Estimating the pest impact under the climate change:

Elevated CO_2 with temperature condition reduces performance of *Spodoptera litura* F. due to reducing the nutritional value and secondary compound on foliage of *Rorippa dubia* Persoon.

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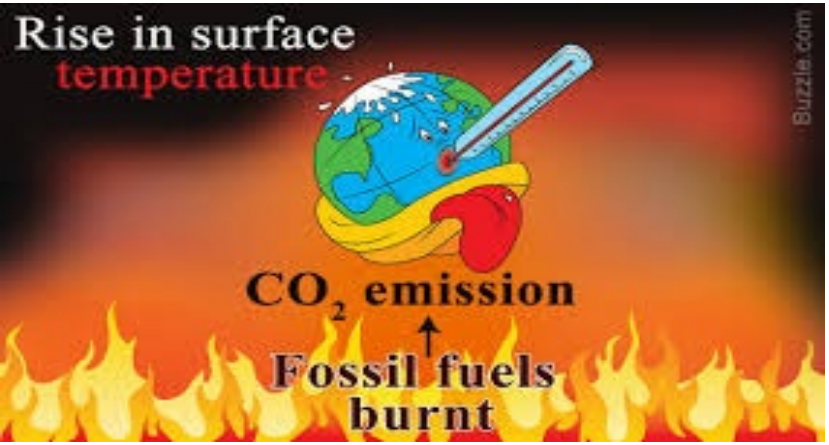
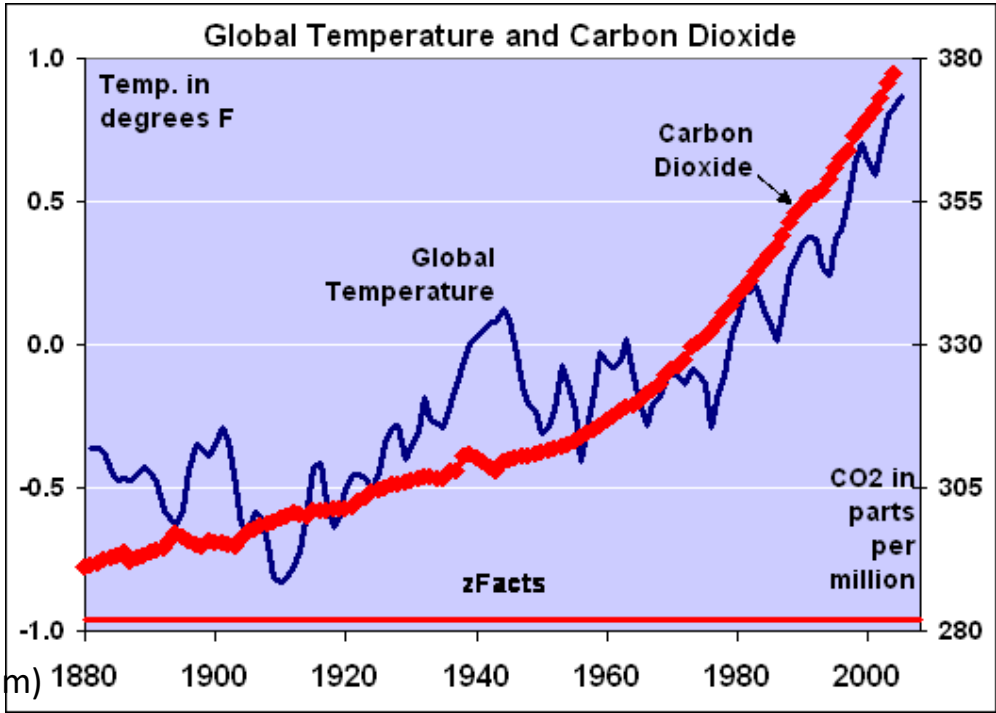
Environmental issue of global warming



1. The increasing of carbon dioxide (CO_2)
2. The increasing of temperature

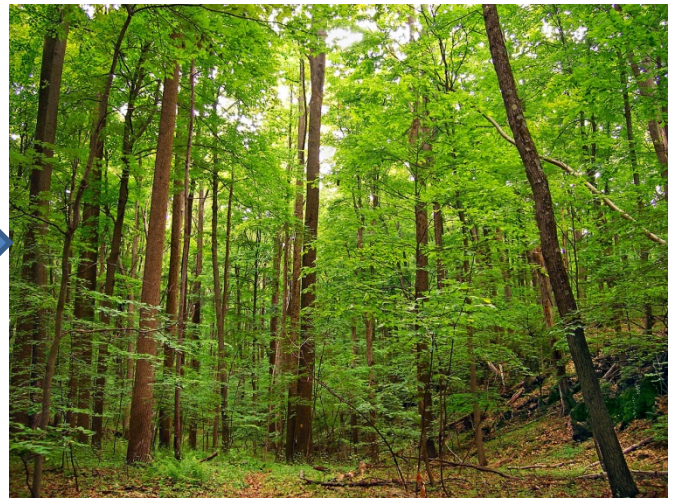


(Image courtesy Zfacts.com)

Increasing

1. CO_2 concentration
2. **Temperature**

Direct effects of climate change



Indirect effects of climate change

Increasing

1. CO_2 concentration (500ppm to **1000** ppm)
2. Temperature (24^0C to **29^0**C)

Question ???

Intact-foliage

Herbivorous damaged-foliage

Material and method

- Plant: *Rorippa dubia* Persoon.
- Insect: *Spodoptera litura*
- Glasses house condition
  - CO_2 :
    - **500** ppm concentration
    - **1000** ppm concentration
  - Temperature:
    - Ambient temp: **24**^{0}C-Day/21^{0}C night
    - Elevated temp: **29**^{0}C-Day/26^{0}C night

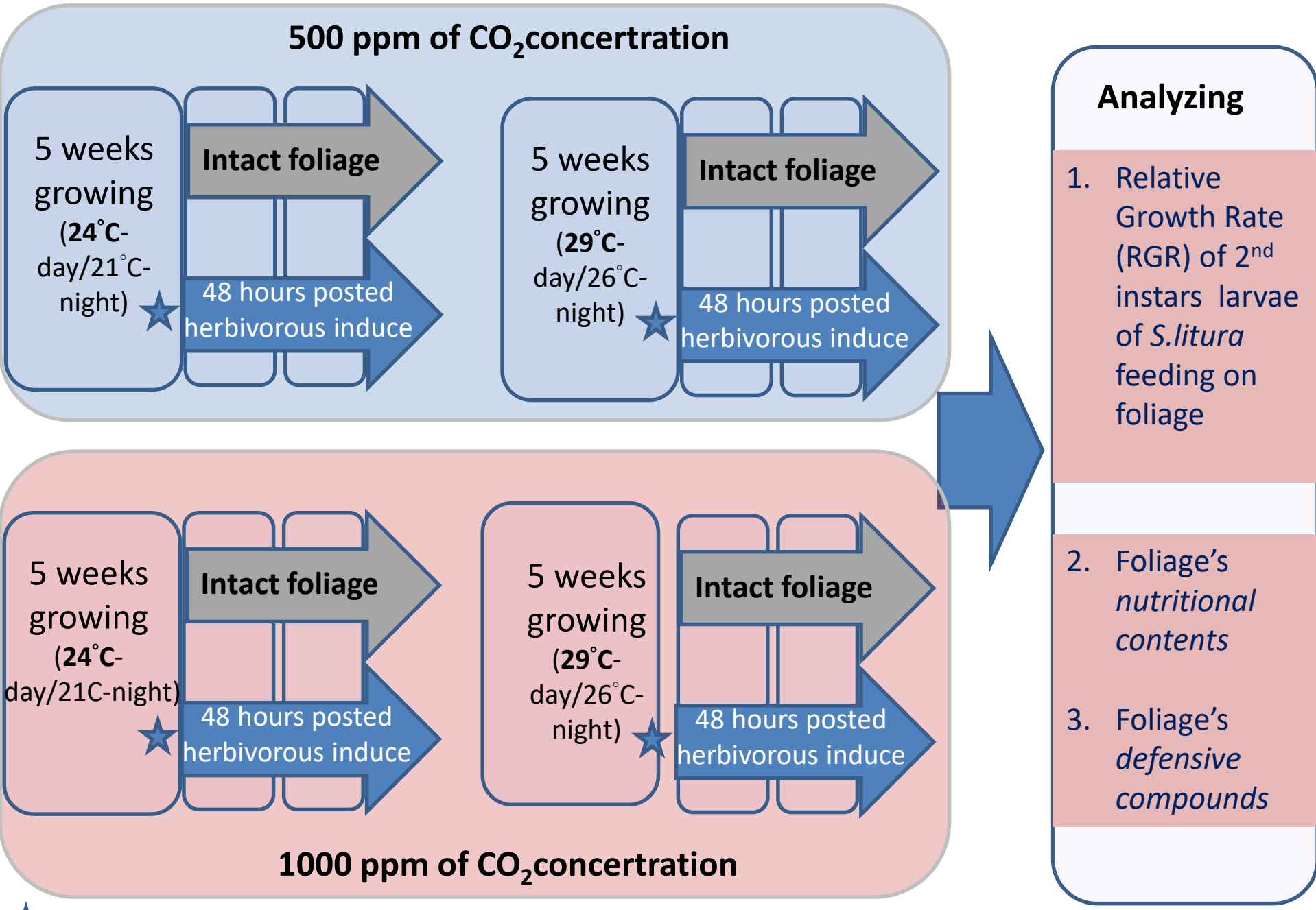
- Larval development: Relative growth rate (RGR)
- Chemical analysis
  - Primary compounds: Nutritional compounds
  - Secondary compounds: Defensive compounds

