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# *Soft Wheat:*

## *Production, Breeding, Milling, and Uses*

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tillering cultivars such as the clubs. Spring seeding rates vary from 67 to 135 kg/ha and depend on individual management and local environmental conditions.

## II. SOFT WHEAT BREEDING

### A. Early Wheat Improvement in the West

Soft wheat production in the West began with wheat cultivars introduced from several areas. Cultivars from Chile, Mexico, Australia, England, and the eastern United States had significant impact on early production on the Pacific Slope. Wheat culture in the West actually predated the time of the Louisiana Purchase, and history is sketchy about the specific dates, places, and kinds of wheat that were first grown.

The Catholic missions fostered early western wheat culture. The old soft white common spring wheat, Sonora, was grown at the Magdalena Mission of Sonora, Mexico, as early as 1770 and arrived in our Southwest about 1820. Sonora could be easily ground by hand or with the early stone mills (29).

Club-type wheat was also grown early, principally around Spanish missions. The old club wheats were probably brought to California from Chile and perhaps also Australia and France (39). Archaeological finds suggest that a wheat identical to Little Club was used in adobe bricks of California missions erected between 1701 and 1845 (43). Little Club was introduced from California to the Pacific Northwest, where it became the progenitor of most of the club wheats developed later. Carleton (39) praised club wheats for their adaptability to the Pacific Northwest because they had excellent cracker quality, high yield, stiff straw, earliness, and drought and shatter resistance.

The introduction of Australian cultivars had great impact on soft wheat improvement in the West. Pacific Bluestem arrived from Australia in the 1850s. A common white wheat with soft to semihard kernels, it became very popular because it could be seeded in the fall or spring in mild climates. This cultivar milled satisfactorily and had good cookie and cake flour characteristics (52,63). White Australian, a popular early wheat in California, is almost identical to Pacific Bluestem (43).

Baart, introduced about 1900 from Australia, was well adapted to the drier areas of California and the Pacific Northwest. It was purported to be drought-resistant (41). Baart came to Australia from South Africa but probably originated in western Europe (43). Although the grain of Baart often graded hard white, it milled well and produced excellent cake flour and good bread flour at high protein levels (63). Baart and Pacific Bluestem were the first true dual-purpose pastry and bread wheats grown on the western slope.

Fortyfold or Goldcoin from New York state was an early soft white common winter wheat that became widely grown in the Pacific Northwest and served as an important parent for western soft wheats. It ranked among the best of the old wheats for flour yield and cookie and cake flour properties (63).

The most important soft red winter wheat in the West before 1900 was Jones Fife. Selected by a New York farmer in 1889, it became a major wheat in the Pacific Northwest and also served as an important parent of subsequent cultivars.



Other less important early-grown soft wheat cultivars were: the common whites—Propo (Prosper), Dawson, Dicklow, Surprise, White Winter, and Defiance; the common reds—Red Russian and Lofthouse; and the clubs—Jenkin, Big Club (Chile Club), Red Chaff, Blue Club. But many other introduced wheats also were grown in the West before 1900. Carleton (39) listed 60 selections and cultivars of soft kernel texture that originated in eight foreign countries and other parts of the United States and that showed promise for culture in the West.

Unlike other U.S. wheat regions, the Pacific Northwest did not significantly exploit selections from originally introduced land cultivars. The club wheats Genro, Hood, Bluechaff, Coppei, and Mayview were selected from introduced cultivars or farmer fields of other wheats. Big Club was derived from Little Club and grew on more than 8,500 ha in 1919. Dicklow, Propo, Foisy, and Silvercoin were common white wheat field selections (43). Most of these cultivars had limited merits compared with those of their progenitors.

