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@terresinovia

# Knowledge exchange for European soybean agronomists

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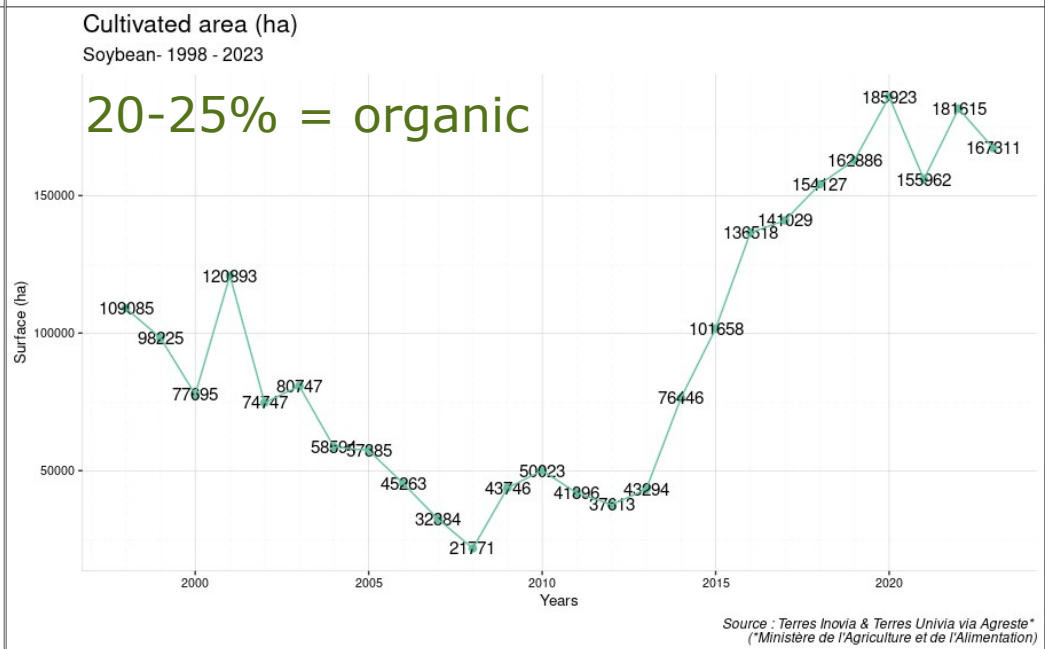
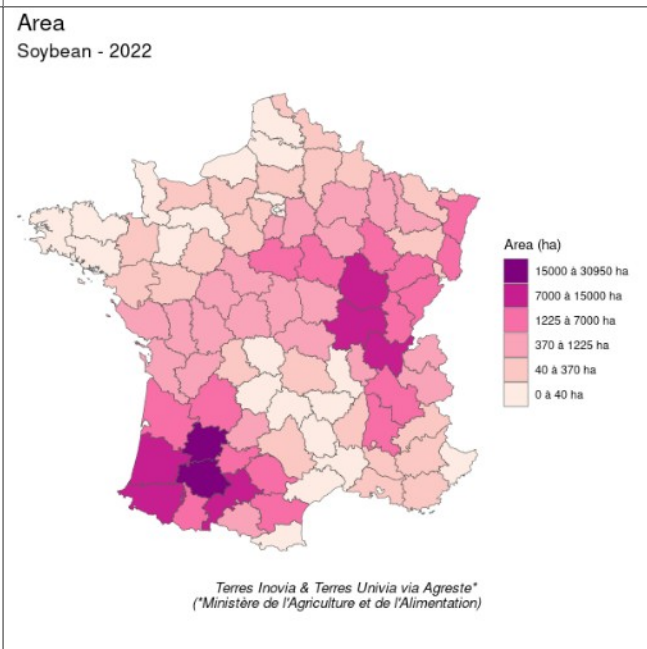
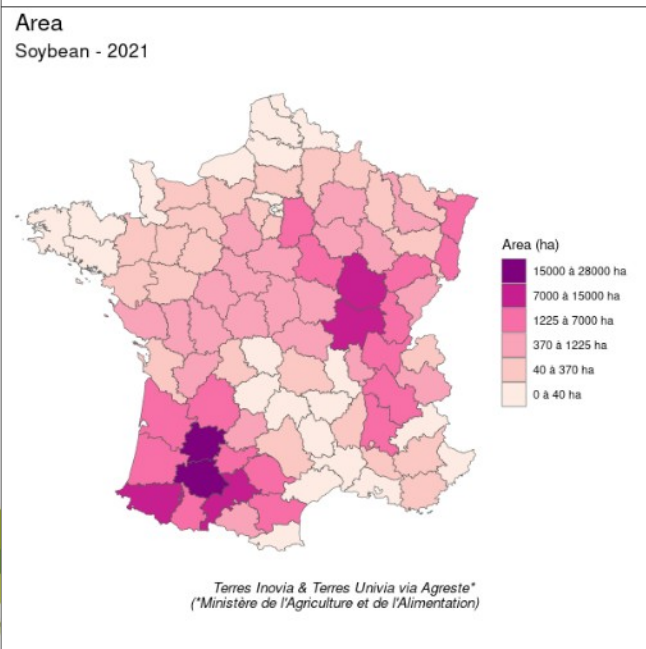
