

Population trend of codling moth (*Cydia pomonella* L.) And woolly apple aphid, (*Eriosoma lanigerum*) on apple (*Malus domestica* L. Borkh) fruit tree orchard

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Abstract

The population trends of *Cydia pomonella* L. and *Eriosoma lanigerum* were studied on apple fruit orchard. These two pests caused serious losses in district Mastung, Balochistan Province, Pakistan. The results of weekly mean population dynamics showed that the mean population of *Cydia pomonella* L. on each apple fruit tree varied. For the first week it varied from 0.0 to 8.0 in which the maximum attack of the Codling moth was 8.0 for treatment (T) 6. In the same way the highest attack in the week; first, second, third, fourth, to tenth was 3.5, 8.0, 4.5, 3.0, 3.0, 4.0, 4.5, 4.5, and 4.5 respectively. While the mean population dynamics of (*Eriosoma lanigerum*) ranged from 0.0 to 4.0 in first week. Among the population maximum invasion of Woolly apple aphid for week first, second, third, fourth, to tenth was 4.0, 3.0, 3.0, 6.0, 6.0, 3, 4, 3, 4 and 6 respectively. The implementation of traditional and automated control was found more obvious way to cope diseases influences. The absence of technical awareness, Finance shortage, and high cost of inputs were the major adoption affecting elements among farmers. Micro credit schemes should be started by the communal sector to lessen the financial problem and trainings should be given by the entomologist to adopt alternate way to manage the insect pests.

Keywords: Population dynamics, codling moth, woolly apple aphid, pest infestation, apple

Introduction

The Apples (*Malus domestica* L.) belongs to the genus *Malus*, order Rosales and family Rosaceae. It is recognized as first cultivated in Egypt in 12 BC. The cultivation of apple is also evidenced in Bible (Ryugo, 1988) [22]. The apple fruits are eaten in all over the world, because it is rich in minerals, carbohydrates, fiber, dierty antioxidant phenolic compounds (Alberto *et al.*, 2006. Wolfe *et al.*, 2003) [3, 28]. From nutritional point of view apple is very important because it contains Vitmain C, B, A and sugar. Recent investigation has exposed that eating of apple and its juice is very important for our body health that is strongly related to decrease the prevalence of virus-related disease, heart disease and lungs disease (Abrosca *et al.*, 2007., Alberto *et al.*, 2006., Boyer *et al.*, 2004., Leontowicz *et al.*, 2003; Wolfe *et al.*, 2003; Stokwe and Malan, 2016) [2, 3, 7, 17, 28, 23].

Pakistan climatic conditions support the cultivation of apple and it is mainly found in Khyber Pukhtunkhwa, Balochistan and hilly areas of Punjab. The biggest producer province of apple fruits in Pakistan is the Balochistan; therefore this province is known as "Fruit Basket of Pakistan". In Balochistan the famous districts of apple production are Pishin, Quetta, Ziarat Loralai, Killa Saifullah, Mastung and Kalat. Due to the suitable climatic conditions deciduous fruits are grown very well in Balochistan province. Different verities of apple in Pakistan are Golden Delicious (Shin Kulu), Red Delicious (Tor Kulu), Amri, Mashadi, Kaja etc. (Mukhtar *et al.*, 2010., Abid *et al.*, 2005) [19, 1].

Codling moth (*Cydia pomonella* L.)

Codling moth *Cydia pomonella* L. Is found throughout the

world. It is a pest of various agricultural crops and mostly attack on fruit trees such as apple pear, walnut etc. In Pakistan this pest is mainly found on apple trees. This pest destroys fruit and there by decrease the production of apple fruits and also lowers the quality of fruits. (Witzgall *et al.* 2008; Ashraf *et al.*, 2014; Stokwe and Malan, 2016) [27, 5, 23]. The larva of the codling moth is very dangerous which enter into fruits and damage the whole fruit and result in about 80% losses (Graora, Jerinic-Prodanovic, 2005) [15]. In first generation fruits attacked and often drop prematurely, which loose the economic value in fruits and yield (Ciglar, 1998; Umer *et al.*, 2019) [11, 25].

Adult of the codling moth larvae spend their winter in silky cocoons beneath the tree barks, soil, crevices, and wooden materials as well as also present in infested trees. Pupation takes place in month of April and adult of codling moth during the early month of May and remains to the end of August according to temperature (Stokwe and Malan, 2016) [23].

