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# Seasonal prevalence of giant mealy bug *Drosicha mangiferae* (Homoptera: Pseudococcidae) in the college of home economics, Dhaka, Bangladesh

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**Abstract**
The seasonal prevalence of giant mango mealy bug, *Drosicha mangiferae* and their host preference was observed fortnightly at the College of Home Economics in Dhaka City from January 2015 to January 2016. Tree and bird species were also noted during the study period. 24 rows of 190 trees belonging to 23 species were identified and observed for counting mealybug population. Out of 18,312 recorded Mealy bugs, 73% were found on the host plants and the rest 27% were in the corridor site. Mealybugs were most abundant during January to March that gradually decreased during April to July. Among 23 species of plants, 11 species were susceptible to mealybug attack whereas the mealybugs have never been seen to attack or climb the rest 12 species of plants. No Mealy bug was found during August to December. Mealybugs were found at a temperature ranging 19 °C to 30 °C, rainfall 1 mm to 359mm, relative humidity 66-84% and average day length 651.5 minute to 813 minute. Mealybugs were negatively and weakly correlated with temperature (r = -0.446), rainfall (r = -0.454), relative humidity (r = -0.032) and day length (r= -0.379). A total of 23 bird species was recorded, belonging to 8 Orders and 16 Families where prevalence of insectivorous bird; which could play role in mealybug population control, is comparatively low. Establishing an ecological balance between mealybugs and its natural predators is recommended for preventing the outbreak of mealybug.

**Keywords:** *Drosicha mangiferae;* seasonal prevalence; correlation; tree; susceptible

## Introduction
The giant mealybug *Drosicha mangiferae* (Homoptera: Pseudococcidae) is a small polyphagous sucking insect with pest status that attacks several genera of host plants, including economically important tropical fruits, vegetables and ornamentals. Mealy bugs are so named because many of the known species are covered in a whitish 'mealy' wax, which helps retard the loss of water from their soft bodies. They generally prefer warm, humid, sheltered sites away from adverse environmental conditions and natural enemies such as beetles, bugs, lacewings and mites. Mealybugs are generally called 'hard to kill pests'. Perhaps the most important factor is their habitat. They live in protected areas such as cracks and crevices of the bark, at the base of leaf petioles, on the underside of leaves and inside the fruit bunch, and most of the stages of this insect are covered with a waxy coating [18]. Recently, the emergence of this mealybug is quite frequent due to certain anthropogenic changes to agro-ecosystems such as agricultural intensification, international trade, habitat fragmentation and climatic change [7].

In Bangladesh, the presence of giant Mealy bug was first seen at Sher-e-Bangla Agriculture University in 2003 [12]. This insect was found in Dhaka's Cantonment, Farm gate, Banani, Rampura, Eskaton, Bayley Road and Azimpur and Khamarbari areas and in some places in Panchagar, Thakurgaon and Dinajpur districts during a survey in 2011 [12]. In April 2014, the College of Home Economics in Dhaka (Under Dhaka University) came under attack of a foreign bug, causing panic among the students and teachers in the college. The bug was spread all over the college campus, infesting the trees, corridors, classrooms, labs and residential halls. These bugs are still found in the following years. Experts at the Department of Zoology in Dhaka University said the harmful bug was Giant Mealy bug (Homoptera: *Drosicha*), a pest that lives on plant juices and sometimes kills the host plant. It can also cause severe skin infection when it comes in contact with humans.

It could easily spread across the country and prove to be fatal for both crops and humans, said the zoologists. Education Minister visited the campus and gave instructions to control the infestation [34].

A complete, year round Research on Mealybug population at the College of Home Economics was necessary to know many things about them and, this is why, we started our project there.

## Methods

### Study area

The study was conducted at Home Economics College of Dhaka University fortnightly for a period of 13 months belonging three seasons *viz.* pre-monsoon (summer), post-monsoon (winter) and monsoon (rainy season) from January 2015 to January 2016. This College is located at Azimpur road, Azimpur, Dhaka having 10.3 acres of land area. It is located from 23.7298°N latitude to 90.3854°E Longitude and 4 meters elevation above the sea level.

