IOBC
OILB

WPRS / SROP

Integrated Protection of Olive Crops

Protection Intégrée des Olivaies

editor:

Argyro Kalaitzaki

IOBC wprs Bulletin
Bulletin OILB srop

Vol. 30(9) 2007

International Organization for Biological and Integrated Control of Noxious Animals and Plants
Organisation Internationale de Lutte Biologique et Intégrée contre les Animaux et les Plantes Nuisibles
West Palaearctic Regional Section / Section Régionale Ouest Paléarctique

Integrated Protection of Olive Crops
IOBC/wprs Bull. 30(9), 2007
pp. 111-117

Tests on the effectiveness of kaolin and copper hydroxide in the control of *Bactrocera oleae* (Gmelin)

Virgilio Caleca, Roberto Rizzo
Dipartimento SENFIMIZO, Sezione di Entomologia, Acarologia e Zoologia, Università di Palermo, Viale delle scienze, 90128 Palermo ITALY. E-mail: caleca@unipa.it

Abstract: Repellent and antiovipositional products in the control of *Bactrocera oleae* (Gmelin) finds a great interest in organic farming, because of the lack of effective products able to kill the olive fly immature stages. In 2003 in Castelvetrano (Trapani province, Sicily), tests on the effectiveness of Surround WP, a product containing 95% of kaolin, were carried out on three table olive cultivars, Nocellara del Belice, Moresca and Tonda Iblea. In 2004, in the same field and on the same cultivars, BPLK kaolin was tested too. In the second year the two products containing kaolin were also tested on Cerasuola cultivar in an organic olive grove located in Trapani, comparing them with copper hydroxide.

At Castelvetrano both in 2003 and in 2004 *B. oleae* infestation levels of the plots treated with the two products containing kaolin were statistically lower than those of the control plots. In this site, in 2004 Surround WP protected olives significantly better than BPLK kaolin, limiting olive fly harmful infestation up to 17-23% vs. 68-87% of BPLK plots. At Trapani in 2004, the two products containing kaolin and copper hydroxide showed statistically significant differences from the untreated control, but not among themselves, limiting the harmful infestation up to 3-37% vs. 87% of the control.

The different results of 2004 recorded by Surround WP and BPLK kaolin in the two olive groves seems linked to the different rainfall of the period after the last treatment, 64 mm in three rainy days at Castelvetrano and 41 mm in eight rainy days at Trapani; BPLK kaolin was probably washed away more than Surround WP.

The tested products containing kaolin and copper hydroxide are effectively able to limit *B. oleae* infestation to a very good level for olive oil production, moreover, considering the earlier harvesting of table olives, these products give a new opportunity for controlling the olive fly also in the organic olive groves for table olives production.

Key words: olive fruit fly, repellent, antiovipositional, organic farming, Sicily

Introduction

The use of repellent and antiovipositional products in the control of *Bactrocera oleae* (Gmelin) finds a great interest in organic farming, because of the lack of effective products able to kill the olive fly preimmaginal stages.

From 1937 to 1953 Russo and some other entomologist (Russo, 1937; Russo and Fenili, 1949; Russo, 1954) tested the effectiveness of clay and Bordeaux mixture against the olive fly, obtaining a similar protection, suggesting their use for early ripening olives to harvest before autumnal rainfall.

Visual and chemical stimuli lead the female olive fly to oviposit into fruits (Katsoyannos and Kouloussis, 2001; Rotundo *et al.*, 2001; Solinas *et al.*, 2001); so 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; Belcari *et al.* 2003), furthermore the

presence of the particles of these products on fruit surface could be another obstacle for the fruit recognition of the female olive fly.

More recently some authors tested copper products (Prophetou-Athanasiadou *et al*, 1991; Belcari and Bobbio, 1999; Petacchi and Minnocci, 2002; Tsolakis & Ragusa, 2002) and kaolin (Saour & Makee, 2004) against *B. oleae* obtaining interesting results.

The aim of this research is to test the effectiveness of kaolin against the olive fly, comparing it with copper hydroxide, in different conditions of infestation level.

