International Journal of AgriScience Vol. 1(2): 75-84, July 2011 *www.inacj.com*
ISSN: 2228-6322© International Academic Journals

Fluctuating Populations of *Ceratitis capitata* Wied. 1824 (Diptera; Trypetidae) In Kabylian Orchards Using Various Traps

Sadoud-Ali Ahmed D.[1], Soltani N.[2], Kellouche A.[1]and Sadoudi R.[1]
[1]*University M. Mammeri of Tizi-Ouzou (Algeria) * Author for correspondence (email: daliahmed@yahoo.fr)*
[2]*University of Annaba (Algeria)*

ABSTRACT
This study was to monitor changes in populations of fruit fly *Ceratitis capitata* on different fruit varieties using different types of traps. The fruit varieties used for the study were; apricot (Hâtif Colomer and Bulida), peach (Redhaven and Cardinal), orange (Thomson) and varieties of fig tree (Thaghanimth: white fig; Ajenjar: Black fig). Traditional gobes flies, Procida gobes flies, Reamol GF and Pherocon CM traps were used.
The highest number of flies was recorded on orange trees (Thomson) and the second highest on fig trees. The lowest catch was observed on peach trees during conditions specific to the year 2005. The flies were trapped to determine changes in populations of *C. capitata.*

Keywords: *Ceratitis capitata,* Dynamic, Trap, Variety of fruit

INTRODUCTION
The Mediterranean fruit fly *Ceratitis capitata* Wied. is an especially formidable polyphagous pest that attacks more than 250 plant species. It causes extensive damage particularly to apricots and peaches in the summer and to figs in the autumn (Ali Ahmed-Sadoudi 2007). The infestation is visible on the fruit through a small blemished patch surrounding a puncture which expands over time. A depression is formed below the decayed tissue causing the fruit to drop prematurely. The method of integrated pest control was to attract flies using an attractive sex lure and trap them with treatment tapes using a blend of attractive food to monitor populations. The sex pheromone Trimedlure is the sex pheromone usually used. Furthermore, significantly higher numbers of *C. capitata* were captured in traps baited with Trimedlure during the fruit ripening stages in mango and apple orchards (Baker et al.1990). This method was common practice for control of tephritids and those of other genera on their respective hosts such as *Bactrocera invadens* (Drew, Tsuruta and White) on mango and citrus (Utomi 2006), *Anastrepha obliqua* (Macquart) on mango (Zahler 1991) and *Bactrocera dorsalis* on mango, peach and pear (Hui and Jianhong 2007).
Recently, a novel and versatile synthetic preparation has been identified, (*E*)-non-6-en-1-ol; a sex pheromone derived from the Mediterranean fruit fly, *Ceratitis capitata*, as a potentially active lure for traps designed to control or eradicate the Mediterranean fruit fly (Olszewski and Grison, 2010). In order to limit damage in the orchards caused by fruit fly infestation, it was important to have a permanent and effective trapping system in place to better control population fluctuations of the fly (Audemard, 1989).

It was in this context that the study aimed to assess the effectiveness of different types of traps set on mature fruit trees in successive time scales to determine patterns of fruit fly populations in the region.

MATERIALS AND METHODS

The study was conducted in various orchards of Kabylia, a region located approximately one hundred kilometers from the capital Algiers. The study focused on different species and varieties of fruit, using different types of traps: *Traps Reamol GF and Pherocon CM which had similar structures: a sticky substance and a roof for the deflection. Each trap was equipped with a cap of 13 mm in diameter and 18 mm in height containing 2 ml of Trimedlure chosen as the best attractant for detection of the fruit fly (Delrio 1983). Trimedlure has a seasonal variation in the duration of its affectivity; four weeks in the spring and two weeks in the summer (Rice et al. 1984). However, the bait becomes repulsive to the fly at high concentrations (Nakagawa et al. 1976, Baker et al. 1988). Both types of traps were installed on two varieties of apricot (Hâtif colomer and Bulida) in the timber yard of Chaib. The trap Reamol GF was applied, to two varieties of fig tree (Thaghanimth and Ajenjar) in the timber yard of Chaib and on a variety of orange trees (Thomson) in the Chabane orchard.

