

Responses of five cowpea (*Vigna unguiculata* L. Walp) varieties to inoculation with five *Rhizobium* strains under semi-controlled conditions in Senegal

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Introduction

Cowpea (*Vigna unguiculata*), the leading grain legume in sub-Saharan Africa, is a strategic food crop due to its high content of protein ($\geq 20\%$), minerals, and vitamins (Avarre et al., 2022). Global cowpea production reaches approximately 8 million tons annually, with a large share concentrated in West Africa (FAOSTAT, 2023).

As a legume, cowpea benefits from the symbiosis with nitrogen fixing bacteria (rhizobium) which naturally improves plant N nutrition and soil fertility (Carsky et al., 2003; Kouame et al., 2020). The success of this symbiosis depends on several factors, including plant varietal diversity, presence of efficient and competitive rhizobium stains in the soil as well as edapho climatic conditions. One way to benefit from this interaction is to inoculate competitive and effective rhizobium strains, adapted to local environment. However, to promote adoption of this practice by farmers, it is essential to identify cowpea variety-rhizobium combinations adapted to agroecological zones where it is cultivated and to develop optimized inoculation protocols.

To achieve these objectives, a primary greenhouse trial was conducted using a selection of rhizobium strains and of cowpea varieties from June 26 to August 27, 2025. The initial greenhouse results allowed comparison of plant growth, nodulation, and nutritional status as estimated by spectrophotometer SPAD across the different variety-strain combinations.

