First time detection of Brome mosaic virus associated with other wheat viruses in Kansas wheat using Nanopore sequencing

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APPLIED WHEAT PATHOLOGY

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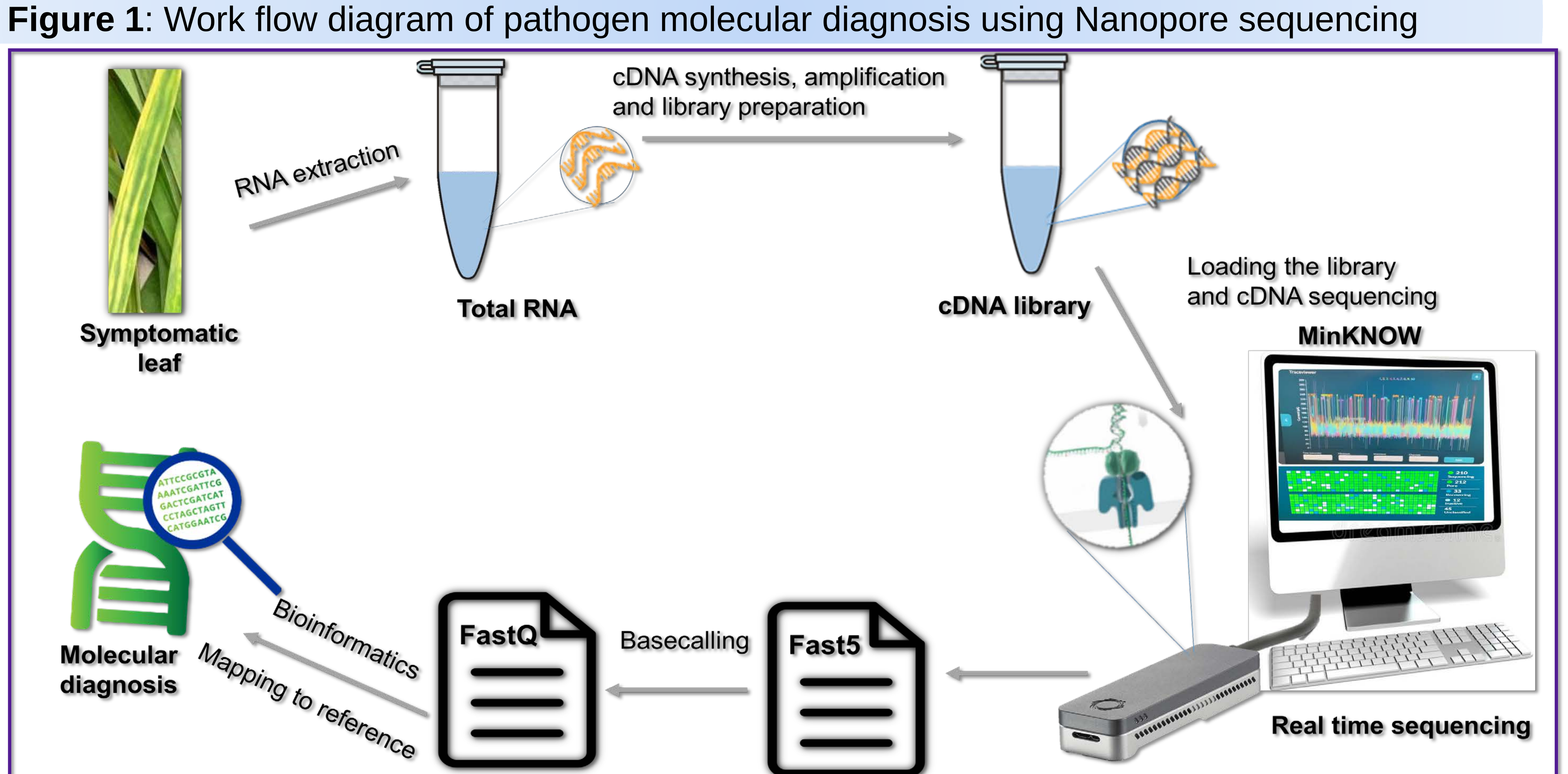
Introduction