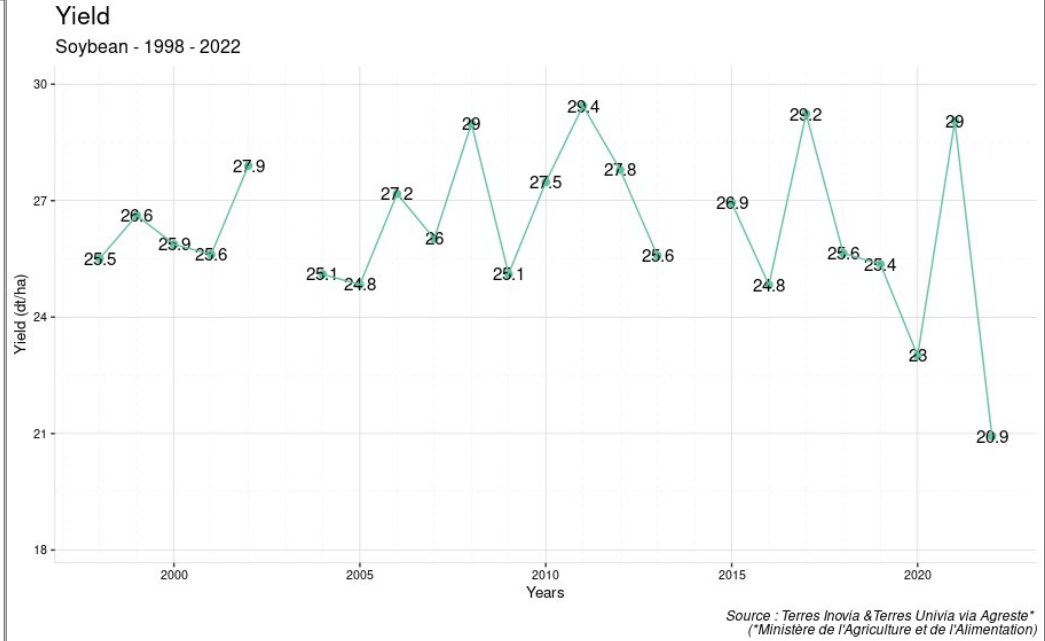
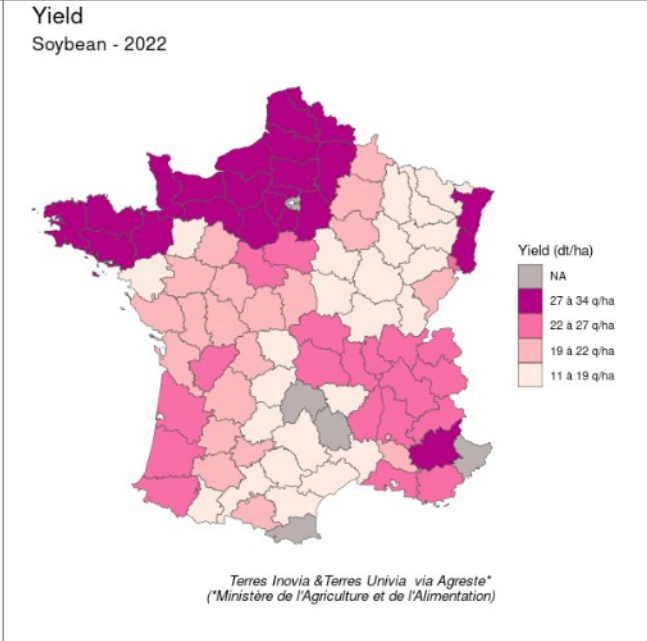
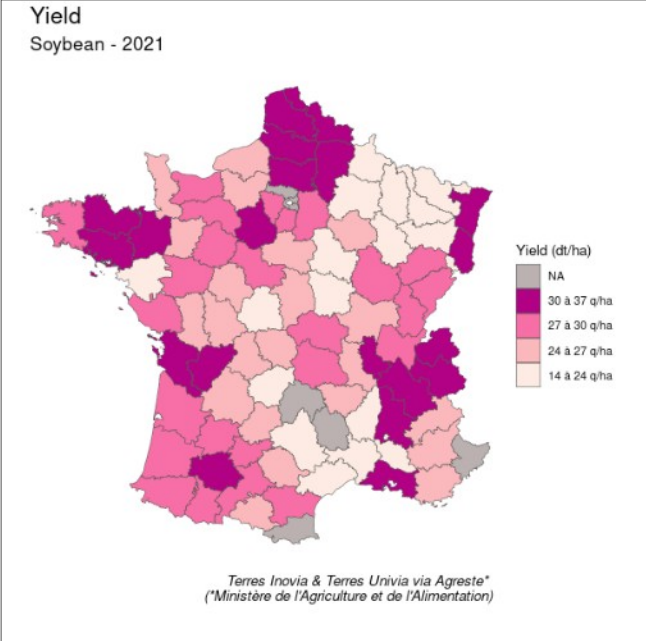


