



Induction of water stress tolerance in soybean by multifunctional microorganisms

Embrapa

Arroz e Feijão

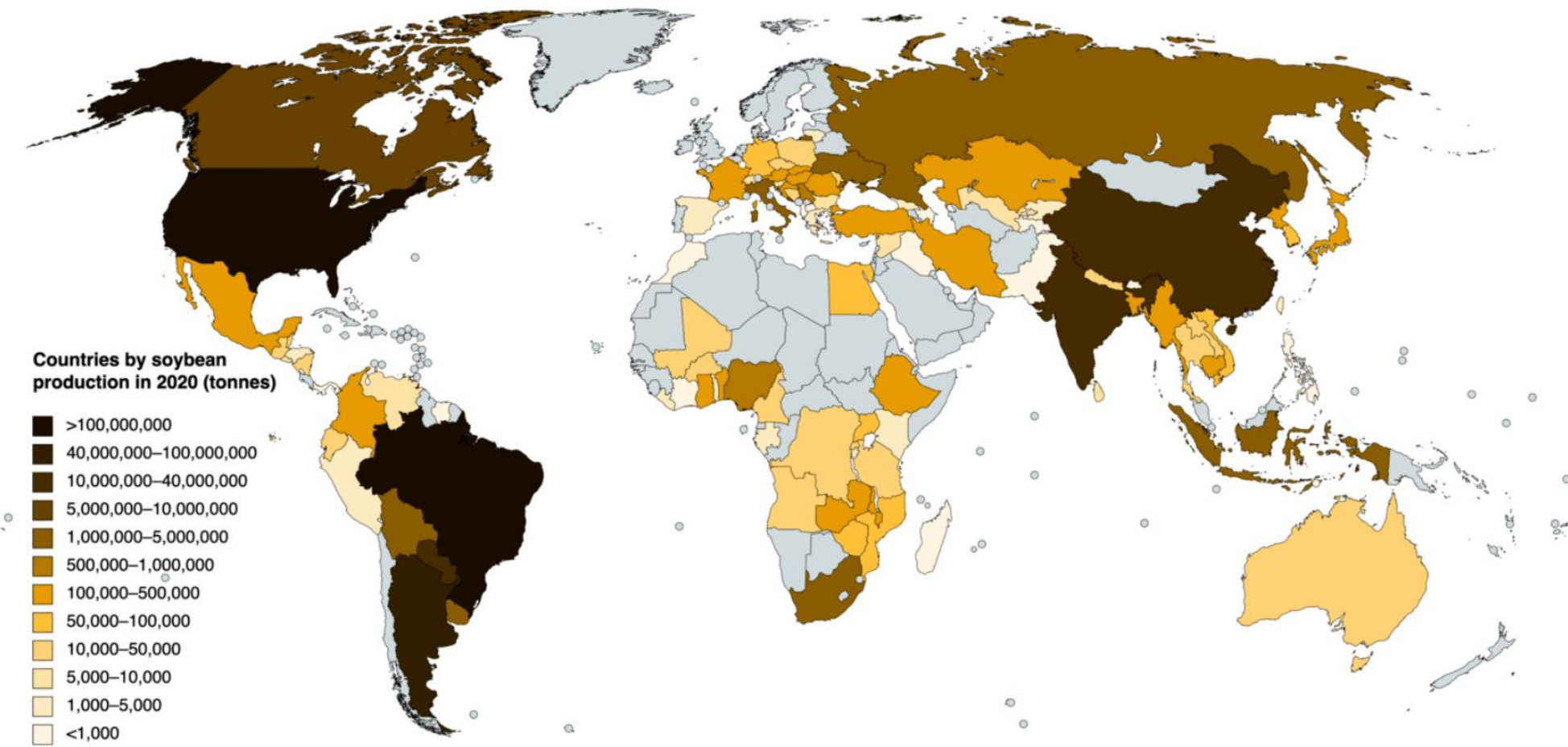
Anderson Ferreira¹, Adriane Wendland¹, Michel Aldrighi²,

¹Brazilian Agricultural Research Corporation (EMBRAPA), National Rice and Beans Research Center (CNPq), Brazil

²Federal University of Goiás, Soil and Water, Brazil

INTRODUCTION

- ✓ Soybean is cultivated all over the world;
- ✓ Brazil is the world's largest producer of soybean;
- ✓ The cropped area with soybean in Brazil has increased by seven times within the last 50 years;
- ✓ Most of the cultivated area is subjected to the occurrence of short periods without rain;
- ✓ Some microorganisms are capable of helping the soybean crop to increase its tolerance to water stress.



