

# **Transmission of Dry Bean Viruses By the Soybean Aphid, Aphis Glycines**

**Project GREEN No.:** GR03-027

*[note – the time frame for this project was extended due to difficulties in obtaining virus source and aphids from the USDA Niles facility]*

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## **Statement of Challenge**

The soybean aphid, *Aphis glycines*, was accidentally introduced into the United States in the late 1990s. In Asia, soybean aphid is a known vector of several potyviruses. In the Midwest, it was recently found to transmit soybean and alfalfa mosaic viruses in soybean. In Michigan, which has a greater diversity of crops, an additional concern is the transmission of viruses in other crops, particularly cucurbits (such as squash, pumpkin, and cucumber) and dry beans. While soybean aphid apparently cannot survive and reproduce on any crop except soybean, soybean, dry beans, and vegetable crops are often grown in close proximity. During aphid outbreaks, we estimate that up to 800 million winged soybean aphids per acre may be produced and leave soybean. These winged aphids move across the landscape, and could pick up and transmit viruses in other crops. During the last two soybean aphid outbreak years (2001 and 2003), virus incidence in cucurbits was greatly elevated in Michigan, and growers suffered economic loss. Previous trapping research funded by Project GREEN [Hausbeck et al, Project GR01-060] showed that soybean aphids indeed made up a large proportion of the aphids landing in cucurbit fields in 2003. The relationship between virus incidence and soybean aphid outbreak years suggested that soybean aphid was responsible for transmitting viruses outside of soybean.

## **Objective**

Determine if soybean aphid transmits viruses important in vine crop and dry bean production, and if so, how efficiently.

## **Results and Accomplishments**

Because of increased security, it was difficult to obtain virus source plants in the mail from other universities. Therefore, all virus sources had to be found within Michigan. The three viruses eventually cultured are the following:

- \* Bean Common Mosaic Virus (BCMV) - from field-collected dry beans in Montcalm County
- \* Cucumber Mosaic Virus (CMV) – from a vine crops sample sent to the MSU diagnostic clinic
- \* Zucchini Yellow Mosaic Virus (ZYMV) - from Dr. Rebecca Grumet's laboratory at MSU

Viruses cultures were kept in, and transmitted to, cv Tebo dry bean and cv Hales Best Jumbo squash. Soybean aphids were initially obtained from the USDA-APHIS Biocontrol facility in Niles, Michigan. That facility closed, so a small greenhouse colony at MSU was established from field-collected aphids.

Alate (winged) aphids were starved before transmission, then given a 5 minute acquisition period to probe a virus infected leaflet. Aphids were moved with a paintbrush to healthy test plants enclosed in a small plastic tubes. The number of aphids used per plant varied from 1 to 100. Aphids were left on the test plants overnight, giving them ample time to transmit virus. The following day, the plastic chambers were removed, the aphids crushed, and the plants sprayed

with insecticide. The test plants were kept in the MSU greenhouse for 2 to 3 weeks, then leaves from each test plant were submitted to the MSU Diagnostic Clinic for testing, along with known infected and healthy control samples.

BCMV was transmitted relatively efficiently by soybean aphid, with as few as one aphid per plant. Zucchini yellows virus was difficult to transmit, although transmission was eventually obtained by using a large number of aphids per plant. This may have been a function of the specific virus strain obtained from Dr. Grumet’s laboratory. Aphids can differentially transmit strains of the same virus, particularly if the virus strain has been in culture for some time, and transmitted by hand inoculation rather than by aphid feeding. SBA was extremely efficient at transmitting CMV to squash from infected squash, with 100% transmission using only 5 aphids per plant. Pathologists at Cornell have reported similar success transmitting CMV in snap beans.

**Table 1:** Transmission of three potyviruses by different numbers of soybean aphids per plant.

<i>Potyvirus</i>	<i># SBA per plant</i>	<i>% transmission</i>
Bean common mosaic virus	1	20
	5	25
Cucumber mosaic virus	5	100
	10	61
Zucchini yellow mosaic virus	5	0
	10	0
	40	100
	100	0

### **Impacts**

Soybean aphid was suspected in the increase in cucurbit viruses in the last few years. Previous research funded by Project GREEN showed that soybean aphids were landing in cucurbit fields during virus outbreaks; this new research demonstrates that soybean aphid can vector these viruses, quite efficiently in some cases. During outbreaks, millions of winged soybean aphids leave soybean. Insecticide sprays on the part of vegetable growers cannot stop this onslaught. However, resistant varieties can lessen the impact of viruses. Recent information suggests that soybean aphid outbreak years may be predicted by suction trap catches of soybean aphids in the fall and sampling overwintering populations in the winter. Given a certain amount of predictability in soybean aphid numbers year by year, vegetable growers can adjust accordingly before the field season, and make decisions about varietal selection in preparation of an outbreak. Soybean aphid predictions and updates are now being routinely shared with campus specialists and extension agents working with vegetable growers, to inform them about virus potential in their crops.

### **Summary Statement**

Soybean aphid is confirmed as a competent vector of three important viruses in cucurbit and dry bean production. In seasons when soybean aphid outbreaks are predicted, growers can take steps to mitigate the impact of viruses by, for example, shifting towards virus-resistant varieties.

### **Funding Partnerships**

There were no funding partnerships for this research project.