IMPACT OF CULTURAL PRACTICES ON SOYBEAN APHID INCIDENCE, SOYBEAN YIELD, AND VIRUS INCIDENCE

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Since soybean aphids (*Aphis glycines* Matsamura) were first reported in Wisconsin in 2000, these insects have become a common sight in many soybean fields. Many growers report finding tens of thousands of aphids colonizing on a single plant. Not much is known about the aphids' biology, persistence or effect on soybean health and productivity. Along with the direct damage apparently done by the feeding aphid, concerns about the possibility of virus transmission to soybeans also concern researchers and growers. In response to this new threat to profitable soybean production, research teams were quickly assembled in several North Central States to determine both short- and long-term solutions to the soybean aphid and associated viruses.

Soybean Aphid and Virus Transmission

The recent discovery of the soybean aphid in the North Central Region of the United States is significant because it is the first time that a soybean-colonizing aphid has been detected in the New World. Although the soybean aphid has the potential to cause physiological loss of up to 52% on soybeans (Wang et al., 1962; Wang et al., 1996), it can also transmit soybean mosaic virus (SMV), alfalfa mosaic virus (AMV), and several other viruses in a nonpersistent manner (Halbert et al.,m 1986; Hill et al., 2001; Irwin et al., 2000; Wang et al., 1962). For these reasons, it was important to determine if an endemic isolate of SMV common to the Midwest could be transmitted by this introduced species of aphid. Transmission experiments were conducted comparing soybean aphid (*A. glycines*) to the, the green peach aphid (*Myzus persicae*). The green peach aphid was the principle vector of SMV prior to the arrival of the soybean aphid (Irwin et al., 2000). Results of the experiment confirmed the soybean aphid is an efficient vector of SMV and comparable to the transmission efficiency of the green peach aphid. For AMV, corresponding transmission efficiency by the soybean aphid was less compared to SMV. The data suggest that the introduced soybean aphid is an efficient vector of SMV, but a less efficient vector of AMV. Transmission of SMV and AMV by the soybean aphid is of concern because it may increase SMV and AMV incidence in soybean.

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Soybean Aphid Research in Wisconsin - 2001

Research has focused on understanding the effect of the soybean aphid and associated viruses on the health and productivity of soybeans and to formulate management strategies to reduce yield losses associated with this pest complex. However, because no insect pests of soybeans have ever reached economic injury levels, soybean growers are not accustomed to managing these insects and may be reluctant to invest in additional inputs needed for insect control.

The most instinctive response to controlling the soybean aphid has been to use insecticides. However, insecticides are an unwelcome additional expense during a time of depressed soybean markets, and may be detrimental to natural enemies of the soybean aphid. These factors are a key driving force to explore cultural practices as effective means to control soybean aphids and associated soybean viruses. Row width, plant population and planting date are common options employed by soybean growers to enhance soybean canopy development to maximize yield potential. Observations in 2000 indicated late-planted soybean fields had higher soybean aphid populations than early-planted fields. Also, less soybean-plant-dense areas of individual fields appeared to have higher aphid populations as well as a greater apparent effect on soybean growth and development. Research is necessary to determine whether management practices can modify aphid activity and transmission of associated viruses.

Field experiments were conducted in 2001 to investigate the effect of planting date and soybean plant population on soybean aphid population dynamics and soybean yield. Other management options such as insecticide efficacy trials and insecticide application timings were investigated as well.

An experiment to confirm our observations regarding aphid response to planting date was conducted in 2001. Three plantings (May 9, May 29, and June 7) were made. Highest soybean yields were harvested from plots planted in early May (Fig. 1). This response to planting date is similar to previous planting date studies. Aphid counts were taken from all plots beginning on July 5 and continuing weekly until August 23. The number of aphids on the youngest trifoliate, including petiole, was recorded. Aphid built up to higher numbers with later planting, plus the timing of peak aphid numbers was delayed by about a week with successive planting dates (Fig. 2). Moreover, aphids on the May 9 planting did not undergo the rapid population growth observed for the latter two plantings. Peak aphid numbers were associated with R3 stage soybeans in the May 29 and June 7 plantings. Note the rapid growth of soybean aphid populations during late July and early August for the two later planting dates. This aphid has tremendous growth potential. In several laboratory studies, we have concluded that the soybean aphid can begin reproducing when she is 5 days old, and under ideal conditions a soybean aphid population can grow from

10 to 1,000 aphids in a little under ten days. It was determined that soybean planting date had a profound effect on soybean aphid dynamics and grain yield.

Enzyme linked immunosorbent assay (ELISA) serological tests were performed on leaf tissue samples from all plots to determine if any common virus pathogens were present. AMV and bean pod mottle virus (BPMV) were found, however the incidence was very low (only in one plot each) and no firm conclusions can be made about virus incidence differences due to planting date.

