Table S1: Influence of humic acid and amino acids on soybean seed yield

Reference	Mode of application	Soil type	Treatments	Yield (kg ha^{-1})	Yield without treatment (kg ha^{-1})	Yield change (kg ha^{-1})	Relative yield change (%)	Country
[32]	Foliar	Fine-textured silt loam	Humic acid (9.6 kg ha^{-1})	3576	2901	674	23.2	Pakistan
[58]	Foliar	Loam silty	Humic acid	2750	1666	1084	65.1	Iran
[59]	Foliar	Clay loam	Humic acid 15 L ha^{-1}	1091	933	158	16.9	Iran
[60]	Foliar	Silt	Humic acids 3 ml L^{-1}	5441	4979	462	9.3	Italy
			Protein hydrolysates – animal origin (Chemical Extraction) 3 ml L^{-1}	5418	4979	439	8.8	
			Protein hydrolysates – animal origin (Enzymatic extraction) 3 ml L^{-1}	5245	4979	266	5.3	
			Protein hydrolysates – vegetal origin (Enzymatic extraction) 3 ml L^{-1}	5464	4979	485	9.7	
[61]	Foliar	Fine loamy	*Yield Igniter applied at 3.0ptacre^{-1} (second unrolled trifoliolate leaf)	3640	3537	104	2.9	USA
			Yield Igniter applied at 3.0ptacre^{-1} (fourth unrolled trifoliolate leaf)	3482	3537	-55	-1.6	
			Yield Igniter applied at 3.0ptacre^{-1} (sixth unrolled trifoliolate leaf)	3685	3537	149	4.2	
			Yield Igniter applied at 3.0ptacre^{-1} (full bloom)	3576	3537	39	1.0	

[33]	Foliar	Gleyic phaeozems	**Terra Sorb Complex 0.3% 300 L ha^{-1} (single sprayed)	3639	3064	575	18.8	Poland
			Terra Sorb Complex 0.5% 300 L ha^{-1} (single sprayed)	2772	3064	-292	-9.5	
			Terra Sorb Complex 0.3% 300 L ha^{-1} (Double sprayed)	3881	3064	817	26.7	
			Terra Sorb Complex 0.5% 300 L ha^{-1} (Double sprayed)	4059	3064	1195	39.0	
[4]	Foliar	Yellow Oxisol	Glutamine acids 100 g ha^{-1}	3726	3434	292	8.5	Brazil
			Leusine 100 g ha^{-1}	3896	3434	462	13.5	
			Alanine 100 g ha^{-1}	3981	3434	547	15.9	
			Asparagine 100 g ha^{-1}	4038	3434	604	17.6	
			Trytophan 100 g ha^{-1}	4104	3434	670	19.5	
			Histidine 100 g ha^{-1}	4113	3434	679	19.8	
			Phenylalanine 100 g ha^{-1}	4132	3434	698	20.3	
			Lysine 100 g ha^{-1}	4189	3434	755	22.0	
			Proline 100 g ha^{-1}	4245	3434	811	23.6	
			Valine 100 g ha^{-1}	4302	3434	868	25.3	

			Amino acid extract 1000 ml ha^{-1}	4330	3434	896	26.1	
			Algae extract 1000 g ha^{-1}	4330	3434	896	26.1	
			Methionine 100 g ha^{-1}	4425	3434	991	28.8	
			Argnine 100 g ha^{-1}	4547	3434	1113	32.4	
			Betaine glycine 100 g ha^{-1}	4679	3434	1245	36.3	
			Serine 100 g ha^{-1}	5075	3434	1642	47.8	
[64]	folair	Oxysol	Wuxal Como Amino at 150ml	4112	3990	122	3.1	Brasil
			Fertiactyl Legumes at 200ml	4260	3990	270	6.8	
			Germinate	4335	3990	345	8.6	
[65]	seed	Dystropic red-yellow oxysol	Soybean oil	4279	4365	-86	-2.0	Brazil
			***CEO 1.6ml/l	5114	4365	749	17.2	

* *Yield Igniter as a Humic product, derived as a liquid extract from leonardite and includes N, P, and K (Innovative Crop Solutions, Radcliffe, IA)*** Terra Sorb, developed *by Bioberica using Enzyneer technology, contains free amino acids, *** CEO=clove essential oil*

Table S2: Influence of seaweed extracts on soybean seed yield

Reference	Mode of application	Soil type	Treatments	Yield (kg ha^{-1})	Yield without treatment (kg ha^{-1})	Yield change (kg ha^{-1})	Relative yield change (%)	Country

