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Concho

Winter Wheat

Harvesting an increase field of breeders seed of Concho.

by
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CONCHO Winter Wheat

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Concho hard red winter wheat is highly productive, high in test weight, widely adapted, and a good quality wheat. It also possesses a high degree of resistance to leaf rust, bunt (stinking smut), and soil-borne mosiac. In regional yield tests in Oklahoma and adjacent states for the 6 years 1949-1954, Concho consistently ranked at or near the top every year. The attractive field appearance of Concho in demonstration plots and in increase fields has given it wide farmer appeal. Its good performance in experimental mill and bake shops will make it an important contribution from the standpoint of processors and consumers. Concho was developed by the Oklahoma Agricultural Experiment Station and the Field Crops Research Branch of the United States Department of Agriculture.

YIELD OF GRAIN

Concho has outyielded Comanche by 16 percent and Pawnee and Triumph by 22 percent in Oklahoma as an average of all 88 station-years. It is significant that Concho has outyielded other recommended varieties in every section of the state. Concho has been tested continuously for yield and other characteristics in Oklahoma since 1946. Experimental grain yields of Concho and the three varieties most widely grown in Oklahoma today—Triumph, Pawnee, and Comanche— are available for all or a part of the period 1949 to 1954 (Table 1**). In the nursery tests grown at Stillwater, Woodward, and Cherokee for the entire 6-year period, Concho outyielded Comanche by 4.8 bushels

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**Tables on pages 13 through 18.

and Pawnee by 6.7 bushels. In the variety test for 17 station-years including Goodwell in addition to the other 3 locations for 1950 to 1954, Concho outyielded Comanche, Pawnee, and Triumph by 4.7, 6.6, and 6.8 bushels, respectively. In the state-wide nurseries for the period 1950 to 1954, Concho outyielded Comanche by 3.5 bushels, Triumph by 3.6 bushels, and Pawnee by 4.0 bushels in western Oklahoma; in eastern Oklahoma Concho has yielded 1.8 bushels more than Comanche, 5.1 bushels more than Pawnee, and 5.2 bushels more than Triumph.

Significant, also, is its consistency in high performance. The comparative yields of Concho and other varieties shown in Table 2 emphasize Concho's high average yield at each location, and its highly consistent production. In the 17 station-years—5 each at Stillwater, Woodward, and Cherokee and 2 at Goodwell—Concho ranked first in yield 13 times and second the remaining 4 times. At the 3 locations with 5-year results, Concho outyielded Comanche, the second-ranking variety at each location, by 5.1 bushels or 22 percent at Stillwater, 3.5 bushels or 19 percent at Woodward, and 6.8 bushels or 26 percent at Cherokee.

Based on these and other data, Concho is recommended for every section of Oklahoma.

TEST WEIGHT

Concho has produced grain of high test weight under most conditions, being about the same as Triumph in this respect, as shown in Table 3. In the nursery tests at Stillwater, Woodward, and Cherokee from 1949 through 1954, Concho exceeded Pawnee by 1.3 pounds per bushel and Comanche by 1.5 pounds. In the variety tests grown 5 years each (1950-1954) at the 3 locations, Concho exceeded the test weight of Pawnee by 1.9 pounds, of Comanche by 1.6 pounds, and of Triumph, a high test weight variety, by 0.2 pound.

MILLING AND BAKING CHARACTERISTICS

Concho has been evaluated for various milling and baking properties in state, Federal, and commercial laboratories over the past 5 to 6 years. Since it is difficult to summarize all these results into a brief, concise form, representative data were selected for presentation. Ten-to 15-bushel lots of Concho and check varieties have been grown in Oklahoma and Kansas and milled in the Kansas State College 160-sack mill. Each sample was milled to a straight grade flour. After the flour samples were treated with Novadel bleach, malted uniformly,

and coded, they were sent to 28 to 30 collaborators who tested them for baking quality. A number of the collaborators also were present to score the samples for milling characteristics.

A summary of the collaborators' baking tests of Concho and other varieties grown in Oklahoma and Kansas in 1953 and 1954 is shown in Table 4.