| Rank | Country | 2020 | 2019 | 2018 |
|------|---------------|-------------|-------------|-------------|
| 1 | Brazil | 121,797,712 | 114,316,829 | 117,912,450 |
| 2 | United States | 112,549,240 | 96,667,090 | 120,514,490 |
| 3 | Argentina | 48,796,661 | 55,263,891 | 37,787,927 |
| 4 | China | 19,600,000 | 18,100,000 | 15,967,100 |
| 5 | India | 11,226,000 | 13,267,520 | 10,932,970 |
| 6 | Paraguay | 11,024,460 | 8,520,350 | 11,045,971 |
| 7 | Canada | 6,358,500 | 6,145,000 | 7,416,600 |
| 8 | Russia | 4,307,593 | 4,359,956 | 4,026,850 |
| 9 | Bolivia | 2,829,356 | 2,990,845 | 2,942,131 |
| 10 | Ukraine | 2,797,670 | 3,698,710 | 4,460,770 |

Fig 1. Soybean cultivation worldwide, ranking of soybean production by different countries, increasing of the cropped area with soybean in Brazil and, Brazilian areas of water stress occurrence.

METHODS

- ✓ A greenhouse experiment was carried out using different PGPRs and their combinations;
 - ❖ 2 Water stress-inducing isolates (M 163 and BRM 034008);
 - ❖ 2 IAA-producing isolates (Ab-V5 and BRM 063574);
 - ❖ 2 Phosphate-solubilizing isolates (BRM 063573 and BRM 67205).
- ✓ Water stress was applied at flowering for 15 days;
- ✓ Evaluations;
 - ❖ Plant growth (shoot dry mass - SDM, root dry mass - RDM, root length - RL and root surface area);
 - ❖ Gas exchange (internal CO₂ concentration - Ci, transpiration - E, stomatal conductance - gs and photosynthetic rate - A);
 - ❖ Yield components (pod mass - PM, pod number - PN, grain number - GN and grain mass - GM).

