Control of *Rhagoletis cerasi* L. (Diptera: Tephritidae) in organic cherry orchard in Bulgaria

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In the world markets the demand of organic fruits is increasing. Very favorable conditions for cherry production exist in Bulgaria where many organic cherry orchards were established in the latest years. The economically most important pest creating problems in the cherry orchards is the cherry fruit fly (*Rhagoletis cerasi*). The paper reports results of the cherry fly monitoring and control in organic orchard during the period 1997 - 2005. In the first years of conversion when the use of synthetic pesticides was stopped about 90% of the fruits resulted damaged. The use of bulgarian yellow traps in 1997 - 1998 did not lead to a significant reduce of the damages. In 1999 the yellow traps (Celaflor, product of Trifolio-M, Germany) combined with treatments with Neem showed very good results - no damaged fruits were observed. For the later trials in 2004 - 2005 swiss yellow traps, product of Andermatt, were used. A relatively small number of flies were trapped and during the harvest no damages were recorded.

POSTER SUBMISSION

Key: 1732

Panel: Alternative Control Strategies, Monitoring and Resistance
Bait sprays to control the European cherry fruit fly *Rhagoletis cerasi*: Status Quo & Perspective

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The European cherry fruit fly (*Rhagoletis cerasi*) is the most serious cherry pest in cherry orchards in Germany. Currently, no sufficient management strategy is available, neither for conventional nor for organic farming, nor for house gardens as infestation sources. Hence, there is an urgent need to establish environment-friendly control strategies. Therein bait sprays could be an option for an alternative control of the pest. The main principle of these is to use food (e.g. sugar and proteins) as baits for the flies with small amounts of insecticides, which are applied on parts of the cherry tree. Investigations on bait sprays against *Rhagoletis cerasi* were carried out in 2005 to 2007. Main focus was aimed at field cage experiments using the commercial GF-120 Naturalyte Fruit Fly BaitTM with the insecticide spinosad, which is registered against North American cherry fruit fly species in the US and Canada. Furthermore, additional bait spray formulations as alternatives to GF-120 were used to define the right food bait quality for a high attractiveness and low reproduction ability of the flies. Therein, a sugar-brewer’s yeast solution and corn steep water were compared. Additionally to spinosad, azadirachtin (neem) was used as insecticidal component. Promising results were obtained, e.g. efficacies up to 99% with infestation rates below the infestation threshold of 2% or significant mortality rates of flies already after 3 hours. From 2008 on, the main attention will be paid to the insecticides azadirachtin and pyrethrine in an appropriate food bait mixture. Questions like efficacy, adequate concentrations, persistence, rainfastness and practicability in commercial cherry orchards will be addressed.

POSTER SUBMISSION

Key: 1736
Panel: Alternative Control Strategies, Monitoring and Resistance
Increasing farmers’ knowledge, perceptions and practices in fruit fly pests control in West Africa

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Most fruit and vegetable crops in Benin and many other countries in West Africa (WA) suffer from attack by fruit flies belonging to the genus Ceratitis, Dacus and Bactrocera (Diptera:Tephritidae) and losses are sometimes reported to be up to 80%. Possible strategies to control these flies include the use of target devices and methods, known to be environmentally safe compared to the common use of large amounts of chemical pesticides. Preliminary investigations in most of WA countries (especially in Benin) revealed that:

• Damages due to fruit flies are not well identified most of the time, mainly during the first stage of the attack.
• Correlations between larvae tunneling in the fruit pulp and adults are not always made (in mango orchards).
• Basic sanitations measures to reduce fruit fly populations are scarcely carried out by growers (everywhere in WA).
• Too few measures of Integrated Pest Management are available and proposed to growers for the moment.

It was therefore necessary and urgent, most particularly in the context of two new invasive fruit fly pest species widespread in West Africa, to increase farmers’ knowledge, perceptions and practices through an efficient transfer of knowledge from research institutions to en-users and key stakeholders. In Benin, the development in local languages of outreach teaching and information package was considered with the objectives to:

1. Inform farmers on the presence and identity of fruit fly species of economic importance in the fruit and vegetable crops systems
2. Educate farmers on available pest management tactics for an efficient and sustainable control of fruit fly pests

This package was provided to farmers and various stakeholders free of charge, therefore enhancing the promotion of recommended fruit fly suppression practices.

