THE UNIVERSITY OF ARIZONA
COLLEGE OF AGRICULTURE AND LIFE SCIENCES
COOPERATIVE EXTENSION

Featured Plant: James' Galleta

Pleuraphis jamesii

Liz Delcamp

Characteristics

Growth Habit: James' galleta is a warm season perennial grass which can grow up to 19 inches tall. It can grow either from seed or from the rhizomes of existing plants. It is most commonly found growing in bunches.

Leaves and Stems: The grass is bluish-green in color with stems which often curve upward from its base. There are long hairs apparent at the joints and at the junction of the leaves. The narrow leaves are about 2 inches long with a sharp stiff point on the end. James' galleta can be differentiated from big galleta because it has smooth stems where big galleta has pubescent stems.

Inflorescence: The inflorescence of James' galleta consist of hairy rectangular spikelets arranged in a raceme along a wavy rachis about 2 to 4 inches long. The spikelets are in clusters of 3 per each node with the inner spikelet being fertile and 1-flowered and the two outer spikelets being staminate.

Occurrence

James' galleta can be found in Apache, Navajo, Coconino, and Mohave Counties as well as in surrounding states from Wyoming to Nevada and Texas to California. It frequently grows in open sandy areas on mesas and in valleys or plains. The grass prefers elevations between 3,500 and 7,500 feet. In Arizona it is found in sandy areas on plateaus.

Forage Value

While it is green, James' galleta is good forage for cattle, horses, and sheep during the late spring and early summer. When the plant is dormant it is less palatable. Deer, antelope, and desert bighorn sheep have also been known to utilize James' galleta.

Grazing Management

During years with adequate rain, James' galleta will begin growing in early summer. The plant is tolerant of close grazing as well as trampling. On seeded areas, grazing should be deferred about two years or enough time for full establishment.

Gould, Frank W. *Grasses of Southwestern United States.* The University of Arizona Press, 1951.

St. John, L., D. Tilley, and D. Goodson. 2012. Plant guide for Galleta (Pleuraphis jamesii) USDA-Natural Resources Conservation Service, Plant Materials Center, Aberdeen, Idaho 83210.

Stubbendieck, J., Hatch, Stephen L., and Kjar, Kathie J., *North American Range Plants.* University of Nebraska Press, 1981.

Image citation: USDA-NRCS PLANTS Database / Hitchcock, A.S. (rev. A. Chase). 1950. Manual of the Grasses of the United States. USDA Miscellaneous Publication No. 200. Washington, D.C.

Inside this Issue

group of spikelets, two views (A), × 5; fertile spikelet (B), staminate spikelet (C), and fertile floret (D), × 5. (Tidestrom 1449, Utah.)

The Science Behind Cool and Warm Season Plants

Andrew Brischke

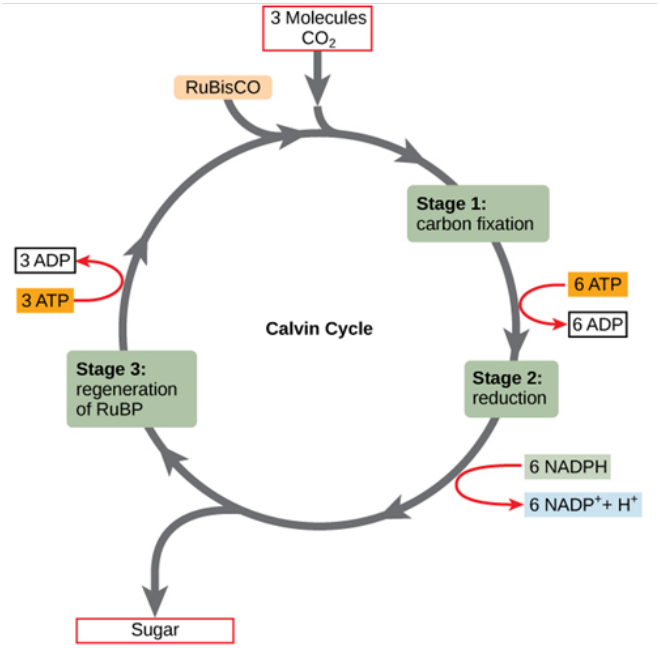
Grasses are the most abundant type of plants on a majority of our Arizona rangelands. One of the principal goals of range management and livestock production is to develop a system of grazing that will utilize the plants during the period of maximum nutritive value without injuring the plant (Humphrey et al., 1952). Livestock animals graze year round. Unfortunately, there is no year round high quality forage source. To reach this goal, managers need to maintain a balance between cool and warm season plants, if a combination of cool and warm season plants are available. Cool season plants typically provide high quality nutrition in the spring while our warm season plants are higher in quality after our monsoon season. Understanding the physiology (internal chemical changes) of cool and warm season plants can further improve the management of these rangeland resources.

All green plants use photosynthesis, a chemical process in which light energy, water, and carbon dioxide (CO_2) are absorbed and synthesized to make water, oxygen, and sugars which are used as food energy.

