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Seasonal incidence of gall forming psyllid, *Pauropsylla tuberculata* infesting *Alstonia scholaris* L., at Meerut Region

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Abstract
From September 2024 to January 2025, the current investigation was conducted in Meerut on the ornamental tree *Alstonia scholaris* (L.) R. Br. The psyllid, *Pauropsylla tuberculata* attack creates unattractive appearance for which it fails to serve the original function. According to the study, a certain percentage of leaf infestation was noted in the first two weeks of November (31.20%) and the second two weeks of November (15.00%). The first two weeks of October saw the highest percentage of leaf infestations (72.50%). The second two weeks of October had the lowest leaf infestation (11.00%).
There was also minor leaf infestation during the first and second two weeks of November. The second two weeks of October had the lowest infestation, at 11.0 percent, while the first two weeks of January had the worst, at 24.8 percent. On average, the maximum number of galls during the second two weeks of October was 36.00. Percentage RH was shown to be positively and significantly correlated (80–89%) with all infestation indicators. The mean maximum temperature (24–30^{0}C) was shown to be negatively but significantly correlated with all of the above-mentioned infestation characteristics.

Keywords: Seasonal incidence, *Alstonia scholaris*, *Pauropsylla tuberculata*, psyllid

Introduction
One of the main insect pests of *Alstonia scholaris* is the leaf gall psylid, *Pauropsylla tuberculata* Crawford, which is a member of the Psyllidae (Homoptera) family (Hodkinson, 1984; Mandal Biswas *et al.*, 2014) [1, 2]. Known by several names around the world, including scholar tree, blackboard tree, Indian devil tree, saptparni, and satpatia, *Alstonia scholaris* R. Br. is an evergreen tropical landscape tree with white funnel-shaped blooms and milky sap. It is a member of the Apocynaceae family. Leaf gall former, *Pauropsylla tuberculata* Crawford (Homoptera: Psyllidae), is one of the main insect pests that afflict *A. scholaris*. On leaves, it causes gall formation (Fig.1). The Psyllids deposit stimulants, which cause the characteristic galls to form. Gall development has an impact on *A. scholaris* growth both directly and indirectly. Reduced photosynthesis causes the impacted leaves to progressively lose their form and develop less. Consequently, this tree is wilting permanently. Young leaves that are infested by psyllids form galls and do not grow. Reproduction is hampered by the galled fruits and flowers (Jain and Dhiman, 2014) [3].
After becoming infected with the psyllid *Pauropsylla tuberculata*, the plant, which is commonly employed as an ornamental tree in landscapes, gardens, and roadside plantations, loses its intended function and takes on an unsightly appearance. The current study is conducted with these facts in mind.
Green galls are the result of *P. Tuberculata* infestations and deformities that occur on different tree components (Albert *et al.*, 2011; Sharma and Raman, 2022) [4, 5]. Mathur (1975) [6] described this pest for the first time in India. They entirely prevent the host tree from reproducing sexually (Chauhan *et al.*, 2020) [7], cause leaf deformities, and have an impact on the tree's economic worth (Dhiman *et al.*, 2012, Chander, 2014; Pandey, 2023) [8, 9, 10].

Materials and Methods
1. **For ecological studies:** The Main Campus of the college in Meerut documented the seasonal incidence of psyllids between September and December of 2024. The primary host plant, *A. scholaris*, is abundant in the Meerut district and surrounding area, although field monitoring was limited. Six trees were chosen and tagged for the first trial. From the base of each tree, five branches were chosen at random, and every two weeks, the number of branches infested with galls was noted.

Six tagged plants were chosen at biweekly intervals to measure the number of infested leaves and the strength of the galls (number of galls per leaf).
The following formula was used to determine the percentage of leaf infestation:

$$\text{Percentage leaf infestation} = \frac{\text{Total number of leaves infested with galls}}{\text{Total number of leaves observed}} \times 100$$

The randomly chosen plants' gall characteristics were examined every two weeks. The Meerut Agrometeorology division provided the meteorological parameter data. Along with the main meteorological parameter's temperature and relative humidity (6 and 14 hours), at the study site observations were made every two weeks.

