

ANNUAL NEWSLETTER SPRING 2020

ARIZONA

Grain Research & Promotion Council



Chairman's Report *By David Sharp*



Contemplating the content of this annual column has certainly become a habit, as I've recently been told by the Council that I'm to continue in the chairman's role for another year – my 14th consecutive year in the role. I appreciate their confidence in me.

I will say that the role is becoming both more and less challenging as Arizona's grain industry has shrunk substantially over the past several seasons. More challenging for the Council having to spread dwindling

resources among the many worthy projects that can utilize our grain growers' checkoff funds. And, less challenging because there are fewer dollars to allocate to worthy causes and to research projects. In either case, teaming with the other Council members has always been a rewarding experience. So, I expect that reward to continue.

A glance through portions of my last year's newsletter column pretty much verifies that the current less than robust economic picture for growing Desert Durum®, especially in central Arizona, is just a continuation of the situation that has developed in recent years.

General demand for our high-quality durum grain is insufficient to generate price offerings that assure growers that planting Desert Durum® will be a reliable profit-making enterprise. This is particularly true in central Arizona. The fact that western Arizona growers choose to plant wheat in rotation with produce does not alter the basic lack of significant bottom-line profitability of the crop itself. Consequently, Arizona's Desert Durum® acreage now is only about one-third of the acreage planted just five seasons ago.

We can speculate about reasons that contribute to our current small durum crops. The primary current domestic reason is that U.S. millers can source adequate quality durum supplies from existing northern and Canadian stocks at prices that are not profitable for desert production. The fact is that millers tend to come to the desert to especially cover their short-term needs for quality durum grain when northern U.S. and Canadian crops face or experience planting, harvesting and/or grain quality issues. Then, the buyers are willing to pay more for limited quantities of high-quality Desert Durum®.

Another somewhat recent development resulting in lower Desert Durum® acreages has been the complete exit of Nigeria as a significant export market for our crop. For a time, the largest flour mill in Nigeria found it convenient to load modest tonnages of our durum in cargoes of other U.S. wheat classes that shipped out of a Texas Gulf port facility that it owned. This practice was responsible for Desert Durum® exports of up to about 100,000 metric tons per year at one time (equivalent to about 30,000 acres of production). However, that owner has sold the gulf port facility and has been buying cheaper durum from northern U.S. and European sources.

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U.S. Wheat Associates marks 40 years

AGRPC counts over 33 years of USW membership

Leaders with wheat farmer groups known as Great Plains Wheat and Western Wheat Associates merged on January 12, 1980 to become one organization, U.S. Wheat Associates (USW), in order to focus on building overseas demand for U.S.-grown wheat. Today, USW counts 17 state grain groups as members who contribute about \$5.5 million in grower funds annually to support numerous overseas offices and marketing programs that work closely with local wheat consuming and baking industries to enhance demand for the six classes of wheat produced by U.S. growers.



AGRPC joined USW on January 2, 1987, following the first season that Arizona growers paid assessments. Gaining ability for Arizona wheat producers to take advantage of USW's export promotion assistance had been a primary goal of the effort to create the AGRPC, according to the late AGRPC Chairman Russ Schlittenhart.

To mark its 40-year history of success, USW has launched an outreach effort to recognize the growers who produce the wheat and their enduring partnerships with the U.S. Department of Agriculture and with wheat buyers and food processors around the world.

Grower funding provided by those current 17 USW state wheat and grain commissions is complemented by awards of competitive USDA grants totaling more than \$14 million annually. These funds are allocated by the USDA's Foreign Ag Service from congressional appropriations for export market promotion.

USW maintains 13 overseas offices that promote the use of the six market classes of wheat grown by U.S. farmers. Most of the staff at these offices are local citizens. Milling and baking specialists perform trade servicing with local industries to maximize uses and advantages of the U.S. classes. USW also

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A message to Arizona's barley and wheat grain growers

The Arizona Grain Research and Promotion Council was created in 1986, by the Arizona legislature, to be a producer-funded and producer-directed program to assist in developing the state's grain industry to be more productive and profitable. The council participated in the State's sunset review re-authorization process during 2012 and 2013. The 2013 Arizona legislature passed legislation, signed by the governor, which has extended the council's existence and assessing authority until 2023.

Programs and projects in which the council may engage include:

1. Cooperation in state, regional, national or international activities with public or private organizations or individuals to assist in developing and expanding markets and reducing the cost of marketing grain and grain products.
2. Research projects and programs to assist in reducing fresh water consumption, developing new grain varieties, improving production and handling methods and in the research and design of new or improved harvesting or handling equipment.
3. Any program or project that the council determines appropriate to provide education, publicity or other assistance to facilitate further development of the Arizona grain industry.

