Soybean Variable Rate Seeding Simulator

User Manual

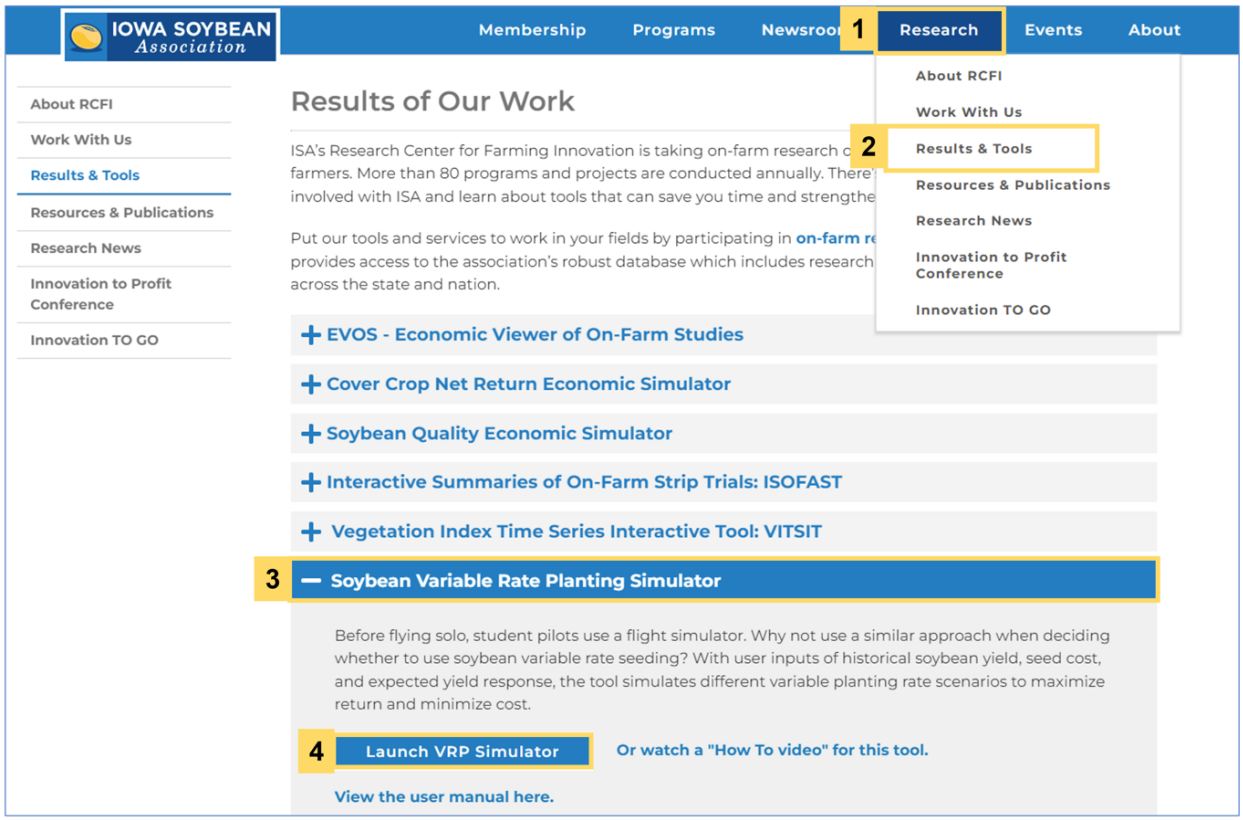


Figure 1. Accessing the Simulator on Iowa Soybean Association website.

Accessing the Simulator

Go to the Iowa Soybean Association website.

www.iasoybeans.com

Select Research -> Results & Tools -> in the Results of Our Work section find -> Soybean Variable Rate Seeding Simulator and then click the blue "Launch VRS Simulator" button.

You will then be redirected to: analytics.iasoybeans.com/cool-apps/SoybeanVRPsimulator/

Uploading & Aggregating Yield Data

NOTE: Sample data is pre-loaded in the simulator. In order to process data for their own fields, users must have access to three, individual years of geo-spatial soybean yield data for the same

field in shape file format (.shp, .shx, .dbf, .prj), which can be exported from applications such as AgLeader SMS, MyJohnDeere or other yield collecting or processing software. Label each of the three shape files including the crop year. Place all three years of yield data into a single folder and "Zip" the file, by right clicking on the folder > send to > compressed zipped folder. Note: the yield maps included in the zip file must be projected in World Geodetic System 1984 (EPSG: 4326 - WGS84) as spatial reference system.

