**Annual Progress Report, June 2020**

**Advancing Varietal Resistance to Soybean Cyst Nematode in Minnesota**

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**Objectives**

The objectives of this project and related accomplishments were as follows:

*Objective 1. Develop and deploy new DNA markers linked to genes conferring SCN resistance in order to enhance the efficiency and efficacy of breeding for SCN resistance and thus expand the availability of superior SCN-resistant soybean germplasm.*

During the summer of 2020, 15 new breeding crosses that included at least one parented specifically targeted for SCN resistance were made. All crosses were successfully made and F1 seed was sent to Chile. F2 seeds were returned in time for planting. The overall number of crosses this past year was reduced because of COVID restrictions placing limits on hiring and work schedules.

F2, F3, and F4 breeding populations previously targeted for SCN resistance were advanced successfully using winter and summer nurseries per standard operating procedures.

In the fall of 2020, we pulled over 4000 F4 plants from populations specifically developed for 88788 SCN resistance. One thing we did that was new this year was tag and genotype individual plants in the field on some populations. This allowed us to tell which exact plants to harvest with SCN resistance, saving resources in both the harvest and threshing. The seeds from these plants are growing in plant rows this year. We will expand this procedure in 2021 and hopefully apply it to all populations segregating for the major SCN resistance locus on chromosome 18.

All of our genotyping efforts help to enrich our breeding pipeline with SCN resistant germplasm. This is evidenced by the number of SCN resistant breeding lines we enter into regional trials. In 2020, we entered 38 advanced breeding lines. Twenty-eight of these lines were determined to in fact have resistant according to a greenhouse bioassay. The 10 lines that did not carries resistance were discarded. Many of the resistant lines performed well in terms of yield and overall agronomics. For example, M13-118036 was the highest yielding line across two years in the MG 0 regional SCN test. It is a RM 0.7 and beat the performance check, ND Dickey, by two bushels. It is also resistant to SCN, whereas ND Dickey is not. M13-118036 is undergoing purification in 2021. Another highlight is MCH13-104087, which carries solid SCN resistance and beat the check variety closest in maturity by five bushels. Breeder’s seed is being produced for this variety in 2021.

We are also striving to integrate SCN resistance into our specialty and food type varieties. For example, natto varieties have not typically carried SCN resistance, but with increased SCN pressure in natto growing regions, there has been more interest in this trait. We now have four new advanced breeding lines for which breeder’s seed is being produced in 2021: M13-170064, M13-171089, M13-172108, M13-172117. All of these lines are predicted to have SCN resistance based on molecular marker data. However, we will bioassay them in the greenhouse for the first time this summer to validate resistance.

We also released two new public varieties in 2020 with SCN resistance, MN0811CN and MN1807CN.

*Objective 2. Advance new sources of SCN resistance and expand the use of these new sources as parents for crossing in the breeding program*

During the summer of 2020, six successful crosses were made between adapted soybean varieties and breeding lines or exotic accessions carrying putative novel SCN resistance genes. New sources ranged from Peking sources, as well as some new sources from the germplasm collection that appear to be novel. The F1 seeds resulting from these crosses were sent to Chile for generational advance. F2 populations were successfully generated from these crosses and have been returned from Chile and planted in the St. Paul breeding nurseries for generation advancement.

Breeding lines developed from crosses with novel sources of resistance back in 2017 have been advanced to preliminary yield trials. From 1337 plant rows with novel resistance planted in 2020, we selected and harvested 587. Of these 138 were advanced to prelim yield trials at two locations and two replications. The remaining lines were also planted again in the plant rows field so we can perform genotyping to ensure that none were missed in the selection process.

Most importantly, advanced breeding lines carrying Peking resistance were again tested regional trials in 2020. These lines continued to perform well. We are making breeder’s seed of these lines in 2021. If performance continues to be good, we will create foundation seed in 2022. M13-250056 is particularly exciting, being a late MG 0, non-88788 resistant line. There are few choices up in northwest MN right now for these types of varieties. According to Bruce Potter’s list (<https://extension.umn.edu/soybean/soybean-variety-selection#variety-selection-1123610>), there is only one Peking-type variety in a MG 0, which is a 0.9.

Table 1. Advanced breeding line M13-250056 displayed high yield in MG 0 regional trials and resistance to HG Type 2.5.7. This line has the Peking source of resistance, whereas most others have the PI 88788 source of resistance and are susceptible to HG Type 2.5.7.



Table 2. Advanced breeding line M13-250046 displayed high yield in MG I regional trials and resistance to HG Type 2.5.7. This line has the Peking source of resistance, whereas most others have the PI 88788 source of resistance and are susceptible to HG Type 2.5.7.



*Objective 3. Conduct SCN bioassays on commercial varieties entering the 2020 UMN Variety Trials and publish the results through the MN Ag Experiment Station publications.*

Twenty-nine commercial varieties were entered into our 2020 SCN variety trials. This year all submitted varieties were found to be either resistant or moderately resistant to race 3. Quantitative differences can be observed, with some varieties showing extremely high resistance (FI = 0), and others showing weather resistance (FI = 20). The results can be observed in Table 15 the Variety Trials Reports found at <https://extension.umn.edu/soybean/soybean-variety-selection#variety-trials-1123611>.

A new activity this year was to identify all non-88788 SCN varieties currently on the market and test them with a bioassay using multiple SCN races to determine whether these varieties truly have broad spectrum resistance. A total of 67 varieties were identified using information seed catalogs, Bruce Potter, and Greg Tylka. These are predominantly Peking types, and ranged in relative maturity from 0.5 to 2.7. Most were a 2.0 RM or higher. The full list is presented below in Table 3.

We tried our best to obtain seed from these companies. In some cases, we just got no response. In others, seed was not available. One company decided to not provide seed for this test. In the end, we were able to secure seeds of just 13 commercial varieties. We tested these for resistance to race 1 SCN, which overcomes the 88788 sources of resistance. The results are presented in Table 4. Nine of the 13 varieties were either resistant or moderately resistant. Four varieties were determined to be either susceptible or moderately susceptible. This is despite the fact that they are advertised to be resistant to race 1 in seed catalogs. We are in the process of contacting these seed companies and will determine how to proceed with reporting. We want to get information to farmers, but also want to be respectful to the companies in how we present that information.

Table 3. List of commercially available non-88788 varieties that we attempted to acquire seed of. We were only able to secure 13 varieties.

Table 4. Resistance to race 1 SCN. Results from bioassay conducted at the Waseca SCN laboratory.

