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# Yellow Sticky Rectangle with Ammonium Acetate Slow-Release Dispenser: an Efficient Long-Lasting Trap for *Dacus oleae* [1]

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## ABSTRACT

The combination of a yellow color sticky rectangle with an ammonium acetate slow-release dispenser (YAA) was compared to a yellow sticky rectangle (Y) and to a McPhail glass trap with Buminal™ (MB), Entomozyl™ (ME), or ammonium sulfate (MAS) odor lure in a 2% water solution, from the beginning of August till December in an olive grove.

When total olive fruit fly, *Dacus oleae* (Gmelin) (Diptera: Tephritidae), captures were compared, no large differences were detected among YAA, MB and ME traps, while Y and MAS ones were found much inferior. When expressed as a ratio to YAA, total captures were: 1 (YAA), 0.95 (MB), 0.70 (ME), 0.33 (Y) and 0.08 (MAS). In the fall (high population density), both yellow traps showed very high catches, while McPhail odor traps had comparatively reduced effectiveness, apparently due to cool humid weather. The opposite was true in August-September (hot dry weather, low population density).

McPhail traps were serviced every 5 days (summer) or 7 days (fall), while YAA and Y traps were replaced by new ones only once, at the beginning of October. The ammonium acetate dispenser could last much longer but traps had been covered by insects and debris.

## Introduction

The development of a sound control system against the olive fruit fly, *Dacus oleae* (Gmelin) (Diptera: Tephritidae), which is the key pest in the olive tree harmful entomofauna, necessitates efficient trapping methodology for population monitoring and/or control. So far, the McPhail trap baited with various odor lures (usually water solutions of ammonium salts or hydrolyzed proteins) has been the standard trap used in practice for monitoring. In the recent years, considerable research has been also devoted to yellow sticky traps, as well as a sex pheromone trap attracting males. In certain instances, lure combinations have resulted in increased catches, e.g. McPhail trap with ammonium sulfate water solution plus yellow color (Prokopy and Economopoulos 1975) or yellow sticky trap plus ammonium acetate dispenser (Economopoulos and Papadopoulos 1983). A trap combining several lures (yellow color + ammonium salt + pheromone + protein hydrolyzate) has been used successfully for control purposes (Delrio 1984). The addition of yellow-color or food-odor lure to a pheromone trap always increases its female catches since the pheromone attracts only

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males. When the pheromone was combined with ammonium-carbonate odor lure, its male catches decreased, while the female catches increased (Haniotakis personal communication).

Odor-lure traps, i.e. ammonium salts, pheromone, protein hydrolyzate, are considerably affected by weather. Their effectiveness decreases in fall because of decreased temperature and increased humidity conditions. Yellow color traps do not appear to be much affected by fall-winter weather conditions. Thus, in summer, when the population density is usually low due to hot-dry weather and the fruit not very suitable for infestation (especially in small fruit varieties, e.g. Koroneiki), odor traps usually show comparatively high catches, while in October-November when the population is very high they show comparatively low catches. On the contrary, yellow traps (which catch few flies in summer and many in fall) follow more accurately than odor traps the population density. It can be said that, to a certain degree, the yellow color short-range sticky trap reflects the population density in the olive tree much better than any of the odor traps. For the latter, data need to be converted by some mathematical formula to reflect the population density. Such an equation (deriving the population per tree from trap catches and mean weekly temperature) has been developed for the Entomozyl water solution McPhail trap in Corfu (Kapatos and Fletcher 1983).

The yellow color sticky trap has been tested in the past successfully for control purposes also, but the number of traps needed makes the method unpractical for large scale application (Economopoulos 1977, 1979a). In addition, the use of many yellow traps per unit olive grove may also pose a serious problem because of the attraction of many other insects, several of which are beneficial (Neuenschwander 1982, Raspi and Malfatti 1984). To substantially increase the number of flies caught on the yellow trap in summer and further increase its catches in fall, it has been combined with an ammonium acetate slow-release dispenser (Economopoulos and Papadopoulos 1983). This combination with an odor lure appears to make the trap practical and suitable for monitoring or even control purposes, since the number of yellow traps needed per unit olive grove can be considerably reduced. In another experiment, when the yellow sticky panel ammonium acetate trap was compared to an Entomozyl water solution McPhail trap (among the most powerful of McPhail odor traps), it gave similar overall catches from July till December (Economopoulos and Papadopoulos 1984). When the detailed results of the above work were analyzed, it became apparent that the combined-lure trap reflected better than the McPhail one the true population density, i.e. lower catches than the McPhail one in summer, equal in September, and higher in October.

