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Qualitative and quantitative estimation of insect pests and their natural enemies on onion crop in Malwa region of Madhya Pradesh

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Abstract
The experiment entitled qualitative and quantitative estimation of insect pests and their natural enemies on onion crop in *Malwa* region of Madhya Pradesh conducted during Rabi 2018- 2019 and 2019 - 2020 in the department of Entomology of School of agriculture at Dr. B.R. Ambedkar University of social science Mhow Indore (M.P.). In quantitative and qualitative estimation of pests and their natural enemies on onion crop the qualitative estimation (incidence of insect pest) of pests on onion crop during Rabi 2018 -19 and 2019 - 2020 is presented in Table 1. It is conspicuous from it that the crop was infested by various insect pests in deferent intensity and at a different interval of time during the crop growth. Among all the infesting insects, Thrips {*Thrips tabaci*, Oder- Thysanoptera, Family- Thripidae}, Pod borer {*Helicoverpa armigera* (Hb.), Oder-Lepidoptera: Family-Noctuidae}, Tobacco caterpillar {*Spodoptera litura*, Order- Lepidoptera: Family Noctuidae} and cutworm {(*Agrotis ipsilon*) Order-Lepidoptera: Family- Noctuidae} were observed.
Quantitative Estimation of insect pest the mean population of onion thrips maximum population 4.74 N & A/ plant and minimum population 2.68 N & A / plant was noted. Pod borer (*H. armigera*) peak infestation 0.64 larva/pant. The lowest population (0.06 larva/ plant) was noted. Tobacco caterpillar (*S. litura*) The rang of pest intensity on the crop varied from 0.38 to 0.56 larva/plant. The average population of the pest persisted during the entire crop period was 0.33 larva/ plant. On the basis of two years study carried out in. Rabi 2018-19 and 2019 ; {*Thrips tabaci* (Lin.)}, Pod borer {*Helicoverpa armigera)* (Hb.)} , Tobacco caterpillar {*Spdoptera litura* (Fabri.)}, Cutworm {*Agrotis ipsilon*) (Huf.)} were recoded as the key /major pests . While among the natural enemies presence of lady bird beetle species *Coccinella septempunctata*, (Coleoptera: Coccinelliiae), Dragonfly (*Cordulega*ster Sp.) {Odonata; Eugerpteridae), praying mantis {Gongylus *gongyloides*, Mantodea : Enpusidae}, Chrysopa {*Chrysoperla carnea* Stephens, Neuroptera : Chryopidae}, registered their presence in the crop- ecosystem.

Keywords: quercetin, ecosystem, anticarcinogenic

1. Introduction
Onion, *Allium cepa* L. is an important vegetable crop of commercial importance belongs to the family Alliaceae. The word onion has been derived from Latin word unio means ‘single,” or “one.” and used to indicate that onion plant produce a single bulb in a plant unlike it cousin garlic that produces many small bulbs in a plant. It is widely cultivated crop of economic importance and categorized as a cash crop. It is used as vegetable in the form of salad and in the preparation of recipes of various curries besides being used as a medicinal plant. It is an essential item of every kitchen because of this reason popularly referred as “Queen of Kitchen. It is considered to be an oldest source of food. Onion is enjoyed for its flavor and pungency which is due to the presence of a volatile oil *i.e.* allyl propyl disulphide. The presence of Quercetin flavonides in onion is considered to lower the risk of heart disease, blood pressure and inflammation. As it contains sufficient quantity of vitamin-C, minerals and flavonoid *quercetin onion* has been credited with anticarcinogenic, anti-inflammatory, and antidiabetic properties. The chemical composition of onion indicate the presence of carbohydrates 14.14%, protein 2.62%, fat 0.4%, vitamin C 6.5% and minerals Ca- 46.9 mg, P-50.6mg, K- 140mg (Bhattacharjee 2013). In recent years, biofertilizers have emerged as an important component of the integrated nutrient supply system and hold a great promise to improve crop yield through environmentally better nutrient supplies.

