



# AGRONOMY PROGRESS REPORT

## Agricultural Experiment Station Cooperative Extension

October 2004 • No. 288

### 2004 REGIONAL BARLEY, COMMON WHEAT AND TRITICALE, AND DURUM WHEAT PERFORMANCE TESTS IN CALIFORNIA<sup>1</sup>

L. F. Jackson<sup>2</sup>, J. Dubcovsky<sup>3</sup>, L.W. Gallagher<sup>3</sup>, O. Chicaiza<sup>4</sup>, D. Stewart<sup>4</sup>, L. K. Gibbs<sup>4</sup>, D. Prato-Mayo<sup>5</sup>, D. Kirby<sup>6</sup>, H. Carlson<sup>7</sup>, M. Canevari<sup>7</sup>, B. Marsh<sup>7</sup>, H. Meister<sup>7</sup>, D. Munier<sup>7</sup>, S. Orloff<sup>7</sup>, B. Roberts<sup>7</sup>, J. Schmierer<sup>7</sup>, R. Vargas<sup>7</sup>, R. Wilson<sup>7</sup>, and S. Wright<sup>7</sup>

University of California Cooperative Extension cereal evaluation tests were conducted in the intermountain valleys of northern California; the Sacramento, San Joaquin, and Imperial Valleys; and in the south central coastal region in 2004. Entries in the tests included standard cultivars, new and soon-to-be released cultivars, and advanced breeding lines from both public and private breeding programs. Fall-sown winter barley (10 entries) was evaluated at two sites; fall-sown spring barley (29 entries), at 7 sites; and spring-sown spring barley (43 entries), at three sites. Fall-sown winter wheat and triticale (20 entries) was evaluated at two sites; fall-sown spring wheat and triticale (41 entries total), at ten sites (not all entries were evaluated at all sites); and spring-sown spring wheat (18 entries), at three sites. Durum wheat (29 entries) was evaluated at 6 sites.

Tests were conducted at University of California Field Stations or in fields of cooperating growers. Tests were sown at seeding rates of 1.2 million seeds per acre for common and durum wheat tests (equivalent to 91 to 136 lbs/acre for common wheat, and from 110 to 161 lbs/acre for durum wheat, depending on the entry) if irrigation was planned and at 1.0 million seeds per acre for rainfed wheat and all barley (equivalent to 58 to 118 lbs/acre) and triticale (equivalent to 80 to 109 lbs/acre) tests. Randomized complete block designs with four replications were used. Each plot was nine drill rows wide (5 to 6-inch row spacing) and 20 feet long, except at the UC Desert Research and Extension Center (Imperial) where plots were 16 feet long. Grain was harvested with a Wintersteiger Seedmaster Universal 150 plot combine. Foliar diseases were assessed at the soft-to-medium dough stage of growth by estimating the percentages of areas of penultimate leaves (flag-1 leaf) affected. BYD assessments, however, were based on the percentage of plants showing symptoms. Black point was assessed on grain samples of durum wheat after harvest. Yield, test weight, kernel weight, plant height, days to heading and maturity, lodging, shattering, disease reaction, and grain quality were determined as indicated in the tables. Information regarding each site is given in Table 1.

The small grain crop for the 2004 season in California, according to the California Agricultural Statistics Service, included 662,000 acres of wheat (including 117,000 acres of durum), 110,000 acres of barley, and 280,000 acres of oat. No statistics on triticale are available, but acreage probably increased above the 50,000 + acres of 2003 as an alternative to wheat because most triticale cultivars are less affected by stripe rust. About 250,000 acres of wheat and triticale are harvested as green-chop forage for dairies in California's Central Valley. Wheat growers responded to 2003's stripe rust epidemic by significantly reducing acreage of susceptible cultivars and increasing acreage of the few available resistant cultivars. For cultivars that began the 2004 season as resistant, acreage of Summit increased from 57,000 to 210,000 acres and Blanca Grande (hard white) increased from 13,000 to 74,000 acres. For stripe rust susceptible cultivars: acreage of Yecora Rojo declined from 135,000 to 80,000 acres, Dirkin (forage) from 37,000 to 17,000 acres; Bonus, from 60,000 to 200 acres; Express, from 98,000 to 13,000 acres; Anza, from 28,000 to 13,500 acres; Brooks, from 32,000 to 5,000 acres; and Klasic (hard white), from 20,000 to 5,000

<sup>1</sup>These tests were conducted by the UC Davis Department of Agronomy and Range Science and Cooperative Extension. Land for the tests, the grain produced and other facilities were contributed by cooperating growers identified in Table 1. Quality evaluations were provided by the California Wheat Commission (CWC) quality laboratory. The assistance of growers and the CWC quality laboratory is acknowledged with appreciation. The regional testing program is supported in part by funds provided by the California Crop Improvement Association and the California Wheat Commission.

