Effect of a 5-Year Multi-Crop Rotation on Mineral N and Hard Red Spring Wheat Yield, Protein, Test Weight and Economics in Western North Dakota, USA

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The objectives of this non-irrigated cropping study was to employ the principles of soil health and determine the effect of rotation on seasonal mineral N, HRSW production, protein, test weight, and economics. Prior to the initiation of this research, the cropping study area had been previously seeded to hard red spring wheat (HRSW). The cropping systems consisted of a continuous HRSW control (**C**) compared to HRSW grown in a multi-crop 5-year rotation (**R**). The 5-yr rotation consisted of HRSW, cover crop (dual crop winter triticale-hairy vetch harvested for hay in June and immediately reseeded to a 7-species cover crop mix grazed by cows after weaning from mid-November to mid-December), forage corn, field pea-forage barley, and sunflower. The cereal grains, cover crops, and pea-barley intercrop were seeded using a JD 1590 no-till drill, 19 cm row spacing, and seed depth of 2.54 cm Cereal grain plant population was 3,088,750 plants/ha. The row crops were planted using a JD 7000 no-till planter, 76.2 cm row spacing, and seed depth of 5.08 cm. Plant population for the row crops was 46,947 plants/ha. Weeds were controlled using a pre-plant burndown and post-emergence control except for cover crops and pea-barley where a pre-plant burndown was the only chemical applied. Fertilizer application was based on soil test results and recommendations from the North Dakota State University Soil Testing Laboratory. During the 1st three years of the study 31.8 kg of N was applied to the C HRSW and then none the last two years of the 5-year period. The R HRSW was fertilized with 13.6 kg of N the 1st two years of the study and none the remaining three years of the 5-year period. However, chloride was low; therefore, 40.7-56.1 kg/ha were applied each year to both the C and R treatments. Based on 2014 and 2015 seasonal mineral N values, the data suggests that N levels were adequate to meet the 2690 kg/ha yield goal. In 2015, however, the R yield goal was exceeded by 673 kg/ha whereas the C yield goal of 2690 kg/ha was not achieved indicating that the multi-crop rotation enhanced soil quality and increased N cycling within the rotation management system.

The 5-year average HRSW yield (C: 2690 vs. R: 2757 kg/ha; P=0.76), protein (C: 13.9 vs. R: 13.3%; P=0.06), and test weight (C: 28.0 vs. R: 28.1 kg/bu; P=0.81) did not differ between management treatments. Improved production is the result of enhanced nutrient cycling of available nutrients. Yields for crop years 1-5 were the same year 1, but in year 2, C wheat yield was 24.4% higher than R wheat (3,766 vs. 3,026 kg/ha). Change that started when the rotation was initiated became more evident in year three, when the yield margin between the two management practices began to narrow, but remained 20.5% higher for the C (3,161 vs. 2,623 kg/ha). Yield reversal became fully realized by year 4, when the R wheat yield was 9.1% higher (2,959 vs. 3,228 kg/ha), and by the 5th crop year R wheat yield was 38.9% higher than the C wheat yield (2,421 vs. 3,363 kg/ha). The 5-yr average input cost (C: $477 vs. R: $440/ha) and gross return (C: $650 vs. R: $638/ha) resulted in a net return that was $25 higher for R HRSW compared to the C HRSW (CTRL $173 vs. ROT $198/ha). The 5-yr net return from the C, R, and combination of all of the R crops was 173, 198, and $213/ha suggesting that growing continuous HRSW is less intensive, but also 14.5% less profitable.