www.sospublication.co.in

Journal of Advanced Laboratory Research in Biology

We- together to save yourself society

e-ISSN 0976-7614

Volume 2, Issue 3, July2011

Research Article

Light-Trap Catch of the Harmful Insects in Connection with the Ozone Content of the Air

Nowinszky L.* and Puskás J.

*University of West Hungary, H-9700-Szombathely, Károlyi Gáspár Square 4, Hungary, Europe.

Abstract: The study deals the efficiency of light trapping of the European Corn Borer (*Ostrinia nubilalis* Hbn.) and the Common Cockchafer (*Melolontha melolontha* L.) in connection with the ozone content of the air. The collected data of which use was made the Hungarian national light trap network between the years 1997 and 2006. We calculated relative catch values from the number of caught insects. We assigned these to the ozone values, we averaged them, and we depicted the results together with the regression equation though. We established that the light trapping of this species most fruitful when the ozone content of the air is high. As opposed to this, the low ozone values reduce the successfulness of the catching on one moderated only. Our results will be exploitable in the plant protecting and environment conservation researches.

Keywords: *Ostrinia nubilalis* Hbn., *Melolontha melolontha* L., light-trap, ozone.

1. Introduction

The ozone content of the air influences the strength of UV-B radiation, which in its turn, as proved by our previous studies (Puskás *et al.*, 2001), bears an impact on the effectiveness of collecting insects by light-trap. Therefore, it seemed reasonable to try to find a connection also between the ozone content of the air and the number of insects trapped. In Hungary, ozone monitoring is carried out at four stations of the Hungarian National Meteorological Service (K-puszta, Hortobágy, Farkasfa and Nyírjes). Monitoring at K-puszta has been done since 1990 and in the other three villages since 1996. Today 10-minute average concentration values are detected at every station with the help of the ozone monitors. Since 1998, MILOS has forwarded data and QLC, having been collected earlier by, a local data collecting programmed (SCANAIR) and stored in PCs. SCANAIR reduced 15-minute data into half-hour averages which were then entered in the database. At three of the stations (K-puszta, Hortobágy, Farkasfa and Nyírjes), the job is performed by an Environment type monitor. A Thermo Electron type monitor at K-puszta also makes parallel monitoring possible. The ozone monitors are UV photometric ozone analyzers, which establish ozone concentration by illuminating with a UV lamp an air sample drawn into an absorption cell, then measuring the decline of illumination at a wavelength of 254 nm. The extent of this is proportionate to the ozone content of the air. The instrument establishes the ozone concentration in a ppb unit, by taking samples in every 10 minutes. The data are in a 0-150 ppb–s range. Sometimes negative values are received after calibration: this is to be handled as 0. High ozone values (> 100 ppb) occur mainly in the summer season, sometimes in early spring. Values over 120 ppb were measured very rarely (so far in 1-2 cases). A Thermo Electron type ozone calibrator is being used. Every measuring instrument must be calibrated at least once a year, in fact, the ozone calibrator, too, must be regularly adjusted to the international standard (in Prague). Calibration and data control cannot be fully automated, as the daily curves must be checked separately and outstanding data must not be automatically discarded. Each data is earmarked with a mistake code, which characterizes the quality of

*Corresponding author:
E-mail: lnowinszky@gmail.com; pjanos@gmail.com.

the data. Every external circumstance, including the various meteorological features, must be examined (wind direction, wind speed, temperature etc.) to explain extreme and seemingly wrong ozone values. A final file of data stores the raw measurement data, the calibrated and controlled data and the mistaken code referring to data quality. The database is copied to CDs annually (Puskás *et al*., 2001).

Ozone content in the summer months - from May until August - is higher than in other months of the year. There are typical daily changes. The ozone content is high from noon to evening and goes down from evening to dawn. It hit its lowest point in the dawn hours and begins to rise again in the early morning. Ozone concentrations in the atmosphere depended on several meteorological factors, too (Tiwari *et al*., 2008).

Kalabokas and Bartzis (1998); Kalabokas *et al*., (2000); Kalabokas (2002); Papanastasiou *et al*., (2002 and 2003); Papanastasiou and Melas (2006) in Greece have been studying the monthly changes and those in the different periods of each day of the ozone content. Ozone content in the summer months – from May until August – is higher than in other months of the year. There are typical daily changes. The ozone content is high from noon to evening and goes down from evening to dawn. It hit its lowest point in the dawn hours and begins to rise again in the early morning.

