

Arizona Triticale Performance Tests

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Triticale is a cross between wheat and rye. The name triticale was formed by using part of the botanical name of the wheat genus *TRITicum* and part of the rye genus *SeCALE*. It is pronounced trit-ih-KAY-lee.

The first triticale was produced in 1888, but there seemed to be little practical value for the cross until the mid-50's, when researchers at The University of Manitoba, Winnipeg, Manitoba, Canada launched a program there. About 10 years later an intensive triticale research program was begun by the International Corn and Wheat Improvement Center (CIMMYT) in Mexico. During this same period several private companies and other organizations became active in triticale research. At The University of Arizona during the past 10 years triticale research has been primarily concerned with the evaluation of lines and varieties, and cultural practices.

Early Adaptation Tests

For tests in Arizona in 1969 and 1970, triticale lines with a spring-type growth habit were obtained from The University of Manitoba, and from the Jenkins Foundation for Research. Replicated yield tests were established at The University of Arizona's Yuma Research Farm, about January 1 in 1969 and 1970. Plots were also established at the Snowflake Research Farm, Snowflake, Arizona April 1, 1970 and at the Phelps Dodge Experimental Plots, Hereford, Arizona April 7, 1971.

At Yuma, each plot was four rows, 15 feet long, spaced 20 inches apart on the flat. At Snowflake and Hereford the plantings were on furrowed-out land, with two rows per 36-inch bed, and each plot consisted of four beds, 25 feet long. Cultural practices at all of the locations were imposed to maximize yield of the spring wheat check. An insecticide was used to control aphids at Hereford, but no other insect or disease problems were observed. Harvest was in late May at Yuma, July 23 at Snowflake, and July 29 at Hereford.

Results of the Early Tests

Principal findings for the top 10 triticales at the three locations are summarized in Table 1. At Yuma the triticale plants were very tall and willowy in comparison with the wheat, and tended to lodge. The grain was shriveled, bushel weight was about 10 pounds less, and yields were considerably lower. At Snowflake and Hereford, both the triticale and wheat plants were shorter than at Yuma with less lodging, but yields and test weights of the grain were in similar ratios.

Protein analyses averaged about 3% above the Siete Cerros 66 wheat, but this appeared to be due principally to failure of the endosperm to fully develop, resulting in a greater ratio of embryo to endosperm, as reflected in the shriveled kernels.

In summary, the major problems which reduced yield potential of the triticales were excessive plant height, some sterility, shriveled kernels and low test weight. On the other hand, the triticale plants were vigorous with large broad leaves which offered a potential for improvement. With development of improved lines and varieties, the crop might ultimately become competitive with wheat.

Table 1. Yield and plant height for the top 10 triticale entries compared with Siete Cerros wheat, all locations 1969 and 1970.

Entry	Plant height in inches			Bushel weight (lbs.)		Yield in % of Siete Cerros			
	Yuma		Snowflake	Yuma		Yuma		Snowflake	Hereford
	1969	1970	1970	1969	1970	1969	1970	1970	1971
Siete Cerros 66	35	35	24	61.3	63.2	100	100	100	100
J. 6TA204 ¹	48	51	29	52.8	50.3	70	83	63	68
6437-6 ²	44	39	25	52.3	50.4	70	34	44	61
J. 6TA208	49	53	33	51.5	50.1	54	75	56	64
6450-3-1	46	50	28	51.3	50.2	54	20	38	53
6450-2-1	47	51	29	52.3	50.6	48	15	38	51
J. 6TA206	47	52	30	50.3	49.3	47	70	53	69
6450-2-2	50	50	25	51.5	51.0	43	15	44	44
6454-7-1	46	48	28	50.5	50.6	43	20	36	39
J. 6TA203	47	54	32	48.0	48.7	42	72	57	65
J. 6TA209	47	51	30	49.5	48.7	39	62	60	64

¹The 5 entries preceded by the letter "J" were from the Jenkins Foundation for research.

²The other 5 entries were from The University of Manitoba, Winnipeg, Manitoba, Canada.

International Triticale Yield Nursery

By 1970 the CIMMYT triticale program was well under way with breeding emphasis on plants having the spring-type growth habit. It followed that Yuma with its mild winter climate was the logical place to continue the Arizona triticale research. The First International Yield Nursery was made available by CIMMYT in mid-1970 and has been included in research plots at The University of Arizona Yuma Research Farm for seven consecutive years, 1971-1977. Identical nurseries are grown throughout the world at latitudes between 28 and 34° and data are shared by all who are interested in this potentially economic crop.

Procedure

The International Triticale Yield Nursery is prepared with a minimum of three replications. Test establishment at the Yuma Research Farm has been about December 20, in each of the seven growing seasons, 1971-1977. Plantings were on the flat, in moisture, about 2 inches deep and under a dry mulch. The first postplanting irrigation was usually applied about February 1. A total of approximately 30 acre inches of water was applied each year by flooding, with the last irrigation about May 1.