### Methods

The survey was conducted through the whole campus area. The plot of 10.3 acres consisted of 24 rows of 190 trees. In each line, all trees were checked at a height of 2 meters above the ground. The number of mealybug species was recorded in the data sheet with their host plant. Beside this, birds were observed and recorded at regular intervals using the line transact method [2]. Common environmental factors of the reproductive requirements of the mealybug species such as maximum and minimum temperature, relative humidity (morning and evening), sunshine hours and rainfall were acquired from the Meteorological Services Agency.

### Insect counting method

The counting method was initially conducted through the observation of all trees, corridors and the whole campus. Mealy bugs were started to count down in all affected trees and in the corridors. In Home Economics College, 24 rows of trees were selected and observed [33]. Mealy bugs were checked at an average height of 2 meters above the ground of the trees including leaves, trunk and rootstock. Total number of Mealy bugs observed in a day within campus was noted. Then their population in affected trees was recorded. Some snap shots of the insects and their affected trees were taken.

### Bird watching method

A list of birds of the study area was made using line transact method. The whole study area was divided into five transects. The birds were identified with the help of different essential books [27, 22, 4] and sometimes from captured photo.A routine bird watching at the college campus was carried throughout the study period that was started from 0600h in summer and 0700h in winter.

### Data analysis

Data were classified on an Excel spreadsheet to determine the graphics and statistical analysis. The fortnightly collected data were subjected to ANOVA test.

## Results and Discussion

### Result

A total of 18,312 mealybugs were recorded by direct field visit, out of which 5,021 (27%) were in corridor and 13,351 (73%) mealybugs were found in the host plants (Fig. 2).

The population of the giant mealybugs in the host plants became high (3310) during the first visit of January 2015 and low (6) during the first visit of July'15. In corridor, the maximum number (1370) of mealybugs was recorded during the first visit of March and the minimum number (2) was in the first visit of July (Fig. 2).

The monthly incidence of giant mealybug indicated that the bugs were higher in pre-monsoon (summer) followed by post-monsoon (winter) and monsoon (rainy season). On an average, the highest number of mealybugs (3562.5) was recorded in the month of February followed by January'15 (3385), March (3383), April (154), May (40.5) and June (15.5). The lowest number of mealybugs (4) was recorded in the month of July. No mealybug was found during the month of August to December (Fig. 1).

During the study period, 24 rows of 190 trees comprising 23 species of plants in the plot of 10.3 acres were recorded. Among the examined trees, the highest number was occupied by Mango (16.84%), Jackfruit (14.21%), Silk tree (7.89%), Coconut and mahogany (8.42%). There are a few number of Arjun (2.63%), Areca nut (4.73%), Blackberry (3.68%), Date-palm (4.21%), Elephant apple (2.63%), Guava (3.15%), Indian palm (3.15%), Ipil (2.63%), Lemon (2.10%), Oil palm (3.68%), Papaya (0.52%), Sisso (2.10%), Wood apple (1.57%) (Table1).

Mealy bugs were checked at a height of 2 meters above the ground of the examined trees including leaves, trunk and rootstock. Survey report revealed that the mango mealybug, *Droshica mangiferae* has been emerged as a major threat to mango (6453) along with different plants. It was found to attack other plants such as Jackfruit (5203), Coconut (577), Mahogany (332), Silk tree (305), Blackberry (245), Indian palm (100), Areca nut (51), Ipil (46), Papaya (28) and Date-palm (11) with varying levels of infestation. No attack was seen in the plants of Arjun, Elephant apple, Guava, Indian gooseberry, Indian oak, lemon, Oil palm, Sisso, Star fruit, Sugar apple, Wax apple and Wood apple (Table 1).

Among 23 species of plants, 11 species were preferable to mealybug attack whereas the rest of 12 species of plants were not susceptible. Mango was mostly preferred to giant mealybug, *Droshica mangiferae* with 51.76%, then to the Jackfruit (35.61%). In contrast, the lowest position was occupied by Date-palm (0.11%) (Table I).

On an average, the highest number of mealybugs was found in Mango (2170) in the month of January'15 and Jackfruit (1410) in February. The lowest number of mealybugs (0.5) was recorded in Date –palm, Mahogany, papaya, Coconut and Blackberry from the month of April to July (Table 1).

Mealybugs (per unit plant) were found largely in Mango (201.66) and in jackfruit (192.70) whereas their abundance was significantly minor in Date palm (1.38) (Fig. 3). In the trees infested by the mealybugs, significantly variations have been found regarding availability of mealybugs infesting a particular plant species ($F$= 1.986495, $F\ crit$= 1.827349, $P$-$value$= 0.030289, $df$= 12, $\alpha\ value$= 0.05%).

