

WSU WILKE RESEARCH AND EXTENSION FARM

OPERATION, PRODUCTION, AND ECONOMIC
PERFORMANCE FOR 2021



Current Situation

The WSU Wilke Research and Extension Farm is a 320-acre facility located on the eastern edge of Davenport, WA, and is split (north and south) by State Highway 2. Washington State University maintains and operates this facility. This annual technical bulletin is written primarily for farmers and crop consultants in the intermediate rainfall zone (12 to 17 inches of annual precipitation). It also provides documentation of the operations and production on the Wilke Farm to assist University faculty with small plot research experiments. Previous technical bulletins can be found on the [WSU Wheat & Small Grains website](#).

The Wilke Farm remains in a direct-seed cropping system using no-till fallow, winter wheat, spring cereals, and broadleaf crops. Broadleaf crops are used in place of spring and winter cereals when weed pressures and market prices create opportunities for profitable production. The predominant cropping system

practiced by farmers in this region is a three-year rotation, which includes summer fallow, winter wheat, and spring cereals. Farmers remain interested in intensifying rotations to reduce fallow years and increase crop diversity to improve long-term agronomic and economic stability.

The south side of the farm is divided into seven fields; three fields are in a more traditional three-year crop rotation, and four fields are in an intensified four-year crop rotation. The north side of the farm remains in an intensified rotation that forgoes summer fallow and is now in diversified, continuous crop production after many years in continuous cereal grain only production. It was divided into two fields this year to increase diversity.

Soil compaction, soil pH, and wireworm population data are collected each spring from GPS-recorded locations within each field. Soil samples are also collected from these GPS locations prior to seeding, and fertilizer is applied according to soil sample results and WSU recommendations.



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Operations

All crops in 2020–2021 were seeded with the farm’s John Deere 750 direct-seed, low disturbance disk drill on 7.5-inch spacing. Deep-banded fertilizer applications were applied in between the rows on 15-inch spacing. The farm was harvested with its new John Deere 9500 combine from July 22 through August 11.

On August 9, 2021, the whole farm except the spring canola stubble in Field Northwest was sprayed with a WEED-IT Precision Sprayer at an average 36 oz/acre RT3, 2.0 oz/acre Full Load Complete, and spray volume of 5.7 gallons per acre (gpa). Some of the crop residue, especially the winter wheat stubble, created significant ghost firing. Spring wheat stubble created some ghost firing, or the sprayer spraying when no weeds were present, and the technology worked very well in the no-till fallow. In the future, this technology will have to be specifically adjusted and calibrated for each of these residue types.

Winter Wheat (3-year Field 2; 4-year Field 1)

Field 2 was seeded to ‘Resilience CL+’ Clearfield soft white winter wheat (SWWW) on September 10, 2020, at 86 lb/acre (912,400 seeds per acre) into no-till fallow. Seed was treated with Highline Grain Growers (HLGG) Gold 0.50 Fall (3.0 oz/cwt Dividend Extreme, 0.16 oz/cwt Vibrance, 0.051 oz/cwt Rancona CTS, and 0.5 oz/cwt Cruiser 5FS). Dry 11-14-0-10 with 0.04 B and 0.26 Zn was applied at a rate of 73 lb/acre with the seed. Solution 32 was variably applied across three

application zones to account for field variability and yield potential and averaged 68-0-0-0. Overall, 16% received greater than 77-0-0-0, 9% received less than 63-0-0-0, and 75% received a rate in between. Prior to seeding, ammonium chloride was spoke-wheel injected into the whole field at a rate of 4-0-0-0-10 Cl.

Postemergence weed control was applied using 15 gpa of carrier that included Beyond applied at 6.0 oz/acre, Rally 11-0-4 fertilizer at 3 gpa, and 4.0 qt/100 gallons MSO on April 26, 2021. At harvest, this field was mostly weed free, but a few downy brome, feral rye, wild oat, and broadleaf weeds were observed in the field.

Field 1 was seeded to ‘Castella’ soft white winter club wheat on September 11, 2020, at 77 lb/acre (902,400 seeds per acre) into no-till fallow. Seed was treated with HLGG Gold 0.50 Fall. Dry 11-14-0-10 with 0.04 B and 0.26 Zn was applied at a rate of 73 lb/acre with the seed. Solution 32 was variably applied across three application zones to account for field variability and yield potential and averaged 67-0-0-0. Overall, 21% received greater than 88-0-0-0, 26% received less than 60-0-0-0, and 52% received an in-between rate.

Postemergence weed control was applied using 10 gpa of carrier that included Bromac applied at 24 oz/acre and Rally 11-0-4 fertilizer at 5 gal/acre on April 23. At harvest, this field was weed free with no noted weeds. Because of feral rye issues in the past, this was the first traditional non-herbicide-resistant winter wheat crop on this field since 2009, and just a handful of feral rye plants were rogued out in an old research location.



Spring Wheat (3-year Field 5; 4-year Field 6; Continuous Northeast)

Field 5 was seeded to 'Ryan' soft white spring wheat (SWSW) on April 7, 2021, at 76 lb/acre (800,000 seeds per acre) into winter wheat residue. Seed was treated with HLG Gold 1.0 (3.0 oz/cwt Dividend Extreme, 0.16 oz/cwt Vibrance, 0.255 oz/cwt Mertect 340F, and 1.0 oz/cwt Cruiser 5FS). Dry 18-30-0.6-6 with 0.05 B, 0.26 Zn, and 0.35 Mg was applied at a rate of 41 lb/acre with the seed. Solution 32 and Thiosul (10:1 ratio) was variably applied across three application zones to account for field variability and yield potential and averaged 51-0-0-4. Overall, 17% received greater than 60-0-0-5, 28% received less than 43-0-0-4, and 55% received a rate in between. On April 5, 2021, a preplant herbicide was applied and included 32 oz/acre RT3 and 1 qt/100 gallons Full Load Complete at 10 gpa. Postemergence weed control was applied on May 25, 2021, in a carrier volume of 10 gpa. This application included Brox-M at 16 oz/acre, AgraSyst 90 at 1 qt/100 gallons, and Rally fertilizer at 1 gal/acre. The Rally in this application contained an additional 1 lb/acre of nitrogen. At harvest, this field was mostly weed free except for wild oats scattered throughout the field.