During the first two years, bulk seed of each entry in sparing amounts was provided by CIMMYT. This seed was then sub-divided for four replications. The 1971 and 1972 plots were single rows 20 feet long, spaced 20 inches apart. The 1973-1977 plots were each six rows 8 feet long, spaced 12 inches apart. In each instance the experimental design was randomized complete blocks with three replications.

Soil test data and cropping history were used to guide fertilization rates and timing. For each of the Yuma nurseries about 50 lbs. P₂O₅ and 150 lbs. N per acre were applied. Phosphorous was incorporated during seedbed preparation and the nitrogen application was usually split - about 100 lbs. N per acre at planting with the balance during the boot stage of growth. Occasionally, aphids were observed on plants in the nursery in the early spring, but never in sufficient numbers to warrant treatment. Disease was never a problem. Harvest for the nurseries was in mid- to late - May each year.

Results

Reduction of plant height, elimination of shrivelling and sterility, and increasing yield have been major objectives of triticale improvement research. Observation of yield and other data in Tables 2-7 shows clearly the progress that has occurred in these problem areas.

In 1971 the 15 best triticales averaged 47 inches in height, 12 inches more than Siete Cerros 66 Wheat. Bushel weight averaged about 10 lbs. less for the triticales than for Siete Cerros 66. The average yield level of the triticales was only slightly more than half as great as for Siete Cerros 66.

Plant Breeders and their associates have made great progress in each of the triticale development problem areas, Table 7. Plant height of the highest yielding triticales is nearly the same as for the check wheat entries. Bushel weight of the triticales has improved, but is still significantly less than that for wheat. In 1976 the average yield of the best triticales was near that of Siete Cerros 66 wheat, and the yield of six triticales in this nursery exceeded that of Siete Cerros 66 wheat.

Siete Cerros 66 was used as the check variety for all the triticale tests reported in this publication. In the years that have elapsed since 1966, the year in which Siete Cerros 66 was released, wheat breeders have also made great strides. Jupateco 73 was included in the 1976 triticale yield nursery. In this test it produced 27% more grain than Siete Cerros 66, and 15% more than the highest yielding triticale. Better triticales are near at hand. Continued research at The University of Arizona will help with this evaluation.

Summary

Triticales have a long history, but most of the significant breakthroughs have occurred during the last 10 years. Plant height and lodging are being reduced, and test weight and yield of grain are steadily improving. Plant breeders are optimistic that yield and quality can ultimately become competitive with other grains.

Table 2. Agronomic yield data for top 15 triticale entries compared with a wheat check in the International Triticale Nursery at Yuma, Arizona 1971.

Entry	Plant Height (in)		Bushel Weight (lbs)		Yield (as % of Siete Cerros 66 wheat)	
	Wheat	Triticale	Wheat	Triticale	Wheat	Triticale
1. Siete Cerros 66	35		62.5		100	
2. Fasgrow 204		59 ²		48.7		86
3. Fasgrow 203		61 ²		49.0		80
4. PC-10 ¹		47		51.3		61
5. PC-17		46		52.5		60
6. PC-15		45		52.2		60
7. PC-13		44		54.5		59
8. PC-12		45		55.0		59
9. PC-14		46		56.8		57
10. PC-18		47		51.7		57
11. PC-19		47		51.7		55
12. PC-16		45		50.7		46
13. PC-1 ⁰		43		54.0		37
14. PC-8 ⁰		46		54.2		37
15. PC-3 ⁰		43		53.8		36
16. PC-7 ⁰		41		50.7		30
Average	35	47	62.5	52.4	100	54.7

¹Entries 4-12 are hexaploides and 13-16 octoploides.

²Some lodging of Fasgrow 203 and 204 plants occurred.

Table 3. Bushel Weight and Yield for top 15 triticale entries compared with a wheat check in the International Triticale Nursery at Yuma, Arizona 1972.

Entry	Bushel Weight (lbs)		Yield (as % of Siete Cerros 66 Wheat)	
	Wheat	Triticale	Wheat	Triticale
1. Siete Cerros 66	61.0		100	
2. Fasgrow 204 ¹		48.3		90
3. Fasgrow 203		47.5		75
4. Armadillo Cross 16		53.2		72
5. " " 14		50.3		70
6. " " 31		50.8		65
7. Badger Cross 1		51.0		64
8. Armadillo Cross 27		53.2		64
9. " " 12		50.8		62
10. " " 28		50.7		62
11. Badger Cross 2		50.2		60
12. PC-12 (from 1971 test)		53.8		59
13. Armadillo Cross 40		50.5		58
14. " " 11		50.3		57
15. " " 13		50.2		57
16. Badger Cross 3		50.5		57
Average	61.0	50.8	100	65

¹Commercial varieties were included in these tests and whenever they ranked in the top 15 entries they appear in the table.

