ANNUAL
NEWSLETTER
WINTER 2018/19

ARIZONA
Grain Research &
Promotion Council

DESERT VALLEY DURUM

Chairman's Report *By David Sharp*

This annual column has usually been developed near the beginning of Arizona's fall small grains planting season. However, we delayed the publication of the annual newsletter in order to allow several scenarios to play out - so as to put some perspective on the current state of our durum and barley grain crop prospects for the 2019 season. However, waiting for a clearer small grain industry picture did not lead to an improvement of the rather dismal small grain crop prospects that existed last fall. I don't recall a gloomier period than what currently exists for growing small grain crops (as grain) since beginning my 30-year term as an AGRPC member.

Virtually zero durum grain market incentives existed during the past winter to encourage our growers to plant durum for grain harvest in 2019 in the expectation of making a profit on the crop. While plenty of western Arizona growers have planted durum primarily for its subsequent produce rotational benefits, central Arizona growers had little incentive to plant the crop for grain. The USDA's survey of durum planted in Arizona, at 45,000 acres, pretty much tells the tale, and it will be hard to find durum fields in central Arizona this season.

Furthermore, corn prices delivered to Arizona for livestock feed are still keeping a lid on local barley grain offerings. But it appears that Arizona's dairy and feedlot cattle will feast on plenty of red wheat, barley, triticale, or oat forage during 2019.

The primary cause of these durum market doldrums is large industry stocks. Both the northern U.S. and Canada harvested moderate-sized durum crops in 2018, mostly of good or better grade quality and protein content. Canadian stocks are reportedly plentiful and are being offered into the U.S. at very competitive prices that are helped by the strength of the U.S. dollar compared to the Canadian. Thus, U.S. domestic durum buyers saw no need to chase the 2019 Desert Durum® crop for its early availability compared to the late summer 2019 northern harvest.

Our Arizona handlers were unable to offer growers profitable prices for the 2019 crop. Growers and handlers who have yet to sell all of their 2017/2018 crops are facing the same

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What's Inside.....

Russ Schlittenhart - was AGRPC's first and long-time chairman

Russell E. (Russ) Schlittenhart, a dedicated Arizona grain grower who was a substantial leader in promoting the legislation that created the AGRPC in 1985-86, passed away in Casa Grande on November 11, 2018 at the age of 86. Russ was an original appointed member of the AGRPC and served as its chairman for 14 years until his resignation from the Council in January, 2000.

Russ moved to Arizona from Wisconsin at age 15 for health reasons. He served in the U.S. Army and worked several routine jobs in agriculture before taking on cotton gin management in 1957. Eventually, he entered farming partnerships in the Eloy area, operated his own farm businesses, and owned a cotton gin in southern Pinal County. His farming operations included growing cotton, wheat, barley, sugar beets, and produce. He was also involved in enterprises dealing with fertilizer, chemicals, harvesting, aviation, and irrigation equipment. He was an early installer of drip irrigation systems. Community involvement activities included the Arizona Cotton Growers Association, Pinal County Farm Bureau, Governor's CAP Advisory Board, Sun State Bank, and several environmental boards.

AGRPC role

Russ knew that grower check-off funds collected on commodities such as cotton in Arizona and wheat in other states contributed to supporting production research and marketing promotion. Collaborating with other industry-minded grain growers, he was instrumental in successfully convincing the 37th Arizona Legislature to pass the statute created the Arizona Grain Research and Promotion Council. The statute called for the Council to consist of nine grain growers appointed by the governor. Schlittenhart was elected Chairman during the first scheduled meeting held in the state office building at 1688 W. Adams St., Phoenix on February 6, 1986, after posting of a public notice.

Russ, as chairman, was deeply involved in virtually every aspect of the Council's start-up years. He traveled extensively to establish contact and build connections with other wheat industry organizations. Former council colleagues will testify to his close involvement in Council activities that continued for the duration of his service. He had keen insight into the grain industry, both national and international, according to former AGRPC colleagues. One of the motivating factors in his early efforts with the AGRPC was the apparent excellence

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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 2019) 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 2018 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 Foundation for Agricultural Literacy ($1,000) - Sponsorship
- Arizona Farm Bureau ($2,000) – Annual Gold Sponsorship
- National Grain Feed Assoc. ($1,000) – Sponsorship of annual meeting in Phoenix when AGPRC member Eric Wilkey was elected chairman
- California Grains Foundation ($1,000) – Support of the annual Wheat Industry Collaborators' Program activities
- Arizona Farm Bureau ($2,000) – Sponsorship of Ag Literacy Day event
- Arizona Farm Bureau Educational Farming Co. ($1,000) - Racin' Bacon Derby swag bag sponsorship
- U.S. Durum Growers Association ($100) – Supporter Membership
- Arizona AgriBusiness and Water Council Roundtable ($1,000) – Sponsorship of a table for AGRPC members

AGRPC Members

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AGRPC's FY 2018 Financial Statement

Beginning fund balance	$223,618
Income items:	
Assessments	$112,147
Investment income	3,589
Less refunds to producers	(6,153)
Net income	$109,583
Total operating fund balance	$333,201
Expenses	
Executive Director (1)	$18,000
ADA Administration	7,500
U.S. Wheat Associates	32,300
Travel & Meeting	8,476
Desert Durum® Quality Survey	3,514
Trade Teams	0
Annual Newsletter	1,958
Promotion & Advertising	16,888
Research Projects	55,437
Total expenses	$144,073
Ending fund balance	$189,128
Less committed research funding	(43,257)
Unencumbered balance	$145,871

Note: Fiscal year from July 1, 2017 - June 30, 2018
(1) Contract with Allan B. Simons

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dismal price picture looking forward. We have to wonder whether the common grower attitude that "It's always going to be better next year" should be sentenced to the scrap heap.

