

## South Dakota Wheat Commission

### Project Report FY2014

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

**Sponsoring Commodity Organization:** South Dakota Wheat Commission

**Reporting Period and Type:** July 1, 2013 to June 30, 2014 Progress Report

**Personnel:** Marie A. C. Langham—Professor, Plant Science Department, SDSU; Plant Science Building; PO 2108; Jackrabbit Drive; Brookings, SD 57002  
Phone: 605-688-5539; Fax: 605-688-4124; E-mail: [marie.langham@sdstate.edu](mailto:marie.langham@sdstate.edu)

**Collaborator:** SDSU Winter Wheat Breeding Program (This grant was during the time that Dr. William Berzonsky was the winter wheat breeder prior to his leaving.)

### Research Summary

**Introduction--** Wheat streak mosaic virus (WSMV) (Family: *Potyviridae*; Genus: *Tritimovirus*) causes the most economically important viral disease affecting winter wheat in South Dakota. Transmitted by the wheat curl mite (*Aceria tosichella* Kiefer), WSMV has a complex disease cycle that includes winter wheat, spring wheat, corn, and a number of alternative hosts that also harbor the wheat curl mite. WSMV overwinters in winter wheat during its vernalization period. Early growth stages have shown a reduction of up to 40% in root and shoot weight. Thus, WSMV also functions as a contributing factor to winter kill in addition to its primary effects. Control of WSMV depends on preventative disease management strategies. The most effective and economical management strategy is the development and deployment of host plant resistance or tolerance. Efforts to develop winter wheat cultivars with higher levels of disease resistance and tolerance require annual evaluation of wheat lines to determine their susceptibility or resistance. Without this process, susceptible materials will not be eliminated from the breeding program, and advances in resistance and tolerance will be lost.

**Description of Accomplishments—**Data collection and harvest for the 2013 WSMV Winter Wheat Nursery and the initiation of the 2014 WSMV Winter Wheat Nursery was covered by the FY14 Wheat Commission funding. Wheat lines had been planted in four row plots. In each plot, two of the rows were inoculated with WSMV and two rows were not inoculated. This research design allows for comparison of the data collected from each half plot to be compared directly with minimum differences in environment. Each are discussed below:

- *Data collection and harvest for the 2013 WSMV Winter Nursery—*The 2013 Winter Wheat Nursery included 60 winter wheat lines (Table 1). These were rated for disease

severity based on mosaic severity, stunting, prostrating, and necrosis. Examples of the range of symptom development can be seen in Fig. 1. Maturity dates and heights were also measured in the field during the season development (data not shown in this report). Differentials in the yields and test weight were measured in the harvested grain, and the yield losses and test weight losses were calculated. These results are shown in Table 1, and some of the points from this data is summarized below.

- Yield losses for evaluated wheat lines ranged from 7.3% to 78% of the total yield from the uninoculated split plot.
- South Dakota winter wheat lines with yield losses in the lower third of the yield loss rankings (in order of increasing yield loss) included SD10020-2, SD110060-1, SD10135, SD10257-2, SD10W153, SD11020-1, SD06158, SD09227, SD10026-2, and SD110039-2.
- Winter wheat cultivars, ranking in the lower third of yield losses when evaluated for response to WSMV, included (in order of increasing yield loss) LCH08-80, Jerry, WB Cedar, Mace, T158, Ron-L, LCS Mint, Jagalene, Camelot, Art, Alice, Vista, Overland, Ideal and NI08708.
- South Dakota winter wheat lines evaluated with yield losses ranked among the greatest in this year's evaluation included (in order of increasing loss): SD11005-5, SD10215-1, SD10015-2, SD11009-5, SD09138, SD110044-7, SD10027-2, SD07165, SD09113, SD10109-2, SD110036-2, SD08141, and SD09140.
- Cultivars with the greatest yield losses included (in order of increasing yield loss): Settler CL, Smoky Hill, Arapahoe, Sage, Millennium, Tomahawk, Robidoux, Wesley, Dawn, Everest, McGill, and Lyman.
- Losses in test weight of the grain from the WSMV-infected split plots ranged from means of 0% to 26.4% of the test weights of the grain from the uninoculated plots.
- Wheat lines with test weight losses less than 5% include (in order of increasing loss): Mace, SD11020-1, SD08141, Settler CL, SD07184, WB Cedar, SD08080, WB-Grainfield, SD10W153, Art, LCS Mint, SY-Wolf, Jerry, NE06545, Jagalene, Ideal, WB-Matlock, SD06158, SD110060-10, and Camelot.
- Cultivars and lines with test weight losses that exceeded 12% included (in order of increasing loss): T163, SD11005-5, SD10135, Overland, SD10215-1, Dawn, Millennium, Everest, SD110036-2, SD10015-2, Sage, Lyman, Vista, Tomahawk, SD09118, and SD09140.
- *Initiation of the 2014 WSMV Winter Wheat Nursery*--WSMV Winter Wheat Nursery was planted with the collaboration of the Winter Wheat Breeding project. Sixty-nine standard varieties and advanced winter wheat breeding lines were inoculated using high pressure spray. Winter wheat lines were planted in four row plots in three replications, and half the plot will be inoculated using a high-pressure (80 psi; 552 kPa) air compressor. Plants will be inoculated in the field during October at Feekes stage 2

