

Biostimulation by GERMANCE improves Soybean Performance Through Enhanced Nitrogen Fixation and Seed protein Quality

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This work is funded by the following projects: ANR-LETSPOSEED (ANR-22-PLEG-0002, *Développer les protéines végétales et diversifier les sources de protéines*), FEADER POTION (Protein from Tropical crops in the North), and FEDER-Région Normandie-Soja Made in Normandie

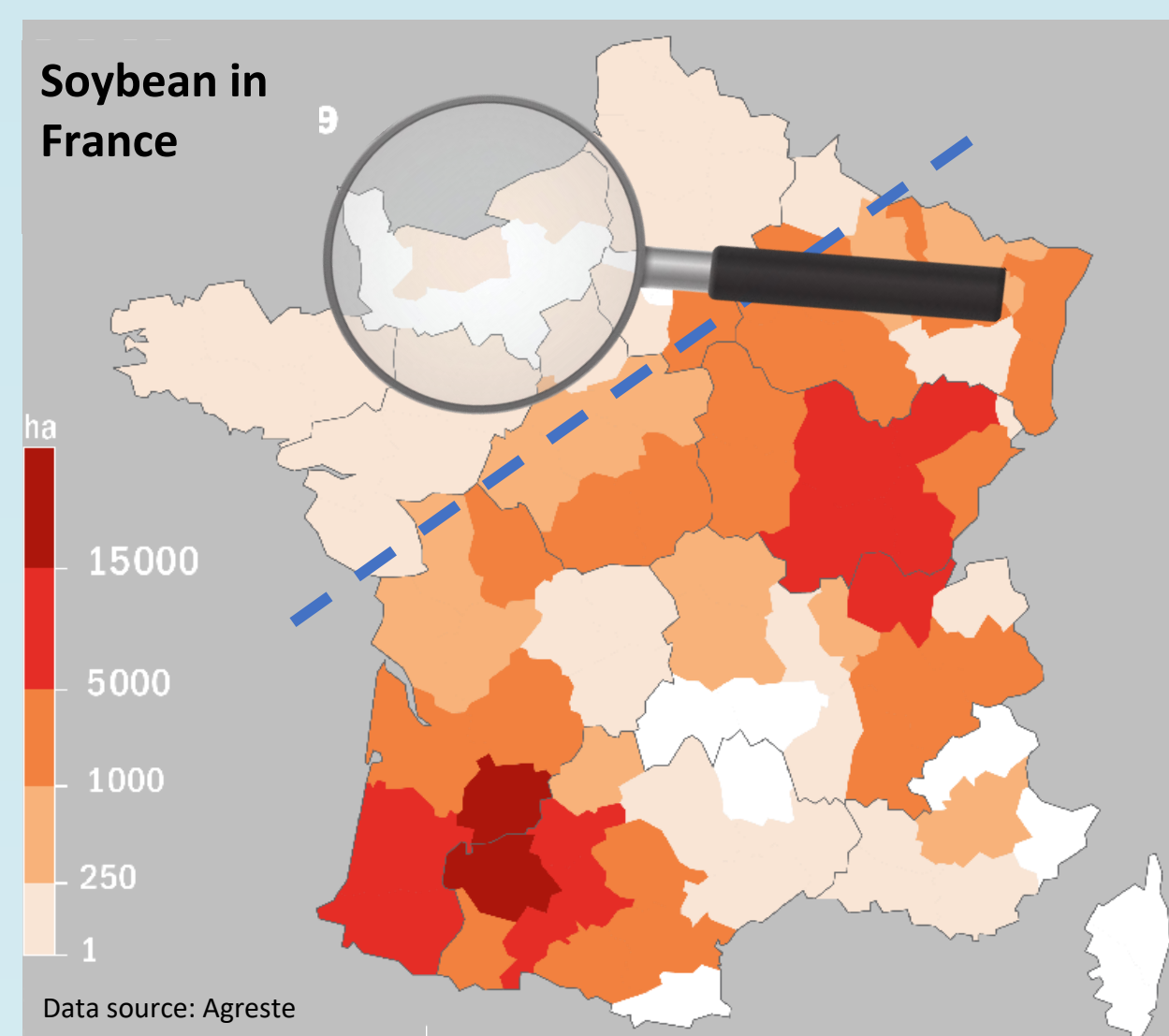
Context & Objectives

Background:

Recent advances in soybean breeding, coupled with gradual climate warming, have enhanced the feasibility of soybean cultivation in temperate Western Europe, including northern France.

