Exploring combined stress incited disease dynamics of chickpea x dry root rot interaction

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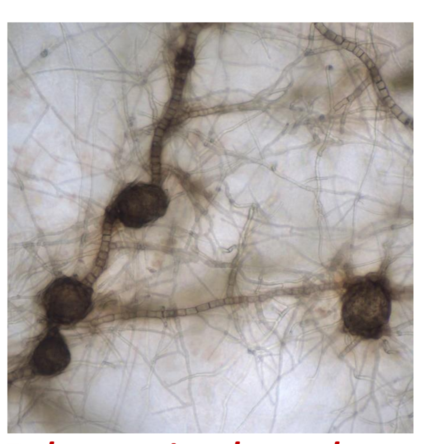
Background

The incidence of dry root rot (DRR) caused by *Rhizoctonia bataticola* (Taub.) Butler (Rb) [Syn: *Macrophomina phaseolina* (Tassi.) Goid] is very high towards later stages of the crop, which incidentally in the semi-arid tropics, coincides with higher atmospheric and soil temperatures and a decrease in soil moisture content. In the near future, increase in average temperature and inconsistent rainfall patterns resultant of changing climatic scenario is strongly believed to exacerbate the disease to epidemic proportions. The present study aims to quantify the collective role of temperature and soil moisture on disease progression in chickpea under simulated environmental conditions.

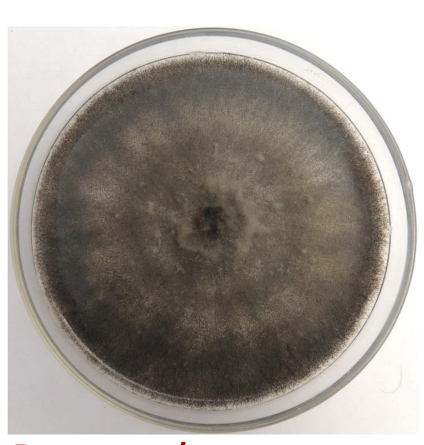
A DRR infested chickpea field

Controlled environmental setup

1. Development of sick soil



R.bataticola sclerotia



Pure culture

Mass multiplication

Inoculum mixing

2. Soil moisture condition (SMC) – 60% and 80%
3. Plant growth chambers (PGC) of Conviron having gradients for temperature and relative humidity (RH) - Controlled environment research facility (CERF), ICRISAT.

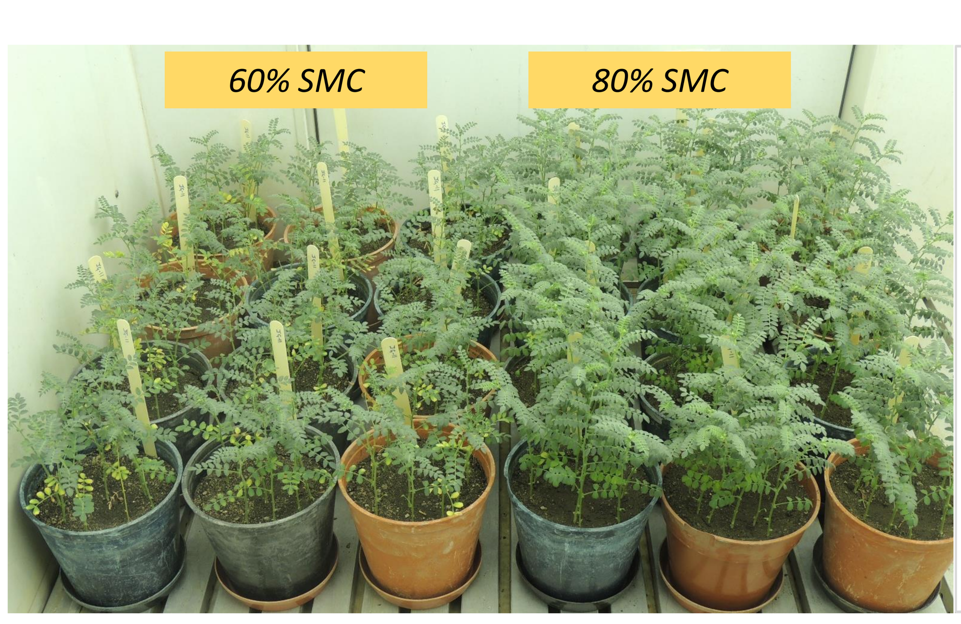
Conviron Plant Growth Chamber

Time	PGC 1 Temp (°C)	PGC 1 RH (%)	PGC 2 Temp (°C)	PGC 2 RH (%)
00.00	22	60	12	60
06.00	25	60	18	60
10.00	30	50	22	60
12.00	35	50	25	60
15.00	30	50	22	60
18.00	26	60	18	60
23.59	22	60	12	60

