

Impact of protein hydrolysate biostimulants on growth of barley and wheat and their interaction with symbionts and pathogens

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Suppl. Table 1. Effect of AMF inoculation on photosynthetic pigments and quantum yield (QY) of winter wheat and spring barley in the pot experiment in sterile soil. Hydrolysate treatment and P-level had no effect.

	Pigments ($\mu\text{g mg}^{-1}$ FW)				Quantum Yield
	Chla	Chlb	Chla/Chlb	carotenoids	(QY)
Barley					
no AMF	3.09 \pm 0.12 a	0.93 \pm 0.030 a	3.31 \pm 0.030 b	0.518 \pm 0.036 a	0.831 \pm 0.0030 b
AMF	2.98 \pm 0.12 a	0.87 \pm 0.028 a	3.41 \pm 0.039 a	0.502 \pm 0.039 a	0.840 \pm 0.0017 a
Wheat					
no AMF	1.02 \pm 0.043 a	0.305 \pm 0.012 a	3.34 \pm 0.041 a	0.15 \pm 0.041 a	0.799 \pm 0.0019 a
AMF	1.05 \pm 0.032 a	0.319 \pm 0.010 a	3.31 \pm 0.032 a	0.160 \pm 0.032 a	0.796 \pm 0.0026 a

Different letters indicate significant differences at $p < 0.05$.

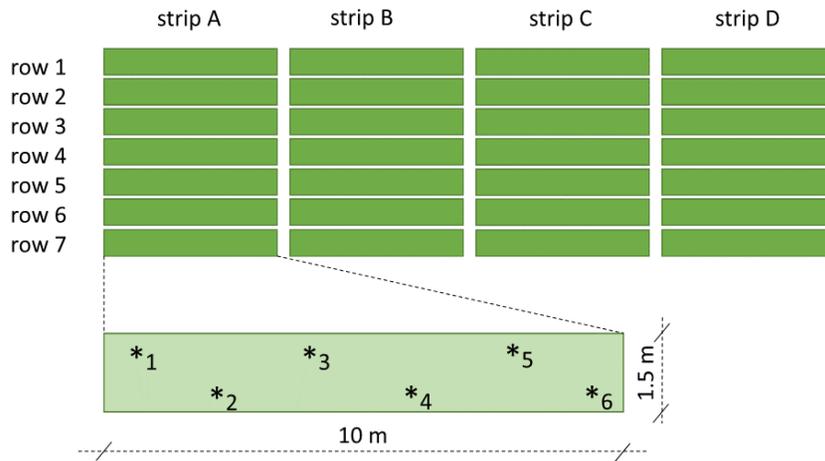
Suppl. Table 2. Effects of hydrolysate treatments on growth parameters of barley and wheat in the pot experiment.

	Height	Shoot DW		Root DW		Total DW		
	[cm]	% of control	[g]	% of control	[g]	% of control	[g]	% of control
Barley								
Control	73 \pm 0.6 a	100	4.4 \pm 0.07 ab	100	1.2 \pm 0.03 ab	100	5.6 \pm 0.09 a	100
FH	74 \pm 0.6 a	102	4.5 \pm 0.10 a	102	1.3 \pm 0.05 a	104	5.8 \pm 0.13 a	103
RH	72 \pm 0.5 a	99	4.2 \pm 0.07 b	95	1.1 \pm 0.03 b	90	5.3 \pm 0.09 b*	94
Wheat								
Control	43 \pm 0.3 a	100	4.8 \pm 0.06 a	100	3.1 \pm 0.11 a	100	7.9 \pm 0.15 a	100
FH	44 \pm 0.8 a	103	5.0 \pm 0.07 a	104	3.2 \pm 0.14 a	103	8.2 \pm 0.18 a	104
RH	44 \pm 0.4 a	102	4.9 \pm 0.08 a	102	3.2 \pm 0.11 a	104	8.2 \pm 0.16 a	103