Field 6 was also seeded to 'Ryan' SWSW on April 6, 2021, at 76 lb/acre (800,000 seeds per acre) into spring canola residue. Seed was treated with HLG Gold 1.0 (3.0 oz/cwt Dividend Extreme, 0.16 oz/cwt Vibrance, 0.255 oz/cwt Mertect 340F, and 1.0 oz/cwt Cruiser 5FS). Dry 18-30-0.6-6 with 0.05 B, 0.26 Zn, and 0.35 Mg was applied at a rate of 41 lb/acre with the seed.

Solution 32 and Thiosul (10:1 ratio) was variably applied across three application zones to account for field variability and yield potential and averaged 46-0-0-4. Overall, 19% received greater than 53-0-0-5, 27% received less than 43-0-0-4, and 54% received a rate in between. On April 5, 2021, a preplant herbicide was applied and included 32 oz/acre RT3 and 1 qt/100 gallons Full Load Complete at 10 gpa. Postemergence weed control was applied on May 25, 2021, in a carrier volume of 10 gpa. This application included Brox-M at 16 oz/acre, AgraSyst 90 at 1 qt/100 gallons, and Rally fertilizer at 1 gal/acre. The Rally in this application contained an additional 1 lb/acre of nitrogen. At harvest, this field was mostly weed free except for wild oats scattered throughout the field.

Continuous Northeast was seeded to 'Ryan' SWSW on April 6, 2021, at 76 lb/acre (800,000 seeds per acre) into winter wheat residue. Seed was treated with HLG Gold 1.0 (3.0 oz/cwt Dividend Extreme, 0.16 oz/cwt Vibrance, 0.255 oz/cwt Mertect 340F, and 1.0 oz/cwt Cruiser 5FS). Dry 18-30-0.6-6 with 0.05 B, 0.26 Zn, and 0.35 Mg was applied at a rate of 41 lb/acre with the seed. Solution 32 and Thiosul (10:1 ratio) was variably applied across three application zones to account for field variability and yield potential and averaged 50-0-0-4. Overall, 26% received greater than 56-0-0-5, 21% received less than 43-0-0-4, and 53% received a rate in between. On April 5, 2021, a preplant herbicide was applied and included 32 oz/acre RT3 and 1 qt/100 gallons Full Load Complete at 10 gpa. Postemergence weed control was applied on May 25, 2021, in a carrier volume of 10 gpa. This application included Brox-M at 16 oz/acre, AgraSyst 90 at 1 qt/100 gallons, and Rally fertilizer at 1 gal/acre. The Rally in this application contained an additional 1 lb/acre of nitrogen. At harvest, this field was mostly weed free except for wild oats scattered throughout the field.



Spring Canola (4-year Field 3, Continuous Northwest

'BY5125 CL' spring canola was seeded in Field 3 on April 14, 2021, at 5.0 lb/acre (492,000 seeds per acre) into winter wheat residue. Dry 18-30-0.6-6 with 0.05 B, 0.26 Zn, and 0.35 Mg was applied at a rate of 41 lb/acre with the seed. Solution 32 and Thiosul (10:1 ratio) was variably applied across three application zones to account for field variability and yield potential and averaged 75-0-0-7. Overall, 26% received greater than 86-0-0-8, 18% received less than 56-0-0-5, and 56% received a rate in between. On April 5, 2021, a preplant herbicide was applied and included 32 oz/acre RT3 and 1 qt/100 gallons Full Load Complete at 10 gpa. Postemergence weed control was applied on May 29, 2021, in a carrier volume of 10 gpa. This application included 5 oz/acre Section Three, 32 oz/acre Destiny HC, and 32 oz/acre Sol 32. Frost in May caused severe damage in this field, and it was sprayed out (destroyed) after an insurance adjuster examined the remaining canola stand. The herbicide was applied on June 8, 2021, with 0.1 oz/acre Patriot; 10 oz/acre WAPC 2, 4-D LV6; and 1 qt/100 NIS at 10 gpa. On July 12, 2021, an application of 32 oz/acre RT3 and 1 qt/100 Full Load Complete was applied at 8.4 gpa to keep the field weed free.

'L345PC' spring canola was seeded in Northwest on April 12, 2021, at 5.6 lb/acre (457,000 seeds per acre) into spring wheat residue. Dry 18-30-0.6-6 with 0.05 B, 0.26 Zn, and 0.35 Mg was applied at a rate of 41 lb/acre with the seed. Solution 32 and Thiosul (10:1 ratio) was variably applied across three application zones to account for field variability and yield potential and averaged 53-0-0-5. Overall, 23% received greater than 56-0-0-5, 8% received less than 50-0-0-4, and 69% received a rate in between. On April 5, 2021, a preplant herbicide was applied and included 32 oz/acre RT3 and 1 qt/100 gallons Full Load

Complete at 10 gpa. Postemergence weed control was applied across the whole field on May 29, 2021, in a carrier volume of 15 gpa. This application included 25 oz/acre Liberty 280 SL, 4 oz/acre Interlock, and 4.5 gal/100 gallons 9-0-0-10 fertilizer. Forty percent of the field was spot sprayed on the same day with 5 oz/acre Section Three, 32 oz/acre Destiny HC, and 1 qt/100 gallons Sol 32 at 10 gpa for wild oat control. At harvest, this field had broadleaf weeds within the canopy throughout the field. On August 25, 2021, a postharvest application of Paraquat Concentrate at 32 oz/acre and NIS at 1 qt/100 was applied at 15 gpa for broadleaf weed control and regrowth on indeterminate spring canola.

