INFLUENCE OF CULTURAL PRACTICES ON SOYBEAN NECTAR PRODUCTION

T. Smith
A. Catchot
J. Harris
N. Krishnan
Mississippi State University
Mississippi State, MS
J. Gore
D. Cook
Mississippi State University
Stoneville, MS

Abstract

Soybean nectar contributes to a large percentage of the nectar used in honey production in many areas across the Mid-Southern U.S. The amount of nectar produced in each cultivar may differ considerably. This research was conducted to identify which modern cultivars produce the highest quantity of nectar. The objective of these tests was to identify how soybean cultivar influences nectar concentration in soybean systems. Tests were conducted during the 2016 and 2017 growing season in the Hills and Delta regions of Mississippi. These tests evaluated variety and location interactions in both regions and how they influenced nectar production. Flowers were pulled at peak nectar hours and individually weighed. Samples were centrifuged and placed in cold storage until analyzed by spectrophotometry. All varieties were significantly different in terms of total sugar in 2017 compared to 2016. A variety by location interaction was also observed in a few varieties. Average amounts of all three sugars were observed to be significantly higher in the Hills region in 2017.

Introduction

Soybean production in the state of Mississippi has increased roughly 800,000 acres in the past ten years. With the increase in soybean production, there has also been an increase in the honey production in the state as well. The major component in the production of honey is nectar. Nectar is a diluted solution of many components, most namely, glucose, fructose, and sucrose. Honeybees gather nectar and add special enzymes to make a complex mixture. The mixture is then placed in honeycombs to let the water in the mixture evaporate. Once the evaporation of the water is complete, the honeycomb is capped and the ripened product is honey.

Honey is a mixture made up of a number of different components. The most notable components are water, glucose, sucrose, and fructose. Other components include: organic acids, ash and other minerals, and nitrogen. Glucose makes up roughly a third of the composition of honey. It is an organic molecule as well as a simple sugar. Fructose is a monosaccharide that makes up a third of honey. Sucrose is a disaccharide that only makes up two percent of honey. The honeybee breaks down the sucrose into glucose and fructose which are the main components needed. Because soybeans are frequently targeted by beekeepers to produce a honey crop in Mississippi, this research is being conducted to see if factors that may influence nectar production can be identified to maximize soybean productivity. If soybean producers can utilize varieties that also benefit beekeepers with no negative economic impact on their operation, it is possible that they can develop a mutually beneficial relationship.

Materials and Methods

Evaluating varietal effects on soybean nectar production

In 2016 and 2017 this experiment was conducted at two locations: the R.R. Foil Experiment Station in Starkville, MS and the Delta Research and Extension Center in Stoneville, MS to evaluate the influence of variety on soybean nectar production. Thirteen varieties were arranged in a randomized complete block design with four replications. Individual plots were 4 rows, 50 ft. long and planted on 38-inch centers. Plots were planted in early May at a seeding rate of 8 seeds per foot. Varieties evaluated were: AG3533, AG3536, AG3832, AG3936, AG4135, AG4232, AG4632, AG4633, AG4835, AG5335, AG5533, AG5535, and AG5935.

Samples were collected at R1 and again at R2 between the times of 10:00 AM and 2:00 PM. Five flowers from the upper most fruiting position of 5 random plants were taken. Flowers were cut and placed peduncle down into 200 µL of deionized water in a 1.5 mL Eppendorf tube. Samples were placed in plastic coolers lined with frozen packs and taken to the lab. In the lab, flowers were weighed individually with a Denver Instrument model P-114 scale after the

peduncle and calyx had been removed. Flowers were then placed upside down in a new 1.5 mL Eppendorf tube filled with 200µL of deionized water. Next, samples were placed into a Sorvall RT6000 Refrigerated Centrifuge and centrifuged at 3000G for 15 min to aid with extraction of the nectar. After centrifugation, the samples were frozen at -20°C until analysis.

The procedure used to process the nectar samples for total sugar analysis was an anthrone assay. 500 µL of a chloroform-methanol (1:2) solution was added to the sample and vortexed rapidly. Samples were then centrifuged at 8000G for 10 minutes at 4°C. 150 µL of the supernatant was then mixed with 100 µL of deionized water in a new 1.5 mL Eppendorf tube and then mixed rapidly. 500 µL of anthrone reagent was then added to the mixture. The anthrone reagent was made by dissolving anthrone in concentrated sulfuric acid to make a 0.2% solution. Samples were then placed in a dry bath for 10 minutes at 90°C. 200 µL of the solution was then pippeted into triplicates in wells of a Fisher brand micro titration plate. Samples were then placed into a BioTek Synergy H1M plate reader and absorbance was read at 630nm. Each value of the individual sugar was then calculated for the unknown samples from a standard curve of each sugar that was generated in the GraphPad Prism 7 computer program. Standards for each sugar was made using the anthrone assay procedure and calculated at a range of 0, 12.5, 25, 50, 75, 100, 150, and 200 µg/mL of deionized water. Plots were mechanically harvested with a plot combine. Test weight, moisture, and weight were recorded for each plot.

