Field Screen for Identification of Resistance to Mite-transmitted Viruses in Winter Wheat

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Introduction

A complex of three viruses (*Wheat streak mosaic virus* - WSMV, *Triticum mosaic virus* - TriMV, and *High Plains wheat mosaic virus* - HPWMoV) causes significant yield loss in winter wheat in the Great Plains. All three of these viruses are transmitted by the wheat curl mite (*Aceria tosichella* Keifer). A wheat screen has been developed to screen developing and advanced lines of hard red and white winter wheat varieties for greater resistance to WSMV and the other mite-vectored viruses. Varieties with *Wsm1* (Graybosch et al. 2009) and *Wsm2* (Lu et al. 2011) genes are WSMV resistant. **The objective of this study was to identify varieties that have greater resistance to WSMV and the other viruses.**

Materials and Methods

- Two separate wheat screens were established with Mace (WSMV resistant - *Wsm1*) and Tomahawk (susceptible) included as check varieties.
  - Varieties commercially available or advanced breeder lines were compared in a randomized complete block design (plots 1 row x 7 m with 3 reps).
  - Breeding lines potentially carrying resistance genes screened (plots 1 row x 1.2 m with 2 reps).
- This screening process was done under field conditions by using natural infestations of mites and virus.
  - An artificial green bridge was established to enable mite survival through the summer to infest the fall planted screen (Fig. 1).
  - After the winter wheat screen was planted in September, mites moved into the screen and infected the newly planted wheat with viruses.
- Visual percentage of maximum plant height and relative chlorophyll readings (SPAD) were taken to monitor virus impact in the spring.
  - For select varieties SPAD readings were taken weekly.

Fig 1. Diagram of green bridge and wheat screen

Sequential wheat plantings through summer allowed natural wheat curl mite population build up and infestation of the wheat screens planted in September.

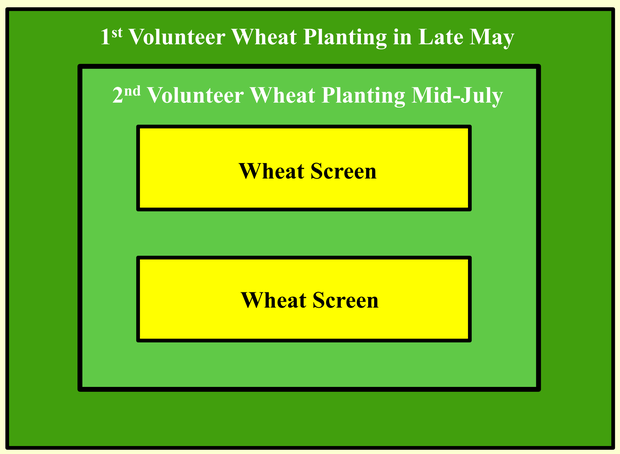
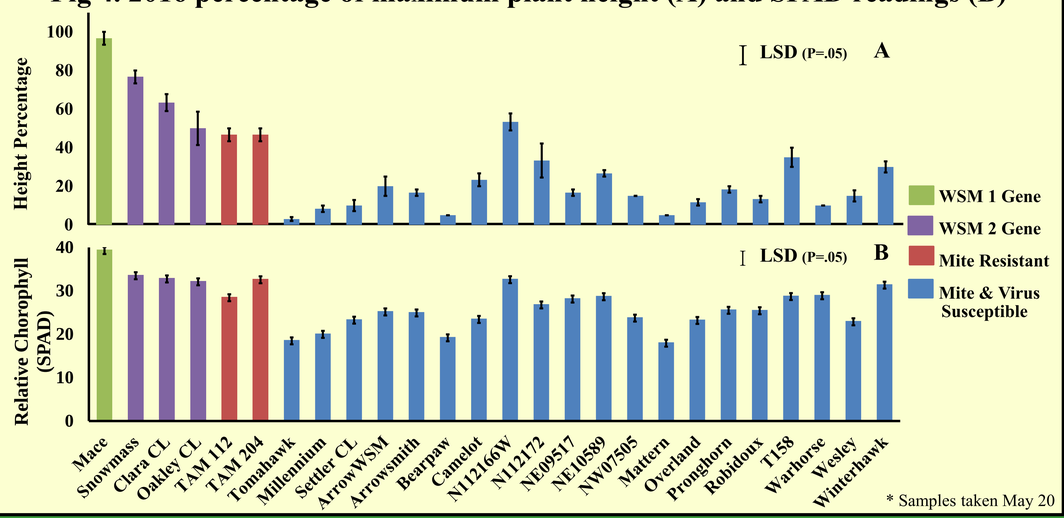


Fig 2. Field screen of commercial varieties

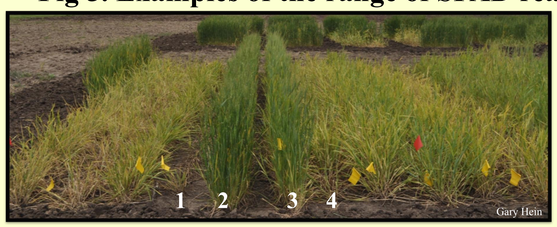
Fig 3. Screen of breeder lines to identify virus resistant and segregating lines

Fig 4. 2016 percentage of maximum plant height (A) and SPAD readings (B)



* Samples taken May 20

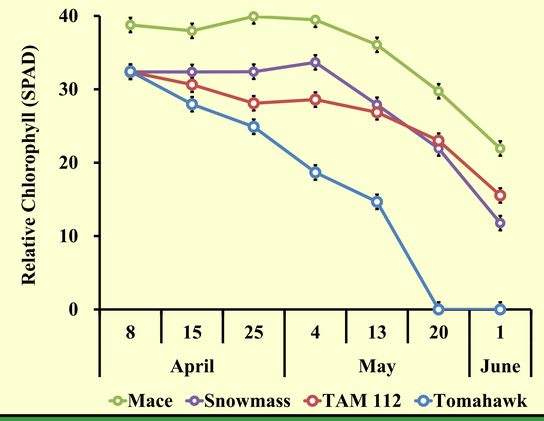
Fig 5. Examples of the range of SPAD readings resulting from virus impact



#	Variety	SPAD reading
1	Tomahawk	18.6
2	Mace	39.4
3	Snowmass	33.6
4	Settler CL	23.4

* Samples taken May 20

Fig 6. Spring 2016 SPAD readings



Results

- Two viruses, WSMV and TriMV, present in the screen resulted in extensive differentiation between varieties.
  - Commercial variety comparisons (Fig. 2).
  - Resistant and segregating breeder lines identified (Fig. 3).
- A combination of relative chlorophyll content (SPAD readings) and plant height provide good metric of virus impact on varieties (Fig. 4-5).
  - Mace provided a higher level of resistance than all other entries.
  - Wheat varieties with *Wsm2* gene or mite resistance had greater SPAD readings than susceptible varieties, but they also had significant height reduction.
  - Severe chlorosis and stunting occurred for all virus susceptible varieties.
- Severity of symptoms via SPAD readings increased through the spring (Fig. 5-6).
  - Mace significantly higher over all dates.
  - Tomahawk significantly lower April 15 - June 1.

Significance

- The screen process has enabled breeders to more confidently select lines with high levels of resistance and identify resistance in segregating lines.
- Resistance levels and limitations in resistance of commercial lines were identified.
- The development and increased availability of more varieties with effective resistance to these viruses will enable growers to better manage this important risk to yield and quality.

References

Graybosch et al., 2009. Plant Registrations 3:51–56.

Lu et al. 2011. Crop Science 51: 5-12.

Acknowledgements

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