No-till Fallow (3-year Field 7; 4-year Field 4)

Both fields of no-till fallow (NTF) were treated the same and were maintained relatively weed free with four herbicide applications. The first herbicide application was at a carrier volume of 10 gpa and was applied November 3, 2020. It included 3 oz/acre Valor SX and 1 qt/100 gallons Activate Plus. The second application was on May 3, 2021, using a carrier volume of 10 gpa and included 32 oz/acre RT3 and 1 qt/100 gallons Full Load Complete. The third application was on June 25, 2021, at a carrier volume of 9.5 gpa and included 32 oz/acre RT3 and 1 qt/100 gallons Full Load Complete. The fourth and final herbicide was applied on August 9, 2021, with a WEED-IT Precision Sprayer and averaged 36 oz/acre RT3 and 2.0 oz/acre Full Load Complete with an average spray volume of 5.7 gpa. Lambsquarters, wild oat, and redroot pigweed were the three most common weeds present during the third and fourth herbicide application, and Russian thistle, prickly lettuce, and horseweed (marestail) were very limited.



Soil Compaction

Soil compaction data were collected with a Spectrum Soil Compaction meter. Data were collected within each field in the spring of the year prior to seeding to determine changes in compaction over time. Compaction levels are monitored within each field and within a given crop rotation, which assists in potential management decisions in the future. Field 5 had the least amount of compaction with an average of 178 psi/18 inches, and Field 3 had the greatest average soil compaction with 209 psi/18 inches (Figure 1). For Fields 4, 6, 7, and North, compaction averaged 197, 194, 200, and 195 psi/18 inches, respectively. Maximum compaction levels were typically observed at the six-inch depth.

Wireworm Populations

Wireworm population data were collected within each field in the spring of the year, prior to seeding, using the modified solar bait trap method (Esser 2012). This is done to monitor populations over time and better match seed-applied insecticide with wireworm populations. Cold soil conditions prior to planting limited wireworm activity and no wireworms were trapped across the farm, even after leaving the traps in for an extended period (10–20 days).

Soil Samples

Soil samples were collected prior to seeding winter wheat, spring wheat, and spring canola from three production zones in each field. Data were used to help determine yield potential and nutrient requirements for the crops within these zones. Soil sample data presented in Tables 1–6 are an average of the three production zones in each field. No-till fallow fields are soil sampled from the same five GPS-marked locations at the same time as those fields being spring cropped (Table 7 and Table 8).



Soil samples are also used as a historical reference for changing soil conditions over time. Soil pH, organic matter, phosphorus, and ammonium nitrogen are collected only from the top 12 inches of soil.

Soil pH and KCl Extractable Aluminum (Al)

Soil pH and KCl extractable Al is rapidly becoming of great interest to farmers and field consultants. Soil pH and exchangeable Al soil samples are collected prior to seeding in fields planted to spring crop and no-till fallow. Soil samples are collected from the same five GPS locations where soil compaction and wireworm data are collected. Samples are collected at a depth of 0–3, 3–6, and 6–12 inches. Aluminum toxicity traditionally begins to occur when soil pH levels are less than 5.0 and KCl extractable Al measurements are greater than 25 ppm. At a depth of 0–3 inches, soil pH levels are at or just above 5.0, and KCl Al ranged from 0.2 to 24.7 ppm (Table 9). At a depth of 3–6 inches, soil pH levels ranged from 5.1 to 5.5, and KCl Al ranged from 8.5 ppm in Field 6 to 33.3 ppm in Field 7. At a depth of 6–12 inches, pH ranged from 6.1 to 6.9, and KCl Al ranged from 0.1 to 0.7 ppm.

Production and Economic Performance

Nitrogen uptake efficiency (NUE) was well below 50 percent, with SWWW between 33 and 36% and SWSW between 21 and 23% (Table 10). For these fields, NUE well below 50 percent implies the crop was overfertilized or fertilizer timing could be adjusted, and above-average fertilizer should be available for next year's production. Soft white wheat traditionally requires 2.7 lb N/bu, and SWWW averaged 5.3 lb N/bu and SWSW averaged 8.4 lb N/bu.



