Eco-Friendly Control Strategy Based on Sex Pheromone and/or Aggregation Traps; Sequence of Partial Chemical Sprays on Two Grape Varieties Against *Ceratitis Capitata* Wied. (Diptera: Trypetidae)

Magdy A. Massoud, H. A. Mesbah, E.A.A. Abd-Elhaq and A.S.A. Saad

Plant Prot. Dept., Fac. of Agric. Saba Basha, Alex. Univ.

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ABSTRACT: Field experiments were conducted in a private vineyard located at kilo 54th Cairo-Alexandria Desert Road in the New Sphinx City, Cairo, Egypt, throughout two successive seasons (2020 and 2021). The present investigation was adopted for attaining eco-friendly, and safer protection strategy for controlling fruit of fly *Ceratitis capitata* on grape by mass attracting traps. Also, the study aimed to determine the susceptibility of two seedless grape varieties, representing white- and red grape, to fruit fly infestation. Three types of mass attracting traps namely: Jakson, McPhail and Fly CAP were experimented for catching medfly adults. Moreover, sequence of partiall sprays of Buminal with one of two insecticides (Malathion 57% and/or Tracer 24%) that concurrently used with used traps were also evaluated. Generally, caught fruit flies started from the third decade interval (21st: 30th of April) and continued up to the end of May. Meanwhile, the highest mean of G-FTD was observed through the first decade of May, especially in the white grape variety (21.33 and 9.78 in seasons 2020 and 2021, respectively). The results indicate that, thin thickness of fruit skin and/or the white yellowish color of grape berries could enhance a high attraction of the Medfly, more than that of red grape berries.

Jackson paper yellow trap showed an early high ability in capturing the fruit fly at the beginning of the 2nd decade of April. Meanwhile, McPhail trap was the superior tested throughout the preharvest interval. Also, the results strongly indicate that both insecticides (malathion and Spinosad) that mixed with Buminal used in the partial sprays could increase the insect's orientation to food baits in Fly CAP and McPhail traps. It is clear that applying partial spray treatment concurrently with attracting traps highly decreased the mean number of captured medflies indicating a good Eco-friendly strategy to control this insect pest.

Keywords:*Grapes, Prime, ARRA 13, Mediterranean fruit fly, biological traps, Fly Cap, Jackson, Fly CAP, Spinosad, Malathion, Buminal.*

INTRODUCTION

Grapes are one of the most commonly produced fruit crops in the world and are consumed as table grapes, wine grapes and dried grapes. In line with consumer demands, seedless grape varieties continue to be an important feature that increases the chances of marketing grapes. In addition, the demand for seedless varieties has increased steadily in the table grape trade over the years **(Akkurt *et al.*, 2019)**.

Grapes are Egypt's second largest crop after citrus fruits in terms of cultivated area and productivity **(El-Banna and Lo'ay, 2019**), where 73,351 hectares of land are used for the production of 1,626,259 tons of grapes **(FAOSTAT, 2019)**. Numerous Seedless grape species mature and ripen throughout the growing season (March to November) (**El-Hady *et al.*, 2014)**, which makes them ideal for cultivation on newly created sandy lands (**Kelany *et al.*, 2011)**.

Prime grapevine is a large seedless berry with a creamy white color. Prime is a very early ripening cultivar, has an amber color, a Muscat flavor, crisp taste and excellent shelf life **(Perl *et al.*, 2003).** Another grape variety is ARRA 13 which is red seedless, early harvest with a sweet neutral taste, berry size as 12-22 mm, and its texture is fleshy and need very high fertility.

