



E-ISSN: 2320-7078

P-ISSN: 2349-6800

[www.entomoljournal.com](http://www.entomoljournal.com)

JEZS 2020; 8(5): 938-941

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Received: 11-07-2020

Accepted: 13-08-2020

**Bashir Ahmad Rather**

High Mountain Arid Agriculture  
Research Institute, (HMAARI),  
SKUAST-K, Leh Ladakh,  
Himachal Pradesh, India

**Mehraj-ud-din Sofi**

High Mountain Arid Agriculture  
Research Institute, (HMAARI),  
SKUAST-K, Leh Ladakh,  
Himachal Pradesh, India

**FA Shah Khan**

High Mountain Arid Agriculture  
Research Institute, (HMAARI),  
SKUAST-K, Leh Ladakh,  
Himachal Pradesh, India

**Shahnawaz A Dar**

Krishi Vigyan Kendra/Extension  
Training Centre, SKUAST-K,  
Pulwama, Jammu & Kashmir,  
India

**Yogesh Kumar**

High Mountain Arid Agriculture  
Research Institute, (HMAARI),  
SKUAST-K, Leh Ladakh,  
Himachal Pradesh, India

**Corresponding Author:****Bashir Ahmad Rather**

High Mountain Arid Agriculture  
Research Institute, (HMAARI),  
SKUAST-K, Leh Ladakh,  
Himachal Pradesh, India

## Occurrence and status of tentiform leaf miner, *Phyllonorycter Populifiella* (Treitesche) (Lepidoptera: Gracillariidae) on poplars in Leh, Ladakh

**Bashir Ahmad Rather, Mehraj-ud-din Sofi, FA Shah Khan, Shahnawaz A Dar and Yogesh Kumar**

**Abstract**

The occurrence of poplar leaf miner *Phyllonorycter populifiella* (Treitesche) (Lepidoptera: Gracillariidae) infestation, responsible for the blotch leaf mines of poplars, was studied in different agroforestry systems in the Leh region. The test plots studied in different blocks in the existing agroforestry systems contained mainly *Populus nigra* L. species of poplars. The data revealed that the leaf miner infestation was observed in both the species of poplars but the infestation was observed higher in *P. nigra* L. as compared to *P. deltoids* L. The mean number of mines/leaf in case of *P. nigra* L. and *P. deltoids* L. was recorded in the range of 2 to 7/leaf and 1 to 3/leaf, respectively. The symptoms of damage due to the pest have been observed to diminish the aesthetic look of poplars in the region. The mean per cent infestation in different blocks of the district was observed in the range of 56.30 to 89.92%. Hence, it is concluded that the pest may be categorised as one of the major insect pests of poplars in Leh region.

**Keywords:** *Phyllonorycter populifiella*, leaf miner, poplar, infestation

**1. Introduction**

Cold arid region of union territory of Ladakh is represented by Leh and Kargil districts. The climate is characterised by cool summer and extremely chilling winter. However, due to extreme aridity and low temperature during most part of the year, lack of vegetation causing extensive soil erosion in the region, is a matter of concern for cultivating subsistence of various crops grown by the people. Agroforestry plays a vital role in the livelihood of rural community in Leh, Ladakh and farmers have a long tradition of raising food crops, trees and animals together as well as exploiting a multiple range of production from natural wood lots. The vegetation of the area is sparse owing to its harsh climatic conditions and reducing factors. The physiographic conditions of the region ensures only short growing season (2-5 months) with exposure to harmful infra-red and ultraviolet radiations. The major trees growing in the area are poplar (*Populus* spp.), willows (*Salix* spp.), Junipers (*Juniperus* spp.) and horticultural trees of mostly apricot and apple. Poplars and willows have shown wider adaptability with multiple uses and occur along the rivers, rivulets, nalas, etc. either naturally or planted by the inhabitants. They have also now established well in different agroforestry systems in the region.