Concho has all the milling and baking properties of a good quality wheat. It has a high water absorption requirement fully equal to that of Comanche and Ponca and greater than that of Pawnee, Wichita, and Triumph. As shown in Table 4, Concho also rates high in other baking quality characteristics. It rated a score of 88.8 (out of 100) compared to 85.7 for Comanche in the 1953 Oklahoma samples; 87.1 for Concho to 83.7 for Comanche in the 1953 Kansas samples; and 90.5 for Concho and 89.8 for Ponca in the 1954 Kansas samples. In answer to the question, "Does the variety fill your need?", Concho received an excellent endorsement by the collaborators. It appears that Concho will satisfy the demands of the milling and baking industries for a strong to a moderately strong type wheat variety.

REACTION TO DISEASES

Leaf Rust

The most damaging wheat disease in Oklahoma is leaf rust and, therefore, it is important that any new variety be highly resistant. Concho meets this requirement. With but few exceptions, in field tests over the state during the past 5 years, Concho has had only a trace of rust. At 17 locations in Oklahoma during the 1954 crop season, Concho had the least amount of leaf rust of any variety in the test with an average of 1.6 percent severity. This may be compared with 6.7 percent for Westar, 17.1 percent for Comanche and Pawnee, and 31 percent for Triumph (Table 5).

A total of 9 races of leaf rust have been identified from collections made in Oklahoma since 1950. Concho is resistant to 6 of these races (Table 6). At the present time, the races to which Concho is susceptible (races 32, 105A, and 105B) constitute less than 5 percent of the leaf rust population in this area. However, as the acreage of Concho increases it is probable that these 3 races will increase also, and Concho will then appear to be somewhat more susceptible. Changes in leaf rust race populations usually have occurred rather slowly; however, there is a good possibility that this variety will remain quite resistant for a period of several years.

Stem Rust

Although stem rust often has been very destructive in the northern plains states, it has not as yet caused any appreciable damage in Oklahoma. All of the commercially grown hard red winter wheat varieties are susceptible to most of the prevalent races of stem rust, and Concho is no exception. Some tests indicate that Concho is resistant to one or more races of stem rust, but in the field it is about equal to Westar in susceptibility to this disease.

Yellow Streak Mosaic

Concho has produced almost twice as much grain as the next best variety in yield tests inoculated with yellow streak mosaic for two successive years. However, it is resistant to yellow streak mosaic only in a relative sense. When inoculated with this disease it yielded only about one-half as much as it did when not inoculated. In fact, among the hundreds of wheat strains that have been tested, not one has been found which is truly resistant to yellow streak mosaic. Concho represents the highest degree of tolerance found in any of these tests.

Soil-borne Mosaic

The disease known as soil-borne mosaic first appeared in Oklahoma in 1952. In the two seasons since that time it has appeared over an area of about 20,000 acres in north-central Oklahoma. A test nursery established in a diseased field on the Robert Thompson farm near Tonkawa in 1954 (See Fig. 1) indicated that only three of the hard red winter wheat varieties tested are resistant. These are Concho, Comanche (one of the parents of Concho), and Westar. Of these three varieties, Concho has been the top yielder.

Bunt or Stinking Smut

Concho has been tested for reaction to bunt or stinking smut at Stillwater for a period of 8 years. During that time it has demonstrated a resistance to this disease equal to that of its Comanche parent, which is one of the most resistant hard red winter wheats. Table 7 shows the average amount of bunt found in Concho over the past 8 years compared with some of the more susceptible varieties.

Fig. 1.—The resistance of Concho to soil-borne mosaic compared to Ponca (moderately susceptible) and Kiowa (susceptible). Note the more vigorous growth of Concho.

Loose Smut

In recent years loose smut has not been particularly severe in Oklahoma and adequate tests for the reaction of Concho have not been available. However, in 1951 at Cherokee there was sufficient loose smut present to indicate that the reaction of Concho to this disease is approximately the same as the Comanche parent. In that test Concho had 11 smutted heads compared with 13 in Comanche, 95 in Kiowa (a loose smut susceptible variety) and none in either Pawnee or Triumph (resistant varieties).

