Project Title: 2024 Western Minnesota Soybean IPM Survey

Principal Investigators: Angie Peltier & Anthony Hanson, UMN Extension

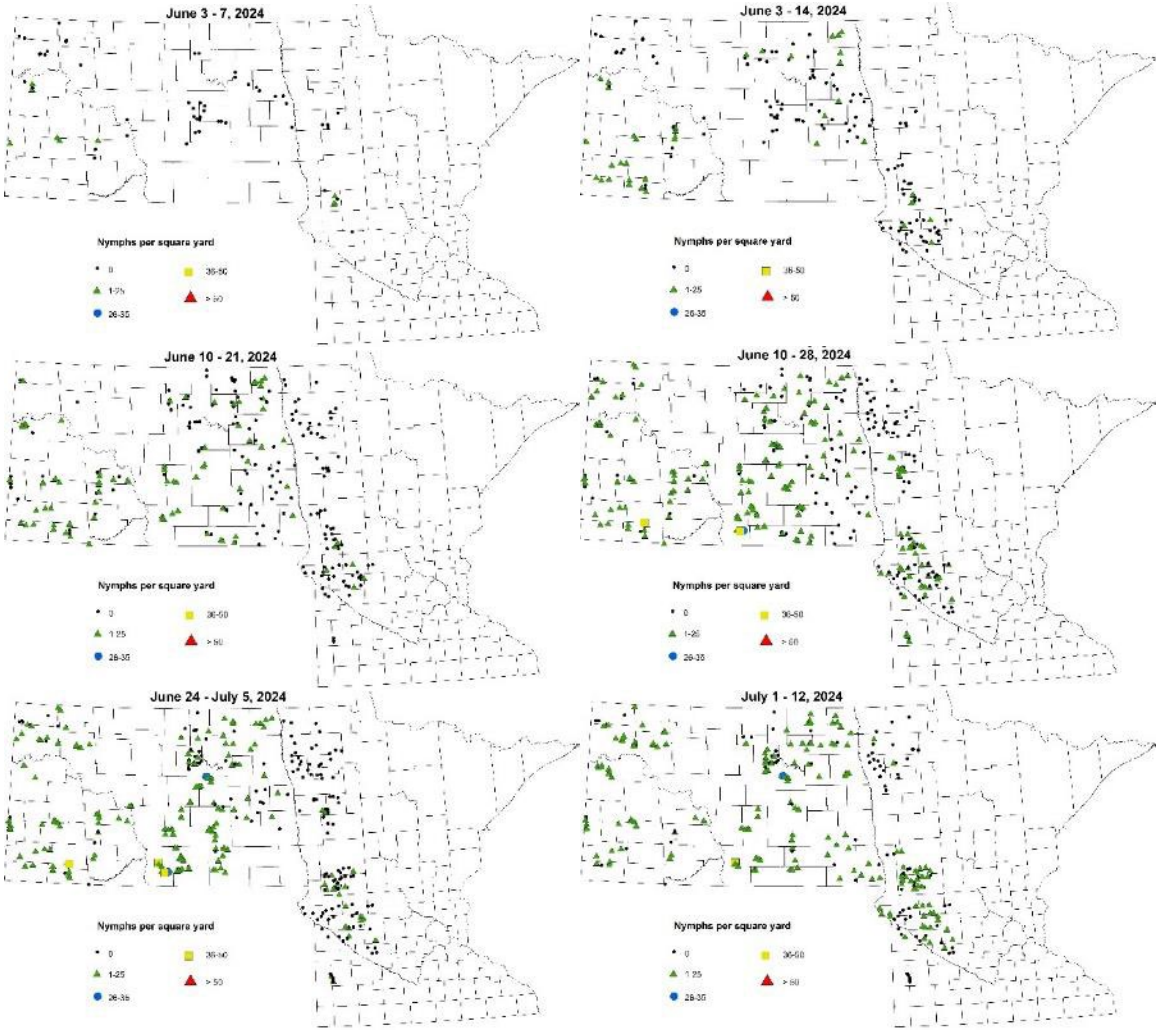
Project Period: May 1 - November 15, 2024

Research Question/Objectives:

1) Conduct field surveys to report soybean crop stage and pest conditions in NW and WC MN.
   a) Partner with the NDSU IPM program in conducting and reporting field and pest conditions across a region that includes NW and WC MN and eastern ND.

b) Deliver timely crop updates based on field observations with an emphasis on soybean aphid, two-spotted spider mite and other crop pest conditions as they develop.

Results: Please find Figures 1 through 20 below. Note that figure captions follow each figure and that figures may spread across multiple pages.



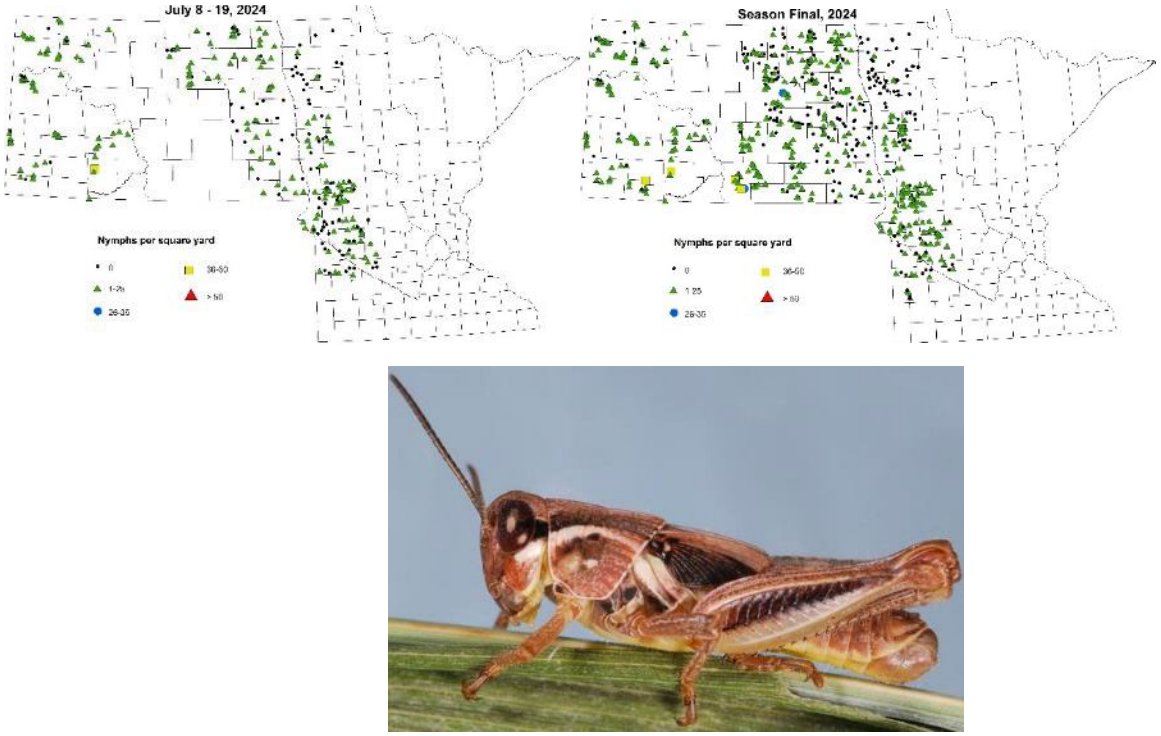
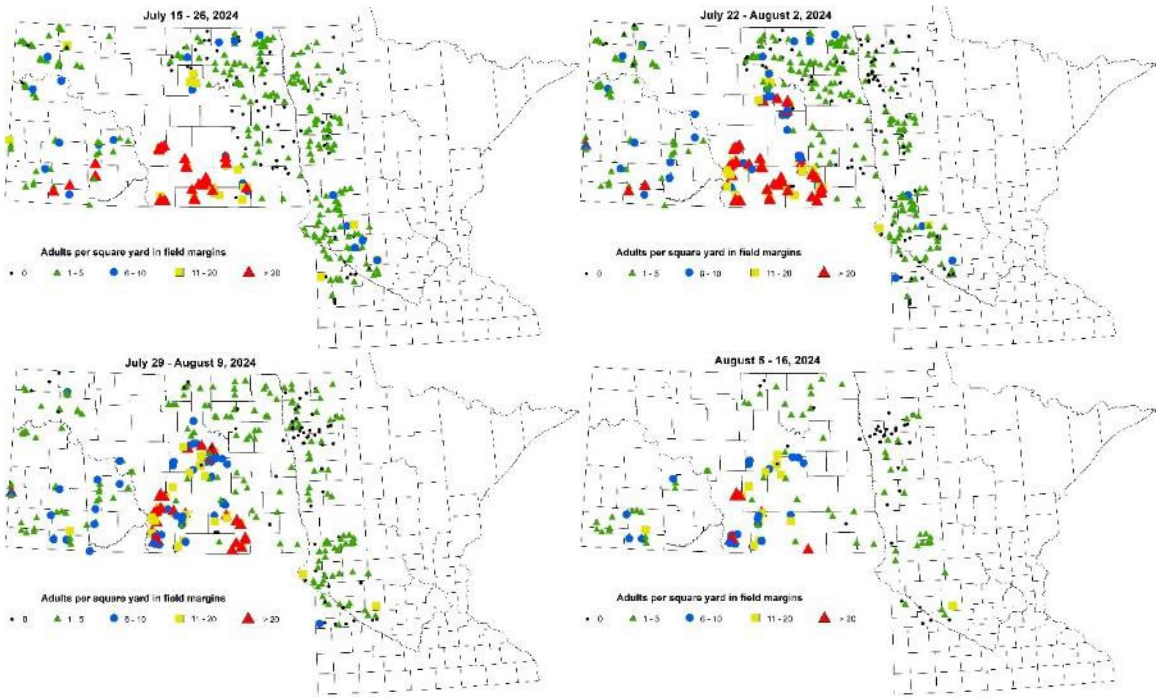


Figure 1. Grasshopper (multiple spp.) nymphs caught on the edge of scouted soybean fields over two-week periods from June 3 through July 19, 2024 and season-long final map. Redlegged grasshopper (*Melanoplus femurrubrum)* nymph, photo: Joseph Berger, Bugwood.org; Maps: NDSU IPM.