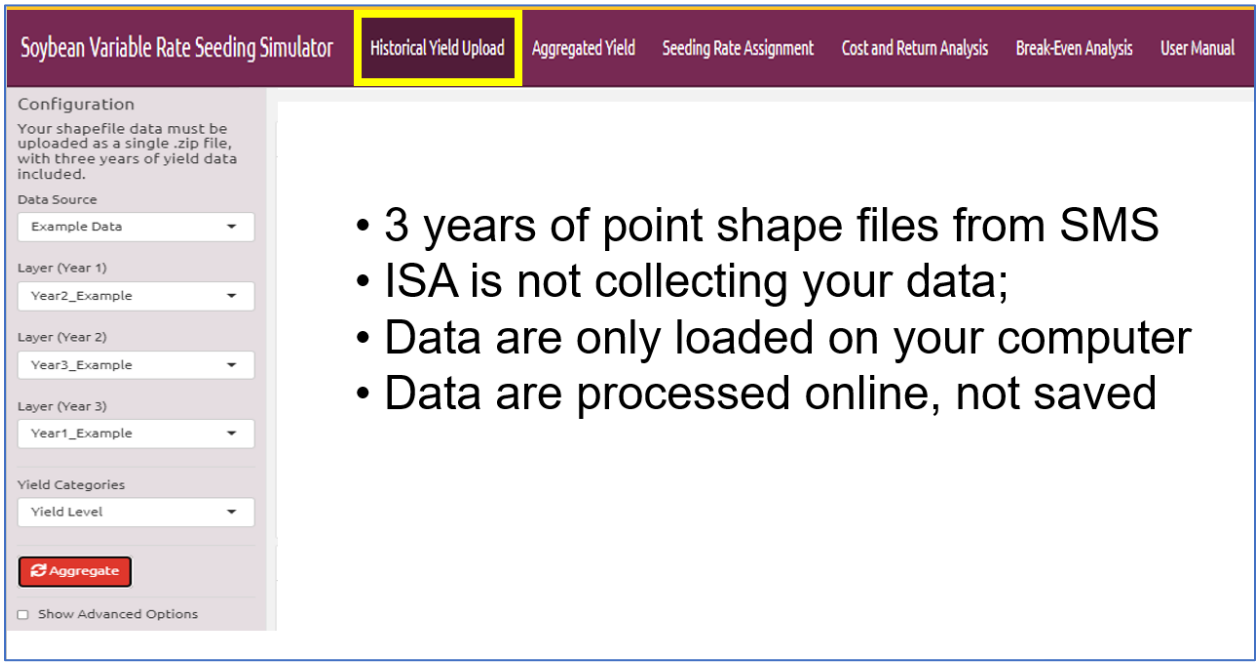
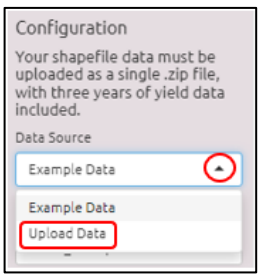


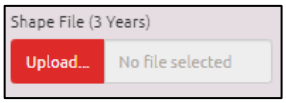
Figure 2. Upload interface for historical yield data.

By default, the tool automatically displays an example using an anonymous field for illustration purposes (Figure 2) that allows users to explore the tool features and usability without first requiring an upload of the user's own yield data.

To Preserve data privacy, the tool does not collect or store any yield or spatial coordinates from user files, but simply processes data "on-the-fly", meaning that when you exit the application, your data exits with you. To view it in the application again, it will be necessary to upload it again.



Step 1. On the left side navigation panel, click on the "Example Data" dropdown and select "Upload Data". An upload button will appear.



Click the red "Upload" button to navigate to and select the zipped folder containing your yield files, then click "Open"
The tool will then begin uploading the yield data.
The bar below "Browse…" will indicate when the Upload is complete

Step 2. Once upload is complete, select "**Aggregate"**

A popup box in the bottom right corner will appear indicating that aggregation is occurring. When finished, the raw and aggregated yield data will appear.