Rorippa dubia Persoon.

Order: Brassicales
Family: Brassicaceae
Genus: *Rorippa*

Maintaining the *S.litura* population

25^{0}C -70%RH
16:8 D:N


500 ppm of CO_2concertration
5 weeks growing (24˚C-day/21˚C-night)
Intact foliage
48 hours posted herbivorous induce
5 weeks growing (29˚C-day/26˚C-night)
Intact foliage
48 hours posted herbivorous induce
5 weeks growing (24˚C-day/21C-night)
Intact foliage
48 hours posted herbivorous induce
5 weeks growing (29˚C-day/26˚C-night)
Intact foliage
48 hours posted herbivorous induce
1000 ppm of CO_2concertration
Analyzing
1. Relative Growth Rate (RGR) of 2nd instars larvae of S.litura feeding on foliage
2. Foliage's nutritional contents
3. Foliage's defensive compounds
Noted as time to cause the induced-resistance by herbivorous

Results

Increasing

1. CO_2 concentration (500ppm to **1000** ppm)
2. Temperature (24^0C to **29^0**C)

Primary compounds

- Nitrogen content
- Increasing carbohydrate (sugar + starch)

Secondary/defensive compounds

- Tripsin inhibitor
- Polyphenol oxydase (PPO)
- Peroxise

Anti-digestion strategy

- Phenolic compounds
- Glucosinolate

Direct metabolism target

Relative growth rate

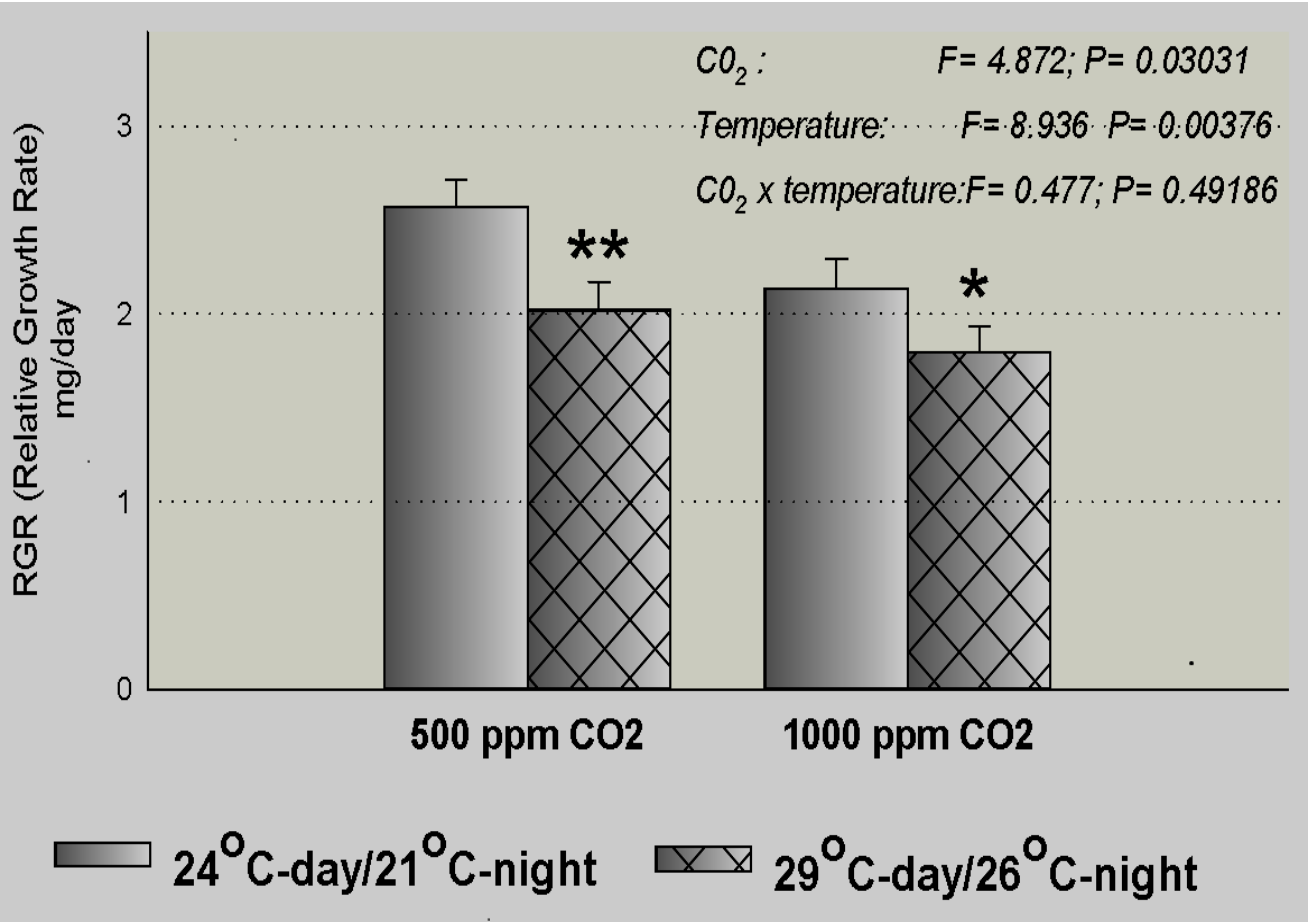
RGR
(relative growth rate)

Newly-molting 2nd larvae

$$\text{RGR (mg/day)} = \frac{\text{final weight} - \text{initial weight}}{\text{days}}$$

