IOWA SOYBEAN ASSOCIATION RESEARCH UPDATE

Dynamic tool empowers farmers with interactive visual summaries of on-farm replicated strip trials

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"I don't have 50 years of experience. I have one year of experience 50 times." – A soybean farmer

Background

Every time a farmer grows a crop, the interaction of genetics, management and environment result in a unique outcome—yield. Yet more effective ways of making agronomic decisions still need to be developed. How can a farmer learn from previous growing seasons? How can the data from on-farm trials be turned into actionable options? How do we make better decisions for the future? Iowa Soybean Association (ISA), in collaboration with the Iowa State University (ISU Agronomy Department, have developed a web-based resource to answer questions about the effect of different treatments and practices on yield gain observed in their agronomic on-farm replicated strip trials.

There is a critical need for soybean research data to be shared among private and public institutions so that its maximum value can be realized by farmers, agronomists and researchers. Small plot research, typically conducted by industry and universities, has not always adequately represented the range of conditions observed in producers' fields. Through recent advancements in technology – such as yield monitors that enable farmers to easily and accurately measure yields – on-farm replicated strip trials have become common. These trials evaluate different practices and products in plant nutrition, disease management, weed and pest control, and crop management such as plant population, tillage or row spacing.

A significant amount of data is being accumulated from on-farm replicated strip trials by farmer networks, some of which partner with university and private researchers across the Midwest. The results of these on-farm trials are usually presented as individual reports showing strip averages and other basic information like field management and weather. Examples of these individual trial reports can be viewed using the ISA On-Farm Network® report database of individual trials http://www.isafarmnet.com/onlinedb/. Within the database trials can be sorted by year, crop, trial category or landform area. This historical trial data provides an outstanding resource from which to develop knowledge-based decision-aid tools.

What is ISOFAST?

Interactive Summaries of On-Farm Strip Trials (ISOFAST) is a web-based interactive tool designed to visualize and summarize data from on-farm replicated strip trials conducted by farmers working with ISA. To better summarize and communicate findings from on-farm replicated strip trials, ISA-ISU developed ISOFAST to:

- Display basic information regarding study objectives, trial locations, field management and weather.

- Provide exploratory dynamic graphics that allow for a quick assessment of the treatment effects on yield response and overall effectiveness of management practices and products.

- Compare an alternative practice and a standard practice using a percentage of yield increase/decrease (%) or as a yield difference (bu/acre).

- Present results of advanced statistical analyses to quantify variability and uncertainty in yield difference for each treatment in an easy-to-understand format.

ISOFAST makes data mining easier

The ISOFAST tool provides multi-location and multi-year summaries from testing new technologies, products and practices in Iowa corn-soybean cropping systems. Through maps and interactive graphics, users have easier accessibility to yield differences across many individual trials and across different years. ISOFAST also summarizes the effects of rainfall, soil texture, planting date and other variables on yield differences.

Users can interact with the graphic summaries by zooming in, selecting variables of interest and filtering data by year(s). Detailed information is available by hovering-over an object on a graph with the pointer. ISOFAST also provides graphic summaries of scouting data from studied locations and how yield responses are related to scouting observations.

A tool for farmers, scientists and students

ISOFAST can help farmers who are interested in trying a new management practice to understand the impact of that practice on yield response under specific conditions. It can help make better management decisions in the future because the data is based on results from trials conducted by farmers in Iowa.

The ISOFAST tool simplifies data summaries and results interpretation by simultaneously reporting all trial results within and across fields. Users can access general agronomic performance (a mean response across all trials) as well as the agronomic performance for each individual trial.

For scientists and researchers, ISOFAST applies advanced statistical methods to the data. Linear mixed effects models are used to quantify multi-locational effects of different treatments. Bayesian statistics is used to better quantify the uncertainty across different levels using prior knowledge and collected data.

ISOFAST can be used to help farmers and agronomists understand the relationship between yield response and soil properties, field management and rainfall.

