TRITICALE
in California

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Comparison of tall triticale (left) and short-statured wheat (center) at the Tulelake Field Station in northern California (see cover also).

Triticale (a wheat-rye hybrid) must compete for acreage mainly with barley and wheat. Assuming no price differential among the cereal feed grains, the yields and production costs for triticale must be equivalent or more favorable before a substantial triticale production can be anticipated in California. The results presented here indicate that, under most conditions, triticale does not yield better than other feed grains. Production costs are expected to be similar for triticale, barley, and wheat except in areas where more irrigations are required for late maturing triticale varieties.

TRITICALE has received considerable attention as a new feed grain in California. Since 1968 the potential for using triticale in grain production has been investigated in several of the major feed grain production areas. The varieties studied have spring growth habits and were grown under conditions known to be favorable for barley or wheat production. The first triticales studied in 1968 were developed at the University of Manitoba. Rosner, the first triticale variety released in Canada, was included in tests reported in CALIFORNIA AGRICULTURE, September, 1969. These varieties proved unadapted for production in California. The grain yields obtained were about 50% of the yields of adapted wheat varieties. Similar results are obtained when wheat varieties from northern latitudes of the U. S. and Canada are grown in California.

A major factor leading to the poor performance of the first triticale varieties tested and of the northern wheats is late maturity, resulting mainly from genetic sensitivity to day length. The long days required for heading are not reached in California before high temperatures and inadequate moisture become factors limiting production. However, additional factors affected the performance of triticale, including genetic instability for seed production resulting in a high degree of sterility (empty florets) in the spikes and partially shrunken grains. The shrunken grains contributed to low test weight—about 50 lbs per bushel—compared with 58 to 64

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OPERATIONAL AND ECONOMIC COMPARISON OF FORKLIFT AND TRAILER PALLET-BIN SYSTEMS WITH THE FIELD-BOX SYSTEM IN LEMON HARVESTING. Bul. 857. This bulletin analyzes the forklift and trailer pallet-bin systems and the conventional field-box system and compares their efficiency and economic feasibility. It presents criteria for getting the most effective use from these systems under various orchard conditions. Although this publication is particularly concerned with problems involving a lower-yield harvest, it should be valuable for improving harvest efficiency of any tree crop.

1972 CROP WEED CONTROL RECOMMENDATIONS. University of California recommendations for weed control in different crops. Includes application and safety suggestions.

lbs per bushel commonly found with wheat. Grain loss due to shattering was also noted.

Through intensive research in plant breeding various public and private institutions have developed improved triticale varieties and made them available for wide-scale evaluation. These varieties, along with Rosner and several other lines from Manitoba, have been included in California regional performance nurseries for the three-year period, 1969–71. All of the varieties tested are hexaploid types, recently given the scientific name *Triticale hexaploide* Lart. Hexaploid triticales are obtained by hybridizing tetraploid wheat with diploid rye followed by doubling the chromosome number of the hybrid plants. Various triticales derived in this way have been intercrossed or crossed with common (hexaploid) wheat. Several generations of selection then resulted in some new varieties which were evaluated.

The triticale varieties tested were from the University of Manitoba (UM-lines and Rosner), Jenkins Foundation for Research (JFR lines), International Grains, Inc. (Graze Grain 70), and CIMMYT, The International Maize and Wheat Improvement Center (Armadillo, Badger, and T-lines). The evaluations were conducted at University of California research facilities at Tulelake near the Oregon border (elevation 4,000 ft), the Agronomy Farm at Davis in the Sacramento Valley, the West Side Field Station near Five Points in the San Joaquin Valley, the Moreno Farm near Riverside, and at the Imperial Valley Field Station, El Centro, near the Mexican border. The tests were planted at Tulelake in April and in the winter at the other locations. The experiments were replicated three to five times using plots 32 to 96 sq ft and standard field plot techniques. The wheat varieties INIA 66, Siete Cerros 66, and Oviachic 65 (durum) were included in all tests and Leeds (durum) and Wocus barley were included in 1969 and 1970 at Tulelake.

Regional performance

Grain yields obtained at each location in 1970 and 1971 are given in tables 1 and 2. The 1969 tests included mainly Manitoba lines and confirmed the observations made in 1968 that yields were much lower than with the standard wheat varieties.

Triticale has performed relatively better at Tulelake than at the other locations. Mean yields for two experiments at Tulelake in 1969 and 1970 showed yields exceeding 6,000 lbs per acre, approaching the yield of the highest yielding wheat varieties. Wocus barley, widely grown for feed in the Tulelake Basin, produced higher yields than varieties of common or durum wheat and triticale.

Average triticale yields at Five Points were lower in comparison with wheat than at other locations. This result was obtained each year and may be due to triticale's susceptibility to the barley yellow dwarf virus, or various root rot diseases.