- ❑ Kansas wheat production has been threatened by Wheat streak mosaic complex of three viruses including Wheat streak mosaic virus (WSMV), Triticum mosaic virus (TriMV), and High Plains wheat mosaic emaravirus (HPWMoV).
- ❑ In 2017, Kansas wheat producers lost 19.2 million bushels of wheat worth $76.8 million due to wheat streak mosaic.
- ❑ Infection of a single plant with multiple viruses is common in wheat fields.
- ❑ Other common wheat viruses have been recorded from Kansas but not the Brome mosaic virus (BMV)
- ❑ Diagnosis of virus like symptoms in plants has been mostly dominated by targeted-specific methods with known antibodies, primers, and probes.
- ❑ These targeted methods identify only already known viruses and virus combinations.
- ❑ Next generation sequencing techniques such a Nanopore sequencing technology has great potential for identifying novel and multiple potential plant pathogens in a single analysis.
- ❑ Reliable diagnostic methods are needed to identify the risks in plant health to develop appropriate plant protection strategies.

Materials and Methods

- ❑ A state-wide survey of Kansas wheat field was carried out from 2019 to 2021.
- ❑ A total of 72 symptomatic wheat leaves (2019 = 37, 2020 = 22, and 2021 = 13) were processed for Nanopore sequencing.

Figure 1: Work flow diagram of pathogen molecular diagnosis using Nanopore sequencing



Results

Figure 1: Distribution of BMV on different counties of Kansas detected using Nanopore sequencing on virus-like symptomatic leaves*

