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Population Dynamic of the Safflower Fly, Acanthiophilus Helianthi Rossi (Diptera: Tephritidae) in Gachsaran Region, Iran

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Abstract

Safflower fly, *Acanthiophilus helianthi* Rossiis is one of the most important pests of safflower in most parts of the country. Losses caused by larval feeding lead to disrupted plant activities, reduction in flower buds and ultimately decreased quality and quantity of the crop. In order to study seasonal flight activity of *Acanthiophilus helianthi*, experiments were conducted for two consecutive years at two different fields in Gachsaran region in 2007-2008. The seasonal flight of *Acanthiophilus helianthi* was investigated by using Baits traps and collecting samples from eggs, larva and pupa stages of the pest. The results showed that *Acanthiophilus helianthi* has three generations with an incomplete 4th in the region. Damage of first and fourth generation was very low. The flower heads were mainly damaged by the second and third generation of *Acanthiophilus helianthi* that happened about ten days after the adult emergency.

Keywords: *Acanthiophilus helianthi*; Flight activity; Population dynamics; Bait traps

Introduction

Safflower is one of the major economical products in Iran. According to statistics of 2007, there was 1000 hectares under cultivation with the production of 800 metric ton, an average of 750 Kg per ha [1,2]. The safflower fields of Kohgiloyeh va Boyer-ahmad are mostly in the counties of Kohgiloyeh [3].

Acanthiophilus helianthi is one of the most important pests causing serious damages to safflower in Iran and around the world. In some years, they appear in high population in fields in central and western Europe [4,5] Mediterranean costs [6-8] and Iran (in the provinces of eastern and western Azerbaijan, Hamedan, Ghazvin, Tehran, Isfahan, and Fars) [2,9,10]. The first reports of *Acanthiophilus helianthi* in Iran goes back to Kosari in 1965 [11]. Currently, this is a major pest of safflower in Iran [12]. In Gachsaran, warm regions of Kohgiloyeh-Va-Boyer-Ahmad, *Acanthiophilus helianthi* has been reported by [3] for the first time in 2006. It is known as the main pest of safflower in this province.

The main host of *Acanthiophilus helianthi* is safflower [13,14]. *Carthamusoxycantha*, a ubiquitous wild plant in southern part of France is also a good host to this pest [15,12]. In Bulgaria, the first generation of this insect attacks *Carthamus oxycanthus* [15].

Despite using different insecticides around the world, new biotype resistive to these chemicals has emerged [16]. The fear that this might happen in Gachsaran, prevents us of using insecticides in this region. Due to this problem and other issues related to chemical substance control such as destruction of natural enemies and environmental damages, a non-chemical method and integrated management control must be used to fight this pest. Development of an integrated pest control management requires knowledge of biology, ecology, economic threshold level and changes in population dynamic of that pest. Methyl eugenols as attractant for *A. helianthi* has been produced [17,18]. Commercial products are already obtainable in the market by American and European companies. This product has been used in studies of manipulation and fluctuations in pest population by [9]. Bagheri [19] have defined the different generation's population and the best point in time for fighting this pest in Esfehan Province by using yellow sticky traps [19]. According to their studies, this pest has four generations in Esfehan. The first generation appears at the end of March. The outbreak of the first generation is by mid-April. The second generation outbreak is in the middle of June. The outburst of the third and the fourth generations are mid-July and end of August respectively. The mean sums of effective temperatures for the above stages are respectively 38.6, 186.1, 774.5, 1614.8 and 2312.3°C [20-22] have used methyl eugenol to control the damages of *A. helianthi* in West Azerbaijan and Fars Provinces. Yellow sticky traps have been also used in conjunction with research at Integrated Pest Management (I.P.M.) in fields region of Gachsaran in the years of 2004 to 2005 [3]. Based on the experience of local field owners of Gachsaran, the best schedule for spraying against *A. helianthi* is as follow: the first spray should be done when the flower heads are formation and then every 20 – 25 days till 15 days to harvesting. Though this recommendation has been used for years, due to following arguments:

- High costs of repetitive sprays
- Use of too much chemicals
- Environmental pollution
- Appearance of a new resistant biotype of *A. helianthi*
- Destruction of natural enemies

Formation of imbalance in natural ecosystems in the farm due to above issues and the importance of fields in Gachsaran, changes in population of *A. helianthi* and the best points in time for spraying have been investigated in Gachsaran.