A severe frost occurred on April 29, 1970 at Riverside when some varieties were heading. Early-maturing varieties such as INIA 66 wheat and T-1324 triticale, were the most severely damaged and grain yields were greatly reduced.

In most areas of California it is very dry and occasionally windy at harvest time. These conditions can result in severe losses of grain by shattering. Three types of shattering have been observed with triticale: loss of individual grains from the head, breakage of the head (brittle rachis), and loss of whole heads (head snapping). Those varieties having brittle rachis as observed in 1971 at

TABLE 1. GRAIN YIELDS OF WHEAT AND TRITICALE AT FIVE LOCATIONS IN CALIFORNIA IN 1970

Variety	Tulelake	Davis	Five Points	Riverside	El Centro	Mean
			lbs per acre			
TRITICALE						
JFR 6TA-204	7400	4940	3300	3130	3350	4420
JFR 6TA-204-33	7880	4880	2490	3030	3070	4270
JFR 6TA-418	7550	4380	2440	2730	2950	4010
JFR 6TA-209	6780	3430	2200	2180	4100	3740
T-1324	4990	4660	3340	1010	3940	3590
JFR 6TA-454	5350	4690	1320	3160	2930	3490
T-1501	4580	4700	3400	1570	3160	3480
T-1524	4350	4600	3620	1650	2840	3410
T-1239	4560	4370	2760	1790	3500	3400
T-1247	4360	3360	2380	1500	2530	2830
T-1303	2900	3510	2080	1440	2200	2430
Rosner	5080	1990	1260	1180	1190	2140
T-1312	3270	2900	1430	1300	1680	2120
WHEAT						
Siete Cerros 66	7410	4170	5390	3020	3050	4610
INIA 66	6260	5930	6180	910	3250	4510
Oviachic 65 (durum)	6940	4550	3760	2650	3470	4280
LSD (.05)	960	1030	1101	392	623	
CV,%	12.9	19.1	27.3	10.0	14.7	
Triticale mean	5310	4030	2460	1970	2880	3330
Wheat mean	6870	4880	5110	2190	3260	4460
Triticale mean as per cent of wheat mean	77	83	48	90	88	75
Best triticale as per cent of best wheat	106	83	59	105	113	96
Date planted	4/22/70	11/25/69	11/20/69	1/22/70	12/12/69	

TABLE 2. GRAIN YIELDS OF WHEAT, TRITICALE, AND RYE AT FIVE LOCATIONS IN CALIFORNIA IN 1971

Variety	Tulelake	Davis	Five Points	Riverside	El Centro	Mean
			lbs per acre			
TRITICALE						
JFR 6TA-419	5210	3710	4460	2590	5390	4270
JFR 6TA-204	5230	3970	3730	2320	5720	4190
JFR 6TA-205-21	5470	3960	3760	2290	5300	4160
JFR 6TA-418	5270	3740	3450	1980	4620	3810
JFR 6TA-454	4780	3430	3840	2240	3180	3490
T-122	5400	3720	1660	2590	3320	3340
Armadillo 1524	4150	3060	2240	2320	3990	3150
T-1239	3890	3540	2310	2280	3440	3090
T-1324	4310	3360	2160	2980	2180	3000
Armadillo 133	4720	3210	1790	1760	3420	2980
T-1524	4530	3230	2010	2210	2910	2980
T-115	4490	2500	1420	2280	4050	2950
Bronco 90	4240	3400	2060	2350	2680	2950
Rosner	3940	1800	1590	1190	3500	2400
T-1312	2880	2550	1710	1780	3090	2400
Badger 46	—	3650	—	—	3480	—
Graze Grain 70	4510	—	—	—	—	—
WHEAT						
Siete Cerros 66	6660	5060	4410	3530	5820	5100
Oviachic 65	5490	4640	3850	3600	4120	4340
INIA 66	5930	4690	4080	2770	3170	4130
RYE						
Merced	2900	3420	3120	2010	1190	2530
PI 243741	2080	3110	—	—	—	—
LSD (.05)	856	771	423	450	955	
CV,%	12.6	15.6	10.8	13.4	15.5	
Triticale mean	4560	3300	2550	2210	3770	3280
Wheat mean	6030	4800	4110	3300	4370	4520
Triticale mean, % of wheat mean	76	69	62	70	86	72
Best triticale, % of best wheat	82	78	101	83	93	84
Date planted	4/28/71	1/22/71	1/6/71	1/12/71	11/18/70	

Tulelake are listed in table 2. All varieties, including the wheats, showed some loss of grain due to shattering.

Currently available triticale varieties are tall and may lodge. Plant height data obtained at Tulelake in 1971 are typical (table 3). The JFR varieties, Rosner, and some of the first varieties developed by CIMMYT exceed 130 cm in height. Several of the Armadillo varieties were less than 120 cm tall and did not lodge at Tulelake in 1971. This represents a great improvement, but further reduction in height is needed—as is evident in comparisons with the short-statured wheat varieties.

