ADVANCES IN BIORESEARCH, Vol 1 [2] DECEMBER 2010: 139 - 142

http://www.soeagra.com
ISSN 0976-4585

RESEARCH PAPER

Flying Activity of the Scarce Bordered Straw (*Helicoverpa armigera* Hbn.) Influenced by Ozone Content of Air

J. Puskás and L. Nowinszky
University of West-Hungary Savaria University Centre
H-9701 Szombathely Károlyi G. Square 4.
E-mail: pjanos@gmail.com

ABSTRACT

The study deals the efficiency of light trapping of the Scarce Bordered Straw (Helicoverpa armigera Hbn.) in connection with the ozone content of air. The collection data of which use was made the Hungarian national light trap network between 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 exceeds it the 80 µg/m3 value. 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.

Key words: *Helicoverpa armigera Hbn., light-trap, ozone*

INTRODUCTION

The ozone content of the air influences the strength of UV-B radiation which in its turn, as proved by our previous studies [1], bears an impact on the effectiveness of collecting insects by light-trap. Therefore it seemed reasonable to try and find a connection also between the ozone content of the air and the number of insects trapped [2].

In Hungary, ozone monitoring is carried out at four stations of the Hungarian National Meteorological Service. Monitoring at K-puszta (The geographical coordinates are 46.58 N and 19.35E) has been done since 1990. 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 programme (SCANAIR) and stored in PCs. SCANAIR reduced 15-minute data into half-hour averages which were then entered in the data base. At the K-puszta the job is performed by an Environment type monitor. A Thermo Electron type monitor also makes parallel monitoring possible. The ozone monitors are UV photometric ozone analysers 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 vary 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 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 mistake code referring to data quality. The database is copied to CDs annually.

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 hits 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 [3]. Greek authors [4, 5, 6, 7, 8, 9] in Greece have been studying the monthly changes and those in the different periods of each day of the ozone content.

The high concentration of ozone is maleficent to insects. The study of Kells et al. [10] 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 [11] as an alternative method for grain disinfestations. Ozone at concentration of $0.07 g/m^3$ 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 [12] examinations made with light traps indicated an inverse relationship between O_3 and insect activity.

We know altogether a study in literature, which examines by the ozone contents of the air, in connection with the efficiency of the light trap catch of the insects. We assessed in an earlier study [1] the number caught of European Corn Borer (*Ostrinia nubilalis* Hbn.) (Lepidoptra: Pyraustidae) increase if the ozone content of air high.

MATERIAL AND METHODS

In our study we used the data pertaining to the Scarce Bordered Straw (*Helicoverpa armigera* Hbn.) from the material of the Hungarian national light-trap network in the years 1997-2006. For we had at our disposal the ozone data registered at K-puszta in the same years.

We have downloaded these data ($\mu g/m^3$) from the website of Norsk institutt for luftforskning (Norvegian Institute for Air Research (NILU) (http://tarantula.nilu.no/projects/ ccc/emepdata. hzml/). The geographical coordinates of K-puszta are the following: 46° 58' N and 19° 35' E

Because the Scarce Bordered Straw (*Helicoverpa armigera* Hbn.) flies in whole night, we worked with the ozone data of the time 23 o'clock (GMT). The light-traps have caught 3882 moths on 533 nights. We have worked up the 1397 observing data.

Observing data means the catching of one trap in one night, regardless of the number of insects caught. The number of observing data exceeds the number of the nights because more light-traps have worked on a night.

From the catching data of the examined species, relative catch (RC) data were calculated for each observation posts and days. The RC is the quotient of the number of individuals caught during a sampling time unit (1 night) per the average number of individuals of the same generation falling to the same time unit. In case of the expected average individual number, the RC value is 1. We correlated the ozone data to the relative catch values. We arranged the pairs of data in classes, and then averaged them. We made correlation calculations to prove the connection.