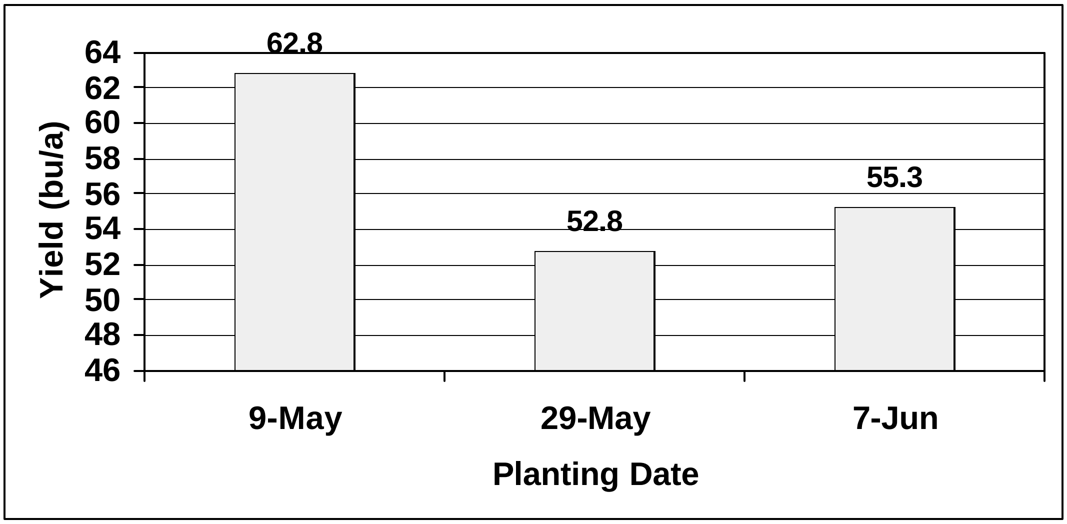

Fig. 1. Soybean grain yield at three planting dates. Arlington, WI. 2001.

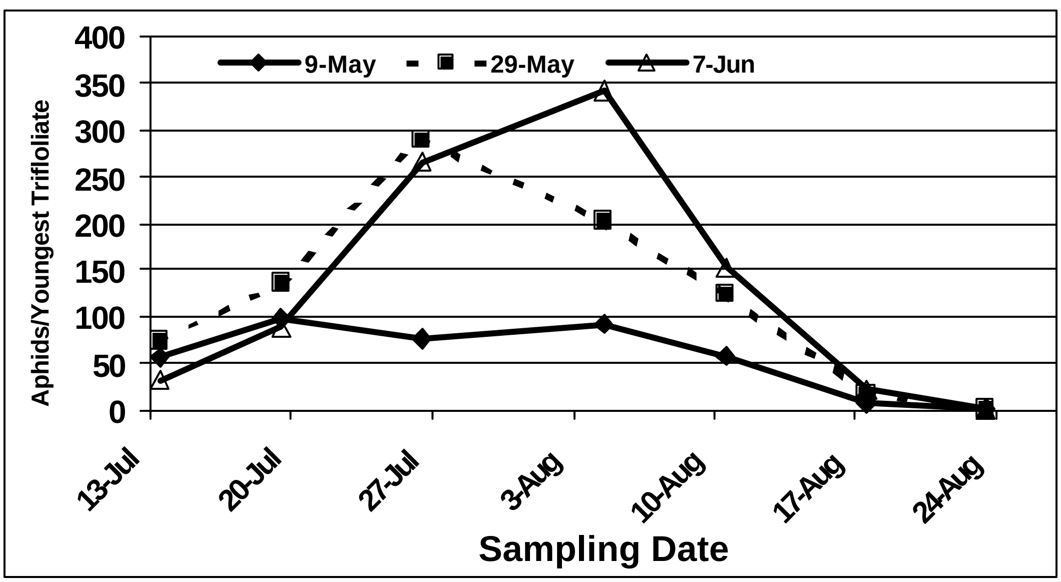

Fig. 2. Soybean aphid count for three planting dates of soybean. Arlington, WI 2001.

In 2000, less soybean-plant-dense areas of individual fields appeared to have higher aphid populations compared to more plant-dense areas. An experiment was initiated in 2001 to test these observations. Soybean was planted in two row widths (7.5” and 30”) and with three seeding rates (150K, 200K, and 250K seeds/a in 7.5” and 75K, 125K, and 175K seeds/a in 30” rows) within each row width. These will be referred to as low, medium, and high. This was designed to produce a wide range of plant densities in order to measure aphid activity in each. Grain yield from the 7.5” row spacing averaged over the three seeding rates was 66.3 bu/a and 18% higher than that from the 30” row spacing (58.8 bu/a) (Fig. 3).