Export headwinds blow stronger

Historically, about half of the Desert Durum® grain crop has been exported, with Italy and, more recently Nigeria as the primary destinations. But, the Nigerian business has dwindled markedly in recent years as its primary importer has largely switched to using cheaper northern U.S. and Black Sea durum for its pasta business. However, future Italian imports from Canada and the northern U.S. may be negatively impacted by concerns about glyphosate residues, hopefully making Desert Durum®. more attractive.

Meanwhile, annual Desert Durum® export volume to Italy has declined somewhat from its peak, driven partially by lower prices for European durum, cheaper northern U.S. and Canadian durum, and by several factors mentioned in prior newsletters. The latter include: 1) Perceptions that durum grown in desert environments does not meet arbitrary sustainability metrics, especially for "water footprint"; 2) Concerns over glyphosate residues – even though sampling of Desert Durum® finds virtually non-detectable glyphosate; and 3) Imposition of an Italian "country-of-origin labeling" (COOL) mandate that raises manufacturing costs and may dissuade some Italian customers from buying products seen to contain non-Italian ingredients.

What might lie ahead for AZ's small grain industry?

Our state has experienced decades of robust small grain production, going back to when much of the grain was used for livestock feed – even the huge durum crops of the 1970's, for example. Then, we grew boatloads of certified 'Yecora Rojo' seed for export to Saudi Arabia. And, the development and growth of our current superior quality identity-preserved Desert Durum® crops beginning in the late 1980's has been an exciting and mostly profitable enterprise that has brought global fame to the state's growers. Now, it seems that a variety of elements are negatively impacting our small grain industry and most of them are largely out of growers' control.

***North American supplies?* -** Over-supply of durum is just one current factor that has lowered demand for our crop, although this situation can improve as market conditions and quality may vary, thus making production offers more attractive and leading to, presumably, profitability and increased acreage. Arizona growers possess a real advantage over other production areas in the realm of weather effects on consistent grain quality (as long as we pay attention to basic crop nutritional needs).

"Politics?"- The extent of the three negative influences, mentioned previously, on demand for Desert Durum® is not likely to diminish as time passes. Philosophical positions such as sustainability tend to become entrenched, even if contrary evidence exists. The EU's rejection of glyphosate as a safe pesticide will likely remain in place, supported by the World Health Organization's (WHO) classification that it is "probably carcinogenic to humans", although the same WHO and the UN have concluded that dietetic consumption of glyphosate is unlikely to pose a carcinogenic risk to humans. That glyphosate is rarely used on Desert Durum® fields doesn't necessarily exempt our grain from discrimination by certain large users.

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and potential future of the first varieties of what we now call Desert Durum® wheat.

Reading the Council's meeting minutes from its initial years of existence provides glimpses of the broad and complex range of issues, discussions, and decisions it faced, with 14 meetings in the first two years alone. Some of the most critical tasks included: establishing a check-off amount ($.02/cwt.) and potential budgets for the 1986 season and beyond; establishing a probable first purchaser list; establishing a grower list; conducting a 1987 grower referendum on continuing the Council's existence (resulting in a 2-1 favorable response from nearly 200 growers); debating the existence of a refund provision to growers; compensating the Commission of Agriculture and Horticulture for its administrative duties; bill payment and reimbursements within state regulations; establishing connections with the California Wheat Commission and with U. S. Wheat Associates for export promotion; and many more.

Perhaps the most harrowing period for the state's grain growers and the Council during Chairman Schlittenhart's term began in early 1996 with the discovery of Karnal bunt-infected (KB) grain in Arizona. This fungus (*Tilletia indica*) was declared a federal-regulated disease in the early 1980's in order to protect the U.S. wheat industry from the organism, which had become established in southern Sonora, Mexico during the "Green Revolution's" activities of the 1950s and 1960s. Fallout over the discovery, from domestic and foreign sources, put Arizona's wheat industry in federal regulatory crosshairs. Coping with overwhelming federal oversight activities during the first year necessitated significant time and energy on the part of the state's grain industry and Russ was a leading spokesman in those efforts.

Original AGRPC appointed members

Besides Russ, the first appointed members who fashioned the Council's initial operations were Richard Bryce (Thatcher), James Cuming (Yuma), Arnot Duncan III (Goodyear), Edward Hooper (Casa Grande), James Palmer (Thatcher), R. Gale Pearce (Arizona City), Robert Woodhouse (Roll), and Gregory Wuertz (Casa Grande). All deserve recognition for their contributions.

Russ Schlittenhart in a Pinal County wheat field in the 1980s.

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Furthermore, it is unlikely that the Italian durum industry will ease off using its political muscle resulting in removal of the COOL requirement, even though the EU apparently says that it violates certain community rules.

