Figure s1. Disease progression, as area under the disease progress curve (AUDPC) from serial disease severity ratings (modified Horsfall Barratt Scale), resulting from sporangial suspension application (spray, spectra $n = 38$) and inoculum plug (plug, spectra $n = 86$) *Phytophthora infestans* inoculation methods. AUDPC was not significantly different between the two inoculation methods. *Horsfall, J. G.; Barratt, R. W. (1945), "An Improved Grading System for Measuring Plant Disease", Phytopathology,* **35***: 655–659.*
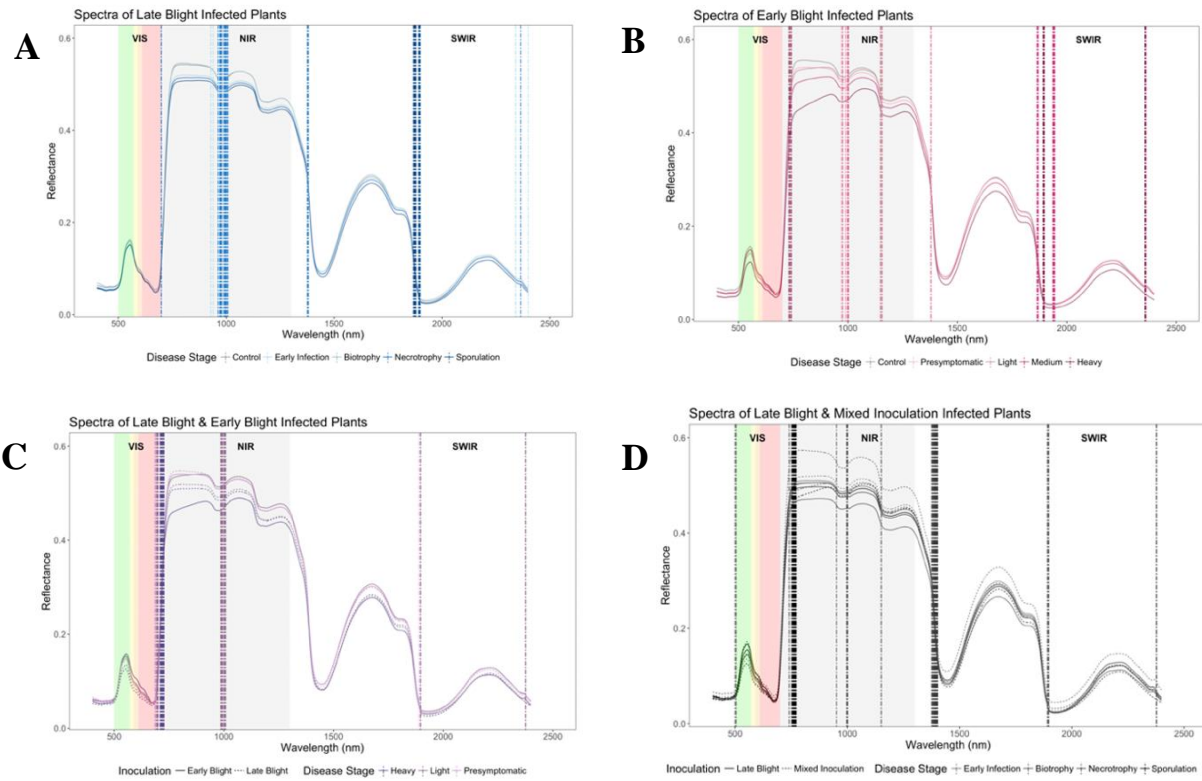
Figure S2. Spectra plots annotated with bars indicating top 1% of standard coefficients that are most important to the partial least squares-discriminant analysis (PLS-DA) models by absolute value for each time stage of potato early and late blight disease. **S2A.** Spectra and standardized coefficients from control, early infection, biotrophy, necrotrophy, and sporulation of potato late blight. **S2B.** Spectra and standardized coefficients from control, pre-symptomatic, light, and heavy post-symptomatic stages of potato early blight. **S2C.** Spectra of potato late blight and early blight with standardized coefficients from models differentiating the two diseases at pre-symptomatic time points, light disease time points, and heavy disease time points. **S2D.** Spectra from potato late blight and mixed late blight and early blight diseased leaves with standardized coefficients from models differentiating the two diseases at pre-symptomatic, light infection, and heavy infection time points.
