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ARIZONA
Grain Research &
Promotion Council

DESERT DURUM®

Chairman's Report

By David Sharp

As usual, this report is being prepared during Arizona's fall small grains planting season. Lack of encouraging durum market intelligence that could provide Arizona producers with promising durum planting choices once again prevails. And, even Arizona's perpetual feed-deficit status is not going to make local barley production a particularly profitable enterprise as long as domestic corn prices stay at current levels.

We know that both the Northern U.S. and Canada harvested moderate-sized durum crops, mostly of good or better grade quality and protein content. Mycotoxin was a virtual non-issue this season. These facts discourage the U.S. domestic durum buyers from chasing the 2018 Desert Durum® crop at this time of year. From their perspectives, adequate supplies of decent quality durum are there for the taking when they need them.

So, with little current interest in our 2018 crop, our handlers are unable to boost current crop price offerings to attractive levels. Growers and handlers who have yet to sell all of their 2016 and 2017 crops are facing the same dismal price picture.

Our Arizona-based grain handlers have recently visited their Italian customers for Desert Durum® and found little immediate enthusiasm for contracting the 2018 crop, given their views of available supplies. Good durum is available at prices below what we desert producers need to suggest a profit. Even the fact that the U.S. dollar has weakened against the Euro over the past year doesn't pencil out for our foreign buyers. Knowledgeable sources think that Arizona's 2018 Desert Durum® crop acreage could be half that of 2017.

Other export market winds are at play

European durum buyers are also facing new socio-political issues that will likely temper their purchases of North American durum and this is particularly true of Italian customers. Italian food companies are now facing a soon-to-be-implemented "country-of-origin" labeling law that will require dry pasta labels to state the origin of production and milling of non-Italian wheat used in their products. Since Italy typically has imported huge quantities of North American durum, this fact will have to be stated on food packaging, adding production costs for the manufacturers and psychological issues for the Italian consumer.

Glyphosate herbicide has become the "no-touch" scare-factor in the European Union, with the EU parliament adopting legislation that could prohibit all uses of glyphosate within a few years. The European Commission has renewed the glyphosate registration for just five years. Furthermore, it appears that maximum glyphosate residues permitted in foods sold in Europe could be set well below current international limits. Glyphosate use is widespread, of course, even in Arizona on non-grain crops, and may be detected at very minute levels (parts per billion) in some wheat lots, even though the herbicide has not been used on the wheat crops to assist dry-down prior to harvest. The impact of both glyphosate residue and Italian labeling issues on EU imports of North American wheat remains to be seen.

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AGRPC Joins Efforts to Improve Water/ Salt Management & Irrigation Efficiency

Multiple funding sources support research to refine knowledge about irrigation and salinity dynamics during typical crop rotations in desert environments

The Arizona Grain Research and Protection Council (AGRPC) has joined other agricultural interest groups to fund a multi-agency research project that aims to answer numerous questions about the fluxes of water and salt during the irrigation of crops produced in a variety of seasonal cropping rotations in the state. Actual and promised AGRPC grants to date exceed $37,000, or nearly 10 percent of the specific grant total that is being administered by the Yuma Center of Excellence for Desert Agriculture (YCEDA), according to its November 2017 figures.

YCEDA is a public-private partnership between industry entities and the University of Arizona College of Agriculture and Life Sciences, formed in 2014, with the aim of solving desert agriculture's pressing problems. One of these challenges involves the cycle of water and salt balance in desert soils during the annual irrigated cropping rotation.

Irrigation water contains salts and salty shallow ground water fluxes by capillarity toward the surface of river valley soils. So, some level of excess irrigation (beyond crop consumptive use) must be applied to leach salts below the crop root zone.

Produce-durum wheat rotations are widely practiced in the Colorado River region. High wheat irrigation volumes are thought to provide the needed leaching. The same principle may apply to other Arizona regions where the soils have been deposited during long-past river flows, such as the Santa Cruz and the Gila Rivers. In these areas, wheat or barley may assist in leaching after cotton, corn, or sorghum crops, for example.

