



Supplementary Material

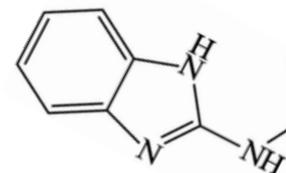
A systemic fungicide might reduce the male genitalia of a stingless bee species by one-third

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Title | A systemic fungicide might reduce the male genitalia of a stingless bee species by one-third

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Tables S1. Procrustes ANOVA. Analysis of directional and fluctuating asymmetry showing the shape variation for genitalia of males of *Scaptotrigona bipunctata* (Hymenoptera: Apidae: Meliponini).

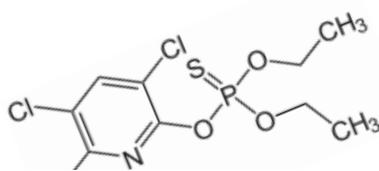
Factors	Degrees of freedom	Sums of squares	Mean squares	R2	F-statistic	P-value
Individual	31	0.143	0.005	0.78	3.82	< 0.001
Side	1	0.002	0.002	0.00	1.31	0.26
Individual:Side	31	0.037	0.001	0.20		
Total	63	0.182				

Notice: individual = variation among individuals; side = directional asymmetry (variation among sides); Individual:Side = fluctuating asymmetry (variation due to an individual vs. side interaction); R2 = indicates the relative contribution of each factor to overall variation.

Tables S2. Allometry analysis using size (predictor) vs. shape (response) of the genitalia of males of *Scaptotrigona bipunctata* (Hymenoptera: Apidae: Meliponini).

Factors	Degrees of freedom	Sums of squares	Mean squares	R2	F-statistic	P-value
Size	1	0.001	0.001	0.01	0.48	0.76
Groups	3	0.003	0.001	0.04	0.44	0.95
Size:Groups	3	0.005	0.001	0.07	0.66	0.76
Residuals	24	0.061	0.002	0.86		
Total	31	0.071				

Notice: Groups = control males and males exposed to agrochemicals (fungicide: Caberdazim; insecticide: Chlorpyrifos; Synergy fungicide+insecticide); R2 = indicates the relative contribution of each factor to overall variation.





Tables S3. Analysis of the size (centroid) of the genitalia of males of *Scaptotrigona bipunctata* (Hymenoptera: Apidae: Meliponini).

Factors	Degrees of freedom	Sums of squares	Mean squares	R2	F-statistic	P-value
Groups	3	0.477	0.159	0.28	3.69	0.031
Residuals	28	1.208	0.043	0.71		
Total	31	1.685				

Notice: Groups = control males and males exposed to agrochemicals (fungicide: Caberdazim; insecticide: Chlorpyrifos; Synergy fungicide+insecticide); R2 = indicates the relative contribution of each factor to overall variation.

Tables S4. Shape analysis of the genitalia of males of *Scaptotrigona bipunctata* (Hymenoptera: Apidae: Meliponini).

Factors	Degrees of freedom	Sums of squares	Mean squares	R2	F-statistic	P-value
Groups	3	0.003	0.001	0.05	0.54	0.89
Residuals	28	0.067	0.002	0.94		
Total	31	0.071				

Notice: Groups = control males and males exposed to agrochemicals (fungicide: Caberdazim; insecticide: Chlorpyrifos; Synergy fungicide+insecticide); R2 = indicates the relative contribution of each factor to overall variation.

Tables S5. Results of the discriminant analysis comparing the Mahalanobis distance between the average shapes of the genitalia of males of *Scaptotrigona bipunctata* (Hymenoptera: Apidae: Meliponini). Lower: cross-validated classification. Note: Overall classification accuracy = 18.75%. Bold means the percentage of correct classification from actual and its underlying maintenance within it after posterior (ascribed) group.

	Degrees of freedom	Wilks' lambda	F-statistic	P-value
Groups	3	0.71	1.06	0.4
Residuals	28			
Assigned group	Carbendazim	Chlorpyrifos	Carbendazim + Chlorpyrifos	Control
Actual group				
Carbendazim	57.1%	28.5%	0.00%	14.2%
Chlorpyrifos	0.00%	0.00%	33.3%	66.6%
Carbendazim + Chlorpyrifos	25.0%	12.5%	12.5%	50.0%
Control	9.09%	54.5%	27.2%	9.09%