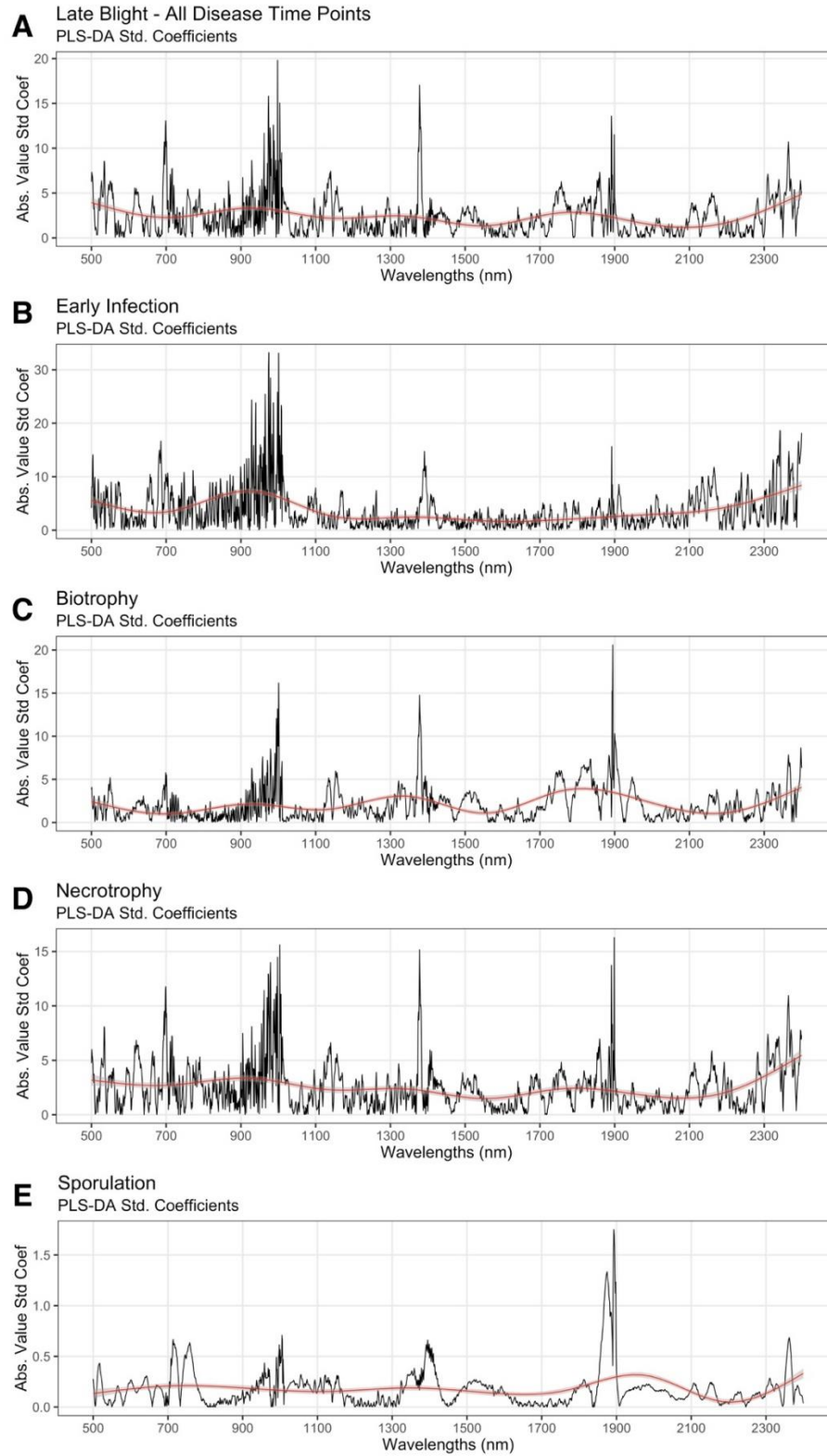
Figure S3. Potato late blight vs. non-diseased (control) partial least squares-discriminant analysis (PLS-DA), absolute value standard coefficients for **(A)** all disease time points, **(B)** early infection, **(C)** biotrophy, **(D)** necrotrophy, and **(E)** sporulation.