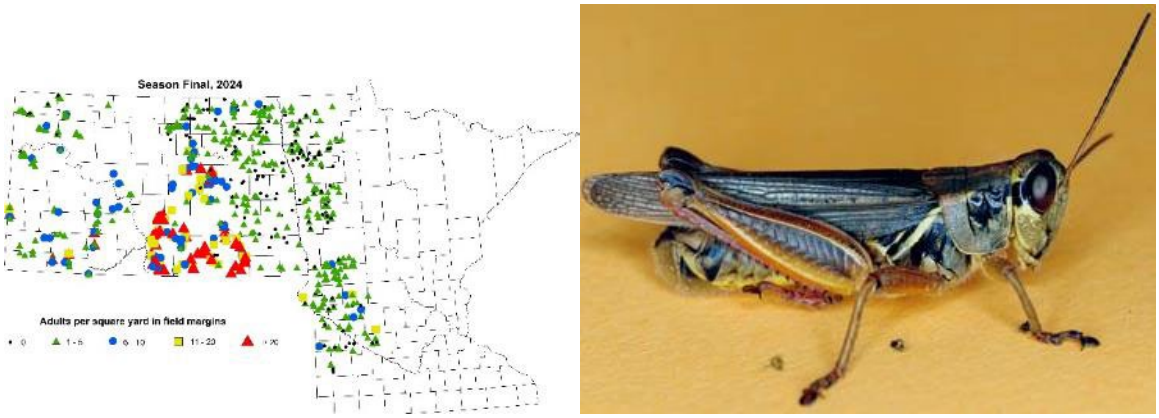
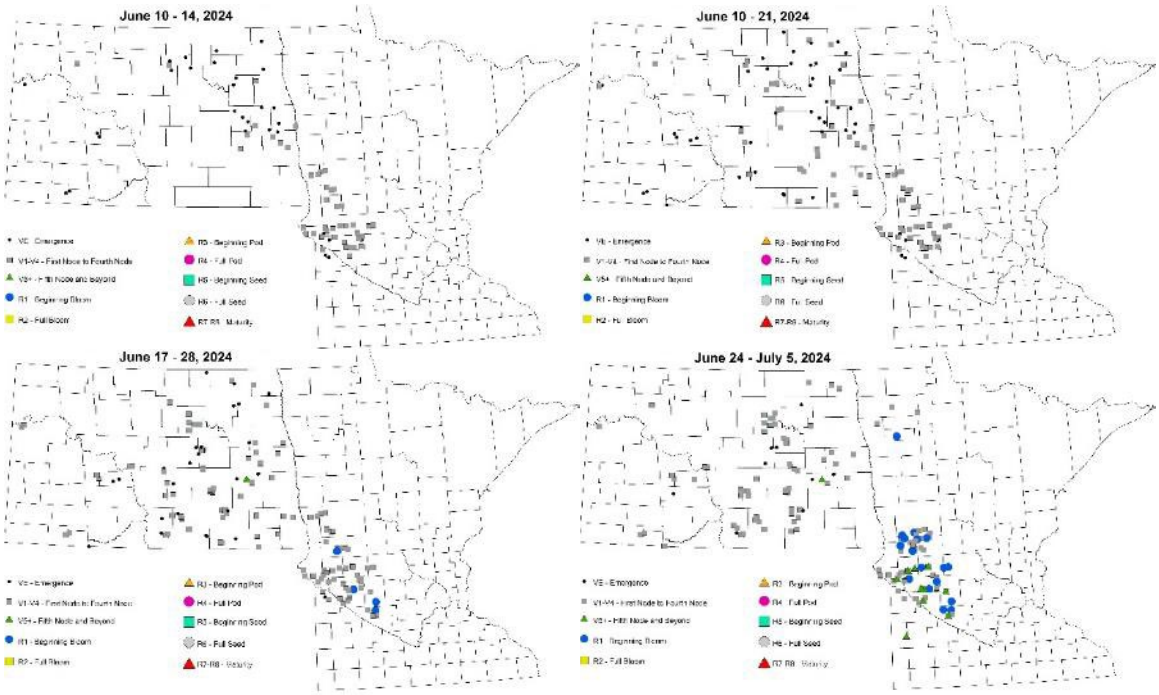


Figure 2. Grasshopper (multiple spp.) adults caught on the edge of scouted soybean fields over two-week periods from July 15 to August 16, 2024 and the season-long final. Redlegged grasshopper (*Melanoplus femurrubrum)* adult, photo: Joseph Berger, Bugwood.org; Maps: NDSU IPM.

Grasshoppers. Grasshoppers observed outside of surveyed fields were more likely to be adults than nymphs by mid-July (**Figures 1 & 2**). As small grains fields began to mature, grasshopper adults were likely to move to adjacent soybean fields. Field edges in WC MN had more adult grasshoppers (colored symbols) than those in NW MN in which there were many more 'no grasshopper' (black dot) locations.

For more information about grasshopper management, visit: https://extension.umn.edu/corn-pest-management/grasshopper-management-minnesota-crops.



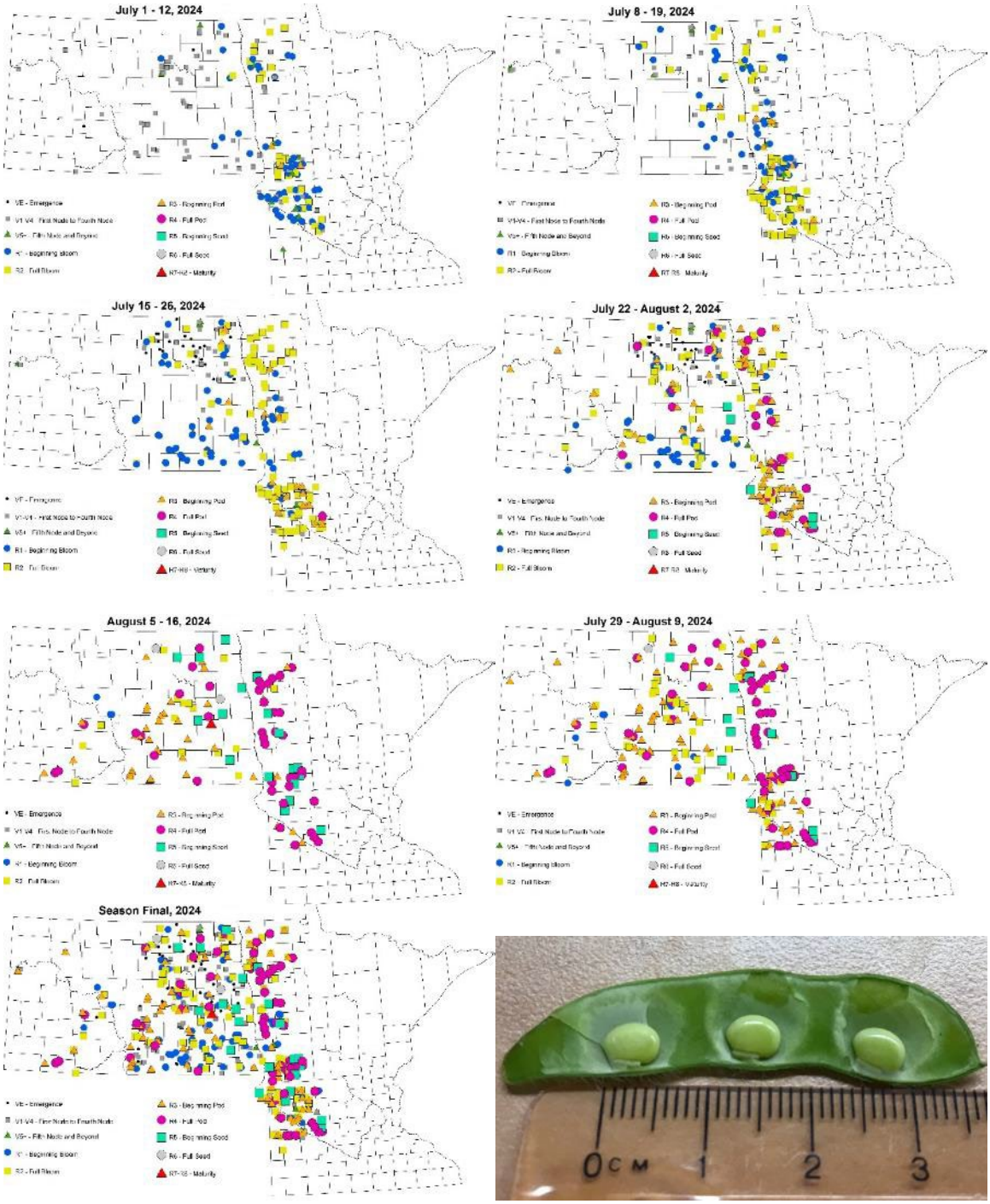
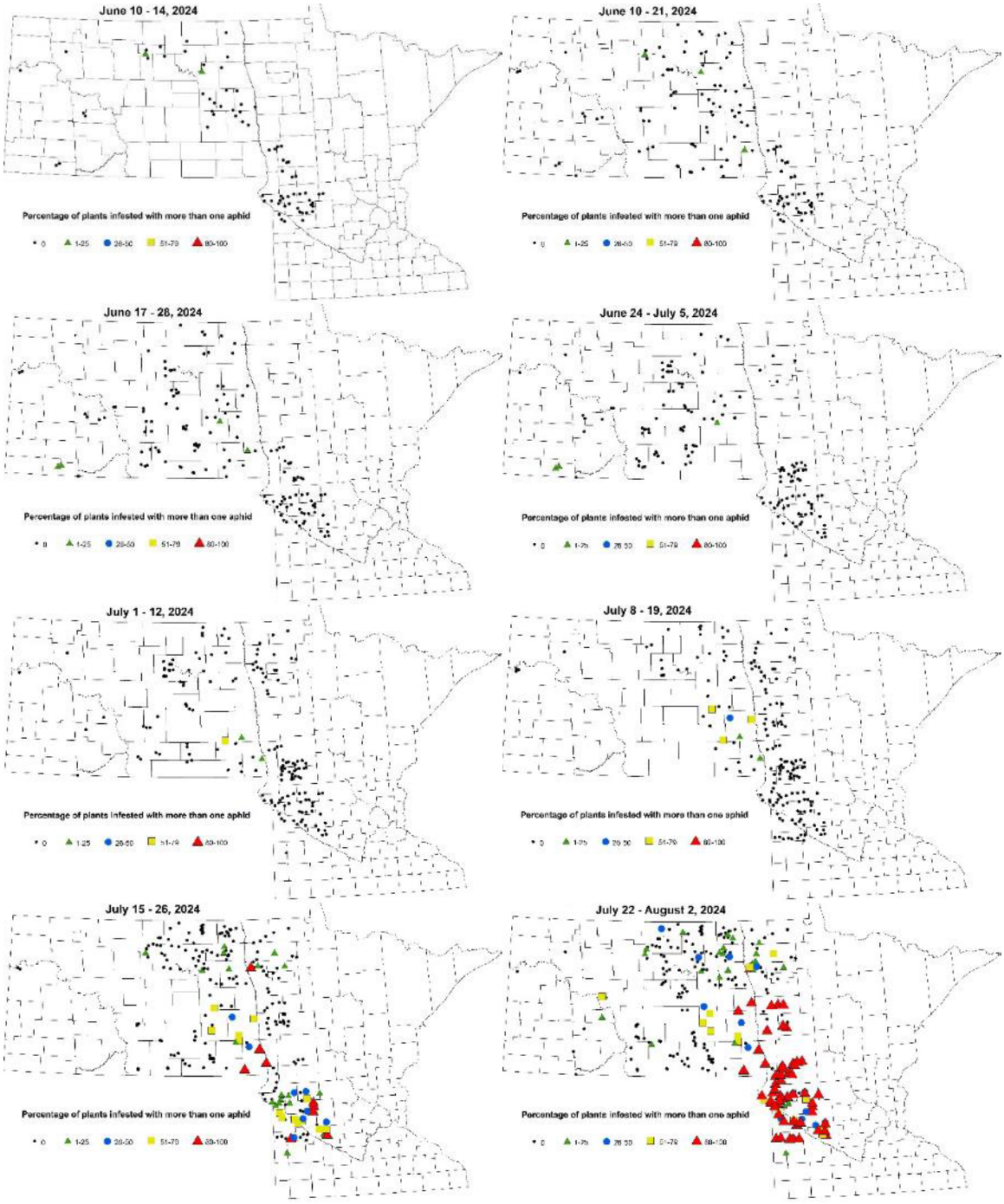


Figure 3. Soybean growth stages over two-week periods from June 10 to August 2, 2024 and season final map; Photo of R5 (beginning seed) soybeans, Angie Peltier, Maps: NDSU IPM.

Soybean growth stages. Early on and throughout the survey period, soybean growth stages in the middle of the Minnesota survey area were delayed in comparison to the NW and SW MN survey area (**Figure 3**). By the last week of the survey, a handful of fields had progressed to the beginning seed growth stage.