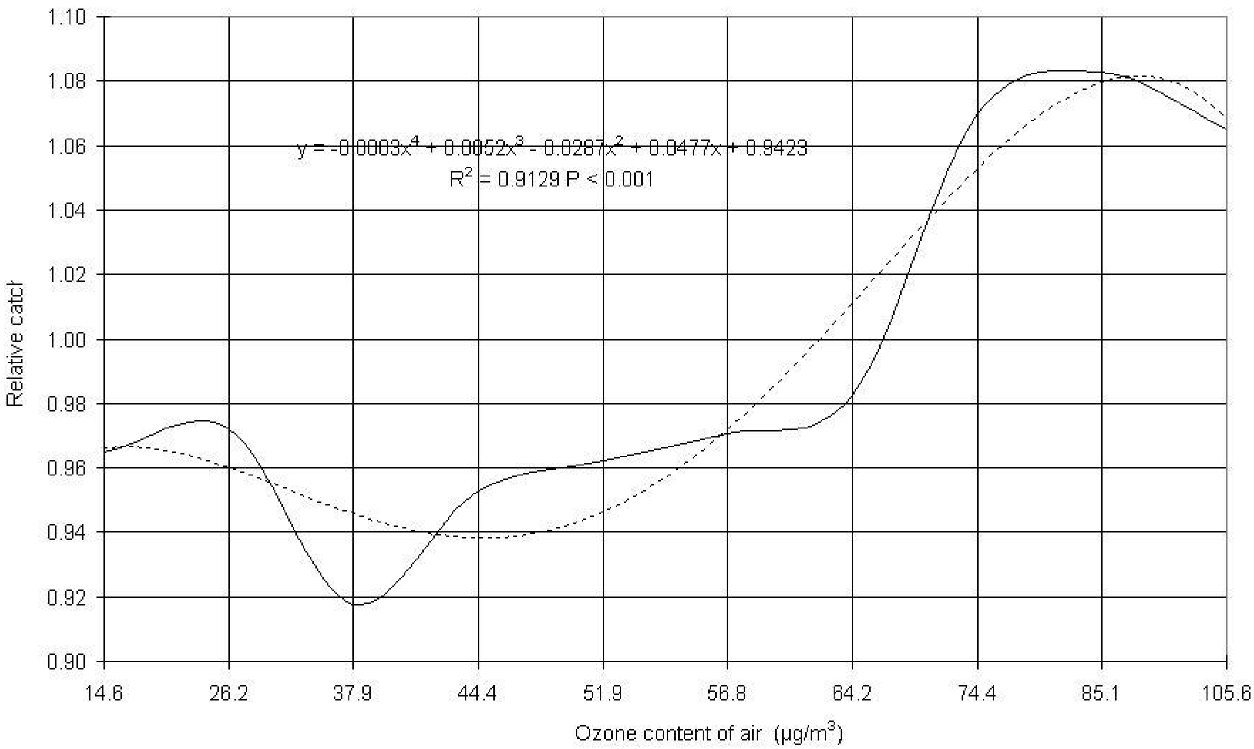
RESULTS AND DISCUSSION

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

Our earlier and 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. 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 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.

Fig. 1.
Light-trap catch of Scarce Bordered Straw (*Helicoverpa armigera* Hbn.) in connected with the ozone content of air from the data of Hungarian national network (1997-2006)



The imago is short-lived; therefore unfavourable 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 unfavourable situation. And so by the present state of our knowledge we might say that favourable and unfavourable environmental factors might equally be accompanied by a high catch.

REFERENCES

[1] Puskás, J., Nowinszky, L., Károssy, Cs., Tóth, Z., Németh, P. (2001). 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.

[2] Puskás, J., Nowinszky, L., Bozó, L., Ferenczy, Z. (2003). The Ozone Content of the Air. In: L. Nowinszky (ed.) The Handbook of Light Trapping, Savaria University Press, Szombathely, Hungary, 170-172.

[3] 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.

[4] 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.

[5] 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.

[6] Kalabokas, P. D. (2002). Rural surface ozone climatology around Athens, *Greece Fresenius Environmental Bulletin* 11 (**8**): 474-479.
[7] Papanastasiou D. K., Melas D. (2008). Daily Ozone Forecasting in an Urban Area, using Meteorological & Pollution Data. *Fresenius Environmental Bulletin* 17 (**3**), 364 - 370.
[8] Papanastasiou D. K., Melas D., (2009). Statistical Characteristics of Ozone and PM10 Levels in a Medium Sized Mediterranean City. *International Journal of Environment and Pollution 36 (1/2/3), Special Issue on Air Pollution,* 127 - 138.
[9] Papanastasiou D. K., Melas D., (2009). Climatology and impact on air quality of sea breeze in an urban coastal environment. *International Journal of Climatology 29,* 305 - 315.
[10] Kells, S. A., Mason, L. J., Maier, D. E., Woloshuk, Ch., P. (2001). Efficacy and fumigation characteristics of ozone in stored maise. *Journal of Stored Products Research* 37 (**4**): 371-382.
[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] 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.