**2. Materials and Methods**

2.1 Treatments

Trials were reared in commercial incubators. Seven treatments were designed to simulate greenhouse conditions under supplemental lighting within commercial incubators by controlling constant temperature, photoperiod, lamp type and quality/wavelength, and theoretical light intensity as in Table 1.

Temperature and relative humidity (RH) were set by the incubators and monitored using HOBOs. Lamps were installed on the ceiling of the incubators, and varying intentisty was established by raising or lowering the platform on which insects were placed on. Spectral output and intensity were verified using a spectroradiometer.

Table 1: Seven treatments simulating greenhouse conditions under supplemental lighting to determine its impact on *Orius insidiosus* life history.



2.2 Insects

A colony of *O. insidiosus* was established from commercially available adults in plastic containers with ventilated lids and sterile vermiculite lining the bottom. *Ephestia kuehniella* eggs adherent to 3.34cm2 Post-it notes were provided as diet, as per the protocol by Waite (2012). Whole *Phaseolus vulgaris* beans were added as an oviposition substrate, and water-soaked cotton balls as source of moisture.

In determining % emergence, beans on which eggs had been oviposited in the colony were placed in small plastic Petri plates and moved to one of the treatments at random. The number of eggs on each bean was counted and marked by a permanent marker. Beans were checked once daily for egg emergence (as indicated by a popped top of an egg) and the number of nymphs were counted.

**3. Results**

3.1 Development of *Orius insidiosus* under Seven Supplemental Lighting Treatments

Treatments: S, W, HPS, HB, HR, LB, LR

Development

* Development Rate (days for each nymphal instar, and hatch-adult)
  + Data manipulations
  + Figures and Tests
  + Assumptions
* %Mortality (percent dead before reaching adult stage)
  + Data manipulations
  + Figures and Tests
  + Assumptions
* Tibial Length (adults which developed under Treatment
  + Data manipulations
  + Figures and Tests
  + Assumptions

3.2 Adult Life History parameters under Seven Supplemental Lighting Treatments

Data clean-up and manipulations

* Pairs where either the male or female were squished or escaped were removed
* Pair where either the male or female lived for less than 1 day were removed
* Fixed a calculation error in Pre-oviposition period

3.2.1 Adult Longevity (days)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Table 1: Longevity (days) Summary Statistics | | | |  |  |
| Treatment | Sex | Mean | SD | SE | n |
| HB | Female | 40.0 | 22.3 | 3.6 | 38 |
|  | Male | 36.4 | 27.1 | 4.4 | 38 |
| HPS | Female | 56.1 | 30.6 | 5.1 | 36 |
|  | Male | 46.9 | 32.8 | 5.5 | 36 |
| HR | Female | 54.0 | 17.5 | 3.0 | 33 |
|  | Male | 50.9 | 28.7 | 5.0 | 33 |
| LB | Female | 50.6 | 21.1 | 3.5 | 37 |
|  | Male | 70.6 | 19.3 | 3.2 | 37 |
| LR | Female | 52.6 | 24.9 | 4.3 | 33 |
|  | Male | 60.8 | 27.8 | 4.8 | 33 |
| S | Female | 14.1 | 9.8 | 1.7 | 33 |
|  | Male | 11.5 | 8.9 | 1.6 | 33 |
| W | Female | 59.0 | 28.3 | 4.5 | 39 |
|  | Male | 50.7 | 29.6 | 4.7 | 39 |

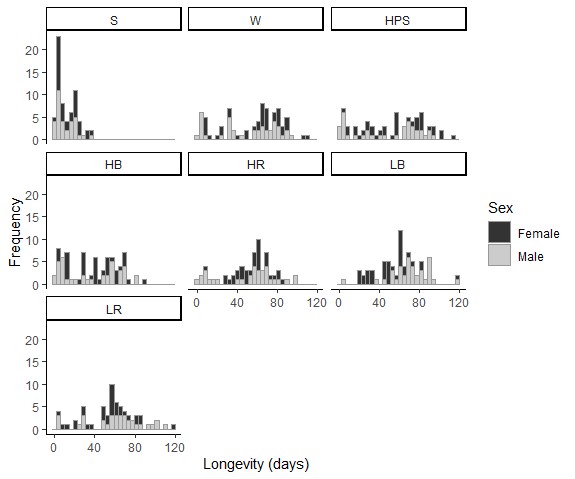


Figure 1: Histograms of Adult Longevity (days)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Table 2: Longevity Two-way ANOVA Results | | |  |  |  |
|  | d.f. | SS | MS | F | P |
| Treatment | 6 | 111191 | 18532 | 30.34 | 2.00E-16 |
| Sex | 1 | 2 | 2 | 4.00E-03 | 0.95 |
| Treatment:Sex Interaction | 6 | 11910 | 1985 | 3.25 | 3.84E-03 |
| Residuals | 484 | 295608 | 611 |  |  |

