Nature & Environment
Vol. 18 (1&2), 2013: 23-34
Website: www.natureandenvironment.org

ISSN (Print) : 2321-810X
ISSN (Online) : 2321-8738

RESEARCH ARTICLE

Population count of economically important insects of Vegetable at different studying sites In Central Uttar Pradesh and Biological control of vegetable pests by Production of *Trichogramma spp.*

K.S. Rana and Subhash Sharma
Department of Zoology, Agra College, Agra (U.P.) India
Email: subhash.sharma1984@gmail.com

Received: 20th Feb. 2013, Revised: 14th March 2013, Accepted: 27th March 2013

ABSTRACT

Trichogramma, an egg parasitoid can be used in controlling many lepidopteran pests. Therefore, it is necessary to demonstrate the capacity of these natural enemies in controlling the pest population so as to use them in biological control programs against the pest. Such an attempt was made in this particular study. The research work has been initiated by surveying farmer's field of vegetables including tomato, cabbage, cauliflower and brinjal at Farah, Sihora and Sonkh in district Mathura; Gopalpur, Jasrana and Tundla in district Firozabad; and Artoni, Basai and Shamshabad in district Agra. Population counts of different economically important insects of Vegetables were observed in year 2010-2011 at these studying sites. The insect pests recorded on tomato crop were tomato fruit borer (Helicoverpa armigera) and aphid (Macrosiphum euphorbiae). However, diamond back moth (Plutella xylostella), cabbage butter fly (Pieris brassicae) and aphids (Lipaphis erysimi, Brevicoryne brassicae) were found to associated with cabbage and cauliflower crops. The insects collected from brinjal crop were: brinjal shoot and fruit borer (Leucinodes orbonalis), Among the insect fauna of vegetables, tomato fruit borer, Helicoverpa armigera on tomato; diamond back moth, Plutella xylostella on cabbage and cauliflower; and shoot and fruit borer, Leucinodes orbonalis on brinjal were observed as major lepidopteran pest, and also parasitized by Trichogramma. Therefore, detailed study has been conducted on the population dynamics of these insects on vegetable tomato on the basis of 15 days interval through the year.

Keyword: *Population Count, Biological Control, Trichogramma spp.*

INTRODUCTION

King and Coleman (1989) define biological control as the management of predators, parasites, microbial organisms and their products to reduce pest population densities. Successful biological control requires a thorough knowledge of both the impact of the biological control agent on pest mortality, and the ecology of the agent itself.

Egg parasitoids of the genus *Trichogramma* are used for inundative biological control against a range of agricultural pests. In fact, *Trichogramma* spp. are the most widely used natural enemies in inundative biological control worldwide and both native and exotic species have been mass reared and released The vast majority of *Trichogramma* species are known to be polyphagous attacking a wide range of lepidopterans as well as insects belonging to other orders (e.g., Thomson and Stinner 1989). Due to this wide host range concerns have been expressed already several years ago that mass released *Trichogramma* may threaten non-target species in natural habitats (Andow *et al.* 1995; Orr *et al*. 2000).Of the several biological control agents ,for which techniques have been standardized for their multiplication ,*Trichogamma spp*. Occupies a prominent niche (Tiwari *et al* ., 2004).

Of the several biological control agents, for which techniques have been standardized for their multiplication, *Trichogramma* spp.occupies a prominent niche, (Tiwari *et al.*, 2004), and efforts are underway todevelop in vitro rearing techniques for *Trichogramma* spp. (Nagarkatti, 1979).In India, about 26 trichogrammatids are recorded of which *Trichogramma chilonis* Ishii is of significant 'importance. Further this list was extended by their markable work done by Tyagi and Khan (1993) who for the first time reported,parasitization by *Trichogrammal* spp. on the eggs of *Clostera cupreata* at Pantnagar. Large-scale production of

Trichogramma is directly dependent upon the successful production of its factitious host. In India, the rice moth, *C.cephalonica* is being used as the laboratory host from the initiation of the release programme with *Trichogramma* since 1930. The eggs of *C. cephalonica* Stainton are ideal for rearing *Trichogramma* spp. (Singh and Verma, 1989), further corroborated by Jalali *et al.* (2007).

A major portion of all biological control work against tropical graminacious borers has been the mass-culture and release of *Trichogramma* egg parasitoids.