Methodology

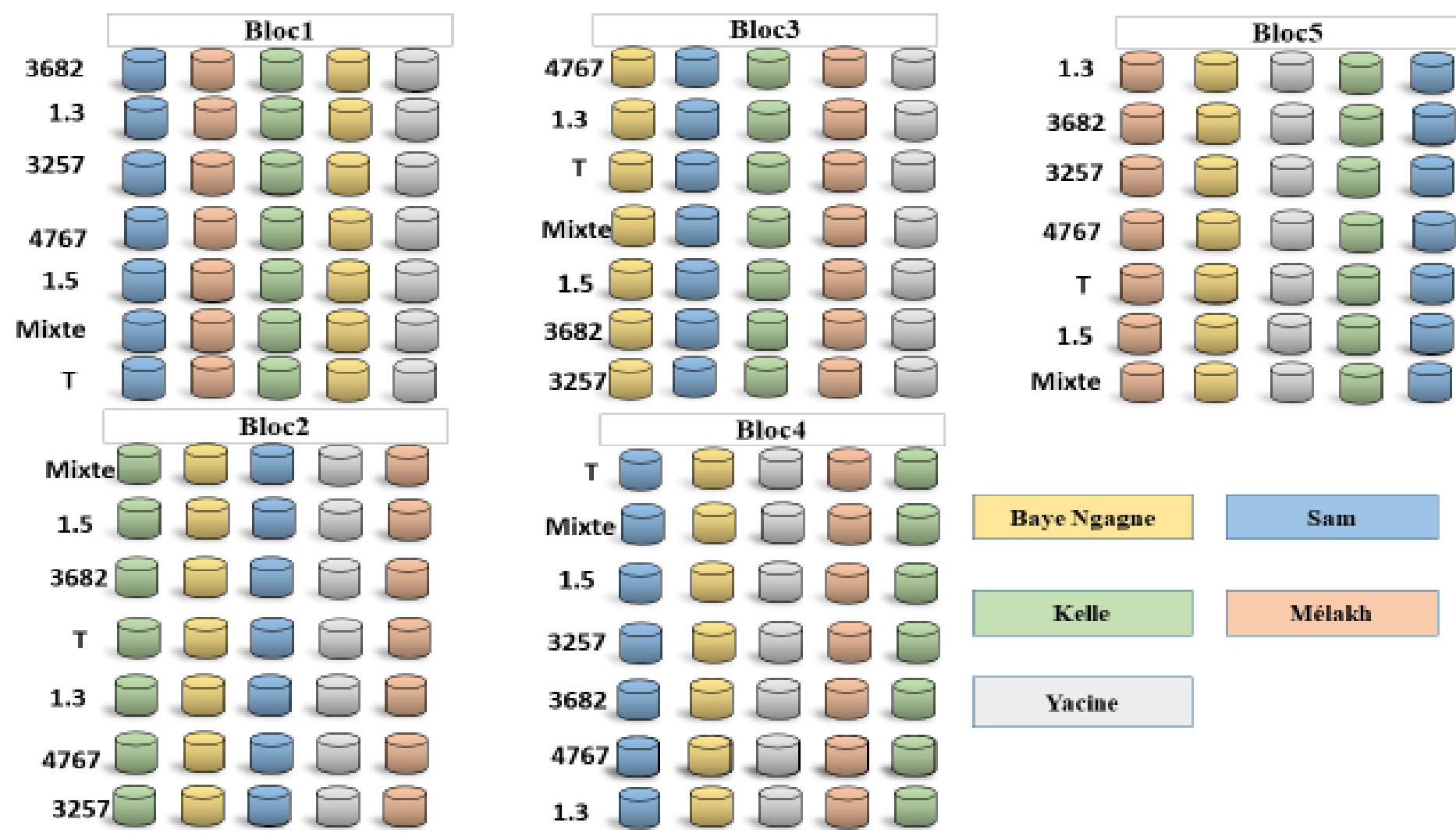
❖ Strains et seeds varieties

Five cowpea varieties (Sam, Mélakh, Yacine, Baye Ngagne, and Kelle), highly valued by farmers for their agronomic traits, were inoculated with five rhizobium strains : LCM3257, LCM3682, LCM4767 (LCM collection) 1.3 and 1.5 isolate). Strains were previously tested under controlled conditions (growth chamber).

❖ Substrate and watering

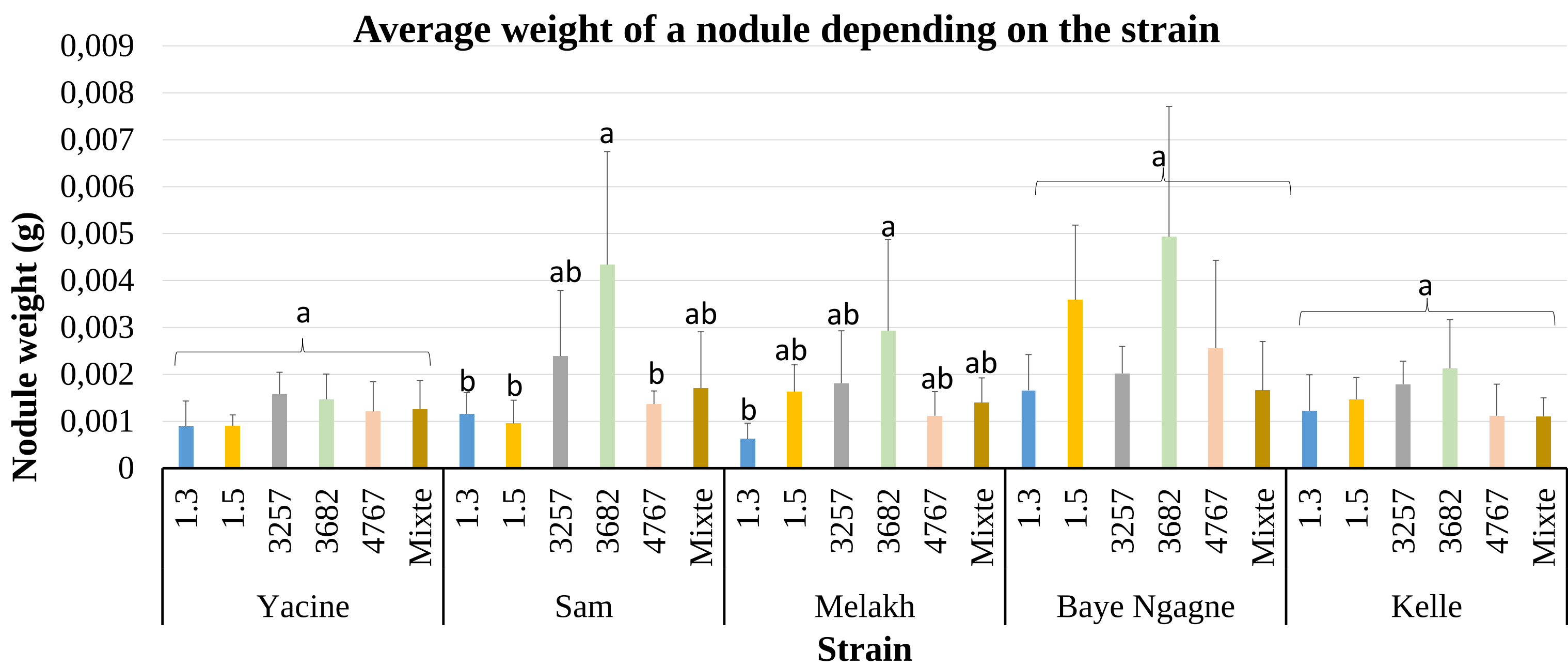
- Compost-based soil used as a growing medium.
- Washed three times in tap water to reduce nitrates, then sterilized (120°C for one hour).
- The plants were grown for two months.