Temperature and rainfall are the important environmental factors associated with mealybug population at the College of Home Economics in different months. From the Prevalence of *Drosicha mangiferae,* it was notice that they develop well, survive, and reproduce successfully at a temperature 20 °C, 22 °C and 27 °C, Poor precipitation of rainfall (1, 3, 17 mm), an average relative humidity (66%, 82% and 84%) and the longest day length ranging 651.5 minute to 813. According to the Meteorological data, there is a variation of average daily temperature in a year. May'15 and June'15 and August'15 were the warmest month with an average temperature of

$30^0$C. The coolest month was January, 2016 having an average temperature of $19^0$C (Table-2). In the present study, it was revealed that the average number of mealybugs at different months correlates negatively with monthly average temperature (r = -0.446, *df* = 12) showing weak relationship (Fig. 4).

The monthly total rainfall ranges from 1mm to 690 mm in different months (Table-2) that show no strong relationship with the population of *Drosicha mangiferae*. Rainfall is correlated negatively with the average number of mealybugs (r = -0.454, *df* = 12) (Fig. 5).

The average lowest and highest humidity varies from 66% to 84% in different months (Table-2). A very weak negative correlation (r = -0.032) of the average number of mealybugs with the average relative humidity was noted during the total study period (Fig. 6).

The longest day of the study period was 813 minutes long recorded during the month of June, 2015 and the shortest day was 646 minutes long during December, 2015 (Table-2). The Figure represents the weak negative relationship (r = -0.379) of the average number of mealybugs with the average day length (Fig. 7).

**Birds in Home Economics College Campus**

During the study period of 13 months, 23 species of 8 orders of 16 families were observed which were belonging to 20 genera. Among the presently recorded bird species on the College of Home Economics, passerine (13 species, 8 families and 1 order) and non-passerine (10 species, 8 families and 7 orders) were recorded.

Of those 23 species of birds, House Sparrow, Common Myna, Pied Myna, House Crow, Oriental Magpie Robin, Red Vented Bulbul, Spotted Dove, House Swift and Rose Ringed Parakeet were more common as they were seen several times in most of the day. Whereas, others recorded bird such as, Jungle Crow, Blackdrongo, Rock Pigeon, Asian Koel etc. were seen sometimes in the 13 months study period (Table 3).

**Table 1:** Number of trees in the College of Home Economics campus, and Monthly average number of mealybugs found on them

| Sl. | Name of trees | No. of trees | Monthly Average number of mealybugs | | | | | | | | | | | | | Total | % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Jan 15 | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan16 | | |
| 1 | Arjun | 5 | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | 0 | 0 |
| 2 | Areca nut | 9 | 7 | 10 | 10.5 | 1.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 51 | 0.35 |
| 3 | Black berry | 7 | 78 | 36.5 | 42 | 2.5 | 0 | 0 | 0.5 | 0 | 0 | 0 | 0 | 0 | 2 | 245 | 1.94 |
| 4 | Coconut | 16 | 35 | 25.5 | 20.5 | 8.5 | 2.5 | 0 | 0.5 | 0 | 0 | 0 | 0 | 0 | 214 | 577 | 3.67 |
| 5 | Date-palm | 8 | 7 | 1.5 | 0 | 0.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 | 0.11 |
| 6 | Elephant apple | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 | Guava | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8 | Indian gooseberry | 2 | 0 | 0 | 0 | 0 | 0 | 0 | k0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9 | Indian oak | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10 | Indian Palm | 6 | 22 | 23.5 | 9 | 1 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2.5 | 100 | 0.73 |
| 11 | Ipil | 5 | 18 | 3.5 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4.5 | 46 | 0.38 |
| 12 | Jackfruit | 27 | 730 | 1410 | 770.5 | 29.5 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 22 | 5203 | 35.61 |
| 13 | Lemon | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14 | Mango | 32 | 2170 | 852 | 1183 | 32.5 | 14.5 | 7.5 | 1 | 0 | 0 | 0 | 0 | 0 | 52 | 6453 | 51.76 |
| 15 | Mahogany | 16 | 135 | 48.5 | 40.5 | 4 | 0.5 | 0.5 | 1 | 0 | 0 | 0 | 0 | 0 | 3.5 | 332 | 2.80 |
| 16 | Oil palm | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 17 | Papaya | 1 | 12 | 4 | 3.5 | 0 | 0.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 28 | 0.24 |
| 18 | Silk tree | 15 | 96 | 41 | 48 | 8 | 2 | 1.5 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 305 | 2.41 |
| 19 | Sisso | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 20 | Star fruit | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 21 | Sugar apple | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 22 | Wax apple | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 23 | Wood apple | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | **Total** | 190 | 3385 | 3562.5 | 3383 | 154 | 40.5 | 15.5 | 4 | 0 | 0 | 0 | 0 | 0 | 304 | 13351 | |

