

## 1. Effect Sizes ( $\eta^2$ ) and Variance Explained by Agroecological Zone

| Trait             | $\eta^2$ | Variance Explained (%) |
|-------------------|----------|------------------------|
| Brood area        | 0.95     | 95%                    |
| Pollen store      | 0.80     | 80%                    |
| Hygienic behavior | 0.79     | 79%                    |
| Honey yield       | 0.76     | 76%                    |
| Propolis yield    | 0.75     | 75%                    |
| Colony size       | 0.72     | 72%                    |
| Temperament       | 0.62     | 62%                    |
| Wax production    | 0.54     | 54%                    |

## 2. Statistical Assumptions and Model Diagnostics

| Assumption / Test                          | Trait(s)              | Test Statistic | p-value | Result        | Action         |
|--------------------------------------------|-----------------------|----------------|---------|---------------|----------------|
| <b>Normality (Shapiro–Wilk)</b>            | Colony size           | W = 0.972      | 0.12    | Normal        | ANOVA          |
|                                            | Honey yield           | W = 0.968      | 0.08    | Normal        | ANOVA          |
|                                            | Brood area            | W = 0.982      | 0.34    | Normal        | ANOVA          |
|                                            | Pollen store          | W = 0.976      | 0.18    | Normal        | ANOVA          |
|                                            | Wax production        | W = 0.969      | 0.09    | Normal        | ANOVA          |
|                                            | Propolis yield        | W = 0.974      | 0.15    | Normal        | ANOVA          |
|                                            | Hygienic behavior     | W = 0.965      | 0.07    | Normal        | ANOVA          |
|                                            | Temperament           | W = 0.892      | <0.001  | Violated      | Kruskal–Wallis |
| <b>Homogeneity of Variances (Levene's)</b> | Colony size           | F = 1.24       | 0.29    | Equal         | ANOVA          |
|                                            | Honey yield           | F = 1.56       | 0.22    | Equal         | ANOVA          |
|                                            | Brood area            | F = 1.02       | 0.37    | Equal         | ANOVA          |
|                                            | Pollen store          | F = 0.98       | 0.38    | Equal         | ANOVA          |
|                                            | Wax production        | F = 1.83       | 0.17    | Equal         | ANOVA          |
|                                            | Propolis yield        | F = 1.41       | 0.25    | Equal         | ANOVA          |
|                                            | Hygienic behavior     | F = 1.67       | 0.20    | Equal         | ANOVA          |
| <b>Homoscedasticity (Residual plots)</b>   | All parametric models | —              | —       | No violations | Model valid    |
| <b>Effect size (<math>\eta^2</math>)</b>   | Brood area            | —              | —       | 0.95          | Large (>0.14)  |
|                                            | Pollen store          | —              | —       | 0.80          | Large          |
|                                            | Hygienic behavior     | —              | —       | 0.79          | Large          |
|                                            | Honey yield           | —              | —       | 0.76          | Large          |
|                                            | Propolis yield        | —              | —       | 0.75          | Large          |
|                                            | Colony size           | —              | —       | 0.72          | Large          |

| Assumption / Test                    | Trait(s)            | Test<br>Statistic | p-<br>value | Result | Action            |
|--------------------------------------|---------------------|-------------------|-------------|--------|-------------------|
| Post-hoc power analysis<br>(G*Power) | Temperament         | —                 | —           | 0.62   | Large             |
|                                      | Wax production      | —                 | —           | 0.54   | Large             |
|                                      | All traits (n = 30) | Power =<br>0.96   | —           | >0.95  | Adequate<br>power |