agriculture

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Supplementary Material

The biocontrol of plant pathogenic fungi by selected lactic acid bacteria – from laboratory to field study

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1. Supplementary Material

Table S1. Indicator microorganisms used for the antifungal activity studies

Strain identification number	Species	Isolation source
KZF 1	*Fusarium graminearum*	Winter wheat
KZF 5	*Fusarium culmorum*	Winter wheat
KZF 27	*Fusarium oxysporum*	Oats
KZF 181	*Fusarium poae*	Oats
KZF 32	*Alternaria alternata*	Winter rapeseed
KZF 38	*Rhizoctonia solani*	Potato
BPR 1303	*Colletotrichum gleosporioides*	Yellow lupine
KZF 53	*Sclerotinia sclerotiorum*	Winter rapeseed

Table S2. Cultivation conditions and soil characteristics in the field experiments

Characteristics of cultivation conditions			
parameter		***sowing period***	
		2015/2016	2016/2017
Forecrop		winter barley	winter wheat
Soil type		sandy loam	loamy sand
Soil class		IVa	IVa
Organic matter content [%]		1.19	0.98
Soil pH		5.6	5.5
Soil granulometric composition [mm]:		***percentage share [%]***	
	sands 2.0 – 0.05	69.12	74.67
	dusts 0.05 – 0.002	27.63	22.74
	clays < 0.002	3.25	2.59
Soil cultivation			
sowing period	***date***	***Type of cultivation***	
2015/2016	17.08.2015	Disc harrow	
	07.09.2015	Plowing	
	10.09.2015	Cultivating aggregate	
	09.10.2015	Cultivating aggregate	
2016/2017	31.08.2016	Disc harrow	
	13.10.2016	Plowing	
	14.10.2016	Cultivating aggregate	

Table S3. General information about fertilization and plant control

Fertilization				
sowing period	***date***	***trade name of mineral fertilizer***	***dose [l; kg/ha]***	***rate of NPK [l; kg/ha]***
2015/2016	08.09.2015	Polifoska	400	N–16; P-48; K-128
	14.03.2016	Saletra amonowa 34%	176	N-60
2016/2017	14.10.2016	Amofoska	500	N–20; P-60; K-100
	06.03.2017	Saletra amonowa 34%	176	N-60
	12.04.2017	Saletra amonowa 34%	176	N-60
Pesticide applications				
sowing period	***date***	***type of pesticide***	***trade name***	***dose [l; kg/ha]***
2015/2016	04.04.2016	herbicide	Mocarz 75 WG	0.2
	25.04.2016	herbicide	Starane Super 101 SE	1.25
2016/2017	23.11.2016	herbicide	Komplet 560 EC	0.5
	25.05.2017	insecticide	Fury 100 EC	0.1

Table S4. Meteorological data during the field experiment in the sowing season 2015/2016.

Location of meteorological station: Winna Góra					
Month/year	Weather parameters	Decades			Mean/total
		I	II	III	
9/2015	average temp. [°C]	15,62	17,50	12,36	**15,16**
	average air humidity [%]	73,36	75,55	75,93	**74,95**
	total precipitations [mm]	12,50	5,50	0,00	**18,00**
10/2015	average temp. [°C]	9,58	6,69	7,92	**8,07**
	average air humidity [%]	68,63	89,10	87,95	**81,89**
	total precipitations [mm]	0,10	24,80	5,50	**30,40**
11/2015	average temp. [°C]	7,51	9,70	2,20	**6,47**
	average air humidity [%]	86,87	88,41	88,55	**87,94**
	total precipitations [mm]	8,20	33,80	7,50	**49,50**
12/2015	average temp. [°C]	6,86	5,13	5,76	**5,92**
	average air humidity [%]	87,98	93,01	82,27	**87,75**
	total precipitations [mm]	6,60	17,30	2,40	**26,30**
01/2016	average temp. [°C]	-6,36	-1,63	2,53	**-1,82**
	average air humidity [%]	85,60	92,28	86,17	**88,25**
	total precipitations [mm]	2,90	16,70	6,30	**25,90**
02/2016	average temp. [°C]	6,09	2,73	2,76	**3,86**
	average air humidity [%]	79,77	89,99	88,62	**86,13**
	total precipitations [mm]	9,70	10,00	16,60	**36,30**
03-2016	average temp. [°C]	3,27	3,02	6,64	**4,31**
	average air humidity [%]	91,81	86,02	83,14	**86,99**

	total precipitations [mm]	15,50	4,80	4,70	**25,00**
04/2016	average temp. [°C]	10,79	9,96	7,22	**9,33**
	average air humidity [%]	67,54	79,95	67,90	**71,80**
	total precipitations [mm]	5,0	18,6	2,1	**25,70**
05-2016	average temp. [°C]	14,39	13,42	19,93	**15,91**
	average air humidity [%]	66,08	71,43	68,64	**68,66**
	total precipitations [mm]	0,00	18,30	9,00	**27,30**
06/2016	average temp. [°C]	18,40	17,48	21,35	**19,08**
	average air humidity [%]	64,22	73,18	73,00	**70,13**
	total precipitations [mm]	6,00	26,50	0,00	**32,50**
07/2016	average temp. [°C]	18,66	18,57	21,25	**19,49**
	average air humidity [%]	69,77	80,24	75,36	**75,12**
	total precipitations [mm]	4,30	89,90	21,80	**115,90**
08/2016	average temp. [°C]	18,41	17,07	19,48	**18,32**
	average air humidity [%]	78,63	71,45	73,41	**74,50**
	total precipitations [mm]	5,80	0,10	12,60	**18,50**

Table S5. Meteorological data during the field experiment in the sowing season 2016/2017**.**