Material and methods

In 2003 in the table olive germplasm collection (0.6 ha) of "Ente di Sviluppo Agricolo della Regione Siciliana" and "Dipartimento di Colture Arboree" (University of Palermo) located in Castelvetrano (Trapani province, Sicily), tests on the effectiveness of Surround WP (Engelhard Co. U.S.A.), a product containing 95% of kaolin, were carried out on three table olive cultivars, Nocellara del Belice, Moresca and Tonda Iblea.

In 2004, in the same Castelvetrano field and on the same cultivars, BPLK kaolin (Goonvean Ltd. U.K.) was tested too. This is a 100% kaolin product utilised for ceramic and other purposes, but never used in agriculture. In the second year the two products containing kaolin were also tested on Cerasuola cultivar in a 1 ha organic olive grove located in Trapani, comparing them with copper hydroxide (Cuprantol Ultramicron) containing 35% of copper.

Olive trees were sprayed twice both in Trapani in 2004 and Castelvetrano in 2003, whereas in the last site in 2004 three treatments were done. First treatment was realised after reaching the threshold of 5% of total infestation, but in any case never later than the first week of September. The second treatment was done when the fruit were no more covered by the kaolin. The doses were 5 kg of kaolin products and 0.3 kg of copper hydroxide per hl of water.

Sampled trees in each thesis were seven at Castelvetrano and eight at Trapani; samples consisted of ten olives from each of the trees of the plot.

Collected fruits were analysed under the stereomicroscope to detect eggs, larvae, pupae, exit holes, empty galleries and punctures without oviposition. The infestation level was expressed as "harmful" infestation (3^{rd} 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 1,7-dioxaspiro[5.5]undecane were placed to monitor the presence of male olive flies.

Thermopluviometric data concerning Castelvetrano Seggio and Trapani Fontanasalsa weather stations were kindly provided by SIAS, Servizio Informativo Agrometeorologico Siciliano (Government of the Sicilian Region).

Data concerning fruit infestation were statistically analysed by T-test ($p<0.05$), repeated measurents ANOVA, 1-way ANOVA and Tukey post-hoc test ($p< 0.05$).

Results

In 2003 at Castelvetrano the temperature of July and August was high, in the last month exceeding 35°C in 22 days; after the conspicuous rainfall of 16^{th}-19^{th} of September (66 mm) the kaolin was still abundant on the fruits; the rainfall of 18^{th} October (71 mm) washed away most of the clay, but the close harvest-time led us not to treat again. The captures of *B. oleae* males were very low until 16^{th} of September, raising up to 38 males per week from 14^{th} to 28^{th} of October.

