

# Irrigation Efficiency for Durum Wheat

*Growing pasta wheat and barley in Arizona*

*By Susan McGinley*



M. Ottman

*Low-input wheat and barley evaluation plots at the Maricopa Agricultural Center in 2002.*

Not all pasta wheat grows in Italy; some is produced right here in Arizona. About half of the state's durum wheat yield is exported to Italy for processing; in 2001 the entire crop was valued at \$30 million. Arizona farmers planted 89,000 acres to durum wheat in 2002, and that number will increase in the coming year due to rising prices. Durum contracts for Arizona farms are currently being written at \$1.00-\$1.50/hundred-weight higher than last year. The contract price growers can receive for durum is higher than what they can get for bread wheat.

"Bread and durum wheat grow here equally well, but Arizona's desert durum is in greater demand because it has an international reputation for quality," says Mike Ottman, an agronomy specialist in the Department of Plant Sciences, UA College of Agriculture and Life Sciences. "Durum wheat does well

in the desert because it has virtually no diseases or insect pests, and it gets nice, plump kernels. Millers like them because they get a higher milling yield of semolina." Most of the kernels are plump; in many other growing regions the kernels are smaller, with a greater size distribution that makes them more difficult to mill.

Another plus for durum in Arizona is that the yields are fairly consistent so the grain companies know how much acreage to contract, and quality is consistent from year to year, so buyers can depend on durum grown in the area. North Dakota, where most of the U.S. durum is grown, doesn't have that yield and quality stability, according to Ottman. And desert durum buyers don't have to worry about sprout, bleaching, and fungal damage from too much rain. "The durum produced here is some of the first durum to hit the marketplace in a crop year," Ottman

says. "We are usually ahead of the North Dakota and Canada harvests by two months."

Of course there is a hitch: wheat needs water, and in the desert, that means it needs to be irrigated. Every irrigation is expensive, so it pays to know the least amount of water that can be applied that will still produce the maximum yield and quality. Water costs vary in Arizona, from as low as \$5/acre foot in Yuma, to \$34/acre foot in central Arizona to even higher costs in areas with deep wells. For both wheat and barley, the high cost of irrigating in the desert is offset somewhat by each crop's efficient use of it: they produce a good amount of grain per unit of water.

Still, no Arizona data were available before 1999 to assist farmers in determining how to time their irrigations based on the depletion of available water in the soil. Beginning in 1999, Ottman and Steve Husman, an area agricultural and natural resources extension agent in Pinal and Pima County, began testing different irrigation regimes on durum wheat and barley to determine the optimum water timing schedule. Ottman has also begun to study 40 varieties of low-input wheat and barley, and evaluated their water use efficiency for Arizona. Although not as widely cultivated as durum wheat in Arizona, last year's barley crop covered 40,000 acres and was valued at about \$11 million.

Sponsored by the Arizona Grain Research and Promotion Council, the project has focused on field experiments at the UA Maricopa Agricultural Center (MAC) in central Arizona, and at a commercial farm in Stanfield, central Arizona. The researchers have tested soil water depletion levels on durum (Kronos and Westbred 881 va-

ieties) and barley (Baretta and Max varieties), applying irrigations at 35, 50, 65 and 80% depletion of available soil water.

For each field experiment at MAC the general protocol has included planting three acres each of wheat and barley (containing two varieties each) at the beginning of December, fertilizing them with nitrogen and phosphorus fertilizers at standard pre- and postplant rates and irrigating them uniformly to germinate the crop. Irrigations are applied using the border flood method and a ditch weir is used to measure the amount of water applied. After that, the different succeeding irrigation rates are applied in plots replicated randomly throughout the field. For each crop, the scientists check periodic soil water content by using a neutron probe inserted to a depth of 52 inches, with measurements taken about every eight inches. Plots are harvested in May, and the grain yield, protein content, kernel weight and hard vitreous amber count taken for durum.

So far for durum, the researchers have found that irrigating when 35 to 50% of the available soil water is depleted results in the highest yield. They also noted that grain protein decreased when the wheat was irrigated more frequently. Contracts are based on a minimum protein level with significant price discounts to the farmer when the minimum protein level is not achieved. Therefore, more frequent irrigations require higher nitrogen fertilizer rates to achieve minimum grain protein levels, and the increased cost of the fertilizer and water when irrigating at 35% depletion may not be economical.

For barley, they determined that the profitability of irrigating at 35% rather than 50% acre depletion is improved with an increase in grain price or a decrease in water cost. Barley contracts do not include a minimum protein provision. It was found that irrigating more frequently (35% depletion) and with less water at each irrigation significantly improved yields and resulted in an average of only two additional irrigations per season when compared to a 50% depletion regime, a very cost-effective option.

Ottman has also been screening about 20 lines each of wheat and barley varieties at MAC that were devel-



M. Ottman

*Durum wheat field in Yuma, Arizona.*

### *Wheat and Barley are Good for the Environment*

Winter cereals such as wheat and barley are good from an environmental standpoint in Arizona because they offer a green ground cover and reduce dust, they normally don't require any pesticides, and they are efficient in their uptake of nutrients. Grown during Arizona's mild winters, they avoid heat stress and their fibrous root systems improve the soil. Salts can be leached from the soil while growing wheat during the winter when water use is low. In addition, the crops are so competitive that they crowd out weeds, break insect and disease cycles, add organic material to the soil due to their high straw content, and may actually increase yields of subsequent crops, especially when grown in rotation with cotton and vegetables.

From an economic development standpoint, wheat and barley do so well in Arizona that three breeding companies operate in the state, developing durum wheat and barley varieties not only for Arizona, but also for international markets.

oped in Arizona as low-input types, designed to use fewer irrigations per season. They have completed the first year in a three-year project, using lines developed by Tom Ramage, a former UA and USDA barley breeder.

All of the grain projects Husman and Ottman have undertaken are designed to produce crops efficiently.

"Growers normally irrigate by a schedule, or by crop appearance, or by their experience, and while there's nothing wrong with that, they may be able to use this research to adjust it," Ottman says. "We're trying to produce as efficiently as possible, getting the highest yield and quality per input cost. There is a point where the increase in water doesn't pay for the increase in yield. Our intent is for growers to use this data to see how their bottom line is affected." 🌱

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*Full reports on the field studies outlined above are available at [cals.arizona.edu/forageandgrain](http://cals.arizona.edu/forageandgrain).*