Light energy + H_2O (water) + CO_2 (carbon dioxide) → H_2O + O_2 (oxygen) + $C_6H_{12}O_6$ (sugar)

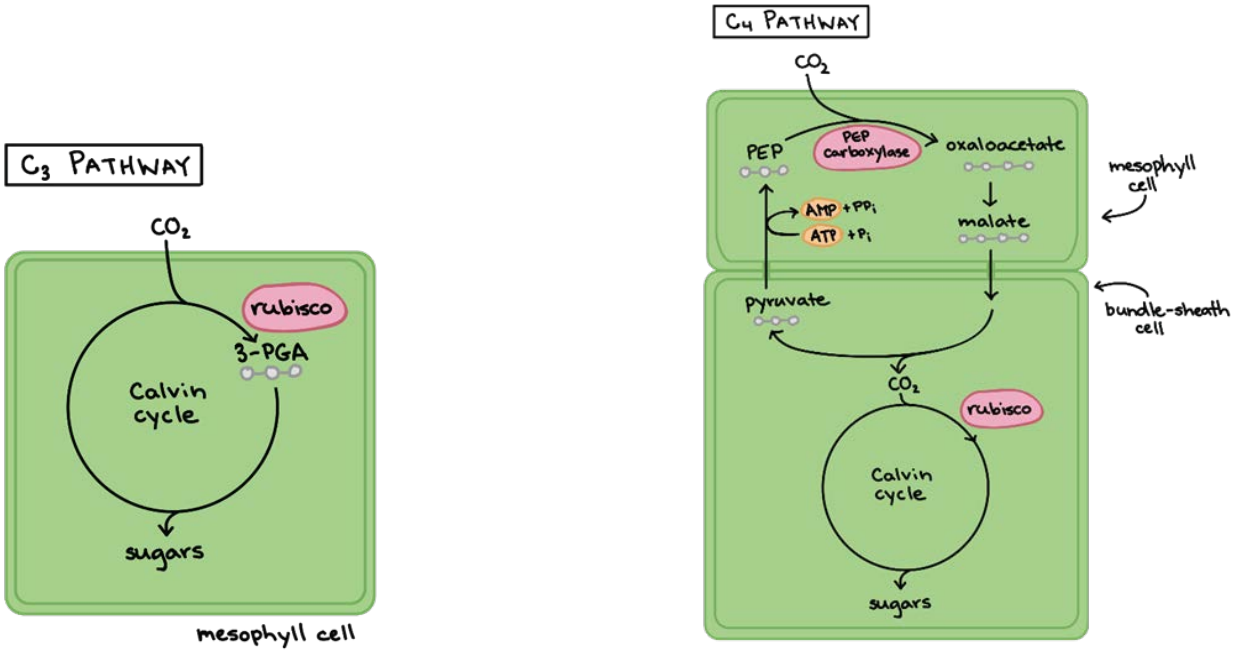
Photosynthesis occurs in two broad steps, a light dependent reaction and a light independent reaction, or a dark reaction. During the light dependent reaction, chlorophyll molecules in the plants absorb energy from sunlight and form energy rich chemical molecules. During the dark reaction, the energy rich chemical molecules combine with CO_2 to form sugars. The different pathways during this dark reaction are what separate our cool and warm season plants.

There are three different types of dark reaction pathways green plants: C_3 (cool season), C_4 (warm season), and CAM (crassulacean acid metabolism used by cacti and succulents). The difference between these pathways are the processes that plants use to fix carbon. Fixing carbon is the way plants remove the carbon from CO_2 and turn it into sugars, known as the Calvin Cycle. The Calvin Cycle is the set of chemical reactions that take place in chloroplasts during photosynthesis.



From: Lumen Learning, 2018. lumenlearning.com

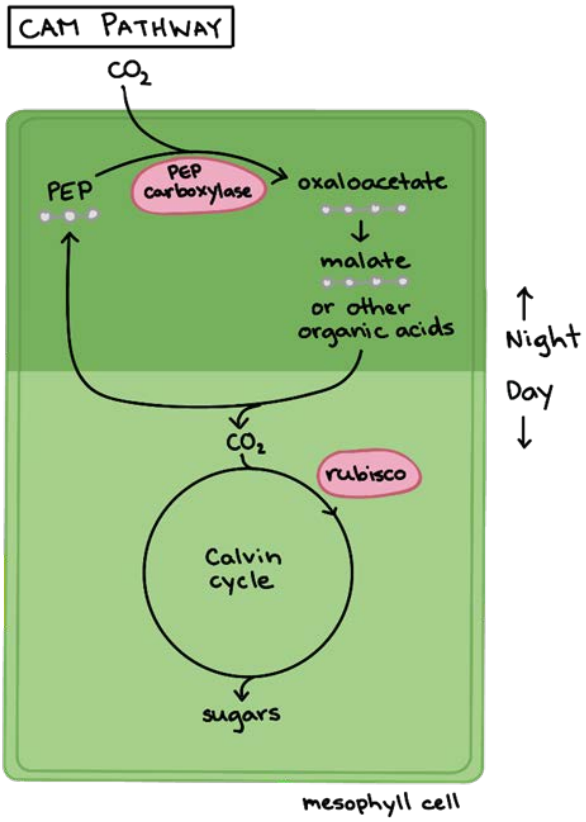
The C_3 pathway gets its name from the first molecule produced in the cycle, a 3-carbon molecule called 3-phosphoglyceric acid. Eighty-five percent of plant species on Earth are cool season plants and use the C_3 pathway to fix carbon via the Calvin Cycle (Moore et al. 2003). During the one-step Calvin Cycle process, an enzyme causes an oxidation reaction in which some of the energy used in photosynthesis is lost in a process known as photorespiration. The result is about a 25% reduction in the amount of carbon that is fixed by the plant and released back into the atmosphere as CO_2 (Biology Dictionary, 2017).