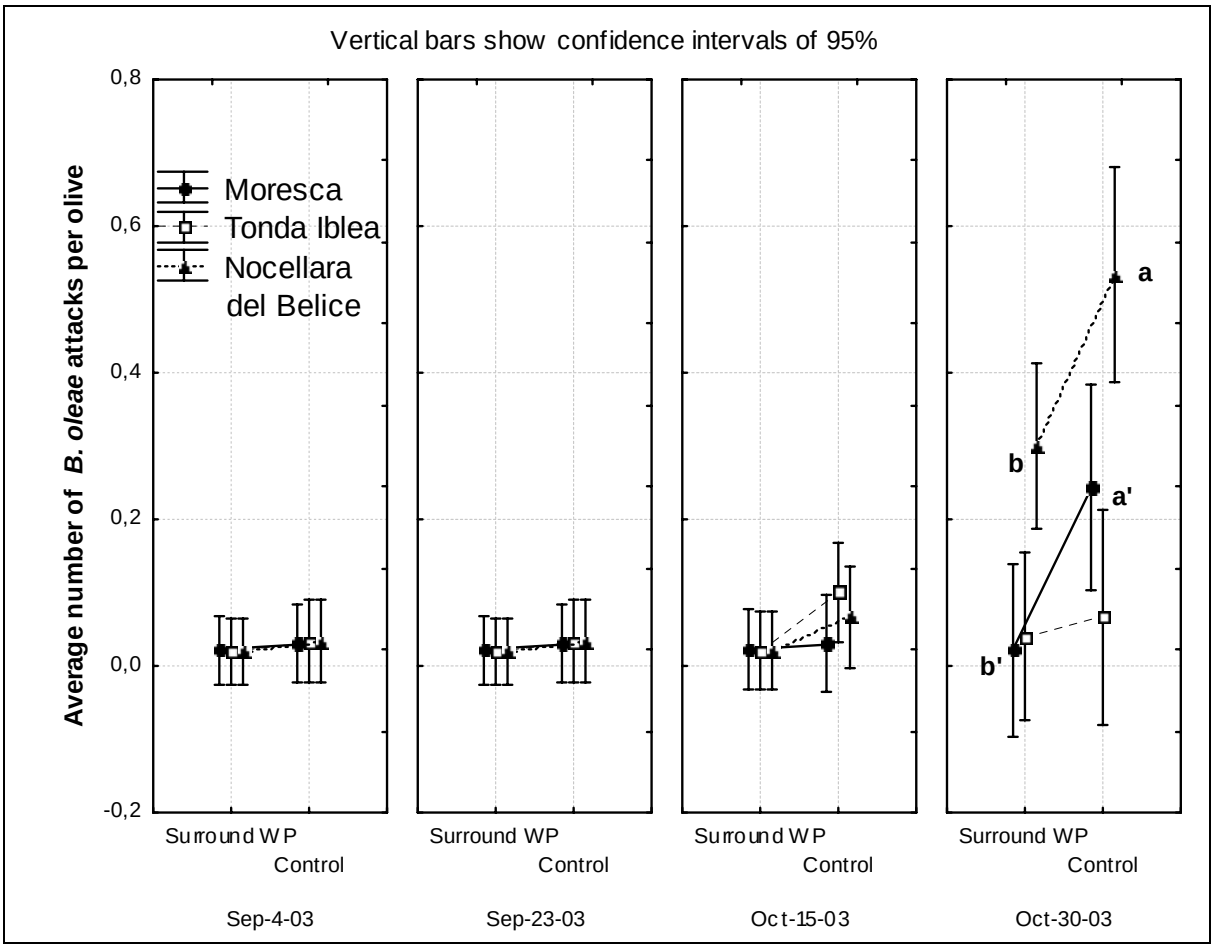

Figure 1. Trend of *Bactrocera oleae* total infestation in olives of three different table cultivars at Castelvetrano in 2003 (Different letters denote statistically significant differences; T-test, $p<0.05$)

In this year, as shown in Figure 1 *B. oleae* infestation level was low; nevertheless, in the last sampling date the total infestation was significantly higher in the control trees than in those treated with Surround WP, both in Moresca and Nocellara del Belice plots.

In 2004 at Castelvetrano, the temperature in August was cooler than in 2003; the rainfall from July 20th to October 26th was 146 mm, 64 of them from 13th to 16th of October, after the last treatment performed in October 6th. The olive fly males caught by pheromone traps ranged between 2 and 5 in July and August, increasing up to 21 at the end of September.

In this site, *B. oleae* infestation levels of the plots treated with the two products containing kaolin were lower than those of the control plots, with statistically significant differences both in total and in harmful infestation (Figures 2 & 4), except the harmful infestation of BPLK kaolin in Moresca cultivar which was not statistically different from untreated trees. As shown in Figures 2 & 4, at Castelvetrano Surround WP protected olives significantly better than BPLK kaolin, limiting olive fly total infestation in the three cultivars up to 0.3-0.5 attacks per olive (27-40% infested fruits) vs. 1-1.8 attacks per olives (70-93% of infested fruits) in BPLK plots, and 1.4-4.4 attacks per olives (70-100% of infested fruits) in untreated trees; in this site harmful infestation reached 0.22-0.25 attacks per olive (15-23% infested fruits) in Surround WP plots, 0.9-1.5 attacks per olives (68-87% of infested fruits) in BPLK plots and 1.2-4 attacks per olives (61-100% of infested fruits) in untreated trees.