<sup>2</sup>Extension Agronomist, <sup>3</sup>Agronomist, <sup>4</sup>Staff Research Associates, Department of Agronomy and Range Science, UC Davis, <sup>5</sup>Lab Assistant, Department of Agronomy and Range Science, UC Davis <sup>6</sup>Staff Research Associate, UC IREC, Tulelake, and <sup>7</sup>UC Cooperative Extension Farm Advisors in Modoc, San Joaquin, Kern, Imperial, Glenn, Siskiyou, Kings, Colusa, Madera, Lassen, and Tulare counties, respectively.

acres. Warm weather and a dry season resulted in an early maturing crop; plot harvests were about 2-3 weeks earlier than average. Rainfall in the Sacramento Valley after the end of February was only about 2.5 inches; rainfall after the end of February in the San Joaquin Valley was less than one inch.

Although there was very high stripe rust pressure on wheat throughout the Central Valley, yield loss (5% on a statewide basis) was significantly less than in 2003 because of the wide-use of resistant cultivars (Summit, Blanca Grande), occurrence of less conducive environmental conditions, and later development of severe levels of disease (initial infection occurred about 1 month later in 2004 than in 2003). Still, disease levels were very high by the soft-dough stage of growth. Stripe rust generally was less severe on durum wheat, but most entries in statewide tests were affected and several had very high disease severity. The wheat stripe rust survey in 2004 identified 10 races, including 4 new races. Highly virulent races PST-100, PST-101, and PST-102 occurred in highest frequency. Each of these races also contained variants that were virulent to Summit (if Summit had been included as a differential, there would have been 3 additional new races identified, for a total of 7 new races).

Other diseases occurred but had less impact than wheat stripe rust. Barley stripe rust occurred relatively late in 2004, but increased to high severity by the end of the season on the UC Davis research farm on susceptible cultivars such as Max, Legacy, and Tradition. Leaf rusts of wheat and barley were very late to develop and were detected on only a few genotypes in 2004. Leaf rust of durum wheat, which occurred in the Imperial Valley in 2003 and was caused by the same durum-specific leaf rust race that currently occurs in Mexico, was not detected in 2004. Septoria tritici blotch of wheat was severe early in the season in nurseries and fields in the Sacramento Valley; low rainfall limited the damage, however, since we received very little rain after the end of February. Scald of barley also was severe early in the season, but dry weather after the end of February limited damage.

## BARLEY

**Fall-sown winter barley.** The fall-sown winter barley test contained 10 entries (7 cultivars and 3 advanced lines). Entries in the test, type of barley, their backgrounds, and seed sources are shown in Table 2. Yield and agronomic performance data are given in Tables 3-5. One test sown in Siskiyou Co. was abandoned because of very severe rye infestation. Both the October-sown and February-sown tests at Tulelake had good stands; the spring check cultivar, Steptoe, survived the winter. Stripe rust was severe on Steptoe and moderately severe on Hoody. There was severe lodging of most entries in the February-sown test. KAB 47 showed good lodging resistance. Yields ranged from 4950-9300 lb/acre (October-sown) and from 2680-7540 lb/acre (February-sown). Eight-Twelve and STAB 113 were the highest yielding entries in the October-sown test while STAB 113 was the highest yielding entry in the February-sown test. Eight-Twelve was the highest yielding in the three-year period 2002-2004.