* The flytrap Procida is a cylindrical plastic container. Suspended on a wire, at the center of the trap is a small basket containing a pheromone combined with an insecticide (Hafraoui et al. 1980). The attractant Trimedlure was used in capsule form and the insecticide was Karate which remains active for 30 to 45 days. This trap was placed on two varieties of peach (Red haven and Cardinal) in the orchard of Legata*The traditional gobes flytrap usually consisted of a simple plastic bottle with side openings for the entry of flies and was installed in the peach orchard of B.D.K. on two varieties of peach (Red haven and Cardinal). In each bottle, there was a solution of the insecticide stimikul, 5%, which is not specific to the fruit fly. All these traps were suspended on branches of trees (approximately 2 m from the ground) with a distance of 50 m between traps to prevent inter-trap interference (Ekesi and Blah 2006). Records for each catch and numbers of flies counted were routinely used for all traps.

RESULTS

1. Population fluctuations on two varieties of apricot (Hâtif colomer and Bulida). The results (Figure 1) illustrate the absence of flies in both traps up to 15/03/1998; the traps had begun to fill with flies by 25/04/1998. At that time, we counted four flies on the apricots Hâtif colomer including three in the trap Reamol GF and a fly in the trap Pherocon CM. On the apricot (Bulida), we caught only two flies in the trap Reamol GF. Subsequently, the catches became increasingly more significant in both types of trap and the two varieties of fruit until mid-June when numbers reached 299 flies and 174 flies respectively, in the trap Reamol GF and Pherocon CM on the variety Hâtif colomer) and 158 flies in the trap Reamol GF compared with 99 flies in the trap Pherocon CM on the variety Bulida. More flies were counted in the trap Reamol GF (769 flies) than were caught in the trap Pherocon CM (375 flies) on the apricot variety Hâtif colomer. Similarly, on the variety Bulida, 271 flies were recorded in the Reamol GF trap and only 151 flies were caught in the Pherocon CM trap. It was noted that catches of flies were higher on the variety Hâtif colomer) at 1044 flies compared to those of the variety (Bulida), where a catch of 423 flies was recorded.

2. Evolution of populations of *C. capitata* on two varieties of peach (Cardinal and Red Haven) at Draa Ben Khedda (DBK).

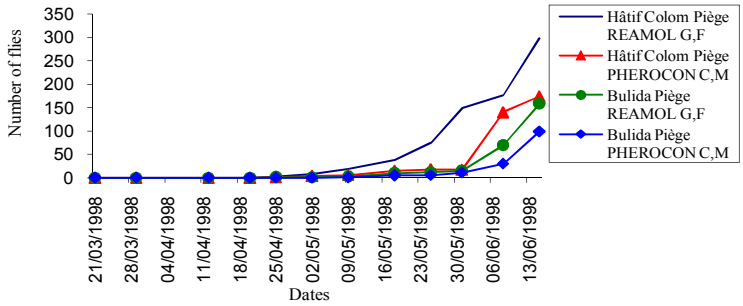

Fig 1. Evolution of catches of *C. capitata* in two traps on two varieties of apricot in the timber yeard of chaib

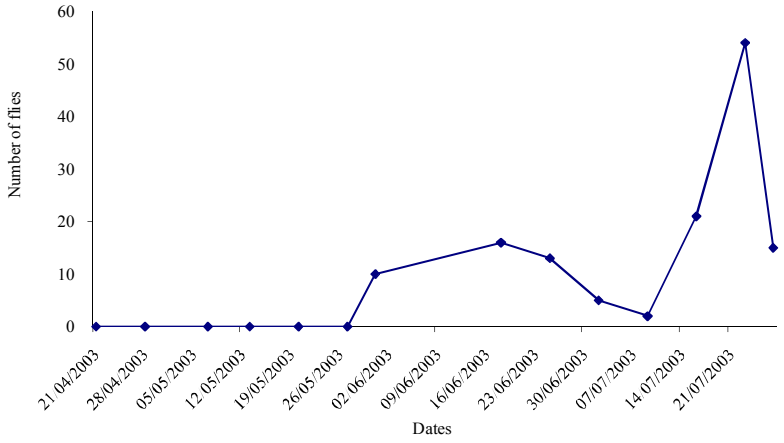

Fig2. Evolution of the catches of *C.capitata* in ordinary gobes flies in the peach orchard of DBK