POSTER SUBMISSION
Key: 1758
Panel: Alternative Control Strategies, Monitoring and Resistance
Evaluation of Success Appat for the control of tephritid fruit flies infesting cucurbits in Benin, West Africa

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Tephritid fruit flies are known to be economically important pests of cucurbit crops in many parts of the world. Several types of protein baits have been used successfully as cover or spot sprays in several fruit fly IPM programs. We conducted two experiments in Benin to test the efficacy of the protein bait product Success Appat® in controlling fruit flies on three cucurbit crops – cucumber, zucchini and watermelon. The two experiments – conducted one year apart – consisted of the same basic experimental design: the three cucurbit crops (first year) and zucchini and watermelon (second year) planted in 9m x 9m subplots within main plot surrounded by three adjacent rows of sorghum (first year) or maize (second year). Main plots were replicated three times and were at least 100m apart. In addition to Success Appat and control, the first experiment included cypermethrin (Cypercal 100 EC), a commonly used cover spray on cucurbit crops in Benin. Success Appat containing 0.02% Spinosad was applied at the rate of 2.5 l/ha in a solution of 1:1.5 (Success Appat: water). Bait was applied weekly in spots on the border plants, as preliminary trials showed that it is phytotoxic to the three cucurbits crops. Totals of 60 and 30 fruits were randomly taken per main plot respectively in the first and second experiment. Fruits were inspected for fruit fly damage and incubated individually in the laboratory to determine fruit fly infestation levels and species composition. Dacus ciliatus, D. vertebratus, D. punctatifrons, D. bivittatus, and Bactrocera cucurbitae infested the cucurbits with varying levels and depending on treatment, crop and year. Regardless of border plants, fruit infestations were as high as 20, 70, and 100 in Cypercal, Success Appat and control plots respectively. Possible reasons for the unsatisfactory effects of Success Appat are discussed.

POSTER SUBMISSION
Key: 1761
Panel: Alternative Control Strategies, Monitoring and Resistance
A new ready-to-use mass trapping system for the control of the Mediterranean fruit fly Ceratitis capitata (Wied.)

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The Mediterranean fruit fly is one of the most destructive and difficult pests to handle due to its polyphagous nature, high mobility, well adaptability and high proliferation, as well as the fact that its attacks are close to the maturation fruit period. All that this implies, that the farmer has a reduced margin of error since they cannot afford to make mistakes with the control of the pest.

Traditional control of the fruit fly based on insecticide treatments closer to the harvest period are nowadays not well considered because of its toxicological and environmental problems. Recently, various alternative control techniques have been developed in Spain, although they are carried out by means of government funds in order to reduce medfly population.

With the aim of searching for an efficient, economical and ecological method for the medfly control, BIOIBERICA, S.A developed Cera Trap®; a liquid protein formulation free of pesticides obtained by an exclusive method of enzymatic hydrolysis with a strong attraction capacity for fruit fly adults. Now we present here a new ready-to-use mass trapping system fast and easy to handle, The Bottle Cera Trap.

It is a terephthalate polyethylene trap baited with enough amount of liquid to maintain the attraction over the whole campaign and ready to be hung on the tree thanks to a cable tie built-in on its cap. The only handling needed is to remove the adhesive seal, from the holes practised on the bottle from where the flies enter the trap, making it a clean, quick and simple system to install.

Here we describe two field trials conducted in Huelva (Spain) during 2007 with mandarin and plum trees comparing the effectiveness of this new Cera Trap bottle system against the local standard mass trapping.

POSTER SUBMISSION
Key: 1747  
Panel: Alternative Control Strategies, Monitoring and Resistance
Mass trapping improvements in *Ceratitis capitata* Wied. control in the northeast of Spain

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*Ceratitis capitata* Wied., acquainted as Mediterranean fruit fly or Medfly, is a pest worldwide distributed that affects more than 350 plant species. In the northeast of Spain it is especially important the cultivation of pome and stone fruit-trees which are susceptible to this pest. In this area is common to use the methodology of Integrated Production, and within this framework, mass trapping system, as a control method for Medfly, has been applied during last years.