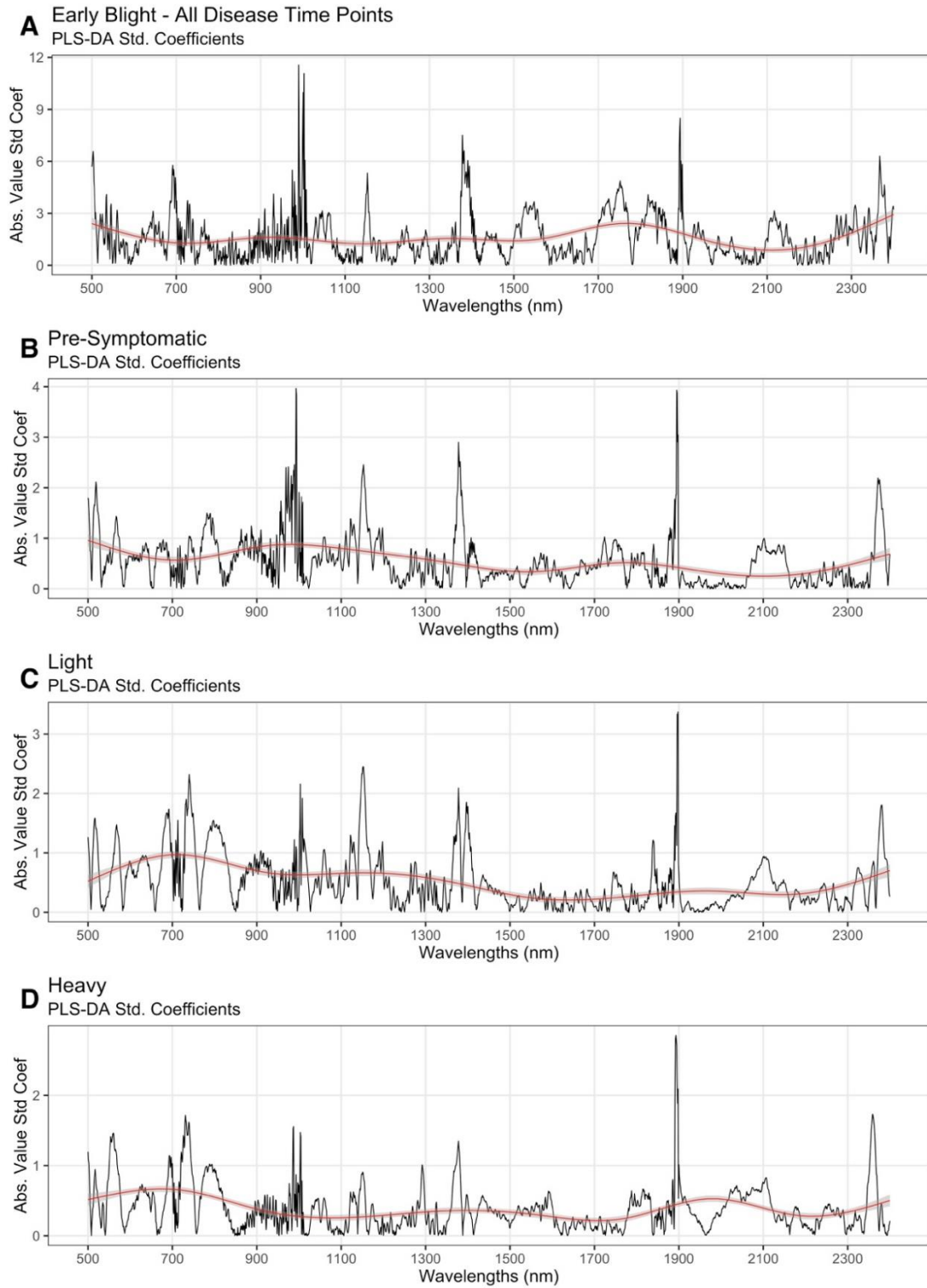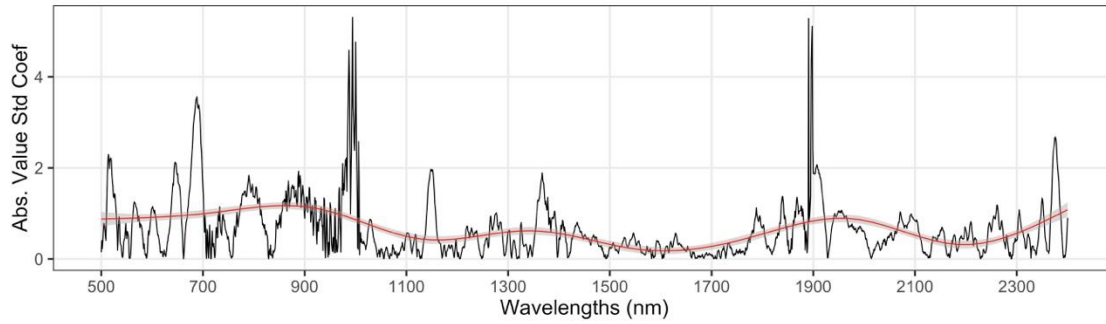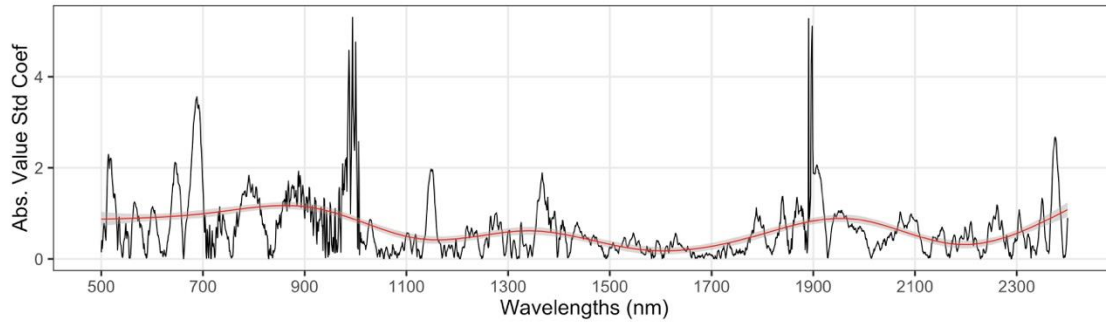
Figure S4. Potato early blight partial least squares-discriminant analysis (PLS-DA) absolute value std. coefficient plots for **(A)** all disease time points, **(B)** pre-symptomatic infection, **(C)** light symptomatic infection, and **(D)** heavy symptomatic infection.
