



## Physiological and yield responses to drought of different cocoa genotypes in Ivory Coast

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**In West Africa**, climate change scenarios predict more intensified droughts, which may threaten crop yield. In cocoa, yield variability depends on climatic variability and the soil moisture regime (Gateau-Rey et al., 2018; Zuidema et al., 2005). Predictions of yield responses to climatic variation require a basic understanding of cocoa yield components under environmental stress. This study aimed to establish this understanding by quantifying relationships between physiological, morphological, yield and bean traits of different cocoa genotypes.

**Keyword:** yield, bean traits, physiology, cocoa

### Aim

This study aimed to assess the effects of water deficit, genotypes and their interaction on cocoa yield and beans traits of different cocoa genotypes.

### Research questions

1. How do different genotypes respond to water deficit in terms of yield and bean traits?
2. Is there a relationship between physiological traits, yield and bean traits?

### Methods

The experiment was conducted at the Nestlé Research station in Zambakro. Planting material was produced through somatic embryogenesis. Trees of six genotypes were planted in 2012: five clones (CI 07, CI 14, CI 01, CI 02, CI 03), and one hybrid (M), which are regularly distributed to farmers in Côte d'Ivoire.

The experiment was set up as a split-plot randomized design with blocks with irrigation as treatment. We measured physiological traits (specific leaf area, SLA; leaf area index, LAI; leaf water potential, PLWP-MLWP) and yield and bean traits. We assessed:

1. The effect of water deficit on yield traits and bean traits
2. The relationship between physiological responses, and bean and yield traits (under water deficit)

### Results

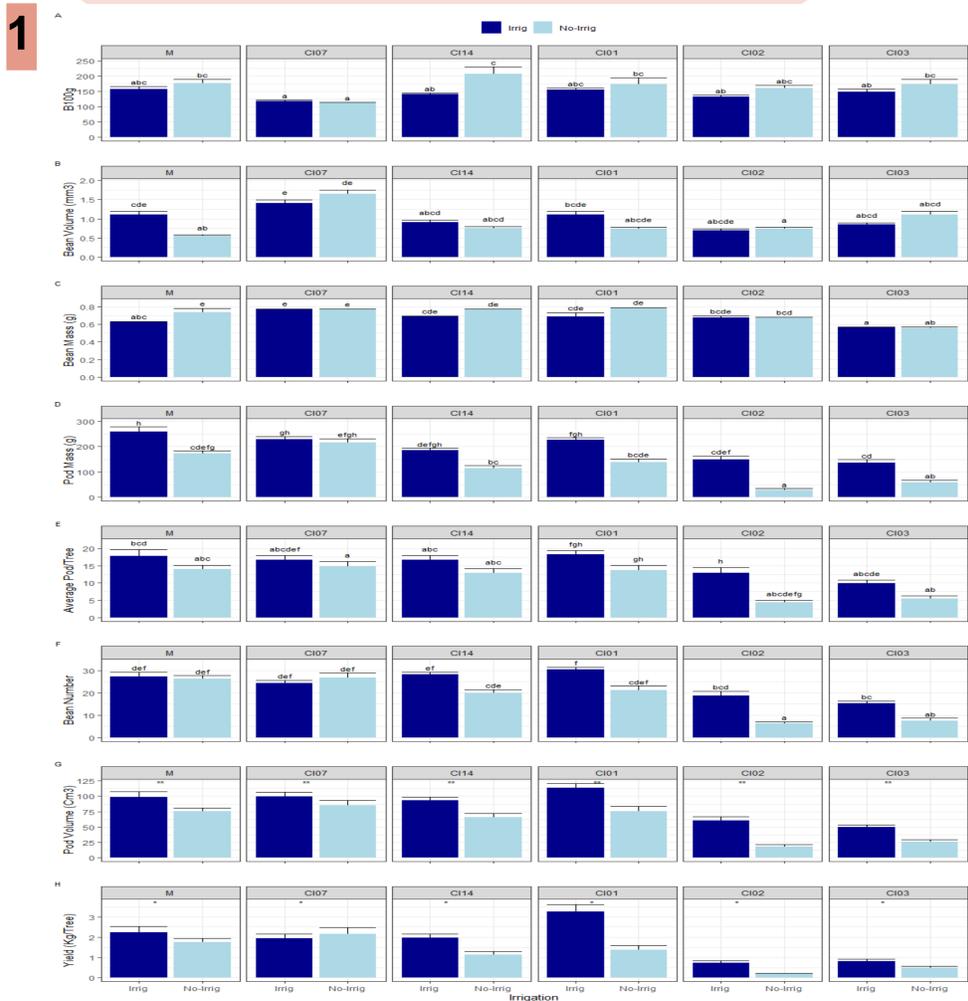


Figure 1 Effects of irrigation on average cocoa bean and yield traits: A) number of bean in 100g B) bean volume C) bean mass D) pod mass E) number of pod recorded per tree F) number of bean per pod per tree G) pod volume H) yield per trees. Errors bars represent to standard errors. Genotypes refer to five clonal varieties CI07, CI14, CI01, CI02, CI03 and one hybrid variety M.\*\*\* shows significant effect of genotypes or irrigation \*\*\*\* shows significant effect of genotypes and irrigation. Different letters indicate significant differences based on Tukey HSD posthoc tests.

