

# WSU WILKE RESEARCH AND EXTENSION FARM

OPERATION, PRODUCTION, AND ECONOMIC  
PERFORMANCE FOR 2020



## 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 are 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 plots; three plots are in a more traditional three-year crop rotation, and four plots 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.

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



# Operations

Above average late summer and early fall precipitation in 2019 (2.18 inches in August and September) greatly impacted cropping decisions for the 2020 crop year. No-till fallow in Field 5 was split, and 9.5 acres was seeded to winter canola and the remaining 13.6 acres was seeded to winter wheat. In Field 4 after spring canola was harvested, it was sprayed and re-crop winter barley was seeded as a substituted for spring cereal. Precipitation also germinated volunteer crop and winter annual weeds in fields that were harvested in 2019, thus a fall application of Roundup was made. Valor, a broad spectrum, preemergent herbicide, was tank-mixed with Roundup and applied in Field 1 and Field 2—both fields were no-till fallow in 2020 as well.

All crops in 2019–2020 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 a John Deere 6622 combine from August 5 through August 26.

## *Winter Canola (3-year Field 5)*

Field 5 was split, and 9.5 acres were seeded on August 22, 2019, to ‘Mercedes’ non-GMO winter canola at 3 lb/acre. Every other opener was plugged to allow for a 15-inch row spacing. No fertilizer was applied at seeding, and in one-half of the drill spring oats were inter-seeded with the winter canola at 17 lb/acre. This practice improved stand establishment early but it was detrimental leaving the oats to overwinter as canola stands were significantly lower in the spring when compared to no oats inter-seeded. The canola was fertilized at 52-4-0-4 with a spoke-wheel applicator on September 19, 2019. An additional 33-0-0-0 was applied via steam-jet application on March 20.

Postemergence weed control was applied on April 10 using 10 gallons per acre (GPA) of carrier that included Assure II at 12 oz/acre, Max-In Boron at 12 oz/acre, and 4 qt/100 gallons crop oil concentrate. On June 22, to mitigate cabbage seed pod weevil, an application of 1.92 oz/acre Grizzly Too insecticide

was applied aerially at 5 GPA with 1.6 oz/acre Chemsurf and 2 oz/acre Interlock. On August 1, an aerial application of Cornerstone at 22 oz/acre and 1 qt/100 gallons Full Load Complete was applied as a harvest aid. This was needed to control excessive broadleaf weed pressure caused by reduced stand establishment as a result of the inter-seeded oats. At harvest, this field had excessive Jim Hill mustard, prickly lettuce, and wild oat populations.

## *Winter Wheat (3-year Field 5; 4-year Field 3)*

Field 5 was seeded to 50% ‘Puma’ and 50% ‘Norwest Duet’ soft white winter wheat blend on September 6, 2019, at 75 lb/acre (800,000 seeds/acre) into no-till fallow. Seed was treated at Highline Grain Growers (HLGG) with HLGG Cruiser 0.66 (2.5 oz/cwt Dividend Extreme, 0.10 oz/cwt Vibrance, 0.051 oz/cwt Rancona, 0.05 oz/cwt Maxim, and 0.66 oz/cwt Cruiser) and ProSeed Zinc. Dry 15-19-0.6-13 with 0.05 B and 0.25 Zn was applied at a rate of 53 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 92-0-0-8. Overall, 24% received greater than 102-0-0-9, 15% received less than 65-0-0-6, and 64% received an in-between rate.

Postemergence weed control was applied using 15 GPA of carrier that included Olympus applied at 0.6 oz/acre, Affinity Broadspec at 0.5 oz/acre, Solution 32 at 1 gal/acre, and 1 qt/100 gallons non-ionic surfactant (NIS) on April 9. Non-forecast freezing temperatures (27°F and 22°F) two to three days after application caused severe negative herbicide crop response and reduced herbicide efficacy. On August 1, an aerial application of Cornerstone at 22 oz/acre and 1 qt/100 gallons Full Load Complete was applied as a harvest aid. This was needed to control excessive broadleaf weed pressure caused by the herbicide crop injury (minimal plant competition) and reduced efficacy. At harvest, this field had excessive Jim Hill mustard, downy brome, and prickly lettuce populations.



Field 3 was seeded to ‘Resilience CL+’ Clearfield soft white winter wheat (SWWW) September 5, 2019, at 68 lb/acre (800,000 seeds/acre) into no-till fallow. Seed was treated with HLGG Cruiser 0.66. Dry 15-19-0.6-13 with 0.05 B and 0.25 Zn was applied at a rate of 53 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 85-0-0-7. Overall, 25% received greater than 99-0-0-9, 17% received less than 59-0-0-5, and 58% received a rate in between. An additional 33-0-0-0 was applied via steam-jet application on March 23.

