APPLICATION OF DETTERENT COMPOUND FOR CONTROL OF OLIVE FRUIT FLIES *BACTROCERA OLEAE* GMELIN. (DIPTERA: TEPHRITIDAE)

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Abstract: Olive Fruit Fly *Bactrocera oleae* Gmelin (Diptera:Tephritidae) is the key constraint against olive production in Iran and many other countries. In Iran the several methods for control of olive fruit fly are applied, such as yellow sticky traps alone and with sexual pheromones, olive traps and McPhail traps that contain protein hydrolysate. In this experiment, conducted in Roudbar olive research station in north of Iran in 2010, we applied kaolin powder as one of the methods for control and decrease of damage of olive fruit fly. We applied 3 different treatments concentrations containing 5, 3 and 1.5% of kaolin and water as control. Solutions were sprayed after monitoring with pheromone traps and protein traps. In first stage, after pit hardening of fruits, kaolin was sprayed on trees which coincided with in the beginning of summer. The second and third stage has been done in the end of summer and in the beginning of autumn when we observed maximum sexual activity. Results showed significant difference between treatment concentrations 5% and 3% with 1.5% and control ($p<0.05$). The average number of attacks (total infestation) per olive tree was 3.84± 0.28, 6.96 ± 0.42, 10.1 ± 0.18 and 18.78 ± 0.34 for treatments of 5, 3 and 1.5% concentrations and water. Due to the low solubility of this material in water, concentration of 5% has been recommended for spraying on trees. Application of kaolin powder was very useful to control of olive fruit fly and will be one of the methods in IPM.

***Key words**: olive fruit fly, antioviposition, kaolin*

INTRODUCTION

Olive fruit fly, *Bactrocera oleae* (Gmelin) (Diptera:Tephritidae) is the key-pest of olive agroecosystem and it represents the major problem for many olive growers of the Mediterranean Basin and in Iran. It is the most critical pest of olive trees that has been introduced in Iran since 2002 (Rezaii et al, 2002). At first, farmers encountered with population outbreak so that the major part of olive fruits were contaminated to eggs, larvae and pupa of the flies, so that quality and quantity of the fruits sharply (Kayhanian et al., 2009). Several methods have been suggested to *B. oleae* control like yellow sticky trap, sexual pheromone as well as nutrient traps that is a combination of protein hydrolysate along with a solution of pesticide mounted in the traps (Haniotakis, 1981). The use of repellent and antioviposition products finds a great interest in organic farming, because of the lack of effective products able to kill the olive fly preimmaginal stages. Results demonstrate an efficacy of kaolin products in reducing attacks of *B. oleae* (Caleca et al., 2006). Traps such as the Mcphail are still used and supply the very good information on the biology of olive flies especially female flies. However, these traps have some deficiencies like lower capability in high humidity and attractiveness effects during raining periods. The clay, especially white clays as kaolin, disrupts ovipositing females, while copper salts through their antibacterial action make fruits less attractive to ovipositing females because of the lack of some bacterial compounds on the surface of fruits (Tsanakakis, 1985). More recently, copper products

(Petacchi & Minnocci, 2002) and kaolin (Saour & Makee 2004) against *B. oleae* revealed interesting results. Kaolin is a white, nonporous, nonswelling, nonabrasive fine grained platy aluminosolicate mineral that easily disperses in water and is chemically inert over a wide pH range. It could be simply sprayed on crops in water-based slurry which sticks to plant leaves and fruits forming a white powdery film. All over the world, kaolin film has controlled well over a dozen species of insects and mites. It doesn't interfere with photosynthesis and seems to be able to reduce heat stress and to lower temperature in tree canopy. Because of its white color, kaolin has light reflective properties which could make the plant visually or tactually unrecognizable as a host (Glenn et al., 1999; U.S.D.A.-A.R.S., 2000). It is also listed in the Annex VI at EEC 2092/91 among the products which may be used in food processing of ingredients of organic agriculture origin. Alternative compounds to synthetic chemical insecticides have been recently used in several laboratory tests and field trials to control *B. oleae*, taking advantage of their repellent nature or anti-ovipositional qualities (Petacchi & Minocci, 2002; Sacchetti et al., 2002; Saour & Makee, 2004; Caleca & Rizzo, 2005). The use of repellent and antiovipositional products in the control of B. *oleae* finds a great interest in organic farming, because of the lack of effective products able to kill the olive fruit fly larvae and eggs.

