



BOTANICALS AND EGG PARASITOIDS AGAINST OKRA SHOOT AND FRUIT BORER (EARIAS VITTELLA FAB.) IN OKRA

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ABSTRACT

A field experiment was conducted in the farm of Agriculture Research Institute Tando Jam, during April 2017 to August 2017. The highest percent of shoot infestation i.e (25.89) was recorded in T8 which was statistically different from all other treatments and followed by T3 and T7 at 7 days interval. Considering the percent reduction of shoot infestation over control, the maximum reduction (96.50) was recorded in T5 which followed by T6 (86.47). In that order, the minimum percent of flower bud infestation (11.11) was recorded in T5 followed by T6, T4, and T1. Furthermore data indicated that the maximum flower bud infestation noted in T8 followed by T3 and T7. Whereas, the lowest flower bud infestation (0.91%) was recorded in T5, T6, T4, T2 and T1. The further results discussed that at early fruiting stage of the okra, the maximum % of fruit infestation was observed in T8 followed by T3 and T7, while the lowest infestation (0.33%) was recorded in T5 followed by T6, T4, T1 and T2. It was also revealed that the fruit infestation was increased at the mid fruiting stage as a result the trend of percent reduction of fruit infestation over control caused by okra shoot and fruit borer due to application of different management practices was T5> T6 > T4 > T1 > T2 > T7 > T3 respectively.

1. INTRODUCTION

Okra or lady's finger, *Abelmoschus esculentus* L., is a popular and most common vegetable crop in Bangladesh and in other tropical and sub-tropical parts of the world [1]. It is locally known as bhendi or dheros. It belongs to the family Malvaceae and originated in tropical Africa though okra is produced mainly in the kharif season but it can be grown throughout the year. Okra is an important summer vegetable in Bangladesh which plays an important role to meet the demand of vegetables of the country when vegetables are scanty in the market [2, 3]. About 38,508 metric tons of okra is produced from 9786 hectares of land per year in Bangladesh and Pakistan. Okra is a popular nutritious fruit and vegetable. Okra provides an important source of

vitamins, calcium, potassium and other mineral matters which are often lacking in the diet of developing countries [4]. A 100-gram edible portion of okra fruit contains moisture 89.6 g, protein 1.9 g, fat 0.2 g, fiber 1.2 g, phosphorus 56.0 mg, sodium 6.9 mg, sulphur 30 mg, riboflavin 0.1 mg, oxalic acid 8 mg, minerals 0.7 g, carbohydrates 6.4 g, calcium 66 mg, iron 0.35 mg, potassium 103 mg, thiamine 0.07 mg, nicotinic acid 0.6 mg, vitamin C 13 mg, magnesium 53 mg and copper 0.19 mg [5]. Okra is cultivated mainly for its immature fruits, which are generally cooked as vegetable when ripe, black or brown white- eyed seeds are sometimes roasted and used as a substitute for coffee. Tender fruits have high mucilage content and are used in soups and gravies. Besides being a vegetable, it acts as

clarifying agent in jaggery preparation [6]. Crude fiber derived from the stem of okra plant is used for rope making the fruits also have some medicinal value. Okra production in Bangladesh is affected by many factors, among them insect pest attack is the major one. Since okra belongs to the family Malvaceae, nineteen insect pests and four mites have been reported on okra [7]. The fruit borer complexes create havoc by causing both quantitative and qualitative loss to the crop. The fruit borers include shoot and fruit borer *E. vittella* and *E. insulana* and American bollworm, *Helicoverpa armigera*. However, *Earias* spp. alone causes damage ranging from 52.33 to 70.75 percent [8]. In general the overall damage due to insect pest mounts to 48.97 percent loss in pod yield [9]. Okra shoot and fruit borer larvae cause damage both in vegetative and reproductive phase of the crop. When the crop is young, larvae bore into the tender shoots and feed on the internal tissue and tunnel downwards which wither, drop down and killed the growing points. In reproductive stage, larvae bore into the flower buds and fruits, and feed on inner tissues. As a result, the infested flower buds droop-off and infested fruits become deformed in shape with low market value [10]. Considering the above facts view in mind, the experiment has been undertaken with the following objectives: To know the infestation of okra and identify the most suitable control tactics for combating okra shoot and fruit borer.