Selection within the older, soft wheat land cultivars received little attention after W. J. Spillman of Washington State College began his classic wheat hybridization studies, which quickly gave superior types. Spillman (154) was aware as early as 1895 that Little Club, Red Chaff, and Pacific Bluestem cultivars had their own specific adaption to eastern Washington. All three were spring types, however, and lacked winterhardiness. Because no winter-hardy types were adapted, he decided to breed new cultivars by crossing the best winter wheats with those three extensively grown spring wheats. Aside from his famous independent rediscovery of Mendel's Laws of Genetics, Spillman's effort led to several high yielding, shatter-resistant, stiff strawed, winter-hardy cultivars. They included Hybrids 60, 128 (winter); 108, 143 (intermediate); 63, 123 (spring). The most successful cultivar was Hybrid 128, derived from a Jones Fife  $\times$  Little Club cross. Released in 1907, it was grown on nearly 50% of the club wheat area between 1924 and 1929. Hybrid 128 excelled both in yield and quality in tests conducted from 1911 to 1914 and yielded about 6% more grain than older wheats (139). Hybrids 108 and 123 had high yields but milled poorly, had red kernels, and lacked popularity. About 1924, Spillman hybrids began to decline because of their common bunt susceptibility and because Federation, a common soft white spring wheat, became popular.

### B. Early Quality Studies and Observations

The importance of soft wheat quality and cultivar differences was recognized as early as 1907 in the West. Thatcher (164) observed that nearly three fourths of Washington's wheat crop was marketed elsewhere. He believed that wheat grown in the state should be at least equal in quality to wheats with which they competed, and he listed five important wheat quality considerations: 1) chemical composition, 2) percentage each of several mill products, 3) distribution of chemical constituents, 4) flour quality, and 5) flour color.

Tests of 19 cultivars grown at several localities showed notable differences in chemical composition among cultivars, but differences were even greater within cultivars; wheats grown in the driest sections produced the largest and best loaves (164). White-seeded types yielded slightly more flour than their red-seeded sister lines (165). He stated that flours of Little Club, Goldcoin, and Red Russian were

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1964	1,
1969	1,
1974	1,

<sup>a</sup> References

<sup>b</sup> Includes cl

were: the common White Winter, and ofthouse; and the club. But many other Carleton (39) listed in eight foreign showed promise for

did not significantly. The club wheats were introduced from Little Club, Moisy, and Silvercoin. These cultivars had received little attention in his classic wheat. Spillman (154) was a Bluestem cultivars. All three were spring-hardy types were the best winter wheats from his famous. Spillman's effort led to hardy cultivars. They were 123 (spring). The Fife × Little Club club wheat area and quality in tests than older wheats, had red kernels, to decline because of common soft white

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poor for bread baking but adapted to the manufacture of special pastry uses.

Clark et al (52) found that Baart satisfied early demands for a better milling wheat and noted that millers paid premiums for Pacific Bluestem grown in the Columbia Basin because of its superior milling quality. Their data showed that Sonora milled very poorly, had low ash flour, and was unsuited for bread but valuable for specialty purposes. The major advantages of Australian wheats were their superior milling and flour qualities; White Federation ranked the best.

### III. SOFT WHEAT IMPROVEMENT, 1919-1944

#### A. Cultivar Distribution

During this time more than 110 cultivars with soft wheat properties, including common soft red winter, spring and winter club, and soft and semihard spring and winter common white were grown in the West (45,46,48-51). In 1919 about 54% of the wheat area of the 11 western states was soft wheat. By 1924 the proportion dropped to 33% owing to the sharp increase in popularity of Turkey-type hard red winter and hard red spring cultivars. Soft wheat comprised 31 to 35% of the area from 1924 to 1944. Soft red winter cultivars consistently declined during that time (Table VII). They represented about 5% of the area in 1919 but decreased to less than 1% by 1944. Club wheat also declined from 11% of the wheat area in 1919 to only 4% in 1944 (Table VII). The common white wheat area, composed of both spring and winter types, varied from 38% of all wheat sown in the West in 1919 to 19% in 1924; and in 1944 this class comprised 30% of the total. For the years 1919, 1924, 1929, 1934, 1939, and 1944, 44, 56, 61, 69, 65, and 56 different cultivars with soft wheat properties were reported to be grown in the West, respectively (45,46,48-51). Table VIII lists the more important cultivars of the four major soft wheat classes and gives their percentage of the total area sown to wheat in the West. Table IX shows the actual area devoted to the principal soft white winter, soft white spring, club, and soft red winter cultivars per period.

