Crop Rotation, Prosaro Fungicide and Cultivar as Management Tools to Control Disease on 2- and 6-Row Barley and Durum Wheat, Langdon, 2007

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Efforts have been initiated and funded by the U.S. Wheat and Barley Scab Initiative to communicate some of the research progress made in developing and identifying strategies that will reduce or minimize the effect on small grains from the disease Fusarium head blight (FHB) or scab. One of these efforts is reported here that compares using crop rotation to ground previously planted to a broadleaf crop and a fungicide treatment in conjunction with some of the different levels of cultivar resistance or tolerance to FHB. Each of the studies utilized a common regional crop rotation as a comparison to a small grain rotation. The theory behind this is that the quantity of inoculum would be reduced when the previous crop was not susceptible to FHB. The second strategy analyzed was an application of Prosaro fungicide to minimize the effects of the disease. The final strategy would be to choose a cultivar with less susceptibility to FHB. The results from these barley studies are being shared with researchers in other states in a coordinated effort to develop a barley forecasting system to help identify risk, plus or minus, of using each of these management strategies to minimize effects of FHB.

MATERIALS AND METHODS

These studies were conducted at North Dakota State University Langdon Research Extension Center in 2007. The objective was to determine the benefit of planting into canola residue compared to small grain residue and to determine the efficacy of Prosaro fungicide (421 SC 3.57 lb/gal. formulation of prothioconazole/tebuconazole, 19% +19% w/w, manufactured by Bayer CropScience) for control of leaf and head diseases on 2- and 6-row barley and durum cultivars. The studies were designed as randomized complete block with a split plot arrangement with six replicates. Whole plots were fungicide applied at Feekes 10.3 growth stage on barley or Feekes 10.51 growth stage on durum. Split plots were cultivars. The two-row barley cultivars tested were ‘CDC Mindon, Conlon, Eslick, Merit, Pinnacle and Rawson’. The six-row cultivars tested were ‘Excel, M122 (previously identified FEG65-02), Legacy, ND20448, Robust, and Tradition. The durum cultivars were ‘Divide, Grenora, Lebsock and Monroe’. The cultivars were selected because they were planted on significant acreages of growers in the region or fit the range of susceptibility to FHB. The plots were seven rows wide six-inch row spacing and measured 20 feet long. A double disk drill was used to seed the plots in late April 2007. Fertilizer was spring applied by broadcast method. A solution of Prosaro fungicide and Induce adjuvant (Helena Chemical Co.) was applied at 6.5 fl oz /acre and 0.125%v/v at head emergence on barley and early anthesis on durum. Fungicide was applied at multiple dates to accommodate maturity differences of the 2-row cultivars. Fungicide treatments were applied with a CO_2-pressurzed backpack sprayer. The boom was equipped with two Spraying Systems Co. XR8001 nozzles mounted on a double swivel. The swivels were spaced on 20-inch centers and oriented to spray 30 degrees downward from horizontal and forward and backward. The spray volume was 18.4 GPA obtained by pressurizing the boom at 40 psi. Leaf disease evaluations were recorded 20 days after flower initiation by assessing five leaves per plot visually and estimating the necrotic

and infected area per leaf. Twenty days after the fungicide application (soft dough growth stage, Feekes 11.2) 20 heads were removed and evaluated to determine FHB incidence (number of spikes infected) and field severity of the infected heads. Field severity rating (index) is the summation of the spikes infected (number of FHB infected kernels per head divided by total kernels). The plots were harvested with a plot combine and the sample processed to determine yield and test weight on all crops and plump on the barley. A sub sample of the grain was ground and sent to North Dakota State University to determine the presence of the toxin deoxynivalenol (DON). North Dakota State University Extension recommended production practices for barley and durum wheat for Northeast North Dakota were followed. Data was analyzed with the general linear model (GLM) in SAS. Fischer's protected least significant differences (LSD) were used to compare means at the 5% probability level (Table 1).

RESULTS

Unless an interaction was measure the results are reported by factor. The previous crop was an average of 72 plots planted on canola or small grain residue and the Prosaro treatment or untreated was also an average of 72 plots. The barley and durum by cultivars are 24 plot averages.

Previous Crop Residue. Yield was increased from 94.7 to 98.7 bu./ acre by planting 2-row barley into canola residue compared to small grain residue (Figure 1). Yield was increased from 88.4 to 97.3 bu./ acre by planting 6-row barley into canola residue compared to small grain residue (Figure 2). Deoxynivalenol concentration was increased from 0.36 to 0.72 and by 1.10 to 2.12%, respectively, by planting 2 and 6-row barley into canola residue compared to small grain residue (Figure 3, 4). Planting durum into small grain residue compared to canola residue increased FHB Incidence by almost 8% and deoxynivalenol concentration from 1.6 to 2.3% (Figure 5). Planting durum into canola residue increased foliar disease severity from 55.3 to 75.3, however, yield was increased from 54 to 65.6 bu./ acre and test weight from 58.1 to 60.1 lbs/ bushel.

Treatment. Deoxynivalenol concentration in the grain was reduced by 0.29 ppm by the fungicide treatment on 2-row cultivars (Figure 6). Applying Prosaro fungicide to 2-row barley decreased FHB incidence and severity from 75.1 to 70.8 and 6.6 to 5.6%, respectively (Figure 7). Leaf severity was also decreased from 66.1 to 45.5%. An application of Prosaro increased test weight by 0.5 lb./ bushel on 6-row barley cultivars (Figure 8). The fungicide treatment also reduced DON by 1 ppm on 6-row barley cultivars (Figure 9). The fungicide application to durum also decreased FHB incidence, field severity and head severity and leaf severity by 23.4, 11.5, 6.9, and 8.6% respectively (Figure 10). Yield and test weight were increased by 6.5 bu./ acre and 0.8 lb./ bushel and deoxynivalenol concentration was decreased from 2.4 to 1.5 ppm by fungicide treatment on durum (Figure 11). The fungicide treatment significantly decreased FHB field severity on Grenora, Lebsock and Monroe durum cultivars but not Divide (Figure 12).

Cultivar. Differences in yield by 2-row barley cultivar are reported (Figure 13). Conlon, Eslick, and Pinnacle were followed in yield by Rawson, CDC Mindon and Merit. Differences in 6-row cultivars by yield and plump are reported in Figure 14. Legacy and Excel had the greatest yield

in this study. Tradition and the Experimental line ND20448 had the highest plumps. All the plumps were very good. Robust had the greatest test weight of the 6-row cultivars (Figure 15). Deoxynivalenol concentrations were much less with the 2-row experimental barley cultivars compared to the other cultivars (Figure 16). The experimental lines from Minnesota and North Dakota, FEG65-02 and ND20448, respectively had significantly lower DON levels than other 6-row barley cultivars (figure 17). Significant differences in leaf severity on 2-row barley by previous crop, treatment, and cultivars are reported (Figure 18). Yields were affected more by previous crop residue on some 6-row barley cultivars than others in this study (Figure 19). Maximum yield increases were obtained by planting Excel and Legacy into canola residue.

Discussion. Yield, test weight and DON concentration are summarized by factor and crop (Table 1). Using a rotation increase yield in all crops, minimally by 4 bu/ acre in 2-row barley but exceeding ll.6 bushel per acre in durum. Rotation had no affect on test weight on barley but increased test weight substantially across varieties on durum. An expectation of increased test weight on barley would usually occur when high levels of foliar disease are present at early heading growth stage or earlier. Rotation increased DON levels in both barley crops. The canopies of all the crops were denser on canola stubble. One should expect the benefits of increased yield opportunity should be correlated with plants with denser canopies and increased number of tillers. The barley and durum crops planted into small grains residue also appeared to suffer a small stand and tiller reduction from the effects of root disease. The fungicide application had minimal affect on barley yield and test weight on the 2-row barley. This is also somewhat expected in the absence of foliar disease. However, the fungicide was effective in reducing DON levels on all three crops. Several excellent choices are available in all crops to improve yield, and test weight. While the option to reduce DON by selection of specific durum cultivar was not available in this study efforts are underway to change that factor. Several barley choices may be available in the future to reduce the affects of DON especially on 6-row barley.

Table 1. Summary of factor effects on yield, test weight, and deoxynivalenol concentration.