**Fall-sown spring barley.** The fall-sown spring barley test contained 29 entries (twenty-two 6-row spring feed types, three 6-row spring malt types, one 2-row spring feed type, two 6-row naked spring types, and one 2-row naked spring type), including 9 cultivars and 20 advanced lines. Entries in the test, type of barley, their backgrounds, and seed sources are shown in Table 6. Yield and agronomic performance data are given in Tables 7-15. Stripe rust was most severe at the UC Davis site, particularly on entries Max, Commander, Tradition, 6B98-9339 and APB BB-409. It occurred in lesser severity at the Butte, Madera, and Kings sites. Net blotch/spot blotch affected most entries at the Glenn site. Entries that were least affected included UC 933, UCD C135, UCD C140, UCD C147, UCD YP03-8/16, UCD YP03-9/3, and G196M046. Net blotch occurred in lower severity at the Butte, UC Davis and Kings sites. BYDV was moderately severe at the Kings, UC Davis, and Madera sites; Meltan was most affected. Leaf rust was rare, but did occur on Commander at the Kings site and on Patti at the UC Davis site. Lodging was severe at harvest and affected most entries at the Madera and Kings sites. Max, Commander, UC 603, UCD YP03-8/16, UCD YP03-9/16 and UCD YP03-9/2, were least affected (most resistant to lodging). Moderate to severe shatter by harvest occurred at the Butte, Madera, and Glenn sites. Tradition, 6B98-9339, UC 969, and G196M046 were most affected. There was very severe drought stress and very low yields at the rainfed San Luis Obispo and Tulare sites. Average yields ranged from 620 lb/acre at the rainfed San Luis Obispo site to 5750 lb/acre at the UC Davis site. Entries UCD C140, 23IBYT 7, and UCD C147 were highest yielding in the Sacramento Valley; entries UCD YP03-9/16 and UCD YP03-8/16, in the San Joaquin Valley; and entries UCD C122, UCD C140, UC 937 and UC 933, at rainfed sites. In the three-year period 2002-2004, entries UCD PYT99 A-13 and 23 IBYT 7 have been the highest yielding in the Sacramento Valley; entry UCD PYT99 A-13 and UCD PYT01 C6, in the San Joaquin Valley; and UC 937, UC 933, and Meltan, at rainfed sites.

**Spring-sown spring barley.** The intermountain spring barley test contained 43 entries (eighteen 6-row spring feed types, seven 6-row spring malt types, nine 2-row spring feed types, and nine 2-row spring malt types), including 22 cultivars and 21 advanced lines. Entries in the test, type of barley, their backgrounds, and seed sources are shown in Table 16. Yield and agronomic performance data are given in Tables 17-19. The test at the Lassen site

(near Honey Lake) was abandoned; severe drought stress combined with a very high Russian wheat aphid infestation resulted in crop failure. Stripe rust was severe at the Tulelake site. Steptoe, Creel, Tradition, Legacy, Aquila, and PB1-95-2R-522 were most affected. Moderately high aphid populations and heavy honey-dew and sooty mold occurred on foliage of most entries at the Tulelake site. Moderate to severe lodging occurred at the Tulelake site. Yield variability was high at the Siskiyou site because of non-uniform irrigation. Average yields ranged from 5320 lb/acre at the Siskiyou site to 6630 lb/acre at the Tulelake site. Overall, UCD-TL20, Creel, and UCD-TLB52 were highest yielding in 2004. In the period 2002-2004, Creel, Millenium, UCD-TL163, and UCD-TL20 were highest yielding region-wide; Xena, in Siskiyou Co; and Creel, Millenium, UCD-TL163, and UCD-TL20, at Tulelake.

## WHEAT

**Fall-sown winter wheat and triticale.** The fall-sown winter wheat and triticale test contained 20 entries (nine soft white winter wheat, two club wheat, one hard red winter wheat, two hard white winter wheat, and six triticale). Entries in the test, their backgrounds, and seed sources are shown in Table 20. Yield and agronomic performance data are given in Tables 21-23. One test sown in Siskiyou Co. was abandoned because of very severe rye infestation. Stripe rust infection foci were observed in plots of Hubbard (October- and February-sown tests at Tulelake) and Golden Spike (February-sown test at Tulelake). Hubbard also had leaf rust foci. Heavy aphid honey-dew and sooty mold occurred on foliage of most entries in the October-sown test; less occurred in the February-sown test. Lodging was severe on Coda in the October-sown test and moderate on Coda in the February-sown test. Triticale Décor had lower plant survival (70% cover versus 100% cover) than other entries in the February-sown test at Tulelake. Bird damage (shatter) was severe just before harvest, greatly reducing yields of two plots each of Lambert, Weatherford, and Hubbard, and one plot each of Stephens, Rod, Boundary, Simon, and ORSF-101 in the October-sown test and one plot each of Stephens, Lambert, Weatherford, Brundage 96, and Hubbard in the February-sown test. Yields ranged from 6440-10,750 lb/acre (October-sown) and from 5630-9950 lb/acre (February-sown). Triticale entries Décor, Elan, and MAH 3800 and wheat entry Rohde all yielded more than 10,000 lbs/acre in the October-sown test while Rohde and triticale entries MAH 3800 and Elan were highest yielding in the February-sown test. Rohde was the highest yielding in the three-year period 2002-2004.