All installed traps in the orchards are normally checked each week to know the Medfly dynamic population throughout the season. That means a lot of time consumption and high economic costs. This study has been carried out with the aim of reducing the number of traps that must be weekly reviewed.

With weekly captures of five mass trapping trials carried out in 2007, a set of data for each sample size has been created. The study was done using a macro written in IML (SAS matrix language). Both averages (estimated and real) have been compared, taking into account in all cases, a 10% acceptance interval. The macro repeated the process 5000 times, obtaining the error, which is the number of times the fictitious average is within the chosen interval. For each week, we obtained the errors associated with tested sample sizes; and errors that did not exceed 10 or 25% were selected. Through this process it was determined, depending on the assumed estimate error, the percentage of traps that should be reviewed.

The results show that the main factors for the estimation of pest population through the trap captures are the plot size and the population level. For a maximum acceptable error of 10% in plots smaller than 1 hectare, it is convenient to review 100% of the traps, since the decrease in the number of traps would be reduced only 10%. In bigger plots, when the population levels are higher than 4,7 fly/trap/day, revised traps would be only 68% of installed ones.

**POSTER SUBMISSION**

Key: 1755
Panel: Alternative Control Strategies, Monitoring and Resistance
Comparative results of insecticide bait spray vs. mass trapping technique against the Mediterranean Fruit Fly Ceratitis capitata (Wied.) (Diptera: Tephritidae)

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With the purpose of controlling the population of C. capitata, a comparative study between insecticide bait sprays vs. mass trapping was conducted in seven citrus orchards in Mallorca (Balearic Islands). Three orchards were sprayed with several insecticides (fention, lambda-cihalotrin and spinosad); in other three plots, mass trapping at a density of 50 traps/ha was installed, being reinforced with insecticide baits sprays when necessary (integrated pest management, IPM). Probodelt traps baited with the synthetic female attractants were used for monitoring the pest population. The seventh plot was organically farmed and only mass trapping at higher density of 80 traps/ha was set up. In addition, in every plot there were 2 traps/ha baited with the male attractant Trimedlure. To monitor the pest, 2 traps/ha for females and 2 traps/ha for males were weekly revised. Fruit damage was also evaluated. This project was financed by the Balearic Government (Conselleria d’Agricultura i Pesca, Plant Protection Service).

The results referred to the female captures led to the following conclusions:

A.- Comparison among all treatments: the most effective was the IPM reinforced by any of the insecticides.

B.- Nevertheless, the mass trapping in the organic farm showed the lowest captures (2 fem/tr/d) when compared with the other farms.

C.- Comparison among the mass trapping treatments: the IPM reinforced with lambda-cialothrin showed the best results (3.26 fem/tr/d).

D.- When only bait sprays were applied, the lambda-cialothrin was the most effective in reducing females (7.13 fem/tr/d).

E.- Comparison of bait spray vs. mass trapping with the same insecticide (IPM): the IPM plus lambda-cialothrin showed the lowest level of captured females (7.13 fem/tr/d vs. 3.26 fem/tr/d), however, when considering the relative level of female reduction, the fention showed the most effective result from 12.60 fem/tr/d to 3.95 fem/tr/d.

F.- Fruit damage followed similar pattern.

POSTER SUBMISSION
Key: 1873
Panel: Alternative Control Strategies, Monitoring and Resistance
A small deletion in the olive fly acetylcholinesterase gene points to a novel resistance mechanism in organophosphates

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Organophosphate (OP) resistance in the olive fly was previously shown to associate with two point mutations in the acetylcholinesterase (ace) gene. The frequency of these mutations was monitored in Bactrocera oleae individuals of increasing resistance. Despite the difference in resistance among the individuals, there was no significant frequency variation and no correlation between mutation frequencies and resistance level, indicating that there are other contributing factors to this variation. The search for additional mutations in the ace gene of highly resistant insects revealed a small deletion of three glutamines at the carboxyl-terminal of the protein (termed BoaceΔ642-644). Significant correlation was shown between the mutation frequency and resistance level, suggesting that BoaceΔ642-644 might be responsible for high levels of OP resistance. In addition, remaining activity of AChE was higher in individuals that possessed the BoaceΔ642-644 mutation. The significance and the potential role of this mutation as candidate of resistance-associated mutation will be discussed.