The council consists of seven members appointed by the governor for three-year terms. Members must be residents and producers in the state and they serve without compensation. Producers seeking consideration for appointment to the council may contact the Arizona Department of Agriculture's council administrator (602-542-3262).

The council has established a check-off fee of \$.02/cwt. (\$.40/ton for 2020) on the barley and wheat of all classes that is produced in Arizona and sold "...for use as food, feed or seed or produced for any industrial or commercial use." Thus, all grain of these kinds is subject to the assessment when it is first sold to a buyer or "first purchaser."

Check-off fees are collected by the "first purchaser" and remitted to the council, in care of the Arizona Department of Agriculture. While producers bear primary responsibility for paying the fee, this liability is discharged if the fee is collected by the first purchaser.

Producers may request a refund within 60 days of paying the fee by submitting the appropriate refund request form available from the council.

The council's quarterly meetings are open to the public. Meeting dates and agendas can be obtained from the ADA council administrator's office.

Producers of grain in Arizona are urged to contact any council member with comments or ideas pertaining to the council's mission or activities. ✂



Promotional & Service Contributions During the 2019 Calendar Year

- Wheat Foods Council (\$500) – Annual "Supporter" membership
- Southwest Ag Summit (\$1,500) – Student breakout session sponsorship
- Summer Ag Institute (\$1,000) – Sponsorship of the annual teachers' educational week program
- Arizona Farm Bureau (\$2,000) – Annual Gold Sponsorship
- U.S. Durum Growers Association (\$100) – Annual "Supporter" Membership
- Arizona AgriBusiness and Water Council Roundtable (\$1,000) – to sponsor a table for AGRPC members
- Racin' Bacon Derby Dinner – Swag bag sponsor to raise funds for Arizona Farm Bureau's Educational Farming Company (\$1,000)
- Table sponsorship for FFA Foundation's Blue and Gold Gala in 2020

AGRPC Members

(All terms expire Jan. 31 of year noted)

David Sharp, Roll (2022)

Chairman

Cell: 928-941-1738

davidsharp@hughes.net

Michael Edgar (2022 – reappplied)

Barkley Seed, Inc., Yuma

U.S. Wheat Associates Board

Phone: 928-782-2571

Cell: 928-246-9947

medgar@barkleyseed.com

Larry Hart, Maricopa (2021)

Treasurer

Cell: 520-251-1059

larryhart@agristar.net

Richard Heiden, Buckeye (2022)

Cell: 623-695-5556

richweiden@gmail.com

Paul Ollerton, Casa Grande (2020)

Cell: 520-560-6111

Pacol441@gmail.com

Jason Walker, Casa Grande (2020)

Secretary (reappplied)

Cell: 520-620-9003

jasoncwalker@gmail.com

Eric Wilkey (2021)

Arizona Grain, Inc., Casa Grande

Phone: 520-836-8228

Cell: 602-390-2122

ewilkey@arizonagrains.com

Paul Ollerton will not reapply for appointment. Thomas Wurtz (Casa Grande) has applied to succeed Paul Ollerton. Appointments are pending at the Arizona governor's office.

AGRPC's FY 2019* Financial Statement

Beginning Funds Balance \$189,129

Income items:

Total Assessments \$93,743

Investment Income 3,672

Less refunds to producers (4,818)

Net Income \$92,597

Total Operating Funds Balance \$281,726

Expenses

Executive Director \$18,000

AZDA Administration 7,500

U.S. Wheat Associates 32,100

Travel & Meeting 9,255

Desert Durum® Quality Survey 4,718

Annual Newsletter 1,503

Promotion & Advertising 18,318

Research Projects 72,434

Total expenses \$163,828

Ending Funds Balance \$117,898

Encumbered Misc. Funds (46,749)

Unencumbered Funds Balance \$71,149

*Fiscal year was July 1, 2018-June 30, 2019

John Skelley, former AGRPC member and AZ grain industry executive

John C. Skelley, 66, who served on the AGRPC from 1994-2001, passed away unexpectedly on August 15, 2019 in Idaho after retiring and relocating to Boise. Skelley was a fixture in the Arizona grain industry for over two decades, as president of Arizona Grain, Inc. of Casa Grande from 1984-2006 and then as general manager of Pinal Energy, LLC, Maricopa, AZ from 2006-2010.



John was born in Kansas and moved to Tempe, AZ as a teenager. He graduated from McClintock High School in 1971. His college education began at the University of Arkansas as a football recruit before he eventually transferred to Arizona State University, from which he earned an undergraduate degree in business administration in 1975. He then earned a masters degree from the American Graduate School of International Management in Glendale in 1976.

Skelley's early professional career involved managing Mississippi River grain barge terminals, where he learned corn hedging at the Chicago Board of Trade. He also managed corn and milo exports through a Gulf of Mexico port facility.