Other Diseases

Septoria leaf blotch occasionally becomes destructive in Oklahoma, particularly when there are extended wet, cool periods in the spring. In 1954 Concho and several other varieties were tested for reaction to this disease. This test indicated that about 30 percent of the leaf area of Concho was destroyed by leaf blotch compared with 32 percent for Ponca, 34 percent for Comanche, 68 percent for Triumph, 71 percent for Westar, and 9 percent for Nabob and Red Chief, which were the most resistant varieties.

The root rot disease of winter wheat caused by *Helminthosporium sativum* has become particularly important in recent years in areas of continuous wheat cropping. In one test in 1954, Concho received a rating of 2 for resistance to root rot, compared with a rating of 1 for Cheyenne and Blue Jacket, which were the most resistant, and a rating of 3.5 and 4 for Triumph and Wichita, which were the most susceptible.

The reaction of Concho to the major diseases of wheat encountered in Oklahoma is summarized in Table 8. In most instances it appears more resistant than many of the varieties already being grown in this area.

OTHER CHARACTERISTICS

Winterhardiness

Concho is superior in winterhardiness to Ponca, but is slightly less winterhardy than Pawnee. There is some indication that Concho is less tolerant than Comanche to a combination of low temperatures and drought, especially when grown out of its main area of adaptation. Tests in Oklahoma indicate it is fully as tolerant to drought as other varieties recommended in Oklahoma.