(weather and growth permitting) with a mixture of 1:10 infected plant tissue and potassium phosphate buffer (KPB), pH 7.0, with 1% of silica carbide powder (600 mesh) added. The following summer these plants will be evaluated for agronomic characters and disease severity.

**Projections**—Field data and samples have been collected for the 2014 WSMV Winter Wheat Nursery. Data analysis of the grain for yield and test weight losses is continuing during the winter. 2015 WSMV Winter Wheat Nursery had to be cut to 35 lines in order to fit the budgeted funding. These lines are primarily SDSU winter wheat lines breed by the Winter Wheat Breeding Program. Lines will be inoculated during the spring. Triticale evaluations that had to be cut to fit budget limitations will be proposed again in the future.

**Publications/Data:**

Table 1. The mean yield losses (%) and test weight losses (%) in winter wheat lines evaluated in the 2013 WSMV Winter Wheat Nursery.

Line	Mean Yield Loss (%)	Mean Test Weight Loss (%)
ALICE	48.6	7.5
ARAPAHOE	61.5	11.9
ART	44.5	3.3
CAMELOT	41.2	4.7
DAWN	66.5	14.3
EVEREST	67.7	14.8
EXPEDITION	58.1	5.9
FULLER	52.5	8.2
IDEAL	49.8	4.6
JAGALENE	38.9	4.4
JERRY	12.4	4.3
LCH08-80	8.3	10.7
LCS Mint	38.7	4.0
LYMAN	78.7	18.6
MACE	19.6	0.0
MCGILL	71.2	8.4
MILLENIUM	62.5	14.4
NE06545	57.8	4.3
NI08708	50.8	5.4
OVERLAND	49.6	13.3
ROBIDOUX	64.4	5.6
RONL	32.8	8.7
SAGE	62.1	18.0
SD06158	45.7	4.6
SD07165	64.1	8.9
SD08080	53.0	1.9
SD08141	71.2	0.7
SD08200	51.3	8.7
SD09113	64.1	11.1
SD09118	58.2	23.5
SD09138	63.0	6.5
SD09140	76.8	26.4
SD09192	57.8	7.1
SD09227	47.6	8.5
SD10015-2	60.7	17.3
SD10020-2	7.3	-1.3
SD10026-2	49.6	9.2

Table 1 continued.

Line	Mean Yield Loss (%)	Mean Test Weight Loss (%)
SD10027-2	63.4	8.4
SD10048	53.1	11.8
SD10066	59.3	6.8
SD10109-2	64.3	11.4
SD10135	21.5	13.2
SD10215-1	60.5	13.9
SD10257-2	33.9	6.9
SD10W006-1	56.8	6.0
SD10W153	44.1	2.3
SD110036-2	67.9	16.3
SD110038-3	51.2	6.5
SD110039-2	50.9	5.4
SD110044-7	62.6	10.3
SD11005-5	59.7	12.9
SD110060-10	19.9	4.6
SD110060-9	55.0	7.4
SD11009-5	61.7	8.0
SD11020-1	45.5	0.6
SETTLER CL	60.4	0.9
SMOKY HILL	60.6	5.0
SY-WOLF	57.0	4.0
T158	23.6	6.5
T163	54.4	12.7
TAM 107	53.4	-1.9
TOMAHAWK	64.4	21.8
VISTA	48.7	20.5
WB CEDAR	18.3	1.6
WB-GRAINFIELD	55.9	2.1
WB-MATLOCK	53.3	4.6
WB-REDHAWK	51.4	8.2
WESLEY	65.0	6.6





Fig. 1. Examples of plots from the WSMV Winter Wheat Evaluation Nursery are seen in the above photos. All four rows are the same variety the two plots on the left are uninoculated control plots and the two plots on the right are the plots inoculated with WSMV. Lines shown in this figure include: A. Art and B. SD110038-3 with severe disease symptoms, C. Millennium with moderate disease symptoms, and D. Ron-L with milder symptoms.