2. MATERIALS AND METHODS

2.1 Experimental Site

The experimental field was located at 90° 33.5' E longitude and 23° 77.4' N latitude at an altitude of 9 meter above the sea level. The field experiment was set up on the medium high land of the experimental farm. The soil of the experiment site was a medium high land, clay loam in texture and having PH 6.47-6.63.

2.2 Experimental Design

There were eight treatments. The experiment was laid out in a Randomized Complete Block Design (RCBD). The entire experimental field was divided into three blocks. Each block was divided into eight plots. Two adjacent unit plots and blocks were separated by 1m apart. Each experimental plot comprised of 3m x 2m area and the total area covered 12m x 20.5m. Each treatment was allocated randomly within the block and replicated thrice time.

2.3 Botanicals used

The comparative effectiveness of the following eight treatments for okra shoot and fruit borer was evaluated on the basis of reduction of this pest.

T1 = Neem oil @ 4ml/Litre of water sprayed at 7 days interval.

T2 = Neem seed kernel extract @ 50 g/Litre of water sprayed at 7 days interval.

T3 = Neem leaf extract @ 200g/Litre of water at 7 days interval.

T4 = *Trichogramma evanescens* @ 0.5g/plot at 7 days interval.

T5 = *Trichogramma evanescens* @ 0.25g/plot at + neem oil @ 4ml/Litre.

T6 = *Trichogramma evanescens* @ 0.25g/plot + neem seed kernel extract @ 50g/Litre.

T7 = *Trichogramma evanescens* @ 0.25g/plot + neem leaf extract @ 200g/Litre.

T8 = Untreated control.

2.4 Application of the Treatments

First application was done after 50 days of germination. Treatments were applied at 7 days interval. Spraying was done by knapsack sprayer having a pressure of 4.5 kg/cm². To get complete coverage of plant spraying was done uniformly on the entire plant with special care.

2.5 Data collection

Data on infestation by okra shoot and fruit borer under different management treatments were recorded during both vegetative and reproductive stages. Infested shoots from 5 randomly selected plants were counted and recorded at two days interval by the presence of bores and excreta on flower bud, shoot and fruit at stages respectively.

3. RESULTS

3.1 Shoot infestation at vegetative stage

The results of Table 1 indicated that the highest percent of shoot infestation (25.89%) was recorded in T8 which was statistically different from all other treatments and followed by (16.22) T3 and T7 (11.67) at 7 days interval. On the other hand, the lowest % of infestation was recorded in T5 followed by T6. This could be partially compared with results of [11] who have reported that the maximum damage occurred in fruits (67.7%) and infestations (17.4%) respectively. However it was also examined that at early fruiting stage, the maximum shoot infestation 13.67% was observed in control treatment which followed by the T3 and T7. Further result was in accordance with the observations of [12, 13, 14] who have reported that the infestation of *E. vittella* on okra fruits appeared from the second week of August on six weeks old okra crop and continued till last harvest of fruit

during 1996-1997. The intensity of fruit damage varied from 11.11% to 40.43% and 10.12% to 47.37%, respectively. However second lowest infestation (2.23) observed in T6 which was statistically similar with T4 and at late fruiting stage, the minimum % (0.40) was recorded in T5 followed by T6. Our results generally agree with [15] whom studied the efficacy of neem oil, offered effective control against okra fruit borers. Considering the percent reduction of shoot infestation over control, the maximum reduction (96.50) was recorded in T5 which followed by T6 (86.47). A similar study conducted by [16] who observed the pest population of *E. vittella* highest reduction (91.6%) was observed in 45th standard week.