The highest concentration of ozone is Maleficent to insects. The study of Kells *et al*., (2001) evaluated the efficacy of ozone as a fumigant to disinfest stored maize. Treatment of 8.9 tonnes of maize with 50 ppm ozone for 3 days resulted in 92–100% mortality of adult Red Flour Beetle, *Tribolium castaneum* (Herbst), adult Maize Weevil, *Sitophilus zeamais* (Motsch.), and larval Indian Meal Moth, *Plodia interpunctella* (Hübner). Biological effects of ozone have been investigated by Qassem (2006) as an alternative method for grain disinfestations. Ozone at a concentration of 0.07g/m3 killed adults of Grain Weevil (*Sitophilus granarius* L.), Rice Weevil (*Sitophilus oryzae* L.) and Lesser Grain Borer (*Rhyzopertha dominica* Fabr.) after 5-15 hours of exposure. Adult death of Rice Flour Beetle (*Tribolium confusum* Duv.) and Saw-toothed Grain Beetle (*Oryzaephilus surinamensis* L.) was about 50% after 15-20 hours of exposure. Total adult death of all insect species was made with 1.45 g/m^3 ozone concentration after one hour of exposure. Valli and Callahan (1968) examinations made with light traps indicated an inverse relationship between O_3 and insect activity.

2. Material

For we had at our disposal the ozone data registered at K-puszta between 1997-2006 years. We have downloaded these data (μg/m^3) from the website of Norsk Institutt for luftforskning (Norwegian Institute for Air Research (NILU) (http://tarantula.nilu.no/projects/ccc/emepdata.html/).

The geographical coordinates of Kpuszta are the following: 46° 58’ N and 19° 35’ E.

In our study, we used the data pertaining to the European corn borer (*Ostrinia nubilalis* Hbn.) from the material of the Hungarian national light-trap network in the years 1997-2001. For we had at our disposal the ozone data registered at K-puszta in the same year. As we could not tell what distance from the monitoring site the assumed impact of the ozone content could be detected, we processed data supplied first by the light-traps within 50 kilometres, then 100 kilometres and finally those provided by all the light-traps in the country. We used the same methods in all three examinations.

The ozone content of the air was monitored once in every hour, while the light-traps supplied a single data of the whole night of collecting. However, the European corn borer (*Ostrinia nubilalis* Hbn.) flies to light throughout the night (Járfás, 1979), and its activity reaches its maximum between 9h p.m. and 2h a.m. Therefore we correlated the collecting data to the ozone data monitored at 11h p.m. (UT). However, with the detected ozone values showing essential differences by years and even months, we could not work with the original data. Therefore we calculated relative ozone values by dividing the ozone values of the given calendar dates by the average of the period of the preceding and following three nights, a total of seven nights that is, and used these relative values in further calculations.

In our study, we used the data pertaining to the Common Cockchafer (*Melolontha melolontha* L.) (Coleoptera: Melolonthidae) from the material of the material of those light-traps which operated up to 100 km away from the K-puszta in the years 1997-2006.

Because the Common Cockchafer (*Melolontha melolontha* L.) fly only in mid-April to mid-May and in the twilight hours only, the ozone data is only slightly changed during this period, there was no ozone data measured by the relative values are expected.

Accordingly, we worked with the ozone data of the time 20 O’clock (GMT). The data used are seen in Table 1.

Table 1. Catching data of the European Corn Borer (*Ostrinia nubilalis* Hbn.) from the years between 1997-2001 and the Common Cockchafer (*Melolontha melolontha* L.) from the years between 1997-2006.

Number of	Within 50 km	Within 100 km	All light-traps
European Corn Borer (*Ostrinia nubilalis* Hbn.)			
Light-traps	7	22	42
Observing data	1570	5712	13237
Specimens	354	13569	27882
Nights	555	650	653
Common Cockchafer (*Melolontha melolontha* L.)			
Light-traps	—	22	—
Observing data	—	2627	—
Specimens	—	12551	—
Nights	—	422	—

3. Methods

From the catch data, we calculated relative catch values by generations at all the observation posts. The relative catch (RC) is the dividend of the number of individuals trapped in one unit of sampling, in case, one night, and the average number of specimens of a generation in a time unit of sampling. Observing data means the catching of one trap in one night, regardless of the number of insects caught. The number of observed data exceeds the number of the nights because more light-traps have worked on a night.

We correlated the relative catch values to the relative ozone data belonging to the same date and prepared in the way described above. We arranged the pairs of data in classes, then averaged and depict them. We have calculated regression equations, the strength of correlation and significance levels.