Larval relative growth rate

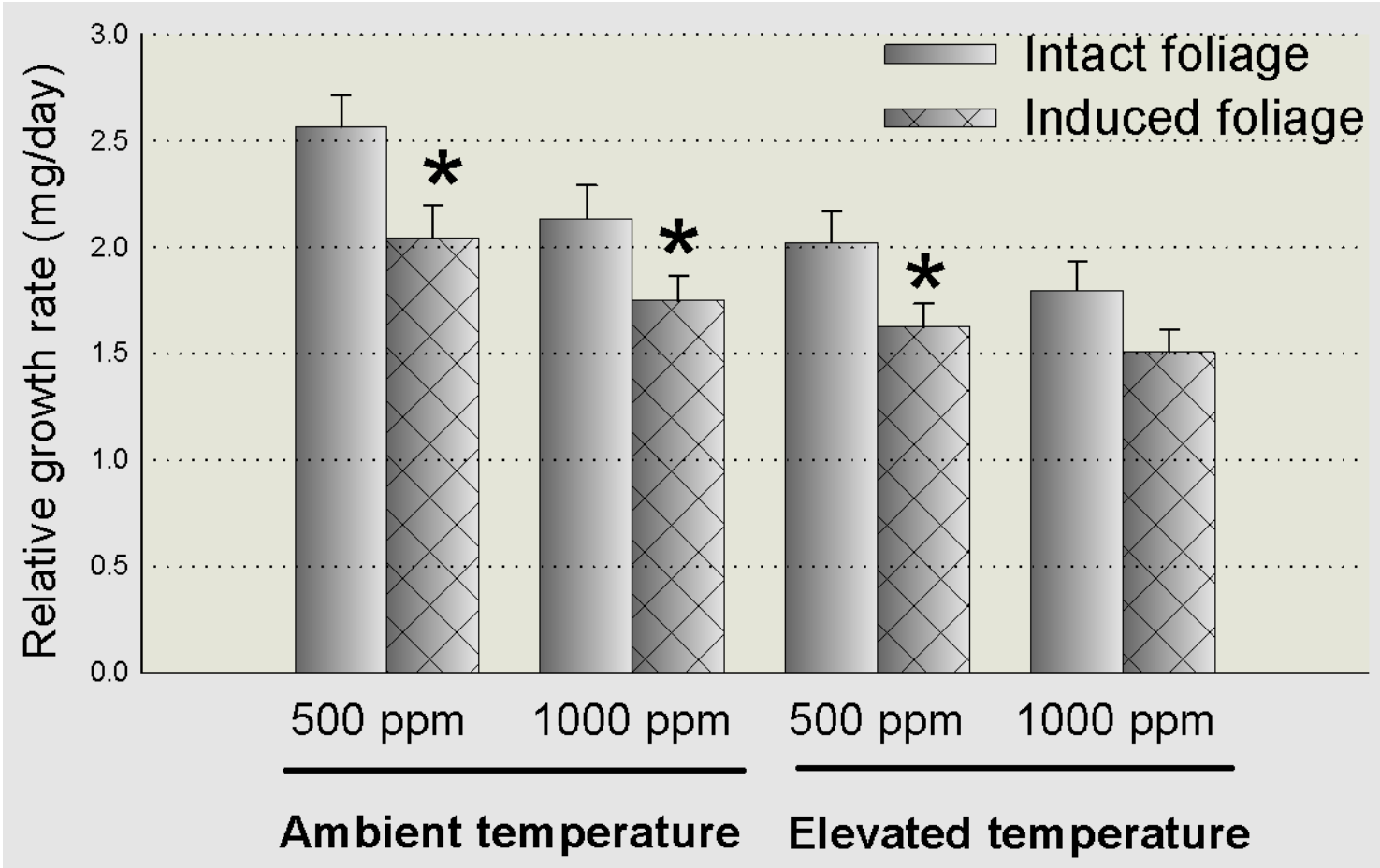
1. Elevated temperature: reduce **16.72 %**
2. Elevated CO_2: **21.23 %**
3. Elevated CO_2-Elevated temp: **29.98 %**

