

Transforming Early Growth of Cruciferous Vegetables with Biochar

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INTRODUCTION & AIM

Agriculture in coastal Bangladesh is challenged by saline soils, nutrient deficiencies, and climatic stresses. Cruciferous vegetables like broccoli (*Brassica oleracea* var. *italica*) and cauliflower (*B. oleracea* var. *botrytis*) are key to local nutrition and income but perform poorly in degraded soils.

Biochar, a carbon-rich by-product of biomass pyrolysis, can improve soil fertility, water retention, and stress tolerance. However, its influence on early growth of crucifers in saline coastal soils remains underexplored.

Our aim was to evaluate the effect of maize straw biochar on the early growth performance of broccoli and cauliflower, identifying which crop responds more favorably under coastal conditions.

METHOD

Site & Period:

NSTU Agricultural Field, Sonapur, Bangladesh (22.79°N, 91.10°E);

Climate & Soil:

Tropical (Aw); 12.6–32°C; rainfall 2218 mm. Sandy loam soil (pH 7.4, OC 1.37%, OM 2.36%).

Crops & Design:

Broccoli (cv. *Barbara*) and Cauliflower (cv. *Snow White*); RCBD with 3 replications. Biochar: 0, 2, 4, 6, 8 t ha⁻¹ from CCDB, Manikgonj, Bangladesh.

Plot sizes: Broccoli 1.36 m²; Cauliflower 1.92 m².

Each plot: six seedlings (total = 90 plants).

Crop Care:

Seedlings were transplanted after soil incorporation of biochar (8 days prior). Standard NPK fertilizers were applied. Routine weeding, irrigation, and pest management were performed as needed.

Measurements:

Plant height, leaf number, and breadth at 15 & 35 DAT (3 plants/plot).

Analysis:

All data analysis and graphing were performed in R. Two-way ANOVA was used to assess effects of crop type and biochar, followed by Tukey's HSD ($p < 0.05$). Results are presented as mean $\pm$ SEM.

RESULTS & DISCUSSION

Results

The ANOVA revealed significant effects of crop type and biochar application on early growth parameters of broccoli and cauliflower under coastal conditions.

Plant Height

At 15 DAT, crop type significantly influenced plant height ($F = 52.43$, $p < 0.001$), while biochar had no immediate effect. By 35 DAT, both crop type ($F = 252.31$, $p < 0.001$) and biochar ($F = 4.89$, $p = 0.007$) became significant, indicating enhanced response over time.