AGRPC funded 2017 crop research in the Yuma and Gila Valleys on salinity fluxes during a lettuce-wheat cropping sequence that is described elsewhere in this newsletter. Additional funding aimed at increasing irrigation efficiency by characterizing evapotranspiration in both southwestern and southcentral Arizona wheat crops has been awarded for the 2018 season, as described under FY 2018 research projects.

Other funding sources and collaborators

In addition to the AGRPC's support, YCEDA lists a number of other funding sources, including: Arizona Iceberg Lettuce Council, USDA-ARS Arid Land Agricultural Research Center, Bureau of Reclamation, Yuma County Agriculture Water Coalition, U of A's Arizona Experimental Station Strategic Investment Funds and U of A Water, Environmental and Energy Solutions-TRIF Funds.

What's Inside.....

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 2017) 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 2017 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
- Arizona Farm Bureau ($750) – to support an AZ ag industry economic contribution study
- Arizona Farm Bureau ($2,500) – to sponsor a Farm Bureau "Ag Day" educational booth during the Roots N Boots Rodeo in March 2018
- California Grains Foundation ($1,000) – to support the annual Wheat industry Collaborators' Program activities
- U.S. Durum Growers Association ($100) – Supporter Membership
- Arizona AgriBusiness and Water Council Roundtable ($1,000) - to sponsor a table for AGRPC members

AGRPC Members

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AGRPC's FY 2017 Financial Statement

Beginning fund balance	$234,778
Income items:	
Assessments	$143,428
Investment income	2,891
Less refunds to producers	(7,230)
Net income	$139,089
Total operating fund balance	$373,867
Expenses	
Executive Director (1)	$18,000
ADA Administration	7,500
U.S. Wheat Associates	31,100
Travel & Meeting	6,921
Desert Durum® Quality Survey	3,640
Trade Teams	0
Annual Newsletter	1,632
Promotion & Advertising	19,481
Research Projects	61,974
Miscellaneous	0
Total expenses	$150,248
Ending fund balance	$223,619

(1) Contract with Allan B. Simons

Chairman – *Continued from page 1*

Post-mortem on the 2017 crop

Weather events had little evident effect on quality of the 2017 Desert Durum® crop, especially compared to 2015, when untimely rains caused some kernel bleaching in the heads. Average test weight over all varieties was 62.2 lb/bu, while average protein was 13.5% on a 12% moisture basis. Hard vitreous amber count (HVAC) was 97.6%. Basically, the 2017 Desert Durum® crop offers the typical high quality, low moisture grain that customers expect.

As usual, durum yields varied widely and USDA states that average yields were just over 3 tons/acre. However, at least a few growers in Yuma County experienced significant yield and quality losses due to stripe rust issues. This disease is an occasional culprit in Arizona, causing yield losses in mostly southwestern Arizona, depending largely on the maturity stage of the crop when weather events sweep in rust spores from northern Mexico. More information about this phenomenon is presented elsewhere in this newsletter.

Wheat, water & salt – effects on cropping sustainability

The AGRPC is a supporter of a major project that is striving to characterize the water and salt balance associated with the wheat and produce crop rotations that are practiced in the lower Colorado and Gila River regions of Arizona. The Council's initial investment in this effort was reported in the 2016 newsletter and a sizeable grant has been awarded covering the 2018 growing season.

Quality, quality, quality

AGRPC supports significant effort each year to characterize the quality of Arizona's Desert Durum® crop. The results are important enough that the AGRPC and the California Wheat Commission jointly publish a detailed report for use by our handlers, their customers, and by U.S. Wheat Associates for export promotion – find it in the AGRPC's state website.

Desert Durum® varieties are developed to exhibit both high grain yield and superior grain, milling, and pasta-making qualities that are achievable in the unique production environment that we enjoy. This environment is conducive to producing consistently high quality grain each season, if Arizona producers provide the cultural resources needed to capture the innate qualities of the varieties from our plant breeding partners.

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 Brett Cameron, Assistant Attorney General Chris McCormack, and Council Administrator Lisa James. Lisa is completing her 14th year serving as the AGRPC's primary liaison with the Department. She handles open meeting compliance issues, most of our official correspondence and documentation, and financial record-keeping with expertise and good humor. We are fortunate to have her on our team.