The larva of Codling moth at the first time make small cavity at lower surface of the fruit and later on feeding for some days it make whole like tunnel in the fruit. Occasionally larva attack another fruit in the similar bunch before a matured period, so damaged fruits incline to ripen and drop on ground. However, biocontrol is not possible slightly because the larva is safe into the apple fruit.

Woolly apple aphid, *Eriosoma lanigerum*

In several apple growing regions, the Woolly apple aphid, *Eriosoma lanigerum* (Hausmann) (Hemiptrea : Aphididae), is considered as secondary main pest of apple fruits (Croft *et*

al., 1975; Umer *et al.*, 2019) [12, 25] and it is also found on pear, hawthorn, elm, *Pyracantha*, Mountain ash, (genus *Sorbus*), however now it is occurred in all over the world (DeBach 1964) [14]. In 19th century it was originated in Australia (Nicholls, 1932) [20]. It attacks especially on vegetative growth such as roots, shoots, woody tissues, trunk or branches and large infestation in fruits as well as also loses in yield (Brown *et al.*, 1995., Brown *et al* 1994; Stokwe and Malan, 2016; Umer *et al.*, 2019) [9, 8, 23, 25]. They are small in size and wingless aphids. They are occurring in different color like reddish, white, purple and brown. A little survey is carried out on apple fruit orchard for population dynamics of Codling moth and woolly apple aphid species and identification of these insect's pests. The production of the current survey will be exploited for managing the population densities of Codling moth and woolly apple aphid in apple fruit orchard. Hopefully, these findings could be helpful in managing the population densities of Codling moth and woolly apple aphid (Stokwe

and Malan, 2016; Umer *et al.*, 2019) [23, 25].

Materials and methods

This field survey was conducted in 2018. In this study the apple orchard encompassed 0.4 ha planting, located in district Mastung, this district is a main apple growing region. The Apple fruits orchards were had main two insect's pests of Codling moth (*Cydia pomonella* L.) and Woolly apple aphid, (*Eriosoma lanigerum*). The field survey in orchards was conducted in a fully randomized block design system in four replication and six treatments of each replication. The space between the trees was 6 × 5, 2m apart, accordingly. Per experimental distance was six meters separately from other. The direction of orchards was divided into four equal region north–south plots and east–west, respectively. The field survey was visited commonly for the record of population density of the concerned insect pest Table 1.

Table 1: During the survey following insect's pest was observed on Apple Fruits in Orchard

Common Name	Scientific Name	Family	Order
Codling moth	<i>Cydia pomonella</i>	Tortricidae	Lepidoptera
Woolly apple aphid	<i>Eriosoma lanigerum</i>	Aphididae	Hemiptera

Data Collection

The major insect's pests of Apple fruits orchard are Codling moth and Woolly apple aphid which invade on fruit trees. The data of population density was recorded of two insect's pests on 70 Apple fruit trees. The data was recorded on weekly basis.

Results

Population Dynamics

The major insect's pests of Apple fruit were observed from the time of producing fruit till the harvest. The mean population of dynamics of Codling moth (*Cydia pomonella* L.) and Woolly apple aphid, (*Eriosoma lanigerum*). Were recorded on weekly basis as mentation in the table 2 and 3.

Codling moth (*Cydia pomonella* L.)

Table 2: Mean population dynamics of Codling moth (*Cydia pomonella* L.)