4. Results and discussion

Our results, including regression equations and significance levels, are displayed in Fig.1-4.

Fig. 1
Light-trap catch of the European Corn Borer (*Ostrinia nubilalis* Hbn.) in connection with the ozone content of air, less then 50 km away to K-puszta

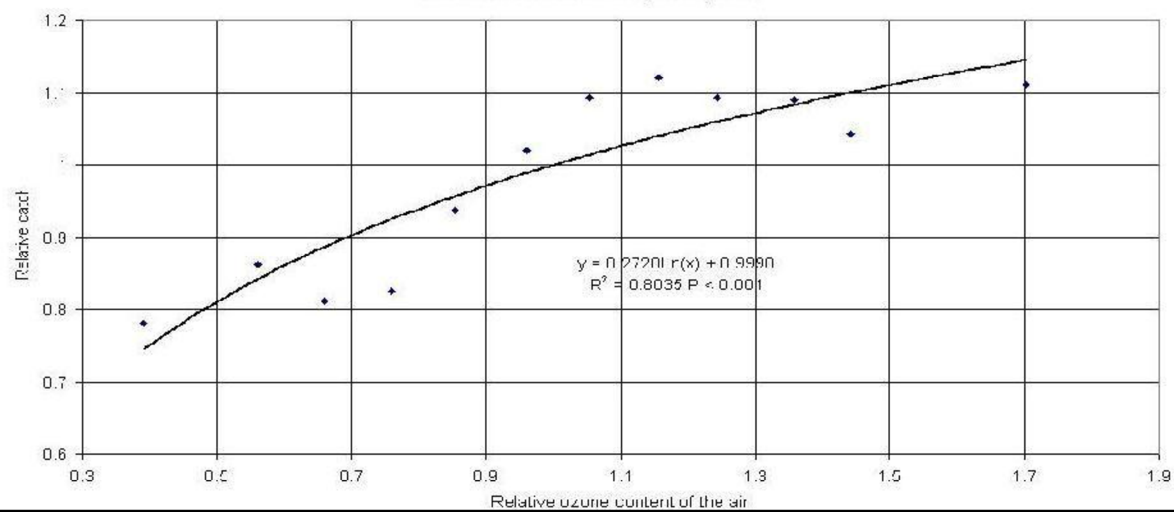


Fig. 2
Light-trap catch of the European Corn Borer (*Ostrinia nubilalis* Hbn.9 in connection with the ozone content of air, less than 100 km away to The K-puszta

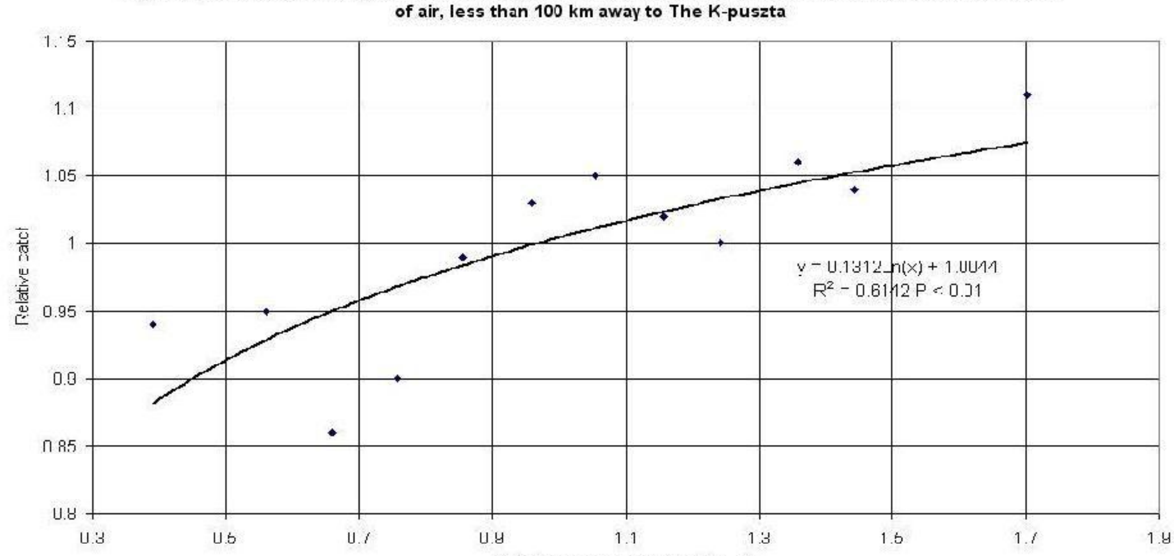


Fig. 3
Light-trap catch of the European Corn Borer (*Ostrinia nubilalis* Hbn.) in connection with the ozone content of air, all the Hungary

