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Seasonal Incidence of Insect Pest and Natural Enemies on Onion Agro Ecosystem at Tandojam, Pakistan

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Abstract
The present study on agro ecosystem of Onion crop was carried in order to know the seasonal incidence of insect pest and natural enemies at Tando Jam, District Hyderabad, Sindh, Pakistan during kharif season 2011. Healthy onion seedlings were transplanted on ridges in natural conditions. The crop was observed on weekly basis to find the number of insect pest, natural enemies and plant growth,. Overall Thrips, army worm, Onion maggot and Cricket were observed infesting the crop at different temperature, relative humidity, growth period of onion throughout the cropping season. On occurrence of insect pests, natural enemies were found on crop to control the pest population in natural agro ecosystem. Over the onion cropping season natural enemies were predatory the pests so the plant growth and yield were not affected by pest. After the harvest of crop 25 onion bulbs were weighted to find the average.
Keywords: Incidence, pest and natural enemies, Onion, Agro Ecosystem

1. Introduction

Onion (Allium cepa L.) belongs to the family Alliaceae and is well known as the most important crop in the world, used as both vegetable and spice crop. Onion bulb is used as spice which is composed of carbohydrates (11.0 g), proteins (1.2 g), fiber (0.6 g), moisture (86.8 g) and several vitamins like vitamin A (0.012 mg), vitamin C (11 mg), thiamine (0.08 mg), riboflavin (0.01 mg) and niacin (0.2 mg) and also some minerals like phosphorus (39 mg), calcium (27 mg), sodium (1.0 mg), iron (0.7 mg) and potassium (157 mg) (Suresh, 2007).
Application of chemicals can kill the onion insect pests, but it's difficult to control the pest on crop (Mau and Kessing, 1991) and several pesticide resistance problems have been found in area were the injudicious chemical poisons are applying for pest control (Rueda and Shelton, 1995)

The use (and misuse) of chemical pesticides are adversely affect the environment, human health, and other beneficial insects/pests (Rola and Pingali, 1993; Antle and Pingali, 1994; and Tjornhom et al., 1997). Chemical pesticide misuse is even more evident in vegetable crop production than in other crops because of its vulnerability to a wider range of pests and diseases (Tjornhom et al., 1997). Due to the known hazards of chemical pesticides and their use to the environment and human health, Integrated Pest Management (IPM) – a system that encourages reduction in chemical pesticide use and increased utilization of non-chemical control methods (Norton et al., 1999). A natural ecosystem is a system that is formed by dynamic interactions between biotic and non-biotic elements in a defined area. Biotic elements include plants, insects (pests, natural enemies, decomposers), microbes and other living organisms, and non-biotic elements comprise weather components such as temperature, relative humidity, wind, sunshine, rain and soil. Each element has its special characteristics and role in the system that, as a function of time and place, will influence the distribution and population of living organisms. The term ecosystem also involves nutrient and energy flows within the system.

Injudicious use of pesticides, however, disturbs this balance due to the killing of natural enemies and other organisms as well reduced soil fertility. Keeping this in view the present study was undertaken to find the agro ecology of onion crop under agro ecosystem.

1.1 Materials and Methods

Experimental design and management
Field study was carried in kharif growing season to evaluate the agro ecosystem of onion crop, at the village Suleman Khan Khatyan near Tandojam, distt, Hyderabad, during 2011.

Seeds of local onion variety Phulkara were obtained from the certified seed company, Hyderabad. The field was ploughed by 3 times and ridges were prepared at 30cm distance. Onion seeds 3500g were sown on 15th may on well prepared beds to raise seedlings for one acre; the germinations were completed up to 20th may. Healthy and disease free uniform sized seedlings were transplanted (on 29th June) after 40 days of germination, on both sides of ridges, with 10cm plant to plant spacing

The field was fertilized with Urea at the rate of 80kg N per ha into two intervals, 3 and 6 weeks after

transplanting. Agronomic practices such as; weeding and earthen up were done to keep the field free of weeds and grow healthy crop. Irrigation was done whenever were necessary, the crop was irrigated by underground water with help of tube-well.