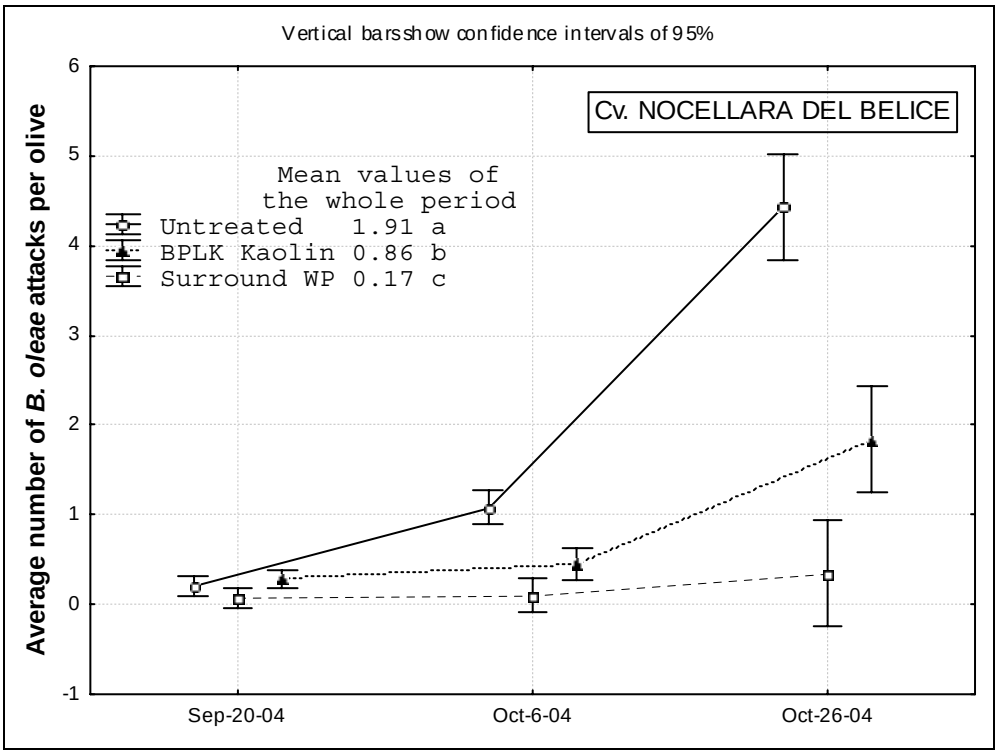

Figure 2. Trend of *Bactrocera oleae* total infestation in Nocellara del Belice cultivar at Castelvetrano in 2004 (Different letters denote statistically significant differences; repeated measurements ANOVA, $p<0.05$)