# Terres Inovia – applied research & technology transfer of the French oilseeds & grain legumes sector

- Board majority = representatives of growers & industry of the oilseeds & grain legumes sector :
- 16 M€/year budget : 60-65% levy on each ton produced
  - +5 M€/year 2021 & 2022 : French National Plant Protein Strategy
- Collective R&D and transfer spanning from inputs to production to 1st transformation of grains
- Terres Inovia = 2015 merger between CETIOM (oilseeds) and UNIP (protein rich crops)



# Soybean in France at a glance

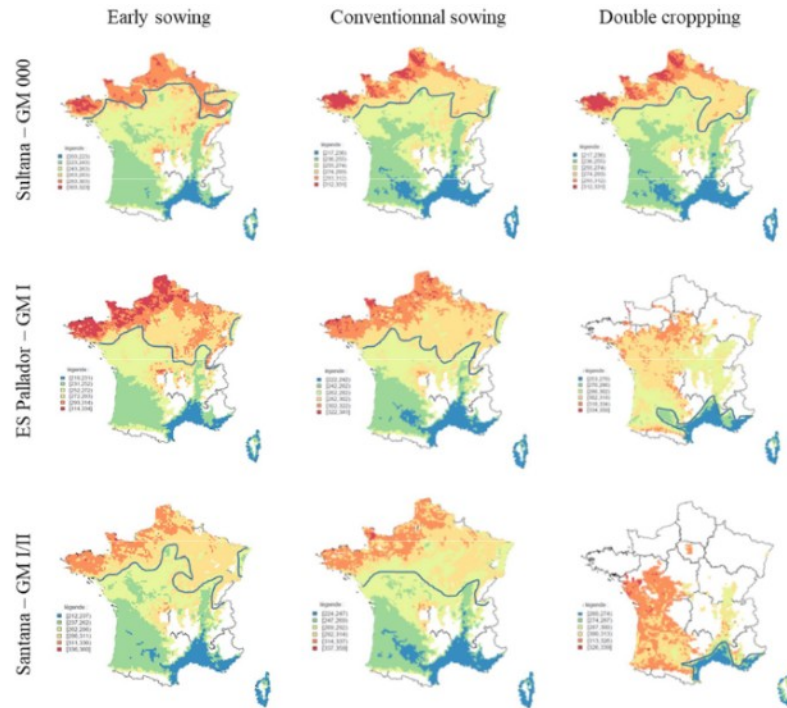


# Soybean perspectives & objectives in France

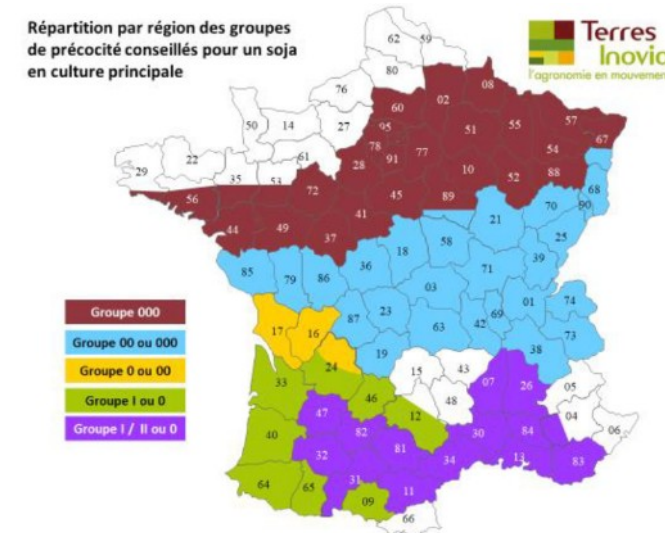
- French National Plant Protéin Strategy = doubling of grain legumes by 2030 → reaching 250-300 kha soybean
- Where is this biologically feasible ?
- What are the technical and economical conditions ?



# Phenological feasibility & recommendations



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



- See following link for details on variety recommendations:  
<https://www.myvar.fr/upload/media/document/0001/02/72aa332853f50efe0e44202059e1fd9d18dbabea.pdf>

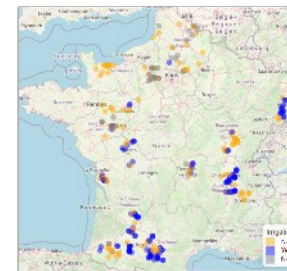






# Avenues to improve yields

- Agronomic diagnosis of 322 fields / 2 contrasting years (21, 22)
- Key limiting factors : weed management, nodulation, water availability → all linked to crop establishment and moisture/water management

