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Precision Agriculture Newsletter

Editor: Michael Plumblee **Edisto REC, Blackville, SC** **November 2018**

From the Editor:

First off, we want to say that we hope you have made it through both hurricanes Florence and Michael with minimal impacts and damages. If there is anything that we can do to assist with the hurricane recovery, please let us know.

For most South Carolina growers cotton, peanut, and soybean harvest is now in full swing. The last two months around Edisto REC and across the state have been busy for us. Our annual Peanut and Agronomic Crops field days were a huge success. Many of the other faculty at EREC, including myself, gave presentations on current crop situations and research that is being conducted at the station. In addition to these field days, Edisto REC hosted a fall hay clinic where topics including irrigation, soil moisture sensors, nitrogen, potassium, and lime were discussed. If you were unable to make it this year to any of these events, we hope to see you in 2019.

The last week of October Edisto REC welcomed the Vice President of Research, Dr. Tanju Karanfil, and his staff to the station for a tour of research. This was a great opportunity for all specialists and researchers at EREC to collaborate and express the importance of the research and programming we do here in Blackville. Furthermore, the Precision Ag Group hosted a group of almost 20 Ag Mech undergraduate students at Edisto REC as part of a special topics class under Hunter Massey. During their time at the REC undergraduate students were involved in data collection on Dr. Kirk's peanut digging loss trial and helped Dr. Plumblee quantify cotton losses due to the hurricanes in the cotton OVT. In addition to the collection of data these students received presentations from the precision ag program on current research and were able to get hands on training/exposure to many of the precision ag technologies and equipment. The help these students provided during their two days at Edisto REC was greatly appreciated, and we look forward to hosting another group again next year.

Ag Mech Undergraduate Group at Edisto REC

Overall, the majority of our research here at the REC and on grower's farms has now been harvested and we will soon begin analyzing data from this year. We look forward to seeing you this winter at meetings where we can share the 2018 results with you. Again if there is anything we can do precision agriculture related please do not hesitate to contact your local extension agent or the Clemson Precision Agriculture program. Be on the lookout for our next newsletter at the end of December.

Happy Harvest,
Michael Plumblee

In This Issue

Variable Rate Nitrogen in Irrigated Tifton-85 Bermudagrass and Hay Yield Monitor Technologies

Author: Perry Loftis

Hay is a vital crop in American agriculture, from its cash value to those producing it, and the necessity of those depending on hay as feed source to livestock. In 2016 hay was the third largest crop harvested in the U.S. by acreage, with 22.7 M ha (56.1 M ac) harvested (USDA-NASS, 2016). With such a large area of land in the U.S. under hay production, proper management of fertilizer is necessary to reduce the impact on the environment. Unlike other major U.S. crops, there are a limited number of precision agriculture technologies commercially available to hay producers to assist them in managing inputs. Producing good quality hay often requires additional crop nutrient inputs into the system if yield and profits are to be maximized. The most important and, in many hay fields, the most limiting nutrient is nitrogen. Hay is one of the few crops produced for the sole purpose of being used as an input for another agricultural production system, that being livestock production. For this reason, determining a price value for hay can be difficult and can vary drastically by region and time.

The concept of precision agriculture has been utilized in production systems for more than three decades and has been a rapidly developing industry for at least the past decade; however, advances in technology for hay producers seems to be lagging behind those for other crops. Of the top nine U.S. crops harvested by acreage in 2016, hay is the only crop that does not have a commercially available yield monitor. A study published in 2016 concluded that yield monitoring technology ranks number one among all utilized precision agriculture technologies available to farmers (Schimmelpfennig, 2016). A project began at Clemson University's Edisto Research and Education Center (REC) in 2014 to develop a yield monitor to be used in hay production and could be adaptable to any hay baler regardless of make or model. Many sensors and system designs were constructed before settling with a pair of ultrasonic sensors from Banner Engineering Inc. (Minneapolis, MN) mounted on the tongue of a John Deere 458 baler (Moline, IL), which were used to estimate windrow height and relate it to hay mass flow feeding into the baler (Ramsey, 2015). Since the initiation of this research, Clemson researchers have a patent-pending design on this technology.

