APHANOMYCES ROOT ROT ON SUGAR BEET: OCCURRENCE AND CONTROL IN THE UNITED STATES. CAROL E. WINDELS, Univ. of Minn., NW Research & Outreach Center, Crookston 56716.

Aphanomyces cochlioides occurs in all sugar beet-production areas in the United States (U.S.) and causes seedling disease and chronic root rot. Disease varies in severity from mild to severe, depending upon the region, weather conditions, and effectiveness of disease control strategies. The results presented here are based on information provided by an informal survey of colleagues; a nationwide survey on sugar beet pests and control strategies conducted by B. Jacobsen, A,G, Dexter, L.J. Smith, and M.B. Mikkelson; and my experience. *A. cochlioides* occurs in an average of 28.5% (419,200) of the 1,473,428 acres planted to sugar beet in 1998 and 1999. In the Red River Valley (RRV) and southern Minnesota, which comprise nearly 725,000 acres of beet production, 51% of the acreage is infested. Occurrence in other regions averages 19.1% in Montana, northern Wyoming, and western North Dakota; 10.9% in Michigan; 14.2% in Colorado, Nebraska, and southern Wyoming; and is rare in California, Idaho, eastern Oregon, and southern Washington. Tachigaren (hymexazol)-treated seed is sown in 9.3% of the U.S. sugarbeet acreage (137,300) and most usage is in southern Minnesota and the RRV (128,000). Planting of varieties with resistance to Aphanomyces occurs in only 8.3% of acres (121,000) planted to beets in the U.S., primarily in the RRV and southern Minnesota (14%); Michigan (8.8%); and Colorado, Nebraska, and southern Wyoming (5.1%). Wet weather in the RRV during the 1990s has increased the prevalence and severity of Aphanomyces diseases. For instance, in 2000, heavy rainfall in late June led to the development of severe Aphanomyces root rot. Twenty thousand acres were destroyed and other infested fields suffered losses in yield and quality. Conservative estimates of direct losses to producers are about $18 million. Overall, *A. cochlioides* is a growing problem in major sugar beet-production regions in the U.S. and increases in use of Tachigaren seed treatment and resistant varieties are anticipated.

APHANOMYCES, A WORLD-WIDE PROBLEM. Klaas Van der Woude, Van der Have Hybrids, ADVANTA

Aphanomyces fungi can damage seedlings in most areas of the world where sugarbeets are sown. Damage to "adult" sugarbeet plants can also be widespread, but is more common in warm and humid climates where soil conditions are conducive. Adult plant infections are most prevalent in the upper mid-west of the U.S, in Chile, Japan and the Ukraine.

Seedling stage infection is primarily avoided by treating seed with fungicides. Where infection rates or pathogen virulence are expected to be high, higher rates of fungicide can be used. Soil assays have been developed to predict pathogen density.

Another possible preventative is seed treatment with biological "fungicides". These are still in the research stage, and not commercially available.

Breeding for tolerance has focused on both early and late season infections. Since seed treatments have efficacy for early season damage, resistance breeding should concentrate on late season tolerance. Unfortunately, growing areas with prevalent late season Aphanomyces often feature other sugarbeet diseases. In the upper mid-west of the U.S., varieties should combine tolerances to Aphanomyces with tolerances to Cercospora, Rhizomania, or both. In Chile, Aphanomyces tolerance should be combined with tolerance to virus yellows and Rhizoctonia. In Japan, Rhizoctonia, Cercospora and increasingly Rhizomania can be prevalent in areas where Aphanomyces is most common.

Van der Have has developed a bioassay to assess tolerance to seedling stage Aphanomyces. Genotypes are compared to ACH205 for 15-day survival percentage. An associated poster presentation further described this technique.

For adult stage resistance, a field test is necessary. Reliable conditions are hard to find. However, there is good correlation for levels of resistance with official trial performance under diseased conditions and grower field results.

EFFECT OF APHANOMYCES ON STORAGE CHARACTERISTICS, Karen L. Klotz and Larry G. Campbell, USDA, Agricultural Research Service, Northern Crop Science Laboratory, Fargo, North Dakota 58105-5677

In recent years root-rots have become more prevalent throughout Minnesota and eastern North Dakota. Because of their persistence in the soil and the lack of effective control methods available, Aphanomyces root-rot is especially threatening. Any increase of root-rots in the field will be accompanied by in increase in the proportion of roots with rot that are placed in storage piles. Information on the effects of root-rot severity on initial quality and storability would assist growers and agriculturalists when determining the level of disease severity that would justify not harvesting a field, or if roots from diseased fields should be segregated and processed first.

Three fields south of Moorhead, Minnesota were sampled in 2000. Roots from each field were divided into four groups, based upon root-rot (primarily Aphanomyces) severity. The most severely infected roots were substantially lower in extractable sugar per ton and had considerably higher respiration rates. The results suggested that roots with some russeting may have slightly lower sugar concentrations and slightly higher respiration rates, but the effects were small when compared with roots with higher levels of Aphanomyces. Respiration rates of roots classified as moderate or severe increased over time while rates for roots with no rot remained relatively constant. The higher respiration rates of the diseased roots would increase pile temperatures, increasing storage losses of adjacent healthy roots.