The Mediterranean fruit fly *Ceratitis capitata* (Wiedemann), is a key pest of citrus fruit (Sapindales: Rutaceae), and can infect over 300 other economically important fruit-bearing plant species globally. The Mediterranean fruit fly moves to different hosts continuously and has 8–10 overlapping generations a year in Egypt. The

female lays the eggs under the fruit peel and hatched larvae use anterior mouth hooks to vigorously feed on fruit flesh until they reach the third and last instar **(Abd-Elgawad, 2021).**

In Egypt, there are approximately 0.65 million hectares of fruit crops yielding 12 million tons of fruit yearly. Annually *C. capitata* and *B. zonata* cause damage to 2.5 million tons of these fruits **(Abou-Saddam, 2021).** The infestation rates of fruit fly species may be as high as 30–40% in Egypt, with an annual loss of 177 million US $ **(Mahmoud *et al.*, 2017).**

A few insecticides are recommended for use in Egypt, but partial spray application is mandated by the Egyptian MOA **(Anonymous, 2018).** Unlike the previously used approach of covering whole crops, partial spraying uses a volume of insecticide solution as low as 50 ml per tree to reduce the adverse environmental and economic consequences of excessive chemical insecticide application **(Mahmoud *et al.*, 2017).**

Chemical treatment threshold levels have been reduced to 0.5 female or one male/trap/day **(Rachid and Ahmed, 2018).** These levels of Mediterranean fruit fly catches are defined for some trapping systems **(Manrakhan, 2016)** to determine the appropriate method and intensity of pest control; they should be similarly applied to various baits and lure-based trapping systems.

Eco-friendly control strategies for *C. capitata* typically involve baits and lure-based trapping systems. Chemical used as host or food baits or aggregation and sex pheromone lure in designed traps for specific goals are continually being improved to offer longer-lasting protection and greater safety **(IAEA, 2003, Ekesi *et al.*, 2016 and Gazia, 2020).**

The McPhail trap used with protein baits to attract both sexes, while the Jackson traps are usually used with trimedlure to attract males. Food baits combined with fruit juices, protein or hydrolyzed protein solutions, or fermenting sugar solutions are often used to capture adult fruit flies but tend to attract more females than males **(Ekesi *et al.*, 2016).**

In many countries, field control of *C. capitata* adults involves spraying plants with insecticides (often organophosphates, pyrethroids, and spinosad) mixed with protein baits **(Rachid and Ahmed, 2018 and CABI, 2020)** or spraying the soil to kill fallen larvae and pupae **(Stark and Vargas, 2009).** Medflies may be attracted to trapping systems that release ammonia and trimedlure, which achieve chemo-sterilization by inhibiting insect growth and reducing the viability of eggs laid by exposed females or females that have mated with exposed males **(Smith, 2020).**

Therefore, the present investigation was adopted for determining the susceptibility of two seedless grape varieties infestation with the fruit fly *Ceratitis capitata* as well as evaluating a control strategy by using three lure-based traps concurrent used with sequenced partial chemical sprays to offer longer-lasting protection and greater safety against this insect pest.

MATERIALS AND METHODS

Field experiments of mass attracting traps were carried out in a private vineyard located at kilo 54th Cairo-Alexandria Desert Road in the New Sphinx City, Cairo, Egypt, throughout two successive seasons (2020 and 2021). The present investigation was adopted for attaining eco-freindly safe control fruit of fly *Ceratitis capitata* on grape by mass attracting traps, and determining the susceptibility of two grape varieties to infestation with fruit fly infestation. Two types of grape varieties were used lonely, Prem Seedless and ARRA13, representing the white grape and red grape, respectively. Besides, the mixed trees of both varietes.

Also, three types of mass attracting traps namely: Jakson (Methyl eugenol), McPhail (Diammonium phosphate) and Fly CAP 48.21% VP (Diaminopentane + Ammonium acetate + Trimethylamine hydrochloride) were experimented and evaluated for catching medfly adults.

Moreover, sequence of partiall admixted sprays of Buminal with one of two insecticides (Malathion 57% and/or Tracer 24%) that concurrently used with used traps were also evaluated.

So, this experiment consisted of eight treatments arranged in a spilt plot design, each tricely replicated with one tree for each replicate. Noteworthy, the tested traps were used in the 1st season, meanwhile, the efficacy of traps alone and/or concurrently with the used partial sprays were evaluated in the 2nd season.