Treatment	Replication	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10
T 1	R1	1.5	1.0	2.0	1.5	3.0	0.0	1.0	1.0	0.0	1.5
	R2	2.0	1.5	1.0	2.5	2.5	1.0	1.5	2.0	0.0	1.5
	R3	1.5	1.0	0.0	0.0	1.0	2.0	0.0	1.5	0.0	0.0
	R4	0.0	0.0	1.0	0.0	1.0	1.0	1.0	1.5	1.0	0.0
T2	R1	1.0	1.0	0.0	0.0	1.5	1.0	2.0	1.0	1.0	1.0
	R2	1.5	2.5	2.0	1.5	1.0	0.0	2.5	1.5	1.0	0.0
	R3	0.0	0.0	1.0	2.5	1.0	1.5	1.0	0.0	0.0	0.0
	R4	1.0	1.5	0.0	0.0	1.0	2.5	1.0	2.0	1.0	1.0
T3	R1	0.0	0.0	2.5	2.0	1.0	0.0	0.0	2.0	1.0	3.0
	R2	1.5	1.5	3.0	1.0	0.0	3.0	1.5	0.0	2.0	1.0
	R3	3.0	1.0	1.5	3.0	2.0	1.0	0.0	3.0	1.0	0.0
	R4	2.0	2.5	1.0	1.5	1.0	1.5	1.0	0.0	1.0	2.0
T4	R1	1.5	3.5	8.0	2.5	1.5	1.0	1.0	1.5	0.0	0.0
	R2	1.0	2.0	1.0	0.0	2.0	2.5	3.5	4.5	1.5	0.0
	R3	3.5	1.5	2.0	1.0	0.0	2.5	0.0	0.0	0.0	0.0
	R4	0.0	0.0	1.0	1.0	2.0	1.5	1.5	2.5	3.0	4.5
T5	R1	1.0	1.0	0.0	0.0	2.0	3.0	4.0	1.5	2.5	0.0
	R2	1.5	1.5	3.0	2.0	1.5	2.5	1.0	1.0	4.5	2.5
	R3	1.5	2.5	1.5	2.0	1.0	2.0	3.0	0.0	1.5	3.5
	R4	3.5	2.5	1.5	4.5	2.5	3.5	1.5	3.0	4.0	2.0
T6	R1	1.5	2.5	1.5	2.0	1.0	1.0	2.0	4.5	0.0	1.0
	R2	8.0	1.5	2.5	3.5	0.0	1.0	3.0	4.0	2.0	1.0
	R3	3.0	1.5	2.0	1.0	1.0	1.5	2.5	1.5	3.0	2.0
	R4	0.0	1.0	1.5	1.0	3.0	2.0	0.0	1.5	0.0	2.5

T= Treatment, R= Replication

The mean population dynamic of Codling moth (*Cydia pomonella* L.) each Apple fruit tree fluctuated from 0.0 to

8.0 in first week. Among the population, maximum attack of Codling moth with mean value of (8.0) was recorded in

treatment 6; in the similar way the no attack of Codling moth was recorded in treatment 1 (0.0). In the second week the invasion of Codling moth ranged from 0.0 to 3.5. Among the population maximum invasion of Codling moth with the mean value (3.5) was recorded in treatment 4. Third week the invasion of Codling moth ranged from 0.0 to 8.0. Among the population of maximum invasion of Codling moth (8.0) was recorded in treatment 4 (8.0); whereas the minimum attack of Codling moth was observed in treatment 1 (RI & 2), T2 (R,3 and 4 as (1.0 each). Fourth week the invasion of Codling moth ranged from 0.0 to 4.5. Among the population maximum attack of Codling moth (4.5) was recorded in treatment 5; whereas no invasion of Codling moth was noted in treatment 4 (0.0). Fifth week the invasion of Codling moth ranged from 0.0 to 3.0. Among the population maximum attack of Codling moth (3.0) was noted in treatment 6; whereas no invasion of Codling moth was recorded in treatment 6 (0.0). Sixth week the invasion of Codling moth ranged from 0.0 to 3.0. Among the population maximum invasion of Codling moth (3.0) was recorded in treatment 3; whereas no attack of Codling moth was observed in treatment 1 (0.0). In the seventh week the invasion of Codling moth was from 0.0 to 4.0. Among the population maximum invasion of Codling moth (4.0) was recorded in treatment 5; whereas no attack of Codling moth was recorded in treatment 3 (0.0). Eighth week; the invasion of Codling moth was from 0.0 to 4.5. Among population maximum invasion of Codling moth (4.0) was noted in treatment 4; whereas no invasion of Codling moth was recorded in treatment 2 (0.0). Ninth week; the invasion of Codling moth ranged from 0.0 to 4.5. Among population of maximum attack of Codling moth (4.5) was recorded in treatment 5; while no attack of Codling moth was recorded in treatment 1 (0.0). In the tenth week the invasion of Codling moth ranged from 0.0 to 4.5. Among population of maximum invasion of Codling moth 4.5 was recorded in treatment 4; while no invasion of Codling moth was recorded in treatment 1 (0.0) as shown in Table 2.

Woolly apple aphid, (*Eriosoma lanigerum*).