He arrived in Casa Grande in 1986 to assume management of Arizona Grain (AZG) when it was a grower cooperative, eventually leading conversion of the business to a privately-owned company. His accomplishments and responsibilities at AZG included: co-founding of Arizona Plant Breeders; acquisition of Valley Seed Company; implementation of a durum wheat grain export program that featured "varietal identity-preserved" production contracting with growers and serving the export market in Europe and South America; and oversight of seven grain terminals and seed processing plants in Arizona, California, and Colorado. He also oversaw completion of a new shuttle train grain handling terminal that can load/unload 100-car unit trains in 15 hours.

According to AZG's current president, Eric Wilkey, John's grain customer connections were tested severely in early 1996 after karnal bunt was discovered in Arizona. The company had originated a cargo of Desert Durum® that was at sea, headed for the Republic of South Africa (RSA), when the fungus was declared a quarantine issue by the USDA. RSA would not let the ship unload and the customer considered dumping the grain at sea. Skelley found that the only country in Europe that could accept the grain was Germany, where he had a close relationship with one potential customer. That buyer eventually purchased the cargo and the RSA buyer was partially compensated for its loss.

When the owners of AZG decided to build an ethanol plant near Maricopa, John was tapped to oversee the facility's construction and initial operations.

After leaving Arizona, John worked for Central States Enterprises in Florida, merchandising corn on a national basis. He ended his career as a grain trader in Kansas City for West Plains, LLC.

John's industry service roles included serving on the executive board of the National Grain and Feed Association in addition to his time as an AGRPC member, which is a gubernatorial appointment.

John Skelley is survived by his wife, Jan, of Boise, by sons Austin and Brock and daughter Caitlin and their respective spouses and by seven grandchildren. His three sisters in Arizona also survive him. A memorial service was held in October at the North Rim of the Grand Canyon at his request. ✕

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Fortunately, loyal Italian export customers have continued buying our durum, if not at quite the pace of recent years. Last year's column discussed some of the issues that Italian buyers contend with to import durum from the U.S. Some are regulatory in nature, such as limits on heavy metals (e.g., cadmium) and country-of-origin labeling requirements. Other issues may be self-imposed, such as sustainability concerns and ultra-low glyphosate residue limits.

Summing up prospects for the current Desert Durum® market requires assessment of existing supplies and speculation about how the northern U.S. and Canadian crops may turn out. At present (late March), durum stocks have declined as millers have sourced their needs from carry-over stocks. Still, a supply of decent quality grain remains so millers aren't anxious now about future sources. Only time will tell how the high-volume northern durum production areas will fare regarding weather and grain quality in the 2020 northern season. The sense is that these acres will be somewhat greater than in 2019.

Arizona's 2020 Desert Durum® acreage, at 50,000 acres, tops the record low 34,000 acres planted in 2019, according to the USDA. However, it is concentrated in the Colorado River regions, where rotational needs predominate. Land rents are higher there than in central Arizona but irrigation water costs less. Meanwhile, the 17,000 barley acres planted for 2020 are similar to totals in recent years and much of this will be chopped for silage.

Quality still matters

Despite the ongoing dismal outlook for Desert Durum® profitability, buyers are going to continue to expect our grain crops to meet their quality expectations. Skimping on crop input requirements will usually not help net crop returns if doing so results in grain going to livestock feed or getting deeply discounted for low protein or low HVAC. Desert Durum® is often purchased by variety, so handlers contract for needed tonnage and rely on growers delivering to quality expectations.

The AGRPC urges all Arizona growers to help maintain the reputation of Desert Durum® as the most reliably high quality durum grain produced in the world. This objective means providing the attention and nutrient inputs needed to achieve high HVAC and satisfactory protein content. ✕

Expressions of gratitude

Arizona Department of Agriculture staffers who assist the Council in various ways include Assistant Director Susan Chase, Assistant Attorney General Deanie Reh, and Council Administrator Lisa James. Lisa has served as the AGRPC's primary liaison with the Department for 16 years. She handles open meeting compliance issues, most of our official documentation, and financial record-keeping with expertise and good humor. We thank you, Lisa.

I also recognize AGRPC's Executive Director Al Simons for his 25 years in that role of supporting AGRPC activities and representing the Council within Arizona and elsewhere. ✕

This annual report and newsletter of the Arizona Grain Research and Promotion Council was edited and published by the AGRPC's contracted executive director, Allan B. Simons. E-mail: simons42ab@gmail.com. Phone: 530-429-1221. Contact the Arizona Department of Agriculture to obtain remittance and refund forms. 1688 W. Adams St., Phoenix, AZ 85007. Lisa James, Council, Board, and Commission Administrator. E-mail: ljames@azda.gov. Phone: 602-542-3262. Fax: 602-364-0830.

AGRPC's Eric Wilkey completes term as chair of National Grain and Feed Assoc.