Temperature and humidity

Climatically, the study area is subtropical humid and receives average annual rainfall of about 129 mm. The average maximum temperature reaches 40.8oĊ in May and minimum 7.9oC in January. The relative humidity is highest (81%) in the month of August and lowest (50%) in the month of April. Air temperature and relative humidity were collected from meteorological station DRC Tandojam every day and make weekly average. Soil thermometers were installed at depths of 10 cm, to monitor thermal regime of the soil. The soil temperature was observed every day and averaged weekly.

Data collection

Biological data collected for the trial on every week after transplanting till the digging of the crop that included: plant height (cm), number of leaves, insect pests, and natural enemies, after digging, the weight of 25 randomly selected bulbs was measured. Pest populations were scout weekly throughout the season, randomly 10 plants checked at 10 different locations spread throughout the onion field from the inner rows, to get an average of onion pest and natural enemies, plant height and leaf numbers per plant. The plant were observed early in the morning, at the first natural enemies and insect pests on plants were count and recorded, then number of leaves and plant height were recorded. All Insects found in the field and were collected, identified and corroborated by the Entomology Section, ARI, Tandojam, Pakistan.

Statistical analysis and calculation

The present study carried agro ecosystem and find the occurrences of insect pest and natural enemies on crop therefore we record the insects and using Microsoft Excel 2010 to calculate the average, mean and figures drawing.

1.1.1 Results

The result so for achieved during studies on agro ecosystem of onion crop near Tando Jam, District Hyderabad, during kharif season, 2011 are as:

Pest Population Development

1. Field Cricket *Gryllus pennsylvanicus*

The cricket population started to appear in first week after transplantation and continued its activity till 4th week, and appears again in 15th week. The maximum pest population of 1.11 insects per plant was recorded in second week of transplanting. The average population of cricket shown in table-1

2. Thrips, *Thrips tabbaci* (Lind.)

Thrips population was observed in the crop in first week after transplantation till the harvest. Thrips population remained comparatively high throughout the season. The maximum population of thrips (62.34 per plant) was recorded in 11th week after transplanting, while the minimum population (2.05 thrips per plant) was recorded in first week of transplanting (Table-1). The seasonal mean population (Table-1) indicated that pest population remained high.

Table 1. Weekly insect pest population on onion

Week After Transplanting	Pest population per plant			
	Thrip	Moth	Onion maggot	Cricket
1	2.05	0.00	0.00	1.03
2	9.16	0.00	2.32	1.11
3	19.16	0.00	3.32	1.08
4	31.06	2.21	3.20	1.05
5	37.33	2.64	4.61	0.00
6	23.56	3.02	3.99	0.00
7	25.21	3.51	5.48	0.00
8	39.16	3.35	7.27	0.00
9	43.17	2.41	5.42	0.00
10	59.32	3.58	9.68	0.00
11	62.34	2.57	4.49	0.00
12	43.44	4.77	7.74	0.00
13	47.14	4.24	4.17	0.00
14	38.93	2.97	4.02	0.00
15	24.05	1.16	5.26	0.78
16	27.25	1.37	3.32	0.00
17	14.20	0.00	2.28	0.00
Average:	32.15	2.22	4.50	0.30

3. Army worm *Spodoptera litura*

Army worm population started on onion crop from 4th week after transplanting when the plant height was 25.1cm with 4.8 leaves and continued till the height 54.4 and 15 leaves, on the 16th week after transplanting. The maximum caterpillar population (4.77 per plant) was recorded in the 12th week after transplanting while the minimum pest population (1.16/plant) was recorded in 15th week after transplanting. Table-1 also indicated the Jassid population

4. Onion maggot *Delia antiqua* (Meigen)

The maggots appeared on onion crop on 2nd week after transplanting with 19.1cm and 3.2 plant height and leaves respectively, till the harvest of crop with average height 54.9cm and 16.3leaves per plant. The maximum maggot population (9.68/plant) was recorded in 10th week after transplanting, while the minimum population (2.28/plant) was recorded in 17th week after transplanting.

Natural enemies population on onion crop

The result regarding natural enemies recorded on onion near Tandojam, are given in Table-2. The natural enemies Spider, Ant, Green lacewing, Orious bug, Lady bird beetles were observed during the crops season, the occurrence of predators varied with one another throughout the cropping season.