The fact that in the experiments mentioned above the combination of a yellow sticky trap with an ammonium acetate slow-release dispenser produced a powerful, long-lived (it can last up to 4 months) trap, which at the same time appeared to reflect the natural population density throughout the season, led us to further compare in the present work the above trap with the standard traps used in practice for monitoring both sexes of the olive fruit fly.

## Materials and Methods

The experiment was conducted in a ca. 200 tree olive grove (10 × 20 tree lines) near the seashore of Malaconda, Evia, from August 9 till December 5, 1983. Almost all trees in which a trap was hung were of a small fruit variety. Thirty five % of all trees with traps produced practically no olives during this year. The rest produced a small, medium, or large crop on 27.5, 20.0 or 17.5% of the trees with a trap, respectively. Traps were hung in every 2nd tree or tree line. This means that traps were probably competing each other, especially during warm-dry weather. Traps within each replication were rotated whenever flies were collected. Olive fruit flies were collected and counted about every 5 and 7 days from August till mid-October, and from mid-October till December, respectively. On the same days, McPhail traps were rinsed and fresh odor-lure water solution was added. During summer, in a few cases, McPhail traps dried out before they were serviced. All yellow sticky traps and ammonium acetate dispensers were replaced by new ones once, on October 3rd. All dispensers still had a considerable amount of ammonium acetate at the time of replacement, but the yellow panels had many insects and much debris on their surface, and a considerable amount of sticky material had been removed with the olive flies. The area was treated with an organophosphate bait-spray by plane three times: July 5-8, September 19-22 and November 3-5.

The following traps were compared at eight replications: 1) YAA = yellow painted (texolac no. 6 color, a product of Syntex Co. Athens, Greece)

FIG. 1. Yellow sticky panel with ammonium acetate slow-release dispenser and olive fruit flies trapped.

14×20 cm cardboard rectangle coated with sticky material (Stickem Special, a product of Michel and Pelton Co. St. Emeryville, California) and ammonium acetate dispenser (Biolure, a product of Bend Research Inc. Bend, Oregon) (Fig. 1), 2) Y = as above, but without an ammonium acetate dispenser, 3) MB = McPhail glass trap baited with 200-250 cc of 2% Buminal odor lure (a product of Fino-Werke H. Luithlem Söhne Gm BH and Co. Andernach/Rhein, W. Germany) water solution, 4) ME = as above, but with a 2% Entomozyl odor lure (a product of Hoechst Hellas Co. Athens, Greece), and 5) MAS = as above, but with a 2% ammonium sulfate salt odor lure. Traps 4 and 5 are routinely used for olive fruit fly monitoring in Greece. Borax (at 1.5%) is often added in the McPhail traps to preserve trapped flies, especially in summer. The addition of borax was often found to increase trap catches slightly. It was not used in the present experiment, since practically no difference was found between ME and MEB (with borax) traps in a recent experiment in the same locale (Economopoulos and Papadopoulos 1984).

In previous experiments, it was found that the number of flies trapped in McPhail traps increased by 2-3 times when the exterior was sticky-coated (all arriving flies captured, Prokopy and Economopoulos 1975). Nevertheless, sticky-coated McPhail traps are not practical, and so far they have been used only for experimental purposes. For this reason, of the traps used in practice for capturing both sexes, the ME and MB ones are considered the most powerful ones. On the other hand, the MAS trap, although it captures only a small number of flies, has been and still is widely used for olive fruit fly monitoring.

