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Population densities *of* ***Liriomyza cicerina*** (Rondani, 1875) (Diptera: Agromyzidae) on ***Cicer arietinum*** L. (Leguminosae: Papilionoidea) in different irrigated conditions

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Summary

Liriomyza cicerina (Rondani, 1875) (Diptera: Agromyzidae) is an important insect pest on chickpea (***Cicer arietinum*** L.) (Leguminosae: Papilionoidea) in Şanlıurfa province, Turkey. This study was carried out during the production seasons of 2004 and 2005. The experiment was carried out with six different irrigation characters with three replicates. The experiment area was checked once a week during the entire production period starting with the sowing of seeds. Each week ten leaves were removed randomly from each of treated and non-treated replicates. During the growth season, periodical living larvae counts on leaves were made in the parcels of different irrigation levels. In addition, adult counts were made by means of a yellow sticky trap were placed randomly in each replicate. Yield results for each yearly period were also recorded. Results showed that, ***L. cicerina*** population was higher on character G, in which the irrigation level was higher than that of the experimental parcels. However, the population was over the economical damage threshold on all irrigation levels. On the other hand, yield was the highest, even over the region average, on high irrigation level parcels. Thus, it was concluded that, according to population and yield characteristics, the highest irrigation level used in G block, where chickpea yield rate was above the South East (GAP) region average, could be recommended.

Key words: ***Liriomyza cicerina***, population density, different irrigated levels, chickpea, Turkey

Anahtar sözcükler: ***Liriomyza cicerina***, populasyon yoğunluğu, farklı sulama seviyeleri, nohut, Türkiye

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Introduction

Turkey ranks as the third country in the world on chickpea production (Anonymous, 2005). Besides, 10 % of GAP region's agriculture is chickpea production (Anonymous, 2000 a). Chickpea, used for both human consumption and as forage plant for livestock, is an important plant, especially in the Mediterranean Region and India (van Rheenen, 1991). In those areas where chickpea is cultivated, ***Liriomyza cicerina*** (Rondani) (Diptera: Agromyzidae) must be considered as one of the most serious insect pests. The infestation of the plants is often severe and can strongly affect the vitality of the plants and reduce the amount and quality of the yield (Pastucha, 1996). The previously prevailing attempts to control measures have been screening for resistance against these efforts were partly successful (Weigand & Tahhan, 1990; Singh et al., 1998).

Leafminer pupation occurs in the soil. The number of generations is 2-4 depending on the availability of host plants and temperature (Lahmar & Zeouienne, 1990; Banita et al., 1992; Pastucha, 1996).

The chickpea leafminer is an important pest species in Aegean Region, Turkey that causes great damages on **Cicer *arietinum*** L. (Leguminosae: Papilionoidea) of Agean region (Lodos, 1962; Giray, 1970). Yabaş & Ulubilir (1992) reported that population fluctuations of chickpea leafminer (***L. cicerina***) was investigated in Kilis and central of Gaziantep province, and studies were conducted at three fields during the chickpea vegetation period. According to the sampling, the chickpea leafminer was present in whole vegetation period. The population reached the peak at the end of May synchronization with the blossom time of crop. Also, ratio of infected plant varied between 95-100 %.

Hıncal et al. (1996) reported that the adults of ***L. cicerina*** emerged in the second half of the April and the first half of the May when average temperature was 9.0-14.3 °C and the ground temperature was 19.2-21.2 °C. The larvae of ***L. cicerina*** appeared after 3-20 days of adult emergence when the plants were 5-10 cm high. The population densities of adults and larvae reached the maximum level two times in the season, one of them at the end of May, the second at the end of June.

It is also an important pest on chickpea in Şanlıurfa, Turkey. Generally, farmers apply insecticides more frequently and in large quantities to avoid the rapid increase in pest population in their field. Insecticides applied to control pests, especially those with systemic and translaminar properties, have a negative impact on beneficial fauna (Such as ***Diglyphus isaea*** Walker) (Hymenoptera: Eulophidae) feeding on the leafminer (Heinz & Chaney, 1995; Weintrab & Horowitz, 1996).

The objective of this study was to compare the population densities of adults ***L. cicerina*** on non-irrigated and different irrigation levels of chickpea. The

underlying aim of this study was to investigate the possibility of controlling the pest population via the control of irrigation level instead of synthetic pesticide applications. Based upon the obtained results, it is aimed to support more environmentally friendly chickpea production by reducing the use of insecticides for controlling pests.

Materials and Methods

Study site

This study was carried out during 2004-2005 in Şanlıurfa on seven different irrigated levels of chickpea plants grown area. The species examined was ***L. cicerina***.

Experiment area

Favorable climatic conditions in Şanlıurfa province allow to chick pea growing seasons every year from January to May and from March to June. In this study, chick pea seeds (ILC-482 variety) were sown simultaneously on 2nd of January in both years. The experimental design was the same for both seasons. Within the field, 7.2 m^2 plots were randomly designated to be treated with 6 different irrigation dosages. Each treatment and non-treated was replicated 3 times and trials were carried out over 2 years. Total experiment area was 1081.35 m^2. There was no any insecticide application throughout the production period.