[71]	Foliar		Macerates (30 kg of roots of *Levisticum officinale* per 300 L of water)	3318	2382	936	39.3	Poland
[70]	Foliar	Silt loam	Ellagic acid at 50 ml L^{-1}	2484	1998	485.9	24.3	Iran
			Seaweed extract at (0.3%)	2729	1998	731.2	36.6	
[60]	Foliar	Silt	*Ascophyllum nodosum* extract 3 ml L^{-1}	5522	4979	543	10.9	Italy
			Ecklonia maxima extract 3 ml L^{-1}	5441	4979	462	9.3	
			Laminaria japonica extract 3 ml L^{-1}	5222	4979	243	4.9	
			Borago officinalis extract 3 ml L^{-1}	5337	4979	358	7.2	
			Potassium-silicate (mineral salt) 3 ml L^{-1}	5061	4979	82	1.6	
[6]	Foliar	Sandy loam	Seaweed extract (5% v/v)	119	102	17	16.8	Bangladesh
			Seaweed extract (10% v/v)	126	102	24	23.6	
[76]	Foliar	Albic luvisol	*FERT H (0.5%)	2010	1480	530	35.8	Romania
			*FERT A (2.5 L ha^{-1})	1880	1480	400	27.0	
[72]	Foliar	No specification	Seaweed extract applied at 1.0% concentration/300 L ha^{-1} via (API 2003)	3512	2673	839	31.4	Poland
			Seaweed extract applied at 1.0% concentration/300 L ha^{-1} via (6MSO3C)	3360	2673	687	25.7	
[33]	Foliar	Gleyic Phaeozem	******Ecklonia maxima,* lower 0.7% /300 300 L ha^{-1} concentration single sprayed	3693	3064	629	20.5	Poland
			Ecklonia maxima, lower 0.7% /300 L ha^{-1} concentration double sprayed	3844	3064	780	25.5	

			Ecklonia maxima, 1.0%/300 L ha^{-1} higher concentration single sprayed	3846	3064	782	25.5	
			Ecklonia maxima, 1.0%/300 L ha^{-1} higher concentration double sprayed	4169	3064	1105	36.1	
[77]	Foliar	Red clay Latosol	*Ascophyllum nodosum Extract (Sealicit™*) at 0.75 L ha^{-1}	3867	3522	345	9.8	Brazil
			Ascophyllum nodosum Extract (Sealicit™) at 1.5 L ha^{-1}	3874	3522	352	10.0	
			Ascophyllum nodosum Extract (Sealicit™) at 3.0 L ha^{-1}	3666	3522	144	4.1	
[78]	Foliar	Dysterophic red Latosol	***Booster® at 250 ml L^{-1}	5247	5079	167	3.3	Brazil
			Booster® at 500 ml L^{-1}	5346	5079	267	5.3	
			Booster® at 750 ml L^{-1}	5259	5079	180	3.5	
			Booster® at 1000 ml L^{-1}	5234	5079	155	3.1	
[120]	Foliar	Gleyic phaeozem	*Levisticum officinale Extract* at 300 L ha^{-1}	4093	3333	760	22.8	Poland
			Levisticum officinale Extract at 600 L ha^{-1}	3839	3333	506	15.2	
[73]	Brown bleached soil	Soil	Potassium humate at 1 L ha^{-1}	2670	2230	440	19.7	Russia
			Vostok EM^{-1} at 0.2 L ha^{-1}	2510	2230	280	12.6	
[111]	Foliar	Brown rendzina sub-type	Biostimulant containing *Ascophyllum nodosum* and free amino acids single sprayed at 0.7%	3706	3227	479	14.8	Poland

			Biostimulant containing *Ascophyllum nodosum* and free amino acids double sprayed at 0.7%	3668	3227	441	13.7	
			Biostimulant containing *Ascophyllum nodosum* and free amino acids single sprayed at 1.0%	3714	3227	487	15.1	
			Biostimulant containing *Ascophyllum nodosum* and free amino acids double sprayed at 1.0%	3937	3227	710	22.0	
[32]	Foliar	Fine-textured silt loam	seaweed extract (24 kg ha^{-1}),	3319	2901	418	14.4	Pakistan
			humic acid + seaweed extract (9 + 24 kg ha^{-1})	3926	2901	1025	35.9	
[79]	Foliar	Silt Loam	kelpak SL	3350	3010	340	11.3	Poland
			Aminoplant	3170	3010	160	5.3	
			Asahi SL	3270	3010	260	8.6	
[80]		dystrophic Latosol Yellow	*Ascophyllum nodosum* at 0.5 L ha^{-1}	2329	2329	0	0.0	Brasil
			Ascophyllum nodosum at 1.0 L ha^{-1}	2329	2329	0	0.0	
			Ascophyllum nodosum at 1.5 L ha^{-1}	2403	2329	74	3.2	

NB: **FERT-H product including a hydrolysed soy protein, matrix containing secondary elements and microelements and FERT-A including an algae extract (Ascophyllum nodosum), matrix containing secondary elements and microelements, **Kelpak contains phytohormones (mostly auxins 11 mg kg^{-1}, cytokinins 0.03 mg kg^{-1}, and auxin: cytokinin ratio 367:1), carbohydrates (16.9 g kg^{-1}), amino acids (2.5 g kg^{-1}), vitamin B1 (0.9 mg kg^{-1}), B2 (0.1 mg kg^{-1}), C (20 mg /kg), and E (0.7 mg kg^{-1}) ***Booster® biostimulant composition: 239 g L^{-1} of seaweed extract (Ecklonia maxima), 24.4 g L^{-1} of Mo and 36.6 g L^{-1} of Zn. The seaweed extract used to manufacture the product contains 10.7 mg L^{-1} of auxins and 0.03 mg L^{-1} of cytokinins.*