Finally, I recognize the AGRPC's association with Executive Director Al Simons, who is completing his 23rd year in the role of supporting AGRPC activities and representing the Council within Arizona and elsewhere.

Richard Heiden Appointed to AGRPC

Richard Heiden of Buckeye was appointed by the governor of Arizona, in mid-2017, to serve on the AGRPC. His current term runs through January 2019, as he succeeds Jason Hardison of Palo Verde, who resigned for personal reasons.

Mr. Heiden belongs to a family having a significant agricultural presence in western Maricopa County, farming land around Buckeye, Arlington, and Gila Bend. Heiden's current role is to manage Paloma Ranch land near Gila Bend, growing cotton, alfalfa, and durum wheat.

Mr. Heiden graduated from Buckeye Union High School in 2004 and from the U of AZ in 2010, majoring in Ag Resources Economics and minoring in Business Management. He is the only one of four children in his immediate family to be a Wildcat, as all of his siblings attended ASU. Prior to joining the family operations in 2011, he worked for the Water Conservation Management Program in Buckeye while in college and then as a fertilizer salesman in central and northern California. He is now in the National Cotton Council's Emerging Leaders program after participating in the Council's Producer Information Exchange and Policy Education programs.

Wheat is a great crop for Arizona, according to Heiden, as it is a very important component of crop rotation practices that help maintain soil productivity. He cites his experiences in the cultural phases of producing wheat during high school breaks – planting, fertilizing tasks, disking fields after harvest, and combining, as factors in developing his devotion to growing wheat and gaining personal maturity. He says that, while the wheat market is not currently favorable to Arizona growers – it has been and likely will be again, given the recognition of Desert Durum's® quality attributes and the continuing efforts of the state's several wheat breeding firms to improve on the yield and quality of their existing superior varieties.

Mr. Heiden understands that agriculture is a more integral part of Arizona's economy than most citizens realize. As examples, he cites its statewide cattle industry, its dairies and dairy product processing firms, its significant poultry operations, its hugely important role of growing winter produce for the nation, its high-yielding cotton lint and cotton seed production industries, and its number one crop - alfalfa hay that is consumed locally and internationally. He suggests that ordinary citizens are so removed from understanding the sources of the food that they buy in a supermarket that the ag industry needs to do a better job of advertising its important roles.

Richard says that he is honored to be appointed a member of the AGRPC, as he believes that the group uses barley and wheat producers' check-off dollars wisely for their benefit. In addition, he appreciates being able to follow in the footsteps of his uncle, Art Heiden, who served on the AGRPC from 2001-2010, including two years as its chairman.

Research Grants Funded – FY 2018

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.*

18-01: Small Grains Variety Testing ($7,002)

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 (about12) 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 and plant height, lodging, test weight, grain protein, and yield. The University of Arizona will summarize all the data and compile a report.

18-02: Water Use and Rooting of Low-Input Barley ($14,896)

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. A study similar to this proposal was conducted at Tucson in 2015.

Objective: The objective of this study is 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, will be grown under low-input (1 irrigation and 50 lbs. N/acre) and high-input (7 irrigations and 200 lbs. N/acre) conditions. Water use will be estimated over time using a neutron probe. Rooting will be measured twice during the growing season by digging a trench beside the plots and will also be measured at harvest using soil cores. Crop growth and light interception will be measured five times. The usual crop growth and grain metrics will be collected at harvest.

18-03: Measuring Evapotranspiration of Desert Durum® at Multiple Locations ($20,884)

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, ETs measured by ECV is only locally representative of environmental water fluxes and are dependent on uncontrollable wind speed and direction, so that 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 will use state-of-the-art technologies to measure durum wheat ET at multiple scales for the purpose of developing irrigation management tools for growers. This project will address 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 will be conducted in grower-cooperator wheat fields in Yuma and Pinal Counties. ECV and LAS systems will be installed in the fields with all data processed for ET estimates. High resolution satellite imagery will be processed using algorithms currently being developed and validated.

