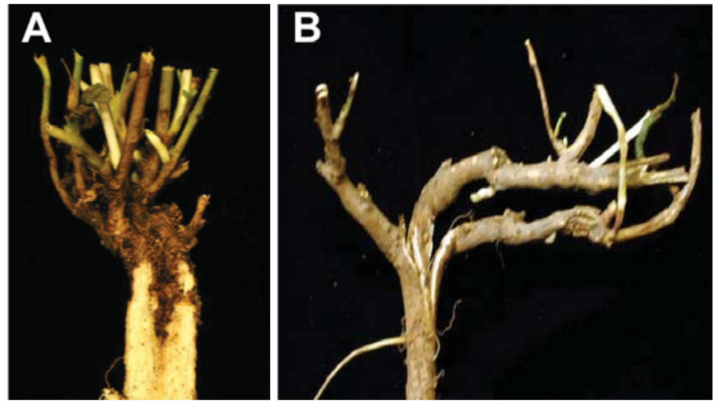
Protecting the (Alfalfa) Crown Jewels

Deborah Samac, JoAnn Lamb, USDA-ARS

The crown of an alfalfa plant is a complex structure extremely important for the development of new stems. However, injury from crown rotting organisms, freezing temperatures, and mechanical stress from wheel traffic can rob the crown of the buds vital to a highly productive stand. The primary crown starts to form as early as one week after seedling emergence. The lower leaf nodes are pulled downward in a process called contractile growth to the soil surface, or in some plants, to below the soil surface. Whether the plant forms a shallow or deep crown is determined partially by genetics and partially by the type of soil, with deeper crowns found in looser textured (sandier) soils. The deeper crowns tend to have greater persistence, perhaps due to better tolerance of physical stresses and temperature extremes. The crown enlarges throughout the life of the plant forming new buds that develop into stems.

Figure 1. Damage to crowns from crown rot. (A) Asymmetric crown and central core decay. (B) Secondary crown formation.

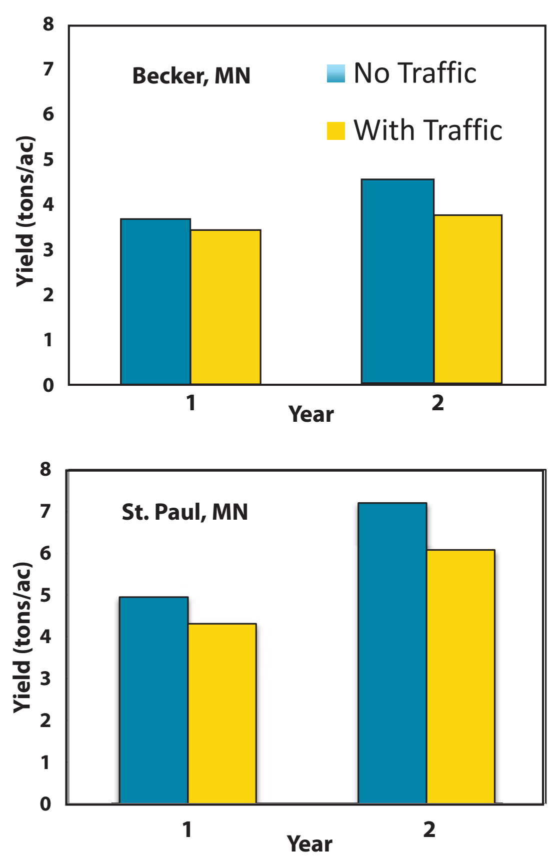


Crown decay from diseases is a major cause of stand decline. Although some crown and root rots can be attributed to an individual pathogen, many cannot be shown to be the result of just one organism and the term 'crown rot complex' is used to describe the pathogens involved. The complex consists of several fungi, possibly bacteria and nematodes, with the specific organisms probably differing in various regions. Pathogens gain access through crown and root wounds and from cut stubble, growing down the stubble into the crown. As a result of infection, brown necrotic areas are seen in the crown or root cortex, and in some cases the central core is rotted and hollow. Death of buds results in an asymmetric or spreading crown or a secondary crown forming on stems above the original crown, which are less productive than the primary crown (Figure 1). Plants with advanced stages of rot are stunted and ultimately wilt and die.

How Can These Crown Bud Jewels be Protected?