Location of meteorological station: Winna Góra					
Month/year	Weather parameters	Decades			Mean/total
		I	II	III	
9/2016	average temp. [°C]	18,69	18,45	13,57	**16,90**
	average air humidity [%]	75,70	65,15	73,10	**71,32**
	total precipitations [mm]	11,3	0,00	3,90	**15,20**
10/2016	average temp. [°C]	10,22	7,16	7,55	**8,31**
	average air humidity [%]	89,35	91,90	92,03	**91,09**
	total precipitations [mm]	0,00	21,20	15,20	**36,40**
11/2016	average temp. [°C]	3,68	3,16	0,62	**2,49**
	average air humidity [%]	93,28	92,09	93,61	**92,99**
	total precipitations [mm]	10,50	7,70	2,30	**20,50**
12/2016	average temp. [°C]	2,90	0,94	1,76	**1,87**
	average air humidity [%]	92,64	94,47	91,51	**92,87**
	total precipitations [mm]	14,80	17,70	7,20	**39,70**
01/2017	average temp. [°C]	-3,45	-2,33	-1,19	**-2,32**
	average air humidity [%]	82,49	91,87	86,93	**87,10**
	total precipitations [mm]	4,00	6,00	0,40	**10,40**
02/2017	average temp. [°C]	-2,82	-0,42	5,90	**0,89**
	average air humidity [%]	88,50	85,25	81,25	**85,00**
	total precipitations [mm]	0,00	6,30	16,40	**22,70**
03/2017	average temp. [°C]	5,91	5,47	9,09	**6,82**
	average air humidity [%]	82,27	80,56	72,34	**78,39**
	total precipitations [mm]	12,30	15,40	10,40	**27,70**

04/2017	average temp. [°C]	11,10	5,99	6,80	**7,96**
	average air humidity [%]	78,80	77,32	75,78	**77,30**
	total precipitations [mm]	4,50	24,60	9,10	**38,20**
05/2017	average temp. [°C]	8,85	16,50	17,28	**14,21**
	average air humidity [%]	85,48	68,84	69,34	**74,55**
	total precipitations [mm]	50,90	0,00	13,40	**64,30**
06/2017	average temp. [°C]	17,19	18,33	18,88	**18,13**
	average air humidity [%]	67,81	73,96	76,73	**72,83**
	total precipitations [mm]	22,60	6,70	21,80	**51,10**
07/2017	average temp. [°C]	17,22	18,39	20,09	**18,57**
	average air humidity [%]	78,94	75,76	80,72	**78,47**
	total precipitations [mm]	0,40	8,00	68,70	**77,10**
08/2017	average temp. [°C]	22,06	19,16	17,90	**19,70**
	average air humidity [%]	70,31	77,64	76,61	**74,85**
	total precipitations [mm]	42,10	33,00	1,70	**76,80**

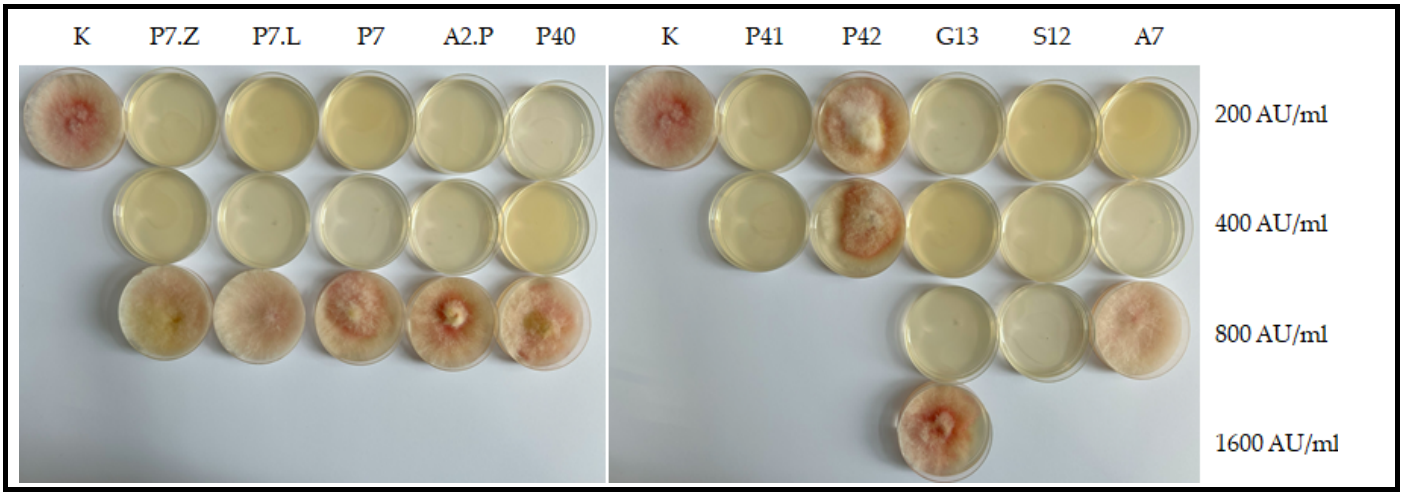

Figure S1. Fungistatic activity of tested LAB isolates against *F. graminearum* (C – control; P7.Z, P7.L, P7, A2.P, P40, P41, P42, G13, S12, A7 – LAB isolates).