Yield monitors can assist growers to manage inputs more efficiently. Since one of the most important inputs for hay production is nitrogen, managing inputs are essential. Bermudagrass hay is one of the most common types of grass hay produced in the Southeastern U.S. Nitrogen fertilizer is often applied to grass hay fields at the beginning of the growing season and sometimes after each cutting, although this depends on soil characteristics and the type of hay being produced. Applying nitrogen not only increases the yield potential of the grass, but it also increases the crude protein (CP) content of the forage. Growing nutritional hay and knowing the CP content is important when determining feed rations for livestock. Several studies have reported the effects of increasing nitrogen rates on the CP content and yield of bermudagrass hay. In 2016, a project was initiated at Edisto REC to investigate the effects of nitrogen on Bermudagrass. The hay yield monitor developed at Clemson was utilized to document yield differences among varying nitrogen rate strips that spanned the entire length of the field. This allowed the entire hay field to be included in the study, in hopes of better understanding the interactions of within-field variability and the relationship of between nitrogen, yield, and forage quality. The main basis for the project at Edisto REC was to explore the relationship of five different nitrogen rates on an established irrigated stand of Tifton 85 Bermudagrass (Figure 1).

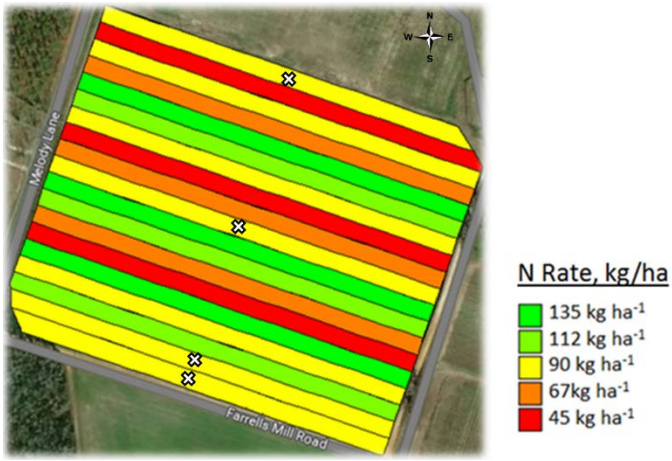

Figure 1. Five different nitrogen rates repeated three times across the field and arranged in a randomized block design. Strips marked with an X were not part of the test

The use of an on-the-go yield monitor in this study also allowed yield data on the entire Tifton 85 Bermudagrass field to be collected, although only the area of the field that was irrigated by the center pivot was included in analysis. When comparisons were made for all harvests of the five nitrogen rates, each increase in nitrogen rate resulted in an increase in yield (Figure 2).

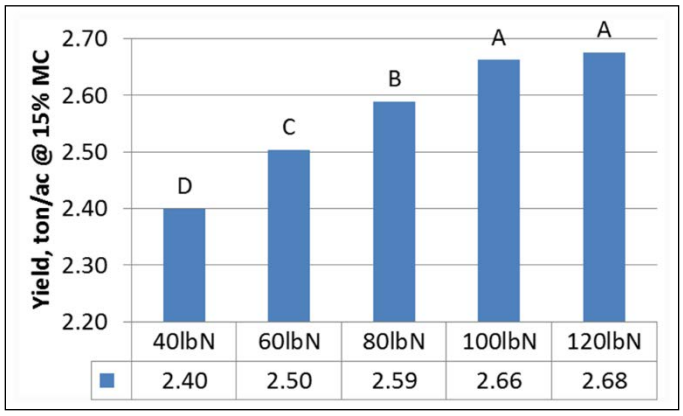

Figure 2. Yield response in tons per acre at 15% moisture content to five different nitrogen rates across all cuttings. Values with different letters represent significant differences.

