

Final Report for FY 2016
Summarizing Soybean Management Trials in Nebraska
Project #: 26-6335-0225-001

Loren J. Giesler, Extension Plant Pathologist
Gary Hein, Doctor of Plant Health Director
Joshua Miller, Doctor of Plant Health and Plant Pathology PhD Student

The Nebraska Soybean Board (NSB) collaborates with the University of Nebraska – Lincoln (UNL) to fund research that will have a positive impact on soybean growers of the state. One area of improvement that has been identified is delivering the results of this research to the end-user. The objectives of this project were to summarize the results of NSB-funded soybean research projects at UNL and to develop a new and effective delivery method to disseminate the information to increase the utility of the summarized information. A new website was developed to achieve both of these objectives and will be housed within the CropWatch website maintained by the university.

Final research reports submitted to NSB were attained and reviewed to understand the importance of the research and how the research would impact soybean production in Nebraska. The final research reports were used to create summaries called “exploratory research summaries” in the website. The exploratory research summaries have been developed to provide soybean growers access to current research in an understandable way. Each summary contains several parts. They begin with the title of the project, the principal investigators, and a box that describes the “Impact on Soybean Production and Value.” Next, a section titled “Key Terminology” is provided to list any words or concepts used in the summary that may not be familiar to the reader. The summary is then broken into “Study Objectives,” “Findings,” and “Next Steps.” Finally, if any additional resources are available, i.e. journal articles, publications, charts, etc., a section titled “Additional Information” is presented at the bottom of the summary (Figure 1). These summaries will provide growers never before seen access to university research that is being funded using their checkoff dollars.

Figure 1. Sample SoyCal summary report

Confirmation of QTL for BPMV Tolerance and Evaluation of Effect of BPMV on Soybean Yields in Tolerant and Susceptible Soybean Lines

Impact on Soybean Production and Value

There is no known resistance to Bean Pod Mottle Virus in soybean. We identified genomic regions that are associated with the amount of virus in the plant, and it appears that the QTLs that limit virus reproduction and/or distribution in the plant may limit the effect on yield loss when BPMV is present.

The more important discovery from this work is that we identified a genomic region, probably a single gene, that is associated with tolerance to BPMV; that is, no yield reduction when the line is infected with BPMV. This is a unique finding that could be useful in developing soybean cultivars with improved yield and stress tolerance.

George Graef, Loren Giesler and Amy Timmerman (2013)

Key Terminology

Alleles are alternative forms of the same gene that are located on different chromosomes.

Near isogenic lines (NILs) are breeding lines that are genetically identical except for specific regions of interest that are associated with a gene, or genes, of interest. This allows researchers to study the effects of the genes of interest without the influence of other genetic variability.

Quantitative traits are traits, or phenotypes, that are influenced by two or more genes and the environment.

Quantitative trait loci (QTL) are regions of DNA that contain, or are closely linked to, genes of quantitative traits.

Recombinant inbred lines (RILs) are lines that are established by crossing two parental strains and inbreeding the resulting progeny. After several generations of inbreeding, the RILs are nearly isogenic and can be evaluated against other RILs to study QTLs.

Study Objectives

This study evaluated a set of soybean recombinant inbred lines (RILs) that exhibited different levels of virus when infected with bean pod mottle virus (BPMV). The objectives were to: 1) Confirm the effect that QTL regions had on limiting the virus amount in tolerant and susceptible lines and 2) Determine the effect that BPMV had on soybean yield in the tolerant and susceptible lines.

Findings

It was determined that BPMV can result in 13% yield loss when a high percentage of plants are infected at an early development stage. QTL that limit virus reproduction and/or distribution through the plant may limit the yield loss associated with infection. More importantly, it was discovered that a single region of the soybean genome, probably a single gene, is associated with tolerance to BPMV so that **no yield reduction is observed** when the line is infected with the virus.

