# TRENDS IN CEREAL FORAGE PRODUCTION

**Gene Aksland and Steve Wright**[1]

## INTRODUCTION

Trends in cereal forage production in California have come about because of the impact of diseases, demand for better production and the availability of new technology. The purpose of this paper is to describe those impact points, their importance, and significance for meeting the needs of California forage producers in the future. The primary technological vehicle for change has been the species of cereal forage crops used in California. The familiar members of this group are oats, barley, wheat and the new comer, triticale

**Key Words: wheat, barley, oats, winter forage**

## Arrival and Early Development of Cereal Grains in California

Cereal grain and forage production in the great Central Valley of California started with the introduction of European, Mediterranean-adapted landraces by Spanish padres between 1770 and 1800. Rapid growth of cereal and forage production occurred during the Gold Rush years to feed and provide for the ever increasing population. The landraces that resulted from centuries of use by European farmers provided the technological platform for the feed and forage in California in its early agriculture. In the late 1800's, the westward expansion from the United States into California brought with it an influx of new landraces of cereal grains and forages from the eastern United States. With this endowment of both the original landraces from the Spaniards and the later ones brought by way of the eastern U.S., the opportunity was now present to breed and select for California conditions.

Public plant breeders began their first work to improve grain and forage production with wheat. Wheat was by far the most important cereal grain used in California. For about thirty years between 1849 and 1890 California produced 41 million bushels of wheat. Today California produces 36 million bushels of wheat compared to Kansas at over 300 million bushels. Early wheat varieties were bred for grain as well as forage. Awnless varieties like "Ramona" were used for hay prior to the introduction of high yielding awned varieties. Wheat dominated the cereal plantings in California until the early 1900's when a new strain of stripe rust appeared causing the collapse of the wheat plantings in

[1] Gene Aksland, Resource Seeds, Inc. P.O. Box 29 Goshen, CA 93227-0029; Steve Wright, UC Cooperative Extension 4437 South Las Pinas St #B Tulare CA 93274. **In**: Proceedings, California Alfalfa and Forage Symposium, 12-14 December, 2005, Visalia, CA, UC Cooperative Extension, Agronomy Research and Extension Center, Plant Sciences Department, University of California, Davis 95616. (See http://alfalfa.ucdavis.edu for this and other proceedings).

California. Because disease prevented the further cultivation of wheat growers moved to growing barley for grain and forage.

**Barley for Grain and forage**

Forage made from barley has been used mainly in the southern San Joaquin Valley.. Originally, barley was harvested for grain and the land was prepared for planting grain sorghum or corn for grain or silage. As silage demand increased the barley crop was chopped for silage allowing for an earlier planting date for the corn. This was a successful cropping system until barley diseases prevented many of the most popular forage barley varieties from being grown.

The lack of straw strength and grain yield were other factors that prevented barley from becoming a dominant forage species in the San Joaquin Valley. The answer to these problems was seen in the variety "Kombar" released from Northup King Company. This variety had excellent straw strength and better grain yields than any previous barley in California. Unfortunately, just as "Kombar" was being widely accepted in the early 1980's, it was found susceptible to a new strain of net blotch disease.

Public and private breeders that had barley breeding programs were also working on wheat breeding. With powerful new traits now available from the Green Revolution for wheat more breeding attention was spent on wheat.

**Oats and Cereal Blends**

During the period 1910 to 1950, much of the breeding and selection was through the efforts of USDA plant scientists working in conjunction with the University of California at Berkeley and Davis. Here, the technological expertise of trained scientists was used to provide new oats, wheat and barley varieties for California farms. Many of the cultivars that were developed were dual purpose. They had a forage use as well as a grain product. Forage for California's expanding livestock industry came primarily from oat hay. In the early development of forage, oats became an easy choice. The tall early plants were adapted to California and the landrace varieties such as California Red and Kanota became the prominent cultivars used throughout the state. Oats grown for hay and chopped for silage became a traditional part of the double crop system in the Central Valley of California. In that system, fall planted oats were subject to the winter rains and windy wet springs. The result was lodging which reduced yields making production difficult.

