Effect of climate change on the over winter survival of volunteer potatoes in Michigan.

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Figure 1. A field planted with corn in Michigan. The field has been over run by volunteer potatoes which survived the winter after being left behind after harvest the previous fall. (Photo courtesy, Chris Long, MSU)

Introduction

From 1950 to present, climatic conditions in Michigan have been becoming steadily more conducive for the initiation and development of potato late blight epidemics (Baker et al., 2005). Epidemics of potato late blight are initiated from mycelium of *Phytophthora infestans*, which survive over winter in infected potatoes left behind in the field after harvest (volunteer) and waste (cull) potatoes (Fig. 1, 4; Zwankhuizen et al., 1998). With the recent trend for warmer winters, more volunteers and cull pile potatoes are surviving the winter and acting as sources of inoculum in the spring. Studies at MSU have shown that mycelia of newer genotypes of *P. infestans* (e.g. US-8 and US-14) are becoming more tolerant to colder temperatures and are tolerant to -3˚C for up to three days continuous exposure (Kirk, 2003). Tubers of most cultivars appear to breakdown after exposure to -3˚C for about one day. Soil temperature data from the past seven years was analyzed to determine the effect of winter soil temperatures on the survival of volunteer potatoes over winter in Michigan.

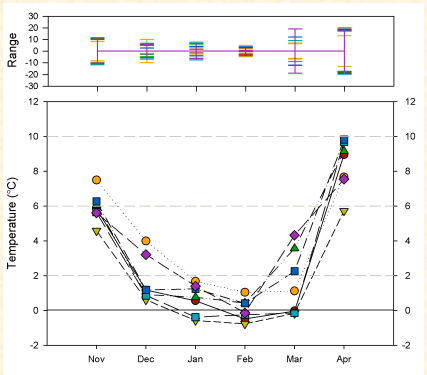

Figure 2. Mean monthly winter soil temperatures from data recorded in Belding, MI. Temperatures were recorded at a depth of 5 cm between November and April from 2000 to 2007. See footnote for legend to colors.

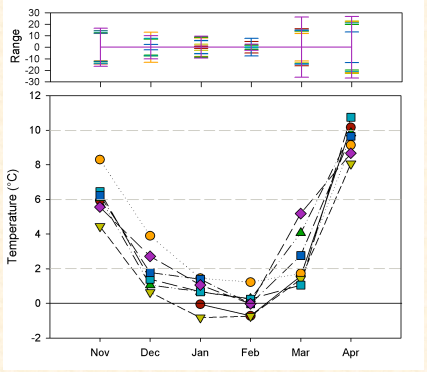

Figure 3. Mean monthly winter soil temperatures from data recorded in Clarksville, MI. Temperatures were recorded at a depth of 5 cm between November and April from 2000 to 2007. See footnote for legend to colors.

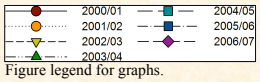

Figure legend for graphs.

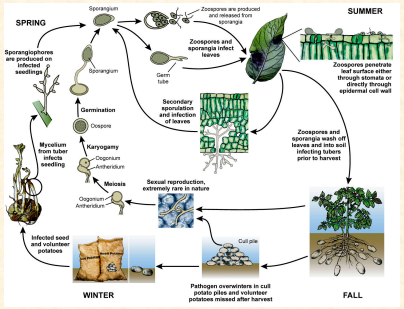

Figure 4. Disease cycle of the late blight pathogen, *Phytophthora infestans*.

Conclusions

Results showed that mean monthly soil temperatures between November and April did not fall below -3˚C even at the most northerly weather station (Hawks). The lowest temperature recorded during the study period (2000 – 2007) was -6.6˚C at the Southwest Michigan Research and Extension Center (SWMREC) in February 2003. This was part of a cold snap in which the temperature remained below -3˚C for 6 days. Further analysis of the data revealed that there were only five other occasions during the study period in which the temperature remained below -3˚C for more than 1 day, and none of these periods lasted longer than 6 days (data not shown). The coldest months of the winter at all stations were January and February and analysis of variance on monthly average and MIN temperatures showed there were no significant differences between stations for these two months. Over the study period the average MIN temperature at Hawks during January and February was -1 and -0.2˚C respectively. This was higher than the averages for Petersburg in the south east of the state (-1.7 and -2.0˚C, respectively) and may be due to the higher snow fall totals which occur in the north of the state and act to insulate the ground.