Experimental design:

The experiment was arranged in spilt-spilt plot design, emplied 8 treatments; each treatment comprised three trees, randomly arranged in blocks. In the 1st season, the applied treatments were arranged as follows:

1) Main plots (grape varieties)

a. White grape (Prem)
b. Red grape (ARRA 13)
c. Mixed of both varieties

2) Sub-plots (traps)

1. Methyl eugenol (Jakson trap)

Chemical name (IUPAC): 4-Allyl-1,2-dimethoxybenzene

Methyl eugenol is a natural chemical compound classified as a phenylpropene, a type of phenylpropanoid. It is the methyl ether of eugenol and is important to insect behavior. Jackson traps are the most commonly used traps for detecting invasive fruit fly male species, including *C. capitata* **(FAO/IAEA, 2018).**

Jackson yellow-paper traps are placed as pheromone to attract male insects. One is placed in the middle of every five acres at 170 cm above the surface of the earth; merely at the level of clusters. Remarkdly, in this type of trays the sexual pheromone (methyl eugenol) is placed in it to attract males and an adhesive substance is painted on suface of the paper trap in order to inhance the flies to be stuck in it.

2. Diammonium phosphate (McPhail trap)

Chemical name (IUPAC): diammonium hydrogen phosphate (DAP)

It is one of a series of water-soluble ammonium phosphate salts that can be produced when ammonia reacts with phosphoric acid. The so called McPhail trap consists of jar with holes filled with attractant liquid salt. The attractant liquid salt is a food attractant, in which diaminophosphate (DAP) is placed at a rate of 200 cm with concentration 30% (3g/100cm water). The traps are placed at a distance of 25 m from each other and at a height of about 170 cm above the surface of the earth, and 20 cm apart from the wire of the grape cube. The traps were constantly supplied with liquid solution, and an acre needs 20 traps with a total of 100/5fed.

3. Fly CAP 48.21% VP (Bucket trap)

Formulation: Steam diffuser product (VP)
Active Ingredient (s): 0,19% Diaminopentane + 43,49% Ammonium acetate + 4,1% Trimethylamine hydrochloride.

It is a specific mass trap used for the control of the females and males of the C. *capitata*. The Fly CAP trap contains a mixture of ammonium salts and amines, smells out, attracts males and females and changes every month. The traps (15 traps/fed.) were placed at a distance of 30-50 m from each other and at a height of about 170 cm above the surface of the earth, at 20 cm from the wire of the grape cube,.

The three types of traps were set in the field for 50 days starting from the 9th of April up to the 30th of May in both seasons and captures were evaluated for every 10 days. The recorded data included the total caught insects; total medflies males and females.

Number of caught medflies was used to calculate the index of Fly-Trap-Day (FTD) according to the equation of **Enkerlin *et al*. (2015).**

F.T.D = F/(TxD)

Where:
F= Total number of flies
T= Number of serviced traps
D= Average number of days traps were exposed in the field

3) Sub-sub plots (Foliar)

1. Non-partial spray
2. Partial spray

Partial insectide/protein spray:

Two admixtures of partial sprays were adopted sequentially 8 times with an interval of 7 days that concurrent with the attracting traps. The 1st admixture (Buminal + Malathion 57% EC) was applied 4 times from April the 10th up to May the 1st. Thereafter, the 2nd admixture (Buminal + Tracer 24% SC) was sprayed 4 times started from May the 8th up to May the 29th with the same intervals. The mixture consisted of one liter of Buminal + 350 ml of either Malathion or Tracer and completed to 20 liters with water in a Knapsack sprayer.

Statistical analysis:

Results of the measured parameters were subjected to computerized statistical analysis using MSTAT package for analysis of variance (ANOVA) and means of treatments were compared using LSD at 0.05 according to **Snedecor and Cochran (1990).**

RESULTS AND DISCUSSION

The research deals with studying susceptibility of white and red seedless grape varieties to the fruit fly infestation and evaluating the efficacy of different attracting mass traps concurrent with applying sequence of partial sprays for controlling fruit fly *Ceratitis capitata* during two growing season of 2020 and 2021. The major aim of the adopted study is to achieve longer-lasting and safer protection strategy for controlling fruit fly *Ceratitis capitata* on white and red seedless grape varieties.