From: Khan Academy, 2018. khanacadem.org

The C_4 pathway was discovered in the 1960's while studying sugar cane and is named for the 4-carbon intermediate molecules that are produced, malic acid. Only about 3% of plants species are C_4 plants and include an additional step prior to the Calvin Cycle which reduces the amount of carbon that is lost in the overall process. CO_2 is fixed in mesophyll cells (inner tissue of a leaf containing chloroplasts) and then transported by the malic acid to bundle sheath cells. Oxygen inside bundle sheath cells is very low, so enzymes are less likely to be oxidized and waste carbon molecules. The malic acid releases the CO_2 in the chloroplasts of the bundle sheath cells and the Calvin Cycle begins (Biology Dictionary, 2018). The photosynthetic efficiency of C_4 plants is very high due to the absence of photorespiration. This pathway evolved as an adaptation to high light intensities, high temperatures, and dryness. Therefore, C_4 plants dominate grasslands and biomass production in warmer climates like Arizona deserts and tropical areas (Edwards et al., 2010).

The CAM pathway used by cacti and succulents is highly adapted to dry climates. The name comes from the family of plants, Crassulaceae, where scientists first discovered the pathway. Instead of separating the light dependent reactions and the use of CO_2 in the same space for the Calvin Cycle, CAM plants separate the process in time. At night, CAM plants open their stomata (pores in the plant that allow respiration), allowing CO_2 to diffuse into the leaves. CO_2 is fixed and converted into malic acid using the same process as C_4 plants. Malic acid is then stored inside vacuoles, or spaces for fluid within the cell, until the next day. During the day CAM plants do not open their stomata, but they can still photosynthesize because the malic acids are transported out of the vacuole and broken down to release the CO_2, which then enters the Calvin Cycle (Bear and Rintoul, 2018). This pathway evolved to avoid photorespiration in order to be more water-efficient. CAM plants stomata only open at night when humidity is typically higher and temperatures are cooler, which results in reduced water loss from leaves. Therefore, many CAM plants occur in very hot and dry climates, such as Arizona deserts.



From: Khan Academy, 2018. khanacadem.org

Type	Separation of Initial CO2 Fixation and Calvin Cycle	Stomata Open	Best Adapted To:
C_3	No separation	Day	Cool, wet ecosystems
C_4	Between mesophyll and bundle sheath cells (in space)	Day	Hot, sunny ecosystems
CAM	Between night and day (in time)	Night	Very hot, dry ecosystems

Adapted from: Bear and Rintoul, 2018

All green plants photosynthesize, and all use the Calvin Cycle to fix CO_2 to make sugars. The different pathways for fixing carbon have different advantages and disadvantages which make plants suitable for different environments. The C_3 pathway works well in cooler and wetter environments, and C_4 and CAM plants are more suited to hot and dry areas. By having a balance of these different types of plants, or knowing where these types of plants are more abundant on our rangelands, managers can develop a grazing plan to optimize the nutritional quality of plants year round if the range has a combination of both cool and warm season plants.

References:

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Biology Dictionary. 2017. https://biologydictionary.net/c3-c4-cam-plants/#ftoc-heading-1

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Humphrey, Robert R., Brown, Albert L., Everson, A.C. 1952. *Common Arizona Range Grasses: Their Description, Forage Value and Management*. College of Agriculture, University of Arizona. Tucson, AZ.

Lumen Learning. 2018. Biology I. https://courses.lumenlearning.com/suny-biology1/chapter/the-calvin-cycle/

Moore, B., Zhou, L., Rolland, F., Hall, Q., Cheng, W. H., Liu, Y. X., Hwang, I., Jones, T. and Sheen, J. 2003. Role of the Arabidopsis glucose sensor HXK1 in nutrient, light, and hormonal signaling. *Science*, 300: 332-336.

Measuring Rangeland Forage Utilization

Ashley Hall and George Ruyle

Measuring forage utilization is a good tool for range managers. However, there are a few key points to keep in mind when using this method. Residual measurements and utilization data can be used to: (1) identify use patterns, (2) help establish cause-and-effect interpretations of range trend data, and (3) aid in adjusting stocking rates when combined with other monitoring data (Interagency Technical Reference, 1999). Utilization is a management tool, not a management objective or standard. Management decisions should be based on information collected over a period of years and take into climate, livestock distribution, season of use, etc. Relying on utilization as an automatic trigger to move or remove livestock without documenting how, when, where it was measured should be avoided. Information collected during monitoring long-term trend efforts should take precedence over utilization when determining management goals and objectives.

Accuracy and precision of utilization measurements is typically low. Different methods often give different results, making it difficult to compare across methods. For example, De Muth (1990) calculated utilization based on current year's growth and found utilization was 17% moderate use and 49% heavy. When De Muth collected utilization in relation to peak standing crop, he found utilization to be 6% for moderate and 17% for heavy use. This also illustrates a method could actually overestimate utilization. Sharp et al. (1994) further compared two other studies in New Mexico and Idaho, which demonstrated utilization may be overestimated.