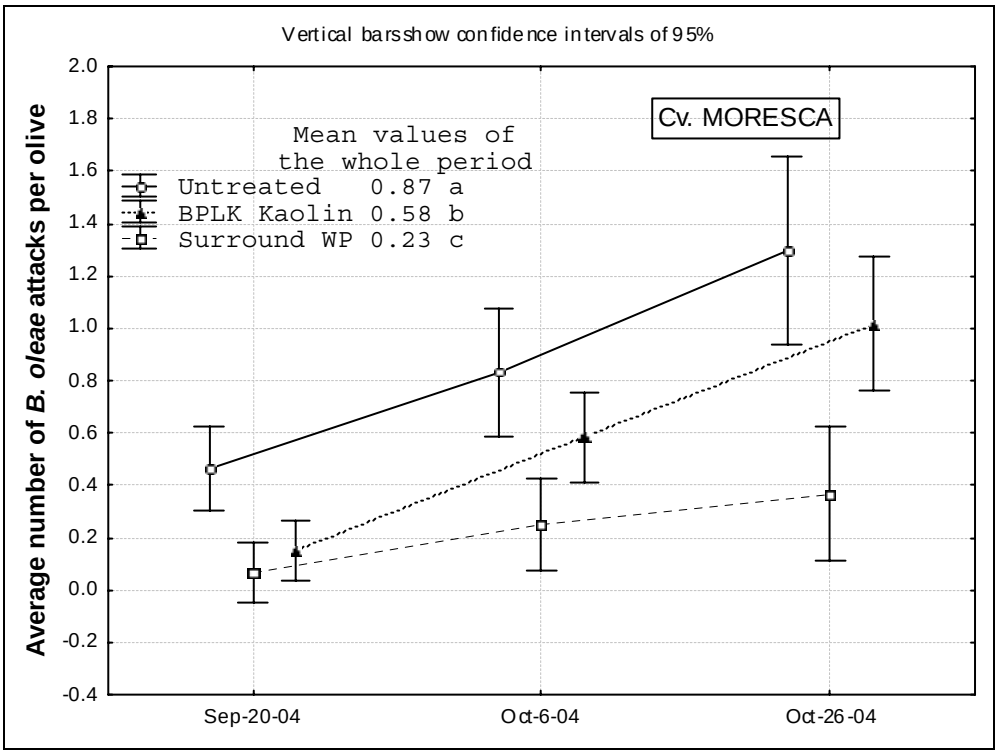

Figure 3. Trend of *Bactrocera oleae* total infestation in Moresca cultivar at Castelvetrano in 2004 (Different letters denote statistically significant differences; repeated measurements ANOVA, $p<0.05$)

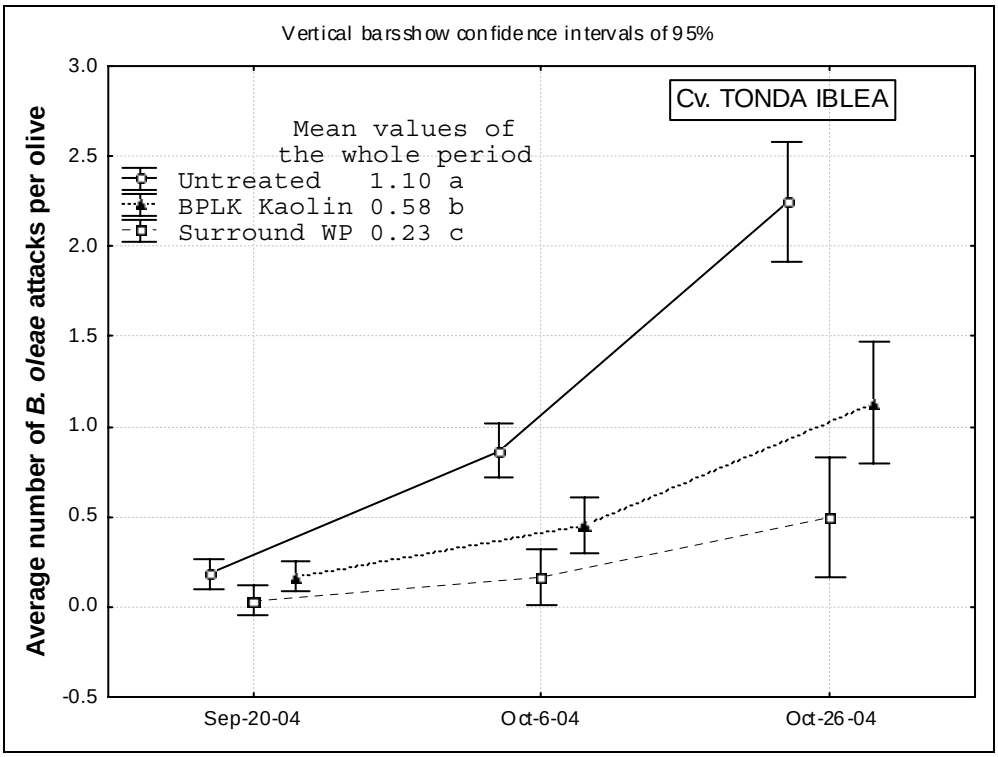

Figure 4. Trend of *Bactrocera oleae* total infestation in Tonda Iblea cultivar at Castelvetrano in 2004 (Different letters denote statistically significant differences; repeated measurements ANOVA, $p<0.05$)

