WSU WILKE RESEARCH AND EXTENSION FARM

OPERATION, PRODUCTION, AND ECONOMIC PERFORMANCE FOR 2023

Current Situation

The Washington State University Wilke Research and Extension Farm is a 320-acre facility located on the eastern edge of Davenport, Washington. 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 farm to assist university faculty with small plot research experiments. Previous technical bulletins can be accessed through the Wheat and Small Grains website.

The Wilke Farm uses a direct-seed cropping system using no-till fallow, winter wheat, winter canola, spring cereals, and broadleaf crops. The predominant cropping system practiced by farmers in this region is a three-year rotation that includes summer fallow, winter wheat, and spring cereals, such as wheat and barley. The south side of the farm is divided into seven fields; three fields (2, 5, and 7) are in the predominate three-year crop rotation, and four fields (1, 3, 4, and 6) are in an intensified four-year crop rotation. In the three-year rotation, winter canola has been incorporated to generate agronomic and economic crop production data within a rotation. The north side of the farm has been in a continuous cropping system since the inception of the Wilke Farm project in 1998 and has evolved over the past few years. One big change occurred to Field 8, located around the homesite, which was brought into continuous rotation in 2023. Two other changes include a name change for Field 9 and Field 10, which were previously referred to as “Northwest” and “Northeast,” respectively.

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. Fertilizer rates are expressed as lb/acre in N-P-K-S format. For example, 16-20-0-13 is the application of 16 lb/acre nitrogen, 20 lb/acre P_2O_2, 0 lb/acre K_2O, and 13 lb/acre sulfur.

WASHINGTON STATE UNIVERSITY
EXTENSION

Operations

All crops in 2022–2023 were seeded with the farm's John Deere 750 direct-seed, low disturbance disk drill using a 7.5-inch row spacing. Deep-banded fertilizer applications were applied in between the rows on a 15-inch spacing. The farm was harvested with its John Deere 9500 combine from August 1 through August 18. Tables 1 to 11 show field treatments and crops grown for Fields 1 through 10.

3-Year Crop Rotation

Table 1. Field 2 (no-till fallow).

Crop	No-till fallow
Herbicide	10-28-22: 3 oz/acre Valor SX @ 10 gpa
Herbicide	5-3-23: 28 oz/acre RT3, 1 qt/100 NIS, and 32 oz/acre molasses @ 10 gpa
Herbicide	6-13-23: 32 oz/acre RT3, 1 qt/100 NIS, and 32 oz/acre molasses @ 10 gpa
Herbicide	7-20-23: (WEEDit)13 oz/acre RT3, 3 oz/acre NIS, and 9 oz/acre molasses (sprayed 9.4%)
Herbicide	8-23-23: (WEEDit) 5.4 oz/acre Gramoxone SL 3.0 and 0.9 oz/acre NIS (sprayed 12%)

Table 2. Field 5 (67% seeded to winter wheat on fallow).

Variety and Crop	'Piranha Cl+' soft white winter wheat
Seed Date & Rate	Sept. 15, 2022. 76 lb/acre (23 seed/ft^2)
Starter Fertilizer	7 gpa liquid starter blend (10-15-0.2-1 plus 0.15 Zn and 0.06 B)
Deep Fertilizer (variable rate)	Average 31-0-0-3 (90% solution 32, 10% thio-sul) 19% received 40-0-0-4 or more 13% received 27-0-0-2 or less 68% received rates in between these
Fertilizer (additional)	9-15-22: 10 gpa ammonium chloride applied with spoke applicator (4 N, 10 Cl) @ 10 gpa
Herbicide	5-6-23: 4.75 oz/acre Osprey Xtra, 13.5 oz/acre Huskie, 2 qt/100 NIS, 32 oz/acre molasses, and 4 gpa Tracite Stand Xtra fertilizer (5-0-0.8-0 plus 0.8 Ca, 0.6 Mg, and 4.5 Cl) @ 10 gpa
Herbicide	8-23-23: (WEEDit) 3.1 oz/acre Gramoxone SL 3.0 and 0.62 oz/acre NIS (sprayed 7.0%)

Table 3. Field 5 (32% seeded to winter canola on fallow).