However, when the harvests were analyzed separately there were inconsistencies among the relationship of yield and nitrogen rates. It was apparent that the first harvest of the year had the highest yield-response to nitrogen. This suggests that the heaviest amount of nitrogen should be applied to a Tifton 85 Bermudagrass field as it is coming out of dormancy each year, and nitrogen can be applied in lesser rates as the growing season progresses. Increasing crude protein (CP) content of the hay was noticed in each harvest with respect to increasing nitrogen rates, as was increasing moisture content. While yield increases were not detected for every harvest in this study, the increase in moisture content at the time of baling and CP content, suggest that the increasing nitrogen rates are having some effect on the grass. To better understand these effects, the relationship of temperature and growing length needs to be further investigated. Since the primary reason for producing hay is to feed livestock, the value of the hay grown was established as a function of CP content. Due to nitrogen directly affected the CP content with all other crop inputs were held uniform, the economic analysis for this portion of the project was reported as returns above nitrogen cost. A linear regression model was developed based on grass hay sold at hay auctions all across the country where hay was sold by the tonnage for three different categories: (1) fair grass hay (5-9% CP); (2) good grass hay (9-13% CP); and (3) premium hay (>13% CP). Using this model it was concluded that profits were maximized for the first harvest of 2017 when the highest rate of nitrogen was applied, but lower nitrogen rates during the remainder of the growing season proved to be more beneficial in terms of profit (Figure 3).

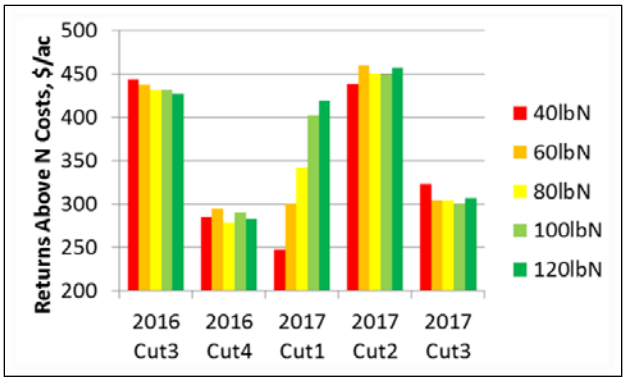

Figure 3 Profit response in dollars per acre to nitrogen rates by cutting

There are a number of benefits from having an on-the-go yield monitoring system on a hay baler, but as with yield monitors for other crops the technology is only beneficial if the yield data is used to evaluate and improve crop management decisions. For hay producers, it is expected that the largest benefit of consulting data derived from a yield monitor may be when determining fertilizer application rates. Although not all fields and grass types behave the same, the data reported from this study suggest high rates of nitrogen should be applied at the beginning of the growing season to maximize returns then reduce the rates later in the season. Additional applications of a yield map from a hay field might be in deciding when to exclude certain areas of the field from production if they are not profitable, locating disease and weed pressure areas in a field, or determining the best areas to plant winter annuals. The full benefit of this new technology is still unknown, and only further research can tell.

References

Ramsey, H. G. (2015). Development and implementation of hay yield monitoring technology. MS thesis. Clemson, South Carolina: Clemson University, Plant and Environmental Sciences.

Schimmelpfennig, D. (2016). Farm profits and adoption of precision agriculture. ERR 217. Washington, DC: USDA-ERR.

USDA-NASS. (2016). Acreage. June 2016. Washington, DC: USDA-NASS. Retrieved from http://usda.mannlib.cornell.edu/usda/current/Acre/Acre-06-30-2016.pdf

Perry Loftis graduated with a M.S. degree in Plant and Environmental Sciences under Dr. Kendall Kirk in December of 2017. Perry currently works at the Savannah River Site as a firefighter. He can be contacted at perryl@clemson.edu.

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Soil Sampling Utility; A free software for site-specific soil sample collection

Authors: Kendall Kirk

As harvest begins to wind down for many growers, the collection and analyses of soil samples is often practiced and recommended. By collecting soil samples each year, fertility levels and crop nutrient removal can be evaluated and quantified for fields.