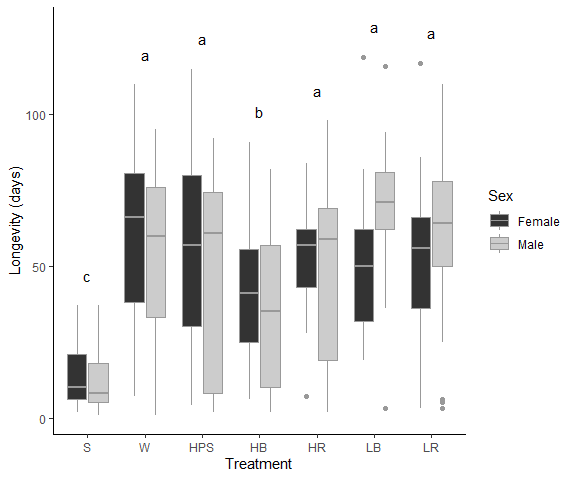


Figure 2: Longevity clustered boxplot with significant Treatment groups in a Tukey post-hoc test (alpha = 0.05). Points represent outlying values beyond 1.5\*IQR

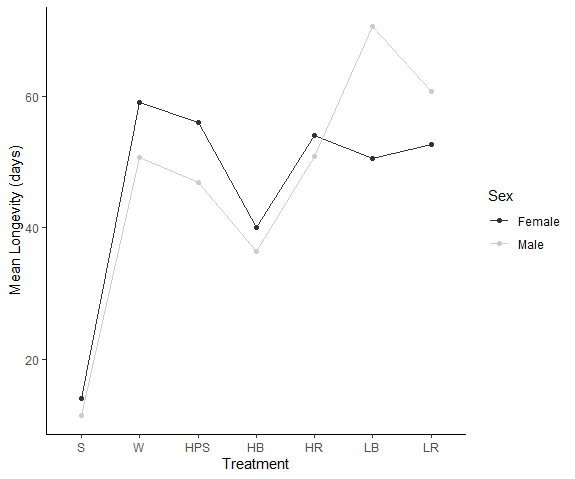


Figure 3: Longevity means plot illustrating potential interaction effect of low-intensity coloured LED light.

|  |  |  |  |
| --- | --- | --- | --- |
| Table 3: Shapiro-Wilk test for normality of adult longevity | | | |
| Treatment | Sex | Shapiro-Wilk Statistic | P |
| HB | Female | 0.959 | 0.179 |
|  | Male | 0.881 | 7.65E-04 |
| HPS | Female | 0.965 | 0.308 |
|  | Male | 0.864 | 3.98E-04 |
| HR | Female | 0.974 | 0.611 |
|  | Male | 0.903 | 6.26E-03 |
| LB | Female | 0.935 | 3.14E-02 |
|  | Male | 0.931 | 2.49E-02 |
| LR | Female | 0.964 | 0.324 |
|  | Male | 0.953 | 0.158 |
| S | Female | 0.883 | 1.94E-03 |
|  | Male | 0.894 | 3.76E-03 |
| W | Female | 0.931 | 1.88E-02 |
|  | Male | 0.905 | 3.07E-03 |

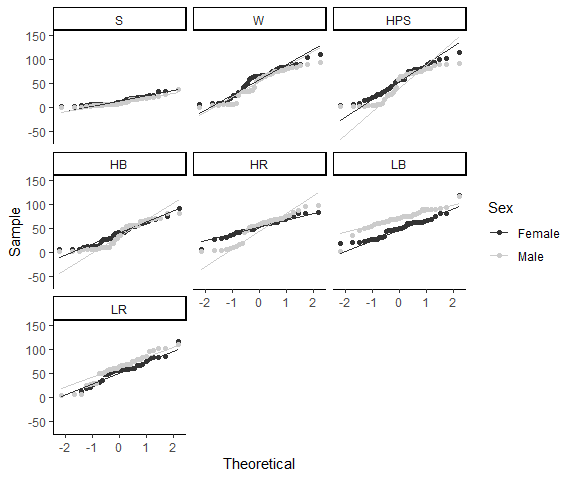


Figure 4: Normal quantile plots for adult longevity

Levene's Test result for longevity across Treatment and Sex: (F = 6.80, P = 4.33e-12, d.f. = 13, 484)