Water? **-** The elephant that is tromping toward the future of our grain acreage, particularly in central Arizona, may "well" (pun intended) be the availability of irrigation water. If growers in that region have to fallow significant acreage due to reduced surface allotments and to rely on groundwater, where will wheat and barley grain fit in their profitability picture? Availability of Colorado River water from the CAP has provided these growers with almost wide-open cropping options for decades, but these options are almost certain to be reduced in the nearby coming years. Allocation and pumping costs as related to profit potential will mean making cropping choices and eliminating potential small grain acreage unless prices improve significantly.

On the other side of the state, southwestern AZ growers have the advantage of facing fewer likely restrictions on river water availability and have apparent economic incentive to plant wheat as part of their year-round cropping rotations with produce, despite the absence of profit potential at current grain offerings. For the near term, western AZ growers are likely to produce the vast majority of the state's grain crops, even without significant barley acreage.

Freight issues? – Our handlers report increasing challenges in coping with rail shipments of our Desert Durum® crop to the Gulf for export and to far-away domestic users. The lack of rail competition (for many U.S. wheat growers) has gradually resulted in reduced frequency of rail car availability in Arizona and increased tonnage fees as the railroads seek to equalize the profitability of their grain handling component with those of other bulk and specialized commodities. That such a business objective has apparently substantially altered how the grain industry must operate seems not to phase the rail industry.

Quality still matters

Despite the seemingly 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, former Assistant Attorney General Chris McCormack, and Council Administrator Lisa James. Lisa has served as the AGRPC's primary liaison with the Department for 15 years. She handles open meeting compliance issues, most of our official correspondence and 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 24 years in that role of supporting AGRPC activities and representing the Council within Arizona and elsewhere.

Desire to use Desert Durum® certification mark for products of the grain presents challenges for AGRPC and CWC

The term Desert Durum® is a certification mark issued by the U.S. Patent and Trademark Office (USPTO) that describes "…at least 90% wheat grain produced under irrigation in the desert valleys and lowlands of Arizona or California." The mark is jointly owned by the AGRPC and the California Wheat Commission (CWC). Only parties granted permission by the owner(s) can describe grain as Desert Durum®. The owners then must certify that those users comply with the definition.

The precise definition of the use of the existing Desert Durum® mark to describe grain begs the question as to whether the term can be used in connection with products derived from the grain. Those uses might include semolina flour made from the grain and pasta products made from such semolina flour. Intellectual property legal experts have advised the owners that awarding use of the current description of Desert Durum® for the describing of those by-products of Desert Durum® could be problematic, even inappropriate and risking loss of the mark.

Additional mark recommended

Those intellectual property experts have recommended that the AGRPC and CWC seek a new Desert Durum® certification mark to be used in association with the products derived from Desert Durum® grain. The challenge facing the two organizations is to agree on the specific requirement(s) and language to be cited in the application for a new mark.

For example, should use of the mark with semolina flour stipulate that the flour be milled from 100% Desert Durum® or is it reasonable to allow a miller to sell a product containing some blended lesser percentage of actual Desert Durum® semolina and what minimum lesser percentage? And, how should this blended condition be stated – "Made with X % Desert Durum® grain"? "Contains X% Desert Durum® semolina"?

The decision(s) that apply to semolina itself might be more straight-forward than those dealing with use of Desert Durum® semolina in pasta, where the semolina is often used in varying amounts blended with semolina of other origins to aid in achieving lot-to-lot product consistency. What should be the minimum percentage of Desert Durum® semolina, if any, that must be used in the pasta in order for the mark to be cited?

Obligations of owning a mark

One of the compelling aspects of a decision to apply for an additional mark is that, once issued, the owners cannot deny requests to use the mark so long as the mark's conditions are met. Once permission for use is described and granted, the mark owners are responsible for certifying that the user is complying with the terms of the "license." So, the AGRPC and CWC could be faced with constantly monitoring of the activities of all authorized users, possibly even multi-national users.

Presently, the AGRPC and the CWC are discussing the options for specifying how the Desert Durum® certification mark might be described in a new application to the USPTO.

2018 Arizona Karnal Bunt Survey Results

Information released by the USDA/APHIS-PPQ in Phoenix following the 2018 Arizona wheat grain crop harvest states that none of the 187 wheat (a host crop) fields located in Arizona's Karnal bunt quarantine areas tested positive for the fungus. This result contrasts with the findings of five (5) positive fields in the 2017 crop's 176 wheat fields. Each host crop field was observed at harvest by examining a four-pound sample of grain (about 35,000 kernels) for bunted kernels.

The 2018 regulated area totaled 441,608 crop and non-crop acres, down 38,149 acres from 2017. Wheat grew on 7,105 acres in the regulated areas in 2018, up 187 acres from 2017.

The KB quarantine was implemented in 1996 after bunted kernels were found in samples from 17 Arizona wheat fields. KB has been under a federal quarantine 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 at 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 become positive regulated fields and all fields located within a three mile radius fall under the KB regulations for future enforcement

Positive fields can be removed from positive status after five cumulative years of tillage (not necessarily consecutive years). Deregulation of a field may reduce the size of the regulated area. Six formerly-positive fields met the five-year tillage requirement in 2018 and are relieved of their positive status. The release of these six fields reduced the regulated area by 20,416 acres and included 211 crop fields. The areas with acreage removed from KB regulation include the Parker area (3,268 acres), the Peoria area (6,877 acres) and the Chandler/Gilbert area (2,010 acres). .