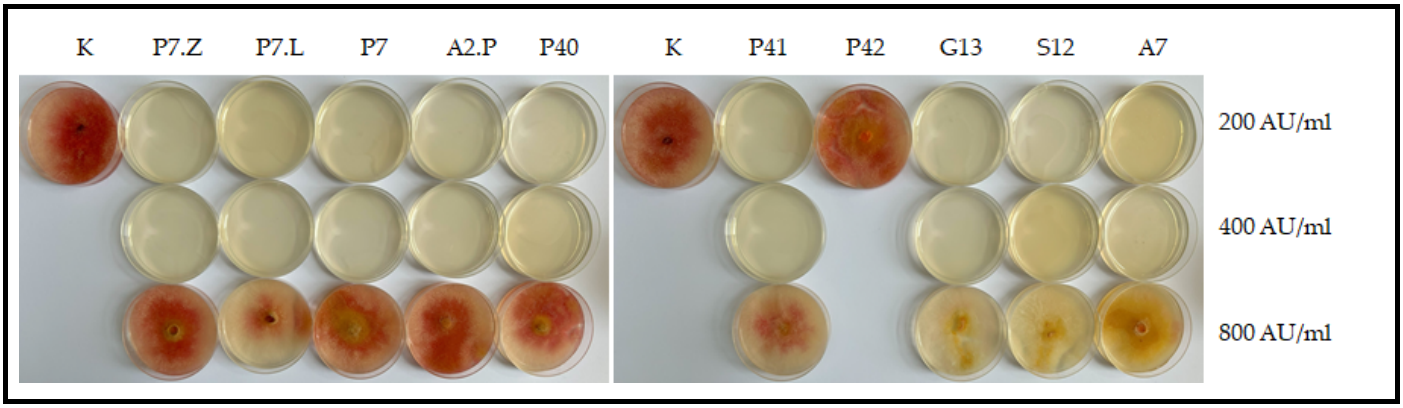

Figure S2. Fungistatic activity of tested LAB isolates against *F. culmorum* (C – control; P7.Z, P7.L, P7, A2.P, P40, P41, P42, G13, S12, A7 – LAB isolates).

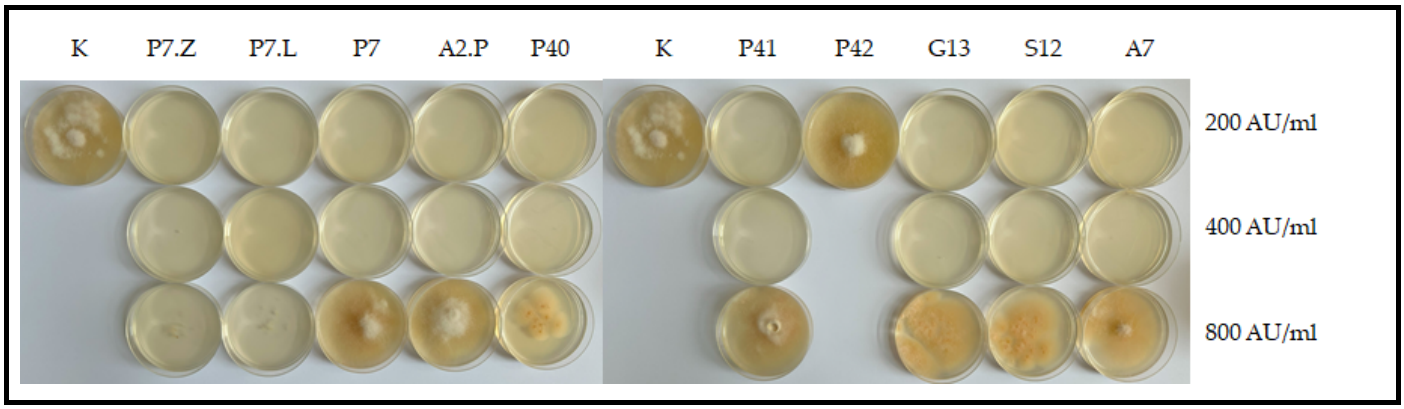

Figure S3. Fungistatic activity of tested LAB isolates against *F. poae* (C – control; P7.Z, P7.L, P7, A2.P, P40, P41, P42, G13, S12, A7 – LAB isolates).

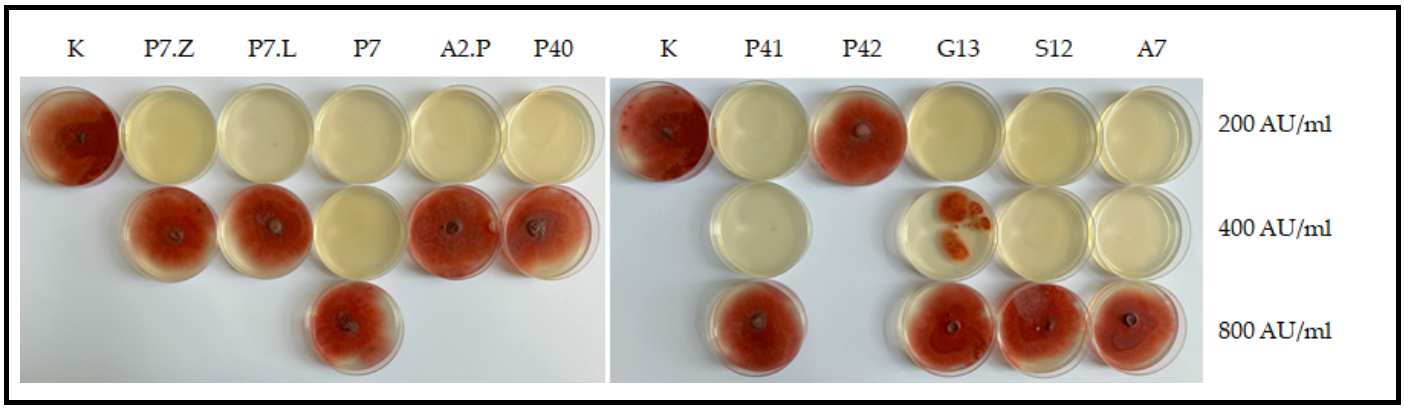

Figure S4. Fungistatic activity of tested LAB isolates against *F. oxysporum* (C – control; P7.Z, P7.L, P7, A2.P, P40, P41, P42, G13, S12, A7 – LAB isolates).