18-04: Evaluation of Weed Resistance to Herbicides Used on Wheat Grown in Arizona ($10, 504)

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 oats and canarygrass in 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. Forty-three (43) grass species across the U.S. have been confirmed to be resistant to this herbicide class.

A new 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 this class of herbicide has been suspected and observed, it has not actually been tested under accepted protocol in Arizona.

Procedures: Grower/cooperator trials (3-5) will be established in central and southwestern Arizona in fields with a history of poor canarygrasss control. A protocol developed by International Herbicide Action committee will apply low to high rates of the ACCase herbicides used on Arizona small grains. Seed will be collected and used in greenhouse testing in Yuma.

Understanding the Stripe Rust Disease

Editorial note: *This article is an excerpt of a pending University of Arizona extension publication. Authors of the publication are Dr. Jia-huai (Alex) Hu, Extension Plant Pathologist and Dr. Michael Ottman, Extension Agronomist. The full article, including references, may be eventually accessed on the U of A CALS website or from the AGRPC.*

Summary

Stripe rust is a fungal disease of cereal grains that is caused by the basidiomycete fungus *Puccinia striiformis*. Stripe rust was first reported in Arizona on barley in 1993. Stripe rust could develop into a serious disease in Arizona if it becomes established on native grasses and weather conditions allow proliferation.

Stripe rust appears as yellow orange stripes between the veins of the leaf blades. The disease increases water use, shrivels the grain, and decreases yield. The fungus is an obligate parasite because it can survive and reproduce only on live hosts. Mild winters and cooler wet weather in the spring favor the development of the disease.

Host plant resistance is the most effective means to manage the disease. However, the fungus evolves rapidly and different races can occur from one year to the next and might overcome resistance. Several fungicides are labeled to control the disease, but scouting and early detection are crucial to time pesticide applications for effective control.

Introduction

Stripe rust, or yellow rust, caused by the fungus *Puccinia striiformis*, is an important disease of wheat, barley, rye, triticale and certain other grass plants, especially in cool climates. This pathogen has specialized to various degrees on these hosts. *Puccinia striiformis* f. sp. *tritici* attacks wheat and has numerous physiological races. A separate special form attacks barley. Stripe rust has emerged as the largest biotic limitation to wheat production worldwide. It is currently estimated that 88% of global wheat production is susceptible to stripe rust and causes annual global losses of 5 million tons of wheat with a market value of one billion dollars. The fungus evolves and migrates rapidly on a global scale by long-distance wind dispersal and human means. The fungus reproduces completely asexually on infected wheat and barley in the Americas.

Stripe rust first established in the western United States in the early 1900s. A second introduction to the Western U.S. in 1993 has spread to more than 20 states from coast to coast. Stripe rust is most destructive in the Pacific Northwest and poses an increasing threat to south-central and Great Plains states.

In Arizona, the first stripe rust outbreak occurred on barley in Pinal County in 1993. Since then, stripe rust has not been of great concern to small grain production in Arizona because it is a cool season disease and warm spring temperatures usually diminish the risk of severe disease development and yield losses. However, significant localized stripe rust infections were observed on wheat in Yuma County in 2017.

Recent research suggests that the fungal populations have evolved and are now more aggressive, producing more spores that are better adapted to higher temperatures. Therefore, stripe rust is likely to become more common in Arizona. Infections in Arizona are believed to be initiated by long-distance movement of spores carried on wind currents from Mexico.

Symptoms

Symptoms of stripe rust can be variable, depending on the resistance level of cultivars affected. The first sign of stripe rust is the appearance of leaf chlorosis with yellow streaks (pre-pustules), followed by long stripes of small, bright yellow, elongated uredial pustules on the leaves and leaf sheaths. Similar symptoms can be noted on awns and inside of glumes. Yellow spores can accumulate on the grain but the kernel is not infected. Mature pustules produce massive quantities of yellow-orange urediospores that are easily dislodged. In some moderately resistant varieties, long, narrow yellow stripes will develop on leaves and the infected tissues will have more of brown or tan coloration. Grain yield reduction is caused by the loss of green leaf area used for photosynthesis and by water loss through evaporation, due to the destruction of the leaf epidermal layer.

