The Effects of Phosphorus Fertilization on Four Wheat Varieties with Differing Tillering Abilities - Summary of Four Years

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An adequate supply of phosphorus is essential to maximizing wheat yields. There are about 0.5-0.6 lbs of phosphorus removed by one bushel of grain. One of the effects of phosphorus deficiency is reduced tillering. Unlike winter wheat, spring wheat does not have many productive tillers. This is due to a shorter growing season, which allows for less time for tillers to mature. Almost all the grain production comes from the main stem and the T1 and T2 tillers which are initiated between two and three weeks after emergence. However the initiation of these tillers is not automatic and depends on favorable conditions early in the growing season (Goos 1995).

There was a trial conducted from 2016 to 2019, looking at the effects of phosphorus fertilization on spring wheat yield, quality and tillering. Four commonly grown spring wheat varieties were chosen based on their differing tillering abilities. Bolles, a variety with very high protein and relatively lower yields has low tiller production. Albany, which has very high yield potential, but lower protein tends to tiller very well, and Linkert and Prosper are somewhere in between these two. All but one site-year was at the Carrington Research Extension Center. In this article only results from the sites at the CREC are included. Each year there were two sites at the CREC. The difference between the two was either based on soil P level: high and low in 2016 and 2017; or based on irrigation: irrigated and dryland in 2018 and 2019, with all sites testing low for phosphorus (Table 1). There were two phosphorus treatments that were consistent across all site-years, which were 24 lbs/A P_2O_5 and no phosphorus applied. In 2017, 2018 and 2019 there was also a 12 lb rate, and in 2018 and 2019 there was a rate of 7.2 lbs applied in-furrow which is 30% of the 24 lb P rate. All other phosphorus treatments were broadcast applied and incorporated. All the phosphorus was applied in the form of triple super phosphate which does not contain any other macro nutrients. Tillering assessment was done in 2016, 2018 and 2019.

Table 1. Soil P levels in site-years.

Site-year	Olsen-P (ppm)
2016 low P	4
2016 high P	15
2017 low P	5
2017 high P	18
2018 dryland	6
2018 irrigated	4
2019 dryland	7
2019 irrigated	9

Results

There was no significant interaction between variety and phosphorus rate for yield, protein or tillering. Which means phosphorus rates affected the different varieties similarly within each site-year. Protein content was not significantly affected by phosphorus rates. Phosphorus rate significantly increased yield in only two site-years, but there was a numerical increase with P rates in five; two of which tested high for phosphorus (Figure 1). Figure 1 also shows that yields of the 7.2 lbs in-furrow P treatments were comparable to those obtained by applying either 12 or 24 lbs P per acre. Tillering numerically increased with P levels in four of the six observed site-years, but this effect was not statistically significant. Tillering in the in-furrow treatment was not significantly different from the rest, but was numerically similar to those of the 12 lb and 24 lb broadcast P rates (Figure 2). The average number of T1+T2 tillers per plant had a very weak slight positive correlation for the variety Bolles in three site years: the low testing site in 2016 and the dryland sites of 2018 and 2019, both testing low for phosphorus (Figure 3).

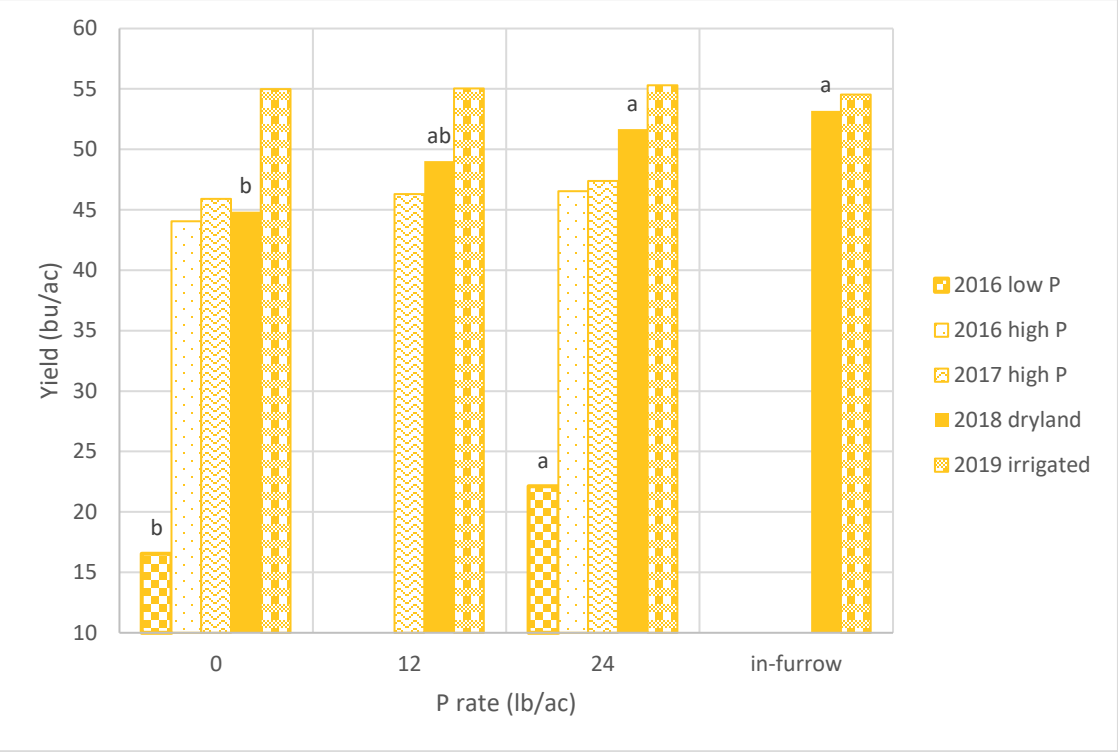

Figure 1. Yield response to phosphorus treatments in 5 site-years.
Letters depict mean separations within their respective site years using Tukey, alpha<0.05.