Factor	Yield	Test Weight	DON
2-row Barley			
Canola Rotation	+ 4*	NS	+ 0.40
Prosaro Fungicide	NS	NS	- 0.29
Cultivar	+ 16.5	+ 3.5	- 1.05
6-row Barley			
Canola Rotation	+ 8.9	NS	+ 1.02
Prosaro Fungicide	NS	+ 0.5	- 1.00
Cultivar	+11.9	+ 1.4	- 1.23
Durum			
Canola Rotation	+ 11.6	+ 2.0	- 0.7
Prosaro Fungicide	+ 6.5	+ 0.8	- 0.9
Cultivar	+ 5.2	+ 0.7	NS

*P ≤ 0.10

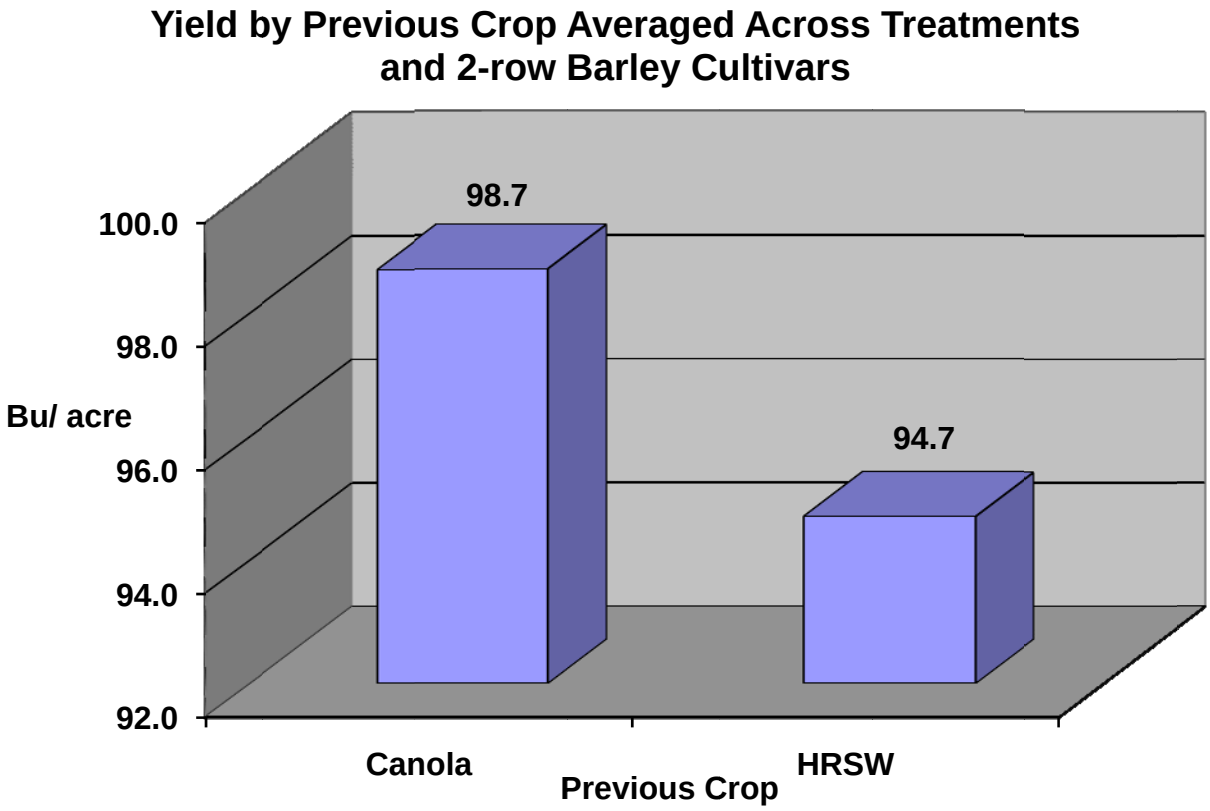

Figure 1. Yield by previous crop averaged across treatments and 2-row barley cultivars.

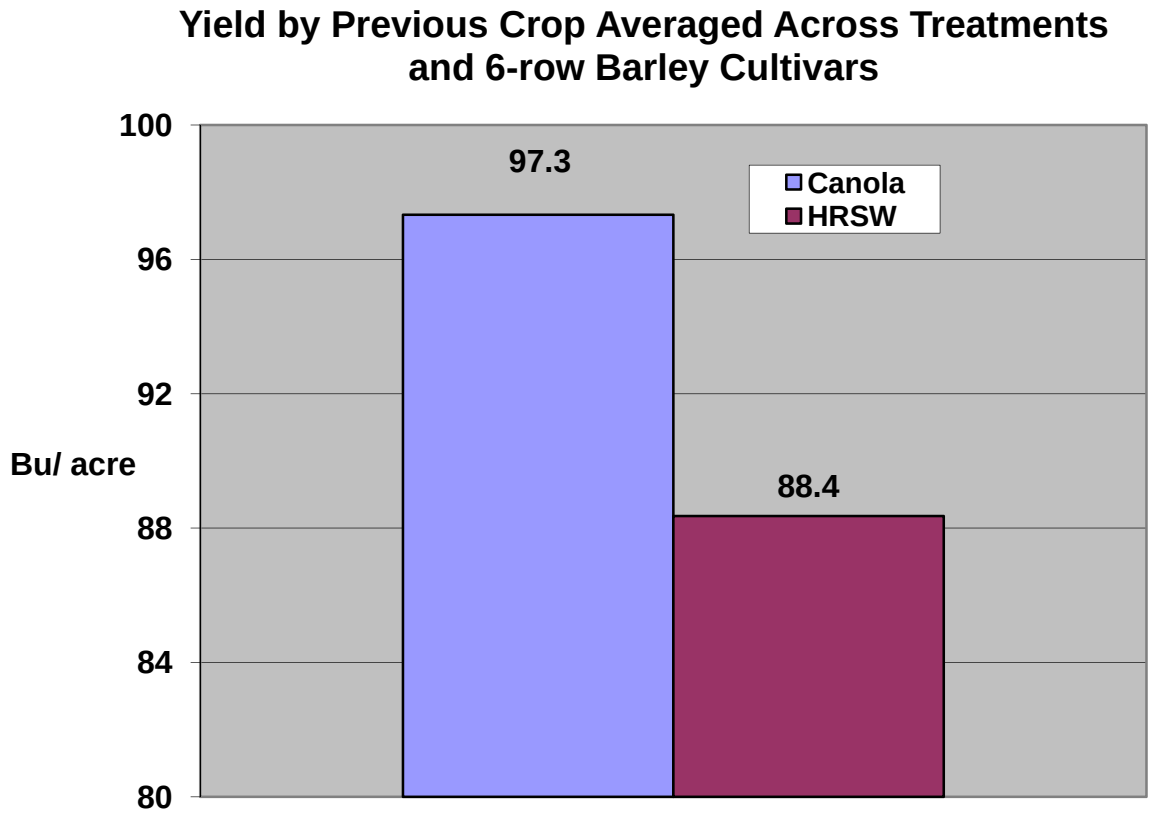

Figure 2.Yield by previous crop averaged across treatments and 6-row barley cultivars.