Optional. Show Advanced Options

The user can adjust the grid size and number of points within each grid.

Step 3. Yield Categories

Yield Level: Selecting this option will group the aggregated yield data into three absolute yield categories based on average Iowa statewide soybean yield (USDA-NASS, 2020).

Low (Less than 52 bu/ac)
Medium (52-63 bu/ac)
High (greater than 63 bu/ac)

Yield Stability Zone: Selecting this will group the aggregated yield data in categories Q1, Q2, Q3, and Q4 which are determined by the average yield relative to the whole-field yield and its temporal standard deviation(SD) relative to the field average temporal standard deviation based on the Kharel et al., 2019 method.

Q1: below mean yield and below mean SD, Low Yield, Stable

Q2: below mean yield and above mean SD, Low Yield, Unstable

Q3: above mean yield and above mean SD, High Yield, Unstable

Q4: above mean yield and below mean SD, High Yield, Stable

Click on the "Aggregated Yield" tab in the navigation bar at the top of the application to view the compiled yield data. From this tab you can also export a csv file of the aggregated data from the field.

Figure 3. Aggregation of historical yield data using yield level option: low, medium, and high.

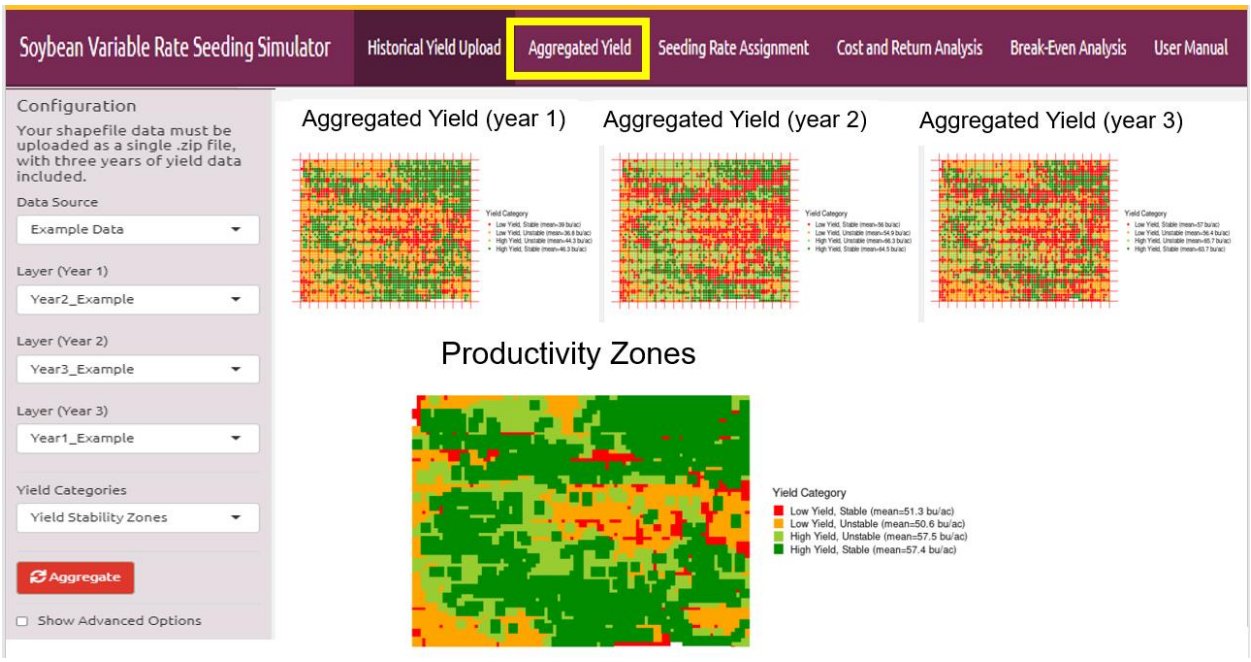


Figure 4. Aggregation of historical yield data using the yield stability zone option: Low Yield Unstable, Low Yield Stable, High Yield Unstable and High Yield Stable.

Aggregated Yield

Export Aggregated Data: There is an option to export the generated aggregated map as a .csv file. Exported headings include: Grid ID, X & Y coordinates, Yield, Yield SD, and Yield Group. This allows the user to conduct additional analyses outside the scope of this simulator.

