

# Climate change reshapes potential distributions and seasonal mismatch in a host–parasitoid system: *Cotesia ruficrus* and fall armyworm

Authors

Jeremy Gonthier<sup>1\*</sup>, Gonzalo Avila<sup>1</sup>

<sup>1</sup> Affiliation: Bioeconomy Science Institute Maiangi Taiao

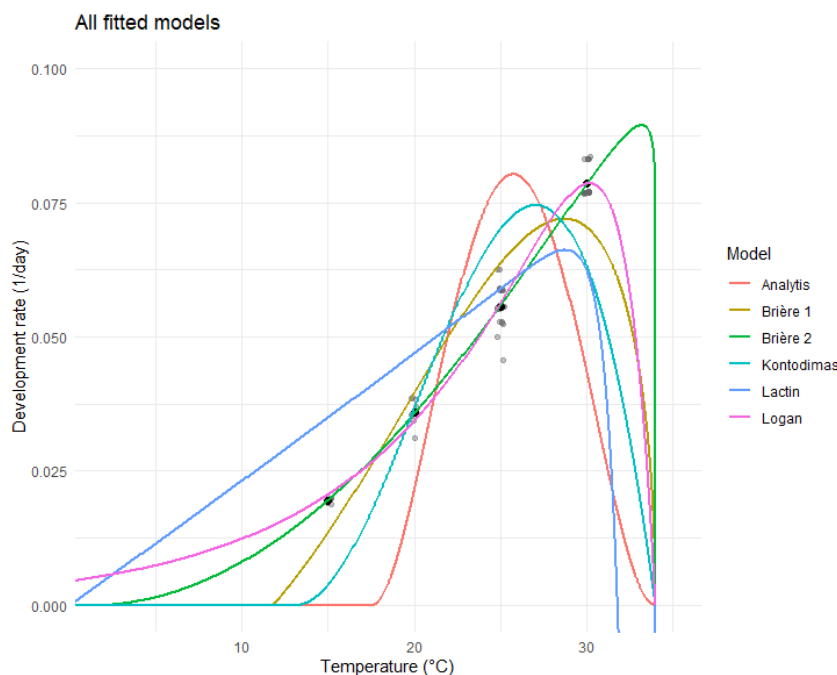
\*Corresponding author email: jeremy.gonthier@plantandfood.co.nz

