

# Functional traits and cropping system design

## A trait-based characterization as a tool to choose the best coverplants according to a set of services

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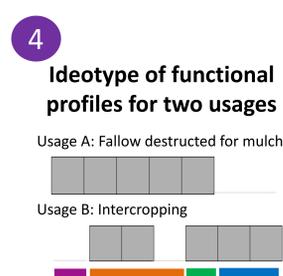
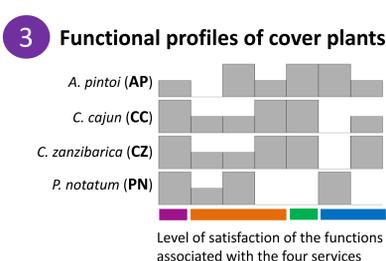
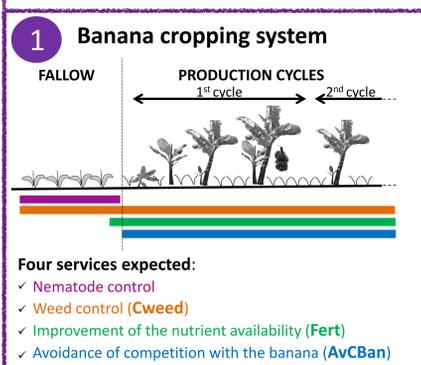
*Crotalaria zanzibarica* © Meynard

- /// The design of sustainable cropping systems based on cover plants requires to choose the best cover plants to deliver a set of services
- /// Tools and methods to assess the potential of plants to deliver these services barely exist
- /// Trait-based approaches, originally developed in the field of comparative functional ecology (Violle 2007, Garnier and Navas 2012), have a strong potential to address these issues

### A trait-based method to choose the best cover plant

#### Based on 5 steps

1. **Analyse of the system:** sequences, bio-physical constraints, services expected
2. Identification of **service-functions-traits relationships** and trait thresholds
3. **Trait-based characterisation** of species - Construction of **functional profiles**
4. Identification of **usages of cover plants** and ideotypes of functional profiles
5. Choice of the best species



Damour et al, 2014

### A validation of the trait-based characterization

#### Materials and Methods

- 2 cover plants tested for the 2 usages (CC and CZ for usage A; AP and PN for usage B)
- Calculation of global notes for the delivery of the services as the mean of the notes of the level of satisfaction of the functions
- Field assessment of the services actually delivered and calculation of synthesized indicators of the services

#### Results

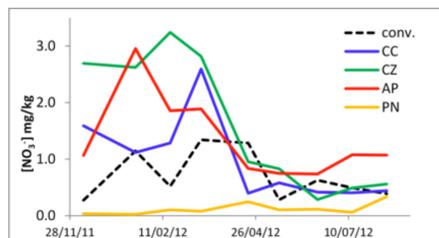


Figure 1: NO<sub>3</sub><sup>-</sup> dynamics during the first cycle of the banana

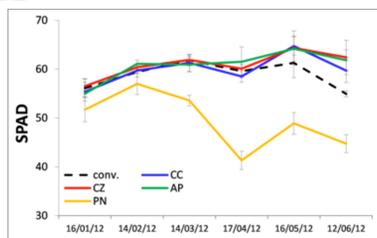


Figure 2: SPAD readings of banana leaves during the first cycle

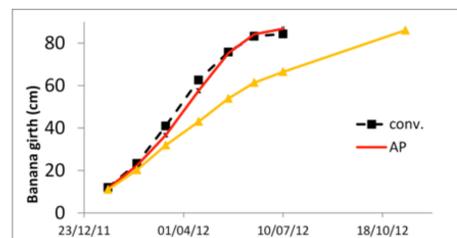


Figure 3: Banana growth until flowering

	Cweed			Fert			AvCBan		
	Note in functional profile	Mean % of soil covered by weeds	Frequency of weedings (/week)	Note in functional profile	Area under the curve of [N] dynamics (-)	Mean SPAD readings (-)	Note in functional profile	Weeks until flowering	Ratio of root densities of cover plant to banana
Conventional	/	41	0.12	/	1881	59.9	/	32	/
Usage A									
CC	0.67	64	0.16	1	2468	59.9	0.25	/	/
CZ	0.67	48	0.16	1	4063	60.9	0.5	/	/
Usage B									
AP	0.5	1	0.04	1	3486	60.8	0.75	33	0.036
PN	0.75	12	0.12	0	274	49.5	0.5	49	0.774

better than conventional; worse than conventional; red numbers: discrepancy between trait-based characterization and field assessment

Table 1: Comparison between the global notes resulting from the trait-based characterization and the synthesized indicators of the services actually delivered in the field

- In agreement with the trait-based characterization, AP and PN provided a good control of weeds (Cweed), AP provided an improvement of the nutrient availability (Fert) and avoided competition with the banana (AvCBan), while PN didn't
- CC and CZ provided Fert but were not able to control weeds, contrary to what was expected from the trait-based characterization
- Hypothesis to explain this discrepancy: i) a wrong trait-based evaluation of the potential of plants for physical barrier against germination, ii) a wrong combination of the 3 functions into a synthesized indicator of the service delivered



*Cajanus cajan* © H TranQuoc

#### Conclusion

The globally consistent comparison of the trait-based characterization and field assessment of the services delivered encourages its further uses as a tool to choose species the best adapted to a set of expected services.

#### References

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- GARNIER, E., NAVAS, M.L. (2012) A trait-based approach to comparative functional plant ecology: concepts, methods and applications for agroecology. A review. *Agron Sustain Dev* 32, 365-399.
- VIOLLE, C., NAVAS, M.L., VILE, D., KAZAKOU, E., FORTUNEL, C., HUMMEL, I., GARNIER, E. (2007) Let the concept of trait be functional! *Oikos* 116, 882-892.



Banana - *Paspalum notatum* © M. Dorel



Banana - *Arachis pintoi* © M Dorel