damage the crops directly by sucking the nutrients from different parts of plants which retards the growth and development of plants. They have great agricultural importance due to parthenogenesis and fast development. Aphids' pest problems are known worldwide, they also damage the plants by transmitting several plant viruses and also responsible for the development of sooty molds which hampers the process of photosynthesis (Stary and Ghosh, 1983). Allelochemicals and the morphological structure of food plants are important factors which can affect the mortality rate of aphids. In most of the empirical studies, the growth, survival, and developmental rate of aphids were found food plant-dependent (Tazerouni, et. al., 2016 and Rakhshan and Ahmad, 2018, 2019). The temperature-dependent biology of aphids was also reported by Wang and Tasai (2000). Therefore, present studies on the bioecology of this aphid are crucial for optimizing control strategies.

Aphis craccivora is a major polyphagous pest on several agricultural plants in Northeast Bihar and recorded on 36 food plants of 12 families, of which 16 plants belong to the family Fabaceae (Kumar, 2013). Hence, this is evident that *A. craccivora* suffered most of the plants of the family Fabaceae. Therefore, in the present investigation, the mortality of *A. craccivora* was studied on four food plants of family Fabaceae viz., *Lablab purpureus*, *Phaseolus sinensis*, *Vigna radiate*, and *Vigna mungo*. This information will help us make decisions, to formulate Biological control programs.

MATERIALS AND METHODS
Four food plants viz., *Lablab purpureus*, *Phaseolus sinensis*, *Vigna radiata*, and *Vigna mungo* were grown in the field laboratory for experiment. The nucleus culture of *A. craccivora* was obtained from the field and maintained them culture on different food plants (*Lablab purpureus*, *Phaseolus sinensis*, *Vigna radiate*, and *Vigna mungo*). Randomly selected apterous females from the stock culture were transferred onto the fresh leaves of different food plants potted in plastic vials (250ml) at room temperature during November, December, January, and February (Table. 1). For each set of the experiment, 10 apterous females were released on fresh and fully extended 4-6 week old plants leaves. Newly born nymphs were removed daily after counting. Nymphs born within 24h were individually confined on the leaf disks in the separate

Petri dishes and every day transferred on to fresh leaves of experimental food plants. The exuviae were used to determine the molting period. Dead nymphs were removed and counted during the experiment. Data were subjected to Analysis of Variance (ANOVA) Test.

RESULTS AND DISCUSSION

The effect of food plants, temperature, and humidity was studied on mortality of *A. craccivora* in the laboratory. The significant effect was recorded on experimental food plants viz. *P. sinensis*, *L. purpureus*, *V. radiata* and *V. mungo*. The highest rate of mortality of *A. craccivora* was recorded on *V. mungo* (17.54 %) during November followed by *V. radiata* (11.52 %), *L. purpureus* (6.27 %), and *P. sinensis* (4.18 %) respectively. Similarly, the highest mortality was also recorded on *V. mungo* during Dec., Jan., and Feb. The difference between mortality and food plants in different months is recorded significantly by the ANOVA test (F1=24.15, F2=29.72; P<0.05) (Table-1).

From the present observation, it is clear that the nymphal survival rate is better on *P. sinensis* and *L. purpureus* than *V. radiata* and *V. mungo* (Table-01). Gupta et al., (2007), reported that the nymphal survival of aphid is based on food plant quality.

A positive linear correlation was observed between nymphal mortality on different food plants in different months (Fig.-2). Due to temperature and humidity, the highest mortality was recorded 49.31 % during January on *V. mungo* (9.24±0.703 ºC and 76.71±1.609 % RH). While the lowest mortality was recorded on *V. mungo* during November (17.54 %) (19.96±0.13 ºC and 79.28±0.71 % RH) (Fig.-1).

Table 1. Nymphal mortality (%) of *A. craccivora* on different food plants in different months

Months / Host plants	*P. sinensis*	*L. purpureus*	*V. radiata*	*V. mungo*	F- value
November	4.18	6.27	11.52	17.54	F1=24.15 F2=29.72 P<0.05
December	13.92	19.56	29.07	32.82	
January	18.39	28.26	36.36	49.31	
February	6.54	18.30	21.64	25.58	

Table 2. Average room temperature and humidity of experimental months.

