2022 USAFRI Research Project Objectives

Do Insect-Transmitted Viruses Affect Forage Alfalfa Yield and Quality?
University of Idaho- Wenninger

Project Award: $58,304

Justification:

- Alfalfa (Medicago sativa L.) is an important forage crop grown on over 1,000,000 acres in the State of Idaho, in support of the burgeoning cattle and dairy industries. As a nitrogen-fixing legume, it is also grown in rotation with other crops to improve soil health. Based on the acreage, it is the second most widely grown of all Idaho crops, behind wheat (USDA-NASS, 2022). In Idaho, alfalfa is grown in the same field for multiple seasons, typically about four, but may stay in the same field even longer. Insecticides are rarely applied to forage alfalfa fields in Idaho, while alfalfa forage production is characterized by up to four cuttings per summer, with subsequent use for hay and haylage. Hence, alfalfa represents a perfect sentinel crop accumulating pathogens, including viruses, over multiple growing seasons, with plenty of opportunities for mechanical transmission of viruses during the repeating cycles of hay cutting that also facilitate insect dispersal and vector transmission. These agricultural practices for alfalfa production are not unique for Idaho but are very similar across the U.S.

  Alfalfa is a non-reseeding legume, which does not have any capability for vegetative propagation or self-seeding potential (due to 'autotoxicity' phenomenon). Thus, all plants in a field stand develop from seeds germinating soon after planting, without further increase in the number of plants. Over the successive seasons, pathogens, including viruses, gradually spread in the alfalfa stand resulting in 'thinning' and the loss of productivity. Several viruses have been reported from alfalfa crops in the U.S., such as alfalfa mosaic virus, pea streak virus, bean leafroll virus, and alfalfa virus S (Samac et al. 2015; Nemchinov et al. 2020), plus, recently, a number of other viruses (Nemchinov et al. 2022). As part of the Center for Agriculture, Food and the Environment (CAFÉ) University of Idaho initiative, during two summer seasons, in 2020 and 2021, alfalfa stands of different ages grown in Minidoka and Twin Falls counties were sampled and subjected to screening for viruses using high-throughput sequencing (HTS) and RT-PCR. The two most common viruses found were aphid-transmitted alfalfa mosaic virus (AMV) and bean leafroll virus (BLRV), along with persistent, vertically transmitted Medicago sativa amalgavirus (MsAV1), two alphapartitiviruses (MsAPV1 and MsAPV2), and one deltapartitivirus (MsDPV1). Additionally, a new virus, tentatively named Snake River alfalfa virus (SRAV), was discovered abundant in multiple alfalfa fields in the two counties of the southern Idaho (Dahan et al. 2022). Presence of SRAV, AMV, and BLRV was associated with virus-like symptoms in alfalfa, such as mosaic, vein-clearing, yellowing, and stunting, with up to 20% of the symptomatic plants in each field found SRAV-positive (Dahan et al. 2022). The mode of transmission for SRAV was not immediately apparent since the virus had an unusual genome and could not be assigned phylogenetically to any other plant virus family. In preliminary tests conducted in August 2021, SRAV sequences were amplified from thrips feeding in alfalfa stands in the area, suggesting a possible role of Frankliniella occidentalis and Thrips tabaci in virus transmission.

  Here, we propose to carry out an analysis of viral populations present in stands of alfalfa in Idaho, using high-throughput sequencing (HTS) as well as conventional tests to study the biotic and abiotic factors affecting alfalfa productivity in Idaho. The role of insect vectors involved in virus spread in alfalfa will be addressed in parallel observations for insecticide-treated and non-treated control fields.

Objectives:

- The objectives of this project are to 1) Evaluate effects of virus infection on alfalfa yield by comparing

yield, quality, and virus prevalence (SRAV, AMV, and BLRV) in insecticide-treated versus check plots and 2) Determine role of insect vectors in SRAV transmission by conducting transmission experiments under controlled greenhouse conditions.