TRITICALE... *problems and progress with a new*

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TRITICALE IS A SYNTHETIC CEREAL species—a product of man's ingenuity and his ability to manipulate delicately balanced biological systems. Specialized techniques used in creating this new species include doubling the chromosome number and culturing immature embryos artificially. Triticales, resulting from hybridizing wheat (*Triticum*) and rye (*Secale*), are technically called amphiploids. The hybrid is not new; in fact, wheat-rye hybrids were first reported in the nineteenth century. In the past 30 years, many triticales have been produced, from both common wheats (42 chromosomes) and durum wheats (28 chromosomes) in crosses with rye (14 chromosomes). The bread wheat-rye triticales (octoploids) were studied extensively but did not combine desirable qualities of the two parents as anticipated. Similarly, durum wheat-rye triticales (hexaploids) did not meet expectations. Major defects of triticales included wrinkled grain, sterility in the spikes, low grain yield, poor baking and milling quality, and late maturity. The poorer qualities of both wheat and rye appeared to be combined in triticale. The stage was set, however, for major improvement when hexaploid and octoploid triticales, obtained from plant breeders throughout the world, were observed and intercrossed at the University of Manitoba from 1954 to 1962. These new crosses, among triticales themselves, produced agronomically promising types. The new types from Manitoba have stimulated interest in triticale research.

Development

Bread wheat can be crossed easily with rye, but the hybrid plants are sterile because the chromosomes from wheat do not pair well with chromosomes from rye. If the hybrid seedling is treated with colchicine, the chromosome number is doubled. Thus, pairing can take place among wheat and among rye chromosomes during the reproductive process. Chromosomal balance is restored so that gamete production, fertilization, and subsequent seed formation are reasonably normal. With this method of producing triticale, the chromosome number of the hybrid is doubled. An alternate, but little used method, is to double the chromosome number of the parental wheat and rye plants before hybridization. Fertile triticale is produced upon crossing the doubled wheat and rye plants.

TABLE 1. GRAIN YIELDS IN POUNDS PER ACRE OF WHEAT VARIETIES AND TRITICALE SELECTIONS AT FIVE LOCATIONS IN CALIFORNIA IN 1969

Variety or selection	Tulelake	Davis	Five Points	Riverside	El Centro	Mean
Triticale*	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Rosner	4,520	2,660	600	630	890	1,860
UM6437-6	5,580	3,160	420	750	1,450	2,270
UM6443	5,360	3,410	800	930	1,180	2,340
UM6456-3-1	4,160	3,110	1,330	1,050	1,240	2,180
Mean	4,900	3,080	780	840	1,190	2,160
Wheat						
Siete Cerros 66	7,940	5,470	4,430	3,120	3,890	4,970
Lerma Rojo 64	7,430	5,420	3,850	2,520	3,440	4,530
Sonora 64	7,310	5,070	4,460	1,370	1,960	4,030
Ramona 50	6,020	4,760	3,550	1,320	3,770	3,880
Mean	7,180	5,180	4,070	2,080	3,270	4,360
Triticale mean as percent of wheat	68	60	19	40	36	50

* The parentage of the triticale selections is (Triticum durum cv. Ghiza × Secale cereale) × (T. durum cv. Carleton × S. cereale) × (T. persicum × S. cereale) × (a Triticum – Secale introduction).

TABLE 2. PERCENT FERTILITY OF SPIKES OF TRITICALE SELECTIONS AT FIVE LOCATIONS IN CALIFORNIA IN 1968

Selection	Tulelake	Davis	Five Points	Riverside	El Centro	Mean
	%	%	%	%	%	%
Rosner	55	62	26	31	40	43
UM6437-6	55	67	27	36	45	46
UM6443	56	63	15	46	35	43
UM6456-3-1	55	70	50	31	40	49
Mean	55	66	30	36	40	45

The production of hexaploid triticale is quite difficult because durum wheats do not cross easily with rye. Hybrid embryos are produced at a low frequency and about 15 days after fertilization they must be excised and cultured in a sterile nutrient medium. Despite many attempts, tetra-triticale, produced by crossing rye and the diploid wheat *T. monococcum*, has not yet been synthesized. Additional research is necessary to develop efficient techniques for producing triticale of all types.