For more information about growth staging soybeans, visit: https://extension.umn.edu/growing-soybean/soybean-growth-stages.



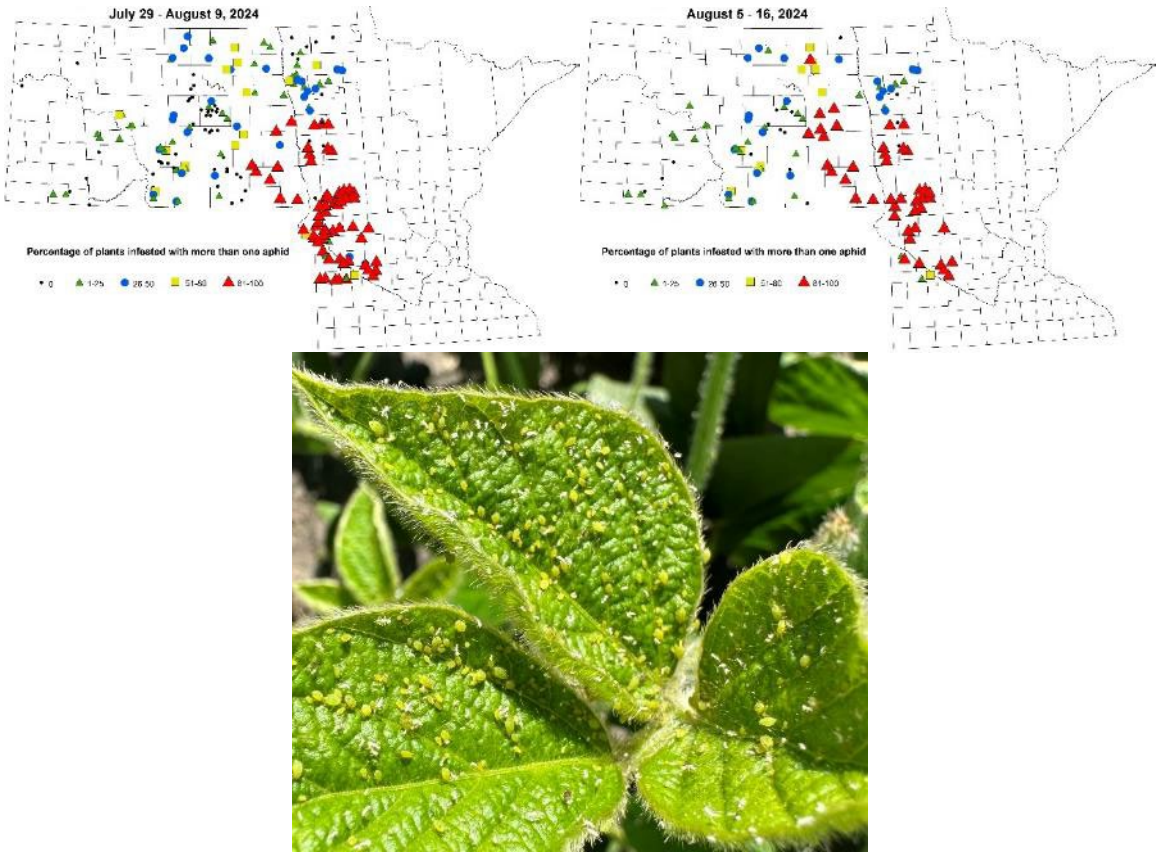
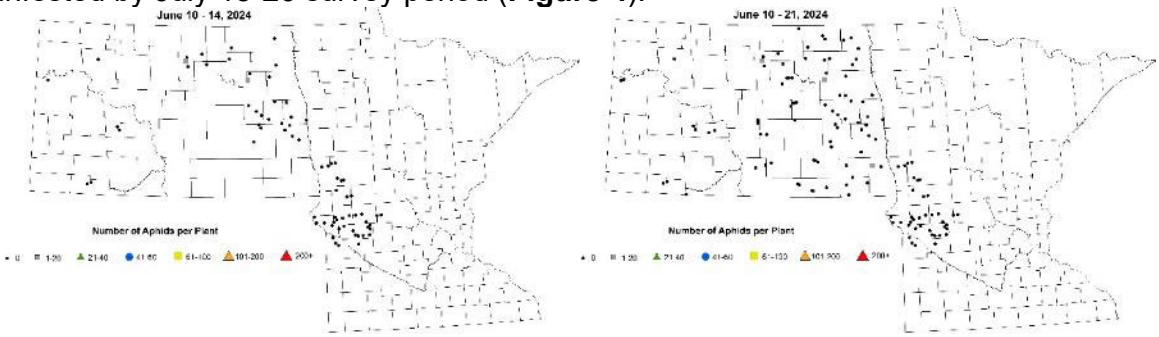


Figure 4. Soybean aphid incidence (percentage of plants infested) over two-week periods from June 10 to August 16, 2024. Soybean aphid infestation in NW MN in 2024, photo: Angie Peltier; Maps: NDSU IPM.

Soybean aphid. Soybean aphid (SBA) incidence, or the percentage of plants infested with SBA grew from zero plants infested during the Jul 8-19 survey period to 1-25% and up to 81-100% of plants infested by July 15-26 survey period (**Figure 4**).



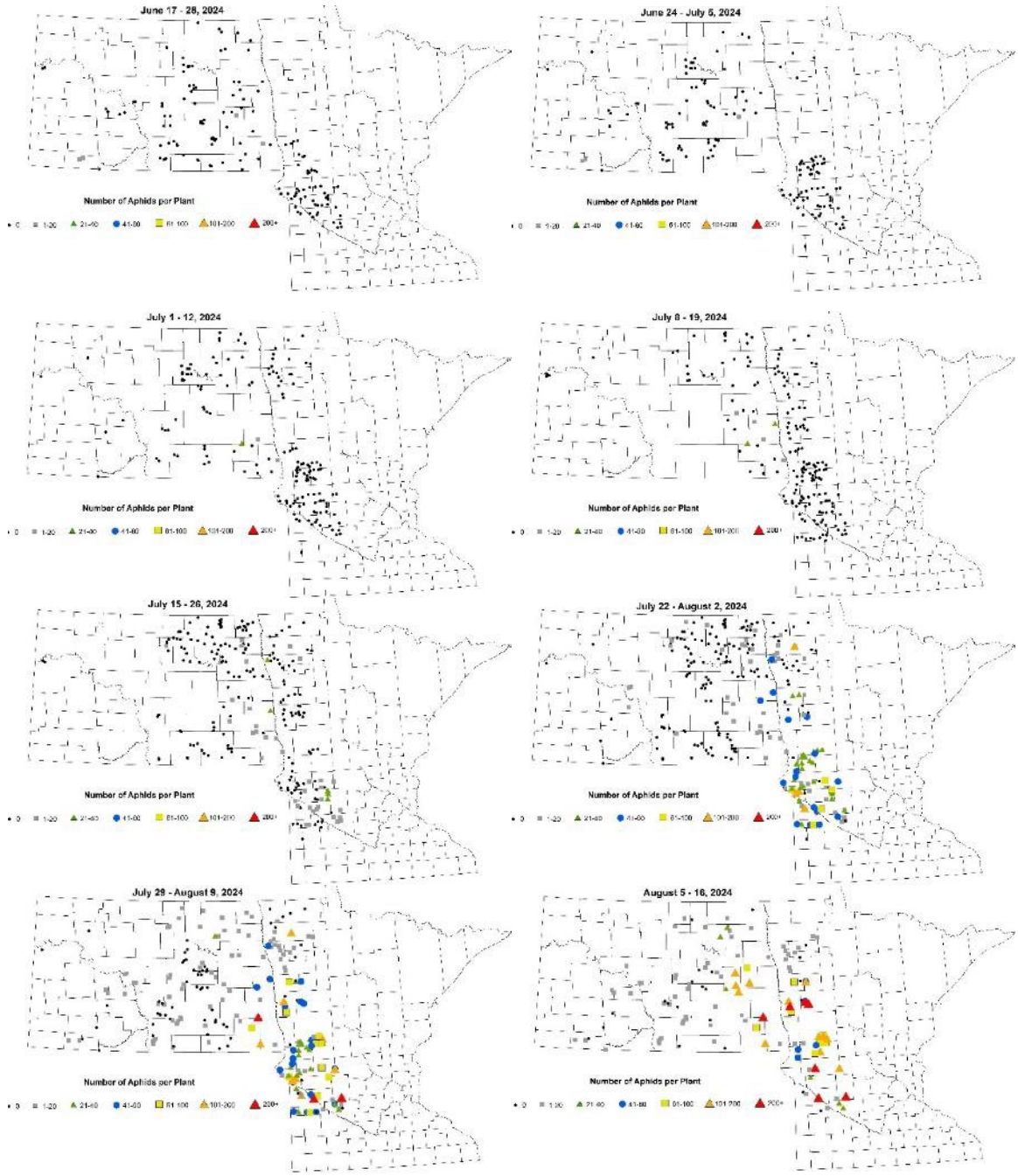


Figure 5. Soybean aphid (*Aphis glycines*) severity (number of aphids per plant) over two-week periods from June 10 to August 16, 2024; Maps: NDSU IPM.

SBA severity, or the average number of SBAs per plant also began to ramp up by mid-July, with multiple fields reaching treatment thresholds (more than 250 aphids per plant + aphids on more than 80% of plants + population densities growing) by the end of the survey period (**Figure 5**). Several fields reached treatment thresholds in both 2023 and 2024 after 3-years (2019, 2021 & 2022) in which no surveyed fields reached the treatment threshold. With 2024 turning out to be a 'good SBA year', possibly in part due to the warm 2023-24 winter, there were likely plenty of adult SBAs traveling to their overwintering host (buckthorn) to mate and lay eggs to find 2025 soybean fields.

For more information about soybean aphid scouting, treatment threshold and insecticide options, visit:
https://extension.umn.edu/soybean-pest-management/soybean-aphid.