Table-2 Weekly natural enemiespopulation on onion

Week(s) After Transplanting	Population of Predators per plant				
	Spider	Ant	Green lacewing	Orious bug	Lady bird beetles
1	0.20	0.02	0.00	0.00	0.00
2	0.77	0.86	0.00	0.00	0.00
3	1.17	2.86	1.32	1.68	1.54
4	0.23	1.54	0.86	0.93	1.31
5	2.88	1.19	2.42	2.77	2.55
6	4.11	0.74	3.27	3.49	1.93
7	2.77	3.59	2.61	3.88	2.95
8	1.87	2.86	1.67	2.46	1.64
9	1.91	2.67	1.94	2.76	1.72
10	2.54	3.38	2.00	2.23	1.53
11	4.91	2.67	2.94	4.30	2.55
12	4.89	0.80	3.17	4.18	0.73
13	1.49	2.23	0.99	1.53	0.25
14	0.36	0.31	0.37	0.53	1.01
15	0.39	1.73	0.69	0.85	2.25
16	1.41	1.24	0.69	0.76	1.24
17	1.92	3.44	1.20	1.80	1.56
Average	1.99	1.89	1.54	2.01	1.46

1. Spiders

Spider population started to appeared on the 1st week after transplanting when the onion crop have 14.5cm height and 2 leaves and continued its predatory activity till the harvesting of the crop with average height 54.9cm and 16.3leaves per plant. The population increased and decreased with the increase and decrease in pest population and plant growth. The maximum spider population of (4.91/plant) was observed in 11th week after transplanting, while the minimum spider population (0.20/plant) was observed during 1st week after transplanting

2. Ant, Solenopsis geminata (F.)

Ants appeared in onion crop in the 1st week after transplanting when the plants have 14.5cm height and 2 leaves. Their predatory activity was observed till the end of the crop. The maximum population of ant (3.59/plant) was recorded in 7th week after transplanting, in this period the spider population was decreased, while the minimum was recorded in 1st week after transplanting. The seasonal mean population indicated in Table-2.

3. Green lacewing, Chrysoperla carnea (Stephels.)

Chrysoperla is an important predator of soft body insects. It is also called lacewing and lion. The Chrysoperla was recorded in the field from 3rd week after transplanting with plant height 21.8cm and 3.9 leaves till the end of crop, lacewing maximum activities (0.37/plant) was recorded during 14th week after transplanting. The maximum population (3.27/plant) was recorded in 6th week after transplanting, when the spider population was also high and ants were low in population. The weekly and season average population of chrysoperla shown in table-2

4. Orious bug

In onion crop field, the orious bug was active against thrips. This bug found in the field in when onion have 3.9 leaves and 21.8cm in height, and predatory the pest continuously till the harvest, the maximum activity of this bug was record in 7th WAT (Table-2), and minimum population was recorded (0.53 bugs/plant) in 14th WAT, whereas the seasonal weekly and average population of bug show in table 2.

5. Lady bird beetles

Lady bird beetles played a vital role in minimizing the population of sucking pests. Lady bird beetle occurred in the 3rd WAT till harvest, the population was at peak (2.95/plant) in the 7th WAT and lowest population found in the 13th WAT. The weekly and season average populations shown in table-2. Different species of lady bird beetle like, Coccinella septempunctata (L.), Brumus saturalis (F.), Cheilomenes sexmaculata (Fabr.) were found in the onion crop field.

Onion crop yield parameters

Plant leaves

Data (Table-3) shown that the leaves of the onion plant were increasing gradually during the growth period. At the time of transplanting the plant have averagely 2 leaves and in the end of crop the leaves average was 16.3 per

plant. Plant leaves from 1st to 17th weekly recorded shown in figure-1.