Selection and breeding for crown rot resistance has been slow and no cultivars with resistance to crown rot are currently available. Due to the diversity of pathogenic organisms associated with crown rot, it may be difficult to develop cultivars with resistance that is effective across locations. Also, fungicides with persistent root and crown activity are not available. Alternative strategies for reducing damage from crown rot are needed. An experiment was done in St. Paul and Becker, MN, to investigate whether incorporation of green plant material (green manure) from buckwheat and sorghum-sudangrass could increase the population of soil microbes that inhibit *Fusarium* and *Phoma*, two crown rot organisms. Four alfalfa entries, 'Integrity' (ABI), 'Magnum V' (Dairyland Seed Co.), 'Summer Gold' (Cal West Seeds), and 'Saranac' were used in the study. 'Integrity' was selected for cattle grazing tolerance under continuous stocking and is considered grazing tolerant. Wheel traffic stress was applied to all plants in a treatment two days after each harvest with a John Deere 5510 (2.9 tons) driven at 4 miles/hour. Forage yield was measured over two years. Plant counts were made and the amount of crown rot rated at the end of the second year.

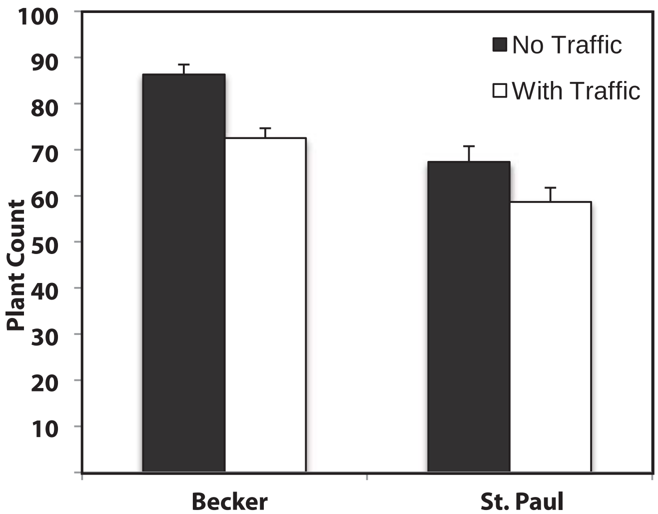
Figure 2. Total annual DM yields from plots with and without wheel traffic.

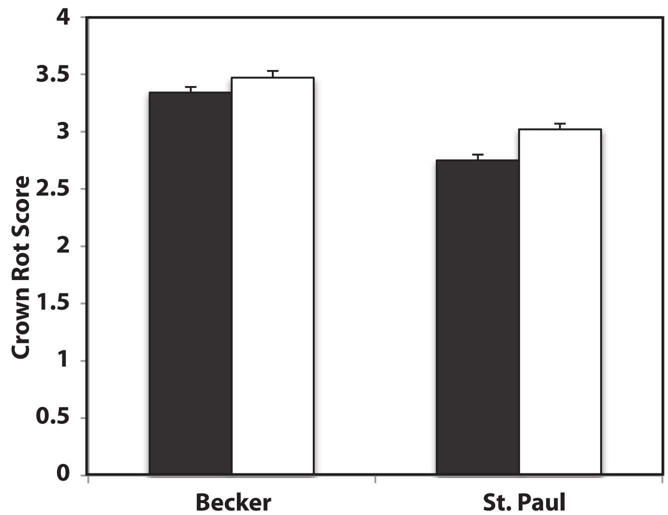


Incorporation of green manures at Becker increased the population of pathogen inhibitors significantly, but inhibitor populations were not significantly increased in St. Paul. This may have been due to the lower initial organic matter in the soil at the Becker location. Although *Fusarium* and *Phoma* species were among the most common crown rot organisms isolated from alfalfa plants grown at the Becker location, the green manure treatments did not significantly reduce crown rot or increase plant counts. However, green manure treated plots in which wheel traffic was applied had greater forage yields than control fallow plots. In plots without traffic stress, there was no effect of the green manure on yield.

As would be expected, wheel traffic had a negative influence on forage yields (Figure 2). At the Becker location traffic decreased total forage yield 12% in the first year and 17% in the second year. At St. Paul, traffic decreased total forage yield across cultivars by 13% the first year and 16% the second year. Traffic also decreased plant counts by 16% at Becker and by 13% at St. Paul (Figure 3). 'Magnum V' and 'Integrity' had the highest plant counts, 'Saranac' had the lowest, and 'Summer Gold' was intermediate. Average crown rot scores were high in both locations even in the absence of traffic. 'Integrity' had the lowest scores, 'Saranac' had the highest scores, and 'Magnum V' and 'Summer Gold' were intermediate.

Figure 3. Effect of wheel traffic on plant counts and crown rot. Plants were taken from 10 feet of a row in the center of the plot. Crown rot was rated from 1 (no rot) to 5 (severe rot).





Results show green manure crops may provide benefits in alfalfa production systems by increasing pathogen antagonists. Wheel traffic has a major effect on forage yield and plant survival. Selection for grazing tolerance in 'Integrity' may have increased wheel traffic tolerance. Wheel traffic had a relatively small negative effect on crown rot in surviving plants suggesting that factors in addition to mechanical damage contribute to decay of crowns.