Table S3: Influence of beneficial bacteria and fungi on soybean seed yield

Reference	Mode of application	Soil type	Treatments	Yield (kg ha^{-1})	Yield without treatment (kg ha^{-1})	Yield change (kg ha^{-1})	Relative yield change (%)	Country
[58]	Foliar/seed inoculation	Loam silty	*Rhizobium*	1721	1288	433	34.4	Iran
			Rhizobium+ *Azospirillum*	1500	1288	212	16.5	
[32]	Seed inoculation	Fine-textured silt loam	*Bradyrhizobium* inoculation	3552	3309	242	7.3	Pakistan
[116]	Foliar	Loam, arenic cambisol	Complex treatment (6.5 mL Lexin 10 mL Agrovital 20 mL Maxim XL 035 FS)	2990	2550	440	17.3	Czech
			lexin at 6.5ml, water	2880	2550	330	12.9	
			brassinosteriods at 2.2 ml, substance 4145, water	2730	2550	180	7.1	
			leginohumate B at 25 ml. water	2600	2550	50	2.0	
[90]	Seed inoculation	Chernozem soil	*Bradyrhizobium japonicum*	4472	4208	264	6.3	Serbia
			Bradyrhizobium japonicum + *Azotobacter chroococcum* + Humic acid	4215	4208	7	0.2	

			Bradyrhizobium japonicum + *Azotobacter chroococcum*	4588	4208	380	9.0	
			Bradyrhizobium japonicum + *Bacillus subtilis*	4328	4208	120	2.9	
			Bradyrhizobium japonicum + *Bacillus megaterium*	4262	4208	54	1.3	
[98]	Soil/seed inoculation	Silt clay loam	Thiram at 3 g kg^{-1}	1428	1245	183	14.7	India
			Thiram + Carbendazim 2.1 at 3 g kg^{-1}	1436	1245	191	15.3	
			Carboxin at 2 g kg^{-1}	1446	1245	202	16.2	
			Vitavax at 2 g kg^{-1}	1386	1245	141	11.3	
			Trichoderma virde at 5 g kg^{-1}	1373	1245	128	10.3	
			Pseudomonas 3 g kg^{-1}	1439	1245	195	15.6	
			Thiomethaxam at 3 g kg^{-1}	1317	1245	72	5.8	
[82]	seed		Inoculated	3645	3072	573	18.7	Turkiye
[104]	Seeds		C0-Mo-plantinum	3131	3176	-45	-1.4	Brazil
			ICB nutrisolo *Trichoderma*	3218	3176	42	1.3	
			Endophytus (50)	3218	3176	43	1.3	
			Endophytus (100)	3325	3176	149	4.7	

			Endophytus (150)	3088	3176	-88	-2.8	
			Endophytus (200)	3473	3176	298	9.4	
[93]		Red Latosol	*A. brasilense* strains Ab-V5 and Ab-V6	3749	3586	163	4.6	Brazil
			P. fluorescens strain CNPSo 2719 and *A. brasilense* strains CNPSo 2083 and CNPSo 2084	3810	3586	224	6.2	
			P. aryabhattai, B. haynesii, and *B. circulans*	3709	3586	123	3.4	
			P. megaterium strain BRM 119 and *B. subtilis* strain BRM 2084	3712	3586	126	3.5	
[84]	seed inoculation	Typic Dystrohumic Cambisol	*Bradyhizobium*	3475	3920	-445	-11.4	
			Azospirillum brasilense	3745	3920	-175	-4.5	Brazil
			Bacillus subtilis	3691	3920	-229	-5.8	
			Trichoderma harzaianum sumbi-T5	3273	3920	-647	-16.5	

[105]	Foliar	Latosolo vermelho	BRM32111 (*Burkholderia* spp)	4188	4335	-147	-3.4	Brazil
			BRM32114 (*Serratia marcens*)	4552	4335	217	5.0	
[106]	seed inoculation	Sandy Loam	*Bacillus velezensis* at 15kgha^{-1}	2178.42	2178	0	0.0	China
			Bacillus velezensis at 30 kgha^{-1}	2390.17	2178	212	9.7	
[83]	seed inoculation	Latossolo Vermelho distrófico	*B. japonicum*	6420	6390	30	0.5	Brasil
[87]	Foliar	Vertisols	Epivio energy at 0.50 ml kg^{-1}	1350	1275	75	5.9	India
			Epivio energy at 1.0 ml kg^{-1}	1427	1275	152	11.9	
			Epivio energy at 2.0 ml kg^{-1}	1439	1275	164	12.9	
			Biozyme seed plus	1420	1275	145	11.4	
			Humesol at 2.5 L ha^{-1}	1345	1275	70	5.5	
			Rhizobium + PSB at 1.25 kg ha^{-1}	1431	1275	156	12.2	
[103]	Foliar	Latosol	*Trichoderma viride* applied at Vegatative stage (300ml)	5331	4966	365	7.3	Brazil
			Trichoderma viride applied at early flowering stage (300ml)	5224	4966	258	5.2	
			Trichoderma viride applied at Productive stage (300ml)	4954	4966	-12	-0.2	

[100]	Seed inoculation	Inceptisol	*Bacillus subtilis*	2699	2386	313	13.1	Iran
			Bacillus licheniformis	2745	2386	359	15.0	
			Control					
[101]	Seed inoculation	Rhodic ferralsol	AMF (*Rizo Plus® Rhizobacter)* inoculant	2984	1508	598	39.7	Brazil
[38]	Seed inoculation	Arcylic Red Latosol	*Trichoderma asperellum*	4448	4044	404	10.0	Brazil
[47]	Soil	Latossolo Vermelho	*Bradyrhizobium* (standard inoculation); co-inoculation with *Bacillus* strains (*B. subitilis* and *B. megaterium*)	4425	4452	-27	-0.6	Brazil
			Bradyrhizobium (standard inoculation) co-inoculation with arbuscular mycorrhiza (*Rhizophagus intraradices*)	4906	4452	454	10.2	
[99]	Soil	Eutric brown	*Microbiological preparation at (30 L ha^{-1})	3770	3378	392	11.6	Brazil
			Microbiological preparation applied at (30 L ha^{-1}) + 2 foliar treatments with microbiological preparation (2 × 6 L ha^{-1})	3759	3378	382	11.3	
[97]	Foliar/seed treatment	Silt clay	**Stimulate®, 500 mL/ 100 kg ha^{-1} 6o day before sowing (Bio OF)	3135	3089	46	1.5	Brazil