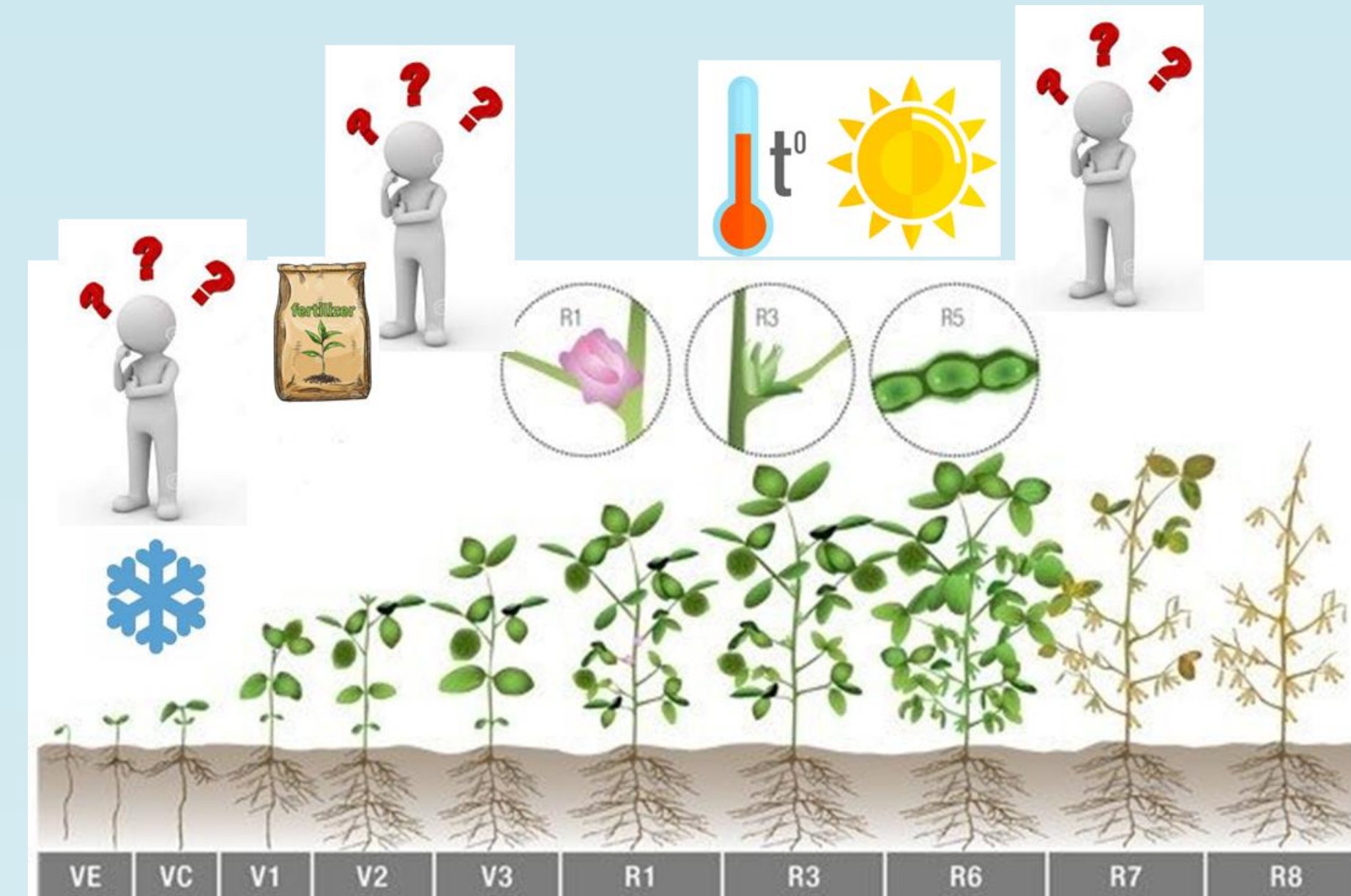
However, regions such as Normandy remain suboptimal for soybean establishment due to relatively low early-season temperatures. Increasing local soybean production is therefore a strategic priority to strengthen feed autonomy and reduce import reliance.

Biostimulants have emerged as promising tools to enhance plant physiological processes aligned with agricultural transition goals (Carillo et al., 2025). Via Végétale, a French company specializing in plant-derived bioactive formulations, has developed biostimulants with demonstrated positive impacts on crop performance, notably improving yield, nitrogen uptake, and N remobilization in wheat (Maignan et al., 2021)



Objectives:

Our general goal is to develop soybean crop in Normandie (feed/food) through the selection of adapted varieties in combination with innovative approaches built on responsible and sustainable agriculture.