## Results and Discussion

Table 1 presents monthly captures and the ratio of overall captures in the different traps to the yellow sticky-panel ammonium acetate dispenser trap. In August and September, the MB and ME traps were superior to the two yellow and the MAS traps. The differences were significant except in one case (the YAA trap in August). For the period October-December, the YAA trap always captured more flies than any of the other traps used. In October, the difference, compared with any of the other traps, was significant except in the case of the MB trap. In summer, the Y trap was the weakest, but in fall it became much stronger than the MAS or even the ME trap (November). The MAS trap, which is used extensively for population monitoring, was the weakest throughout the experiment, except in September, when it captured more flies than the Y trap. When we compare the ratio of total captures in the different traps to the YAA one, we see that the YAA and MB traps, although their efficiency in the different months was different, trapped approximately equal total numbers of flies. The ME trap captured considerably (but not significantly) fewer flies, while the Y and MAS traps captured only 1/3 and 1/12 of the number captured in the YAA trap, respectively. The McPhail odor traps were relatively more efficient than the yellow ones in August-September as compared to October-December, when the opposite was true. This was more pronounced with the Y trap, which did not have any odor lure.

When the sex ratio of flies captured in the various traps was examined, it was found that the McPhail odor traps captured the sexes at a level of about 50% each, or else slightly more females than males. The yellow traps usually captured more males than females. In October,

when the largest numbers of flies were found in all traps, the percentages of males were as follows: YAA = 59.8, Y = 68.8, MB = 46.4, ME = 47.8 and MAS = 52.6. That is, the yellow-color traps captured more males than females. For YAA, the addition of odor lure increased the percentage of females captured. It could be that females, having greater nutrient requirements because of egg-production, are attracted more than males to food odors. The above differences were found not significant due to extensive variation. Nevertheless, similar differences in the sex ratio of flies attracted have been consistently recorded in practically all of our experiments with traps of food-odor or yellow-color lures, although in most cases they were found not significant.

Figure 2 presents the detailed 5-day (summer) or 7-day (fall) captures of flies in the different traps throughout the experiment. Up to the first 1/3 of October, the MB and ME traps were superior to any of the other traps. In the second half of October, the YAA trap captured more flies than the MB or the ME trap, while the Y trap also showed increased catches. From the start of October, the latter became superior to the MAS trap and towards the end of October it surpassed the ME trap also. Unfortunately, the spray at the beginning of November killed most of the population and did not allow substantial differences to show up. Nevertheless, the yellow traps were usually superior to the McPhail ones till the end of the experiment. This was not the case in September, following a similar bait spray, when the yellow traps continued to be inferior to the odor traps until mid-October. Apparently, this was because the weather, which is a key factor affecting the efficiency of odor traps, was warm-dry till the beginning of October.

From the results of the present research it is concluded that: a) the addition of an ammonium acetate slow-release dispenser to the yellow sticky panel increased its total captures of olive fruit flies by about 3 times, reaching those of the McPhail Buminal trap, b) the increase was greater in summer than in fall, apparently due to more favorable weather for ammonia evaporation-diffusion, c) the YAA trap, in spite of the odor lure, tracks the population density (low in summer high in fall, Economopoulos 1979b, Economopoulos et al. 1982) rather well, apparently because its odor lure is not a very powerful one, d) the combination of a yellow sticky panel with ammonium acetate dispenser, which can last up to 4 months under field conditions, results in a comparatively powerful trap which does not require frequent service (it should be replaced when it gets covered by insects and debris). So far, the only traps found more powerful than the YAA one for both sexes of the olive fruit fly were the MB and ME ones when coated with sticky material (Economopoulos and Papadopoulos 1983). Nevertheless, these traps are not handy, require frequent service, and break easily.

