

August 22, 2012

Re: Distorted and yellow common mulleins in the Black Hills National Forest; RCSC-14-12

To: Forest Supervisor, Black Hills

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Distorted and yellow common mullein plants (*Verbascum thapsus*) were discovered by Ryan Leron and Kayla Sisk (Mystic weed crew). Eugene Bolka requested a site visit to examine the symptomatic plants. On August 20, 2012 Eugene Bolka (Range/Weeds Technician), Kelly Owens (Botanist), Joey Charboneau (Botany Technician), and I visited two areas in the Black Hills National Forest (BHNF), Mystic Ranger District with symptomatic mulleins (**Fig. 1**) to determine the disease involved. The plant distortion and yellowing is likely the result of aster yellows disease (AYD). Since mulleins are weeds introduced from Eurasia there is potential interest in using this disease as a biocontrol agent to control these plants.



Fig. 1. Healthy (left) and symptomatic (right) common mullein.

Aster yellows disease is caused by phytoplasma (*Phytoplasma asteris* or *P. japonicum*) which are prokaryotic (bacteria or “bacteria-like”) organisms that lack cell walls and have triple layered cell membranes. These organisms are 0.5-1 micrometer in diameter. They live in the phloem of their hosts and in the bodies of their insect vectors, often leafhoppers. Leafhoppers insert their stylets (a straw-like, sucking mouthpart) into plant stems and feed on phloem cells. The insects acquire the phytoplasma through their stylet from infected plants. The pathogen overwinters in infected biennial and perennial hosts, not in leafhopper eggs.

Symptoms that were seen and are common for AYD on other hosts include chlorosis (yellowing) and necrosis (death) of leaves, plant stunting, and phyllody (development of floral parts into leafy structures). Symptoms were observed for the first time throughout the BHNF in 2012. It is not clear if AYD has been reported previously in mullein in South Dakota, but mullein species are listed as hosts of AYD. Chlorosis was typically associated with purple leaf veins and purple discoloration in leaves (**Fig. 2**) and stems. Symptoms observed in flowers included: distortion, stunting, elongation, and development of flowers into leaves and brooms (excessive branching) with leaves (**Fig. 3**). Stamens (male, pollen-producing organs) were seen on some of the distorted flowers (**Fig. 4**). Sterility (*i.e.*, no seeds) was observed in the distorted flowers. Phloem tissues were discolored (**Fig. 5**) which is common for diseases caused by phytoplasma. No leafhoppers were observed on plants, but they might not be active year-round.



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Fig. 2. Healthy (left) and symptomatic (center and right) common mullein leaves.



Fig. 3. Normal common mullein flowers (left); flowers that are elongate, distorted, necrotic, and stunted (3 center); flowers that developed into leaves (3 right) and brooms with leaves (far right).



Fig. 4. Stamen on a distorted common mullein flower.



Fig. 5. Discolored phloem in a symptomatic plant (left) and healthy tissues in asymptomatic plant (right).

Chlorosis, necrosis, and stunting can have various causes including environmental stresses (drought, nutrient imbalance, frost, etc.). Herbicide damage can cause deformation of flowers. The disease pattern at the landscape level was not typical for these causes.

Would AYD be a good biocontrol agent?

Although infection causes plant sterility which might reduce seed production in an area, AYD is a poor choice as a biocontrol agent for the following reasons:

1. The AYD phytoplasma affects over 300 species in 38 families, thus the disease could spread to non-target hosts and there is no field treatment for this disease.
2. Phytoplasma cannot be cultured in media. The production of inoculum for application over a large area would not be possible.
3. Phytoplasma are strongly dependent upon their insect vectors. An insect vector, likely the aster leafhopper, is required for disease transmission and it would be difficult to manage.