Project title: Soybean insect management (2020): Soybean aphid and Japanese beetle

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Final progress report - the project was granted a no-cost extension

Justification: Soybean aphid (*Aphis glycines*) continues to be the most damaging insect pest of soybean. However, the Japanese beetle (*Popillia japonica*), another invasive species from Asia, is spreading and causing increasing injury to soybean. Japanese beetle is an emerging crop pest concern across the region. These two pests now co-occur in soybean fields in southern Minnesota, but it remains unknown how their combined injury affects soybean. Without this knowledge, growers are unable to make fully informed manage decisions. Growers could be unnecessarily increasing insecticide inputs or incurring yield losses due to damaging infestations not being treated appropriately. Likewise, it is unclear how Japanese beetle feeding could affect efforts to use drone-based scouting for soybean aphid. The aim of this project is to improve the sustainability of soybean production by advancing management recommendations for combined infestations of soybean aphid and Japanese beetle.

Objective**:** Assessing combined effects of Japanese beetle and soybean aphid on soybean

Goals: The first component of this objective will quantify the effects of combined infestation of soybean aphid and Japanese beetle on soybean yield and quality. The second component will characterize the effects of soybean aphid and Japanese beetle feeding individually and combined on plant spectral reflectance to increase the accuracy of drone-based remote sensing for soybean insect pests.

Methods: Experimental plots of soybean were established during 2020 in two locations in southern Minnesota where soybean aphid and Japanese beetle are likely to occur. In St. Paul, cages were used to manipulate pressure from aphids and Japanese beetles (treatments included: control, aphid infestation, Japanese beetle infestation, combined aphid and Japanese beetle infestation, artificial defoliation, and combined artificial defoliation and aphid infestation). In Rochester, cages could not be used so we relied on ambient levels of insects (treatments included: control, aphid infestation, artificial defoliation, and combined artificial defoliation and aphid infestation). Per plant aphid counts, visual defoliation, computer calculated defoliation, and hyperspectral measurements were taken of all plots over multiple weeks at each site. At the end of the season, plots were harvested for yield comparisons.

Results: Due to COVID-related complications, analyses of project results from this year and the previous year were delayed; therefore, a no-cost extension was requested and granted. Data were fully analyzed and results indicated: Defoliation was significantly higher in plants fed on by Japanese beetle (P < 0.05). On average, defoliation by Japanese beetle was most severe in the upper third canopy of soybean (P < 0.05). Upper canopy defoliation as high as 6.1% were observed, but total canopy defoliation of plants fed on by Japanese beetle ranged from 0.6 to 3.3%. These levels of defoliation are representative of real field defoliation levels in the Midwest. Low levels of soybean aphid (~ 100 aphids/plant) and Japanese beetle total canopy defoliation (< 5%) did not reduce total yield or seed quality (P > 0.05). However, high levels of soybean aphid (upwards of 1000/plant) reduced seed weight (P < 0.05), and intense defoliation (33%) decreased total yield (P < 0.05), and the weight (P < 0.05) and number of seeds (P < 0.05). Japanese beetle defoliation (≤ 5%) was found to increase red-edge (P < 0.05), but not near infra-red reflectance of soybean plants (P > 0.05). Near infra-red reflectance was previously identified as promising for the detection of soybean aphids. Thus, typical levels of Japanese beetle defoliation in the field is unlikely to affect the detection of soybean aphids with remote sensing. However, intense defoliation (33%) decreased reflectance at near infra-red and therefore could affect remote sensing for aphids. Finally, currently management recommendations for soybean aphid (250 aphids/plant) and Japanese beetle (30% defoliation during the vegetative stage, or 20% during the reproductive stage) should be followed.

Dissemination of data/information: Results of this research and relevant information were presented in a national conference (Entomological Society of America annual meeting) and extension meetings. Furthermore, these data have been incorporated into a manuscript that is now being prepared for publication in a scientific journal.

Key benefits: The findings resulted from this project helped advance the scientific knowledge on the combined effects of soybean aphid and Japanese beetle feeding on soybean. Additionally, the results will benefit growers by refining management recommendations for these two pests.