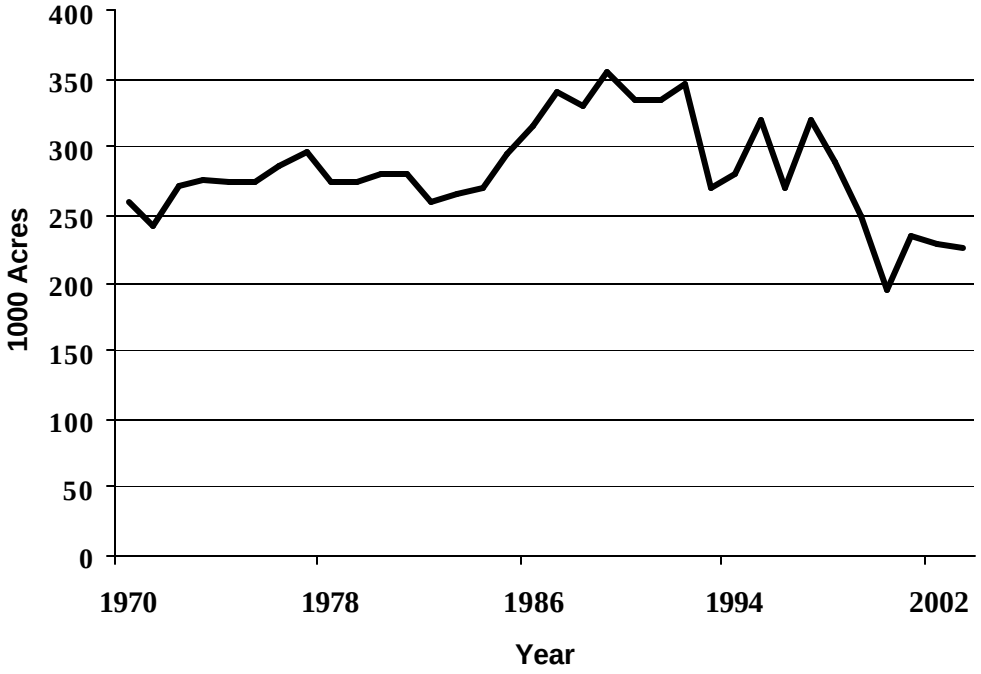


Fig. 1 California Oat and Blend Silage Acres
California Field Crops Statistics Service

The cultural limitations to oats were first addressed by the farmers themselves and then by seed companies that supplied oat seed to farmers. Blends of oats, vetch, awnless wheat, and barley became strong proprietary products as seen in Fig.1 in the 1980's. The added components were meant to overcome the weaknesses that oats had alone. There was a degree of success in this risk management process of blending cereal species to make a better product. Dairies needed more nutrient dense forage feed so the blends were designed to provide better growth habit and improve the energy and protein levels. Many seed companies developed special proprietary blends to compete in the market place. An example is the University of California Research Trial conducted in 1986-87 in Denair (Table 1).

Table 1 1986-87 Merced/Stanislaus Winter Forage Trial Marsha Mathews UCCE

| Mix or Variety | Components |
|---|---|
| Mission Top Milker | O,B,W,P,F |
| Stan Farm Max –Yielder | O,B,W,V |
| Lockwood Special mix #2 | O,B,V |
| Hatch Forage Mix I | O,B,W,V |
| Lyng Forage Blend | O,B,W |
| Swan Oats | O |
| Gilbert's Mix + Fava | O,B,W,F,V |

Components: O=Oats, B=Barley, W=Wheat, P=Peas, V=Vetch, F=Fava Beans

The blends included an early oat that would be in flower when the late oat and the awnless wheat would be in the boot stage. The barley, usually a hooded very late variety, would be visible as the oats were reaching harvest stage. Legumes were added in hope of increasing the protein level.

This objective however was difficult to attain because of the difference in maturities of the various components of the blends. The addition of legumes further complicated management of blends because of increased lodging and the lack of the option to apply broadleaf herbicides.

The number of acres of oats and oat forage blends (Fig. 1) has been relatively constant in the northern San Joaquin Valley. This may be due to the shorter season in the northern area and the need to harvest the forage crop early. Most of the forage blends in the Northern San Joaquin Valley area are chopped for silage while they are in the flower stage. This early harvest is needed so that land preparation can move ahead for timely corn planting.

A new option for the forage grower is using very late maturing oats for boot stage harvest. This plant type is expressed in the variety EverLeaf 114 oat. This is variety ready for boot stage harvest during the middle of April. The forage produced is high in protein and highly digestible. EverLeaf 114 oats produced 18.5 tons per acre at 70% moisture when harvested April 20th in the 2005 University of California Stanislaus County Small Plot Forage Trial.