Seeding Rate Assignment (sd/ac)

Step 4. Select the seeding rate Assignment tab in the top menu bar

There are three Common Uniform Seeding Rate (CUSR) data sources to **choose** from:

1) *ISU Data Source*

This data source allocates seeding rate recommendations according to Iowa cropping district. This data source applies recommendations from an Iowa State University published study, *DeBruin et al. 2008*

2) *Midwest Data Source*

This data source applies recommendations from a midwestern seeding rate study, *Carciochi et al. 2019*

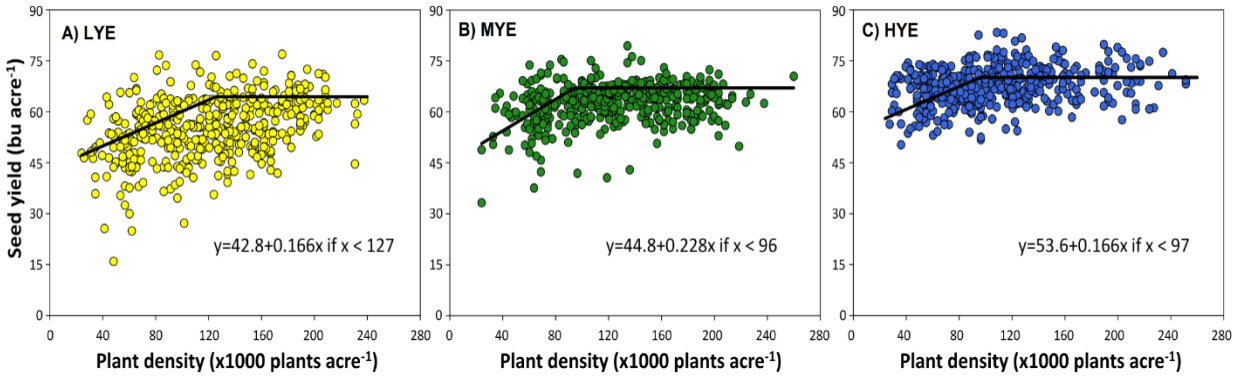


Figure 5. Relationship between seed yield and plant density for low (LYE, <59.6 bu acre^{-1}, A), medium (MYE, 59.6-64.1 bu acre^{-1}, B), and high yield environments (HYE, >64.1 bu acre^{-1}, C) from Carciochi et al., 2019 on-farm studies across Midwest, including Iowa.

3) *User Defined*

This data source employs a user indicated seeding rate. This is intended to be the common seeding rate that has been applied to this field in the past.