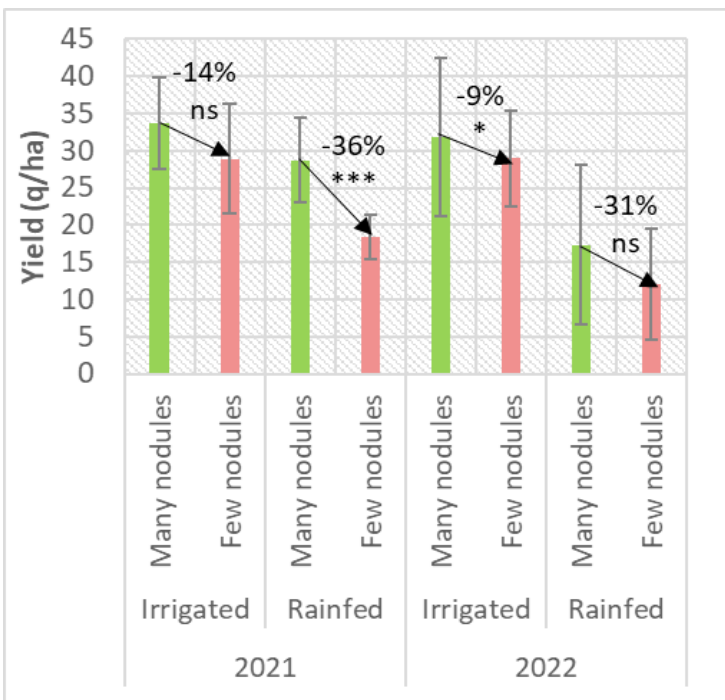


Limiting factors 2021-2022	Number of fields	Thresholds for calculation	Average yield difference 2021-2022	Impact level 2021-2022
Presence of weeds at flowering	315	«very weedy» vs «no weed»	-49%	5
Quantity of nodules at flowering	170	« Few » vs « Many »	-35%	4
Quantity of incoming water flow-mat (mm)	167	<100 vs >280	-34%	4
Height of first pod (cm)	297	<10 vs >18	-33%	4
Presence of pests at early/late stage	304	Damage >20% vs 0	-31%	4
Uniformity of stand	315	« very het. » vs « very hom. »	-27%	3
Nitrogen Nutrition Index at flowering	49	>0.6 vs >0.95	-25%	3
Root depth at flowering	91	« <15cm » vs « >15 cm »	-15%	2
Stand density (early stage) (plants/m <sup>2</sup> )	97	<40 vs 40-65	-14%	2
Fresh biomass at flowering (g/m <sup>2</sup> )	202	<1400 vs >2500	-8%	1
Presence of diseases at flowering	312	Damage >20% vs 0	ns	1



# Avenues to improve yields – inoculation ?

- In our grower surveys, ~80% consistently say they are satisfied with their level of nodulation → in contradiction with expert observations here
- 97% of areas with a “first soy” for 4 years are inoculated
- 91% of areas with frequent soy are inoculated : more secure than Terres Inovia recommendations



Plot history	Nodulation quality on previous soy	Years since previous soy	Soil type	DECISION	
First Soy				INOCULATE	INDISPENSABLE
Soy previously planted	Good	<4 years ago	Calcareous soil or sandy soil with low organic matter	INOCULATE	INDISPENSABLE
			Others	DO NOT INOCULATE	USELESS
	Poor	>4 years ago		INOCULATE	IN CASE
				INOCULATE	NECESSARY

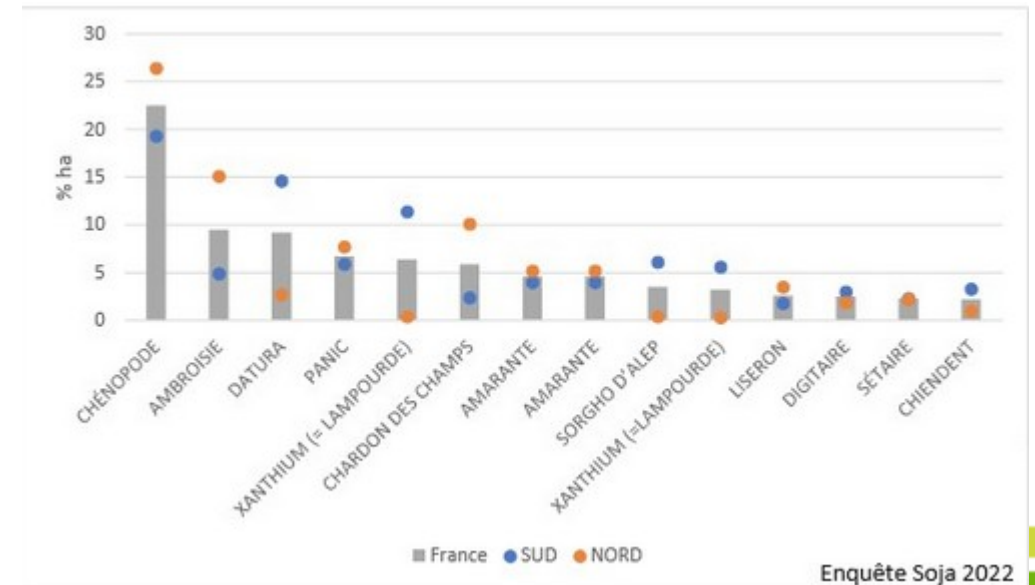
- Maintain high inoculum quality control :  $>10^6$  bacterium/grain
- Inoculum storage/application before sowing leads to losses in rhizobia populations ?
- Interaction with crop establishment conditions and drought



