CERCOSPORA FORUM
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A special forum on Cercospora leaf spot was held during the biennial meeting of the American Society of Sugar Beet Technologists, in Salt Lake City, Utah, on Saturday March 3, 2007.

The forum was moderated by Gary Secor, North Dakota State University. The invited presenters were: Linda Hanson, USDA-ARS, East Lansing, Michigan; Barry Jacobson, Montana State University; Robert Harveson, University of Nebraska - Panhandle Research and Extension Center; Willie Kirk, Michigan State University, and Mohamed Khan, North Dakota State University. A report from Gary Franc, University of Wyoming, was presented by Linda Hanson.

Gary Secor, North Dakota State University. Cercospora leaf spot (CLS), caused by the fungus *Cercospora beticola*, is an endemic disease of sugarbeets produced in the Northern Great Plains area of North Dakota and Minnesota. The disease is controlled by crop rotation, resistant varieties and timely fungicide applications. *Cercospora* leaf spot usually appears in the last half of the growing season, and one to four fungicide applications are made for disease control. The most frequently used fungicides are triphenyl tin hydroxide, thiophanate methyl, tetraconazole, trifloxystrobin and pyraclostrobin. Fungicides are alternated and customarily applied singly. It is necessary to monitor for shifts in sensitivity to these five fungicides since they have a previous history of resistance development in many biosystems.

Leaves were collected from approximately 1000 fields from 1998-2006 and analyzed for fungicide sensitivity. Spores were collected from five lesion/leaf and five leaves/sample. A bulk spore sub-sample was used for tin and thiophanate methyl testing by calculating germination of 100 spores on water agar amended with either 1 ppm tin or 5 ppm thiophanate methyl. A single spore isolate was used for tetraconazole, trifloxystrobin and pyraclostrobin testing. An EC-50 value was calculated for tetraconazole using radial growth on CV8 medium amended with tetraconazole from 0.001-1.0 ppm, and for trifloxystrobin and pyraclostrobin using spore germination on water agar + 100 ppm SHAM with pyraclostrobin and trifloxystrobin from 0.001-1.0 ppm.

Resistance to Tin at 1.0 ppm has basically disappeared, due to the use of alternate fungicides that reduced the annual number of Tin applications from 2.14 in 1998 to <1.0 every year from 2001-2006. Resistance to thiophanate methyl at 5 ppm is widespread across all production areas, and is not declining. Sensitivity to tetraconazole is relatively stable, but there has been a gradual shift in the direction of increased resistance of both average EC50 values and the number of isolates with an EC50 > 1.0. In 2006, there was a reduction in both the average EC50 values and the percent of isolates with EC50 values >1.0 to tetraconazole.

There has been an 8-10 fold change in sensitivity to trifloxystrobin and pyraclostrobin compared to the pre QOI use baseline.

It appears that the resistance management plan we are following is working, but it will be necessary to continue to use alternations and combinations of fungicides with different modes of action to prevent reduced sensitivity of *C. beticola* to currently registered fungicides. Recommendations include only one triazole per season and only one strobilurin per season. So far we have not had any fungicide failures, but we have had low disease pressure in recent years. Increased disease pressure may accelerate fungicide resistance because C. beticola is such a variable fungus, and since mating types have been found in the USA and Europe, the potential always there for fungicide resistance.

Willie Kirk, Michigan State University. In Michigan, Cercospora leaf spot *(Cercospora beticola)* is the most serious foliar disease of sugarbeet and when conditions are conducive can cause yield losses. Major issues that have developed include application timing of fungicides and the development of insensitivity to currently used fungicides such as Headline, Topsin, Eminent and Super Tin. The objectives of sensitivity monitoring work in MI, have been to determine the sensitivity of the population of *C. beticola* in eastern Michigan from 2003 to 2006 to fungicides triphenyltin OH (Super Tin), thiophanate-methyl (Topsin), pyraclostrobin (Headline) and tetraconazole (Eminent)]. The type of survey used in MI was designed to test a wide range of Cercospora lesions from throughout the MI sugarbeet region (100 to 120 locations/year). This method can quickly detect if there are any changes in the population and further analyses of the effective concentration can then be done. Since the field sampling season of 2003 to that of 2006 the population has fluctuated only slightly. There have been no reports of field failure of the tested products in MI although Topsin and Super Tin are not used as stand alone products. The majority of lesions sampled were sensitive to tetraconazole and pyraclostrobin but by 2006 about 10 lesions (0.01%) were found to produce colonies with decreased sensitivity. There appears to be a decrease in the number of isolates insensitive to thiophanate-methyl and triphenyltin OH tested at 10 ppm (both products) from 2004 to 2006. The reason for this is not clear however use of both products has declined over the same period.