TABLE 1. Wild olive fruit flies trapped on 14×20 cm yellow sticky cardboard rectangle with (YAA) or without (Y) ammonium acetate slow-release dispenser as compared to flies trapped in McPhail glass traps baited with 2% water solution of Buminal (MB) or Entomozyl (ME) or ammonium sulfate (MAS) odor lure in Malaconda, Evia, from August 9 till December 5, 1983. YAA and Y traps were replaced by new ones on October 3rd. McPhail traps were provided with fresh lure solution about every 5 and 7 days from August till mid October and mid-October till December, respectively. Organophosphate bait sprays were applied by plane on July 5-8, September 19-22 and November 3-5. Eight replications per trap type.

| | Flies per trap per day* | | | | | |
|---|---|---|---|---|---|---|
| Trap | August | September | October | November | December | Ratio to YAA** |
| YAA | 0.14 a | 0.21 b | 5.69 a | 0.27 a | 0.35 a | 1.00 a |
| Y | 0.02 b | 0.03 b | 1.80 c | 0.19 ab | 0.29 a | 0.33 bc |
| MB | 0.21 a | 0.97 a | 4.44 ab | 0.22 a | 0.10 a | 0.95 a |
| ME | 0.18 a | 1.39 a | 2.51 bc | 0.05 bc | 0.10 a | 0.70 ab |
| MAS | 0.02 b | 0.11 b | 0.34 c | 0.01 c | 0 | 0.08 c |

* In each column, means having same letter are not significantly different at p=0.05 according to Tukey's HSD test.
** Based on total flies captured throughout the experiment.

The present experiment compared the YAA trap to the most commonly used traps for population monitoring. The results are in agreement with previous studies and further show that the YAA trap is comparable to the most powerfull traps currently used for both sexes. The fact that its efficiency increases with population density, and that it can last long time, is of particular importance in cases of control application. In such cases, traps could be installed at the beginning of summer and be replaced by new ones probably once, at the beginning of fall. In the case of small-fruit variety groves (e.g. Koroneiki), where olives are not suitable for infestation before fall, traps could be placed in the trees only once at the beginning of fall. Again, however, we caution that capture of beneficial incests in such traps can have adverse consequences to control of other pest species.

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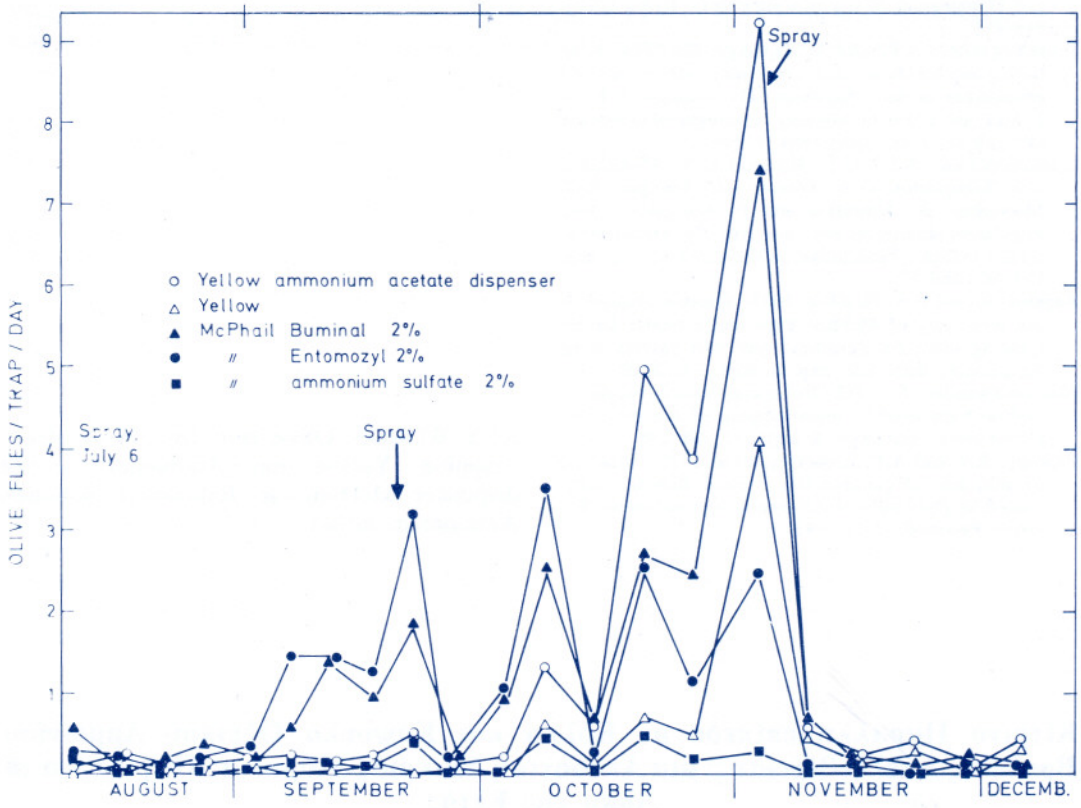