Postemergence weed control was applied using 15 GPA of carrier that included Beyond applied at 4.0 oz/acre, Solution 32 at 24 oz/acre, and 4.0 qt/100 gallons MSO on October 14, 2019, and April 19, 2020. On May 7, 2020, Maestro MA was applied at 24 oz/acre, with Solution 32 at 32 oz/acre, and 1 qt/100 gallons NIS for prickly lettuce control. At harvest, this field was mostly weed free and no feral rye was observed in the field.

### Winter Barley (4-year Field 4)

With above-average summer precipitation in 2019, Field 4 was sprayed with RT3 at 32 oz/acre and 12 lb/100 gallons AMS Premium Blend Max at 10 GPA on September 10, 2019. The field was then seeded to ‘Saturn’ winter barley on September 17, 2019, into spring canola residue. It was seeded at 66 lb/acre (1,000,000 seeds/acre) and was treated with HLGG Cruiser 0.66. Dry 15-19-0.6-13 with 0.05 B and 0.25 Zn was applied at a rate of 53 lb/acre with the seed. Solution 32 and Thiosul (10:1 ratio) was applied across the field at 47-0-0-4. An additional 33-0-0-0 was applied via steam-jet application on March 23. Stand establishment was assessed two weeks later, and ‘Lenetah’ spring barley was inter-seeded into fifty percent of the field on April 7. No fertilizer was applied with spring seeding. On April 9, Tricor DF (metribuzin) was applied at 3 oz/acre with 1 qt/100



gallons NIS. On August 1, an aerial application of Cornerstone at 22 oz/acre and 1 qt/100 gallons Full Load Complete was applied as a harvest aid. This was needed to control excessive broadleaf weed pressure caused by reduced stand establishment and limited postemergence weed control options. At harvest, this field had excessive downy brome, Jim Hill mustard, and prickly lettuce populations.

### Spring Wheat (3-year Field 7; Continuous North)

Field 7 was seeded to ‘Ryan’ soft white spring wheat (SWSW) on April 8 at 78 lb/acre (800,000 seeds/acre) into winter wheat residue. Seed was treated with HLGG Gold 0.66 (3.0 oz/cwt Dividend Extreme, 0.16 oz/cwt Vibrance, 0.255 oz/cwt Mertect, and 0.66 oz/cwt Cruiser) and ProSeed Zinc. Dry 15-19-0.6-13 with 0.05 B and 0.25 Zn was applied at a rate of 53 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 67-0-0-6. Overall, 19% received greater than 80-0-0-6, 9% received less than 43-0-0-4, and 72% received a rate in between. Field 7 was sprayed at 10 GPA on October 16, 2019, with 16.0 oz/acre RT3, 1 qt/100 gallons Full Load Complete, and 1 gal/acre Solution 32. On April 13, a post plant preemergent application was applied and included 24 oz/acre RT3 and 12 lb/100 gallons AMS Premium Blend Max at 10 GPA. Postemergence weed control was applied on May 26 in a carrier volume of 10 GPA. This application included Huskie at 15 oz/acre, Rhonox at 12 oz/acre, Topez at 4 oz/acre, Solution 32 at 1 gal/acre, Ag-Xcelerate at 1 gal/acre, and Activate Plus at 1 qt/100 gallons. This application contained an additional 5 lb of nitrogen. At harvest, this field was mostly weed free with the exception of a few wild oats throughout the field and some downy brome around the edge of the grassy waterway.



Continuous North was seeded to 'JD' SWSW club on April 13 at 58 lb/acre (900,000 seeds/acre) into spring wheat residue. Seed was treated with HGG Cruiser 1.33 (2.5 oz/cwt Dividend Extreme, 0.10 oz/cwt Vibrance, 0.051 oz/cwt Rancona, 0.05 oz/cwt Maxim, and 1.33 oz/cwt Cruiser) for additional hessian fly management. Dry 15-19-0.6-13 with 0.05 B and 0.25 Zn was applied at a rate of 53 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, 30% received greater than 56-0-0-5, 18% received less than 43-0-0-4, and 52% received a rate in between. North was sprayed at 10 GPA on October 16, 2019, with 16.0 oz/acre RT3, 1 qt/100 gallons Full Load Complete, and 1 gal/acre Solution 32. On April 20, a post-plant, preemergent application was applied and included 24 oz/acre RT3 and 12 lb/100 gallons AMS Premium Blend Max at 10 GPA. Postemergence weed control was applied on May 26 in a carrier volume of 10 GPA. This application included Axial Bold at 15 oz/acre, Bison at 6 oz/acre, Orion at 17 oz/acre, Solution 32 at 1 gal/acre, and Ag-Xcelerate at 1 gal/acre. This application contained an additional 5 lb of nitrogen. During the year, no hessian fly damage was observed but excessive wireworm damage was observed across the field, despite low trapping numbers prior to seeding. At harvest, this field had was mostly weed free.