RESULTS

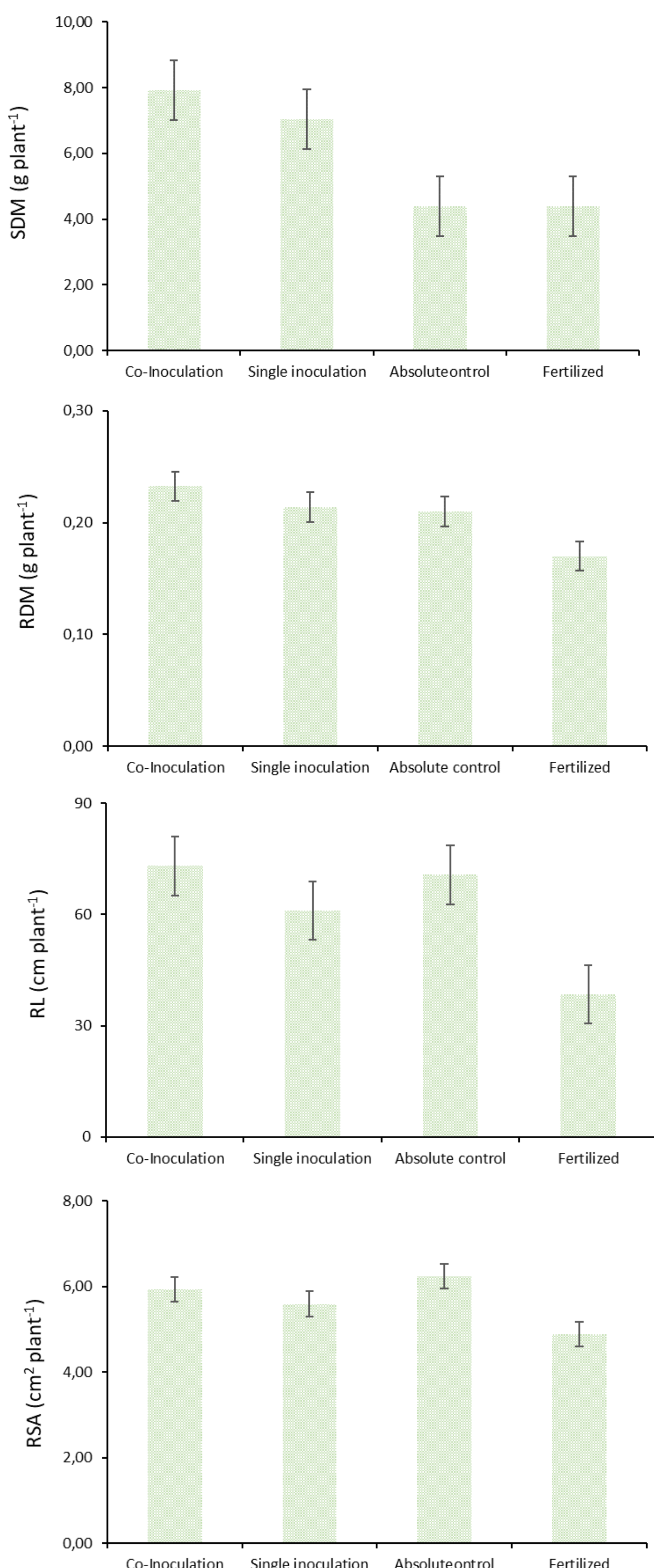


Fig 3. Shoot dry mass (SDM), root dry mass (RDM), root length (RL) and root surface area (RSA) of soybean under different inoculation treatments.

CONCLUSIONS

- ✓ Co-inoculation treatments allowed better growth, physiological performance and productive rates to soybean under water stress conditions;
- ✓ The co-inoculation treatment containing the isolates BRM 063574, BRM 67205, BRM 034008 and Ab-V5 provided greater soybean tolerance to water stress.

