Applied Research & Development for French Soy – Priorities Contributing to France's National Protein Strategy

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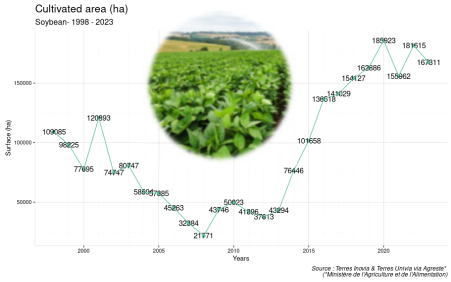
Background

- Soy area in France fell to 20kha but has since been multiplied by ~8-9
- What were the key factors and innovations driving this success ?
- Genetic gain → making soy competitive for farmers
- An adapted grain crush model for industry



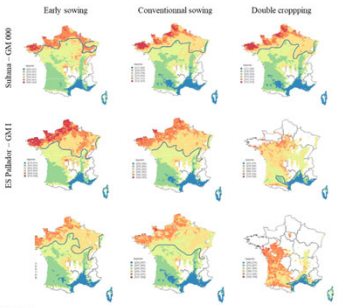
Objectives

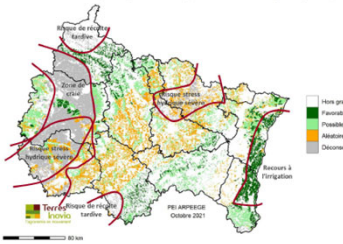
- French national protein strategy calls for doubling of grain legume area by 2030 → 250-300 kha soybean
- How do we pursue this trajectory ?
- Building on historical factors (genetics, grain crushing)
- Diagnosing potential and limits to expansion
- Diagnosing and addressing yield limiting factors

Components of french R&D strategy

Evaluating technical feasability of soy expansion

- Phenology : SPA simulations (Schoving 2020) → Feasability limit (harvest date) for sowing date X cultivar X climat scenario





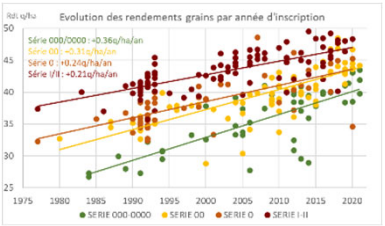
- Overall agronomic feasability with expert rules and GIS (Baillet 2022)
→ New soybean crush factory

Economical feasability of soy expansion (Charon, 2022)

- Center-West of France : technically feasible, large arable growing area, close to major livestock areas → yet only 5 kha (2021)
- 4 representative farm types (with & without irrigation) for the region → 2-3 hypotheses for integration of soy in cropping systems → analysis and comparison to baselin with Systerre® multicriteria evaluation tool
- At the farm level, with current yield and price levels, gross margin loss for growers of ~ 60 €/ha (13-117), compared to ~30€/ha with pre-2020 prices = 4 % gross margin and 7% net margin (without CAP aids) loss
- At the crop level, soy gross margin lacks ~ 900 €/ha compared to main arable crops → 1 t/ha yield gain (!!) or 0.5 t/ha yield gain + 100€/t price gain

Genetic gain

- Variety registration and post-registration re-analysis → 0.2-0.36 t/ha / 10 years & 0.5 protein % / 10 years



Phenology shift	Irrigated	N	Yield gain (t/ha)
000 → 00	No	7	+0.26
000 → 00	Yes	9	+0.13
00 → 0	Both	7	-0.05
0 → I/II	Both	11	+0.4

- Shift to later maturity groups → yield gains
- Sustain breeding effort for later groups
- Too much farm saved seed

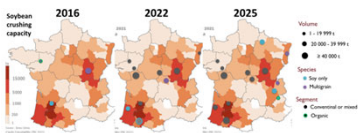
Yield gap diagnosis (Tribouillois et al, this conference)

- 322 fields, 2 very contrasting years
- Presence of weeds, nodulation quality, and water availability = main yield limiting factors

Limiting factors 2021-2022	N	Thresholds for calculation	Average yield difference 2021-2022
Presence of weeds at flowering	315	«very weedy» vs «no weed»	-49%
Quantity of nodules at flowering	170	« Few » vs « Many »	-35%
Quantity of water flow-mat (mm)	167	<100 vs >280	-34%
Height of first pod (cm)	297	<10 vs >18	-33%
Presence of pests at early/late stage	304	Damage >20% vs 0	-31%
Uniformity of stand	315	very het. vs very hom.	-27%
NNI at flowering	49	>0.6 vs >0.95	-25%
Root depth at flowering	91	« <15cm » vs « >15 cm »	-15%
Stand density (early stage) (plants/m²)	97	<40 vs 40-65	-14%
Fresh biomass at flowering (g/m²)	202	<1400 vs >2500	-8%
Presence of diseases at flowering	312	Damage >20% vs 0	ns

Grain crushing

- Solvent-free (cooking-pressing) grain crushing model in France allowed scaling up the crop despite relatively low volumes (Quinsac et al., 2012 ; Carré et al., 2022)
- Quality diagnosis of expeller soybean meals vs standard (Carré, 2023) :
  - 18 monogastrics studies, 9 ruminant studies → rare differences in zootechnical performance in litterature
  - Feedbase : expeller = more variable
- Reducing variability → increasing demand for french meals
- Diagnostics in french industry : thermal diagnostics and modeling of time of residence in cooker → significant proportion of overcooking
- Providing expertise to existing and future soy crush factories



Conclusions and perspectives

- Further rise in soy area requires yield and value increase
- Yield gap : improve crop establishment
- Yield potential : maturity groups, sustain breeding effort
- Improve grain crushing to compete with import soy meals

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