Current status

Triticales with the best agronomic characteristics were made available by the University of Manitoba in 1967. These are hexa-triticale with the complex parentage indicated in the footnote of table 1. In Canada these triticales produce about the same amount of grain as does wheat, and somewhat less than barley. The flour is not suitable for making bread by standard methods, presumably because of the absence of the D genome, which contributes greatly to the good bread-making properties of the bread wheats. At present, therefore, triticale must be considered primarily a feed grain. Canadian results have shown it to be comparable to barley in feed value, though its palatability has not been fully investigated.

Performance

Four of the Manitoba triticale strains were evaluated in replicated yield tests at five locations in California in 1968. The test was spring-planted at Tulelake and fall-planted or winter-planted at the other locations. Four wheat varieties were used as standards of performance in these tests. Good stands were obtained in all tests, with little or no shatter loss.

Of most concern is the relative yielding ability of the triticales. Table 1 shows that average yields were only half those of wheat; clearly triticale was not competitive with wheat in these experiments. The triticales were considerably more productive at Tulelake and Davis, in northern California, than in the three southernmost locations. Growth and de-

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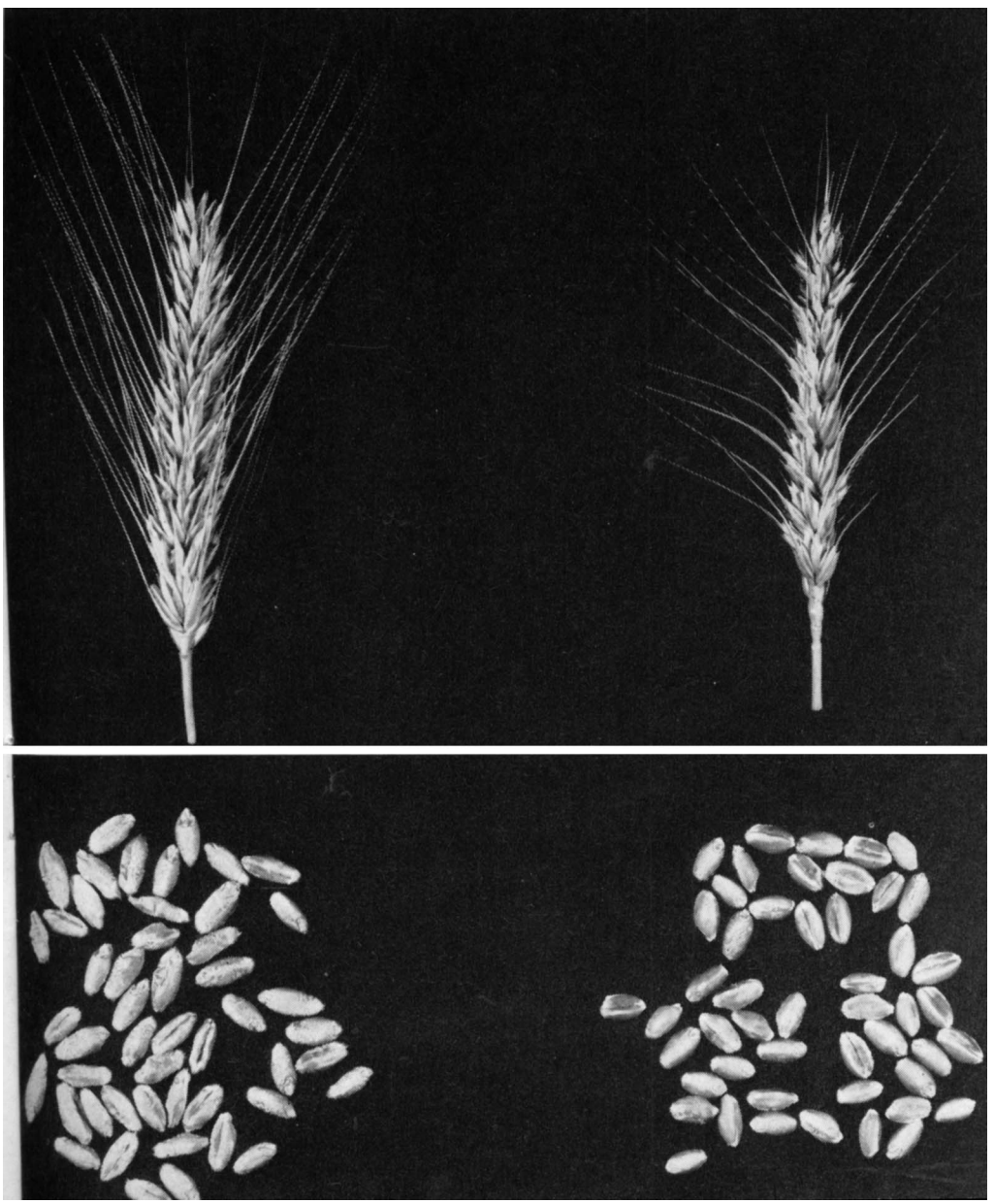
TABLE 3. COMPARISONS OF TRITICALE AND WHEAT FOR SEVERAL CHARACTERISTICS. MEANS FROM SEVERAL LOCATIONS