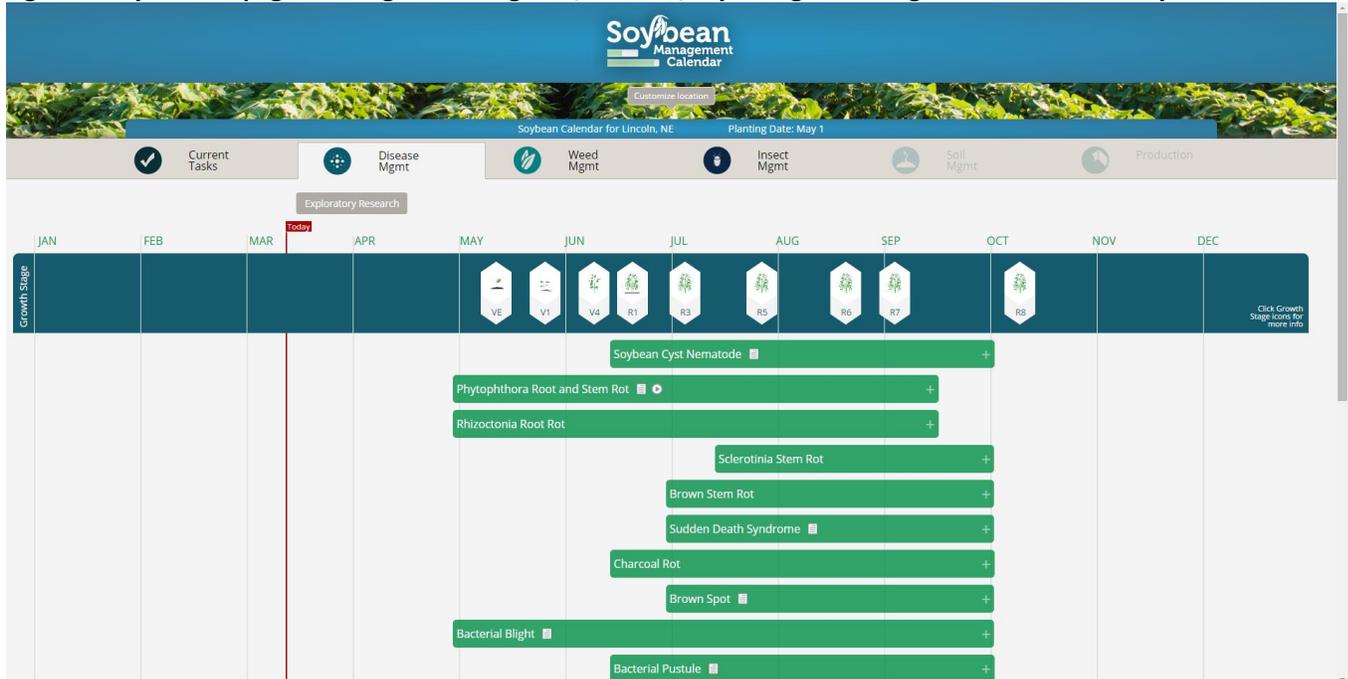
Next Steps

Current work has begun using DNA markers to identify the candidate genes associated with the tolerant QTL and to create NILs to test and confirm the tolerance response. These results will be important to breed for soybean lines that are tolerant to BPMV.

In order to increase the accessibility, and therefore the utility, of soybean research conducted by the university, a website, referred to as SoyCal from this point forward, was designed and

developed. The goal of SoyCal is to serve as an interface for growers to access information regarding disease, insect and weed management in soybeans. The website was designed as a calendar to allow growers to visualize when pests will occur during the season, as well as when management actions should be taken (Figure 2). The idea of referencing information to a calendar date was used to make gathering information more intuitive.

Figure 2. SoyCal start page showing main categories, timeline, soybean growth stages and selection of soybean diseases.