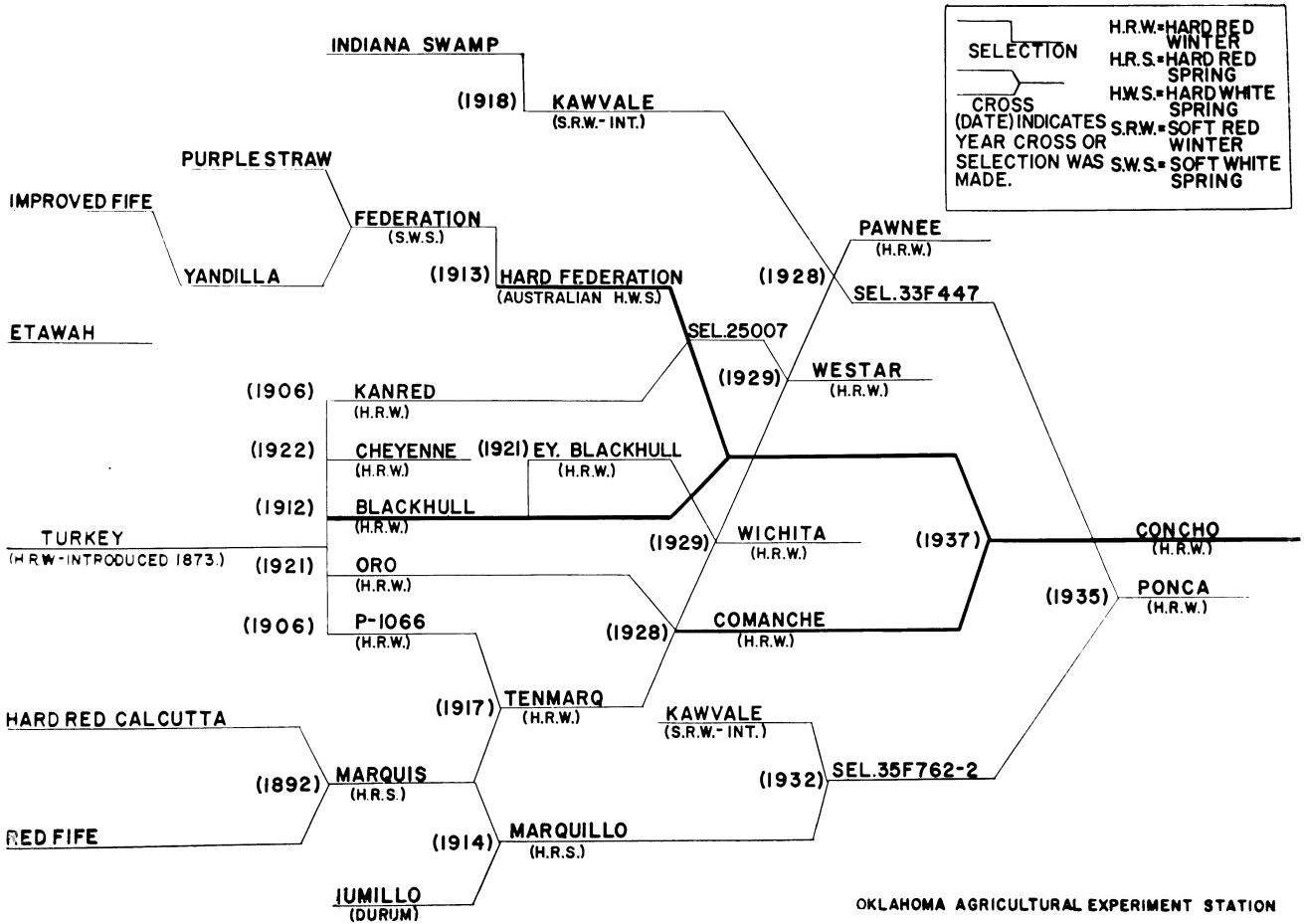

Fig. 2—Pedigree of Concho and some other hard red winter wheat varieties.

Maturity

Concho is classed as a medium early wheat, usually ripening about the same time as Comanche. There are some indications from tests in Oklahoma that in seasons when early maturing varieties are favored, Concho is a comparatively better grain producer than Comanche and other medium early wheats. It also has responded well in seasons that favor the later maturing varieties.

Lodging

In strength of straw and extent of lodging, Concho has been about equal to Comanche and superior to Wichita.

Height

Plants of Concho are about equal in height to Comanche.

Hessian Fly

Concho is susceptible to hessian fly.

ORIGIN AND HISTORY

Concho winter wheat originated as a selection from a cross between Comanche and a pure-line selection of a cross between Blackhull and Hard Federation (See Fig. 2). The final cross was made in 1937 at the U. S. Southern Great Plains Field Station, Woodward, Okla. From 1937 through 1946 (F_1 through F_9), it was grown continuously at Woodward. In 1943 (F_6), 356 head selections were made and these were grown in head-rows in 1944. In 1946, it was grown in a Woodward yield nursery in 4 replications. Because of its promising appearance and good yield and test weight in 1946, it was one of many Woodward-bred wheats chosen for more advanced testing. In 1947, it was first grown in a Stillwater yield nursery, in a greenbug nursery, and in the Uniform Regional Bunt Nursery. In 1948, it was advanced to the Oklahoma 4-station yield nurseries (Stillwater, Woodward, Cherokee, and Goodwell). Since 1949 it has been grown continuously in the Uniform Regional Hard Red Winter Wheat Nursery Tests, and in 1952 it was advanced to the Uniform Regional Hard Red Winter Wheat Plot Tests.

Breeder's seed, purified by head-rowing and thorough roguing (See Fig. 3) has been made available to the Oklahoma Foundation Seed Stocks, Inc. and to the Kansas and Texas Agricultural Experiment Stations.

Fig. 3—Production of high quality breeder's seed of Concho involved careful roguing of hundreds of individual progenies. All progenies with any off-type plants were removed before harvesting.

VARIETAL PURITY

The heads or spikes of Concho are bearded, lax, fusiform, and of medium to large size. The kernels are usually short, plump, and of medium size. Glume or chaff color is normally brown or bronze. However, numerous white-chaffed plants appeared in the original increase fields, and, therefore, Concho was repurified after its initial release to the Oklahoma Foundation Seed Stocks, Inc. for increase in 1952.

A low percentage of white-chaffed types may appear in fields of Concho. By selection of solid bronze heads (not intermediate types), the strain can be kept relatively pure. Inasmuch as no differences have been noted in productivity, quality, maturity, etc. between the two different chaff-colored types in Concho, a small percentage of white-chaffed types should be allowed in certified and registered stocks. Tolerance allowable can best be determined after several years of field experience.

In any certification program, variety identification and purity are always of great concern. For the producer of purebred seed, stability of field characteristics is a great aid in maintaining purity.