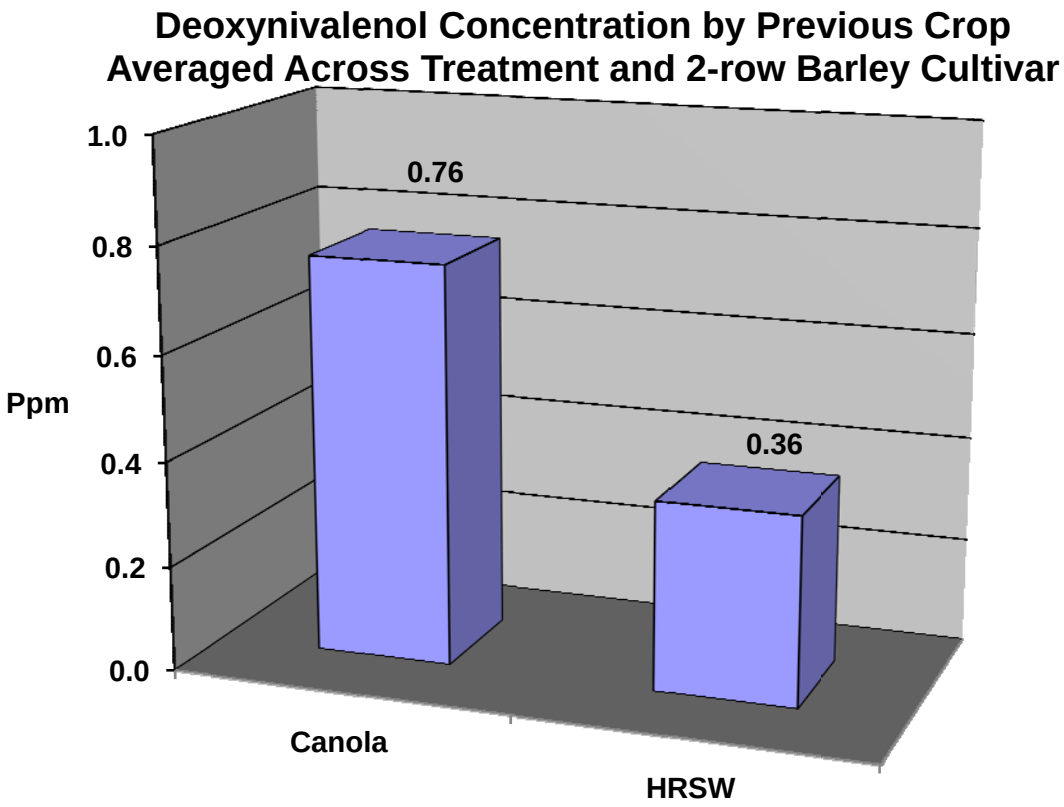

Figure 3. Deoxynivalenol concentration by previous crop averaged across treatments and 2-row barley cultivars.

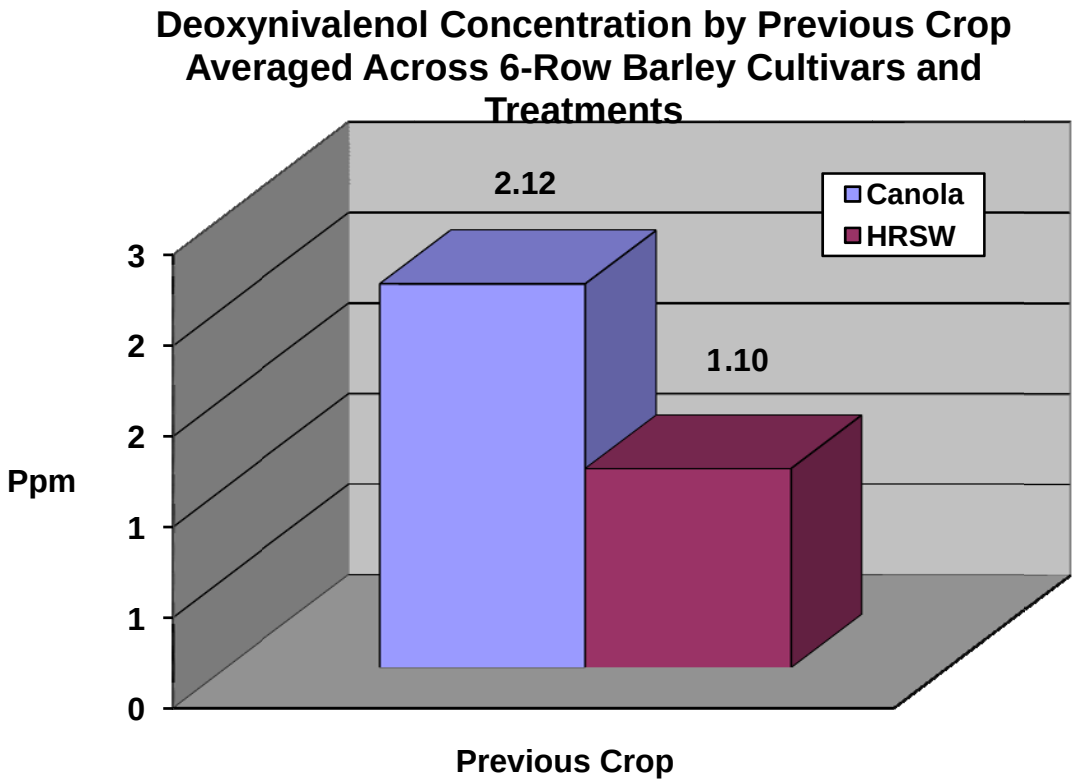

Figure 4. Deoxynivalenol concentration by previous crop averaged across 6-row barley cultivars and treatments.

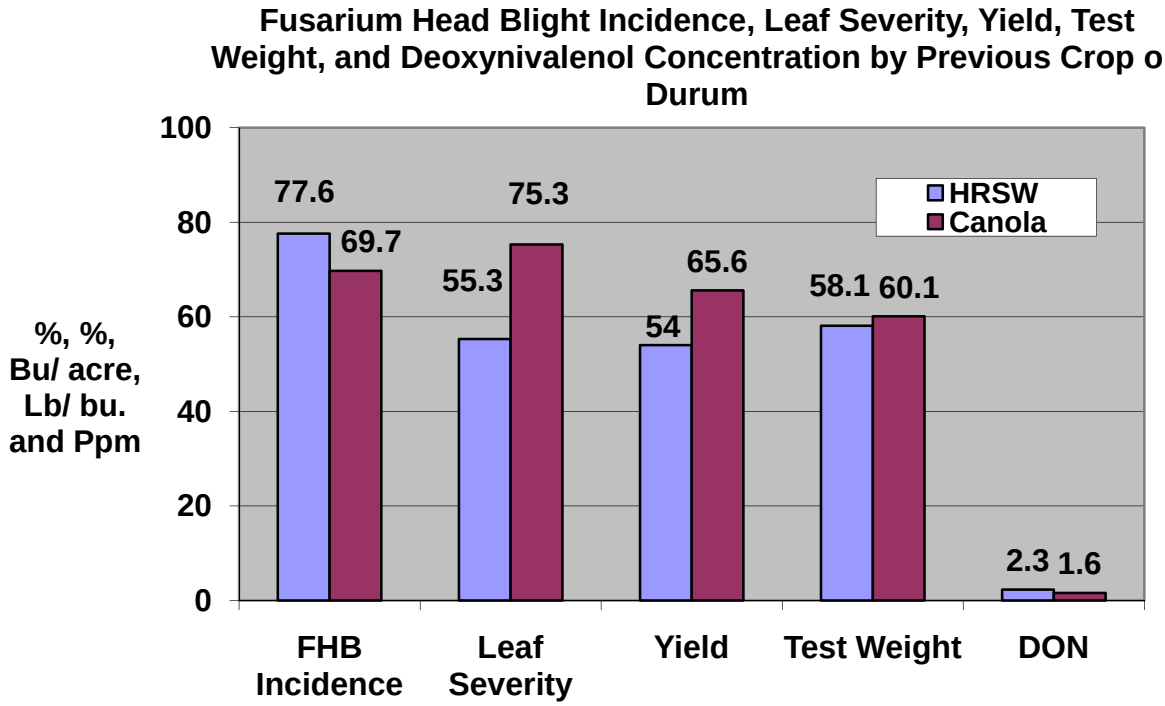

Figure 5. Fusarium head blight incidence, leaf severity, yield, test weight and deoxynivalenol concentration by previous crop averaged across treatments and durum cultivars.