In the southern United States and Latin America, *Trichogramma minutum* has been mass-produced and released for many years against *Diatrea saccharalis* on sugarcane. In Barbados, Tucker (1931, 1932, 1933, 1934, 1935, 1951 and 1954) reported that, after 20 years of releasing the incidence of *D. saccharalis* was reduced by about one-half. Hinds and Spencer (1930) showed a much higher rate of parasitism in Louisiana. They credited the release of 20,000*T. minutum* parasitoids per acre from May 28 to June 24 for the control of *D.saccharalis.* Smyth (1939) observed marked reductions of borer incidence anddamage in fields receiving artificially reared *Trichogramma* spp. Box (1951) reported mass rearing and release of *T. minutum* against *D. saccharalis* for 20 years.

Wolcott and Martorell (1943) found the results of five years investigations on the effects of mass releases of *T. minutum* against *D. saccharalis* in Puerto Rico, and concluded that such releases are useful only when a high host eggpopulation is present.

In Malaya, large numbers of *T. japonicum* were reared and released in 1931 to 32 against rice stem borers up to 1,30,000 parasitoids were released per acre. Chen (1963) reported the results of release of artificially reared *T. auslralicum* against sugarcane stalk borers in Taiwan. These trials, conducted on 2,000 hectares and repeated for more than 8 years, gave good results. From 1957 to1960, approximately 40,000 parasitoids were released annually per hectare. In 1960, he observed 80 per cent less bored joints and 62 per cent less bored stalks in the release than in the control areas.

As insecticidal control of sugarcane stalk borers is difficult, he considered mass rearing and release of *Trichogramma* spp. as the best control approach . *Trichogramma* spp. are presently the most widely augmented entomophagous arthropod in the world. They are used particularly in the USSR (8 million ha) and PRC (2 million ha) (Voronin and Grinberg, 1981). Ridgway *el at.,* (1977) reported that *Trichogramma* spp. might be released over as many as 200,000 ha in the U.S.A. King and Morrison (1984) have reviewed the rearing of *Trichogramma* spp. several U.S. commercial insectaries produce *Trichogramma* spp. with as many as 50 to 100 million wasps produced daily by one company,Rincon-Vitova Insectaries. This company supplies *T. ptalneri, T. minulum* and *T. pretiosum* for control of caterpillar pests infesting cotton, corn, apple, spruce and avocado.

MATERIALS AND METHODS

As per objective, a laboratory has been established in the department of Zoology at Agra College, Agra for rearing of *Trichogramma* spp and their hosts *viz*., rice meal moth, *Corcyra cephalonica*; tomato pod borer, *Helicoverpa armigera;* diamond back moth, *Plutella xylostella* and brinjal fruit and stem borer, *Leucinodes orbonalis*. The equipments and materials required for rearing of above insect pests and parasitoids are-

1. BOD incubator:

BOD (Biological Oxygen Demand) incubator for rearing of insect pests of vegetables including *H. armigera*, *P. xylostella*, *L. orbonalis*. These insects were collected from the farmer's field at different locations. However, to maintain culture of *Trichogramma* spp.,

2. Rearing Cages:

A special wooden cage for rearing rice of *Trichogramma* spp. has been designed and prepared with the help of carpenter. The height and width of the cage were maintained 8 inch and the length was 14 inch. This cage has been opened by sliding the lid and a mesh has also been fixed on the lid for proper ventilation.

3. Glass Jars:
The glass jars have been purchased for rearing of the larvae of *H. armigera* on tomato and *P. xylostella* on cabbage as well as cauliflower. The eggs and pupae of *L. orbonalis* collected from the fields were also placed in the glass jars for adult emergence. In this way the culture of *H. armigera*, *P. xylostella* and *L. orbonalis* has been maintained in the glass jars in laboratory.

4. Petri dishes:
The infected or parasitized eggs of different insect pests of vegetables *i.e. L. orbonalis*; *Helicoverpa armigera* and *Plutella xylostella* has been collected from brinjal; tomato, and cabbage and cauliflower crops, respectively. They were put in Petri dishes and these Petri dishes were placed in the BOD incubator for emergence of adults of *Trichogramma*. The height and radius of Petri dish were 15 and 55 mm, respectively.

5. Insect Collecting Net:
The adult of different lepidopteran pests has been collected through sweeping net in the field of vegetables. Therefore, an insect collecting net was purchased for trapping adult insects from the field of farmers at different places/ villages of district Mathura, Firozabad and Agra.