TABLE VII  
Area and Percent of Total Soft Wheat Grown by Class from 1919 to 1974 in the 11 Western States<sup>a</sup>

Year	Common White		Club		Soft Red Winter		All Soft		Total (ha)
	(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(%)	
1919	1,464,205	38	417,069 <sup>b</sup>	11	197,795	5	2,079,069	54	3,839,679
1924	682,868	19	338,961 <sup>b</sup>	10	138,949	4	1,160,778	33	3,550,700
1929	1,293,749	26	293,712 <sup>b</sup>	6	135,580	3	1,723,041	35	4,944,335
1934	1,030,756	25	281,649 <sup>b</sup>	7	84,447	2	1,396,852	34	4,139,066
1939	1,188,364	26	166,569 <sup>b</sup>	4	56,358	1	1,411,291	31	4,547,340
1944	1,440,204	30	188,849 <sup>b</sup>	4	36,386	<1	1,665,439	34	4,867,290
1949	1,497,299	21	508,900	7	27,256	<1	2,033,454	28	7,161,615
1954	870,733	15	720,260	13	7,460	<1	1,598,452	28	5,689,440
1959	807,775	16	745,655	14	4,011	<1	1,557,441	30	5,187,240
1964	1,228,894	25	213,450	4	933	Tr	1,443,277	29	4,909,410
1969	1,376,913	26	285,834	5	217	Tr	1,662,963	31	5,314,046
1974	1,700,207	26	403,453	6		Tr	2,103,660	32	6,514,830

<sup>a</sup> References for values: 44-46,48-51,129-132,136.

<sup>b</sup> Includes club cultivars with red seed (Dale, Coppei, Mayview, Hybrids 123 and 108).



TABLE VIII  
Cultivars with Soft Wheat Properties Most Extensively Grown in the West and their Percentages of Total Western Wheat Area at Five-Year Intervals<sup>a</sup>

Cultivar and Class	Percentage of Total Western Wheat Area—Five-Year Intervals											
	1919	1924	1929	1934	1939	1944	1949	1954	1959	1964	1969	1974
Common white winter												
Goldcoin	5.2	3.0	3.4	1.9	1.2	3.2	2.0	trace	trace	0.4		
Golden					0.3	1.4	1.3	1.1	0.8	trace	0.2	0.1
Rex					3.3	3.7	2.4	1.1	trace	trace	trace	
Brevor								1.7	1.7	1.1	trace	
Gaines										13.2	7.9	3.3
Nugaines											11.1	10.3
Hyslop												4.2
Yamhill												0.7
Common white spring												
Baart <sup>b</sup>	5.3	5.5	6.3	7.8	7.9	8.3	3.7	2.8	1.2	0.3	0.2	
Sonora	2.8	1.0	0.8	0.5	0.2	0.1	trace	trace	trace			
Pacific Bluestem <sup>b</sup>	14.4	4.2	3.0	1.6	1.2	0.5	0.2	0.1	0.1	0.1	trace	
Defiance	2.0	0.4	0.3	0.3	0.1	trace	trace	trace	trace			
Dicklow	1.7	1.3	2.1	1.7	1.2	0.7	0.2	0.1	trace	trace		
Bunyip		0.3	1.0	0.7	0.8	0.4	0.1	0.1	trace	trace		
Federation <sup>b</sup>		0.5	7.0	8.0	7.4	7.9	4.8	2.3	1.8	0.8	0.5	0.1
Idaed <sup>b</sup>					trace	0.4	0.9	1.0	0.6	0.6	0.8	0.2
Lemhi <sup>b</sup>					trace	0.9	1.1	1.4	2.2	0.6	1.2	0.1
Ramona <sup>b</sup>					0.1	0.1	1.1	1.2	2.1	2.3	0.8	0.1
Marfed							0.2	0.4	0.8	0.8	1.6	1.0
Orfed							1.0	0.2	0.1	0.1	trace	
Twin												2.0
Springfield												2.0
Siete Cerros <sup>c</sup>												1.0
Club												
Little Club	1.1	0.3	0.1	0.3		trace						
Hybrid 128	3.0	4.8	2.9	1.4	0.4	0.9	0.4	trace	trace			
Jenkin	0.7	1.3	0.8	0.5	0.1	0.1	0.1	trace				
Albit			0.6	3.8	1.1	0.2	trace	trace				
Hymar					1.1	1.7	1.5	0.3				
Elgin							4.7	2.0	1.2	0.7	trace	
Elmar								10.1	1.0	0.1	trace	
Omar									12.0	3.5	0.8	0.8
Moro											4.5	2.4
Paha												3.0
Soft red winter												
Red Russian	1.6	0.6	0.5	0.2	0.1	0.2	0.1	0.1	trace			
Jones Fife <sup>a</sup>	2.8	1.9	0.7	0.5	0.2	0.1	trace	trace				
Triplet		1.1	1.4	1.2	0.8	0.4	0.3	trace				