ISOFAST overview

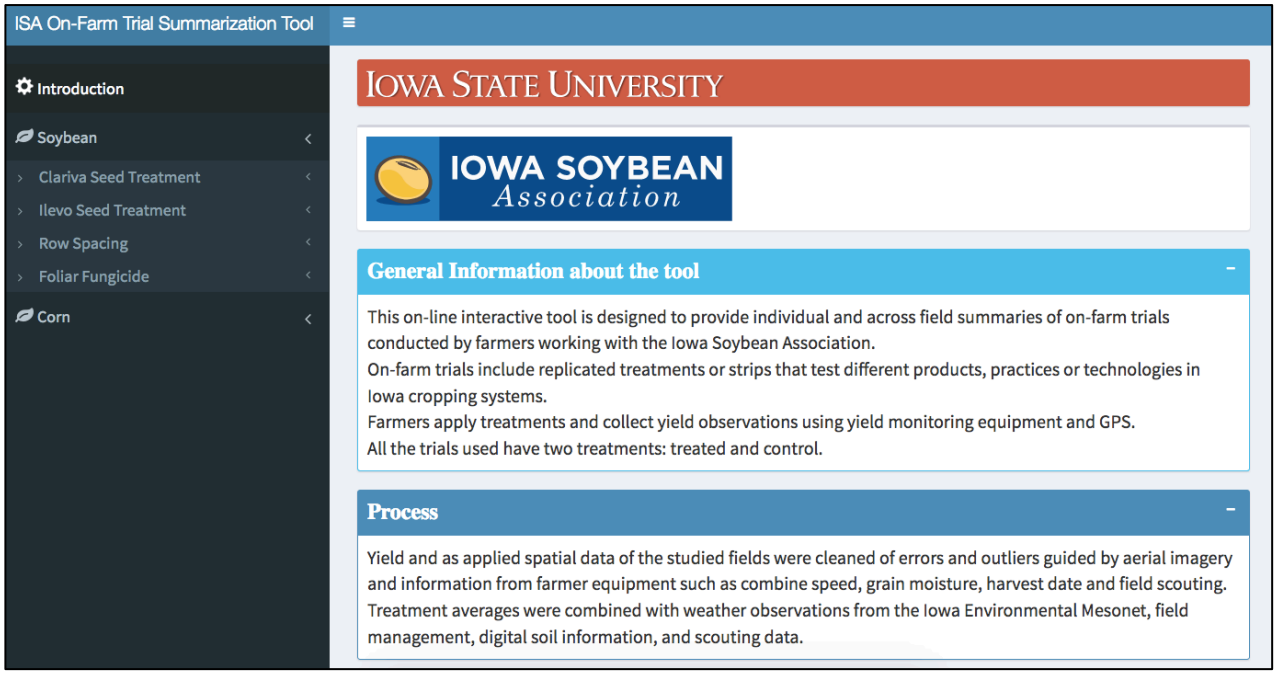

Figure 1: The ISOFAST homepage. Users select the crop and a specific trial category from the sidebar menu.

Figure 2: Users have different ways to interact with ISOFAST tools.

- Select which factor, such as rainfall or growing degree days, to display (#1).
- A box (#2, usually located on the top left of the graphic) invites the user to select a variable.
- With the legend on the right side of the graphic, (#3) users can click to select or deselect specific years of data to view.
- Trial detail information is available by hovering over data points with the pointer (#4).
- A box below each graph will provide a summary of the information presented (#5).