**Table 2:** Monthly Average temperature, rainfall, relative humidity and day length during the research

| Month | Avg temp. (˚C) | Rainfall (mm) | Avg Relative humidity (%) | Avg day length (min) |
|---|---|---|---|---|
| 2015 January | 20 | 1 | 84 | 651.5 |
| February | 22 | 17 | 82 | 677.5 |
| March | 27 | 3 | 66 | 734 |
| April | 28 | 201 | 74 | 764 |
| May | 30 | 205 | 76 | 795 |
| June | 30 | 359 | 79 | 813 |
| July | 29 | 690 | 83 | 805.5 |
| August | 30 | 360 | 81 | 775.5 |
| September | 29 | 304 | 81 | 737 |
| October | 28 | 66 | 76 | 697 |
| November | 25 | 0 | 70 | 691.5 |
| December | 21 | 0 | 76 | 646 |
| 2016 January | 19 | 3 | 84 | 654 |

**Table 3:** Bird species in the College of Home Economics

| Sl. | Local name | English name | Scientific Name | Family | Order |
|---|---|---|---|---|---|
| 1 | Dar Kak | Jungle Crow | *Corvusmacrorhynchos* | Corvidae | Passeriformes |
| 2 | Patikak | House Crow | *Corvussplendens* | | |
| 3 | Harichacha | RufousTreepie | *Dendrocittavagabunda* | | |
| 4 | Bhat-shalik | Common Myna | *Acridotherestristis* | Sturnidae | |
| 5 | Go-shalik | Pied Myna | *Sturnus contra* | | |
| 6 | Khoyralej-shalik | Chestnut Tailed Starling | *Sturniamalabarica* | | |
| 7 | Kala-fingey | Black Drongo | *Dicrurusmacrocercus* | Dicruridae | |
| 8 | Mete-fingey | Ashy Drongo | *Dicrurusleucophaeus* | | |
| 9 | PatiChorui | House Sparrow | *Passer domesticus* | Passeridae | |
| 10 | Doel | Oriental Magpie Robin | *Copsychussaularis* | Muscicapidae | |
| 11 | Bangla Bulbul | Red Vented Bulbul | *Pycnonotuscafer* | Pycnonotidae | |
| 12 | Tuntuni | Common Tailor Bird | *Orthotomussutorius* | Cisticolidae | |
| 13 | Begunimoutushi | Purple Sunbird | *Cinnyrisasiaticus* | Nectariniidae | |
| 14 | Bangla Kaththokra | Black RumpedFlameback | *Dinopiumbenghalense* | Picidae | Piciformes |
| 15 | BatabiKathkuruli | Fulvous Breasted Woodpecker | *Dendrocoposmacei* | | |
| 16 | Dhola-golaMachranga | White Throated Kingfisher | *Halcyon smyrnensis* | Halcyonidae | Coraciiformes |
| 17 | PatiMachranga | Common Kingfisher | *Alcedoatthis* | Alcedinidae | |
| 18 | JalaliKobutor | Rock Pigeon | *Columba livia* | Columbidae | Columbiformes |
| 19 | Tilaghughu | Spotted Dove | *Streptopeliachinensis* | | |
| 20 | Kokil | Asian Koel | *Eudynamysscolopaceas* | Cuculidae | Cuculiformes |
| 21 | DeshiTalbatashi | House Swift | *Apusnipalensis* | Apodidae | Apodiformes |
| 22 | BhubonCheel | Black Kite | *Milvusmigrans* | Accipitridae | Falconiformes |
| 23 | Shobujtia | Rose Ringed Parakeet | *Psittaculakrameri* | Psittaculidae | Psittaciformes |