Variety and Crop	'Plurax' winter canola
Seed Date & Rate	Aug. 20, 2022. 3 lb/acre (7 seed/ft^2)
Starter Fertilizer	-
Fertilizer	10-20-22: applied 23-0-0-2 with stream jet nozzles 5-4-23: applied 60-0-0-5 with stream jet nozzles
Herbicide	9-19-22: 5 oz/acre Cleanse, 32 oz/acre molasses, 12.8 oz/acre crop oil @ 10 gpa
Herbicide	5-3-23: 10 oz/acre Assure II, 3 lb/acre AMS, 12.8 oz/acre crop oil @ 10 gpa

Table 4. Field 7 (spring cereal).

Variety and Crop	'Ryan' soft white spring wheat
Seed Date & Rate	April 20, 2023. 62 lb/acre (18 seed/ft^2)
Starter Fertilizer	7 gpa liquid starter blend (12-12-0.2-1 plus 0.17 Zn and 0.07 B)
Deep Fertilizer (variable rate)	Average 73-0-0-6 (90% solution 32, 10% thio-sul) 19% received 86-0-0-8 or more 26% received 66-0-0-6 or less 55% received rates in between these
Herbicide	4-17-23: 28 oz/acre RT3, 1 qt/100 NIS, and 32 oz/acre molasses @ 10 gpa
Herbicide	5-23-23: 16 oz/acre Bison, 1 qt/100 NIS, 32 oz/acre molasses, and 3 gpa Tracite Stand Xtra fertilizer (4-0-0.6-0 plus 0.6 Ca, 0.5 Mg, and 3.4 Cl) @ 10 gpa
Herbicide	9-1-23: (WEEDit) 1.6 oz/acre Gramoxone SL 3.0 and 0.31 oz/acre NIS (sprayed 3.6%)

4-Year Crop Rotation

Table 5. Field 1 (continuous winter wheat).

Variety and Crop	'Sockeye Cl+' soft white winter wheat
Seed Date & Rate	Oct. 19, 2022. 85 lb/acre (23 seed/ft^2)
Starter Fertilizer	7 gpa liquid starter blend (10-15-0.2-1 plus 0.15 Zn and 0.06 B)
Deep Fertilizer (variable rate)	Average 72-0-0-6 (90% solution 32, 10% thio-sul) 22% received 86-0-0-8 or more 16% received 66-0-0-6 or less 62% received rates in between these
Herbicide	10-20-22: 3 oz/acre Anthem Flex @ 10 gpa
Herbicides	5-6-23: 13.5 oz/acre Huskie, 2 qt/100 NIS, 32 oz/acre molasses, and 4 gpa Tracite Stand Xtra fertilizer (5-0-0.8-0 plus 0.8 Ca, 0.6 Mg, and 4.5 Cl) @ 10 gpa
Herbicide	8-23-23: (WEEDit) 5.9 oz/acre Gramoxone SL 3.0 and 1.16 oz/acre NIS (sprayed 6.8%)

Table 6. Field 3 (no-till fallow).

Crop	No-till fallow
Herbicide	10-28-22: 3 oz/acre Valor SX @ 10 gpa
Herbicide	5-3-23: 28 oz/acre RT3, 1 qt/100 NIS, and 32 oz/acre molasses @ 10 gpa
Herbicide	6-13-23: (WEEDit) 14 oz/acre RT3 and 0.5 oz/acre NIS (sprayed 33.3%)
Herbicide	7-20-23: (WEEDit) 6 oz/acre RT3, 1 oz/acre NIS, and 4 oz/acre molasses (sprayed 14.4%)
Herbicide	8-23-23: (WEEDit) 3.8 oz/acre Gramoxone SL 3.0 and 0.8 oz/acre NIS (sprayed 13.6%)

Table 7. Field 4 (broadleaf).