			Stimulate®, 500 mL 100kg ha^{-1} just before sowing (Bio BS)	3040	3089	-49	-1.6	
[44]	Foliar	Sandy clay loam	*Bradyrhizobium japonicum* inoculant (Liquid) at 150 mL	1724	1330	394	29.7	South Africa
			Bradyrhizobium japonicum inoculant (Liquid) at 300 ml	1692	1330	362	27.2	
			Bradyrhizobium japonicum inoculant (Liquid) at 150 mL	1602	1330	272	20.5	
		Sandy loam	*Peat inoculant* at 250 g	1742	1333	409	30.6	
			Peat inoculant at 500 g	1688	1333	355	26.6	
			Peat inoculant at 150 mL	1642	1333	308	23.1	
[95]	Foliar	Latossolo Vermelho Distrofico	Nicotinamide concentrations at 100 mg L^{-1}	4411	3962	449	11.3	Brazil
			Nicotinamide concentrations at 200 mg L^{-1}	4572	3962	610	15.4	
			Nicotinamide concentrations at 300 mg L^{-1}	4510	3962	548	13.8	
			Nicotinamide concentrations at 400 mg L^{-1}	4379	3962	417	10.5	

			Nicotinamide concentrations at 500 mg L^{-1}	4333	3962	371	9.4	
			Nicotinamide concentrations at 600 mg/L	4215	3962	253	6.4	
[92]	seed inoculation	Oxisol	inoculation with *B. japonicum* at (150 mL)	3346		433	14.9	
			***inoculation with A. brasilense at (150 mL)	3216	2912	303	10.4	Brazil
			co-inoculation with *B. japonicum* + *A. brasilense* at (75 mL + 75 mL)	3211	2912	298	10.2	
			co-inoculation with *B. japonicum* + *A. brasilense* at (150 mL +150 mL)	3591	2912	679	23.3	
			co-inoculation with *B. japonicum* + *A. brasilense* at (225 mL+ 225 mL)	4080	2912	1168	40.1	
			co-inoculation with B. japonicum+ *A. brasilense* at (300 mL+ 300 mL)	3221	2912	308	10.6	
[119]	Foliar	Brown rendzina soil	****Atonik (lower single sprayed) 0.1%	3662	3064	598	19.5	Poland
			Atonik (Lower double sprayed) 0.1%	3806	3064	742	24.2	
			Atonik (Higher single sprayed) 0.2%	3715	3064	651	21.2	
			Atonik (higher double sprayed) 0.2%	3979	3064	915	29.9	

			Control					
			Tytanit (lower single sprayed) 0.07%	3518	3064	454	14.8	
			Tytanit (Lower double sprayed) 0.07%	3787	3064	723	23.6	
			Tytanit (Higher single sprayed) 0.13%	3856	3064	792	25.8	
			Tytanit (higher double sprayed) 0.13%	4097	3064	1033	33.7	
[91]	Seed inoculation	Latossolo Vermelho Distrófico	*****Peat *Bradyrhizobium* spp	3482	1902	1580	83.1	Brazil
			Liquid *Bradyrhizobium* spp	3150	1902	1249	65.7	
			Single *Bradyrhizobium* + Single *Azospirillum brasilense*	3613	1902	1712	90.0	
			Composite inoculant *Bradyrhizobium* + *Azospirillum brasilense*	3796	1902	1894	99.6	
[94]	Seed inoculation	Acrustox	******standard inoculation (SI) with *Bradyrhizobium* spp	4581	4297	284	6.6	
			SI + 1.0 µl ml^{-1} ME-LCO	5033	4297	737	17.1	Brazil
			SI + 0.5 µl ml^{-1} LCOp	4780	4297	483	11.2	
			SI + of 2.0 µl ml^{-1} COp	4412	4297	115	2.7	

			SI + of 62.5 µl ml^{-1} EPS	4573	4297	276	6.4	
[96]	Soil	not specified	Organic fertilizer after 3 days of composting at 30 $t \cdot ha^{-1}$	2116	2334	-218	-9.3	China
			Organic fertilizer after 14 days of composting at 30 $t \cdot ha^{-1}$	2500	2334	166	7.1	
			Organic fertilizer after 21 days of composting at 30 $t \cdot ha^{-1}$	2687	2334	353	15.1	
			Organic fertilizer after 28 days of composting at 30 $t \cdot ha^{-1}$	2568	2334	234	10.0	
			Organic fertilizer after 45 days of composting at 30 $t \cdot ha^{-1}$	2508	2334	174	7.5	
			Organic fertilizer after 60 days of composting at 30 $t \cdot ha^{-1}$	2477	2334	142	6.1	
[86]	Soil	Ferric acrisol	PS foundation (1-0-1) 0.45l/38l/acre	2944	2510	434	17.3	Ghana
	Seed treatment		*Rhizobium* Inoculant 1:500 g	2310	1772	538	30.4	
[110]	Soil	Silt clay	Biozyme™ @25 kg	2510	2536	-26	-1.0	India
			Biozyme™ @35 kg	2496	2536	-40	-1.6	
			Biozyme™ @45 kg	2575	2536	39	1.5	
			Biozyme™ crop-plus spray@250 ml ha^{-1}	2511	2536	-25	-1.0	
			Biozyme™ crop-plus spray@500 ml ha^{-1}	2585	2536	49	1.9	