Interpretation of utilization and residual data must have demonstrated relevance to management decisions. It is important to remember that livestock distribution, season of use and/or grazing system can affect levels of utilization. Utilization mapping as opposed to measuring in one location can provide a better estimate of use in the pasture as a whole. Mapping will provide further insight into actual management issues, there may be a livestock distribution problem as opposed to an overgrazing problem.

Using utilization as a trigger for moving livestock is not consistent with coordinated management. Utilization data alone does not provide adequate information about management objectives. Rangeland trend, climate data, wildlife use, and past management are also key factors that should be taken into consideration. When collecting utilization keep in mind that the season of measurement is important for interpretation. Society for Range Management (1989) defines utilization as the proportion of current year's biomass production removed or damaged by grazing animals. To fit this definition, utilization measurements should only be collected at the end of the growing season. Measurements taken during the growing season are not comparable.

Utilization guidelines based on research in one region may only have general application to specific situations. Standards and guidelines in one area may not be applicable to another based on species composition, plant growth, plant size, soils, precipitation. Height-weight curves for utilization scales or grazed-photo class guides for a specific area can be created using the Utilization Studies and Residual Measurements guide (1999).

References:

De Muth, C. 1990 Seasonal variation in utilization estimated on sideoats grama plants. M.S. Thesis, University of Arizona, Tucson.

Interagency Technical Reference 1734-3. 1999. Utilization Studies and Residual Measurements. National Applied Resources Center. Denver, CO.

Sharp, L, Sanders, K. Rimby, N. 1994. Management decisions based on utilization – is it really management? Rangelands 16:38-40.

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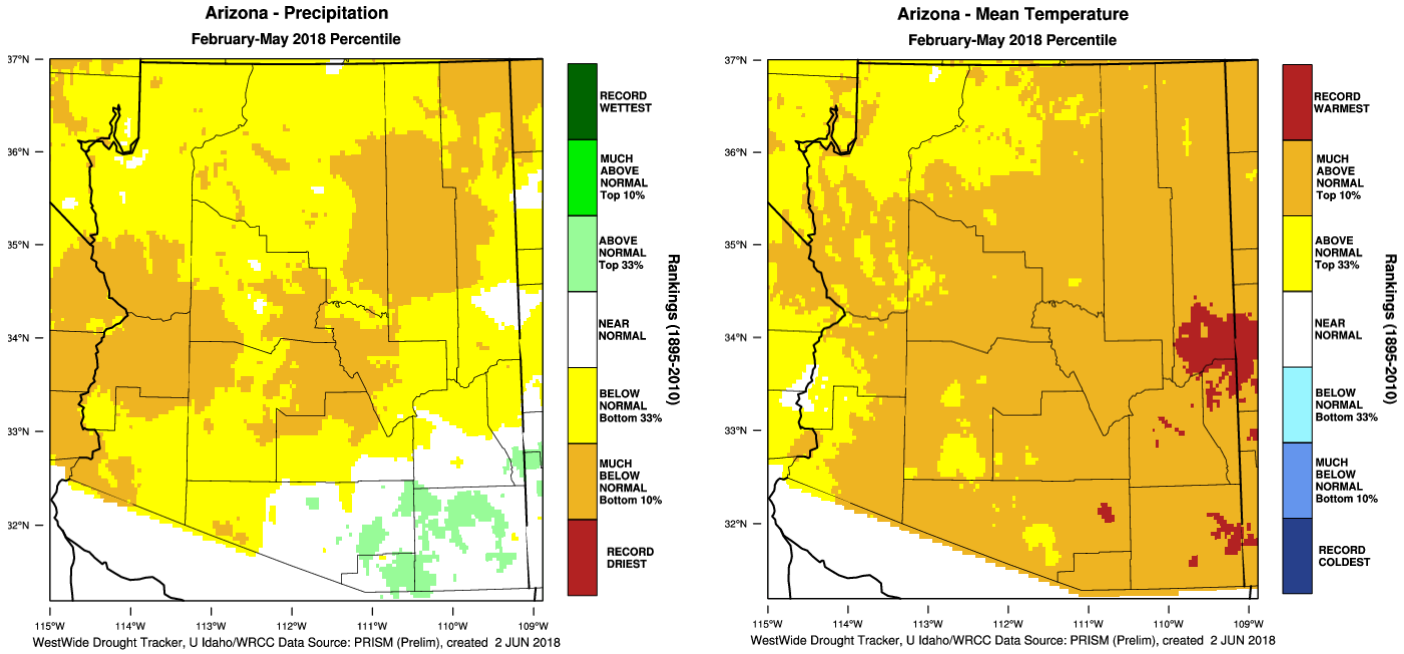
Arizona Seasonal Climate Summary: Spring 2018

June 4, 2018 - The February through May period was a bit wetter with more moderate temperatures in comparison to the record dry and warm winter across Arizona, but overall was still drier and warmer than average. A very warm and wet precipitation event lasting several days occurred in mid-February across far southeast Arizona bringing several inches of rain (over 10 inches at highest elevations in the Sky Islands) to parts of Pima, Santa Cruz, and Cochise Counties. This was the only precipitation that region received over the past several months. Areas to the north didn't observe much if any precipitation in February, but saw more storm activity in the following months of March, April, May. Precipitation amounts were still very light with some higher elevation snow, but overall not enough to come any-where close to average conditions for the period. Winslow, for example, observed several small precipitation events (<0.1") in March and April, but still had its driest October-May period on record (1947-2018, https://goo.gl/bgHcG9).