Three separate rust pathogens can attack wheat and barley: **stripe rust, leaf rust,** and **stem rust.** Symptom resemblance between rusts can complicate diagnosis, especially at late infection stage when all three rusts can produce black spores (teliospores, thick-walled spores specialized for survival) on mature plants. In general, these three rusts can be distinguished based on color, shape, and location on the plant.

Stripe rust is yellow, small circular pustules densely packed in yellow stripes running in parallel along leaf edges, located mainly on upper surfaces of leaf, leaf sheaths, awns and glumes. In contrast, **leaf rust** is orange brown, circular to oval in a random pattern, located mainly on upper surfaces of leaf and leaf sheaths. **Stem rust** is reddish brown, oval to elongated, with tattered edges in random patterns located on both leaf surfaces, on leaf sheaths, on stems and on the outside of the wheat spike. Rusts are easy to distinguish from other wheat diseases, such as bacterial leaf streak and Septoria leaf blotch, when the rust pustules are young, but it can be difficult to distinguish rust from these two diseases and other abiotic disorders if leaves have died and become brown and dry.

Disease Cycle

The life cycle of stripe rust includes five spore stages on two hosts: wheat and barley as primary hosts and barberry (*Berberis vulgaris*) as alternate host. However, in-season rust cycles in Arizona are simple because the alternate host and three of the five spore stages are of little importance for rust development. In Arizona, the urediospores (thin-walled spores specialized for repeating infection) are the spore type that can cause autoinfection (spores re-infect the same plants on which they were produced) and result in dispersal in the wheat crop.

In spring, air currents carry urediospores from Mexico into Arizona or locally from plant to plant and from field to field. Spores land, germinate, and infect leaves of susceptible wheat plants. After penetration, fungal mycelia (vegetative part of the fungus consisting of thread-like hyphae) elongate beneath the surface of the leaf and stem. New urediospores develop in pustules that erupt through the leaf surface, releasing massive amounts of spores into the air. These airborne spores can serve as a source of initial infection through long distance wind dispersal or as the repeating stage on the same host, thus responsible for the rapid development of disease outbreaks.

The annual progression of rusts across regions and continents is well known. Spores can also adhere to clothing and travelers can inadvertently carry and spread them. The yellow urediospores in the pustules are replaced by black teliospores later in the season.

Stripe rust – *Continued on page 5*

Stripe rust – *Continued from page 4*

The teliospores are not important because they cannot infect any known alternate hosts and are thought to play no role in the infection process. It is not clear whether the fungus can over-summer in volunteer wheat plants in Arizona.

Disease Requirements to Flourish

High moisture on leaf surfaces is required for the infecting spore to germinate and temperatures must be between 32 and 70 F (40-60 F is optimum). Infection occurs within 6-8 hours under optimum conditions. Infection rarely occurs below 36F and tends to cease above 73F. Disease development is most rapid and secondary spores can be produced in 7-10 days if temperatures are between 50 and 60 F and adequate moisture is available. Intermittent rain or heavy dew can accelerate the development and spread of the disease. The fungal mycelium in green leaf tissue can survive temperatures as low as 23 F. The disease can progress rapidly, since a 10,000 fold increase in spores is possible in one generation. In the deserts of Arizona below 4,000 ft, stripe rust on winter wheat is first observed in late winter or early spring.

Control

The overall goal of stripe rust management is to minimize yield loss by protecting the flag leaf and the second leaf. This goal is achieved by reducing the rate of disease progression and thus delaying the onset of the epidemic. Specifically, stripe rust can be managed by a combination of resistant cultivars, seed treatment, and fungicide spray.