There are 4,069 fields and 169,876 field acres within the KB regulated area in 2019. This is a net reduction of 20,416 field acres from the 2018 crop year.

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 U of A bulletin contains management practices that may minimize the likelihood of KB infection in host crops in Arizona. https://extension.arizona.edu/pubs. Enter publication no. 1287.

Desert Durum® Grain Production in Crop Years 2016-2018 and Export Volumes in Marketing Years (MY) 2017-2019

The following figures were obtained from USDA/NASS reports or estimated from USDA/GIPSA and CDFA figures. Figures are in Metric tons (2,205 lbs).

Production	2016	2017	2018
Arizona	256,000	244,000	202,000
So. California*	75,000	46,000	55,000
Total	**331,000**	**290,000**	**257,000**

**Estimated*

MYs ending on 5/31

Exports to:	2017 MY	2018 MY	2019 MY*
Italy	114,549	151,996	148,201
Nigeria	35,265	13,000	0
Japan	1,175	49	34
Rep So. Africa	8,739	0	0
Ecuador	0	6,465	4,677
Total	**159,728**	**171,510**	**152,912**
% of production	49	47	60

* Covers 2019 MY to date - March 11, 2019

AGRPC's Eric Wilkey fills national role as chairman of NGFA

Eric Wilkey of Casa Grande, an appointeed member of the AGRPC since 2003 and President of Arizona Grain, Inc. since 2006, is in the midst of a two-year term as chairman of the North American Grain and Feed Association (NGFA). He was elected to the position in March 2018 during the NGFA's 122nd annual meeting in Scottsdale and will serve until March 2020. Wilkey served as first vice-chairman from 2016-2018 and in previous levels of the officer rotation.

The NGFA is a trade association of 1,184 current member companies representing a multitude of businesses that participate in all sectors and aspects of the grain and feed industry. The association's activities cover issues and policies involving feed, safety, trade, farm bills, biotechnology and transportation. Wilkey states that global trade and domestic transportation issues are paramount current concerns for NGFA.

NGFA's chairman is the group's top elected official and shares the group's spokesperson role with the president who heads the professional staff. The chair leads the board of directors, is a member of all 16 standing committees and appoints committee chairs. The board is responsible for setting and approving all budgets.

Arizona Farm Bureau's *Arizona Agriculture* issue of April 2018 contained an extensive interview with Wilkey that covered his perspectives on a wide range of topics, many of them still relevant. Read it on AZ Farm Bureau's website at the following URL: *www.azfb.org/Article/April-2018-Arizona-Agriculture*.

AGRPC's Michael Edgar makes a point about how Desert Durum® competes in the global market during a September 2018 visit to Nigeria as part of a U.S. Wheat Associates (USW) Board Team that also visited the Republic of South Africa. USW technical consultant James Ogunyemi (center) and marketing consultant Olatunde Omotayo listen.

A Nigerian mill imported substantial tonnage of Desert Durum® over the decade preceding 2019 – nearly 600,000 tons according to USDA export records. The annual volume has dwindled as the mill reduced its purchases of U. S. red wheat in favor of cheaper Black Sea supplies. The Desert Durum® buys were convenient add-ons to cargoes of red wheat leaving the Texas Gulf. No Desert Durum® has gone to Nigeria as of March 2019 for the Marketing Year ending May 31, 2019.

Research Projects Funded – FY 2019

Note: *Grants 19-01, 19-02 and 19-04 were all submitted by Principal Investigator Dr. Michael J. Ottman, Extension Agronomy Specialist and Professor, College of Agriculture and Life Sciences (CALS), University of Arizona. Collaborators are listed following each project description.*

19-01: Tools for Nitrogen Management of Wheat ($19,657)

Rationale and objectives: Nitrogen (N) fertilizer is normally applied to wheat based on one or more of the following decision points: a predetermined recipe of quantity and timing; 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 commonly-used feedback approach used in Arizona is correlation of lower stem nitrate content at various stages with previously-determined crop performance data. But, this approach requires lag time to dry and lab-test for nitrate.

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 are lacking. The immediate goals and objectives during the grant period are to investigate the use of the chlorophyll meter and optical sensors for wheat N-management.

Procedures: Field trials will be conducted at the U of A's Maricopa Ag Center to compare the functionality of four N-management tools: 1) lower stem nitrate content; 2) leaf chlorophyll meter; 3) hand-held optical sensors; 4) tractor-mounted optical sensors. N fertilizer will be applied at eight (8) rates, from 0 to 350 lbs. N/acre split equally among the first five of seven irrigations. Sampling with the four methods will occur about one week before each of the first five irrigations. Data collected using each tool will be compared with wheat crop results to begin developing N-management guidelines.

Collaborating researcher: Dr. Pedro Andrade Sanchez, Associate Specialist, Agricultural Biosystems Engineering

19-02: Small Grains Variety Testing ($5,461)

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: To 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, 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.

19-04: Drought Tolerance in Barley: Discovery of a Possible Mechanism Involving Root Tip Characteristics ($25,000)

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 (DT) crop plants is one approach to achieving sustainability. Successful examples of such development in Arizona include DT barley and wheat lines produced by the USDA-ARS and the University of Arizona, although 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 these and other crops.