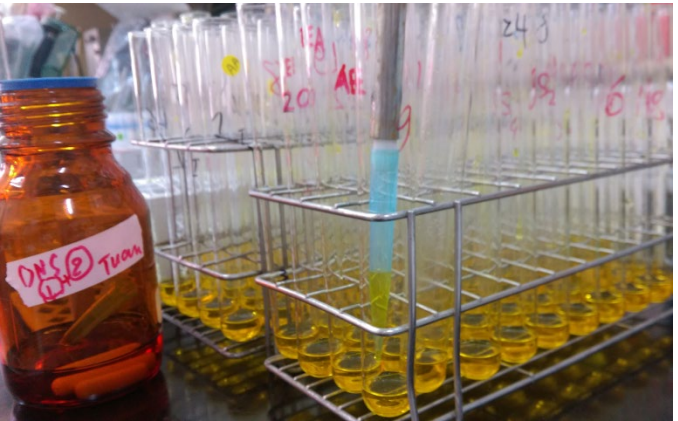


Larval relative growth rate

Herbivorous induced-responds

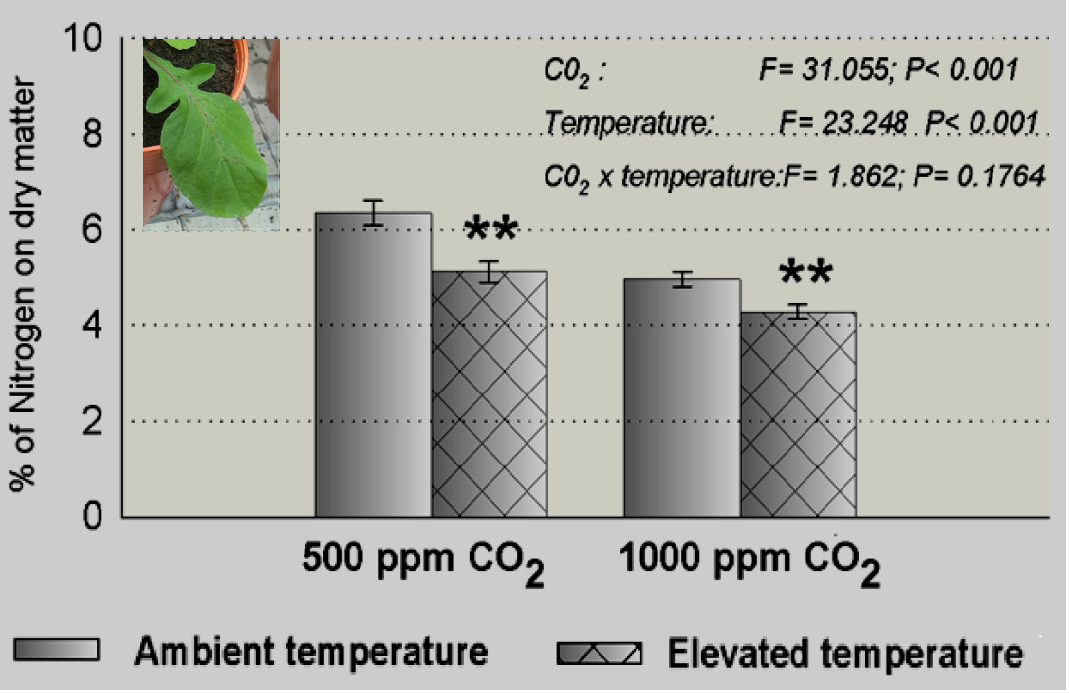
Reduce 18.53%





Primary compounds

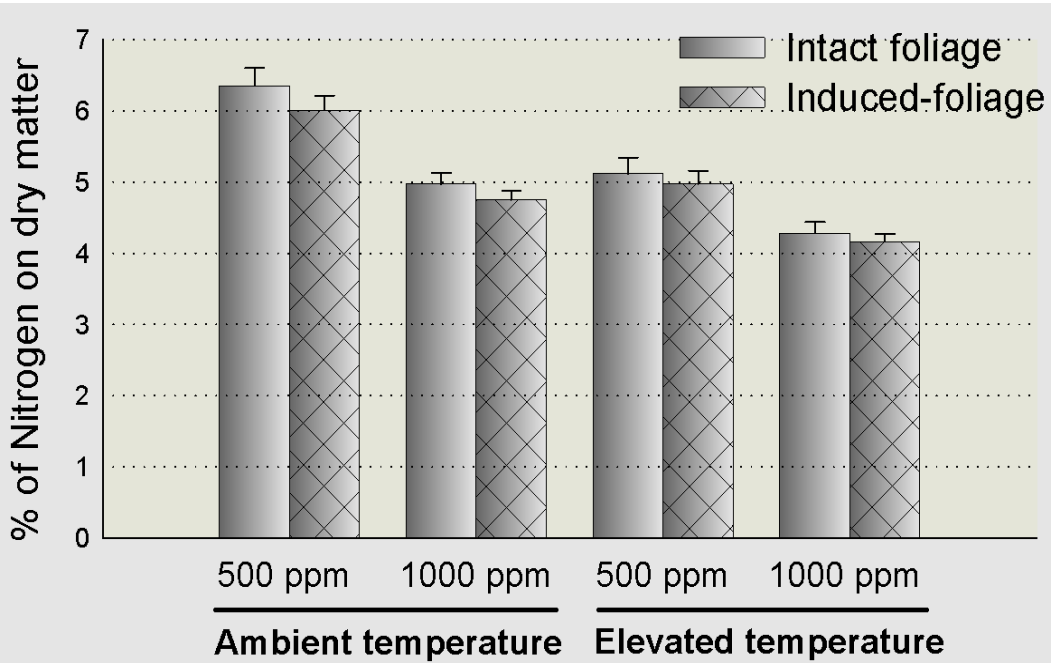
- Nitrogen content
- Protein content
- Soluble carbohydrate (sugar)
- Insoluble carbohydrate (starch)



Nitrogen content

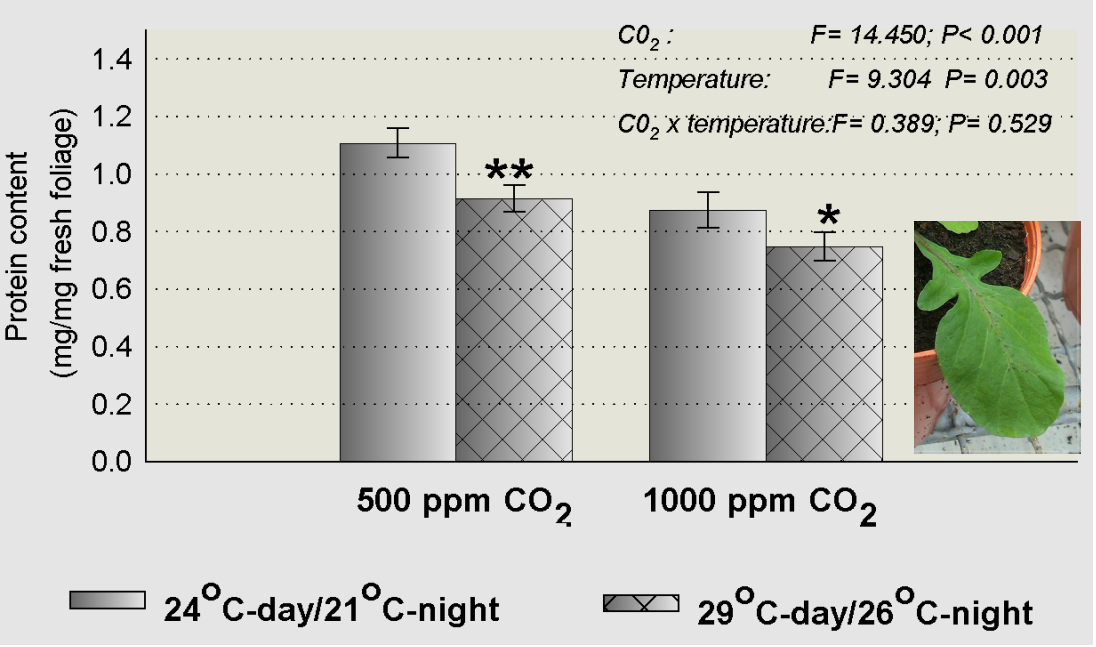
1. Elevated temperature: Reduce **21.69 %**
2. Elevated CO_2: Reduce **19.43 %**
3. Elevated CO_2-Elevated temp: Reduce **32.51 %**

Reduce the Nitrogen content



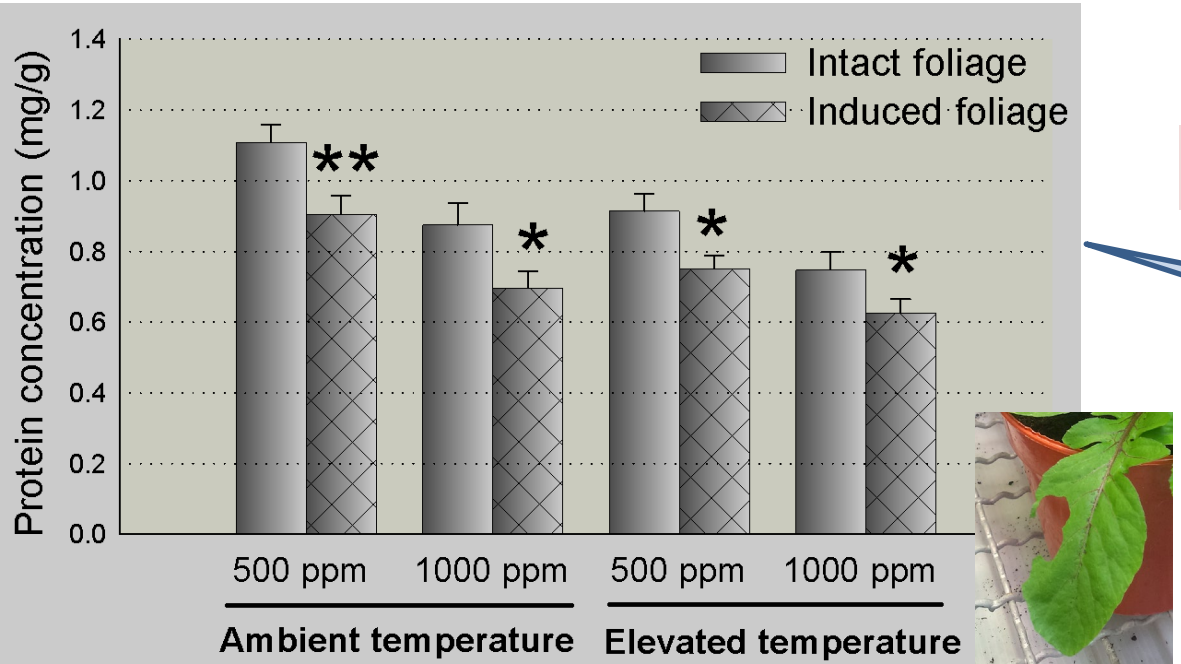
Herbivorous induced-responds

2. No change of Nitrogen content



Protein content

1. Elevated temperature: **Reduce 20.99 %**
2. Elevated CO_2: **Reduce 17.43 %**
3. Elevated CO_2-Elevated temp: **Reduce 32.45 %**