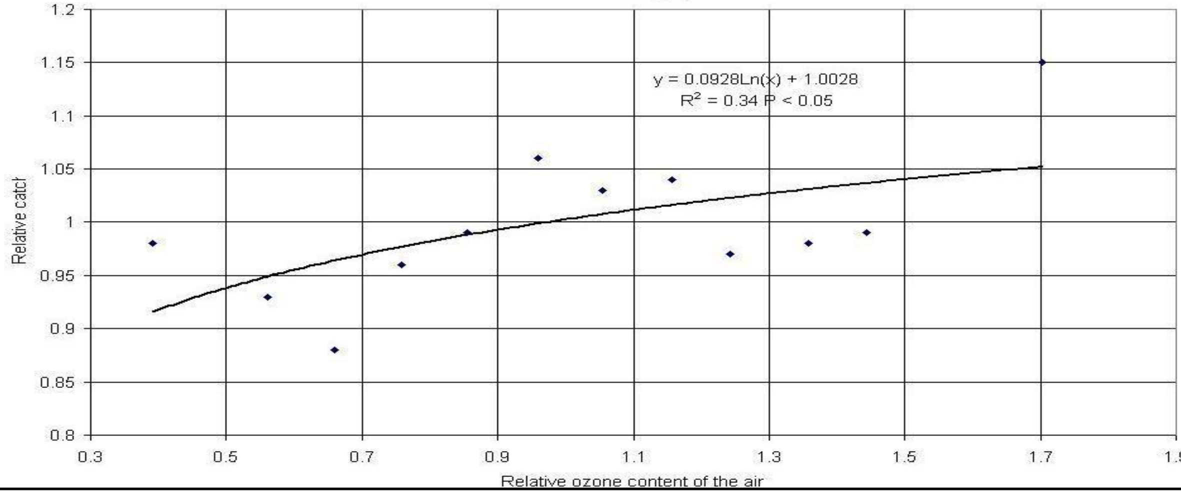
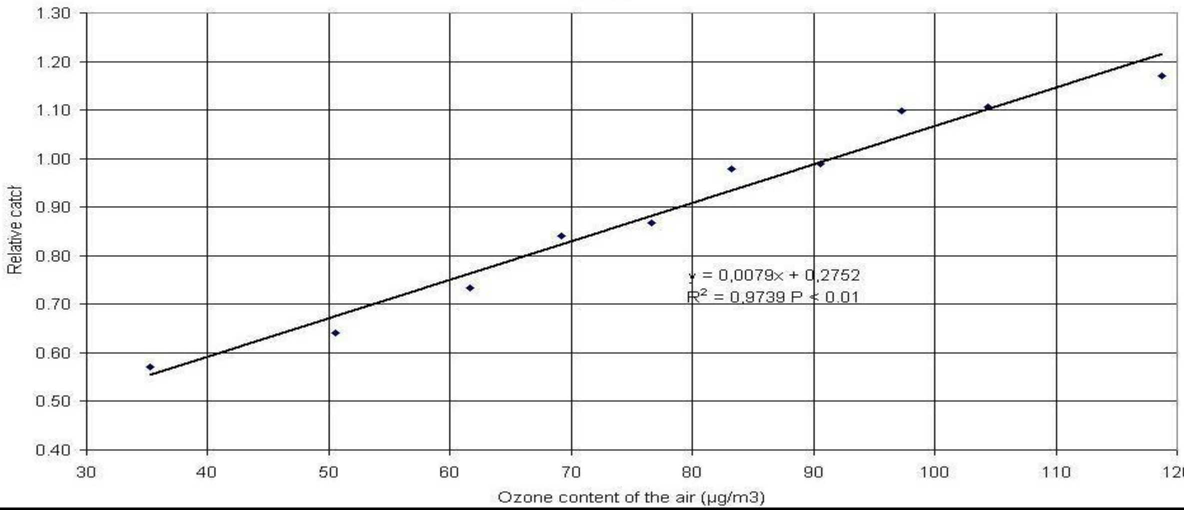


Fig. 4
Light-trap catch of the Common Cochcafer (*Melolontha melolontha* L.) depending on the ozone content of the air



Our present results suggest that the flying activity of the European corn borer *(Ostrinia nubilalis* Hbn.) and Common Cockchafer (*Melolontha melolontha* L.) increase when the ozone content is high. The light-trap catches verify this fact.