<sup>a</sup>References for values: 44-46, 48-51, 129-132, 136.

<sup>b</sup>Includes backcross prototypes, and for Federation also White Federation and Hard Federation.

<sup>c</sup>Siete Cerros is classed as a hard white spring but has some soft wheat uses when sown in the fall as in California.

TABLE IX  
Area of the Three Most Widely Grown Cultivars for Each Class or Subclass of Soft Wheat in the 11 Western States (1919-1974)

Year	Rank	Soft White Winter		Soft White Spring		Club		Soft Red Winter	
		Cultivar	1,000 ha	Cultivar	1,000 ha	Cultivar	1,000 ha	Cultivar	1,000 ha
1919	1	Goldcoin	201.4	Pacific Bluestem	552.2	Hybrid 128	117.1	Jones Fife	108.6
	2	White Winter	21.3	Baart	202.5	Little Club	43.0	Red Russian	62.7
	3	Martin	10.7	Sonora	106.8	Jenkin	26.9	Odessa	10.5
1924	1	Goldcoin	107.8	Baart	196.5	Hybrid 128	168.7	Jones Fife	68.7
	2	White Winter	12.0	Pacific Bluestem	150.4	Jenkin	45.4	Triplet	40.8
	3	Prohibition	6.3	Dicklow	47.0	Hybrid 123	21.0	Red Russian	20.5
1929	1	Goldcoin	169.9	Federation <sup>a</sup>	345.5	Hybrid 128	144.5	Triplet	68.0
	2	White Winter	10.8	Baart	310.5	Jenkin	37.3	Jones Fife	35.1
	3	Wilhelmina	9.3	Pacific Bluestem	147.4	Albit	31.7	Red Russian	23.3
1934	1	Goldcoin	78.8	Federation <sup>a</sup>	330.5	Albit	159.0	Triplet	49.9
	2	Wilhelmina	15.2	Baart	322.1	Hybrid 128	57.8	Jones Fife	19.9
	3	White Winter	6.6	Dicklow	70.1	Jenkin	19.4	Red Russian	9.9
1939	1	Rex	149.9	Baart <sup>a</sup>	360.2	Hymar	51.4	Triplet	38.0
	2	Goldcoin	52.6	Federation <sup>a</sup>	338.3	Albit	50.9	Jones Fife	11.1
	3	Golden	15.6	Dicklow	56.6	Hybrid 128	18.8	Red Russian	4.6
1944	1	Rex	182.2	Baart	403.9	Hymar	82.9	Triplet	17.8
1949	2	Goldcoin	156.4	Federation	385.0	Hybrid 128	43.2	Red Russian	8.9
	3	Golden	66.8	Lemhi	43.9	Alicel	25.4	Jones Fife	5.9
	1	Rex	173.1	Federation <sup>a</sup>	342.6	Elgin	336.2	Triplet	17.9
1954	2	Goldcoin	141.0	Baart <sup>a</sup>	266.6	Hymar	109.3	Red Russian	3.7
	3	Golden	94.9	Lemhi	81.9	Hybrid 128	31.5	Mediterranean	2.2
1959	1	Brevor	94.8	Baart <sup>a</sup>	160.5	Elmar	573.9	Red Russian	3.0
	2	Rex	62.7	Federation <sup>a</sup>	128.7	Elgin	112.4	Triplet	2.0
	3	Golden	62.5	Lemhi	79.0	Hymar	19.1	Jones Fife	0.9
1964	1	Brevor	87.8	Lemhi <sup>a</sup>	112.5	Omar	622.6	Red Russian	1.3
	2	Golden	40.3	Ramona <sup>a</sup>	109.6	Elgin	64.3	Triplet	1.2
	3	Alba	15.8	Federation <sup>a</sup>	91.6	Elmar	50.0	Jones Fife	0.8
1969	1	Gaines	646.8	Ramona <sup>a</sup>	112.5	Omar	172.0	Only trace area	
	2	Brevor	53.3	Marfed	39.6	Elgin	34.7		
	3	Goldcoin	17.3	Federation <sup>a</sup>	38.8	Elmar	4.9		
1974	1	Nugaines	589.4	Marfed	86.5	Moro	237.9	Only trace area	
	2	Gaines	422.1	Lemhi <sup>a</sup>	62.7	Omar	42.3		
	3	Druchamp	12.4	Idaed <sup>a</sup>	43.7	Big Club 60	1.0		
1974	1	Nugaines	667.9	Twin	132.8	Paha	194.1	Only trace area	
	2	Hyslop	275.5	Springfield	127.3	Moro	158.0		
	3	Gaines	215.9	Marfed	66.6	Omar	50.3		