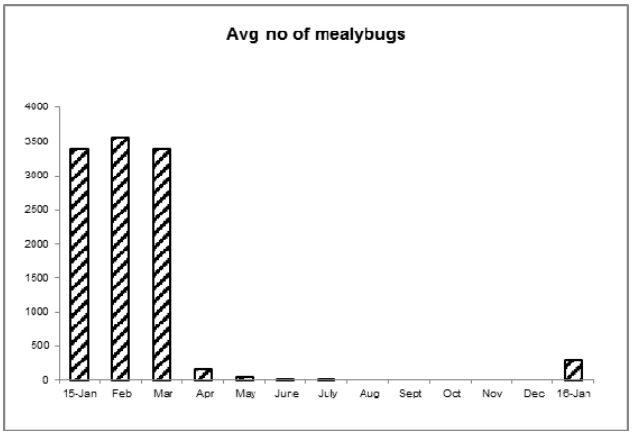


**Fig 1:** Mealybugs (Avg) in different months during the study period

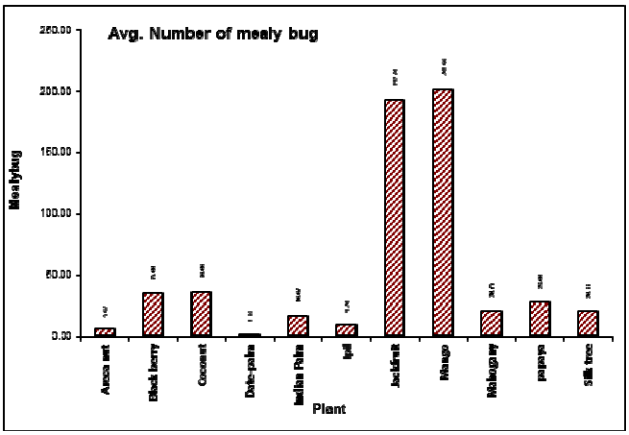


**Fig 3:** Average number of mealybugs per unit plant

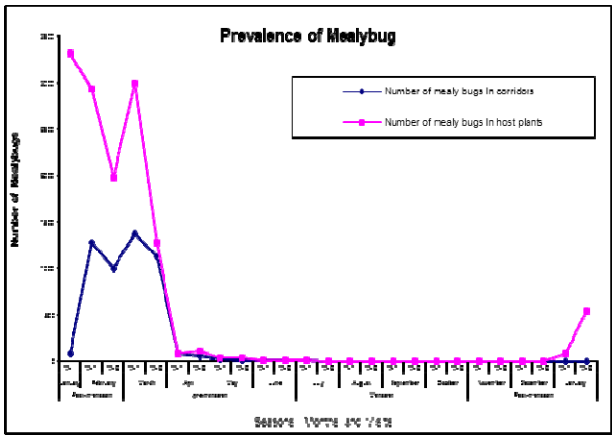


**Fig 2:** Seasonal prevalence of mealybugs in host plants and corridors

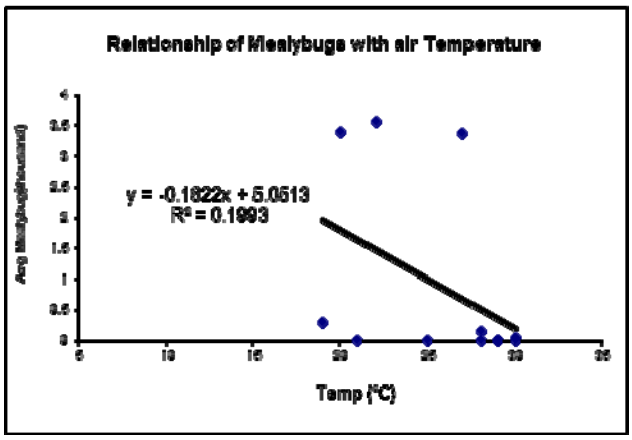


**Fig 4:** Relationship between the average number of mealybugs and average temperature during study period

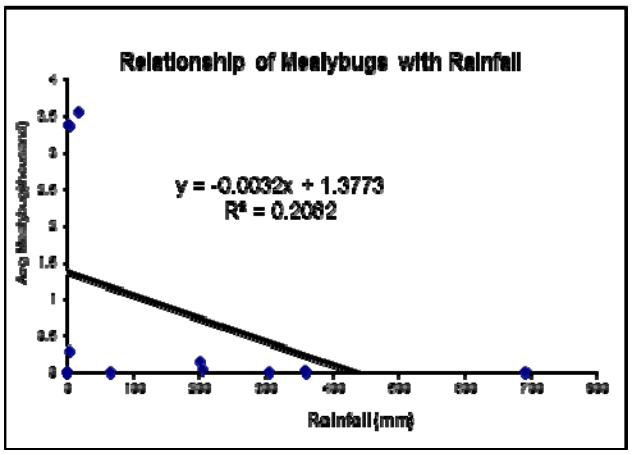


**Fig 5:** Relationship of the average mealybugs with rainfall

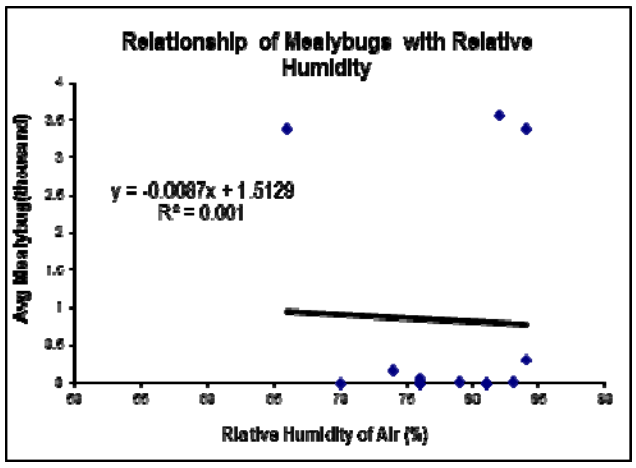


**Fig 6:** Variation of the average number of mealybugs with average relative Humidity

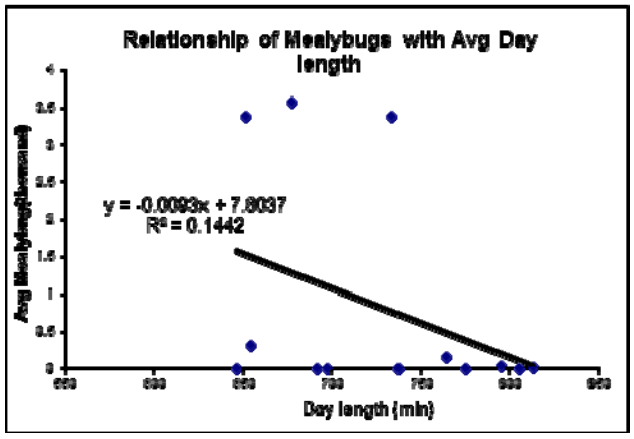


**Fig 7:** Relationship between the average number of mealybugs and average day length

## Discussion

### Seasonal prevalence of *Drosicha mangiferae* population

The present study deals the monthly prevalance of giant Mealy bugs, *Drosicha mangiferae* in different plants and the related factors in the College of Home Economics, Dhaka. This study gives an insight when to expect possible pest outbreaks and the best time to apply control measures.