MATERIAL AND METHODS

In 2010, in the oil olive germplasm collection (6.6 ha) of "Olive Research Station" located in Roudbar (Guilan province, IRAN), tests on the effectiveness of kaolin (SEPIDAN, WP®) (Kimia Sabz Avar Co. IRAN), a product containing 100% of kaolin, were carried out, on cultivar Roghani (native cultivar of Iran for olive oil extraction).

In 2011, in the same field and on the same cultivar, kaolin powder (SEPIDAN, WP®.) was tested too. This was a 100% kaolin product utilized for ceramic and other purposes, but never used in olive pests control in Iran.

In first year the doses were 5, 3 and 1/5 kg of kaolin products per hl of water and control. Five trees in each thesis were sampled at "Olive Research Station". Olive trees were sprayed thrice in "Olive Research Station" in 2010 and 2011. First treatment was realized after reaching the pit hardening stage of fruits, but in any case never later than the first week of May. The second treatment was done when the fruit were no more covered by the kaolin and fruit fly population increased in September. Third treatment was done when fruit fly population increased again in late of October. Samples consisted of twenty olives from each of the trees of the plot. Collected fruits were analyzed under the stereomicroscope to detect eggs, larvae, pupae, exit holes, empty galleries and punctures without oviposition. The infestation level was expressed as "harmful" infestation (3rd instar larvae, pupae, exit holes in absence of larvae and pupae) and "total" infestation (harmful infestation plus eggs and other larvae). In each olive grove, two traps with sex pheromone and Mcphail traps were placed to monitor the presence of male and female olive flies. Thermo-pluviometric data concerning Roudbar weather stations were kindly provided. Data concerning fruit infestation were statistically analyzed by Duncan ($p<0.05$), repeated measures ANOVA, 1-way ANOVA and Duncan post-hoc test ($p< 0.05$)

RESULTS AND DISCUSSION

The thermo-pluviometric trend at Roudbar weather station in 2010, is shown in Figure 1. A conspicuous daily rainfall occurred on 22 August, 5-6 October (40.5, 53.4 and 54.1 mm, respectively). The three treatments were done on 23 June 2010, 5 September 2010 and 16 October 2010.

Total infestation level with *B. oleae,* during first sampling, is shown in Table 1. Statistically significant differences among 5, 3 and 1/5% and control concentrations and the untreated olives began to be significantly more infested than treated ones were recorded. During the second sampling period before harvesting, the infestation reached high levels, and the concentrations of 5% and 3% did not recorded any statistically significant differences but began to be significantly less infested than treated 1/5% and control. Similar situation was during the third sampling period.

The thermo-pluviometric trend at Roudbar weather station in 2011 is shown in Figure 2. Daily rainfall occurred on 7 and 27 September, 29 October were 50.1, 42.8 and 46.8 mm, respectively. The three treatments were done on 11 June, 11 September and 12 October 2011 (Figure 3). Sampling was done on 23 June, 3 July, 19 July, 20 September, 1 October, 11 October, 22 October, 1 November and 12 November 2011.

The trend of total infestation (expressed as a percentage of infested olives) due to olive fruit fly is shown in Figure 3. Regarding the total infestation recorded in each single date, as shown in Table 2 and in Figure 3, the control olives began to be significantly since 23 June, remaining in this condition until 12 November.

In Figure 4, the number of adult olive fruit flies attracted in the two traps, pheromone traps and Mcphail traps, during 2010 and 2011, and the time of spray were presented.

From statistical analysis of the whole period, from 23 June to 12 November 2011, (Table 2) we noticed that the total infestation in case of treatment with Kaolin 5% (SEPIDAN WP®) was significantly lower than other treatments. Only on 20 September 2011 concentrations of 5 and 3% of Kaolin did not recorded any statistically significant differences. After mid of October 2011 the total infestation increased.

CONCLUSION

Kaolin products reduced attacks by *Bactrocera oleae* on olive fruits. In olive groves, kaolin clays gave better results than control kaolin which were washed off by rainfall more easily. This is an issue, olives require protection from their olive fruit fly during a rainy period, and the products ‘poor performances were linked to their limited permanence on fruits in the test plots. Kaolin is very effective, but other tested clay products are much less expensive (4–6 times).

In olive groves, it is necessary to cover fruits with repellent products up to one to two weeks before harvest and oviposition period of olive fruit fly. Kaolin residues on olives is easily removed by a common washing, but it prevents marketers from selling fruit with leaves. For the earlier harvesting of table olives (before mid-September) these products give a new opportunity for controlling the olive fruit fly, also in the groves for table olives production.