2. **For Morphological studies:** Six trees were chosen at random and tagged. Each tree had ten leaves randomly removed, which were then brought to the lab for morphological analysis. The number of galls per leaf, the depression pit, the number of juvenile, mature, and perforated galls, the gall chamber, the gall diameter, and the number of exit holes were the parameters on which the observations were made. According to Albert *et al.* (2011) [4], the galls on the leaves were classified as

young, mature, and perforated, and the various sizes of the galls were tallied to determine the total number of galls per leaf.

Results

The study examined the seasonal occurrence of *P. Tuberculata* on *A. scholaris* during the experimental period, manifested as infestations on plant components, specifically leaf infestation and the ensuing gall characteristics. Table and graph 4 presents statistics on leaf infestation from the first two weeks of January 2025 to the second two weeks of September 2024.

Graph 2 shows that the percentage of infested leaves varied from 11 to 72.5%. In the second two weeks of September, 72.00 percent of the leaves were infested. It then rose gradually until it peaked in the second two weeks of October at 72.50 percent. The infestation rate thereafter steadily decreased, reaching its lowest point (11.00%) in the second two weeks of October.

Table and Graph 3 provide information on leaf infestation for each month of the year. During the several observation months, the leaf infestation ranged from 72.50 to 11.0 percent. The first two weeks of October saw the highest percentage of leaf infestation (72.50%). The second two weeks of October had the lowest infestation, at 11.0 percent, while the first two weeks of November had the worst, at 31.2 percent. The psyllid *P. Tuberculata* likewise showed a low leaf infestation (15%) during the second two weeks of November. The first two weeks of December had the lowest infestation, 17.14%, while the second two weeks of December had the highest, 18.80%. The first two weeks of December likewise saw the lowest infestation, at 24.88%. The number of eggs laid by the adult female psyllid varies depending on the season, and this number determines the number of galls per leaf. During the first two weeks of October, the average maximum number of galls was 72.0. The average number of galls per leaf during the first two weeks of October was 36. The first two weeks of December had the fewest galls per leaf (06/leaf). November through December of the year had the highest number of galls per leaf (Table and Graph 1).

Graph 3 showed the relationship between *A. scholaris's* mean percentage leaf infestation, gall strength (number of galls/leaf), and weather conditions such as temperature and relative humidity (24–30%). All of the infection characteristics, including the percentage of infested leaves and the gall intensity (number of galls per leaf), showed a positive and substantial connection with rainfall. All of the infestation metrics showed a positive and significant connection with the % RH. All of the above-mentioned infestation characteristics showed a negative but substantial connection with mean maximum temperature. During the 2024–25 trial period, the psyllid *P. Tuberculata* attacked the plant *Alstonia scholaris* in Meerut, Western Uttar Pradesh.

The same pattern was seen in the gall intensity, which peaked in the first two weeks of November during the study period. These characteristics may be responsible for the high relative humidity (100%) and low temperature (18^0C) that predominated during that time.