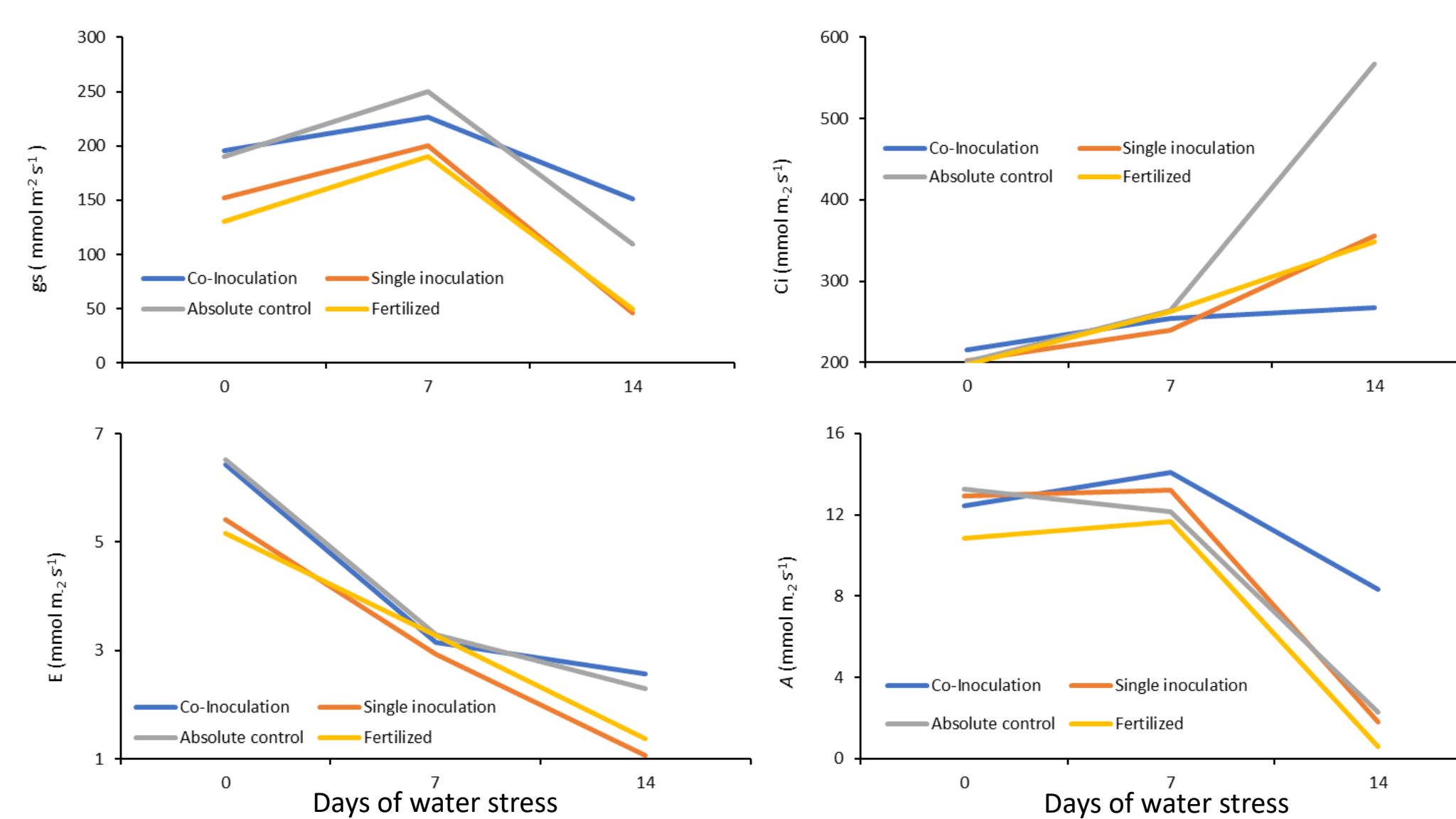


Fig 3. Stomatal conductance (gs), Internal CO₂ concentration (Ci), transpiration (E) and photosynthetic rate (A) of soybean under different inoculation treatments.

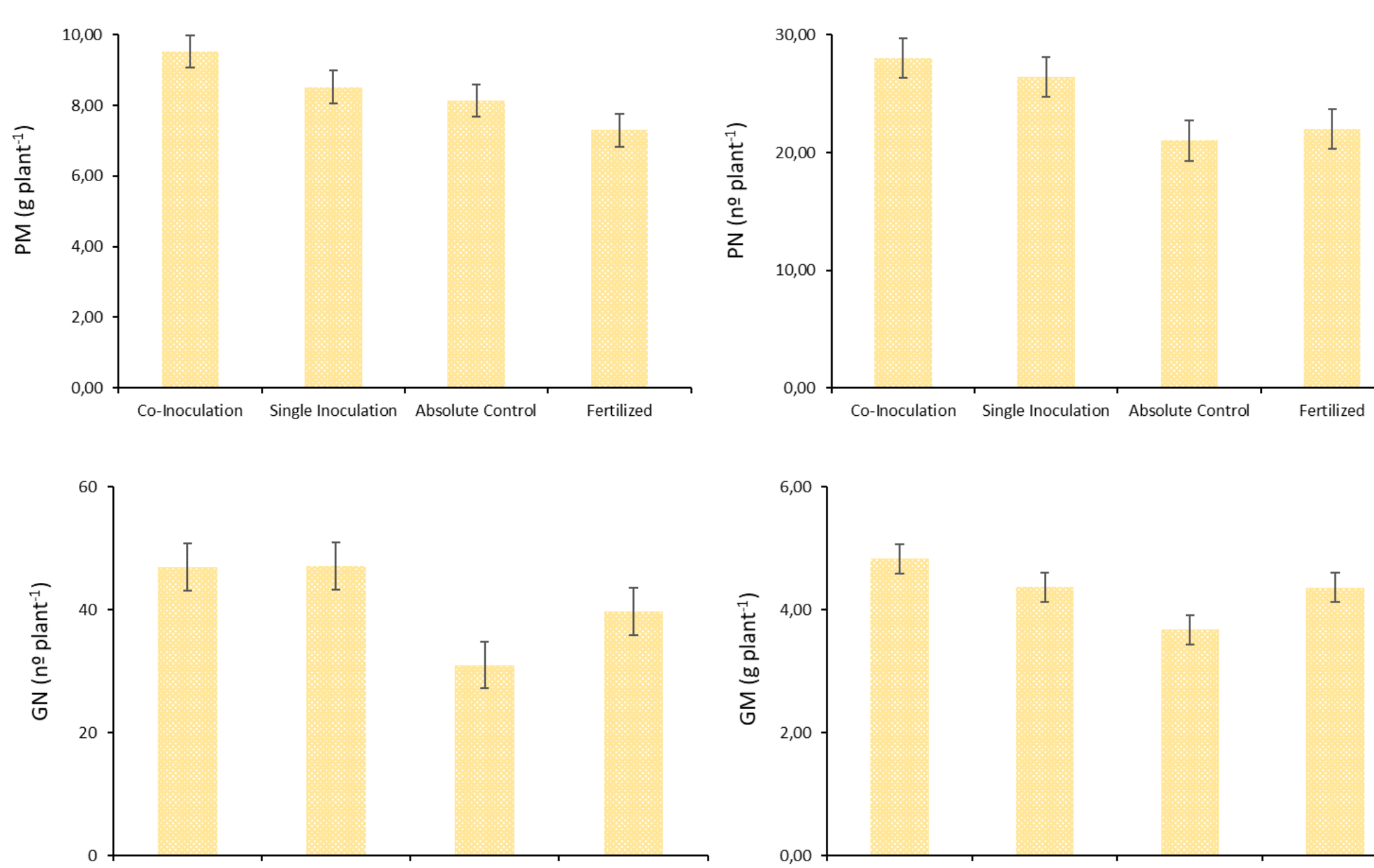


Fig 4. Pod mass (PM), Pod number (PN), Grain number (GN) and Grain mass (GM) of soybean under different inoculation treatments.