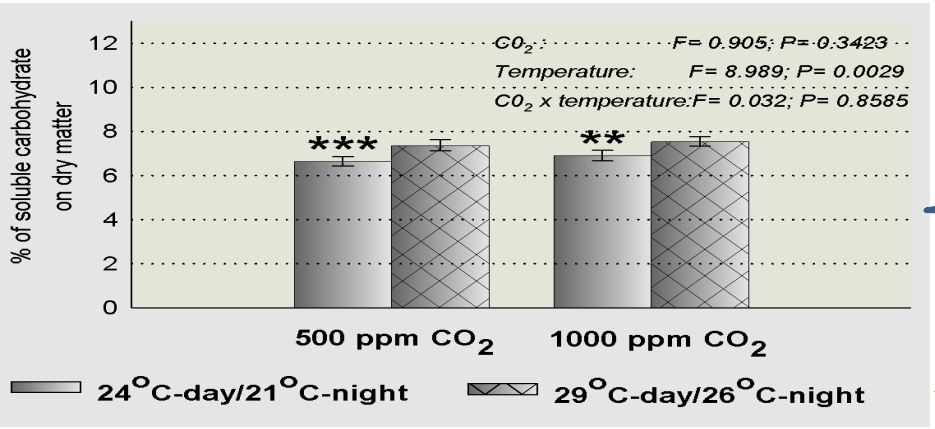


Herbivorous induced-responds

Reduce 18.17%

Carbohydrate

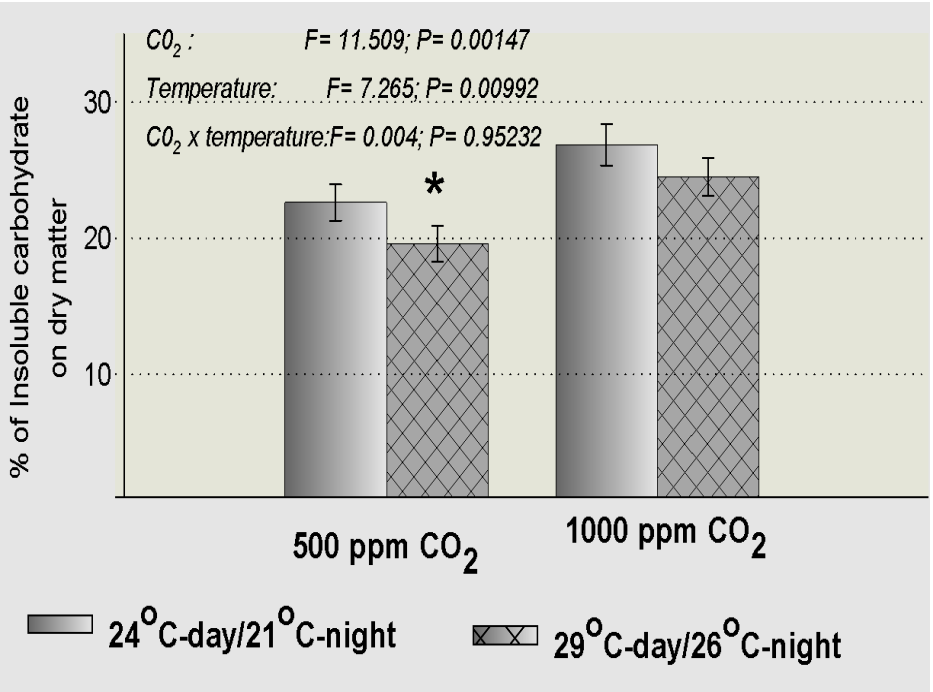
Increasing
1. CO_2 concentration (500ppm to **1000** ppm)
2. Temperature (24^0C to **29^0**C)



Increasing Sugar

1. Elevated temp: **Increase 3.91 %**
2. Elevated CO_2: **Increase 10.97 %**
3. Elevated CO_2-Elevated temp: **Increase 13.64 %**

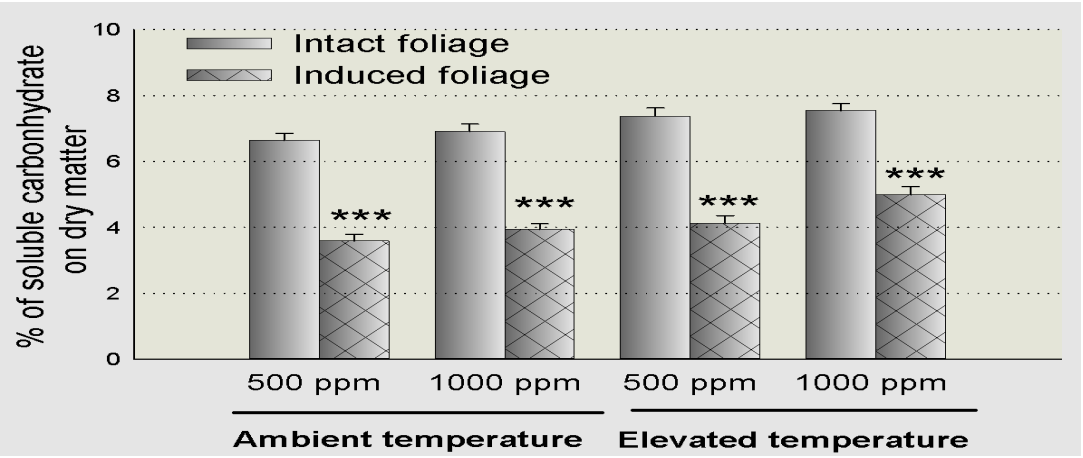
Increasing total carbohydrate



Increasing **starch**

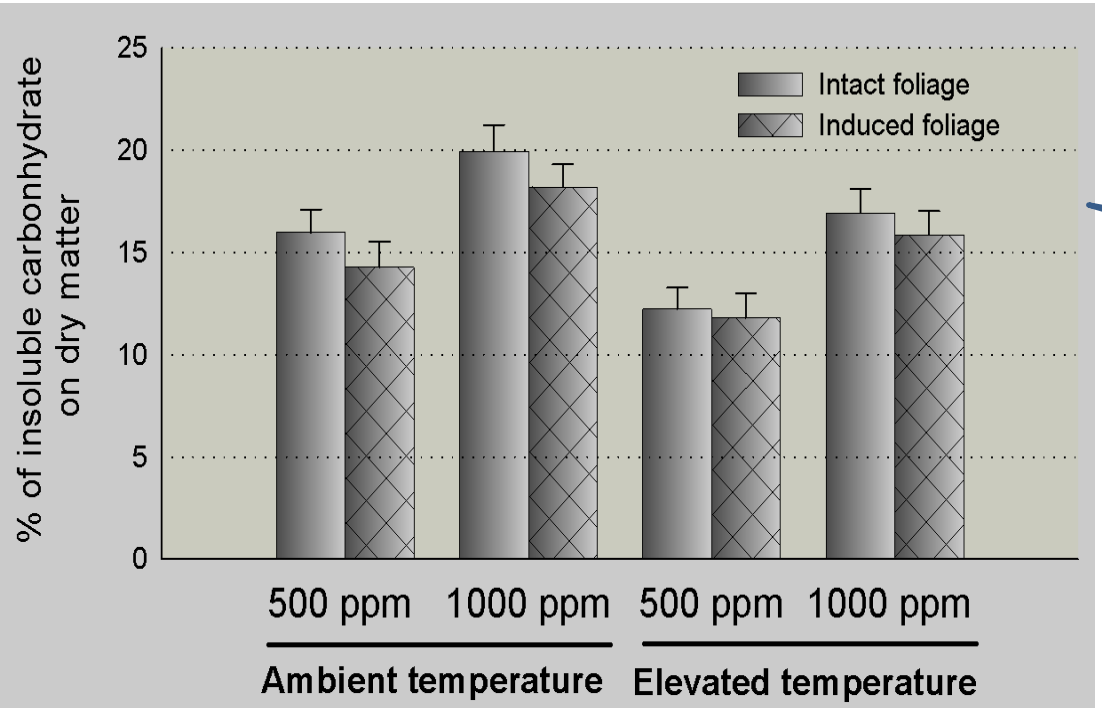
1. Elevated temp: **Decrease 24.81 %**
2. Elevated CO_2: **Increase 23.45 %**
3. Elevated CO_2-Elevated temp: **Increase 5.98 %**