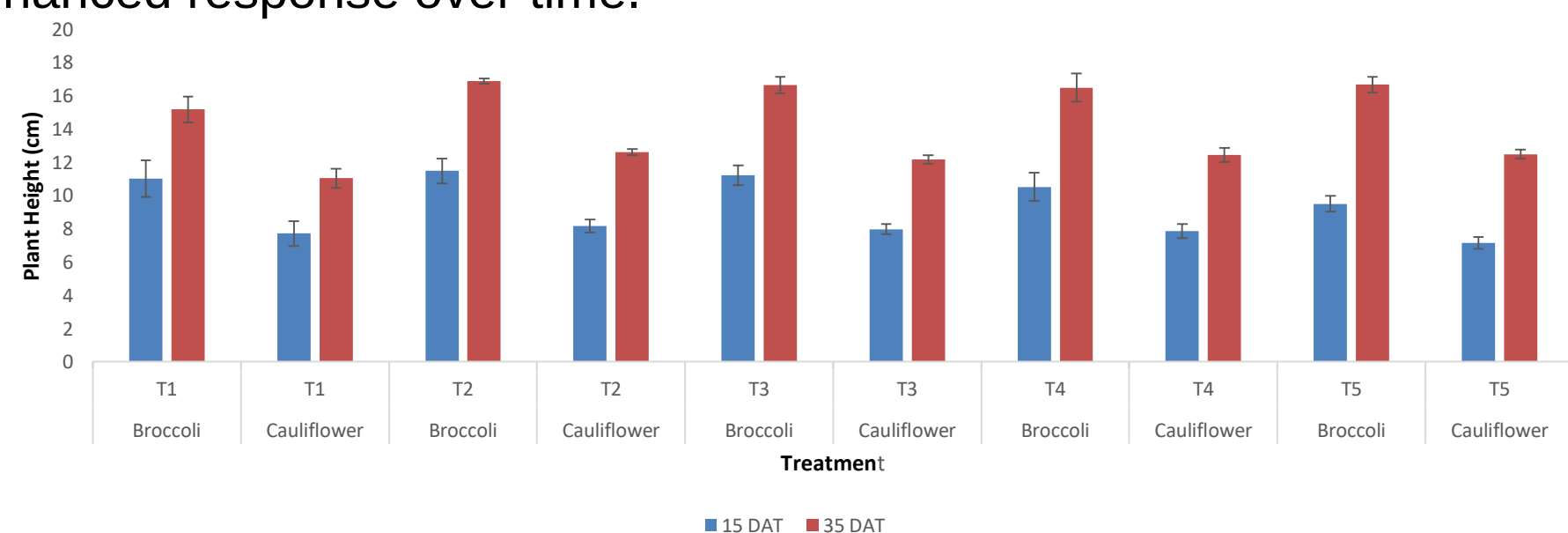


Figure 01: Interaction and effect of maize straw biochar doses on leaf breadth at 15 and 35 DAT. Data are the averages of three replicates $\pm$ SEM (standard error mean).

RESULTS & DISCUSSION

Leaf Number:

At 15 DAT, both crop type ($F = 111.93$, $p < 0.001$) and biochar ($F = 4.37$, $p = 0.011$) influenced leaf development, but biochar's effect was transient and disappeared by 35 DAT ($p = 0.113$).

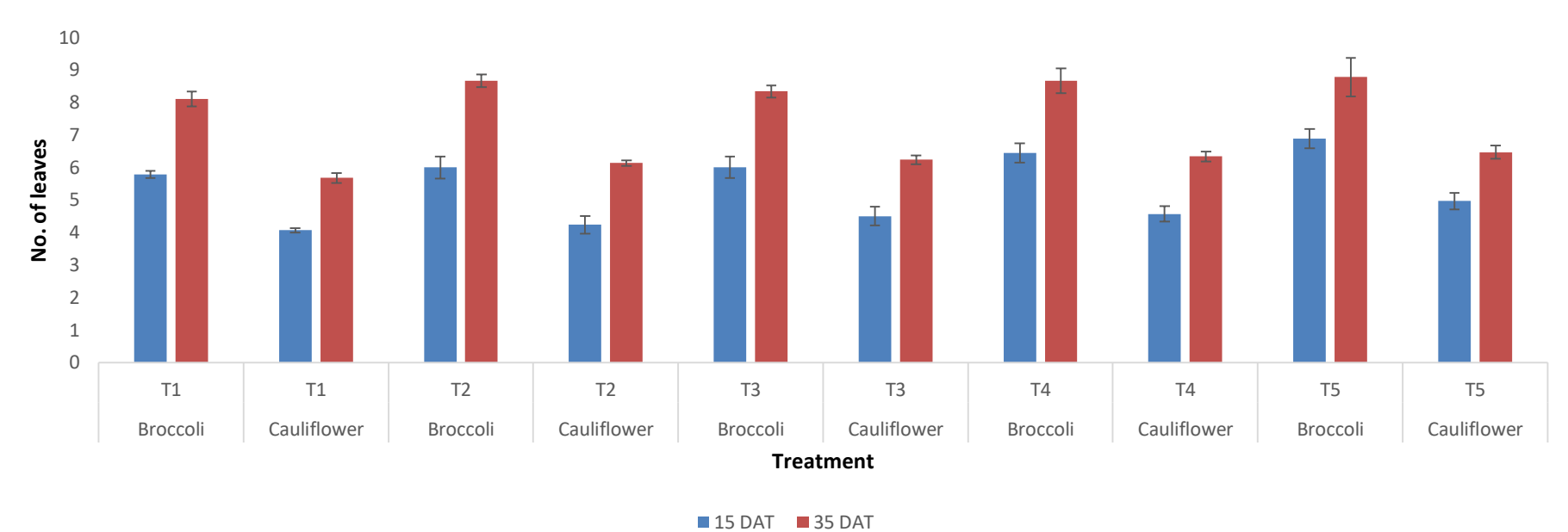


Figure 02: Interaction and of the effect of maize straw biochar doses on leaf number at 15 and 35 DAT. Data are the averages ree replicates $\pm$ SEM (standard error mean).