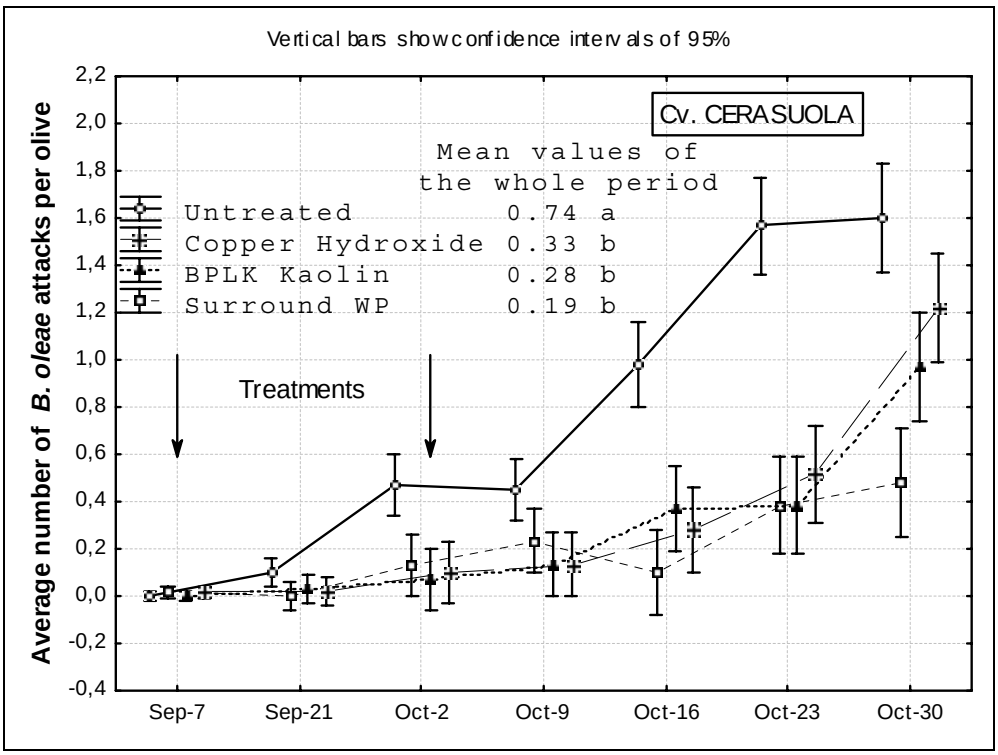

Figure 5. Trend of *Bactrocera oleae* total infestation at Trapani in 2004 (Different letters denote statistically significant differences; repeated measurements ANOVA, $p<0.05$)

In 2004 at Trapani, the trend of the mean temperature was similar to Castelvetrano one; the rainfall from July 12th to October 30th was 118 mm, 41 of them after the last treatment (October 3rd) distributed in eight rainy days. Mean captures of males by pheromone traps remained below 5 individuals per week until mid-October, reaching afterwards 13 males per trap per week.

The total infestation in the untreated plot was clearly higher than in the other three plots since October 2nd; in BPLK kaolin and copper hydroxide plots the total infestation sharply increase only in the last date (Figure 5). Nevertheless both the total and the harmful infestation of the plots with the two products containing kaolin and copper hydroxide recorded statistically significant differences from the untreated control, but not among themselves.

The two sprays of the three products limited the total infestation at the harvesting up to 0.48-1.22 olive fly attacks per olive (45-87% of infested fruits) vs. 1.6 attacks per olive (98% of infested fruits) in the control, while the harmful infestation in the three sprayed plots was much more different from that one in the control reaching 0.03-0.48 olive fly attacks per olive (3-37% of infested fruits) vs. 1.43 fly attacks per olive (87% of infested fruits) in the control.

Discussion

The tested products containing kaolin and copper hydroxide are effectively able to limit *B. oleae* infestation to a very good level for olive oil production, moreover, considering the earlier harvesting of table olives (before mid October), these products give a new opportunity for controlling the olive fly also in the organic olive groves for table olives production.

The different results of 2004 recorded by Surround WP and BPLK kaolin in the two olive groves seems linked to the different rainfall of the period after the last treatment, 64 mm in three rainy days at Castelvetrano and 41 mm in eight rainy days at Trapani; BPLK kaolin was probably washed away more than Surround WP.