The mean population of (*Eriosoma lanigerum*) ranged from 0.0 to 4.0 in first week. Among the population maximum invasion of Woolly apple aphid (4.0) was noticed in

treatment 6; whereas no attack of woolly apple aphid was recorded in treatment 1 (0.0). Second week the attack of woolly apple aphid ranged from 0.0 to 3.0. Among the population maximum invasion of woolly apple aphid (3.0) was recorded in treatment 3; however no invasion of woolly apple aphid in treatment 1 (0.0). Third week the invasion of woolly apple aphid ranged from 0.0 to 4.0. Among the population maximum invasion of woolly apple aphid (4.0) was recorded in treatment 6; while zero invasion of woolly apple aphid was found in treatment 1 (0.0). In the fourth week the invasion of woolly apple aphid ranged from 0.0 to 6.0. Among the population maximum invasion of woolly apple aphid (6.0) was recorded in treatment 3; while no attack of woolly apple aphid was noted in treatment 1 (0.0). In the fifth week the invasion of woolly apple aphid ranged from 0.0 to 6.0. Among the population maximum invasion of woolly apple aphid (6.0) was recorded in treatment 1; similarly no invasion of woolly apple aphid was noticed in treatment 2 (0.0). Sixth week; the invasion of woolly apple aphid ranged from 0.0 to 3.0. Among the population maximum invasion of woolly apple aphid (3.0) was recorded in treatment 2; whereas no invasion of woolly apple aphid was recorded in treatment 1 (0.0). In Seventh week the invasion of woolly apple aphid was from 0.0 to 4.0. Among the population maximum invasion of woolly apple aphid (4.0) was recorded in treatment 5; while no invasion of woolly apple aphid was recorded in treatment 1 (0.0). Eighth week; the invasion of woolly apple aphid ranged from 0.0 to 3.0. Among the population maximum invasion of woolly apple aphid (3.0) was noted in treatment 1; whereas no attack of woolly apple aphid was recorded in treatment 1 (0.0). Ninth week; the invasion woolly apple aphid ranged from 0.0 to 4.0. Among the population maximum invasion of woolly apple aphid (4.0) was recorded in treatment 1; whereas no invasion of woolly apple aphid was noted in treatment 2 (0.0). Tenth week; the attack of woolly apple aphid ranged from 0.0 to 6.0. Among the population maximum invasion of woolly apple aphid (6.0) was noted in treatment 5; whereas no invasion of woolly apple aphid was noted in treatment 2 (0.0). Mean population dynamics of Woolly apple aphid, (*Eriosoma lanigerum*) per apple fruit tree during April to July 2018 is mentation in Table 3.

Table 3: Mean population dynamic of Woolly apple aphid, *Eriosoma lanigerum*

Treatment	Replication	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9
T1	R1	1.5	1.0	1.5	1.5	2.5	2.0	0.0	3.0	1.0
	R2	0.0	0.0	0.0	1.0	1.5	2.0	2.5	1.0	0.0
	R3	3.0	2.0	1.5	2.5	1.0	0.0	3.0	0.0	4.0
	R4	2.5	1.0	0.0	0.0	6.0	2.0	3.0	1.5	0.0
T2	R1	1.0	0.00	1.0	1.5	0.0	1.0	3.0	2.0	0.0
	R2	0.0	0.0	1.0	2.0	1.0	1.5	0.0	2.0	1.0
	R3	1.0	1.5	0.0	1.0	1.0	1.0	0.0	3.0	2.5
	R4	0.0	1.0	3.0	3.0	1.0	0.0	1.5	0.0	2.0
T3	R1	2.5	0.0	2.0	0.0	1.5	3.0	1.0	1.0	0.0
	R2	0.0	0.0	0.0	1.5	1.0	2.0	1.0	0.0	0.0
	R3	0.0	0.0	2.0	1.0	1.5	2.0	3.0	2.5	1.0
	R4	1.0	3.0	0.0	6.0	2.5	3.0	1.0	0.0	0.0
T4	R1	0.0	1.0	1.0	0.0	1.5	1.0	2.0	1.0	1.0
	R2	2.0	1.5	3.0	1.0	2.0	2.0	3.0	2.5	3.0
	R3	0.0	3.0	1.0	0.0	3.0	0.0	1.5	0.0	0.0
	R4	0.0	1.0	2.0	1.0	1.5	2.5	0.0	2.0	3.0
T5	R1	1.0	3.0	1.5	4.0	2.0	0.0	1.0	0.0	3.0
	R2	1.0	2.0	2.5	3.0	2.0	3.0	4.0	1.0	0.0
	R3	1.0	2.0	1.5	0.0	2.5	0.0	3.0	2.5	1.5