Eric Wilkey, President of Arizona Grain, Inc. and long-time AGRPC member, stepped aside from his two-year term as chairman of the National Grain and Feed Association (NGFA) into the role of past chairman during the group's annual meeting in Austin in March 2020. He will now assume the role of chair of the group's executive committee for the next year.

The NGFA is a trade association of about 1,200 member companies that participate in all sectors and aspects of the grain and feed industries. The association's activities include issues and policies involving feed, commodity trade, safety, farm bills, biotechnology and transportation, among others.

Wilkey began his service with the group in 1995 by volunteering to serve on the Country Elevator committee and progressed through leadership roles to the chairmanship in 2018. He states that the issues of greatest focus during his chairmanship have dealt with the correction of a major unintended error in the new tax code that Congress adopted in recent years and efforts that led to the trade agreements recently announced by the Trump administration.



NGFA officers assumed new roles during the group's annual meeting in Austin, TX on March 9. L-R: President & CEO Randy Gordon; Past Chairman Eric Wilkey of Arizona Grain, Inc.; Chairwoman JoAnn Brouillette of Demeter, LLP in Fowler, IN; and First Vice Chairman Greg Beck of CGB Enterprises, Covington, LA. ✕

2019 Arizona Karnal bunt survey results

Information released by the USDA/APHIS-PPQ in Phoenix following the 2019 Arizona wheat grain crop harvest indicates that none of the 35 wheat (a host crop) fields located in Arizona's Karnal bunt (KB) quarantine areas tested positive for the fungus. This result mirrors the zero KB findings in 187 host crop fields in the 2018 crop. The most recent KB observations in Arizona were five (5) positive fields identified in the 2017 crop's 176 host crop fields. Each host crop field in the regulated area is observed at harvest by examining a four-pound sample of grain (about 35,000 kernels) for bunted kernels.

The 2019 regulated area totaled 388,854 gross acres (crop and non-crop), down 52,754 acres from 2018. Wheat was planted on 1,448 acres within the regulated area in 2019, down 5,657 acres from 2018.

Why are Arizona wheat fields tested for Karnal bunt?

The KB quarantine was implemented in 1996 after bunted

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maintains two offices in the U.S. The headquarters office is in Arlington, VA and a western office is situated in Portland, OR.

AGRPC member Michael Edgar of Barkley Seed, Inc. in Yuma says that the fledgling USW organization played an important role in the very beginning of Arizona's varietal identity-preserved Desert Durum® production successes. It happened that USW sponsored a visiting trade team consisting of potential European customers that visited the desert in 1983. While evaluating durum grain samples, an Italian visitor focused on a sample that displayed an attractive dark vitreous amber color and requested to receive a small quantity. The variety turned out to be WestBred 881, which became an early staple of exports to Italy.

A number of USW-sponsored trade teams have visited Arizona and Southern California in the decades since that first team. Groups representing Morocco, Algeria, South Africa, the EU, and Peru have learned about Desert Durum® and its unique qualities as a semolina milling wheat.

Despite representing a relatively small wheat-producing state, the AGRPC has maintained a significant presence in the USW membership picture and its modest funding of USW is hugely leveraged by the major wheat-producing states, the largest of which supply funding of as much as \$1 million. In addition, Michael Edgar served in the elected member officer rotation from 2006-2010, and as chairman in the 2008-2009 period. Overall, Edgar considers that AGRPC's membership in USW has benefitted Arizona's reputation as a producer of premium quality durum wheat. ✕

kernels were found in samples from 17 Arizona wheat fields. The pathogen has been recognized as a federal quarantine pest since about 1983.

KB quarantine regulations enforced by APHIS-PPQ require that all wheat fields located within the regulated areas be sampled and examined for bunted kernels before harvest. Grain from fields in which bunted kernels are found must be treated and used only as animal feed. Fields in which KB is found are designated as positive regulated fields and all cultivatable fields which are located within a three-mile buffer area fall under the KB regulations.

Positive regulated fields can be removed from their positive status by meeting a five cumulative years of tillage requirement. Deregulation of a field may reduce the size of the regulated area. Fourteen (14) formerly positive fields met the five-year tillage requirement and their positive status was dropped. Release of these 14 fields from their positive status reduced the regulated area by 38,547 field acres that included 211 fields. The areas with reductions include: La Paz County with 2,167 field acres removed; Maricopa County with 29,353 field acres removed; and Pinal County with 7,027 acres removed from the KB regulations.

For the 2020 crop year, there are 3,366 fields and 131,296 field acres within the KB regulated area.

Source of KB information

APHIS/PPQ in Phoenix can inform growers of the potential regulated status of their fields and cultural requirements to remove them from regulation (Phone 602-431-3202). A brochure published by the U of AZ contains management practices that may minimize the likelihood of KB infection in host crops in Arizona. Find it at www.cals.arizona.edu/pubs. Search for Pub Number 1287. ✕

Research reports – 2019 growing season

Note: Grants 19-01, 19-02 and 19-04 were all submitted and reported by Principal Investigator Dr. Michael J. Ottman, Extension Agronomy Specialist and Professor, College of Agriculture and Life Sciences (CALS), University of Arizona.

