Result summary for growers

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**Manipulating primary carbon metabolism to improve seed composition and yield – year two**

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Despite the importance of seed composition and yield in determining crop value, little is known about the genes responsible for controlling these traits. To be able to harness the power of molecular breeding approaches we need to identify the genes that are responsible for controlling seed yield and composition. Towards that end, we are making use of information obtained from studies on a model oilseed plant, *Arabidopsis thaliana*. Studies on Arabidopsis revealed that the *LUCI1* gene is a candidate to help regulate seed composition, and possibly yield, in Arabidopsis. To test whether *LUCI1* affects seed yield or composition in soybean, it was transformed into soybean.

During the summer of 2018 we conducted a field test of our LUCI1 transgenic soybean lines, plus the parental line from which the transgenic lines were generated. We grew 15 plots of each of eight different soybean lines that carry the Arabidopsis LUCI1 gene. We also grew 45 plots of the non-transgenic soybean line from which the transgenic lines are derived. At the end of the growing season mature seeds were harvested and weighed separately for each plot. This data was then used to calculate the average weight of seeds produced per unit of plot area for each soybean line. Analysis of this data showed that three of the LUCI1 soybean lines had statistically significant increases in seed yield per unit plot area, relative to the non-transgenic control line. In addition, during the growing season we collected developing seeds from plants in each plot. We analyzed samples of some of these developing seeds to measure LUCI1 activity levels in the developing seeds. Comparison of these results revealed that seed lines that had moderate levels of SIS8 activity exhibited the highest seed yields.

We also measured seed composition in the LUCI1 transgenic lines and the non-transgenic control line. These analyses showed that five of the eight LUCI1 lines tested had statistically significant increases in seed protein levels, relative to seeds from the non-transgenic control plants. These increases in seed protein levels ranged from 1.4 to 2.4%. In other words, the seeds harvested from non-transgenic plants had seed protein levels of 40.1% on a dry weight basis, as compared to 40.7-41.1% for the five best LUCI1 transgenic lines. One LUCI1 transgenic line also exhibited a statistically significant increase of 1.9% in seed oil content, with the transgenic line having 19.2% oil, as compared to 18.8% for the non-transgenic line.

Going forward, we plan to study the mechanism(s) by which LUCI1 affects seed yield and composition. We also want to test the reproducibility of these results in other parts of Minnesota and to introduce the LUCI1 gene into an elite Minnesota variety.