Variety or selection	Heading date	Height, cm.	Test weight lbs./bu.	Kernel weight, mg.	Protein %
Triticale					
Rosner	April 16	120	49.2	35.5	16.5
UM6437–6	April 14	111	49.5	42.6	15.5
UM6443	April 15	120	50.4	41.2	16.4
UM6456–3–1	April 14	117	50.6	35.9	17.0
Mean	April 15	117	49.9	38.8	16.4
Wheat					
Siete Cerros 66	April 9	94	63.0	33.1	13.4
Lerma Rojo 64	April 2	99	62.4	39.6	15.0
Sonora 64	March 28	84	61.8	35.0	15.9
Ramona 50	March 29	106	61.0	45.7	15.3
Mean	April 2	96	62.0	38.4	14.9
Locations included*	2,4,5	1,2,4,5	2,5	2	2

* 1= Tulelake, 2= Davis, 3= Five Points, 4= Riverside, 5= El Centro

Spikes and kernels of Rosner triticale (left) and Sonora 64 wheat (right).



velopment were normal at all locations, but with considerable sterility in the spikes of all triticales, especially at Five Points, Riverside, and El Centro (table 2).

The high level of sterility was the main factor contributing to low grain yields. The reproductive system of triticale is not well stabilized and sterility can result if adverse growing conditions such as high temperature, drought, or disease occur during the flowering period. The high sterility at southern California locations was doubtless increased by the high temperatures at flowering time. Temperatures were higher at heading time (table 3) for triticale than for wheat varieties, which flower about two weeks earlier. In this respect these triticale selections are similar to wheat varieties from northern United States and Canada which are photoperiod-sensitive and flower late when planted in California.

Kernels large

The kernels of triticales are large and somewhat wrinkled, have a low volume weight, and have significantly more protein than wheat (table 3 and photo). No information has been obtained on the feed value or milling and baking properties of triticales grown in California. These triticales were substantially taller than the wheat varieties, and more susceptible to lodging.

The results indicate that triticale needs major improvement before it can be a competitive crop in California; it needs increased spikelet fertility, improved chemical and physical properties of the kernel, earlier maturity, and shorter plants. These triticales are very new, and little plant breeding effort has been directed toward their improvement.

At present, triticale must be considered a feed grain and, as such, produce an economic return comparable to that from wheat and barley. Triticales developed more recently are under evaluation in University of California tests, and research is under way on the development of new types. Within a few years the potential of this species as a food or feed grain should be well established.

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