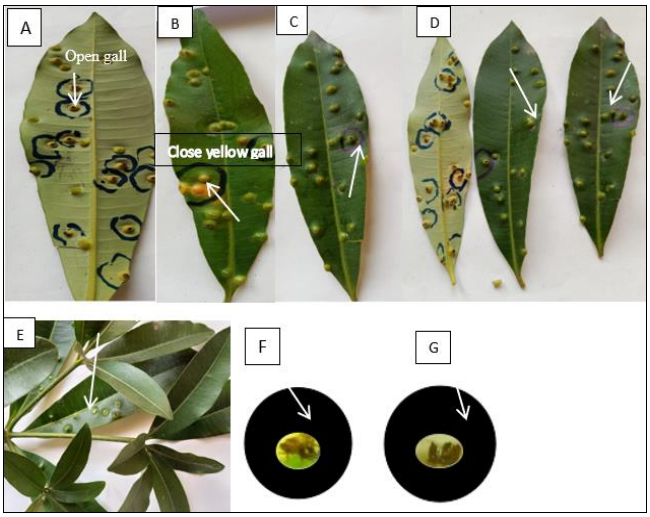
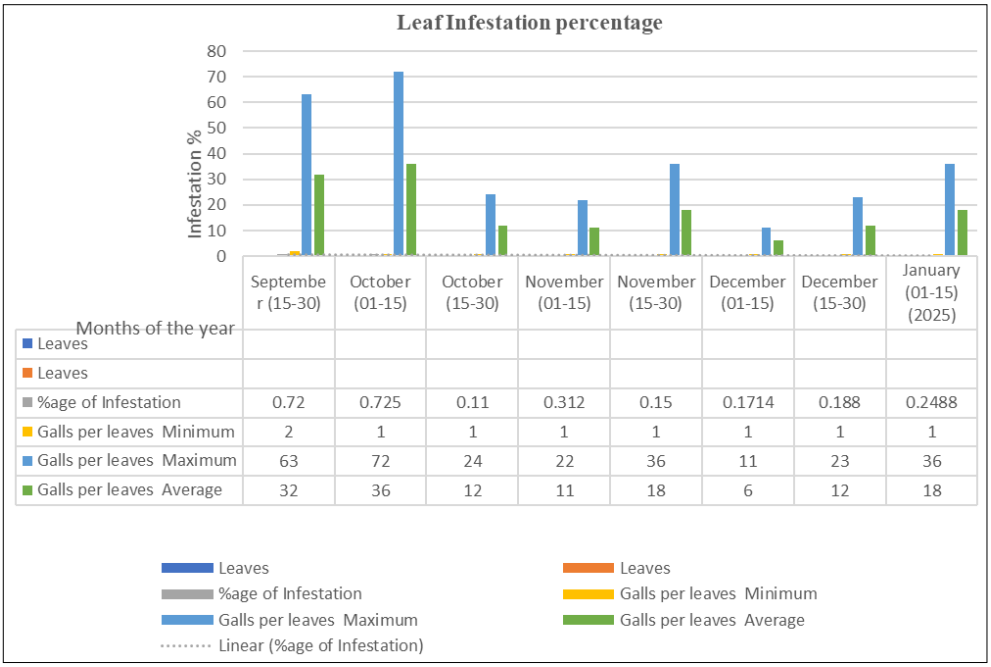
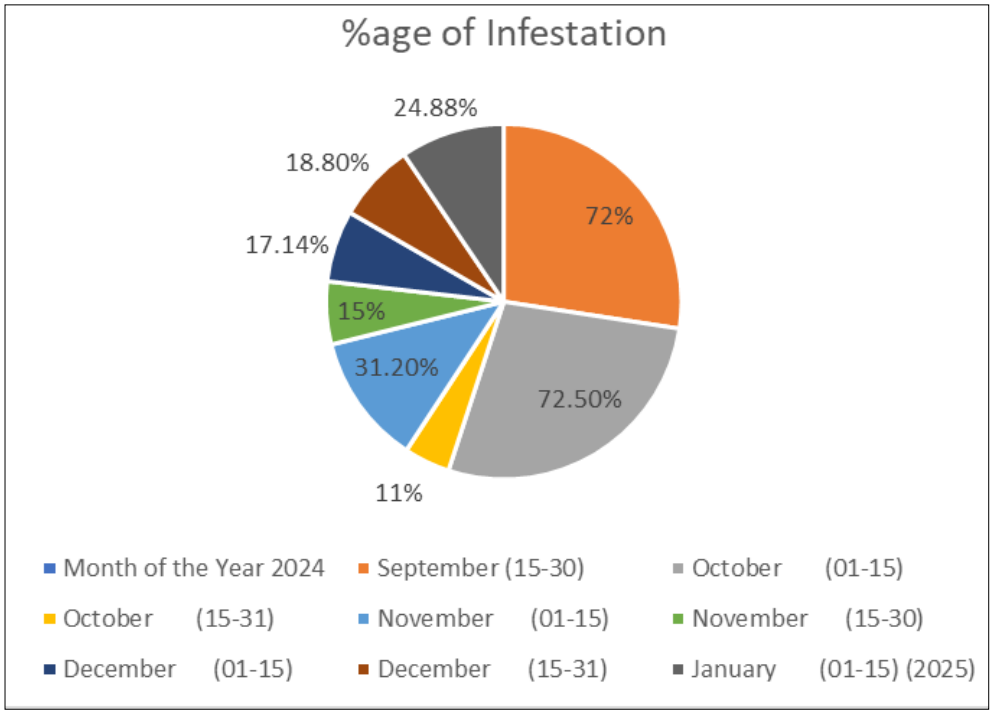


