Evaluating maize-bean intercropping: Practices, Nutrition, Plant-Soil interactions

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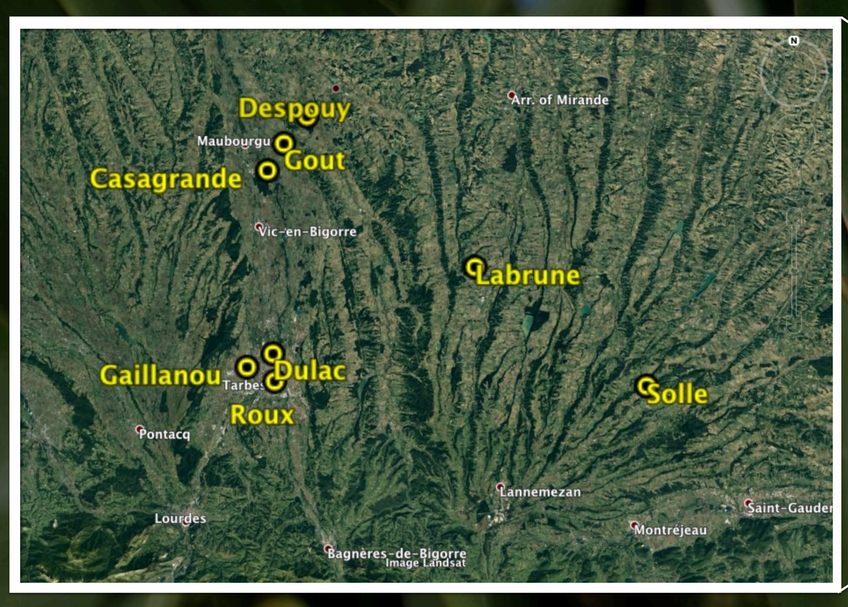
Intercropping of maize and common bean in the *milpa* has been a common practice since ancient times in Latin America where both crops originated. However, selection operated by modern plant breeding has been applied within each crop independently, thereby minimizing species interactions. Monoculture has gradually replaced coculture, but maize-bean association is still found in some European traditional farming systems.

Despite reported benefits of mixed intercropping[1], little is known about their ecological, genetical and physiological bases [2]. Synergies may occur through complementary of canopy and root structure[3], and facilitation processes such as increased phosphorus and nitrogen availability (N_2 fixation via legume-rhizobia symbiosis) [4,5], stimulation of nutrients acquisition[6], recruitment of plant-growth-promoting rhizobacteria populations (PGPR)[7], plant pathogen control responses[8].

In order to assess potential synergies in maize-bean associations and their impact on plant growth, productivity, health and competitiveness, we undertook a comparative study among 3 modalities: maize, bean and maize-bean cultivation. We combined ethnological surveys to plant nutrition evaluation and bacterial assemblage metagenomic characterization.

Field collection and treatments

We have collected samples in 8 farms located in the Tarbais region in the fall 2016 (right before harvest)



Farmer	maize	bean	maize-bean
Casagrande			
Despouy			
Dulac			
Gaillanou			
Gout			
Labrune			
Roux			
Solle			

16 treatments were sampled including 5 maize monoculture, 4 bean monoculture and 7 intercropping
The colours indicate the varieties used in monoculture and intercropping
For a given farmer, dashed lines surrounding treatments signal that the same technical itineraries were employed

8 interviews
+
many others to come

cultivation practices, technical itineraries, and farm description

16 treatments x 3 repeats
x 5 (mono) to 10 (co) plants
=345 dried samples
(x2: vegetative parts + seeds)
+
16 treatments x
3 repeats
=48 soil samples
from 5-20cm depth

16 treatments x
1 repeat (mix from 3 locations) x
1 (mono) to 2 (co) + 16 controls
=39 soil samples

Ethnological surveys

- Differences among treatments in terms of disease, bean yield
- Perception of bean grain (quality, quantity, taste)
- Historical perspectives on intercropping

Plant nutrition

Plants: N, P, K content of vegetative parts and seeds. Dry weight of vegetative parts and seeds. Width and Length of bean seeds.
Soil: Texture, pH and calcium carbonate, mineral N (ammonium +nitrate) and organic N, Cation exchange capacity

Bacterial assemblage

- 16S characterization
- Composition and genetic distances among taxa
- Gene function predictions
- Plant beneficial taxa

Are there any differences among treatments in measured parameters?
If so, is there any evidence for the effect of monoculture/intercropping on any of these parameters?
Or are the differences linked to environmental variation across fields, varieties, itineraries?
Are there correlative links between: soil content and plant nutrition/yield, microbiota and plant nutrition/yield when accounting for differences in itineraries, varieties? Are some bacterial species stimulated in intercropping?
Can we verify hypotheses formulated from ethnological surveys (bean grain and yield))?
Can we formulate new hypotheses based on surveys (disease, taste)?
Which specific experiments do we need to design to help defining breeding strategies for intercropping?

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