6. Insect Preservation Box:
On account of the mortality of adult, they were stretched by using entomological pin and preserved in the collection/preservation box. Therefore, an insect collection or preservation box has also been purchased to maintain the record of insect pests of different vegetable crops.

7. Plastic vials:
Different stages of insect *viz.,* eggs, and various larvae stages of each species were collected and preserved in the alcohol in plastic vials. The size of vials was also in accordance to the size of the larvae.

OBSERVATION AND RESULTS

1. At Mathura:
At district Mathura, *H. armigera* remain active in the field of tomato from November second week to April first week; and *P. xylostella* showed association with cabbage and cauliflower on fifth standard week (st wk) of October, 2010 to first week (13 st wk) of April, 2011. The variation in population of *L. orbonalis* was recorded on brinjal from first week (13 st wk) of April to third week of August, 2011 (Table 1). The highest population of *H. armigera* on tomato, *P. xylostella* on cabbage and cauliflower was recorded as 52.00, 128.00, 97.00/five plants on second week (1 st wk) of January, 2011, respectively (Table 1). On the other hand, the maximum number of *L. orbonalis* was recorded (56.00/five plants) on fourth week (29 st wk) of July, 2011 (Table 1).

2. At Firozabad:
The population of *H. armigera* on tomato and *P. xylostella* on cauliflower start their attack in the first week (44 st wk) of November 2010 and remain active till the fourth week (08 st wk) of February and second week (14 st wk) of April, 2011, respectively. Similarly, on cabbage, diamond back moth remained vigorous from fourth week (42 st wk) of October, 2010 to last week (12 st wk) of March, 2011. However, brinjal fruit and shoot borer appeared in the first week (18 st wk) of May and remained up to the last week (34 st wk) of August, 2011 (Table No. 2).
As far as population is concern, *H. armigera* on tomato, *P. xylostella* on cabbage and cauliflower attained their highest population of 54.00, 118.00, 91.00/five plants on first week (52 st wk) of January, 2011, respectively (Table2). On the other hand, the highest population of *L. orbonalis* was recorded (59.00/five plants) on last week (30 st wk) of July, 2011 (Table 2).

3. At Agra:

At district Agra, the appearance of *H. armigera* on tomato and *P. xylostella* on cauliflower was recorded in the second week (45 st wk) November 2010 and they remain active till third week (11 st wk) of March, 2011, respectively. However, *L. orbonalis* initiated their attack from the last week (17 st wk) of April, 2011 to third week (33 st wk) of August, 2011 (Table 3). On the other hand, the highest population of *H. armigera* on tomato, *P. xylostella* on cabbage and cauliflower was recorded as 56.00, 119.00, 111.00/five plants during second week (1 st wk) of January, 2011, respectively (Table3). The fruit and shoot borer, *L. orbonalis* was attained their highest population (54.00/five plants) on fourth week (29 st wk) of July, 2011 (Table 3).

COLLECTION OF *TRICHOGRAMMA* SPP. FROM EGGS OF DIFFERENT PESTS

An extensive survey has been made for collection of the eggs of different insect pest, which were laid freshly as well as infected by *Trichogramma* spp. The eggs were collected from the farmer's field; they were counted and brought to the laboratory for rearing and also to record the percent parasitization.

The observations have been recorded in the field of vegetable tomato at three different places / villages of district Mathura, Firozabad and Agra. The eggs of different insect pests of vegetables have been collected on the basis of 15 days intervals. The infected eggs were separated with the help of camel hair soft brush and leave them for hatching in Petri dishes in BOD incubator at department of Zoology, Agra College, Agra. After hatching of these eggs, the percent parasitization has been recorded by comparing them from the total eggs.

Tomato:

The eggs of *Helicoverpa armigera* has been collected from the farmer's field of tomato at three different places *i.e.* Farah, Sihora and Sonkh in district Mathura; Gopalpur, Jasrana and Tundla in district Firozabad and Artoni, Basai and Shamshabad in district Agra. The observations revealed a quite variation in the preparation time of seedlings of tomato, the farmers of Mathura prepared seedlings of tomato in the third week (41 st wk) of October, and at Firozabad in second week (40 st wk) of October, whereas, at Agra it was seeded late and prepared in the last week (43 st wk) of October (Table 4, 5 & 6). As far as eggs were concerned, the maximum number of eggs (29, 36 & 34 eggs/five plants) of pod borer was recorded in the second week (1 st wk) of January at Farah, Sihora and Sonkh of district Mathura, respectively (Table 4). At Firozabad, the eggs were maximum of 34, 32 and 39 eggs/five plants during first week (52 st wk) of January at Gopalpur, Jasrana and Tundla, respectively (Table 5). Similarly at district Agra, the maximum number of eggs of *H. armigera* was obtained as 31, 29 and 29 eggs/five plants in the second week of January (1 st wk) at Artoni, Basai and Shamshabad, respectively (Table 6).