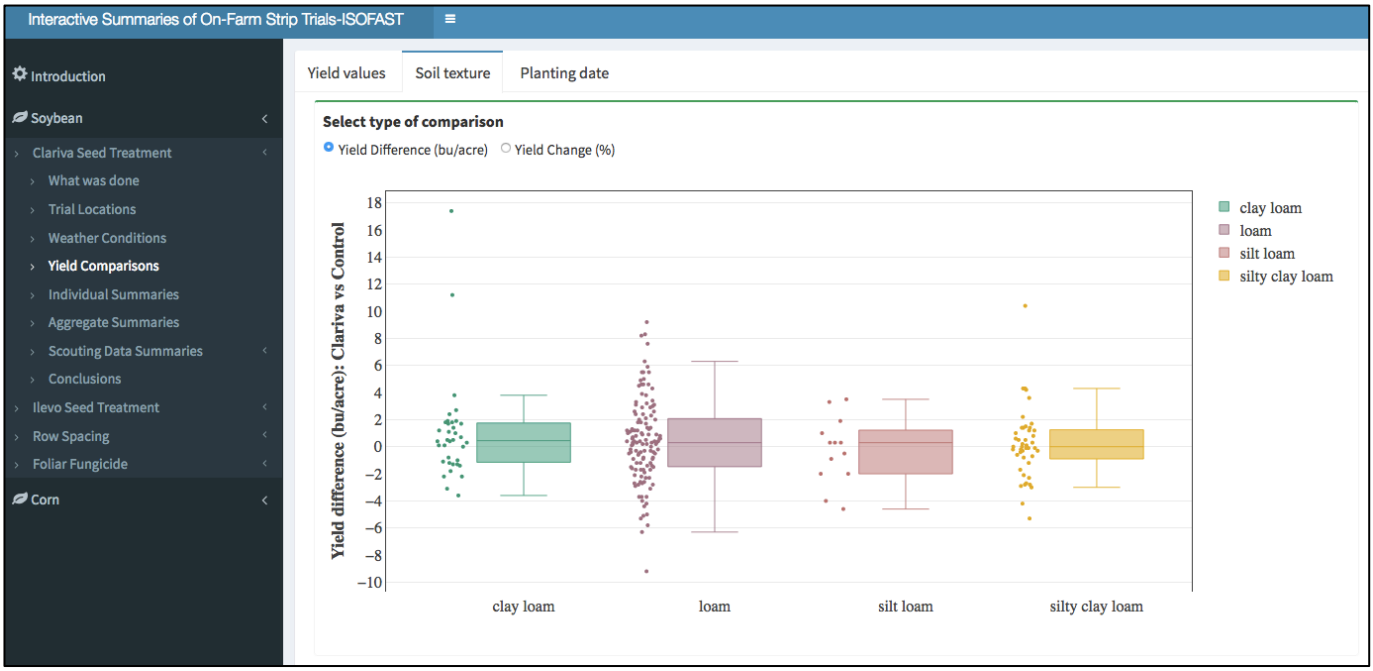

Figure 3: Display the relationship between yield difference and other variables.

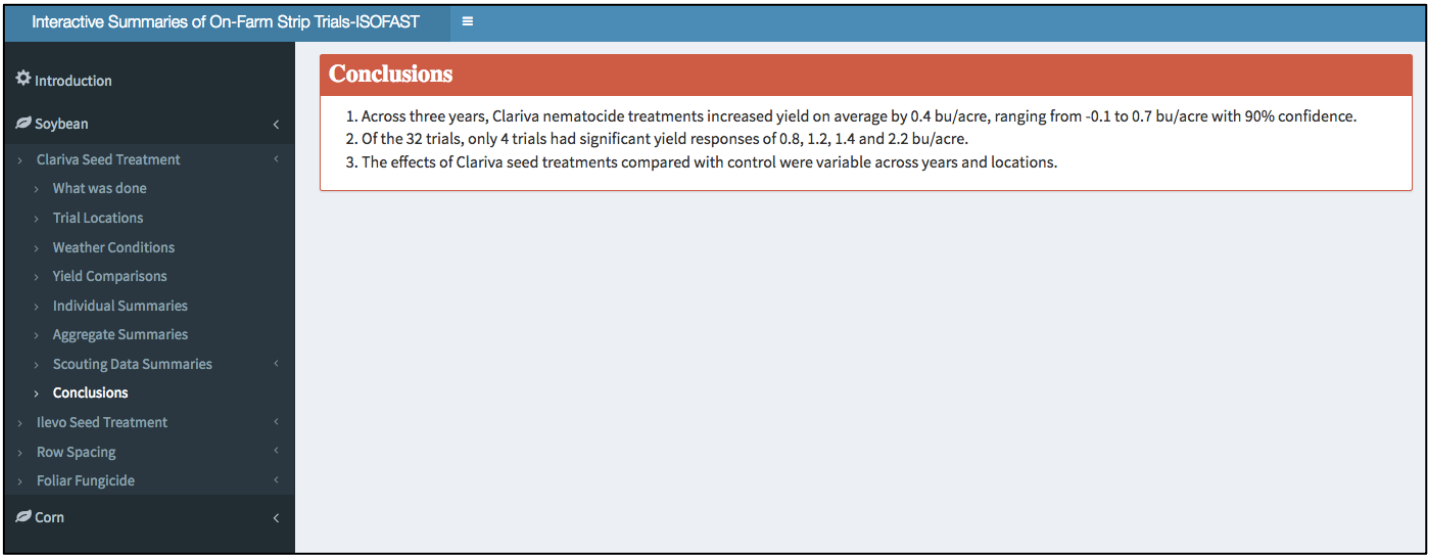

Figure 4: For those who prefer to skip the graphics, it's possible to jump straight to the Conclusions section.