Note: Complete versions of these reports are found at the following website: <https://agriculture.az.gov/boards-councils/arizona-grain-research-promotion-council>. Once there, scroll down to "Previously Funded Research"

19-01: Tools for Nitrogen Management of Wheat

Rationale and objectives: Nitrogen (N) fertilizer is normally applied to wheat based on one or more of the following decision points: on a predetermined recipe of quantity and timing; on visual appearance of the crop; or with the aid of a feedback approach using a nitrogen management tool. The first two approaches are subject to under- or over-estimation of crop needs compared to feedback approaches.

The most common feedback approach used in Arizona has been correlation of lower stem nitrate content at various growth stages with previously determined crop performance data. However, this approach requires lag time to dry and lab-test for nitrate before N-fertilization decisions can be made

Tools for N-management that deliver instantaneous results include: 1) a leaf chlorophyll meter, and 2) an optical sensor that measures reflectance of radiation from the crop canopy. Each of these methods requires correlation of previous data collection results to crop performance. These methods are promising but the protocols for N-management in wheat in Arizona have been lacking. The immediate goals and objectives of this project during the 2019 growing season were to investigate the use of the chlorophyll meter and the optical sensor for wheat N- management in Central Arizona.

Procedures: Field trials were conducted at the University of Arizona Maricopa Agricultural Center, where data collected using four nitrogen management tools were compared at multiple nitrogen rates. The durum varieties 'Powell' and 'Tiburon' were planted with a grain drill at a rate of 150 lbs. of seed/acre. Nitrogen fertilizer in the form of urea (46-0-0) was applied at 8 rates from 0 to 350 lbs. N/acre and split equally among five applications. The experimental design was a split plot with two varieties as main plots and eight N rates as subplots, with four replications. The subplot size was 20 ft x 20 ft.

The nitrogen management tools investigated in this study were: 1) lower stem nitrate; 2) Minolta chlorophyll meter (SPAD 502); 3) Greenseeker active-light handheld crop sensor; and 4) a Cropscan passive multispectral radiometer with 16 wavelength bands (MSR 16). The wavelengths measured by multispectral radiometer included portions of the spectrum in the visible range and into the near infrared.

Editor's note: Readers who are interested in viewing the actual crop data and other details of the results are urged to access the final report in the AGRPC's pages on the website of the AZ Department of Agriculture – detailed above

Results and Discussion: Yield and other crop characteristics were very responsive to nitrogen fertilizer rate. Yield increased with nitrogen rate up to about 250 lb. N/acre after which yield decreased with increasing N rates. Test weight was not affected by N rate. Seed weight was lowest where no N fertilizer was applied and at the highest N rates. Plant height increased with N rate similar to the response of grain yield. Lodging occurred at N rates of 250 lb. N/acre and higher. HVAC and grain protein increased with N rate. The durum crop responded to N fertilizer in a predictable and expected way. The optimum N rate for yield was 250 lb. N/acre.

The various nitrogen management tools tested in this study increased in their respective numeric values with N rate at all sampling times, locations, and varieties.

Grain yield was correlated with the various nitrogen management tools tested in this study. The correlation coefficient (r) with grain yield was 0.25 for stem nitrate and 0.51-0.57 for the SPAD readings on the first through fifth fully expanded leaves. However, the correlation coefficients for the spectral indices were generally higher and ranged from 0.42 to 0.73. NDVI (normalized difference vegetation index) measured using the Greenseeker Handheld Crop Sensor and the Cropscan MSR-16 multispectral radiometer averaged 0.72. The highest correlation coefficients were obtained from Red Edge NDVI (0.92) and Red Edge Chlorophyll Index (0.91). The differences in correlation coefficients of yield vs. the spectral indices may not be of practical significance except for Green VI, which had a much lower correlation coefficient (0.42) with yield than the other spectral indices (0.68-0.72).

In conclusion, the spectral indices we measured in this study show promise as tools for determining when and how much nitrogen fertilizer should be applied.

Dr. Pedro Andrade Sanchez collaborated on this project.



Handheld optical sensor meter. Such a meter is one means by which growers may eventually determine the nitrogen status of their wheat crops. Readings taken with the meter could be correlated with readings taken over a limited area test crop strip that has received what typically would be an optimum rate and timing of nitrogen. Eventually, additional research data may be developed and published that could be the reference evidence that determines the timing of subsequent nitrogen applications. At this point in time (2020), commercial availability of these sensors is likely problematic.