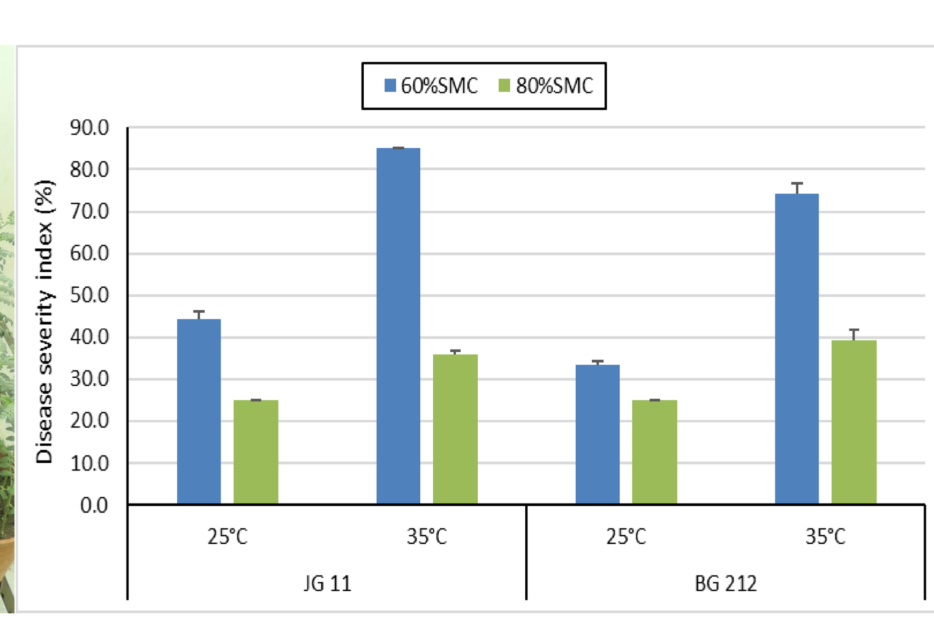
Gradients set in PGC

Results

- ❖ A high positive correlation (R^2= 0.68) was found between disease severity and temperature
- ❖ The disease severity showed high negative correlation (R^2= -0.71) with SMC
- ❖ A significant reduction in root dry weight was also observed in infected plants