How to interpret ISOFAST graphs

Below are some examples of data visualization provided by ISOFAST.

Boxplot

A boxplot represents the distribution of the data without statistical transformation (figure 5).

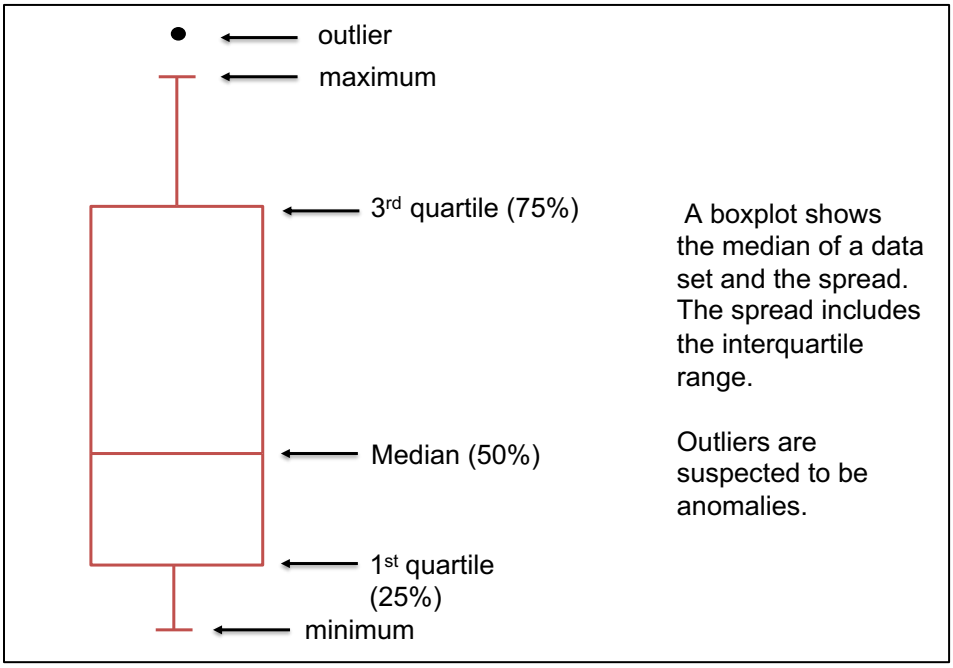

Figure 5: How to read a boxplot.

Individual effects and overall effect

The agronomic performance (positive or negative) of a new management practice, product or treatment is expressed by the yield difference (bu/acre) or the yield change (%). Both are given for each individual trial, called individual effect, and across all trials, called overall effect.
For example, if the yield change is equal to 2%, there is an increase in yield of 2% using the new management practice compared with the control.

The range of plausible values of the yield difference and yield change is represented by a confidence interval (horizontal line in the graph). The dot represents the mean treatment effect on yield and the horizontal line represents the plausible values (figure 6). The plausible values are estimated yields or percentages created from simulations of many trials based on the variability in the yield results. In that way, if the confidence interval crosses the vertical line (at zero), it means that the overall effect or individual effect is not significant.

