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Exploring the Biochemical Dynamics of Rice and Rice Leaf Folder (*Cnaphalocrocis medinalis*) Under Elevated CO2 Conditions

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INTRODUCTION & AIM

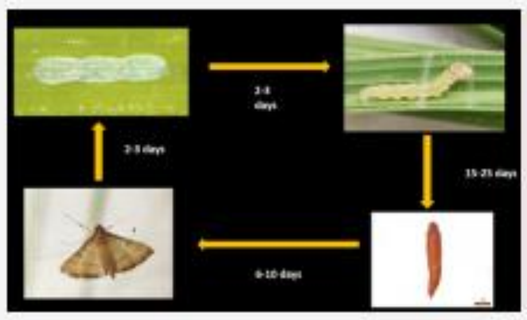
Rice is the primary staple food for much of the global population, especially in Asia. In India, it is cultivated over 32.87 million hectares, with a production of 135.7 million tonnes in 2022–23 [1].

The rice leaf folder (RLF) (*Cnaphalocrocis medinalis*) has shifted from being a minor pest to a major threat since the 1980s, causing substantial damage to rice crops. Yield losses can be severe during outbreaks, and even moderate infestations can significantly reduce productivity.

With atmospheric CO_2 projected to reach 570 ppm by the end of the 21st century, climate change is expected to impact insect pests by altering plant nutritional quality, thereby influencing insect growth and development.

Hence, it is important to study the impact of climate change on the biochemical profile of both the rice leaf folder and its host plant, rice.

METHODOLOGY



Life Cycle of RLF

Egg: 2-3 days
Larva: 15-25 days
Pupa: 6-10 days
Adult: 2-3 days

Insect rearing

Temperature: 27 ± 1°C
RH: 70 ± 5%

Experimental setup

- Facility: Open Top Chamber (OTC), IARI, New Delhi
- eCO2- 570ppm
- Design: 5 replications/treatment
  2 pots/replication
  5 second instar larvae per pot

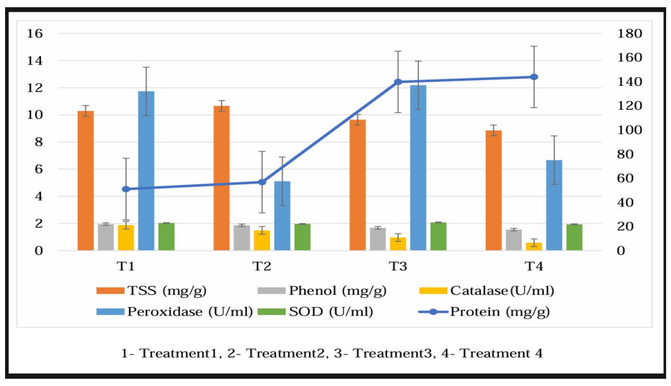
Treatments

Treatment Code	Conditions
T1	eCO_2 + Rice Leaf Folder (RLF)
T2	eCO_2 only
T3	RLF only
T4	Ambient Control

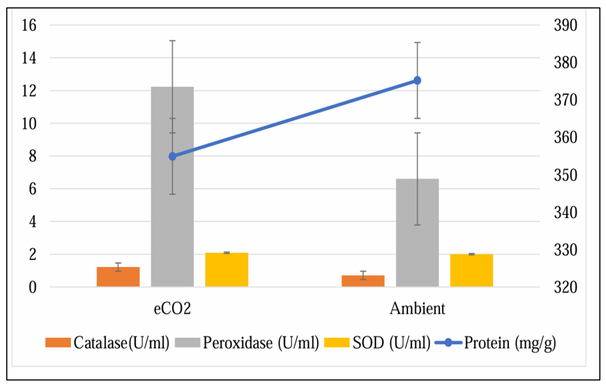
Biochemical parameters analysed

RESULTS & DISCUSSION

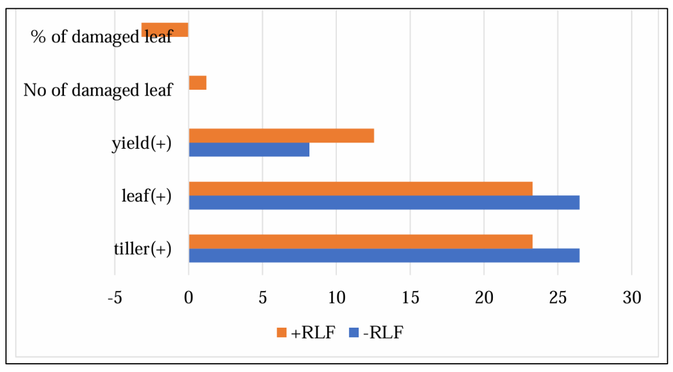
Effect of eCO_2 and *C. medinalis* infestation on biochemical constituents of rice plant