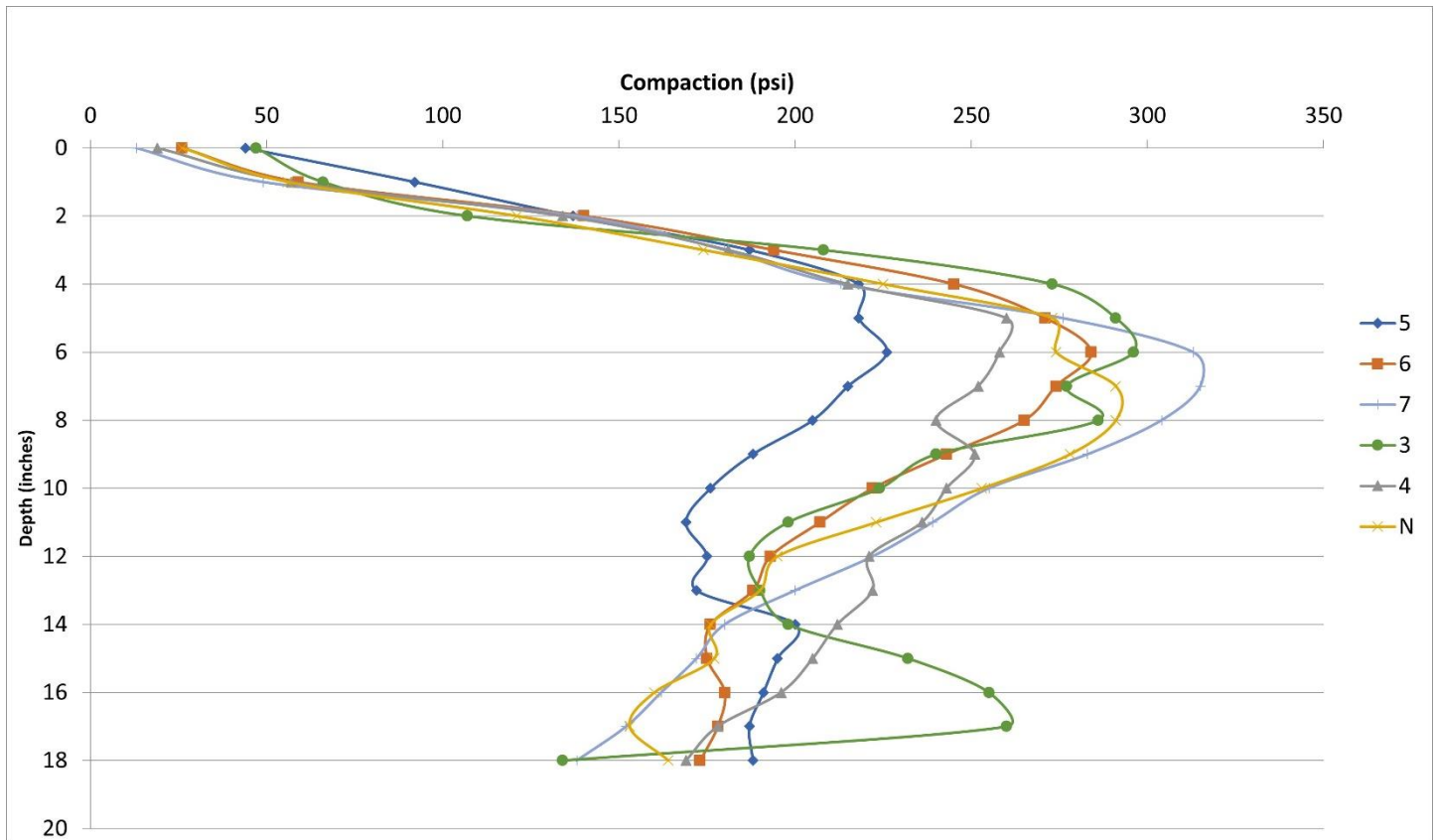


Figure 1. Soil compaction data collected in the spring of the year from six fields at the WSU Wilke Research and Extension Farm in 2021.

Table 1. Winter wheat, 3-year, Field 2.

	Soil pH	6.0	Phosphorus	16 mg/kg	
	Organic Matter	2.4% (70 lb/acre N credit for OM)	Ammonium N	14 lb/acre	
	Soil Depth (in)				
	0–12	12–24	24–36	36–48	Total
Nitrate-N (lb/acre)	64	32	30	51	177
Sulfate-S (mg/kg)	9	6	4	--	19
Soil Water (in)	2.0	2.1	1.9	1.9	7.9
Sum of Tested N: 261 lb/acre N					

Table 2. Winter wheat, 4-year, Field 1.

Soil pH	5.6			Phosphorus	16 mg/kg
Organic Matter	2.6% (79 lb/acre N credit for OM)			Ammonium N	12 lb/acre
	Soil Depth (in)				
	<u>0-12</u>	<u>12-24</u>	<u>24-36</u>	<u>36-48</u>	<u>Total</u>
Nitrate-N (lb/acre)	78	29	46	53	206
Sulfate-S (mg/kg)	10	10	17	--	37
Soil Water (in)	2.3	2.4	2.1	2.0	78.9
Sum of Tested N: 297 lb/acre N					

Table 3. Spring wheat, 4-year, Field 6.

Soil pH	4.9			Phosphorus	26 mg/kg
Organic Matter	2.2% (52 lb/acre N credit for OM)			Ammonium N	10 lb/acre
	Soil Depth (in)				
	<u>0-12</u>	<u>12-24</u>	<u>24-36</u>	<u>36-48</u>	<u>Total</u>
Nitrate-N (lb/acre)	16	14	14	25	69
Sulfate-S (mg/kg)	19	5	7	--	30
Soil Water (in)	2.8	2.0	1.7	1.9	8.3
Sum of Tested N: 132 lb/acre N					

Table 4. Spring wheat, 3-year, Field 5.

Soil pH	5.2			Phosphorus	19 mg/kg
Organic Matter	3.3% (66 lb/acre N)			Ammonium N	9 lb/acre
	Soil Depth (in)				
	<u>0-12</u>	<u>12-24</u>	<u>24-36</u>	<u>36-48</u>	<u>Total</u>
Nitrate-N (lb/acre)	18	32	41	22	113
Sulfate-S (mg/kg)	15	8	6	--	29
Soil Water (in)	2.9	2.9	2.0	1.8	9.5
Sum of Tested N: 188 lb/acre N					

Table 5. Spring wheat and spring canola, Continuous North.