<sup>a</sup>Includes all forms of the cultivar.



The five common white spring wheats Baart, Sonora, Pacific Bluestem, Defiance, and Dicklow dominated during 1919 (Table VIII). Pacific Bluestem and Defiance declined notably by 1924 and were replaced by hard red winter and hard red spring wheats. The area of Baart and Dicklow remained rather stable throughout the period. These cultivars were well adapted to drier regions on the Columbia and Snake River plateaus and were desired by industry. Sonora also enjoyed long popularity, especially in Arizona and southern California. Bunyip, bred by William Farrer of New South Wales, Australia, was important in California from 1929 to 1939 (43).

One of the most important common soft white spring wheats from 1929 to 1944 was Federation (Tables VIII, IX). Farrer bred Federation from a cross Purplestraw  $\times$  Improved Fife  $\times$  Etawah (14). Heralded as this famous breeder's greatest crossbreeding achievement, Federation had a major impact on western soft wheat culture. It contributed genes for early maturity, short stiff straw, shatter resistance, dual-purpose end product use, and facultative growth habit to many subsequent soft wheats. Federation was tested at Moro, Oregon, and released in 1920. By 1929 it was grown on 7% of the western wheat area (Table VIII). Federation and Baart were the two most extensively grown soft wheat cultivars from 1929 to 1944 (Table IX). They complemented each other, because Federation was adapted to heavy soil and moist areas, and Baart grew best in light soil and dry areas.

Three popular common soft white winter wheat cultivars during this time were Goldcoin (Fortyfold), Golden, and Rex (Table IX). Goldcoin was well liked because it was more winter-hardy, matured earlier, and was less subject to smut than many other early winter wheats (139). Golden was a selection made from Goldcoin at Moro, Oregon, in 1923; it exceeded Goldcoin for shatter resistance, straw strength, and yield (135). Less important soft white winter cultivars grown from 1919 to 1944 included White Winter, Martin, and Wilhelmina (Table IX).

Rex was the first extensively grown soft white common winter wheat with resistance to common bunt. Selected from the cross Hard Federation  $\times$  White Odessa in 1926 at Moro, Oregon, Rex possessed the desired combination of shatter resistance, short straw, lodging resistance, and high yielding ability and was grown extensively throughout the Northwest after 1944. Notoriously poor milling quality became the cause of its downfall.