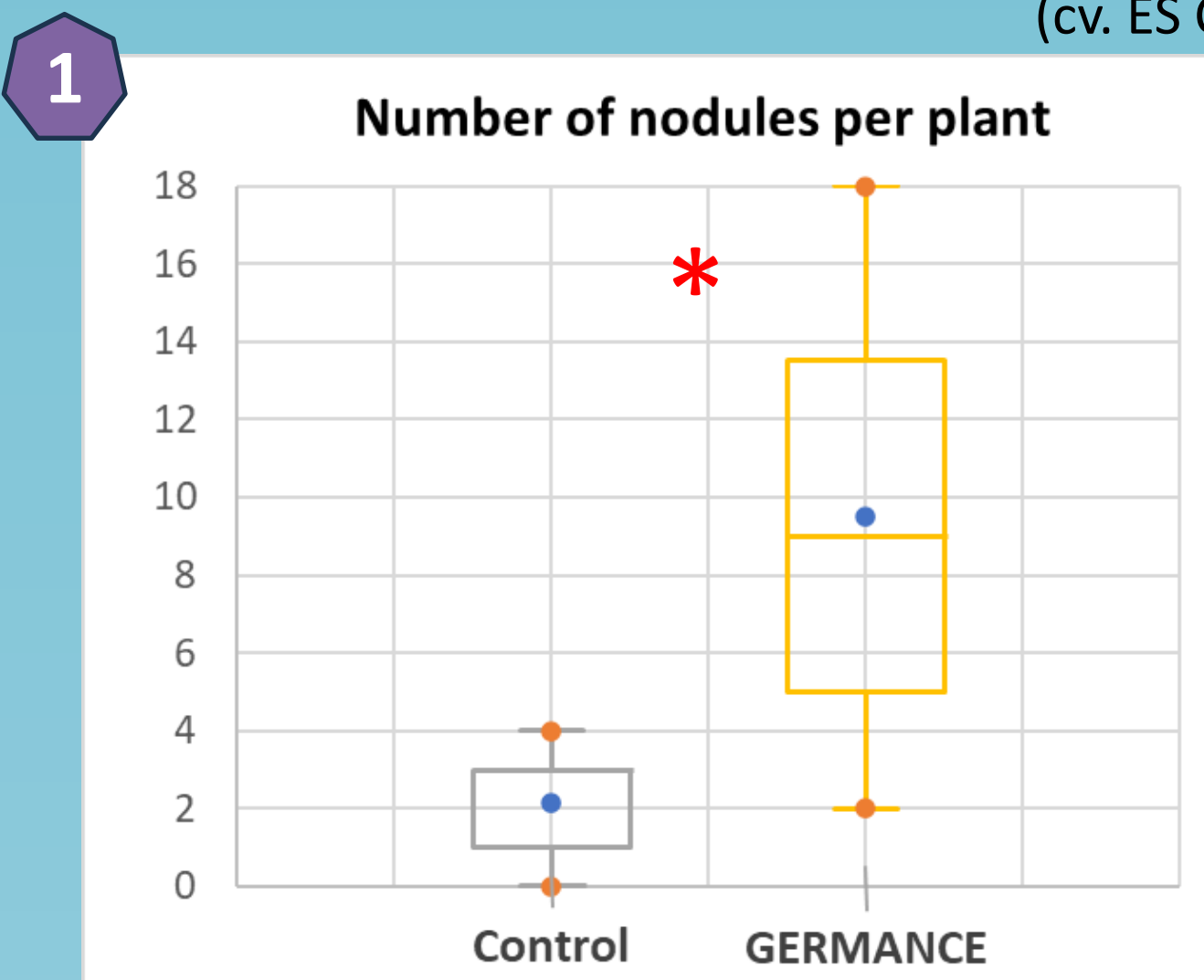


Using controlled or field conditions, this study investigates the effects of GERMANCE® (a biostimulant highly concentrated with plants extracts and applied as seed treatment (Via Végétale)) on :

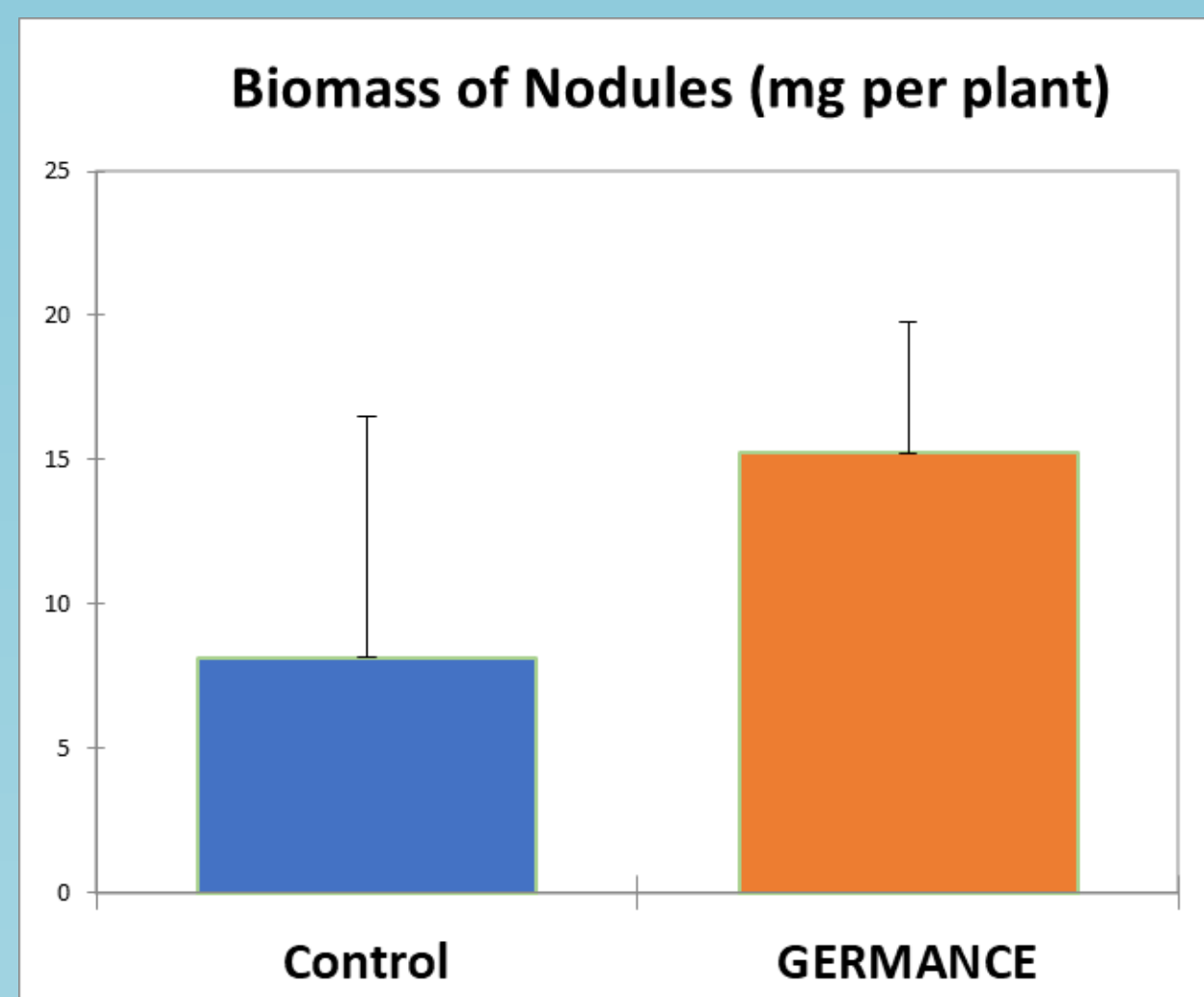
- soybean establishment, nodulation, nitrogen fixation,
- yield components,
- seed quality (seed proteome)