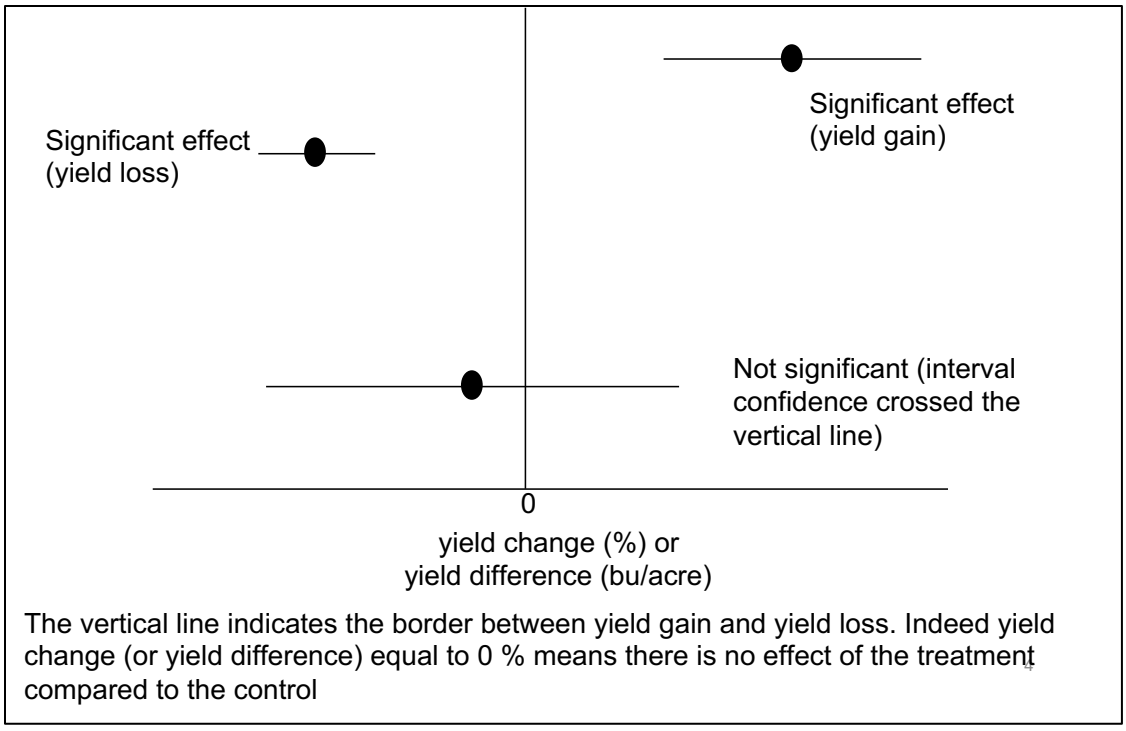

Figure 6: How to read a confidence interval for yield differences in the ISOFAST tool.

The individual effects and overall effect are presented simultaneously with ISOFAST (figures 7 and 8). The trials are ranked by decreasing mean effect value to show the variability between trials. The overall effect is always at the bottom of the graph. A significant overall effect does not necessarily mean that all the individual effects are significant (figure 7). In this graph the results from only the first nine trials down from the top of the graph had a significant percentage increase in yield. To make reliable decisions for the future, both information about overall and individual effects are required.