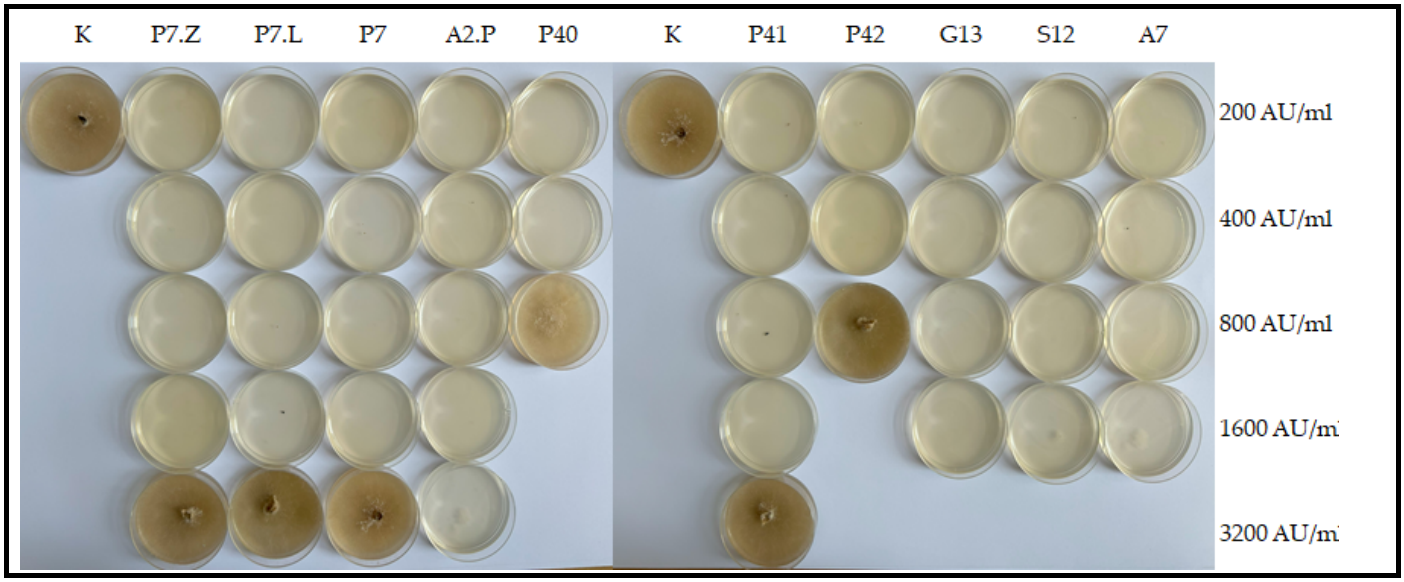

Figure S5. Fungistatic activity of tested LAB isolates against *R. solani* (C – control; P7.Z, P7.L, P7, A2.P, P40, P41, P42, G13, S12, A7 – LAB isolates).

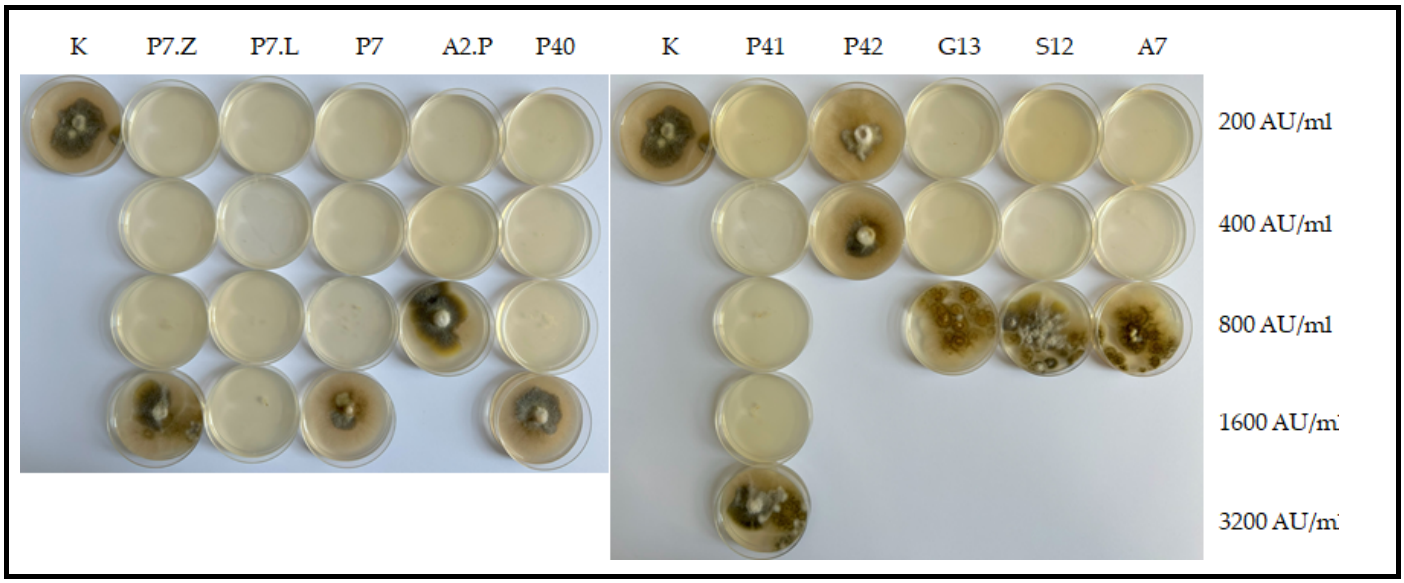

Figure S6. Fungistatic activity of tested LAB isolates against *A. alternata* (C – control; P7.Z, P7.L, P7, A2.P, P40, P41, P42, G13, S12, A7 – LAB isolates).