The number of *Trichogramma* emerged from the infected eggs of *H. armigera*, the variation were also recorded. It ranged from 1 to 5 at different places of every district (Table 4, 5 & 6). The highest emergence of *Trichogramma* was recorded as 5, 5 & 5 from the eggs collected on 3 st wk, 1 st wk and 1 st wk of January from Farah, Sihora and Sonkh of district Mathura, respectively (Table 4). From the culture of Firozabad, the maximum emergence was obtained as 5, 3 and 4 from the eggs collected from Goplapur, Jasrana and Tundla during first week (52 st wk) of January, respectively (Table 5). The higher emergence of *Trichogramma* from the culture of Agra was recorded as 4, 5 and 4 from eggs of Artoni, Basai and Shamshabad on second week of (1 st wk) of January, respectively (Table 6).

The higher per cent prasitization at different places was recorded (13.79, 13.89 and 14.71 %), (15.79, 12.50 and 20.00 %), and (12.90, 17.24 and 13.79 %) at (Farah, Sihora and Sonkh in district Mathura), (Gopalpur, Jasrana and Tundla in disctrict Firozabad) and (Artoni, Basai and Shamshabad in district Agra) during Second week (1 st wk) of January, first week (52 st wk) of January, and Second week (1 st wk) of January, respectively (Table 4, 5 & 6).

Table- 1: Observation on population count of different economically important insects of vegetables at Mathura during year 2010-2011

Months	St Wks.	MATHURA			
		H. armigera on tomato	***P. xylostella on cabbage***	***P.xylostella on cauliflower***	***L.orbonalis on brinjal***
September	35	*	*	*	*
	37	*	*	*	*
October	39	*	*	*	*
	41	0.00	0.00	0.00	*
	43	0.00	3.00	1.00	*
November	45	1.00	13.00	6.00	*
	47	10.00	38.00	27.00	*
December	49	22.00	78.00	53.00	*
	51	37.00	110.00	85.00	*
January	01	52.00	128.00	97.00	*
	03	44.00	113.00	92.00	*
February	05	29.00	76.00	57.00	*
	07	13.00	50.00	34.00	*
March	09	3.00	24.00	17.00	*
	11	1.00	14.00	6.00	*
	13	1.00	2.00	1.00	0.00
April	15	*	0.00	0.00	0.00
	17	*	*	0.00	5.00
May	19	*	*	*	13.00
	21	*	*	*	17.00
June	23	*	*	*	27.00
	25	*	*	*	32.00
July	27	*	*	*	41.00
	29	*	*	*	56.00
August	31	*	*	*	30.00
	33	*	*	*	10.00

*=Crop not available

Table- 2: Observation on population count of different economically important insects of vegetables at Firozabad during year 2010-2011

Months	St Wks.	FIROZABAD			
		***H. armigera* on tomato**	***P. xylostella* on cabbage**	***P.xylostella* on cauliflower**	***L.orbonalis* on brinjal**
September	36	*	*	*	*
	38	*	*	*	*
October	40	0.00	0.00	0.00	*
	42	0.00	3.00	0.00	*
November	44	1.00	10.00	3.00	*
	46	7.00	32.00	13.00	*
December	48	27.00	66.00	37.00	*
	50	39.00	99.00	69.00	*
	52	54.00	118.00	91.00	*
January	02	32.00	114.00	77.00	*
	04	28.00	75.00	64.00	*
February	06	14.00	46.00	44.00	*
	08	3.00	24.00	24.00	*
March	10	0.00	9.00	13.00	*
	12	0.00	2.00	4.00	*
April	14	0.00	0.00	1.00	0.00
	16	0.00	0.00	0.00	0.00
May	18	*	*	0.00	4.00
	20	*	*	*	14.00
June	22	*	*	*	19.00
	24	*	*	*	23.00
July	26	*	*	*	48.00
	28	*	*	*	50.00
	30	*	*	*	59.00
August	32	*	*	*	34.00
	34	*	*	*	15.00