Perhaps a more practical means of scanning a crop than walking the field holding a meter would be to attach one to a drone to more thoroughly and rapidly complete the task.

19-02: Small Grains Variety Testing – 2019 crop

Small grain varieties are evaluated each year by University of Arizona personnel in collaboration with the state's private breeding programs. Barley and wheat variety trials are established at Maricopa Ag Center and at private program field sites near Arizona City and the Gila and Colorado River Valleys near Yuma. Varietal growth, yield, and grain quality data are summarized and published by the University of Arizona.

Varietal entries and results for 2019 and prior years are available at the following University of Arizona website: www.cals.arizona.edu/pubs. Search for Pub. 1265.



2019 Small grains trials at MAC. Left border - low input barley seed increase. Next 2 borders - N management trial. Center border – variety yield trial. Right 3 borders – triticale forage yield trial.

19-04: Drought Tolerance in Barley: Discovery of a Possible Mechanism Involving Root Tip Characteristics

Rationale: and scope: Producing crops in desert regions in a sustainable manner is a world-wide challenge, especially as it applies to water use efficiency. Development of drought-tolerant crop plants is one approach to dealing with this challenge. Successful examples in Arizona include drought-tolerant (DT) barley and wheat lines developed by the USDA-ARS and the University of Arizona. The underlying “mechanisms” of such advancements are unclear. However, the availability of these DT lines provides opportunity to study them with the goal of determining the nature of their DT attribute. Gaining such knowledge may then be applied to more efficiently develop widespread drought tolerance in all crops.

Preliminary studies conducted in 2018, supported by the AGRPC, showed differences existing in the root systems of DT cultivars vs. conventional cultivars. DT barleys produced more root border cells than did conventional cultivars. Previous published studies have shown that root border cell numbers and amount of mucilage production in various cereal crops, including corn, oats, wheat, and rye, are positively correlated with colonization by mycorrhizal fungi. These fungi are beneficial soil microbes that help plants grow by attaching to their roots, thereby facilitating mineral nutrition, protection against plant pathogens, and increased water uptake.

The evidence stated above strongly suggests that the study of root border cell-mycorrhizal interactions may help to define mechanisms of drought tolerance in plants, thus contributing to the development of sustainable agricultural practices in arid zones. It is suggested that a higher number of root border cells promotes the establishment of mycorrhizal colonization and improves water absorption.

The main objective of this research was to determine the underlying mechanisms of drought tolerance in cereal crops. To accomplish this goal, the University of Arizona research team studied barley and wheat root traits (specifically root tip border cells and root tip mucilage) that could promote mycorrhizal colonization and consequently improve absorption of water. This project could potentially contribute to two AGRPC objectives: reduction of freshwater consumption and development of new grain varieties.

Procedures: Seventy (70) lines representing DT and conventional barley and wheat varieties were planted at the Maricopa Ag Center to characterize root samples during the 2019 growing season. DT lines were chosen from remnants of the breeding program of the late Dr. R. T. Ramage, former USDA-ARS and U of A small grain breeder. Conventional lines were commercially available cultivars. Root samples were taken during February 2019 and analyzed for relevant characteristics including

root tip border cells and root tip mucilage, with results correlated with the known DT of each cultivar.

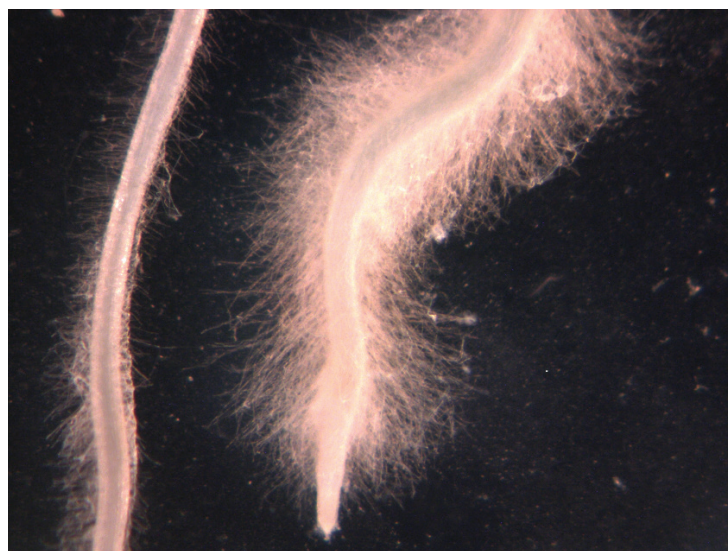
Results and Discussion: Statistical analyses indicated that border cell numbers from high input barley and low input wheat lines have a positive linear relationship to mycorrhizal colonization as confirmed by their respective correlation coefficients. Conversely, border cells from low input barley and high input wheat did not present a positive relationship to mycorrhizae. Also, mucilage production revealed weak linear negative relationships to mycorrhizal colonization in both barley and wheat lines.