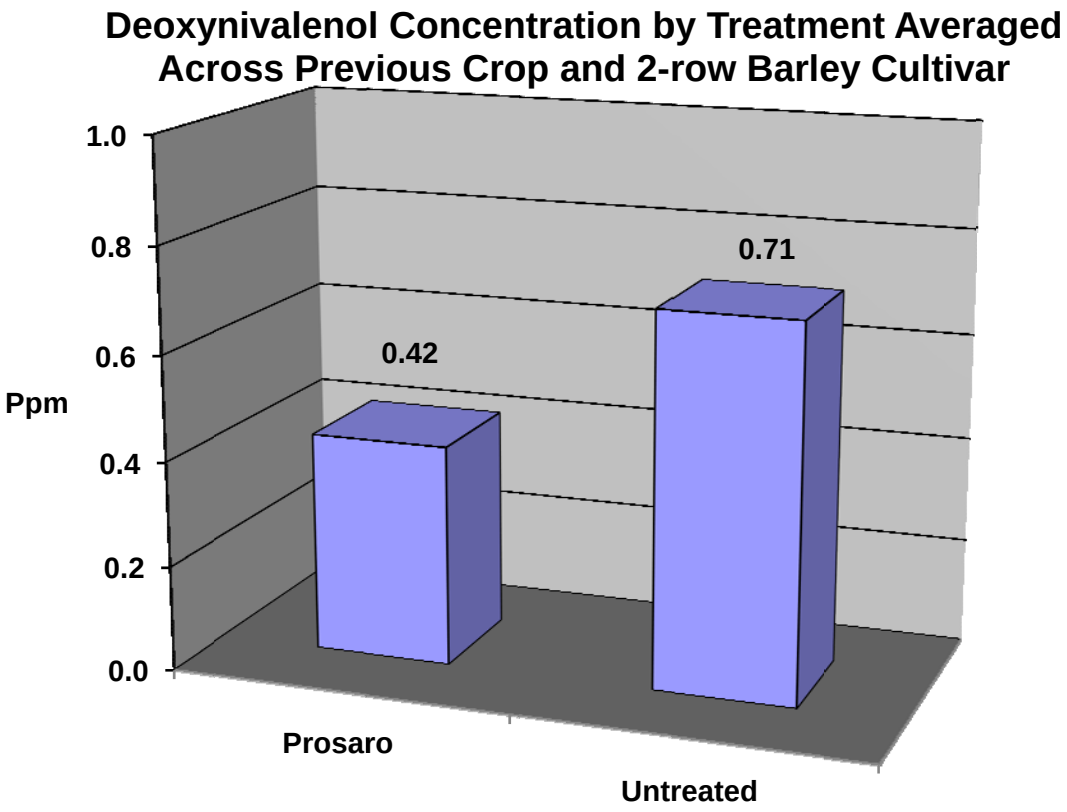

Figure 6. Deoxynivalenol concentration by treatment averaged across previous crop and 2-row barley cultivars.

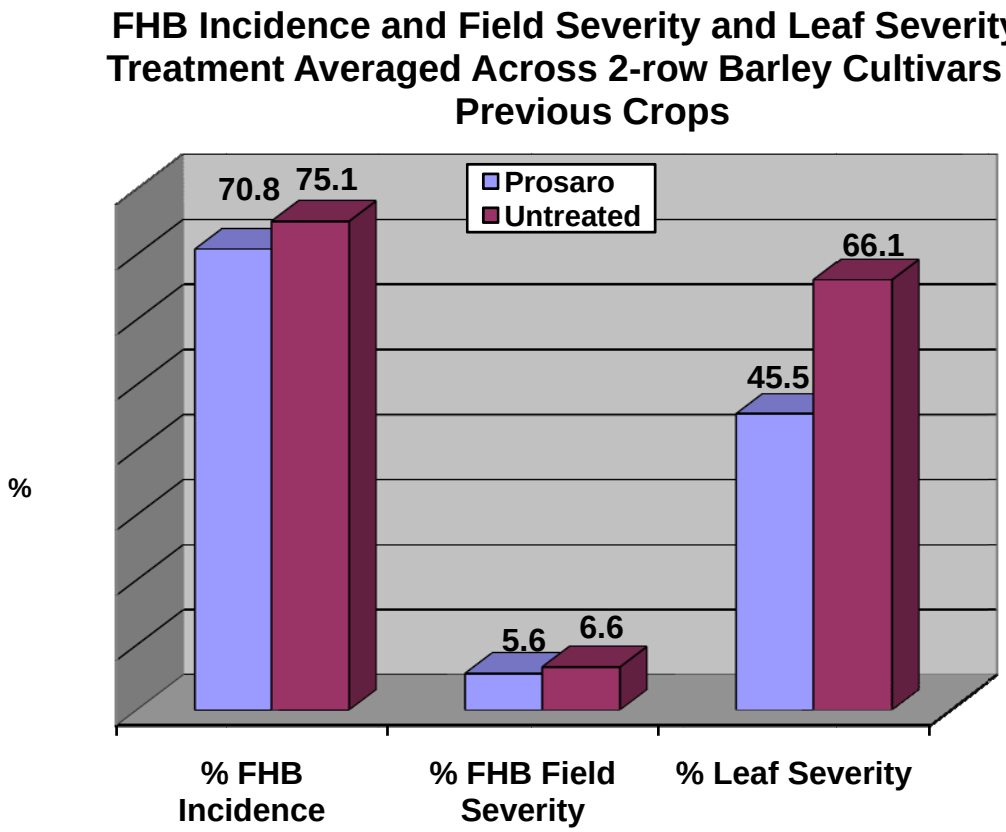

Figure 7. Fusarium head blight incidence and field and leaf severity by treatment averaged across previous crops and 2-row barley cultivars.

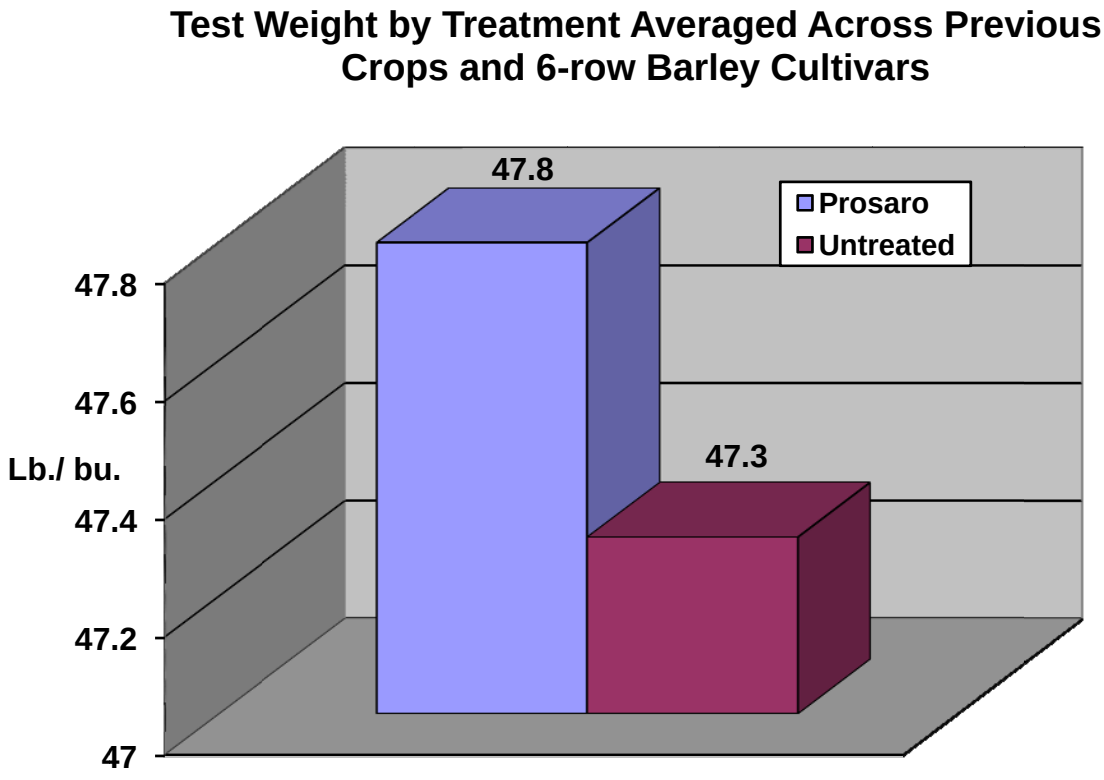

Figure 8. Test weight by treatment averaged across previous crops and 6-row barley cultivars.