	R4	2.0	1.0	2.5	0.0	0.0	1.0	1.0	0.0	2.0
T6	R1	3.0	2.0	1.5	2.0	0.0	1.5	0.0	1.0	1.5
	R2	4.0	0.0	2.0	1.0	0.0	2.5	1.5	3.0	1.0
	R3	0.0	1.5	0.0	0.0	1.5	2.0	1.5	0.0	3.0
	R4	2.0	3.0	4.0	1.0	0.0	2.0	0.0	1.0	1.5

T= Treatment, R= Replication

Discussion

The apple is cultivated on round about 47.7 thousand hectares with an annual yield production was 315.4 thousand tones; the normal production of apple fruit is being 6.6 thousand tone/ha (Ali Muhammad, 2011) [18]. Balochistan is the main production region for Apple fruit yield in Pakistan whereas Khabar paktoonkhawa positioned on second number with providing 25 percent of national growth (Abdul Wahid, 2001) [16]. The customers are attracted at procure highest price due to the shape and size, very beautiful crispy taste, pleasant flavor and nourishing price (Asif Ali *et al.*, 2004; Umer *et al.*, 2019) [4, 25].

The production gap of apple in Pakistan is linked with several elements like most dominant factor is the insect pests and diseases. According to Batool *et al.* (2007) [6] fruit diseases has emerged as potential threat to fruit productivity globally. In Pakistan, the agriculturalists associated with apple fruit tree orchards face a lot of problems from insect pests, mostly Sanjose Scale, Apple Tree Borer, Apple Scab, Codling moth and wholly apple Aphid. The apple is a species that requires the greatest number of treatments in control of pests and diseases (Stokwe and Malan, 2016) [23]. The control of these insects' pests which relay more use of chemical insecticides that are often overused or misused.

The most important pests on apples are Codling moth (*C. pomonella* L.) that occur frequently (Stokwe and Malan, 2016) [23]. Our study reported that the attack Codling moth was somewhat very high and the mean population trend of Codling moth (*Cydia pomonella* L.) fluctuated from 0.0 to 8.0. The attack was very high in the treatment 6 and so on this study is comparable with the investigation of Umer *et al.* (2019) [25]. In additional investigation, the grasshopper Grasshopper (*Chortjippus brunneus*) and Cabbage Butter Fly (*Pieris brassicae*) are the main harmful and serious insect pests invade on mustard crops (Sharma *et al.*, 1972, Umer *et al.*, 2019) [25].

Similarly the attack of *Eriosoma lanigerum* was also very frequent and the mean population dynamic of *Eriosoma lanigerum* ranged from 0.0 to 6.0. Among the population maximum invasion of Woolly apple aphid was 6.0 in the treatment T1 in fourth week and treatment T3 in the fifth week. *Grapholita molesta* Oriental fruit moth, (Busck) (Lepidoptera: Tortricidae) is the most serious and destructive pest and major preventive factor for fruit tress such as apples, peaches, apricots (Rothschild and Vickers, 1991) [25].

Conclusion

Codling moth and woolly apple aphid has been present in Pakistan that it is absolutely the major pests on apple. On the basis of our current study, we concluded that awareness level of growers is at usual but adoption is at unusual level. Farmers know the affecting pest but ignorant about the management trick, maximum apple fruit producer have no knowledge about control of apple insects pests and they have no plan at the time of fruit germinating to apply the management to control insect pests. Growers need training

to enhance the technical knowledge, finance for investment and pure chemicals for better protection. Growers were found more dependent on extensive application chemicals they should be made aware of bio-control and in order to promote bio-control instead of chemicals, there is a need to monitor pest population regularly especially the peak time of Insects/pests emergence. In current study the data was recorded on the weekly basis and mean population dynamics of Codling moth (*Cydia pomonella* L.) and Woolly apple aphid (*Eriosoma lanigerum*) was very high and caused serious loses to apple fruit production.

Authors Contribution

MU did experimental and field work, NM wrote the Paper, NU and MKK helped in data analysis, SU and NA reviewed the Paper. All the authors reviewed and approved the final manuscript.

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