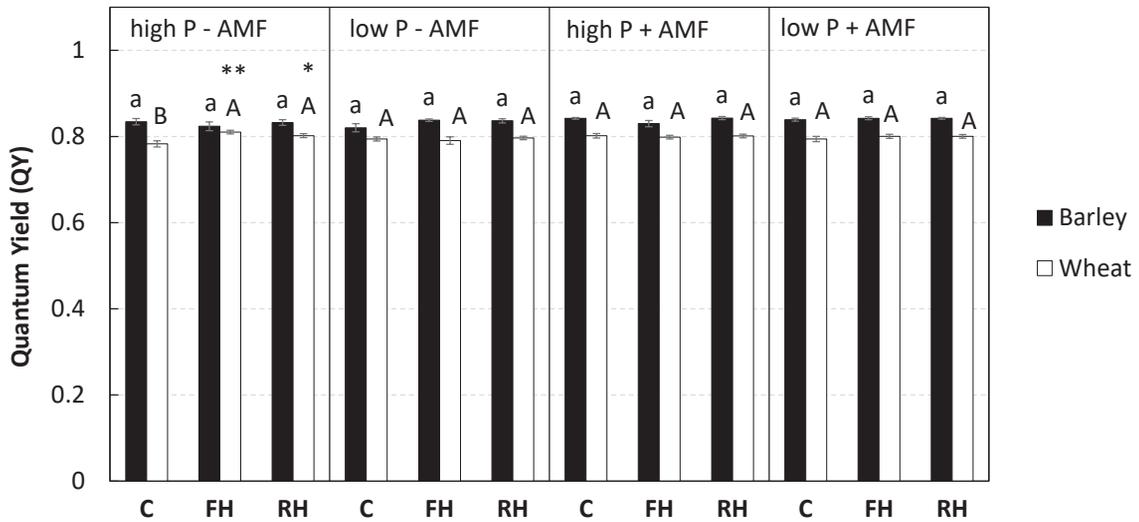
DW = Dry weight; FH = chicken feather hydrolysate; RH = reference hydrolysate. Both absolute and relative values are given. Averages are pooled over the P-level and AMF-inoculation. Different letters indicate a significant difference at $p < 0.05$ (a comparison within one crop). Asterisks indicate a significant difference to the control at $p < 0.05$. Height was measured at the time of harvest (BBCH49-51). Shoot DW of barley also includes spikes unlike wheat which did not form any spikes.

Suppl. Table 3. Quality parameters of barley and wheat in the field experiment 2017. There were no significant effects of hydrolysates on quality parameters except in wheat, where reference hydrolysate (RH) increased the grain size distribution > 2.5 mm compared to chicken feather hydrolysate (FH) (86.45 vs 85.54, respectively) and that FH slightly increased the Hagberg Falling number compared to RH (354 vs 333, respectively).