The first flies were observed in the traps on the last day of May (31/05/2003) (Figure 2). A first peak of 16 flies was recorded on 18/06/2003. From this date, we recorded a decline, to two flies trapped on 09/07/2003. Subsequently, the number of flies increased to reach a second peak of 54 individuals on 23/07/2003. This peak was three times higher than the first. Then, the number of trapped flies decreased.

3. Fluctuating populations of *C. capitata* on two varieties of peach (Cardinal and Red Haven) at Legata.

Fluctuations in catches are shown in Figure 3.

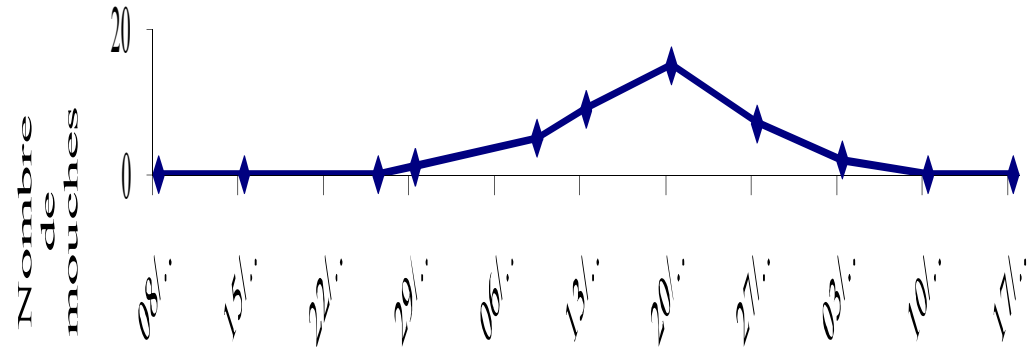

Fig3. Evolution of the catches of *C. capitata* in Procida gobes flies in the peach orchard of Leghata

The analysis shows the absence of flies in the traps from 08/06/2005 to 29/06/2005, when one fly was trapped. Beyond this period, the catch grew to a maximum of 15 individuals in late July. From that date, the number of trapped flies dropped sharply to none by the end of August.

4. Fluctuating populations of *C. capitata* in the timber yard of Chaïb on fig. 4

The results are illustrated in Figure 4.

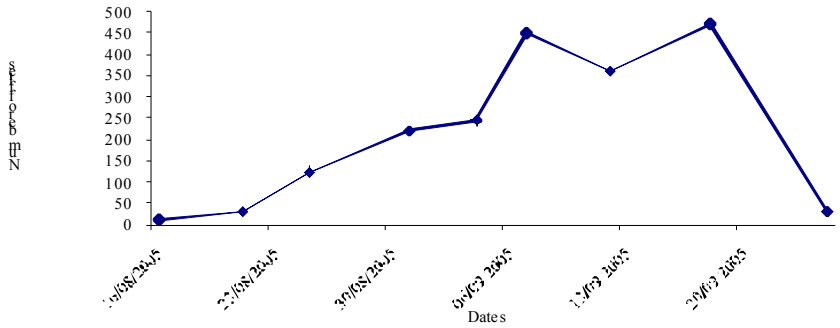

Figure 4: Evolution of the catches of *C. capitata* in Réamol G.F. trap on fig in the timber yeard of Chaib

The analysis shows that during the first week of trapping, few flies were caught (12 individuals). Subsequent, catches caught increasingly larger amounts of flies which peaked at 442 individuals on 07/09/2005. Then the number of trapped flies decreased slightly, probably due to rising temperatures and high rainfall recorded for the month of September. The curve illustrates growing numbers of trapped flies that reached a maximum of 470 flies on 18/09/2005. The capture rate gradually decreased thereafter, and ceased at the end of September due to the complete absence of fruit in the orchard.