As the productivity of onion crop is being adversely affected by onion thrips (*Thrips tabaci* Lindeman, Thysanoptera: Thripidae), by sucking the plant sap through rasping process and transmitting the viral disease ------(Kritzman *et al*. 2001) make this insect a key pest of the crop and need its management on onion crop for better and quality yield of onions.

3. Materials and Methods

The study was carried out x During Rabi 2018 -2019 and 2019-2020 in field condition on the onion crop sown in an area of 400 m^2 following the standard package and practices of the crop. Using the onion variety Bhima Red, No insecticides application was done on this crop until harvesting of the crop the appearance of insect pests and the natural enemies of insect pest at weekly interval besides recording the population on ten randomly plants for sucking pest and on one meter row length for insects belonging to Lepitopteron order. The observation was recorded from location of the experimental field the crop season. The observation was recorded on population of infesting insects and their natural enemies at weekly interval. The incidence of the Lepidopteron pests i.e. Pod borer (*Helicoverpa armigera)*, Tobacco caterpillar (*Spdoptera litura*), Cutworm (*Agrotis ipsilon*) was recorded on one meter row length of the crop at the same time as for small insects like thrips on 10 randomly selected plants from the five location of the experimental area. The population of natural enemies *Coccinella septempunctata*, Order – Coleoptera, Family- Coccinelliiae, Dragonfly (Cordulegaster, Order – Odonata, Family- Eugerpteridae), praying mantis (Gongylus gongyloides, Order- Mantodea, Family- Enpusidae), *Chrysoperla carnea* Stephens, Order Neuroptera Family Chryopidae was counted in 01 sq m. area from five location of the trial. The period of the activity of insect pests and natural enemies on the crop was also recorded.

3. Result

3.1 Qualitative Estimation of Insect Pests on onion crop

The findings on the Qualitative estimate of insect pests on onion crop in Malva region of Madhya Pradesh, occurred during Rabi 2018-19 and 2019-20 has indicated the incidence of the following insects pests presented in table 1 . In fact, the incidence of pests on the crop were same in both the year but their time of appearance differed. The recorded insect pest were Thrips, pod borer, Tobacco caterpillar and cutworm. Among them; thrips was most dominating insect and credited as the major pest of the crop. The details of the recorded insects have been tabulated below.

Table 1: Insect pests on Onion crop in Malwa Region; Rabi 2018-19& 2019-20

Sr. No.	Name of Insect	Scientific Name	Order	Family	Period of activity	
					2018- 2019	2019-2020
1	Thrips	*Thrips tabaci* (Lindeman)	Thysanoptera	Thripidae	24 Feb to 28 April	29 March to 26 April
2	Pod borer	*Helicoverpa armigera* (Hubner)	Lepidoptera	Noctuoidae	24 Feb to 14 April	08 March to 03 May
3	Tobacco caterpillar	*Spodoptera litura* (Fabricius)	Lepidoptera	Noctuoidae	24 Feb to 14 April	15 March to 26 April
4	Cutworm	*Agrotis ipsilon* (Hufnagel)	Lepidoptera	Noctuoidae	24 Feb to 14 April	08 March to 26 April
5	Hairy caterpillar	*Amsecta mori*	Lepidopera	Noctuoidea	-	29 feb to 23 April

Quantitative estimation of insect pests, 2018-19 and 2019-20: the quantitative estimate of the infesting insects on the crop, divulged the difference in appearance time and intensity on the crop. First Season Findings-(*rabi* 2018-19): the findings revealed that during the rabi 2018-19 the pest activity started little bit earlier. The incidence initiation and period of activity is described below.

Among the infesting insects, the activity of thirps (*T. tabaci*) was recorded in IInd week of February (24.04.2019) which continued up to IVth week of April (28.04.2019) with a peak infestation of (4.74/plant). The initiation of incidence was noted as 0.62 thrips/plant with an overall average of 2.68 thrips/ plant during the entire period of activity.

