STRAWBERRY GROWING CONDITIONS AND BENEFICIAL INSECTS:

THE IMPACT OF LOW NIGHTTIME TEMPERATURES AND LED LIGHTING ON APHID PREDATORS

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Introduction

Controlled-environment strawberry production in Canada has increased fivefold since 2020[3], driving rapid research and innovation in this emerging field. Aphids remain a major challenge, reducing yields through direct feeding damage and by transmitting plant diseases[2]. Advances such as novel LED lighting regimes have been shown to enhance yield[5] and reduce energy costs[1], while cooler nighttime temperatures can improve fruit quality[4]. Despite these benefits for plant growth, little is known about how these environmental conditions affect biological control agents, such as *Aphidoletes aphidimyza*.

Figure 1. Key biological control agents and target pests in strawberry crops: (a) *Aphidoletes aphidimyza* larva, (b) *Myzus persicae* (green peach aphid).

Objective

Evaluate how **controlled-environment strawberry growing conditions** affect the **development and predation rates** of key aphid predators.

Methodology

01 Trials were conducted in programmable Conviron PGR-15 growth cabinets with dynamic LED lighting (Sollum SF05B)

02 Predators were placed in Petri dishes on strawberry leaf discs with 10 aphids, which were replaced daily. Each treatment received 20 replications.

03 Data Collection:

- Daily counts of live and dead aphids (predation)
- Recorded predator survival and larval development time
- Observations continued until predator pupation

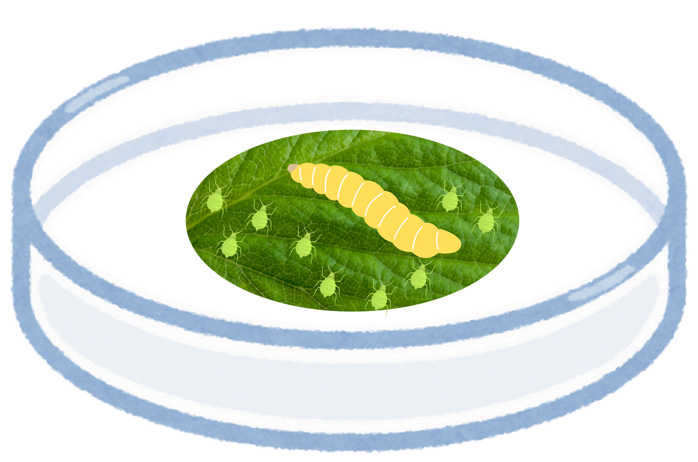

Figure 1. Experimental setup showing *Aphidoletes aphidimyza* larva on a strawberry leaf disc within a Petri dish. Each dish contained 10 aphids as prey, replaced daily.