FIG. 2. Olive fruit flies trapped in yellow sticky traps with or without odor-lure dispenser and McPhail traps baited with water solutions of various odor lures. Organophosphate bait sprays applied by plane in July, September and November. Eight replications per trap. Experiment run in Malaconda, Evia, during 1983.

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KEY WORDS: Olive fruit fly, *Dacus oleae*, Trapping, Yellow trap, Ammonium acetate dispenser, McPhail trap, Entomozyl, Buminal, Ammonium sulfate

## Κίτρινο Παραλληλεπίπεδο με Κόλλα και Κάψουλα Οξεικού Αμμωνίου Βραδείας Απελευθέρωσης: μια Αποδοτική Μακριάς Διάρκειας Παγίδα για το Δάκο της Ελιάς

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### ΠΕΡΙΛΗΨΗ

Ο συνδυασμός κίτρινου παραλληλεπίπεδου (14×20 εκ.) με κόλλα και κάψουλα οξεικού αμμωνίου βραδείας απελευθέρωσης (ΚΟΑ) συγκρίθηκε με ίδια παγίδα χωρίς οξεικό αμμώνιο (Κ), καθώς και με παγίδες γυάλινες McPhail με προσελκυστικό Buminal (ΜΒ) ή Entomozyl (ΜΕ) ή θειϊκή αμμωνία (ΜΘΑ) σε 2% διάλυμα νερού, από τις αρχές Αυγούστου μέχρι τις αρχές Δεκεμβρίου.

Όταν συγκρίθηκαν οι συνολικές συλλήψεις δάκου ελιάς σε όλη την περίοδο, δεν βρέθηκαν μεγάλες διαφορές ανάμεσα στις παγίδες ΚΟΑ, ΜΒ και ΜΕ, ενώ οι παγίδες Κ και ΜΘΑ έπιασαν πολύ λιγότερα έντομα. Όταν οι συνολικές συλλήψεις εκφράστηκαν σαν

λόγος κάθε παγίδας προς την παγίδα ΚΟΑ τότε η αποδοτικότητα των παγίδων ήταν: 1 (ΚΟΑ)-0,95 (ΜΒ)-0,7 (ΜΕ)-0,33 (Κ)-0,08 (ΜΘΑ). Το φθινόπωρο (μεγάλος δακοπληθυσμός), οι παγίδες ΚΟΑ και Κ έπιασαν πάρα πολλά έντομα ενώ οι παγίδες McPhail είχαν συγκριτικά μειωμένη απόδοση προφανώς λόγω χαμηλών θερμοκρασιών και υψηλής υγρασίας. Το αντίθετο συνέβη τον Αύγουστο-Σεπτέμβριο (θερμός-ξηρός καιρός, μικρός δακοπληθυσμός).

Οι παγίδες McPhail εφοδιάζοντο με φρέσκο διάλυμα προσελκυστικού κάθε 5 περίπου μέρες το καλοκαίρι και 7 μέρες το φθινόπωρο. Οι κίτρινες παγίδες αντικαταστάθηκαν με καινούργιες μια φορά μόνο, στις αρχές Οκτωβρίου. Η κάψουλα οξεικού αμμωνίου μπορούσε να διαρκέσει πολύ περισσότερο (συνολικά περί τους 4 μήνες) αλλά οι επιφάνειες των παγίδων είχαν ήδη καλυφτεί με έντομα και άλλα αντικείμενα (φύλλα, κλαδάκια κ.λπ.).