Preliminary studies conducted in 2018 with support of the AGRPC have shown that differences exist in the root systems of DT cultivars vs. conventional cultivars. DT barley produced a higher number of root border cells than did conventional cultivars. Previous published studies have shown that root border cell numbers and the amount of root 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 available strongly suggests that the study of root border cell-mycorrhizal interactions may help to define mechanisms of drought tolerance in plants and contribute to the development of sustainable agricultural practices in arid zones. In this context, it is suggested that a higher number of root border cells promotes the establishment of mycorrhizae, thus improving water absorption. This project potentially will contribute to two AGRPC objectives: reduction of fresh water consumption and development of new grain varieties.

Procedures: The project will start with the biological characterization of root tips from 20 conventional and 20 DT barley and wheat lines. The conventional lines will come from commercially-available cultivars in Arizona, while the DT lines will be chosen from the breeding program of R. T. Ramage, deceased USDA-ARS breeder at the U of A.

The characterization will employ microscopic techniques to estimate root border cell numbers, to determine cell viability and measure production of root tip mucilage. Next, mycorrhizae will be inoculated under laboratory condition to quantify the interaction of root-mycorrhizal associations. Isolation and identification of mycorrhizal species associated with drought-tolerant barley and wheat plants in the field will follow.

Objectives: 1) Compare root border cell numbers, cell viability, and quantify mucilage production in conventional and DT barley and wheat varieties; 2) Determine if differences in mycorrhizal associations exist between each group of varieties; and, 3) Identify mycorrhizal species from each group.

Collaborating researchers: Dr. Martha Hawes, Professor, Soil/Water & Environmental Science (SW&ES); Dr. Fushi Wen, Assoc. Professor, SW&ES; Dr. Gilberto Curlango Rivera, Research Scientist, Plant Sciences; Graduate students: Andrea Carter and David Huskey.

Research Reports – 2018 Growing Season

Note: *Grants 18-01 and 18-02 were submitted by Dr. Michael J. Ottman, Extension Agronomy Specialist and Professor, College of Agriculture and Life Sciences (CALS), University of Arizona. Grant 18-03 was submitted by Paul Brierly, Executive Director, Yuma Center of Excellence for Desert Agriculture (YCEDA), CALS. Grant 18-04 was submitted by Barry Tickes, Area Extension Agent, CALS, in La Paz and Yuma Counties and Marco Pena, Research Specialist, CALS, Yuma Ag Center.*

NOTICE: Final reports for all AGRPC-funded research since 2006 are available on the website of the Arizona Department of Agriculture. Use the following sequence of browser key strokes:

- Go to **www.agriculture.az.gov**
- Enter AGRPC in the "Search this site" bar
- Click on "Grants" at the top of search results
- Click on "Learn More About the AGRPC" under the Council's name
- Scroll own to "Related Links" and click on "Final Reports" under PREVIOUSLY FUNDED RESEARCH PROJECTS to access final reports by year of funding.

18-01: Small Grains Variety Evaluation at Maricopa

Small grain varieties are evaluated each year by University of Arizona personnel. The purpose of these tests is to characterize varieties in terms of yield and other attributes. Variety performance varies greatly from year-to-year. Several site-years are needed to adequately characterize the yield potential of a variety. A cumulative multi-year summary of small grain variety trials conducted by the University of Arizona and cooperating private breeding programs can be found online at: *www.cals.arizona.edu/pubs* and entering pub no. 1265.

18-02: Water Use and Rooting of Low Input Barley

Rationale: Two low-input barley varieties developed and released by the University of Arizona are intended to be grown with reduced irrigation water. These varieties produce grain with 1-2 irrigations and typically mature earlier than full-season varieties, which yield less and display low test weights when grown with 1-2 irrigations. Low input varieties may escape high temperatures but also may produce deeper roots that reach more subsoil moisture than full-season varieties.

Previous work at Marana confirmed the ability of the low-input varieties to out-yield the conventional varieties under low water regimes. However, soil water extraction was not measured and rooting patterns were inconclusive in that study. Also, a study similar to this proposal was conducted at Tucson in 2015.

Objective: The objective of this study was to obtain a second year of data by evaluating water use, rooting, and yield of low-input vs. high-input barley varieties.

Procedures: Low-input (*Solum* and *Solar*) and high-input (*Cochise* and *Kopious*) varieties, planted in small replicated plots at Tucson in December 2017, were grown under low-input (1 irrigation and 50 lbs. N/acre) and high-input (7 irrigations and 200 lbs. N/acre) conditions. Water use was estimated over time using a neutron probe. Rooting was measured twice during the growing season by digging a trench beside the plots and was also measured at harvest using soil cores. Crop growth and light interception were measured five times. The usual crop growth and grain metrics were collected at harvest.

Results: *[Editor's note: The final report submitted by the authors contains voluminous data, complex figures, and lengthy discussion. Therefore, Dr. Ottman volunteered to prepare a short abstract of the results in order to present sensible results and conclusions for newsletter readers. The abstract follows below.]*

An ever-growing challenge to agricultural production in Arizona is the reduced availability of water. The development and release of low-irrigation barley cultivars Solum and Solar by the USDA/ARS and the U. of Arizona marks a significant achievement in breeding efforts for drought tolerance. However, their mechanisms of adaptation to water stress remain unclear.