Results

The amount of total sugar for the 2016 season is significantly different across all varieties. The amount of total sugar for the 2017 season was significantly different across all varieties for 2017 (Figure 1). There was significant variability for each variety across both years. All varieties were significantly different between both years. AG3533, AG3936, AG4135, and AG4835 produced significantly higher total sugar than the other varieties for 2016. AG4835, AG5533, AG5535, and AG5935 produced significantly higher total sugar than the other varieties for 2017. All varieties produced significantly lower amounts of total sugar in 2017 compared to 2016.

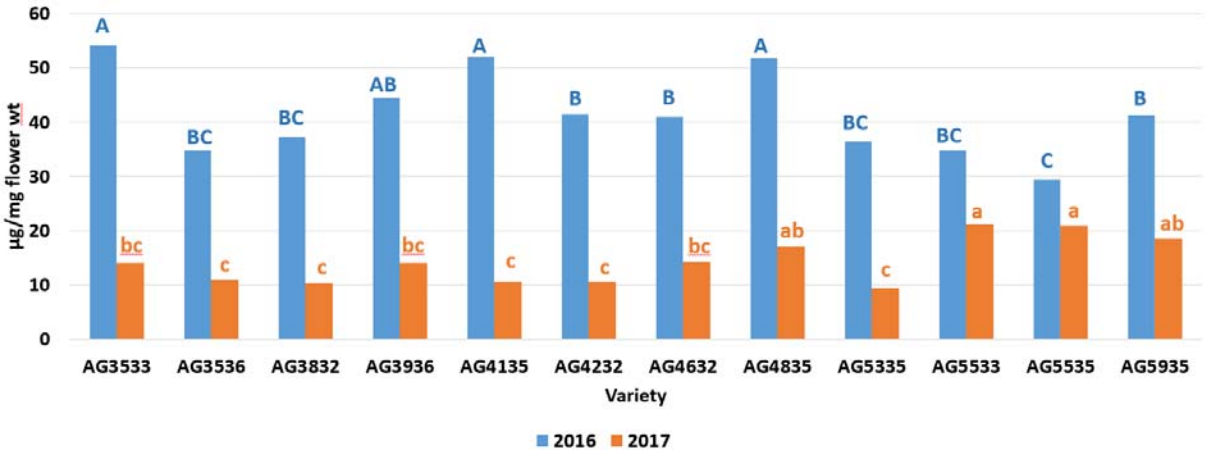

Figure 1. Total Sugar Interaction by Variety (P<0.0001)

There was a variety by location interaction observed in some varieties (Figure 2). Most varieties were not significantly different in respect to total sugar across both locations, however, a few varieties were observed to have a significant difference between the two locations. AG3536 and AG3832 had significantly less total sugar in the Hills region compared to the Delta region. AG3832 and AG5535 had significantly lower total sugar in the Delta region compared to the Hills region.

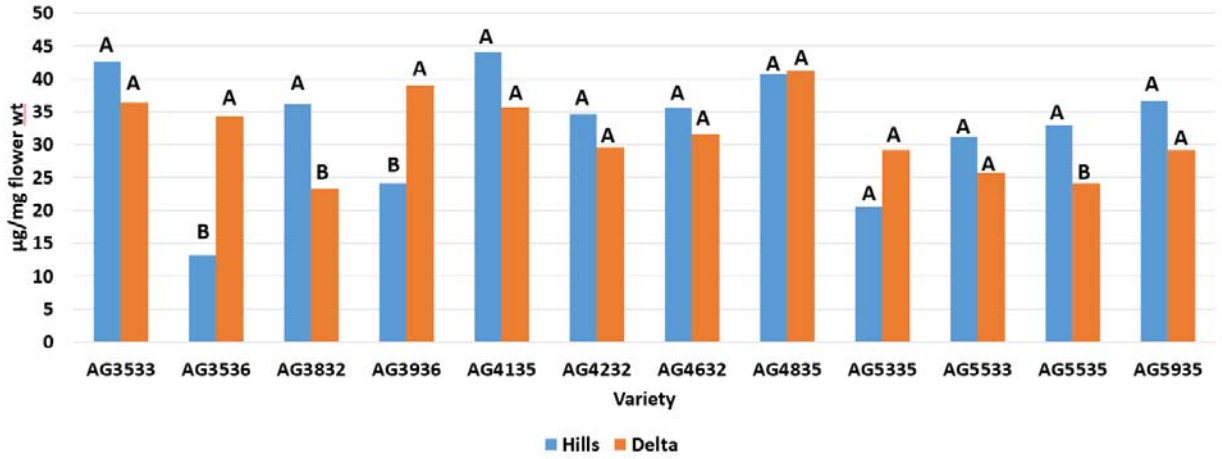

Figure 2. Total Sugar for Variety by Location (P<0.0001)

Across all varieties, glucose was higher in the Hill region compared to the Delta region. However, there was significantly more fructose found in the Delta region than the Hills region. There was no difference for sucrose between the two regions (Figure 3). Across all varieties, all three sugars were significantly higher in the Hills region compared to the Delta region.

