A collaboration between:

Barley Production in California

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Background

Barley was brought to California by the Spanish padres via Mexico and was cultivated on mission lands since at least 1771 [7]. Until 1860, when it was surpassed by wheat, barley was the most important grain grown by the early American settlers in California [1]. It was the principle feed grain for livestock, and malting barley was also the basis for an early California export trade with Great Britain [8]. Production grew steadily through the 1800s (Figure 1). Around the turn of the century, the wheat boom fueled by the population growth after the Gold Rush began to decline in part due to soil exhaustion. Barley is comparatively salt- and drought-tolerant and its acreage grew as to some extent it replaced wheat. The increasing use of irrigation and expansion of high-value fruit and nut crops contributed to a general reduction in the importance of grains and hay in California agriculture as a whole over the course of the 1900s. The passage of Prohibition also contributed to barley's decline in favor of other crops [5]. However, as Prohibition ended and barley's value as a rotation crop became recognized, barley acreage rose through the 30s and 40s, and it ranked as California's 8th most important commodity in 1950 [5, 6]. Production peaked in 1955 at nearly 2 million acres; however, it has since declined steadily, with only 80,000 acres of barley harvested in 2013 (Figure 1) [10]. This decline is related to competition from higher value crops, fueled by rising incomes and improvements in transportation and cooling technology after World War II, as well as the increasing diversity of California agriculture [6]. In addition, after 1970 there rose a trend towards uniformity in the malting barley industry that excluded California varieties, which differ in malting characteristics from those grown in the larger malting barley producing areas of the Midwest and Great Plains [7].

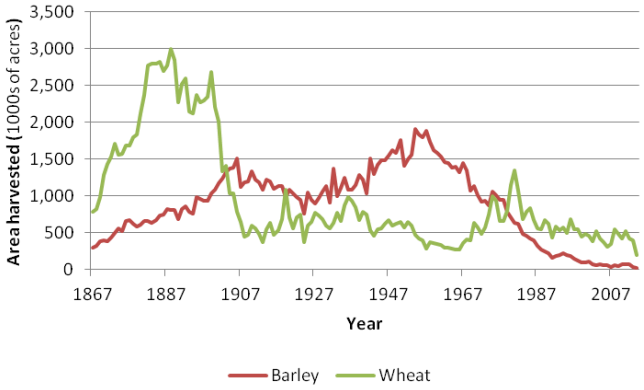

Figure 1: Barley and wheat production in California since 1867 [10].

Barley Production in California

Around 50% of US-grown barley produced for domestic consumption goes to animal feed, about 45% to the malting industry, 3% towards seed and 2% for direct consumption as food [4]. Barley has two distinct types; six-row varieties, which are commonly grown for animal feed (although historically in the US they have also been used for malting) and two-row varieties, which are used for malting. All else being equal, six-row barleys and barleys bred for feed tend to

be higher yielding; two-row barleys tend to be lower yielding but are generally thought to have better malting and brewing characteristics, and obtain a higher price [3, 9].

Barley varieties grown in California are mostly fall sown six-row feed types. Although classified as winter barley because of marketing time most have a spring growth habit; that is, they do not require vernalization. Most California barley is grown in the Sacramento and San Joaquin valleys as an irrigated rotation crop, and in the foothills and south Central Coast area as a rainfed crop. Conservation tillage is common in the Central Coast region. Some irrigated two-row and six-row spring sown barley is grown the Tulelake basin as a rotation crop with potato, onion and alfalfa (Figure 2). Malting barley is also occasionally grown in this region. Some feed barley is also grown in valleys in the Southern Desert Region, irrigated and in rotation with vegetable and field crops or rainfed under conservation tillage in the northern part of the region [4].

Barley straw may be baled, and the remainder incorporated. Alternately, it may be spread and incorporated [4]. Residue management may become a problem where barley is grown as a short-season rotation crop.

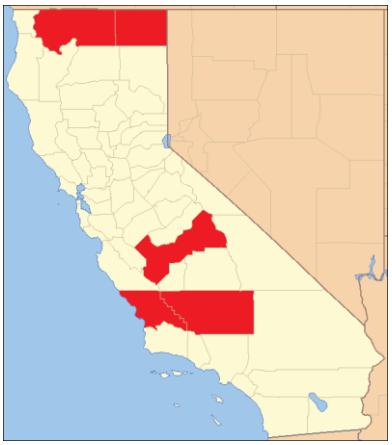

Figure 2: Location of the five leading barley producing counties in California, 2000-2011 [10].

Barley Yield

California barley yields are similar to the national average (Figure 3). Yields have steadily increased through most of the 20th century, largely due to improved varieties and cultivation practices, especially moving production to irrigated lands from dryland production [5]. Key varietal improvements include lodging resistance and fertilizer response. A relative plateau in California yields since the 1980s reflects the fact that while significant varietal improvements have been made since that time, barley production has moved to more inferior soils due to its low profitability and greater tolerance for salinity and drought [5]. Between 2010 and 2014, barley yields in California averaged 65 bu/acre (3,200 lbs/acre) [10].

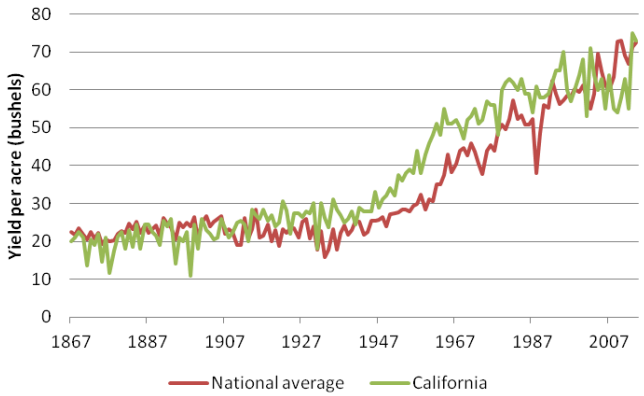

Figure 3: California and national barley yields since 1867 [10].

Fertilization

Barley fertilization depends on whether it is grown irrigated or rainfed, in winter or spring, and is a feed or malting variety. As rainfed barley yields are mainly limited by moisture and seeding rates are lower, fertilization is accordingly reduced. Spring barleys have a shorter season and fertilized less than winter barleys. Feed and malting barleys have different quality goals-- while high protein is desirable in feed barleys, it reduces malt quality and is avoided for malting barleys [3]. Thus, growers of malting barley must take care not to use too much nitrogen (N) fertilizer or apply it too late, as this can increase protein to undesirable levels (greater than 12.8% cannot be used for malting) [2]. Excess N fertility can also decrease the percentage of plump kernels, another important malting characteristic. The American Malting Barley Association has more stringent plumpness standards for 2-row than for 6-row barley [2]. Reduced quality due to excess N fertility is especially a danger for irrigated malting barley in rotation with highly-fertilized vegetables or alfalfa, such as is grown in the Tulelake basin area [3].

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