3.2 Effect of management practices on the infestation of flower bud

The highest percent of flower bud infestation (6.40%) was recorded in T8 which followed by (4.27) by T3 (spraying of neem leaf extract) and T7 (2.79) comprised of spraying of neem leaf extract + *Trichogramma evanescens* egg parasitoid @ 0.25 g/plot (Table 2). According to some researcher's among the various groups of biocontrol agents, *Trichogramma* are well known parasitoids for the management of different Lepidopteran pests, including okra fruit borer complex [16, 17]. [18, 19] Also reported the natural incidence of *Bracon hebetor*, *B. greeni* and *Trichogramma* spp., were found suitable for *Earias* spp. in okra fields. On the other hand, the lowest percent of flower bud infestation (0.12 %) was recorded in T5 (spraying of neem oil + *T. evanescens* egg parasitoid @ 0.25 g/plot at 7 days interval) followed by (0.93) T6.

As shown in Table 1 and II, the insect fauna generally comprised of three main categories i.e Insect Pest, Predatory insects and pollinators. The data is also categorized insect order wise and the insect belong to order Diptera, Coleoptera, Hymenoptera, Odonata, Orthoptera and Lepidoptera. Further the pest include 2 major pest which are; Pea Aphid *Acyrtosiphon pisum* and Pea leaf minor *Chromatomyia horticola*. Predators include *Coccinella septempunctata*, *Pterostichus melanarius*, *Orthetrum pruinosum*, *Crocothemis servilia*, *Lucilliasericata* while. While pollinators include *Eristalis tenax*, *Eristalis arbustorum*, *Apis mellifera*, *Bombus haemorrhoidalis*, *Xylocopa dissimilis*, *Pieris brassicae*, *Colias fieldi*, *Junonia orithya*, *Pontia diploidice*, *Pieris canidia*, *Colias erate*, *Cynthia cardui*, *Neptis hylas* and *Eurema laeta*.

A. Insect Pest of Pea Crop

1. Pea Leaf Minor *Chromatomyia horticola* (Agromyzidae; Diptera)

Pea Leaf Minor is a very serious pest of Green Pea in larval form. Its larvae (maggot) are white, without legs

and wedge-formed. Adult is a partly black small fly. During the present study Pea leaf minor was found in all localities. Table 2 shows that the major infestation was found in Dhodial (L1) with an average of 64 larvae/5 plants, followed by Baffa (L2) $\geq$ Shinkari (L3) $\geq$ Oghi (L4). As shown in Fig. 1, infestation of pea leaf minor was nil in February, started in March with an average of 88 larvae and reaches up to the peak in April and then start decline in May.

2. Cow Pea Aphid *Acyrtosiphon pisum* (Hemiptera; Aphididae)

This is small, reddish to dark brown aphid with cauda dark, slightly pointed and has bristles. During the present research Cow pea aphid was recorded in all 4 localities with maximum infestation in L2 (13.8) followed by L1 $\geq$ L3 $\geq$ L4.

As shown in Table. 2 and Fig. 1 infestation of Cow Pea Aphid was on peak during the month of Feb with an average of 12.55, start to decrease in March while become nil in April.

Table 1- Temporal distribution of Major Insect pests of pea crop in district Mansehra

Species	Feb	March	April	Total
<i>Chromatomyia horticola</i>	0	88	154	242
<i>Acyrtosiphon pisum</i>	12.55*	1.05*	0	13.6

*Figures in decimal show average aphid population/5 plants

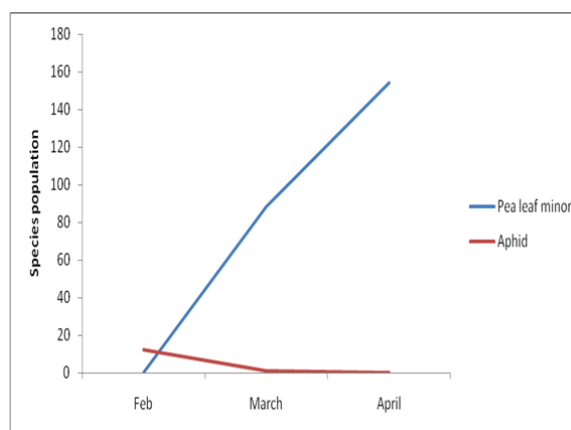


Figure 1- Population fluctuation of major insect pests of Pea crop in District Mansehra.