Sampling

The experiment area was checked once a week during the entire production period starting with the sowing of seeds. Each week ten leaves were removed randomly from each of treated and non-treated replicates, and brought to the laboratory set to 25±2 °C temperature and 65±5% relative humidity. Leaves were examined under a stereo microscope and living larvae were counted and recorded.

Mass trapping and sampling

The traps used in the study were constructed from yellow plastic boards (20x15 cm). The boards were coated on both sides with a sticky coating. Twenty one yellow sticky traps were placed randomly in each replicate and changed weekly. The traps elevated 10 cm above the top of the plants. The number of flies caught on each side of the boards were counted and recorded weekly.

Statistics

Data were analyzed using one-way analysis of variance (ANOVA), and means were separated via Duncan's test, using SPSS 11.0 software program. All tests were conducted at $\alpha = 0.05$ significance level.

Results

Irrigation symbols, application numbers and times of the study carried out in 2004-2005 period is given in Table 1. Yearly precipitation levels and irrigation information are given in Table 2-3.

Table 1. Irrigation symbols, application numbers and times of the study carried out in 2004-2005 period

A	B	C	D	E	F	G
No irrigation (non-treated)	Irrigation before blossoming	Irrigation during blossoming period	Irrigation during capsulation period	Irrigation during pea growth	1.Irrigation during blossoming period 2.Irrigation during pea growth	1. Irrigation before blossoming 2. Irrigation during capsulation period 3. Irrigation during pea growth

Table 2. Amount of precipitation and irrigation water, and date of irrigation (mm/ m^2) in 2004

Precipitation (mm/ m^2)							
	January	February	March	April	May	Total	
	96.4	64.9	0.4	30.3	6.9	198.9	
Irrigation Amounts (mm/ m^2)							
Date of Irrigation	A	B	C	D	E	F	G
02.04.2004	-	81.87	-	-	-	-	81.87
15.04.2004	-	-	157.06	-	88.00	157.06	-
10.05.2004	-	-	-	176.80	-	-	186.58
18.05.2004	-	-	-	-	173.39	147.44	88.00
Total	-	81.87	157.06	176.80	253.39	304.50	356.45

Table 3. Amount of precipitation and irrigation water, and date of irrigation (mm/ m^2) in 2005

Precipitation (mm/ m^2)							
	January	February	March	April	May	Total	
	82.7	68.8	29.7	24.3	2.3	207.8	
Irrigation Amounts (mm/ m^2)							
Date of Irrigation	A	B	C	D	E	F	G
02.04.2005	-	81.87	-	-	-	-	81.87
15.04.2005	-	-	157.06	-	88.00	157.06	-
10.05.2005	-	-	-	176.80	-	-	186.58
18.05.2005	-	-	-	-	173.39	147.44	88.00
Total	-	81.87	157.06	176.80	253.39	304.50	356.45

As it can be seen from Table 2 and 3, total precipitation levels were 198.9 mm/ m^2 and 207.8 mm/ m^2 in the years of 2004 and 2005, respectively. The amount of irrigation water was fixed in both years. During the production season of the years of 2004 and 2005, the number of living larvae taken weekly from 10 leaves on each replication and the number of adults on one sticky yellow trap of each replication are given in Table 4.

As it can be seen from Table 4, in 2004, the lowest living larvae/leaf number was recorded in character A where irrigation level was zero. Character B followed this with the irrigation level of 81.87 mm/m^2. On the other hand, the highest number of living larvae/leaf was recorded on character G where it was irrigated 3 times to the level of 356.45 mm/m^2. Statistically, there was no difference among characters E, F and G in terms of living larvae/ leaf numbers ($P<0.05$). Similarly, lowest adult numbers were recorded on character A. It was followed by characters B, C, E and D.

Table 4. Average number of live larvae and adults of ***Liriomyza cicerina*** (Rond.) in different irrigation levels

	2004		2005	
	Larvae/7.2 m^2	Adult/trap	Larvae/7.2 m^2	Adult/trap
A	1.8733±0.69 a	24.7±3.43 a	1.8262±0.77 a	26.9±4.18 a
B	2.0956±0.74 ab	33.2±5.51 ab	2.0405±0.69 a	34.4±5.37 ab
C	2.3486±0.87 b	42.2±6.59 ab	1.8833±0.60 a	39.6±6.04 ab
D	3.5133±0.17 c	42.2±8.41 ab	2.9667±0.14 b	40.7±8.11 ab
E	4.4756±0.20 d	37.4±8.88 ab	3.7548 ±0.17 c	32.6±7.88 ab
F	4.5444±0.21 d	58.6±12.97 b	3.2571±0.18 b	51.4±14.18 ab
G	4.6822±0.20 d	63.3±17.17 b	4.7952±0.22 d	60.7±15.12 b

Different letters within a column indicate differences of $P < 0.05$.

Statistically, the number of adults per trap was not different among these characters ($P<0.05$). Whereas, on characters F and G, in which irrigation levels were highest among all characters, the number of adults per trap was the highest.