Materials and Methods

The most part of this study has been performed on the fields infected

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by *A. helianthi* in Gachsaran region. In some cases where performing of the research was difficult or impossible, the experiments have been carried out under laboratory condition (natural room temperature of 13-24°C and relative humidity of 34-58%).

To investigate the biological status of *A. helianthi* in 2008 and 2009, two fields, one in the Plains (Basht, Gachsaran) and another in the mountains (Yasooj region) have been chosen. Firstly, these two were good examples in the 200 ha of fields and secondly they have been reported of being infected by *A. helianthi*. To gather information regarding overwintering of *A. helianthi* during the winters of 2008 and 2009, twice a week samples of the soil and from the fields has been collected. Each time, filthy flower heads have been chosen randomly. Then inner side of the flower heads have been observed and investigated by lens. The soil and the fallen leaves in different random places have been collected in plastic bags and sent to the laboratory for test. With the knowledge about overwintering of *A. helianthi*, twenty bolls were chosen, pupae inside flower heads been counted and collected. Four bait traps, two in each field have been installed to determine the flight activity of *A. helianthi*, the first outbreak of the flies in spring, the flight climax of each generation and the number of generations. The traps have been installed at the height of 80 cm from ground, 200 m way from the field edge and 500 m apart from each other. The bait traps have been replaced every 3 days. Observation of eggs were conducted to determine the beginning date of laying eggs, the exact hatching date and the first damages on flower heads has been recorded at Pest Investigation Laboratory of Agricultural and Natural Resources Research Center of Yasooj by collecting and investigating 50 flower heads every other day after the first appearance of each generation of the safflower fly.

Data of observations and observations on different growth stages in the field and in Laboratory including: beginning of laying eggs, hatching date of different generations, the start and appearance of damages on flower heads and infection percentage have been recorded. The trapped flies have also been counted and presented in related tables. To calculate the average infection of bolls in percentage, twenty bolls of each variety (Sina, Padideh, Karajand Esfehan) has been chosen in random. Then the total flower heads and the number of infected bolls been counted.

To investigate the different life stages of each generation of *A. helianthi* in laboratory (natural room temperature of 13-24°C and relative humidity of 34-58%), fifty larvae of first in star have been collected from each field one week after flight climax. They have been placed in bowl of 30 cm in diameter and 50 cm depth along with a flower heads.

Data regarding temperature changes, precipitation and relative humidity have been collected from Yasooj Meteorological Center. Minimum, maximum and average values of temperature and relative humidity have been calculated and their effects on growth of larvae have been explored.

Results and Discussion

The researches done in the falls of 2007 and 2008 and the consecutive winters of 2008 and 2009 revealed that *A. helianthi* overwinters as a pupa. The highest pupal population has been observed inside flower heads.

The flight activity of different generations of *A. helianthi*

The results of researches during the years of 2008–2009 regarding the flight activity of different generations of *A. helianthi* in the warm regions of Gachsaran (plains and mountains) shows that the first generation of this insect appears at the end of April, the second generation in mid-June and the third generation in mid-August (Table 1).

