Management of High Plains Disease in Western Colorado Sweet Corn

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Introduction

High plains disease (HPD) is a newly described virus disease of wheat, corn, and related grasses first discovered in the Great Plains in 1993. It has probably been present for some time prior to its identification as a unique disease, but it was either confused with similar diseases, or made a sudden increase in distribution and abundance. Symptoms similar to those of HPD have been observed in western Colorado sweet corn seed production fields as long ago as the mid 1970's.

High plains disease affects several crops, but economic damage is limited to isolated instances because of present crop management and disease resistance in many sweet corn hybrids. Symptoms of HPD vary with crop or host species, variety, time since infection, temperature, multiple infection with other diseases and other variables. On sweet corn, symptoms include stunting, yellowing and mosaic pattern, and plant death (Figure 1). On wheat, symptoms can be indistinguishable from those of wheat streak mosaic, and the diseases can be positively identified only with serological laboratory analysis (Figure 2).

Figure 1 Severe HPD symptoms in sweet corn inbreds
Figure 2  HPD symptoms in wheat. These symptoms cannot be distinguished from those of wheat streak mosaic and other virus disease without laboratory testing.

**HPD Vector: Wheat Curl Mite**

High plains disease is transmitted by wheat curl mite, Aceria tosciella (WCM). This tiny mite has a host range that is limited to a wide range of grasses. They have piercing and sucking type mouthparts, and require green plant material to feed on. When host plants mature, WCM must migrate to other suitable hosts to survive. The time that WCM can survive off of green host plants varies with temperature and humidity, but is probably no longer than a few days to a week under the best conditions. Wheat curl mites move short distances by crawling, and longer distances by moving with the wind, or by clinging to the legs of more mobile insects such as aphids.

Wheat curl mites feed at the base of newly expanding leaves on actively growing grasses. The majority of WCM will be found on the youngest leaves of the plant. They cannot be observed without a good hand lens or dissecting microscope.

Wheat curl mites are extremely tolerant of cold. They may actively feed and reproduce when temperatures are above freezing, and simply lay dormant when temperatures are below freezing. Wheat curl mite populations on plants located on south-facing slopes tend to increase over the winter in areas with mild climate. Population levels may reach hundreds to more than a thousand WCM per leaf during February and March (Figure 3.) If these mites are on HPD infected plants, they are capable of spreading the disease very early in the season.
The High Plains disease virus is capable of surviving in many grass species, but only a few are important in the management of the disease. Crops that can be affected include wheat, barley, oats, rye and corn. There are presently no small grain varieties that are resistant to HPD, but many hybrid corn and sweet corn varieties are resistant to the disease. There is a wide range of resistance levels in inbred corns used in hybrid seed production.

Many wild grasses are HPD host plants. Winter annual grasses tend to be the most important hosts for overwintering HPD and WCM. These grasses may become infected with the disease in fall, winter or early spring, and serve as inoculum and vector sources for sweet corn when they mature in early to late spring. Grass species that fall into this classification include volunteer wheat, downy brome, cheatgrass, jointed goatgrass and hare barley. Of these, hare barley is the most widespread, and is present near almost all severe outbreaks of HPD (Figure 4.) It typically matures in late April or early May, when new sweet corn seedlings are at their most susceptible growth stage.

The summer annual grasses green and yellow foxtail are excellent indicators of the presence of HPD (Figure 5.) They show good virus symptoms when ever they are infected, but they are not important in the disease cycle of HPD in sweet corn because they do not germinate until the

**Figure 3** Wheat curl mites can only be seen with the aid of a good hand lens or microscope. They can become abundant, as this picture of mites on a wheat leaf collected in February 1998 shows.
infection has already taken place in the sweet corn crop.

HPD Management in Sweet Corn
Determination of Risk

The determination of risk of HPD infection is largely dependent upon the type of sweet corn production. Sweet corn production can be characterized into three production groups:

Fresh market production is typically used by growers who plant small acreage, and harvest fields several times during the harvest window. Hybrid varieties with resistance to HPD are typically used. These fields are the lowest risk.