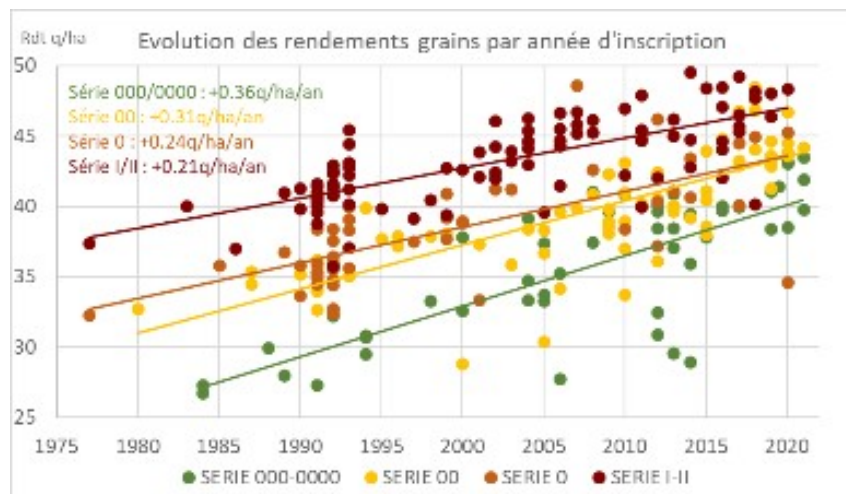


# Avenues to improve yields – weed management

- 32% growers unsatisfied with their level of weed control in 2022, especially in southern France (36% in 2022 compared to 25% in 2019)
- Probable link to dry conditions having negatively affected proper crop density establishment (despite growers having increased their sowing densities in 2022)
- As previously for nodulation → importance of crop establishment, soil moisture management and water availability
  
- Dominant herbicide programs follow our recommendations :
  - Post-sowing/pre-emergence + post emergence
  - S-metolachlore + imizamox dominate
- ~10% mechanical weeding
- Probable attention needs to be paid to specific situations with difficult weeds, that require
  - Particular attention to herbicide timing
  - Specific combinations of active substances & alternative measures



# Avenues to improve yields – variety choice



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

- Significant breeding progress : 0.2-0.36 t/ha / 10 years & 0.5 protein % / 10 years
- Opportunity to shift to later maturity groups to increase yields
- Breeding progress poorly exploited by growers : 64% area in South = ISIDOR (registered 2004), 30% area in North = ES MENTOR (registered 2009)
  - Linked to downstream uses : food uses
  - Linked, in South, to farm saved seed (50-80% depending on data sources)
- A major national public-private R&D project to improve soy :

Soyustainable



# Other notable aspects of cropping practices

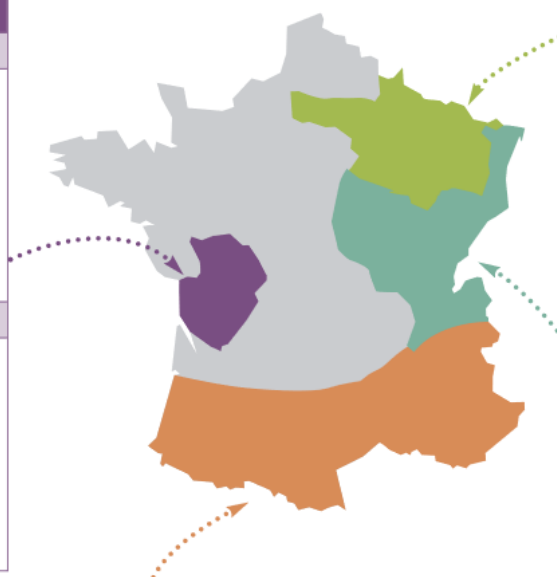
- In diversified, long rotations : 87% with maximum 2 soy crops / 6 years
- Increase in cover crops preceding soy from 16% (2016) to 38% (2022)
- Sowing dates slightly earlier in North vs South (4 vs 7 May) with only 21% area sown in April in South vs 46% in North → opportunity for yield increases and drought avoidance ?
- Tillage practices stabilized after a decade of deep tillage reduction (~40% ploughing)
- 53% area irrigated in 2022 & 2019 (69% in 2016, 54% in 2012)
- Increase of irrigation doses in 2022 linked to strong drought : + 10 mm on deep soils, +40 mm on shallow soils (baseline = 150 & 180 mm)