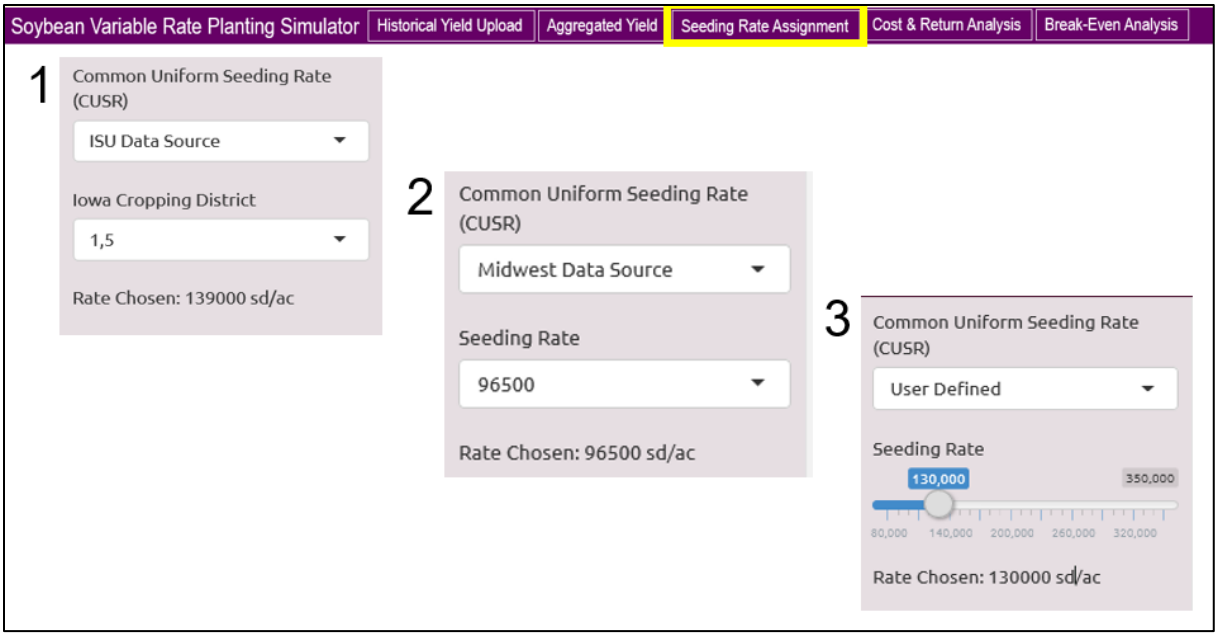


Figure 4. Options for selecting common uniform seeding rates.

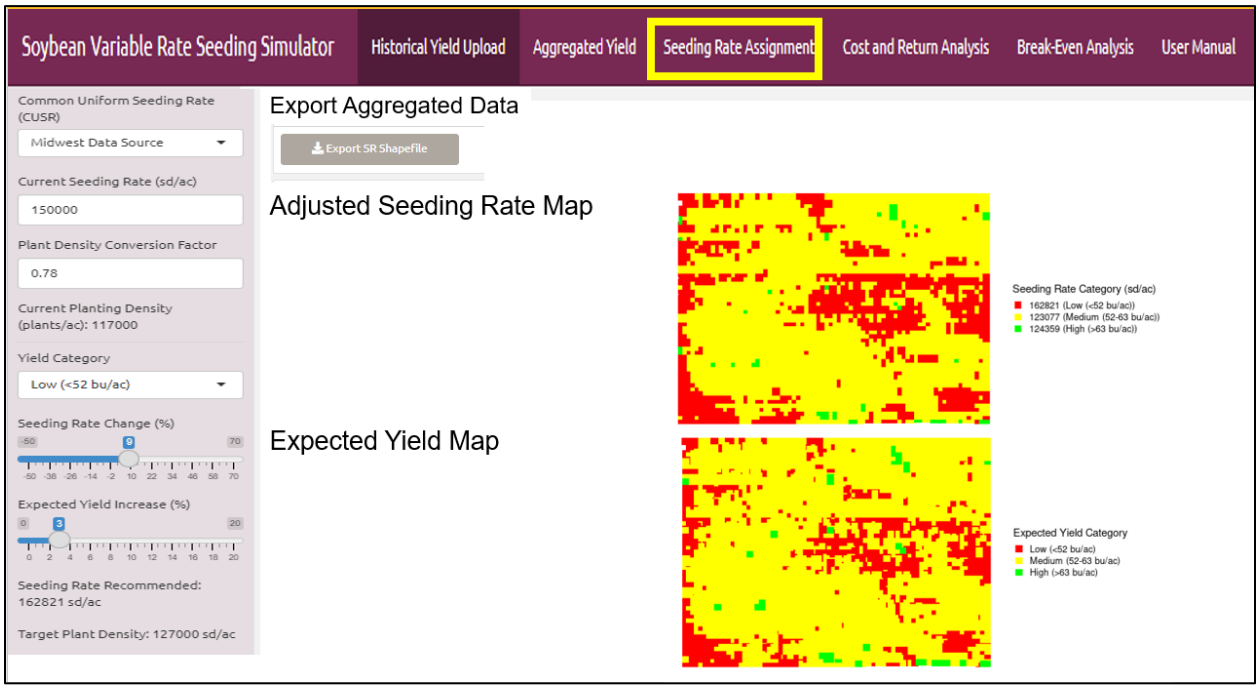


Figure 6. Seeding rate assignment for Yield Level Classification using the Midwest Data Source (*Carciochi et al. 2019).*

Figure 7. Seeding rate assignment for Yield Stability Classification using the Midwest Data Source (*Carciochi et al. 2019).*

For the yield level classification, the recommendations are based on plant density targets of 127,000, 96,000, and 97,000 plants/acre, for Low, Medium, and High yield environments, respectively (*Carciochi et al. 2019)*. For the yield stability classification, the recommendations are based on plant density targets of 127,000, and 97,000 plants/acre, for Low-Stable, and High-Stable yield environments, respectively; while a compromise solution of 112,000 plants/acre is recommended for both Low-Unstable, and High-Unstable yield environments

Variable rate seeding prescription can be exported using the Data Export option on the Seeding Rate Assignment Tab (Figure 6 and 7).