Additional information on how to properly collect a soil sample can be found at the following website: https://www.clemson.edu/public/regulatory/ag-srvc-lab/soil-testing/collecting-samples.html

In our last newsletter, Alex Coleman showed some work demonstrating the amount of variability that can be seen in soil fertility recommendations across a field. In his study in one field, recommendations varied from 0 to 5,500 lb/ac for lime, 0 to 160 lb/ac for phosphate, and 0 to 190 lb/ac for potash. If soil sampling for this field were conducted on a "whole field" basis, using a single composite sample, then indicated (average) recommendations would have been 1,500 lb/ac for lime, 90 lb/ac for phosphate, and 94 lb/ac for potash. Application of these uniform rates would have resulted in under-application and over-application on substantial portions of the field. Using potash as an example, 37% of the field would have been under-applied by at least 30 lb/ac and 29% of the field would have been over-applied by at least 30 lb/ac. The under-applied areas are likely to result in yield losses and the over-applied areas are likely to result in waste of (unutilized) inputs. His preliminary data shows that the cost of suboptimal management from uniform application can be substantial, amounting to much more than $100/ac in lost yield potential and wasted inputs.

Variability in input recommendations will not be the same in all fields, but it is safe to say that most S.C. fields larger than 20 ac will benefit from either zone or grid management, as opposed to uniform, "whole-field" applications. The process of zone or grid management is simple and represents the similar practices to what you are likely already implementing. In whole-field management, a composite sample is collected from across the field; in zone or grid management, a composite sample is collected from across each grid or zone. If you are not practicing zone or grid management, think about it as the same thing as what you have been doing, but sub-dividing your fields for the purpose of sampling into smaller fields. It's that simple.

If you have been implementing whole field management and wish to move towards zone or grid sampling, we recommend you start with a handful of fields in the first year, to "get your feet wet". Start with the fields exhibiting the greatest amount of variability in terms of soil characteristics or observed yield. For each field selected, zones or grids need to be established. These can be created by a service provider or we can help you get started. Some growers use county soil survey maps for zone definition, but we like to caution folks to take a good look at the maps to evaluate whether or not they are truly representative of soil and/or yield differences that they have observed; these maps were created decades ago and were never intended to be used for field level management. You know your fields better than anyone else, perhaps you would prefer to draw your zones on a map by hand.

Once you have grids or zones defined for your fields, as shapefiles or Google kml files, they can be uploaded to SSU (Soil Sampling Utility, our free soil sampling software). The software shows your position in the field while sampling, relative to your defined sampling grids or zones. In the upper-right corner of the map, the software displays the zone or grid ID.

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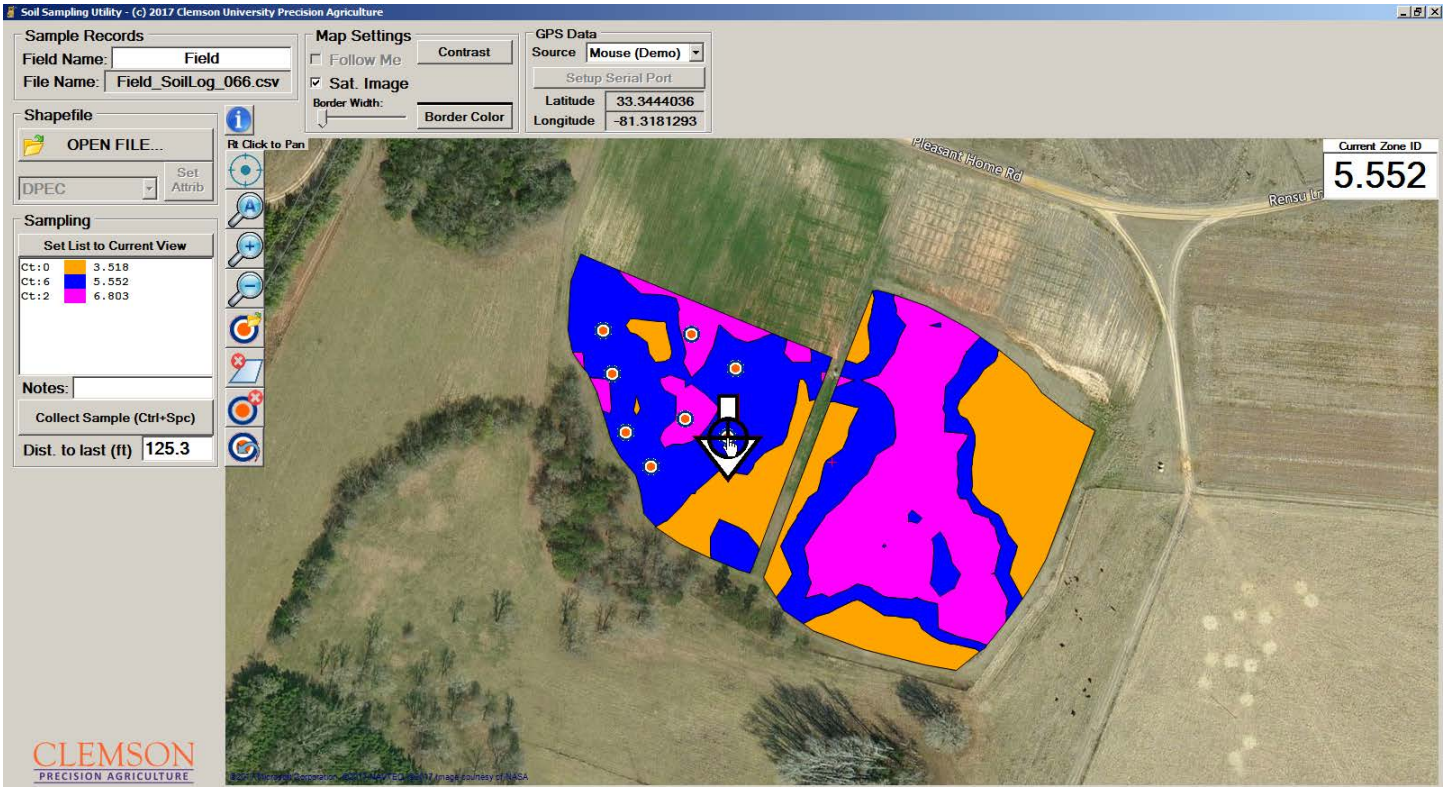