Microbiological preparation Em - Aktiv (composition includes nitrofixing bacteria of the genus Bradyrhizobium and Azotobacter, as well as the bacteria Pseudomonas fluorescens, Bacillus spp.),[Stimulate®, (0.009% kinetin + 0.005% auxin + 0.005% gibberellic acid)],***Isolated inoculation and com-bined inoculation of B. japonicum (Gelfix 5 SEMIA 5079 andSEMIA 5080– 5×10 9 UFC m L^{-1}) and A. brasilense (MasterfixL Ab-V5 and Ab-V6- 5×10 9 UFC m L^{-1}),**** Atonik consist of sodium p-nitrophenolate $NaC_6H_4NO_3$ (3.75 g L^{-1}), sodium o-nitrophenolate $NaC_6H_4NO_3$ (2.5 g L^{-1}), sodium 5-nitrogualacolate $NaC_7H_6NO_4$ (1.25) and Tytanit also consist of Titanium ascorbate (8.5 g L^{-1}) magnesium sulfate $MgSO_4$ (40.8 g L^{-1}) and S as Magnesium sulfate $mgSO_4$ (54.4 g L^{-1}),*****Peat and liquid inoculant with Bradyrhizobium spp. strains SEMIA 5079 + SEMIA 5080, ******Bradyrhizobium spp. and secondary metabolism molecules inoculation*

Table S4: Interactive effect of biostimulants and other fertilizer types or agro-inputs on soybean yield

Reference	Mode of application	Soil type	Treatments	Yield (kg ha^{-1})	Yield without treatment (kg ha^{-1})	Yield change (kg ha^{-1})	Relative yield change (%)	Country
[58]	Foliar/seed inoculation	Loam silty	Humic acid + *Rhizobium*+ Co	2948	1288	1660	128.9	Iran
			Humic acid + *Rhizobium*+ Co+Mo	2967	1288	1679	130.4	
			Humic acid + *Rhizobium*+ Co+Mo+B	3125	1288	1837	142.6	
			Humic acid+*Rhizobium*+ *Azospirillum* +Co	2747	1288	1459	113.3	
			Humic acid+*Rhizobium*+ *Azospirillum* +Co+Mo	2720	1288	1432	111.2	
			Humic acid+*Rhizobium*+ *Azospirillum* +Co+Mo+B	3288	1288	2000	155.3	
[59]	Foliar	Clay loam	Humic acid + N+P+Fe+Mo	1772	931	841	90.3	Iran
			Humic acid + P+Fe+Mo	1465	931	534	57.4	
			Humic acid + N+Fe+Mo	1679	931	748	80.3	
			Humic acid + N+P+Mo	1619	931	688	73.9	
			Humic acid + N+P+Fe	1706	931	775	83.2	
[110]	Soil	Silt clay	BiozymeTM @25 kg + Half NPK	2820	2536	284	11.2	India
			BiozymeTM @35 kg + Half NPK	2915	2536	379	14.9	

			BiozymeTM @45 kg + Half NPK	2955	2536	419	16.5	
			BiozymeTM crop-plus spray@250 ml ha^{-1} + Half NPK	2868	2536	332	13.1	
			BiozymeTM crop-plus spray@500 ml ha^{-1} + Half NPK	3277	2536	741	29.2	
[77]	Foliar	Red clay Latosol	Shatter-susceptible (SS) UFUS 6901 + *Ascophyllum nodosum Extract (Sealicit™*) 0.75 L ha^{-1}	3792	3558	234	6.6	Brazil
			Shatter-susceptible (SS) UFUS 6901 + *Ascophyllum nodosum Extract (Sealicit™*) 1.5 L ha^{-1}	3636	3558	78	2.2	
			Shatter-susceptible (SS) UFUS 6901 + *Ascophyllum nodosum Extract (Sealicit™*) 3.0 L ha^{-1}	3779	3558	221	6.2	
			Shatter-resistant (SR) UFUS 7415 + *Ascophyllum nodosum Extract (Sealicit™*) 0.75 L ha^{-1}	3942	3486	456	13.1	
			Shatter-resistant (SR) UFUS 7415 + *Ascophyllum nodosum Extract (Sealicit™*) 1.5 L ha^{-1}	4111	3486	625	17.9	
			Shatter-resistant (SR) UFUS 7415 + *Ascophyllum nodosum Extract (Sealicit™*) 3.0 L ha^{-1}	3554	3486	67	1.9	

[100]	Seed inoculation	Inceptisol	Water deficit stress from mid pod development stage × *Bacillus subtilis*	1543	1400	143	10.2	Iran
			Water deficit stress from mid pod development stage × *Bacillus licheniformis*	1611	1400	211	15.1	
			Water deficit stress from grain filling development stage × Untreated with PGPR	2135	1400	735	52.5	
			Water deficit stress from grain filling development stage × *Bacillus subtilis*	2641	1400	1241	88.6	
			Water deficit stress from grain filling development stage × *Bacillus licheniformis*	2771	1400	1371	97.9	
			Optimum irrigation in all development stages × Untreated with PGPR	3624	1400	2224	158.9	
			Optimum irrigation in all development stages × *Bacillus subtilis*	3844	1400	2444	174.6	
			Optimum irrigation in all development stages × *Bacillus licheniformis*	3921	1400	2521	180.1	