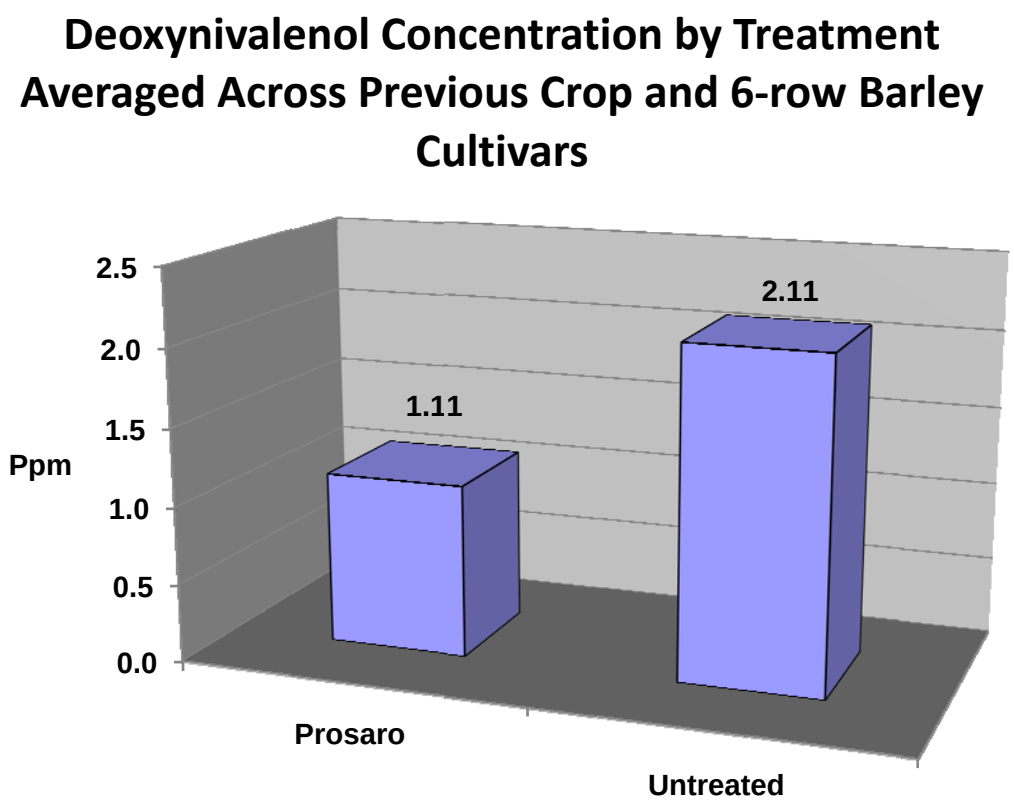

Figure 9. Deoxynivalenol concentration by treatment averaged across previous crop and 6-row barley cultivars.

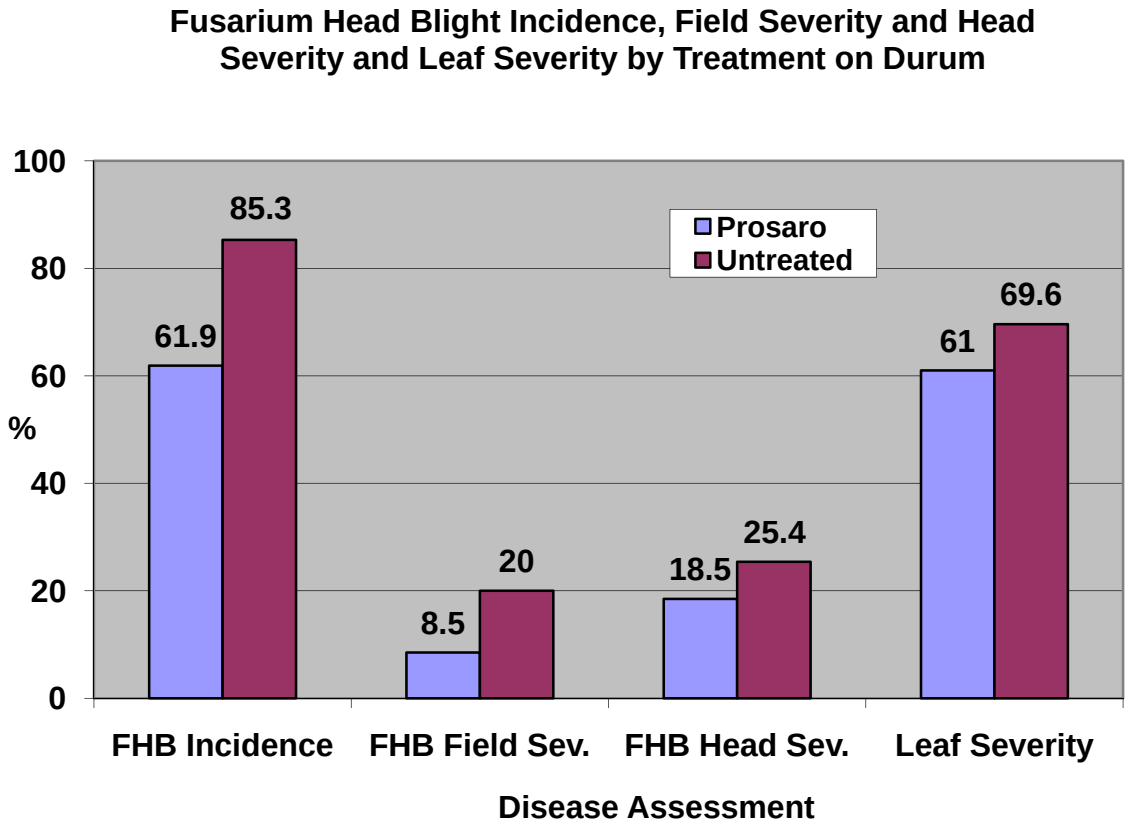

Figure 10. Fusarium head blight incidence, field and head severity by treatment averaged across all treatments and durum cultivars.

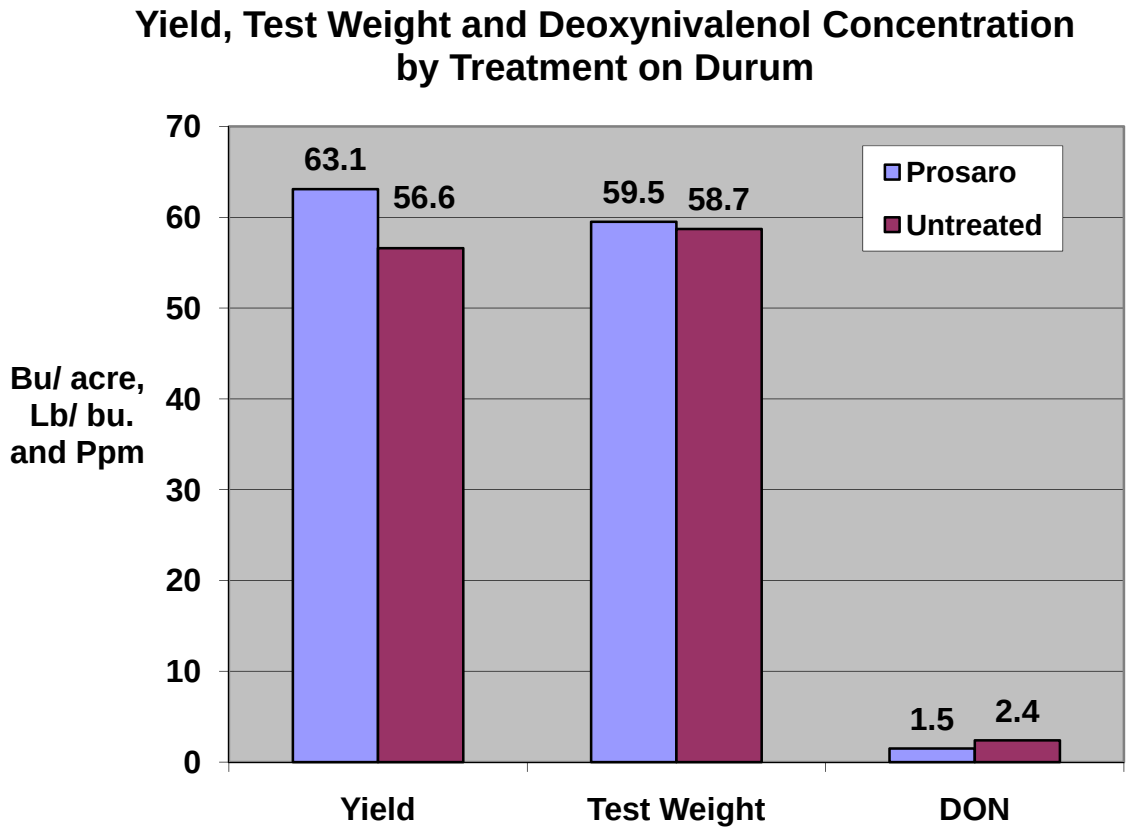

Figure 11. Yield, test weight and deoxynivalenol concentration by treatment averaged across previous crops and durum cultivars.