## *Spring Canola (4-year Field 6)*

'NCC101S' spring canola was seeded on April 15 at 5.0 lb/acre (429,690 seeds/acre) into winter wheat residue. Dry 15-19-0.6-13 with 0.05 B and 0.25 Zn was applied at a rate of 53 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 47-0-0-4. Overall, 38% received greater than 49-0-0-4, 15% received less than 40-0-0-3, and 47% received a rate in between. Field 6 was sprayed at 10 GPA on October 16, 2019, with 16.0 oz/acre RT3, 1 qt/100 gallons Full Load Complete, and 1 gal/acre Solution 32. On April 20, a post-plant, preemergent application was applied and included 24 oz/acre RT3 and 12 lb/100 gallons AMS Premium Blend Max at 10 GPA. Postemergence weed control was applied on May 27 using a carrier volume of 10 GPA. This application included 5.3 oz/acre Section Three (clethodim), 16 oz/acre Max-In Boron, and 24 oz/acre crop oil. On June 22, an application of 1.92 oz/acre Grizzly Too insecticide was aerially applied at 5 GPA with 1.6 oz/acre Chemsurf, and 2 oz/acre Interlock for cabbage seed pod weevil. At harvest, this field had excessive Russian thistle, common lambsquarter, and prickly lettuce populations.

## *No-till Fallow (3-year Field 2; 4-year Field 1)*

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 on October 15, 2019. It

included 3 oz/acre Valor, 16 oz/acre RT3, 1 qt/100 gallons Activate Plus, and 17 lb/100 gallons ammonium sulfate. The second application was on May 18 using a carrier volume of 8.4 GPA and included 32 oz/acre RT3 and 1 qt/100 gallons Full Load Complete. The third application was on June 26 at a carrier volume of 10 GPA and included 28 oz/acre RT3, 1 qt/100 gallons Full Load Complete, and 2.2 gal/acre Sol 32 to help facilitate residue decomposition. The fourth and final application was applied on July 30 at a carrier volume of 8.4 GPA and included 32 oz/acre RT3 and 1 qt/100 gallons Full Load Complete. Lambsquarter, wild oat, and pigweed were the three most common weeds present in the 3rd and 4th herbicide application, and Russian thistle, prickly lettuce, and mares tail were very limited. Both NTF fields were mowed four days prior to the third herbicide application to enhance seeding conditions.

## **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. Compaction levels are monitored over time within a given crop rotation, which assists in potential management decisions. Field 6 had the least amount of compaction with an average of 176 psi/18 inches, and Field 1 and Field North had the greatest average soil compaction with 217 psi/18 inches (Figure 1). For Fields 7 and 2, compaction averaged 194 and 193 psi/18 inches, respectively. Maximum compaction levels were typically observed at the six-inch depth.