[101]	Seed inoculation	Rhodic ferralsol	AMF (Rizo Plus® Rhizobacter)					Brazil
			AMF (R clarus inoculant plus 65kg ha^{-1} KCL) + Fertilizer (200 kg ha^{-1} NPK 0:20:20)	3286	1508	1778	117.9	
			AMF (R clarus inoculant plus 65 kg ha^{-1} KCL) + 1/2 Fertilizer (100 kg ha^{-1} NPK 0:20:20)	2095	1508	587	38.9	
[99]	Soil	Eutric brown	IKA + 00kg N_2 ha^{-1} + Microbiological preparation *(EM-Aktiv) at 30 L ha^{-1}	3684	3167	518	16.3	Brazil
			IKA + 00 kg N_2 ha^{-1} + Microbiological preparation (EM-Aktiv) at (30 L ha^{-1}) + 2 foliar treatments with microbiological preparation (2 × 6 L ha^{-1})	3657	3167	491	15.5	
			IKA + 50 kg N_2 ha^{-1} + Control	3468	3167	302	9.5	
			IKA + 50 kg N_2 ha^{-1} + Microbiological preparation (EM-Aktiv) at 30 L ha^{-1}	3702	3167	535	16.9	
			IKA + 50 kg N_2 ha^{-1} + C3 - Microbiological preparation (EM-Aktiv) at (30 L ha^{-1}) + 2 foliar treatments with microbiological preparation (2 × 6 L ha^{-1})	3696	3167	529	16.7	

			Vita + 0 Kg N_2 ha^{-1} + Microbiological preparation (EM-Aktiv) at 30 L ha^{-1}	3684	3368	316	9.4	
			Vita + 00Kg N_2 ha^{-1} + Microbiological preparation (EM-Aktiv) at 30 L ha^{-1} + 2 foliar treatments with microbiological preparation (2 × 6 L ha^{-1})	3921	3368	554	16.4	
			Vita + 50 kg N_2 ha^{-1} + Control	3508	3368	141	4.2	
			Vita + 50 kg N_2 ha^{-1} + Microbiological preparation (EM-Aktiv) at 30 L ha^{-1})	4010	3368	642	19.1	
			Vita + 50 kg N_2 ha^{-1} + Microbiological preparation (EM-Aktiv) at (30 L ha^{-1}) + 2 foliar treatments with microbiological preparation (2 × 6 L ha^{-1})	3762	3368	395	11.7	
[47]	Soil	Latossol Vermelho	100 kg ha^{-1} MAP + *Bradyrhizobium* (standard inoculation); co-inoculation with *Bacillus* strains (*B. subitilis* and *B. megaterium*)	5289	4425	864	19.5	Brazil
			100 kg ha^{-1} MAP + *Bradyrhizobium* (standard inoculation)co-inoculation with	5200	4906	294	6.0	

			arbuscular mycorrhiza (*Rhizophagus intraradices*)					
[36]	Seed inoculation	Ultic ustochrepts	**R0P1 (100% Phosphorus without *P. striata*)	1090	844	246	29.1	Bangladesh
			R0P2 (75% Phosphrous with *P. striata*)	1239	844	395	46.8	
			R1P0 (100% Nitrogen without *R. japonicum*)	1271	844	427	50.6	
			R1P1 (100% Nitrogen + 100% Phosphorus)	1848	844	1004	119	
			R1P2 (100% Nitrogen + 75% Phosphorus + *P. striata*)	1891	844	1047	124.1	
			R2P0 (50% Nitrogen with *R. japonicum*)	1368	844	533	62.0	
			R2P1 (50% Nitrogen with *R. japonicum* + 100% Phosphorus without *P. striata*)	1934	844	1090	129.1	
			R2P2 (50% Nitrogen with *R. japonicum* + 75% Phosphorus with *P. striata*)	2051	844	1207	143.0	
			R3P0 (*R. japonicum*)	1271	844	427	50.6	
			R3P1 (*R. japonicum* + 100% Phosphorus without *P. striata*)	1656	844	812	96.2	

			R3P2 (*R. japonicum* + 75% Phosphorus with *P. striata*)	1848	844	1004	119.0	
			R0P0 Control (No nitrogen, *R. japonicum*, Phosphorus & *P. striata*					
[86]	Soil	Ferric acrisol	TSP at 60 kg ha^{-1} + *Rhizobium* inoculant	3666	1772	1894.00	106.8	Ghana
[105]	Foliar	Latosolo vermelho	co-inoculation (BRM 32111 + BRM 32114)	4574	4335	239	5.5	Brasil
[108]	foliar	medium loam	P + Amino turbo	3880	3070	810	26.4	Kazakhstan
			P +Ruter AA	4010	3070	940	30.6	
			P + Geogumat	4130	3070	1060	34.5	
[109]	soil	Latossolo vermelho Amarelo	MAP+HA+M	3448	3240	209	6.4	Brasil
			MAP+HA	3376	3240	137	4.2	
[82]	seed		40 kg ha-1 N + *Bradyrhizobium japonicum*	3189	2598	591	22.8	Turkye
			80 kg ha-1 N + *Bradyrhizobium japonicum*	3524	2598	926	35.6	