After sampling, send your samples to your soil test lab just as you have in the past for "whole field" management (make sure your zone IDs are unique). When you receive the results, they can be used to create variable rate application plans by zone or grid. Most fertilizer dealers offer these services and many growers have invested in equipment to do this on their own. We have worked with some growers who have used SSU in the tractor cab to apply variable rate inputs with a uniform-rate applicator; let us know if you are interested and we can show you how.

We developed our free soil sampling software to try to reduce barriers for growers to begin practicing variable rate nutrient application. The software requires a Windows operating system and a NMEA capable GPS receiver (starting at less than $30, one-time cost). We recommend a tablet or a rugged laptop for using the software and we would be happy to visit your farm or coordinate a demonstration in your area to show you how easy it is to begin your own precision nutrient management program, which is likely to increase your farm's profit and environmental stewardship substantially. More details on the software, including links to tutorial videos can be found at the following link or by searching "Clemson SSU"; please know that we are always here to help out if you have any questions: https://www.clemson.edu/cafls/research/edisto/programs/PrecisionAg/software/ssu/.

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Precision Ag. Program Pictures

Combine calibration agent training at Edisto REC

Jay Crouch, Agronomic Team Leader, speaking to county agents

Calibrating a variable rate spreader

Calibrating a grower's combine for corn

Simpson REC Agronomic Crops Field Day

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Dr. Plumblee speaks at the Simpson REC Field Day

Dr. Kendall Kirk speaking at the Peanut Field Day at Edisto REC

Dr. Kirk's stop at the Peanut Field Day

Dr. Plumblee speaking at the Agronomic Crops Field Day at Edisto REC

Peanut Field Day at Edisto REC

Agronomic Crops Field Day at Edisto REC

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Dr. Plumblee discusses soil moisture sensors

Collecting digging loss data on a local cooperators farm

Rating peanuts for disease prior to harvest

Presentation at the Fall Hay Clinic at Edisto REC

Harvesting Dr. Kirk's on-farm peanut trial with peanut yield monitor

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Collecting peanut samples off the combine prior to Hurricane Florence

