Salt stress can induce plants to recruit specific root-associated bacterial communities, but long-term salt tolerance is usually provided not by a single strain, but by bacterial consortia with complementary functions (Li et al., 2021). For broomcorn millet, this means future studies should not only search for a single “universal salt-tolerant bacterium.” Instead, synthetic microbial communities should be constructed around highly enriched rhizosphere bacteria of millet. For example, strains with different abilities such as phosphate solubilization, IAA production, antioxidant induction, and extracellular polysaccharide formation can be combined to form compound microbial agents suitable for millet production in saline-alkali soils.

4.3.2 Arbuscular Mycorrhizal Fungi (AMF)

Arbuscular mycorrhizal fungi have special importance in crop adaptation to saline-alkali soils. AMF can expand the root absorption area through fungal hyphae, improve phosphorus uptake efficiency, enhance water utilization, and influence Na^+/K^+ balance and antioxidant enzyme activity. This mechanism is especially important for broomcorn millet because saline-alkali soils are often characterized by low phosphorus availability, poor soil structure, and restricted root absorption. These limitations are difficult to overcome through root function alone.

Liu et al. (2024) analyzed the rhizosphere microbial community structure and metabolic characteristics under broomcorn millet/mung bean intercropping and further examined the relationship between microbial communities and nutrient limitation. Intercropping altered the rhizosphere microbial structures of both crops and affected nutrient utilization status. This indicates that the rhizosphere of broomcorn millet is not fixed, but can be reshaped by planting systems and rhizosphere interactions. Under saline-alkali conditions, coordinated regulation of the rhizosphere using AMF together with nitrogen-fixing microorganisms and phosphate-solubilizing bacteria may become an effective way to improve nutrient uptake and yield stability in broomcorn millet.

In saline-alkali cultivation systems, AMF should not simply be regarded as external additives. Instead, they should be incorporated into a broader “rhizosphere ecological management” framework. Future studies could focus on AMF colonization rates, hyphal density, changes in soil available phosphorus, Na^+/K^+ ratios, and yield performance among different millet varieties in order to identify which genotypes are more suitable for stable symbiosis with AMF.

4.3.3 Endophytic and salt-tolerant microorganisms

Endophytic and salt-tolerant microorganisms are another important potential resource for saline-alkali adaptation in broomcorn millet. Compared with ordinary rhizosphere microorganisms, endophytes can enter internal plant tissues such as roots, stems, and leaves, forming relatively stable colonization relationships within the host. Therefore, they are more likely to provide long-term effects under continuous salt stress. Salt-tolerant endophytes can help plants resist saline-alkali damage by regulating plant hormones, improving antioxidant capacity, promoting osmotic adjustment substance accumulation, enhancing membrane stability, and stimulating root growth.

Salt-tolerant bacteria isolated from saline environments have shown the ability to produce plant growth-promoting substances. Radhakrishnan and Krishnasamy (2024) screened four salt-tolerant bacterial strains and suggested that these microorganisms could be used to promote plant growth and improve soil conditions. Since broomcorn millet is often cultivated on dry, barren, and saline marginal lands, its rhizosphere and endophytic environments are likely to contain microbial resources already adapted to combined stresses.

The saline-alkali tolerance of broomcorn millet should therefore be evaluated not only from the perspective of “plant material,” but also from the perspective of “associated microbial material.” Salt-tolerant millet varieties may possess not only stronger ion homeostasis and antioxidant capacity, but also a greater ability to recruit or maintain salt-tolerant endophytes and rhizosphere microorganisms. In the future, functional strains could be isolated from the rhizosphere and tissues of salt-tolerant materials such as ST47 and tested for their growth-promoting effects on sensitive varieties. This would support the establishment of a “salt-tolerant variety + functional microbial agent” production model for saline-alkali soils.