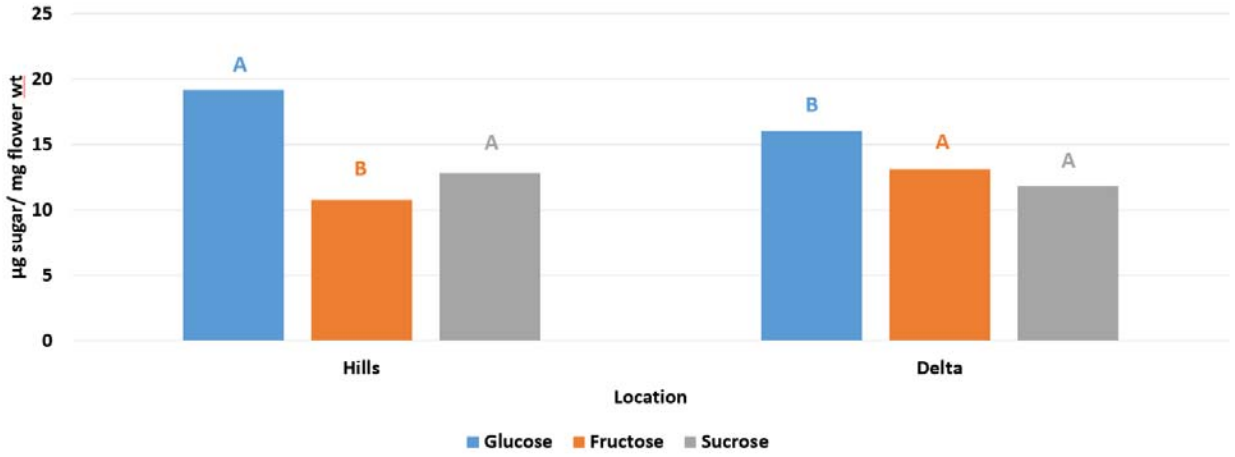

Figure 3. Sugars by Location for 2016

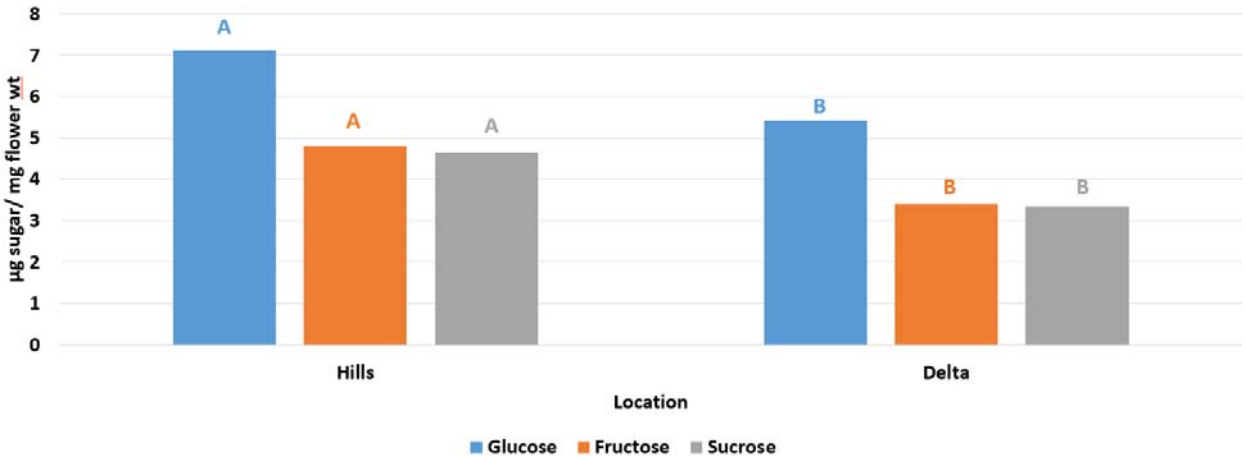

Figure 4. Sugars by Location for 2017 (P<0.0001)

Summary

There was significantly less sugar collected in 2017 compared to 2016. There was considerable variability in the total amount of sugar that was collected across all varieties. The generalization is that due to very different conditions between the two growing seasons that it could have a profound effect on the overall growth of the soybean plants and their ability to produce adequate sugar. A variety by location interaction was observed in some varieties. AG3536, AG3832, AG3936, and AG5535 were significantly different between the two locations. In 2016, the concentration of glucose was significantly higher in the Hills region than the Delta. Fructose was significantly lower in the Hills than in the Delta. Sucrose was not significantly different. In 2017, all three sugars were significantly higher in the Hills region than in the Delta.