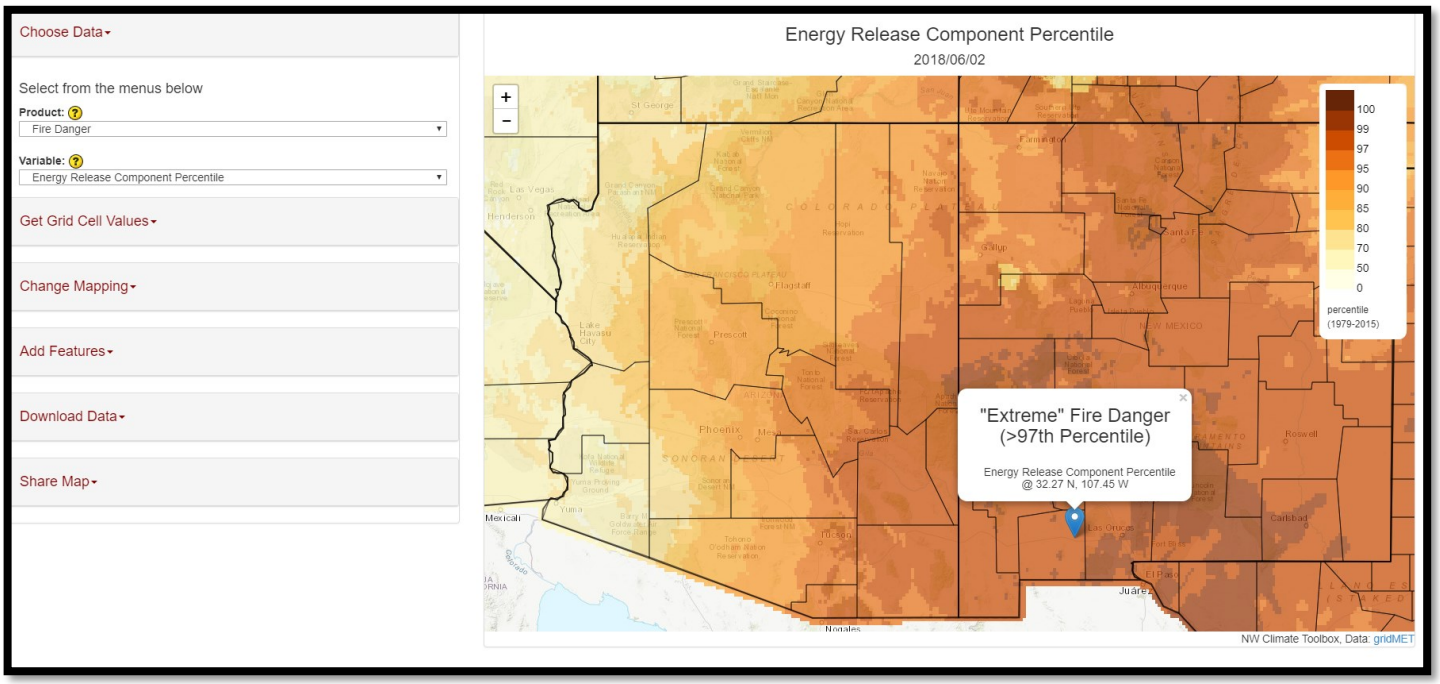
Subsequently, drought conditions have continued to degrade across all of Arizona with almost 75% of the state observing 'Extreme' to 'Exceptional' drought according to the May 31st U.S. Drought Monitor map. The depiction of Extreme to Exceptional drought hasn't been this extensive across Arizona on the U.S. Drought Monitor map since spring of 2002. Temperatures moderated slightly over this period, but continued to be much-above average leading to added drought and water stress. This combination of warm and dry conditions has also enhanced spring wildfire danger across the region to near record levels in some areas.



October-January precipitation and temperature rankings from the WestWide Drought Tracker

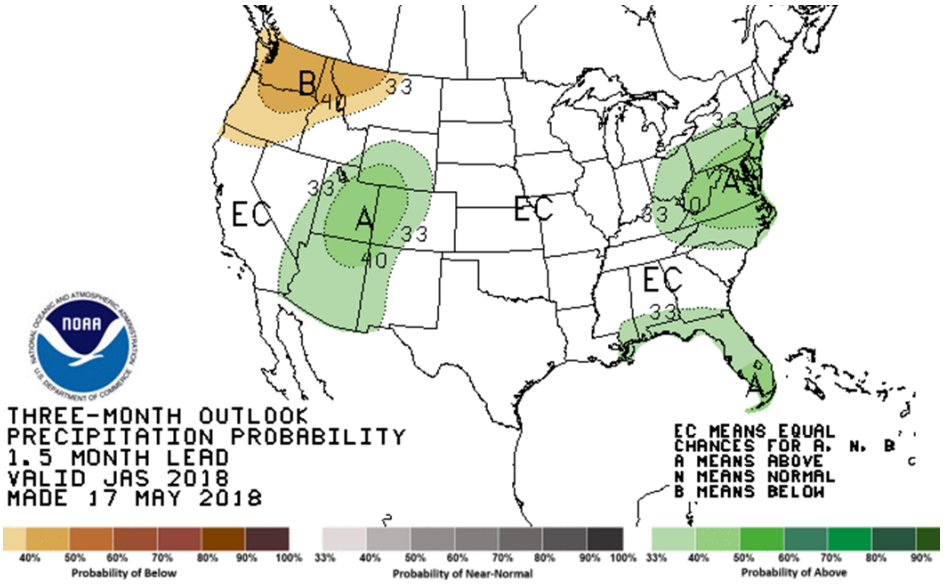
(http://www.wrcc.dri.edu/wwdt/)

