N Management for California Malting Barley

Background

Growing quality malting barley requires precise nitrogen (N) management due to specific grain quality requirements for malting (typically 9–10.5% protein for use in two-row all-malt craft brew). The timing and the rate of N fertilizer application are important management decisions, but their impacts on grain yield and protein vary with environmental conditions including soil type, climate, and cropping system management. There is a wide diversity of agroecosystems in which malting barley is grown in California ranging from upland, rainfed sites with lower relative yield potential, to lowland, irrigated sites with higher yield potential due to deeper, more fertile soils. Furthermore, the timing and amount of rainfall and heat can vary widely from year to year within a given location. Like many other small grains, barley can be planted in the fall (Sacramento Valley) or spring (Intermountain region), depending on the environment.

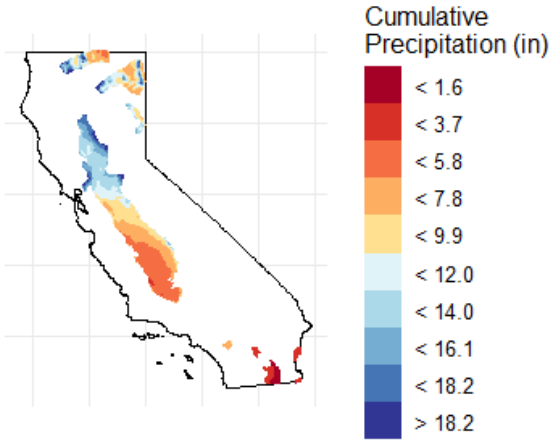

Figure 1. The historical geographic variability in precipitation in the grain-growing regions of California.

In general, the total N fertilizer required to achieve maximum yield is greater than the amount required to achieve acceptable protein. Absolute yield and protein outcomes will depend on site characteristics such as yield potential and are an essential factors to consider before deciding to fertilize.

Key Takeaways

1. Protein should be prioritized over yield when managing malting barley. Price scenarios make prioritizing the protein above yield a clear economic decision. Malting barley that meets protein requirements results in higher gross income compared to the commodity price of feed barley (1.5 to 4 times higher as of July 2018 – see Fig. 2). Check your contracts for the penalty of not meeting protein goals. In some cases, barley that does not meet protein specifications may be rejected and forced into the lower revenue feed market.

2. Calculate your crop's N needs before applying N fertilizer (both pre-plant and in-season).

This is an example calculation of the N needs of a field with a typical yield of 3000 lb/ac and the desired protein of 9.5%:

3000 lb/ac (typical yield) x 9.5% protein (desired protein) = 285 lb protein/ac

↓

285 lb protein/ac ÷ 5.75 (conversion factor from protein to N) = 50 lb N/ac (removed in grain)

↓

50 x 1.25 (to account for N in straw) = 62 lb N/ac (total N removal over the course of the season)

Do not apply more N than the crop will take up. Test your soil and account for any residual soil N (by subtracting the fertilizer equivalent from the remaining N uptake) before adding fertilizer N. Application of excess N often leads to protein above the recommended protein levels.

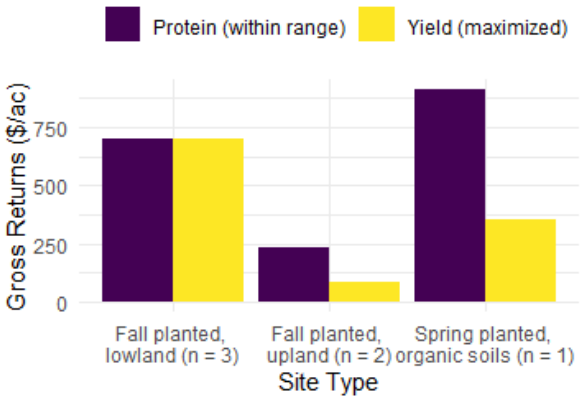

Figure 2. The difference between gross income when yield is maximized as a function of N fertilizer management compared to when N fertilizer is applied at low enough rates to ensure that grain protein stays within the acceptable malting quality range of 9-10.5%. Figure assumes $0.06/lb for crops outside the desired protein range and $0.15/lb for crops within the range.

3. Understand and consider the location-specific factors that interact with N and contribute to increased protein. Many environmental and management factors interact with N including variety choice, seeding rate, and drought. 2-row barley varieties generally require less N and result in lower protein than 6-row varieties. A relatively high seeding rate is recommended (~1.1 million seeds/ac) for quality malting barley. Adjustments should be made so that more seeds are planted in poor growing conditions. Shorter grain fill duration and faster time to senescence typically result in lower yield and higher protein. This can be the result of drought and/or heat stress as well as variety choice. Terminal drought-related stress is common in rainfed fields in California and has been shown to reduce starch accumulation while increasing protein. For sites with these characteristics, apply only small amounts of N fertilizer relative to the crop N budget and little to no N fertilizer in season.

4. More N is allocated to protein than yield the later in the season it is applied. It is not recommended to apply N fertilizer to malting barley after the tillering growth stage. If an in-season application is a possibility at or before tillering, consider putting in an N rich strip at planting and using it to inform whether the crop will respond to an in-season N fertilization at tillering.

5. Follow N Best Management Practices to ensure fertilizer incorporation into the crop root zone. When you have determined that an N application is needed, apply N such as urea or ammonium sulfate before significant rainfall (> 0.5 in) or irrigation to ensure incorporation and reduce volatilization. If applying N fertilizer below the soil surface at pre-plant, do not place the fertilizer too deep as plants will not be able to access the N early in the season.

Conclusion

There is a large amount of yield and protein variation between locations and years and a wide range of potential grain yield and protein outcomes across California. Many factors can contribute to grain protein outcomes, but N fertilizer is the number one factor that growers can control to manage their protein.

For more on this topic:

- ✓ http://smallgrains.ucanr.edu/General_Production/Malting_Barley/

Agronomy Research and Information Center

http://agric.ucdavis.edu/

University of California Cooperative Extension

Author(s): Taylor Nelsen, Konrad Mathesius, Mark Lundy

2020