During 2019-2020 the incidence of thrips was started during in the Vth week of March2020 and prevailed up to April. 2020. The population during this period varied from 2.14 to 7.15 N & A / plant. The highest population (12.16 N & A /plant) was noted during the Vth Week of March (29.03.2020) to IVth week of April (26.04.2020). The Pod borer (*H. armigera*) appearance during the first season crop began in the IVth week of February (24.02.2019) and continued up to IIIrd week of April (14.04.2019) with a peak infestation of 0.64 larva / mrl. The lowest population (0.06 larva/ mrl) was noted in the month of March. The average population of the entire crop period was 0.35 larva/mrl. Pod borer (*Helicoverpa armigera*) infestation during 2019-2020 period began in IInd week of March 20 and persisted upto IInd week of May20. The maximum, 0.42 larva / mrl , minimum 0.2 larva / mrl. and average population (0.31larva / mrl.) was recorded during second season study.

As regard to the activity of Tobacco caterpillar (*S. litura*), it was observed from the month of Feb. 2019 to April 2019. The initiation of the pest infestation was recorded in IVth week of Feb. 2019 and lasted in IIIrd week of April 2019. The range of pest intensity varied from 0.38 to 0.46 larva/ mrl. The average population during the entire crop period was 0.38 larva/ mrl. While in 2019 -2020 Its' appearance and presence on the crop was observed from the IInd week of March (08.03.2020) to IVth week of May (26.04.2020). The population varied from 0.80 to 0.02 larva/ mrl with an average population of 0.41 larva / mrl.

As regard to the activity of Cutworm *(Agrotis ipsilon)* during 2018-19 rabi; it was observed from the month of Feb. 2019 to April 2019. The initiation of the pest appearance was noted from the IVth week of Feb. 2019 to IIIrd week of April 2019. The pest intensity varied from 0.10 to 0.56 larva /mrl. The average population of it during crop stand was recorded 0.33 larva/ mrl. However, in rabi 2019- 2020, pest existence on crop recorded from IInd week fo March to IVth week of April with a maximum 0.56 larva/ mrl, Minimum 0.06 larva / mrl. and average 0.3 larva /mrl/ season. During the rabi 2019-2020 infestation of black hairy caterpillar (*Pericallia ricini*) was recorded from IInd week of January to IIIrd week of April 20 with a maximum 1.60 larva/ mrl. Minimum 1.20 larva / mrl. and average 1.40 larva /mrl/ season.

It can be seen from the second season findings that all pest incidence on crop started slightly late than previous year study. The Scenario of infesting insects were almost same except the infestation of black hairy caterpillar.

Table 2: Insect pests on Onion crop in Malwa Region; Rabi 2018-19& 2019-20

Sr. No.	Name of Insect	Scientific Name	Order	Family	Period of activity	
					2018- 2019	2019-2020
1	Thrips	*Thrips tabaci* (Lindeman)	Thysanoptera	Thripidae	24 Feb to 28 April	29 March to 26 April
2	Pod borer	*Helicoverpa armigera* (Hubner)	Lepidoptera	Noctuoidae	24 Feb to 14 April	08 March to 03 May
3	Tobacco caterpillar	*Spodoptera litura* (Fabricius)	Lepidoptera	Noctuoidae	24 Feb to 14 April	15 March to 26 April
4	Cutworm	*Agrotis ipsilon* (Hufnagel)	Lepidoptera	Noctuoidae	24 Feb to 14 April	08 March to 26 April
5	Hairy caterpillar	*Amsecta mori*	Lepidopera	Noctuoidea	-	29 feb to 23 April

Table 3: Quantitative estimation of insect pests on Onion crop; Rabi 2018-19& 2019-20

Sr. No.	Name of Insect	Period of Activity	Population of pest / palnt or/ mrl	
			2018 - 2019	2019-20120
1	Thrips	24 Feb to 28 April	L - *0.62	L - *2.14
			H - * 4.74	H - *12.16
			A - *2.68	A - *7.15
2	Pod borer	24 Feb to 14 April	L - *0.06	L - *0.20
			H - *0.64	H - *0.42
			A - *0.35	A - *0.31
3	Tobacco caterpillar	24 Feb to 14 April	L - *0.30	L - *0.20
			H - *0.46	H - *0.80
			A - *0.38	A - *0.41
4	Cutworm	24 Feb to 14 April	L - *0.10	L - *0.06
			H - *0.56	H - *0.56
			A - *0.33	A - *0.31
		29 Feb to 23 April	-	L - *1.60
			-	H - *1.20
5	Rairy caterpillar		-	A - *1.40