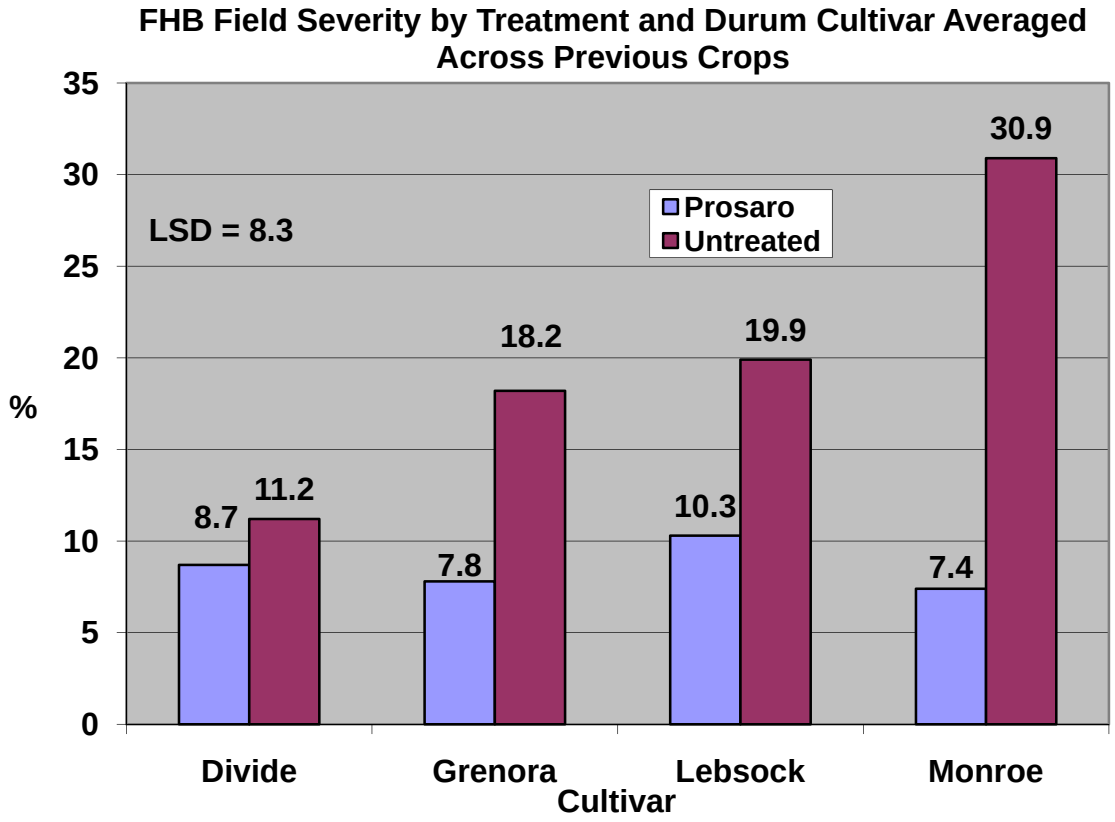

Figure 12. Fusarium head blight field severity by treatment and durum cultivar averaged across previous crops.

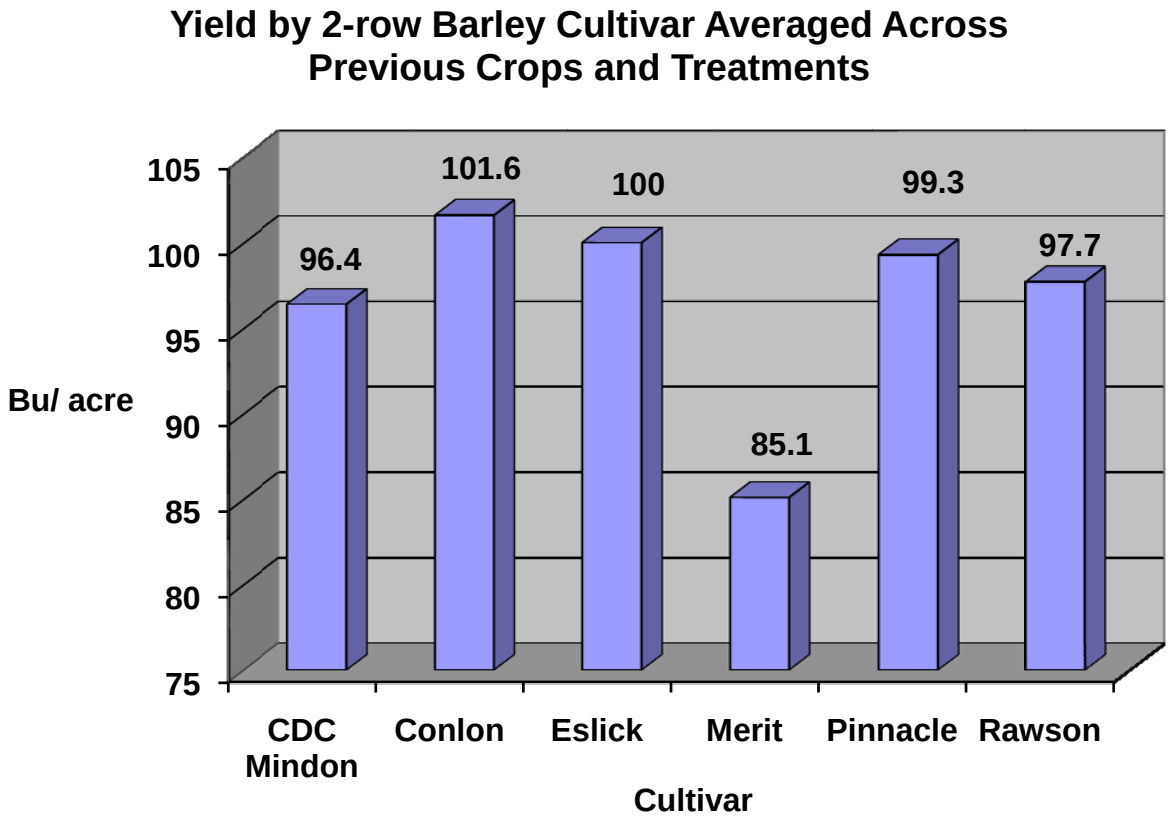

Figure 13. Yield by 2-row barley cultivar average across previous crops and treatments.

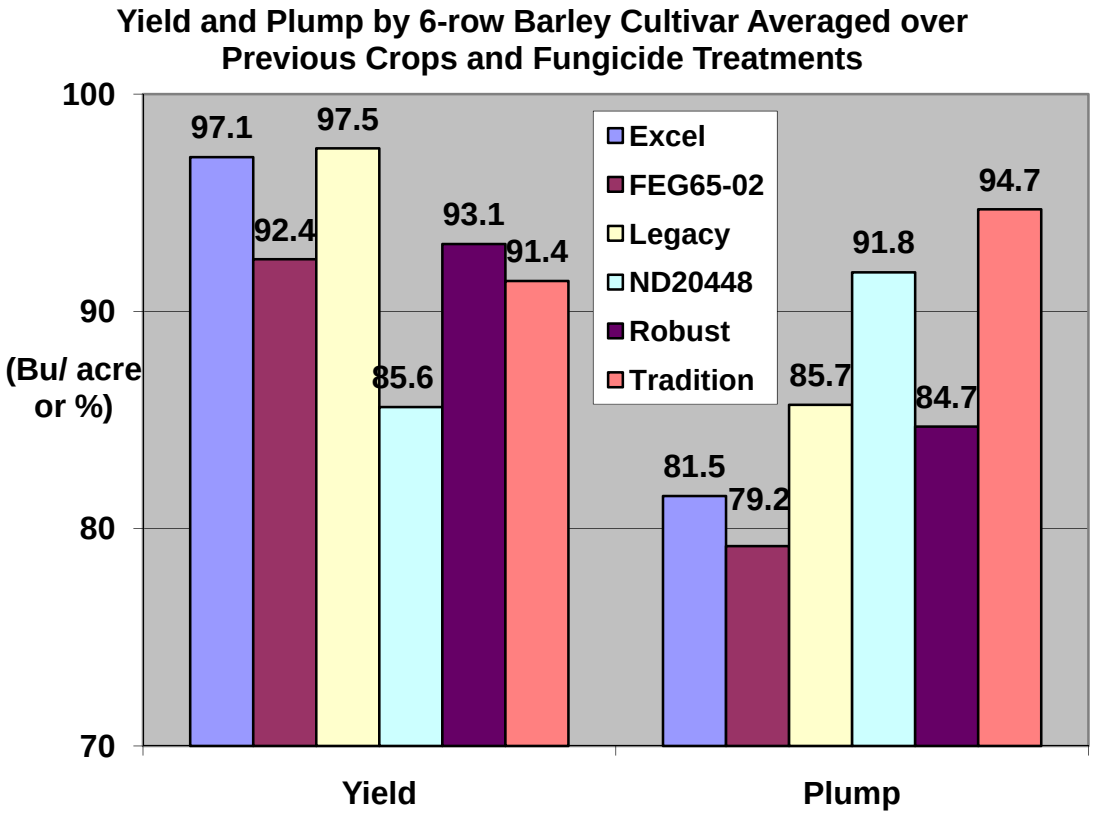

Figure 14. Yield and plump by 6-row barley cultivar averaged across previous crops and fungicide treatments.