5. Fluctuating populations of *C. capitata* on citrus orchard of Chabane (Thomson variety).

The evolution of the catches is shown in Figure 5.

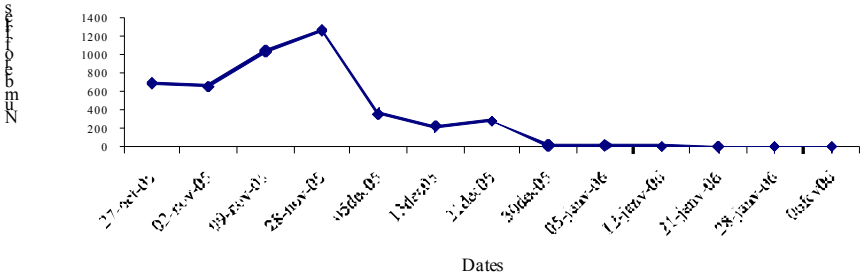

Figure 5: Evolution of the catches of *C. capitata* in Réamol G.F. trap in the orange Thomson orchard of Chabane.

During the month of October a significant number of catches was recorded (698 flies) at this time the fruit was at its ripening stage. During the month of November, catch levels remained high and peaked at 1268 flies on 28/11/2005; this coincided with the emergence of individuals of the generation developed on clementines and tangerines. The number of flies decreased thereafter to reach 360 individuals on 12/05/2005. From that date, catches decreased, and then gradually ceased on 28/01/2006. This decline was due to the early harvest of varieties of citrus fruit Clementine and Thomson as well as adverse climatic conditions (T = 10.6 ° C, RH = 81% and 87.2 mm of rain).

DISCUSSION AND CONCLUSION

The effectiveness of the two types of traps Reamol GF and Pherocon CM was evaluated on the apricot tree. There were more significant catches on the variety (Hâtif colomer) in comparison to those obtained on the variety Bulida and were about 2.5 times more on the first variety. This was probably due to earlier maturity (15 days) of the variety Hâtif colomer and its superior quality.

Moreover, on the latter, catches were recorded with the lure Reamol GF (769 flies), double the amount trapped with Pherocon CM at 375 flies. The same results were obtained on the apricot tree Bulida; we counted 271 and 152 flies respectively in traps Reamol GF and Pherocon CM.

This test for of different trapping techniques demonstrated that the trap Reamol GF was more effective compared to the other traps in both varieties studied. This was contrary to the findings of Soltani et al. (1986), following the evolution of populations of codling moth, *Cydia pomonella* L. (Lepidoptera: Tortricidae) in quince orchards in Annaba, the study of which found that Pherocon CM traps were more effective than traps Reamol GF. This may be due to the timing of our experiment during a

period of unusually high rainfall. Heavy rains were, recorded during the month of May (231.8 mm) and very strong seasonal winds made the Pherocon CM traps less traps effective that Reamol GF traps, the prismatic form of the latter gave them some rigidity allowing rain to run off without causing damage.

In 2003 the effectiveness of an insecticide stimikul not specific to the fruit fly was tested on peach trees using ordinary gobes fly traps. From the third week of April until the end of May, no flies were captured, probably due to the immaturity of the fruit (different varieties of peaches), as noted by GUENNELON AND FERON (1958), the susceptibility to attacks by the fruit fly was possible 6-8 weeks before harvest but the first larvae did not evolve. The first flights were recorded in late May. Catch levels peaked at 16 flies in mid-June, a period corresponding to the maturity of the early peach variety (Cardinal).

Beyond this date, a gradual drop in numbers of flies caught was probably due to the harvesting of early varieties of peach. According to Martin (1950), decreased activity of the fruit fly was observed after fruit harvest. As the fruit on the ground was not collected, the larvae found additional hosts in the late variety Red haven; therefore the number of catches rose again.