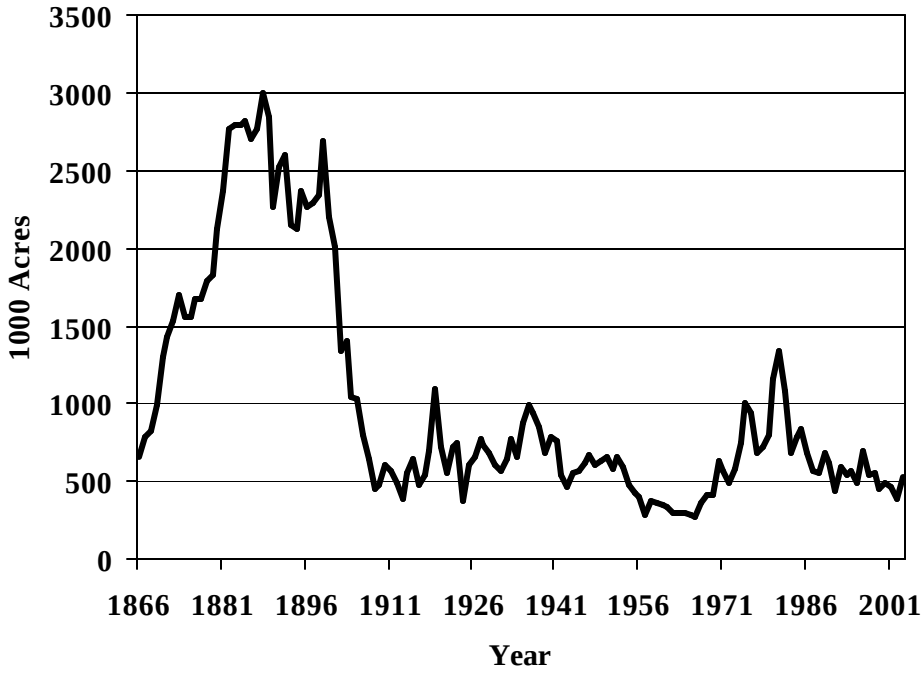


Fig. 3 Wheat All Acres
California Field Crops Statistics Service

The pivotal point in the upturn in the use of wheat was the release of varieties from the Green Revolution in the late 1960's. Wheat breeders located at the International Center for Maize and Wheat Improvement, (CIMMYT in Mexico, brought about the introduction of broadly adapted, short-statured, disease resistant wheat that excelled in converting fertilizer and water into high yields. During the 1970's the old landrace wheat varieties were replaced with the new high yielding varieties. Wheat varieties from the CIMMYT program have a high grain-to-stem ratio and other characteristics that are needed to produce grain or cereal silage harvested in the soft dough. The CIMMYT varieties stood up under lagoon water irrigation and were early enough to permit a following double crop of corn silage. After climbing during the 1960's and 1970's, wheat acres in California for grain production have been declining (Fig.3).

Overall milling wheat acreage declined after the 1980's peak; however, wheat acreage for silage began to climb. The new short statured high grain yielding varieties from CIMMYT fit well into the requirements of dairy producers. The University of California released variety Yecora Rojo became the one variety to enter this market on a large scale.

Table 2 U.C.C.E. Winter Forage Trial 1988 Kings and Tulare Counties
Carol Collar, Allan Fulton and Steve Wright

| Varieties | Tons per acre at 30% DM |
|---|---|
| Klasic Wheat | 18.02 A |
| Yecora Rojo Wheat | 17.95 A |
| Dirkwin Wheat | 15.49 A B |
| NK Cutmor forage mix | 13.72 A B C |
| UC 337 Barley | 13.37 B C |
| UC 476 Barley | 12.53 B C |
| NK-BB 82-2 Barley Blend | 10.70 C |
| LSD .5 | 4.409 |
| % CV | 12.39 |

The U.C.C.E Winter Forage Trial 1988 (Table 2) is indicative of what growers and dairymen found when growing cereal forages. Wheat gave them more yield, better nutrition, with less risk than barley and mixes at that time. The decision to grow wheat for their cereal forage was practically demonstrated for them in the field. The new short statured wheat gave consistent results, supplying dairymen with nutrition and quality they needed for milk production. In the late 1980's and early 1990's wheat silage harvested at soft dough became the dominant forage over forage mixes and barley in the Southern San Joaquin Valley.