*=Crop not available

Table- 3: Observation on population count of different economically important insects of vegetables at Agra during year 2010-2011

Months	St Wks.	AGRA			
		H. armigera on tomato	*P. xylostella on cabbage*	*P.xylostella on cauliflower*	*L.orbonalis on brinjal*
September	35	*	*	*	*
	37	*	*	*	*
October	39	*	*	*	*
	41	0.00	0.00	0.00	*
	43	0.00	0.00	0.00	*
November	45	0.00	4.00	3.00	*
	47	8.00	19.00	13.00	*
December	49	20.00	46.00	40.00	*
	51	40.00	79.00	83.00	*
January	01	56.00	119.00	111.00	*
	03	35.00	96.00	95.00	*
February	05	23.00	60.00	67.00	*
	07	13.00	37.00	31.00	*
March	09	4.00	17.00	13.00	*
	11	2.00	6.00	4.00	*
	13	0.00	0.00	0.00	0.00
April	15	0.00	0.00	0.00	0.00
	17	0.00	0.00	0.00	4.00
May	19	*	*	*	8.00
	21	*	*	*	13.00
June	23	*	*	*	23.00
	25	*	*	*	38.00
July	27	*	*	*	39.00
	29	*	*	*	54.00
August	31	*	*	*	37.00
	33	*	*	*	18.00

*=Crop not available

Table- 4: Survey for collection of *Trichogramma* spp. from parasitized eggs of *Helicoverpa armigera* associated with tomato at Mathura during year 2010-2011

Months	St Wks.	MATHURA								
		Farah			Sihora			Sonkh		
		A	B	C	A	B	C	A	B	C
September	35	*	*	*	*	*	*	*	*	*
	37	*	*	*	*	*	*	*	*	*
October	39	*	*	*	*	*	*	*	*	*
	41	0	0	0.00	0	0	0.00	0	0	0.00
	43	0	0	000	0	0	0.00	0	0	0.00
November	45	0	0	0.00	0	0	0.00	0	0	0.00
	47	7	0	0.00	4	0	0.00	3	0	0.00
December	49	13	1	7.69	16	1	6.25	13	1	7.69
	51	21	2	9.52	25	3	12.00	23	3	13.04
January	01	29	4	13.79	36	5	13.89	34	5	14.71
	03	38	5	13.16	21	2	9.52	19	2	10.53
February	05	17	1	5.88	7	0	0.00	6	0	0.00
	07	4	0	0.00	2	0	0.00	3	0	0.00
March	09	0	0	0.00	0	0	0.00	0	0	0.00
	11	0	0	0.00	0	0	0.00	0	0	0.00
	13	0	0	0.00	0	0	0.00	0	0	0.00
April	15	*	*	*	*	*	*	*	*	*
	17	*	*	*	*	*	*	*	*	*
May	19	*	*	*	*	*	*	*	*	*
	21	*	*	*	*	*	*	*	*	*
June	23	*	*	*	*	*	*	*	*	*
	25	*	*	*	*	*	*	*	*	*
July	27	*	*	*	*	*	*	*	*	*
	29	*	*	*	*	*	*	*	*	*
August	31	*	*	*	*	*	*	*	*	*
	33	*	*	*	*	*	*	*	*	*

A=Number of eggs collected
B=Number of *Trichogramma* spp.emerged
C=Percent parasitization
*=Crop not available

Table- 5: Survey for collection of *Trichogramma* spp. from parasitized eggs of *Helicoverpa armigera* associated with tomato at Firozabad during year 2010-2011