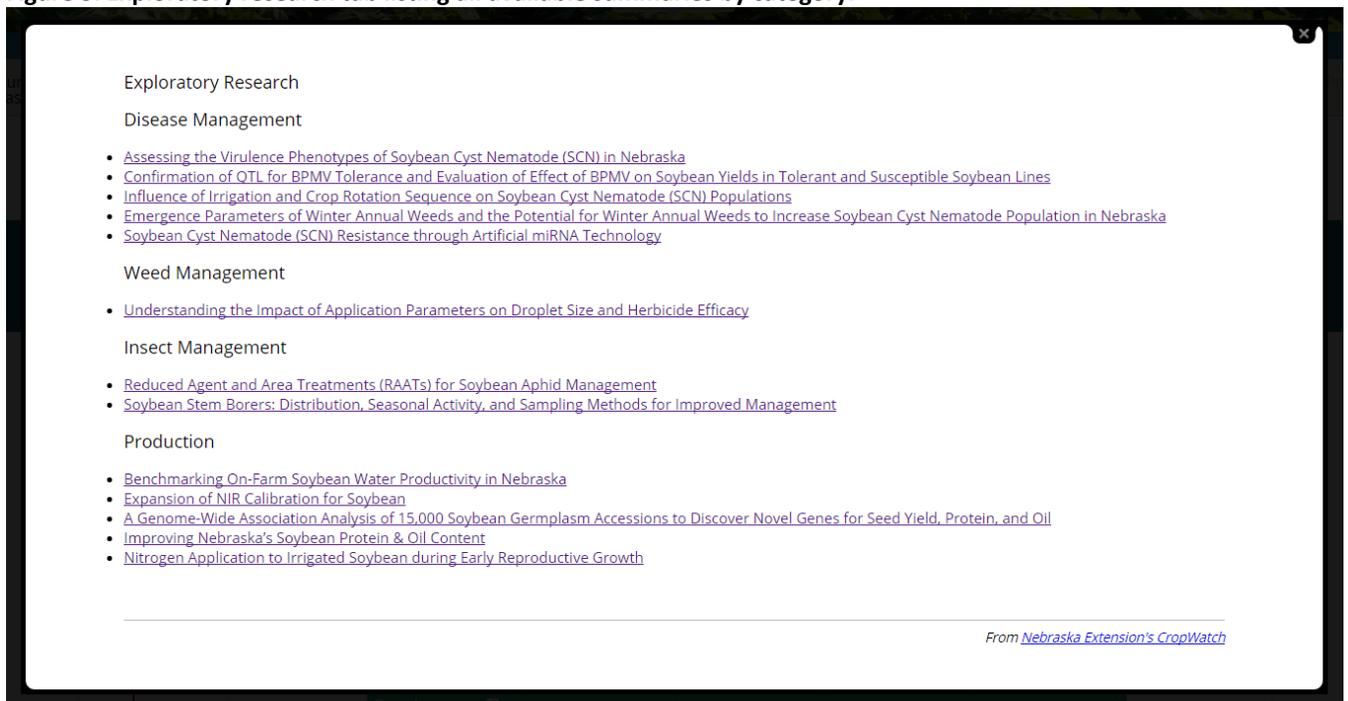


The website is divided into four main categories that are listed along the top of the calendar - disease management, insect management, weed management, and current tasks. Under each of these main categories, individual diseases, insects or weeds are shown in bars that corresponds to their occurrence during the season. By clicking on a particular pest, another set of bars will appear that correspond to management practices for each pest and when they would be implemented during the season. Finally, each of these management practices can be selected to bring up a small dialogue box that provides the user with a summary of the current knowledge regarding that management practice.

In addition to the informational text, several links are used in SoyCal to deliver information to the user. When these additional resources are available, they are indicated by an icon. The external sources are categorized as videos , NebGuides , and Exploratory Research . The Exploratory Research refers to the summaries that have been developed for recent NSB-funded research.

