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Developing a Method to Contain the Feeding of the Wheat Curl Mite (*Aceria tosichella* Keifer)

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Abstract

To better understand the ecology and epidemiology of the wheat curl mite (Aceria tosichella Keifer) as a vector of wheat streak mosaic virus (WSMV), it is necessary to develop a method to confine the microscopic mites and their infection to specific areas of their host plants, particularly wheat and corn. In this study, corn was the plant of interest. The device developed for this mite-confining method was made by removing the lens of a phone camera lens clip and gluing a 2.5 cm x 4.5 cm piece of wood to the other arm of the clip. Clips were utilized by placing mite-infested wheat leaves on the wooden arm of the clip, opening the clip, and gently lowering the arms onto either side of the corn leaf with the wooden base on the underside. Mite survival, confinement, and feeding were recorded to be satisfactory for use in subsequent studies examining virus transmission by the mites. Future work utilizing this device will center around Red Fluorescent Protein-Tagged WSMV spread in resistant and non-resistant corn varieties along with susceptible wheat varieties.

Introduction

The wheat curl mite (Aceria tosichella Keifer) is the vector of wheat streak mosaic virus (WSMV) to wheat. Wheat streak mosaic virus reduces yields and causes annual losses to the economy of the Great Plains in the millions of dollars. The epidemiology of WSMV and its vector, the wheat curl mite, is somewhat unknown in certain characteristic. To further study and understand the pathology of WSMV and the wheat curl mite as a vector, confinement of feeding and movement of mites to a limited area on a plant would be advantageous. The purpose of this study was to develop a tool limiting wheat curl mite activity on a plant. This will enable localizing infection in order to better study the cellular and systemic spread of the virus from the site of mite feeding. Current studies will focus on corn as a host.

Fig 1. Phone Camera Lens Clip

Materials and Methods

By modifying phone camera lens clips such as the one illustrated in Fig. 1, mite confinement clip cages were developed. Modifications were made by removing the lens from the optical device and gluing a 2.5 cm x 4 cm wooden piece to the non-lens arm of the clip. When gluing this wooden piece it was made sure that when closed, the ring's rubberized rim pressed flush against the wooden piece. This resulted in a circular area that confined the mites with access to the corn leaf for feeding. The phone camera lens clip had a soft but strong clamping force which made for a clip cage that was firm enough to contain mites but also gentle enough to not damage or cut off circulation to the leaf. In order to prevent damage to the leaf by the clip cage, a ¼ inch hole was drilled into the middle of the two extending arms of the clip cage as a means to support the clip cage once attached to a leaf. A rubber band tied to the area where the two arms connect on a clip cage could be used to anchor the clip cage to a wooden dowel inserted into the soil and aforementioned hole.

The clip cages' success and reliability in ensuring both mite and plant leaf survival was examined in multiple trials. Trials were primarily qualitative with respect to plant health, but data relating to mite survival were recorded.

Clip cages were tested during trials by cutting two to four ≈ 0.5cm pieces of mite-infested wheat leaves and placing them inside a clip cage. The clip cages were carefully opened and positioned next to the desired corn leaf. The two extending pieces of the cage, the ring of confinement and the wooden base, were positioned above and below the leaf, respectively. After checking to guarantee the infested wheat leaves were still inside the area of confinement on the wooden base, the clip cage was gently allowed to close.

Clip cages were kept on corn leaves for a total of 7 days. Mite presence was examined after 1, 3, and 7 days within the clip cage.

Corn plants involved in these trials were a WSMV-resistant Hoegemeyer line. Corn seeds were planted in 5-gallon pots with potting soil and allowed to grow for 3-5 weeks before being clipped. Plants used in the trials had about 5 cm wide leaves so that clip cages could close with no exposed gaps.

Results

Qualitative data gathered from the trials depict a satisfactory reliability in mite survival, attached plant health, mite confinement, and mite feeding. The quantitative data gathered from trials show a high number of mites migrating from the wheat leaf pieces to the clipped corn leaf (Fig 2 & 3). The data also depicts a high mite survivability with mites living for up to 7 days (Fig 2 & 3). Mite congregation on the corn leaf material peaked at 3 days across all trials (Fig 2 & 3).

If this study was to be repeated, examining the number of mites moving and health of the wheat leaf pieces at different times would aid in understanding the movement patterns of mites in clip cages. This could possibly allow changes to be made to the clipping methods in order to maximize mite movement and feeding. It would also be beneficial to quantitatively determine the most preferred corn leaf material for mite movement. In trials, mite movement was highest on the soft newer leaves compared to tough older leaves. This caging process will be used in further trials to investigate virus transmission spread in corn.

Fig 2. Average Number of Mites Alive on Corn Leaf Material Over Time

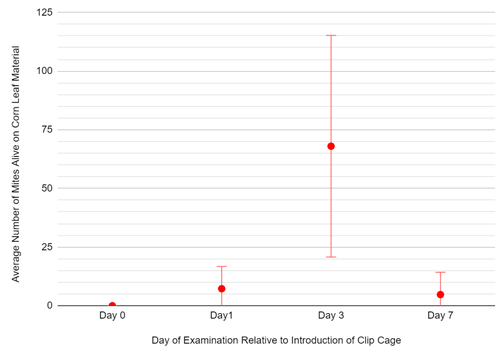

Figure 2 depicts high variability between the 4 studies which could be due to variable mite density on wheat leaves used for infestation along with variable corn leaf age.

Fig 3. Number of Mites Alive on Corn Leaf Material Over Time

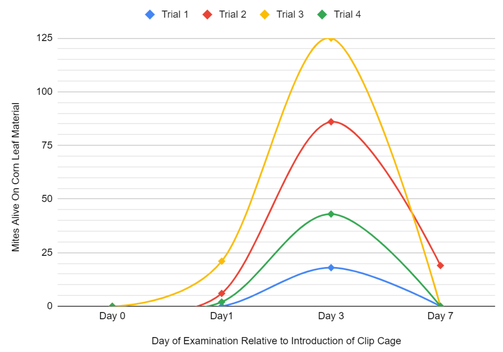

Fig 4. Constructed Clip Cage

Fig 5. Clip Cage Attached to a Corn Plant with Wooden Dowel for Support

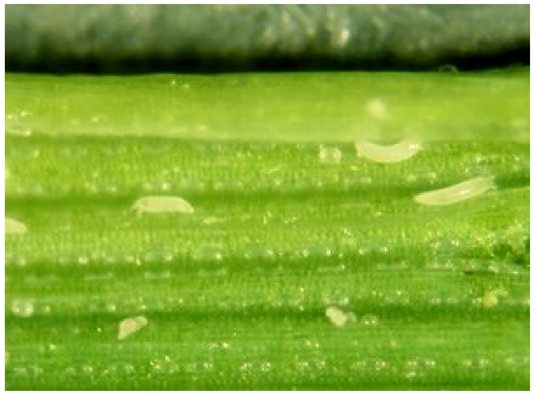

Fig 6. Wheat Curl Mites Feeding on Wheat Leaf Material

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