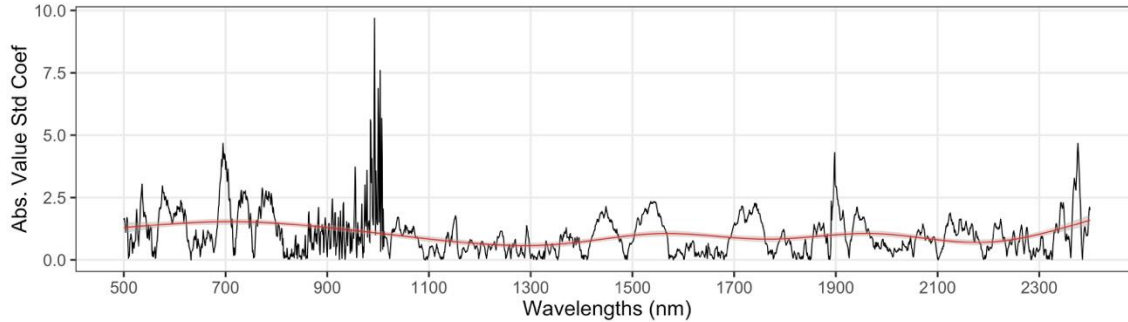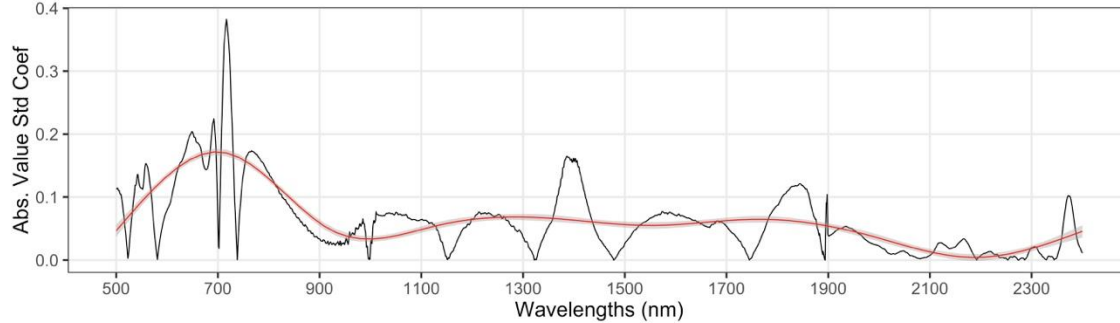
Figure S5. Partial least squares-discriminant analysis (PLS-DA) absolute value std. coefficient plots for differentiation between late blight and early blight during **(A)** all disease time points, **(B)** pre-symptomatic infection (early infection and biotrophic late blight), **(C)** light symptomatic infection (necrotrophic late blight), and **(D)** heavy symptomatic infection (sporulation late blight). .

Figure S6. – Potato late blight vs. potato late blight and potato early blight (mixed inoculation) partial least squares-discriminant analysis (PLS-DA) absolute value std. coefficient plots **(A)** all disease time points, **(B)** early infection, **(C)** biotrophy, **(D)** necrotrophy, and **(E)** sporulation.