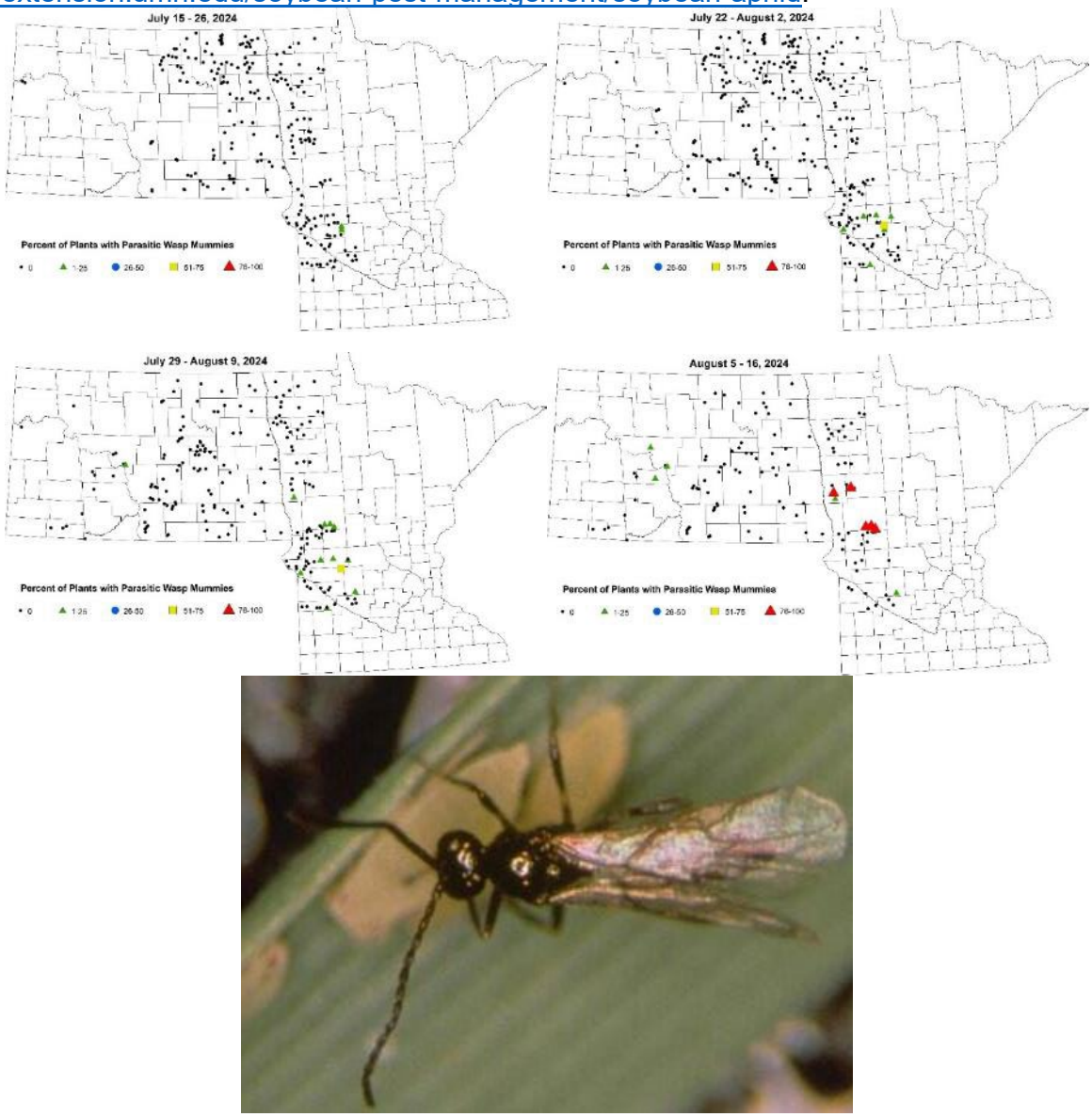


Figure 6. Percentage of plants with soybean aphids (*Aphis glycines*) that were colonized by parasitic wasps over two-week periods from July 15 through August 16, 2024; *Aphelinus* spp. colonizing an aphid, photo: Frank Peairs, Colorado State University, Bugwood.org. Maps: NDSU IPM.

Wasps parasitic to SBA. Several natural enemies of soybean aphids (SBA) are commonly observed in Minnesota, including Asian lady beetles/larvae, lacewings, pirate bugs and parasitic wasps. These insects can feed on SBA adults and nymphs and help to keep their population densities in check. Many of the insecticide active ingredients are effective against both SBA *and* these natural enemies. Careful scouting for both SBA and these natural enemies can ensure that one does not spray for SBA before treatment thresholds have been reached, unintentionally eliminating these natural enemies. Similar to in 2023, in 2024, natural enemies such as the *Aphelinus* spp. of wasp were slow to build to detectable levels in soybean fields as evidenced by

mummies, or infested SBA only being observed beginning in the middle of July (**Figure 6**).

For more info on natural enemies of SBA, visit: https://extension.umn.edu/soybean-pest-management/scouting-soybean-aphid#predators-and-parasites-of-soybean-aphid-1354514.

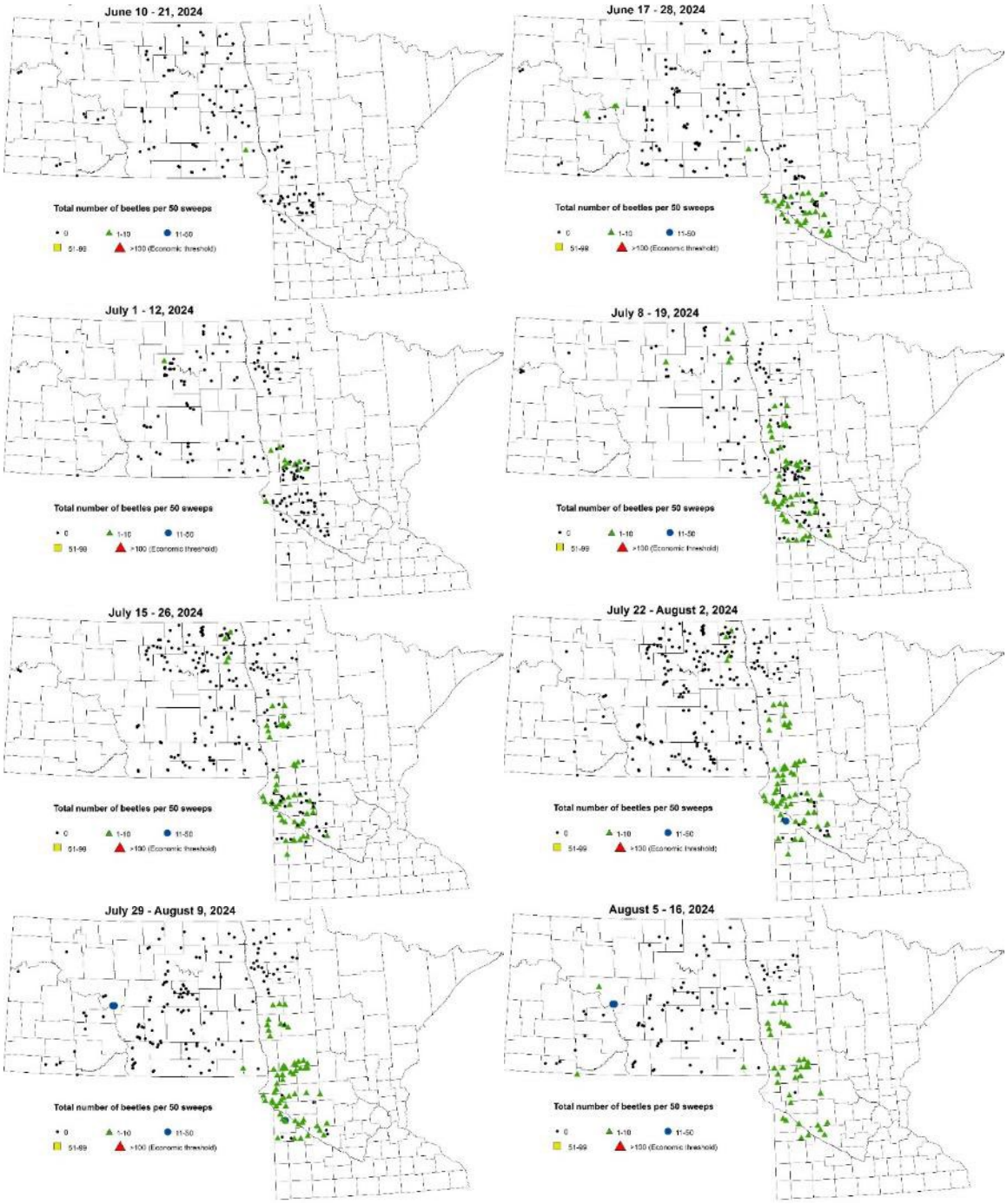
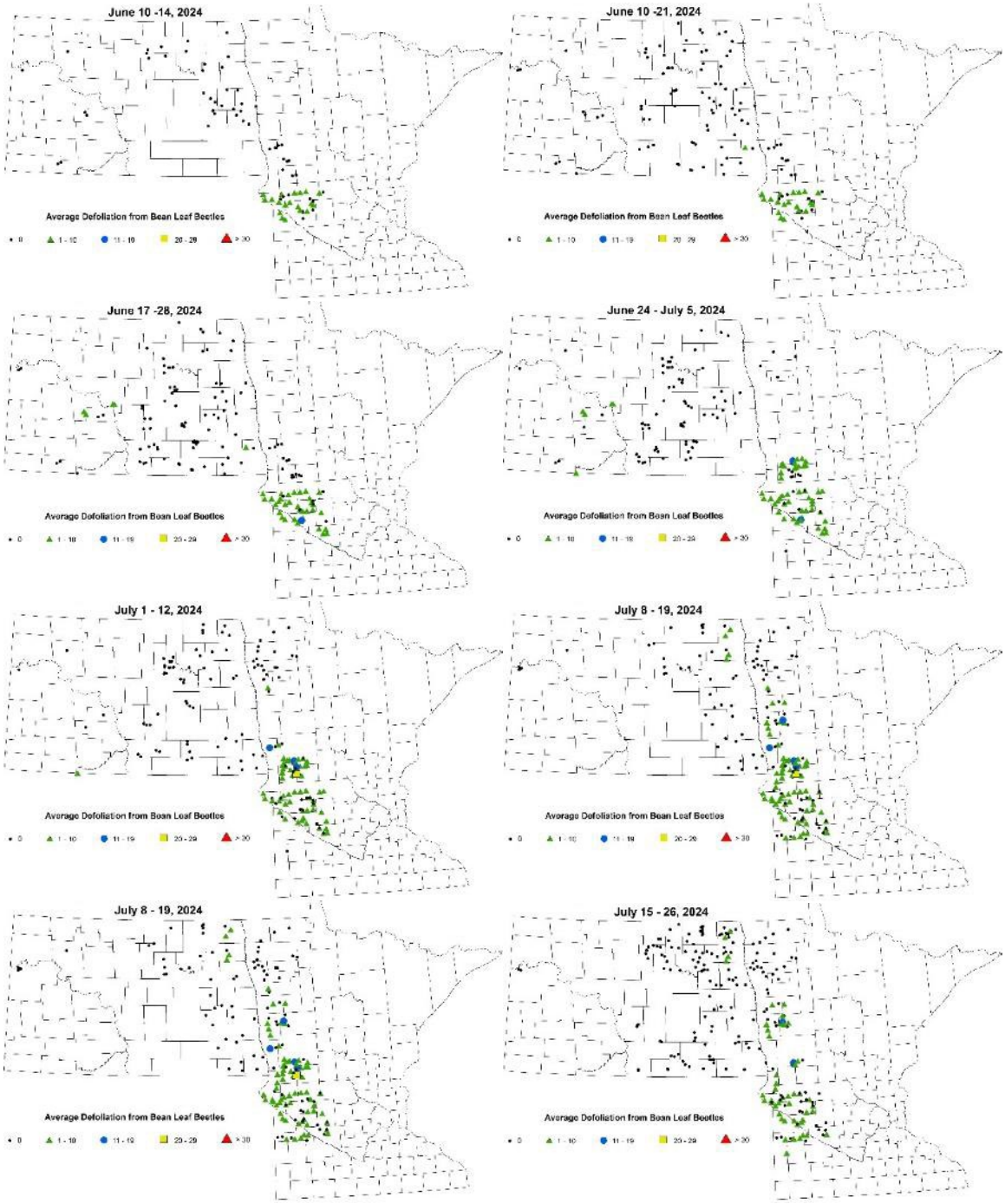


Figure 7. Number of bean leaf beetles (*Cerotoma trifurcate)* per 50 sweeps over two-week periods June 10 to August 16, 2024, Photo: Angie Peltier; Maps: NDSU IPM.