B. Predatory Insects

1. Lady Bird Beetle *Coccinella septempunctata* (Linnaeus, 1758) (Coleoptera; Coccinellidae)

Ladybird Beetle is common and important predator, which feed on soft-bodied insects both in larval and adult form. Adult is medium sized beetle and is mostly oval shape. Elytra are mostly seven spotted. Larvae are elongated and crocodile shaped. During the present study, adult of Ladybird beetle *Coccinella septempunctata* was found in all the four localities of District Mansehra. As shown in Table. 3, maximum population (29) was found in Dhodial (L1), followed by Oghi (19) , Shinkiari (13) and Baffa (12). As shown in Table.4 and Fig.6, population of predatory coccinellid *Cocinella septumpunctata* was found at peak in April with 49.09% while found absent in February and March.

2. Ground Beetles *Pterostichus melanarius* (Latreille, 1802)

(Coleoptera; Carabidae)

Ground beetle has dark glossy black body with big eye, large jaws spiny long legs. During the current stud, it was found only in one locality Dhodial (L1) with 3 specimens during March.

3. Yellow-legged Hornet *Vespa velutina* (Lepeletier, 1836):

(Hymenoptera; Vespidae)

This hornet is black to brown colour with shadow crosswise line in the centre. During collection, this was collected from only 2 localities. Two specimens of *V. velutina* were collected each from Dhodial (L1) and Oghi (L4). As shown in the Table. 3 and Fig. 2, this hornet is active in March and April.

4. Blue/green bottle fly *Lucilia sericata* (Meigen,1826):

(Diptera; Calliphoridae)

This fly is blue green with shadowy patterns; covered with small, thin dark spines and with three cross-grooves on thorax. During the present survey, *Lucilia sericata* was collected from all 4 localities with maximum number of 6 in Dhodial (L1), followed by Shinkiari (L3) > Oghi (L4) > Baffa (L2) as shown in Table: 3. It ppeared in the month of February and raises to peak in April as shown in Fig. 2.

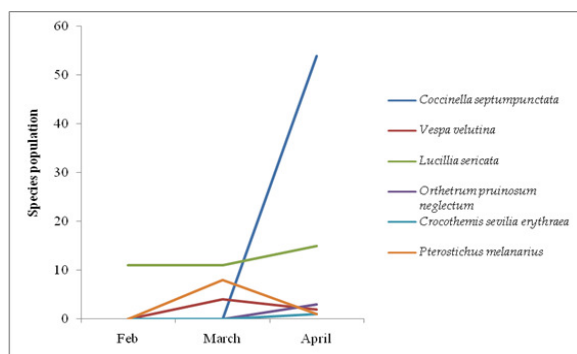


Figure 2- Population fluctuation of Bio-control agent in Pea crop.

5. Scarlet skimmer *Crocothemis servilia* (Fraser, 1936):

(Odonata; Libellulidae)

Scarlet skimmer is a dragonfly of red clour and with moderate body size. It can be identified by its forewing with oblique discoidal cell. During the present study, only one specimen was collected in locality (1) Dhodial in April.

6. Common Red Skimmer *Orthetrum purinosum* (Rambur, 1842):

(Odonata; Libellulidae)

Body color usually red but mostly unstable in colour. It can be differentiated from Scarlet Skimmer by black central carina on 8th and 9th segment on dorsum. During the present study conducted in 4 localities of District Mansehra, this Dragon fly species *Orthetrum purinosum* was found only in Dhodial (L1) with 8 specimens only in March as shown in Table 3 and Fig. 3.