Outbreak of adult fly

Figures 1 and 2 show adult male fly caught by bait traps in two fields, in the plains (Figure 1) and in the mountains (Figure 2) from 16th of April to 10th of October in 2008 and 2009. Figure 1 reveals that outbreak of adult fly from overwintering pupae in the plains beginning early April (2, April 2008 and 4, April 2009) and by increasing temperature, the number of trapped males were growing rapidly so that the flight climaxes were within 20 days (23rd of April 2008 and 20th of April 2009). In the mountain area (Figure 2) the outbreak started in the late of April (21st of April 2008 and 23rd of April 2009) with the flight climax in the late of April (27, April 2008 and 29, April 2009). The outbreak in the warmer areas of Fars Province (for example, Shiraz has been recorded in mid-March [2]. This difference between warm and cold areas is due to longer and colder winters in Gachsaran. Figures 1 and 2 proved that transforming from pupa to adult fly follows the changes in temperature in the region and reached its peak in mid-May. However, it can be seen that there wasn't a significant variation in the start, end and fluctuation of population in respect to geographical characteristics (plains or

Year	First Generation	Second Generation	Third Generation
2007	21, April	14, June	17, August
2008	15, April	15, June	16, August
2009	18, April	18, June	13, August

Table 1: First appearance of different generation, caught in bait traps.

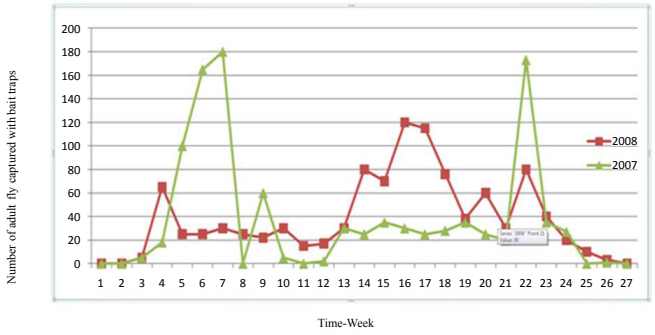

Figure 1: Population dynamics safflower flies in Gachsaran region (plain). 2007-2008.

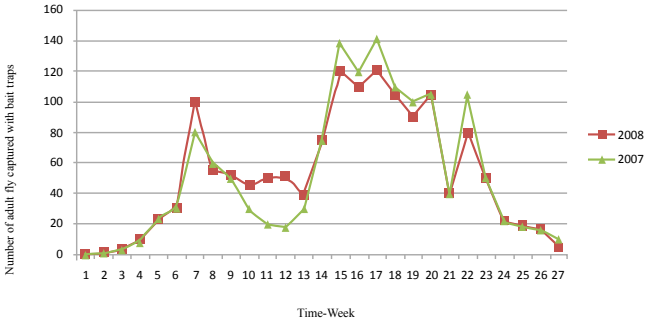

Figure 2: Population dynamics safflower flies in Gachsaran region (Mountain). 2007-2008.

mountains). Figure 3 shows minimum and maximum of temperature during the pest activities.

The results of bio-ecological and population dynamic studies showed that in the cold regions of Gachsaran, *A. helianthi* lived in pupae in winter from the early of October onward. According to the researches, daily temperature was a major factor in the start and end of winter. Figures 3A and 3B reveals that the insect development activities started after reaching the minimum threshold temperature of 10°C. The results tell us that if the mean daily temperature is 10°C for 8-11 days, the pupae will transform into adult fly and come out of the pupae.

In table 2, the start and the period when effective temperature is 10°C or higher along with the outbreak dates of moths in years of 2008-2009 are presented. Throughout these two years in Gachsaran, the effective temperature started in the mid of April and after 8-11days adult flies haves been seen in the field. In the summer because temperatures was higher than lower temperature threshold temperature (33°C), continuous in growth and different life stages of *A. helianthi* has caused interference of the second and third generations (Figures 1 and 2). Also, it was found that after the 25th week, due to falling of temperature under the lower threshold temperature, the growth activities of the third generation ended.