Note * = mrl (meter row length)

As regard to the occurrence of natural enemies in onion crop under the agro-climatic condition of Malva belt during rabi 2018-19 and 2019- 20 , the study indicated the presence of ; three species of ladybird beetle i.e. *Coccinella septempunctata*, *Harmonia octomaculata*, *Menochilus sexmaculatus*, Coleoptera: Coccinelliiae), which were present in the crop from Ist week of February to IInd week of March with a record population of 0.76 A & G /mrl . Among these, *Menochilus sexmaculatus* was the dominating species.

As regard to the activity of this predatory insect (*Coccinella septempunctata and other species*) they wre active from the Feb. to April in 2018- 2019. The initiation was recorded in-Ist week of February 2019 and continued upto IInd week of March 2019. The intensity varied from 0.04 to 0.76 A & G/mrl. The average population was recorded as 0.04 A & G/mrl / season during this period. However, during 2019-2020 rabi, their activity was observed from IInd week of February to IVth week of March with maximum 0.52 A & G/mrl, minimum 0.04 A & G/mrl, and average population of 0.28 A & G/mrl/ season.

The second dominating entmophagous insects in the agro-ecosystem were two species of Dragonflies i.e..*Diplacodes trivialis & Brachythemis contaminata* which recorded their presence from February to April 2019 and-2020. The presence appeared in the IInd and ivth week of Feb. 2019 and 2020 respectivey and persisted upto IInd and ivth week of April 2019&2020 respectively. Their intensity varied from 0.04 to 0.80 Adult / mrl with an average 0.42 Adults /mrl/ season during first season and 0.58 A & G/mrl,0.04 A & G/mrl and 0.28 A.& G/mrl/season as maximum , mimimum and average population , respectively of predatory insect in second season.

As regard to the activity of Praying Mantis (*Mantis religosa*) , It was observed from the month of Feb. 2019 to April 2019 with its appearance in IInd week of February 2019 and occurrence upto IInd week of April 2019. The intensity varied from 0.04 to 0.24 A & N /mrl and the average population of 0.14 A & N /mrl/ season. while in the year 2019 - 2020 activity observed from Ist week of March to IVth week of May. The Maximum population 0.56/ mrl, minimum 0.08/ mrl) and average 0.32/ mrl / season was recorded during this period.

The species of lace wing i.e. Green lace wing (*Chrysoperla carnea*, Neuroptera: Chrysopidae), was observed from IIIrd week of March to I^{tst} week of April during the first and second season trials. The highest population 1.00 A & G /mrl and i.20 A&G / mrl was noted in the respective years. Their activity were found confined between march to April of 2019 &2020 beginning from IVth week of March to Ist

Table 4: Quantitative estimate of natural enemies on Onion crop; Rabi 2018-19 & 2019-2020.

Sr. No.	Name of Insect	Period of Activity	Population of natural enemies / mrl	
			2018-2019	2019-2020
4	Ladybird beetle	II nd week of February to II nd week of April	L - *0.04	L - *0.52
			H - *0.76	H - *0.04
			A - *0.4	A - *0.28
5	Dragonfly	II nd week of February to II nd week of April	L - *0.04	L - *0.58
			H - *0.80	H - *0.04
			A - *0.42	A - *0.28
6	Praying Mantis	II nd week of February to II nd week of April	L - *0.04	L - *0.56

			H - *0.24	H - *0.08
			A - *0.14	A - *0.32
7	Green lacewing	I[st] week of March to II[nd] week of April	L - *0.20	L - *1.20
			H - *1.00	H - *1.20
			A - *0.60	A - *0.70

4. Discussion

The findings on studies of "Insect pest scenario and management of thrips (*Thrips tabaci Lindeman*) on onion crop (*Allium cepa* L.) covering the various objectives, is presented and discussed in the light of earlier studies carried out by the earlier wrkers under the following headings.