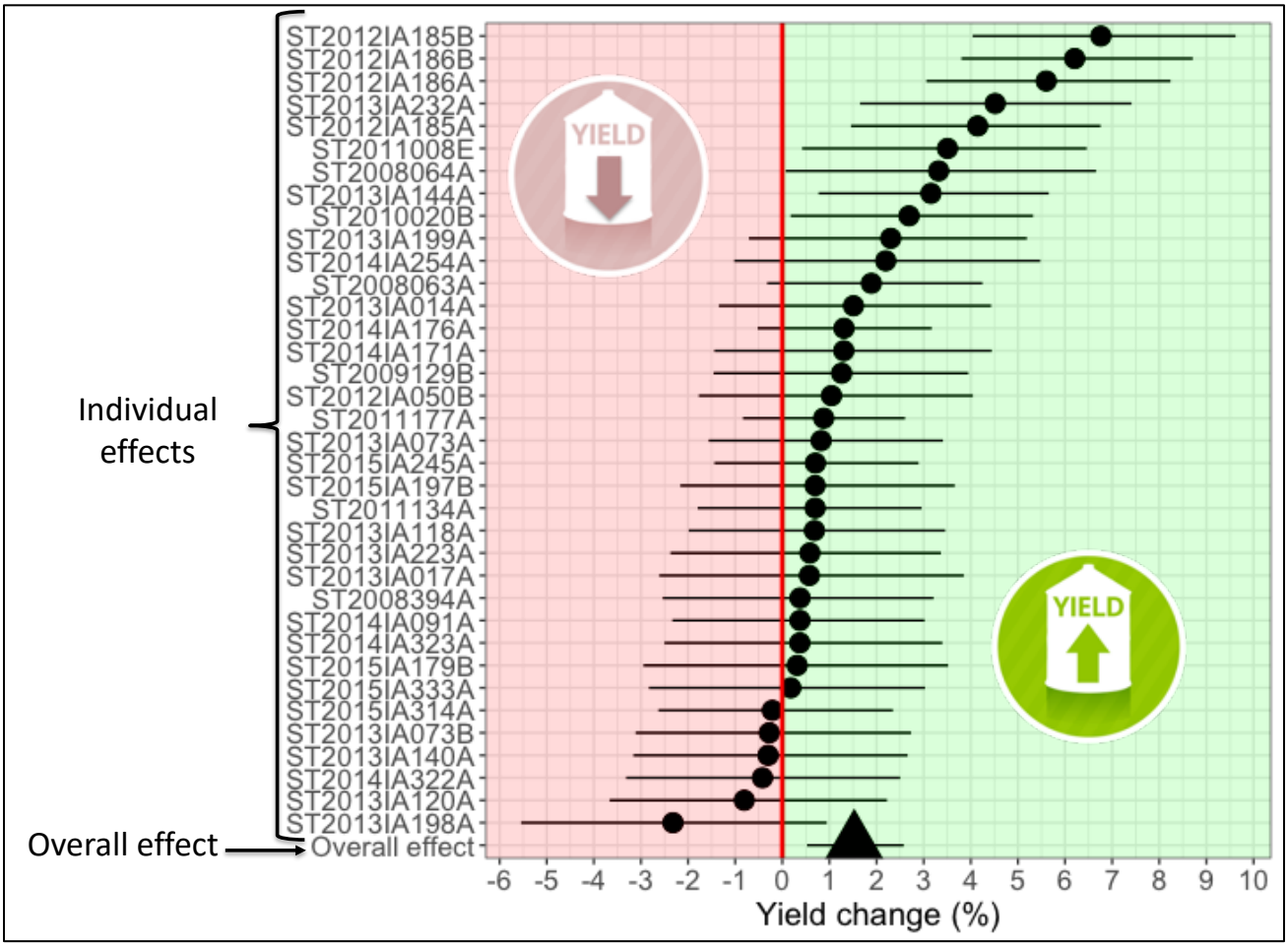

Figure 7: Overall and individual effects. In red, the negative yield change; in green, the positive yield change.