3.2.2 Fecundity

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Table 4: Fecundity (eggs/female/day) Summary Statistics | | | | |
| Treatment | Mean | SD | SE | n |
| HB | 1.82 | 1.30 | 0.21 | 38 |
| HPS | 1.28 | 0.87 | 0.14 | 36 |
| HR | 2.06 | 1.32 | 0.23 | 33 |
| LB | 2.39 | 1.12 | 0.18 | 37 |
| LR | 1.97 | 1.24 | 0.22 | 33 |
| S | 2.45 | 2.22 | 0.39 | 33 |
| W | 0.94 | 0.80 | 0.13 | 39 |

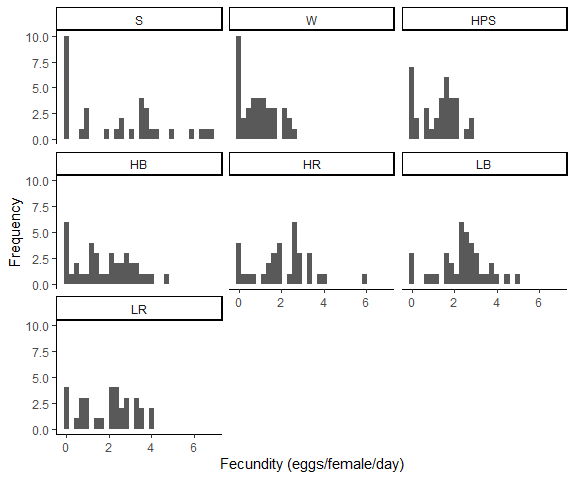


Figure 5: Histograms of Fecundity (eggs/female/day)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Table 5: Fecundity One-way ANOVA Results | | | |  |  |
|  | d.f. | SS | MS | F | P |
| Treatment | 6 | 68.7 | 11.46 | 6.59 | 1.85E-06 |
| Residuals | 242 | 421.1 | 1.74 |  |  |

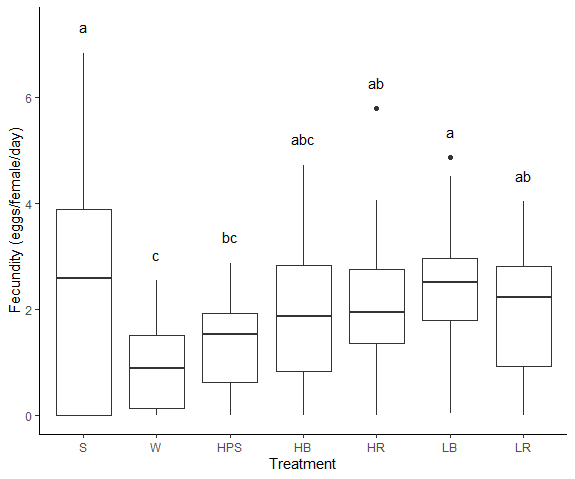


Figure 6: Fecundity clustered boxplot with significant Treatment groups in a Tukey post-hoc test (alpha = 0.05). Points represent outlying values beyond 1.5\*IQR

|  |  |  |
| --- | --- | --- |
| Table 6: Shapiro-Wilk test for normality of fecundity | | |
| Treatment | Shapiro-Wilk Statistic | P |
| HB | 0.95 | 0.11 |
| HPS | 0.93 | 1.79E-02 |
| HR | 0.95 | 0.14 |
| LB | 0.96 | 0.23 |
| LR | 0.94 | 6.25E-02 |
| S | 0.89 | 2.83E-03 |
| W | 0.92 | 6.89E-03 |

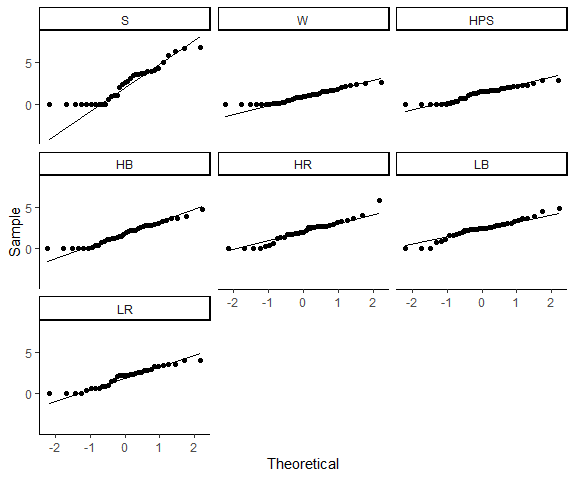


Figure 7: Normal quantile plots for fecundity

Levene's Test result for fecundity across Treatment: (F = 10.7, P = 1.47e-10, d.f. = 6, 242)