**Fall-sown spring wheat and triticale.** The fall-sown spring wheat and triticale test contained 40 entries (twenty hard red spring wheat, thirteen hard white spring wheat, one hard white winter wheat, and six triticale), including 15 cultivars and 25 advanced lines. Entries in the test, type, background, and seed sources are shown in Table 24. Yield, agronomic performance, and quality data are given in Tables 25-39. The Madera site (Table 29) was extremely moisture stressed by soft dough stage when irrigation was delayed, resulting in early senescence and low grain yield. A few entries, including triticale entries Trical 96, Trical 111, and RSI 97TV38011 had poor stand emergence at the Kern site (Table 31). Very low precipitation (6.1" total) and severe drought stress (leaves below flag senesced) occurred by early heading (4/7) at the rainfed Tulare site (Table 34). Some entries showed better green leaf retention than others under the stress, including triticale entries Trical 105, Trical 111, and RSI 97TV38011 and wheat entries APB W01-374-4 and APB W01-106-2 B4. Stripe rust pressure was very high throughout the Central Valley, although it was later to develop in 2004 than in 2003. Earliest infections occurred at the Sacramento/San Joaquin Delta site where stripe rust foci were first observed at early jointing (2/12) in plots of Express, Cavalier, Clear White and DA 998-12. Final disease levels were very high for susceptible entries at 8 sites (Table 35). Entries highly susceptible at one or more sites included Anza, Yecora Rojo, Serra, Express, Cavalier, Stander, Stellar, BZ 998-247W, WWW CHBR1933, DA 998-12, RSI 99WY51394, DA901-12W, YU900-62W, RSI 98WV11014, and RSI 00WB80082. Cultivars and lines with the lowest disease reactions (most resistant) to stripe rust included Summit, Blanca Grande, UC 1296, WWW BR3677, UCD 010390601, UCD 010310/17, UCD 010310/18, UCD 010310/24, YU999-158, APB W01-374-4, and triticale entries Trical 105 and Trical 111. Triticale entry Trical 96 showed a severe necrotic reaction to stripe rust. Septoria tritici blotch occurred at four sites (Table 35) and was most severe at the Colusa site where Yecora Rojo, Cavalier, BZ 998-247W, YU999-178, and WWW CHBR 1933 were most affected. High aphid populations and severe to moderately severe BYDV damage was detected at six sites in the Central Valley and the Imperial Valley (Table 36). Entries most affected included Beth Hashita, Wincal 14, WWW BR3677, YU99-178, and APB W01-106-2 B4. Lodging was severe at harvest at several sites (Table 36); entries least affected (most resistant to lodging) included Stander, Clear White, UCD 03010/17, UCD 03010/18, DA 901-12W, RSI 98WV11014, and triticale entries Trical 96 and Trical 111. Grain protein content of samples from four sites in the Sacramento Valley and three sites in the San Joaquin Valley was measured (Table 37). Mean grain protein content ranged from 10.9% to 14.1% for samples from the Sacramento Valley and from 13.3% to 14.1% for samples from the San Joaquin Valley. All wheat entries except Anza had grain protein content

averages of 13% or above for the San Joaquin Valley sites; 12 wheat entries had grain protein content averages of 13% or above for the Sacramento Valley sites, where protein content was highest for entries UCD 03010/17, DA 900-229, WWW BR3677, RSI 99WY51394, and Express. Quality evaluations (conducted by the California Wheat Commission laboratory) of samples from the Kings site (Table 38) showed that the highest loaf volumes and overall bread scores were produced by entries DA 900-229, DA901-14W, YU999-178, and RSI 00WB80082. Average grain yields ranged from 990 lb/acre at the rainfed Tulare site to 6210 lb/acre at the Colusa site. Triticale RSI 97TV38011 and Summit were the highest yielding in the Sacramento Valley (averaging 6710 and 5760 lbs/acre, respectively) and in the San Joaquin Valley (averaging 6110 and 5940 lbs/acre, respectively). Blanca Grande was the highest yielding in the Imperial Valley. In the three-year period 2002-2004, Summit was the highest yielding in the Sacramento Valley, the San Joaquin Valley and the Imperial Valley, while Express, Summit, Blanca Grande, Serra, Stander and Beth Hashita were highest yielding at rainfed sites (Table 39).