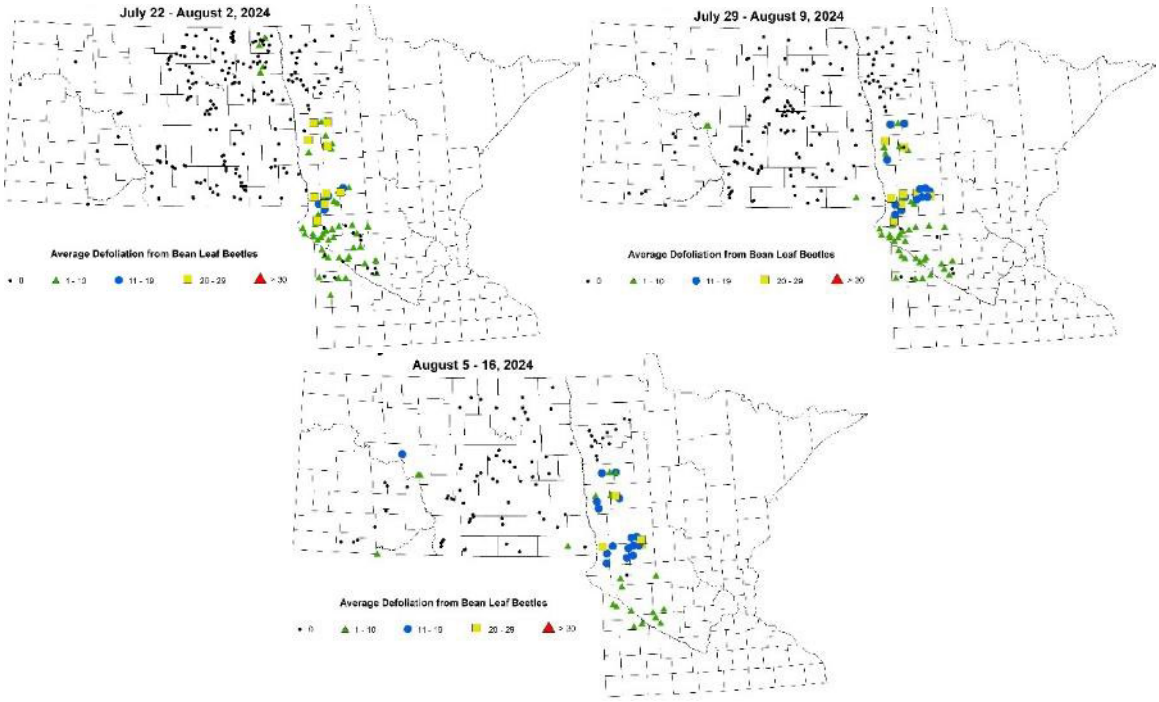


Figure 8. Average bean leaf beetle (*Cerotoma trifurcate)* defoliation injury over two-week periods June 10 to August 16, 2024; Maps: NDSU IPM.

Bean leaf beetle. Scouts used a sweep net to estimate bean leaf beetle (BLB) population densities and examined soybean leaves to estimate feeding injury. Severity of BLB infestations remained relatively low with all field locations in which they were detected having fewer than 11 beetles (**Figure 7**). UMN treatment thresholds are not based on BLB population density, but rather feeding injury plus continued presence of the beetles. Feeding injury as high as 20-29% defoliation was observed in multiple fields, primarily in WC MN in early July (**Figure 8**). Treatment thresholds are reached before flowering when beetles are present and defoliation is 30% or greater and between flowering (R1) and pod fill (R6) when beetles are present and defoliation is greater than 20% throughout the canopy.

For more information about bean leaf beetle, visit: https://extension.umn.edu/soybean-pest-management/bean-leaf-beetles.

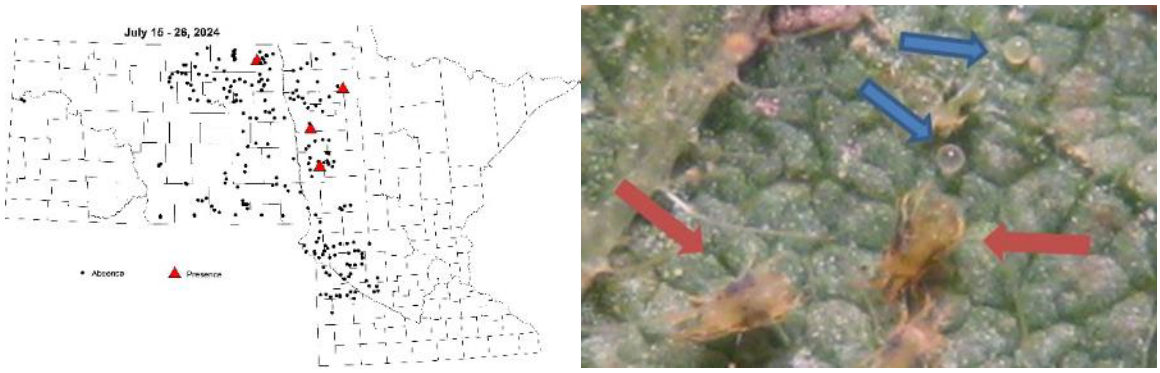


Figure 9. Presence of two-spotted spider mites (*Tetranychus urticae*) field edges (red triangle) over two-week periods July 15-26, 2024, Photo: two-spotted spider mites (red arrows) and their eggs (blue arrows), Angie Peltier; Maps: NDSU IPM.

Two-spotted spider mites. Scouts evaluated the presence (red triangles) or absence (black dot) of two-spotted spider mites (TSSM) on field edges (**Figure 9**) and inside fields. TSSM can first often be observed feeding on perennial plants outside of fields where they survive the winter. TSSM were present on the outside of scouted fields by mid-July in a handful of fields.

As the quality of the perennial plants outside the field declines, TSSM can begin to move into the field, using webbing to 'balloon' into the soybean field starting from field edges and progressing further into the field over time. The abnormally wet 2024 growing season during the scouting period resulted in few sightings of TSSM and no infestations meeting treatment thresholds in the survey period.

For more information about TSSM, visit:
https://extension.umn.edu/soybean-pest-management/managing-spider-mite-soybean.

For more information about managing the crop when both TSSM and soybean aphid are present, visit:
https://blog-crop-news.extension.umn.edu/2023/07/management-of-soybean-aphids-and.html.

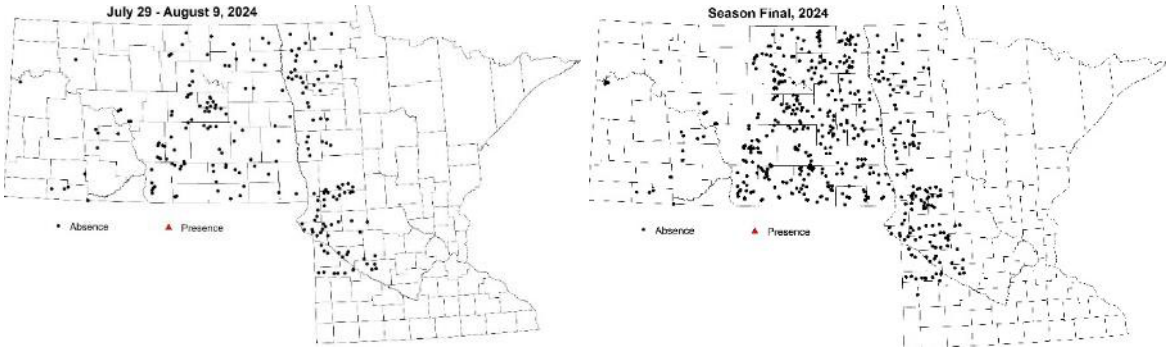


Figure 10. Soybean gall midge (*Resseliella maxima*) presence (red triangle) and absence (black dots) in scouted soybean fields July 29 - August 9, 2024 and season-long, Photo: soybean gall midge larvae, Bruce Potter; Maps: NDSU IPM.

Soybean gall midge. There were no sightings of soybean gall midge in any of the surveyed fields visited during the survey period in 2024 (**Figure 10**).

For more information about soybean gall midge, visit: https://extension.umn.edu/soybean-pest-management/soybean-gall-midge-minnesota-soybean.

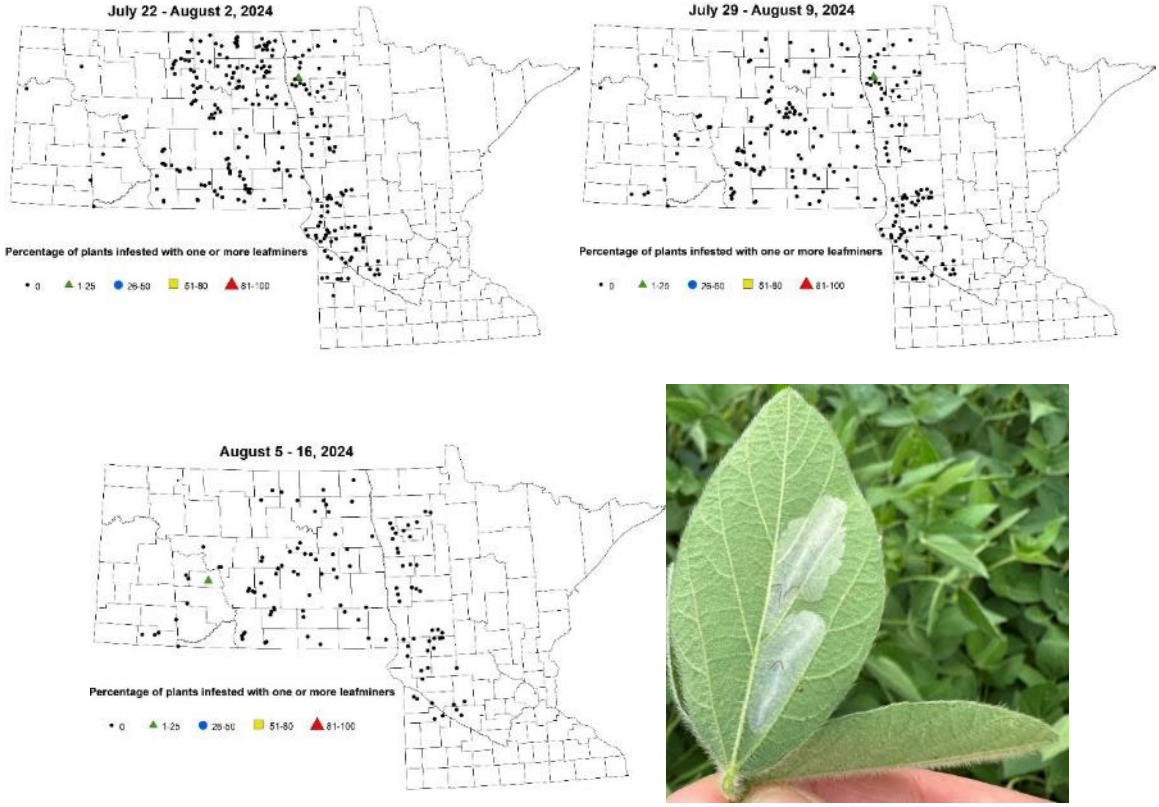


Figure 11. Soybean tentiform leafminer (*Macrosaccus morrisella*) presence (red triangle) and absence (black dots) in scouted soybean fields July 22-August 16, 2024, Photo: soybean tentiform leafminer mines, Angie Peltier; Maps: NDSU IPM.