Soil pH	5.9			Phosphorus	17 mg/kg
Organic Matter	2.4% (50 lb/acre N credit for OM)			Ammonium N	9 lb/acre
	Soil Depth (in)				
	<u>0-12</u>	<u>12-24</u>	<u>24-36</u>	<u>36-48</u>	<u>Total</u>
Nitrate-N (lb/acre)	15	12	19	25	71
Sulfate-S (mg/kg)	8	5	7	--	20
Soil Water (in)	2.5	2.3	1.8	1.4	8.1
Sum of Tested N: 129 lb/acre N					

Table 6. Spring canola, 4-year, Field 3.

Soil pH	6.1				Phosphorus	17 mg/kg
Organic Matter	2.8% (55 lb/acre N credit for OM)				Ammonium N	9 lb/acre
	Soil Depth (in)					
	<u>0-12</u>	<u>12-24</u>	<u>24-36</u>	<u>36-48</u>	<u>Total</u>	
Nitrate-N (lb/acre)	14	12	10	8	44	
Sulfate-S (mg/kg)	8	5	10	--	23	
Soil Water (in)	2.8	2.6	1.5	1.3	8.1	
Sum of Tested N: 107 lb/acre N						

Table 7. No-till fallow, 3-year, Field 7.

Soil pH	5.8				Phosphorus	14 mg/kg
Organic Matter	2.3% (46 lb/acre N credit for OM)				Ammonium N	5 lb/acre
	Soil Depth (in)					
	<u>0-12</u>	<u>13-24</u>	<u>25-36</u>	<u>37-48</u>	<u>Total</u>	
Nitrate-N (lb/acre)	12	10	17	23	62	
Sulfate-S (mg/kg)	8	1	4	--	13	
Soil Water (in)	2.8	2.5	1.9	1.7	8.9	
Sum of Tested N: 113 lb/acre N						

Table 8. No-till fallow, 4-year, Field 4.

Soil pH	5.8				Phosphorus	11 mg/kg
Organic Matter	2.6% (50 lb/acre N credit for OM)				Ammonium N	7 lb/acre
	Soil Depth (in)					
	<u>0-12</u>	<u>12-24</u>	<u>24-36</u>	<u>36-48</u>	<u>Total</u>	
Nitrate-N (lb/acre)	17	10	21	12	60	
Sulfate-S (mg/kg)	5	5	4	--	17	
Soil Water (in)	3.1	3.0	2.1	1.6	9.8	
Sum of Tested N: 120 lb/acre N						

Table 9. Soil pH and KCl extractable aluminum in six fields at the WSU Wilke Research and Extension Farm in the spring of 2021.

	Field 3 (canola)	Field 4 (NTF)	Field 5 (SWSW)	Field 6 (SWSW)	Field 7 (NTF)	North (Canola/SWSW)
0–3 inches						
pH	6.0	5.8	5.3	5.4	5.4	5.5
KCl Al (ppm)	0.4	0.2	24.7	5.0	0.7	2.4
3–6 inches						
pH	5.5	5.3	5.5	5.4	5.1	5.3
KCl Al (ppm)	10.9	21.9	30.4	8.5	33.3	25.2
6–12 inches						
pH	6.4	6.1	6.9	6.4	6.5	6.3
KCl Al (ppm)	0.4	0.1	0.5	0.3	0.7	0.6

Table 10. 2021 nitrogen use efficiency.

	Field 1 (SWWW)	Field 2 (SWWW)	Field 5 (SWSW)	Field 6 (SWSW)	Northeast (SWSW)
Soil Test Nitrogen*	242	212	150	125	107
Applied Nitrogen	83	83	59	54	58
Total Nitrogen	325	295	209	179	165
Grain Yield	60.2	55.5	24.3	21.4	20.3
Grain Protein	12.0%	12.6%	12.7%	11.8%	12.2%
lb N/bu	5.4	5.3	8.6	8.4	8.1
Nitrogen Uptake Efficiency	33%	36%	22%	21%	23%

*Soil test nitrogen is calculated by inputting soil test results into the WSU Dryland Wheat Nitrogen Fertilizer Calculator.

The WSU Wilke Farm grain marketing plan, which begins once the crop has emerged, uses forward contracts and postharvest selling. All grain is marketed by November 15. The average marketing window for winter wheat is about 13 months, and 7 months for spring crops. Forward contract values do not exceed the crop revenue insurance coverage value. The potential for a forward contract is evaluated monthly and is based on a targeted rate of return on investment based on estimated expenses. In 2021 before harvest, an estimated 30% of the wheat crop was forward contracted and an estimated 33% of canola was forward contracted. Harvest was well below average, and, overall, 62% of the wheat was sold under forward contract and 87% of the canola was sold under forward contract. Market grades for each crop are provided as these also impact final market price.

Average input costs (excluding crop insurance costs) per year at the WSU Wilke Farm were up only 1.8% over the three-year average (2018–20). Economic returns over input costs were down 2.8% over the previous three-year average and were nine dollars per acre less than in 2020. This is mostly the result of

very low crop yields across the board and increased insurance revenue. Tables 11–16 summarize the rotation, production, and economic performance of the three-year rotation, four-year rotation, and continuous cropping system at the Wilke Farm in 2021.

The three-year crop rotation returns above input costs averaged \$112/acre, 6% less than the three-year average. The four-year crop rotation returns above input costs averaged \$129/acre, 7% less than the previous three-year average. The continuous cropping system returns above input costs averaged \$168/acre, 9% greater than the previous three-year average. The WSU Wilke Farm is enrolled in the farm program and purchases crop insurance each year. Revenue associated with the farm program is not included, but revenue and costs associated with crop insurance are included for the first time in the field summaries to maintain consistency over the years.

Table 11. Three-year cropping rotation sequence at the Wilke Farm from 2017 to 2022.