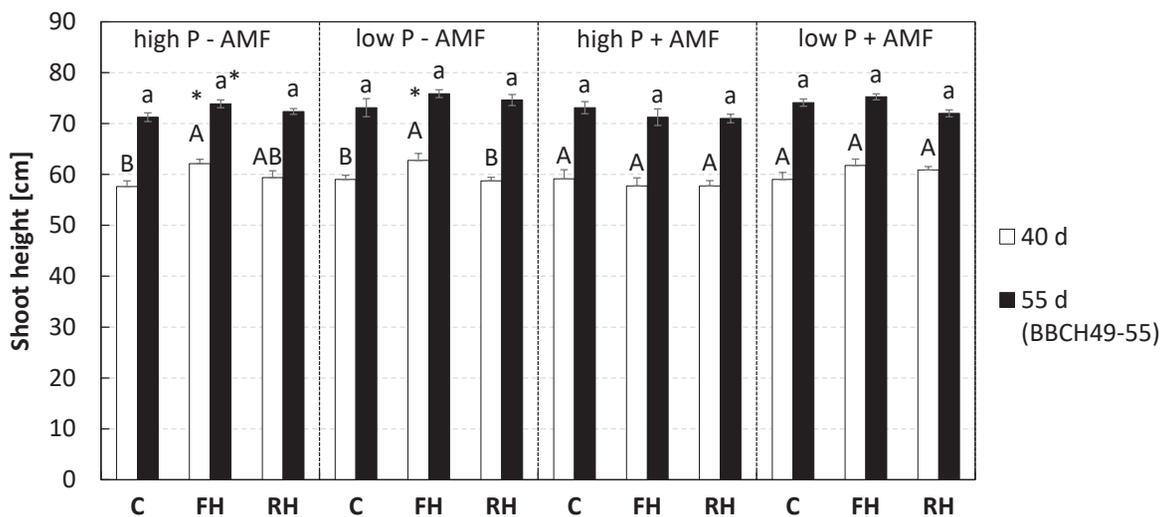
	OH (kg hl^{-1})	N-containing substances (% of dry mass)	Zeleny index	Hagberg Falling No. (s)	Grain size distribution		
					> 2.8 mm (%)	> 2.5 mm (%)	> 2.2 mm (%)
Barley	65.2 \pm 0.27	10.6 \pm 0.12	–	–	95.9 \pm 0.12	98.4 \pm 0.06	99.2 \pm 0.04
Wheat	79.2 \pm 0.08	11.8 \pm 0.10	37.0 \pm 0.79	340 \pm 3.5	63.1 \pm 0.57	86.2 \pm 0.23	94.8 \pm 0.20



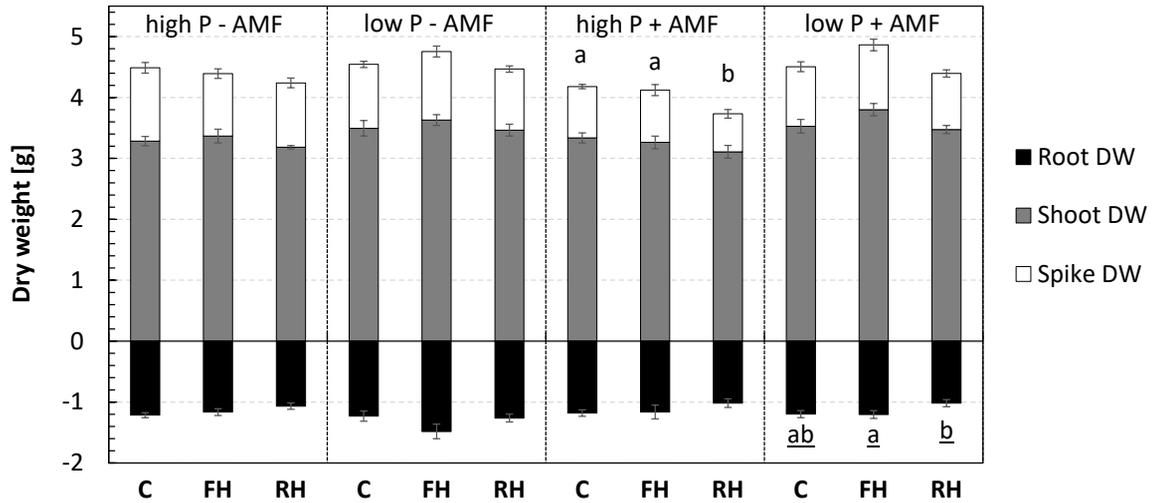
Suppl. Fig. 1. Block design of the field experiment in Lukavec. Top: Illustration of the block design; Bottom: Individual replicate plot with 6 sampling spots for biometric measurements, root microscopy analyses and disease assessment.