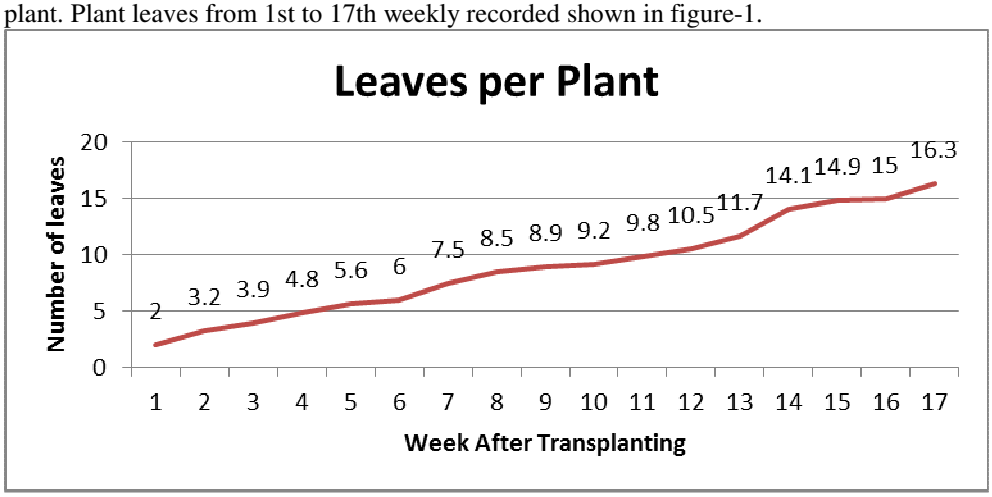

Figure-1 weekly observed plant leaves in onion crop field

Plant height

Onion seedlings sown in the last week of June, when the seedlings were 40 days old, in the first WAT the average 10 plants height was 14.5cm, plant height was increasing with increasing the number of leaves, till harvest (54.9cm/plant). Weekly recorded plant height shown in figure-2.

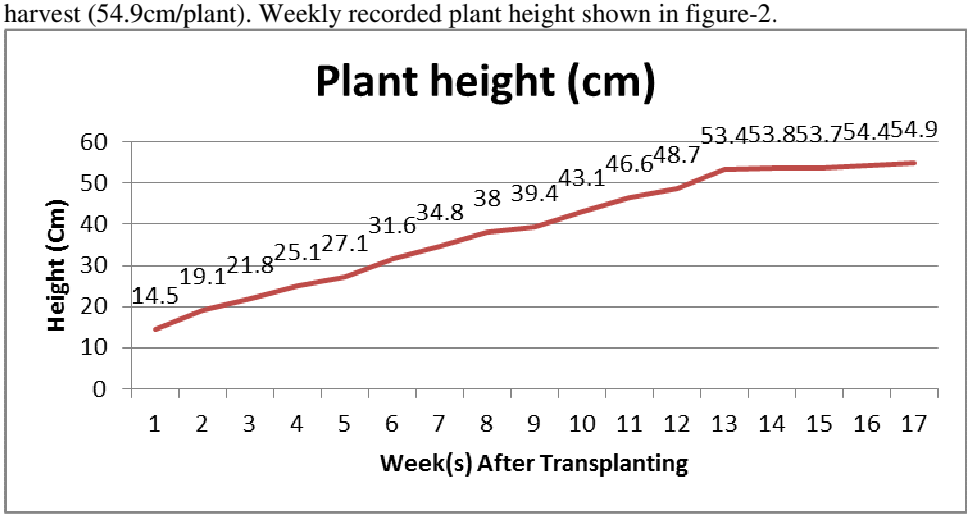

Figure-2 weekly observed plant height (cm) in onion crop field

Onion bulb weight

The crop harvested after 17 WAT, 25 onion bulbs were weighted, having different weight from each other, the maximum bulb weight was 168.83(grams) and minimum weight was 121(gram) the average weight of 25 bulbs recorded 141.44(grams) the onion weight are shown in table-4.

Table-4 Single onion bulb weight after harvesting of crop

Onion Bulb Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
single bulb weight (grams)	164.13	150.22	129.04	168.83	146.91	129.84	138.22	152.82	146.01	138.96	145.01	136.94	141.82	127.22	135.01	127.66	142.5	142.69	136.2	121	119.5	170.3	134.9	146.9	143.4