POSTER SUBMISSION
Key: 1751
Panel: Alternative Control Strategies, Monitoring and Resistance
Low levels of spinosad resistance in the olive fruit fly in California

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The naturalyte spinosad is a relatively new and promising insecticide. It is characterized by high efficacy against target pests and low risk to humans and other non-target organisms and the environment. Its mode of action is still not entirely elucidated. Among its target pests is the olive fruit fly Bactrocera oleae (Gmelin). In Cyprus, spinosad is sporadically used since 2002, whereas in Greece it has a very limited use since 2004, particularly in biological olive cultivars in Crete. In California, instead, it is the only insecticide used against the olive fly since its invasion in the State in 1998. The present study aimed at examining the resistance status of the olive fruit fly in spinosad. Populations collected from Cyprus, Greece and California, plus a laboratory-reared population were tested. Bioassays were performed by topical application of different concentrations of the insecticide. Cypriot populations demonstrated no resistance as compared to that of the laboratory-reared population. Among the Greek populations, only the one from Crete demonstrated a 3-fold increase in resistance, whereas the populations from California demonstrated a 5-fold increase with regard to the laboratory population. These values are still quite low and do not pose any resistance problems in the field. However, the observed variation indicates a tendency of spinosad resistance to increase in areas where the insecticide is more extensively used.

POSTER SUBMISSION
Key: 1762
Panel: Alternative Control Strategies, Monitoring and Resistance
Evaluation of trimechlore dispensers by a method based on Thermal Desorption coupled to Gas Chromatography

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Knowledge about the behavior of trimechlore (TML) dispensers is essential to ensure the efficacy of monitoring and fight methods based on TML as attractant. There are several commercially available TML dispensers, and each of them has a different useful life and TML release profile. Their emission is also affected differently by environmental factors. Even the same type of dispenser sometimes shows an important variability in the TML release rate. Because of the importance of methods based on TML lures in the control of the Mediterranean fruit fly and the influence of the TML dispenser on the efficacy of these fight methods, we developed a non-destructive flow-through system to measure the TML release rate. This method, called Dispenser Breath Analysis (DBA), collects TML vapor on a Tenax desorption tube, and TML is quantified by Thermal Desorption coupled to Gas Chromatography/Mass Spectrometry (TD/GC/MS). Two types of TML dispensers, a polymeric (Aralure) and a mesoporous (Epalure), were field aged during three months. The TML release rates of these dispensers were determined by both DBA and Solvent Extraction Method (SEM). In this paper, the correlation between both measurement methods is shown. A field trial has also been carried out in order to correlate trap catches and TML emission of each type of tested dispenser. The DBA method allows a quick and accurate evaluation of the current behavior of commercial dispensers along their useful life. It also allows comparing the TML release rate between different dispensers. We believe that the DBA method can be useful for dispenser manufacturers to determine seasonal dispenser performance before a new product is introduced in the market, and to rapidly verify TML dispenser release when field-aged dispenser efficacy is in question. Thus, it can be employed as a quality control of commercial dispensers.

POSTER SUBMISSION
Key: 1759
Panel: Alternative Control Strategies, Monitoring and Resistance
Fruit flies in the genus *Anastrepha*, especially the reproductive age females, are attracted to protein baits. Synthetic lures based on the principal components of protein degradation, especially ammonia along with acetic acid, were tested against three of the most economically important *Anastrepha* species in Florida, USA; Mexico and the Dominican Republic. The results varied among the species, perhaps in part because of the different environmental conditions where these pests are prevalent. In Mexico and Florida, *A. ludens* and *A. suspensa*, respectively, were caught in higher numbers by traps baited with ammonium acetate and putrescine. But, in the Dominican Republic where *A. obliqua* is the dominant pest, traps with liquid protein baits outperformed the synthetic blends. Identification of additional attractants from liquid protein baits is needed to improve efficacy of the synthetic lures for *A. obliqua* as well as other species that prefer liquid protein baits.