As many as 133 insect species so far have been recorded by different workers at various locations infesting different poplar species in India. They include all categories of pests including stem and shoot borers, defoliators, sap suckers, pests of felled trees and converted timber and termites, etc, but lepidopterans make an important group of poplar pests. So far 45 lepidopteran insect species have been recorded infesting different species of poplars. Most of them are defoliators, while some are borers, sapsuckers, skeletonisers and nursery pests [1]. Several insect pest species have been reported infesting poplar and willow in Leh region and also cause significant damage, which include gypsy moth (*Lymantria* spp.), willow scale (*Chionaspis salicis*), tent caterpillar (*Malacosoma* spp.), willow leaf beetle (*Altica* spp.), goat moth (*Cossus cossus*), ermine moth (*Yponomeuta rorella*), poplar petiole gall insect (*Pemphigus* spp.) and willow apple gall insect (*Pontania* spp) [6]. However, during the last few years' leaf miner damage in poplar has become so prevalent in the region that almost 80-90%

of the poplar leaves is mined by this insect species and cause premature defoliation and also affecting the aesthetic look of these plantations. All the poplar tree species have been found attacked by this leaf miner species and is presently considered as a well known poplar pest. The Leaf miner species have been observed actually the larvae of tiny moth species of genus *Phyllonorycter* (Lepidoptera: Gracillariidae) which is one subgroup of blotch leaf mines commonly known as tentiform leaf miner. The species level identification has not been observed so far. That is why the present studies were undertaken for incidence and identification of the leaf miner genus *Phyllonorycter* on poplars in Leh.

## 2. Materials and Methods

An extensive survey of poplar species viz., *Populus deltoids* and *Populus nigra* growing in the four different agroforestry

systems in the Leh district like boundry plantations, agri-silvicultural, horti-silviculture and horti-silvipasture systems was conducted during 2019 and 2020. The study was conducted in five different blocks of Leh district and aimed at to observe the occurrence of leaf mining insects of the genus *Phyllonorycter* developing on these tree species. Two test plots were selected in each agro-forestry system in each block and per cent incidence of mines per tree was recorded on 5 poplar trees selected randomly in each test plot (Table 1). The observations were recorded on three different branches from three different sectors of the lower crown of each tree; all the leaves on these branches were examined, the percentage of mined leaves was determined, and the mines were counted on each mined leaf. If the mean infestation density was greater than 1 mine per leaf, we selected 10–15 leaves on each branch, to count mean number of mines per leaf [8].

**Table 1:** Different agroforestry systems observed in district Leh for leaf miner infestation during 2019-20.

Agro-forestry systems	No of test plots examined in each block	Major Poplar species observed	No. of trees examined for infestation				
			Chuchot	Khalsi	Leh	Saspol	Thicksay
Boundry plantations	02	<i>Populus nigra</i>	10	10	10	10	10
Agri-silvicultural	02	-	10	10	10	10	10
Horti-silvipasture	02	-	10	10	10	10	10
Horti-silviculture	02	-	10	10	10	10	10

Counts were made four times in each block during 2019 and 2020 i.e. twice in each season during mid-summer i.e. on June 15-20 and July 25-30; and late summer i.e. on August 15-20 and September 25-30.

Leaves with mines of tentiform leafminer (*Phyllonorycter* spp.) were also collected from July to September to obtain adults for identification of the species. In this regard leaves with mines containing pupae were kept in the plastic boxes (200ml) maintained in the laboratory under room temperature. The adults emerged were dried and pinned specimens were sent to IARI, New Delhi for identification. The adults were photographed with Leica digital microscope.