Variety and Crop:	'Liberty L345PC' spring canola
Seed Date & Rate:	April 28, 2023. 5 lb/acre (9 seed/ft^2)
Starter Fertilizer	7 gpa liquid starter blend (12-12-0.2-1 plus 0.17 Zn and 0.07 B)
Deep Fertilizer (variable rate)	Average 79-0-0-7 (90% solution 32, 10% thio-sul) 14% received 86-0-0-8 or more 16% received 76-0-0-7 or less 70% received rates in between these
Herbicide	4-17-23: 28 oz/acre RT3, 1 qt/100 NIS, and 32 oz/acre molasses @ 10 gpa
Herbicides	5-23-23: 5.3 oz/acre Cleanse, 1.6 oz/acre Warrior II, 32 oz/acre molasses, 12.8 oz/acre crop oil, and 3 gpa Tracite Stand Xtra fertilizer (4-0-0.6-0 plus 0.6 Ca, 0.5 Mg, and 3.4 Cl) @ 10 gpa
Herbicide	5-25-23: 25 oz/acre Liberty 280SL, 4.2 gal/acre AMS @ 19 gpa

Table 8. Field 6 (winter wheat on fallow).

Variety and Crop:	'Piranha Cl+' soft white winter wheat
Seed Date & Rate:	Sept. 15, 2022. 76 lb/acre (23 seed/ft^2)
Starter Fertilizer	7 gpa liquid starter blend (10-15-0.2-1 plus 0.15 Zn and 0.06 B)
Deep Fertilizer (variable rate)	Average 35-0-0-3 (90% solution 32, 10% thio-sul) 19% received 46-0-0-4 or more 16% received 27-0-0-2 or less 65% received rates in between these
Other Fertilizer	9-15-22: 10 gpa ammonium chloride applied with spoke applicator (4 N, 10 Cl) @ 10 gpa
Herbicides	5-6-23: 13.5 oz/acre Huskie, 2 qt/100 NIS, 32 oz/acre molasses, and 4 gpa Tracite Stand Xtra fertilizer (5-0-0.8-0 plus 0.8 Ca, 0.6 Mg, and 4.5 Cl) @ 10 gpa
Herbicide	8-23-23: (WEEDit) 3.8 oz/acre Gramoxone SL 3.0 and 0.77 oz/acre NIS (sprayed 8.6%)

Continuous Crop Rotation

Table 9. Field 8 (broadleaf).

Variety and Crop	'IdaGold' yellow mustard
Seed Date & Rate	April 27, 2023. 7 lb/acre
Starter Fertilizer	3.5 gpa liquid starter blend (6-11-0.4-0)
Deep Fertilizer (variable rate)	Average 54-0-0-5 (90% solution 32, 10% thio-sul) 19% received 60-0-0-5 or more 27% received 53-0-0-5 or less 54% received rates in between these
Herbicide	4-17-23: 28 oz/acre RT3, 1 qt/100 NIS, and 32 oz/acre molasses @ 10 gpa
Herbicides	5-23-23: 5.3 oz/acre Cleanse, 1.6 oz/acre Warrior II, 32 oz/acre molasses, 12.8 oz/acre crop oil, and 3 gpa Tracite Stand Xtra fertilizer (4-0-0.6-0 plus 0.6 Ca, 0.5 Mg, and 3.4 Cl) @ 10 gpa
Herbicide	9-1-23: (WEEDit) 4.0 oz/acre Gramoxone SL 3.0 and 0.80 oz/acre NIS (sprayed 9.1%)

Table 10. Field 9 (spring cereal).