<u>Cost and Return Analysis</u>

Step 5. Input economic variables to run the cost and return analysis.

Select which yield category to adjust seeding rates (**Low, Medium** or **High**)
Input a grain price ($/bu).
Input seed cost per bag (140,000 seeds/bag)
Seed cost per acre will be populated based on the cost per bag

Expected Yield Gain in Selected Yield Category

- The simulator will calculate approximate field size.
- The simulator will calculate approximate size (ac) and average yield (bu/ac) of the selected yield category.

- Applying the economic variables, the simulator will calculate the expected yield gain or loss in the selected yield category.

Additional Seed Cost

- The simulator will calculate the additional or reduced cost (ac) due to the adjusted seeding rate using the input seed cost and CUSR.

Potential Profit for Selected Yield Category

- The simulator will subtract the Additional Seed Cost from the Expected Yield Gain in Selected Yield Category, then multiply by the total yield category area.

Potential Profit for Whole Field

- The simulator calculates whole field profit per acre by dividing the Potential Profit for Selected Yield Category by the whole field area.

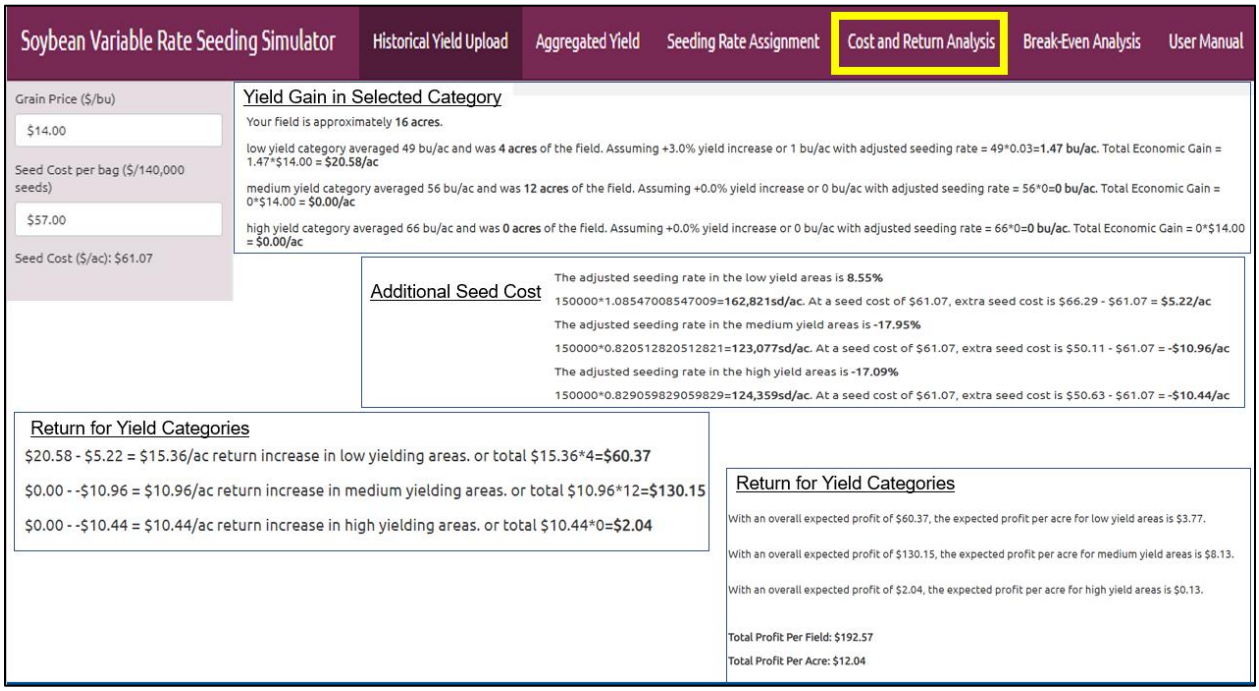


Figure 8. Example of Cost and Return Analysis

<u>Break-Even Analysis</u>

This analysis indicates the minimum return necessary to pay for using variable rate technology.