## Supplementary Material

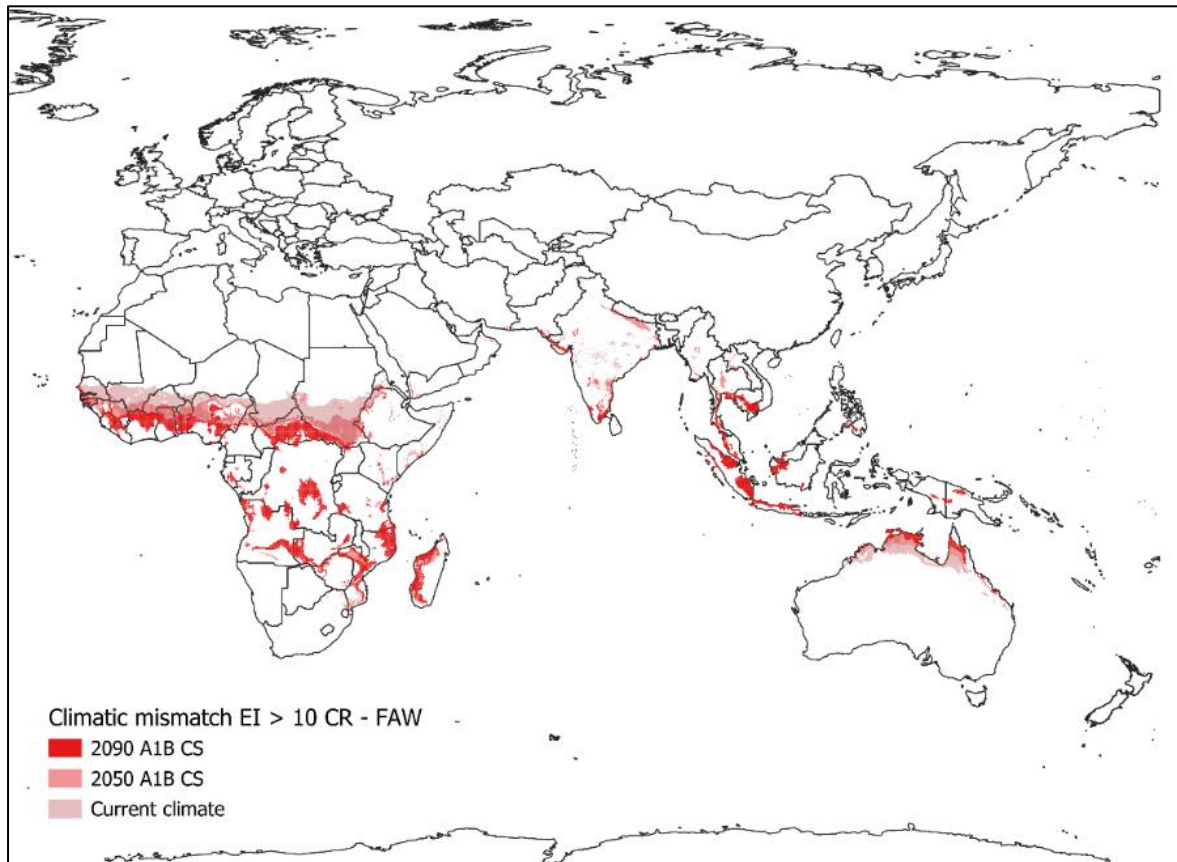
**Supplementary Table S1.** Model comparison for temperature-dependent development of *Cotesia ruficrus*. Developmental rates (1/day; calculated as the inverse of egg-to-adult development time) were fitted across experimental temperatures using six nonlinear thermal performance models (Analytis Brière type I, Brière type II, Kontodimas, Logan, and Lactin models). For each model, the estimated parameter values and goodness-of-fit metrics (including Akaike's Information Criterion, AIC) are reported. The model with the lowest AIC (Brière-2) was selected and used to derive the lower and upper developmental thresholds (LDT, UDT) and degree-day requirement applied in subsequent CLIMEX parameterisation. The models were compared with R version 4.5.2 (<https://cran.r-project.org/>).

| Model   | Brière 1 | Brière 2 | Analytis | Kontodimas | Logan | Lactin |
|---------|----------|----------|----------|------------|-------|--------|
| Tmin °C | 11.8     | 2.2      | 15.0     | 12.3       | n/a   | n/a    |
| Tmax °C | 34       | 34       | 34       | 34         | 34    | 34     |
| Topt °C | 28.7     | 33.2     | 24.5     | 26.8       | 30.1  | 28.6   |
| df      | 4        | 5        | 5        | 4          | 5     | 5      |
| AIC     | -28.9    | -63.2    | -12.2    | -22.0      | -45.7 | -19.3  |

**Supplementary Figure S1.** Temperature-dependent development of *Cotesia ruficrus* and fitted nonlinear models. Observed developmental rates (1/day; calculated as the inverse of egg-to-adult development time) are shown across experimental temperatures, with curves representing fitted thermal performance models (Analytis, Brière type I, Brière type II, Kontodimas, Logan, and Lactin). The figure was created with R version 4.5.2 (<https://cran.r-project.org/>).



**Supplementary Figure S2.** Overlap and mismatch maps using  $EI > 10$ . Overlap = areas where both FAW and *C. ruficus* were suitable ( $EI > 10$ ). CR–FAW (mismatch) = FAW-only areas ( $FAW EI > 10$ ;  $CR EI \leq 10$ ). Colours correspond to the baseline (WorldClim 2.1, 1970–2000), 2050 (A1B), and 2090 (A1B). The figure was created with QGIS version 3.4 (<https://qgis.org/>).



**Supplementary Figure S3.** Site-level Glw phenology for the four focal regions under baseline and 2050 (A1B) climate simulations: Landes (France), Lockyer Valley (Australia), Songnen Plain (China), and Wallachian Plain (Romania). Each panel shows the weekly Glw for *Cotesia ruficrus* (purple) and FAW (green), with the red dashed curve for temperature. Orange shading denotes mismatch weeks (FAW Glw > CR Glw and FAW Glw > 0.05). The figure was created with R version 4.5.2 (<https://cran.r-project.org/>).