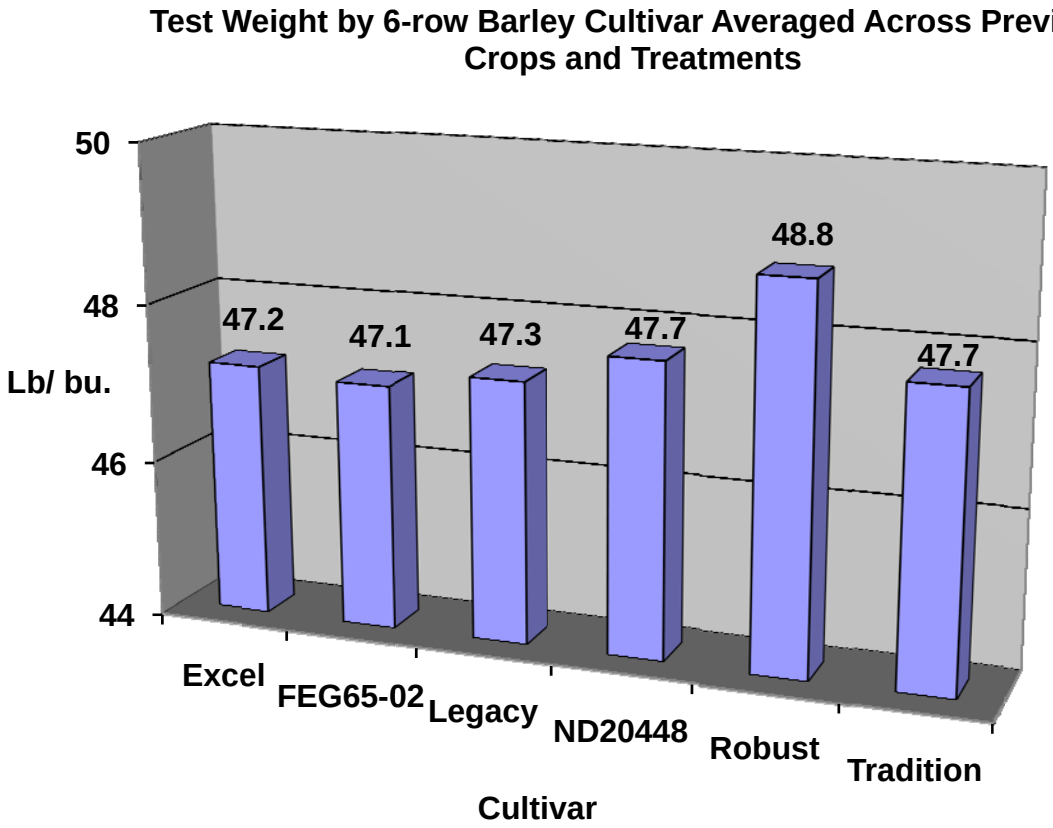

Figure 15. Test weight by 6-row barley cultivar averaged across previous crops and fungicide treatment.

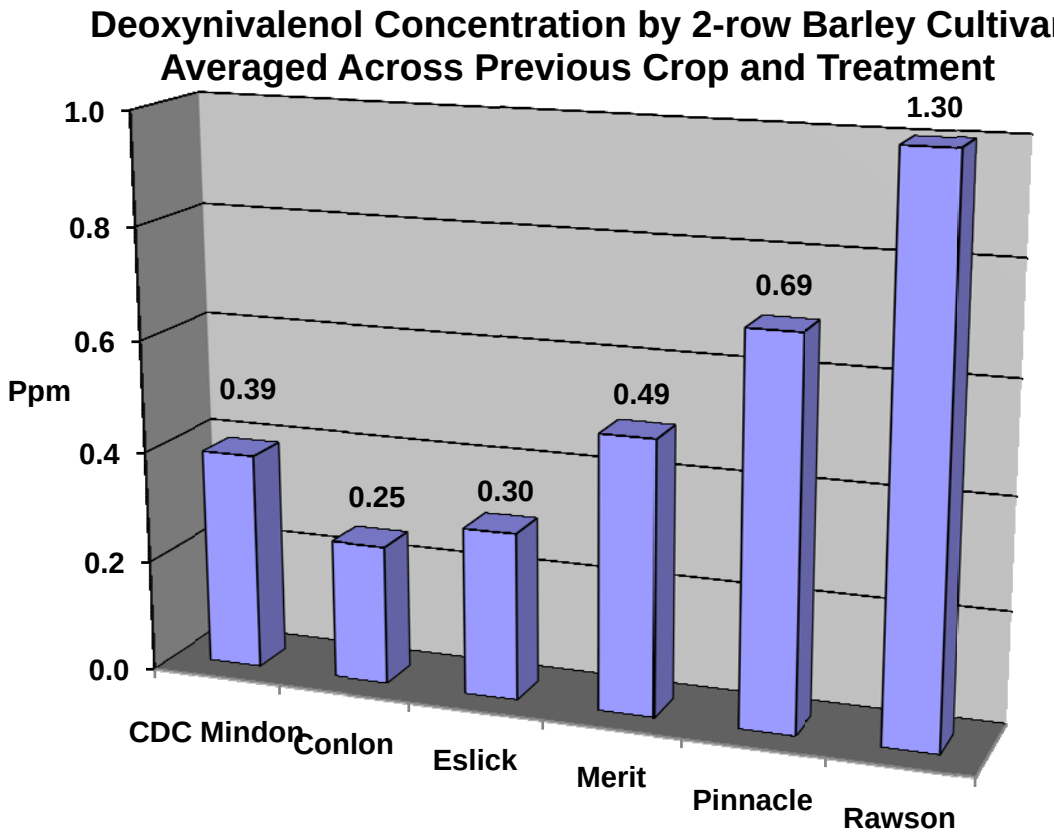

Figure 16. Deoxynivalenol concentration by 2-row barley cultivar averaged across previous crop and treatment.

