AUDPC Analysis

July 5, 2016

Background

Stripe rust of wheat is caused by a basidiomycete pathogen called *Puccinia striiformis*. Parallel lines of pustules form on the leaves of wheat plants, releasing enormous numbers of spores, especially when it is cool and humid. Spores are dispersed by wind, sometimes very far, and infect more wheat or other grass hosts. It can cause up to 40% loss of crop yields and seems to be adapting to warmer temperatures and resistant varieties of wheat. *Puccinia striiformis* was first found in Australia but has since spread world wide.

Analysis

I will be using data found on this tutorial to explore the effects of wheat cultivar and fungicide treatment on the incidence of disease caused by *Puccinia striiformis*. I will do this by comparing the **AUDPC** (area under disease progress curve) for the three cultivars and two fungicide treatments.

Load packages

```
library('knitr')     # Used to make tables
library('dplyr')     # Used for data.frame manipulations
library('tidyr')     # Used for data.frame manipulations
library('agricolae') # Used to calculated AUDPC
library('ggplot2')   # Used for graphing
library('magrittr')  # Adds %>% operator for chaining commands
```

Parse input file

```
data <- read.csv("fungicide_example.csv")
kable(data[, 1:3]) # make a table of first 3 columns
```

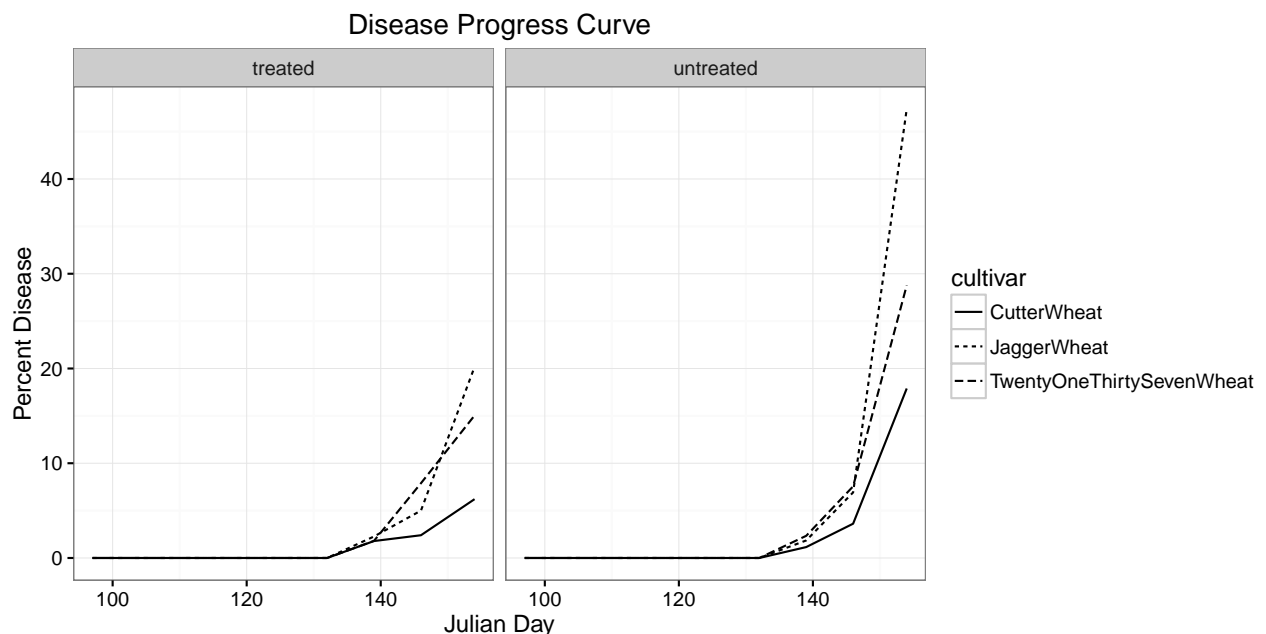| Julian.Date	TwentyOneThirtySevenWheat	TwentyOneThirtySevenWheat.trt
97	0.00	0.00
104	0.00	0.00
111	0.00	0.00
118	0.00	0.00
125	0.00	0.00
132	0.00	0.00
139	2.34	1.81
146	7.56	7.89
154	28.78	15.04

Tidy up the data

```
long_data <- data %>%
  gather(cultivar, disease, -Julian.Date) %>%
  mutate(fungicide = grepl(pattern = "\\.trt$", cultivar, ignore.case = TRUE)) %>%
  transform(fungicide = ifelse(fungicide, "treated", "untreated")) %>%
  transform(cultivar = gsub("\\.trt$", "", cultivar, ignore.case = TRUE))
kable(long_data[1:15, ]) # make a table of first 5 rows
```

