EXPERIENCES WITH REMOTE SENSING OF LEPIDOPTERAN PESTS USING DIFFERENT ATTRACTANTS

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ABSTRACT

In 2012 we started testing Trapview devices, a new technology in agricultural forecasting services. The new approach offers rationalisation of current procedures considering monitoring of insect pests. Time and material consuming field visual inspections are replaced by viewing images through web or mobile application. The device takes snapshots of field situation on a daily basis, thus a farmer, a producer or an expert entomologist are informed of the situation in the field in time. We primarily focused on remote sensing of polyphagous Lepidopteran pests, which are complicated to attract and are also of significant economic importance. Starting with the European corn borer (*Ostrinia nubilalis*) we expected low efficiency with pheromone luring due to phenotypic variation in attractant production and its perception. However, the species' morphological characteristics could allow faster recognition using computer vision techniques. In the beginning preliminary results showed some lack in luring performance, but were generally promising. Subjects of observation also became species whose presence is difficult to mark due to their migrability: cotton bollworm (*Helicoverpa armigera*), *Noctua fimbriata* and *Noctua comes*. These can be detected with Trapview AURA, specific wave length light emitter device. Also combinations of light and pheromone attractant were tried. At the same time we also routinely compared standard delta trap and Trapview on codling moth (*Cydia pomonella*) in the apple orchard using pheromone attractants.

Keywords: agricultural forecasting, *Cydia pomonella*, *Ostrinia nubilalis*, remote sensing, Trapview

IZVLEČEK

IZKUŠNJE Z DALJINSKIM ZAZNAVANJEM ŠKODLJIVIH METULJEV Z UPORABO RAZLIČNIH ATRAKTANTOV

S preizkušanjem naprav Trapview, ki predstavljajo novo tehnologijo v prognozi v kmetijstvu, smo začeli leta 2012. Nov pristop nudi racionalizacijo obstoječih postopkov spremljanja škodljivih vrst žuželk. Terenske preglede, ki so časovno zahtevni in povzročajo materialne stroške tako zamenja pregledovanje posnetkov na spletu ali mobilnih aplikacijah. Trapview zajame posnetke na terenu v želenem časovnem intervalu, medtem ko imajo kmet, pridelovalec ali entomolog informacijo stanja vedno pri roki. Primarno smo se osredotočili na

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daljinsko zaznavanje polifagnih škodljivih vrst metuljev, ki so težavne za privabljanje in so hkrati gospodarsko izredno pomembne. Pri preizkušanju na koruzni vešči (*Ostrinia nubilalis*) smo pričakovali nizko učinkovitost privabljanja s feromoni, saj vrsta fenotipsko variira ravno na nivoju kemične komunikacije. Po drugi strani pa bi njene morfološke lastnosti omogočale hitrejše prepoznavanje s pomočjo računalniškega vida. Preliminarni rezultati so sprva kazali pomanjkljivosti privabilne tehnike, a so bili na splošno obetavni. Predmet opazovanj so postale še vrste, katerih spremljanje je oteženo zaradi njihove migrabilnosti: južna plodovrtka (*Helicoverpa armigera*), *Noctua fimbriata* in *Noctua comes*. Te spremljamo z napravo Trapview AURA, ki metulje privablja s svetlobo specifične valovne dolžine. V tem okviru smo preizkušali tudi kombinacijo svetlobnih in feromonskih privabil. Hkrati smo na jabolčnemu zavijaču (*Cydia pomonella*) v nasadu jablane rutinsko primerjali Trapview s standardno delta pastjo, kjer smo kot privabilo uporabili feromon.

Ključne besede: *Cydia pomonella*, daljinsko zaznavanje, *Ostrinia nubilalis*, prognoza v kmetijstvu, Trapview

1 INTRODUCTION

According to Loughlin (2013), frequent and reliable monitoring of pest populations is one of the most fundamental components of IPM and semiochemical systems help in IPM since it provides precise information as to when and where insect pests arise. Currently pheromone traps, densely deployed in the field, are used to monitor insect populations. However checking these traps on a regular basis can be a time consuming activity making insect population monitoring currently one of the most laborious and often neglected tasks in IPM. All this is may soon be a thing of the past as a few new and competing technologies that bring innovative solutions to the task of monitoring insect populations in crops continue to be rolled out.

Following latest innovations we started testing Trapview devices in 2012 (Rodič *et al*., 2013). The new approach offers rationalisation of current procedures considering monitoring of arthropod pests. Time and material consuming field visual inspections are replaced with viewing images through web or mobile application. The device takes snapshots of field situation on a daily basis, thus a farmer, a producer or an expert entomologist are informed of situation in the field in time.

