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Population ecology of onion leaf miner, *Liriomyza hoidobrenssis* (Blanchard) on garlic agro-ecosystem in Manipur, India

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Abstract
Liriomyza huidobrensis (Blanchard), the onion leaf miner or commonly known as pea leaf miner, is a highly polyphagous and cosmopolitan in distribution capable of inflicting severe damage to vegetable crops as well as various ornamental plants. Affected crops include field and glasshouse grown vegetable and flowers. Studies on population ecology of onion leaf miner on garlic agro-ecosystem were carried out for three cropping seasons (2017-18, 2018-19 and 2019-2020) in Manipur. Initially the pest density was very low *i.e*., 0.20 larvae/plant during first, second and third year, respectively. Their abundance gradually increased reaching the peak values of 16.15 larvae/plant, 28.05 larvae/plant and 20.45 larvae/plant with the infestation of 90 % (2017-2018), 70 % (2018-19) and 95 % (2019-2020) during March. The correlation coefficient showed higher temperature, lower relative humidity, lower total rainfall, longer duration of sunshine hours and higher wind speed seem to favour the pest population build up.

Keywords: abiotic factors, garlic, *Liriomyza huidobrensis*, population

Introduction

Onion leaf miner, *Liriomyza huidobrensis* (Blanchard) (Diptera: Agromyzidae) is an important polyphagous and highly cosmopolitant destructive pest of variety of crops and ornamental plants specially liliaceae crops like *Allium* sp. throughout the world (Spencer, 1992; Martinez *et al*., 1993 and Singh and Lukhoi, 2013) [16, 7]. Agromyzid flies of the genus *Liriomyza* are small in size which is rangiest from 1.5 to 2.0 mm long. They are mostly shiny black except for yellow on the scutellum, sides of thorax and middle portion of head; two pairs of reclinate orbital setae and costal vein extending to M1+2. *L. huidobrensis* is distinguished from other pest species of *Liriomyza* particularly *L. sativae* Blanchard and *L. trifolii* (Burgess) that share many of the same host plant, by its larger body size and overall dark color; larger discal cell and relatively short distal section of vein M3+4; the darkened femora (yellow in *sativae* and *trifolii*); and the male genitalia (Spencer, 1973) [15]. In India, it is considered to be the most devastating pest of the *Allum* sp. crops having assumed the pest status of national importance (Sing and Lukhoi, 2013). This insect pest is recorded to cause total destruction of *Allum* sp. crop if left untreated. In Manipur also, the pest is a limiting factors in production of *Allum* sp. vegetables particularly onion, *Allium cepa* L.) and garlic, *Allium sativum* L. and also legume crops *i.e*., garden pea (*Pisum sativum* L.) and broad bean (*Vicia faba* L.). It attacks from nursery stage onwards feeding, mining and boring into the vegetative as well as reproductive stage of the crop finally resulting in reduction of its yield as well as market value. Frass is deposited in a thin, broken to continuous line down the middle of the mine. The placement of mines on the leaf underside, the association with leaf veins and frass deposition pattern of *L. huidobrensis* larvae are distinctive and distinguish them those of other species, however, this pattern may be obscured when many larvae feed together on the same leaf (Spencer, 1973) [15]. A mine usually begins on the leaf surface and moves to the lower surface after a few millimeters of feeding by the larva (Parrella and Bethke, 1984) [11]. Flies puncture leaves for both feeding and oviposition; punctures may be numerous enough to greatly reduce photosynthesis and may kill young plants. Unsightly mines and punctures further reduce the value of ornamental plants. On the other hand, constant and injudicious use of insecticides led to development of multiple resistances in the insect pest (Tabashnik *et al*., 1990 and Ramachandran *et al*., 1998) [13]. The period of incidence as well as intensity of activity of the pest depends on the variety of crop, agro-technological practice and environmental factors (Bhakhetia and Sekhon, 1989). Of these the climatic factors such as temperature, relative humidity and rainfall influenced the insects population greatly (Bakhetia *et al*., 1989; Bishnoi *et al*., 1992; Prasad, 2003) [2, 3, 4, 12]. Keeping in view, the economic importance of the pest as well as the crop the present study was undertaken to study its population ecology in relation to ecological factors in the state to that timely and effective management strategies for its control could be developed.

