Field Assessment of the Mass Trapping Technique for the Control of the Chickpea Leaf Miner *Liriomyza cicerina*

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ABSTRACT

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This work evaluated the chickpea leaf miner *Liriomyza cicerina* mass trapping technique as an alternative to insecticide spraying. A trap density of 2000 per ha was used. Trials were conducted in Beja during 2015 and 2016 using Nour variety. Leaves were sampled weekly from all treated and control plots and observed under binocular microscope. Regarding the reduction in infestation at harvest, results showed reductions of 20.11 and 18.13% respectively for chemical and mass trapping treatments compared to control. Efficacy also was assessed on the basis of captures and infestations reductions compared to control, the yield and 100-seeds weight. Results showed significant difference (at $P < 0.05$) between treatments, with 0.21 kg/m² grain yield for the control and 0.8 kg/m² for the chemical treatment and the mass trapping. Also, regarding the 100-seeds weight, it was 21.5g for the control and respectively 38.2 and 41.7 g with the chemical treatment and the mass trapping.

Keywords: Chickpea leafminer, deltamethrin, *Liriomyza cicerina*, mass trapping

The chickpea leafminer *Liriomyza cicerina* is an important insect pest attacking both spring and winter-planted chickpea (Bouhssini et al. 2008). It is widespread serious pest in Europe and North Africa, particularly Morocco and Tunisia (Çikman et al. 2008; Reed et al. 1987; Spencer 1976). The damage is caused by the larvae, which feed on the leaf mesophyll tissue, resulting in hole, galleries and premature leaf fall (Çikman 2006). Chickpea leaf miner causes yield reductions that can reach 40% (Reed et al. 1987). This insect pest can be controlled using various methods including insecticides (Çikman et al. 2011) and control practices like mass trapping (Çikman and Kaplan 2008). The aim of this research was to evaluate the impact of mass trapping technique used at the density of 2000 yellow sticky plastic traps/ha on the reduction of the infestation level and yield. Chemical treatment using Deltamethrin 25 ml/100 liters water and untreated plots served as control.

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MATERIALS AND METHODS

Study site and plant material.

This study was carried out during 2015 and 2016 in Beja site (North-west

Tunisia, 36°44'56.83"N 9°12'50.24"E). Trials were conducted in the experimental station of the Regional Center of Research on Field Crops (CRRGC). The experimental plan was identical for both seasons. Inside the field, 30 m² plots were randomly selected consisted of 30 rows each 4 m long. Each treated and untreated plot was replicated 3 times and trials were carried out during two years 2015 and 2016. Total experiment area was 270 m². There was no fertilization and no watering application during production period. The winter chickpea variety Nour (Pedigree: X96TH61-A3-W1-A2-W1-A1-W1-W1) was used for these trials. Chickpea has been sown on 25 December 2015 and 15 January 2016 at a density of 30 seeds per m² and no fertilization was applied during the season crop on both years.

Mass trapping trials.

A density of 2000 traps/ha was assessed. Traps were constructed from yellow plastic boards (20 × 15 cm) with a sticky coating. Traps were elevated 10 cm above the top of the plants as described by Çikman and Kaplan (2008) when plants height was 10 cm. Traps were checked once a week and changed weekly. Moreover, 6 traps were placed respectively in the field where 1 trap per 5 m² was placed in the middle (1 traps per 150 plants) to monitor *L. cicerina* adults. Trials were carried out in 3 plots of 30 m^2 each. Mass trapping efficacy was assessed on pest infestation means of larvae, emerged adults and chickpea yield. The traps were placed on 1st February on 2015 and 10 February on 2016. For treated plots with chemical spray and untreated plots, 1 trap was placed for the control of emerged adults' number.

Chemical treatment.

Deltamethrin (Decis® EC 50, Bayer Crop Science, France) was used at the dose of 25 ml/100 l water. Treatments were applied when the pest density reached a level of 2-3 larvae/leaf in 50% of plants in the field (Çikman and Kaplan 2008). Thus, three sprays were realized on 23 April, 20 May and 4 June in 2015, and 15 April, 15 May and 30 May in 2016. Untreated plots with no chemical sprays served as control. Infestation percentage, emerged adults and chickpea yield were noted.

