Entomology

Surveillance for potato tuber moth, *Phthorimaea operculella* Zeller (Lepidoptera: Gelichiidae) in Hassan district of Karnataka

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Received 8 Jul 2022; Accepted 30 Aug 2022; Published 5 Sep 2022

Abstract

Potato tuber moth (PTM), *Phthorimaea operculella* Zeller has become one of the most serious insect pests of potato (*Solanum tuberosum* L.) around the world, including in India. Field studies were conducted against PTM in *Kharif* and *Rabi* seasons during 2019-20 in seven and two taluks of Hassan districts of Karnataka, respectively to understand the extent of foliage damage and leaf mines. Among the mean per cent infestation of PTM during both the seasons of survey in Hassan district, where highest mean PTM incidence (6.19%) was witnessed during *Kharif*-2019 and it was least during *Rabi*-2019-20 (5.19%). Number of mined leaves per plant and number of mines per plant were observed lowest during *Kharif*-2019 season (2.62 and 4.32) compared to *Rabi*-2019-20 season with 3.04 mined leaves per plant and 4.44 mines per plant, respectively. All the above damage parameters didn't reveal significant differences among the surveyed villages and taluks. In recent years, the temperature has been steadily rising due to climate change, and it is predicted that the occurrence of the PTM will continue to increase in the future. Therefore, the development of control technologies and intensive monitoring will be necessary for stable potato production as well as potato post-harvest.

Keywords: potato tuber moth (PTM), *Phthorimaea operculella*, survey, hassan

1. Introduction

Potato (*Solanum tuberosum* L.) is a root vegetable native to America, a starchy tuber of the plant and a perennial in the family of solanaceae. The potato is a staple food belonging to the tuber and root family. It is one of the top four crops in the world after rice, wheat and maize (Ross, 1986; Douches *et al*., 2004). Potato is an essential food in developing countries claiming fourth place after rice, wheat and corn. These countries produce approximately one-third of the worldwide production of potato. It is a fat-free food containing protein, vitamins and minerals (Meyhuay, 2001). Unfortunately, severe losses may occur in storage, especially in the developing countries where,low-income farmers cannot afford cold storages.

A worldwide pest of potatoes is a major challenge that farmers are facing as they are intensifying their production techniques to satisfy the increasing demands of the international market. Among them, potato tuber moth (PTM), *Phthorimaea operculella* Zeller is a major pest of potato throughout the world, but prefer sub-tropical, tropical and Mediterranean climates. It is also known as potato tuber moth, potato tuber worm, potato tubeworm moth, potato moth, potato leaf miner; tobacco split worm and tobacco leaf miner. It is an oligophagous pest, feeds on crops belonging to the family solanaceae (mainly potato, tomato, tobacco, brinjal, bell pepper, cape-gooseberry and other solanaceous weeds like black nightshade, datura etc.). Earlier it was a minor pest of tobacco for more than 100 years, but recently over last five years in North Carolina, it has emerged as a problem in tobacco plantings. Also, it has been reported in tropical, subtropical and Mediterranean agro-zones (Flanders *et al*., 1999; Golizadeh and Esmaeili, 2012).

PTM is the most economical potato pest in the mid-hills and plateau areas of India causing severe damage particularly in rustic, non-refrigerated stores during summer. Nearly 90 per cent of the production is kept in stores after harvesting. Storage facilities are traditional, non-refrigerated, low cost "*kutcha*" stores allowing free access of PTM to stored potatoes. PTM damage in stores depends mainly on tuber infestation at harvest. Infected tubers brought into traditional stores are the primary source of infestation. Without control measures, tuber infestation can reach up to cent per cent (Chandel *et al*., 2001). Farmers depend heavily on non-selective pesticide applications to reduce storage losses from PTM. There is concern to reduce pesticide usage and finding alternate control strategies and to integrate them for effective management of pest. Temperature is an important factor in the survival rate and development of PTM, so they are typically found in warmer climates, preferring subtropical and tropical habitats.

2. Materials and methods

The survey taluks were initially selected on the basis of major

potato cultivation areas. In total, 28 potato fields were surveyed in *Kharif* season (July to September) in the seven taluks and eight potato fields were surveyed in *Rabi* season (December to March) in only two taluks of Hassan district of Karnataka during 2019-20. Extents of damage in terms of per cent incidence are recorded for PTM. In each taluk, two villages were selected at random and in each village two plots were selected at random. From each plot, 10 plants at random were observed for detailed pest incidence.The extent of damage due to PTM was recorded in terms of number of leaves mined or number shoots bored or number of tubers damaged.