To determine the breeding behavior of the white-chaffed segregates a number of progeny tests has been carried out. The data in Table 9 show the results when a total of 81 plants were selected for chaff-color and grown in 1953 at Stillwater, Okla. Of 18 bronze-chaffed selections, all bred true. However, of 42 selections which were thought to be white-chaffed, 33 were true breeding and 9 segregated, with a range of from 0.54 to 46 percent bronze heads. Of 11 intermediate color selections classified light-bronze to white, 10 segregated with an average of 75 percent bronze-chaffed heads, and one line was pure breeding for bronze chaff. Of 10 lines classified as light-bronze, only 5 segregated, 4 were true-breeding bronze, and one line was true-breeding white.

Results from progeny tests for chaff-color conducted in 1954 are summarized in Table 10. While slightly different results were obtained with respect to the true breeding, bronze-chaffed types than in 1953, they were similar. Of 32 bronze-chaff selections, 25 or 78 percent were true-breeding bronze and 7 or 22 percent had some white-chaffed plants. Of those classified with various grades of chaff-color intensity, as the degree of "bronzing" decreased there was also a decrease of the percentage of all lines (within a class) that were true-breeding bronze.

Table 1.—Comparative acre yields in bushels of Concho, Comanche, Pawnee, and Triumph in Oklahoma, 1949—1954.

Variety	Nursery tests[1] 18 station years		Variety tests[2] 17 station years		Experiment station tests[3] 35 station years		Western Oklahoma[4] 38 station years		Eastern Oklahoma[5] 15 station years		Average of all tests 88 station years		Percent of Comanche same years
	Avg.	Rank	Avg.	Rank	Avg.	Rank	Avg.	Rank	Avg.	Rank	Avg.	Rank	
Concho	30.4	1	27.7	1	29.1	1	26.3	1	26.9	1	27.5	1	116
Comanche	25.6	2	23.0	2	24.3	2	22.8	2	25.1	2	23.8	2	100
Pawnee	23.7	3	21.1	3	22.4	3	22.3	4	21.8	3	22.3	3	94
Triumph	---	--	20.9	4	---	-	22.7	3	21.7	4	---	-	94

[1] Uniform Yield Nurseries at: Stillwater, Woodward, and Cherokee, 1949-1954.
[2] Variety Tests at: Stillwater, Woodward, Cherokee, and Goodwell, 1950-1954.
[3] Weighted Average of Variety Tests and Uniform Yield Nurseries.
[4] State-wide nurseries: total of 12 locations, 1950-1954.
[5] State-wide nurseries: total of 7 locations, 1951-1954.

Table 2.—Annual and average acre yields of Concho, Comanche, Pawnee, and Triumph at 4 locations in Oklahoma, 1950-1954.*
(Bushels)

Variety	1950	1951	1952	1953	1954	Avg.
			Stillwater			
Concho	31.6	22.5	24.4	37.7	22.8	27.8
Comanche	22.8	17.4	20.1	35.6	17.4	22.7
Pawnee	23.8	16.8	17.7	34.5	14.3	21.4
Triumph	24.4	15.4	18.3	27.5	9.8	19.1
			Woodward			
Concho	16.5	21.4	30.3	19.8	22.9	22.2
Comanche	11.7	21.4	26.4	17.1	17.0	18.7
Pawnee	10.9	17.2	26.6	18.5	16.9	18.0
Triumph	9.5	8.4	26.4	24.4	16.3	17.0
			Cherokee			
Concho	22.5	41.3	42.6	25.9	32.3	32.9
Comanche	17.4	30.2	35.9	21.7	25.2	26.1
Pawnee	14.5	19.5	37.6	22.8	24.2	23.7
Triumph	13.3	19.3	36.4	31.5	23.9	24.9
			Goodwell			
Concho	---	---	---	33.1	23.0	28.1
Comanche	---	---	---	29.6	24.4	27.0
Pawnee	---	---	---	29.0	13.8	21.4
Triumph	---	---	---	33.8	16.4	25.1

* A summary of these data is shown in column 4, Table 1.