Population of *Drosicha mangiferae* was surveyed throughout the year from January 2015 to January 2016. From the survey, it was revealed that the abundance of mealybug population was in peak during January to March and to a lesser extent during April-July. The highest average number of mealybugs (3562.5) was recorded in the month of February and the lowest average number of mealybugs (4) was in the month of July. No mealybug was found during the month of August to December. Result of this survey was similar with the findings of Prasanna *et al.* (2015) and Tanga Mbi Chrysantus (2012) who reported that the peak incidence of mango mealybugs recoded during the month of December to February in the mango fruiting season. According to Karar *et al.* (2013), the peak activity period of the Mango mealybug (*Drosicha mangiferae)* was 2nd week of February to 2nd week of March and the population decreased thereafter that were similar to Kumar *et al.* (2009) who reported that population of mealybug increased to the middle of March and then declined. The present observation disagrees with the observations of Shahid *et al.* (2012); Hanchinal *et al.* (2010) and Ghada *et al.* (2010) who have recorded the peak population of different species of mealybug during August and September. The result also conflicted with those observed by Hala *et al*. (2011) who indicated two periods of fluctuation - a latency period, from October to mid-March, characterized by a low and nearly constant level of the pest. And a grading period, from mid-March to August marked by a significant variation in the density of the pest.