1) The 1st season of 2020:

A) Susceptibility of white and red grape varieties to the fruit fly infestation and efficacy of three mass attracting traps throughout the following decades of pre-harvest 50 days

Data in **Table (1)** represent the mean number of total captured fruit flies per trap per day during five decades of 10 days-intervals in each grape variety and/or in both the mixed cultivated varieties by all the evaluated three types of traps (Grand-FTD). Also, the data represent the G-FTD of each tested type of attracting trap, that captured from each of both and/or the mixed tested varieties.

In general, the caught fruit flies started from the second decade interval (21st: 30th of April) and continued up to the end of May. Meanwhile, the highest mean of G-FTD was observed through the first decade of May, especially in the white grape variety (21.33) and the mixed cultivated white and red varieties (5.89).

In respect to the susceptibility of examined grape varieties, the seedless white grape variety (Prem) was more susceptible to the fruit fly infesting more than the red one (ARRA 13) and/or their mixed varieties. Whereas, the estimated values of the G-FTD were significantly higher (0.11, 21.33, 12.22 and 7.33) throughout those recorde for four following decades from April the 21st up to May the 30th, respectively, than the red grape variety, ARRA 13, (0.11, 0.11, 0.11 and 1.56) and/or both the mixed grape varieties (0.00, 5.89, 1.89 and 4.33) during the same decadely intervals. Herein, it coud suggested that the low sensitivity of red seedless grape variety could be attributed to its thicker waxy skin than white one; resulting in unfavorable stout surface of berries for laying eggs. Similarly, grape berries from American cultivars (*V. labrusca*) present pellicles with thicker skin and "juicy" pulp, resulting in a lower susceptibility of these cultivars to fruit fly attack **(Botton *et al*., 2003).**

For evaluating the efficacy of each trap, the mean of total captured flies (G-FTD) in each of the three performed experiments; cultivated with each of both and/or mixed grape varieties was calculated **(Table, 1)**. The McPhail (diaminophosphate) trap showed a remarkable superiority in attracting fruit flies compared to Jackson and Fly CAP traps, indicating 21.11, 10.44 and 5.67 G-FTD during three subsequent decades starting from the1st up to the 30th of May. Meanwhile, the Fly CAP trap came in the second order giving 5.89, 3.78 and 7.11 G-FTD at the same consequent decadely periods. Whilst, the Jakson trap was only capable to catch fruit flies at the 1st and the 3rd decades of April; generally showing the least significant caught flies at the same compararative decadely periods giving 0.33, 0.00 and 0.44 G-FTD, successively.

In conclusion, from the above-mentioned results, the McPhail trap was the best efficient trap, followed by Fly CAP trap and then the least attractive Jackson trap under the prevailing conditions of this experiment.

These results are partially agreed with those of arrived at by **Boulahia-Kheder *et al*. (2015)** in Tunisia; they reported that Flycap was more attractive to Medfly Ceratrap. IPM based on mass-trapping programs, Ceratrap (at rate of 100 traps/Ha) and Flycap (at a rate of 40 traps/ha) could be used for controlling the Medfl on Citrus in Tunisia **(Boulahia-Kheder *et al*., 2012).**

Table (1): Susceptibility of white and red grape varieties to the fruit fly infestation and efficacy of mass attracting traps throughout five following decades of pre-harvest interval in the 1st season.