Fig 2. View of the greenhouse experiment with soybean cultivated under water stress conditions.

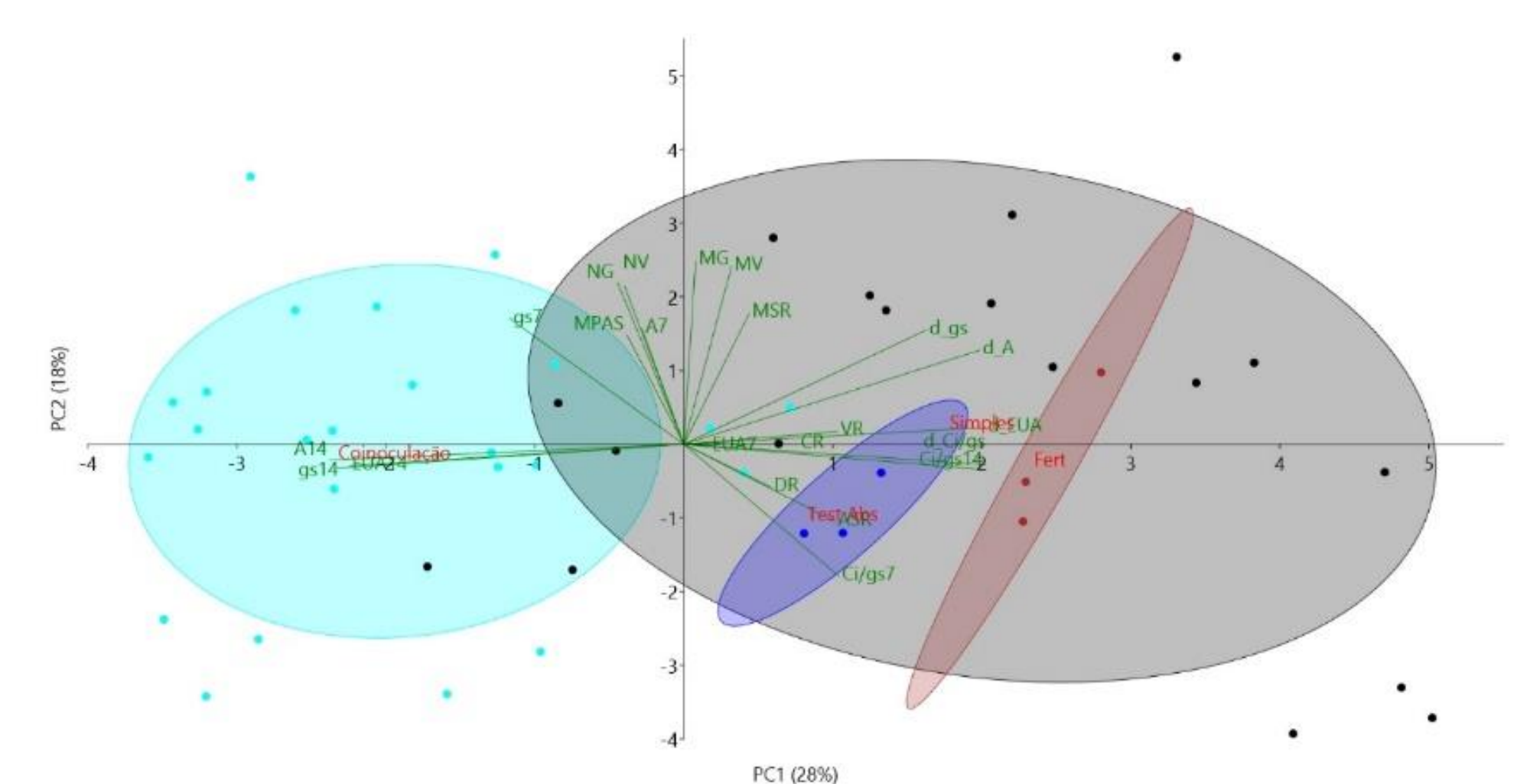


Fig 5. Principal component analysis plot showing the multivariate variation among inoculation treatments in terms of growth, physiological and productivity data of soybean. Vectors indicate the direction and strength of each variable to the overall distribution.