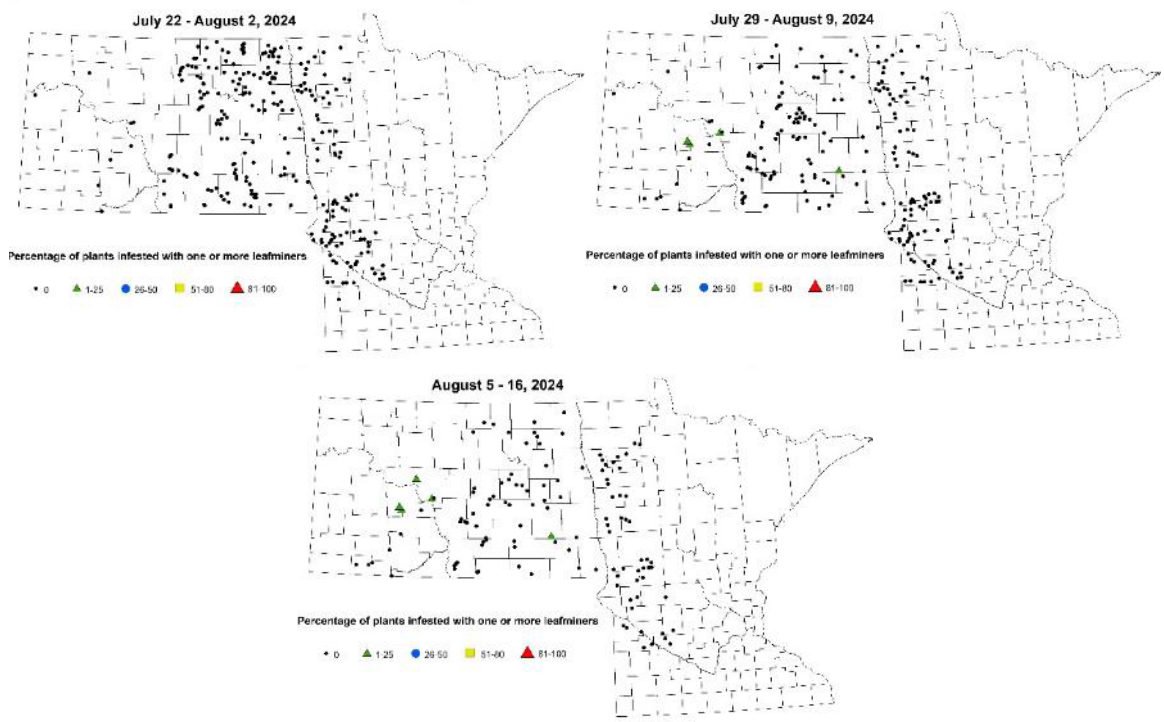


Figure 12. Soybean tentiform leafminer (*Macrosaccus morrisella*) presence (red triangle) and absence (black dots) on the edge of scouted soybean fields July 22 - August 16, 2024; Maps: NDSU IPM.

Soybean tentiform leafminer. While native to North America and a pest of two native legumes, American hogpeanut and slickseed fuzzybean, soybean tentiform leafminer (STL) was initially found feeding on soybean leaves in southeast Minnesota. Mined leaf tissue can reduce a leaf's photosynthetic area and if enough leaf area is affected (similar to injury caused by defoliating insects), yield loss will occur.

Scouts looked for mines on the underside of soybean leaves of plants both inside (**Figure 11**) and on the edge (**Figure 12**) of scouted fields. If the field had a wooded area adjacent to it, the soybeans closest to the wooded area were examined first. Only one surveyed field on the border of western Polk and Marshall Counties in NW MN was infested with STL (**Figure 11**). Other Minnesota surveys targeted specifically for STL have continued to find widespread presence. At least in 2024, populations likely were not large enough for widespread detection in this general pest survey.

For more information about soybean tentiform leafminer, visit: https://extension.umn.edu/soybean-pest-management/soybean-tentiform-leafminer-minnesota-soybean.

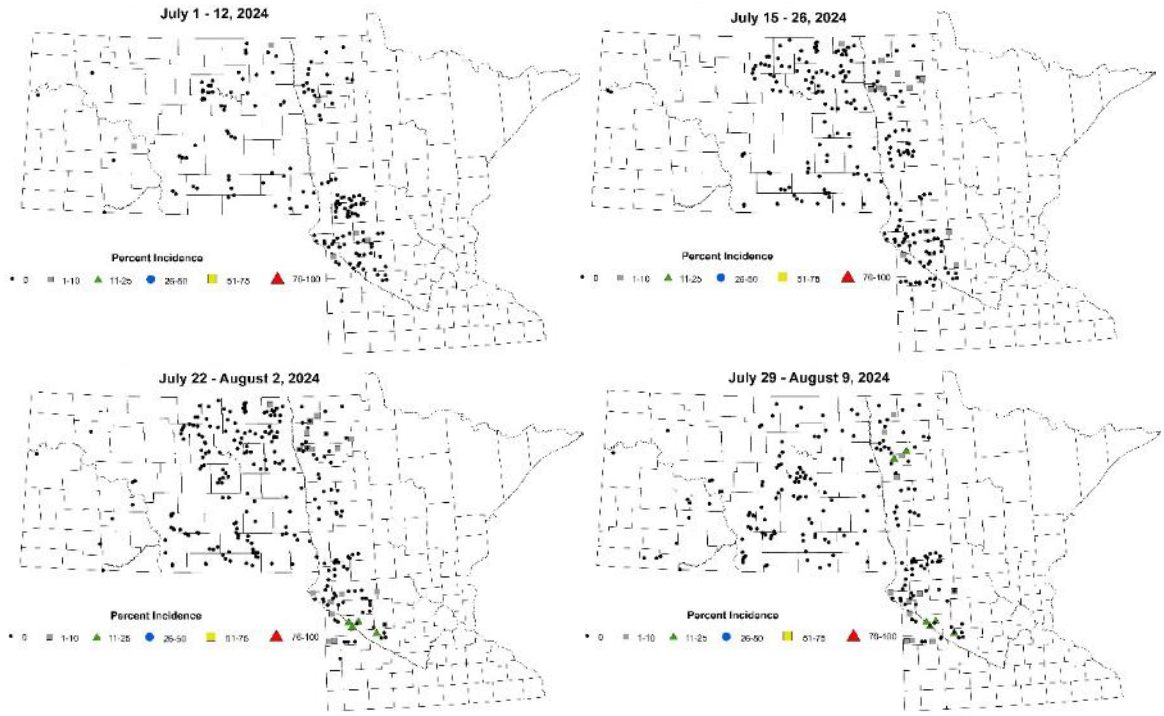


Figure 13. Incidence (%) of foliage feeding caterpillars in scouted soybean fields from July 1 through August 9, 2024. Maps: NDSU IPM.

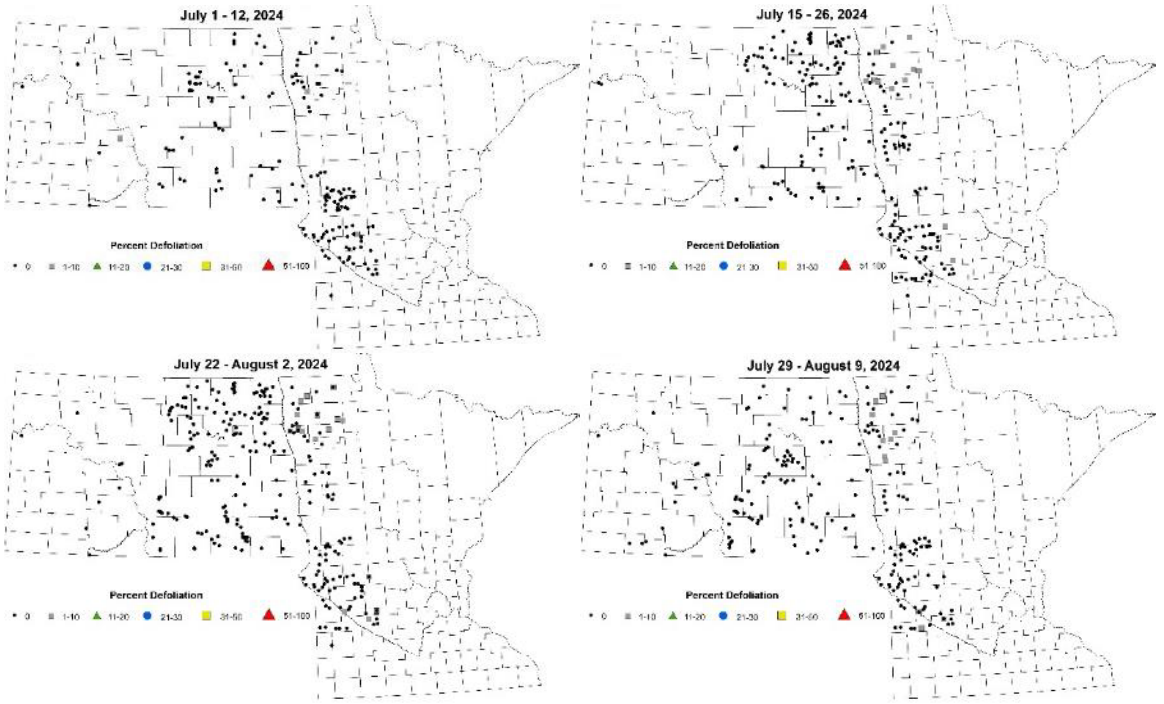


Figure 14. Defoliation injury (%) from foliage feeding caterpillars in scouted soybean fields from July 1 through August 9, 2024. Maps: NDSU IPM.

Foliage feeding caterpillars. Overall, there was low incidence of foliar feeding caterpillars (think green cloverworms & thistle caterpillars) in 2024 (**Figure 13**). This low incidence of caterpillars

resulted in feeding injury that fell below treatment thresholds (**Figure 14**, see discussion about treatment thresholds in the bean leaf beetle section).

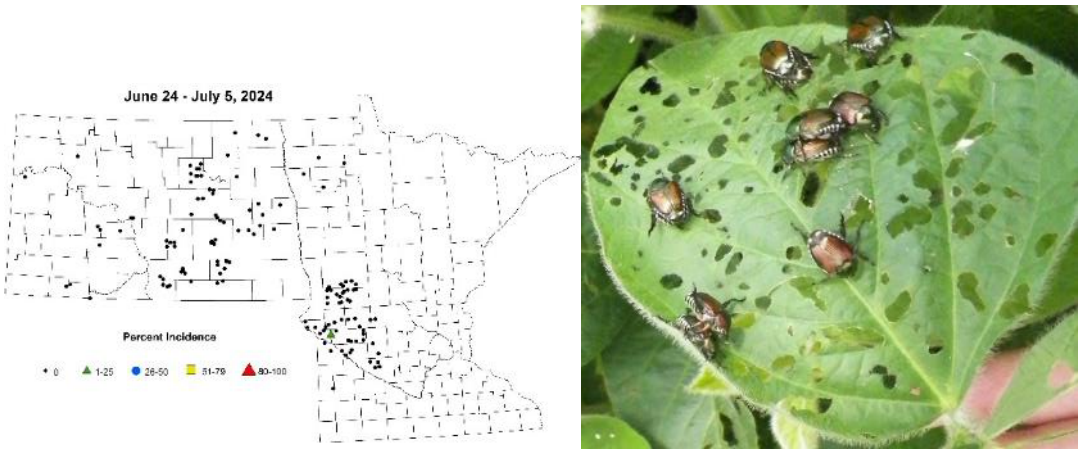


Figure 15. Incidence (%) of Japanese beetles in scouted soybean fields from June 24 through July 5, 2024, Photo: Japanese beetles, Angie Peltier. Maps: NDSU IPM.