Variety and Crop:	'Lenetah' spring barley
Seed Date & Rate:	April 25, 2023. 70 lb/acre (20 seed/ft^2)
Starter Fertilizer	7 gpa liquid starter blend (12-12-0.2-1 plus 0.17 Zn and 0.07 B)
Deep Fertilizer (variable rate)	Average 73-0-0-6 (90% solution 32, 10% thio-sul) 17% received 80-0-0-7 or more 14% received 66-0-0-6 or less 69% received rates in between these
Herbicide	4-20-23: 28 oz/acre RT3, 1 qt/100 NIS, and 32 oz/acre molasses @ 10 gpa
Herbicides	5-23-23: 16 oz/acre Bison, 1 qt/100 NIS, 32 oz/acre molasses, and 3 gpa Tracite Stand Xtra fertilizer (4-0-0.6-0 plus 0.6 Ca, 0.5 Mg, and 3.4 Cl) @ 10 gpa
Herbicide	9-1-23: (WEEDit) 4.0 oz/acre Gramoxone SL 3.0 and 0.80 oz/acre NIS (sprayed 9.1%)

Table 11. Field 10 (continuous winter wheat).

Variety and Crop:	'Sockeye Cl+' soft white winter wheat
Seed Date & Rate:	Oct. 18, 2022. 85 lb/acre (23 seed/ft^2)
Starter Fertilizer	7 gpa liquid starter blend (10-15-0.2-1 plus 0.15 Zn and 0.06 B)
Deep Fertilizer (variable rate)	Average 74-0-0-6 (90% solution 32, 10% thio-sul) 19% received 86-0-0-8 or more 26% received 66-0-0-6 or less 55% received rates in between these
Herbicide	10-20-22: 3 oz/acre Anthem Flex @ 10 gpa
Herbicides	5-6-23: 13.5 oz/acre Huskie, 2 qt/100 NIS, 32 oz/acre molasses, and 4 gpa Tracite Stand Xtra fertilizer (5-0-0.8-0 plus 0.8 Ca, 0.6 Mg, and 4.5 Cl) @ 10 gpa
Herbicide	8-23-23: (WEEDit) 1.8 oz/acre Gramoxone SL 3.0 and 0.36 oz/acre NIS (sprayed 4.1%)

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 8 had the least amount of compaction with an average of 138 psi/18 inches, and Field 9 had the greatest average soil compaction with 180 psi/18 inches (Figure 1). For Fields 2, 3, 4, and 7, compaction averaged 179, 165, 179, and 161 psi/18 inches, respectively. Maximum compaction levels were typically observed at the six- to eight-inch depth.