Per cent incidence was calculated by using the formula

$$\% \text{ incidence} = \frac{\text{Number of plants infested}}{\text{Total number of plants observed}} \times 100$$

For observations on tuber moth at each location, one meter row was randomly selected at three different sites in the field and observed for number of shoots showing mining symptoms and later calculated the per cent incidence.

3. Statistical analysis

All the collected data were précised and suggested to analysis of variance (ANOVA) for Complete Randomized Block Design (CRBD) using the OPSTAT analysisat 5 per cent level of significance after necessary transformations are required.

4. Results and discussion

4.1 PTM infestation in Hassan district during Kharif-2019

In total,28 potato fields were surveyed among seven taluks of Hassan district.In the present study, the PTM was reported in all the survey locations. Irrespective of villages and taluks surveyed during *Kharif*-2019 in Hassan district, the mean infestation of PTM was 6.19 per cent (Table 1). It ranged from a minimum of 4.72 per cent (Nygere village of Arkalgud taluk and Anike village of Belur taluk) to a maximum of 8.00 per cent (Hunasavalli village of Alur taluk) which did not differ statistically. The taluk-wise infestation of PTM ranged from 5.37 (Arkalgud) to 6.83 per cent (Hassan) which too varied non-significantly among taluks.

The number of mined leaves per plant ranged from a minimum of 1.66 in Bageshpura village of Arsikere taluk to a maximum of 3.86 in Hosahalli village of Arsikere taluk. There was no significant difference in terms of mined leaves per plant (Table 1). The same thing was witnessed with taluk-wise analysis of number of mined leaves per plant ranging from 2.12 mines per plant (Channarayapatna) to 3.16 (Alur).

Among the total mines per plant due to PTM infestation considered, there was no difference observed among villages as well as taluks during Kharif-2019 in Hassan district. It varied from 2.90 mines per plant (Nygere, Doddakanagal and Anike villages) to 5.35 mines per plant in Chakenahalli village (Table 1). Among the taluks of Hassan district, it varied from 3.16 (Arkalgud) to 5.10 mines per plant in Channarayapatna.

4.2 PTM infestation in Hassan district during Rabi-2019-20

Among the four villages surveyed and in two taluks of Hassan district during *Rabi*-2019-20, there was no statistical difference in terms of mean PTM infestation and number of mined leaves per plant. It was minimum in Chikkamenahalli village of Hassan taluk (3.90% and 2.49, respectively) and the same were maximum in Muthathi village of Hassan taluk (6.02% and 3.71, respectively) (Table 2). Among the taluks, lowest mean infestation of PTM was recorded in Hassan taluk (4.96%) and highest was recorded in Channarayapatna taluk (5.42%). The minimum number of mined leaves per plant was in Channarayapatna taluk (2.99) and maximum was in Hassan taluk (3.10) which also not differed significantly.

The total number of mines per plant due to PTM was also not significant among villages as well as taluks. It was least in Chikkamenahalli village (Hassan taluk) and Belaguli (Channarayapatna taluk) with 4.12 mines per plant and was highest in Muthathi village (Hassan taluk) with 5.35 mines per plant (Table 2). Among the taluks, it varied from 4.59 in Channarayapatna taluk to 4.73 mines per plant in Hassan taluk.

Table 1: Extent of damage by potato tuber moth, *P. operculella* in Hassan district during *Kharif*-2019

Taluk	Village	Per cent infestation by PTM*		No. of mined leaves / plant**		No. of mines / plant**	
		Per village	Per taluk	Per village	Per taluk	Per village	Per taluk
Hassan	Ankapura	7.08 (15.43)	6.83 (15.14)	2.90 (1.95)	2.58 (1.86)	5.04 (2.49)	4.82 (2.45)
	Banavase	6.57 (14.85)		2.25 (1.75)		4.60 (2.39)	
Arkalgud	Neralahalli	6.02 (14.20)	5.37 (13.39)	2.49 (1.83)	2.37 (1.79)	3.41 (2.10)	3.16 (2.03)
	Nygere	4.72 (12.54)		2.25 (1.75		2.90 (1.95)	
Holenarasipur	Chakenahalli	7.08 (15.43)	6.55 (14.82)	3.71 (2.18)	2.98 (1.89)	5.35 (2.56)	4.98 (2.48)
	Malali	6.02 (14.20)		2.25 (1.75)		4.61 (2.40)	
Channarayapatna	Belaguli	5.41 (13.44)	5.99 (14.16)	1.98 (1.66)	2.12 (1.71)	5.05 (2.50)	5.10 (2.51)
	Kundur	6.57 (14.85)		2.25 (1.75)		5.15 (2.52)	
Arsikere	Bageshpura	5.41 (13.44)	6.25 (14.47)	1.66 (1.54)	2.76 (1.91)	5.04 (2.49)	5.04 (2.49)
	Hosahalli	7.08 (15.43)		3.86 (2.21)		5.04 (2.49)	
Alur	Doddakanagal	5.41 (13.44)	6.71 (15.01)	2.90 (1.95)	3.16 (2.03)	2.90 (1.95)	3.58 (2.14)
	Hunasavalli	8.00 (16.42)		3.41 (2.10)		4.25 (2.31)	
Belur	Anike	4.72 (12.54)	5.65 (13.75)	2.25 (1.75)	2.37 (1.79)	2.90 (1.95)	3.51 (2.12)
	Bitravalli	6.57 (14.85)		2.49 (1.86)		4.12 (2.28)	
Mean		6.19		2.62		4.32	
S.Em(±)		0.82		0.33		0.43	
CD		NS		NS		NS	