Months	St Wks.	FIROZABAD								
		Gopalpur			Jasrana			Tundla		
		A	B	C	A	B	C	A	B	C
September	36	*	*	*	*	*	*	*	*	*
	38	*	*	*	*	*	*	*	*	*
October	40	0	0	0.00	0	0	0.00	0	0	0.00
	42	0	0	0.00	0	0	0.00	0	0	0.00
November	44	0	0	0.00	0	0	0.00	0	0	0.00
	46	4	0	0.00	3	0	0.00	5	0	0.00
December	48	24	3	12.50	19	2	10.53	21	3	14.29
	50	29	4	13.79	28	3	10.71	31	4	12.90
	52	34	5	14.71	32	3	9.38	39	4	10.26
January	02	19	3	15.79	16	2	12.50	20	4	20.00
	04	6	0	0.00	9	1	11.11	11	2	18.18
February	06	3	0	0.00	5	0	0.00	6	0	0.00
	08	0	0	0.00	0	0	0.00	0	0	0.00
March	10	0	0	0.00	0	0	0.00	0	0	0.00
	12	0	0	0.00	0	0	0.00	0	0	0.00
April	14	0	0	0.00	0	0	0.00	0	0	0.00
	16	0	0	0.00	0	0	0.00	0	0	0.00
May	18	*	*	*	*	*	*	*	*	*
	20	*	*	*	*	*	*	*	*	*
June	22	*	*	*	*	*	*	*	*	*
	24	*	*	*	*	*	*	*	*	*
July	26	*	*	*	*	*	*	*	*	*
	28	*	*	*	*	*	*	*	*	*
	30	*	*	*	*	*	*	*	*	*
August	32	*	*	*	*	*	*	*	*	*
	34	*	*	*	*	*	*	*	*	*

A=Number of eggs collected
B=Number of *Trichogramma* spp.emerged
C=Percent parasitization
*=Crop not available

Table- 6: Survey for collection of *Trichogramma* spp. from parasitized eggs of *Helicoverpa armigera* associated with tomato at Agra during year 2010-2011

Months	St Wks.	AGRA								
		Artoni			Basai			Shamshabad		
		A	B	C	A	B	C	A	B	C
September	35	*	*	*	*	*	*	*	*	*
	37	*	*	*	*	*	*	*	*	*
October	39	*	*	*	*	*	*	*	*	*
	41	*	*	*	*	*	*	*	*	*
	43	0	0	0.00	0	0	0.00	0	0	0.00
November	45	0	0	0.00	0	0	0.00	0	0	0.00
	47	6	0	0.00	3	0	0.00	8	0	0.00
December	49	14	1	7.14	11	1	9.09	13	1	7.69
	51	27	3	11.11	21	3	14.29	24	2	8.33
January	01	31	4	12.90	29	5	17.24	29	4	13.79
	03	12	1	8.33	10	1	10.00	11	1	9.09
February	05	9	1	11.11	6	0	0.00	7	0	0.00
	07	2	0	0.00	4	0	0.00	3	0	0.00
March	09	0	0	0.00	1	0	0.00	0	0	0.00
	11	0	0	0.00	0	0	0.00	0	0	0.00
	13	0	0	0.00	0	0	0.00	0	0	0.00
April	15	0	0	0.00	0	0	0.00	0	0	0.00
	17	0	0	0.00	0	0	0.00	0	0	0.00
May	19	*	*	*	*	*	*	*	*	*
	21	*	*	*	*	*	*	*	*	*
June	23	*	*	*	*	*	*	*	*	*
	25	*	*	*	*	*	*	*	*	*
July	27	*	*	*	*	*	*	*	*	*
	29	*	*	*	*	*	*	*	*	*
August	31	*	*	*	*	*	*	*	*	*
	33	*	*	*	*	*	*	*	*	*

A=Number of eggs collected
B=Number of *Trichogramma* spp.emerged
C=Percent parasitization
*=Crop not available

DISCUSSION

Preliminary work on biological control of crop pests was initiated in the thirties in India, which has gained momentum in the light of increasing awareness about ecologically sustainable methods of pest management. As far as population is concern, at district Mathura, highest population of *H. armigera* on tomato, *P. xylostella* on cabbage and cauliflower was recorded as 52.00, 128.00, 97.00/five plants on second week of January, 2011, respectively; and the maximum number of *L. orbonalis* was recorded (56.00/five plants) on brinjal during fourth week of July, 2011. At Firozabad, *H. armigera* on tomato, *P. xylostella* on cabbage and cauliflower attained their highest population of 54.00, 118.00, 91.00/five plants on first week of January, 2011, respectively. On brinjal crop, highest population of *L. orbonalis* was recorded (59.00/five plants) on last week of July, 2011 in Firozabad. At district Agra, the maximum population of *H. armigera* on tomato, *P. xylostella* on cabbage and cauliflower was recorded of 56.00, 119.00, 111.00/five plants during second

week of January, 2011, respectively. *Leucinodes orbonalis* was attained their highest population (54.00/five plants) on brinjal during fourth week of July, 2011.