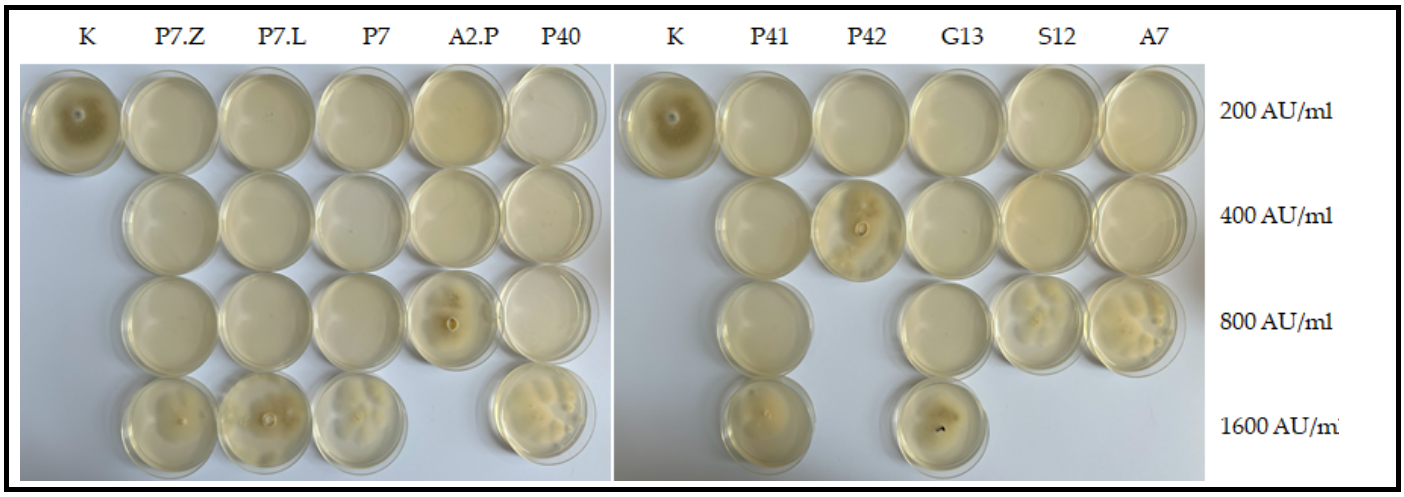

Figure S7. Fungistatic activity of tested LAB isolates against *C. gleosporioides* (C – control; P7.Z, P7.L, P7, A2.P, P40, P41, P42, G13, S12, A7 – LAB isolates).

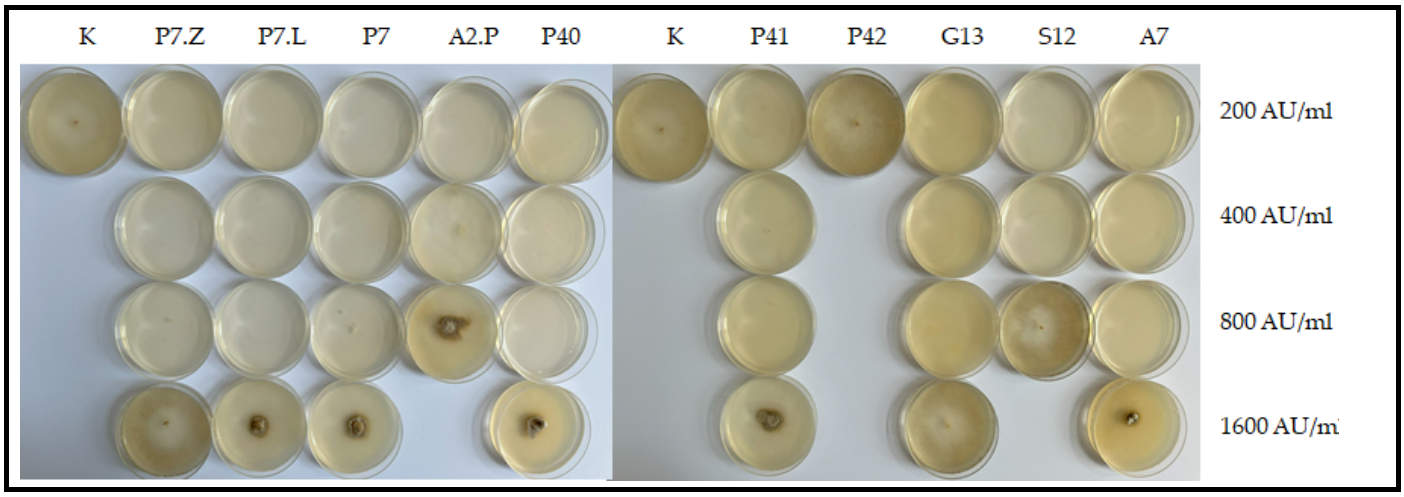

Figure S8. Fungistatic activity of tested LAB isolates against *S. sclerotiorum* (C – control; P7.Z, P7.L, P7, A2.P, P40, P41, P42, G13, S12, A7 – LAB isolates).

Table S6. Identification of selected strains based on proteomic and genetic profiles.

Strain no.	MALDI-TOF Identification		16S rRNA gene sequencing		Result (GeneBank ID)
	Reference strain (NCBI strain no.)	LS value[1,2]	Reference strain (GeneBank ID)	ID value[3] (%)	
A7	*Lactiplantibacillus plantarum* (1255)	2.13	*Lactiplantibacillus plantarum* (MT538342.1)	99.93	*Lactiplantibacillus plantarum* (OR763289.1)
G13	*Lacticaseibacillus paracasei* (47714)	2.34	*Lacticaseibacillus paracasei* (MT613551.1)	99.93	*Lacticaseibacillus paracasei* (OR757169.1)
S12	*Lacticaseibacillus paracasei* (47714)	2.36	*Lacticaseibacillus paracasei* (OR287076.1)	99.78	*Lacticaseibacillus paracasei* (OR757260.1)
P7	*Lentilactobacillus buchneri (*1581)	1.83	*Lentilactobacillus buchneri* (OR029286.1)	99.66	*Lentilactobacillus buchneri* (OR757276.1)
P41	*Lentilactobacillus buchneri* (1581)	1.78	*Lentilactobacillus buchneri* (MG646732.1)	99.93	*Lentilactobacillus buchneri* (OR757298.1)

[1]LS value—BioTyper Log score value;.
[2]The significance of the identification index according to Bruker MALDI Biotyper: range ≥ 2.00 high-confidence identification, 1.99-1.70 low-confidence identification;.
[3]ID value—identification value.