Table 3.—Comparative test weights of Concho, Comanche, Pawnee, and Triumph in Oklahoma, 1949-1954.
(Pounds)

Variety	Nursery tests 18 station years[1]	Variety tests 15 station years[2]
Concho	60.2	60.8
Comanche	58.7	59.2
Pawnee	58.9	58.9
Triumph	---[3]	60.6

[1] Six years each at Stillwater, Woodward, and Cherokee, 1949-1954.
[2] Five years each at Stillwater, Woodward, and Cherokee, 1950-1954.
[3] Triumph not grown in nursery tests in 1953 and 1954.

Table 4.—Summary of collaborators' baking tests of Concho and check varieties.

Factor	Max. Score	Oklahoma samples 1953 Comanche	Oklahoma samples 1953 Concho	Kansas samples* 1953 Comanche	Kansas samples* 1953 Concho	Kansas samples* 1953 Pawnee	Kansas samples* 1954 Concho	Kansas samples* 1954 Ponca
Analytical characteristics:								
Protein (%)		15.5	13.8	12.9	14.3	12.6	14.1	13.9
Ash (%)		0.52	0.48	0.47	0.50	0.50	0.42	0.45
Absorption (%)		62	60	56	60	58	66	67
Baking quality characteristics:								
Loaf volume	20	18.6	18.8	17.3	18.4	17.0	18.2	18.4
Break and shred	5	4.6	4.4	3.8	4.1	3.5	4.3	4.5
Crumb color	5	4.0	4.3	4.3	4.4	4.0	4.7	4.3
Grain and texture	35	27.7	30.5	29.7	30.1	28.8	31.5	31.9
Absorption	10	9.2	8.5	7.5	8.3	7.6	9.4	8.8
Dough handling properties	15	13.1	13.4	13.1	13.3	11.4	13.3	13.2
Mixing tolerance	10	8.5	8.9	8.0	8.5	6.5	9.1	8.7
Total score	100	85.7	88.8	83.7	87.1	78.8	90.5	89.8
Additional information:								
Mixing time (short, med., long)		med.	long	med.	med.	short	long	med.-long
Fermentation time (short, med., long)		med.	med.	med.	med.	med.	med.	med.
Oxidation req. (low, med., high)		med.	med.-low	med.	med.	low	low-med.	low-med.
Does variety fill your need?		13 Yes 2 No	14 Yes 2 No	11 Yes 4 No	13 Yes 2 No	3 Yes 12 No	17 Yes 1 No	17 Yes 1 No
General rating (VG, G, F, P,):**								
Strong blending type		VG	VG	F	G	P	G	G+
Baker's type		VG	VG	G	G	P	G	G

* Acknowledgements are made to personnel of the Kansas Agricultural Experiment Station for use of the Kansas data.
** VG = very good; G = good; F = fair; P = poor.

Table 5.—The reaction of Concho and several other winter wheat varieties to leaf rust.
(Percent)

	Comanche	Concho	Pawnee	Triumph	Westar
Severity of Infection	17.1*	1.6	17.1	31.0	6.7

* Each figure is an average of the severity reading at 17 locations in Oklahoma in 1954.

Table 6.—The reaction of Concho and several other winter wheat varieties to certain races of leaf rust.

	Leaf Rust Race								
Variety	5	9	15	21	32	58	105	105A	105B
Concho	R*	R	R	R	S	R	R	S	S
Comanche	S	S	S	S	S	S	S	S	S
Pawnee	S	R	S	S	S	S	S	S	S
Triumph	S	S	S	S	S	S	S	S	S
Westar	R	R	R	R	R	S	R	S	S

* R=Resistant; S=Susceptible.

Table 7.—The average percent of bunt found in Concho over the 8-year period 1947-1954 compared with several susceptible varieties.

	Variety				
	Cheyenne	Concho	Kharkof	Ponca	Red Chief
Percent of bunt	46	3	47	42*	73

* An average of only 3 years; 1947, 1951, 1952.

Table 8.—The disease reaction of Concho compared with several other winter wheat varieties.