S. No	Species	Feb	March	April	Total	%
1	<i>Coccinellaseptum punctata</i>	0	0	54	54	49.09
2	<i>Vespa velutina</i>	0	4	2	6	5.45
3	<i>Lucilliasericata</i>	11	11	15	37	33.63
4	<i>Orthetrumpruinios umneglectum</i>	0	0	3	3	2.72
5	<i>Crocothemissevili aerythraea</i>	0	0	1	1	0.9
6	<i>Pterostichusmelan arius</i>	0	8	1	9	8.18
Total		11	23	76	110	

C. Pollinators Insects

1. Honey bee *Apis mellifera* (Linnaeus, 1758) (Hymenoptera; Apidae)

Honey bee is a common insect and can be found everywhere. Besides producing honey it is also important due to its role in pollination of field and horticulture crops. However, it was recorded only from two localities L1 and L2. Maximum number of honey bees was collected during February and March when the crop was in blooming stage.

2. Syrphid Fly *Eristalis tenax* (Linnaeus, 1758): (Diptera; Syrphidae)

This Syrphid species is yellowish orange with grayish wings. Maximum number of this species was recorded from L4 (Oghi) followed by L1 > L2 > L3 respectively. Its activity was at peak during February and March as shown in Fig. 3.

3. *Eristalis arbustorum* (Linnaeus 1758) (Syrphidae; Diptera)

This Syrphid fly species is dirty dark on thorax with dainty marks and yellowish wings.

It was collected from all 4 localities but in variable number. Maximum activities were observed in March and April as shown in Table.5 and Fig.7

4. Bumble Bee *Bombus haemorrhoidalis* (Smith, 1852) (Bombicidae; Hymenoptera)

Bumble bee is very active pollinator and this species is of dark colour with blackish hair. It has bright yellow pubescence on basal two abdominal segments and reddish on the rest of abdominal segments. During the present study, it was found in all 4 localities as shown in Table.5. It appears in March and get peak in population in April.

5. Carpenter Bee *Xylocopa dissimilis* (Lepeletier, 1841): (Xylocopidae; Lepidoptera)

Carpenter bee is a common pollinator. It can be recognized pale pubescence on head and, densely scattered with stretched black hairs. Wings more or less fusco-hyaline.

During present survey it was found rarely in all selected localities. Its population is at peak in April with increase in temperature as shown in Table.5 and fig.7

6. Butterflies complex (Lepidoptera)

A large number of butterfly species were observed in Green Pea fields in all localities during this survey course. Adult of about 9 species of Nymphalid and Pierid butterflies were found in the fields of Green Pea crop. Although some of these butterflies are pest of cruciferous vegetables but act as pollinators in adult stage. The list of these butterfly species are:

- Large Cabbage White *Pieris brassicae* (Linnaeus, 1758)
- Indian Cabbage White *Pieris canidia* (Sparrman, 1768).
- Bath White *Pontia daphnice* (Linnaeus, 1758):
- Dark Clouded Yellow *Colias Fieldi* (Menetries, 1855):
- Spotless Grass Yellow *Euremalaeta* (Boisduval, 1836)
- Eastren Pale Clouded Yellow *Colias erate* (Butler, 1880)
- Painted Lady *Cynthia cardui* (Linnaeus, 1758)
- Blue Pansy *Junonia orithya* (Linnaeus, 1758)
- Common Sailor *Neptis hylas* (Linnaeus, 1758)

Table 2- Temporal distribution of Pea pollinators in District Mansehra.