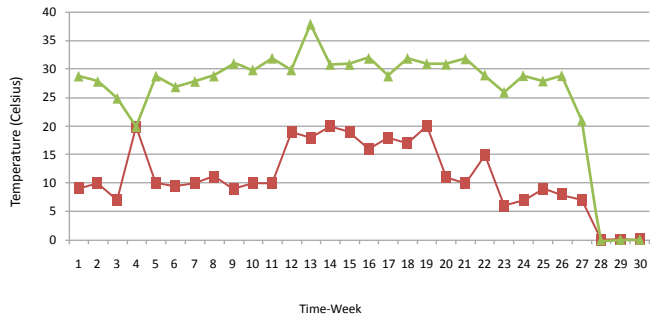

Figure 3a: Fluctuation curve daily Min and Max temperature (Celsius). 2007.

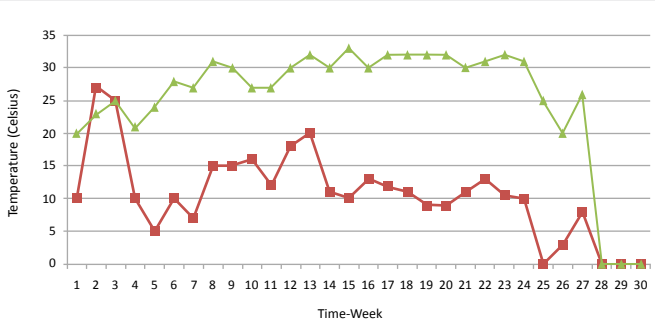

Figure 3b: Fluctuation curve daily Min and Max temperature (Celsius). 2008.

Year	Start of the effective temperature	Length of the effective temperature (days)	Sum of effective temperatures (°C)	Appearance of the first safflower fly
2007	12, April	9	112	21, April
2008	7, April	8	105	15, April
2009	9, April	11	96	18, April

Table 2: Appearance of the first flies from overwintering pupae in relation to effective temperature in Gachsaran in year of 2007 – 2008.

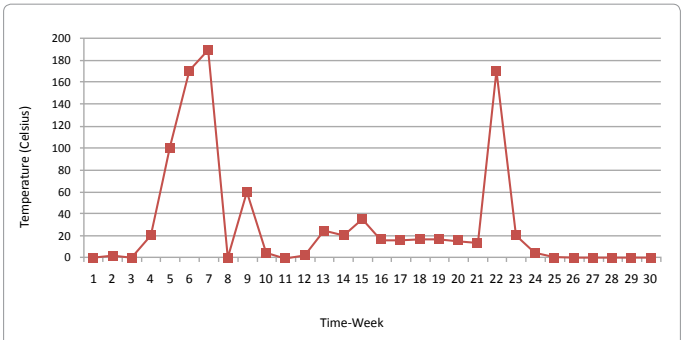

Figure 4: Exit trend adults in laboratory conditions (2008).

Stages of generations	Plains	Mountains
Start of 1st gen.	18, April – 25, April	24, April – 1, May
Fly climax of 1st gen.	4 – 11, May	13 – 18, May
End of 2nd gen	26, May – 5, June	25, May – 4, June
Start of 2nd gen.	5 – 12, June	4 – 11, June
Fly climax of 2nd gen.	19 – 26, June	18 – 25, June
End of 2nd gen	17 – 31, July	13 – 28, July
Start of 3rd gen.	31, July – 11, August	28, July – 13, August
Fly climax of 3rd gen.	20 – 27, August	22 – 29, August
End of 3rd gen	3 – 9, September	6 – 16, September
Start of 4th gen.	9 – 16 September	16 – 24, September

Table 3: Comparing stages of the 3 generations of *Acanthiophilus helianthi* in the Mountains and in Plains of Gachsaran2008.

