Crop Rotation Effects on Corn with a Focus on Buckwheat as the Previous Crop

Mike Ostlie, Eric Eriksmoen, Jasper M. Teboh, and Steve Zwinger

Buckwheat is a specialty crop grown in North Dakota. It has long been used as a grain crop for non-gluten flour, noodles, and groats, while the hulls can be used for various purposes including pillow stuffing. Buckwheat is often used as a cover crop in mixes or alone. It establishes quickly, and can be very competitive with weeds. Buckwheat is also believed to increase available soil phosphorous (P) for the subsequent crop. Evidence for this has been documented in lab or greenhouse studies, but field research of the P effect from buckwheat has not occurred. Past research has shown that buckwheat could increase available P because it accumulates more P in the crop residue than it does the seed, which is fairly unique. Most crops will export more P (with high P content in harvested grain) than is retained in the field through residue.

In 2016 a large research project was initiated to test whether buckwheat as a previous crop can substitute or supplement a P application. The trial was initiated in Carrington and Minot. Sites were chosen for their likelihood of eliciting a P response, and no P was added to the sites during the experiment. This was a two-year trial, with year one consisting of either buckwheat (harvested for grain), spring wheat, soybeans, or sugarbeet, and year two consisting of corn as a test crop. Buckwheat was split into three plant population treatments of either 25, 50, or 75 lbs of seed/ac. The comparative crops were chosen based on differences in mycorrhizal association; Spring wheat > soybean > sugarbeet. Sugarbeets and buckwheat are not mycorrhizae hosts. Mycorrhizal fungi are often associated with P uptake in plants and are important to corn productivity. The trial was repeated once at each location. Year one for both sites was in 2016 and 2017, and year two (corn only) was in 2017 and 2018. Each treatment was replicated four times. Extensive soil and tissue sampling was conducted to determine P import/export rates and soil P balance. The focus for this report is the effect of the previous crop, including soil P balance, on corn.

Previous crop affected corn performance (Table 1). In all environments, corn yields and test weight were generally lower following buckwheat than wheat or soybeans. Corn performance also varied by buckwheat population. The high rate of buckwheat performed similar to soybean and sugarbeet as a previous crop, and the middle buckwheat rate was still similar to sugarbeet. The low rate of buckwheat caused corn yields to be lower than any other crop. When evaluating soil P and P found in crop residue, buckwheat and sugarbeets theoretically left the highest amount of P in the soil. Our testing confirmed that on a per acre basis, buckwheat was the only crop in this study that had a higher amount of P in the straw than in the grain. Soybeans had the highest percent export with nearly 10:1 lb P in the grain compared to straw. Yet, the P left in the buckwheat straw was not affecting corn yields, even under low soil P conditions.

Table 1. Corn performance and predicted P amount as a result of previous crop in the rotation.

Previous crop[1]	Test Weight	Corn Yield	Predicted Phosphorous[2]
			ppm
Buckwheat 25	55.7	97.8	11.7
Buckwheat 50	55.7	100.9	14.6
Buckwheat 75	56.6	106.5	10.7
Spring Wheat	57.3	116.8	6.1
Soybean	57.0	111.1	4.9
Sugarbeet	57.1	109.2	9.7
LSD (0.10)	0.7	8.7	3.3

[1]25, 50, and 75 indicate the buckwheat seeding rate in lb/ac

[2]soil test P + P content in biomass from the previous crop in the rotation

Terminating a buckwheat cover crop.

There is a good chance that the lack of mycorrhizal association is the more important rotational effect compared to P export rates. This would explain why sugarbeet and buckwheat sometimes had a similar yield influence on corn. One of the goals of the study was to determine if P mining could be accomplished by using different buckwheat populations. In our study, the middle seeding rate theoretically left the largest contribution of P in the soil, yet the corn yield response was nil, even compared to the other buckwheat treatments. The reasons for lack of P response warrants further study, perhaps through mycorrhizal inoculation to corn or maybe a crop other than corn is best to utilize any extra P in the soil. Regardless, it appears that corn may not be a good choice to follow a buckwheat grain crop. Using buckwheat as a cover crop prior to corn may yield different results.