More information available at :
http://cals.arizona.edu/climate
http://www.climas.arizona.edu
Questions /comments? Contact Mike Crimmins, crimmins@email.arizona.edu



This map from the Climate Mapper online tool (https://climatetoolbox.org/tool/Climate-Mapper) shows the percentile of Energy Release Component (ERC) values across Arizona and New Mexico on June 2nd. The ERC is a fire danger index used in the National Fire Danger Rating System (NFDRS) and is used to track how hot a fire could burn and how hard it would be to control based on estimated moisture in heavier fuels. Cumulative drought conditions will lead to lower fuel moisture values and higher ERC values showing higher fire danger risk. The map above shows the percentile of observed ERC values for this time of year. Very high percentiles (>97th) indicate very rare ERC values in the observed record indicating how extreme current fire conditions are. Very warm and dry conditions over the past several months have pushed ERC percentile values above the 95th percentile across much of eastern Arizona. These high ERC values will persist until monsoon season precipitation raises fuel moisture conditions and reduces seasonal fire risk. This map is available at https://goo.gl/FnUoS9 .

The July-August-September seasonal precipitation outlook issued by the NOAA Climate Prediction Center in late May depicts an increased chance of above-average seasonal total precipitation for all of Arizona with the largest shift in odds towards wet conditions across northern Arizona. This lean towards wetter than average conditions for Arizona over the upcoming summer monsoon season is being driven by several forecast models that indicate the possibility of above-average precipitation later in the summer, not necessarily an earlier or wetter early monsoon. This may be in response towards a slow progression towards possible El Niño conditions later this summer and enhanced East Pacific tropical storm activity. The official NOAA Eastern Pacific Hurricane Season Outlook also indicates an increased chance of above-average tropical storm activity this upcoming summer season. The impact of tropical storms on Arizona summer precipitation is highly variable from year to year and doesn't always lead to substantial changes in total precipitation. This leads to lower confidence in this seasonal outlook. (More info at http://www.cpc.ncep.noaa.gov/products/predictions/long_range/)



Range and Livestock
University of Arizona Cooperative Extension Resources

Drought and Grazing Dashboard Website https://cals.arizona.edu/droughtandgrazing/dashboard

Summary: Tools for drought information tools, guides to monitor drought conditions, and guides to support the drought planning process. This web site provides access to those tools, guides and other resources to improve drought planning where ever it is needed.

Drought View: Satellite-based Drought Monitoring and Assessment. Jeremy Weiss and Michael Crimmins. Publication #AZ1737
https://extension.arizona.edu/sites/extension.arizona.edu/files/pubs/az1737-2017.pdf

Summary: Remotely sensed data are valuable for monitoring, assessing, and managing impacts to arid and semi-arid lands caused by drought or other changes in the natural environment.

Do-it-yourself Construction Guide: Rugged Accumulation Precipitation Gauge for Remote Monitoring. Micheal Crimmins, Mitchel McClaran, Julie Brugger, Ashley Hall and Douglas Tolleson. Publication #AZ1747
https://extension.arizona.edu/sites/extension.arizona.edu/files/pubs/az1747-2017_0.pdf

Summary: Precipitation is the key variable in assessing drought status and tracking changes in drought conditions. Precipitation is also highly variable in space and time and having your own rain gauge ensures you have data specifically for your location.

Ionophore Toxicity in Horses. Peder Cuneo, Betsy Greene, and Ashley Wright. Publication #AZ1758-2018
https://extension.arizona.edu/sites/extension.arizona.edu/files/pubs/az1758-2018.pdf

Summary: Ionophores are a class of antibiotics labeled for use in cattle, small ruminant, and poultry feed to slow the growth of intestinal coccidia and improve feed efficiency.

Preventing Sand Colic. Betsy Green and Carli Grimbleby. Publication #AZ1759-2018
https://extension.arizona.edu/sites/extension.arizona.edu/files/pubs/az1759-2018.pdf

Summary: Colic is a generalized term for any type of abdominal pain in the horse, most commonly digestive tract pain. There are multiple causes of colic, these include gas build up, a blockage or impaction, a twisted bowel, and enteroliths, among other things.

Rain Gauges for Range Management: Precipitation Monitoring Best Practices Guide. Michael Crimmins, Mitchel McClaran, Julie Brugger, Ashley Hall, Douglas Tolleson, and Andrew Brischke. Publication #AZ1751
https://extension.arizona.edu/sites/extension.arizona.edu/files/pubs/az1751-2017.pdf

Summary: Precipitation in the form of rain and snow is critical to many aspects of working lands from controlling the growth of vegetation used in grazing by livestock and wildlife to recharging local water resources found in springs, tanks and riparian areas.