As of early July, numbers of trapped flies grew and a second peak of 54 individuals was reached during the last decade of July coinciding with the full maturity of Red haven. From that date, the catch rates fell, which coincided with the full crop of that variety and higher temperatures which exceeded the maximum normal of 37 ° C. According to Balachowsky (1950) Bodenheimer (1951), Nunez (1987), temperatures above 33 ° C hinder the activity of the fruit fly.

In 2005, Procida traps on peach trees were monitored. The first flies were observed toward the end of June, about a month later than in the year 2003. This can be attributed to the delay of the overwintering generation of *C. capitata,* a consequence of the shift caused by seasonal climatic variations that occurred during that year. Indeed, low temperatures were recorded in winter and heavy snow fall (9 days of snow in January and February) were the cause of a very high mortality rate that limited overwintering population levels not exceeding the economic threshold and did not cause damage to early maturing species (May, June and July), especially apricots and peaches on when no bite was observed and no pupae were obtained. Apiah et al. (2009) reported that multiple regression analyses also revealed that rainfall and temperature are significant influential factors on pest populations.

During the year the influence of climatic conditions on the activity of the fruit fly was documented and this was reported by Delanoué (1951). According to the author, just a mild winter for 15 days ahead of normal time affected populations of fruit fly, which allowed it to reach the fruit that was generally not infested and to weigh more heavily its action on others.

The number of captures increased slightly and a small peak of 15 individuals was reached in late July and was related to the maturation of most varieties of peach. Thereafter, catches decreased gradually, ceased in late August because of rising temperatures which exceeded the seasonal average maximum of 34 ° C. We noted that the highest number of flies caught during that year (15 individuals) was very low compared to the records for 2003 on the same fruit varieties (54 individuals) and with an insecticide that was not specific to the fruit fly. This was due to unfavorable climatic conditions in winter 2005 and probably also to the effectiveness of treatment with the ultracide 40 applied during the orchard study.

Also in 2005, trapping the fig tree by using Reamol GF traps , showed that the catch level was low during the third week of August, this was due in particular to the lack of mature fruit in the orchard. During the month of September, catches of flies were relatively high, and a peak of 470 individuals was reached on 9/18/2005 possibly because of the emergence of a new generation of pupae having evolved on different varieties of figs.

Between 7th and 18th September a decrease in numbers of trapped flies was observed, possibly due to high temperatures and heavy rains (over the season). It was, in fact, repeatedly verified that precipitation caused a reduction in the activity of the fruit fly, resulting in a transient decrease of catches in traps (Scotto La Massese 1965). Subsequently, the number of catches rose again to cease at the end of September coinciding with the complete absence of figs in the orchard.

During the same year on oranges Thomson, we used traps Reamol GF. During the first week of trapping, while the fruit was at its ripening stage, catches of flies in the traps were very significant. This was reflected in the receptivity of citrus fruit especially with early varieties. These flies came from the emergence of pupae from late summer fruit, especially from figs and prickly pears.

Martin (1950) found that the first spots on early varieties of citrus fruits took place September 20th in the Algiers region and it was only in October that larval penetration into the pulp was observed. Similarly, Lekchiri (1982) reported that in Morocco, it was from September that a significant revival of fruit fly activity was recorded. This was consistent with our results. Catches remained very high during the month of November up to a maximum value of 1268 flies towards the end of that month. The results of this study were similar to those of Cirio and Vita (1978) who were able to capture a maximum of 6000 individuals / trap / hectare during the month of November in Sardinia. Subsequently, the number of flies decreased gradually and vanished by late January.

It appeared from the overall results that the fruit fly seemed to resume its activity at the end of April, when the first flies were caught on the apricot tree. It continued during the month of June on the varieties of apricot and early peach varieties.

In July, it reached levels high enough on the late varieties of peach. At the end of this month and the month of August, it grew on pear varieties. Thereafter, fly populations remained on fig trees from late August until late September, months during which populations reached high densities.

Finally, this pest continued activity on citrus fruit during the months of October and November. During the first month, we recorded a significant number of flies on oranges during November and found very high levels of trapped flies. Then the density of flies diminished in December.