Species	Feb	March	April	Total	Percentage %
<i>Apismelifera</i>	5	4	2	11	3.5483871
<i>Eristalistenax</i>	16	9	3	28	9.03225806
<i>Eristalis arbustorum</i>	9	13	1	23	7.41935484
<i>Bombus haemorrhoidalis</i>	0	5	8	13	4.19354839
<i>Vespa velutina</i>	0	4	2	6	1.93548387
<i>Xylocopa dissimilis</i>	0	1	15	16	5.16129032
<i>Lucilia sericata</i>	11	11	15	37	11.9354839
<i>Neptis hylas</i>	0	1	0	1	0.32258065
<i>Pieris brassicae</i>	6	14	46	66	21.2903226
<i>Pieris canidia</i>	0	15	18	33	10.6451613
<i>Pontia daphnice</i>	0	0	36	36	11.6129032
<i>Colias fieldi</i>	1	0	18	19	6.12903226
<i>Cynthia cardui</i>	0	0	9	9	2.90322581
<i>Junonia orithya</i>	0	0	7	7	2.25806452
<i>Euremalaeta</i>	0	4	0	4	1.29032258
<i>Colias erate</i>	1	0	0	1	0.32258065
Total	49	81	180	310	

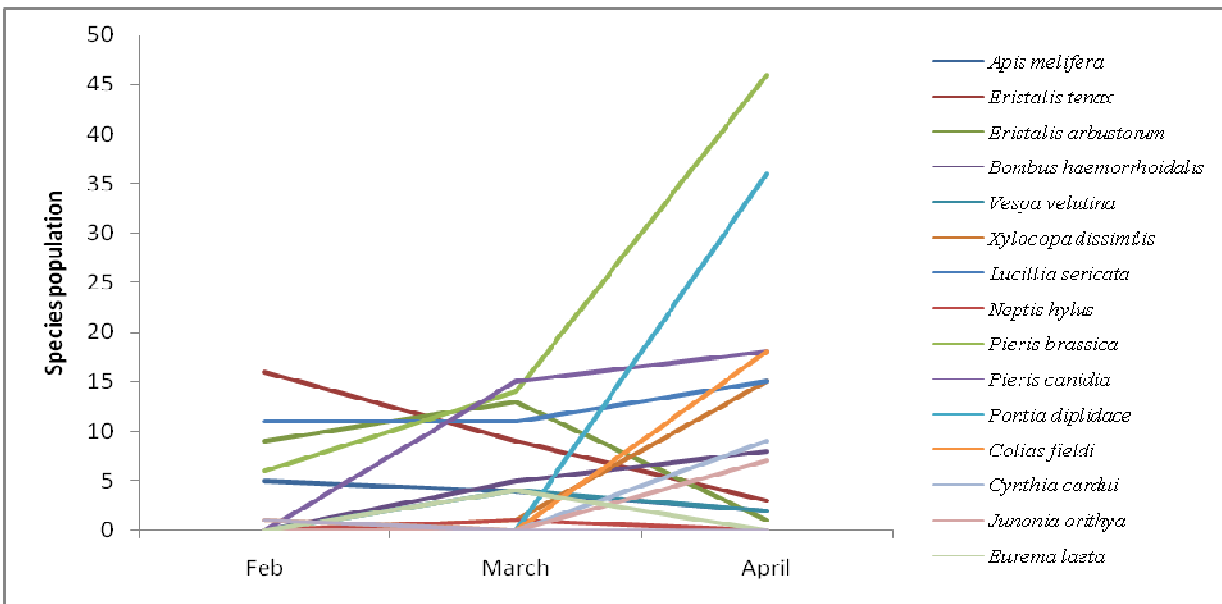


Figure 3- Population fluctuation of insect pollinators of pea crop at District Mansehra.