Table S7. 16S rRNA gene sequences for selected LAB isolates.

Isolate	Sequence
A7: *Lactiplantibacillus plantarum* (OR763289.1)	TGGGCAATGCGGGCTGCTATACATGCAGTCGAACGAACTCTGGTATTGATTGGTGCTTGCATCATGAT TTACATTTGAGTGAGTGGCGAACTGGTGAGTAACACGTGGGAAACCTGCCCAGAAGCGGGGGATAAC ACCTGGAAACAGATGCTAATACCGCATAACAACTTGGACCGCATGGTCCGAGTTTGAAAGATGGCTT CGGCTATCACTTTTGGATGGTCCCGCGGCGTATTAGCTAGATGGTGGGGTAACGGCTCACCATGGCAA TGATACGTAGCCGACCTGAGAGGGTAATCGGCCACATTGGGACTGAGACACGGCCCAAACTCCTACG GGAGGCAGCAGTAGGGAATCTTCCACAATGGACGAAAGTCTGATGGAGCAACGCCGCGTGAGTGAA GAAGGGTTTCGGCTCGTAAAACTCTGTTGTTAAAGAAGAACATATCTGAGAGTAACTGTTCAGGTATT GACGGTATTTAACCAGAAAGCCACGGCTAACTACGTGCCAGCAGCCGCGGTAATACGTAGGTGGCAA GCGTTGTCCGGATTTATTGGGCGTAAAGCGAGCGCAGGCGGTTTTTTAAGTCTGATGTGAAAGCCTTC GGCTCAACCGAAGAAGTGCATCGGAAACTGGGAAACTTGAGTGCAGAAGAGGACAGTGGAACTCCA TGTGTAGCGGTGAAATGCGTAGATATATGGAAGAACACCAGTGGCGAAGGCGGCTGTCTGGTCTGTA ACTGACGCTGAGGCTCGAAAGTATGGGTAGCAAACAGGATTAGATACCCTGGTAGTCCATACCGTAA ACGATGAATGCTAAGTGTTGGAGGGTTTCCGCCCTTCAGTGCTGCAGCTAACGCATTAAGCATTCCGC CTGGGGAGTACGGCCGCAAGGCTGAAACTCAAAGGAATTGACGGGGGCCCGCACAAGCGGTGGAGC ATGTGGTTTAATTCGAAGCTACGCGAAGAACCTTACCAGGTCTTGACATACTATGCAAATCTAAGAGA TTAGACGTTCCCTTCGGGGACATGGATACAGGTGGTGCATGGTTGTCGTCAGCTCGTGTCGTGAGATG TTGGGTTAAGTCCCGCAACGAGCGCAACCCTTATTATCAGTTGCCAGCATTAAGTTGGGCACTCTGGT GAGACTGCCGGTGACAAACCGGAGGAAGGTGGGGATGACGTCAAATCATCATGCCCCTTATGACCTG GGCTACACACGTGCTACAATGGATGGTACAACGAGTTGCGAACTCGCGAGAGTAAGCTAATCTCTTA AAGCCATTCTCAGTTCGGATTGTAGGCTGCAACTCGCCTACATGAAGTCGGAATCGCTAGTAATCGCG GATCAGCATGCCGCGGTGAATACGTTCCCGGGCCTTGTACACACCGCCCGTCACACCATGAGAGTTTG TAACACCCAAAGTCGGTGGGGTAACCTTTTAGGAACCAGCCGCTAAGGTGACAGATGCTG