1) While planting cultivars that exhibit reliable stripe rust resistance is good management in California regions where stripe rust is now endemic, there is little assurance that those cultivars will exhibit resistance to the stripe rust races that blow into Arizona from Mexico. Furthermore, developing resistant cultivars where the disease occurs only occasionally is problematic.
2) Planting seed that is treated with a triazole fungicide usually offers approximately 40 days of protection.
3) Apply a foliar fungicide at the boot stage of development if the rust develops. A second fungicide application 20 days after the first may be required. Products belonging to the strobilurin class have excellent protective activities against stripe rust when applied before infection. If stripe rust is present at the time of application, use triazole fungicides or premixes of the two classes because triazoles are thought to have stronger curative activity. For best results, these products should be applied before stripe rust becomes well established in the crop.
4) Monitor crops for stripe rust. Initiate checking for early winter infection on a bi-weekly basis, then check weekly as the potential rate of stripe rust development increases. Decide on foliar fungicide application based on findings.

Discussion

Although summer temperatures in low elevations of Arizona may be too high for the fungus to survive locally, weather conditions during recent growing seasons appear to have been more favorable for stripe rust disease development. This observation suggests that, although stripe rust was not often detected in the field until the middle of spring, severity often reached 100% on susceptible cultivars. Information is limited regarding the effectiveness of controlling stripe rust and the economic benefit under desert conditions of low elevation.

Research is needed to answer several questions that address the management of stripe rust in Arizona: What are the major environmental and agronomic factors contributing to epidemics in Arizona? How much yield loss is caused by the late infections that are typically observed in Arizona? Is seed treatment effective in delaying the onset of stripe rust in winter cereals in the spring, thus helping to limit a potential disease source? Is late application of foliar fungicide beneficial? What are the dominant forms (wheat stripe rust vs. barley stripe rust) and races of stripe rust in Arizona? Are the current genetics sufficient for resistance to the major races? What is the status of variety resistance in Arizona? Research projects to address these questions will help to provide a strong basis for integrated control of stripe rust in Arizona.

2017 Arizona Karnal Bunt Survey Results

Data released by the USDA/APHIS-PPQ in Phoenix following the 2017 Arizona wheat grain crop harvest indicate that five (5) wheat fields (totaling 212 acres) of the 176 wheat fields located in Arizona's Karnal bunt (KB) quarantine areas tested positive for KB. Each 4-lb sample (approximately 35,000 kernels) contained one (1) bunted kernel. This finding was three (3) more positive fields than were detected in the 2016 crop, but was substantially under the incidence of the fungal disease that occurred in the 2015 crop. The positive durum fields were located in western Pinal County, south of Phoenix.

The 2017 crop's regulated area totaled 479,757 acres, all located in La Paz, Maricopa, and Pinal Counties. Wheat was planted on 6,918 acres within the quarantined area in 2017, down from the 11,766 acres planted in 2016.

The KB quarantine was implemented in 1996 after bunted 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 now enforced by APHIS-PPQ require that 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 as animal feed. Fields found to be KB-positive are designated as regulated fields and all other fields and land located within a three-mile radius fall into the KB quarantine area if they are not already in it. The positive findings in 2017 will add 8,272 new acres to the regulated areas in Pinal County.

Regulated fields can achieve deregulation by following a protocol that involves tillage and/or negative KB sampling of host crops for a total of five years. Deregulation of a field may eliminate surrounding fields and land from quarantine status, depending on their proximity to other nearby regulated fields.

Compliance with the deregulation protocol resulted in the removal of 596 fields, totaling 12,502 acres, from regulation following the 2017 season.

APHIS/PPQ in Phoenix can inform growers of the potential regulated status of their fields and cultural requirements to remove them from regulation (Phone 602-431-3216). A brochure published by the U of AZ contains management practices that may minimize the likelihood of KB infection in host crops in Arizona. It is available at: **http://uacals.org/395.**

Research reports – 2017 Growing Season

NOTE: 2017 growing season reports were submitted by scientists in the College of Agriculture and Life Sciences at the University of Arizona. Reports 1, 2, and 4, were submitted by Dr. Mike Ottman, Extension Agronomy Specialist and Professor, CALS, Tucson. Report 3 was submitted by Dr. Charles Sanchez, Soil Scientist at the University of Arizona's Maricopa Ag Center.