Results

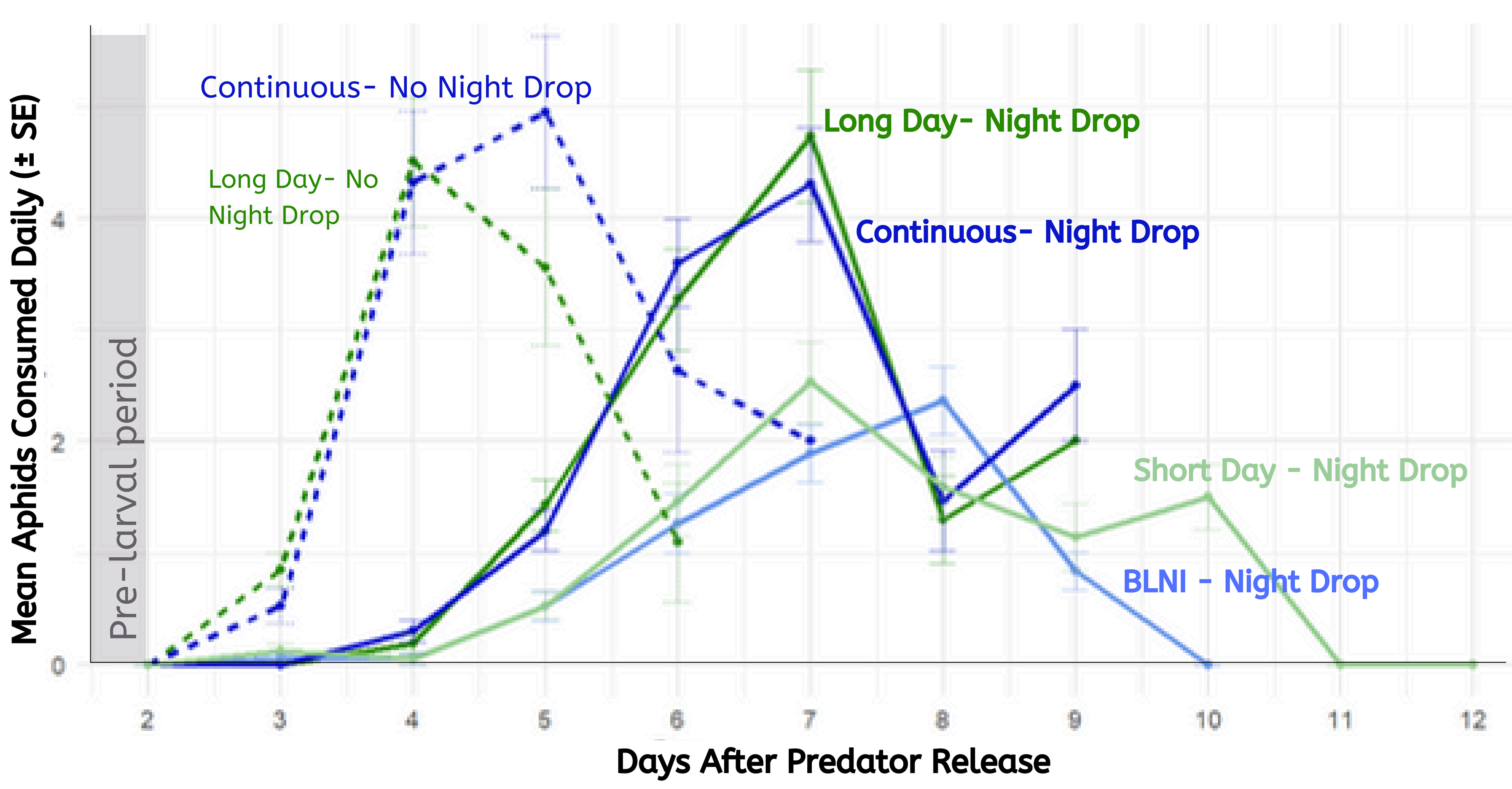

Figure 2. Daily predation by *A. aphidimyza* (mean ± SE). No night drop led to earlier peaks in daily predation and a shorter feeding period. Long Day and Continuous had later, extended peaks, while Short Day and BLNI showed flatter peaks and the longest feeding periods. Results are based on a generalized linear mixed-effects model with lighting, and temperature as fixed effects and day as a random effect.