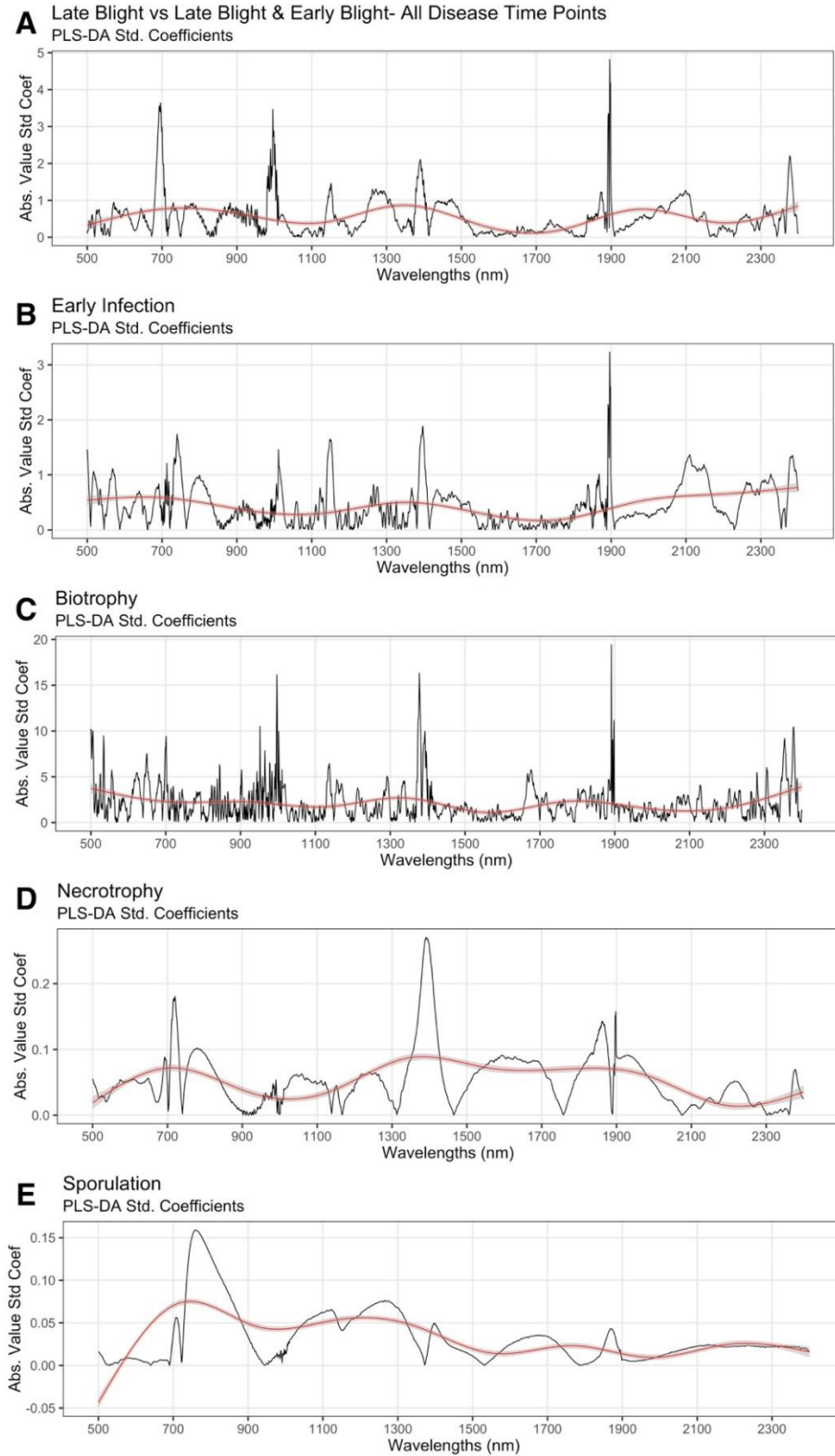**Table S1.** ANOVA tables for spectrally derived biochemical and physiological trait indices (partial least squares regression, late blight vs. control.

Non-Destructively Sensed Traits- Late Blight vs. Control				
Data binned by late blight disease time				
	numDF	denDF	Fvalue	Pvalue
Total Phenolics				
Intercept	1	358	3587	**<0.0001**
Disease Time	3	358	11	**<0.0001**
Treatment	1	170	17	**<0.0001**
Disease Time by Treatment	3	358	3	0.021
Sugars				
Intercept	1	358	1416	**<0.0001**
Disease Time	3	358	14	**<0.0001**
Treatment	1	170	9	0.003
Disease Time by Treatment	3	358	1	0.265
Starch				
Intercept	1	358	5361	**<0.0001**
Disease Time	3	358	12	**<0.0001**
Treatment	1	170	2	0.177
Disease Time by Treatment	3	358	1	0.417
Nitrogen				
Intercept	1	358	3440	**<0.0001**
Disease Time	3	358	22	**<0.0001**
Treatment	1	170	15	**<0.0001**
Disease Time by Treatment	3	358	4	**0.012**
Leaf Mass / Area (LMA)				
Intercept	1	358	3820	**<0.0001**
Disease Time	3	358	5	**0.001**
Treatment	1	170	8	**0.007**
Disease Time by Treatment	3	358	7	**<0.0001**
NDWI				
Intercept	1	358	17,999	**<0.0001**
Disease Time	3	358	15	**<0.0001**
Treatment	1	170	11	**0.001**
Disease Time by Treatment	3	358	2	0.107

Table S2. ANOVA tables for spectrally derived biochemical and physiological trait indices (partial least squares regression), early blight vs control.