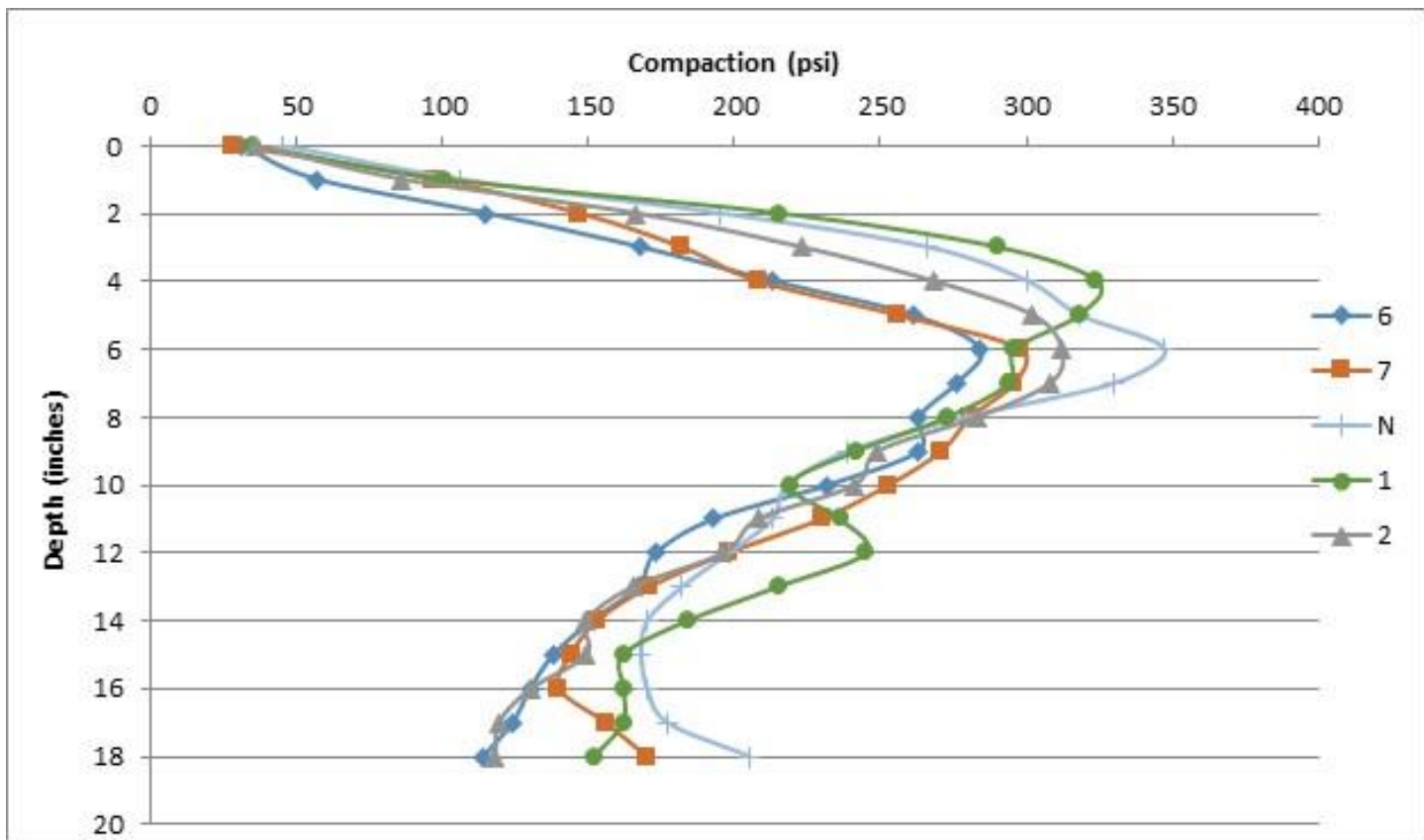


Figure 1. Soil compaction data collected in the spring of the year from five fields at the WSU Wilke Research and Extension Farm in 2020.

## 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. 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 trapping numbers overall were very low. Field North had the least number of wireworms, averaging 0.2/trap, and Field 6 had the greatest population, averaging 1.6/trap. Fields 1, 2, and 7 averaged 0.6, 0.3, and 0.6/trap, respectively.

## Soil Samples

Winter wheat and winter canola soil samples were collected prior to seeding in the fall from three production zones and used to help determine yield potential and nutrient requirements for the crops within these zones. Fall soil samples in Table 1 and Table 2 are an average of the three production zones. Winter barley was soil sampled in the spring prior to spring top-dress applications and no production zones were used (Table 3). Fields seeded to spring crop are sampled according to three production zones and are used to help determine yield potential and nutrient requirements for the crops within these zones. Spring soil

samples in Table 4, Table 5, and Table 6 are an average of the three production zones. 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.



Table 1. Winter wheat and winter canola, 3-year, Field 5.

Soil pH	6.0			Phosphorus	20 mg/kg
Organic Matter	2.3% (45 lb/acre N)			Ammonium N	8 lb/acre
	<u>Soil Depth (in)</u>				
	<u>0-12</u>	<u>12-24</u>	<u>24-36</u>	<u>36-48</u>	<u>Total</u>
Nitrate-N (lb/acre)	68	22	18	18	126
Sulfate-S (mg/kg)	4	2	3	--	8
Soil Moisture (in)	2.4	2.4	2.0	2.0	8.9
<b>Sum of Tested N: 179 lb/acre N</b>					

Table 2. Winter wheat, 4-year, Field 3.

Soil pH	6.1			Phosphorus	17 mg/kg
Organic Matter	2.3% (46 lb/acre N)			Ammonium N	6 lb/acre
	<u>Soil Depth (in)</u>				
	<u>0-12</u>	<u>12-24</u>	<u>24-36</u>	<u>36-48</u>	<u>Total</u>
Nitrate-N (lb/acre)	59	29	25	29	142
Sulfate-S (mg/kg)	2	1	1	--	5
Soil Moisture (in)	2.0	2.1	2.0	1.7	7.8
<b>Sum of Tested N: 193 lb/acre N</b>					

Table 3. Winter barley, 4-year, Field 4.

Soil pH	6.2			Phosphorus	17 mg/kg
Organic Matter	2.2% (44 lb/acre N)			Ammonium N	11 lb/acre
	<u>Soil Depth (in)</u>				
	<u>0-12</u>	<u>12-24</u>	<u>24-36</u>	<u>36-48</u>	<u>Total</u>
Nitrate-N (lb/acre)	15	23	33	20	91
Sulfate-S (mg/kg)	9	8	5	--	21
Soil Moisture (in)	3.2	3.2	2.1	2.1	10.6
<b>Sum of Tested N: 146 lb/acre N</b>					

Table 4. Spring wheat, 3-year, Field 7.