The seasonal incidence of giant mealybug indicated that, the bugs were higher in pre-monsoon (summer) followed by post-monsoon (winter) and monsoon (rainy season). This might be due to prevailing higher temperature, low relative humidity and low rainfall (Abiotic factors), which are favourable for this pest multiplication. These results are in close conformity with the findings of Sathyaprasad (1994) and Hemalatha *et al*. (2008) who indicated that maximum infestation of mealy bug was observed in pre-monsoon season. Similarly, the infestation of mealy bugs was higher in summer season, which may be attributed to congenial environment prevailing in the season for proper framing of their secretions into protective layers by avoiding interruption in their feeding and breeding processes. These results are similar to the findings of Sriharan *et al*. (1979) and Hemalatha *et al*. (2008).

The infestation of mealy bugs declined significantly during rainy season. This may be due to washing off mealy bugs by initial rains received during June and July months. Hemalatha *et al*. (2008) observed decline in the mealy bug population after initial onset of rains. Bavoida *et al*. (1995) also stated that population density of *Rastrococcus invadens* (Green) decreased during the rainy seasons and peaked during dry seasons.

Chandra *et al.* (1987) studied the biology of mango mealybug, *Drosicha mangiferae* and reported that the pest had 1 generation in a year and diapause in the egg stage in soil for about 7 months. In the present study it was observed that the population of mealy bug nymphs started crawling on tree trunk on the month of January in fruit plants. This population of mealy bug then went on increasing till first week of March as plants growth advanced. The nymphs then started congregating on tender parts of tree such as the buds, leaves of the growing shoots. Because, mealybugs feed on plant sap, fruits, flowers or seed heads. The population of giant mealybug was seen to be decreased thereafter from mid-March till mid-July. And the full grown mealybugs were seen coming down through the branches and then trunks to the ground level were found to be gravid and they were ready to oviposit in the ground. This study is partially consistent as Kumar *et al.* (2009) reported that the nymphs of mealy bug

seen on trunks in the beginning were identified as first instar till mid-February that were seen to be decreasing thereafter from mid-February till last May. As their eggs undergo diapause, there is a great chance of the species to spread all over Dhaka University campus and associated areas in the rainy season. Above all, from place to place, for various environmental as well as fruiting conditions, this fluctuation should be considered quite normal.

**Prevalence of mealybugs on different host plants**

During the study period, 24 rows of 190 trees comprising 23 species of plants and the corridor site were observed. Mealy bugs were checked at an average height of 2 meters above the ground of the examined trees including leaves, trunk and rootstock. From the experiment, it was found that the number of recorded mealybugs was significantly higher (73%) in the host plant compared to the corridor site (27%). According to the survey of Sirisena *et al.* (2013), Mango, guava, pomegranate and citrus crops were highly susceptible to mealybug attack. But the present study report reveals that the mango mealybug, *Droshica mangiferae* has been emerged as a major threat to mango (51.76%) followed by jackfruit (35.61%) and other host plants such as Coconut (3.67%), Mahogany (2.80%), Silk tree (2.41%), Blackberry (1.94%), Indian Palm (0.73%), Ipil (0.73%), Areca nut (0.35%), papaya (0.24%) and Date-palm (0.11%). No attack was seen in the rest of plant species at the survey area during the study period. On an average, the density of mealybugs in the host plants was higher in January 2015 (2170) followed by the February (1410) and March (1183). And the lowest (0.5) had been found from the month of April to July 2015. To control the population of mealybug, the present study recommends the application of not attacked (Table I) plant extracts such as plant sap, leaf or bark juice, flower, and seed or leave dust as their repellants.

**Interaction of mealybugs with climatic factors**

The population dynamics of *Drosicha mangiferae* is strongly influenced by climatic conditions. Temperature and rainfall are the important environmental factors associated with mealybug population at different months during the study period (January 2015 to January 2016). In this period air temperature, rainfall and relative humidity were 11-36ºC, 1-690 mm and 66-84% respectively.

