Progress Report for
South Dakota Wheat Commission FY18 and FY19 Grants
Marie A. C. Langham

Project Title: EVALUATION OF WHEAT FOR RESISTANCE AND RESPONSE TO VIRAL DISEASES IN SOUTH DAKOTA

Sponsoring Commodity Organization: South Dakota Wheat Commission

Reporting Period: July 1, 2017 -September 30, 2018

Total Project Period: July 1, 2018-June 30, 2019

Report Type: Progress Report

Personnel: Marie A. C. Langham; Professor, Plant Virology Project;
Address: South Dakota State University; Department of Agronomy, Horticulture, and Plant Science; Plant Science Building; PO 2108; Brookings, SD 57007
Phone: 605-688-5539
E-mail: marie.langham@sdstate.edu

Collaborator: Sunish Sehgal; Assistant Professor, Winter Wheat Breeding Project:
Address: South Dakota State University; Department of Agronomy, Horticulture, and Plant Science; Seed Technology Laboratory; PO 2108; Brookings, SD 57007
Phone: 605-688-5709
E-mail: sunish.sehgal@sdstate.edu

Research Summary: Wheat is a significant component of agricultural production in South Dakota. *Wheat streak mosaic virus* (WSMV) (Family: *Potyviridae*; Genus: *Tritimovirus*) causes the most economically damaging viral disease affecting wheat in South Dakota. Winter wheat losses due to WSMV represent at least 5 million bushels of wheat annually with greater losses in epidemic years and in severely affected fields. Transmitted by the wheat curl mite (*Aceria tosichella* Kiefer), WSMV cycles through a number of hosts during the year including winter wheat, spring wheat, corn, and wild grasses that also harbor the wheat curl mite. The most effective control for WSMV is host plant resistance or tolerance. Efforts to develop winter wheat cultivars with higher levels of disease resistance and tolerance require the evaluation of breeding lines and parents to eliminate highly susceptible lines and identify lines with enhance tolerance/resistance. Collaborative efforts of the plant virology and winter wheat breeding projects are utilized for the **WSMV Winter Wheat Evaluation Nursery** which is the focus of this grant. Data from this Nursery allows the selection and advancement of wheat lines with improved tolerance/resistance. Continued development of wheat cultivars requires annual evaluation. Without this process, susceptible materials cannot

be eliminated from the breeding program, and previous gains in resistance/tolerance will be lost.

Introduction: The *Evaluation of Wheat for Resistance and Response to Viral Diseases in South Dakota* assesses winter wheat lines for susceptibility, tolerance, or resistance to *wheat streak mosaic virus* (WSMV) (Family: *Potyviridae*; Genus: *Tritimovirus*). The nursery is focused on lines being developed by the SDSU Winter Wheat Breeding Project and on lines needed for future breeding crosses. This report covers some results from the 2018 WSMV Evaluation Nursery and the establishment of the 2019 Nursery. Twenty-five winter wheat lines were evaluated in the 2018 WSMV Evaluation Nursery, and forty winter wheat lines have been planted for evaluation in the 2019 Nursery.

Methods: In the WSMV Winter Wheat Nursery, winter wheat lines from the Advanced Yield Trials (AYT) were planted in four-row plots (three completely randomized blocks). A split plot design was created by inoculating two rows of each plot with WSMV-infected sap extract [pressed from a macerated mixture (1:10 w:v WSMV-infected Arapaho winter wheat:0.02 M potassium phosphate buffer, pH 7.0) with 1% silica carbide added] using high-pressure spray (80 PSI) to penetrate the wheat's epidermis. The remaining two rows in each plot were not inoculated. Disease severity, WSMV infection levels (as determined by ELISA), yield, test weight and other agronomic measures are the types of data collected from both inoculated and non-inoculated rows of each plot. Utilizing split plots for this research greatly reduces the impact of environmental effects on differential comparisons between the WSMV-inoculated and non-inoculated values.

Description of Results: The results achieved this year is summarized in the following:

- *2018 WSMV Winter Wheat Nursery*--The 2018 Nursery was subjected numerous adverse weather conditions that delayed planting, provided highly variable growing conditions, and rain-delayed harvest. However, the Nursery was inoculated and the data was collected. Some of this data is still under testing or analysis, such as the ELISA determination of WSMV infection is still under analysis. However, one of the most interesting variables, the yield loss caused by WSMV, can be seen in Table 1.

- 2019 WSMV Winter Wheat Nursery—The 2019 Nursery will evaluate the performance of ALICE, ARAPAHOE, DAWN, MACE, OVERLAND, SD12DHA00031, SD12DHA00324, SD12DHA00969, SD12DHA01131, SD12DHA01328, SD12DHA01364, SD12DHA01373, SD12DHA01688, SD12DHA03282, SD12DHA03429, SD12DHA03614, SD13062-2, SD13099-8, SD13DHA02346, SD13DHA02489, SD13W064-7, SD14355-2, SD15004-2, SD15004-4, SD15004-7, SD15006-3, SD15009-1, SD15020-1, SD15035-2, SD15041-1, SD15083-2, SD15103-6, SD15108-1, SD15205-1, SD15215-1, SD15240-2, SD16001, SD16006-1, SD16010, and TOMAHAWK. The nursery has been planted; although, the planting date was too late to allow fall

inoculation. However, the production of WSMV infected Arapahoe wheat for the production of WSMV inoculum to utilize in the spring inoculations is underway.

Projections: This grant will allow finishing the sample and data analysis from the 2018 Nursery and the inoculation of the 2019 WSMV Winter Wheat Nursery. Winter wheat planting was delayed again this year, but the nursery is planted and began to emerge. However, it did not reach the size to inoculate and have the 10-14 days needed for infection development before the risk of consistently freezing temperature began. Thus, inoculation will have to be delayed until the spring. This has the disadvantage of modeling spring infection rather than fall infection. Although spring inoculation is not the preferred method, it has provided good evaluation data in the past and should do the same this year.

Publication/Data: None yet

Acknowledgements: This research is supported by the South Dakota Wheat Commission, the South Dakota Board of Regents and the National Institute of Food and Agriculture through the South Dakota Agricultural Experiment Station at South Dakota State University. The work will be conducted wholly or in-part at the Aurora Farm of SDAES. We wish to acknowledge the assistance of the South Dakota Winter Wheat Breeding Project who plant and harvest the nursery and of the many student workers who currently work or have worked in the past with the Virology Project.

Table 1. Yield losses (%) in Winter Wheat Lines and Varieties Evaluated in the 2018 WSMV Winter Wheat Nursery	
Winter Wheat Lines	Yield Loss (%) in the WSMV Infected Plants
ALICE	15.8
ARAPAHOE	64.6
DAWN	66.2
MACE	58.1
OVERLAND	33.9
SD12DHA00031	75.9
SD12DHA01038	56.6
SD12DHA01043	89.7
SD12DHA01353	19.5
SD12DHA01373	63.9
SD12DHA01556	62.1
SD12DHA03282	56.8
SD13DHA02346	84.4
SD13DHA02641*	91.3*
SD13W064-7	83.5
SD14059-4	50.1
SD14239-2	40.3
SD14295-3	55.5
SD15009-1	67.6

Table 1. Continued

Winter Wheat Lines	Yield Loss (%) in the WSMV Infected Plants
SD15083-2	81.6
SD15103-6	65.1
SD15205-1	68.9
SD15232-2	78.2
SD16006-3	66.6
TOMAHAWK	60.7

*Calculated from two plots due to missing row in the third plot.