**Spring-sown spring wheat.** The intermountain spring wheat test contained 18 entries (seven soft white spring, one soft white club, seven hard red spring, and three hard white spring), including 12 cultivars and 6 advanced lines. Entries in the test, type of wheat, their backgrounds, and seed sources are shown in Table 40. Yield and agronomic performance data are given in Tables 41-43. Severe drought stress combined with a high Russian wheat aphid infestation resulted in crop failure at the Lassen site (results not shown). There was moderate to heavy volunteer alfalfa in several plots at the Siskiyou site. High levels of aphid honey-dew and sooty mold occurred on foliage at the Tulelake site. Moderate to severe stripe rust occurred on Winsome at the Siskiyou site, on ID 0592 at the Tulelake site, and on Twin at both sites. Yield variability was high at the Siskiyou site because of non-uniform irrigation. Average yields ranged from 5090 lb/acre at the Siskiyou site to 7420 lb/acre at the Tulelake site, where the top-yielding entry (ID 0599) yielded 8650 lb/acre. In the three-year period 2002-2004, Alturas and Nick were highest yielding region-wide; Alpowa, at Siskiyou; and Alturas and Nick, at Tulelake (Table 43).

**Durum wheat.** The durum wheat test contained 29 entries, including 13 cultivars and 16 advanced lines. Entries in the test, their backgrounds, and seed sources are shown in Table 44. Yield, agronomic performance, and quality data are given in Tables 45-56. Two tests were conducted at Imperial, one with normal irrigation (at planting (12/16) + 4 irrigations (1/22, 3/9, 4/12, 5/7); total applied water: 38.4") and one with reduced irrigation (at planting (12/16) + 2 irrigations (3/8, 4/20); total applied water: 24.0") (Tables 49-50). Most entries in the reduced irrigation test had low tillering (but plump spikes), and by early April (soft dough) many entries showed leaf-tip necrosis and senescence. Entries in the reduced irrigation test averaged 5 days earlier in heading and 8 days earlier in maturity than in the normal irrigation test, and yielded an average of 980 lb/acre less (4390 lb/acre vs 5370 lb/acre) than they did in the normal irrigation test. The Madera site (Table 46) was extremely moisture stressed by soft dough stage when irrigation was delayed, resulting in early senescence and low grain yield. Severe stripe rust developed on many entries, including Kofa, Kronos, Ria, Mohawk, Matt, Topper, Orita, Candura, YU 895-130, WWW D5384-2, WWW D9737, APB D99-425, APB D00-627, APB D00GE-5, and APB D990D-82 at one or more of the UC Davis, Madera, Kings and Kern sites by the soft dough stage. Cultivars and lines with low disease reactions (resistant) to stripe rust included Oro, Crown, and RSI 00WV50064 (Table 51). Low to moderate levels of black point occurred on some entries at one or more of the UC Davis, Kings, and Kern sites; Kofa, Matt, APB D00-232, APB D990D-82, APB D99-425, APB D00AZ-248 and APB D00-627 had relatively high average black point severity, while Bravadur, Oro, Duraking, Platinum, Candura, BZ 898-63, RSI00WV50064, RSI00WV50014, WWW D8227, WWW D8270, WWW D9737 and APB D00GE-5 had low black point severity (Table 51). Many entries were severely lodged at harvest at the UC Davis and Kings sites (Table 51); entries least affected (most resistant to lodging) included Duraking, Topper, Oro, RSI 00WV50064, and WWW D8227. Grain protein content of samples from the four sites in the Central Valley and the normal irrigation test in the Imperial Valley was measured (Table 52). Mean grain protein content ranged from 12.5% to 14.6% for samples from the Central Valley, and from 13.7% to 15.9% for samples from the Imperial Valley. Only APB D99-425 had grain protein content of less than 13% averaged over all sites. Quality evaluations (conducted by the California Wheat Commission laboratory) of samples from the Kings (Table 53) and Imperial (Table 54) sites showed that samples of 13 entries from the Kings site and 14 entries from the Imperial site had the highest possible pasta color scores. Entries Kofa, Kronos, Mohawk, Orita, YU 895-130, RSI00WV50064, APB D00-627, APB D00-232, APB D00GE-5, and APB D990D-82 had the maximum pasta color score at both sites. Average grain yields ranged from 3520 lb/acre at the Madera site to 6050 lb/acre at the Kern site. Oro and RSI00WV50059 were the highest yielding in the San Joaquin Valley; and Duraking, APB D00-232, and Topper, in the Imperial Valley. In the three-year period 2002-2004, Oro and Platinum were the highest yielding in the San Joaquin Valley; and Duraking, Topper, Oro, and Orita, in the Imperial Valley normal irrigation) (Table 55). In the three-year period 2002-2004, Kofa and Duraking were the highest yielding in the Imperial Valley under reduced irrigation (Table 56).