Months	Temperature	Relative Humidity
November	19.96±0.13 ºC	79.28±0.71% RH
December	15.43±0.77 ºC	63.31±1.17% RH
January	9.24±0.703 ºC	76.71±1.60% RH
February	17.92±0.38 ºC	57.88±0.47% RH

Aphids are poikilotherms, their rate of growth, development, and survival is proportional to ambient temperature. At very low temperatures, inhibit the rate of development. As temperature increases, development begins to occur and gets faster. At high-temperature development rate level off and then drops quickly near the upper limit of survival which is in the agreement with Rakhshan, et.al., (2018b). In the present investigation, the highest survival of aphids was recorded during November at 19.96 ºC, which shows a more favorable temperature for aphid multiplication in comparison to other months. Wang and Tasai (2000) also recorded the highest rate of survival of aphid at a temperature around 20 ºC. In the present observation, the highest temperature around 20 ºC- 24 ºC and lowest (9ºC to 11ºC) has found to be favourable for *A. craccivora* multiplication. If temperature increased or decreased from this level, adversely affects the mortality rate of *A. cracccivora*. Similarly, Khandwe et al., (1999) also found that the highest temperature (22 ºC to 24 ºC) lowest (8ºC to 9.9ºC) and 66% to 88% relative humidity favorable for *Myzus persicae*.

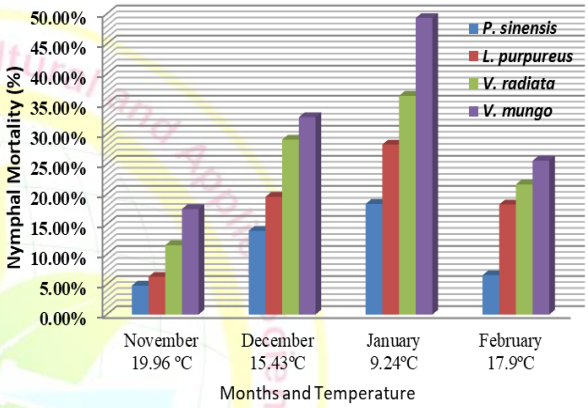

Fig. 1. Nymphal mortality of *A. craccivora* on different food plants in different months

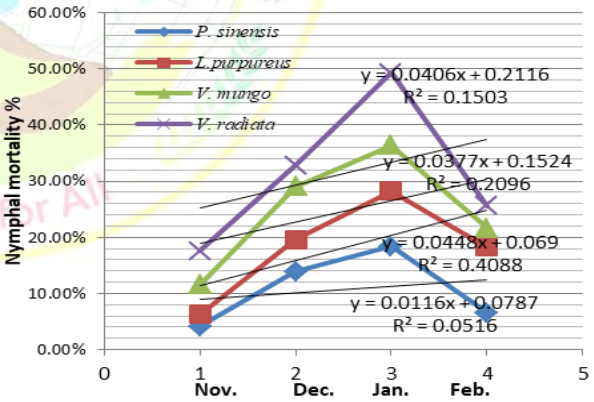

Fig. 2. Relationship between nymphal mortality on different food plants in different months

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The population aphid exhibited a negative correlation with maximum and minimum temperature, rainfall, wind velocity, evaporation, and positive with afternoon and morning relative humidity. The values of the coefficient of determination (R) were high (0.92 to 0.99), indicating that the population of mustard aphid greatly governed by the weather parameters. The temperature (maximum 18.7 and minimum 5.0 C), relative humidity (morning 91.5 and evening 50.5 percent), rainfall (000.0 mm), evaporation (below 1.55 mm), bright sunshine hours (below 5.8 hr) along with wind speed below 3.4 km/hr were found very conductive for *L. erysimi* (Hasan and Singh, 2010). Shweta, et al 2020 found that the multiple linear equations developed for the weather data observation one week prior to peak aphid population has higher R2 (0.71) with a standard error of 2.72 but predicted the same population of aphid with corresponding weather conditions, in comparison to the observed data of the experimental year 2015-16 and 2016- 17.

CONCLUSION

It can be concluded that *P. sinensis* is suitable food plant and the temperature of November month is favorable for better survival of *A. craccivora*. Hence, it is clear that unfavorable temperature, humidity, and food plant can increase the mortality rate of *A. craccivora*.

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