Temperature and humidity

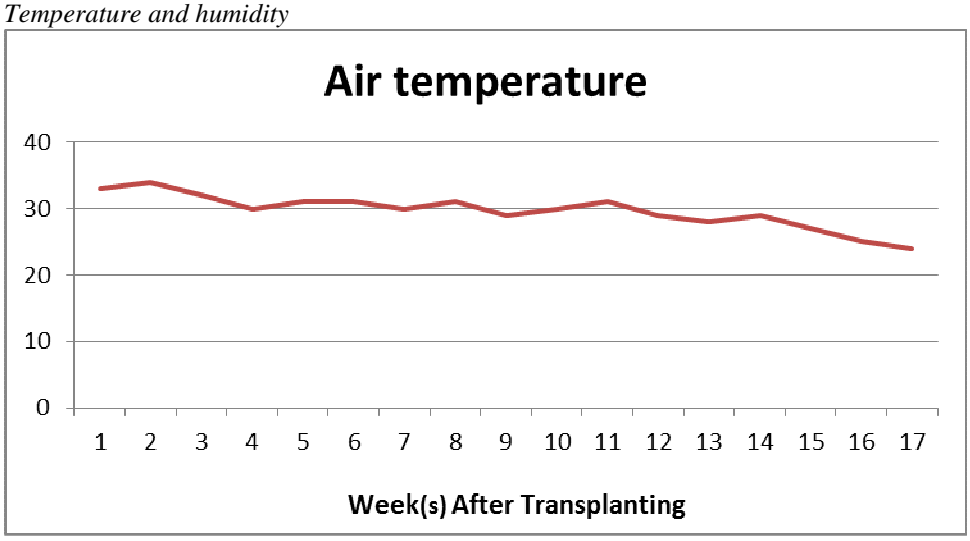

Figure-3 Weekly average air temperature at Tandojam

Air temperature

Air temperature is one of the most important climatic variables that affect plant life. Plants growth is restricted to certain limits of air temperature. The main dry matter process i.e. photosynthesis is also temperature dependent. Temperature not only affects the plant life but also positive effect on occurrence and infestation of insect pest and effects on predatory nature of predators in field. The variation in temperature may disturb growth and maturity of onion crop, raise crop water requirement and trigger pest attack on the plant during humid monsoon period. Cropping season of 2011 mean weekly temperature was observed normal during crop life. Whereas day time maximum temperature remained normal to slightly above normal during early growing stages from 1st to 3rd WAT, Figure-3.

Soil Temperature

Soil temperature plays important role in crop growth, right from the germination to maturity. The observed data tells us a general status of soil temperature upto 10cm in depth and any deficiency in soil moisture indicated by soil temperature

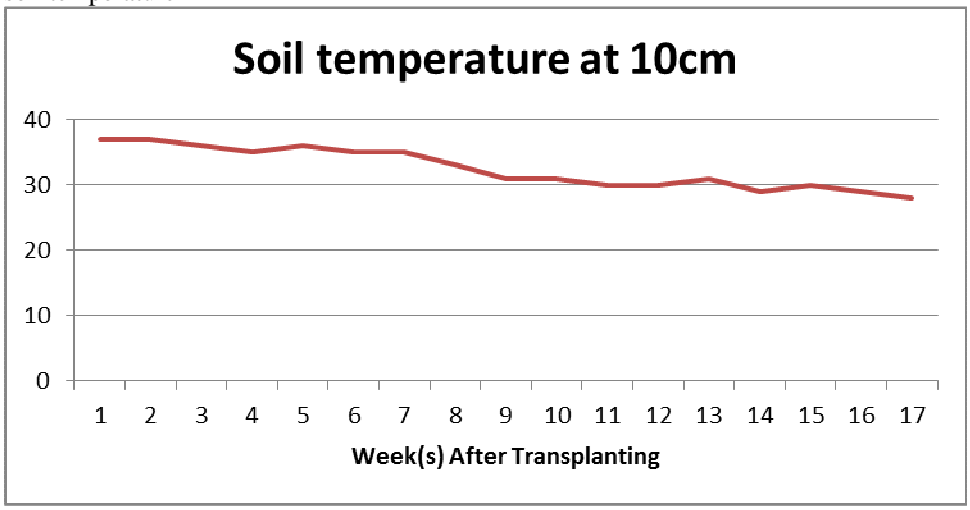

Figure-4 Weekly average soil temperature in onion crop field

During the crop growing season, soil temperature was observed above normal at 10cm depths. After the transplanting of seedlings soil temperature was reducing till maturity with increasing the plant height and leaves, figure-4.

