**Title: Plant viral synergism: Identification of viral determinants required for synergistic interaction between wheat streak mosaic virus and Triticum mosaic virus in wheat**

**Abstract**

Synergistic interactions among unrelated viruses in mixed infections cause devastating crop losses, and the viral determinants of these interactions are poorly understood. Co-infection of wheat by wheat curl mite-transmitted wheat streak mosaic virus (WSMV) and Triticum mosaic virus (TriMV) results in disease synergism. This leads to drastically increased symptom phenotype of stunted growth and leaf bleaching with enhanced titers of both viruses compared to individual virus infections. In this study, we report viral determinants responsible for WSMV-TriMV disease synergism in wheat. In wheat coinfected by WSMV and TriMV, the accumulation of virus-specific small interfering RNAs increased, similar to the accumulation of viral genomic RNA copies. These data suggest that the synergistic effect between WSMV and TriMV is not caused by the suppression of host post-transcriptional gene silencing by dual RNA silencing suppressors, the P1 proteins of both viruses, in co-infected wheat. We found that the expression of P1 or NIaPro cistrons of either virus in wheat through WSMV or TriMV resulted in slightly severe symptoms with a moderate increase in virus titer. However, the co-expression of P1 and NIaPro cistrons of either virus with TriMV or WSMV in wheat developed a synergism-like phenotype with severe symptoms and increased accumulation of genomic RNA copies and coat protein. Taken together, these data suggest that the P1’s function of WSMV and TriMV in synergism is distinct from that of RNA silencing suppression. Additionally, we found that the HCPro, P3, and NIaVPg cistrons of WSMV and TriMV are not the primary contributors to the synergism. Our findings indicate that the P1 and NIaPro proteins of WSMV and TriMV play crucial roles in driving synergistic interactions in wheat.