**POSTER SUBMISSION**
Key: 1760
Panel: Alternative Control Strategies, Monitoring and Resistance
Mediterranean fruit fly (*Ceratitis capitata* Wied.) monitoring in the northeast of Spain

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The population of the Mediterranean fruit fly (MFF) *Ceratitis capitata* Wiedemann has increased considerably, in the northeast of Spain, over the last 8 years.

In order to find out the population dynamics for the year, two types of monitoring methods were established: the first one was carried out from 2004 to 2007 and was aimed at studying MFF behaviour in the perimeter of the fruit growing area. With this objective, five monitoring stations were installed in peach and apple orchards; four of them were placed at the north, south, east and west limits and the fifth in the centre of the area. In 2004 and 2005, two kind of lures were used: Aralure® (Aragro) a formulation of Trimedlure and Bio-Lure Medfly® (Suterra) (composed of Trimetilamine, Ammonic acetate and Putrescine) and, since 2006, a third lure, Ferag® CC DDD TM (SEDO) composed of Trimetilamine, Alcane diamine and Ammonic acetate was also used. For all of these years, lures were installed in Maxitrap® (Probodelt) traps, they were hung 25 m apart in every point of the monitoring web. Traps were checked once a week, counting and sexing the individuals, from May to November during the first two years and all year round in 2006 and 2007. The second type of monitoring aimed at finding out the population dynamics in the main Girona fruit areas. This started in 2005 and consisted of a large number of Maxitrap® traps with Ferag® CC DDD TM attractants hung in different cultivars of peach orchards (2005-2007), and in some apple cultivars (Gala, 2006-2007; Fuji, 2007). Traps were installed in early May and checked weekly until the end of November; and 30 of them were maintained all year round in the field. Temperature, rain, and humidity were registered for all the monitored areas.

The results of the first monitoring method have shown higher levels of MFF population in the North and the centre of the fruit area. While in the monitoring places located far from the sea (West), the MFF arrival was later in the season (end of July) than in the eastern point of monitoring, where MFF started its fly activity at the end of May or beginning of June. In all cases the maximum population was registered in October, though this value was very different between controlled points and years. Fly activity finished in December or January, depending on the place and the year.
In the second kind of monitoring, the MFF population evolution was established for each area, and the population curves found were similar to the curves of the first method, but differences between fruit species and years have been appreciated. These results were examined taking into consideration the climatic conditions of each area and the different years. Their implication in the fruit protection strategy was also analysed.

POSTER SUBMISSION
Key: 1794
Panel: Alternative Control Strategies, Monitoring and Resistance
Monitoring of *Bactrocera oleae* (Diptera; Tephritidae) in Mallorca (Balearic Islands, Spain) by using yellow and red sticky traps

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The olive fruit fly *Bactrocera oleae* (Gmelin) is the most important pest for the olive production. The larvae develop inside the fruits damaging them and decreasing the final quality of the oil production. The monitoring techniques for this tephritidae are still mainly based in ammonia liquid attractants, female pheromones and yellow panel traps. Previous studies conducted in the framework of a IAEA supported CRP indicated that red spheres (RS) were a promising tool to be used as “lure and kill” devices when baited with ammonium solid salts and coated with insecticides. In this work, we present results regarding the comparison of non-baited sticky yellow traps (YT) vs. non-baited sticky red spheres used for the monitoring of the olive fly in Mallorca. Four olive orchards (A, B, C, D) were selected in Mallorca, being two of them (C, D) organically farmed. A total of four YT and four RS were set up in each orchard. Captures were weekly revised and females and males counted separately. The presence of natural enemies was also evaluated. Results showed that both systems used for monitoring *B. oleae* population performed differently when total amount of captures and temporal pattern is considered. In general, the RS captured more males and females than the YT in the organic farms, meanwhile the contrary situation was observed in the A and B farms. In regards to the sex ratio, the results from A and B orchards showed a 50 % of both females and males either in the YT or RS. However, when considering the organic farms, the RS captured more females (60 %) in contrast to the YT which captured the same ratio observed in orchards A and B. These results suggest that RS could be used for targeting olive fly females more efficiently than the YT.