For the collection of the vegetable pests, an extensive survey has been made in the farmer's field of tomato, cabbage, cauliflower and brinjal at different places in district Mathura, Firozabad and Agra. From tomato crop, the maximum number of eggs of *H. armigera* was collected as 29, 36 & 34 eggs/five plants in the second week of January at Farah, Sihora and Sonkh of district Mathura, respectively.

At Firozabad, the eggs of pod borer were recorded maximum of 34, 32 and 39 eggs/five plants during first week of January at Gopalpur, Jasrana and Tundla, respectively. Similarly at district Agra, the maximum number of eggs of pod borer was obtained as 31, 29 and 29 eggs/five plants in the second week of January at Artoni, Basai and Shamshabad, respectively. As far as percent *Trichogramma* parasitization is concern, the higher percent parasitization in the eggs of *H. armigera* at tomato crops was recorded (13.79, 13.89 and 14.71 %), (15.79, 12.50 and 20.00 %), and (12.90, 17.24 and 13.79 %) at (Farah, Sihora and Sonkh in district Mathura), (Gopalpur, Jasrana and Tundla in district Firozabad) and (Artoni, Basai and Shamshabad in district Agra) during Second week of January, first week of January, and Second week of January, respectively. Data reported by Oatman and Platner (1971,1978) demonstrated that technical feasibility of augmenting T. pretiosum population to reduce damage in tomato caused by the tomato fruit worm Heliolhis zea, cabbage looper *Trichopiusia ni* and *Manduca sp.*

Applications of Insect Parasitoids as biological control agents was attempted in South Africa during the 1930"S when *Trichogremma luteum* was mass reared and released in cotton fields .Further work on *Trichogramma spp*. Has been carried out recently ,using imported cultures .One species *T. pretiosum* was established in the field (Van Humburg, 1981). From the mid 1960's the growing concern by the general public for the environment, and more recently a move toward sustainable land use, has lead to the development of a range of alternative control measures for use in integrated pest management (IPM) programs. IPM aims to limit economic damage to crops from pests and simultaneously minimize the effects on non-target organisms within the crop, the surrounding environment and consumers (Gullan and Cranston 1994). This can be achieved by combining the effective use of selective pesticides with biological control to provide the farmer with a variety of pest management options.

ACKNOWLEDGEMENT

Financial assistance from Council of Science and Technology U.P. (India) is gratefully acknowledged. The authors are also thankful to the authorities of Agra College, Agra for providing the facilities

REFERENCES

1. Andow D.A., Lane C.P. and Olson D.M. (1995): Use of *Trichogramma* in Maize- Estimating Environmental Risks. *In* "Benefits and Risks of Introducing Biocontrol Agents" (J. M. Lynch, and H. H. Hokkanen, Eds.), pp. 101-118. Cambridge University Press, New York, pp. 101-118.
2. Box HE (1951): The sugar cane borers (Diatraea, Chilo) in Mexico based oit a survey carried out in March-April 1951 in the cane regions of Sinaloa, Nayarit, and Huasteca with supplementary observations. *Mexico D. F., Un. nac. Prod. Azuc.,* pp.93.
3. Chen C.B. (1963): An effective criticism of utilizing indigenous egg parasites *(Trichogranmza inimcticnt* and *Trichogramma australicum)* and introducing parasites for controlling the sugar cane moth borers. *J. agric. Ass. China* 44:1-8
4. Gullan P.J. and Cranston P.S. (1994): *The Insects An Outline of Entomology*. Chapman and Hall, London
5. Hinds W.E. and Spencerh H. (1930): Progress in utilization of *Trichogramma minutum* in cane borer control in Lousiana. *Ibid* 23: 121-127.
6. Jalali S.K., Venkatesana T., Murthya K.S., Rajaratnam, Rabindraa J. and Lalithaa (2007): Vacuum packaging of *Corcyra cephalonica* (Stainton) eggs to enhance shelf life for parasitization by the egg parasitoid *Trichogramma chilonis*. *Biological Control*, 41(1): 64-67.
7. King E.G. and Coleman R.J. (1989): Potential for biological control of *Heliothis* species. *Annual Review of Entomology* 34, 53-75.

8. King E.G. and Morrison R.K. (1984): Some systems for production of eight entomophagous arthropods. In: Advances and Challenges in Insect Rearing (Ed. by E. G. King and N. C. Leppla) pp.206-222, USDA, ARS, New Orleans, Louisiana.

