PANELLA, LEE[1*], TRAVIS VAGHER[1], ANN FENWICK[2] AND LINDA E. HANSON[3], [1]USDA, Agricultural Research Service, 1701 Center Avenue, Fort Collins, CO 80526 [2]Beet Sugar Development Foundation, 800 Grant Street, Denver, CO 80203, and USDA, ARS, 494 Plant and Soil Sciences Bldg. MSU, East Lansing, MI 48824-1325. **Development of a field inoculation method to screen for sugar beet seedling resistance to *Fusarium oxysporum* f. sp. *betae*.**

ABSTRACT

Fusarium yellows is an important disease in many sugar beet production areas throughout the U.S. and yield losses can be devastating. Also seedling damping off caused by *Fusarium* can result in serious damage to the sugar beet stand establishment. This can lead to a severe loss in yield. The objective of this research has been to develop the methodology for field screening of sugar beet for *Fusarium* resistance at the seedling stage. *Fusarium oxysporum* f. sp. *betae* isolate, FOB220a (highly virulent), was used to prepare infested barley inoculum. Sterile barley inoculated with a liquid *Fusarium* culture was incubated at room temperature until all barley grains were fully colonized. Ground, dried inoculum, added to the seed packets, was used to inoculate field experiments. Sterile barley was used as a control. The nursery consisted of one-row plots (75 cm spacing, 4.9 m long), at the ARS Research Farm, in Fort Collins, CO. Trials were planted in 2008 through 2013. Crusting after heavy rains impeded germination in 2009, 2011, and 2012 and there were no data from those years. Four public germplasms, which varied in their resistance to FOB220a were tested – FC708, FC716, FC709-2, and FC702-2. Seedling stands were counted every 7-10 days for six weeks post emergence. There were significant differences between the lines in the inoculated and control plots when averaged over years. In all years no significant difference between the inoculated and control plots at the first count was observed. Therefore, no pre-emergence death was detected in the inoculated plots. All of the inoculated lines lost seedlings over time and there were significant differences between the highest and lowest (last) counts in the inoculated plots.