2 MATERIAL AND METHODS

2.1 Testing Trapview AURA

A proper forecasting issue for the Plant protection service is testing devices on pests which are complicated to attract and are also of significant economic importance. This is the reason why we focused on an European corn borer (*Ostrinia nubilalis*). Pheromone luring shows low efficiency due to phenotypic variation in attractant production and its perception (Shannon *et al*., 2010). However the species morphological characteristics could allow faster recognition using computer vision techniques.

Since most of Lepidoptera pests are nocturnal and consequently also attracted to light, we tested beta version device (Trapview AURA) with specific wave length light emitter (λ=375 nm) operating 4 hours a day from 21:00-01:00. Combinations of light and pheromone attractant were also tried.

Polyphagous Lepidoptera as an European corn borer is a threat to different types of crop. In the agriculture of our south-east region it attacks corn, hops, millet, hemp, while in vegetables it preferably attacks pepper (Tomše *et al*., 2003-08; Bajec *et al*., 2009-14). It is also indicated to attack apples. Field testing of Trapview AURA was performed on two different locations: on a field in Krasinec, with different neighbouring cultures: corn, peppers, tomato, cabbage, onion, and in the vineyard Piroški vrh.

2.2 Testing standard Trapview

Standard delta trap and Trapview were compared on a codling moth (*Cydia pomonella*) in the apple orchard in Raka, Novo mesto. We used Trece Inc., Pherocon® codling moth pheromones in both traps. Pheromones were applied at beginning of April, before the moths begin to fly. Dispensers were changed on a monthly basis.

3 RESULTS

3.1 Testing Trapview AURA

In the beginning preliminary results showed some lack in luring performance, but were in general promising. Subjects of observation have also suddenly become species whose presence is difficult to mark due to their migrability: cotton bollworm (*Helicoverpa armigera*), *Noctua fimbriata* and *Noctua comes*. These are now easily detected with Trapview AURA. Some other pest species appeared according to the neighbouring crops: diamondback moth (*Plutella xylostella*) was easy to detect and recognize from other caught insects, though small dimensions. These microlepidoptera was already tested by Rempe-Vespermann and associates in 2013 and 2014.

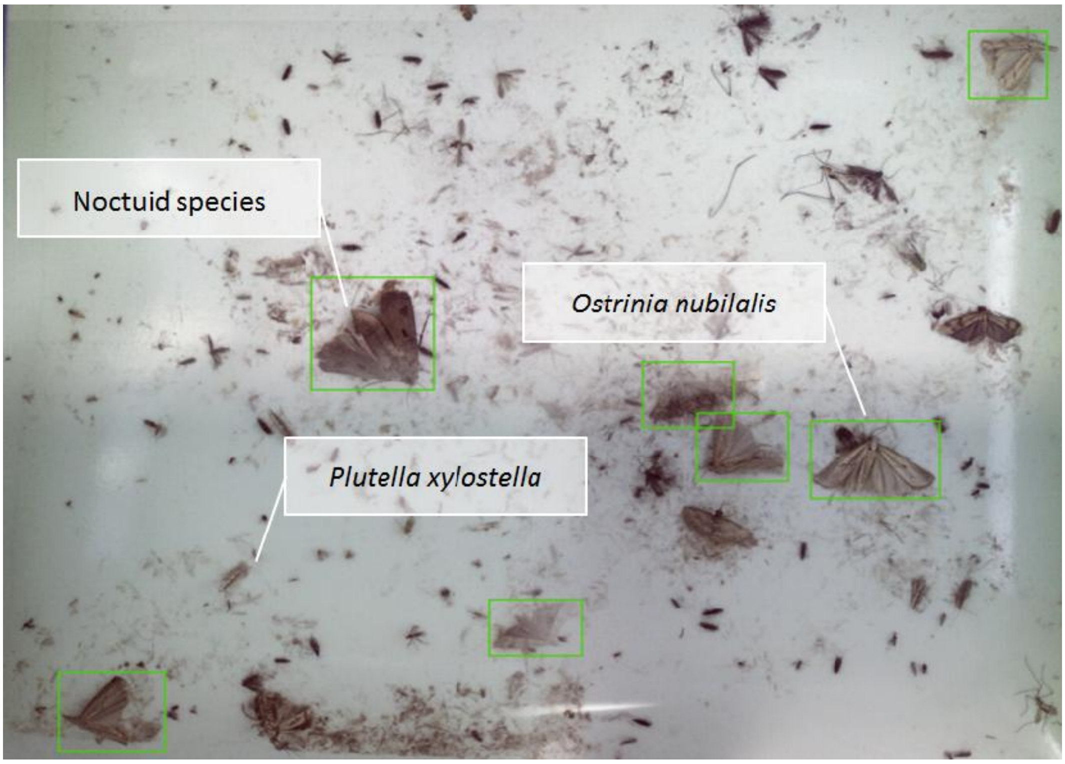

Figure 1: Section of adhesive layer in AURA. Pest species were recorded according to neighbouring host plants (photo: AURA, D. Bajec).