# Examples of recommended crop management

## Exemples de conduite du soja

Poitou-Charentes
<b>Sol superficiel - Conduite irriguée</b>
Rendement : 32 q/ha Variétés : groupes 0 à 00 Interligne : 18 à 40 cm Densité de semis : 500 000 graines Engrais P/K : 50 unités Herbicides : prélevée + post-lévée Protection ravageurs et maladies : antillimaces selon besoin Irrigation : 200 mm Charges opérationnelles (1) : 872 €/ha Marge brute (2) : 600 €/ha
<b>Sol profond - Conduite en sec (pluviale)</b>
Rendement : 30 q/ha Variétés : groupes 0 à 00 Interligne : 18 à 40 cm Densité de semis : 550 000 graines Engrais P/K : 40 unités Herbicides : prélevée + post-lévée Protection ravageurs et maladies : antillimaces selon besoin Irrigation : non Charges opérationnelles (1) : 503 €/ha Marge brute (2) : 877 €/ha



Lorraine, Champagne-Ardenne, Sud Picardie
<b>Sol profond - Conduite en sec</b>
Rendement : 25 q/ha Variétés : groupe 000 Interligne : 18 à 30 cm Densité de semis : 700 000 graines Engrais P/K : 50 unités Herbicides : prélevée + post-lévée Protection ravageurs et maladies : antillimaces selon besoin Irrigation : non Charges opérationnelles (1) : 614 €/ha Marge brute (2) : 536 €/ha

Bourgogne, Rhône-Alpes-Nord, Alsace, Franche-Comté, Auvergne
<b>Sol profond - Conduite en sec</b>
Rendement : 32 q/ha Variétés : groupes 00 Interligne : 18 à 40 cm Densité de semis : 600 000 graines Engrais P/K : 50 unités Herbicides : prélevée + post-lévée Protection ravageurs et maladies : antillimaces ou anti-chenilles défoliatrices selon besoin Irrigation : non Charges opérationnelles (1) : 558 €/ha Marge brute (2) : 914 €/ha
<b>Sol moyennement profond - Conduite irriguée</b>
Rendement : 42 q/ha Variétés : groupes 00 Interligne : 18 à 40 cm Densité de semis : 700 000 graines Engrais P/K : 50 unités Herbicides : prélevée + post-lévée Protection ravageurs et maladies : antillimaces ou anti-chenilles défoliatrices selon besoin Irrigation : 150 mm Charges opérationnelles (1) : 931 €/ha Marge brute (2) : 1 001 €/ha

Sud-Ouest, Rhône-Alpes Sud	
<b>Sol superficiel - Conduite irriguée</b>	<b>Sol très profond - Conduite en sec</b>
Rendement : 36 q/ha Variétés : groupes I à II Interligne : 35 à 60 cm Densité de semis : 400 000 graines Engrais P/K : 50 unités Herbicides : prélevée + post-lévée Protection ravageurs et maladies : antillimaces selon besoin Irrigation : 200 mm Charges opérationnelles (1) : 780 €/ha Marge brute (2) : 876 €/ha	Rendement : 24 q/ha Variétés : groupes I Interligne : 18 à 40 cm Densité de semis : 500 000 graines Engrais P/K : 40 unités Herbicides : prélevée + post-lévée Protection ravageurs et maladies : non Irrigation : non Charges opérationnelles (1) : 475 €/ha Marge brute (2) : 629 €/ha

Productivité et charges basées sur 100 % de semences certifiées et avec des variétés récentes et adaptées au territoire.