So, this insect had only three generations in the studied region and the fourth generation are been aborted. To compare this with other places in Iran and the world, in Romania there are 1-3, in Spain 3-4, in Sweden and Finland 1, in Turkey 3-4, around Shiraz 4 and in Tehran 3 generations in a year [2, 23-25]. In the laboratory, the outbreak of a complete insect of overwintered generation started 10th of April with the climax on 25th of April (Figure 4). In this region, the outbreak of the adult males of *A. helianthi* starts after mid-April of each year with the climax in the end of April. Due to the lower threshold temperature for the larvae (10°C) and based on data received from meteorological institute center in Gachsaran, the insect activities–transformation of pupa to insect-start around 5th of April and by mid-April adult fly population grew fast. The flight climax of the first generation was around 5th of May. Based on frequent sampling of pheromone traps in the field, the peak of laying eggs of the first generation is was 10-15 days after appearance of the flies in the field. Due to embryonic length, the peak of larvae hatching is 10 days after the flight climax. The date of laying eggs and hatching of larvae is very important in preparation for insecticidal activities. Based on observation and frequent sampling, the time period of laying eggs has been determined as 5th to 20th of May for the first generation, 1st to 5th of August for the second generation and 1th to5th of September for the third generation (Table 3). Based on observations, the results of catching males of safflower fly by bait traps and fluctuations in file's population of the first generation; the first spraying is recommended to be done from 10th of May to end of May. This is to control the second generation of *A. helianthi*. To get a better result and protecting the fields from damages of this pest, another spraying is done in the 3rd late of July. This reduced the infested crops and the population of *A. helianthi* in the next year drastically.

Conclusion

The production of safflower in Asia is threatened by three major insect pests namely, Aphids (Homoptera: Aphididae), Capsule borer (Lepidoptera: Noctuidae) and Fruit flies (Diptera: Tephritidae). However, only the latter cause large scale economic damage to the safflower seeds. For example seed losses due to fruit flies of up 50% have been reported in West Asia and between 15 to 65% in East Asia.

Studies on the species range of fruit flies associated with safflower in the Gachsaran showed that *Acanthiophilus helianthi*, *Chaetorellia carthami* and *Terellia luteola* were the most important fruit fly species. The results from the present study showed that *A. helianthi* was the dominant species during the third five months of the year, that is from March to May.

It was also the dominant fruit fly species that emerged from incubated safflower flower heads. The dominance of this fruit fly species coincided with the fruiting of both early and late maturing safflower varieties. This could be due to the absence of flower heads on the alternative host plants (sunflower, weed plants from family Compositae, etc) during the period. In addition, the months of Mach to May are the dry periods in the Gachsaran, which is conducive for the population growth of *A. helianthi*. Safflower capsule fly therefore, causes enormous damage to safflower seeds and can result in complete seed loss if appropriate control measures are not taken.