G13: *Lactocaseibacillus paracasei* (OR757169.1)	ATACATGCAGTCGAACGAGTTCTCGTTGATGATCGGTGCTTGCACCGAGATTCAACATGGAACGAGTG GCGGACGGGTGAGTAACACGTGGGTAACCTGCCCTTAAGTGGGGGATAACATTTGGAAACAGATGCT AATACCGCATAGATCCAAGAACCGCATGGTTCTTGGCTGAAAGATGGCGTAAGCTATCGCTTTTGGAT GGACCCGCGGCGTATTAGCTAGTTGGTGAGGTAATGGCTCACCAAGGCGATGATACGTAGCCGAACT GAGAGGTTGATCGGCCACATTGGGACTGAGACACGGCCCAAACTCCTACGGGAGGCAGCAGTAGGG AATCTTCCACAATGGACGCAAGTCTGATGGAGCAACGCCGCGTGAGTGAAGAAGGCTTTCGGGTCGT AAAACTCTGTTGTTGGAGAAGAATGGTCGGCAGAGTAACTGTTGTCGGCGTGACGGTATCCAACCAG AAAGCCACGGCTAACTACGTGCCAGCAGCCGCGGTAATACGTAGGTGGCAAGCGTTATCCGGATTTA TTGGGCGTAAAGCGAGCGCAGGCGGTTTTTTTAAGTCTGATGTGAAAGCCCTCGGCTTAACCGAGGAA GCGCATCGGAAACTGGGAAACTTGAGTGCAGAAGAGGACAGTGGAACTCCATGTGTAGCGGTGAAA TGCGTAGATATATGGAAGAACACCAGTGGCGAAGGCGGCTGTCTGGTCTGTAACTGACGCTGAGGCT CGAAAGCATGGGTAGCGAACAGGATTAGATACCCTGGTAGTCCATGCCGTAAACGATGAATGCTAGG TGTTGGAGGGTTTCCGCCCTTCAGTGCCGCAGCTAACGCATTAAGCATTCCGCCTGGGGAGTACGACC GCAAGGTTGAAACTCAAAGGAATTGACGGGGGCCCGCACAAGCGGTGGAGCATGTGGTTTAATTCGA AGCAACGCGAAGAACCTTACCAGGTCTTGACATCTTTTGATCACCTGAGAGATCAGGTTTCCCCTTCG GGGGCAAAATGACAGGTGGTGCATGGTTGTCGTCAGCTCGTGTCGTGAGATGTTGGGTTAAGTCCCGC AACGAGCGCAACCCTTATGACTAGTTGCCAGCATTTAGTTGGGCACTCTAGTAAGACTGCCGGTGACA AACCGGAGGAAGGTGGGGATGACGTCAAATCATCATGCCCCTTATGACCTGGGCTACACACGTGCTA CAATGGATGGTACAACGAGTTGCGAGACCGCGAGGTCAAGCTAATCTCTTAAAGCCATTCTCAGTTCG GACTGTAGGCTGCAACTCGCCTACACGAAGTCGGAATCGCTAGTAATCGCGGATCAGCACGCCGCGG TGAATACGTTCCCGGGCCTTGTACACACCGCCCGTCACACCATGAGAGTTTGTAACACCCGAAGCCG GTGGCGTAACCCTTTTAGGGAGCGAGCCGT
S12: *Lactocaseibacillus paracasei* (OR757260.1)	GAGTGGCGGACGGGTGAGTAACACGTGGGTAACCTGCCCTTAAGTGGGGGATAACATTTGGAAACAG ATGCTAATACCGCATAGATCCAAGAACCGCATGGTTCTTGGCTGAAAGATGGCGTAAGCTATCGCTTT TGGATGGACCCGCGGCGTATTAGCTAGTTGGTGAGGTAATGGCTCACCAAGGCGATGATACGTAGCC GAACTGAGAGGTTGATCGGCCACATTGGGACTGAGACACGGCCCAAACTCCTACGGGAGGCAGCAG TAGGGAATCTTCCACAATGGACGCAAGTCTGATGGAGCAACGCCGCGTGAGTGAAGAAGGCTTTCGG GTCGTAAAACTCTGTTGTTGGAGAAGAATGGTCGGCAGAGTAACTGTTGTCGGCGTGACGGTATCCAA CCAGAAAGCCACGGCTAACTACGTGCCAGCAGCCGCGGTAATACGTAGGTGGCAAGCGTTATCCGGA TTTATTGGGCGTAAAGCGAGCGCAGGCGGTTTTTTAAGTCTGATGTGAAAGCCCTCGGCTTAACCGAG GAAGCGCATCGGAAACTGGGAAACTTGAGTGCAGAAGAGGACAGTGGAACTCCATGTGTAGCGGTG AAATGCGTAGATATATGGAAGAACACCAGTGGCGAAGGCGGCTGTCTGGTCTGTAACTGACGCTGAG GCTCGAAAGCATGGGTAGCGAACAGGATTAGATACCCTGGTAGTCCATGCCGTAAACGATGAATGCT AGGTGTTGGAGGGTTTCCGCCCTTCAGTGCCGCAGCTAACGCATTAAGCATTCCGCCTGGGGAGTACG ACCGCAAGGTTGAAACTCAAAGGAATTGACGGGGGCCCGCACAAGCGGTGGAGCATGTGGTTTAATT CGAAGCAACGCGAAGAACCTTACCAGGTCTTGACATCTTTTGATCACCTGAGAGATCAGGTTTCCCCT TCGGGGGCAAAATGACAGGTGGTGCATGGTTGTCGTCAGCTCGTGTCGTGAGATGTTGGGTTAAGTCC CGCAACGAGCGCAACCCTTATGACTAGTTGCCAGCATTTAGTTGGGCACTCTAGTAAGACTGCCGGTG ACAAACCGGAGGAAGGTGGGGATGACGTCAAATCATCATGCCCCTTATGACCTGGGCTACACACGTG CTACAATGGATGGTACAACGAGTTGCGAGACCGCGAGGTCAAGCTAATCTCATAAATCCATTCTCAG TTGGGACTGTAGGCTGCAACTCGCCTACACGAAGTCGGAATCGCTAGTAATCGCGGATCAGCACGCC GCGGTGAATACGTTCCCGGGCCTTGTACACACCGCCCGTCACACCATGAGAGTTTGTAACACCC