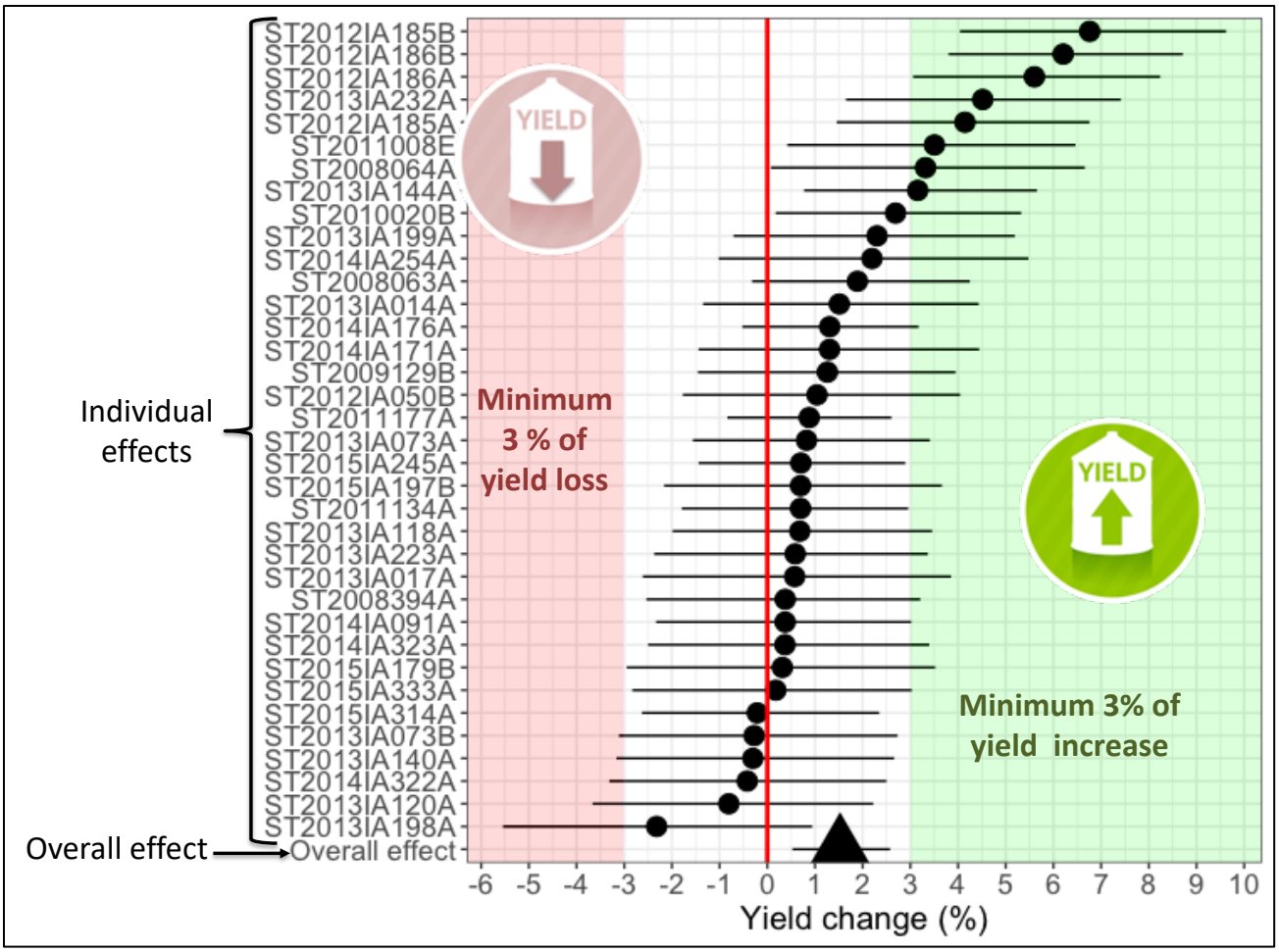

Figure 8: Overall treatments effects across all trials (bottom triangle) and effect for individual trials. In red, a yield loss of 3% or higher. In green, a yield gain of 3% or higher. The value of the threshold (3%) is arbitrary in this example.

ISOFAST returns the number of significant individual effects below the graph (like figure 2, box #5).

Information about the statistical model used to estimate the yield change and yield difference and the associated confidence intervals

The chosen model is a linear mixed effects model with trial as a random effect. The confidence intervals were obtained using a Bayesian approach, which considers previous knowledge as prior distributions and better quantifies the uncertainty in variation of yield differences within and across trials.

Relationship between yield response shown on the Y-axis and the yield observed at the control or untreated strips on the X-axis (Figures 9 and 10).

The shaded part on left (figure 9) indicates low yield values at the control (X-axis), hence, potential limiting conditions. As the yield differences (Y-axis) were always positive, the treatment worked most of the time under limiting conditions.