Fig 1: A, B, C, D and E: *Alstonia scholaris* leaves infested with psyllid galls (*Pauropsylla tuberculata)* F. Female and G. Male of *Pauropsylla tuberculata* (gall insect)

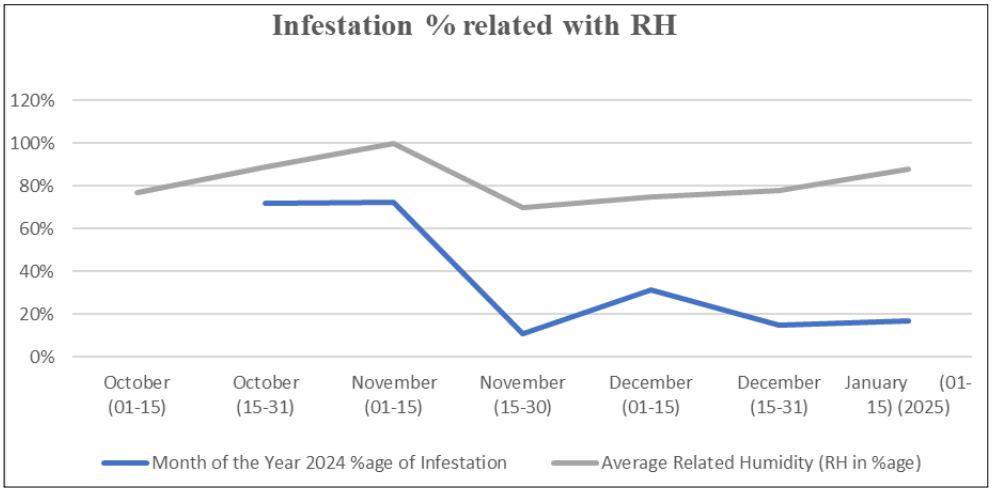


Months of the year	September (15-30)	October (01-15)	October (15-30)	November (01-15)	November (15-30)	December (01-15)	December (15-30)	January (01-15) (2025)
Leaves								
Leaves								
%age of Infestation	0.72	0.725	0.11	0.312	0.15	0.1714	0.188	0.2488
Galls per leaves Minimum	2	1	1	1	1	1	1	1
Galls per leaves Maximum	63	72	24	22	36	11	23	36
Galls per leaves Average	32	36	12	11	18	6	12	18

Table and Graph 1: Infestation percentage Maximum and Minimum *Pauropsylla tuberculata* galls on the leaves of *Alastonia scholaris*



Graph 2: Infestation percentage of *Pauropsylla tuberculata* galls on the leaves of *Alastonia scholaris* in different months



Graph 3: Infestation percentage of *Pauropsylla tuberculata* galls on the leaves of *Alastonia scholaris* and their relationship with relative humidity (%)

