**Morphological adaptation in host races of Tephritis conura**

**Introduction:**

Many phytophagous insects, including Tephrities conura, strongly favor specific hosts, leading to limited plant species consumption. Host races observed in various insect groups suggest that speciation via distinct host preferences is common. The initiation of host-race formation theoretically requires a change in host preference. Mate choice in phytophagous insects is often tied to habitat selection, potentially restricting gene flow between host populations. Host-race formation involves additional adaptations, including physiological adjustments to host chemistry or phenology, and may lead to morphological changes for better host adaptation.

**Aim:**

To investigate and compare the morphological characteristics of *T. conura* host races associated with the host plants Heterophyllum and Oleraceum and to explore whether observed morphological differences are indicative of distinct morphotypes. This study further aims to assess how these morphological variations may be influenced by ecological conditions, specifically in allopatric and sympatric contexts, contributing to a comprehensive understanding of the morphological diversity within T. conura populations. This distinction is important in understanding whether observed differences are due to genetic adaptations (fixed traits) or environmentally induced changes (phenotypic plasticity).

**Methods:**

To assess the impact of host plants on morphological characteristics, we selected ovipositor length (OL), wing length, and body length of T. conura flies as response variables. Predictor variables included host plants, sex, and patry conditions. An ANOVA model was employed to examine the influence of host plants on ovipositor length, separately analyzing two distinct patry conditions. Additionally, we investigated the combined effects of sex and host plants on wing length. Analyzing these morphological variables under different patry conditions allows for insights into the geographical role, while the analysis based on host plants provides information on phenotype plasticity.

Box plots depicting ovipositor length (OL) based on host plant and patry conditions revealed a normal distribution of OL data with no outliers. In contrast, box plots illustrating wing length concerning host plant and sex displayed normally distributed data, but some outliers were observed in wing length for both male and female flies across different host plants.

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| Fig. 1 Box plot of ovipositor length againt hostplant and patry conditions |  | | Fig. 2 Box plot of Wing length ovipositor againt hostplant and patry conditions |
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| Fig. 3 Ovipositor length of T.conura depending on hostplants and different patry conditions | |  | Fig. 4 Wing length of T.conura depending on Sex and different hostplants | | |
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Fig. 5 Wing length of T.conura depending on hostplants and different patry conditions

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| Table 1. Statistical results for ovipositor length of *Tephritis conura* under different patry condition | | |  | Table 2. Statistical results for wing length of *Tephritis conura* under different patry condition | | |
| Ovipositor length(mm) | Allopatry | Sympatry |  | Wing length(mm) | Allopatry | Sympatry |
| Sum. Square | 0.59 | 0.148 |  | Sum. Square | 2.883 | 3.073 |
| p-value | 4.75 x 10 -7 | 0.006 |  | p-value | 9.06 x 10 -7 | 1.47 x 10 -7 |
| r2 | 0.16 | 0.05 |  | r2 | 10.5% | 10.08% |
| Effect Size | 7.17% | 3.9% |  | Effect Size | 3.97% | 4.34% |

Table 3. Statistical results for ovipositor length and wing length of Tephritis conura under different patry and host plant conditions



**Results**

**Influence of Hostplants on ovipositor length:**

Overall, host plants exert a highly significant influence on ovipositor length in T. conura flies. The impact of both host plants and patry conditions is discernible, with host plants demonstrating a more substantial effect on ovipository length than patry conditions, as indicated by larger sum of squares, F-values, and corresponding p-values. Notably, the effects of host plants and patry conditions are independent, supported by a weak interaction term (Table 3).

In the allopatry condition, T. conura female flies exhibited a 7.17% longer ovipositor length when hosted on Heterophyllum compared to those hosted on Oleraceum. Similarly, under sympatry conditions, the ovipositor length of female flies on Heterophyllum was 3.9% greater than those on Oleraceum. The observed higher sum squares, lower p-value, and r^2 values further substantiate these findings, indicating a statistically significant difference in ovipositor length between the two host plants under both allopatry and sympatry conditions (Table 1 & Fig. 3). These results suggest a host plant preference or specialization contributing to reproductive strategies or ecological adaptations within T. conura populations.

**Influence of hostplants on wing length of flies**

The impact of host plants on wing length in T. conura flies does not yield a statistically significant effect. Conversely, the influence of patry conditions on observed effects is highly significant, substantiated by larger sum of squares, F-values, and corresponding p-values (Table 3 & Fig. 5). Specifically, female flies exhibited wing lengths exceeding those of males in both allopatric and sympatric conditions by 3.97% and 4.34%, respectively. In contrast, no consistent differences in wing length were observed between Heterophyllum and Oleraceum populations. This observation is further validated by higher sum squares, lower p-values, and lower r^2 values, providing additional support for this trend (Table 2 & Fig. 4). The noted distinctions in wing length between female and male flies, in both allopatric and sympatric conditions, suggest a potential sexually dimorphic trait in T. conura.

**Conclusion:**

The host races of T. conura exhibited highly significant differences in ovipositor length, with flies associated with Heterophyllum displaying both absolutely and relatively longer ovipositors compared to those associated with Oleraceum signifies the host specific adaptations. In contrast, no consistent differences in wing length were observed between populations associated with Heterophyllum and Oleraceum. This implies that the host races differ in shape but not in size. The absence of consistent wing-length differences suggests that the observed morphological differentiation is unlikely to be solely due to phenotypic plasticity.