Infestation assessment.

Thirty leaves were randomly sampled from each plot weekly starting from March to June. Samples were checked under binocular and the infestation percentage was determined according to the following formula (Toker et al. 2010):

$$Infestation\ (\%) = \frac{\text{Number of infested leaves}}{Total\ number\ of\ leaves} * 100$$

$$Reduction(\%) = 1 - \frac{\%\ infestation\ intreated}{\%\ infestation\ in\ control}$$

Yield assessment.

Grain yield per m^2 (GY/m^2) and 100-seed weight (100 SW) were determined in three replications for each plot.

Statistical analysis.

Statistical analyses were performed using the "SPSS statistical software version 20.0". Presented values were the average of three replications and were expressed as the mean ± standard deviation ($\bar{x}$ ± SD). Significant differences between the mean values ($P \leq 0.05$) were determined based on Duncan's Multiple Range test.

RESULTS

Effect of mass trapping and chemical treatments on chickpea leafminer infestation

Infestation was recorded weekly starting from the beginning of *L. cicerina* attacks on the 1st week of March during 2015 and 2016. Table 1 reports the average number of live larvae of *L. cicerina* on chemically treated plots, untreated plots and those with mass taping during March, April and May in 2015 and 2016 years.

As shown in Table 1, the highest infestations were recorded in control plots during May for both years. Infestations reached 50.6 and 57.3% for 2015 and 2016, respectively. However, plots treated with mass trapping and insecticide (Deltamethrin) showed lower infestations (Table 1). As it can be seen from these results, control plots' infestation level was 2-3 times higher than insecticide-treated plots and 1.5 times than mass trapping managed plots. Statistical analysis revealed significant differences between untreated (control) and treated plots (mass trapping and insecticide). Moreover, for results pointed out at the beginning of the infestation (March for both years), no significant differences were detected between mass trapping and insecticide-based treatment. However, when the insect populations increased during April and May, significant differences were thus observed between mass trapping and insecticide treatment. Best performances were achieved for the chemical control since infestations did not exceed 24% while they reached 42% for mass trapping treatment (Table 1).

Table1. Impacts of mass trapping and insecticide treatment on Nour chickpea variety infested by *Liriomyza cicerina* in Beja during 2015 and 2016 (Mean of larvae ± Standard Error/leaf)

Treatment	2015			2016		
	March	April	May	March	April	May
Control	8.9 ± 1.3 b	27.2 ± 1.2 c	50.6 ± 2.4 c	8.0 ± 0.0 b	28.3 ± 0.55 c	57.3 ± 0.57 c
Mass trapping	6.4 ± 0.7 a	22.0 ± 0.3 b	35.3 ± 1.1 b	5.3 ± 0.57 a	17.3 ± 0.75 a	42.0 ± 0.0 b
Deltamethrin	5.1 ± 0.6 a	15.0 ± 0.7 a	23.4 ± 0.5 a	5.3 ± 0.57 a	15.3 ± 0.57 a	22.3 ± 0.57 a

In each column, means followed by the same letter are not significantly different according to Duncan's Multiple Range test at $P < 0.05$.

Effect of mass trapping and chemical sprays on the reduction of *L. cicerina* populations.

Table 2 reports the results of the impact of mass trapping and insecticide treatment on the chickpea leafminer populations' reductions.

Table 2. Impact of mass trapping and insecticide treatment on reduction of *Liriomyza cicerina* infestation (%) on Nour chickpea variety in Beja during 2015 and 2016

Treatment	2015			2016		
	March	April	May	Marh	April	May
Mass trapping	2.52 a	5.18 a	15.32 a	1.79 a	6.97 a	15.04 a
Deltamethrin	2.23 a	12.25 b	29.44 b	2.22 a	15.03 b	34.92 b
Control	0 b	0 c	0 c	0 b	0 c	0 c

In each column, means followed by the same letter are not significantly different according to Duncan's Multiple Range test at $P < 0.05$.

