long-term application potential, offering empirical evidence for the long-term impact of SynComs on maize physiology and resilience (Figure 3) (Armanhi et al., 2021).

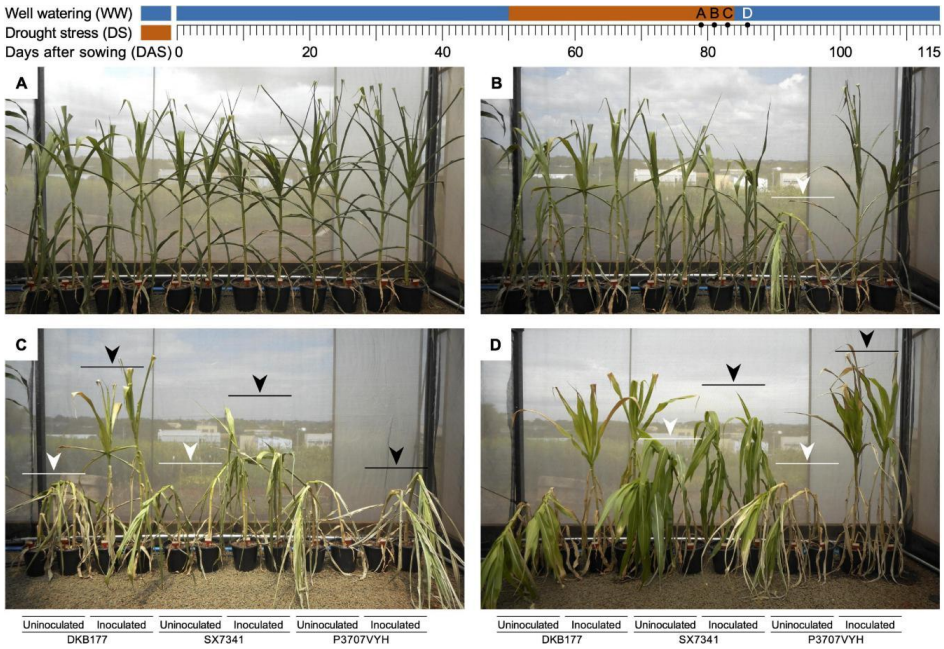

Figure 2 A SynCom containing beneficial microbes induces a physiological response against DS in three commercial maize hybrids (Adopted from Armanhi et al., 2021)

Image caption: (A) Plants kept in SDS for 29 days (79 DAS) had their leaves rolled inward, and older leaves fell for all hybrids, regardless of whether they were inoculated; (B) P3707VYH was the less tolerant hybrid in the absence of SynCom, completely bent after 31 days of SDS (81 DAS), in contrast to the inoculated hybrid (white arrow); (C) Uninoculated DKB177 and SX7341 were completely bent (83 DAS), as shown by the white arrows; In the presence of SynCom, plants were maintained in a straight position (DKB177) and partially or completely bent (SX7341 and P3707VYH, respectively), as shown by the black arrows; (D) Inoculated plants (SX7341 and particularly P3707VYH) straightened 2 days after rewatering (86 DAS; black arrows), while uninoculated plants were not capable of completely recovering their structure (white arrows); WW, well watering; DS, drought stress; DAS, days after sowing; SDS, severe drought stress (Adopted from Armanhi et al., 2021)

The study of Armanhi et al. (2021) demonstrates that SynCom can enhance maize resilience to severe drought conditions by maintaining plant structure and promoting recovery post-stress. The inoculated plants showed better physiological responses, suggesting that SynCom can help mitigate the adverse effects of drought stress, ensuring better plant health and stability. In the long term,, this could lead to more consistent crop yields and reduced susceptibility to extreme weather conditions. By leveraging high-resolution temporal data, the study better understands the dynamic interactions between SynCom and plant physiology under stress conditions, seeing the potential of SynCom in improving overall crop resilience and productivity.

6.4 Lessons learned from specific case studies

The following lessons have been gleaned from specific case studies and long-term field trials of SynCom applications:

1) Importance of Tailored Compositions: Successful SynCom applications often involve tailored compositions that are specifically designed for the target crop and environmental conditions. Functional screening and precise microbial selection are critical for achieving desired outcomes (Yin et al., 2022).

2) Need for Long-Term Monitoring: Short-term benefits of SynComs are well-documented, but long-term monitoring is essential to understand their persistence, stability, and ecological impact. Continuous data collection helps in fine-tuning SynCom applications and mitigating potential risks (Martins et al., 2023).

3) Integrating Multidisciplinary Approaches: Effective SynCom design and application benefit from integrating multidisciplinary approaches, including microbial ecology, plant physiology, genetics, and computational