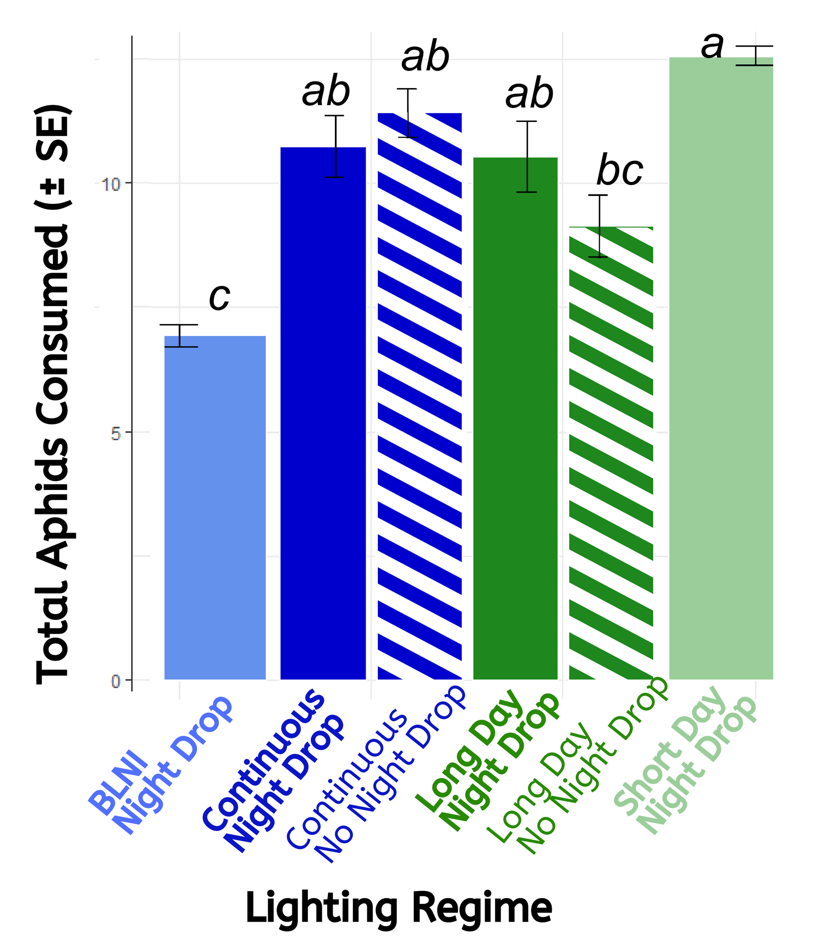

Figure 3. Total predation by Aphidoletes aphidimyza (mean ± SE) under different lighting and temperature regimes. Estimated marginal means were obtained from a generalized linear mixed model (GLMM) using the emmeans package in R. Different letters indicate significant pairwise differences among treatments (Tukey-adjusted, $p < 0.05$).

Table 2. Impact of different light and temperature strategies on *Aphidoletes aphidimyza* performance. Treatments affected predator development, daily and total aphid consumption, and overall suitability for both strawberries and predators. Green = better performance; red = poorer performance. Check marks indicate a balance between suitability for crop and predator performance. Values are means ± SE. Different letters within a column indicate significant differences among treatments ($p < 0.05$).

Lighting	Temperature	Larval Develop. (days)	Predation/Day (#aphids)	Total Predation	Suitability for Crop	Suitability for Predator
BLNI	Night Drop	[5] **6.1** (±0.2)	[6] **0.8** (±0.1)^{c}	[6] **6.9** (±0.2)^{c}	Suitable	Unsuitable
Short Day	Night Drop	[6] **6.7** (±0.3)	[5] **0.9** (±0.1)^{c}	[1] **12.6** (±0.2)^{a}	Unsuitable	Acceptable
Continuous	No Drop	[1] **3.6** (±0.1)	[1] **2.5** (±0.3)^{a}	[2] **11.4** (±0.5)^{ab}	Unsuitable	Best
	Night Drop	[4] **5.8** (±0.1)	[3] **1.6** (±0.2)^{b}	[3] **10.8** (±0.6)^{ab}	Suitable	Acceptable ✓
Long Day	No Drop	[2] **3.7** (±0.2)	[2] **2.1** (±0.2)^{a}	[5] **9.2** (±0.6)^{bc}	Unsuitable	Best
	Night Drop	[3] **5.4** (±0.2)	[3] **1.6** (±0.2)^{b}	[4] **10.5** (±0.7)^{ab}	Suitable	Acceptable ✓

Table 1. Lighting strategies (BLNI, Continuous, Long Day, and Short Day) were tested under two temperature regimes: either a nighttime drop (22°C during the day / 14°C at night) or no drop (continuous 22°C). Treatments mimic seasonal conditions or provide benefits such as higher yield, sweetness, or energy savings.

Treatment	Benefit	Description
Blue Light Night Interruption (BLNI)	Increases strawberry yields[5]	10 hrs white, 2 hrs blue night interruption
Continuous Lighting	Energy savings[1]	8 hrs blue, 16 hrs white low intensity
Long Day	Simulates summer conditions	16 hrs white, 8 hrs dark
Short Day	Simulates fall conditions	10 hrs white, 14 hrs dark
Night time temperature drop	Increases berry sweetness[4]	22°C during day 14°C at night
No temperature drop	Control	Continuous 22°C

Disucssion

Our results indicate a trade-off between crop performance and predator success in CEA strawberry production. While low nighttime temperatures and some LED regimes improve yield and fruit quality, they can reduce predator activity and/or slow development. Continuous and Long-day lighting offered the best balance, supporting strong predator development and predation while maintaining acceptable crop outcomes. In contrast, Blue-light night interruption and Short-day conditions improved crop traits but risked biocontrol failure. Adopting **continuous** or **long-day regimes**, especially with a **nighttime temperature drop**, offers growers a practical path to combine **yield, energy efficiency, and reliable pest control.**

Next Steps

- Compare predator species (in progress with *Chrysoperla carnea*)
- Compare with different aphid species (*Chaetosiphon fragaefolii*)
- Scale up to greenhouse trials for validation in production conditions

Acknowledgements

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