Greenhouse experiments

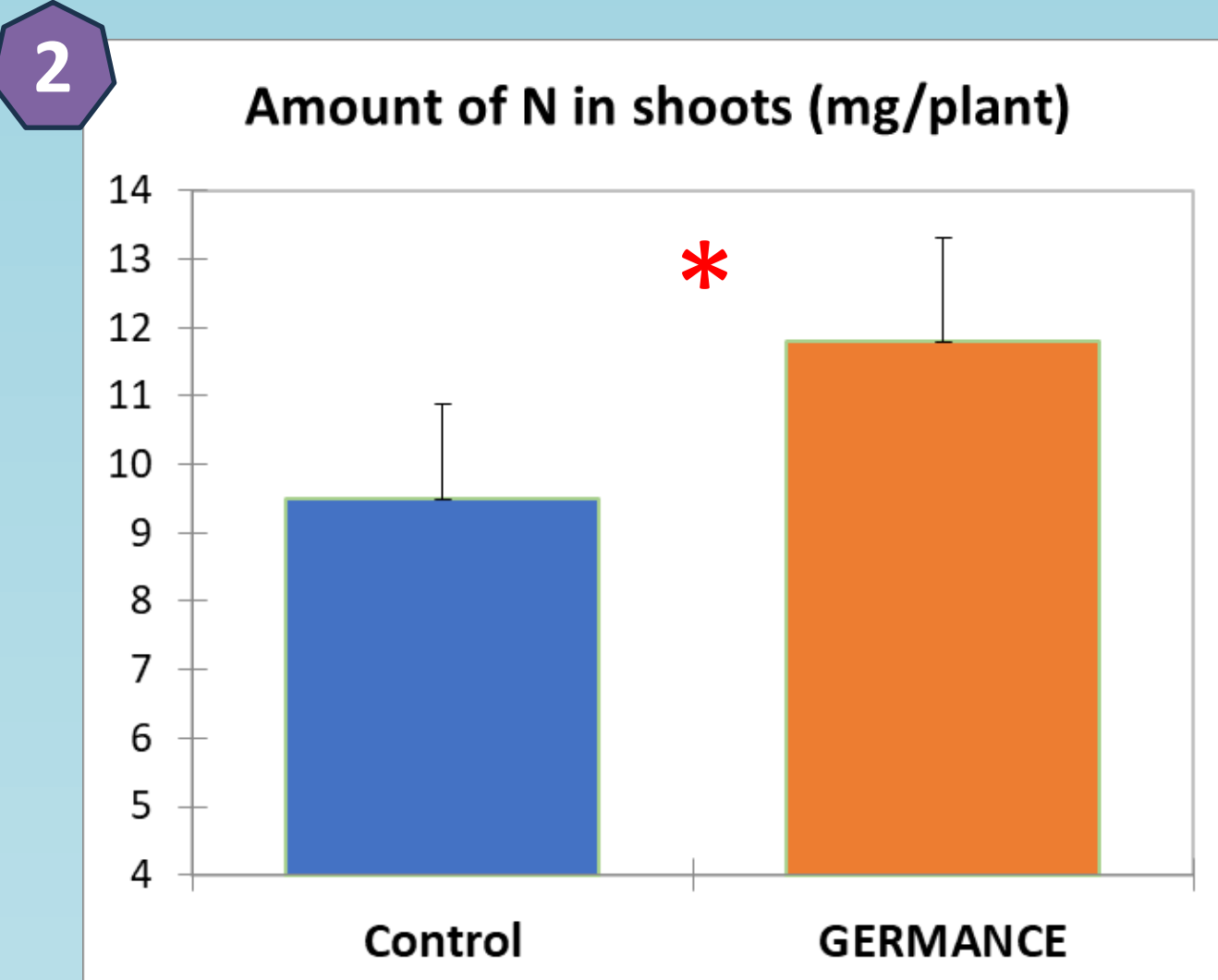
(cv. ES Commandor, n= 4 to 5)