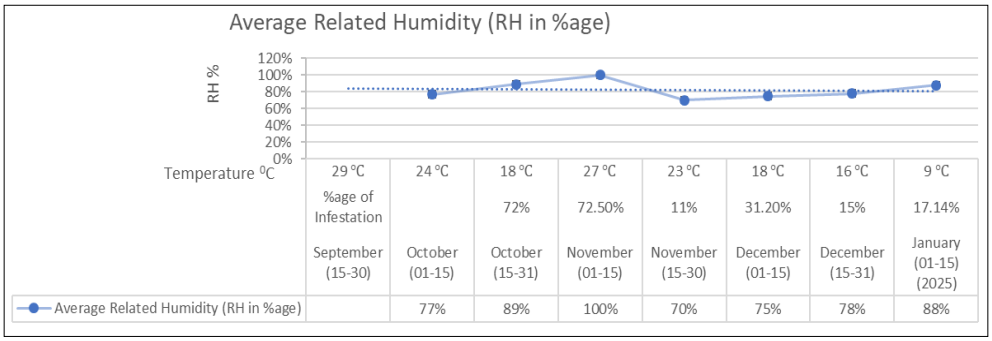


Table and Graph 4: Infestation percentage of *Pauropsylla tuberculata* galls on the leaves of *Alastonia scholaris* and their relationship with Temperature (°C) and Relative humidity (%)

Discussion

In Pothohar, Pakistan, Rasheed *et al.* (2022) [11] investigated the *P. Tuberculata* infestation on *A. scholaris* and found that the gall symptoms appeared on the leaves. The adult psyllids were observed gathering along the edge of the leaves.

During the first two weeks of September, 72.00 percent of the leaves were infested. From then on, it grew gradually until it peaked at 72.50% in the first two weeks of October. The infestation rate thereafter steadily decreased, reaching its lowest point (11.00%) in the second two weeks of October. These characteristics may be responsible for the

high relative humidity and low temperature that predominated throughout those times. The findings are consistent with those of Tripathy *et al.* (2018) [12], who found that the mean percentage of leaf infestation in September was 85.70. Changes in meteorological parameters could be the cause of these minor deviations. Additionally, they noted that the amount of leaf infection fluctuates with the seasons, with the infestation being higher during the rainy season (August–October) than during the summer and winter. Our results showed a non-significant negative link between mean relative humidity and percentage of leaf infestation, and a non-significant positive correlation between mean temperature. Similar results were also noted by Jain and Dhiman (2014) [3], who found a direct correlation between rising temperatures and *P. Tuberculata* population growth. Our findings are consistent with those of Jain and Dhiman (2014) [3], who found a direct correlation between the rise in *P. Tuberculata* nymphs and temperature. Similar results were also noted by Singh (2016) [13], who found a positive correlation between the quantity of *P. Tuberculata* nymphs on *Alstonia* and mean temperature and rainfall. Our current findings are supported by Tripathy *et al.* (2018) [12], who found a non-significant positive association between rainfall and the proportion of leaf infestation.

According to Dhar (2017) [14], temperature significantly impacted both the length of the pest's developmental period and the longevity of the female, although relative humidity only had an impact on the latter. On the other hand, light intensity was directly correlated with the female's life span and incidence and inversely correlated with the development period. Additionally, the gall aphid infection was directly linked to rainfall.