	Reaction to:							
Variety	Leaf rust	Stem rust	Bunt	Loose smut	Yellow streak mosaic	Soil-borne mosaic	Leaf blotch	Root rot
Concho	VR*	VS	VR	MR	MT	R	MR	MR
Cheyenne	VS	VS	S	—	VS	VS	MR	VR
Comanche	S	S	VR	MR	VS	R	MR	MR
Pawnee	S	S	MR	VR	VS	MS	MS	MS
Ponca	VR	S	S	VR	VS	MS	MR	S
Red Chief	VS	VS	VS	VS	VS	VS	R	MS
Triumph	VS	VS	S	VR	MS	VS	VS	S
Westar	VR	VS	S	MR	S	R	VS	R

* VR=Very resistant; R=Resistant; MR=Moderately resistant; VS=Very susceptible; S=Susceptible; MS=Moderately susceptible; MT=Moderately tolerant.

Table 9.—Results of segregation for chaff-color from selected plants of Concho. Stillwater, Oklahoma, 1953.

Family no.	Parent chaff-color[1]	Progeny chaff-color		Total	Percent bronze
		Bronze	White		
		(Number of Lines)			
----	W.	0	33	33	0.00
----	Br.	18	0	18	100.00
		(Number of Heads)			
4711	W.	1	184	185	0.54[2]
4713	W.	2	161	163	1.23[2]
4709	W.	3	181	184	1.63[2]
4803	W.	3	144	147	2.04[3]
4717	W	6	148	154	3.95[2]
4802	W.	10	112	122	8.20[3]
4731	W.	30	116	146	20.55[4]
4770	W.	55	88	143	38.46[4]
4728	W.	74	86	160	46.25[4]
4723	Lt. br.-W.?[5]	147	39	186	79.03
4724	Lt. br.-W.?	98	43	141	69.50
4725	Lt. br.-W.?	107	49	156	68.59
4732	Lt. br.-W.?	82	18	100	82.00
4733	Lt. br.-W.?	117	33	150	78.00
4736	Lt. br.-W.?	89	69	158	56.33
4737	Lt. br.-W.?	92	24	116	79.31
4738	Lt. br.-W.?	97	25	122	79.51
4774	Lt. br.-W.?	117	18	135	86.67
4779	Lt. br.-W.?	80	31	111	72.07
4735	Lt. br.-W.?	83	0	83	100.00
4722	Lt. br.[6]	60	27	87	68.97
4739	Lt. br.	95	27	122	77.87
4740	Lt. br.	81	14	95	85.26
4768	Lt. br.	136	24	160	85.00
4773	Lt. br.	126	22	148	85.14
4729	Lt. br.	152	0	152	100.00
4734	Lt. br.	149	0	149	100.00
4746	Lt. br.	100	0	100	100.00
4767	Lt. br.	100	0	100	100.00
4791	Lt. br.	00	100	100	0.00

[1] W.=white. Br.=bronze. Lt. br.=light bronze. Lt. br.-W.?=could not distinguish betwee "stained" white and light bronze.

[2] From head rows which produced all white-chaffed plants in 1952.

[3] From head rows which were predominantly white-chaffed in 1952.

[4] From head rows which were 50% or more bronze-chaffed in 1952.

[5] The progeny from the Lt. br.-W.? parents which segregated had an average of 74.62% bronze heads.

[6] The progeny from the Lt. br. parents which segregated had an average of 81.37% bronze heads

Table 10.—Results of segregation for chaff-color from selected plants of Concho. Stillwater, Oklahoma, 1954.

Parent head class	Total no. of progeny lines	Lines segregating		Percent bronze in seg. lines	Percent of all lines true-breeding	
		Number	Percent		Bronze	White
Bronze	32	7	22	85.8	78.1	0.0
White	26	3	11	5.8	0.0	88.5
I_1*	2	2	100	83.4	0.0	0.0
I_2	11	7	63	79.7	36.4	0.0
I_3	42	31	74	79.4	23.8	2.4
I_4	19	12	63	80.9	15.8	21.1
I_5	21	11	54	53.8	4.8	42.9
Total	153					

* I_1 to I_5 grades of intermediate bronze to white color with I_1 the most intense bronze.


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