References

1. Al-Ali AS, Al-Neamy K, Abbas SA, Abdul-Masih AM (1977) On the life history of the safflower fly, *Acanthiophilus helianthi* Rossi (Diptera: Tephritidae) in Iraq. Zeitchrift fur Angewandte Entomologie 83: 216-223.
2. Esmaeili M (1983) Important pests of fields in Iran. Publishing Center of Sepehr. Tehran, Iran.
3. Saeidi K (2006) Biology safflower fly, *Acanthiophilus helianthi* (Diptera: Tephritidae) in Gachsaran region. Annual report office of Yasooj agricultural research center P 10-19.
4. Verma AN, Singh R, Mehratra N (1974) *Acanthiophilus helianthi* Rossi-A serious pest of safflower in Haryana. Indian Journal Entomology 34: 364-365.
5. Zandigiacomo P, Iob M (1991) *Acanthiophilus helianthi*, Rossi (Diptera: Tephritidae) on safflower in Friuli. Bollettino di zoologia Agraria e di Bachicoltura 23: 31-38.
6. Ricci C, Ciriciofolo E (1983) Observations on *Acanthiophilus helianthi* Rossi (Diptera: Tephritidae) injurious to safflower in central Italy. Redia 66: 577-592.
7. Rahoo GM, Lohar AG, Kazi, AJM (1997) Studies on the biology and behavior of safflower fly, *Acanthiophilus helianthi* Rossi (Diptera: Tephritidae) on safflower. Pakistan Entomologist 1: 64-69.
8. Weiss EA (2000) Oilseed crops. (2ndedn), Blackwell Science Ltd, oxfords.
9. Eghtedar E (1993) Review safflower fly, *Acanthiophilus helianthi* (Diptera: Tephritidae) in Fars province. Annual report office of Fars agricultural research center P1-15.
10. Sabzalian MR, Saeidi G, Mirlohi A (2008) Oil on tent and fatty acid composition in seeds of three safflower species. Journal American Oil chemistry Society 85: 717-721.
11. Behdad E (1984) Important pests of agricultural crops. Neshat publication. Esfahan, Iran.
12. Sabzalian MR, Saeidi G, Mirlohi A, Hatami B (2010) Wild safflower species (*Carthamusoxyacanthus*): A possible source of resistance to the safflower flies (*Acanthiophilus helianthi*). Crop Protection 29: 550-555.
13. Selim AA (1977) Insect pests of safflower (*Carthamus tinctorius*) in Mosul northern Iraq. Mesopotamia Journal Agriculture 12: 75-78.
14. Singh RN, Dass R, Singh RK, Gangasaran R (1982) Incidence of root fly, *Acanthiophilus helianthi* in safflower under rainfed conditions at Delhi. Indian Journal of Entomology 44: 408-412.
15. Gopaul S, Price NS (2002) Local Production of Protein Bait for Use in Fruit Fly Monitoring and Control. Indian Ocean Regional Fruit Fly Programme.
16. Ashri A (1971) Evaluation of the world collection of safflower, *Carthamus tinctorius* L. II, Resistance to the safflower fly, *Acanthiophilus helianthi* R. Euphytica 20: 410-415.
17. Keyhanian AK (2007) Seasonal abundance of the safflower fly, *Acanthiophilus helianthi* Rossi (Diptera: Tephritidae), an infestation on safflower, *Carthamus tinctorius* L. in Ghom province, Iran. Pajouhesh-va-Sazandegi 78: 57-62.
18. Hegazi EM, Moursi KS (1983) Studies on the distribution and biology of capsule fly, *Acanthiophilus helianthi* Rossi on wild plants in Egyptian western desert. Zeitchrift fur Angewandte Entomologie 94 : 333-336.
19. Bagheri MR (2007) Study on the biology of safflower shoot fly and its damages in spring culture in Esfahan (Iran) Final Report. Esfahan Agricultural and Natural Resources Research Center, 25 pages.
20. Jakhmola SS, Yadav HS (1980) Incidence of and losses caused by capsule fly, *Acanthiophilus helianthi* Rossi in different varieties of safflower. Indian Journal of Entomology 42: 48-53.
21. Vaishampayan SM, Kapoor KN (1970) Note on assessment of losses to safflower (*Carthamustinctorius*) by capsule fly, *Acanthiophilus helianthi* Rossi. Indian Journal of Agricultural Science 40: 29-32.
22. Talpur MA, Hussan T, Rustamani MA, Gaad MA (1995) Relative resistance of safflower varieties to safflower shoot fly, *Acanthiophilus helianthi* Rossi (Diptera: Tephritidae). Proc. Pakistan Conger. Zool. 15: 177-181.
23. Rezvani A (1981) Safflower fly, *Acanthiophilus helianthi* (Diptera: Tephritidae) Journal of Plant Pests and Diseases Research Institute 49: 35-44.
24. Bueno AM, Jones O (2002) Alternative Methods for Controlling the Olive Fly, *Bactrocera oleae*, Involving Semi chemical. IOBC wprs Bulletin 25: 1-11.
25. Witzgall P, Bengtsson M, Timbel RM (2000) Bait trap of safflower fly (Diptera: Tephritidae) Environ. Entomol 29: 233-236.