			120 kg ha-1 N + *Bradyrhizobium japonicum*	3856	2598	1258	48.4	
			160 kg ha-1 N + *Bradyrhizobium japonicum*	3859	2598	1261	48.5	
			200 kg ha-1 N + *Bradyrhizobium japonicum*	3894	2598	1296	49.9	
			240 kg ha-1 N + *Bradyrhizobium japonicum*	3922	2598	1324	51.0	
			280 kg ha-1 N + *Bradyrhizobium japonicum*	3932	2598	1334	51.4	
[84]	seed inoculation	Typic Dystrohumic Cambisol	*Bradyrhizobium* + *Azospirillum brasilense*	3085	3920	-835	-21.3	Brasil
			Bradyrhizobium + *Bacillus subtilis*	3812	3920	-108	-2.8	
			Bradyrhizobium + *Trichoderma harzaianum* sumbi-T5	4310	3920	390	9.9	
			Bradyrhizobium + *Azospirillum brasilense* + *Bacillus subtilis*	3785	3920	-135	-3.44	

			Bradyrhizobium + *Azospirillum brasilense* + *Trichoderma harzaianum* sumbi-T5	2748	3920	-1172	-29.9	
			Bradyrhizobium + *Bacillus subtilis* + *Trichoderma harzaianum* sumbi-T5	4243	3920	323	8.2	
			Bradyrhizobium + *Azospirillum brasilense* + *Bacillus subtilis* +*Trichoderma harzaianum* sumbi-T5	4108	3920	188	4.8	
[83]	seed inoculation	Latossolo Vermelho distrófico	*B. japonicum* + *B aryabhattai*	6130	6390	-260	-4.1	Brasil

**NB: Microbiological preparation Em - Aktiv (composition includes nitrofixing bacteria of the genus Bradyrhizobium and Azotobacter, as well as the bacteria Pseudomonas fluorescens, Bacillus spp.) A1&2 = Cultivar, B1&2=N fertilizer and C= Microbiological preparation Em – Aktiv, **R0: Control (no nitrogen and R. japonicum), R1: 100% N (as recommended for soybean in FRG without R. japonicum, R2: 50% N with R. japonicum, and R3: only R. japonicum inoculant and three treatments for Pseudomonas viz. P0: Control (no P and no P. striata), P1: 100% P (as recommended for soybean in FRG without P. striata and P2: 75% P with P. striata*

Table S5: Effect of biostimulants on soybean quality traits

Reference	Mode of application	Soil type	Treatments	Protein (%)	Protein content without treatment (%)	Change in protein (%)	Oil content (%)	Oil content without treatment (%)	Change in oil content (%)	Country
[58]	Foliar/seed inoculation	Loam silty	Humic acid	34.98	34.55	0.43	13.81	12.56	1.25	Iran
			Rhizobium	34.89	31.41	3.48	15.88	12.56	3.32	
			Rhizobium+ Azospirillum	35.68	31.41	4.27	13.86	12.56	1.30	
[59]	Foliar	Clay loam	Humic acid	29.76	28.68	1.08	12.86	12.4	0.46	Iran
[116]	Foliar	loam, arenic cambisol	Complex treatment (*saturated solution of saccharose 6.5 ml lexin, 10 ml Agrovital, 20 ml Maxim xl 035 FS)*	33.43	33.34	0.09	19.09	18.74	0.35	Czech
			lexin 6.5ml, water	33.02	33.34	-0.32	19.02	18.74	0.28	
			brassinosteriods 2.2 ml, substance 4145, water	32.48	33.34	-0.86	19.08	18.74	0.34	

			leginohumate B 25 ml. water	33.38	33.34	0.04	18.59	18.74	-0.15	
[76]	Foliar	Albic luvisol	*FERT H (0.5%)	35.60	33.80	1.80	25.30	24.80	0.50	Romania
			FERT A (2.5L/ha)	35.50	33.80	1.70	24.80	24.80	0.00	
[33]	Foliar	Gleyic Phaeozem	**_Ecklonia maxima,_ lower 0.7% /300l/ha concentration single sprayed	39.70	39.40	0.30				Poland
			Ecklonia maxima, lower 0.7% /300 L ha^{-1} concentration double sprayed	40.70	39.40	1.30				
			Ecklonia maxima, 1.0%/300 L ha^{-1} higher concentration single sprayed	40.50	39.40	1.10				
			Ecklonia maxima, 1.0%/300 L ha^{-1} higher concentration double sprayed	39.90	39.40	0.50				

[118]	Foliar	Brown rendzina soil	***Atonik (lower single sprayed) 0.1%	29.78	26.33	3.45		Poland
			Atonik (Lower double sprayed) 0.1 %	25.59	26.33	-0.74		
			Atonik (Higher single sprayed) 0.2%	24.99	26.33	-1.34		
			Atonik (higher double sprayed) 0.2%	27.83	26.33	1.50		
			Tytanit (lower single sprayed) 0.07%	29.78	29.48	0.30		
			Tytanit (Lower double sprayed) 0.07%	27.53	29.48	1.95		
			Tytanit (Higher single sprayed) 0.13%	28.58	29.48	-0.90		
			Tytanit (higher double sprayed) 0.13%	30.37	29.48	0.89		