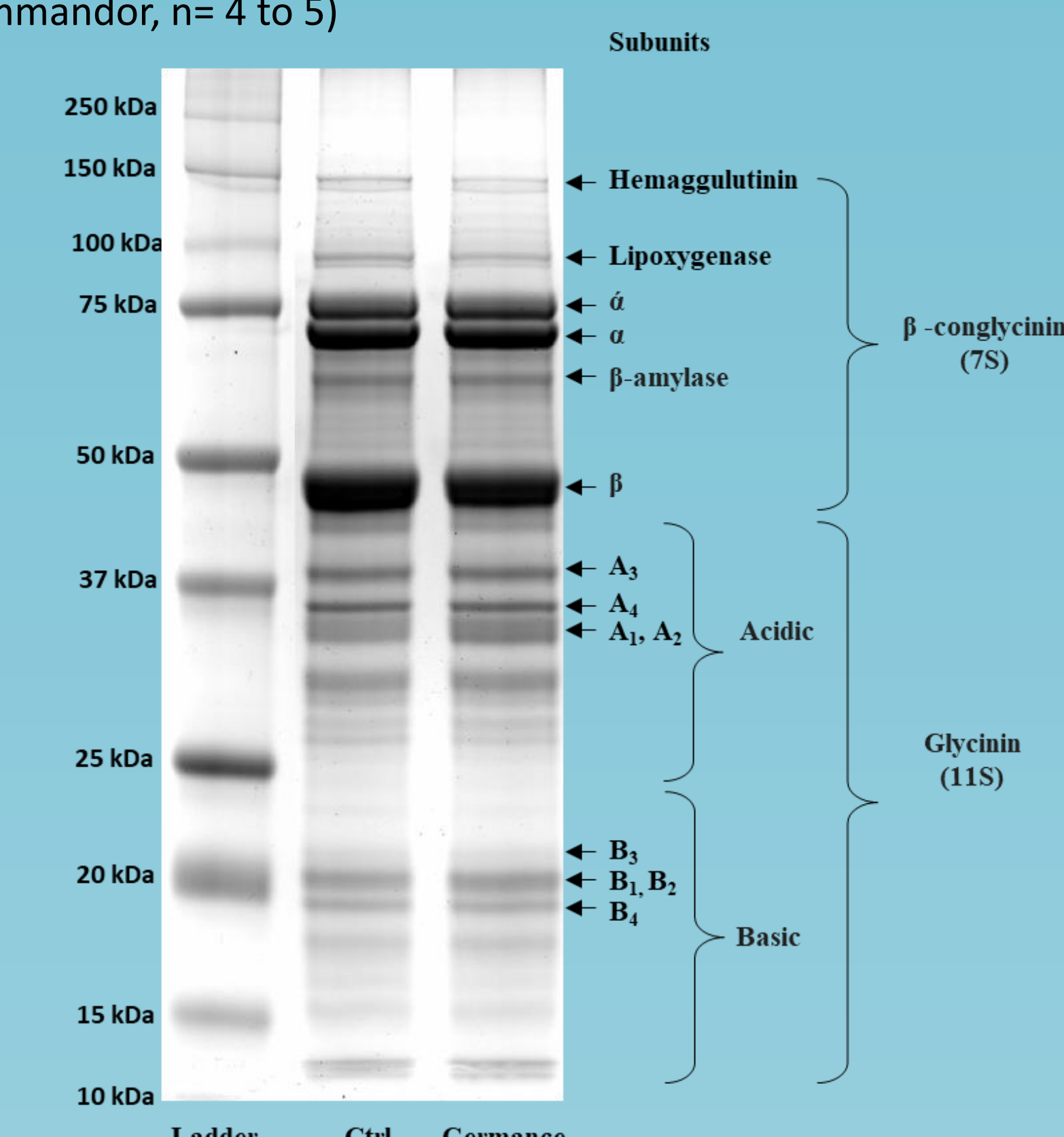
*Significant effect (p=0.022, Test t, n = 4 to 5)



Not Significant (p=0.155, Test t, n = 4 to 5)



*Significant effect (p=0.030, Test t, n = 4 to 5)