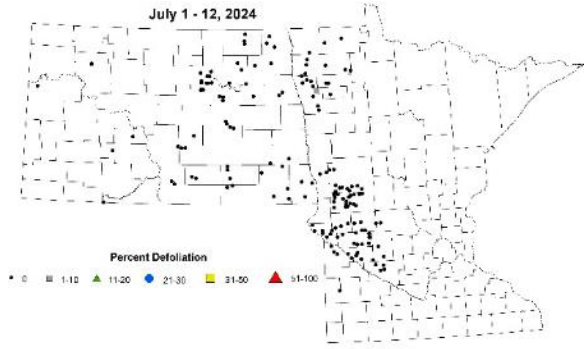
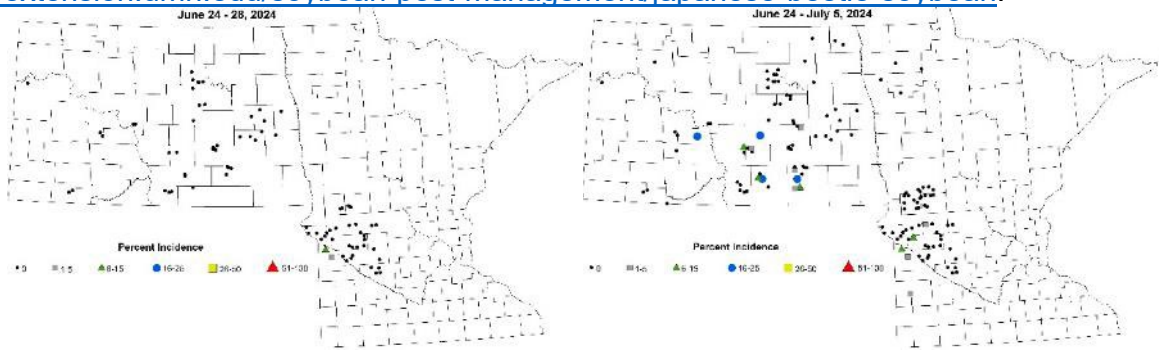


Figure 16. Defoliation injury (%) caused by Japanese beetles in scouted soybean fields July 1-12, 2024. Maps: NDSU IPM.

Japanese beetles. Only a single Japanese beetle infestation on the edge of Big Stone and Swift Counties was found in Minnesota during this survey (**Figure 15**). While Japanese beetles can easily reach defoliation-based treatment thresholds after becoming endemic in a region, the foliage feeding injury (**Figure 16**) observed and attributed to Japanese beetle in NW MN was very likely caused by another defoliating insect as this pest has not yet been found in Polk County.

For more information about Japanese beetle, visit: https://extension.umn.edu/soybean-pest-management/japanese-beetle-soybean.



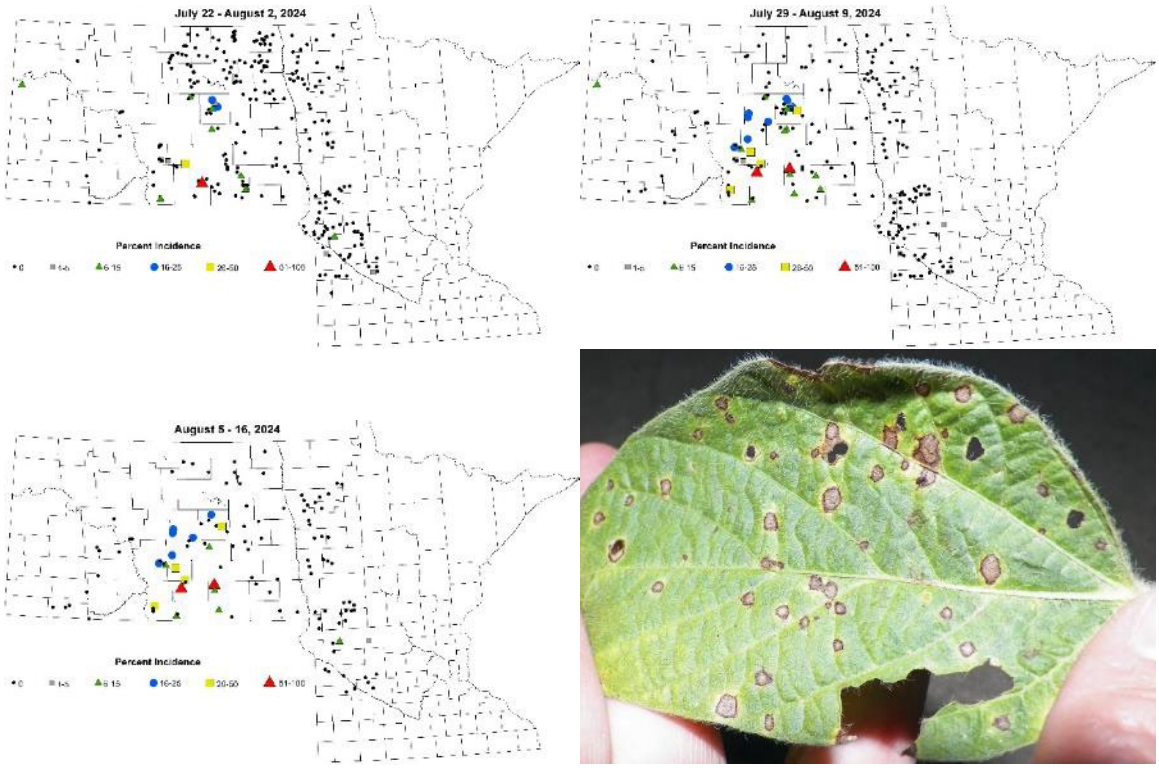
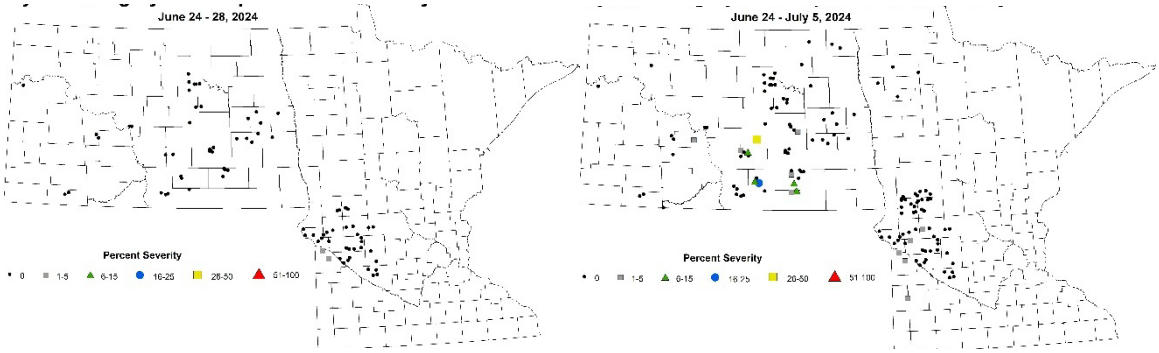


Figure 17. Incidence (%) of Frogeye leaf spot in scouted soybean fields June 24 - August 16, 2024, Photo: FLS lesions, Angie Peltier. Maps: NDSU IPM.



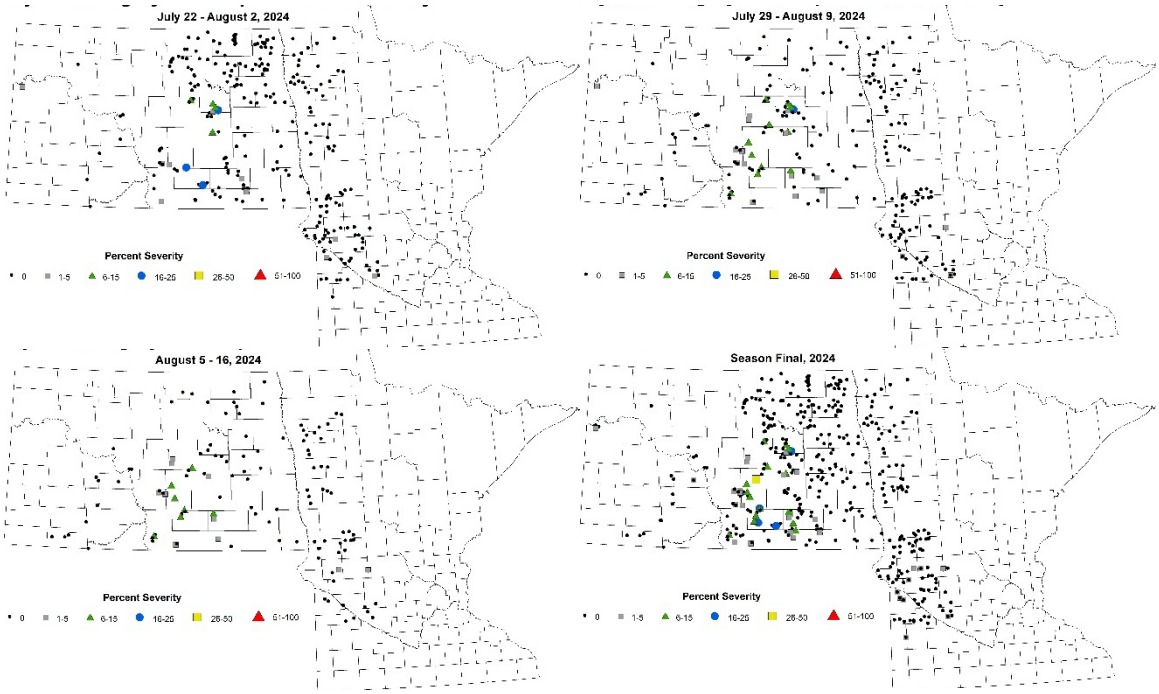
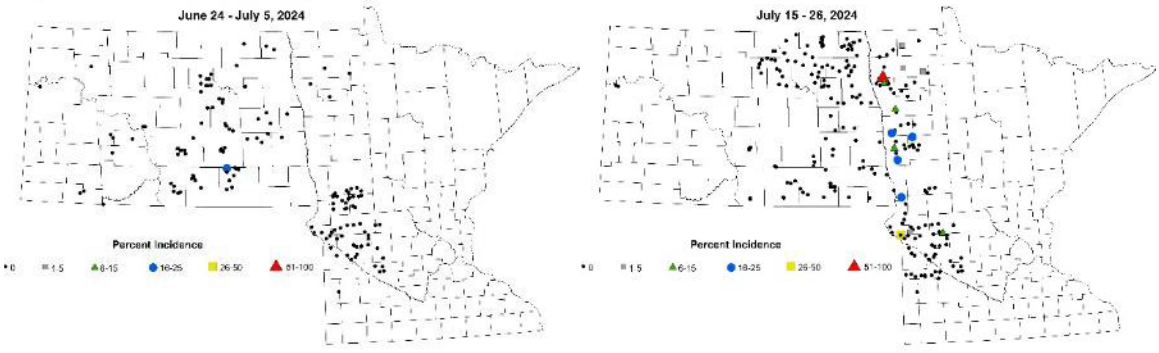


Figure 18. Severity (%) of Frogeye leaf spot in scouted soybean fields June 24 - August 16, 2024. Maps: NDSU IPM.

Frogeye leaf spot. Frogeye leaf spot (FLS) is a fungal disease of soybean favored by periods of warm weather and high relative humidity, conditions that are common in the southern half of Minnesota, but much less so in NW MN. The northernmost positive FLS infestation in Minnesota was found in Wadena County several years ago. There were several locations in the southern part of the survey range in 2024 that had FLS (**Figure 17**), although severity remained low overall (**Figure 18**).

For more information about frogeye leaf spot, visit: https://extension.umn.edu/soybean-pest-management/frogeye-leaf-spot.