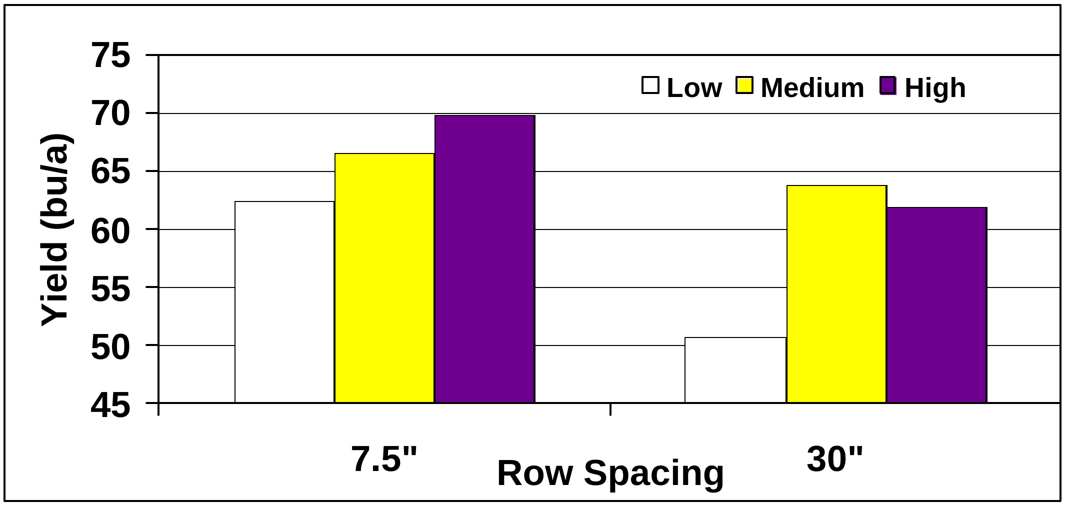

Fig. 3. Soybean grain yield at two row widths and three seeding rates within each row width. Arlington, WI. 2001.

The number of aphids on the youngest trifoliate, including petiole, were also recorded. Aphid numbers were progressively lower in the 7.5” row spacing plots as seeding rate was increased on the July 19 sampling date. Aphid numbers were lowest in the high seeding rate of the 30” rows, however they were highest in the medium seeding rate (Fig. 4a). At the July 26 sampling, there was no difference in the aphid counts for any of the seeding rates in the 7.5” rows. In the 30” rows, aphid numbers were highest in the low seeding rate and equal in the medium and high seeding rates (Fig. 4b). Aphid numbers were lowest in the high plant density plots in three of the four comparisons shown here. Aphid numbers were more inversely correlated with plant densities within row spacing than between row spacing. Grain yield (Fig. 3) was inversely correlated with aphid numbers at the July 19 sampling date but had no relationship with counts at later dates. It appears that higher plant densities, no matter what row width, are an effective cultural deterrent to aphid colonization.

ELISA serological tests were performed on leaf tissue samples from all plots, however none of the tests indicated viral activity and no firm conclusions can be made about virus incidence differences due to plant density.

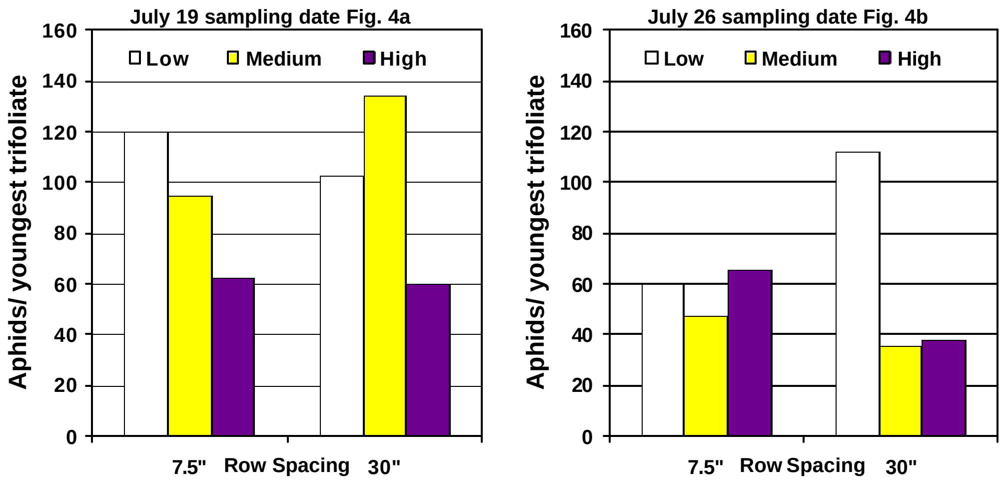

Fig. 4a and 4b. Soybean aphids per youngest trifoliate at two row widths and three seeding rates within each row width on July 19 (Fig 4a) and July 26 (Fig. 4b). Arlington, WI. 2001.

Summary

The soybean aphid represents a significant threat to soybean health and productivity in the upper Midwest. One year of field data indicates that the aphid is reducing yield directly with variable serological positive tests for viral activity. Early planting date and high plant populations can be an effective management tactic to suppress soybean aphid populations and subsequent yield loss, however insecticides may have to be used if aphid populations reach damaging levels.

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