Collecting cotton losses from the hurricanes

Ben Fogle and Brennan Teddy collecting end of the year cotton data

Dr. Kirk discussing the digging loss trial with undergraduates

Dr. Plumblee talking to Ag Mech undergraduates about cotton losses in the OVT

Undergraduate Ag Mech students observing the cotton plot picker

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Precision Agriculture Faculty Member Spotlight

Dr. Kendall Kirk

Dr. Kirk was born and raised in Columbia, SC and began working for Clemson as the Precision Agriculture Engineer in May of 2014. Kirk holds three degrees in Biosystems Engineering from Clemson: a B.S. in 2002, an M.S. in 2004, and a Ph.D. in 2010. His current work focuses on developing technologies and software that are useful, profitable, and cost effective for growers. Prior to starting his current position, he held teaching and research appointments on campus for almost 10 years in the Agricultural Mechanization & Business program. Since joining the faculty at Edisto REC, Kirk and cooperators have been awarded U.S. patents for a peanut yield monitor and an automated depth control system for peanut harvest. He and his former graduate students also have patents pending for a hay yield monitor and a round hay bale weighing system. Some of his current research includes variable rate prescription development for inputs in cotton, corn, and soybean, optimization of peanut harvest operations, and precision ag software development. In his spare time, Dr. Kirk enjoys spending time with his wife, Emily, and his children, Katie and Caulden. The Kirks are active members of St. Paul Lutheran Church in Aiken, SC and both kids are involved in scouts, sports, and love the outdoors.

Precision Agriculture Team Member Spotlight

Ben Fogle

Ben is from Neeses, South Carolina and began working for Clemson as the Technician for the Precision Agriculture program in 2017. He received his B.S in Agricultural Mechanization and Business in December of 2016, and is currently working on a M.S. in Plant and Environmental Sciences with a focus on technologies on peanut equipment. Ben's research project objectives are to quantify yield losses on peanut harvesters and to determine a way to decrease yield losses. In Ben's free time, he enjoys farming at home with his father and spending time family, friends, and girlfriend. Ben hopes that his research will help increase profits for peanut growers in South Carolina.

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Industry Spotlight

CapstanAG

CapstanAG™, a leader in precision application technology, offers systems for chemical and liquid fertilizer application. Using patented Blended Pulse™ technology the CapstanAG product line includes systems for sprayers, planters, toolbars, and turf application. Located in Topeka, Kansas, CapstanAG is able to design, engineer, and manufacture each system, with extensive Quality Control measures to ensure each system is fully operational prior to being shipped. The current systems offered are PinPoint™ II, SharpShooter™ with Rate Sync, N-Ject™ LF, N-Ject™ NH3, N-Vision™, and Seed-Squirter™.

Currently, CapstanAG offers a system specifically for liquid application as part of the planting process. This system, Seed-Squirter™, allows the operator to place the optimal rate on a per-seed basis. Rather than a traditional dribble system, Seed-Squirter only applies the amount of liquid proximal to the seed, based on user presets. Each seed is able to utilize only the appropriate amount of liquid, reducing the risk of over or under application. Through proven application results, Seed-Squirter has given operators application consistency, leading to optimal rates per seed, improved crop health, and increased yield potential.

For more information please visit CapstanAG online at www.capstanag.com or call 855-628-7722.

Submitted by: Stephen Mount and Jason Perry, CapstanAG

Upcoming Events:

- ~~**13 October – Forage Bull Test Sale – Edisto REC**~~
- **13-15 November - CCA Workshop (Santee, SC)**
- **22 November – Thanksgiving**
- **6 December – Corn and Soybean State Meeting (Santee, SC)**
- **24 December – Christmas Eve**
- **25 December – Christmas Day**
- **1 January – New Year's Day**

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Pest Management Handbook – 2018

Insect, Weeds, and Disease control recommendations are available online in the 2018 South Carolina Pest Management Handbook at:
http://www.clemson.edu/extension/agronomy/pest%20managment%20handbook.html

Need More Information?

For more Clemson University Extension Information: http://www.clemson.edu/extension/

Sincerely,

Michael T. Plumblee

Michael T. Plumblee, Ph.D.
Precision Agriculture Extension Specialist

Contact Us:

If you would like more information on a topic discussed in this issue please contact me.

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