Carbohydrate impurity concentration also increased with disease severity. The concentration of the invert sugars, glucose and fructose, increased with disease severity, although the trisaccharide content was slightly lower in the most severely diseased roots. Raffinose was the major trisaccharide present. The concentration of all impurities declined with prolonged storage regardless of the severity of disease symptoms.

The results presented in this report are based on a few samples collected in a single year and should be considered preliminary. Continuing research in this area will provide more reliable information for making decisions regarding harvesting and storing diseased roots.

DEVELOPMENT OF APHANOMYCES RESISTANT HYBRIDS. Bengt-Olle Jonsson, Hilleshog Hybrids/SYNGENTA

Aphanomyces can damage sugarbeets at both the seedling stage and adult stage. Both infection rate and severity increases in different growing areas depending on temperature and humidity.

It has been difficult to develop a precise and reliable field methodology to assess differences in adult stage damage. However, greenhouse and climate controlled chambers can be used to create uniform and virulent seedling infections.

The assumption is that selection for tolerance to seedling Aphanomyces will also result in tolerance to adult stage infections. Selection for resistance at the seedling stage can be done quickly, with fairly high precision, and with lower cost than for selection of adult stage tolerance.

This presentation described a greenhouse/climate room method used by Syngentia to artificially infest seedlings. Seedlings are classified for damage and survival rate, and a root rot disease index is calculated. Percentage of dead plants and number of healthy plants are key factors.

In field tests under diseased conditions, root yield was strongly correlated to genotype disease index, with those having the best resistance also having the highest root yield.

EVALUATION OF OFFICIAL TRIAL ENTRIES IN THE APHANOMYCES ROOT ROT NURSERY AT SHAKOPEE, MINNESOTA. Margaret Rekoske, BETASEED, Inc.

Official trial hybrids have been evaluated for Aphanomyces root rot at Shakopee, MN since 1995. That year, a small pilot trial resulted in root rot data consistent with grower's previous observations for the same hybrids. The current strategy for testing Official trial entries is to test varieties under conditions similar to those of growers facing potential Aphanomyces infection. Factors include early planting, Tachigaren treated seed, and typical upper midwestern field preparation practices. However, adequate soil moisture is maintained to promote Aphanomyces infection. During the growing season, foliar ratings are taken on stand and plant health using a 1-9 scale where 1 is healthiest and 9 is dead. In late September or October, all roots are dug and evaluated for Aphanomyces root damage using a 1-9 scale where 1 represents a full stand of healthy roots, and 9 indicates no roots survived. Very significant differences have been detected using both the foliar and root ratings. Varietal reaction to Aphanomyces root rot has been uniform and repeatable. Both foliar and root readings can be used to evaluate materials. There was a very high correlation between foliar and root ratings of 0.91 in the 2000 official trial.

APHANOMYCES RESISTANCE IN VARIETIES TO BE USED IN THE CRYSTAL GROWING AREA John Kern, American Crystal Sugar Company.

Prior to 1988, there was no Aphanomyces (Aph) specialty variety category in the ACS variety approval system. From 1988-1998, there was an Aph category, but no actual Aph or Cercospora resistance requirements, and seed companies could sell seed of Aph varieties after one year of testing. At the present time, there are specific Aph and Cercospora resistance levels that an Aph specialty variety must meet, and companies must test for two years before seed sales can begin. There is no sugar content or yield approval requirement for the Aph specialty varieties.

Each year Aph specialty varieties are evaluated at 11 "Aph free" sites and two Aph infected sites in the Crystal growing area. In the non-Aph sites, we overseed and thin to eight inches (20 cm), while in the Aph locations, we plant to stand at 4.5 inches (11.4 cm). At the Aph sites, we use pelleted seed treated with Tachigaren at the 45-gram rate, so we are evaluating the effect of chronic Aph and not seedling Aph.

Generally it is difficult to obtain reliable data from Aph yield trials. However, in the last two years, we have obtained in the Aph trials yield CV's of 7.1 and 4.8 and sugar CV's of 2.3 and 3.0. When appreciable Aph symptoms do not appear at the Aph locations, we do not harvest those trials.

Evaluation of coded test varieties for Aph resistance is conducted by Betaseed at Shakopee, MN. Cercospora evaluation is also done by Betaseed, but at Rosemount, MN. The Aph ratings are foliar at this time. Since Aph is a root disease and since the Crystal agricultural staff keeps or discards fields for root storability based on root symptoms, we would like to change from a foliar rating to a root rating. Betaseed has been developing such root ratings in recent years, but a longer history is needed.

In addition to evaluating the Aph specialty varieties for Aph resistance, we also evaluate the fully approved and third year candidate non-specialty varieties for Aph resistance. This is independent of full market variety approval criteria, and also is not part of the Aph specialty variety approval system. Initiated in 1999, it is funded by ACS and provides growers and Aph susceptibility or tolerance level of non-specialty varieties.

The production potential of the new generation of Aph tolerant specialty varieties is much higher than that exhibited by the Aph varieties seed companies have offered in the past, without a significant loss of either Aph or Cercospora resistance. The most important feature of these new Aph varieties is that they perform very well, often producing even higher revenue per acre than the non-Aph varieties, in both Aph and Aph-free environments.