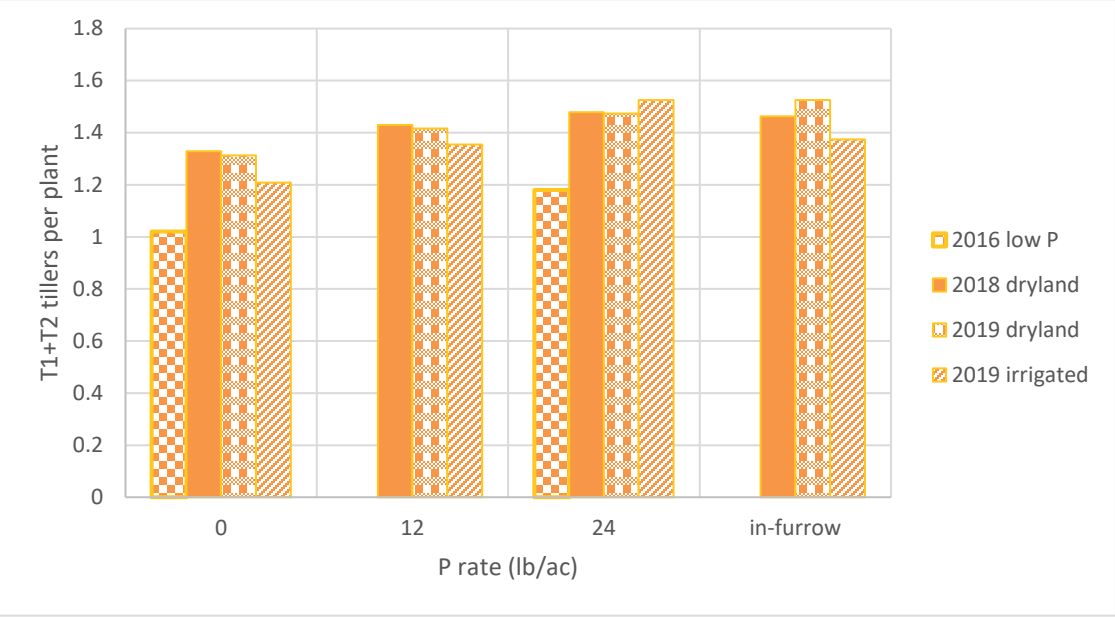

Figure 2. T1+T2 tillers per plant by phosphorus treatment and year.

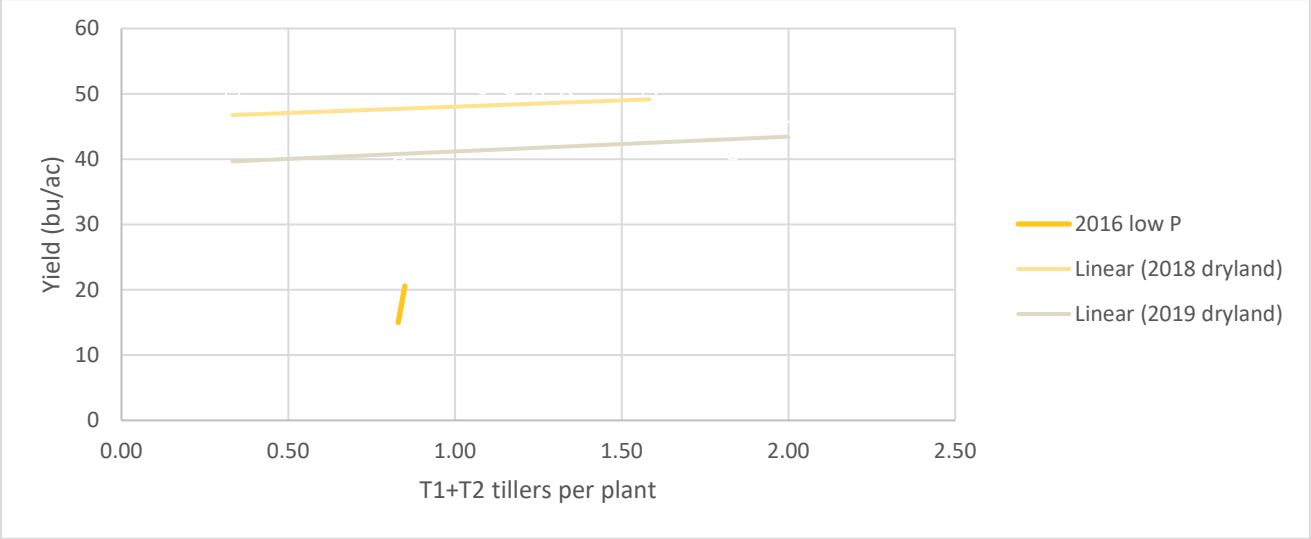

Figure 3. Yield response of the variety Bolles to T1+T2 tiller initiation.
Results are not significant.

Conclusion

Phosphorus fertilization can increase yields across varieties in responsive environments. There was no difference between the 12 and the 24 lb phosphorus treatments in our study. The 7.2 lb in-furrow treatment performed similarly to the 12 lb and 24 lb broadcast P rates. Despite the fact that tillering generally increased with phosphorus rates, tiller counts were a very poor predictor of yield in this trial. It is possible that the differences in tillering ability and yield weren't great enough to be able to pick up a more consistent correlation between the two