4. DISCUSSION

Diversity of flora and fauna is the gift of nature. An area or region rich in plant and animal diversity is considered blessing for their residents. Insect fauna in this connection is also has its own significance in nature. It is due to the importance of insect as pest, pollinator, biocontrol agent, and decomposer, source of food (Honey), source of raw silk for textile industry and source of food for higher animals in food web. Human disturbance of nature ultimately effect insect fauna of the area which include industrialization, urbanization, monocropping and pesticide use. The present study is therefore conducted to explore the insect fauna associated with Green Pea crop cultivated in different localities of district Mansehra namely; Dhodial, Baffa, Oghi and Shinkari. In the results of this survey, a total of 22 different insect species were collected belonging to 6 orders, 11 families and 22 genera namely Coleoptera, Diptera, Hemiptera, Hymenoptera, Lepidoptera and Odonata. The identified insect species of pea crop were further categorized insect pests, predator and pollinators. Among insect pests category there are two major insect pests of pea crop found in the study area i.e Pea Leaf minor *Liriomyza chinensis* and Cow pea aphid *Acyrtosiphon pisum*. [14] also reported these two species as pest of pea crop from Tando Jam, sindh beside other insect pest Pea Pod Borer (*Helicoverpa armigera*) and PeaThrips. Similarly [15], [16] and [17] reported pea crop is attacked by different insect pests like Cutworms, thrips, aphids, Pod Borer and Pea leaf minors. As shown in the results, Pea leaf minor is dominant pest of pea crop in the area with 34.90 percent infestation Similar results were reported by [13] from other selected Pea growing

areas of the province NWFP (currently Khyber Pakhtunkhwa) with 81.52 % from Peshawar region, 30.93 % from Swat and 26.74 % from Kalam. Infestation of Pea leaf minor was also reported by [14] from Tando Jam, Sindh with infestation 3.45/leaf. [11] also reported it as serious pest of crop from Pakistan. Another significant pest species is Cow Pea Aphid *Acynthosiphon pisum* of pea crop in district Mansehra with 13 % infestation. [14] also reported it as pest of pea crop from Tando Jam, Sindh with 2.25 aphids/plant infestation level. Similarly [11] also reported that pea aphid is widely distributed pest of pea crop in Pakistan. Among predators insects in the insect fauna of Pakistan, there are 5 species namely Ladybird beetle *Coccinella septumpunctata*, Ground beetle *Pterostichus melanarius*, Dragonfly *Orthetrum pruinsum*, *Crocothemis servilia* and *Lucillias ericata*. Ladybird beetle *Coccinella septumpunctata* was found as the dominant predator during the present study with 49 percent of the predator insect category in Pea crop. It is universal and voracious predator of aphids and other soft bodied insects. It has been collected and reported by many workers from plains to mountains of Pakistan [18]. Among dragonflies, two species were recorded during the present study. These species are; *Orthetrum pruinsum* and *Crocothemis ilivia*. Among these, *O. pruinsum* was recorded from Dhodial. These are widely distributed as it has been reported from Punjab and KPK, Pakistan [19]. The third component of insect fauna of Pea crop in district Mansehra is Pollinator insects. Insect as pollinator play important role for ensuring cross pollination in plants which results in good quality of high seed and fruit production. A reasonable number of pollinator species were collected from the pea crop fields in district

Mansehra with 14 insect pollinators. Most of these pollinators are Syrphid fly, Bees and Butterflies.

5. RECOMMENDATIONS

- Pea leaf minor is the serious pest of Pea crop in the area with high infestation rate. Therefore IPM strategy needs to be developed for its management compatible with the agro-climatic conditions of the study area.
- Infestation of pest species usually starts in early March and become high in April. Therefore control measures must be initiated in early March.
- The area is harbouring a reasonable amount of beneficial insects in the shape of predators and pollinators. For the conservation of these useful insects to sustain their services in the nature, judicious use of pesticide must be applied.
- The farmers do not follow crop rotation in the pea crop growing areas. Monocropping leads to the depletion of biodiversity. Therefore proper crop rotation and encouragement of natural flora must be carried out.

6. CONFLICT OF INTEREST

All authors have declared that there is no conflict of interest regarding publication of this article.

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