Red Russian, Jones Fife, and Triplet were the major soft red winter wheats grown from 1919 to 1944 (45,51) (Tables VIII, IX). Odessa was important early in the period but declined rapidly in popularity (Table IX). Red Russian and Jones Fife were the two most important winter wheats of the soft type in the West before 1919. Jones Fife's strong points were adaptation to dry regions and high yield, but it lodged and shattered badly and was very susceptible to common bunt. Red Russian was adapted to heavy soil and high rainfall, had strong straw, competed with weeds, matured late, and had "dilute resistance" to common bunt (67,139). Triplet was developed in 1910 at Pullman, Washington, from a compound cross. It had shorter, stiffer straw, shattered less than Jones Fife, and averaged about 30% higher yields than Jones Fife or Red Russian (139). Triplet was the last important soft red winter wheat to be grown in the West and was ultimately replaced by improved common white winter cultivars.

Five club wheats were grown extensively between 1919 and 1944 (Table VIII).

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The old white, spring-sown Little Club was phased out of production after 1934. Jenkin grew on a sizable area between 1919 and 1935 mainly because of its superior flour quality traits (Table IX), but it was replaced by Hybrid 128 and later Albit because of its poor yield, low test weight, weak straw, and lack of adaptation to fall seeding (169). Shatter resistance, winterhardiness, straw strength, and improved yield favored Hybrid 128 over Red Russian, Jenkin, and Little Club. It was the best yielding fall-sown wheat from 1911 to 1914 in Washington tests, but it was highly susceptible to common bunt (139).

Albit was the first club cultivar with resistance to common bunt and was the leading club wheat by 1934 (Tables VIII, IX). Selected from a cross of Hybrid 128 × White Odessa in 1923 at Pullman, Washington, it carried the  $Bt_1$  gene for bunt resistance and was more winterhardy than Jones Fife or Hybrid 128 (169). Hymar had common bunt resistance similar to Albit's and was selected at Pullman from a cross of Hybrid 128 and Martin. Hymar was very winter-hardy, had high test weight, and resisted shattering. However, its yield equalled that of Hybrid 128 and it produced too much straw, so it never became too popular (169) (Tables VIII, IX). Hybrid 123 and Alicel were also grown in significant quantities for rather short periods during that time (Table IX).

The club wheats Dale, Coppei, Mayview, Hybrid 123, and Hybrid 108 actually had red seeds with many properties similar to soft red winter wheats. They were grown on 4,300 to 75,600 ha between 1919 and 1944 but later became unimportant.

### B. Cultivar Quality Traits

During this time the wheat quality characteristics of the region were formulated. More than 100 major and community mills were located in the West by about 1918 (157). Before then, many more mills were operating in the area (157). The region's millers and bakers quickly identified the specific desirable or undesirable quality traits of local cultivars. Furthermore, with the diversity of growing conditions and classes of wheat found in the West, complex marketing and utilization problems were encountered early (135). The quality traits have been described for the wheats grown most extensively during this period.

The old club white wheat, Jenkin, rated excellent for flour yield and very good for cake quality (63). Jenkin's cookie quality was outstanding. It produced yellow, medium ash flour. Hybrid 128 gave good flour yields but less than those of Jenkin. Its flour rated very good for cookies, but it was inferior to Jenkin for cakes and was high in ash (63). Albit, with flour yields lower than those of Hybrid 128, was low in ash but equal to Hybrid 128 for cake and cookie quality (63). The club, Hymar, milled slightly better than Hybrid 128, but its flour quality varied from season to season (63).

The old soft white common wheat, Goldcoin (Fortyfold), milled comparably to Hybrid 128 and produced good cookie and cake flour. Golden was similar to the quality of Goldcoin except that it was less desirable as a cake flour (63).

Pacific Bluestem often graded hard white, but produced a flour valued for its soft wheat properties. Its flour yield was less than that of Jenkin, but the flour made excellent cakes, good cookies, and fair bread (63). Like Pacific Bluestem, the common white spring, Baart, often graded hard white but had several desirable soft wheat quality traits. Baart produced a soft, velvety flour, low in ash