Year	Field 2	Field 5	Field 7
2017	No-till Fallow	Winter Wheat (93.6 bu/acre)	DNS Wheat (32.8 bu/acre)
2018	Winter Wheat (66.7 bu/acre)	DNS Wheat (34.3 bu/acre)	No-till Fallow
2019	Spring Wheat (49.6 bu/acre)	No-till Fallow	Winter Wheat (68.1 bu/acre)
2020	No-till Fallow	Winter Wheat/Canola (76 bu/acre; 2,080 lb/acre)	Spring Wheat (55.5 bu/acre)
2021	Winter Wheat (55.5 bu/acre)	Spring Wheat (24.3 bu/acre)	No-till Fallow
2022	Spring Cereal	No-till Fallow	Winter Wheat

Table 12. Three-year crop rotation production at the Wilke Farm, 2021.

	Field 2	Field 5	Field 7
Cropping Specifics			
Acreage	25.8	25.6	34.1
Crop	‘Resilience CL+’ SWWW	‘Ryan’ SWSW	No-till Fallow
Crop Production			
Yield	55.5 bu/acre	24.3 bu/acre	--
Mkt Grade	#1 SWH, 60.1, 0.2% dockage	#1 SWH, 60.9, 0.7% dockage	--
Gross Economic Return*			
Mkt Price	\$6.83/bu	\$6.19/bu	--
Crop Sales	\$378.96/acre	\$150.42/acre	--
Insurance	\$1.70/acre	\$140.05/acre	--
Gross Return	\$380.66/acre	\$290.47/acre	--
Input Costs			
Seed	\$24.75/acre	\$24.52/acre	--
Fertilizer	\$60.88/acre	\$46.22/acre	--
Herbicides	\$34.56/acre	\$22.14/acre	\$36.83/acre
Insurance	\$17.84/acre	\$17.84/acre	--
Total	\$138.03/acre	\$110.72/acre	\$36.83/acre
Summary			
Return over Costs	\$242.63/acre	\$179.75/acre	-\$36.83/acre
3-Year Rotation Return over Input Costs[†]		\$112/acre	

*Revenue and costs include crop insurance, unlike previous years’ publications.

†Costs do not include fixed costs associated with the farm.

Table 13. Four-year cropping rotation sequence at the Wilke Farm from 2017 to 2022.

Year	Field 1	Field 3	Field 4	Field 6
2017	Winter Wheat (90.8 bu/acre)	Chickpea (1,066 lb/acre)	No-till Fallow	DNS Wheat (32.1 bu/acre)
2018	Spring Canola (1,020 lb/acre)	DNS Wheat (50.3 bu/acre)	Winter Wheat (77.5 bu/acre)	No-till Fallow
2019	Spring Wheat (57.1 bu/acre)	No-till Fallow	Spring Canola (1,278 lb/acre)	Winter Wheat (71.9 bu/acre)
2020	No-till Fallow	Winter Wheat (99.2 bu/acre)	Winter Barley (1.82 ton/acre)	Spring Canola (1,755 lb/acre)
2021	Winter Wheat (60.2 bu/acre)	Spring Canola (not harvested, frost)	No-till Fallow	Spring Wheat (21.4 bu/acre)
2022	Broadleaf	Spring Cereal	Winter Wheat	No-till Fallow

Table 14. Four-year crop rotation production at the Wilke Farm, 2021.

	Field 1	Field 3	Field 4	Field 6
Cropping Specifics				
Acreage	18.1	27.0	26.2	29.5
Crop	'Castella' SWWW (club)	'BY5125 CL' Spring Canola	No-till Fallow	'Ryan' SWSW
Crop Production				
Yield	60.2 bu/acre	--	--	21.4 bu/acre
Mkt Grade	#1 WHC, 59.3, 0.5% dockage	--	--	#1 SWH, 60.0, 0.5% dockage
Gross Economic Return*				
Mkt Price	\$7.83/bu	--	--	\$6.22/bu
Crop Sales	\$470.82/acre	--	--	\$133.11/acre
Insurance	\$1.84/acre	\$281/acre	--	\$119.77/acre
Total Return	\$472.66/acre	\$281/acre	--	\$252.88/acre
Input Costs				
Seed	\$21.50/acre	\$43.70/acre	--	\$24.52/acre
Fertilizer	\$49.16/acre	\$59.47/acre	--	\$43.50/acre
Herbicides	\$24.50/acre	\$36.69/acre	\$36.83/acre	\$22.14/acre
Insurance	\$17.84/acre	\$23.36/acre	--	\$17.84/acre
Total	\$113.00/acre	\$163.22/acre	\$36.83/acre	\$108.00/acre
Summary				
Return over Costs	\$359.66/acre	\$117.78/acre	-\$36.83/acre	\$144.88/acre
4-Year Rotation Return over Input Costs†			\$129/acre	

*Revenue and costs include crop insurance, unlike previous years' publications.

†Costs do not include fixed costs associated with the farm.

Table 15. Continuous crop rotation sequence at the Wilke Farm from 2017 to 2022.

Year	Field Northwest	Field Northeast
2017	Spring Canola (1,055 lb/acre)	Spring Canola (1,055 lb/acre)
2018	Winter Wheat (52.3 bu/acre)	Winter Wheat (52.3 bu/acre)
2019	Spring Wheat (44.1 bu/acre)	Spring Wheat (44.1 bu/acre)
2020	Spring Wheat (49.6 bu/acre)	Spring Wheat (49.6 bu/acre)
2021	Spring Canola (705 lb/acre)	Spring Wheat (20.3 bu/acre)
2022	Winter Wheat	Broadleaf

Table 16. Continuous crop rotation production at the Wilke Farm, 2021.