Materials and Methods

The population ecology of onion leaf miner in relation to abiotic factors was assessed on garlic agro-ecosystem at the non-commercial field of Manipur for three consecutive cropping seasons (2017-18, 2018-19 and 2019-2020). Observations on the population ecology of onion leaf miner was made at weekly interval by random selection of 25 plants at the rate of 5 plants per plots after transplantation of the seedlings and it was continued till harvest of the crops (*i.e*., January to April). The corresponding field data of meteorological parameters such as temperature, relative humidity, total rainfall, sunshine and wind speed were also recorded during the period of study. The data thus collected were computed and subjected to suitable statistical analysis (Panse & Sukhatme, 1985) [10] using Minitab in order to find out the relationships of environmental factors with the population densities of the individual insect pest.

Results and Discussion

The studies on population ecology of *L. huidobrensis* on garlic (Local bread) conducted in non-commercial filed of Manipur for three consecutive cropping seasons (2017-18, 2018-19 and 2019-2020). In Manipur garlic crop is normally cultivated from December/January to March/ April.

Population ecology of onion leaf miner

The activities of L. huidobrensis on garlic agro-ecosystem prevailing during the three cropping seasons are depicted in Table 1. The occurrence of onion leaf miner was observed from the second week of January during first year (2017-2018) and second year (2018-19) and first week of January during third year (2019-20) till harvesting of the crop *i.e*., second week of April. Initially the pest density was very low *i.e*., 0.10 larvae/plant, 0.05 larvae/plant and 0.20 larvae/plant during first, second and third year, respectively. Their abundance gradually increased reaching the peak value of 16.15 larvae/plant during 5th week of March infesting 90 % (Table 1) of the plants in first cropping season, 28.05 larvae/plant during 4th week of March infesting 70 % of the plants in second cropping season and 20.45 larvae/plant during 4th week of March infesting 95 % of the plants in third cropping season. In the present finding the higher level of larval population was recorded during the month of March and April, after which the larval population revealed a steep decline (Fig. 1). This abrupt decline was mainly due to the fact that the crops by then were approaching harvest and there was lack of fresh green leaves to sustain the larvae. Similar period of incidence was reported on another crop pest by Gera and Bhatnagar (1992) in Rajasthan and Dhaliwal and Gona (1979) in lower hills of Solan. However, variations in the period of peak activity of the pest in different agro-ecosystem were reported by various workers (Abraham and Padmanabhan, 1968; Yadav *et al*., 1974; Sachan and Gangwar, 1980; Mulik *et al*., 2000 and Mosiane *et al*., 2003) [1, 19, 14, 9, 8]. Respectively.

Table 1: Population incidence and percentage plant infestation of *L. huidrobrensis* on *Allium sativum* L. (Garlic)

Period of observation		% Population incidence			% plant infestation		
Months	Weeks	2017-18	2018-19	2019-20	2017-18	2018-19	2019-20
January	1st			0.20			10
	2nd	0.10	0.05	0.45	5	5	15
	3rd	0.15	0.25	1.05	5	10	35
	4th	0.10	0.45	0.95	5	20	30
February	1st	0.05	0.50	0.85	5	20	25
	2nd	0.25	0.65	2.35	10	30	50
	3rd	2.15	0.90	5.45	20	30	85
	4th	2.20	1.65	10.15	30	55	95
March	1st	2.30	4.35	11.10	40	70	90
	2nd	1.30	15.10	13.40	50	70	95
	3rd	1.65	39.00	15.15	70	75	95
	4th	10.15	28.05	20.45	80	70	95
	5th	16.15	20.00	20.05	90	65	85
April	1st	13.45	16.55	15.95	85	65	90
	2nd	12.85	14.40	16.05	80	60	85