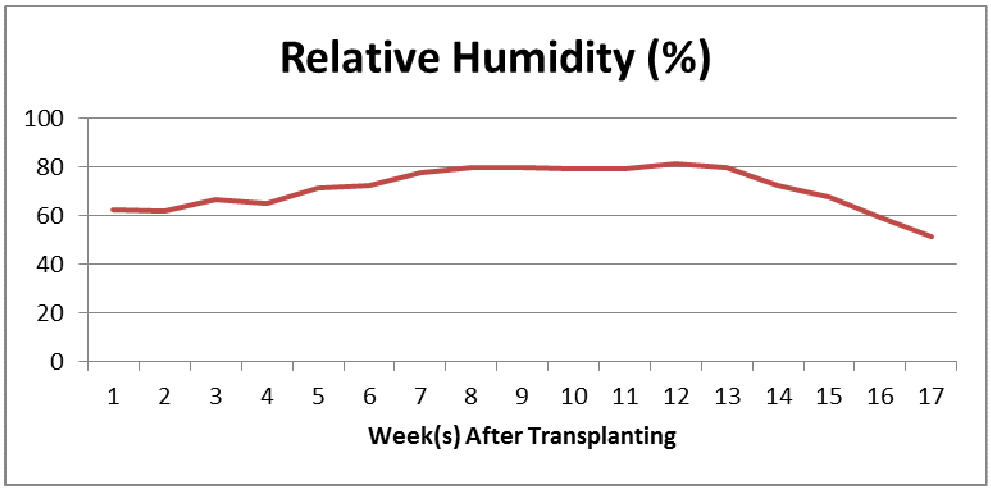

Figure-5 Weekly average relative humidity at Tandojam

Relative humidity
The humidity reference crop evapotranspiration during crop growth, relative humidity remained normal in first 4 weeks after that it observed above normal till 14 WAT, of cropping season, figure.5 shows the weekly average of relative humidity.

1.1.2 Discussion
Onion is an important vegetable of Pakistan cultivated in both rabi and kharif seasons. Farmers use very toxic insecticides for the control of insect pest, during peak activity of insect pests as often as after every 2nd or 3rd day. This heavy burden of insecticides causes health hazards to consumers. Realizing this fact, agro ecosystem was tested in present study to find the insect pests occurrence and predatory of natural enemies.

This study has demonstrated that agro ecosystem of onion crop, which firstly occurrences the populations of insect pests that attract different natural enemies, the insect pest infestation and predators predatory were continued on crop till the harvest. The pest populations (Thrips, Army worm, Onion maggot and Cricket) on onion crop were occurred from first WAT and infested the crop till harvest; the damage incidence was high from the first WAT and remained high until physiological maturity of plant. The current study concurs with previous findings by Oparaocha and Okigbo (2003), Dubey et al. (1999) reported that sucking pests attack on vegetables from sowing till harvest. Nault et al (2011) also describe the onion thrips feed primarily on leaves, reducing bulb growth and also transmit Iris yellow spot virus (IYSV), onion maggot larvae tunnel in roots, seedlings and young bulbs causing reduced stands and stunted plants. High temperatures greater than 30°C (86°F) favor thrips, while lower temperatures favor maggots. Moisture stress (drought) also favors thrips; while excess moisture favors maggots. Alimousavi et al. (2007) and Bergant et al. (2005) also find that Thrips tabaci is a very prolific species and can have overlapping generations under conductive environmental conditions especially at high temperatures.

Among beneficial the predators (insect and non-insect) seemed active after the infestation of pest throughout cropping season, different natural enemies predate different pest and suppress the pest population till the end of season. The predators recorded were: spider, ants, chrysopa, orious bug, and lady bird beetle. Pfadt (1980) describe the same results that natural enemies; parasitoids and predators are the main sources of reductions in the populations of noxious insect pests. In natural agro-ecosystem they suppress the population of pests and regulate the natural balance of ecosystem. These biological agents reduce the pest population below the level that causes economic damage. Singh and Brar (2004) reported that coccinellids are the most important predators they prey upon large numbers of sucking pests. Praveen and Dhandapani (2001) evaluated the effectiveness of the predator, Chrysoperla carnea as biological control agents against the major pests of vegetables. Kumar et al. (2004) and Kubar et al. (2006) also observed many spider species in vegetable crop feeding on phytophagous insects. Sardana et al. (2005a) evaluated the impact of a large build-up of natural enemies such as spiders and coccinellids in the plots where none of the pesticides were applied. LaMana & Miller (1996) and Snyder et al. (2000) also resulted that natural enemies play important role in the population regulation of phytophagous insects; these are generalist predator that feeds on several types of soft body insect pests, and on other herbivores.

Conclusion
On the basis of the result achieved it is concluded that; In onion crop pest were occur after transplanting of

seedling and continue their infestation till the harvest but later on different natural enemies appeared on crop and continue their predatory habit till the pest were controlled, also the same time agro ecosystem encourage the activities of predators.

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