## 3. Results and Discussion

The survey of different agroforestry systems existing in the district revealed that the agri-silviculture was observed the most preferred and dominating agroforestry system in the region. The test plots studied in different blocks in the existing agroforestry systems contained mainly *Populus nigra* (90-98%) followed by *Populus deltoides* (2-10%), due to commercial importance of the former species in the region. The herbarium material collected from the different poplar species for identification of leaf miner species in the existing agroforestry systems, revealed that the adults emerged out of the mines belonged to a single species *Phyllonorycter populifoliella* (Treitschke) (Fig 2). The data further revealed that the poplar species of the test plots in all agroforestry systems in different blocks of the district reflected infestation with this leaf miner species. The poplar leaf miner species *Phyllonorycter populifoliella* (Treitschke) was observed responsible for the blotch leaf mines of poplars thereby diminishing their aesthetic and economic value in the Leh region. The species is described as a narrow oligophage and a eurytopic synanthrophilous forest species [2]. It has been

reported a well-known and widespread poplar pest in Europe and Siberia also and commonly noted for prolonged outbreaks in cities leading to premature defoliation, thereby strongly reducing the ornamental value and ecological functionality of poplar stands [8]. The data revealed that the leaf miner infestation was observed in both the species of poplars but the infestation was observed higher in *P. nigra* as compared to *P. deltoides*. The mean number of mines/leaf in case of *P. nigra* was recorded in the range of 2 to 7/leaf while in case of *P. deltoides* the mean number of mines was observed in the range of 1 to 3/leaf (Table 2). The findings on the host plant range of this poplar leaf miner species has revealed that the pest feeds on twelve species of genus *Populus*: *P. alba* L., *P. balsamifera* L., *P. deltoides* W. Bartram ex Marshall, *P. koreana* Rehder, *P. laurifolia* Ledeb., *P. maximowiczii* A. Henry, *P. nigra* L., *P. pseudosimonii* Kitag., *P. simonii* Carrière, *P. suaveolens* Fisch., *P. talassica* Kom., and *P. tremula* L. Out of these only *P. nigra* and *P. tremula* were observed widespread within the pest range. The black poplar *P. nigra* has been observed the main host of the leaf miner. The ranges of *P. alba*, *P. laurifolia*, *P. simonii*, *P. suaveolens*, and *P. talassica* only partly overlap with that of the leaf miner. The species of the genus *Populus* vary considerably in the size, the degree of pubescence, and biochemical composition of their leaves. This fact has been attributed for the highly variable densities of poplar infestation with *Ph. populifoliella* with the maximal value of 130 mines per leaf [4]. The symptoms of damage due to the pest resulted in diminishing the aesthetic look of poplars in the region. The leaves first become mottled marmorate pattern then become white as the individual mines merge. This also reduces the assimilative capacity of leaves considerably and may induce premature leaf abscission (Fig 1). The strongly damaged leaves dry out, curl, and fell off early in the season.

**Table 2:** Host plants of *Phyllonorycter populifoliella* (Treitesche) observed in district Leh for leaf miner infestation

Names of Blocks	Poplar species observed	Density, mines/leaf	Max. Infestation observed in poplar species
Chuchot	<i>Populus nigra</i>	3-5	<i>Populus nigra</i>
	<i>Populus deltoides</i>	2-3	
Khalsi	<i>Populus nigra</i>	3-6	
	<i>Populus deltoides</i>	1-3	
Leh	<i>Populus nigra</i>	3-5	
	<i>Populus deltoides</i>	1-2	
Saspol	<i>Populus nigra</i>	3-7	
	<i>Populus deltoides</i>	2-3	
Thicksay	<i>Populus nigra</i>	3-5	
	<i>Populus deltoides</i>	1-2	



**A:** Leaf miner infested poplar trees

**B:** Symptoms on Lower and upper surface of leaves

**Fig 1:** Nature of damage of of Tentiform leaf miner (*Phyllonorycter populifoliella*) on Poplar in Leh Ladakh



**C.** Larva

**D.** Pupa

**E.** Adult moth

**Fig 2:** Life Stages of Tentiform leaf miner (*Phyllonorycter populifoliella*) on Poplar in Leh Ladakh.

The mean per cent infestation in different blocks of the district was observed in the range of 56.30 to 89.92%. The highest leaf miner infestation was observed in Leh city followed by Saspol and Khalsi blocks because of the favourable weather conditions which prevailed mostly in these locations during the season (Table 3). The results also

revealed severe infestation during mid-August in all the locations. The poplar leaf miner has been observed a common inhabitant of community landscape, occurring in great numbers in the central areas of cities [4]. The attack of leaf miners has also been reported practically common in all the natural stands that include poplars [7].