	Field Northwest	Field Northeast
Cropping Specifics		
Acreage	25.0	34.4
Crop	'L345PC' Spring Canola	'Ryan' SWSW
Crop Production		
Yield	705 lb/acre	20.3 bu/acre
Mkt Grade	#1 GMO canola, 3.2% dockage	#2 SWH, 59.9, 0.9% dockage
Gross Economic Return*		
Mkt Price	\$0.28/lb	\$6.14/bu
Crop Sales	\$197.40/acre	\$124.41/acre
Insurance	\$102.08/acre	\$195.55/acre
Total Return	\$290.96/acre	\$319.96/acre
Input Costs		
Seed	\$71.29/acre	\$24.52/acre
Fertilizer	\$47.32/acre	\$45.46/acre
Herbicides	\$33.04/acre	\$22.14/acre
Insurance	\$29.30/acre	\$17.84/acre
Total	\$180.95/acre	\$109.96/acre
Summary		
Return over Costs	\$110.01/acre	\$210.00/acre
Continuous Rotation Return over Input Costs[†]		\$168/acre

*Revenue and costs include crop insurance, unlike previous years' publications.

†Costs do not include fixed costs associated with the farm.

Summary

Weather in the second half of the crop year played a major role in the overall agronomic and economic production in 2021. The 2021 (Table 17) and 2020 (Table 18) growing seasons started very similarly through the first six months. During the fall (Sept.–Nov.) and winter (Dec.–Feb.), 6.72 inches of precipitation and 1601 cumulative growing degree days (GDD) were recorded in 2021, and 7.14 inches of precipitation and 1375 GDD were recorded in 2020. In the spring (March–May) and fall (Sept.–Nov.) of 2021, only 0.50 inches of precipitation was recorded, compared to 4.15 inches the previous year during that same period. It was also hotter, with 11% more GDD accumulated during the summer and fall of 2021 compared to the previous year. Near-record heat was recorded during the end of June and the first of July in 2021 across the region. The hot, dry summer and early fall conditions of 2021 severely limited grain yield and increased protein.

A summary of WSU Wilke Research and Extension Farm economic returns over input costs using three-year averages is shown in Figure 2. Over the last three years (2019 to 2021), the three-year rotation, four-year rotation, and continuous cropping rotation have averaged returns above input costs of \$125, \$134, and \$148 per acre, respectively. Over the last six years, the three-year rotation and four-year rotation have averaged returns above input costs of \$118 and \$132 per acre, respectively, and

are not significantly different. The continuous cropping system has averaged \$129/acre return above cost during this period, and, unlike years prior to 2018 when it was significantly less, it is not significantly different from either the three-year or four-year rotation.

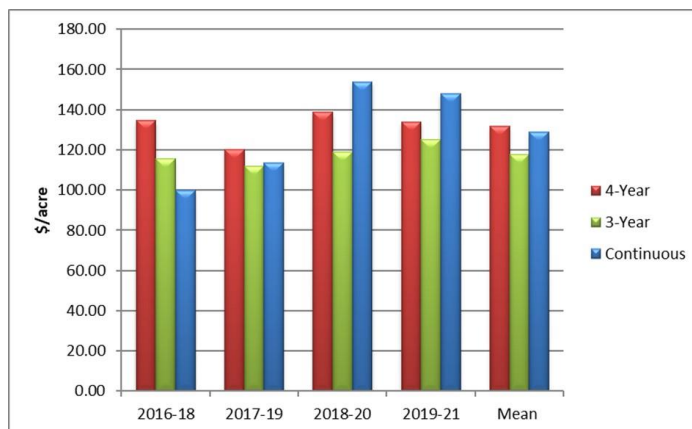


Figure 2. Three-year average economic return over input costs of three-year, four-year, and continuous cropping systems at the WSU Wilke Research and Extension Farm. Costs do not include fixed costs associated with the farm. Means within columns assigned different case letters are significantly different ($p < 0.10$).

Weather Data

The following tables provide weather data for Davenport, Washington, in 2021 (Table 17) and 2020 (Table 18), respectively.

Table 17. Weather data for Davenport, Washington, in 2021 (crop year summary: Sept. 1, 2020, to Aug. 31, 2021).

Month	Temperature (°F)			Degree Days*	Rain Fall (in.)	Rain Days
	High	Low	Mean			
9	76.3	47.5	61.7	897	0.58	4
10	57.0	34.6	45.2	473	0.91	6
11	41.4	28.0	34.1	111	1.22	14
12	33.5	23.9	28.8	25	1.39	12
1	35.9	26.4	31.1	48	2.41	16
2	34.0	21.2	27.4	47	0.21	6
3	50.9	27.9	38.9	231	0.08	2
4	59.4	32.2	47.0	414	0.39	3
5	67.7	39.0	55.2	662	0.03	2
6	82.2	53.2	69.1	1072	0.49	3
7	90.2	57.8	76.0	1,302	0.02	1
8	81.7	53.8	68.6	1,108	0.00	0
Total				6,390	7.73	69

*Degree days calculated using 32°F as the base temperature.

Table 18. Weather data for Davenport, Washington, in 2020 (crop year summary: Sept. 1, 2019, to Aug. 31, 2020).

Month	Temperature (°F)			Degree Days*	Rain Fall (in.)	Rain Days
	High	Low	Mean			
9	68.1	45.6	56.4	746	1.38	8
10	51.4	30.6	40.4	294	0.92	8
11	41.9	26.2	33.5	116	0.51	6
12	34.8	27.4	31.1	53	1.48	8
1	37.2	26.2	31.6	85	2.13	18
2	42.1	25.4	33.1	81	0.72	5
3	47.4	27.5	37.0	191	0.54	6
4	58.1	32.5	46.0	399	0.21	5
5	65.3	42.3	53.9	675	2.43	9
6	70.6	47.3	59.4	810	0.84	9
7	83.3	51.3	58.6	1,094	0.07	1
8	84.3	53.2	69.9	1,138	0.06	1
Total				5,682	11.13	84

*Degree days calculated using 32°F as the base temperature.