Treatments	Grand mean number of flies per trap per day (G-FTD)				
	April		May		
	10:20	21:30	1:10	11: 20	21:30
A) Variety					
White grape	0.00	0.11a	21.33a	12.22a	7.33a
Red grape	0.00	0.11a	0.11c	0.11c	1.56c
Mixed grapes	0.00	0.00	5.89b	1.89b	4.33b
B) Traps					
Jakson	0.00	0.22a	0.33c	0.00c	0.44c
McPhail	0.00	0.00	21.11a	10.44a	5.67b
Fly CAP	0.00	0.00	5.89b	3.78b	7.11a

Values having the same alphabetical letter(s), within a particular group of means in each character, do not significantly differ, using revised L.S.D. test at 0.05 level.

B) Interaction between the different evaluated traps and grape varieties on the caught fruit flies throughout the pre-harvest interval

As shown in **Table (2)**, there are noticeable differences in the recorded interaction between the differentiated traps and both grape varieties. Generally, the highest captured FTD was observed in the 3rd decade of preharvest interval, (the 1st up to 10th of May); indicated the highest occurrence of medfly in this period and followed by gradual decrease of captured flies until the end of May. In this concern, the red seedless grape variety showed the least value of caught medfly by all types of tested traps, revealing high tolerance against infestation by the insect-pest. Whereas, Jakson trap captured only 0.33 FTD in the lasted period from 21 to 30 of April, versus 1.67 FTD by McPhail trap through the period of 21-30 of May and 0.33, 0.33 and 3.00 FTD by Fly CAP trap during the three following decades of May.

Table (2): The mean number of captured fruit flies/trap/day by different tested mass attracting traps throughout the pre-harvest period of two grape varieties, in the 1st season.

Treatments		Mean number of flies per trap per day (FTD)				
		April days		May days		
Varieties	Traps	10:20	21:30	1:10	11: 20	21:30
White grape	Jakson	0.00	0.33	1.00	0.00	0.33
	McPhail	0.00	0.00	49.67	28.67	11.33
	Fly CAP	0.00	0.00	13.33	8.00	10.33
Red grape	Jakson	0.00	0.33	0.00	0.00	0.00
	McPhail	0.00	0.00	0.00	0.00	1.67
	Fly CAP	0.00	0.00	0.33	0.33	3.00
Mixed varieties	Jakson	0.00	0.00	0.00	0.00	1.00
	McPhail	0.00	0.00	13.67	2.67	4.00
	Fly CAP	0.00	0.00	4.00	3.00	8.00
LSD (0.05)		0.00	0.89	1.42	1.23	1.24

Values having the same alphabetical letter(s), within a particular group of means in each character, do not significantly differ, using revised L.S.D. test at 0.05 level.

Table (3): Interaction between susceptibility of grape varieties, ability of mass attracting traps, efficacy of the partial spray throughout pre-harvest interval in the 2nd season.

Treatments	Grand mean number of flies per trap per day (G-FTD)				
	April		May		
	10:20	21:30	1:10	11: 20	21:30
A) Varieties					
White grape	**0.44a**	**3.00a**	**9.78a**	**4.39a**	**3.72a**
Red grape	0.00b	0.00b	0.17b	0.83c	0.00c
Mixed varietis	0.33a	0.00b	1.11b	1.50b	2.39b
B) Traps					
Jakson	0.78a	0.44b	1.11b	**2.89a**	0.44c
McPhail	0.00b	**2.56a**	**9.28a**	**2.78a**	**4.33a**
Fly CAP	0.00b	0.00c	0.67b	1.06b	1.33b
C) Foliar					
Without spray	0.26a	**1.41a**	**4.67a**	**2.63a**	**3.04a**
Partial spray	0.26a	0.59b	2.70b	1.85b	1.04b

Values having the same alphabetical letter(s), within a particular group of means in each character, do not significantly differ, using revised L.S.D. test at 0.05 level .