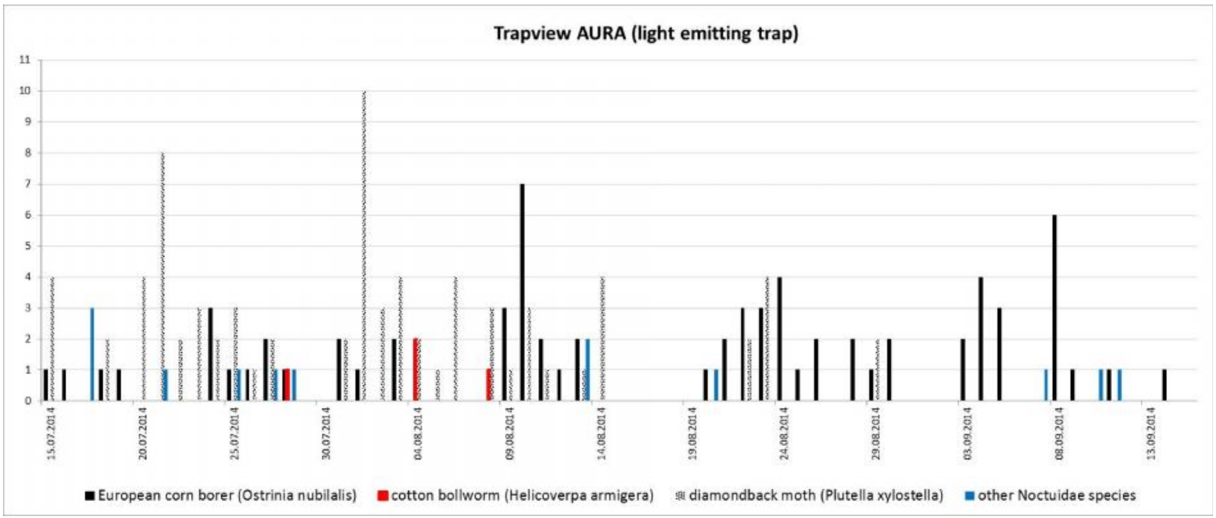

Figure 2: Display of two months section of Trapview AURA multiple trapping. Range of detected species can be stressed by adding specific pheromone dispenser.

3.2 Testing standard Trapview

Monitored species are adequately trapped on both traps. The flight dynamics reflects regional population specifics with 1st and 2nd generation slightly overlapping and shows comparable data. Maximum catch of nine specimen on Trapview per day is above local average records on standard delta pheromone trap.