Soil pH	6.2			Phosphorus	10 mg/kg
Organic Matter	2.1% (41 lb/acre N)			Ammonium N	15 lb/acre
	<u>Soil Depth (in)</u>				
	<u>0-12</u>	<u>12-24</u>	<u>24-36</u>	<u>36-48</u>	<u>Total</u>
Nitrate-N (lb/acre)	12	10	9	9	40
Sulfate-S (mg/kg)	5	342	6	--	10
Soil Moisture (in)	3.2	2.7	2.0	2.1	9.9
<b>Sum of Tested N: 95 lb/acre N</b>					

Table 5. Spring wheat, Continuous North.

Soil pH	5.9			Phosphorus	14 mg/kg
Organic Matter	2.1% (42 lb/acre N)			Ammonium N	9 lb/acre
	<u>Soil Depth (in)</u>				
	<u>0-12</u>	<u>12-24</u>	<u>24-36</u>	<u>36-48</u>	<u>Total</u>
Nitrate-N (lb/acre)	11	12	17	18	58
Sulfate-S (mg/kg)	5	3	3	--	10
Soil Moisture (in)	2.9	2.6	2.0	1.9	9.4
<b>Sum of Tested N: 109 lb/acre N</b>					

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

Soil pH	5.8			Phosphorus	22 mg/kg
Organic Matter	2.3% (47 lb/acre N)			Ammonium N	7 lb/acre
	<u>Soil Depth (in)</u>				
	<u>0-12</u>	<u>12-24</u>	<u>24-36</u>	<u>36-48</u>	<u>Total</u>
Nitrate-N (lb/acre)	11	12	21	40	85
Sulfate-S (mg/kg)	8	5	3	--	16
Soil Moisture (in)	2.9	2.8	1.9	1.6	9.2
<b>Sum of Tested N: 139 lb/acre N</b>					

Table 7. No-till fallow, 3-year, Field 2.

Soil pH	6.2			Phosphorus	13 mg/kg
Organic Matter	2.7% (54 lb/acre N)			Ammonium N	3 lb/acre
	<u>Soil Depth (in)</u>				
	<u>0-12</u>	<u>13-24</u>	<u>25-36</u>	<u>37-48</u>	<u>Total</u>
Nitrate-N (lb/acre)	14	28	41	23	106
Sulfate-S (mg/kg)	8	6	4	--	19
Soil Moisture (in)	3.3	3.2	2.5	2.3	11.3
<b>Sum of Tested N: 163 lb/acre N</b>					

Table 8. No-till fallow, 4-year, Field 1.

Soil pH	5.9			Phosphorus	13 mg/kg
Organic Matter	2.5% (50 lb/acre N)			Ammonium N	6 lb/acre
	<u>Soil Depth (in)</u>				
	<u>0-12</u>	<u>12-24</u>	<u>24-36</u>	<u>36-48</u>	<u>Total</u>
Nitrate-N (lb/acre)	12	15	41	16	84
Sulfate-S (mg/kg)	9	5	15	--	30
Soil Moisture (in)	3.2	3.1	2.5	2.1	10.9
<b>Sum of Tested N: 140 lb/acre N</b>					

# Soil pH and KCL Exchangeable Aluminum (Al)

Soil pH and KCL exchangeable Al is rapidly becoming of great interest to farmers and field consultants. Soil pH and exchangeable Al are collected in fields that are seeded to spring cereal and will be 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 where soil pH levels are less than 5.0 and KCL exchangeable 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 2.1 to 16.0 ppm (Table 9). At a depth of 3–

6 inches, soil pH levels ranged from 4.9 to 5.1, and KCL Al ranged from 10.1 ppm in Field 2 to 35.0 ppm in Field 1. At a depth of 6–12 inches, pH ranges from 5.9 to 6.4, and KCL Al ranged from 0.1 to 0.5 ppm.

## Production and Economic Performance

Nitrogen uptake efficiency was at or above 50 percent for SWSW in Field 7 and North, and SWWW in Field 3 and Field 5 (Table 10). For fields at or above 50 percent efficiency this implies the nitrogen fertilizer program was adequate and an average amount of nitrogen should be available in the soil for next year’s production. Fields below 50 percent efficiency imply the crop was overfertilized or fertilizer timing could be adjusted, and above average fertilizer should be available for next year’s production.

Table 9. Soil pH and KCL exchangeable aluminum in five fields at the WSU Wilke Research and Extension Farm in the spring of 2020.

	<b>Field 1</b> (NTF)	<b>Field 2</b> (NTF)	<b>Field 6</b> (Canola)	<b>Field 7</b> (SWSW)	<b>North</b> (SWSW)
<b>0–3 inches</b>					
pH	5.3	5.4	5.2	5.0	5.5
KCL Al (ppm)	6.0	2.1	4.4	16.0	2.3
<b>3–6 inches</b>					
pH	5.1	5.3	5.0	5.1	4.9
KCL Al (ppm)	35.0	10.1	24.1	30.7	33.7
<b>6–12 inches</b>					
pH	6.1	6.2	6.0	6.4	5.9
KCL Al (ppm)	0.5	0.3	0.3	0.5	0.1

Table 10. Nitrogen use efficiency, 2020.

