

IMPORTANCE OF SOYBEAN APHIDS TO VEGETABLES

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Since its discovery in the United States in the upper Midwest in 2000, the soybean aphid (*Aphis glycines* Matsumara) has spread to over 20 states. The soybean aphid overwinters on buckthorn and after spring movement to its primary host, soybean, it reproduces rapidly and reaches peak populations in late July. At this time direct feeding damage to soybean is widespread with early senescence and reduced pod set, seed quality and yield reported throughout the Midwest. As populations peak in soybean, winged forms are produced in huge numbers which migrate to new crops seeking new host plants and/or overwintering sites. This mass migration of winged aphids from over 20 million acres of infested soybean in the Midwest – Voegtlin and Onstad (2003) estimated that over 400 million soybean aphids emigrated from a single 80 acre field in a single day – represent a significant threat to other crops grown in the region.

As winged soybean aphids disperse to new crops seeking new host plants they land indiscriminately on green foliage and test the suitability of the crop by a series of short probes into the leaf epidermis. These probes last only seconds and the aphids subsequently leave non host plants but they are significant because they can cause damage to the probed plant in two ways. First, the probes are frequently accompanied by the introduction of saliva which can cause phytotoxicity particularly when high numbers of aphids are present. Second, the short, shallow probes are ideally suited for the transmission of plant viruses from plant to plant. Again, individual aphids may not be very efficient in virus transmission and frequently leave the probed plants but what they lack in efficiency is more than compensated for in the large numbers of individuals.

Vegetable crops are susceptible to a wide range of viruses which can be transmitted in short, superficial probes. These viruses can be from several virus groups and are collectively known as non-persistent aphid transmitted viruses. Common examples include cucumber mosaic virus, potato virus Y, alfalfa mosaic virus, bean yellow mosaic virus, zucchini yellow mosaic virus, soybean mosaic virus, tobacco ring spot virus, watermelon mosaic virus, and potentially many others.

The first confirmed losses associated with soybean aphid feeding on vegetables occurred in 2001 on snap beans in Wisconsin. Widespread losses were reported in late planted snap beans with plant stunting, leaf yellowing, mosaic and distortion and pod discoloration. These losses were associated with a complex of aphid transmitted viruses with cucumber mosaic and alfalfa mosaic viruses being prevalent. Extensive surveys conducted in Wisconsin snap bean production areas in 2002 and 2003 found widespread virus incidence (German, 2003) and losses have also been reported in Minnesota, Michigan, Ontario, and New York.

In addition to virus transmission, soybean aphids also deposit nymphs on snap beans and although these do not survive beyond 2-3 instars, the combined effect of winged adult and nymphal feeding has been linked to phytotoxic effects. This apparent phytotoxicity, including extensive leaf curling is usually temporary and plants recover following treatment or when aphids leave or die.

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Other vegetable crops have also been impacted negatively by soybean aphid transmitted viruses. In Wisconsin, peppers and cucumbers were diagnosed with cucumber mosaic virus in 2003 with serious yield loss occurring. In Michigan, vine crops were extensively damaged in 2003 (Hausback, 2003). Losses were reported in cucumber, summer squash, winter squash, melons, and pumpkins which were diagnosed with single or multiple infections with cucumber mosaic virus, watermelon mosaic virus 2 and zucchini yellow mosaic virus. Symptoms which include leaf and fruit mosaic, plant stunting, fruit distortion and yield loss, occurred first in mid-July to early August after heavy flights of soybean aphids had been detected. These viruses were also detected and associated with yield losses in pepper, tomato, and celery. In the Michigan reports it was noted that cucurbit varieties with reported tolerance or resistance to virus were also infected.

Direct evidence of the role of soybean aphid in virus transmission was provided on potato in Minnesota (Davis et al., 2003). In extensive studies, soybean aphids were shown to be moderately efficient (27% to 65% transmission in groups of 1-5 aphids) in the transmission of PVY to potato. Although this level of efficiency was significantly lower than green peach aphid (100%) and potato aphid (88%) which are resident aphids on potato, the far greater numbers of soybean aphids entering potato fields make them a potentially serious new vector species.

The reports of virus infection in a wide range of vegetable crops in 2001-2003 which include succulent beans, peas, peppers, tomatoes, celery, and vine crops represent a significant new threat to the vegetable industry. Although soybean aphids do not colonize and reproduce on most vegetable crops, their host seeking behavior is ideally suited to the movement of plant viruses between crops and their huge numbers overcome individual inefficiencies as vectors. Since virus inoculation requires only seconds and thus cannot be prevented by insecticidal control of the vectors, the potential for crop damage is high. It is likely that host plant resistance to the individual viruses, together with a suite of physical and cultural approaches to reduce transmission, will be needed to reduce crop losses.