NOTICE: Complete final reports for all AGRPC-funded research since 2006 are available on the website of the Arizona Department of Agriculture (**www.azda.gov**). Enter "AGRPC' in the search bar, then click on "Grants" followed by "Learn More about the AGRPC." Scroll to the "Related Links" heading to find the final reports of previously-funded research.

17-01: 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 and several site-years are necessary 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 this URL address: **http://ag.arizona.edu/pubs/crops/az1265-2017.pdf .**

17-02: Late -Season N Application Method Effect on Grain Protein

Nitrogen (N) fertilizer is normally applied around flowering time to boost grain protein content. The mineral can be applied in different physical forms: UAN32 in irrigation water; as a foliar application; or in a granular form. Previous work on the subject, funded by the AGRPC, was inconclusive in that late-season N application method did not influence grain protein content compared with a no-N control when averaged over varieties. However, late application did increase protein content in one variety and the application methods differed in effectiveness. The objective of the 2017 study was to repeat evaluating the effects of late-season N application method on grain protein.

Procedure: Two late-season N-application methods (urea granules and low biuret liquid as a foliar) were used to apply about 35 lbs. N/acre to three durum varieties at flowering. This application supplemented prior application of 209 lbs. N/acre. A third treatment was a control receiving no late-season N.

Results: Grain protein was not affected by late season N application, regardless of application method, presumably since the protein contents were so high (15.9% on average) that late-season N could not increase the protein content further. In this study, we were not able to detect a difference in grain protein or any other variable measured due to the late N application methods of foliar or granular applications, or compared to the control with no late-season N fertilizer applied..

Late N application also had no effect on grain yield, grain test weight, seed weight, plant height, lodging, heading, flowering, maturity, or HVAC (hard vitreous amber count). Differences among varieties were detected, but it was not the intent of this study to compare variety differences. We were interested in variety x late N application method interaction, but this interaction was not significant for any variables measured.

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

Water and salt management in crop fields are important aspects of agricultural sustainability in the lower Colorado River region near Yuma. Irrigation water contains salts, as does the shallow ground water in the valleys that fluxes up through the fine textured soil by capillarity. Excess irrigation (beyond crop consumptive use) must be applied to leach salts below the crop root zone. Effective leaching is important because many of the crops produced locally are sensitive to salinity.

Crop production systems and rotations can have a profound impact on water delivery, leaching achieved, and resulting salt distribution. Level-basin flooding, level impounded furrow flooding and sprinkler application each influence opportunity time and water distribution and application depth and, therefore, salt-leaching profiles. The objective of this study was to quantitatively track water use and salt balance across typical crop production systems and rotations in the lower Colorado River basin while growing produce followed by durum wheat.

Procedures: Data collection on the entire cropping system began in August during the pre-irrigation for fall produce and continued through the durum wheat crop in two fields, one in the South Gila Valley and one in the South Yuma Valley. Numerous methods were employed to measure variables such as water infiltration, depth-related salinity distributions, evaporation losses during irrigation, and soil temperature.

Results: This project generated an enormous amount of data that were still being analyzed for results at the time of newsletter printing. When available, the final report will be posted in the AGRPC section of the Department of Agriculture website.

An eddy covariance (ECV) measuring device located in a wheat field near Yuma in spring, 2017. The solar panel provides power to the evapotranspiration measuring equipment located on the adjacent post.

17-4: Can the Yield of Late-Planted Small Grains be Enhanced by Nitrogen Fertilizer Rates?

Wheat and barley are often planted later than optimum due to the timing of the previous crop or to reduce the risk of frost damage. The seeding rate of late-planted small grains is often increased as a way to increase the number of stems and productive spikes per acre, but this practice does not always achieve the desired effect. The problems with late planting are that the growing season is shortened, temperature may be higher than optimum during critical

Research results – *Continued on page 8*

Research results – *Continued from page 7*

growth stages and water stress may be difficult to avoid, all of which contribute to lower yield potential. The objective of this trial was to determine whether high N applications can compensate for the expected lower yield potential of late grain plantings.

Procedure: A trial including one durum variety (150 lbs. seed/acres) and one barley variety (120 lbs. seed/acre) was established at the Maricopa Ag Center. Planting dates were December 7, 2016 and February 16, 2017. N fertilizer was applied at about 125, 250, and 375 lb./acre.