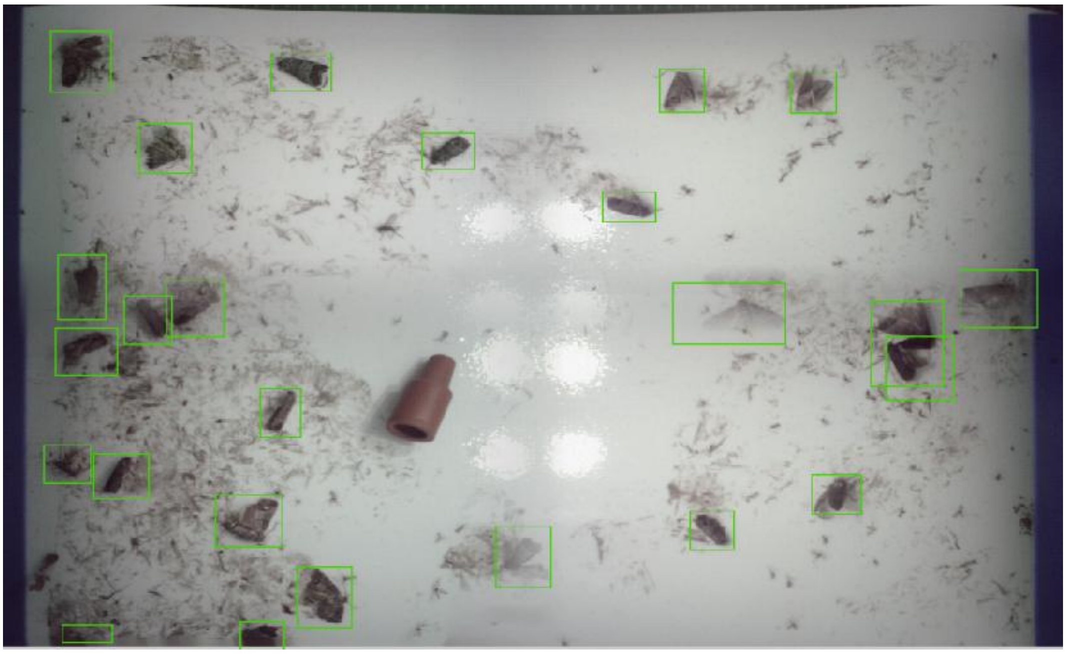

Figure 3: Picture of a codling moth caught on the adhesive layer. Moths are automatically detected and marked (photo: Trapview, D. Bajec).

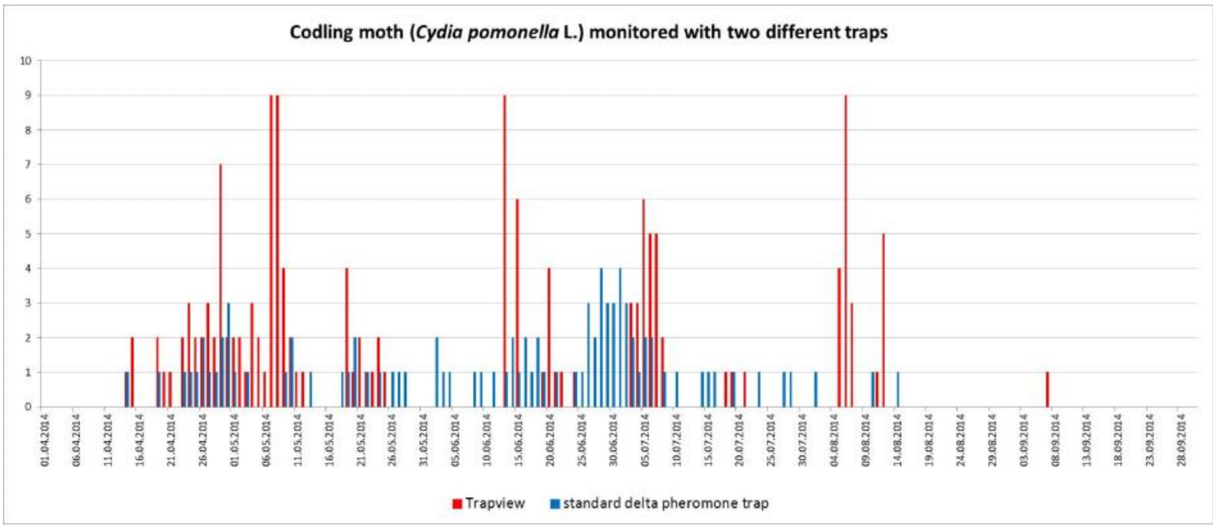

Figure 4: Comparable dynamics of a codling moth caught on Trapview and a standard delta trap.

4 CONCLUSIONS

Testing Trapview on Tortricid species codling moth (*Cydia pomonella*), which is usually not complicated to monitor, shows a positive experience comparable to traditional delta pheromone traps. Attraction as well as automated detection with pest marking work well. It also seems, that the Trapview‘s housing attracts more moths (Benvenuto *et al*., 2013).

On the other hand, the catch in Trapview AURA depends on location of a trap application and can be diverse and host plant specific. Less different species will appear in monoculture. While tests with the majority of these species still show no great abundance (Rak Cizej *et al*., 2008 and 2014), they are important as an efficient perception system for instant decision making. Low threshold pests demand only two options to choose from – to act or to hold.

Light emitting remote sensing device with cloud based web application eg. Trapview is developing into a powerful forecasting tool and a good early warning system. Non-skilled users can easily identify insects caught by selective attractant (pheromone). However help from a skilled entomologist is needed when non selective attractant (light) is used or when it is difficult to determine which insects are monitored.

During the process several modifications were made. Results can be discerned in better image production. Slides of an adhesive insert layer are stitched together from four photos taken in optional or periodical time intervals.

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