The monthly survey found that the highest percentage of galls on leaves occurred in the winter months of September (72%), and October (72.5%). However, according to Graph 2, the months of November (15%), December (17.14%), and January (24.88%) had the fewest galls. October saw the highest amount of both mature and open galls, suggesting that adults develop from mature galls while the galls stay open. However, the greatest number of juvenile galls was seen in November, which may be connected to the best time of year for nymphal development. The findings supported the idea that low temperatures throughout the winter months accelerate oviposition, gall formation, and possibly nymphal growth. High temperatures during the summer have a negative impact on the severity of galls. Additionally, it was shown that Psyllid, *P. Tuberculata*, produces multiple generations annually, with temperature having an impact on the duration of each generation. Previous studies (Chatterjee *et al.*, 2019; Dhar 2017; Haldar *et al.*, 2018; Singh and Sangha, 2018) [15, 14, 16, 17] reported similar findings. They had a significantly higher rate of development and reproduction in the winter and a lower population in the summer.

In the first two weeks of October, the highest average of 36 galls was recorded. However, the first two weeks of December had the lowest average of 6 galls. The months of September and the beginning of October saw the highest number of galls. Additionally, it declined in late September, October, and November before reaching its lowest point in December. Our findings are consistent with Singh (2016) [13] found that the infestation decreased in December (13.77) and that the largest number of galls per leaf occurred in August (44.93 galls) and September (41.20 galls). According to Datta and Dhiman (2016) [18], the months of August through October had the highest number of galls (151) while March through June had the lowest number of galls (1). In August, September, and October, the mean number of galls was 52.33, 41.28, and 38.27, respectively, according to Dhar (2017) [14]. The differences in the number of galls could be the result of psyllids being more common in 2017 than in 2021. According to our research, the mean temperature (0.720) and mean relative humidity (0.613) significantly and directly correlated with the frequency of galls. The number of galls was determined using table 1, which displayed an increasing trend as the temperature gradually rose. Our findings are consistent with those of Jain and Dhiman (2014) [3], who found that the number of galls on *A. scholaris* leaves significantly increased from August to October when the temperature ranged from 19 to 32°C and the relative humidity was between 55 and 93%. Singh (2016) [13] also found a positive correlation between temperature and rainfall and the total number of galls on leaves. According to Dhar (2017) [14], one significant abiotic factor contributing to an increase in infestations has been found to be temperature. However, the gall aphid infections were directly correlated with rainfall.

According to Halder *et al.* (2018) [16], mature galls have a little aperture on the lower side of the moult to allow for escape, while young galls are green and spherical in appearance. Our results showed that juvenile galls had a significant negative association with mean temperature, a non-significant negative correlation with mean relative humidity, and a positive non-significant correlation with mean relative humidity.

Decreased in late October and early November before falling to its lowest in December. Importantly, the current study found a link between meteorological conditions and gall chambers that had not been previously documented. As a result, there is no previous data on this. Albert *et al.* (2011) [4], however, noted that the gall chambers created are exposed to the abaxial side through a little hole. Mature pouch galls can have one chamber and be unilocular, or they can have three or four chambers and be multilocular.

Significance statement

Grown throughout India, *Alstonia scholaris* is a significant ornamental plant with both aesthetic and practical applications. However, the presence of gall insect pests reduces the aesthetic and commercial value of this tree. The main one inflicting significant economic harm to the *Alstonia* tree is the gall-forming psyllid, *Pauropsylla tuberculata* Crawford (Psyllidae: Hemiptera).

Given the significance of *A. scholaris* for forestry and plantation programs and the scant information on the condition and control of this pest in India, the current study,

Conclusion

According to the findings, the gall bug *P. Tuberculata* is unique to the host plant *A. scholaris* and goes through three stages of life: egg, nymph, and adult. On the host plant's leaves, branches, stems, fruits, and inflorescence, nymphs and adults developed galls; however, the frequency of galls was higher on the leaf surfaces. Each leaf has brownish-black open mature galls from which the adult emerges on the underside, while the upper surface has green immature galls with developmental phases. The nymphs consume the

leaves' nutrition, which causes the leaves to collapse and distort. A single year saw the observation of many gall psyllids with overlapping generations. Wintertime low temperatures have an impact on nymphal development, gall creation, and oviposition rates, whereas summertime high temperatures have an impact on gall populations and intensity.

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