### Are there genotype-specific responses to water deficit?

- ✓ Pod volume and yield decreased in response to water deficit
- ✓ Generally, bean traits did not change in response to water deficit
- ✓ Genotypes CI 02 and CI 03 were less drought tolerant

### 2

### Can the physiological traits predict bean size?

- ❖ LWP was significantly and negatively related to bean mass, positively related to bean volume and positively related to the number of beans in 100g.
- ❖ Gs was positively related to bean mass and beans in 100g.
- ❖ LAI was significantly and positively related to the number of beans in 100g, bean mass and negatively related to bean volume.

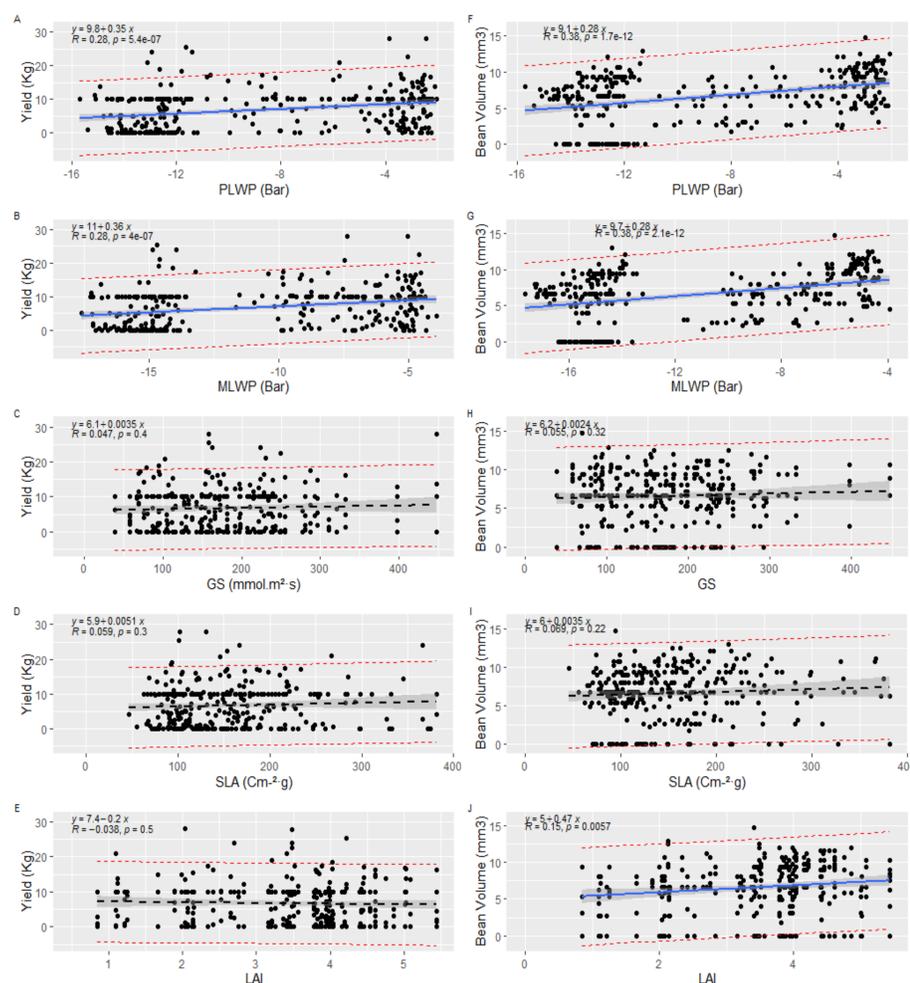


Figure 2 Linear regression plots of relationships between Yield (kg) and bean volume (mm<sup>3</sup>), and physiological traits PLWP (Bar), MLWP (Bar), GS (mmol.m<sup>-2</sup>.s), SLA (cm<sup>2</sup>/g), LAI. Blue lines show significant relationships while dashed black lines show no-significant relationships.

### Can the physiological traits predict yield trait responses?

- ❖ LWP was significantly and positively related to yield, pod count and pod mass.
- ❖ LAI was significantly and positively related to pod traits and yield and negatively related to pod index.
- ❖ Bean volume was significantly and positively related to LWP and LAI.

### Conclusions and implications

- ❖ Drought led to a lower yield, and smaller pods, which translates into reduced income for farmers.
- ❖ LWP and LAI were positively related to yield and bean volume
- ❖ Thus, physiological traits might be used as screening criteria for breeding efforts.
- ❖ Response to water deficit were genotype-specific; CI 02 and CI 03 were less drought tolerant
- ❖ Low yield as a result of water deficit implies low income for farmers' livelihoods

### References

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