Table 4. Agronomic and yield data for top 15 triticale entries compared with a wheat check in the International Triticale Nursery at Yuma, Arizona.

Entry	Plant Height (in)		Bushel Weight (lbs)		Yield (as % of Siete Cerros 66 Wheat)	
	Wheat	Triticale	Wheat	Triticale	Wheat	Triticale
1. Siete Cerros 66	32		63.0		100	
2. ITYN 81		38		51.0		97
3. " 97		35		51.0		95
4. " 102		32		52.0		88
5. " 105		36		54.0		88
6. " 1		34		52.0		84
7. " 65		35		51.0		84
8. " 18		31		50.0		82
9. " 32		32		48.0		81
10. " 77		38		53.0		80
11. " 24		34		49.0		79
12. " 48		34		50.0		77
13. " 64		35		53.0		77
14. " 44		34		53.0		76
15. " 96		35		50.0		75
16. " 79		36		52.0		75
Average	32	34	63.0	51.3	100	83

*The yield of Siete Cerros 66 Wheat was 3389 lb/acre.

Table 5. Agronomic and yield data for top 15 triticale entries compared with a wheat check in the International Triticale Nursery at Yuma, Arizona 1974.

Entry	Plant Height (in)		Bushel Weight (lbs)		Yield (as % of Siete Cerros 66 Wheat)	
	Wheat	Triticale	Wheat	Triticale	Wheat	Triticale
1. Siete Cerros 66	37		61.1		100	
2. Maya II-Arm "S"		39		52.8		88
3. Maya II-Arm "S"		37		52.1		85
4. Maya II-Arm "S"		42		54.5		80
5. Maya II-Arm "S"		41		53.1		75
6. INIA-Arm "S"		40		51.3		74
7. Maya II-Arm "S"		41		53.0		74
8. Maya II-Arm "S"		40		52.5		73
9. Cinnamon		41		51.6		69
10. Maya I-Arm "S"		42		53.1		69
11. Koala "S"		38		50.5		69
12. Maya II-Arm "S"		37		52.8		62
13. Maya I-Arm "S"		39		53.1		60
14. INIA-Rye-Arm "S"		42		53.6		60
15. Maya II-Arm "S"		41		50.6		58
16. Maya II-Arm "S"		41		53.6		
Average	37	40	61.1	52.5	100	71

*The yield of Siete Cerros 66 wheat was 9509 lb/acre.

Table 6. Agronomic and yield data for top 15 triticale entries compared with a wheat check in the International Triticale Nursery at Yuma, Arizona 1975.

Entry	Plant Height (in)		Bushel Weight (lbs)		Yield (as % of Siete Cerros 66 Wheat)	
	Wheat	Triticale	Wheat	Triticale	Wheat	Triticale
1. Siete Cerros 66	35		62.0		100	
2. Maya II-Arm "S"		41		52.3		102
3. Maya II-Arm "S"		40		53.7		101
4. INIA-Arm "S"		41		52.0		99
5. Koala "S"		38		51.7		98
6. Maya I-Arm "S"		43		52.0		95
7. Beagle		48		52.3		94
8. Koala "S"		40		53.3		94
9. INIA-Arm "S"		39		51.3		93
10. Maya II-Arm "S"		39		52.0		92
11. INIA-Guarda-Arm "S"		39		52.0		92
12. Maya II-Arm "S"		39		50.7		92
13. Maya II-Arm "S"		39		52.7		91
14. F.S. 1897		44		53.3		91
15. Maya II-Arm "S"		41		54.0		89
16. Maya I-Arm "S"		39		52.7		87
Average	35	41	62.0	52.4	100	94

*The yield of Siete Cerros 66 wheat was 6279 lb/acre.

Table 7. Agronomic and yield data for top 15 triticale entries compared with a wheat check in the International Triticale Nursery at Yuma, Arizona 1975.

Entry	Plant Height (in)		Bushel Weight (lbs)		Yield (as % of Siete Cerros 66 Wheat)	
	Wheat	Triticale	Wheat	Triticale	Wheat	Triticale
1. Siete Cerros	35		60		100	
2. Jupateco 73	35		62		127	
3. Navojoa "S"		36		54		112
4. Navojoa		36		55		110
5. Yoreme-TC75		36		53		110
6. Yoco (Rose1)		36		53		107
7. Maya I-Arm "S"		35		55		106
8. UM 2038		38		53		101
9. Maya II-Arm "S"		37		53		97
10. Setter		39		53		93
11. Rahaum "S"		39		52		92
12. Cinnamon		36		53		89
13. F.S. 1897		38		54		89
14. INIA-Arm "S"		37		53		87
15. Bacum		36		55		87
16. Arabian		35		55		83
17. Koata "S"		33		53		82
Average	35	36	61	54		96