P7: *Lentilactobacillus buchneri* (OR757276.1)	CGTCTCCGTTGATGATTTTAGGTGCTTGCACTTGAAAGATTTAACATTGAGACGAGTGGCGAACTGGT GAGTAACACGTGGGTAACCTGCCCTTGAAGTAGGGGATAACACTTGGAAACAGGTGCTAATACCGTA TAACAACCAAAACCACCTGGTTTTGGTTTAAAAGACGGCTTCGGCTGTCACTTTAGGATGGACCCGCG GCGTATTAGCTTGTTGGTAAGGTAACGGCCTACCAAGGCGATGATACGTAGCCGACCTGAGAGGGTA ATCGGCCACATTGGGACTGAGACACGGCCCAAACTCCTACGGGAGGCAGCAGTAGGGAATCTTCCAC AATGGACGAAAGTCTGATGGAGCAACGCCGCGTGAGTGATGAAGGGTTTCGGCTCGTAAAACTCTGT TGTTGGAGAAGAACAGGTGTCAGAGTAACTGTTGACATCTTGACGGTATCCAACCAGAAAGCCACGG CTAACTACGTGCCAGCAGCCGCGGTAATACGTAGGTGGCAAGCGTTGTCCGGATTTATTGGGCGTAA AGCGAGCGCAGGCGGTTTTTTAGGTCTGATGTGAAAGCCTTCGGCTTAACCGGAGAAGTGCATCGGA AACCGGGAGACTTGAGTGCAGAAGAGGACAGTGGAACTCCATGTGTAGCGGTGAAATGCGTAGATA TATGGAAGAACACCAGTGGCGAAGGCGGCTGTCTGGTCTGTAACTGACGCTGAGGCTCGAAAGCATG GGTAGCGAACAGGATTAGATACCCTGGTAGTCCATGCCGTAAACGATGAGTGCTAAGTGTTGGAGGG TTTCCGCCCTTCAGTGCTGCAGCTAACGCATTAAGCACTCCGCCTGGGGAGTACGACCGCAAGGTTGA AACTCAAAGGAATTGACGGGGGCCCGCACAAGCGGTGGAGCATGTGGTTTAATTCGATGCTACGCGA AGAACCTTACCAGGTCTTGACATCTTCTGCCAACCTAAGAGATTAGGCGTTCCCTTCGGGGACAGAAT GACAGGTGGTGCATGGTTGTCGTCAGCTCGTGTCGTGAGATGTTGGGTTAAGTCCCGCAACGAGCGCA ACCCTTATTGTTAGTTGCCAGCATTCAGTTGGGCACTCTAGCAAGACTGCCGGTGACAAACCGGAGGA AGGTGGGGATGACGTCAAATCATCATGCCCCTTATGACCTGGGCTACACACGTGCTACAATGGACGG TACAACGAGTCGCGAAACCGCGAGGTCAAGCTAATCTCTTAAAGCCGTTCTCAGTTCGGATTGTAGGC TGCAACTCGCCTACATGAAGTTGGAATCGCTAGTAATCGTGGATCAGCATGCCACGGTGAATACGTTC CCGGGCCTTGTACACACCGCCCGTCACACCATGAGAGTTTGTAACACCCAAAGCCGGTGAGGTAGCC TT
P41: *Lentilactobacillus buchneri* (OR757298.1)	TGCAGTCGCCCGCGTCTCCGTTAATGATTTTAGGTGCTTGCACTTGAAAGATTTAACATTGAGACGAGT GGCGAACTGGTGAGTAACACGTGGGTAACCTGCCCTTGAAGTAGGGGATAACACTTGGAAACAGGTG CTAATACCGTATAACAACCAAAACCACCTGGTTTTGGTTTAAAAGACGGCTTCGGCTGTCACTTTAGG ATGGACCCGCGGCGTATTAGCTTGTTGGTAAGGTAACGGCTTACCAAGGCGATGATACGTAGCCGAC CTGAGAGGGTAATCGGCCACATTGGGACTGAGACACGGCCCAAACTCCTACGGGAGGCAGCAGTAG GGAATCTTCCACAATGGACGAAAGTCTGATGGAGCAACGCCGCGTGAGTGATGAAGGGTTTCGGCTC GTAAAACTCTGTTGTTGGAGAAGAACAGGTGTCAGAGTAACTGTTGACATCTTGACGGTATCCAACCA GAAAGCCACGGCTAACTACGTGCCAGCAGCCGCGGTAATACGTAGGTGGCAAGCGTTGTCCGGATTT ATTGGGCGTAAAGCGAGCGCAGGCGGTTTTTTAGGTCTGATGTGAAAGCCTTCGGCTTAACCGGAGA AGTGCATCGGAAACCGGGAGACTTGAGTGCAGAAGAGGACAGTGGAACTCCATGTGTAGCGGTGAA ATGCGTAGATATATGGAAGAACACCAGTGGCGAAGGCGGCTGTCTGGTCTGTAACTGACGCTGAGGC TCGAAAGCATGGGTAGCGAACAGGATTAGATACCCTGGTAGTCCATGCCGTAAACGATGAGTGCTAA GTGTTGGAGGGTTTCCGCCCTTCAGTGCTGCAGCTAACGCATTAAGCACTCCGCCTGGGGAGTACGAC CGCAAGGTTGAAACTCAAAGGAATTGACGGGGGCCCGCACAAGCGGTGGAGCATGTGGTTTAATTCG ATGCTACGCGAAGAACCTTACCAGGTCTTGACATCTTCTGCCAACCTAAGAGATTAGGCGTTCCCTTC GGGGACAGAATGACAGGTGGTGCATGGTTGTCGTCAGCTCGTGTCGTGAGATGTTGGGTTAAGTCCCG CAACGAGCGCAACCCTTATTGTTAGTTGCCAGCATTCAGTTGGGCACTCTAGCAAGACTGCCGGTGAC AAACCGGAGGAAGGTGGGGATGACGTCAAATCATCATGCCCCTTATGACCTGGGCTACACACGTGCT ACAATGGACGGTACAACGAGTCGCGAAACCGCGAGGTCAAGCTAATCTCTTAAAGCCGTTCTCAGTT CGGATTGTAGGCTGCAACTCGCCTACATGAAGTTGGAATCGCTAGTAATCGTGGATCAGCATGCCACG

	GTGAATACGTTCCCGGGCCTTGTACACACCGCCCGTCACACCATGAGAGTTTGTAACACCCAAAGCC GGTGAGGTAACCTTCGGGACC

Table S8. The effect of LAB treatment on phytotoxicity (%).

Treatment	2015/2016						2016/2017					
	12.11.2015 BBCH 12		20.11.2015 BBCH 12		17.03.2016 BBCH 23		18.11.2016 BBCH 11		12.12.2016 BBCH 12		31.03.2017 BBCH 23	
	wheat	rye	wheat	rye	wheat	rye	wheat	rye	wheat	rye	wheat	rye
L. plantarum A7	0	0	0	0	0	0	0	0	0	0	0	0
L. paracasei G13	0	0	0	0	0	0	0	0	0	0	0	0
L. paracasei S12	0	0	0	0	0	0	0	0	0	0	0	0
L. buchneri P7	0	0	0	0	0	0	0	0	0	0	0	0
L. buchneri P41	0	0	0	0	0	0	0	0	0	0	0	0
Vibrance Gold 100 FS/Vitavax 200 FS	0	0	0	0	0	0	0	0	0	0	0	0

0 – no phytotoxic effect has been stated