* Figures in parentheses are arcsine transformed data, ** Figures in parentheses are √x ± 0.25, NS: Not significant

Table 2: Extent of damage by potato tuber moth, *P. operculella* in Hassan district during *Rabi*-2019-20

Taluk	Village	Per cent infestation by PTM*		No. of mined leaves / plant**		No. of mines / plant**	
		Per village	Per taluk	Per village	Per taluk	Per village	Per taluk
Hassan	Chikkamenahalli	3.90 (11.39)	4.96 (12.86)	2.49 (1.83)	3.10 (2.01)	4.12 (2.28)	4.73 (2.42)
	Muthathi	6.02 (14.20)		3.71 (2.18)		5.35 (2.56)	
Channarayapatna	Belaguli	5.42 (13.46)	5.42 (13.46)	2.90 (1.95)	2.99 (1.98)	4.12 (2.28)	4.59 (2.39)
	Thimmalapura	5.42 (13.46)		3.08 (2.00)		5.05 (2.50)	
Mean		5.19		3.04		4.44	
S.Em(±)		0.77		0.26		0.42	
CD		NS		NS		NS	

* Figures in parentheses are arcsine transformed data, ** Figures in parentheses are √x ± 0.25, NS: Not significant

An intensive survey for the incidence of PTM on potato crops across 37 locations of South Korea during 2009-12 revealed that, the pest had expanded by 200 km into the northern parts within three decades. The main factor contributed for the expansion of PTM distribution was, increase in the mean temperature by approximately 0.9°C during that time (Kwon *et al*., 2017). Potato tuber moth was prevalent throughout Nepal excluding three districts of high hill zone and was more predominant in mid-hills (March to October) compared to plains (March to July) (Giri *et al.*, 2014). They have made year round pheromone trap caches to establish a sound basis for its management as the pest is spread throughout Nepal.

Rowing surveys conducted in Hassan district during *Kharif* 2016 and 2017 revealed no PTM infestation during vegetative stage. While at reproductive stage, the infestation was 0.23 larvae per plant during both 2016 and 2017 seasons with 3.94 and 4.33 per cent tuber infestation, respectively which further advanced at harvesting stage (5.28 and 7.08%, resp.) (Natikar and Balikai, 2018).

Compared to the infestation reported by Natikar and Balikai (2018), the infestation level of PTM in Hassan district during *Kharif*-2019 is very low which may be due regular and intermittent rains during the cropping period, compared to 2016 and 2017 cropping seasons. The regular and intermittent rains have restricted the pest buildup besides the heavy incidence of late blight. There was absolutely no tuber infestation documented during *Kharif*-2019 in Hassan district, it may be for lack of pest buildup during vegetative and reproductive stages due to intermittent rains.

Moreover, it has been documented that the Hassan potato fields were rich with diversity and density of insect natural enemies (Natikar and Balikai, 2018). The present documentation of PTM infestation on foliage and tubers forms the first of its kind from Kolar and Chikkaballapur districts which are relatively newer to potato.

Besides the cropping area of potato is being shrinking but, the season of cultivation is shifting to *Rabi* to harness various situations like locally available seed tubers, reduced blight incidence compared to *Kharif* crops and a relatively higher market price. In this background, regular monitoring of PTM incidence is the need of the hour, as the farmers being spraying a lot of insecticides along with fungicides unknowingly for the management of late blight. From the studies it was evident that, improvising the monitoring tools with pheromone traps is needed and should be on a regular basis to forewarn the PTM outbreak to suggest the suitable mitigation measures.

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