Roudbar area of Iran have the especially weather and climate, rainy fall in year is low (200-250 mm) and during the June until October is least therefore application of Kaolin powder for three or four times is very useful for garden owners.

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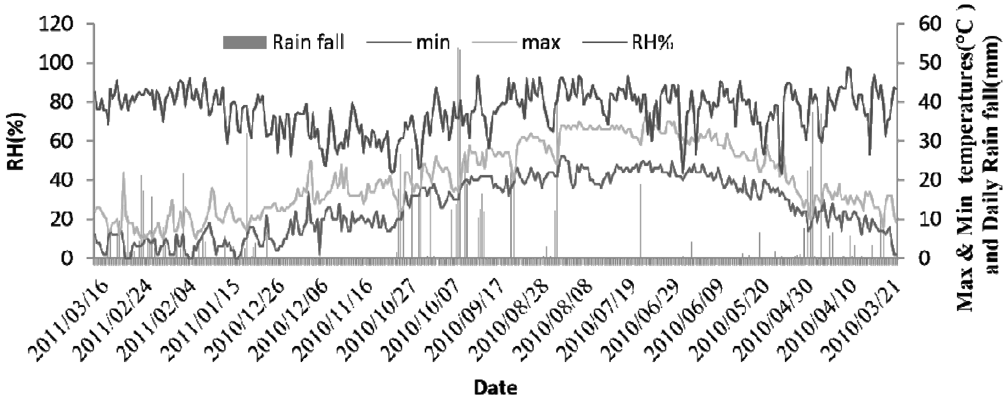

Figure 1. Thermo-pluviometric trend, treatments and total infestation in untreated plots in Roudbar olive groves in 2010

Table 1. *Bactrocera oleae* total infestation (number of attacks per olive) recorded in olive grove of Roudbar Olive Research Station in 2010

Stage of spray	Treatment	Mean ± se
1	Control	18.84 ± 0.85 [a*]
1	1.5%	10.1 ± 0.60 [b]
1	3%	6.96 ± 0.54 [c]
1	5%	3.84 ± 0.81 [d]
2	Control	22.76 ± 0.54 [a]
2	1.5%	14.88 ± 0.63 [b]
2	3%	12.34 ± 0.47 [c]
2	5%	11.62 ± 0.41 [c]
3	Control	1.57 ± 0.80 [a]
3	1.5%	1.30 ± 0.65 [b]
3	3%	1.22 ± 0.34 [c]
3	5%	1.17 ± 0.14 [c]

*Mean + S.E.: 1-way ANOVA followed by Duncan post-hoc test ($\alpha = 0.05$). Means followed by the same letter in each column are not significantly different

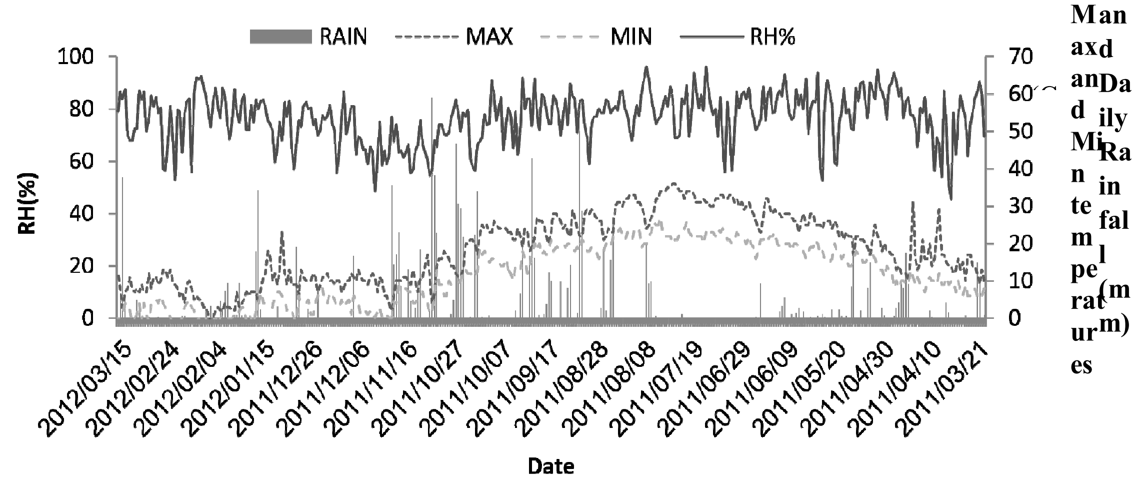

Figure 2. Thermo-pluviometric trend, treatments and total infestation in untreated plots in Roudbar olive groves in 2011