Carbohydrate



Herbivorous induced-responds

Reduce 41.68 % sugar



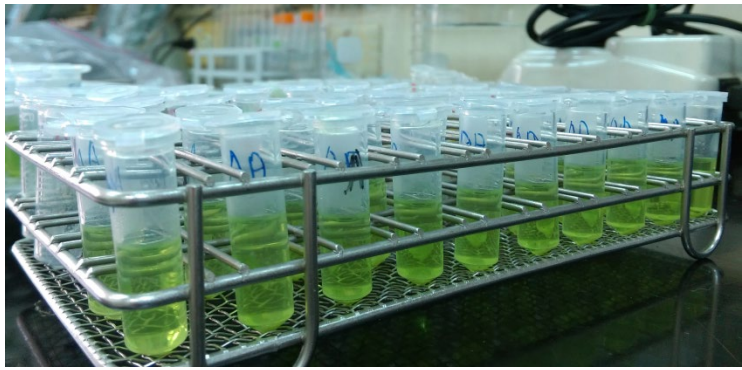
Herbivorous induced-responds

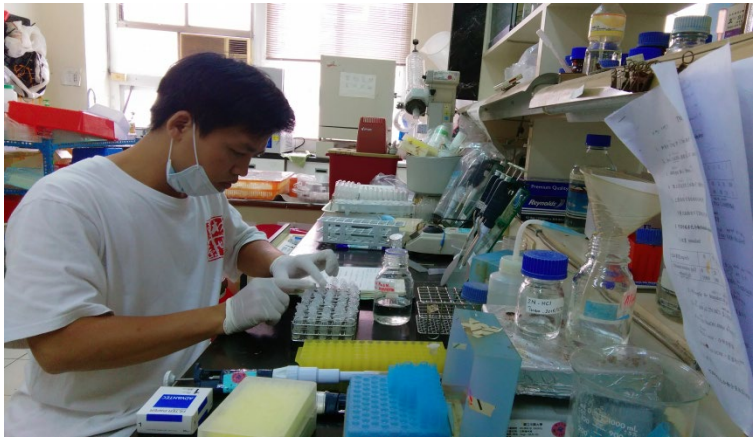
Reduce 7.29 % starch

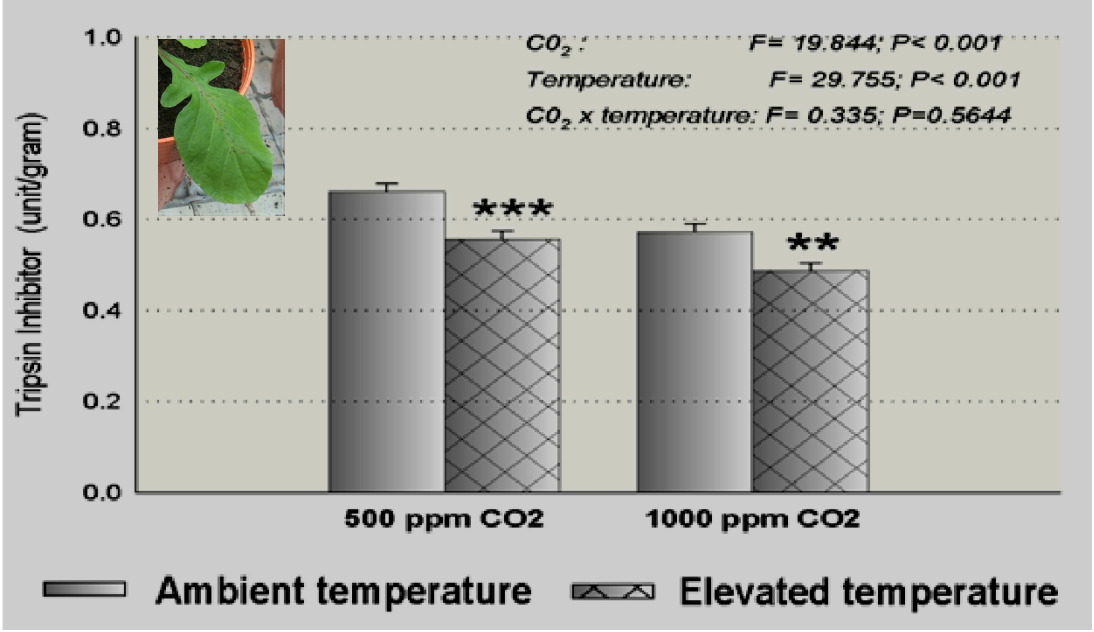
No significant difference

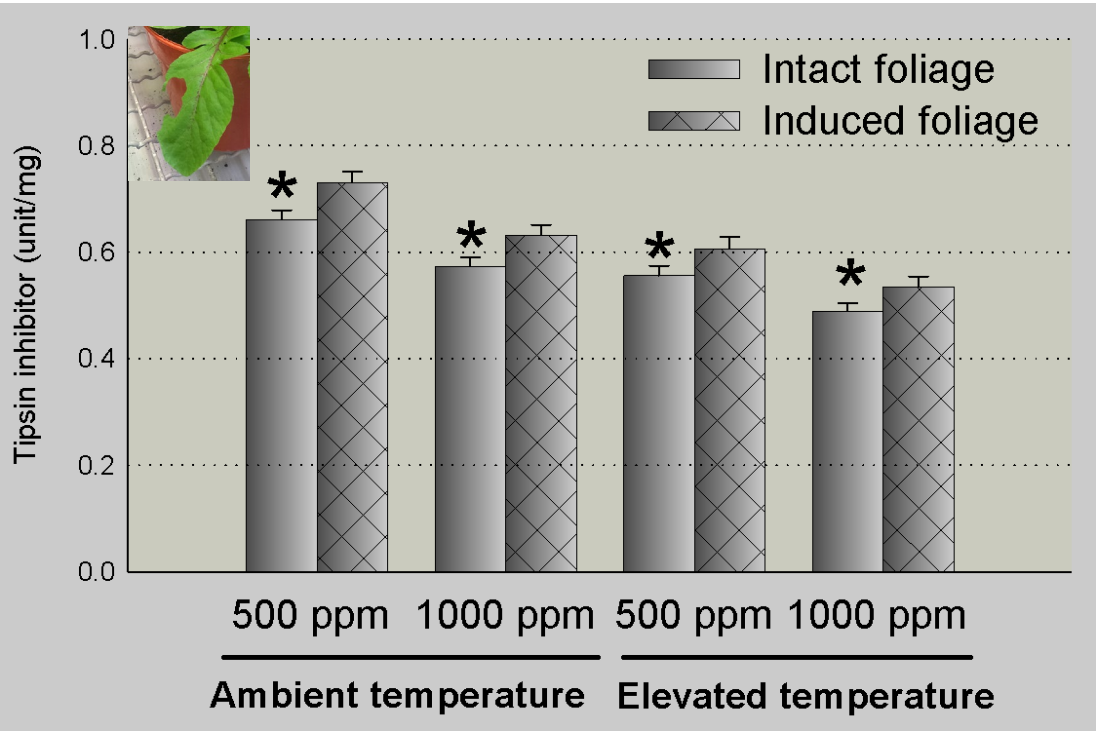
Secondary metabolism
(defensive compounds)

- Tripsin inhibitor (TI)
- Polyphenol oxidase (PPO)
- Peroxise (POD)
- Total phenolic compounds