A 2018 field trial conducted in Tucson was similar to a trial conducted in 2015, comparing yield, development, water usage, and rooting characteristics of low-irrigation varieties *Solar* and *Solum* to high-input, semi-dwarf varieties *Kopious* and *Cochise*. Rooting characteristics were analyzed by digging in-field root profile walls to a depth of 6 ft. Varieties were compared under high (34.5 in/acre) and low (8.8 in/acre) water regimes, including irrigation and precipitation averaged over years.

The varieties bred for low water use had higher grain yield, higher test weight, and higher kernel weight under low irrigation in both years. Under water stress, the high input varieties had lower biological grain yield, unacceptable grain quality and a plant stature rendering grain mechanically unharvestable.

Observed traits associated with improved performance of the low-irrigation varieties under drought conditions included early vigor, early flowering, greater root growth at 16 to 32 inches in depth, and more effective water use as exhibited by greater water extraction post-flowering.

The deeper rooting pattern of the low-irrigation varieties may be related to their ability to use more water post-flowering under water stress compared to high input varieties.

18-03: Measuring Evapotranspiration of Desert Durum® at Multiple Locations

Rationale: All wheat grown in Arizona requires multiple surface irrigations. Efficient irrigation management is enhanced with accurate estimates of evapotranspiration (ET) from soil and crop growth. Irrigation timing is determined by the allowable depletion of available water in the soil profile to avoid yield loss. The required irrigation volume must replace water lost by ET.

Accurate estimates of wheat ET are critical for efficient irrigation management, as are the tools to use these estimates. Work is needed to develop crop coefficients for irrigating wheat planted between November and early March in Arizona.

One technology for measuring crop ET in the field is eddy covariance (ECV). ET occurs when turbulent airflow (eddies) causes net upward movement of water vapor. Water vapor, heat, and carbon dioxide transferred by eddies can be measured directly using ECV. However, an ET value measured by ECV is only locally representative of environmental water fluxes and is dependent on uncontrollable wind speed and direction, so ET values measured over multiple sites can be biased.

An alternative approach useful for large-scale ET studies is large aperture scintillometry (LAS), a technique that allows ET measurements to be scaled up over time and space.

Recently, high resolution satellite imagery availability has been enhanced such that it can be combined with ECV and LAS data to provide irrigation guidance to growers.

Objective: This project used state-of-the-art technologies to measure durum wheat ET at multiple scales for the purpose of developing irrigation management tools for growers. The project addressed the primary research priority of the AGRPC: "Reduction of fresh water consumption" in producing grains and is part of a large YCEDA project in the lower Colorado River region aimed at modeling water and salt balance across multiple cropping systems.

Procedures: Studies were conducted in grower-cooperator wheat fields in Yuma and Pinal Counties. ECV and LAS systems were installed in the fields with all data processed for ET estimates. High resolution satellite imagery was processed using algorithms being developed and validated for this project.

Results: The results of this study were not due or available at the time this newsletter was finalized. They will be summarized in the next issue of this newsletter. When available, the entire final report will be published on the Arizona Department of Agriculture's website.

Research reports – *Continued on page 8*

Research reports – *Continued from page 7*

[Editor's note: *The AGRPC funded an introductory study of water and salt balance in two Yuma-area produce-durum fields and one non-rotational wheat field during the 2017 growing season. That final report was unavailable in 1917. A partial abstract of the final report (17-03), written by the authors, is presented below. The final report is posted as described above.]*

17-03: Water and Salt Balance for Durum Wheat Irrigation (Abstract)

These studies verified previously-obtained data showing that the vegetable component of the produce-wheat rotation was generally net salt loading in the crop root zone upon completion of its growth cycle and harvest. However, in two of the three wheat sites, there were more total salts in the surface soil layer after the wheat crop than before. The one wheat field that presented net leaching of salts over the wheat production period consisted of a coarse-textured soil.

Analysis of the cations and anions in soil extracts suggests that precipitation and dissolution reactions with carbonate species likely complicated estimates of leaching fractions determined using the steady state mass balance approach with total salinity. However, we found no evidence of chloride precipitation, suggesting that chloride ratios can be used to estimate the leaching fractions achieved.

The use of chloride ratios as a conservative tracer suggests that the leaching fractions from the surface soil ranged from 8% to 20% during wheat production - the high values being associated with the coarse-textured soil. However, leasing fractions of less than 20% would not be sufficient to relieve the salt burden accumulated during the vegetable production periods of the cycle. These data suggest that the pre-plant irrigation event before vegetables may be of paramount importance in vegetable-wheat production systems.

18-04: Evaluation of Canarygrass Control and its Potential Resistance to Herbicides Used on Wheat Grown in Arizona

Rationale: Weeds are the primary pests affecting small grain production in Arizona. Post-emergence herbicides are fairly effective in controlling broadleaf weeds. Grass weed control can be more difficult, although effective herbicides exist. The most popular grass–control herbicides used to control wild oat and the predominant canarygrass specie occurring in Arizona wheat are called ACCase inhibitors that all use the same mode of action. Resistance to ACCase inhibitors has been documented in canarygrass and wild oat across the U.S. and as close to Arizona as the Imperial Valley. Such resistance is suspected in Arizona. Grass-control herbicides exhibiting a different mode of action than ACCase inhibitors are called ALS inhibitors.