❖ Experimental design



Results

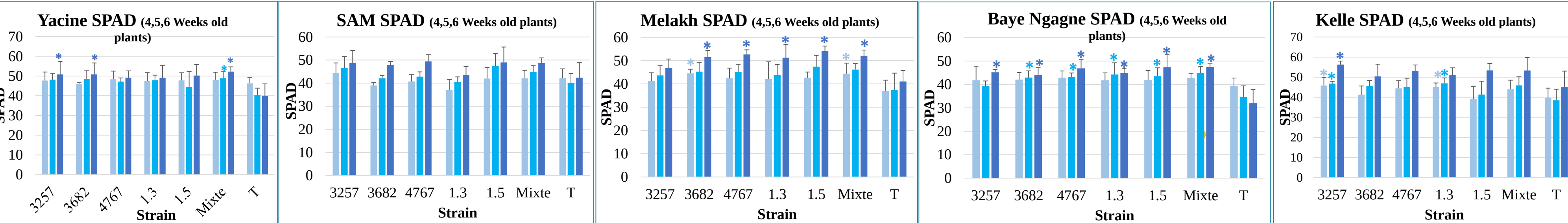
❖ Nodule dry weight



In Yacine, Baye ngagne, and Kelle varieties, no significant differences was noted between the average weights of nodules from different strains.

However, the average weight of a nodule from strain 3682 was significantly higher than those of strains 1.3, 1.5, and 4767 in the Sam and strain 1.3 in the Melakh variety.

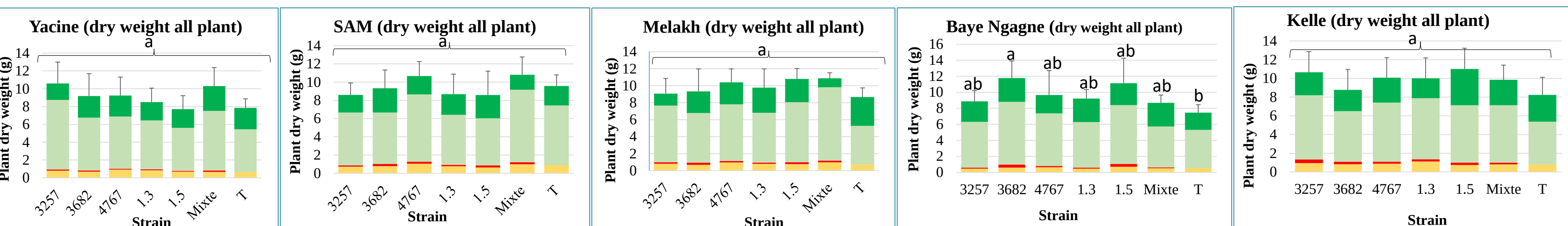
❖ Chlorophyll



* Strains showing chlorophyll content significantly higher than control

4 Weeks 5 Weeks 6 Weeks

❖ Plant dry weight



The results show that varieties react differently to inoculation and depend on the strains inoculated.

In Baye Ngagne variety, plant dry weight of 3682 is significantly higher than the control for total dry weight of the plant.

Conclusion

The overall objective of this trial was to compare the efficiency of strains on cowpea varieties of interest and study host specificity in a semi-controlled greenhouse assay. The results show that varieties react differently to inoculation and depend on the strains inoculated. The results obtained provide further evidences that the cowpea variety and the rhizobium strain can be modulated so as to improve symbiosis efficiency.

However, in order to assess the effects of soil and climate conditions on the inoculation output for selected cowpea and *Bradyrhizobium* genotypes, agronomic trials were launched this summer in 3 agronomical stations with the same treatments in contrasting agroecological zones of Senegal: Bambey (center), Dahra (north), and Nioro (south), representative of the national rainfall gradient. These field assays in agronomic stations will enable us to test whether the environmental conditions alter the association output and have thus to be taken into account for the formulation of inoculum.

Selected cowpea variety-rhizobium associations will later be tested under real field conditions in multilocal assays and include Arbuscular mycorrhizal fungi inoculation and eventually limited amounts of Phosphorus to fully express the nitrogen fixation potential.

References

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