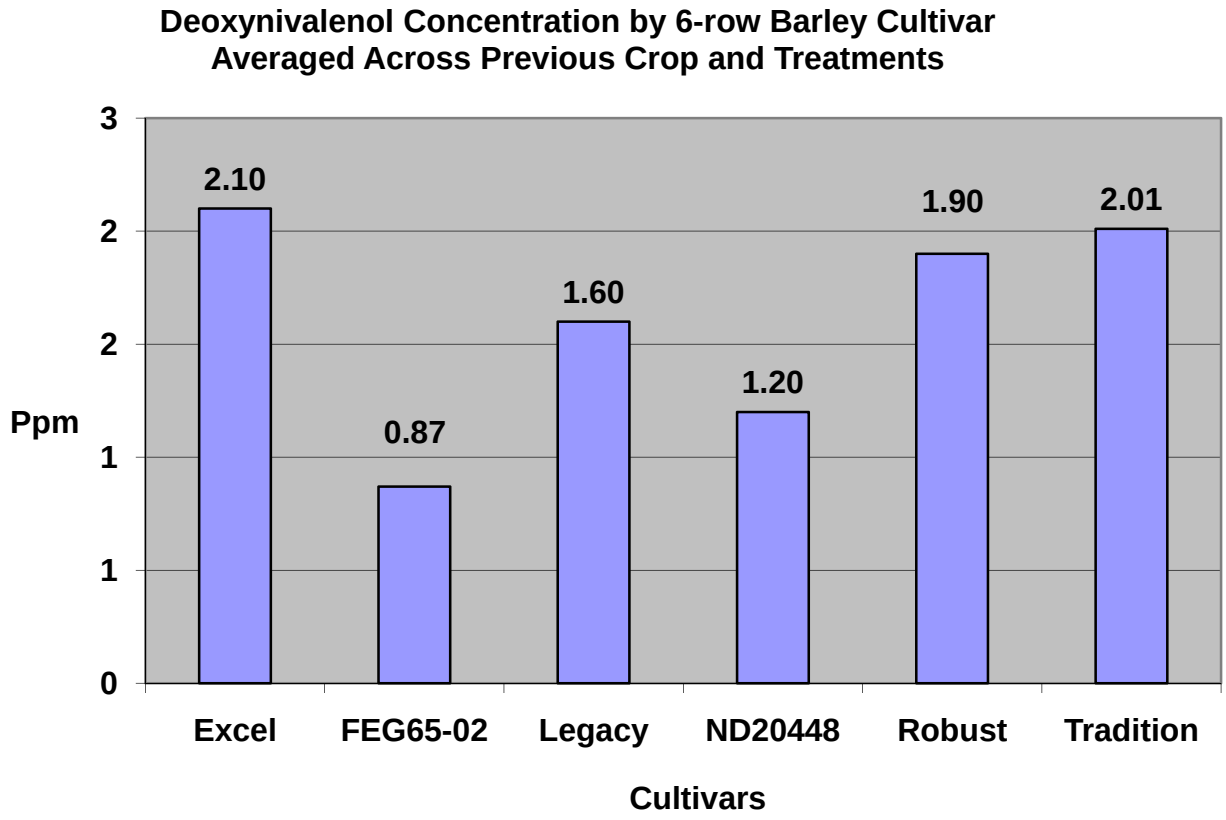

Figure 17. Deoxynivalenol concentration by 6–row barley cultivar averaged across previous crop and treatments.

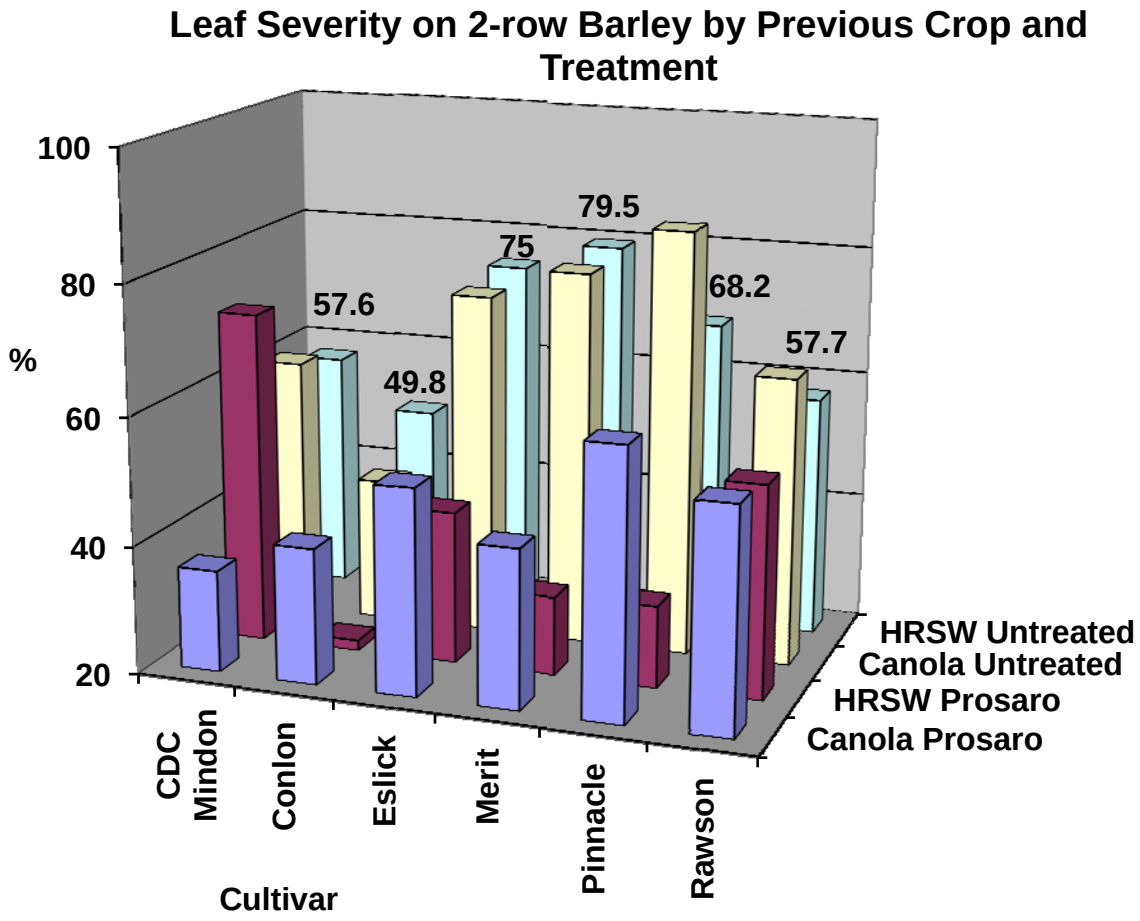

Figure 18. Leaf severity by previous crop, treatment and 2-row barley cultivar.

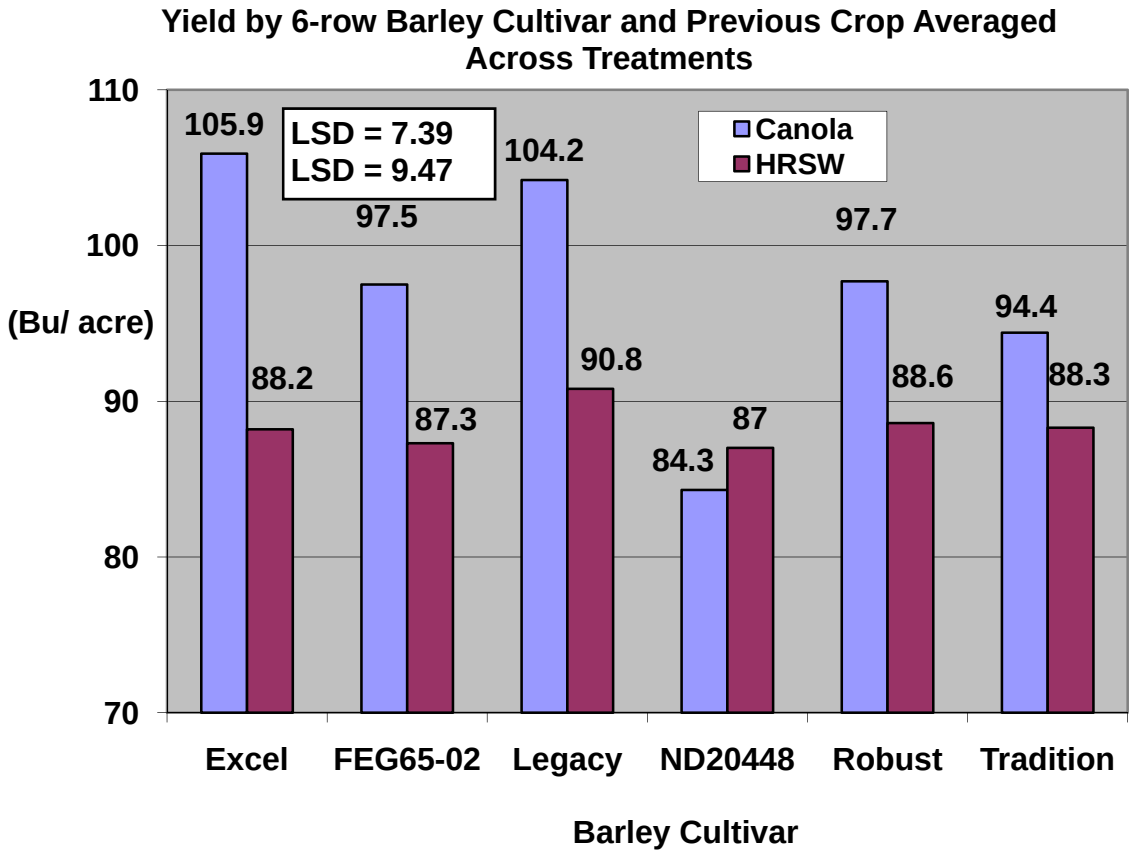

Figure 19. Yield by 6-row barley cultivar and previous crop averaged across treatments.