Understanding Ecological Sites. Andrew Brischke, Ashley Hall, and Kim McReynolds. Publication #AZ1766
https://extension.arizona.edu/sites/extension.arizona.edu/files/pubs/az1766-2018.pdf

Summary: Today, land managers are challenged with synthesizing an overwhelming amount of scientific information concerning soils, hydrology, ecology, management, etc.

Value of University of Arizona Cooperative Extension's Involvement in Immediate Post-Wallow Fire Grazing Recovery. Dari Duval, George Ruyle, and Judith Dyess. Publication #AZ1749 https://extension.arizona.edu/sites/extension.arizona.edu/files/pubs/az1749-2017.pdf

Summary: The University of Arizona Cooperative Extension participated in cooperative efforts to monitor rangeland recovery and assess forage availability after the Wallow Fire that provided critical information supporting the Forest Service's decision to allow grazing to resume on allotments.

Vegetation GIS Data System (VGS) Online Tutorial Videos. Ashley Hall, Andrew Brischke, and Charles Perry
https://www.youtube.com/channel/UC-yp3X3SVqZVcLx_R6NgElQ/featured

Summary: VGS is a software application for recording and managing vegetation and other ecosystem related data. This tutorial series is designed for new and current users of VGS to assist in working through basic program issues.

Clostridial Diseases of Cattle
https://extension.arizona.edu/sites/extension.arizona.edu/files/pubs/az1712-2016.pdf

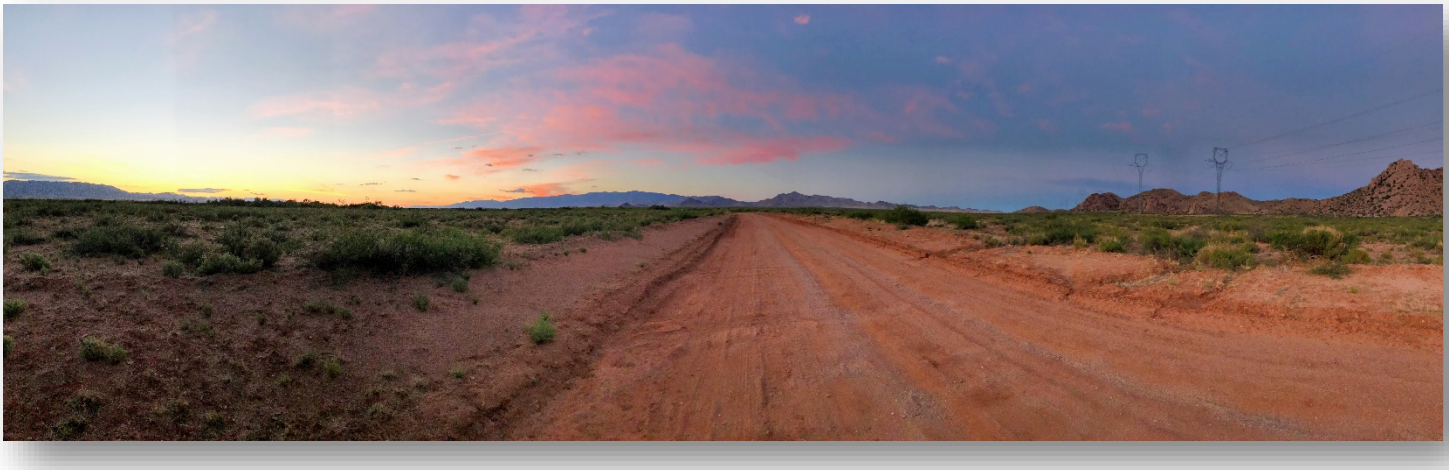
Summary: Clostridial diseases present a risk to cattle in Arizona, however vaccination with a 7-way or 8-way clostridial is an effective preventative measure. Learn about the different types of *Clostridial* bacteria and why it's important to protect your cattle.

Veterinary Feed Directive Changes for Arizona Producers
https://extension.arizona.edu/sites/extension.arizona.edu/files/pubs/az1705-2016.pdf

Summary: The Veterinary Feed Directive rules changed January 1, 2017. This fact sheet covers common questions and misconceptions that affect Arizona livestock producers.

Rabies in Horses: Equine Risk and Prevention
https://extension.arizona.edu/sites/extension.arizona.edu/files/pubs/az1700-2016.pdf

Summary: Although horses do not commonly contract rabies, when they do they may expose a significant number of people. Vaccination is an effective strategy to prevent this fatal disease in ranch horses.



Southeastern Arizona Regional Update

Ashley Wright

How can Cooperative Extension help your operation? The mission of Cooperative Extension is to provide accurate, research based information and bring the science from the universities down to ground level and put it into practice addressing the problems you, the producer, encounter on a daily basis. In addition to the workshops and other education opportunities we put on, you can always reach out to your local livestock or natural resources agent at any time. We are here as a resource: to answer questions, to help find resources for questions we can't answer, to collaborate on applied research projects that can benefit Arizona livestock production and rangeland health. Contact us with your questions or to have us out for a site visit. You can us via phone or email; find our contact information on the back page of this newsletter, or at https://extension.arizona.edu/

Upcoming workshops: The southeast region has several upcoming workshops planned for the early fall in Sells, Benson, and Globe. These workshops will focus on drought management tools on the ranch, including the effects drought has on nutrition, rangeland health, and profitability, insurance options through the USDA, record keeping, and a Beef Quality Assurance certification. Check out the upcoming events page for dates, we may add additional locations or other events. Look for agendas to be sent out later this summer!

