



Red is safer: influence of gall traits on parasitism in *Garuga pinnata* Roxb.

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Introduction

- ▶ Galls are extended phenotype of gall inducers (GI) conferring protection to their offsprings by retuning the plant morphology in favour of themselves.
- ▶ Galls induced by *Phacopteron lentiginosum* Buckton on the leaves of *Garuga pinnata* Roxb. varies in size and colour (red and green morphotypes).
- ▶ The gall inducer *P. lentiginosum* attacked by species of Braconidae and Encyrtidae.

Objectives

- ▶ To test aposematic gall hypothesis.
- ▶ To determine the relation between Gall volume (GV), number of GIs and parasitoids.

Materials and methods

- ▶ Galls (n=2094) were collected from Pattambi, Kerala, India (10.81 14°N, 76.190 4°E) during 2019–2021; photographed under Leica S8 APO stereozoom trinocular microscope and GV, GC, number of GI and parasitoids (larva, pupa, adult, emergence hole) were recorded.
- ▶ Measurements made using Vernier callipers:
 - (1) H: Maximum horizontal width
 - (2) V: Maximum vertical height (Fig 1).
 Further, gall volume: $GV = \frac{4}{3} \pi * H^2 * V / 1000$
- ▶ Biochemical analyses: Fresh galls with 5th instar GI and ungalled leaves were used (anthocyanin: Teng et al., 2020; phenolics: Guedes et al., 2022).
- ▶ Statistical analysis: R software (R Core Team, 2021): “ggplot2” for graphics, “tidyverse” for analyses.

Results

- ▶ Overall parasitization was lower in red galls than in green galls (GLM Binomial: -0.33 ± 0.10 , $Z = -3.27$, $P = 0.001$) (Fig. 1).
- ▶ Parasitization by Braconidae was lower in red galls than in green galls (GLM Binomial -0.38 ± 0.11 , $Z = -3.44$, $P = 0.0005$) (Fig. 1).
- ▶ Concentration of phenolics (54.6%, $p < 0.01$) and anthocyanin (64.6%, $p < 0.05$) were significantly higher in red galls compared to green galls (Tab. 1).
- ▶ The volume of the galls was positively correlated with the number of GI (GLM Poisson 0.17 ± 0.01 , $Z = 11.9$, $P < 0.005$) (Fig. 2).
- ▶ Gall volume and the rate of parasitization by braconids was not correlated (GLM Poisson 0.08 ± 0.05 , $Z = 1.62$, $P = 0.106$).
- ▶ Number of GI had a significant negative effect on parasitization by braconids (GLM Poisson 0.19 ± 0.04 , $Z = -4.55$, $p < 0.005$).

Biochemical parameters	Ungalled leaf	Red gall	Green gall	P-value	
				Wilcoxon signed-rank	t test (paired)
Phenolics (mg/g)	29.639±3.521	20.943±4.174	13.544±3.948	0.001**	0.000**
Anthocyanin(μmol/ml)	0.014±0.002	0.005±0.003	0.003±0.001	0.016*	0.015*

Tab. 1: Total phenolics and anthocyanin content in the ungalled leaves, red galls and green galls of *G. pinnata*. All values represented as mean±SD. *significant at $p < 0.05$ **significant at $p < 0.005$.

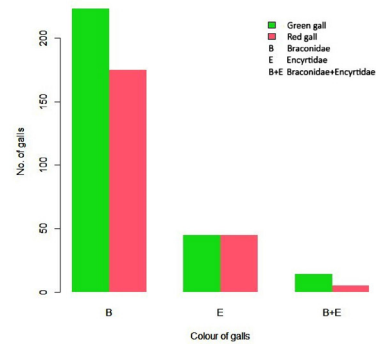


Fig. 1: Effect of colour on parasitization by braconids, encyrtids and braconids+encyrtids (B-braconids; E-encyrtids; B+E-braconids+encyrtids).

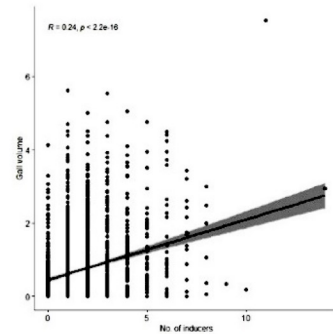


Fig. 2: Gall volume dynamics with number of inducers.

Conclusions

- ▶ Parasitization lower on GI of red galls compared to green.
- ▶ Anthocyanin and phenolic content higher in red galls compared to green; providing an evidence for the aposematic gall hypothesis.
- ▶ GV increases with the number of GIs.
- ▶ GV did not influence the rate of parasitization by braconids.
- ▶ Number of GIs negatively influenced the rate of parasitization of *P. lentiginosum* by braconids.

References

- ▶Teng et al. (2020). Qualitative and quantitative methods to evaluate anthocyanins. *Efood*, 1(5), 339-346.
- ▶Guedes et al. (2022). High antioxidant activity of phenolic compounds dampens oxidative stress in *Espinosa nothofagi* galls induced on *Nothofagus obliqua* buds. *Plant Science*, 314, 111114.
- ▶R Core Team (2021). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria.

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