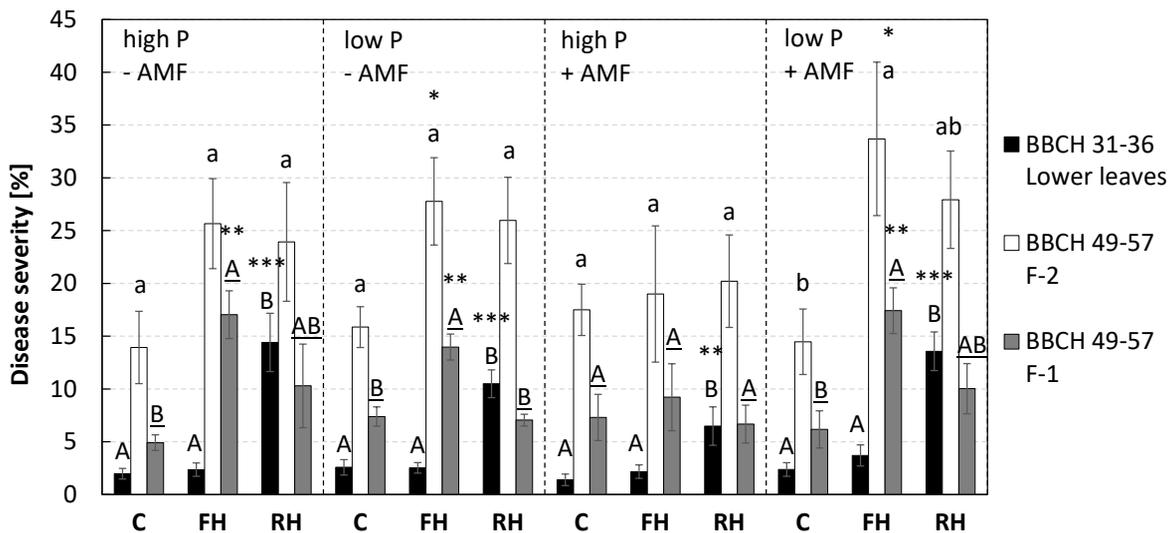
Suppl. Fig. 2. Effect of hydrolysate treatment on Quantum yield in barley and wheat at different P-levels and in the presence/absence of AMF in the pot experiment. C = control; FH = chicken feather hydrolysate; RH = reference hydrolysate. Significant effects of hydrolysate within P-level x AMF-treatment combinations are indicated by different letters ($p < 0.05$). Significant effects of hydrolysates compared to the control within P x AMF combinations are shown by asterisks (* at $p < 0.05$, ** at $p < 0.01$, *** at $p < 0.001$).



Suppl. Fig. 3. Effects of hydrolysate treatments on shoot height of barley at different P-levels and presence/absence of AMF in the pot experiment. C = control; FH = chicken feather hydrolysate; RH = reference hydrolysate. Significant effects of hydrolysate within P-level x AMF-treatment combinations are indicated by different letters ($p < 0.05$; Tukey HSD test); significant effects of hydrolysates compared to the control within P x AMF combinations according to Dunnett's test ($p < 0.05$) are shown by asterisks.



Suppl. Fig. 4. Effects of hydrolysate treatments on biomass (dry weight) of barley at harvest (55d, BBCH49-57) at different P-levels and in the presence/absence of AMF in the pot experiment. C = control; FH = chicken feather hydrolysate; RH = reference hydrolysate. Significant effects of the hydrolysates within P-level × AMF-treatment combinations are indicated by different letters ($p < 0.05$). Underlined letters below columns indicate a significant effect of hydrolysate treatments on total dry weight; letters above columns indicate a significant effect of hydrolysate treatments on spike dry weight.



Suppl. Fig. 5. Effects of hydrolysate treatments on severity of the spot form of net blotch (*Pyrenophora teres maculata*) in barley at different P-levels and in the presence/absence of AMF in the pot experiment. C = control; FH = chicken feather hydrolysate; RH = reference hydrolysate. Different letters indicate significant effects of hydrolysate treatment within each P-level/AMF-combination according to Tukey HSD-test at $p < 0.05$. Asterisks indicate a significant effect of hydrolysate treatment compared to the control within each P-level/AMF-combination according to Dunnett's test (* at $p < 0.05$, ** at $p < 0.01$, *** at $p < 0.001$). Statistical comparisons were done within each data series. F-2 = second leaf below flag leaf; F-1 = first leaf below flag leaf. In BBCH31-36, where no flag leaf was present, only older leaves within the plastic sheeting surrounding the plant had disease symptoms and were assessed.