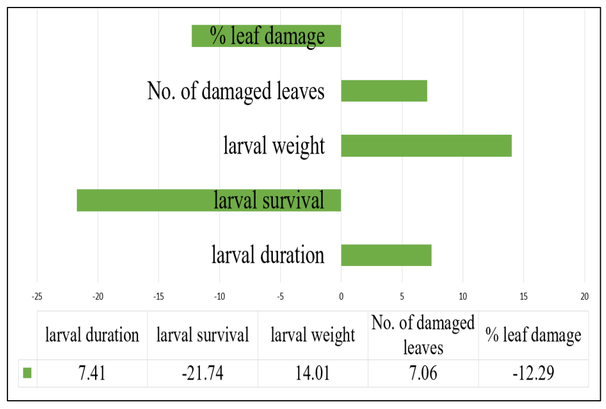
Effect of eCO_2 on biochemical constituents of *C. medinalis* larvae



Growth Variations in Rice Under eCO2 With/ Without RLF Infestation

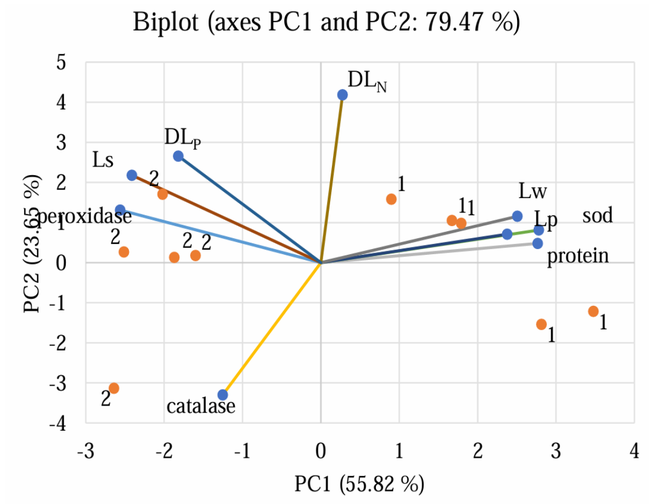


Larval development and leaf damage parameters under eCO_2 conditions



larval duration	larval survival	larval weight	No. of damaged leaves	% leaf damage
7.41	-21.74	14.01	7.06	-12.29

Principle Component Analysis considering different parameters under study



Where Ls- larval survival (%), DL_P- damaged leaf (%), DL_N- number of damaged leaves, Lw- larval weight, Lp- larval period. 1- treatment 1, 2- treatment 2.

Rice leaf folder grown under eCO2:

- Reduction in protein content
- Rise in protective enzyme activities (catalase, peroxidase, and SOD)
- Number of damaged leaves has increased while the percentage damage caused by the larvae showed a decline.
- Reduction in larval survival rates with increase in its duration

Rice grown under eCO2:

- Reduction in the protein content,
- Rise in total soluble sugars (TSS), phenol, and catalase activity
- No significant difference in peroxidase and superoxide dismutase (SOD) activities.

Infested rice plants:

- lower protein content
- Higher phenol content, peroxidase, and SOD activity
- No significant difference in the TSS content and catalase activity

PCA was conducted to study the influence of eCO2 on the physico chemical characteristics and damage potential of RLF.

- Two PCs explaining a variation of 79.47% were obtained, with PC1 having loadings for protein, peroxidase, SOD, larval period, larval survival, and larval weight.
- While catalase, number of damaged leaves, and percentage of damaged leaves were loaded in PC2.

CONCLUSION

- Rice plants exhibited reduced protein levels but increased sugar and phenol concentrations, the leaf folder larvae display protective enzyme responses despite decreased protein and survival rates.
- The increased leaf damage, paired with lower larval survival, suggests potential changes in pest management dynamics.
- The PCA analysis revealed that the most impactful variables were clearly distinguished between two main components, indicating targeted areas for further investigation.

These insights emphasize the need to consider complex plant-insect interactions when predicting agricultural responses to climate change

REFERENCES

[1] May-os, Ruth. (2024). Top 10 Rice Producing Countries as of 2023-2024.