Population fluctuations that were identified in the various orchards were comparable to the findings of Anonyme (1992): that the seasonal fluctuations in the density of fly populations followed a broadly similar pattern in all countries of the Maghreb. Population densities increased slightly from early April until early June. Then a rapid increase occurred and the density of flies in July reached a very high level which was maintained until mid-August and declined thereafter.

In September and October, the densities remained at moderate levels up to a peak in November and December. The numbers dropped suddenly and then stayed low from January to March. During this period, the pest had an arrest of development as it entered into hibernation either at the larvae stage inside the fruit or as pupa underground or in adulthood (Cirio et al. 1972, Delrio 1986, Zervas et al. 1995, Papadoulous et al. 1998b). The Mediterranean fruit fly was

found present almost all year round, in most the areas where fruit was farmed. This was due to climatic conditions and the presence of preferred hosts. From field observations during the course of this study, it can be concluded that densities of fruit fly populations varied from one season to the next in relation to climate, availability and receptivity of the host fruit. The highest total number of flies was recorded on oranges (Thomson), with 4590 flies. The second highest was recorded on fig trees with 1933 flies, followed by 1044 flies caught on apricot (Hâtif colomer). The lowest number of flies (136) was caught on peaches in 2003 using a nonspecific insecticide notwithstanding the low fly count of 39 during conditions sufficiently specific to the year 2005.

Both of the different types of traps used were effective for monitoring changes in populations of *C. capitata* and the study found that simple traps had equally satisfactory results with an insecticide that was non specific to the fruit fly such as the stimikul.

We concluded that the trap Reamol GF, given its structure and rigidity seem to be the most appropriate to follow the population dynamics of *C. capitata* and advised its use to treat farm crops with more efficiency.

REFERENCES

Anonyme (1992) Programme d'éradication de la mouche méditerranéenne des fruits en Algérie, en Jamahiriya rabe Libyenne, au Maroc et en Tunisie. Rapport d'un groupe d'experts Vienne, 30 mars- 10 avril 41p

Ali Ahmed-Sadoudi D (2007) Bioécologie de la mouche méditerranéenne des fruits *Ceratitis capitata* Wied. 1824 (Diptera; Trypetidae) dans quelques vergers de la Kabylie. Thèse de Doctorat. Univ. M.Mammeri de Tizi-Ouzou (Algérie): 197p

Appiah EF, Afreh-Nuamah K, Obeng-Oforis D (2009) Abundance and distribution of the Mediterranean fruit fly *Ceratitis capitata* (Diptera: Tephritidae), in Late Valencia citrus orchards in Ghana. International Journal of Tropical Insect Science Vol 29 No 1: 11-16

Audemard H (1989) Emploi du piégeage avec des attractifs dans la conduite de la lutte contre les insectes nuisibles aux vergers. Bull SROP, Vol 12 N°2: 105- 108

Baker PS, Hendrichs J, Liedo P (1988) Improvement of attractant Dispensing systems for the Mediterranean fruit fly (Dipetera, Trypetidae) sterile release programme in Chiapas. Mexico J. Econ Entomol 81 (4): 1068 - 1072

Baker PS, Howse PE, Ondarza R N, Reyes J (1990) Field trials of synthetic sex pheromone components of the male Mediterranean fruit fly (Diptera: Tephritidae)
In Southern Mexico. Journal of Economic Entomology 83: 2235–2245

18. Balachowsky AS (1950) Sur l'origine de la mouche des fruits (*Ceratitis capitata* Wied, 1824) C.R. Acad Agric Fr, 36: 259-362

Bodenheimer F (1951) Citrus entomology in the Middle East. Junk, The Hague: 663p

Cirio U, De Murtas I, Gozzo S, Enkerlin D (1972) Preliminary ecological observation of *Ceratitis capitata* Wied. On the island of Procida with an attempt to control the species using the sterile male technique. Boll. Lab. Entomol. Agrar. Fillipo Silvestri 30: 175- 188

Cirio U, Vita G (1978) Fruit flies control by chemicals attractants and repellents. Bull. Srop/Sassaric.Sardaigne: 63 - 78

Delanoué P (1951) Encore la cératite! Extrait de la feuille d'informations viticoles de Tunisie N° 24: 8- 18