Late maturity is characteristic of many triticale varieties, including Rosner, Graze Grain 70, and the JFR varieties. This is a disadvantage for production under irrigation because more water is required to bring the crop to normal maturity. This was the case at El Centro in 1971 where late irrigation was applied to prevent moisture stress from reducing yield in some varieties. Lateness is also disadvantageous in dryland production because the lack of moisture frequently becomes a limiting factor before maturity is reached. Adequate earliness has been incorporated in some of the CIMMYT varieties (Armadillo and Badger types).

Since the triticale plant type differs from that of other cereals, yields may be increased as additional information is obtained on cultural practices such as planting date, irrigation, and fertilization. For example, in a date-of-planting study conducted for two years at El Centro, using 6TA-204, yields for plantings made in mid-November were 4,310; mid-December, 3,560; and mid-January, 3,130 lbs per acre.

Since the first triticale varieties were evaluated in 1968, grain yield has improved remarkably. Triticale (mean) yield percentages as compared with wheat were 50, 69, 75, and 72%, respectively, in the years 1968–71. In individual tests, triticale varieties occasionally exceeded the best wheat variety. However, these results showed that no triticale consistently produced more grain than the standard wheat varieties.

Further genetic improvements are needed in triticale, but it is also remarkable that this new crop performs so well after only a few years of intensive plant breeding research. Specific improvements needed include (1) shorter height of triticale for improved lodging resistance and ease of harvest. At present this is being done by incorporating genes for dwarfness from durum and common wheat and rye. (2) Elimination of wrinkled grain is needed to improve grain density (test weight). (3) Major improvements in spike fertility have been made, but there still exists some genetic instability for seed production which tends to lower grain yields of the present triticales. (4) Brittle rachis and other forms of shattering need to be eliminated for consistent production in California environments. (5) The barley yellow dwarf virus (BYDV) is a major disease of triticale in California and causes significant reduction in grain yield. Rye and some triticales show tolerance to BYVD, suggesting that improvements can be made through breeding.

At present, triticale grain is not suitable for large-scale milling and baking; it therefore must be considered as a feed grain. The protein content of triticale has been slightly higher than wheat and barley, providing reason for some interest in use of the grain in nonruminant nutrition. Some studies of swine and poultry nutrition using triticale are currently in progress in various laboratories at the University of California.

Comparisons of triticale, wheat, barley, and grain sorghum in high energy finishing rations for cattle were made by G. P. Lofgreen at the Imperial Valley Field Station. No palatability problems were encountered and the net energy of the triticale ration was equivalent to barley and wheat. Triticale was also used in combination with barley and grain sorghum with satisfactory gains and efficiency. Although not observed in California, triticale produced in some areas has a high incidence of ergot. This has reduced the value and palatability of triticale as a feed for swine and cattle.

TABLE 3. PERFORMANCE OF WHEAT, TRITICALE, AND RYE AT TULELAKE, CALIFORNIA IN 1971 (PLANTED APRIL 28, 1971)

Variety	Yield	Height	Lodging	Test weight
	lb/acre	cm	%	lb/bu
TRITICALE				
JFR 6TA-203	6010	149	85	50
Armadillo 108	5820	114	0	53
Armadillo 107	5620	116	0	53
JFR 6TA-205-21	5470	140	25	50
T-122	5400	118	0	51
Armadillo 113	5370	117	0	52
Badger 122	5330	120	0	52
Armadillo 116	5290	121	0	54
JFR 6TA-418	5270	144	90	47
Armadillo 103	5240	116	0	52
JFR 6AT-204	5230	141	95	47
JFR 6TA-419	5210	131	70	48
JFR 6TA-204	5230	141	95	47
Badger 121	5120	115	0	51
Armadillo 122	5110	117	0	52
Badger 118	5090	113	0	52
Badger 123	5040	116	0	51
JFR 6TA-454	4780	131	55	45
Armadillo 133*	4720	130	5	49
T-1524	4530	129	0	50
Graze Grain 70	4510	124	50	51
T-115	4490	119	0	51
T-1324	4310	115	0	54
Bronco 90	4240	131	0	52
Armadillo 1524	4150	132	0	51
JFR 6TA-514	4060	128	0	51
Rosner*	3940	133	5	49
JFR 6TA-421	3920	141	95	48
T-1239	3890	141	0	55
Armadillo 106*	3720	115	0	51
JFR 6TA-518	3630	135	0	51
T-1312	2880	143	5	50
WHEAT				
Siete Cerros 66	6660	95	0	60
INIA 66	5930	90	0	64
Oviachic 65	5490	74	0	59
RYE				
Merced	2900	121	15	56
P.I. 243741	2080	129	55	51
LSD (.05)	856	8.8		
C.V., %	12.6	2.6		

* Brittle rachis.

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