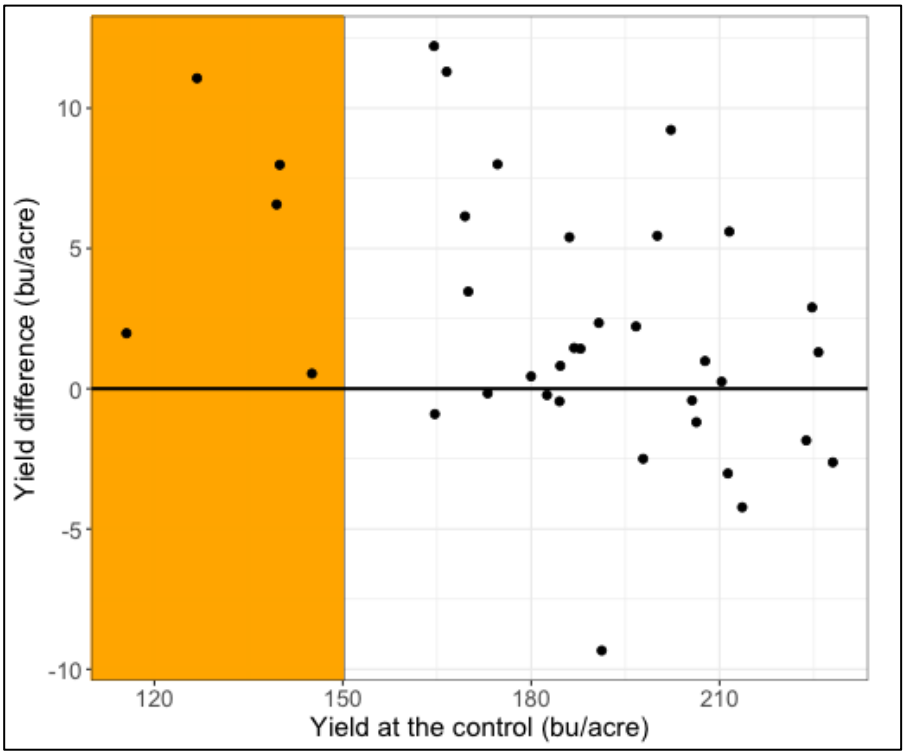

Figure 9: If it is assumed that a low yield value at the control indicates a limiting factor, does the treatment work better?

The shaded part on the right (figure 10) indicates high yield values at the control (X-axis), hence, the absence of potential limiting conditions. As the yield differences (Y-axis) were not always positive, the treatment did not increase yields systematically under non-limiting conditions.

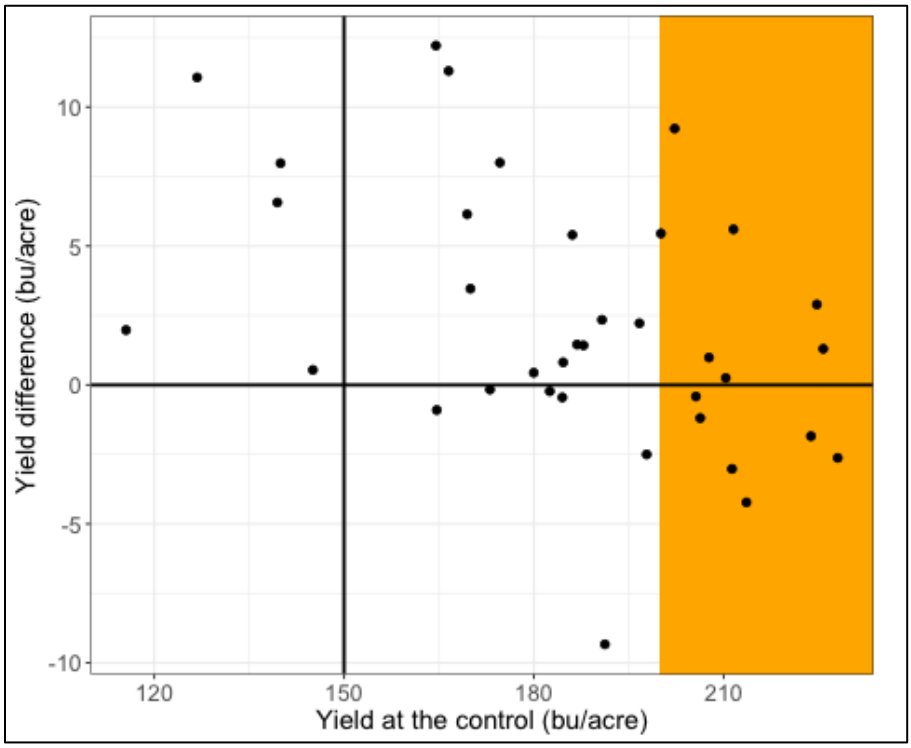

Figure 10: If it is assumed that a high yield for the control indicates no limiting factor, is the treatment still necessary?

Link to ISO-Fast

http://iasoybeans.com:3838/On_Line_Strip_Trial_Tool/

Thanks to Dr. Tom Morris, University of Connecticut, for review of this article.