A new canarygrass specie called "hood canarygrass" (*Phalaris paradoxa*) was found in the Gila Valley east of Yuma in 2016. It is significantly more tolerant of ACCase inhibitors than littleseed canarygrass (*Phalaris minor*), which has been present in Arizona for many years. Although resistance of canarygrasses to the ACCase class of herbicides has been suspected and observed, it has not actually been tested under accepted research protocol in Arizona.

Objectives: 1) To determine whether the hood canarygrass that was found in the Gila Valley of Arizona in 2016 can be controlled with the same herbicides that are used to control littleseed canarygrass, and; 2) To determine whether the resistance to ACCase inhibitor herbicides exhibited by littleseed canarygrass in the Imperial Valley of California in 2001 has spread to littleseed canarygrass populations existing in Arizona.

Procedures: A protocol developed by the International Herbicide Action Committee was followed in applying low-to-high rates of the ACCase and ALS herbicides used on Arizona small grains on plots or fields containing either littleseed canarygrass or hood canarygrass. Seed of the hood canarygrass infestation in the Gila Valley was harvested and planted in plots at the Yuma Agricultural Experiment Station for subsequent use in testing its reaction to common ACCase and ALS herbicides. Trials in Parker-area grower-cooperator fields were conducted to further characterize the responses of both littleseed and hood canarygrasses to these herbicides.

The ACCase herbicides tested are currently available in generic formulations and included: clodinaflop, fenoxyfop, quizalafop, sethoxydim, .fluaziflop, and pinoxaden, The ALS inhibitors included pyroxsulam and mesosulfuron (Osprey®).

Results: All of the herbicides used in the study, both ACCase and ALS inhibiters, controlled littleseed canarygrass and no herbicide resistance was detected in the several Arizona populations of the specie that were studied. Continued monitoring of Arizona littleseed canarygrass populations for development of resistance is recommended.

Hood canarygrass was controlled adequately (90% or more) only by the ALS inhibitor Osprey®, which is the only one of the herbicides tested that remains on patent and is not available as a generic product. Osprey® has been registered for use on crops in Arizona but is not widely used due to a 10-month plant-back restriction for most crops grown in the state, except for cotton (3 months). Such a restriction is problematic for its potential use in a wheat/produce rotation. Trials involving slightly reduced Osprey® application rates provided reasonable hood canarygrass control and might lead to a shortened plant-back requirement if registration work were to be undertaken.

The ALS inhibitor pyroxsulum (brand name Simplicity® used in this study) controlled hood canarygrass in the 50-76% range, depending on the formulation used. Most growers would likely not consider this level of control to be satisfactory.

There is no simple explanation for the occurrence of hood canarygrass in the Gila Valley, so the population warrants continued close monitoring to limit its spread.

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: 520-429-1221. Contact the Arizona Department of Agriculture to obtain remittance and refund forms. 1688 W. Adams, Phoenix, AZ 85007. Phone: 602-542-3262. Fax: 602-364-0830. Lisa James - Council, Board, and Commission Administrator. E-Mail: ljames@azda.gov.

DURUM

Alberto is a large-seeded, short-statured variety with excellent lodging resistance.

Desert King is a later-maturing variety with slightly above average height.

Duraking is a high-yielding variety with excellent lodging resistance.

Havasu is a early-maturing variety with large seed and high test weight.

Helios has good lodging resistance and early maturity.

Kronos is an early-maturing variety with large grain size.

Maestralle is a tall, early maturing variety that originated in Italy.

Miwok is a high-yielding variety with large seed and late maturity.

Orita is a full season variety with excellent lodging resistance and high grain protein content.

Platinum has short stature and good lodging resistance.

Powell is a new variety intended as a replacement for Orita.

Saragolla has high test weight and low protein content and originated in Italy.

Tiburon has excellent lodging resistance, large grain size, and high protein.

WB-Mead is a high yielding, tall, late maturing variety with excellent lodging resistance and high grain protein.

WB-Mohave is a high-yielding variety with high grain protein.

Westmore HP is similar to Kronos except it has smaller kernels, higher grain protein, and better semolina color.

BARLEY

Baretta is a full-season, high-yielding variety.

Chico is a full-season variety with excellent lodging resistance.

Cochise is a short-season variety intended for Cochise County.

Kopious is a short-season, high-yielding variety with excellent lodging resistance.

Nebula is a tall variety with large kernels.

WHEAT

Joaquin is a high yielding variety taller than Yecora Rojo but similar in protein and maturity.

WB-9229 is taller and later than Yecora Rojo.

WB-Joaquin Oro is a high protein variety with good lodging resistance and is taller and earlier than Yecora Rojo.

Yecora Rojo is an early-maturing, short-statured variety.

