STATEWIDE DISTRUBITION OV VIRUS PROBLEMS ON PROCESSING BEANS

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Wisconsin is the leading producer of succulent beans in the United States with 79,800 acres in production creating a fresh market and processing industry valued at 36 million dollars/year (Wisconsin Ag Statistics, 2003). Virus problems in the Midwest continue to seriously affect the financial viability of this industry. A virus complex involving cucumber mosaic virus (CMV) alfalfa mosaic virus (AMV) and perhaps others first appeared in 2000 in production fields in eastern and south-central Wisconsin causing significant losses. In 2001 losses were less but the presence of virus symptoms was noted in these same growing areas. Losses in 2002 were minimal and appeared to relate to reduced populations and delayed appearance of the soybean aphid. During the 2003 growing season, losses were widespread in Wisconsin and in southern Minnesota, western and southeastern Michigan, and parts of New York State.

With the sudden and dramatic appearance of the soybean aphid (*Aphis glycines*) in soybean fields in 2000 and its known role in virus transmission (Wang et al., 1962; Hill et al., 2001) it was logical to suspect its involvement in the sudden rise in virus-like symptoms in succulent bean. While several viruses have been known to occur on succulent beans intermittently in Wisconsin (Delahaut et al., 2001) they had not previously created serious problems. Therefore, a preliminary survey was undertaken to assess the virus status of the crop in 2000 and 2001. Various experiments have demonstrated that *Aphis glycines* can transmit AMV and suggest that it may be involved with other virus components of the succulent bean virus syndrome (Hill et al., 2001). Taken together, these data clearly implicate these viruses and the soybean aphid as the cause of the problems associated with snap bean production.

In 2002 and 2003, an extensive survey from the major production regions of Wisconsin was undertaken to determine the incidence of CMV, AMV and (in 2003) bean common mosaic virus (BCMV). Leaf samples were selected at random to obtain incidence and ELISA was used to determine infection. These data show that the incidence of CMV and AMV is extremely high in all growing regions of the state and that CMV is more common than AMV. In 2003 we included BCMV in our survey and found it to be present at a relatively low level. Notably, spread of the virus in commercial fields and small research plots was uniform throughout the plantings. Either the plantings were affected or not and this seemed to relate to whether the plantings were in the path of aphid migrations. Symptoms were relatively uniform throughout the plantings indicating a near simultaneous inoculation of susceptible materials. The incidence of virus-infected plants was clearly less in early-planted succulent beans as compared to planting after mid-July and the arrival of soybean aphids to these fields was timed as to expose the later crop to insect pressure at an earlier stage of development resulting in more serious damage to the crop.

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The dynamics of insecticide use on the soybean aphid has been discouraging and succulent bean germplasm adapted to the North Central region has not been thoroughly characterized for reaction to viruses found in Wisconsin. We have been working with the rest of the management team to address these concerns. In the last two years, efforts to devise acceptable control by preventing aphid transmission have been unsuccessful. As part of our testing efforts we tested leaf samples from insecticide trials conducted in Dr. Jeff Wyman's laboratory. In 2002 and 2003 fourteen different trials involving multiple locations and 56 replications using various combinations of systemic insecticides (imidacloprid and thiamethoxam), foliar insecticides (bifentrin and acephate) and oil applications at various rates and timings were conducted. In all of this work no combination of treatments provided adequate control as measured by virus infection rates (ELISA tests), symptom development or crop quality. While these results could be expected when directed towards stylet borne viruses, it was surprising that there were no significant differences between untreated plots and any of the treatments designed to control aphid transmission of either AMV or CMV in these experiments. It was concluded that the large influx of alate soybean aphids into these trials (over 50/leaf) during peak dispersal from soybean, was sufficient to overwhelm any potential benefit from the treatments.

Data on the relative reaction of northern succulent bean germplasm are critical. We are working with Walt Stevenson and Craig Grau who initiated field studies in 2001 with a single replicated planting of 40 breeding lines of processing beans at the West Madison Ag Research Station. In 2002, they expanded the study to include 120 lines with three replications planted in both early and mid-July at West Madison and mid-July at Manitowoc (NE Wisconsin). In 2003, they took the top 30 lines exhibiting the least amount of damage in the 2002 trials and added 20 promising lines from breeders so that 50 lines were planted at W. Madison (2 plantings three weeks apart) and Manitowoc (mid-July). Data were collected at two-week intervals on symptom severity at all planting sites and leaves from two collections at each site were assayed for CMV and AMV. While all plot entries were infected and CMV and most were infected with AMV, symptom severity ranged from mild to severe. Symptom severity on some entries was severe early in the season and decreased as the season progressed. On other entries, symptom severity was mild early and became increasingly severe as the season progressed. Still other lines expressed mild symptoms through much of the season. Interestingly, our ELISA testing has shown that even viruses with relatively mild symptom expression are often virus positive. Plants such as these are considered tolerant. We will evaluate these materials to see if they may form a source of useful material in the short run. There is clearly a diversity of disease reactions to uniform distribution of the virus complex and it is our hope that breeders will be able to capitalize on this information to provide lines that are minimally affected by these viruses.

We have little information on the soybean aphid virus complex as it relates to succulent bean production, and a rigorous analysis of all components of the system is essential to developing rational control for the North Central States. The combination of factors and the consequences (severe plant stunting, pod twisting, leaf mottling and pod necrosis (chocolate pods) need to be analyzed in more detail. The effects of standard

agronomic practices on the seasonal biology of the soybean aphid are unknown, as well as the subsequent effects on succulent bean health. Knowledge gained on the soybean aphid's biology, impact and management in the U.S. will be novel and vital in developing management programs. We currently only have three seasons of observations on the biology of aphids and their impact on succulent bean plant health. Information based on experimentation in Wisconsin is critical in determining procedures for aphid management. The source of virus inoculum in the field needs to be determined: is it seed, weeds (in 2002 and 2003 we found several potential alternate host plants), other agronomic crops or aphids moving in from long distances…..or perhaps all of these things? Additional data are required to determine the agronomic impact of single viruses and virus complexes on the yield and quality severity. Are there additional viruses that we have not detected in the complex? How does the timing of infection related to disease severity and crop degradation? We hope to address these and other questions in the coming year and welcome any help or suggestions from growers and other interested stakeholders.

References Cited

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