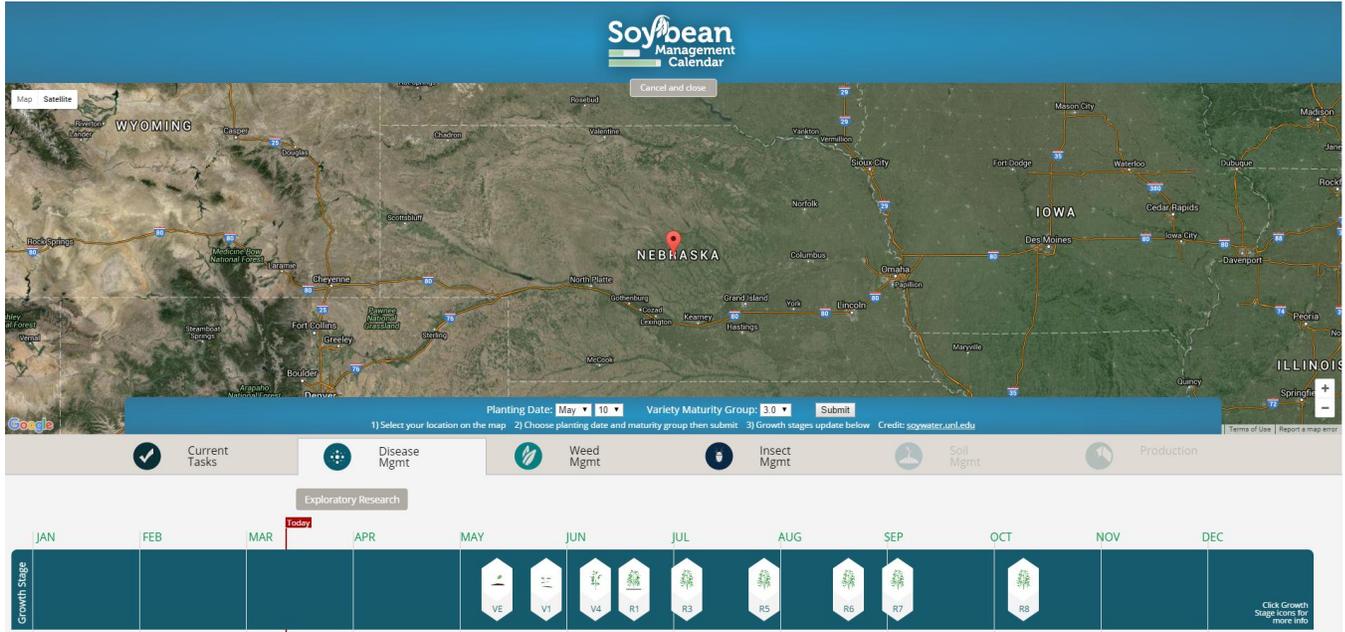
Exploratory research can be accessed by one of two ways. The first is using the “Exploratory Research” button located directly underneath the main category tabs. Selecting this button will open a box providing a link to all research summaries located in SoyCal listed by category (Figure 3). The second way is through links provided within the website. Each exploratory research summary may be pertinent to one or several pests or management practices, and will be indicated by the icon when one is available.

Figure 3. Exploratory research tab listing all available summaries by category.



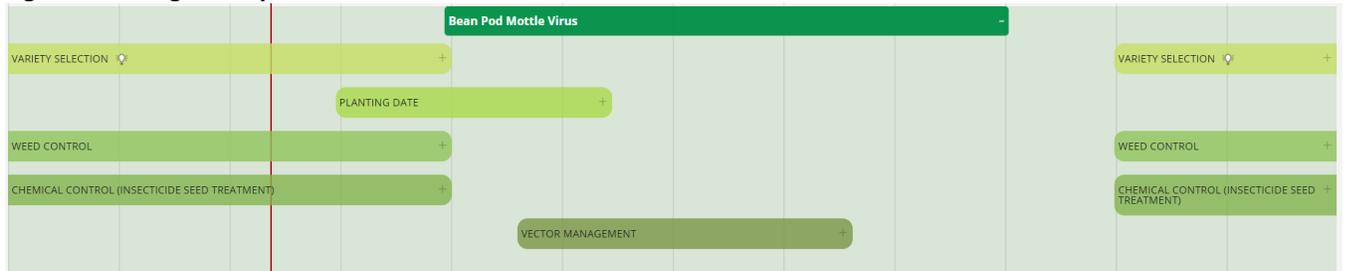
The timeline across the top of the web page also includes the soybean growth stages, which can be clicked to provide a description of each stage. An indicator line is also provided to show the current date on the calendar. To make SoyCal more relevant to the user, the growth stages are linked to SoyWater, an irrigation management tool that was developed with funds from the NSB. To access this, users can select the “Customize Location” button at the top of the page. This will prompt the user to select their location on Google Maps, as well as the planting date and maturity group of the soybeans they planted (Figure 4). Once this is selected, the growth stages will be repositioned according to the prediction algorithms used by SoyWater.