Ghada *et al.* (2010), Ahmed and Rabou (2010) studied the effects of some biotic and abiotic factors influencing the population of the long-tailed mealybug. Their study revealed that the lowering of the temperature increased the dimension of the mealy bug and lengthened the developmental period. According to the present survey, the average number of mealybugs at different months correlates negatively and weakly with the monthly average temperature, rainfall, relative humidity and average day length. This finding is similar with the result of Suresh and Kavitha (2007) who showed that the abundance was negatively correlated with rainfall and evening relative humidity.

The present result conflicts with the observations of various researchers. Mani (1986) observed a positive and significant correlation of the grape mealy bug population with maximum temperature and negative correlation with the relative humidity. Shreedharan *et al*., (1989) reported that the population of mealy bug, *P. citri* in Mandarin orange was positively correlated with the temperature and negatively with relative humidity, while it had no clear correlation with total rainfall. Koli (2003) reported that, the egg sacs, nymphs and adults of mealy bugs on grapes showed highly significant positive correlation with maximum and minimum temperature and highly significant negative correlation with morning and evening relative humidity and non-significant negative correlation with rainfall. In pomegranate, a significant and positive correlation with maximum temperature, minimum temperature and significant negative correlation with morning relative humidity was reported for mealy bugs [3]. Tehniyat *et al.* (2015) observed that there was no effect of relative humidity on the cotton mealybug (CMB), *Phenacoccus solepnosis* Tinsely. Tanga Mbi Chrysantus (2012) revealed that the population dynamics of *Rastrococcus iceryoides* were significantly and positively influenced by temperature, while it was significantly and negatively correlated with rainfall. Shahid *et al.* (2012) observed that temperature and relative humidity exerted positive effects on mealybug population. Rizvi *et al.* (2015) found a positive significant correlation between the population of *Drosicha* mealybug and temperature which showed that temperature greatly affects the population and reproduction of mealy bug. Prasanna *et al.* (2015) noted that the mealy bug showed negative correlation with relative humidity, rainfall, minimum temperature and positive correlation with maximum temperature and bright sunshine hours. This present result slightly disagrees with the findings of Mahimasanthi *et al.* (2015) who investigated the biotic and the abiotic factors influencing the mealy bug species where the temperature showed positive correlation with the mealy bug infestation and its population while the relative humidity, rainfall and rainy days showed a negative correlation. Katke *et al.* (2009) studied on the seasonal incidence of grape mealy bug, *Maconellicoccus hirsutus*. According to them, mealy bug incidence correlated significantly and negatively with minimum temperature, bright sunshine hours and rainfall but positively with morning and afternoon relative humidity.

**Bird species in Home Economics College**

During the study period of 13 months, 23 species of 8 orders of 16 families were observed which were in 20 genera. Among the presently recorded bird species on the College of Home Economics, passerine (13 species, 8 families and 1 order) and non-passerine (10 species, 8 families and 7 orders) were recorded. Of those 23 species of birds, House Sparrow, Common Myna, Pied Myna, House Crow, Oriental Magpie Robin, Red Vented Bulbul, Spotted Dove, House Swift and Rose Ringed Parakeet were more common as they were seen several times in most of the day. Whereas, others recorded bird such as, Jungle Crow, Blackdrongo, Rock Pigeon, Asian Koel etc. were seen sometimes in the 13 months study period. This observation is partially similar with the result of Chowdhury *et al*., (2014) who have reported that 78 species of 11 orders of 39 families were observed which were in 64 genera on the University of Dhaka campus. From the present survey, it was found that the lower numbers of predatory birds was present in Home Economics College. This was one of the reasons for Insect outbreaks. Because we know that most birds will eat at least some insects to feed hatchlings sufficient protein for healthy growth. Another reason for Mealy bug outbreaks in Home Economics College is birds does not eat Mealy bug. Because the predator pressure, especially insectivorous bird prevalence is comparatively low in the College of Home Economics.

So, the present research recommends a better bird-friendly campus against Mealy bug outbreak and planting some fruit-yielding native plants. Also planting the trees of no attack can help in this regard.

## Conclusion

Mealybugs are highly polyphagous and inflict direct damage to fruit plants by sucking their sap. They become very serious pests on various crops due to elimination of natural bio control agents or due to the pest developing resistance to insecticides or due to indiscriminate and frequent application. An ecological balance between prey and predators must be maintained for preventing outbreak of any mealybug population. If not, such things can emerge again. So the present study will be a basis for the development of future mealybug management. This study gives an insight when to expect possible pest outbreaks and the best time to apply control measures.

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