Qualitative Estimation of Insect Pests on onion crop; Rabi 218-19:

Incidence of insect pests on onion crop in Malwa region.

Two years studies on insect pest incidence and their succession on onion crop in Malwa region , carried out during Rabi 2018-19 and 2019-20, on onion crop; variety-Bhima red, has indicated the incidence of four insect pest on the crop . These pests species were i.e. Thrips {*Thrips tabaci*, Oder-Thysanopter : Family- Thripidae}, Pod borer { Helicoverpa armigera (Hb.), Oder-Lepidoptera: Family-Noctuidae }, Tobacco caterpillar {Spodoptera litura, Order- Lepidoptera: Family Noctuidae } and cutworm {(*Agrotis ipsilon*) Order-Lepidoptera: Family- Noctuidae} . Incidence were recorded on the crop right from seedling transplanting to harvesting of the crop with a variable number in different months . The incidence of onion thrips invariably reported by almost all workers from all parts of the country as well as from abroad. But , attack of Helicoverpa armigera and *Spodoptera litura* and cutworm {(*Agrotis ipsilon*)have been reported inconsistently from different locations of the country as well as from other parts of the world. Sudhir Kumar (2011) [5] have also mentioned that onion crop suffer from above mentioned lepidopterous pests but they were recorded from june to October in 2011. support from the studies of Naresh and Singh (1984) [8] and Lal and Yadhav (1987) [7] who also reported this pest on onion crop from early May to June and mid July to mid September, respectively. which contradict the present findings on the time of appearance. Perhaps this is due to difference in agro climatic zones.

Among the infesting insects, initiation of thirps (T. tabaci) activity was recorded in IInd week of February (24.04.2019) which continued up to IVth week of April (28.04.2019) with a peak infestation of (4.74/plant) and the lowest population of 0.62 N & A/plant. On an average, the entire period average population was recorded 2.68 thrips (N & A)/ plant . While in rabi 2019-20 The insect pests scenario was found same as in 2018-19 but the variability in activity of pest was observed. Thrips activity was noted from the Vth week of March 2020 to April 2020 with a record of population; ranging from 2.14 N & A / plant to 7.15 N & A / plant. including the highest record of 12.16 N&A /plant in the Vth week of March i.e. 29.03.2020. Rehman and Batra (1945) [10] reported that onion thrips appears on onion in November and remained till Februar y in Punjab. El-Serwiy *et al*. (1985) [2] found that the initiation of thrips population took place on onion in late February or early March and its peak during the 1st week of April in Iraq. Edelson *et al*. (1986) recorded the infestation of thrips on onion in February, which continued up to harvesting of the crop.

Mohammed Suleiman (2016) [4], Butani and Verma (1976) [9], El-Serwiy *et al*.(1985) [2] as have mentioned the infestation of onion thrips only on onion crop from Katsina State, Nigeriai. The present finding regarding the intensity of thrips on onion crop has indicated higher population of thrips during the months of March and April in both the year of study when. average temperature of 31.80 ^{0}C and humidity 37.50% was existing during 2019 at,

The activity of Pod borer (*H. armigera*) in Malwa region began in IVth week of February2019 and continued up to IIrd week of April 2019) with a peak infestation of 0.64 larva/pant and the lowest population (0.06 larva/ plant) in the month of March 2020. The average population of pod borer during the entire period was recorded at 0.35 larva/ plant. in Ist season trial While in 2nd season trial i.e. rabi 2019 -20 it was was noted from the IInd week of March to IInd week of May2020. The maximum population was recorded (0.42 larva / plant) and minimum (0.2 larva / plant) with an average of 0.31 larva /plant. Soro et. al. (2001) and Rubiya *et al*. (2019) have also mentioned the infestation of heliothis on onion crop from Northern Burkina Faso. and Tamil Nadu State.