A) Interaction between the evaluated attracting traps, two seedless grape varieties and partial spray of insecticide/protein bait against fruit fly throughout pre-harvest interval in the 2nd season of 2021

The elucidated data in **Table (4)** declear that the white seedless grape variety was more succeptible to infestation by *C. capitata* than the red seedless variety during the consequent inspection periods along April and May months. However, the highest FTD in red grape ranged between 0.33 to 2.0 during the 1st and the 2nd decades of May. These results are in agreement with the findings of **Soria (1985) and Botton *et al.* (2003).**

The efficacy of attracting traps ability significantly increased with the application of partial spray of chemical/food bait. Whereas, the highest means of FTD (11.33, 33.33, and 9.67) were captured with Fly CAP trap in the 3rd decade of April; the 1st and 3rd decades of May, respectively. Meanwhile, Jakson trap was the most efficient in the nonspray treatment recording 17.33 FTD in the 1st decade of May.

The same trend of results was also observed in both mixed cultivated grape varieties, where, Fly CAP trap caught 3.0, 6.67 and 9.33 FTD in the three decades of May, respectively, in case of applying the partial chemical/protein bait. Whilest, Jakson catched 1.67, 1.67 and 2.33 FTD during the same periodical decades of May in the non sprayed experiment.

These results strongly indicate that both insecticides used in the partial sprays could negatively affect the response of male adults to the sex pheromone in Jakson traps and increase the insect's orientation to food baits in Fly CAP trap.

Epsky *et al.* (2014) and **Pinero *et al.* (2015)** mentioned that the effectiveness of protein bait is behaviorally relying on the fact that immature females need a protein meal to reach sexual maturity and for the development of eggs to maturity. So, food sources which are rich in

nitrogen act as food attractants (**Bayoumy and ElMetwally, 2017; Hemeida *et al.*, 2017 and Ghanim and El-Metwally, 2019**).

The use of toxic baits is an essential tool for the control of adult medflies in substitution for or in combination with the spraying of insecticides **(Navarro-Llopis *et al.*, 2013)**. **Gazit and Akiva (2017)** evaluated the toxicity of malathion and spinosad to *B. zonata* and *C. capitata* as contact exposure (tactile) or feeding (insecticides mixed with bait). Results showed that the low doses of were highly toxic rather than the high doses either upon contact or when eaten with bait.

Spinosad, a naturally derived insect control chemical, has become a popular choice for the control of Mediterranean fruit fly populations because of its short persistence in the environment; the compound degrades rapidly 3–7 d after application with little residue, although significant toxicity was also reported after 10 d **(Pinheiro *et al.*, 2020)**. Spinosad has been applied during the harvest period as the preharvest interval is relatively short **(Rachid and Ahmed, 2018)**. A spinosad-based fruit fly bait (GF-120 NF Naturalyte; Dow AgroSciences, Indianapolis, IN, USA) was proposed as a safe alternative to Malathion-based baits in Egypt **(Mahmoud *et al.*, 2017)**.

Table (4): The mean number of decadely captured fruit flies/trap/day by different mass attracting traps throughout pre-harvest 50 days interval of two grape varietis in the 2nd season.

Treatments			Mean number of flies per trap per day (FTD)				
Varieties	Traps	Foliar	April days		May days		
			10:20	21:30	1:10	11: 20	21:30
White grape	Jakson	Partial spray	1.33	1.33	2.00	6.33	1.00
	McPhail		1.33	1.33	2.00	6.33	1.00
	Fly CAP		0.00	11.33	33.33	3.67	9.67
	Jakson	Without spray	0.00	4.00	17.33	3.67	4.67
	McPhail		0.00	0.00	2.00	3.67	5.00
	Fly CAP		0.00	0.00	2.00	2.67	1.00
Red grape	Jakson	Partial spray	0.00	0.00	0.33	2.00	0.00
	McPhail		0.00	0.00	0.33	2.00	0.00
	Fly CAP		0.00	0.00	0.33	1.00	0.00
	Jakson	Without spray	0.00	0.00	0.00	0.00	0.00
	McPhail		0.00	0.00	0.00	0.00	0.00
	Fly CAP		0.00	0.00	0.00	0.00	0.00
Mixed	Jakson	Partial spray	1.00	0.00	1.00	0.33	0.33
	McPhail		1.00	0.00	1.00	0.33	0.33
	Fly CAP		0.00	0.00	3.00	6.67	9.33
	Jakson	Without spray	0.00	0.00	1.67	1.67	2.33
	McPhail		0.00	0.00	0.00	0.00	2.00
	Fly CAP		0.00	0.00	0.00	0.00	0.00
$LSD_{(0.05)}$			**1.24**	**0.27**	**0.30**	**0.52**	**0.74**

Values having the same alphabetical letter(s), within a particular group of means in each character, do not significantly differ, using revised L.S.D. test at 0.05 level .