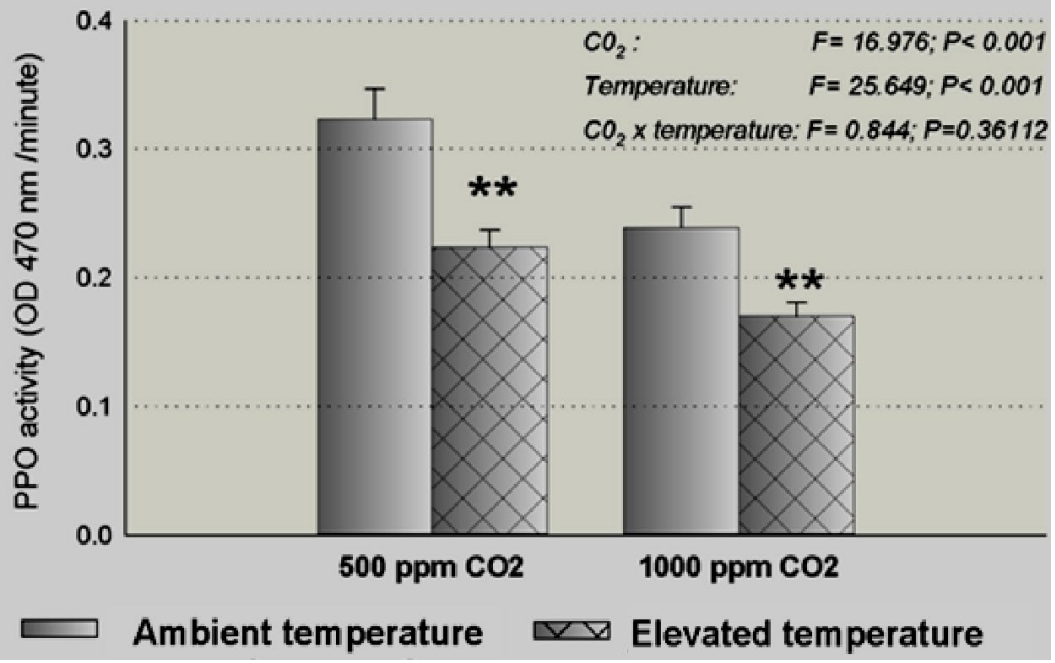
Tripsin inhibitor

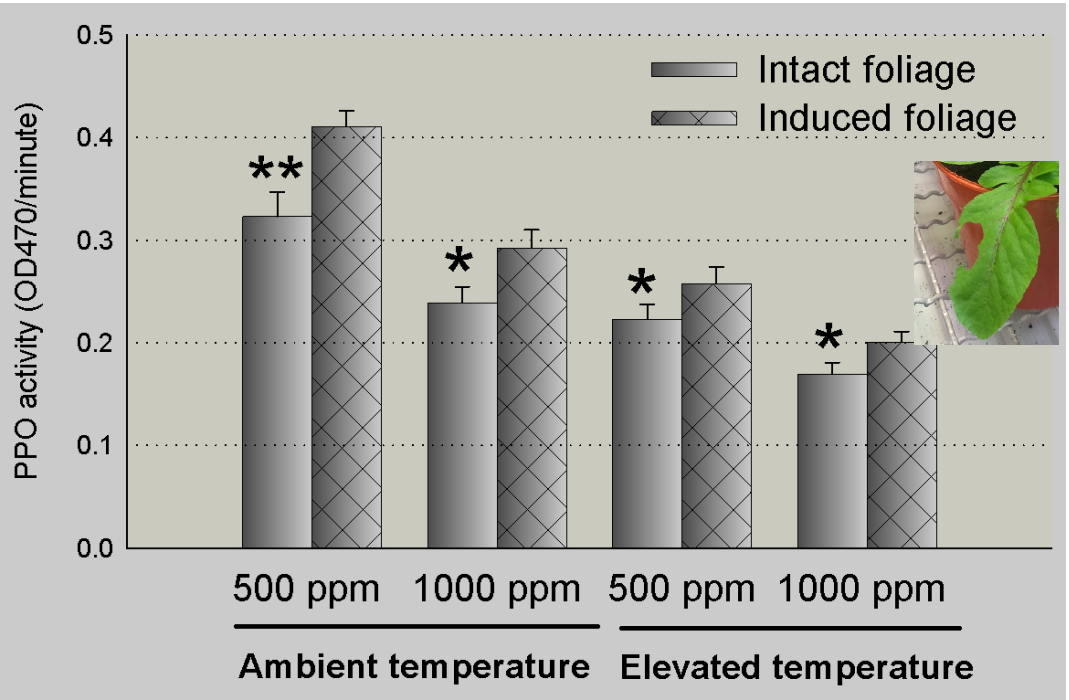
1. Elevated temp: **Decrease 13.28 %**
2. Elevated CO_2: **Decrease 15.91 %**
3. Elevated CO_2-Elevated temp: **Decrease 26.14 %**

Reduce the tripsin inhibitor activity

Herbivorous induced-responds

Increasing 9.78 %





Polyphenol oxidase (PPO)

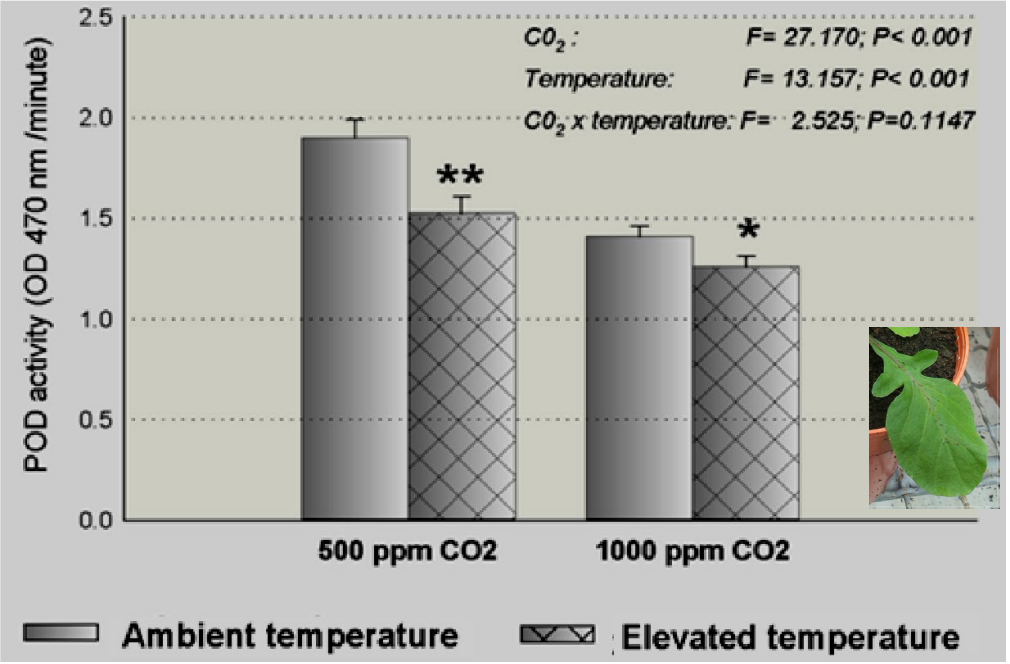
1. Elevated temp: **Decrease 26.01 %**
2. Elevated CO_2: **Decrease 30.88 %**
3. Elevated CO_2-Elevated temp: **Decrease 47.41 %**