Linda Hanson, USDA-ARS, East Lansing, MI. Fungicide resistance is an important concern in *Cercospora beticola*. Current detection methods are labor intensive, and it would be desirable to have rapid detection methods that could be used in making disease management decisions and assessing resistance management practices. Based on findings with other fungi of specific gene mutations associated with several of the major classes of fungicides, work is ongoing to develop rapid molecular tests for fungicide sensitivity. Based on previous findings of a single mutation conferring benzimidazole-tolerance in *C. beticola*, PCR primers to distinguish between benzimidazole-sensitive and benzimidazole-tolerant isolates have been developed. Differential amplification was observed, but temperature differentials were narrow. Thus other methods are being tested. In addition, amplification of important gene targets for other fungicide classes has been initiated.

Gary Franc, University of Wyoming. A survey of Cercospora fungicide resistance was conducted in the High Plains sugar beet production area of CO, NE, MT and WY from 1998-2006. Approximately 20-60 production fields were tested each year. Resistance was tested in vitro using fungicide amended media by bulk testing on media with discriminate dosages; the dosages were 5 ppm for Topsin, and 1 ppm for Eminent, Tilt, Quadris, Gem and Headline. A field was considered resistant if at least one isolate grew equal to or greater than 80% of growth on non-amended medium. Survey results show that in 2006, 50-100 of the isolates sampled in the four states were resistant to Topsin at 1 ppm. No resistance to was detected to tin, Emeinent, Gem or Headline. One isolate showed resistance to Quadris and is being retested.

Robert Harveson, University of Nebraska. A Cercospora leaf spot management system was studied from 2000-2006 in western NE. The study included a Cercospora leaf spot forecasting system and fungicide management components. The Cercospora Alert Forecasting System was a collaborative effort between UNL and Western Sugar Cooperative. The system was based on RH and temperatures within plant canopies at 12-15 sites in NE, CO, MT and WY. Results are reported by fax or email to more than forty stakeholders and includes a risk factor for infection. Fungicide trials were conducted to determine the optimum time and form of fungicide application for best control. Fungicide trials were established as replicated field plots and disease control evaluated 4-6 times per season using a 0-9 rating system where 1 = 1-10 spots and 9 = >90% coverage by spots. Based on six years data, the form of fungicide is less important than when it is applied. The best results were obtained with an early first application based on either the alert system or prior to symptom appearance. The use of sugar beet varieties with host plant resistance are also important to use, as resistance delays disease onset and progress. It is important to rotate fungicides to prevent resistance development in *Cercospora beticola.*

Barry Jacobson, Montana State University. During the growing season of 2003, the Shane and Teng model predicted severe infection periods during the month of July for Cercospora leaf spot in eastern Montana. However, very little disease developed even though early infection was present. It was noted that high temperatures (>90F) were recorded for 22 days during July. Trails were established at Sydney, MT to determine the effect of high temperature on Cercospora disease severity. Trial results showed increased latent period (30% longer), up to a ten-fold reduction in spore production and less disease severity as temperature increased, especially at temperatures >90F. It appears that temperatures >90F are unfavorable for Cercospora leaf spot development, and temperatures only need to be >909F for 12 hours to suppress Cercospora leaf spot severity. These data suggests that under high temperatures, the Shane and Teng model may over estimate disease potential particularly where more resistant varieties are used.