The kaolin clay has some advantages: unlike copper hydroxide it has no environmental toxicity; thanks to the white coating due to kaolin sprays the need of further treatments is easily detectable by the growers watching the fruits in the field.

Acknowledgements

We thank Ente di Sviluppo Agricolo della Regione Siciliana, Dipartimento di Colture Arboree (University of Palermo) and Giovanni Curatolo for providing the research fields, labour and machinery for treatments. Thanks to Marco Corcella, Isabella Battaglia and Dario Parrivecchio for their help in samplings. Research funded by University of Palermo Fondi di Ateneo ex quota 60% (“Il controllo degl’insetti fitofagi nell’agricoltura biologica e convenzionale”) and Assessorato Agricoltura e Foreste della Regione Siciliana (“Innovazioni della filiera olivicola da mensa”)

References

Belcari, A. & Bobbio, E. 1999: L’impiego del rame nel controllo della mosca delle olive *Bactrocera oleae*. – Informatore fitopatologico 49 (12): 52-55.

Belcari, A., Sacchetti, P., Marchi, G., Surico, G. 2003: La mosca delle olive e la simbiosi batterica. – Informatore Fitopatologico 53(9): 55-59.

Katsoyannos, B. I. & Kouloussis, N. A. 2001: Captures of the olive fruit fly *Bactrocera oleae* on spheres of different colors. – Entomologia Experimentalis et Applicata 100: 165–172.

Petacchi, R. & Minnocci, A. 2002: Olive fruit fly control methods in sustainable agriculture. – Acta Horticulturae 2002 (586): 841-844

Prophetou-Athanasiadou, D. A., Tsanakakis, M. E., Myroyannis D., Sakas G. 1991: Deterrence of oviposition in *Dacus oleae* by copper hydroxide. – Entomologia Experimentalis et Applicata 61: 1-5.

Rotundo, G., Germinara, G. S., De Cristofaro, A., Rama, F. 2001: Identificazione di composti volatili in estratti da diverse cultivar di *Olea europaea* L. biologicamente attivi su *Bactrocera oleae* (Gmelin) (Diptera: Tephritidae). – Bollettino del Laboratorio di Entomologia Agraria "Filippo Silvestri" 57: 25-34.

Russo, G. & Fenili, G. 1950: Esperimenti antidachici eseguiti in Marina di Ascea (Salerno) nel 1949. – Olearia (5-6): 1-12.

Russo, G. 1937: Primi esperimenti di un nuovo metodo di lotta contro la Mosca delle Olive. – L'Olivicoltore, Roma 14 (11): pp. 3

Russo, G. 1954: Reperti biologici, sistemi e metodi di lotta sui principali insetti dannosi all'olivo. – Bollettino del Laboratorio di Entomologia Agraria "Filippo Silvestri" 13: 64-95.

Saour, G. & Makee, H. 2004: A kaolin-based particle film for suppression of the olive fruit fly *Bactrocera oleae* Gmelin (Dip., Tephritidae) in olive groves. – Journal of Applied Entomology 128: 28-31.

Solinas, M., Rebora, M., De Cristofaro, A., Rotundo, G., Girolami, V., Mori , N., Di Bernardo, A. 2001: Functional morphology of *Bactrocera oleae* (Gmel.) (Diptera: Tephritidae) tarsal chemosensilla involved in interactions with the host-plant. – Entomologica 35: 103-123.

Tsanakakis, M. E. 1985: Considerations on the possible usefulness of olive fruit fly symbionticides in integrated control in olive groves. – In: Cavalloro R. & Crovetti A. "Proceedings of Integrated control in olive groves" CEC7FAO/IOBC Int. Joint Meeting, Pisa 3-6 April, 1984: 386-393.

Tsolakis, H. & Ragusa, E. 2002: Prove di controllo di *Bactrocera oleae* (Gmelin) (Diptera Tephritidae) con prodotti a basso impatto ambientale. – Phytophaga 12: 141-148.