Our results have shown that the high ozone content of the air is accompanied by a higher light-trap catch. The influence of the ozone content is detected in 100 kilometres from the monitoring site and is hardly weaker than within a 50 kilometres distance.

We suggest similar examinations onto other harmful insect species relevantly with other sampling methods (for example pheromone-, suction-, Malaise-, bait traps). If it would be provable that the high ozone content of the air increases the flying activity of other insect species, it would be necessary to take this fact into consideration when developing the plant protection prognoses. There could be more accurate plant protection prognosis hereby be prepared. Our result contradicts that of Valli and Callahan (1968), who experienced a decrease, in the activity of Corn Earworm (*Heliothis zea* Boddie) with the increase of the ozone content in parallel with. It may be the reason of the contradiction that low relative catch values always refer to environmental factors in which the flight activity of insects diminishes. However, high values are not so clear to interpret. Major environmental changes bring about physiological transformation in the insect organism. The imago is short-lived; therefore unfavorable environmental endangers the survival of not just the individual, but the species as a whole. In our hypothesis, the individual may adopt two kinds of strategies to evade the impacts hindering the normal functioning of its life phenomena. It may either display more liveliness, by increasing the intensity of its flight, copulation and egg-laying activity or take refuge in passivity to environmental factors an unfavorable situation. And so by the present state of our knowledge, we might say that favorable and unfavorable environmental factors might equally be accompanied by a high catch (Nowinszky, 2003).

References

[1]. Járfás, J. (1979). Forecasting of harmful moths by light-traps (in Hungarian). Ph.D. Thesis. Kecskemét. 127.

[2]. Kalabokas, P.D. (2002). Rural surface ozone climatology around Athens. *Greece Fresenius Environmental Bulletin*, 11(8): 474-479.

[3]. Kalabokas, P.D., Bartzis, J.G. (1998). Photochemical air pollution characteristics at the station of the NCSR-Demokritos, during the MEDCAPHOT-TRACE campaign in Athens, Greece (20 August-20 September 1994). *Atmospheric Environment*, 32 (12): 2123-2139.

[4]. Kalabokas, P.D., Viras, L.G., Bartzis, J.G., Repapis, Ch.C. (2000). Mediterranean rural ozone characteristics around the urban area of Athens. *Atmospheric Environment*, 34: 5199-5208.

[5]. Kells, S.A., Mason, L.J., Maier, D.E., Woloshuk, Ch., P. (2001). Efficacy and fumigation characteristics of ozone in stored maize. *Journal of Stored Products Research*, 37 (4): 371-382.

[6]. Nowinszky, L. (2003). The Handbook of Light Trapping. Savaria Univ. Press, Szombathely, Hungary, 276.

[7]. Papanastasiou, D.K., Melas, D., Zerefos, C.F. (2002). Forecast of ozone levels in the region of Volos. 6th Hellenic Conference in Meteorology, Climatology and Atmospheric Physics. Ioannina (Grece) Abstracts, 79-80.

[8]. Papanastasiou, D.K., Melas, D., Zerefos C.F. (2003). Relationship of meteorological variables and pollution with ozone concentrations in an urban area. 2nd International Conference on Applications of Natural-, Technological- and Economical Sciences, Szombathely (10th May), CD-ROM. 1-8.

[9]. Papanastasiou, D.K., Melas, D. (2006). Predicting daily maximum ozone concentration in an urban area. 4th International Conference on Applications of Natural-, Technological- and Economical Sciences, Szombathely (28th May), CD-ROM.: 1-7.

[10]. Puskás, J., Nowinszky, L., Károssy, Cs., Tóth, Z., Németh, P. (2001). The relationship between UV-B radiation of the Sun and the light trapping of the European corn borer (*Ostrinia nubilalis* Hbn.). Ultraviolet Ground- and Space-based Measurements, Models and Effects, Proceedings of SPIE – The International Society for Optical Engineering. San Diego, 4482: 363-366.

[11]. Qassem, Emad (2006). The use of ozone against stored grain pests. Ninth Arab Congress of Plant Protection, 19-23 November 2006, Damascus, Syria, C 5 E-225.

[12]. Tiwari, S., Rai, R., Agrawal, M. (2008). Annual and seasonal variations in tropospheric ozone concentrations around Varanasi. *International Journal of Remote Sensing*, 29 (15): 4499-4514.

[13]. Valli, V.J., Callahan, P.S. (1968). The effect of bioclimate on the communication system of night flying moths. *International Journal of Biometeorology*, 12 (2): 99-118.