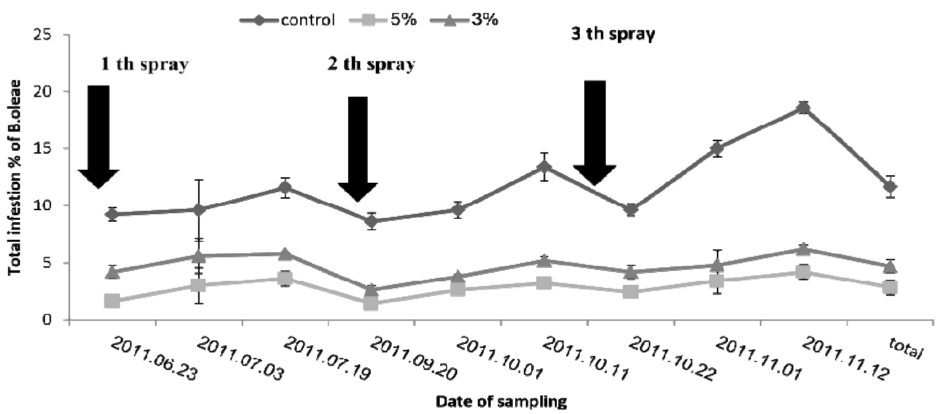

Figure 3. Total infestation due in the third time spray to *Bactrocera oleae* in Roudbar olive groves in 2011

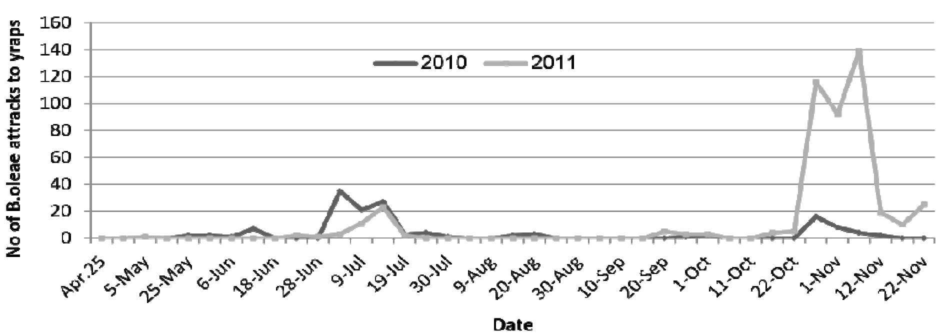

Figure 4. Olive fruit flies attracted in different traps in Roudbar olive groves in 2010 and 2011

Table 2. Mean values of *B.oleae* total infestation in three different periods at Roudbar olive grove in 2011

Date of sampling	Treatments	Total infestion (Mean ± Se)
2011.June.23	Control	9.2 ± 0.58 a*
	Kaolin 5%	1.6 ± 0.5 c
	Kaolin 3%	4.2 ± 0.58 b
2011.July.3	Control	9.6 ± 2.7 a
	Kaolin 5%	3 ± 1.58 c
	Kaolin 3%	5.6 ± 1.51 b
2011. July.19	Control	11.6 ± 0.87 a
	Kaolin 5%	3.6 ± 0.67 c
	Kaolin 3%	5.8 ± 0.11 b
2011.September.20	Control	8.6 ± 0.74 a
	Kaolin 5%	1.4 ± 0.24 b
	Kaolin 3%	2.6 ± 0.4 b
2011.October.1	Control	9.6 ± 0.74 a
	Kaolin 5%	2.6 ± 0.4 c
	Kaolin 3%	3.8 ± 0.2 b
2011. October.11	Control	13.4 ± 1.2 a
	Kaolin 5%	3.2 ± 0.48 c
	Kaolin 3%	5.2 ± 0.37 b
2011. October.22	Control	9.6 ± 0.5 a
	Kaolin 5%	2.4 ± 0.24 c
	Kaolin 3%	4.2 ± 0.68 b
2011.November.1	Control	15 ± 0.7 a
	Kaolin 5%	3.4 ± 1.14 b
	Kaolin 3%	4.8 ± 1.3 b
2011. November.12	control	18.6 ± 0.5 a
	Kaolin 5%	4.2 ± 0.66 c
	Kaolin 3%	6.2 ± 0.37 b

*Mean + S.E.: 1-way ANOVA followed by Duncan post-hoc test ($\alpha = 0.05$). Means followed by the same letter in each column are not significantly different;

(Different letters in the columns denote statistically significant differences; Anova 1-way followed by Duncan post-hoc test; ($p < 0.05$)