Results showed interesting reductions in *L. cicerina* populations due to mass trapping and insecticide treatment. Furthermore, results indicated that the reduction varied according to the increase of the pest population. Indeed, during March, when the infestation is still at the beginning, reductions reached only 2.52 and 2.23% during 2015 and 1.79 and 2.22% during 2016, respectively, for mass trapping and insecticide treatment. However, reductions were more interesting at May for insecticide treatment with respective values of 29.44 and 34.92% during 2015 and 2016.

As shown in Table 2 for means separated based on Duncan's Multiple Range test, there was no significant difference on reduction percentage during March for both years 2015 and 2016 between plots with mass trapping and chemical spray. However, there was significant difference between mass trapping and Deltamethrin treatment during April and May.

Effect of mass trapping and chemical treatment on chickpea yield.

Effects of mass trapping and chemical treatment on *L. cicerina* adult density and chickpea yield (Grain yield per m^2 (GY/m^2) and 100-seed weight (100 SW)) are illustrated in Tables 3 and 4.

Table 3. Average number of *Liriomyza cicerina* adults by weekly count (lowercase letter) and Duncan groups (uppercase letter) during 2015 and 2016

Treatment	2015			2016		
	March	April	May	March	April	May
Control	17.7±1.5 aB	52.6±3.5 bB	78±2 cB	15.7±1.5 aB	52.6±6 bB	81.3±6 cB
Mass trapping	9±1 aA	31±1 bA	47.3±1.5 cA	9.3±0.6 aA	29±1 bA	48.3±1.5 cA
Deltamethrin	7.6±1.5 aA	25.7±4.9 bA	45.3±3 cA	8.7±0.6 aA	27±3 bA	45±2 cA

In each column, means followed by the same letter were not significantly different according to Duncan's Multiple Range test at $P < 0.01$.

During March, the mean number of fly adults was low in plots, and increased progressively in April to reach the peak in May for both years 2015 and 2016. As shown in Table 3 for Duncan groups, it was determined that there was no significant difference between years (df = 1, F = 0.14, $P > 0.05$). A significant difference was noted between months (df = 2, F = 1148.61, $P < 0.01$) and between treatments (df = 2, F = 345.9, $P < 0.01$). Number of adults per traps was not significantly different in mass trapping and Deltamethrin treated plots, and there was a significant difference between control and treated plots in both years.

Table 4. Impact of mass trapping and insecticide treatment on *Liriomyza cicerina* on Nour chickpea variety grain yield (GY) and 100-seed weight (100 SW) in Beja during 2015 and 2016

Treatment	2015		2016	
	GY (kg/m^2)	100 SW (g)	GY (kg/m^2)	100 SW (g)
Control	0.34 ± 0.02 a	21.56 ± 0.15 a	0.21 ± 0.02 a	23.13 ± 0.25 a
Mass trapping	0.80 ± 0.01 b	38.56 ± 1.33 b	0.81 ± 0.01 b	38.2 ± 0.41 b
Deltamethrin	0.83 ± 0.02 b	39.7 ± 0.55 b	0.82 ± b	41.7 ± 1.10 c

In each column, means followed by same letter were not significantly different according to Duncan's Multiple Range test at $P < 0.05$.

Results showed that yield values were higher for treated plots (mass trapping and insecticide treatment) compared to control. Statistical analysis showed significant differences between grain yield and 100-seed weight values of control and both treatment. It appears that mass trapping and insecticide treatment preserve grain weight during 2015 and 2016. In this respect, no statistical differences were observed between grain yield and 100-seed weight values between mass trapping and insecticide treatment. Results indicated that *L. cicerina* infestations had an effect on chickpea yield that could be reduced by more than 50% using both management methods.