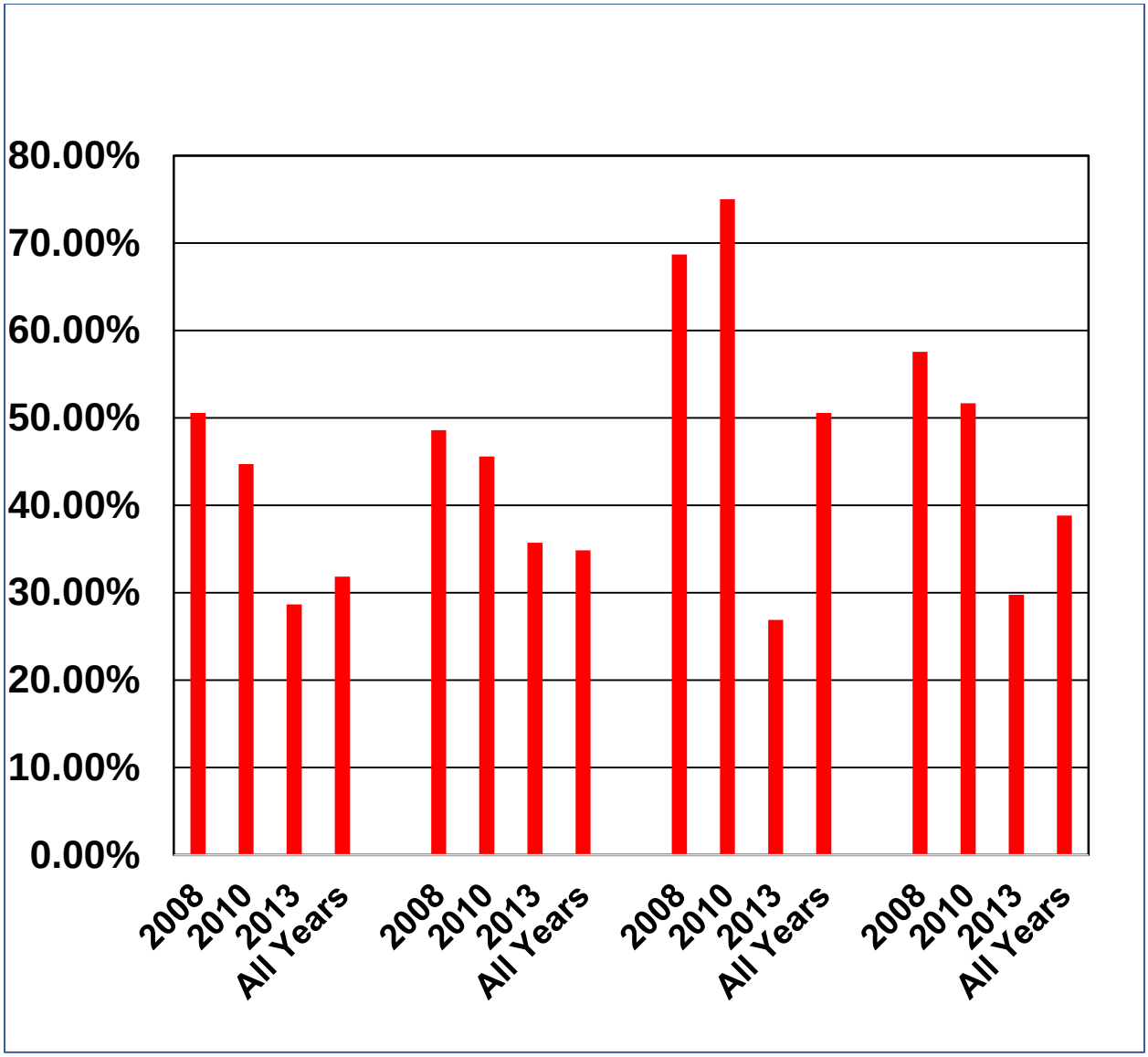
The control plot never had significantly higher survival than the inoculated plot for any of the different germplasm, in any of the three years at the first counting of seedling survival. In some years, maximum emergence was not reached until the second counting date. On the third and fourth dates that seedlings were counted, there were significant differences between the inoculated and the control in 2008 and 2010. There was cool, wet weather in 2013. In 2013 at the fourth counting date, only FC709-2 showed significant differences between the inoculated and control plots, although differences were significant for FC716 at the P=0.10 level. Nonetheless there was always a drop in survival in the inoculated plots.

As with any field trial, the planting dates, soil moisture levels, rainfall, irrigation timing, and therefore the germination of the seeds are variable year to year. The variation in timing of emergence and percentage germination is especially high in non-commercial, inbred lines used in this study; commercial seed should have more uniform emergence and increased seedling vigor. The figure below shows the percentage of seedling death from the graph in, which equalizes the differences due to variability in the rate of germination. It is clear that even with particularly poor germination, FC702-2 was extremely susceptible to *F. oxysporum* f. sp. *betae*, as expected. FC708CMS and FC709-2 performed better but still averaged between 30 and 35% loss of stand.

Due to the emergence of the control and inoculated seedlings not being significantly different initially, we feel confident that for large scale screening it is not necessary to plant a control for every line screened. It is sufficient to obtain a good count of emergence in an inoculated plot

and then calculate seedling loss over time. Even in 2013, when differences were not pronounced, had the last count been taken two weeks later, differences that were starting to show might have been significant.

The amount of inoculum used provided a uniform severity of disease, and was able to distinguish the levels of resistance among the germplasm tested. This protocol provides a viable strategy to screen sugar beet germplasm for seedling response to *F. oxysporum* f. sp. *betae*.



The loss of seedlings in the inoculated plots expressed as the percentage of loss from the highest seedling survival count to the lowest survival count. Germplasm lines are grouped by years and averaged over all years.