Correlation between population onion leaf miner with abiotic factors

The incidence of onion leaf miner during the study period on the host plant occurred when abiotic factors were of follows: the average temperature 11.59 – 30.250C, average relative humidity 43.50 – 87.86 %, total rainfall of 0.10 – 110.90 mm, sunshine of 2.06 – 8.98 hrs and wind speed 0.43 – 6.36 km/hr, respectively. Whereas, the above mentioned environmental factors during peak periods of the onion leaf miner is range from 21.41 – 30.250C, 42.35 – 75.79 %, 0.00 – 23.70 mm, 5.14 – 8.25 hrs and 2.31 – 5.85 Km/hr, respectively. The correlation coefficient of onion leaf miner with that of the abiotic factors showed in general that temperature, sunshine as well as wind speed correlated positively ($P < 0.05$) (Table 2). On contrary, relative humidity and total rainfall revealed negative correlation with onion leaf miner population. As such higher temperature, lower relative humidity, lower total rainfall, longer duration of sunshine hours and higher wind speed seem to favour the pest population build up. On the contrary Sujatha *et al.*, 1997 [17], reported negative relationship of diamond back moth population with temperature and morning relative humidity while it was non-significant positive relationship with evening relative humidity in south Indian. Whereas, Devjani (1999) [5] reported that among the environmental factors only mean temperature and relative humidity showed significant positive and negative influence on pest population, whereas, total rainfall showed a week negative relation with the pest population. Furthermore, Mulik *et al*. (2000) [9] reported that the incidence of pest population did not show any significant correlation with mean temperature and relative humidity. On the other hand, Guilloux *et al*. (2003) observed negative effect of rainfall on insect pest population and assumed it to be the principal factor in control of the pest in early November. The influence of weather factors on the incidence of pest during three cropping seasons as assessed by multiple regression analysis are presented in Table 3. The multiple correlation coefficient (R) was observed with range of 0.969 – 0.978 during the present study (Table 3). While extending results of the analysis, the co-efficient of determination (R2) was 0.951 (2017-18), 0.939 (2018-19) and 0.956 (2019-20) showing thereby that as much as 95.10 % and 95.60 % variation in incidence of pest was contributed by all the weather factors (Table 3). Thus, it was observed that the activity of onion leaf miner does not depend only on fixed climatic regime rather its activity is mostly dependent upon the cropping pattern of the region or country.

Table 2: Correlation co-efficient between *L. huidobrensis* and abiotic factors on *sativum* L. (Garlic)

Years	Temperature (0C)	Relative Humidity (%)	Total rainfall (mm)	Sunshine (hrs)	Wind peed (Km/hr
2017-18	0.883**	-0.058	-0.299	0.348	0.433*
2018-19	0.835**	-0.460*	-0.124	0.134	0.014
2019-20	0.950**	-0.521*	-0.059	0.678**	0.470*

* Significant at 5 % level: ** Significant at 1 % level

Table 3: Multiple linear regression models for *L. huidobrensis* on *A. sativum* L. against abiotic factors.

Year	Pure constant	Partial regression coefficient of variables	Multiple correlation coefficient (R)	R2
2017-18	-4.31	0.252X2 + 0.101X3 – 0.0240X4 –0.75X5+0.002X6	0.975	0.951
2018-19	11.30	0.999X2 – 0.048X3 - 0.069X4 - 3.77X5 + 1.00X6	0.969	0.939
2019-20	-25.60	0.902X2+0.179X3-0.0054X4+0.933X5-0.607X6	0.978	0.956

X2 = Mean Temperature; X3 = Mean Relative Humidity; X4 = Total Rainfall; X5 = Sunshine; X6 = Wind Speed

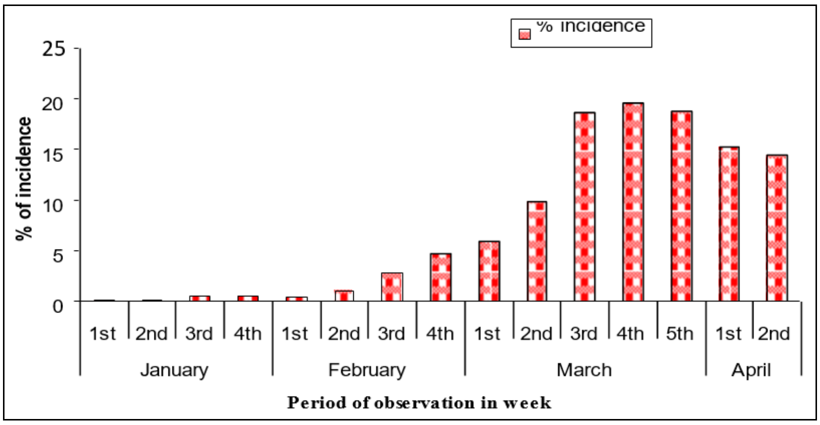

Fig 1: Mean value of three cropping season % incidence of *L. huidobrensis* on *Allium sativum* L.

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