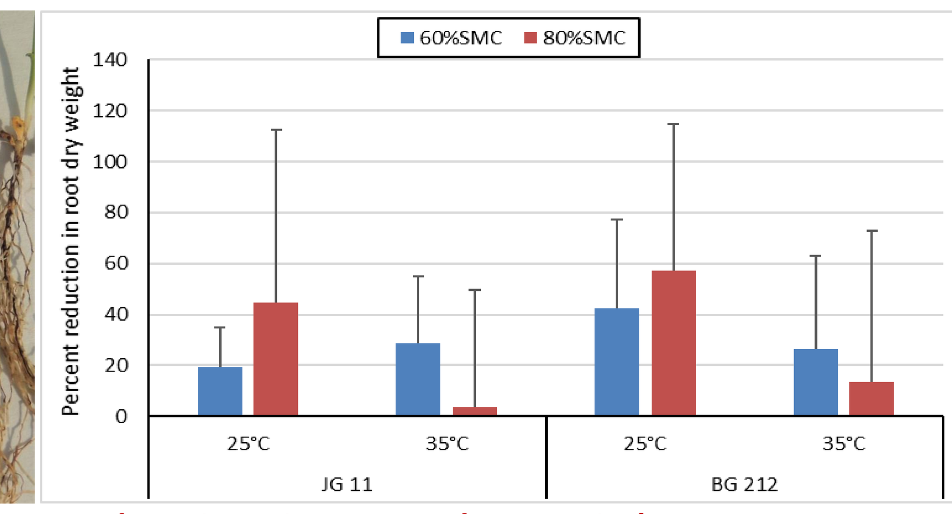


Foliar symptoms of DRR at 28 DAS



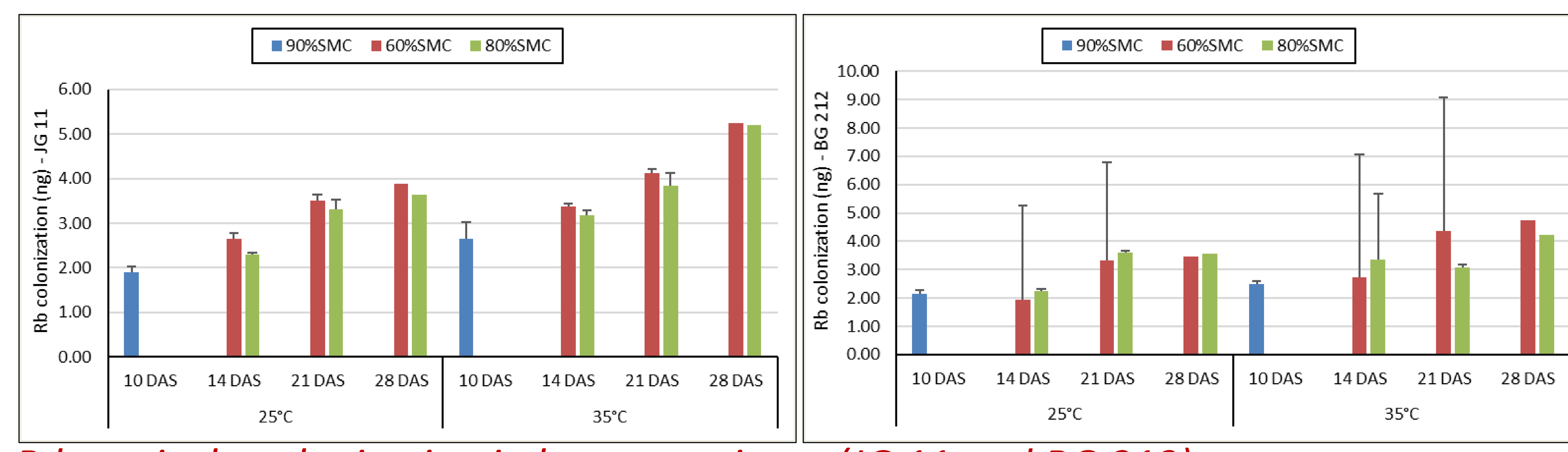
Disease severity index

Root symptoms of DRR at 28 DAS

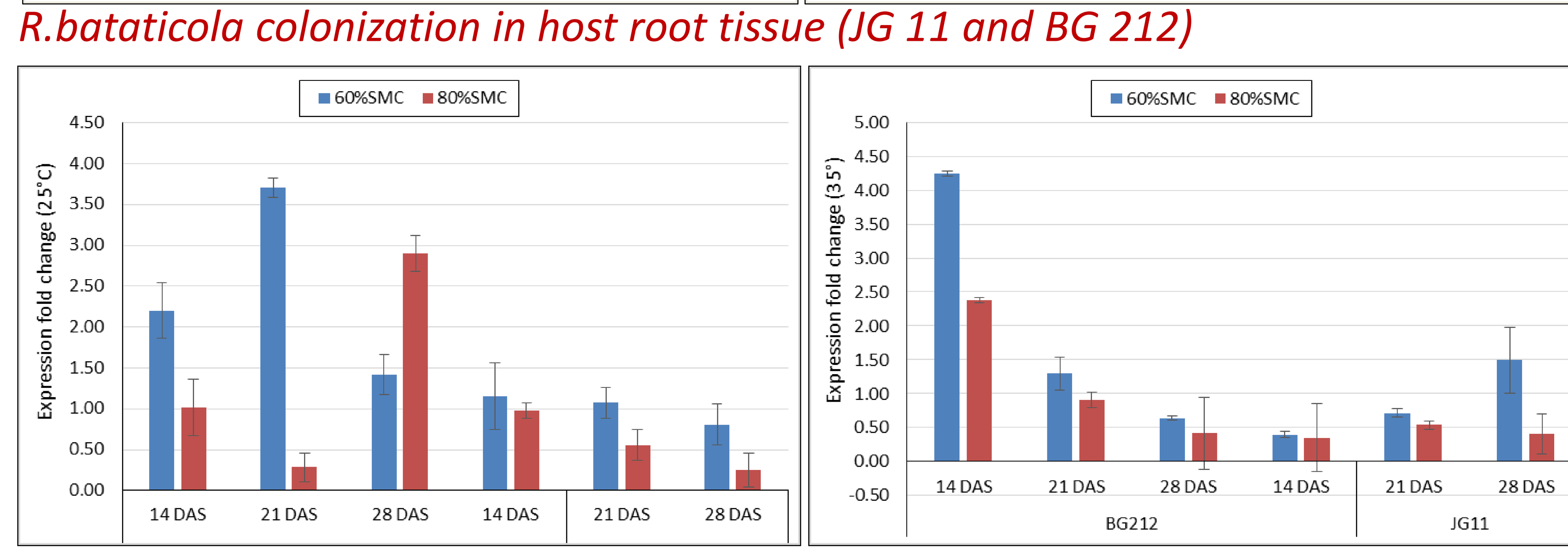


Reduction in root dry weight

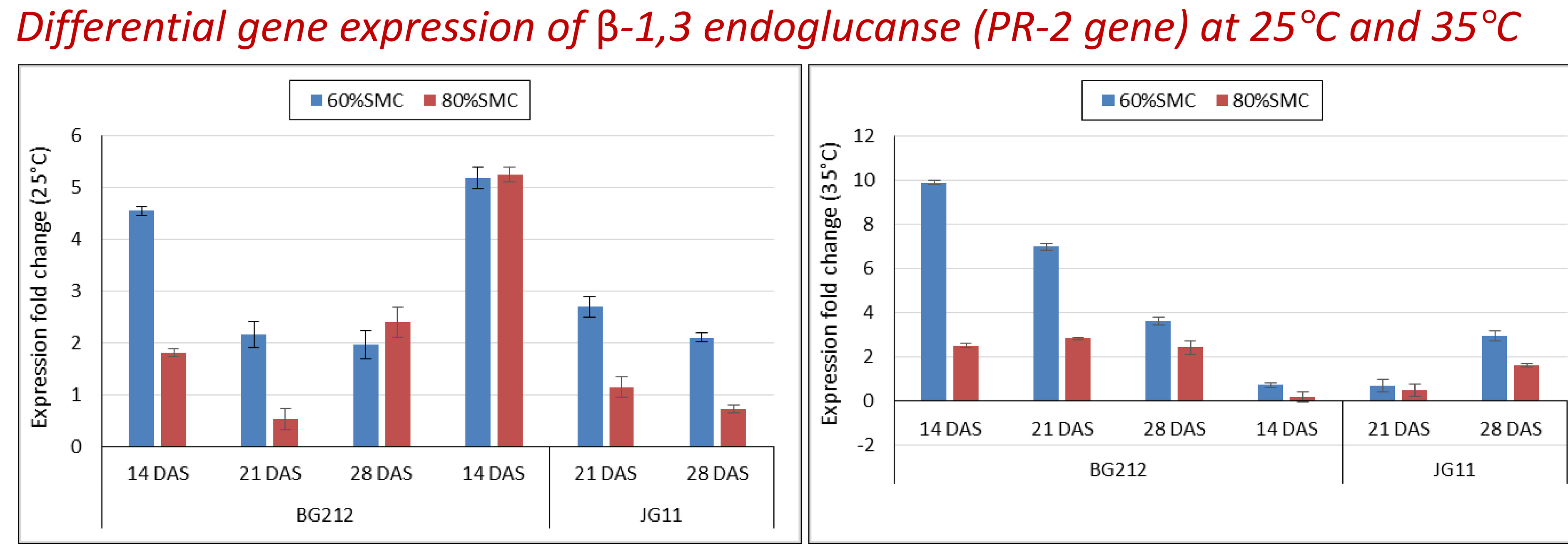
- ❖ Rb colonization was observed to increase with increasing time points in both cultivars
- ❖ Colonization of Rb was realized in both cultivars irrespective of temperature and SMC
- ❖ Pathogenesis-related (PR) genes responded with significant difference under different temperatures and soil moisture



R.bataticola colonization in host root tissue (JG 11 and BG 212)



Differential gene expression of β-1,3 endoglucanse (PR-2 gene) at 25°C and 35°C



Differential gene expression of chitinase, CH III (PR-3 type) at 25°C and 35°C

Conclusion

- ❖ As evident from the disease severity index, a high temperature and low soil moisture plays a crucial role in pre-disposing chickpea to DRR
- ❖ Since Rb colonization occurred at all the temperatures and soil moisture range tested, it is to be assumed that regulation of different PR genes is responsible for the differential expression of disease symptoms
- ❖ Climate change incited disease epidemic scenario is possible in near future due to the nature of disease dynamics. Hence, further studies in patho-genomics and transcriptomics is necessary

Acknowledgment

The authors are thankful to the SPLICE- Climate Change programme under DST Govt. of India, and CRP- GLDC for partial funding support to conduct the study