**Table 3:** Per cent leaf miner infestation observed on poplar trees in district Leh during 2019-20

Name of Blocks	No of trees examined	Mean per cent infestation of poplar trees with leaf miners				
		15/6/19	15/7/19	15/8/19	15/9/19	Mean
Chuchot	20	56.35 (48.63)	72.45 (58.31)	85.40 (67.52)	86.10 (68.09)	75.07
Khalsi	20	66.87 (54.84)	71.17 (57.50)	83.17 (65.76)	85.73 (67.80)	77.73
Leh	20	72.30 (58.22)	73.95 (59.29)	82.40 (65.17)	85.50 (67.62)	79.66
Saspol	20	64.17 (53.21)	72.33 (58.24)	82.50 (65.28)	88.50 (70.18)	78.53
Thicksay	20	58.37 (49.79)	64.76 (53.56)	85.60 (67.69)	89.92 (71.50)	74.66
Mean		63.61	70.93	83.82	87.15	
CD (0.05)		1.16	1.15	1.84	2.34	

Moreover, the studies also revealed the life cycle of *Ph. Populifoliella* as bivoltine in the study regions (i.e. when two generations are completed in the season), first generation from May to July and second generation from July to September. The life cycle of *Ph. populifoliella* is variable, being bivoltine or univoltine in different parts and two annual generations were recorded in Europe <sup>[10]</sup>. During the studies premature leaf abscission has also been recorded twice in the season. The first generation of the leaf miner induced the mass abscission of leaves during mid-August while the second generation of the pest colonized the newly formed leaves on the shoot tips and apparently induced a repeated shedding response during early September, so that in mid-October the poplars are observed with severe infestation and completely defoliated. Similar findings were reported in USSR where the attack of *Phyllonorycter populifoliella* (Treitschke) enhanced leaf fall, delayed growth and diminished the aesthetic value of poplars <sup>[3]</sup>. Premature leaf abscission has been commonly observed twice in the areas where *Ph. Populifoliella* is bivoltine <sup>[5]</sup>. It has also been reported that the strongly damaged leaves dried out, curled, and fell off between the last third of July and the last third of August <sup>[9]</sup>. A significant positive correlation has been observed between the number of fallen leaves and the leaf miner density <sup>[11]</sup>.

#### 4. Conclusion

Thus, it is concluded that the infestation of poplar leaf miner *Phyllonorycter populifoliella* (Treitschke) is widespread in the entire Ladakh region and developing on both the two species of poplars of family Salicaceae. Such outbreaks have often led to premature defoliation of poplars as early as in mid-August in the region and thereby strongly reducing the ornamental value and ecological functionality of poplar stands. So the pest may be categorised as one of the major pests of poplars in Leh region. The present status of the pest in the region demands much concern for future studies on viable and eco-friendly management options. Although management options involve integrated pest management practices which include cultural practices, use of bio-pesticides, tolerant poplar varieties/clones, natural enemies, recommended safe insecticides and avoiding alternate host plants of the pests. However, if chemicals are to be attempted for the management then timing of spray has a significant role. The timing of any contact insecticide spray like Chloropyrifos 20EC @ 1ml/Litre of water should coincide with the ovipositional period which is shortly after leaves have expanded in the spring. Soil application of granular systemic insecticides can also be effective through root uptake.

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