Root tip characteristics: The number of root border cells and mucilage area in barley differed from evidence found in a previous study. This could be due to the low number of observations in this study, or to seeds coming from differing lots, or to high variability among barley seeds. Wheat root tips also presented a high degree of variation in border cells and mucilage. Multiple root tips that develop in germinating seeds may present differing border cell numbers and mucilage production.

Mycorrhizal colonization. A low colonization rate was observed in most barley and wheat lines in this study. Root samples were taken early (February) in the growing season of these crops, which may suggest that mycorrhizae were not fully developed. For future studies, root samples should be taken at different growth stages.

Conclusions: The positive correlation between border cell numbers and mycorrhizal colonization of high input barley and low input wheat lines supports previous observations suggesting that border cells may promote the establishment of mycorrhizae. This evidence suggests that root border cells could play a role in the mechanism responsible for drought tolerance in low input lines. However, it is interesting that low input barley or high input wheat lines are not associated with mycorrhizae colonization. Contrary to results observed in previous studies, results from the four groups of barley and wheat indicate that mucilage production is not involved in promoting mycorrhizal colonization.

Nevertheless, it could be useful to consider lines that produce high border cell numbers in drought tolerance breeding programs in order to improve water absorption in barley or wheat. Overall, the observed positive correlation between border cells and mycorrhizae numbers suggests that root border cell numbers may be a low-cost and simple means to screen for enhanced drought tolerance in cereal crops. ✕



Conventional (left) and low-input (right) barley variety root tips display dramatically different root tip hairiness. The low input variety “Solar” was developed by the University of Arizona.

Research projects funded – FY 2020

20-01: Development of an APP for Durum Wheat Water Management (\$17,082) – Submitted by Paul Brierly, Executive Director, YCEDA, as spokesperson for a larger project involving other public and private partners.

Rationale: This project addresses AGRPC's Priority for "Reduction of Fresh Water Consumption." Durum wheat grown in the desert is established by seeding into soil moisture after pre-irrigation, by sprinkler irrigation after seeding, or by basin surface irrigation after seeding. All wheat is surface irrigated. Accurate estimation of crop evapotranspiration (ET) is a critical aspect of efficient irrigation management after stand establishment. Irrigation timing and quantity are determined by allowable depletion and/recharge of soil profile water such that crop yields are not imperiled.

The depletion of soil moisture in crops can be estimated directly by soil sensing devices or from weather-based ET measurements obtained by sophisticated ground-based equipment and by satellite imagery measurements. AGRPC has funded previous research that has contributed to the collection of ET data that can be applied to determining irrigation management in wheat in Yuma and Maricopa Counties.

Objective: To develop algorithms for a component of a mobile phone APP management tool that will allow wheat growers to use existing databases and current and historical weather data, satellite imagery and revised crop ET coefficients to make durum wheat irrigation decisions based on ET data and soil salinity needs.

Collaborators in this project will include Dr. Charles Sanchez, U of AZ Department of Environmental Science and Dr. Andy French, USDA-ARS Arid Lands Ag Research Center.

20-02: Small Grains Variety Testing (\$5,457) – Submitted by Dr. Michael Ottman, Extension Agronomy Specialist and Professor, College of Agriculture and Life Sciences (CALS), University of Arizona.

Rationale: The seed is the starting point in crop production. Seed companies provide variety characteristics but there is still a need for unbiased testing of varieties overseen by an independent entity such as the U of A. Small grain varieties can differ greatly in their adaptation and performance characteristics and statewide testing provides useful varietal information.

Objective: Evaluate performance of commercially available barley and wheat varieties at the Maricopa Ag Center and by private breeding programs in Arizona City, the Gila Valley and the Yuma Valley.

Procedures: Commercially available varieties of durum (about 12) and barley (about 6) will be evaluated at each location. The plots will be small (5 ft x 20 ft) and will not include experimental varieties. Measurements will include heading, flowering, and maturity date, plant height, lodging, test weight, grain protein, and yield. The University of Arizona will summarize all the data and compile a report.

Variety testing collaborating researchers: Eric Norton of Arizona Plant Breeders; Kirk Dunn of Dunn Plant Genetics; and Donny Gray of Second Nature Research.

20-03: Alternatives to Glyphosate for Use In and Around Wheat Fields in Arizona (\$7,500) – Submitted by Barry Tickes, U of AZ Area Agriculture Agent, Yuma, La Paz and Mohave Counties.

Rationale and scope: Weeds can be a problem in and around wheat fields, from pre-planting to harvest, and consist of a wide range of both broadleaf and grass species. Weeds often grow along ditch banks, roads, fence lines and other locations where they cannot be mechanically controlled. While herbicides exist

for controlling these weeds in Arizona, there is a need for broad spectrum, nonselective herbicides that have low risk of being detected in adjacent crop fields (especially wheat) through either spray drift, component volatilization or residue in soil after use on non-grain crops.