WSU Wilke Research Summary

Research and outreach are a large component of the farm. In 2021, there were 16.45 acres of Farm Service Agency (FSA) certified research plots in the fall and an additional 6.00 acres certified in the spring. These are mostly small research plots established and harvested with plot equipment. Large-scale research plots are not certified as research because they are harvested with the commercial combine and grain is taken to the warehouse.

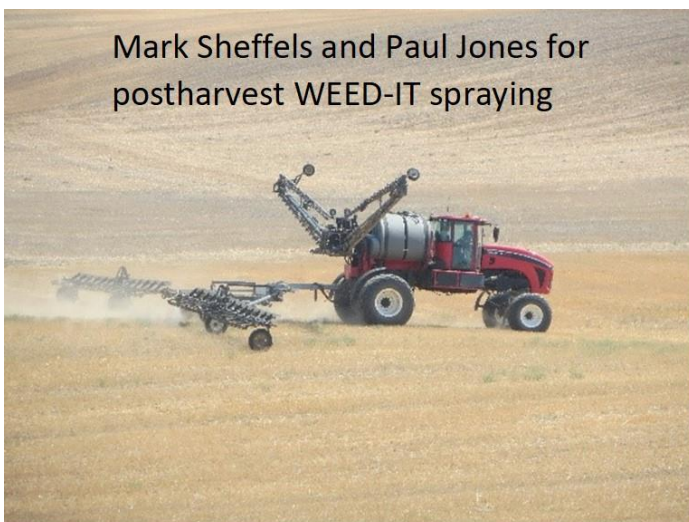
Small Plots

- Jack Brown, University of Idaho. “Spring Canola Variety Plots.” This project helps companies bring the best canola genetics to market and helps farmers with selecting the best genetics. The trial was not harvested because of severe frost damage.
- Arron Carter, WSU. “Soft White Wheat Breeding Plots.” These are the advanced generation selections for the intermediate rainfall zone.
- Haiying Tao, WSU. “Spring and Winter Canola Phosphorus Fertilization.” This project is focused on finding the optimum phosphorus fertilizer rates for both spring and winter canola production.
- Isaac Madsen, WSU. “Peola Feasibility.” This project is evaluating the feasibility of intercropping winter canola and winter pea together to enhance overall production and potentially increase profitability. A spring peola study was also established but was not taken to harvest because of severe frost damage.
- Isaac Madsen, WSU. “Growth Regulators/Seeding Date of Winter Canola.” This project is evaluating the feasibility of growth regulators and seeding date to improve winter canola establishment and winter survivability.
- Aaron Esser, WSU. “Winter Canola Stand Establishment Study.” This project is evaluating the feasibility of STOCKOSORB as a seed-applied, water absorbent material to improve stand establishment and yield.
- Aaron Esser, WSU. “Enhanced Wireworm Control in Spring Wheat.” This project is evaluating the feasibility of Teraxxa seed-applied insecticide over time in comparison with other insecticides for wireworm control.
- Aaron Esser, WSU. “Spring Cereal Seed Treatment Studies.” These studies look at biological and fungicide seed-applied products to reduce disease and improve yield.
- Aaron Esser, WSU. “Fungicide Application in Spring Wheat.” This project examined six different fungicides applied at herbicide timing on spring wheat.
- Ian Burke, WSU. “Herbicide Efficacy Studies.” This project has multiple studies evaluating herbicide efficacy and includes both preemergent and postemergence compounds. This project is also focused on no-till fallow management.
- Aaron Esser, WSU. “Mycorrhiza Application in Spring Wheat.” This study is examining commercially available mycorrhiza products applied to spring wheat following both winter wheat and winter canola.

Large Plots

- Aaron Esser, WSU. “Benefits of Spring Fungicide and Pi-Dust Application in Winter Wheat Production.”
- Isaac Madsen, WSU. “Spring Canola Variety Plots.” This project evaluated six spring canola varieties and is designed to help farmers select the best genetics for their situation.
- Ian Burke, WSU. “Compost Application and Winter Pea Production Feasibility in the Intermediate Cropping System.” This study was initiated in the fall of 2016.
- Aaron Esser, WSU. “Calcium Carbonate Application to Improve Soil pH and Improve Profitability.” This study was initiated in the fall of 2016.
- Aaron Esser, WSU. “Value of Incorporating Spring Canola and Chickpea into Cereal Grain Cropping Systems.” This study was initiated in the spring of 2014.
- Aaron Esser, WSU. “Chloride Application in Winter Wheat.” This project is examining the feasibility of ammonium chloride application in winter wheat production for improved yield.

Special Thanks



AGWEATHERNET STATION located at the Wilke Research and Extension Farm.

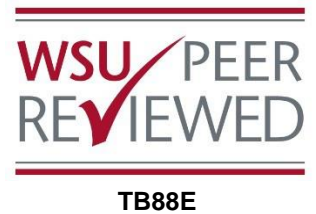
You can access Wilke weather data at <https://weather.wsu.edu/>. AgWeatherNet link on the widget takes you to a map of weather stations throughout the state.

For additional information, please contact Aaron Esser, aarons@wsu.edu, (509) 660-0566.

References

Esser, A.D. 2012. Wireworm Scouting: The Shovel Method and the Modified Solar Bait Trap. *Washington State University Extension Publication FS059E*. Washington State University.

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