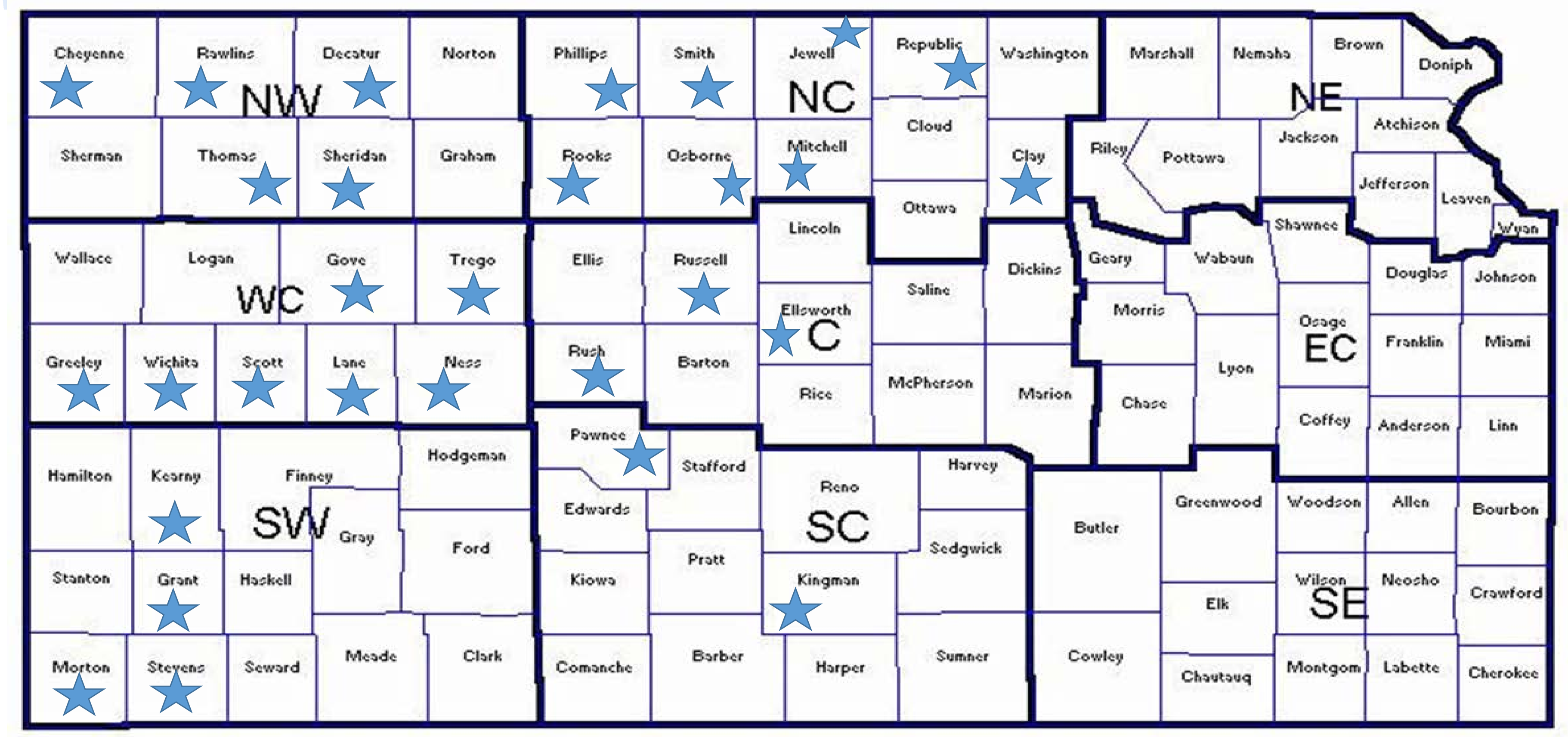


Figure 2: BMV was common in virus-like symptomatic wheat leaves* (n = 72)

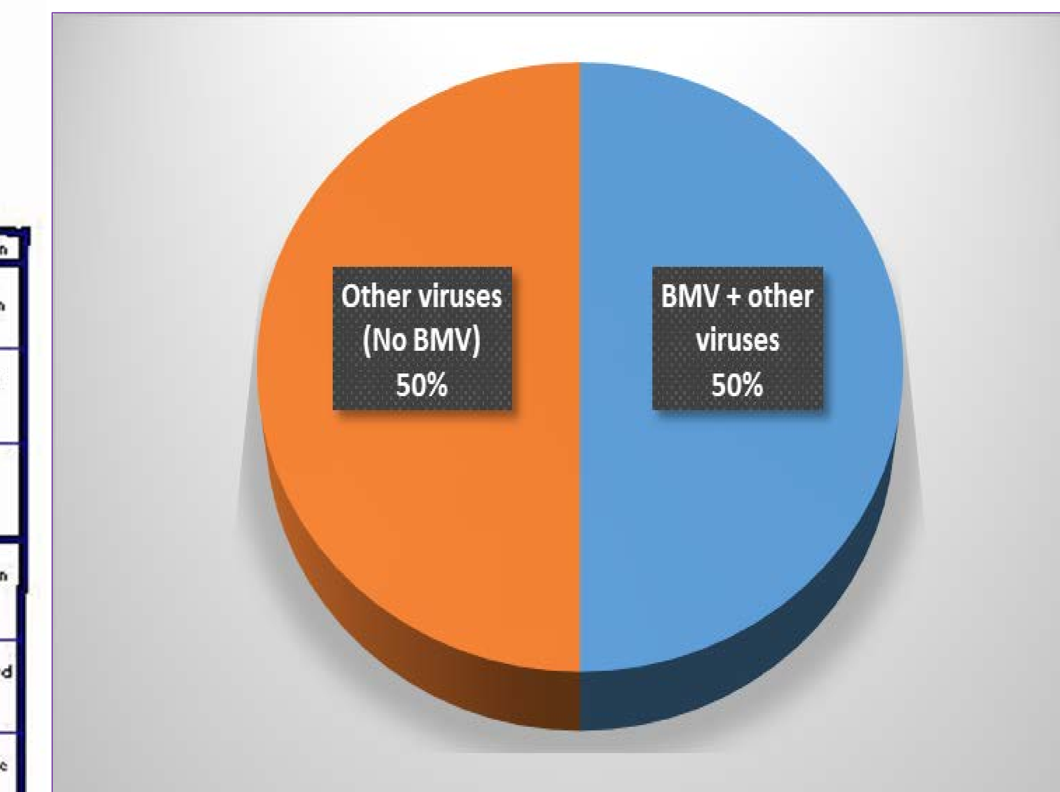


Figure 4: A chord interaction diagram of coinfection of wheat viruses in symptomatic wheat leaves detected by Nanopore sequencing (n = 72). The arch shows the connection and size of the total percentage of virus co-infected in a single samples*.