POSTER SUBMISSION
Key: 1871
Panel: Alternative Control Strategies, Monitoring and Resistance
Comparison of susceptibility and nycthemeral rhythms between reared insects of Mediterranean fruit fly (*Ceratitis capitata*) and wild population of Algeria

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Fenthion toxicity was studied with topical application and lethal dose LD 50 and DL 80 were assessed on various *C. capitata* Wiedemann populations. Toxicity was lower in wild individuals than in reared insects, among which individuals irradiated at 90 Gy gamma ray were significantly more susceptible. A nycthemeral variation in the susceptibility to this insecticide was characterized, with some peculiarities related to the origin of the insects and the LD considered.

**POSTER SUBMISSION**

Key: 1719

Panel: Alternative Control Strategies, Monitoring and Resistance
Study of female attractants to control Mediterranean fruit fly, Ceratitis capitata (Wiedemann), (Diptera: Tephritidae) by mass trapping

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There are many studies that evaluate different lures and traps for monitoring programs or mass trapping technique. Currently, mass trapping technique against Ceratitis capitata (Wiedemann) is increasing notably as a control method in Spain. In this work we have tested the efficacy of commercial and new developed lures in citrus orchards Citrus reticulata Blanco. Trials were conducted in Valencia, Spain, during 2007. Six commercial attractants have been evaluated. All the attractants contain a three component lure of ammonium acetate, trimethylamine and a diaminoalkane (putrescine or cadaverine). Male and female catches were recorded every week during 4 months. Moreover the longevity of the attractants has been studied. For this purpose, the fly catches in traps baited with aged attractants were compared with catches in traps baited with new attractants. Catches show important differences between dispensers. Biolure was the most efficient lure during the first two months. The study of dispensers longevity shows that Econex, and Epalure were as efficient as Biolure during the last two months of the trial.

POSTER SUBMISSION
Key: 1753
Panel: Alternative Control Strategies, Monitoring and Resistance
Population Dynamics of Fruit Flies and On-Farm Integrated Pest Management In Mango Orchards

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The trend of the population of fruit flies follows the dynamic of the rains. This tendency is more perceptible on Bactrocera invadens than on Ceratitis cosyra. From 350 individuals captured per trap, B. invadens seemed to disrupt the presence of C. cosyra and the other related Ceratitidae species. This behavior is probably due to an interspecific competition. Such behavior could be due by the fact that C. cosyra dominated emergences from the incubated fruits of alternate host plants up to 87% even though B. invadens was observed. The sex ratio was dominated by females especially at the end of the harvesting period of mangoes, corresponding to the end of the rainy season. Integrated pest management (IPM) package which including 1) male annihilation using wood blocks soaked in insecticide and lure (methyl eugenol and terpinyl acetate), 2) two protein hydrolysate bait applications (Success Appat at 1 liter per ha) and 3) sanitation (mechanical weeding, destroying of the collected fallen fruits in using black plastic bags, digging holes and burning with a barrel transformed into incinerator), were used for the control of the fruit flies in mango orchards in the natural region of Niayes in Senegal. Results showed an inferred improvement in fruit fly (B. invadens and C. cosyra) infestations in the treated plot up to 83% compared to the untreated. When comparing lures, we found that methyl eugenol attracted significantly B. invadens than the home-made baits of grinded nutmeg and NET (beauty cream). Methyl eugenol's half life is also significantly longer (5 weeks) than the grinded nutmeg (less than 1 week) (P = 0.0109; t = 9.4935; Df = 2). There were no capture recorded in the NET based trap.

POSTER SUBMISSION
Key: 1726
Panel: Alternative Control Strategies, Monitoring and Resistance