Using artificial neural networks to predict the distribution of bacterial crop diseases from biotic and abiotic factors

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Supplementary Material

Table S1 Climate variables (units).

Temperature first month of summer (C)
Temperature second month of summer (C)
Temperature third month of summer (C)
Temperature first month of autumn (C)
Temperature second month of autumn (C)
Temperature third month of autumn (C)
Temperature first month of winter (C)
Temperature second month of winter (C)
Temperature third month of winter (C)
Temperature first month of spring (C)
Temperature second month of spring (C)
Temperature third month of spring (C)
Summer temperature (C)
Winter temperature (C)
Annual temperature (C)
Rainfall first month of summer (mm)
Rainfall second month of summer (mm)
Rainfall third month of summer (mm)
Rainfall first month of autumn (mm)
Rainfall second month of autumn (mm)
Rainfall third month of autumn (mm)
Rainfall first month of winter (mm)

Rainfall second month of winter (mm)
Rainfall third month of winter (mm)
Rainfall first month of spring (mm)
Rainfall second month of spring (mm)
Rainfall third month of spring (mm)
Annual rainfall (mm)
Annual potential evapotranspiration (mm per year)
Annual actual evapotranspiration (mm per year)
Moisture index (mm)
Length of day from sunrise to sunset (hours)
Annual soil moisture deficit at 50mm (mm)
Annual soil moisture surplus at 50mm (mm)
Annual soil moisture deficit at 150mm (mm)
Annual soil moisture surplus at 150mm (mm)
Annual soil moisture deficit at 300mm (mm)
Annual soil moisture surplus at 300mm (mm)
Annual soil moisture deficit at 700mm (mm)
Annual soil moisture surplus at 700mm (mm)
Soil moisture index at 300mm depth (mm)
Degree days 5 degrees (degree days)
Degree days 15 degrees (degree days)
Moisture index based on summation of monthly moisture values (mm)
Most extreme minimum of all climate values (no units)

Table S2 Target species. "Prevalence" lists the number of geographical regions in which each species is recorded as being present.

Scientific Name	Common Name	Prevalence
Rhizobium radiobacter	crown gall	101
Xanthomonas campestris pv. aberran	leafspot of cauliflower	123
Erwinia carotovora subsp. atroseptica	potato blackleg disease	99
Xanthomonas campestris pv. campestris	black rot	23
Spiroplasma kunkelii	corn stunt disease	57
Xanthomonas axonopodis pv. dieffenbachiae	anthurium blight	143

Table S3 Training epochs per species per data set, and number of hidden neurons selected for cascaded networks

Species	Climate	Hosts	Hidden Neurons
R. radiobacter	500	750	8
X. campestris pv. aberrans	750	750	4
E. carotovora subsp. atroseptica	750	500	8
X. campestris pv. campestris	500	500	10
S. kunkelii	500	750	7
X. axonopodis pv. dieffenbachiae	500	750	5

Table S4 Ensemble methods used for each species and data set.

Data Set	*R. radiobacter*	*X. campestris pv. aberrans*
Climate	Majority	Majority
Host	Majority	Median
Climate + Host	Mean	Mean
Data Set	*E. carotovora subsp. atroseptica*	*X. campestris pv. campestris*
Climate	Median	Max
Host	Majority	Max
Climate + Host	Mean	Max
Data Set	*S. kunkelii*	*X. axonopodis pv. dieffenbachiae*
Climate	Max	Median
Host	Majority	Median
Climate + Host	Mean	Mean