Julian.Date	cultivar	disease	fungicide
97	TwentyOneThirtySevenWheat	0.00	untreated
104	TwentyOneThirtySevenWheat	0.00	untreated
111	TwentyOneThirtySevenWheat	0.00	untreated
118	TwentyOneThirtySevenWheat	0.00	untreated
125	TwentyOneThirtySevenWheat	0.00	untreated
132	TwentyOneThirtySevenWheat	0.00	untreated
139	TwentyOneThirtySevenWheat	2.34	untreated
146	TwentyOneThirtySevenWheat	7.56	untreated
154	TwentyOneThirtySevenWheat	28.78	untreated
97	TwentyOneThirtySevenWheat	0.00	treated
104	TwentyOneThirtySevenWheat	0.00	treated
111	TwentyOneThirtySevenWheat	0.00	treated
118	TwentyOneThirtySevenWheat	0.00	treated
125	TwentyOneThirtySevenWheat	0.00	treated
132	TwentyOneThirtySevenWheat	0.00	treated

Graph the disease progress curves

The disease was first detected in all treatments on Julian day 140 (May 19) and continued to rise until the end of the study in all treatments.

Calculate AUDPC

```
audpc_data <- long_data %>%
  group_by(cultivar, fungicide) %>%
  summarize(AUDPC = audpc(disease, Julian.Date))
```

cultivar	treated	untreated
CutterWheat	55.370	106.76
TwentyOneThirtySevenWheat	132.005	188.20
JaggerWheat	134.070	254.41

Graph AUDPC results

In general, "Jaggar" is the most susceptible and "Cutter" is the least. The incidence of disease for all cultivars was less when treated with fungicides.

Area Under the Disease Progress Curve
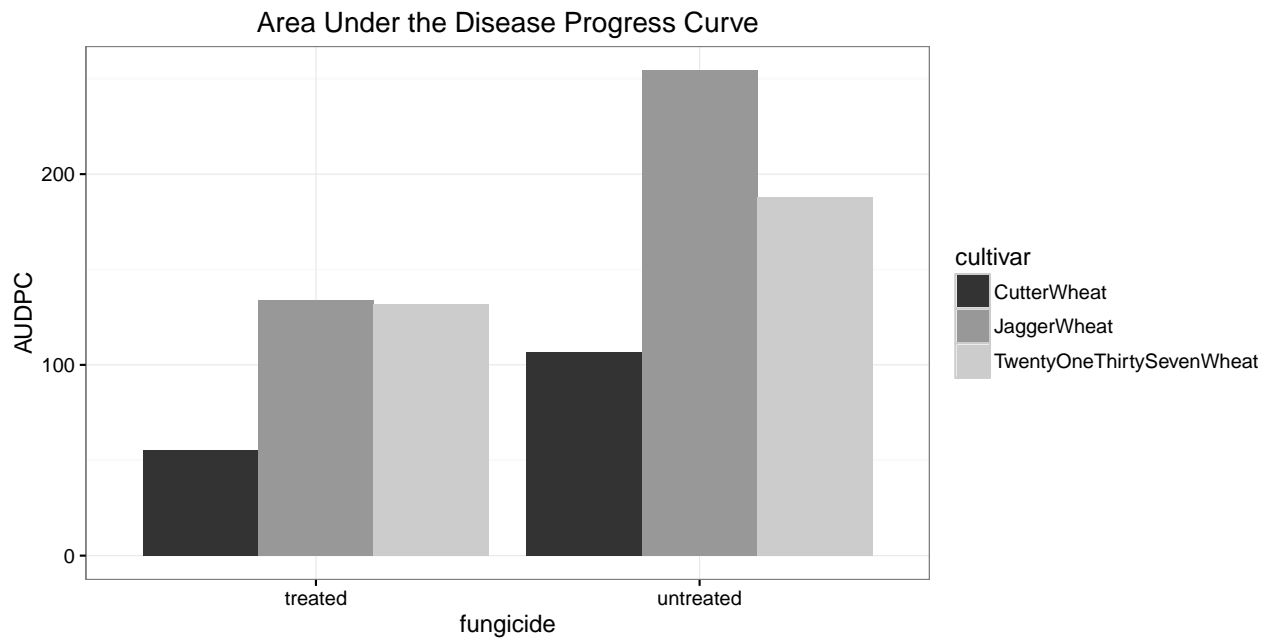
Conclusions

In general, the AUDPC only changes between the fungicide treatments during the last 10 days of the experiment. The "Cutter" seemed to be most resistant to the disease followed by "2137" and "Jagger". The results suggest that the best yields will be obtained when "Cutter" wheat is used and it is treated with fungicide.