* + 1. Pre-oviposition Period

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Table 7: Pre-oviposition Period (days) Summary Statistics | | | | |
| Treatment | Mean | SD | SE | n |
| HB | 6.5 | 4.530676 | 0.734973 | 38 |
| HPS | 10.36111 | 7.750218 | 1.291703 | 36 |
| HR | 6.333333 | 3.048224 | 0.530628 | 33 |
| LB | 8.756757 | 8.015282 | 1.317704 | 37 |
| LR | 9.212121 | 7.432015 | 1.293748 | 33 |
| S | 3.090909 | 2.363309 | 0.411399 | 33 |
| W | 9.128205 | 6.72458 | 1.076795 | 39 |

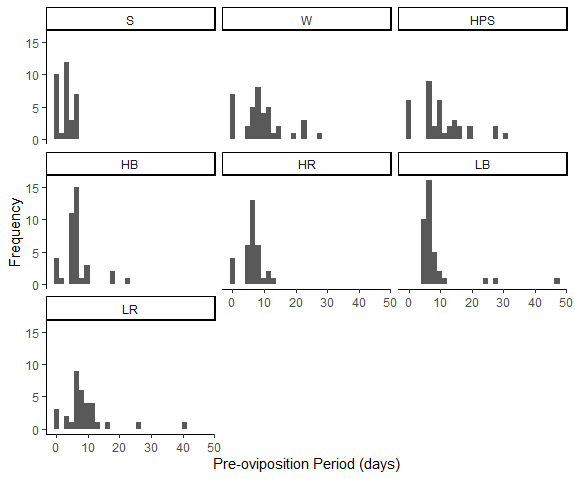


Figure 8: Histograms of Pre-oviposition Period (days)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Table 8: Pre-oviposition Period One-way ANOVA Results | | | | |  |
|  | d.f. | SS | MS | F | P |
| Treatment | 6 | 1269 | 211.44 | 5.6 | 1.84E-05 |
| Residuals | 242 | 9137 | 37.75 |  |  |

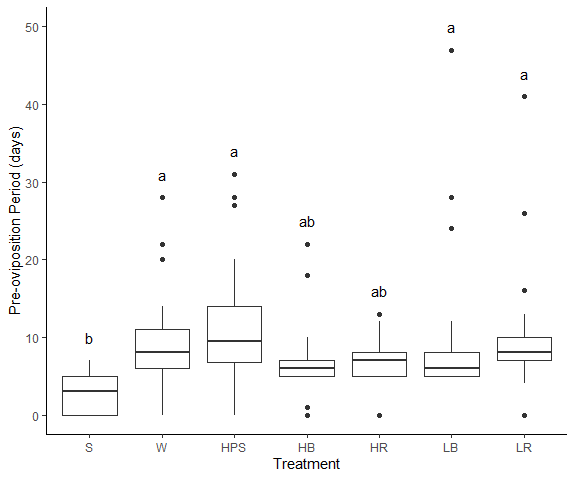


Figure 9: Pre-oviposition Period clustered boxplot with significant Treatment groups in a Tukey post-hoc test (alpha = 0.05). Points represent outlying values beyond 1.5\*IQR

|  |  |  |
| --- | --- | --- |
| Table 9: Shapiro-Wilk test for normality of pre-oviposition period | | |
| Treatment | Shapiro-Wilk Statistic | P |
| HB | 0.77 | 3.21E-06 |
| HPS | 0.91 | 6.97E-03 |
| HR | 0.89 | 2.86E-03 |
| LB | 0.47 | 2.04E-10 |
| LR | 0.71 | 9.06E-07 |
| S | 0.87 | 1.06E-03 |
| W | 0.90 | 2.59E-03 |

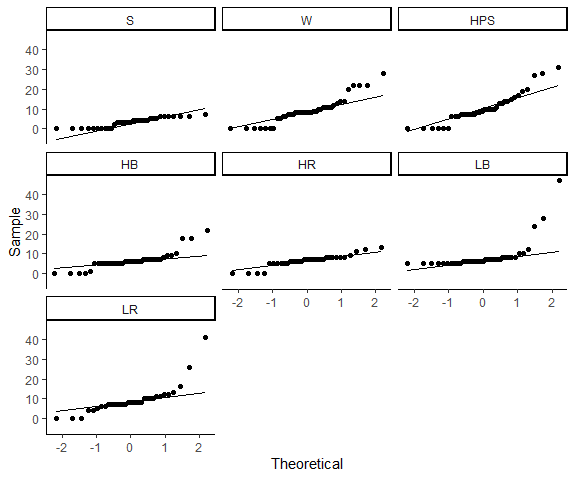


Figure 10: Normal quantile plots for pre-oviposition period

Levene's Test result for pre-oviposition period across Treatment: (F = 2.66, P = 1.61e-2, d.f. = 6, 242)

3.2.4 Oviposition Period

Green LED?

Greenhouse?