Figure 4. Customize location function. Users select their location on the map, planting date and maturity group to predict the growth stages on the timeline.



To illustrate the hierarchical nature of the website, the management practices listed for Bean Pod Mottle Virus (BPMV) are shown in Figure 5. By clicking on the disease bar, five more bars appear that correspond to Variety Selection, Planting Date, Weed Control, Chemical Control and Vector Control, all management practices that are important for controlling or managing BPMV.

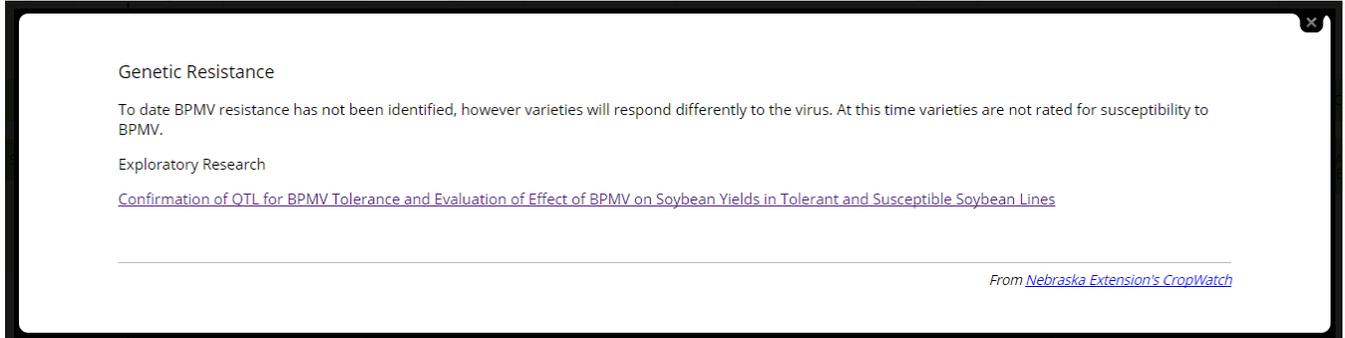
Figure 5. Management practices listed under Bean Pod Mottle Virus.



In Figure 5, the icon for Exploratory Research can be seen in the box for Variety Selection. When this box is selected, a small dialogue box opens with a short text relating to variety selection for BPMV, as well as a link titled “Confirmation of QTL for BPMV tolerance and evaluation of effect of BPMV on soybean yields in tolerant and susceptible lines” (Figure 6). Clicking on this link will open a summary of this project in a new tab.



Figure 6. Dialogue box for Disease Management -> Bean Pod Mottle Virus -> Variety Selection.



The original goal of this project was to summarize current NSB-funded projects in order to provide growers access to soybean research being conducted at the university. Although this was accomplished, a new, interactive delivery tool was also developed to ensure that the information was disseminated in the most effective way possible. SoyCal is an interactive, intuitive, calendar-based hub for current information regarding disease, insect and weed management in soybeans.

Since the completion of SoyCal, the website has been featured in CropWatch and Nebraska Farmer, and on Pure Nebraska and several radio outlets. It has also been presented at the 2016 Soybean Management Field Day locations. The site is fully operational and can be accessed at cropwatch.unl.edu/soycal.