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الملخص العربي

إستراتيجية مكافحة صديقة للبيئة اعتماداً على فرمون جنس ومصائد جاذبة وتتابع من رشات جزيئية كيماوية على نوعين من العنب ضد *Ceratitis Capitata* Wied. (Diptera: Trypetidae)

مجدي عبد الظاهر مسعود،. حسن على عبد الحميد مصباح، عماد عبد الله عبد الفتاح عبد الحق، عبدالفتاح سيد عبد الكريم

قسم وقاية النبات– كلية الزراعة سابا باشا– جامعة الإسكندرية

أجريت تجارب حقلية في مزرعة عنب خاصة، تقع في الكيلو 54 طريق القاهرة الإسكندرية الصحراوي في مدينة سفنكس الجديدة، القاهرة، مص، على مدار موسمين متتاليين (2020 و 2021). حيث إستهدفت الدراسة الوصول إلى استراتيجية مكافحة صديقة للبيئة تعطي وقاية لفترة أطول وتكون أكثر أمانًا لمكافحة ذبابة الفاكهة *Ceratitis capitata* على ثمار العنب. في البداية تم تقييم مدى قابلية صنفين من العنب الخالي من البذور، يمثلان العنب الأبيض والأحمر، للإصابة بذبابة الفاكهة. وتم اختبار ثلاثة أنواع مختلفة من المصائد لجذب وإصطياد الحشرة الكاملة من ذبابة الفاكهة وهي: جاكسون وماكفيل و فلاي كاب، كذلك تم تقييم أستخدام طريقة الرش الجزئي لمخلوط مكون من مادة بومينال مع ملاثيون 57% أو تريسر 34% بشكل متزامن مع إستخدام المصائد الممختبرة.

أظهرت النتائج أن إصطياد الحشرة الكاملة من ذبابة الفاكهة إبتدأ من العقد الثالث من شهر إبريل (21: 30 أبريل) واستمر حتى نهاية مايو. ، وأن أعلى متوسط عام من الحشرات التي تم إجتذابها كان خلال العقد الأول من شهر مايو، خاصة في صنف العنب الأبيض (21.33 و 9.78) في موسمي 2020 و 2021 على التوالي. وأشارت الدراسة إلى أن السمك الرقيق لقشرة ثمار العنب و/أو اللون الأبيض المصفر لها يمكن أن يشجع على إنجذاب ذبابة الفاكهة بدرجة أكثر من تلك الموجودة في ثمار العنب الأحمر.

كما أوضحت النتائج أن مصيدة جاكسون الورقية الصفراء لها قدرة على عالية على إصطياد ذبابة الفاكهة مبكرا منذ بداية العقد الثاني من أبريل. بينما كانت مصيدة ماكفيل هي الأفضل على مدار فترة ما قبل الحصاد (50 يوم). كذلك أشارت النتائج بقوة إلى أن خلط أيا من المبيدين الحشريين (ملاثيون وسبينوساد) مع البومينال في طريقة الرش الجزئي يمكنه أن يؤثرعلى زيادة توجيه الحشرة نحو الطعوم الغذائية في كلا من مصائد فلاي كاب وماكفيل. لذا أوضحت الدراسة أن إستخدام طريقة الرش الجزئي بالتزامن مع إستخدام المصائد الجاذبة أدى إلى انخفاض كبير في متوسط عدد ذباب الفاكهة مما يشير إلى استراتيجية صديقة للبيئة لمكافحة هذه الحشرة.