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This information has been reviewed by University faculty.
extension.arizona.edu/pubs/az1265-2018.pdf

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Cooperative Extension

Wheat and Barley Varieties for Arizona 2018

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Summary of Small Grain Variety Characteristics for Arizona (2018)[1]

Variety	Seed source	Grain yield	Test weight	Seed weight	Plant Height	Lodging	Heading	Maturity[2]	Grain protein	HVAC
		lbs/acre	lbs/bu	g/1000	inches	%	date	date	%	%
					BARLEY					
Baretta	Arizona Grain	6482	51.7	44	31	17	3/20	4/29	11.9	•
Chico	Barkley Seed	6138	51.4	37	27	2	3/20	4/30	11.7	•
Cochise	Barkley Seed	6155	51.9	38	30	14	3/12	4/24	12.0	•
Kopious	Arizona Grain	6406	52.4	43	30	3	3/14	4/24	11.4	•
Nebula	Barkley Seed	6185	52.1	47	32	14	3/19	4/28	12.1	•
					DURUM					
Alberto	Arizona Grain	6781	62.2	51	31	1	3/25	•	13.8	98
Desert King	Western Milling	6455	59.6	43	35	16	3/29	•	13.0	98
Duraking	Dunn Grain	6988	63.2	47	34	8	3/26	5/06	13.0	98
Havasu	Barkley Seed	6490	63.8	51	35	25	3/24	5/03	13.6	98
Helios	Arizona Grain	6608	63.0	47	35	17	3/20	5/03	13.2	97
Kronos	Arizona Grain	6488	62.6	54	34	33	3/22	5/03	13.5	97
Maestralle	Allstar Seed	6437	63.8	50	37	42	3/25	5/03	13.5	99
Miwok	Western Milling	6879	63.4	54	35	18	4/01	•	13.9	98
Orita	Barkley Seed	6760	61.5	52	35	8	3/29	5/06	14.4	98
Platinum	Dunn Grain	6628	62.5	44	32	13	3/26	5/05	13.1	98
Powell	Barkley Seed	6821	62.6	•	34	•	3/25	•	•	•
Saragolla	Allstar Seed	6736	64.3	52	34	30	3/26	5/05	12.9	94
Tiburon	Arizona Grain	6747	62.1	56	34	10	3/26	5/06	13.9	98
WB-Mead	Barkley Seed	6903	62.3	46	36	7	3/31	5/08	13.8	99
WB-Mohave	Barkley Seed	6770	63.2	49	35	22	3/25	5/05	13.9	99
Westmore HP	Arizona Grain	6480	62.4	43	34	42	3/23	5/03	14.1	99
					WHEAT					
Joaquin	Barkley Seed	7039	63.7	44	35	9	3/21	4/28	13.7	98
WB-9229	Barkley Seed	6681	64.4	39	35	6	3/27	5/01	14.4	98
WB-Joaquin Oro	Barkley Seed	6503	63.1	42	35	0	3/18	4/25	14.9	97
Yecora Rojo	Barkley Seed	6224	62.6	44	31	8	3/23	4/28	13.9	98

[1] Since not all varieties were in each test, performance was summarized using least-squares means. Most of this information is derived from trials conducted in Maricopa, Pinal, and Yuma Counties planted in late November through mid-January. Actual variety performance may differ from these results.

[2] Maturity: Physiological maturity, which is about 2 weeks before harvest ripe stage.

AGRPC members attending a field tour of grain research sponsored by the Council at Maricopa Ag Center in April 1996. U of A Extension Agronomist Dr. Mike Ottman (third from right) was the host. L-R: Russ Schlittenhart, Greg Wuertz, Steve Sossaman, John Skelley, Ottman, Dick Cooley, and Dick Eaton. Members not attending were Bob Layton, Michael Kelly and David Sharp.

The Racin' Bacon Derby Dinner held at the Arizona Farm Bureau office building lawn in October 2018 provided an opportunity for the AGRPC to help raise funds to support the AZ Farm Bureau's Educational Farming Company. AGRPC sponsored a "swag bag" that was filled with edible goodies for guests.

150 guests helped raise $20,000 in support the AZ FB's ag education activities through other sponsors, admissions, a blind auction of donated items, and bets placed on the results of the piglet racing events.

The AGRPC has participated for years in the trade show hosted by the Arizona Farm Bureau Federation during its annual meetings. Here, AGRPC Executive Director Al Simons mans the table that displays promotional materials about Arizona's grain industry, with some barley and wheat grain for folks to run through their fingers during the 2018 event in Mesa.

Educators try their hands at filling irrigation siphon tubes during a recent Summer Ag Institute (SAI) session at Maricopa Ag Center. SAI is a five-day, traveling tour designed to teach K-12 teachers about food and fiber production and help them incorporate that knowledge in the classroom curriculum. SAI combines hands-on learning about agriculture with practical curriculum development. AGRPC has sponsored a participant for many years. The 29th SAI will visit Cochise County in June 2019 with 30 educators. Go to https://cals.arizona.edu/agliteracy/SAI.

"Ag in the Classroom AGtivities" at Roots 'n' Boots Rodeo

(Above) Youngsters experience the grainy feel of Desert Durum® wheat retained in a tractor tire in the Arizona Farm Bureau's exhibit tent. The "wheatbox" feature was constantly enjoyed by youngsters during the 3-day event in March of 2018 and 2019.

AGRPC sponsored a grain exhibit in the Arizona Farm Bureau tent featuring Desert Durum® wheat and information about grains during the 2018 three-day affair at Horseshoe Park and Equestrian Center in Queen Creek. The exhibit featured educational facts about many of Arizona's ag industries, such as grains, dairy, poultry, cotton, beef and more. Hundreds of families toured the Farm Bureau's "AGtivities" exhibit. Go to https://www.azfb.org/Programs/Agriculture-in-the-Classroom/ to learn about the Ag in the Classroom (AITC) programs.