9. Nagarkatti S: (1979): Experimental comparison of laboratory-reared vs. wild-type *Trichogramma chilonis* [Hym.: Trichogrammatidae]: Tolerance of nonoptimal temperatures. *Entomophaga*, 24: 417-421.

10. Oatman E.R. and Platner G.R. (1971): Biological control of the tomato fruitworm, bavvage looper and hornworms on processing tomatoes in southern California using mass releases of *Trichogramma pretiosum*. *Journal of Economic Entomology*, 64: 501-506.

11. Oatman E.R. and Platner G.R. (1978): Effect of mass release of *Trichogramma pretiosum* against lepidopterous pests on processing tomatoes in southern California, with notes on host egg population trends. *Journal of Economic Entomology*, 71: 896-900.

12. Orr D.B., Garcia-Salazar C. and Landis D.A. (2000): *Trichogramma* Nontarget Impacts: A Method for Biological Control Risk Assessment. *In* "Nontarget Effects of Biological Control", (P. A. Follett, and J. J. Duan, Eds.), pp. 111-125. Kluwer Academic Publishers, Norwell/U.S.A.

13. Smyth E.G. (1939): *Trichogramina* proves itself in sugar cane borer control. *Proc. Int. Soc. Sug. Cane Techizol.* 6: 367-377.

14. Thomson M.S. and Stinner R.E. (1989): *Trichogramma* spp. (Hymenoptera: Trichogrammatidae): field hosts and multiple parasitism in North Carolina. *Journal of Entomological Science* 24, 232-240.

15. Tiwari S. and Khan M.A. (2004): Effect of endosulfan on percent parasitization by three species of *Trichogramma*. *Indian J. Ent.*, 66, 135-7.

16. Tucker R.W.E. (1931): An account of *Diatraea saccltaralis* and of the technique of breeding *Trichogramma minutum* and of the results of two years field liberations of the parasite in Barbados and control of root borer. *Ibid.* pp. *80-97.*

17. Tucker R.W.E. (1932)*:* The status of *Tricltogramma* as a control of *Diatraea saccharalis* in Barbados. *Agric. J. Dep. Sci. Agric. Barbados*, 1: 29-36.

18. Tucker R.W.E. (1933): Rate of egg deposition of *Diatraea saccharalis* and extent of larval mortality in canefields and their relation to control of *Diatraea* by *Trichogramma*. *Agric. J. Dep. Sci. Agric. Barbados*, 2: 33-52.

19. Tucker R.W.E. (1934): A contribution towards the solution of the problem of control of *Diatraea saccharalis* in cane through a mathematical evaluation of the real mortality of *D. saccharalis* due to egg parasites, egg predators, natural larval mortality, larval parasitism and other factors. *Ibid*, 3: 59-80.

20. Tucker R.W.E. (1935): The control of *Diatraea saccharalis* in sugar cane in Barbados by frequent liberation of mass-reared *Trichogramma. Ibid.* 4: 25-50.

21. Tucker R.W.E. (1951): A twenty-year record of the biological control of one sugar cane pest. *Proc. Int.* Soc. *Sup. Cane Technol.* 7: 343-354.

22. Tucker R.W.E. (1954): Biological control of insect pests in Barbados. *Ibid.* 8: 573-581.

23. Tyagi A.K. and Khan M.A. (1993): Infestation of *Pygaera cupreata* Butler (Lepidoptera: Notodontidae) on different clones of poplar in iarai region of Uttar Pradesh and its multiple egg parasitization. *Indian Forester*, 119: 63-70.

24. Van Hamburg H (1981): The inadequacy of egg counts as indicators of threshold levels for control of *Heliothis armigera* on cotton. *Journal of the Entomological Society of Southern Africa*, 44: 291-297.

25. Voronin K.E. and Grinberg A.M. (1981): The current status and prospects of *Trichogramma* utilization in the USSR, *In: JR Coulson (ed.). Proceedings of the Joint American Soviet Conference on the Use of Beneficail Organisms in the control of crop pests. Entomological Society of America, College Park,Md.*, pp. 49-51.

26. Wolcott G.N. and Martorell L.F. (1943): Natural parasitism by *Trichogramma minuticm* of the eggs of the sugar cane moth borer *Diatraea sacclzaralis* in the cane fields of Puerto Rico. *J.Agric. Univ. P. Rico.*, 27: 39-83.