Step 6. Adjust economic variables:

Enter soybean grain price ($/bu)

Enter costs associated with using variable rate seeding technology

Add an item for each cost: Equipment, hardware, software, time, Rx development, advisor

Enter total estimated cost of soybean production, ***<u>excluding</u>*** seed costs.

Note: This will default using ISU estimates

Break-Even Yield Response

- The simulator will indicate the needed yield increase to justify the additional cost associated with variable rate seeding.

Break-Even Soybean Cost or Price

- The simulator will calculate the necessary soybean price to cover the cost of variable rate seeding and total production costs.

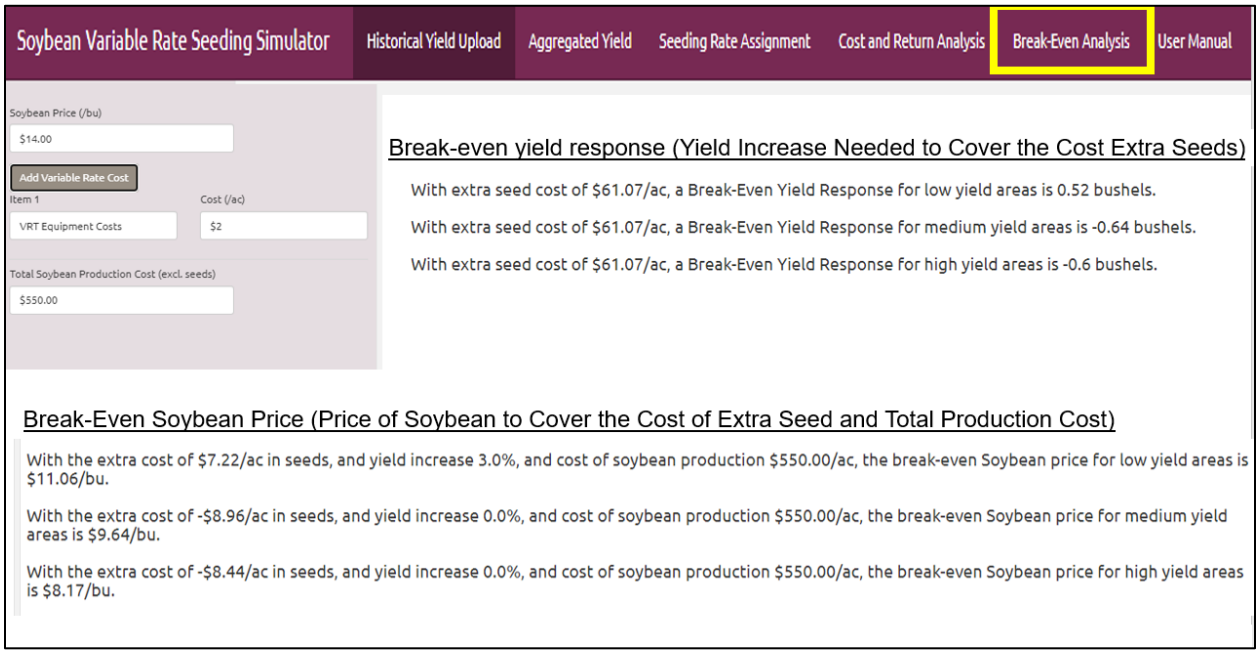


Figure 8. Example of Break-Even Analysis

Simulator Value

Simulation-based decisions can be a way for farmers and advising agronomists to build knowledge and skills while not exposing their customers, farm, or crop to any unnecessary risks. Simulation-based scenarios can be a platform which provides a valuable tool in learning to mitigate economic and practical dilemmas. Simulation-based training techniques, tools, and strategies can be applied in designing learning modules, as well as be used as a measurement tool to establish realistic economic and agronomic objectives and outcomes.

References:

Carciochi, W.D., Schwalbert, R., Andrade, F.H., Corassa, G.M., Carter, P., Gaspar, A.P., Schmidt, J. & Ciampitti, I.A. (2019), Soybean Seed Yield Response to Plant Density by Yield Environment in North America. *Agron. J.*, 111: 1923-1932. https://doi.org/10.2134/agronj2018.10.0635