Leaf Breadth:

Both crop type and biochar significantly affected leaf breadth at 15 DAT and 35 DAT ($p < 0.001$). No interaction effect was observed, suggesting consistent positive responses across both crops.

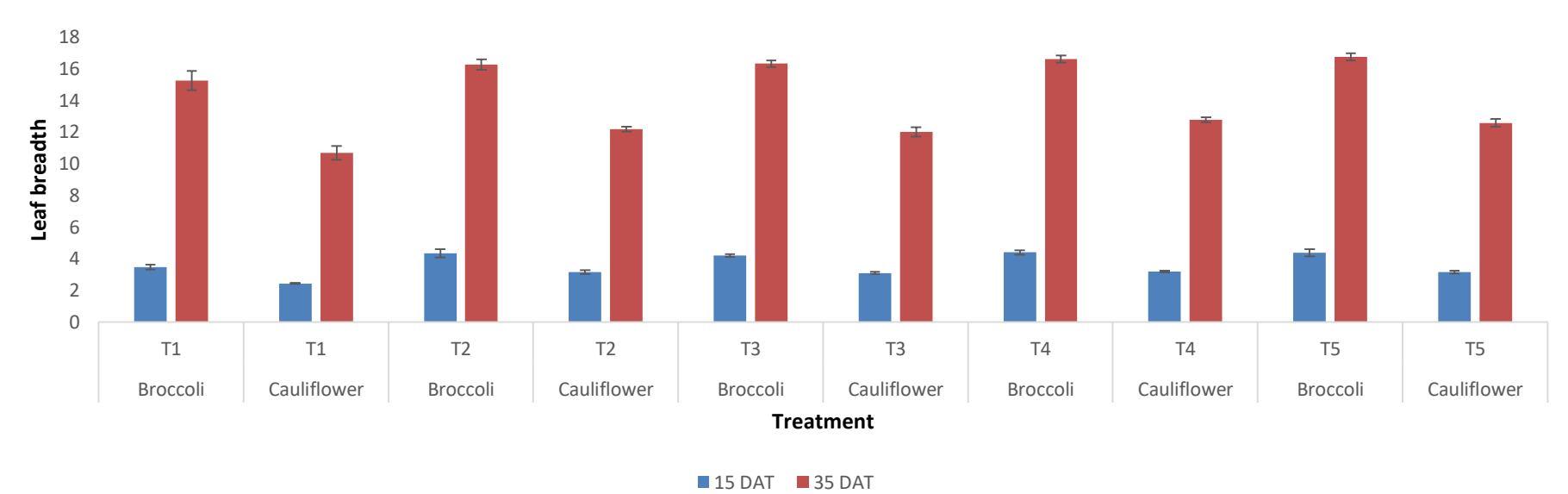


Figure 03: Interaction and effect of maize straw biochar doses on leaf breadth at 15 and 35 DAT. Data are the averages of three replicates $\pm$ SEM (standard error mean).

As a whole, Biochar's effects on early growth were time- and crop-dependent.

- **15 DAT:** Minimal impact on plant height, consistent with Carter et al. (2013).
- **35 DAT:** Positive influence on height observed, aligning with Khadka (2017) and Haque et al. (2019).
- **Leaf number:** Early improvement was transient, supporting Hamad et al. (2017); primarily boosts initial vegetative vigor.
- **Leaf breadth:** Consistently increased across crops, suggesting improved soil–plant interactions and water use.

CONCLUSION

- Biochar can enhance early growth of broccoli and cauliflower under coastal conditions.
- Significant effects observed on leaf number and leaf size; plant height improved mainly by 35 DAT.
- Effects are transient and crop- and timing-dependent.
- Biochar is a promising tool for improving vegetative performance in challenging coastal soils.
- Findings support sustainable agriculture with crop-specific biochar strategies.

FUTURE WORK / REFERENCES

- Assess full-season growth and yield under biochar.
- Study soil nutrient and microbial changes.
- Optimize biochar type and dose for each crop.
- Explore long-term sustainability in coastal farming.