These results demonstrate the increased potential for volunteer potatoes to survive over the winter even in the most northerly potato growing regions in Michigan. Late blight is known to over winter in potato tubers intended for replanting as seed, but the disease may also be incubated in volunteer and cull potatoes. The increased probability of volunteer and cull potatoes surviving the winter in Michigan increases the chances of them acting as a source of infection for the establishment of late blight epidemics.

Materials and Methods

- Winter soil temperature data from the Michigan Automated Weather Network (MAWN) was collected from five weather stations located around the state of Michigan (Fig. 6). Stations with data records going back to 2000 were selected for the study.
- Soil temperature sensors recorded the temperature at 5 and 10 cm depths. Daily MAX and MIN reading from November to April were selected for analysis.
- Analysis of variance revealed no significant differences between 5 and 10 cm measurements so only data for the 5 cm depth sensors was used in the study.
- For each station the monthly mean temperatures were calculated along with the range between monthly MIN and MAX temperatures.

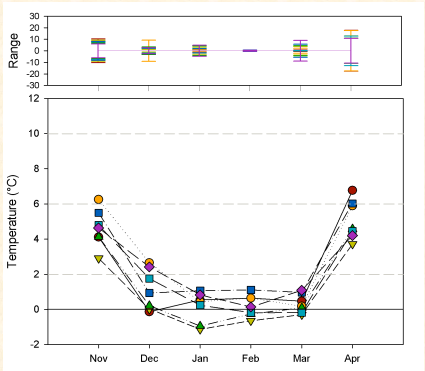

Figure 5. Mean monthly winter soil temperatures from data recorded in Hawks, MI. Temperatures were recorded at a depth of 5 cm between November and April from 2000 to 2007. See footnote for legend to colors.

References

Baker K.M., Kirk W.W., Stein J.M., and Andresen J.A., 2005. Climatic trends and potato late blight risk in the upper great lakes region. *HortTechnology* **15**: 510-518.

Kirk W.W., 2003. Tolerance of mycelium of different genotypes of *Phytophthora infestans* to freezing temperatures for extended periods. *Phytopathology* **93:** 1400-1406.

Zwankhuizen M.J., Govers F., and Zadoks J.C., 1998. Development of potato late blight epidemics: Disease foci, disease gradients, and infection sources. *Phytopathology* **88:** 754-763.

Figure 6. Location of Michigan Agricultural Weather Network stations used in the study.

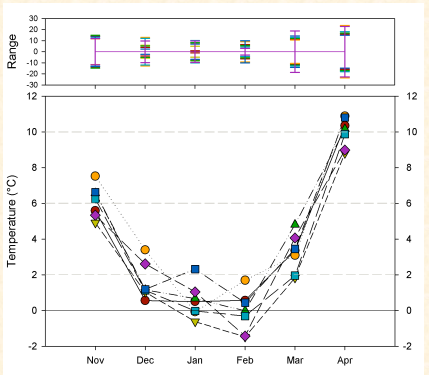

Figure 7. Mean monthly winter soil temperatures from data recorded in Petersburg, MI. Temperatures were recorded at a depth of 5 cm between November and April from 2000 to 2007. See footnote for legend to colors.

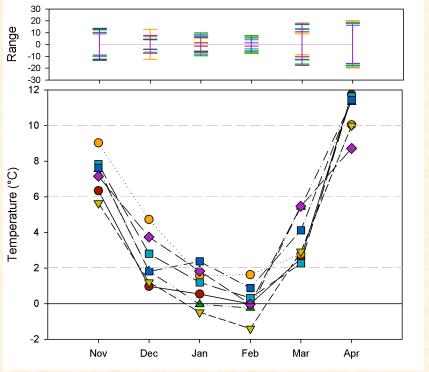

Figure 8. Mean monthly winter soil temperatures from data recorded in Southwest Michigan Research and Extension Center (SWMREC), MI. Temperatures were recorded at a depth of 5 cm between November and April from 2000 to 2007. See footnote for legend to colors.

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