**Forage Triticale**

Triticale is a close relative of wheat, which was created by pollinating durum wheat with rye pollen, then using that cross in a breeding program to produce stable, self-replicating varieties. Through forty years of breeding, modern triticale has become similar to common wheat, but has proven over the years to be superior to common wheat in many respects as demonstrated in University of California Agronomy Progress Reports (Tables 3-5).

Table 3 Comparisons of Wheat and Triticale 1969 at 5 Locations

| Crop | Mean Grain Yield | Mean Height cm. | Mean Test Weight |
|---|---|---|---|
| Triticale | 2,160 | 117 | 49.9 |
| Wheat | 4,360 | 96 | 62 |

Table 4 Comparisons of Wheat and Triticale 1997-99 at 7 Locations

| Crop | Mean Grain Yield | Mean Height cm. | Mean Test Weight |
|---|---|---|---|
| Triticale | 6,930 | 110 | 59.0 |
| Wheat | 5,285 | 105 | 60.5 |

Table 5 Comparisons of Wheat and Triticale 2005 at 7 Locations

| Crop | Mean Grain Yield | Mean Height cm. | Mean Test Weight |
|---|---|---|---|
| Triticale | 7,580 | 109.2 | 58.9 |
| Wheat | 6,220 | 96.5 | 60.6 |

Triticale in its introduction into the market place was over sold. The species was in the very beginning of the process of breeding and selection as is shown in Tables 3 during the first years of its introduction the enthusiasm for its potential got a head of how it could perform. Unadapted types were brought in from other parts of the United States and were very unsuccessful. In Table 4 triticale bred in California by Resource Seeds is competing with wheat and exceeding wheat in grain yield. The plant type at this stage was still tall and with few leaves.

At this time growers began to recognize how valuable triticale was in growing a crop on alkaline soil. The powerful extensive root system coupled with strong disease tolerant plant made triticale an excellent choice for silage production on saline and alkaline soil.

The latest variety of triticale is compared with wheat in Table 5. Wheat and triticale are now similar in plant height and test weight. Grain yield however is very different, triticale out yields wheat in trials that have been run over the last 8 years. Triticale also has better silage yields than wheat making it an excellent choice for the San Joaquin Valley dairy shed.

**Small Grain Forage Trial**
UCCE - Kings Co. - Hanford – 2005

**Table 6**

| Variety | Height | Lodging | Rust | Harvest Wt. lbs | Stage of Harvest | * As Cut Harvest Tons/A |
|---|---|---|---|---|---|---|
| 1. Summit | 36.3 | 0% | 1.8 | 29.7 | Soft dough | ***25.55*** |
| 2. Trical 96 | 36.5 | 0% | 0.0 | 31.0 | Soft dough | ***26.62*** |
| 3. Trical 118 | 41.3 | 0% | 0.0 | 35.1 | Soft dough | ***30.15*** |
| 4. Blanca Grande | 39.0 | 73% | 1.0 | 19.4 | Soft dough | ***16.68*** |
| 5. Super Dirkwin | 38.5 | 23% | 1.9 | 20.7 | Soft dough | ***17.83*** |
| 6. PR 1404 | 40.8 | 16% | 1.4 | 22.8 | milk | ***19.61*** |

*** An error was made with the dried harvest samples so a true weight at 70% moisture could not be determined**

The silage yields in Table 6 show the two TRICAL triticale varieties 96 and 118 at he top of the ranking for forage harvest. Also note the percent stripe rust rating being 0.0 for both varieties. These valuable production traits have given growers the confidence to plant more triticale. In 1994 very little triticale was planted for soft dough silage, in 2005 about 75,000 acres will be planted to triticale.

## Summary

The present state of the California cereal forage industry is the result of the impact of disease pressure on the cultivars being grown by forage producers. Next, the varieties that are disease tolerant must meet yield and quality goals. Once adapted varieties are grown widely they are open to replacement by the most recent technologically advanced entry to the market place. Over the many years of forage production in California there have been dramatic changes in the San Joaquin Valley in forage type. Soft dough silage is a key component of the dairy inventory. In the northern San Joaquin Valley oats and forage mixes have remained constant in their use in forage production.

The technological advancements that came over time to California through out history have made an impact. The early landraces, the CIMMYT introductions and the advancement in high yielding triticale all contributed to a strong Central Valley forage industry.

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