The present finding regarding the intensity of pod borer on onion crop has indicated a lower population of pod borer during the months of March and April in both the year of study when climatic condition has indicated an average temperature of 31.80 ^{0}C in 2019 and 49.70 ^{0}C in 2020 and humidity during respective years were found 37.50% and 36.20% respectively. Imam, *et al*. (2010) [3] observed the pod borer infestation more during dry weather conditions at Jakara, Nigeria.

As regard to the activity of Tobacco caterpillar (S. litura), it was observed from the month of Feb. 2019 to April 2019. The initiation of the pest recorded in IVth week of Feb. 2019 and lasted for IIIrd week of April 2019. The range of pest intensity on the crop varied from 0.38 to 0.56 larva/plant. The average population of the pest persisted during the entired crop period was 0.33 larva/ plant. While in rabi 2019-20,Tobacco caterpillar (Spodoptera litura) was observed on the crop from IInd week of March (08.03.2020) to IVth week of May (26.04.2020) with an average population of from 0.2 larva/ plant to 0.41 larva/ plant. Rubiya *et al* (2001) Mohammad *et al*. (2007), Rao *et al*. (2006). The present finding on the intensity of S. litura has indicated a lower population of S. litura during March and April in both the season study.

The next pest recorded on the crop in Malwa region was cutworm (*Agrotis ipsilon*) whose infestation began on the crop in the IVth week of February2019 and continued to IIIrd week of April 2019 during first season trial and from IInd week of March 2020 to IVth week of April 2020 in the second season trial . The maximum population of 0.8 larva /plant and minimum; 0.2 larva / plant was recorded in first season trial with an average population of 0.41larva /plant. Cut worm activity during second season was observed from IInd week of March 2020 to IVth week of April 2020. Maximum population 0.56 larva /plant and minimum 0.06 larva / plant) with an average population of 0.31larva / plant was observed). Imam, *et al*. (2010) [3], Sudhirkumar (2011) [5] , Naresh and Singh (1984) [8] and Lal and Yadhav (1987) [7]. The present finding regarding the intensity of Cutworm on onion crop has indicated lower population of Cutworm during the months of March and April in both the year study.

As regard to the presence of natural enemies in the crop under the agro climatic condition of Malwa belt during Rabi 2018-19: the ladybird beetle (*Coccinella septempunctata*) occurence was observed from IInd week of February to IInd week of April--. with a maximum population of 0.76/ Adult and grub /plant . However , during Rabi 2019-20 the beetle was found active from IVth week of February to IV the week of April with a maximum population of 0.56 grub and adult /plant and minimum 0.04 grub& adult /plant) and an average population of 0.28 grub& adult / plant . The earlier workers,viz. Elaine (2012), kumavat *et. al*. (2018). Have also reported variability in occurrence of natural enemies on onion crop at different locations and different number of peaks in diverse years.

Green lacewing (*Chrysoperla carnea*), Order – Coleoptera, Family- Coccinelliiae) was the second natural enemies was recognized during rabi 2018-19 in 3rd week of March to 4th week of April with the highest population of 1.00 Adult and grub / plant was noted. while in rabi 2019-20 green lacewing was also observed from 3rd week of March to 4th week of April20. The highest population 1.20/ plant Adult and grub was noted during rabi 2019-20. Elaine (2012) also recorded the green lacewing presence in onion crop along with other natural enemies, population of *Chrysoperla carnea* ranging from 0,74 to 1.90 /plant in onion crop have been reported from Karnataka (Anonymous, 2005). the present findings gets support from earlier studies.

5. Conclusion

The maximum population of thrips was recorded 4.74 N & A / plant and lowest population of 0.62 N & A / plant was found in 2018-19 and in 2019-20 the pest population ranging from 2.14 N & A / plant to 7.15 N & A / plant dude the highest recorded of 12.16 N & A / plant.

The Lepidopteron activity began in IV th week of ferbruary 2019 and continued up to II nd week of April 2019 with a peak infestation of 0.64 larvae/ plant and in May 2020 maximum population was recorded 0.42 larvae / plant.

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