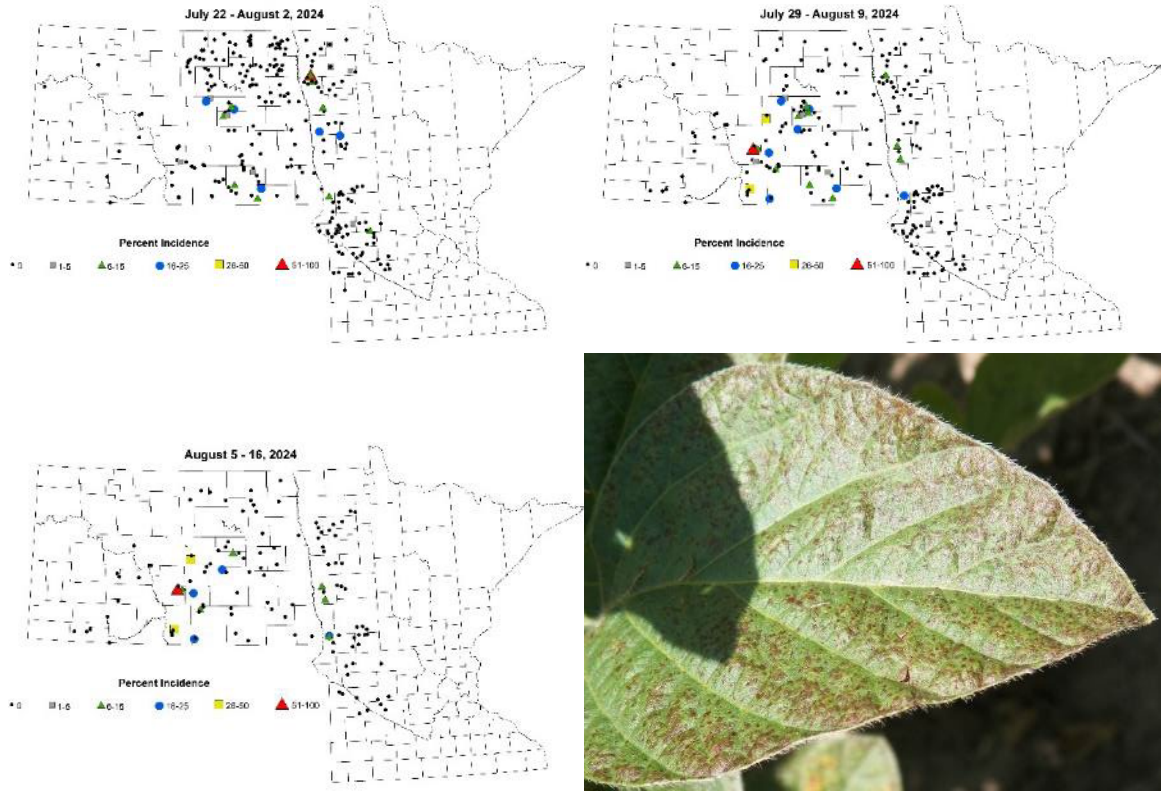
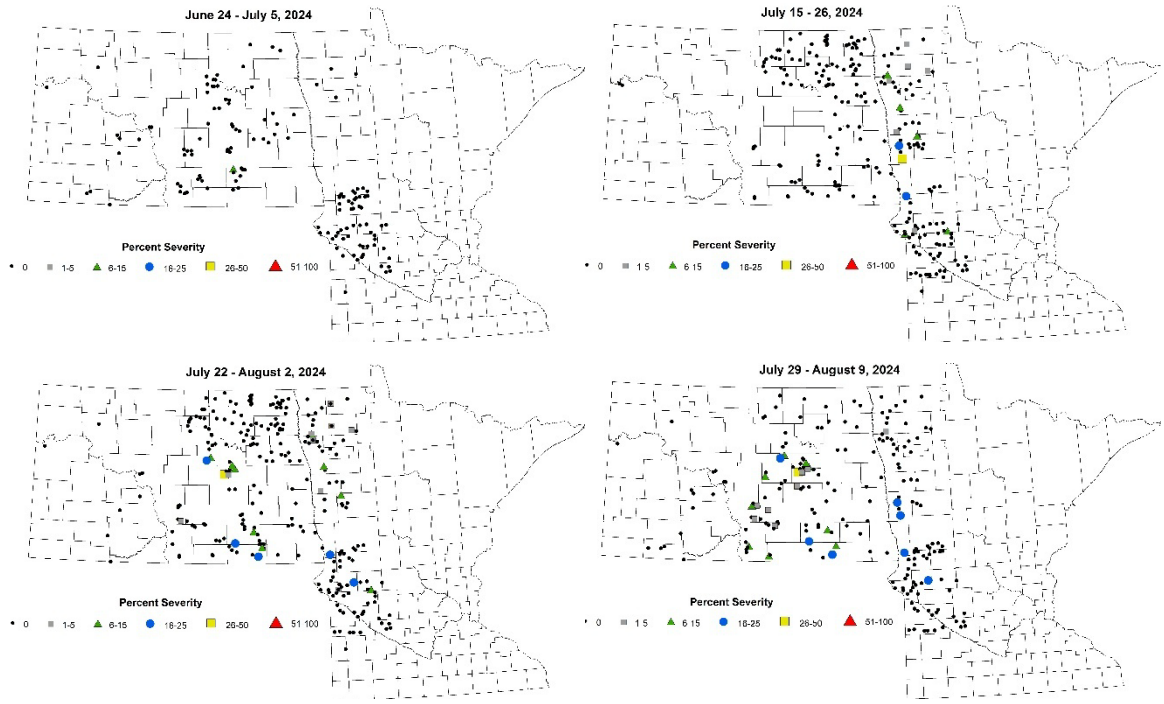


Figure 19. Incidence (%) of Cercospora leaf blight in scouted soybean fields June 24 - August 16, 2024: Photo: CLB, Angie Peltier. Maps: NDSU IPM.



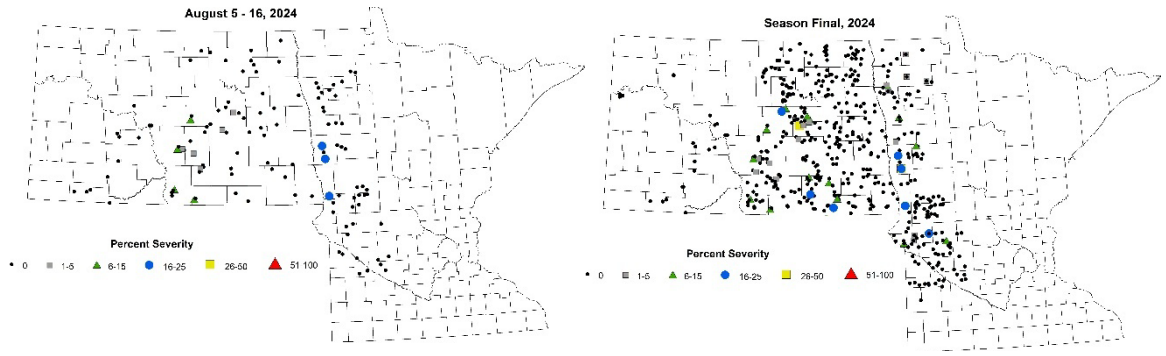


Figure 20. Severity (%) of Cercospora leaf blight in scouted soybean fields June 24 - August 16, 2024. Maps: NDSU IPM.

Cercospora leaf blight. Cercospora leaf blight (CLB) is caused by a fungal pathogen that has been observed throughout Minnesota for many years. Symptoms of CLB appear on the uppermost leaves and petioles of soybean plants as the pathogen produces a light-activated toxin; severe infections can lead to premature defoliation. CLB can also result in seed symptoms called purple seed stain when pods and seeds become infected.

For more information about Cercospora leaf blight, visit: https://extension.umn.edu/soybean-pest-management/cercospora-leaf-blight-and-purple-seed-stain-soybean.

Application/Use: The MSRPC-sponsored western IPM survey is essential to feed valuable pest incidence and severity information to UMN Extension specialists and regional educators (such as these authors) alike. This information is then used to provide timely research-based information regarding pest ID, scouting strategy, treatment thresholds and management. Local and regional radio interviews, digital and email newsletter articles shared on social media and webinars were all used during the 2024 growing season to share information gathered through this survey.

Materials and Methods: The MSRPC-sponsored IPM Survey was funded and conducted for the first time in 2015. UMN Extension continued this project in 2024 in coordination with similar efforts in North Dakota.

IPM scouts began the season scouting small grains fields, switching over to soybean fields mid-season. A total of 469 soybean fields were visited throughout the scouting season, resulting in several timely articles, webinars and radio interviews. Scouts collected data both inside and outside fields. Outside each field, grass areas that bordered fields were swept for grasshopper nymphs (**Figure 1**) and adults (**Figure 2**). Soybeans were inspected for growth stage (**Figure 3**), soybean aphid incidence (**Figure 4**), soybean aphid severity (**Figure 5**), presence of aphids colonized by parasitic wasps (**Figure 6**), number of bean leaf beetles (**Figure 7**) and the severity of chewing injury they caused (**Figure 8**), two spotted spider mite (TSSM) presence on the field edge (**Figure 9**) and inside fields, soybean gall midge presence (**Figure 10**), soybean tentiform leafminer presence within the field (**Figure 11**) and on the field edge (**Figure 12**), incidence of foliage-feeding caterpillars (**Figure 13**), percentage defoliation injury caused by foliage-feeding caterpillars (**Figure 14**), Japanese beetle incidence (**Figure 15**), percent of foliar injury caused by Japanese beetles (**Figure 16**), frogeye leaf spot incidence (**Figure 17**), frogeye leaf spot severity (**Figure 18**), Cercospora leaf blight incidence (**Figure 19**) and Cercospora leaf blight severity (**Figure 20**).

Economic Benefit to a Typical 500 Acre Soybean Enterprise: It has been several years since many farmers last saw threshold-level soybean aphid populations and so armed with the results of this IPM survey, the PIs were able to share with farmers how best to manage this pest given our current labeled pesticides. With pyrethroid-resistant soybean aphid populations still the norm, it is important to understand how using premixes with active ingredients from two different insecticide groups may impact both current management and the insecticide-resistance profile of soybean aphid populations. Premixes have multiple active ingredients combined often at lower than the label rates when each active ingredient (a.i.) is packaged on its own. When one of the a.i.'s is in the pyrethroid class of insecticides, the other tank mix partner is doing the 'heavy lifting' from a position of vulnerability. This is because lower rates of a single effective active ingredient puts tremendous selection pressure on the soybean aphid population to select out those individuals capable of surviving what would now be two different classes of insecticides. Having effective pesticides from multiple insecticide classes to control this damaging insect is essential for long-term, high-yielding soybean production in Minnesota and so is priceless.

Related Research: The 2024 soybean IPM scouts began the summer scouting wheat fields in western MN in a complementary survey. Look elsewhere in this booklet for a summary of the Minnesota Wheat Research & Promotion Council-sponsored Small Grains IPM survey.

Thank you: The authors would like to thank the 2024 IPM scouts, Katie Olson, Brett Barbeln and Logan Blanke for their hard work on behalf of western MN soybean producers. The NDSU IPM Crop Survey is supported by the Crop Protection and Pest Management Program - Extension Implementation Program, award number 2021-70006-35330 from the USDA National Institute of Food and Agriculture and is coordinated by Dr. Janet Knodel and Patrick Beauzay of NDSU Extension Entomology.