	<b>Field 3</b> (SWWW)	<b>Field 5</b> (SWWW)	<b>Field 7</b> (SWWW)	<b>North</b> (SWSW)
Soil Test Nitrogen*	167	152	60	86
Applied Nitrogen	126	100	79	64
Total Nitrogen	293	252	139	150
Grain Yield	99.2	76.0	55.5	49.6
Grain Protein	10.5%	12.9%	10.0%	11.2%
lb N/bu	3.0	3.3	2.5	3.0
<b>Nitrogen Use Efficiency</b>	<b>53%</b>	<b>58%</b>	<b>60%</b>	<b>55%</b>

\*Soil test nitrogen is calculated using soil test results in combination with 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. No forward contracts were utilized in 2020. Market grades for each crop are provided as these also impact final market price.

Average input costs per year at the WSU Wilke Farm were up 10.8% over the three-year average. This is mostly because increased precipitation resulted in additional herbicide application and greater fertilizer rates. Economic returns over input costs were up 21% over the previous three-year average and \$10/acre greater than 2019. This is mostly reflective of greater crop yields across-the-board, including the highest winter wheat yield (Field 3) and spring canola yields since the duration of the Wilke Project. Spring wheat also had some of the highest

yields in the past ten years. 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 2020.

The three-year crop rotation returns above input costs averaged \$123/acre, 10% greater than the three-year average. Winter barley was substituted for spring cereal, but yield was compromised by reduced stand and excessive weed pressure. Winter wheat yields were also compromised by reduced stands caused by hair-pinning associated with the disk drill. The four-year crop rotation returns above input costs averaged \$145/acre, 241% greater than the previous three-year average. The continuous cropping system returns above input costs averaged \$155/acre, 37% greater than the previous three-year average. The WSU Wilke Farm is enrolled in the farm program and purchases crop insurance each year. Revenue or costs associated with both the farm program and crop insurance are not included in the field summaries to maintain consistency over years, and results are based on crop production only.



Table 11. Three-year cropping rotation sequence at the Wilke Farm from 2016 to 2021.

Year	Field 2	Field 5	Field 7
2016	DNS Wheat (49.0 bu/acre)	No-till Fallow	Winter Wheat (84.2 bu/acre)
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)
<b>2020</b>	<b>No-till Fallow</b>	<b>Winter Wheat/Canola</b> (76 bu/acre; 2,080 lb/acre)	<b>Spring Wheat</b> (55.5 bu/acre)
2021	Winter Wheat	Spring cereal	No-till Fallow

Table 12. Three-year crop rotation production at the Wilke Farm, 2020.

	Field 2	Field 5	Field 5	Field 7
<b>Cropping Specifics</b>				
Acreage	27.5	13.6	9.5	34.1
Crop	No-till Fallow	'Puma-Duct' SWWW	'Mercedes' Winter Canola	'Ryan' SWSW
<b>Crop Production</b>				
Yield	-	75.6 bu/acre	2,080 lb/acre	55.5 bu/acre
Mkt Grade	-	#1 SWH, 62.1, 0.3% dockage	#1 Canola, 1.2% dockage	#1 SWH, 60.6, 0.3% dockage
<b>Gross Economic Return*</b>				
Mkt Price	-	\$5.02/bu	\$0.17/lb	\$5.06/bu
Gross Return	-	\$379.23/acre	\$353.60/acre	\$281.07/acre
<b>Input Costs</b>				
Seed	-	\$22.18/acre	\$36.00/acre	\$22.62/acre
Fertilizer	-	\$67.04/acre	\$58.23/acre	\$51.01/acre
Herbicides	\$41.60/acre	\$28.08/acre	\$29.23/acre	\$34.10/acre
Insecticide	--	--	\$11.39/acre	--
Total	\$41.60/acre	\$117.29/acre	\$134.85/acre	\$107.73/acre
<b>Summary</b>				
Return over Costs	-\$41.60/acre	\$261.94/acre	\$218.75/acre	\$173.34/acre
<b>3-Year Rotation Return over Input Costs†</b>				<b>\$123/acre</b>

\*Revenue does not include crop insurance revenue.

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

Table 13. Four-year cropping rotation sequence at the Wilke Farm from 2016 to 2021.

Year	Field 1	Field 3	Field 4	Field 6
2016	No-till Fallow	Winter Wheat (94.5 bu/acre)	DNS Wheat (48.9 lb/acre)	Oriental Mustard (1,325 lb/acre)
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/acre)
<b>2020</b>	<b>No-till Fallow</b>	<b>Winter Wheat</b> (99.2 bu/acre)	<b>Winter Barley</b> (1.82 ton/acre)	<b>Spring Canola</b> (1,755 lb/acre)
2021	Winter Wheat	Broadleaf	No-till Fallow	Spring Cereal

Table 14. Four-year crop rotation production at the Wilke Farm, 2020.