Non-Destructively Sensed Traits- Early Blight vs. Control				
Data binned by early blight disease time				
	numDF	denDF	Fvalue	Pvalue
Total Phenolics				
Intercept	1	225	793	**<0.0001**
Disease Time	2	124	4	**0.022**
Treatment	1	94	7	**0.012**
Disease Time by Treatment	2	124	9	**<0.0001**
Sugars				
Intercept	1	225	382	**<0.0001**
Disease Time	2	124	11	**<0.0001**
Treatment	1	94	2	0.212
Disease Time by Treatment	2	124	5	**0.007**
Starch				
Intercept	1	225	1900	**<0.0001**
Disease Time	2	124	3	**0.051**
Treatment	1	94	0	0.527
Disease Time by Treatment	2	124	7	**0.001**
Nitrogen				
Intercept	1	225	1449	**<0.0001**
Disease Time	2	124	20	**<0.0001**
Treatment	1	94	2	0.154
Disease Time by Treatment	2	124	6	0.003
Leaf Mass / Area (LMA)				
Intercept	1	225	1714	**<0.0001**
Disease Time	2	124	7	**0.001**
Treatment	1	94	0	0.531
Disease Time by Treatment	2	124	6	**0.003**
NDWI				
Intercept	1	225	4,544	**<0.0001**
Disease Time	2	124	32	**<0.0001**
Treatment	1	94	27	**<0.0001**
Disease Time by Treatment	2	124	14	**<0.0001**

Table S3. ANOVA tables for spectrally derived biochemical and physiological trait indices (partial least squares regression), late blight vs. early blight, binned by early blight disease time stages.

Non-Destructively Sensed Traits- Early Blight vs. Late Blight				
Data binned by early blight disease time				
	numDF	denDF	Fvalue	Pvalue
Total Phenolics				
Intercept	1	327	1998	**<0.0001**
Disease Time	2	215	0	0.709
Treatment	1	164	0	0.498
Disease Time by Treatment	2	215	16	**<0.0001**
Sugars				
Intercept	1	327	1258	**<0.0001**
Disease Time	2	215	9	**<0.0001**
Treatment	1	164	1	0.294
Disease Time by Treatment	2	215	10	**<0.0001**
Starch				
Intercept	1	327	3853	**<0.0001**
Disease Time	2	215	3	**0.04**
Treatment	1	164	3	0.106
Disease Time by Treatment	2	215	5	**0.007**
Nitrogen				
Intercept	1	327	3564	**<0.0001**
Disease Time	2	215	16	**<0.0001**
Treatment	1	164	5	**0.034**
Disease Time by Treatment	2	215	1	0.363
Leaf Mass / Area (LMA)				
Intercept	1	327	3124	**<0.0001**
Disease Time	2	215	1	0.509
Treatment	1	164	4	0.061
Disease Time by Treatment	2	215	6	**0.003**
NDWI				
Intercept	1	327	9,256	**<0.0001**
Disease Time	2	215	18	**<0.0001**
Treatment	1	164	25	**<0.0001**
Disease Time by Treatment	2	215	38	**<0.0001**