Glyphosate is an effective non-selective herbicide to control weeds in non-crop areas. It possesses low volatility and is barely detectable in soils when applied to control preplant weeds or on glyphosate resistant crops. However, glyphosate has come under heavy scrutiny in recent years as a possible human carcinogen, leading to lawsuits decided in favor of plaintiffs as well as to implementation of very low detectable limits in grain products in some countries that import Desert Durum®. In addition, several serious glyphosate-resistant weed problems have developed in some localities outside of Arizona.

The quantity of concerning issues related to use of glyphosate around wheat fields strongly suggests that alternatives to its use around Arizona wheat fields will be an important endeavor. Alternatives would be broad spectrum, non-volatile, and have no soil residual presence. Identifying such alternative(s) is the objective of this project.

Procedures: Replicated field plots of durum wheat were established at the University of Arizona Yuma Ag Center in October 2019, to evaluate weed control effectiveness, chemical volatility, and soil residual activity of 15 EPA-approved herbicides that might be able to be utilized in place of glyphosate to control weeds around and in crop fields. The 15 herbicides represented five modes of action. Wheat, lettuce, broccoli, and spinach will also be planted in plots that are treated with the herbicides to determine their potential toxicity to those crops. Several crops will also be planted across the treated areas to evaluate residual toxicity during the following season. ✂



A "Pre-Season Wheat Meeting" was convened at the University of Arizona's Yuma Ag Center in October 2019. It was sponsored by U of AZ's Cooperative Extension Service and the Yuma Center of Excellence for Desert Agriculture. The program featured presentations on measuring the evapotranspiration of wheat, on food industry calculations of water footprint for growing wheat in the desert, on tools for managing nitrogen fertilization of wheat, and on using sensors to manage nitrogen applications.

Panel discussions featured the outlook for wheat marketing and wheat varieties available for planting in the desert. Representative of Arizona's three breeding companies (above) discussed their programs. L-R: Donny Gray (Second Nature Research); Wesam AbuHammad (Arizona Plant Breeders) and Kirk Dunn (Dunn Plant Genetics) ✂

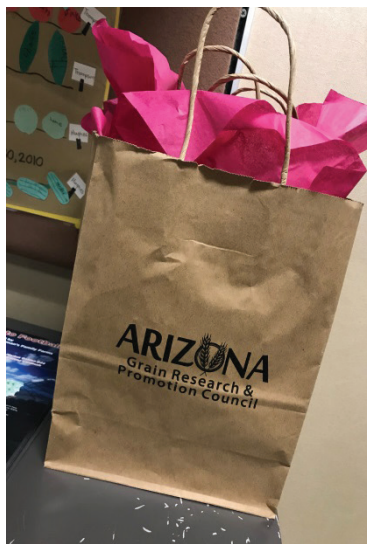


2020 FFA Blue & Gold Gala silent auction set-up.



The AGRPC sponsored a table for the 4th annual Blue & Gold Gala, "The Biggest Night in Arizona Agriculture." Over 600 attendees came together in Scottsdale to celebrate youth in agriculture. This year the event raised \$257,670 to support programs such as the FFA Career Development Events, proficiency awards, scholarships, Supervised Agriculture Education Programs, leadership development programs and much more.

The Foundation helps support agriculture education and the FFA in Arizona through the Arizona Association FFA, Arizona Agriculture Teachers Association, the Department of Agricultural Education, Technology & Innovation in the College of Agriculture & Life Sciences at the University of Arizona and the Arizona FFA Alumni.



AGRPC once again sponsored the giveaway swag bag at the Racin' Bacon Derby Dinner put on by the Arizona Farm Bureau on its office lawn in October 2019 to raise funds for its Educational Farming Company. Over 150 guests enjoyed betting on piglet races and silent auction bidding. The affair raised over \$20,000. Above, one of the racing piglets is introduced to an adoring fan.



AGRPC Chairman David Sharp helped promote the Council's mission during a "Legislative Luncheon" held on the state capitol lawn in Phoenix in March 2020. The affair was organized by the Agribusiness and Water Council of Arizona. Senators, representatives and their staffs circulated among a variety of commodity group exhibits and were given the products such as produce displayed by the groups. Here, AGRPC passed out boxes of pasta made in Italy that was made with at least some semolina flour milled from Desert Durum® grown in Arizona.



Arizona Farm Bureau again sponsored an agricultural education tent at the 2020 Roots 'n' Boots Rodeo held in Queen Creek in March 2020 and AGRPC helped fund the activity. One of the learning experiences featured was a grain table that showed mature wheat spikes and a model combine and grain trailer. Youngsters were shown what a bushel will hold and they were given a chance to immerse themselves in wheat grain.