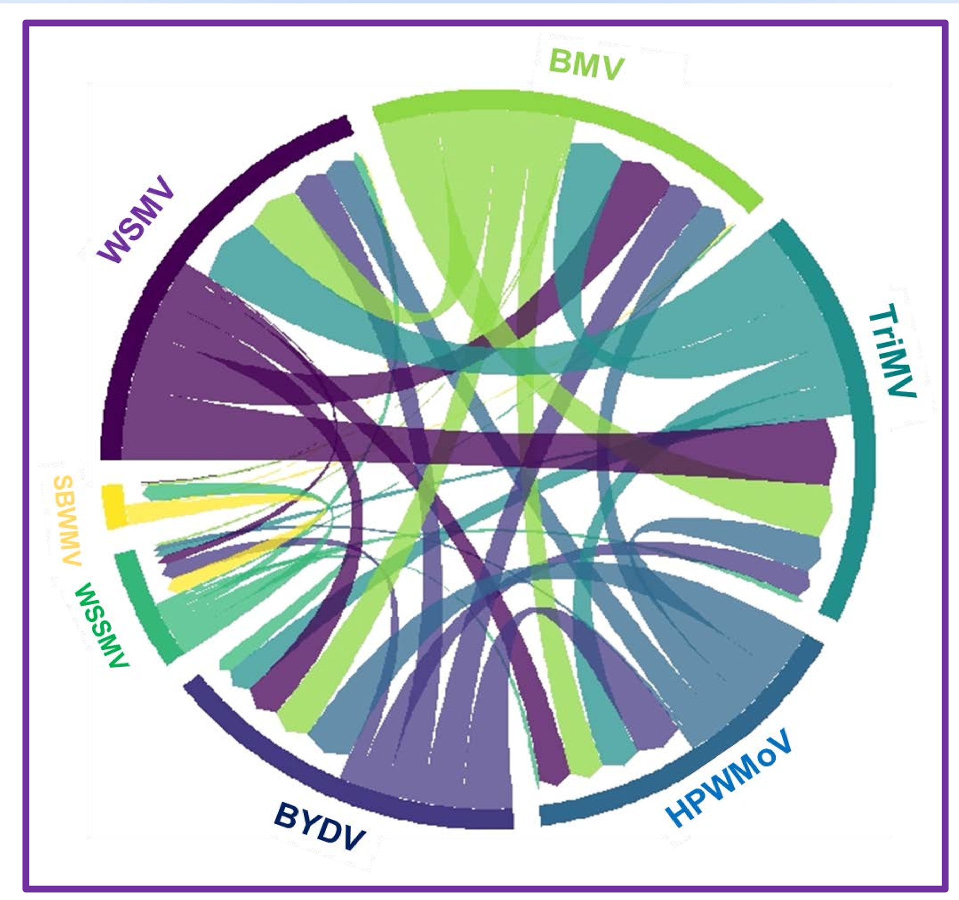
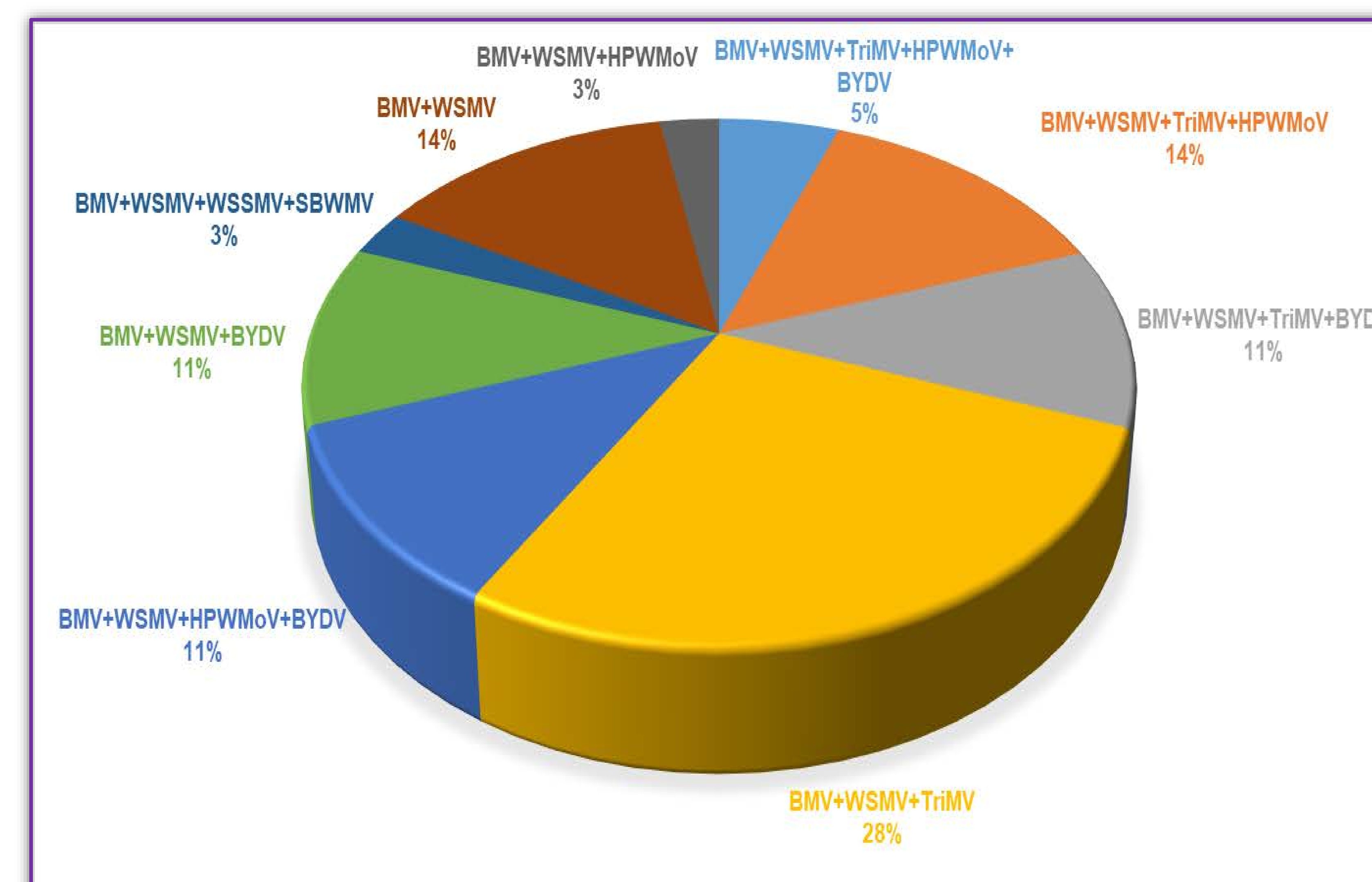


Figure 3: BMV was most commonly co-infected with WSMV and TriMV* (n = 36)



*WSMV = Wheat streak mosaic virus, TriMV = Triticum mosaic virus, BMV = Brome mosaic virus, HPWMoV = High Plains wheat mosaic emaravirus, BYDV = Barley yellow dwarf virus, SBWMV = Soilborne wheat mosaic virus, WSSMV = Wheat spindle streak mosaic virus

Conclusion and Future Work

- ❑ For the first time, we report Brome mosaic virus is highly associated with other wheat viruses in Kansas wheat fields
- ❑ Co-infection of BMV is more common with WSMV + TriMV than other wheat viruses.
- ❑ This finding warrants future research to answer following questions:
  - ➢ Does BMV co-infect with other wheat viruses only or can infect wheat individually?
  - ➢ How does BMV spread in the field? What is the potential vector of BMV?
  - ➢ How does BMV interact with Kansas wheat varieties having different defense mechanism?
  - ➢ How does BMV infection impact yield during single and co-infection with other wheat viruses?

Acknowledgements

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