[111]	Foliar	Gleyic phaeozems	Terra Sorb Complex 0.3%300 L ha^{-1} (single sprayed)	41.10	37.90	3.20				Poland
			Terra Sorb Complex 0.5%300 L ha^{-1} (single sprayed)	39.20	37.90	1.30				
			Terra Sorb Complex 0.3%300 L ha^{-1} (Double sprayed)	40.40	37.90	2.50				
			Terra Sorb Complex 0.5%300 L ha^{-1} (Double sprayed)	40.10	37.90	2.20				
[100]	Seed inoculation	Inceptisol	*Bacillus subtilis*	30.70	27.70	3.00				Iran
			Bacillus licheniformis	30.60	27.70	2.90				
[99]	Soil	Eutric brown	Microbiological preparation	38.20	37.50	0.70	22.53	21.97	0.56	Brazil

			****(*Em – Aktiv)* at (30 L ha^{-1})							
			Microbiological preparation applied at (30 L ha^{-1}) + 2 foliar treatments with microbiological preparation (2 × 6 L ha^{-1})	36.82	37.5	-0.68	22.37	21.97	0.40	
[121]	Foliar	Brown rendzina sub-type	Biostimulant containing *Ascophyllum nodosum and free amino acids* single sprayed at 0.7%	37.12	36.61	0.51				Poland
			Biostimulant containing *Ascophyllum nodosum and free amino acids* double sprayed at 0.7%	37.11	36.61	0.50				
			Biostimulant containing *Ascophyllum nodosum and free*	37.80	36.61	1.19				

			amino acids single sprayed at 1.0%					
			Biostimulant containing *Ascophyllum nodosum and free amino acids* double sprayed at 1.0%	37.54	36.61	0.93		
[120]	Foliar	Gleyic phaeozem	*Levisticum officinale Extract* (Infusion spray at 300 L ha^{-1})	36.72	35.34	1.38		Poland
			Levisticum officinale Extract (water spray 600 L ha^{-1})	35.59	35.34	0.25		
[115]	Seed inoculation	Latossolo Vermelho Distrófico	co inoculation of *Bradyrhizobium spp. and Azospirillum Brasilense*	35.00	33.10	1.90		Brazil
[71]	Foliar		Macerates (30 kg of roots of *Levisticum*	38.38	36.31	2.07		Poland

		officinale per 300 L of water)							
[82]	seed	*40 kg ha-1 N + Bradyrhizobium japonicum*	39.30	37.90	1.40	18.00	18.90	-0.90	Turkye
		80 kg ha-1 N + Bradyrhizobium japonicum	39.30	37.90	1.40	17.80	18.90	-1.10	
		120 kg ha-1 N + Bradyrhizobium japonicum	39.60	37.90	1.70	17.90	18.90	-1.00	
		160 kg ha-1 N + Bradyrhizobium japonicum	39.80	37.90	1.90	17.60	18.90	-1.30	
		200 kg ha-1 N + Bradyrhizobium japonicum	39.60	37.90	1.70	17.40	18.90	-1.50	
		240 kg ha-1 N + Bradyrhizobium japonicum	39.90	37.90	2.00	17.30	18.90	-1.60	
		280 kg ha-1 N + Bradyrhizobium japonicum	40.1	37.9	2.2	17.30	18.90	-1.60	

[84]	seed inoculation	Typic Dystrohumic Cambisol	*Bradyrhizobium* + *Azospirillum brasilense*	42.00	27.00	15.00	10.70	12.60	-1.90	Brasil
			Bradyrhizobium + *Bacillus subtilis*	41.00	27.00	14.00	10.10	12.60	-2.50	
			Bradyrhizobium + *Trichoderma harzaianum* sumbi-T5	41.70	27.00	14.70	8.90	12.60	-3.70	
			Bradyrhizobium + *Azospirillum brasilense* + *Bacillus subtilis*	42.20	27.00	15.20	8.80	12.60	-3.80	
			Bradyrhizobium + *Azospirillum brasilense* + *Trichoderma harzaianum* sumbi-T5	42.20	27.00	15.20	8.80	12.60	-3.80	
			Bradyrhizobium + *Bacillus subtilis* + *Trichoderma harzaianum* sumbi-T5	42.50	27.00	15.50	8.30	12.60	-4.30	

	Bradyrhizobium + Azospirillum brasilense + Bacillus subtilis +Trichoderma harzaianum sumbi-T5	42.40	27.00	15.40	9.20	12.60	-3.40

NB: FERT-H product including a hydrolysed soy protein, matrix containing secondary elements and microelements and FERT-A including an algae extract (Ascophyllum nodosum), matrix containing secondary elements and microelements,NB:Kelpak contains phytohormones (mostly auxins 11 mg kg^{-1}, cytokinins 0.03 mg kg^{-1}, and auxin: cytokinin ratio 367:1), carbohydrates (16.9 g kg^{-1}), amino acids (2.5 g kg^{-1}), vitamin B1 (0.9 mg kg^{-1}), B2 (0.1 mg kg^{-1}), C (20 mg kg^{-1}), and E (0.7 mg kg^{-1}),***NB : Atonik consist of sodium p-nitrophenolate NaC6H4NO3 (3.75 g L^{-1}), sodium o-nitrophenolate NaC6H4NO3 (2.5 g L^{-1}), sodium 5-nitrogualacolate NaC7H6NO4 (1.25) and Tytanit also consist of Titanium ascorbate (8.5 g L^{-1}) magnesium sulfate MgSO4 (40.8 g L^{-1}) and S as Magnesium sulfate mgSO4 (54.4 g L^{-1}), ****Microbiological preparation Em - Aktiv (composition includes nitrofixing bacteria of the genus Bradyrhizobium and Azotobacter, as well as the bacteria Pseudomonas fluorescens, Bacillus spp.*