2023

The Influence of Colored Light on Mexican Jumping Bean Larva (Laspeyresia saltitans) Activity

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BACKGROUND

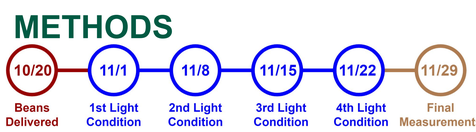
Organisms are exposed to variations in wavelengths of light throughout the course of each day, and colored light is comparable to the various light conditions of species.[1] *Cydia saltitans*, commonly known as the Mexican jumping bean larva, is known for its tumbling and jumping movements that occur when a larva moves inside its symbiotic seed (*Sebastiania pavoniana* or *Sapium biloculare*) (Fig. 1 and 5).[2] The environmental factors that cause the motion of Mexican jumping bean larvae are mostly unknown. We investigated how exposure to light affected larval movement.

Hypothesis:

- Shorter-wavelength light (e.g., purple, blue) will result in greater larval activity levels because shorter-wavelength sunlight is more common mid-day, when larvae often must move out of direct light to avoid thermal damage.

Fig. 1: The shrub, *Sebastiania pavoniana,* from which Mexican jumping beans originate.

METHODS



Scan to watch a trial!

Experimental Design

- Split 60 beans among 4 groups → n = 15
- Labeled beans in each group 1→15
- Lined black out box with grid paper and numbered bean spots 1→15

Light Conditions

- Lined beans up in order and turned on light bulb
- Recorded with iPhone 0.5x lens for 10 mins
- Measured displacement every 1 minute

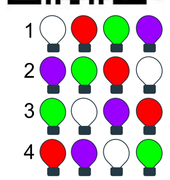


Fig. 2: Order of light treatment for each of the four weeks.

Final Measurements

- Recorded temperature of light bulbs

Statistics → R studio + binomial and poisson mixed models, pairwise Tukey post-hoc tests

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RESULTS

- Light treatment affected whether or not *C. saltitans* larvae moved during the 10-minute trial (χ^2_3 = 38.506, P < 0.001), with movement occurring more often when larvae were exposed to longer wavelength (redder) light
- Whether or not larvae moved was also affected by trial date (χ^2_3 = 147.39, P < 0.001)

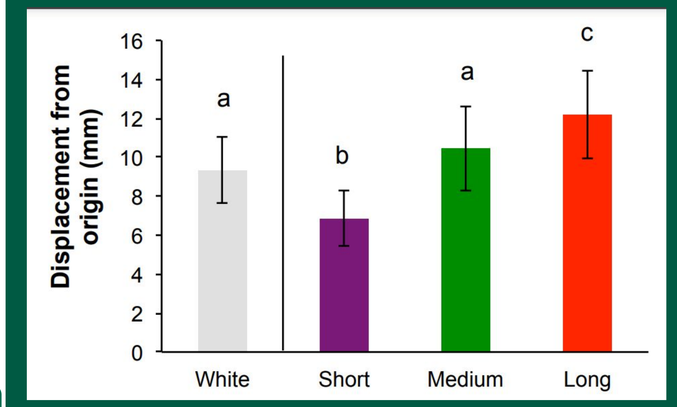

Fig. 3: The displacement of the Mexican jumping bean larvae, measured in millimeters, resulting from the various light conditions, purple (short), green (medium), red (long wavelength) or white light (control). Displacement under white light was found to be significantly different from displacement under purple or red light (P < 0.001). Error bars are +/- 1 SE, and lower-case letters indicate significant differences.

χ^2_3 = 481.75, P < 0.001

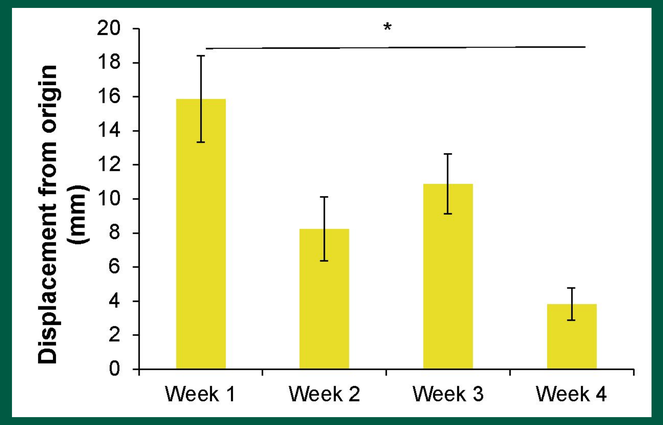

Fig. 4: The displacement of the Mexican jumping bean larvae, measured in millimeters, for each of the four weekly trials, which were completed on 11/1/2022, 11/8/2022, 11/15/2022, and 11/22/2022. Asterisks donate statistical significance among groups (P < 0.001). Error bars are +/- 1 SE.

χ^2_3 = 4996.7, P < 0.001

Mexican jumping bean larvae showed the **greatest activity** when exposed to **long wavelength (red) light** (Fig. 3) and their **activity decreased** over the course of the experiment (Fig. 4).

DISCUSSION

We found there was a significant difference between the activity levels of the red and purple treatment groups when compared with the control. *C. saltitans* displayed the most activity under the longer-wavelength red light (~700 nm), and the least activity when exposed to the shorter-wavelength purple light (~380 nm). *C. saltitans* activity under the white light was intermediate to that of red and purple light and most similar to that of green light. Longer wavelength light has better penetration through materials (e.g., the seed), which may explain greater *C. saltitans* activity. This is consistent with other published studies, such as in birds, where red light was able to best penetrate the photoreceptors in their skin and skulls.[3] Additionally, we found that there was a significant difference between activity levels and week, where average displacement decreased at later dates.

CONCLUSION

- Results suggest that light stimulates jumping behavior in Mexican jumping bean larvae
- Different wavelengths stimulate different levels of activity
- Red light has a longer wavelength, which can more easily penetrate the exterior seed and better reach the larva inside
- Future investigation of other types of light, such as infrared or ultraviolet, could further clarify the responses of *C. saltitans* to different wavelengths
- Possible future research may determine the physiological mechanisms leading to response to light

Fig. 5: Mexican jumping bean seeds (A) and a *C. saltitans* larva (B).

Acknowledgments: We thank J. Talavera for assistance and the Fall 2022 Biol 375 students for their comments.

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