Reduce the PPO inhibitor activity

Herbivorous induced-responds

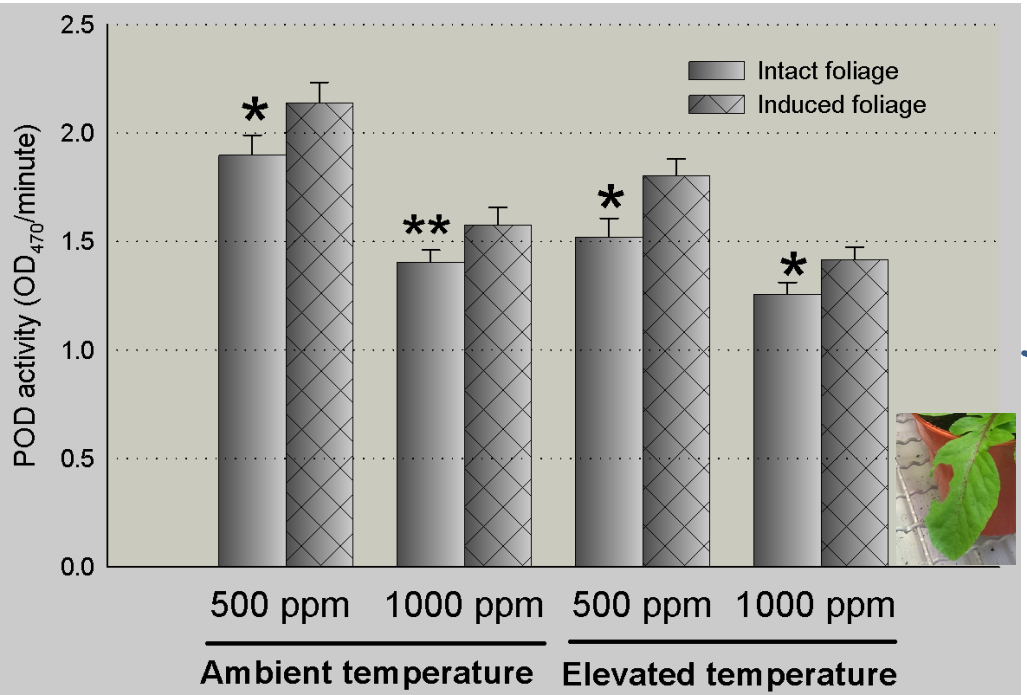
Increasing 20.76 %

Peroxise (POD)



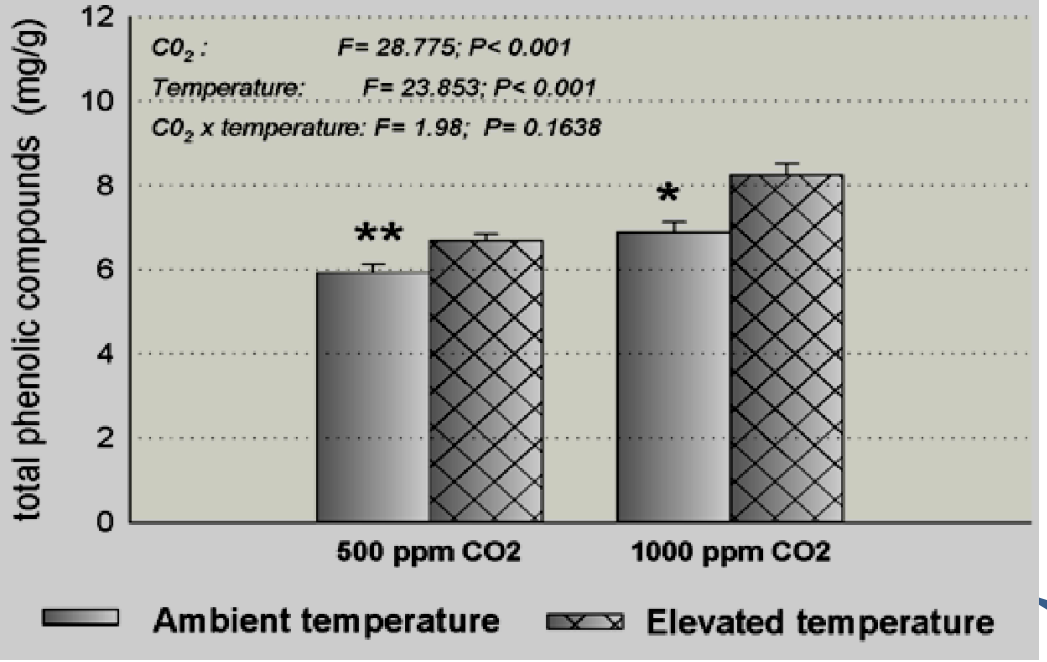
1. Elevated temp: **Decrease 25.93 %**
2. Elevated CO_2: **Decrease 19.88 %**
3. Elevated CO_2-Elevated temp: **Decrease 33.71 %**

Reduce the POD activity



Herbivorous induced-responds

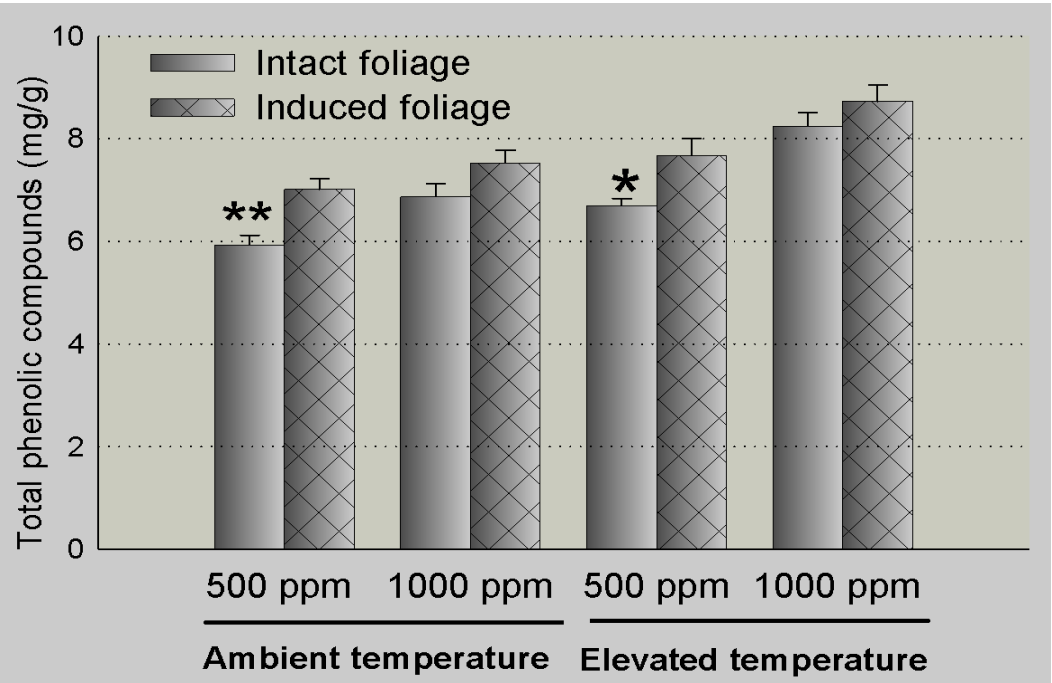
Increasing 13.96 % activity



Total phenolic compounds

1. Elevated temp: **Increase 15.91 %**
2. Elevated CO_2: **Increase 12.81 %**
3. Elevated CO_2-Elevated temp: **Increase 39.09 %**

Increase total phenolic compounds



Herbivorous induced-responds

Increasing 12.05 % phenolic compounds

Conclusion

Increasing

1. CO_2 concentration (500ppm to **1000** ppm)
2. Temperature (24^0C to **29^0**C)

Primary compounds

- Nitrogen content
- Increasing carbohydrate (sugar + starch)

Secondary/defensive compounds

- Tripsin inhibitor
- Polyphenol oxydase (PPO)
- Peroxise
- Phenolic compounds
- Glucosinolate

Anti-digestion strategy

Direct metabolism target

Relative growth rate

Thanks you for attention

Thanks you for attention