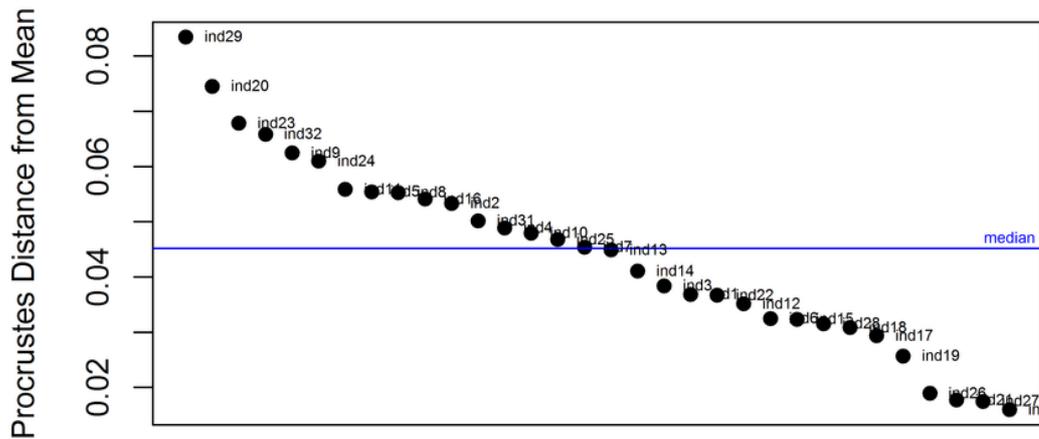


Figure S1. An analysis for potential outliers was conducted using all individuals (points) ordered by their Procrustes distance from the mean shape (blue line). Please note that the upper and lower quartiles are not displayed, as all individuals were located within these quartiles; however, if an outlier were detected, it would appear as a red point above the upper quartile.

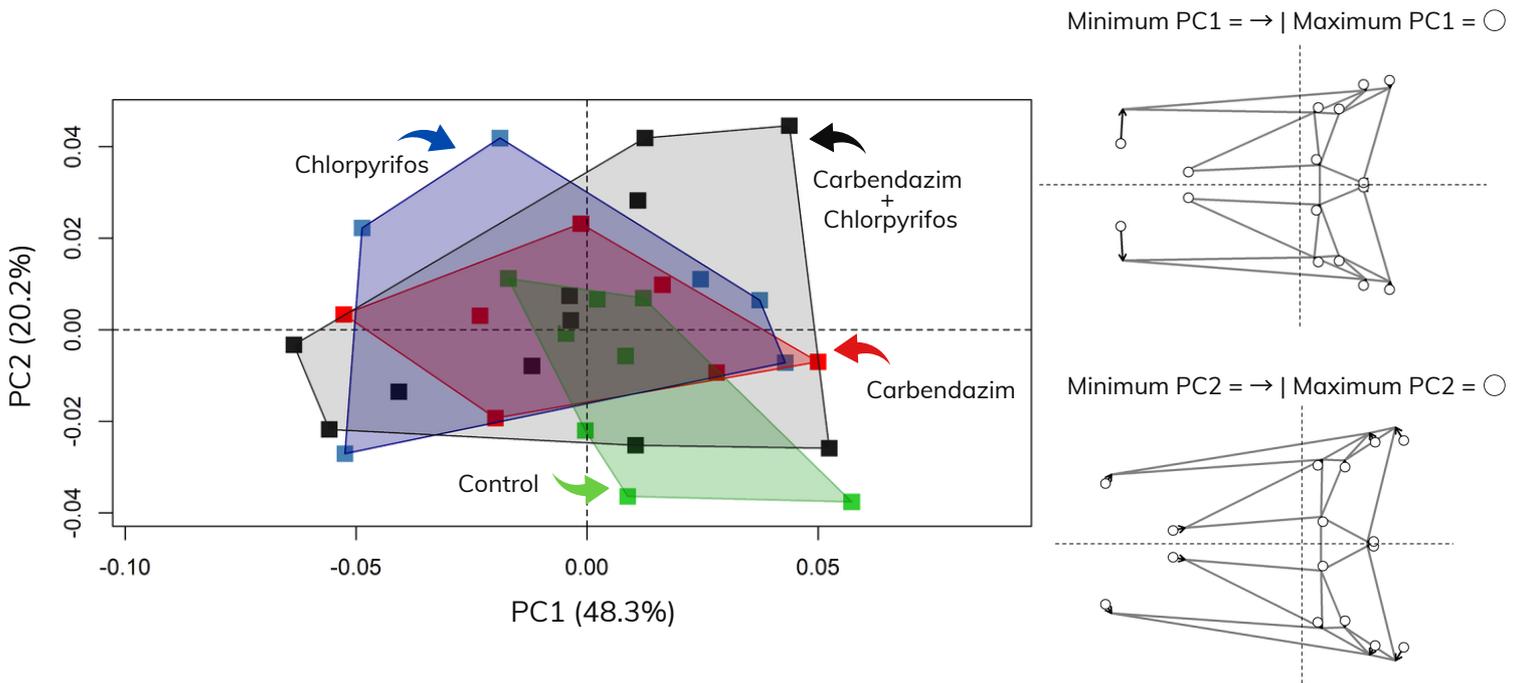


Figure S2. (LEFT) Principal components analyses were conducted on Procrustes shape coordinates using the aligned genitalia of *Scaptotrigona bipunctata* males (Hymenoptera: Apidae: Meliponini). This procedure illustrates how shape varies along both axes (PC1, PC2) within a multidimensional space, allowing for the visualization of subtle changes in shape patterns. Colors represent different treatments: red for Carbendazim, blue for Chlorpyrifos, green for Control, and black for the synergy of Carbendazim + Chlorpyrifos. (RIGHT) In a more detailed representation (vectors), we show how the shape of male genitalia changes. Please note that in both panels at the right-hand side (upper and lower), points indicate genitalia positions over the maximum sides in PC1 and PC2, respectively, while arrowheads point to the minimum sides in PC1 and PC2. As indicated in Table S4 and Table S5, there are no significant differences in the shape of genitalia among the different groups of males exposed to agrochemicals. In panel B, the shapes were not augmented.