WeLASER
Eco-innovative weeding with laser

Practice Abstract N.46

How do laser beams affect pupae?

Pupae

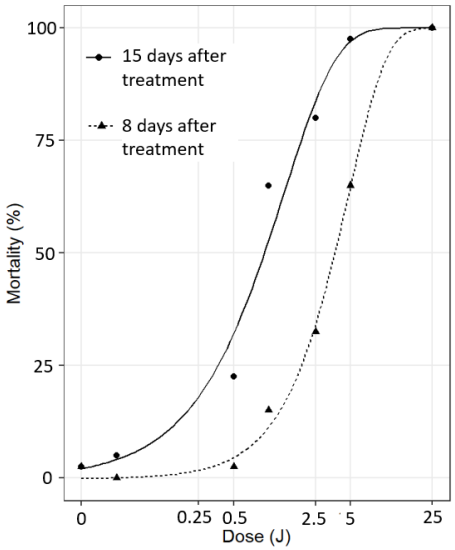
Some insects have a life stage called a pupa. Insects that go through a pupal stage are called holometabolous, meaning that they have four stages in their life cycle: egg, larva, pupa, and imago, which is the last stage an insect attains. The insects' juvenile hormones control the processes of entering and completing the pupal stage. Becoming a pupa is called pupation.

The insect *Tenebrio molitor* has a whitish pupa that turns brown over time. It uses its stored fat to grow into a beetle. Depending on the temperature and other environmental conditions, it emerges as an adult beetle after 3 to 30 days. At room temperature, it will stay in the pupa stage of its life cycle for approximately a week. The pupa can only wiggle but not move.

We exposed *T. molitor* pupae to increasing dosages of laser energy (Joule) from a collimated thulium-doped 2 µm 50 W fiber laser with a 2 mm beam diameter. Afterwards, we recorded the number of dead pupae 8 and 15 days after treatment (see the figure).

Results and Conclusion

Tenebrio molitor pupae were exposed to different laser energy dosages



The mortality of the pupae increased with increasing dosages. All pupae immediately died when exposed to a dose of 25 J, which is appropriate for killing weed seedlings. Generally, the mortality rate increased significantly after eight days. After 15 days, nearly all pupae died after being exposed to an energy dose of 5 J. Hence, pupae are very vulnerable to laser irradiation. However, only a small area (less than 1%) will be exposed to the laser treatment, even with a high weed density in the field. Therefore, the probability of hitting some pupae with the laser beam is very low.

Authors: UCPH

Date: 16 April 2023