	<b>Field 1</b>	<b>Field 3</b>	<b>Field 4</b>	<b>Field 6</b>
<b>Cropping Specifics</b>				
Acreage	23.3	27.5	26.2	28.5
Crop	No-till Fallow	'Resilience CL+' SWWW	'Saturn' Winter Barley	'NC101S' Spring Canola
<b>Crop Production</b>				
Yield	--	99.2 bu/acre	1.82 ton/acre	1,755/acre
Mkt Grade	--	#1 SWH, 62.3, 0.3% dockage	#1 2-row Barley, 51.0, 0.3% dockage	#1 Canola, 3.0% dockage
<b>Gross Economic Return*</b>				
Mkt Price	--	\$4.74/bu	\$120/ton	\$0.17/lb
Gross Return	--	\$470.00/acre	\$218.13/acre	\$298.43/acre
<b>Input Costs</b>				
Seed	--	\$20.19/acre	\$24.31/acre	\$50.71/acre
Fertilizer	--	\$83.21/acre	\$67.72/acre	\$45.07/acre
Herbicides	\$41.60/acre	\$46.72/acre	\$23.73/acre	\$22.21/acre
Insecticide	--	--	--	\$11.39/acre
Total	\$41.60/acre	\$150.12/acre	\$115.77/acre	\$129.39/acre
<b>Summary</b>				
Return over Costs	-\$41.60/acre	\$319.88/acre	\$102.36/acre	\$169.04/acre
<b>4-Year Rotation Return over Input Costs†</b>			<b>\$145/acre</b>	

\*Revenue does not include crop insurance revenue.

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

Table 15. Continuous crop rotation sequence at the Wilke Farm from 2016 to 2021.

<b>Year</b>	<b>Field North</b>
2016	Spring Barley (1.68 ton/acre)
2017	Spring Canola (1,055 lb/acre)
2018	Winter Wheat (52.3 bu/acre)
2019	Spring Wheat (44.1 bu/acre)
<b>2020</b>	<b>Spring Wheat</b> <b>(49.6 bu/acre)</b>
2021	Broadleaf/Spring Cereal

Table 16. Continuous crop rotation production at the Wilke Farm, 2020.

<b>Field North</b>	
<b>Cropping Specifics</b>	
Acreage	65.86
Crop	'JD' SWSW club
<b>Crop Production</b>	
Yield	49.6 bu/acre
Mkt Grade	#1 WCW, 62.1, 0.7% dockage
<b>Gross Economic Return*</b>	
Mkt Price	\$5.38/bu
Gross Return	\$266.68/acre
<b>Input Costs</b>	
Seed	\$17.74/acre
Fertilizer	\$51.01/acre
Herbicides	\$42.67/acre
Insecticide	--
Total	\$111.42/acre
<b>Summary</b>	
<b>Continuous Rotation Return over Input Costs<sup>†</sup></b>	<b>\$155/acre</b>

\*Revenue does include any crop insurance revenue.

<sup>†</sup>Costs do not include fixed costs associated with the farm.

## Summary

Weather played a major role in the overall agronomic and economic production in 2020. Overall, the crop year 2020 (Table 17) and the crop year 2019 (Table 18) growing seasons were similar with the exception of a couple events. Precipitation in the fall (Sept.–Nov.) of crop year 2020 was similar to crop year 2019 with 2.81 inches compared to 3.07 inches. However, 1.38 inches of precipitation was recorded in the September crop year 2020 and no precipitation was recorded in the September crop year 2019, which enhanced early winter wheat stand establishment, growth, and development. The winter (Dec.–Feb.) of crop year 2020 was also very favorable for winter wheat production as it was warmer than crop year 2019 with 219 cumulative growing degree days (GDD) compared to only 65 GDD in 2019, and precipitation was 17% more in crop year 2020 compared to crop year 2019. The spring (March–May) of 2020 was a little cooler and wetter, with 1,265 GDD and 3.18 inches of precipitation compared to 1,359 GDD and 3.05 inches in 2019. However, March and April 2020 were dry and May was very favorable with 2.43 inches of precipitation and was very beneficial for spring crop production. The temperature in the summer (June–Aug.) of 2020 was very similar to the summer of 2019 with 3,042 GDD compared to 3,086 GDD. In June 2020, 0.84 inches of precipitation was very favorable for spring crop production and for spring and winter cereal grain test weight.