Arizona Cattle Growers' Association Update

Heidi Crnkovic
Director of Communications
Arizona Cattle Growers' Association

Now that the final hours at the legislature have been logged, the race is on towards summer convention at the Prescott Resort July 26-28. This will mark the 114th Annual Convention of the Arizona Cattle Growers' Association. These meetings are an integral time for members of the Arizona cattle industry to make their voices heard, help form policy, network, learn and help shape the direction of the association with the added benefit of seeing new products and services at the state's best trade show.

Meetings will kick off the day before convention officially begins on Wednesday, July 25 with Arizona State Cowbelles meetings and the Landowner Lessee Sportsman Relations and Habitat Partnership Committee Meeting (LLSRC/HPC) with the Arizona Game and Fish Department. The LLSRC/HPC meeting includes discussion of opportunities for collaboration to achieve common goals with ranchers and the grant programs that are available to fund habitat enhancing projects for the benefit of wildlife. The Arizona Cattle Industry Foundation hosts their annual meeting Thursday morning.

Multiple educational opportunities will be present with a Cattlemen's College, coordinated by Dr. Dan Faulker and the University of Arizona featuring Stephen Foulke, DVM with "Maximizing Vaccinations: What, When and Why", a panel discussion on herd genetics from the perspective of the Arizona Rancher (Chuck Backus, Quarter Circle U Ranch), bull developer (Bob Prosser, Bar T Bar Ranch) and cattle feeder (Narcisco Perez, Zia Agriculture Consulting) followed by a presentation on common vitamin and mineral issues and their diagnosis in cattle of Arizona by Jeffrey Hall, DVM, Ph.D. Other educational opportunities include a session featuring Scott Teich and Michael McCormack from Lincoln Agribusiness discussing how to best navigate the new tax laws and a Beef 101 education session which will walk attendees through the development of recipes by the beef checkoff program with National Cattlemen's Beef Association's Chef Marci Levine.

Society for Range Management Arizona Section

Iric Burden, President and Andrew Brischke, President-Elect

We find ourselves in the midst of a drought throughout Arizona that seems daunting. We all know the saying about how rain makes managers look good, but it is really the droughts that show the true talents of a truly great range manager, right? I would like to declare that getting through tough situations, such as a drought, the best managers don't do it alone, rather they rely on past teachings, neighbors, friends, family, peers and colleagues to get through. While we can't predict, with certainty, the monsoon season, all of us from Arizona know what possibilities lie ahead. This is when range managers must be at their best and use all the resources possible. That being said, this year seems timely for our Annual Summer meeting to discuss collaboration.

The Annual Summer meeting's theme: Cooperation, Collaboration, and Coalitions will bring producers and agencies together to explore opportunities to work together. The campout meeting will be held August 15 – 17th, 2018 at Moqui Group Campground on the Coconino National Forest near Happy Jack, Arizona in partnership with Diablo Trust. AZSRM are refocusing their efforts to be more relevant to ranchers, the day to day stewards of our rangelands. We would like to extend a special invitation to the ranchers across Arizona to join us at our summer meeting. More information about registration and meeting agenda can be found at: http://azrangelands.org/ or contact Andrew Brischke, AZSRM President-Elect, at brischke@cals.arizona.edu.

July

16-20 **54th Annual Natural Resource Conservation Workshop for Arizona Youth Camp (NRCWAY)** – James 4-H Camp, contact Kim McReynolds: kimm@cals.arizona.edu for more information.

26-28 **Arizona Cattle Growers' Association 114th Annual Convention**, Prescott, AZ see http://www.azcattlemensassoc.org/ for more information.

August

15-17 **Society of Range Management, Arizona Section Summer Meeting,** Happy Jack, AZ, Contact Andrew Brischke for more information: brischke@cals.arizona.edu

29-30 **Applied Reproductive Strategies in Beef Cattle Symposium** – Ruidoso, NM see http://www.appliedreprostrategies.com/ for more information and registration.

September

7 **Drought Management Tools and Resources, Cost: $5 per person –** Benson, AZ, Contact Ashley Wright for more information: awright134@email.arizona.edu

14 **Drought Management Tools and Resources, Cost $5 per person –** Globe, AZ, Contact Ashley Hall for more information: AshleyS3@email.arizona.edu

November

9 **Mesquite Control Workshop** – Elfrida/McNeal, AZ, Contact Kim McReynolds for more information: kimm@cals.arizona.edu

Dates to be Determined

TBD **Drought Management Tools and Resources, Cost $5 per person –** Sells, AZ, contact Russell Tronstad for more information: tronstad@ag.arizona.edu

TBD **Livestock Artificial Insemination Workshop,** (Taking place this fall) – V Bar V Ranch, Contact Ashley Hall for more information: AshleyS3@email.arizona.edu

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