Delrio G (1983) Biothecnical methodes for *Ceratitis capitata* Wied: CEC / IOBC Symposium / Athens / Nov.: 11-21

Delrio G (1986) Tephritid pests in citriculture. Integrated pest control in citrus grove A.A. Balkema, Rotterdam, Boston. Ed. Cavalloro R, Dimartino: 135- 149

Ekesi S, Billah MK (2006) A field guide to the management of economically important Tephritid fruit flies in Africa. ICIPE Science Press, Nairobi, Kenya: 1-14

Guennelon G, Feron M (1958) La réceptivité des pêches aux attaques de *Ceratitis capitata* Wied dans la vallée du Rhône Ann. Epiphyties/INRA N°3: 357-372

Hafraoui A, Harris EJ, Chakira A (1980) Plastic traps for detection and survey of the Mediterranean fruit fly, *Ceratitis capitata* (Diptera :Trypiditae): in Morocco.Prol.Haw. Soc vol 23, N°2: 190- 203

Hui Y, Jianhong L (2007) Population dynamics of oriental fruit fly Bactrocera dorsalis (Diptera: Tephritidae) in Xishuangbanna, Yunnan Province, China. Frontiers of Agriculture in China 1: 76-80

Lekchiri A (1982) La cératite au Maroc CEC/IOBC Symposium Athènes Ed R. Cavallero: 571-574

Martin H (1950) Note préliminaire sur le comportement de *Ceratitis capitata* WIED. Dans la région algéroise. Bull. Entomol Suisse Vol 23 N°2: 120-124

Nakagawa S, Chamber DI, Bradshaw TI, Vracot T, Harris EJ (1976) Performance of sticky trap with trimedlure impregnated in the adhesive material J. Entomol, Vol 68: 817-818

Nunez BL (1987) La moska del mediterreo. CA: Informa (Enera. Febrero-maio): 9- 17

Olszewski T, Grison C (2010) A concise synthesis of sex pheromone of mediterranean fruit fly, *Ceratitis capitata* via lithiated carbanion derived from enephosphoramide. Heteroatom Chemistry Volume 21 Issue 3 : 139-147

Papadoulous NT, Karsoyannos BI, Carey JR (1998b) Tomporal changes in the composition of the over wintering larval population of the Mediterranean fruit fly (Diptera: Tephritidae) in Northen Greece. Ann. Entolol. Soc Am, 91 (4): 430-434

Rice RE, Cunningham RT, Leonhardi BA (1984) Weathering and efficacy of trimedlure dispensers for attraction of Mediterranean fruit fly (Diptera: Trypetidae). J. Econ. Entomol 77: 750-756

Scotto La Massese C (1965) Influence de l'addition de l'hydrolysat de protéines sur l'activité insecticide du malathion utilisé en pulvérisations localisées contre *Ceratitis capitata* Wied. dans une orangeraie de la Mitidja. Journ Phytiatr Phytopharm. Circum- méditerr Marseille: 89-97

Soltani N, Semir M, Djebbar R (1986) Contribution à la bioécéolgie de *Cydia pomonella* dans le verger de cognassier à Annaba: essai de piégeage comparatif et cycle évolutif. Ann. Inst. Nat. Agron Alger, vol 10 (1): 196-206

Utomi CI (2006) The distribution, host range and natural enemies of the new invasive fruit fly species, *Bactrocera invadens* (Diptera: Tephritidae) in southeastern Ghana. M. Phil. Thesis, ARPPIS, University of Ghana, Legon, pp 60

Zahler PM (1991) Fruit flies (Diptera: Tephritidae) in two mango orchards (Mangifera indica) from the Federal District, Brazil. Survey of species and population fluctuation Revista Eeres 38: 206-216

Zervas G, Kateva AX, Christopoulos A (1995) Ways of overwintering of medfly *Ceratitis capitata* (Wied.) (Diptera: Tephritidae). The overwintering of larvae suspended fruits of citrus trees in Attica, Greece. Proc V Panellenic Entoml Congr Athens, Greece: 10- 112