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 (2018 to 2020), the three-year rotation, four-year rotation, and continuous cropping rotation have averaged returns above input costs of \$119, \$139, and \$154/acre, respectively. Over the last six years, the three-year rotation and four-year rotation have averaged returns above input costs of \$111 and \$123/acre, respectively, and are not significantly different. The continuous cropping system has averaged \$101/acre return above cost during this period, and, unlike previous years, it is not significantly different from either the three-year or four-year rotation.

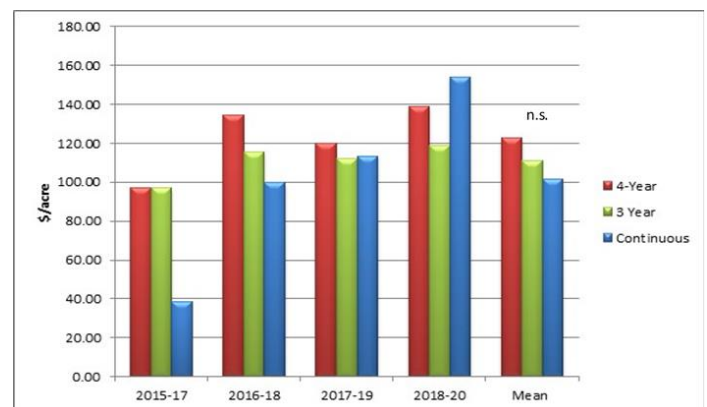


Figure 2. Three-year average economic return over input costs of three-year, four-year, and continuous cropping systems at the WSU Wilke Research and Extension Farm. Costs do not include fixed costs associated with the farm. Means within columns assigned different case letters are significantly different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

# Weather Data

The following tables provide weather data for Davenport, Washington, in 2020 (Table 17) and 2019 (Table 18), respectively.

Table 17. Weather data for Davenport, Washington, in 2020 (crop year summary: Sept. 1, 2019, to Aug. 31, 2020).

Month	Temperature			Degree Days*	Rain Fall	Rain Days
	High	Low	Mean			
9	86.7	30.8	56.4	746	1.38	8
10	66.2	12.8	40.4	294	0.92	8
11	52.5	12.8	33.5	116	0.51	6
12	49.3	17.3	31.1	53	1.48	8
1	53.0	-2.6	31.6	85	2.13	18
2	58.9	15.2	33.1	81	0.72	5
3	58.3	16.2	37.0	191	0.54	6
4	75.0	22.3	46.0	399	0.21	5
5	84.4	26.1	53.9	675	2.43	9
6	86.0	37.5	59.4	810	0.84	9
7	83.3	39.6	58.6	1,094	0.07	1
8	99.8	40.5	69.9	1,138	0.06	1
<b>Total</b>				<b>5,682</b>	<b>11.29</b>	<b>84</b>

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

Table 18. Weather data for Davenport, Washington, in 2019 (crop year summary: Sept. 1, 2018, to Aug. 31, 2019).

Month	Temperature			Degree Days*	Rain Fall	Rain Days
	High	Low	Mean			
9	86.7	34.2	56.9	736	0.00	0
10	66.7	26.7	45.6	440	1.56	9
11	58.9	18.8	24.4	131	1.51	15
12	45.4	11.3	30.0	40	2.16	9
1	42.4	10.7	29.4	24	1.05	9
2	35.8	3.1	20.2	1	0.49	8
3	57.4	2.1	31.7	153	0.53	12
4	65.5	27.2	46.3	425	1.17	8
5	81.3	31.5	57.7	781	1.35	8
6	88.5	32.1	62.0	863	0.25	3
7	94.0	42.1	67.5	1,069	0.17	2
8	97.3	45.2	69.7	1,154	0.80	2
<b>Total</b>				<b>5,817</b>	<b>11.04</b>	<b>85</b>

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

# WSU Wilke Research

## Summary

Research and outreach are a large component of the facility. In 2020, there were 5.91 acres of FSA certified in the fall and an additional 3.00 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. Winter Canola Variety Plots. The project assists companies to bring the best canola genetics to market and helps farmers select the best genetics.
- Arron Carter, WSU. Soft White Wheat Breeding Plots. These are the advanced generation selections for the intermediate rainfall zone.
- Kurt Braunwart, ProGene, and Stephen Van Vleet, WSU. Winter Pea Variety Plots. This project assists companies to bring the best winter pea genetics to market and helps farmers select the best genetics under early and late planting conditions.
- Haiying Tao, WSU. 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.
- 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.
- Ian Burke and Drew Lyon, 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.

### 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. Value of Incorporating Winter Canola and Winter Pea into Cereal Grain Cropping Systems. This study was initiated in the fall of 2016.



# Special Thanks



AGWEATHERNET STATION located at the Wilke Research and Extension Farm.

You can access Wilke weather data at the [AgWeatherNet link on the widget](#) that takes you to a map of weather stations throughout the state.

[Wilke Research and Extension Farm website](#)

[Lincoln & Adams Counties Extension website](#)

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