This article was listed in Forest Nursery Notes, Summer 2007

97. Light affects pests, beneficials. Cloyd, R. Greenhouse Management and Production 27(3):52-53. 2007.

The GM PRO Raymond Cloyd on Pest Management

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Light affects pests, beneficials

Light is important for plant growth, development and flowering. It is essential in the plant's ability to manufacture food during photosynthesis.

Light is classified based on its wavelength, typically measured in nanometers (nm). This is referred to as light quality. Ultraviolet light involves short wavelengths (less than 400 nm). Visible or white light occurs at wavelengths between 400 to 700 nm.

Plant growth and reproduction are influenced by light intensity (quantity of light) and photoperiod (relative difference between light and dark). In greenhouses, light may be natural sunlight, artificially provided (supplemental) or both.

Different insect responses

Insect pests, mite pests and natural enemies respond to different light intensities and photoperiods. In general, insects respond to light wavelengths between 250 and 730 nm (ultraviolet to red light).

Insect behavioral responses to ultraviolet light vary. Night-flying insects, such as moths and certain beetles, are attracted to ultraviolet light, whereas many natural enemies fail to respond to ultraviolet light. Many insect species are actually disoriented when ultraviolet light is absent. Light may also influence insect activity, orientation and dispersal capabilities.

Photoperiod may impact diapause, reproduction, foraging and feeding of insects and mites. Light quality and intensity may modify the photoperiodic response of insects and mites at different life stages.

The physiological state or age of an insect may influence its response to specific light intensities. Egg hatch of sweet potato whitefly *(Bemisia tabaci)* is enhanced under high-light intensities and extended photoperiods, but nymphal survival is affected by photoperiod, not light intensity. Although whiteflies are attracted to lamps, this attraction is dependent on the light source (e.g., mercury vapor, incandescent, fluorescent or ultraviolet lamps) and light intensity.

Insects may also respond differently to light intensity depending on the distance from the light source. Factors, such as natural sunlight, reflected light and background illumination, or a combination of them may influence insect response to light.

Impact on natural enemies

Artificial or supplemental lighting may impact the foraging behavior of natural enemies. For example, short daylength and low-light intensity may affect certain whitefly parasitoids.

Research has shown that *Encarsia formosa* and *Eretmocerus eremicus* attack more whiteflies under high-light intensity (112-114 watts per square meter) than low-light intensity (12-14 watts per square meter). *E. formosa* parasitizes more whiteflies when exposed to long daylengths (16:8 hours) than short daylengths (8:16 hours), whereas *E. eremicus* is not affected by photoperiod.

Overall, both parasitoids increased their foraging activity at high-light intensities and longer daylengths. In addition, *E. eremicus* parasitizes more whiteflies than *E. formosa* at high-light intensities and longer photoperiods, which indicates that *E. eremicus* may be a more effective parasitoid throughout the year.

The quality and intensity of artificial or supplemental light may impact the foraging behavior of natural enemies during winter when natural daylight levels are low. Light produced by high-pressure sodium lamps attract *E. formosa,* interfering with foraging behavior and decreasing its effectiveness. Reproductive diapause and natural enemy foraging activities may be inhibited by long photoperiods provided by artificial or supplemental lighting. For example, continuous illumination can negatively impact the activity of natural enemies that forage at night such as the twospotted spider mite predator *Feltiella acarisuga.*

Light effects on plant defenses

Photosyntheticially active radiation (PAR) and spectral distribution not only affect plants, but inadvertently impact insect and mite pests. High-light intensity may promote changes in the defense mechanisms of plants that negatively affect insect and mite pests. For example, tomato plants *(Solanum lycopersicum* or *Lycopersicon lycopersicum)* exposed to full sunlight develop more durable leaves with higher concentrations of secondary plant metabolites (defensive compounds) and lower concentrations of protein. Insect or mite pests feeding on these tomato plants may have reduced growth rates since they are not able to obtain adequate nutrition.

Artificial or supplemental light may increase the incidence of whiteflies and thrips. This is influenced by climatic differences and latitude. Although it has been shown that twospotted spider mite *(Tetranychus*

urticae) adult females do not respond to wavelengths longer than 600 nm, they may still be affected by light. Research has demonstrated that growth is inhibited when twospotted spider mite adults are exposed to red light (658 nm). Additionally, the reproductive rate of female twospotted spider mites is much higher when exposed to periods of light than when exposed to darkness.

In research with fungus gnats *(Bradysia* spp.) at the University of Illinois and Kansas State University, we have discovered that fungus gnat adults are attracted to extremely low-light intensities. Fungus gnat adults have been observed to respond positively to light intensities less than 0.0837 micromoles per square meter per second. Adults even respond to light intensities that are too low to detect using a PAR light sensor. Under total darkness, fungus gnat adults migrate randomly.

Research is planned to determine if light can be used as a means to minimize problems with fungus gnats in greenhouses.

The author acknowledges Fred C. Gloeckner Foundation Inc. for funding to support his research with fungus gnats.