DISCUSSION

L. cicerina is an important insect pest on chickpea plants (Çikman 2006). Adults emerged from March until June (Soltani et al. 2016). Previous works indicated that *L. cicerina* is a serious pest of chickpea in Tunisia (Soltani et al. 2016). Thus, control methods should be implemented. Bouhssini et al. (2008) reported that Deltamethrin had an impact in limiting *L. cicerina* populations. On the other hand, Arida et al. (2007) demonstrated that yellow sticky board traps could be incorporated in the management strategy against leaf miner adults under field conditions. The present study revealed that both mass trapping and Deltamethrin-based treatments significantly reduced *L. cicerina* damage on chickpea leaflets. However, Deltamethrin significantly reduced more the number of alive larvae compared to mass trapping and control. Yield losses are likely to appear due to damage caused by *L. cicerina* larvae and adults which could be eliminated by applying insecticides (Çıkman et al. 2011). This study pointed out that *L. cicerina* led to significant yield loss on chickpea winter crops (Nour variety). Additionally, this study showed that insecticide and mass trapping treatments displayed an important role to reduce pest losses.

Regarding the above results, mass trapping could well be used to control *L. cicerina* populations. Mass trapping should be taken into consideration in IPM studies and recommended for farmers to use when low pest populations densities occur.

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RESUME

Soltani A., Amri M. et Mediouni-Ben Jemâa J. 2018. Évaluation aux champs de la technique de piégeage de masse pour la lutte contre la mineuse du pois chiche *Liriomyza cicerina*. Tunisian Journal of Plant Protection 13 (si): 107-112.

Ce travail constitue une évaluation de la technique de piégeage de masse contre la mineuse du pois chiche *Liriomyza cicerina* comme une alternative à la pulvérisation d'insecticide. Les essais ont été menés à Beja en 2015 et 2016 en utilisant la variété Nour. Les feuilles ont été échantillonnées chaque semaine à partir de toutes les parcelles traitées et témoins et observées sous loupe binoculaire. En ce qui concerne la réduction de l'infestation à la récolte, les résultats ont montré des réductions de 20,11% et 18,13% respectivement pour les traitements chimiques et de piégeage de masse par rapport au contrôle. L'efficacité a également été évaluée sur la base des captures et les réductions d'infestations par rapport au témoin, le rendement et le poids de 100 grains. Les résultats ont montré une différence significative (à $P < 0,05$) entre les traitements avec un rendement de 0.21 kg/m² pour le témoin et 0.8 kg/m² pour le traitement chimique et le piégeage de masse. Egalement pour le poids de 100 graines, il

était de 23.1 g pour le témoin et respectivement 38.2 et 41.7 g pour le traitement chimique et le piégeage de masse.

Mots clés: Deltaméthrine, *Liriomyza cicerina*, mineuse du pois chiche, piégeage de masse

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ملخص

سلطاني، عبير ومعز عمري وجودة مديوني بن جماعة. 2018. تقييم حقلي لتقنية الصيد المكثف لمكافحة حشرة نافقة أوراق الحمص *Liriomyza cicerina* . Tunisian Journal of Plant Protection 13 (si): 107-112.

يشكل هذا العمل تقييما لتقنية الصيد المكثف ضد نافقة أوراق الحمص *Liriomyza cicerina* كبديل للمداواة الكيميائية. أجريت التجارب في باجة في عامي 2015 و 2016 باستخدام صنف "نور". أخذت عينات من الأوراق أسبوعيا للمراقبة تحت العدسة المكبرة. أظهرت النتائج في ما يتعلق بالحد من الإصابة انخفاضا بنسبة 20,11% و 18,03% على التوالي في الحقل المُعامل كيميائيا والصيد المكثف. كما جرى تقييم الفعالية حسب عدد الحشرات المسجلة وانخفاض نسبة الضرر والانتاجية ووزن 100 حبة. بينت النتائج أن هناك فرق معنوي ($P < 0,05$) بين المعاملات حيث كانت انتاجية الحب 0.21 كغ/م² بالنسبة للشاهد و 0.8 كغ/م² بالنسبة للمعاملة الكيميائية والصيد المكثف. كذلك في خصوص وزن 100 حبة، كان 23.1 غ لدى الشاهد وعلى التوالي 38.2 و 41.7 غ بالنسبة للمعاملة الكيميائية والصيد المكثف.

كلمات مفتاحية: دلتامترين، صيد مكثف، نافقة أوراق الحمص، *Liriomyza cicerina*

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