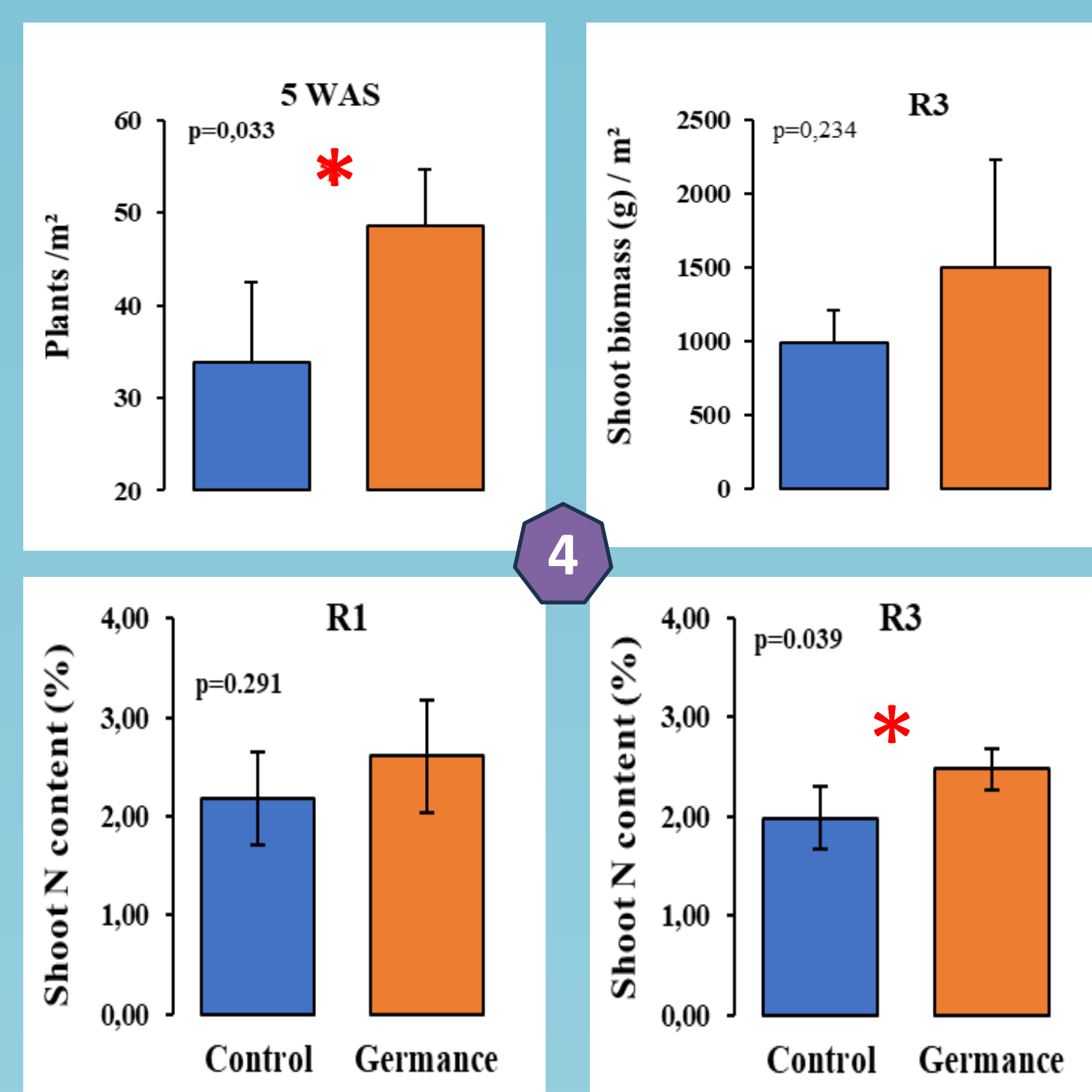


# Peak	Molecular weight (kDa)	Peak identification	Control protein abundance (%)	Germance protein abundance (%)	p-value
1	150	Hemagglutinin	0,740 ± 0,198	0,666 ± 0,350	0,732
2	125	Hemagglutinin	0,378 ± 0,082	0,352 ± 0,079	0,692
3+4	95	Lipoxigenase	1,758 ± 0,353	1,925 ± 0,2501	0,520
5	90	Lipoxigenase	0,338 ± 0,136	0,381 ± 0,081	0,660
6	74	7S α	11,48 ± 0,088	11,36 ± 0,483	0,645
7	70	7S α	14,02 ± 0,573	13,56 ± 0,573	0,336
8	66	Unknown	1,900 ± 0,130	1,949 ± 0,291	0,769
9+10	60	β-amylase	5,144 ± 0,550	5,274 ± 0,082	0,707
11	56	Unknown	0,231 ± 0,029	0,283 ± 0,026	0,057
12	48	7S β	12,77 ± 1,357	10,56 ± 0,403	0,044
13	47	7S β	7,810 ± 0,829	7,125 ± 0,822	0,327
14	44	Unknown	1,698 ± 0,182	1,464 ± 0,442	0,374
15	38	A3	4,338 ± 0,263	4,478 ± 0,264	0,509
16	36	A4	3,676 ± 0,085	3,660 ± 0,581	0,954
17	34	A1	2,318 ± 0,289	3,106 ± 0,187	0,010
18	33	A2	2,829 ± 0,610	3,399 ± 0,144	0,182
19	31	Unknown	4,851 ± 0,670	5,088 ± 0,336	0,603
20	30	Unknown	1,119 ± 0,216	1,197 ± 0,222	0,659
21+22	28	Unknown	2,160 ± 0,266	2,422 ± 0,360	0,315
23	22	B3	1,391 ± 0,1123	1,282 ± 0,315	0,540
24	21	B1B2	6,154 ± 0,608	6,451 ± 0,258	0,469
25	20	B4	3,691 ± 0,162	3,654 ± 0,063	0,733
26	19	Unknown	3,527 ± 0,327	3,400 ± 0,443	0,034
27	18	Unknown	0,885 ± 0,097	0,720 ± 0,149	0,132
28	17	Unknown	1,872 ± 0,159	2,130 ± 0,266	0,167
29	14	Unknown	2,183 ± 0,236	1,965 ± 0,186	0,247
30	10	Unknown	1,022 ± 0,433	1,150 ± 0,112	0,646