Commercial production fields are typically larger than ten acres, and harvested one time. A uniform stand is critical to profitability in these fields because skips in plant stand lead to differences in plant maturity. Over or under mature ears which are out of phase with the rest of the field are not picked, and are lost. Plants which die from early HPD infection are one cause of stand skips, and every percent of stand that is lost can actually lead to a several percent loss in production. Commercial production fields can be severely affected by HPD, but it is relatively rare for this to happen, and

Figure 4 Hare barley can be identified by its winter annual growth habit and unique seed head. However, once the head is formed, it may be too late to manage HPD, as WCM has probably begun to migrate from the plant.

Figure 5 Yellow foxtail is an excellent indicator of the presence of HPD, as it expresses distinct symptoms. It is relatively unimportant in the HPD cycle in sweet corn.
cultural methods of control are usually sufficient to prevent economic loss.

Sweet corn seed production presents a unique combination of a high value crop which may be very susceptible to HPD. Many inbred genetic lines are vulnerable to HPD, although others show excellent resistance. In addition, sweet corn seed is very valuable, and every plant that is lost to HPD is economically significant. Sweet corn grown for seed also tends to be planted relatively early in the season, at the same time that many winter annual grasses are maturing, which makes it vulnerable to infection.

The risk of economic damage from HPD is a product of the amount of inoculum present, the timing of the vector movement from maturing host plants, the growth stage of the sweet corn crop when the vectors move, and the sweet corn production system. In general, high risk sweet corn can be characterized into groups:

1) HPD susceptible sweet corn grown for seed.

2) Late May and early June emerging commercial sweet corn planted adjacent to wheat that is between heading and hard dough growth stage.

3) Commercial sweet corn near winter annual grasses that have not yet matured.

Cultural Control of HPD

Cultural control of HPD inoculum and vector sources focus on winter annual grass control. Most winter annual grasses may serve as sources of both HPD virus and WCM. These grasses should be controlled in the vicinity of all sweet corn fields at least two weeks before the field is planted. There are several herbicides labeled for control of winter annual grasses. The grasses may be located along roadsides, farm lanes, fence rows, equipment lots and waste areas. Once the sweet corn crop has emerged, grasses should not be mowed or treated with herbicides because that will simply trigger WCM movement off of the host plants and into the sweet corn. There are no effective insecticides labeled for use in non cropland situations, so all host plant management MUST be done prior to crop planting.

Management of overwintering WCM can be accomplished by controlling cool season grasses on south-facing slopes. These grass species include winter annual grasses, wheatgrasses, and wild ryes. Cool season grasses stay green during cold weather and provide acceptable feeding sites for WCM. The microclimate provided by south-facing slopes is responsible for allowing WCM, as well as Banks grass mite, Russian wheat aphid, western flower thrips and other pest numbers to build up over the winter. Control of these grasses can be done any time between October and February when conditions allow, but sprays applied after early March may simply cause mites to move to other nearby plants.

Chemical Control

There is one effective chemical control labeled for use in sweet corn. Furadan 4F, applied at 1.0
lb a.i./a (1.8 oz/1000 linear feet at 30 inch row spacing), either in furrow or side dressed with starter fertilized has provided 30 days control in test plots. Furadan 4F kills WCM as they move to the plant. Foliar applications of Furadan 4F have not been effective in controlling the disease in test plots, and label restrictions would preclude them in any production system other than sweet corn grown for seed. The use of Furadan 4F at planting should be limited to those fields that are determined to be high risk.

Figure 6 This view shows the experimental layout at Fruita CO. Sweet corn was planted within a HPD infected wheat field, and planting was delayed to maximize disease pressure. The greener sweet corn strips in the chemical control experiment at the foreground were treated with Furadan 4F at planting. Surrounding plots were either untreated or treated with an ineffective insecticide.