To investigate the impact of maternal and larval host plants (Barbarea and Bertoa) on some key variables involved in butterfly development, we fitted multiple linear regression models with maternal and larval host plants as well as their interactions, as fixed factors or explanatory variables and development time, growth rate and adult weight as dependent variables. To analyze the variation resulting from different combinations of maternal and larval host plants, involving multiple groups, the model was subjected to Two-way ANOVA and the results were tabulated.

Table 1

Statistics of impact of maternal and larval host plants on key variables of butterfly development

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Host plant** | **Development Time (days)** | | | **Growth Rate (cm/day)** | | | **Adult Weight (g)** | | |
| **Sum Sq** | **F Value** | **P-value** | **Sum Sq** | **F Value** | **P-value** | **Sum Sq** | **F Value** | **P-value** |
| MaternalHost | 623.61 | 177.9 | < 2.2e-16 | 0.004734 | 133.4552 | <2e-16 | 73.7 | 0.8198 | 0.366 |
| LarvalHost | 2682.41 | 765.21 | < 2.2e-16 | 0.029906 | 843.0077 | <2e-16 | 13019.8 | 144.8883 | <2e-16 |
| MaternalHost:LarvalHost | 80.8 | 23.05 | 2.56E-06 | 0.000208 | 5.8621 | 0.0161 | 336.7 | 3.7471 | 0.0539 |

Overall larval host factor has a highly significant effect on all three key variables considered. The influence of both larval and maternal host plants on the observed effects is discernible, with larval host exerting a more substantial impact, as evidenced by the larger sum of squares and corresponding values of F and P-values. Notably, the effects of larval and maternal hosts are not independent, demonstrating a detectable interaction (Table.1). However, the variance explained by the interaction term is limited in development time and growth rate (Fig. 1 & 2) but less significant interaction is observed in the case of adult weight (Fig. 3).

|  |  |  |
| --- | --- | --- |
| Fig. 1 Larval development time depending on larval and maternal host plant | Fig. 2 Larval growth rate depending on larval and maternal host plant | Fig. 3 Adult weight depending on larval and maternal host plant |

Specifically, larvae exhibited a 22.1% faster development when reared on Barbarea compared to Berteroa (mean development time = 22.6 and 29.0 days, respectively). Similarly, larvae reared on Barbarea exhibited a higher growth rate (35.8%) and increased adult weight (27.1%) compared to Berteroa. Larvae from mothers grown on Barbarea demonstrated a 10.7% acceleration in development (mean development time = 24.3 and 27.3 days, respectively). Similarly, larvae from mothers reared on Barbarea exhibited a higher growth rate (11.3%) but there was no significant influence observed in the adult weight (1.5%). Interestingly, the difference in development time between larval host plants was slightly larger when the mother was reared on Berteroa compared to Barbarea, with a 24.2% reduction in developmental time on Berteroa versus a 19.6% reduction on Barbarea, respectively. A similar trend was also observed in larvae growth rate (30.3% increase on Barbera versus 41.9% on Berteroa) and in adult weight (22.2% increase on Barbera versus 32.5% on Berteroa).