Inoculum : sur graines    Labour : oui  
(1) 100 % de semences certifiées  
(2) Avec un prix de vente indicatif de 460 €/t  
Valeur provisoire estimée sur la récolte 2021.

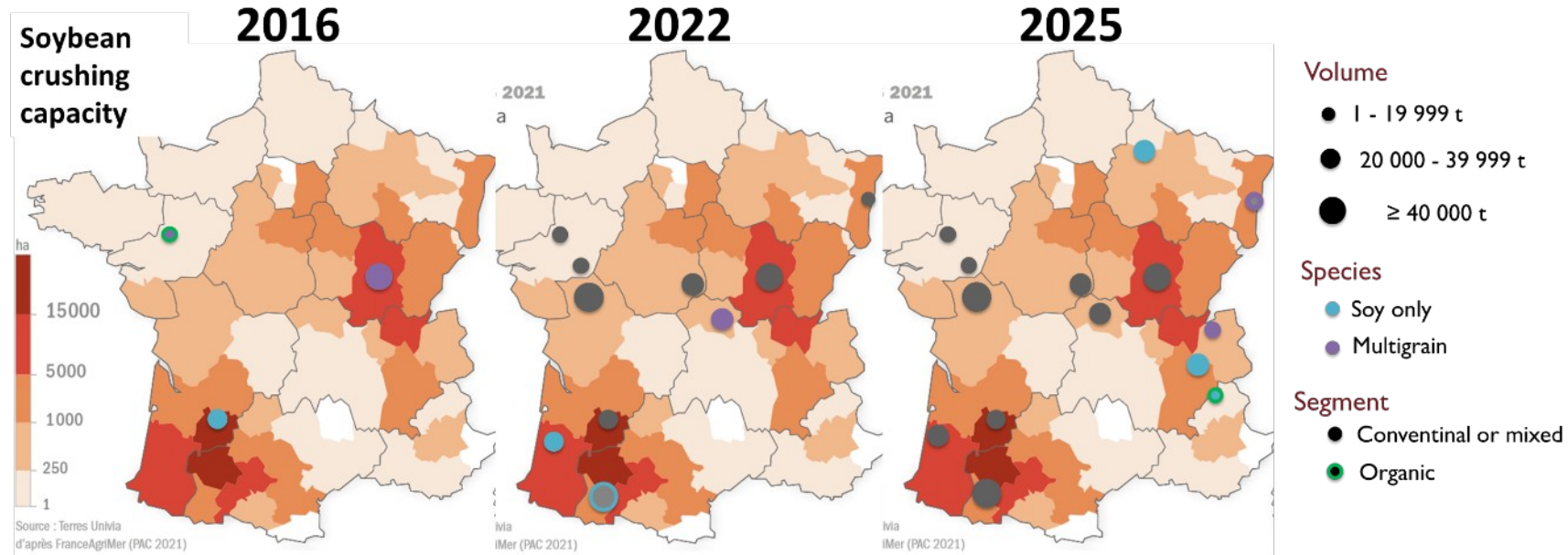
Source : experts Terres Inovia

- See following links for details :
- Conventional : <https://www.terresinovia.fr/o/commerce-media/products/454326/guide-soja/4122454/Guide%20de%20culture%20soja%202022.pdf?download=false&title=fichier.pdf>

- Organic :



# Beyond the field, improving soy meals for feed



- New factories → need to support best agronomic practices
- New & existing factories : need to improve expeller soy meal qualities → diagnosis and expertise to improve cooking systems and reduce heterogeneity





# Conclusions

- Pursue yield gap diagnostics
- Address specific crop husbandry issues : establishment, weed management, nodulation
- Pursue breeding progress and ensure its transfer to the field
- Link to soy transformation industry to improve value



# Acknowledgments

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