Results: Nitrogen rate had no effect on yield and yield components, including protein content in the December planting. For the February planting, grain yield was decreased by high nitrogen (especially for the barley) and grain protein was higher in the high nitrogen rate compared to the low nitrogen rate. No variables other than yield and protein were affected by nitrogen rate in the February 16 planting. The lack of response to nitrogen fertilizer could have been the result of high residual nitrogen in the soil at planting.. Nevertheless, at the February 16 planting, nitrogen fertilizer rate did not appear to have an effect on tillering or growth in general, contrary to what we hypothesized. Therefore, for later planting dates, the only known method to increase stem count is higher seeding rates, but this may not necessarily have an effect on yield.

17-05: Small Grains Variety Testing in Plant Breeder Nurseries

In addition to the unbiased variety testing of commercial barley and wheat varieties conducted by the University of Arizona, variety trials conducted by plant breeding firms in diverse locations provide additional information of potential value to growers. The objective of this project was to evaluate commercially available barley and wheat varieties at Arizona City, in the Gila Valley near Yuma, and in the Yuma Valley.

Procedures: Variety tests on small plots were conducted at the three locations by three plant breeding programs. Commercially available varieties tested (12 wheat and 6 barley) were identical to those planted in the U of A variety trial at the Maricopa Ag Center. Measurements taken included yield, test weight, kernel weight, grain protein, and vitreous count.

Results: Results from these trials and those obtained in the U of A's trial were combined with the long-term performance evidence contained in the Cooperative Extension Service's annual variety trial publication. A report containing individual trial results is available in the AGRPC section of the Arizona Department of Agriculture's website (see the note at the beginning of these reports).

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NOTICE: The following two reports cover successive grants that were awarded to Arizona Plant Breeders on the condition that resulting breeding lines will be made available to the industry.

Rationale: Lodging is a serious concern that causes reduction in grain yield and quality and often increases harvest costs in durum wheat. A generalized improvement in the lodging resistance of Desert Durum® varieties available to growers should enhance the industry's profitability for all concerned.

Objective: To transfer straw strength and lodging resistance from triticale chromosomes to durum wheat in a short period.

16-10: The Use of Interspecific Hybridization Breeding Method to Improve Lodging Resistance in Durum Wheat (*Triticum turgidum L, var. durum*)

Procedures: Five durum wheat varieties and five triticale lines were used to perform a diallel crossing, in which all parents were crossed in all possible combinations. The F_1 seeds from each cross were embryo-rescued and transferred to a medium. Surviving plantlets were transferred to soil. The F_1 plant seeds were harvested at maturity as the F_2 generation, planted in a nursery to be backcrossed to the recurrent male durum parents. The progeny of this and subsequent backcrosses will be selected for durum characteristics and apparent straw strength.

Results: The survival rate of recued embryos indicated a successful initial stage. The first backcrossed harvest to recurrent durum lines was completed and replanted for more backcrossing.

17-06: Double Haploid Breeding to Improve Lodging Resistance in Durum Wheat

Procedure: Normal wheat breeding consists of growing numerous generations with selection to obtain the genetic homozygosity that stabilizes varietal traits. Such homozygosity can be achieved more rapidly by producing doubled haploid lines to achieve homozygosity by a well-established procedure. Seed of backcross lines presenting desirable standability potential will be sent to a Kansas lab to produce double haploid lines to be further evaluated in Arizona for standability before being made available for development of commercial varieties.

Desert Durum® Grain Production in Crop Years 2015-2017 and Export Volumes in Marketing Years (MY) 2015 -2016

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	2015	2016	2017
Arizona	412,245	256,000	244,000
So. California*	87,000	75,000	46,000
Total	**499,245**	**331,000**	**290,000**

**Estimated*

MYs ending on 5/31

Exports to:	2016 MY	2017 MY
Italy	236,470	114,549
Nigeria	35,796	35,265
Japan	1,494	1,175
Panama	1,308	1,494
Rep So. Africa		8,739
Total	**275,068**	**161,222**