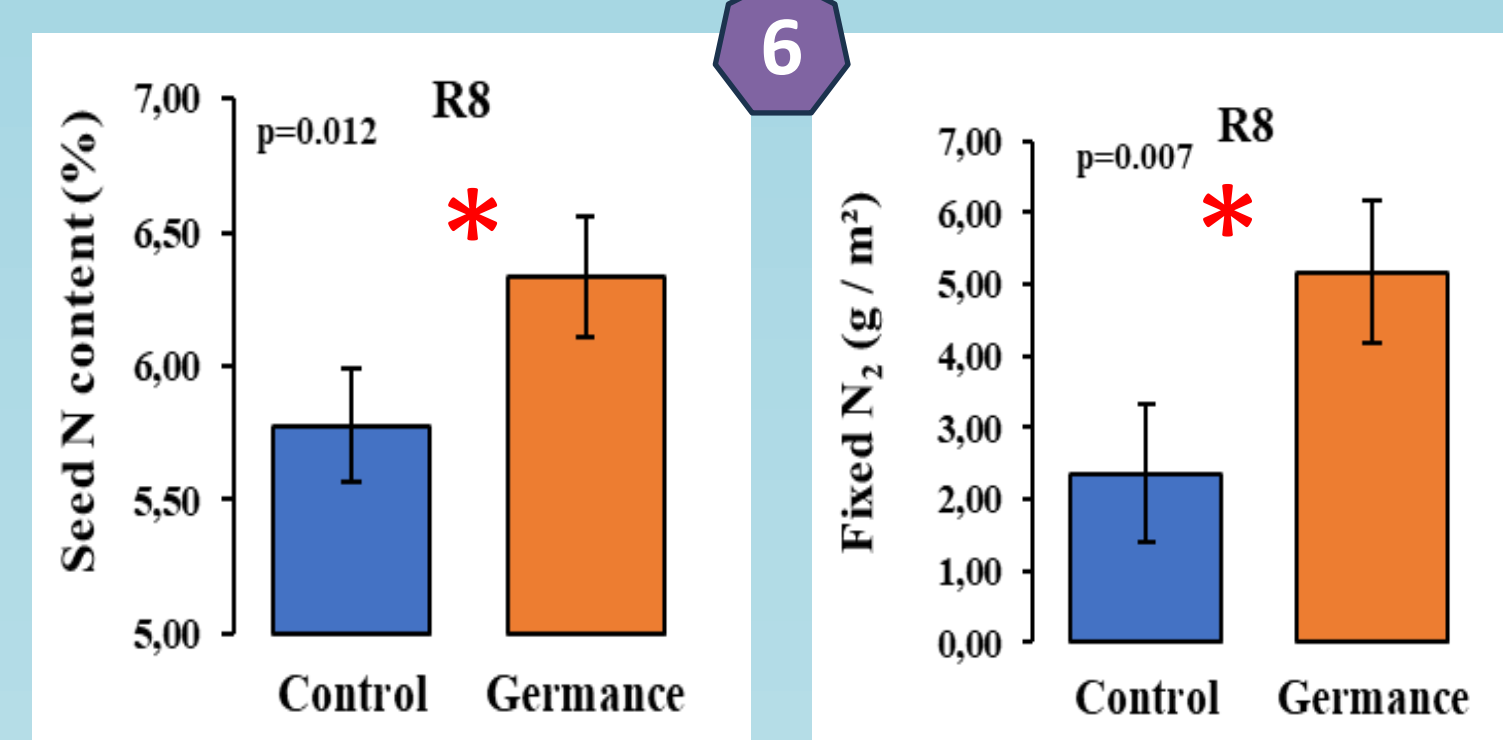
SDS-PAGE protein profiles and abundances from mature soybean seeds coming from control or GERMANCE® treated greenhouse-grown plants. Band annotation based on [Arif & Pauls, \(2018\)](#).

