EMS Annual Meeting Abstracts
Vol. 8, EMS2011-328, 2011
11th EMS / 10th ECAM

Forecasting the weather
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Impact of artificial illumination on the diapause induction of moths

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Recent decades have been characterised by a profound transformation of the nightscape as a result of increasing night-time illumination. The negative effects are considered as light pollution. For insects, light is not only the zeitgeber for the rhythm of night and day, but also for the timing of egg laying, hatching, pupation, mating and the induction of the diapause.
For the present research, the horse chestnut leaf miner (Cameraria ohridella) was used as a test organism, because it is highly adaptive to changing environmental conditions, and moths are known to be light-sensitive. The horse chestnut (Aesculus hippocastanum) is among the most common and favored trees in Berlin. The city alone has over 48.000 specimens. The invasive leaf miner has major impact on both aesthetics and plant health. Infested leaves wilt in early summer and appear prematurely like autumn foliage. Cameraria ohridella develops three generations in Berlin and up to five in warmer regions.
In field trials, in October 2010, infested leaves were collected from seven sites illuminated by street lights versus nine sites with natural nightly darkness in Berlin and Brandenburg. Densities of cocoons, larvae, mines and the degree of discoloration did not differ significantly at illuminated trees versus trees in natural darkness. However, the number of mines was significantly increased on illuminated trees. This effect was more prominent in Brandenburg than in Berlin.
For the greenhouse trials horse chestnut seedlings were infested with C. ohridella larvae at 20°C under long-day conditions (16 h). At 8-15°C, half of the seedlings were treated with artificial illumination for 24 h (Megaman dimmable energy-saving lamps, ∼100 lux). The other half was kept under short-day light regime (8 h). Non-diapausing pupae, which develop another generation, were mainly observed on leaves treated with artificial illumination, whereas the number of diapausing cocoons was significantly higher on leaves kept in natural darkness.
The higher number of mines per leaf at illuminated sites indicates an attraction of female moths towards light and therefore increased oviposition at illuminated sites. Thereby single light sources outside conurbations might have a higher impact compared to the broad range of different light sources in the city. In the greenhouse the diapause of C. ohridella was inhibited by artificial light. This threatens moth populations in the event of early frosts and implies the possibility of the development of a fourth generation of C. ohridella in Berlin when artificial illumination is combined with higher temperature due to e.g. climate change. The leaf miner, like other invasive species, has a high potential to adapt to changes in climate and other conditions. Parts of each generation annually go dormant for six months. The population is therefore not threatened by the event of early frost. However, other moth species, less adapted to climate conditions, might also be impeded in dormancy by artificial light. In conclusion, the effect of artificial illumination on moths, which function as pollinators for wildflowers, might be fatal.