In 2005, the lowest living larvae per leaf was recorded on character A. It was followed by characters C and B and there were no statistical difference among characters A, B and C in terms of numbers ($P < 0.05$). The highest number of living larvae was recorded on character G. Similarly, in 2005, the lowest number of adult per trap was on character A while the highest number was achieved on character G. There was no statistical difference among the other characters ($P < 0.05$).

The yield data for the years 2004 and 2005 are given on Table 5.

Table 5. Average yield data (± S.E.) for different irrigation levels in 2004-2005 (kg/da)

	2004	2005
A	150±9.00 a	150.6±9.68 a
B	176.3±4.41b	177.3±4.05 b
C	170.3±11.31 ab	171.0±10.69 ab
D	177.0±4.58 b	177.0±4.58 b
E	149.0±1.73 a	150.0±1.73.a
F	177.6±6.17 b	177.6±6.17 b
G	246.6±5.20 c	247.0±4.72 c

Different letters within a column indicate differences of $P < 0.05$.

As it can be seen from Table 5, yield values for both years are very close to each other. The lowest yield was achieved on character A with zero irrigation and character E with 253.9 mm irrigation; while the highest yield was recorded with the character G.

Discussion

It is deduced that the lowest leafminer damage but also the lowest yield was observed on chickpea which received no artificial irrigation, but only natural precipitation. This study showed that increase in irrigation level increased the number of larvae and adult; however, this increase did not result in loss of yield. Furthermore, as it can be seen on Table 4, increased irrigation level, also increased the yield. The economical damage threshold of ***L. cicerina*** is 50 % infestation. The plant is considered to be infested when it has 2-3 larvae (Anonymous, 2000 b). The observations showed that in all levels and all replications, plants were more than 50 % infested; thus, the pest population was over the threshold. This result lead to a conclusion that there is no need to lower the irrigation since less irrigation does not affect pest level, which is already over the threshold, and there seems to be no need to also lower the yield. On the other hand, yield was the highest, even over the region average, on high irrigation level parcels. The regular yield level of chickpea in GAP region is 108 kg/da, while all experimental plots had a higher yield (Anonymous, 1998). Therefore, it can be said that chickpea production in the region should be done with irrigated agriculture techniques.

Unfortunately, there is no literature that will allow for a comparison of the results of this study. Some studies are related to resistance of pesticides against ***Ascochyta rabiei***, ***Fusarium oxysporum*** f.sp. ***ciceris*** (Sequeira et al., 2001; Ilarslan & Dolar, 2002) and ***Heliocoverpa armigera*** Hübner (Lepidoptera: Noctuidae) (Ramasubramanian & Regupathy, 2004) on chickpea.

To summarize, this study was carried out to investigate the effects of different irrigation levels on population densities of ***L. cicerina***, and possibility of controlling of this the most harmful pest species on chickpea. Results indicated that irrigated agriculture techniques can be utilized in chickpea production. Because of the fact that in both irrigated and non-irrigated parcels, the economical damage threshold was passed and farmers make at least two pesticide applications every production period. Moreover, low or zero irrigation clearly lowered the yield. Thus, when economical conditions considered, in GAP region chickpea production, it is recommended to utilize the irrigation level studied on character G which gives over 2.5 times more yield than that of GAP region.

Özet

Farklı sulama koşullarında *Liriomyza cicerina* (**Rondani, 1875)** (Diptera: Agromyzidae)**'nın Nohuttaki (***Cicer arietinum* **L.) (Leguminosae: Papilionoidea) populasyon yoğunluğu**

Liriomyza cicerina (Rondani, 1875) (Diptera: Agromyzidae) Şanlıurfa ili nohut üretim alanlarında önemli bir zararlıdır.

Bu çalışma 2004-2005 yıllarında nohut üretim periyodunda gerçekleştirilmiştir. Deneme üç tekkerürlü ve altı farklı sulama koşullarında yürütülmüştür. Yetiştirme periyodu

süresince haftalık olarak farklı sulama seviyesine sahip her parselden tesadüfi olarak on yaprak alınarak bulaşık yapraklardaki canlı larva sayımı yapılmıştır. Ayrıca her tekerrüre yerleştirilen sarı yapışkan tuzaklarla da ergin sayımı yapılmıştır. Her yıl için farklı sulama koşullarındaki verim değerleri alınarak kaydedilmiştir. Elde edilen sonuçlara göre sulama seviyesinin en yüksek olduğu G bloğunda ***L. cicerina*** populasyonu sulamanın yapılmadığı veya sulama seviyesinin düşük olduğu parsellerden daha yüksek bulunmuştur. ***L. cicerina*** populasyonu tüm sulama seviyelerinde ekonomik zarar eşiğinin üzerinde saptanmıştır. Sulama seviyesinin en yüksek olduğu parsellerde verim Güney Doğu Anadolu (GAP) bölge ortalamasının üzerinde alınmıştır. Böylece, ***L. cicerina*** populasyonu ve verim karakteristiklerine göre, nohut veriminin GAP bölgesi ortalamasının üzerinde olduğu G karekterinde kullanılan en yüksek sulama suyu seviyesinin önerilmesi gereği sonucu elde edilmiştir.

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