Field experiment

Ryes, Normandy, France (49.307177N, 0.633568W), 2021 (cv. ES Commandor, n=4)



#	Pods /m²	Seeds / plant	Seeds / pod	Normalized seed yield (q / Ha)	Biomass harvest index (%)
Control	1183 ± 189.2	73.20 ± 14.32	2.034 ± 0.045	26.18 ± 3.483	0.484 ± 0.011
Germance	1650 ± 425.3	74.30 ± 7.847	2.237 ± 0.401	27.43 ± 5.126	0.498 ± 0.025
p-value	0.092	0.897	0.354	0.701	0.353



# Peak	Molecular weight (kDa)	Peak identification	Control protein abundance (%)	Germance protein abundance (%)	p value
1	150	Hemagglutinin	1,332 ± 0,089	1,307 ± 0,088	0,695
2+3	125	Hemagglutinin	1,312 ± 0,190	1,144 ± 0,126	0,191
4+5	95	Lipoxigenase	2,857 ± 0,191	2,724 ± 0,344	0,524
6	90	Lipoxigenase	0,667 ± 0,101	0,667 ± 0,118	0,997
7	74	7S α	9,750 ± 0,219	9,773 ± 0,187	0,880
8	70	7S α	10,84 ± 0,165	10,73 ± 0,260	0,492
9	66	Unknown	1,766 ± 0,243	1,661 ± 0,222	0,548
10+11	60	β-amylase	6,983 ± 0,372	6,716 ± 0,178	0,244
12	56	Unknown	0,739 ± 0,123	0,703 ± 0,105	0,673
13	54	Unknown	1,403 ± 0,086	1,271 ± 0,120	0,123
14	52	Unknown	1,404 ± 0,061	1,312 ± 0,051	0,060
15	48	7S β	4,504 ± 0,167	4,253 ± 0,117	0,049
16	47	7S β	3,163 ± 0,450	3,172 ± 0,445	0,977
17	44	Unknown	1,010 ± 0,047	0,920 ± 0,061	0,058
18+19	38	A3	5,011 ± 0,221	5,117 ± 0,216	0,520
20	36	A4	3,213 ± 0,257	3,491 ± 0,148	0,110
21	34	A1	5,733 ± 0,164	5,604 ± 0,429	0,595
22	33	A2	5,730 ± 0,487	6,492 ± 0,163	0,025
23	31	Unknown	5,053 ± 0,311	4,938 ± 0,290	0,609
24	30	Unknown	1,642 ± 0,105	1,543 ± 0,201	0,416
25+26	28	Unknown	3,291 ± 0,155	3,541 ± 0,375	0,264
27	22	B3	1,923 ± 0,113	2,013 ± 0,170	0,412
28	21	B1B2	8,177 ± 0,254	8,623 ± 0,346	0,083
29	20	B4	2,897 ± 0,176	2,841 ± 0,258	0,728
30	19	Unknown	3,278 ± 0,163	3,261 ± 0,179	0,889
31	18	Unknown	0,627 ± 0,200	0,574 ± 0,154	0,684
32	17	Unknown	1,434 ± 0,094	1,445 ± 0,120	0,892
33+34	14	Unknown	3,527 ± 0,289	3,413 ± 0,143	0,504
35	10	Unknown	0,735 ± 0,047	0,759 ± 0,126	0,738

SDS-PAGE protein profiles and abundances from mature soybean seeds coming from control or GERMANCE® treated plants in field conditions. Band annotation based on [Arif & Pauls, \(2018\)](#).

Results:

Preliminary tests in phytotron confirmed that GERMANCE® seed coating did not impair germination (95% success for treated and control seeds). Under greenhouse conditions, GERMANCE-treated plants tend to have a faster emergence and an increased nodule number (1), leading to potential benefits for N acquisition and increase of shoot N accumulation (2). Proteomic changes in greenhouse-grown seeds indicated that GERMANCE® leads to (i) increase the abundance of sulfur-rich 11S glycinin subunits and (ii) decrease the accumulation of sulfur-poor 7S β-conglycinin subunits (3).

Results:

In field trial, GERMANCE® significantly boosted plant density at 5 weeks after sowing (45 vs. 36 plants/m², 4). Shoot biomass tends to increase (not significant) at flowering (R1 stage) and early pod formation (R3 stage, 4), while shoot N content was significantly higher at R3 stage (+25%, 4). At maturity (R8 stage), GERMANCE® does not affect yield components but tends to increase pod density per m² (+40%, p = 0.092, 5). Seed N content rises significantly (+10%, 6), and biologically fixed N₂ per m² strongly increases (+119%, 6) in response to GERMANCE® treatment. Proteomic analysis of field-grown seeds reveals that GERMANCE® increases sulfur-rich 11S glycinin subunits (+5.9% for 33 kDa A2 subunit, 7) and decreases sulfur-poor 7S β-conglycinin subunits (−13% for 48 kDa β subunit, 7), confirming data observed under controlled conditions (3).

Conclusions: Overall, these studies have demonstrated that GERMANCE® enhances early plant establishment, N acquisition and seed protein composition of soybean, suggesting positive influence of GERMANCE® on both N and S metabolism as well as seed protein quality.