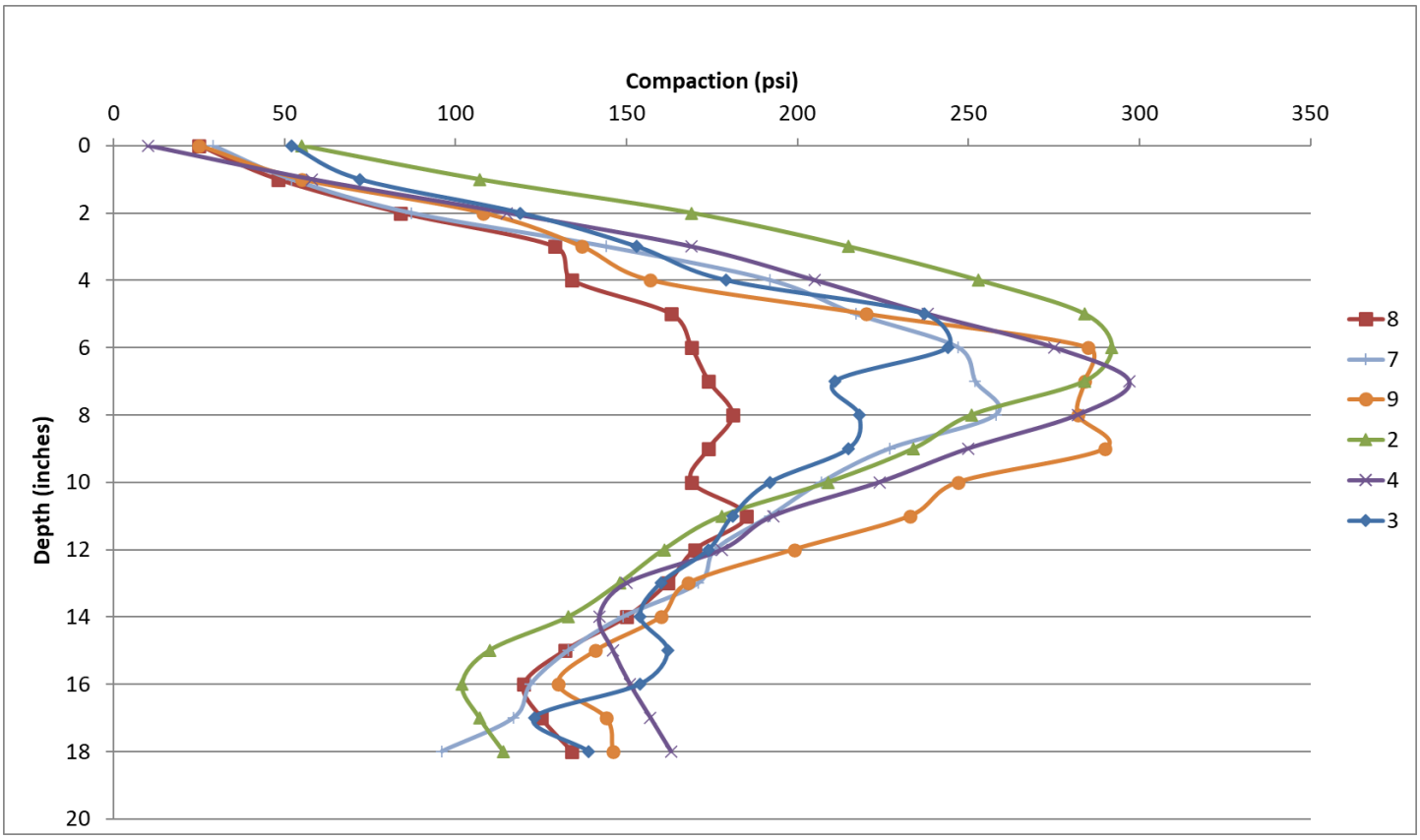

Figure 1. Soil compaction data were collected in the spring of the year from six fields at the WSU Wilke Research and Extension Farm in 2023.

Soil Samples

Soil samples were collected prior to seeding each crop 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 on planted crops is an average of the three production zones in each field (Tables 13, 14, 15, 17, 18, 19, 20, and 21). No-till fallow fields are sampled in the same five GPS-marked locations at the same time as those fields being spring-cropped (Tables 12 and 16).

3-Year Crop Rotation

Table 12. No-till fallow, Field 2.

Soil pH	6.0			Phosphorus	18 mg/kg
Organic Matter	3.1% (63 lb/acre N credit for OM)			Ammonium N	8 lb/acre
	Soil Depth (in)				
	0–12	12–24	24–36	36–48	Total
Nitrate-N (lb/acre)	14	11	14	31	70
Sulfate-S (mg/kg)	12	7	5	--	24
Soil Water (in)	3.3	3.0	2.7	2.1	11.1

Sum of Tested N: 141 lb/acre N

Table 13. Fallow-winter wheat, Field 5.

Soil pH	5.7			Phosphorus	15 mg/kg
Organic Matter	2.5% (50 lb/acre N credit for OM)			Ammonium N	9 lb/acre
	Soil Depth (in)				
	0–12	12–24	24–36	36–48	Total
Nitrate-N (lb/acre)	67	37	31	41	175
Sulfate-S (mg/kg)	18	13	11	--	41
Soil Water (in)	1.9	2.1	1.6	1.5	7.0

Sum of Tested N: 234 lb/acre N

Table 14. Spring wheat, Field 7.

Soil pH	6.1			Phosphorus	20 mg/kg
Organic Matter	2.1% (43 lb/acre N credit for OM)			Ammonium N	11 lb/acre
	Soil Depth (in)				
	0–12	12–24	24–36	36–48	Total
Nitrate-N (lb/acre)	9	8	9	7	33
Sulfate-S (mg/kg)	12	5	8	--	21
Soil Water (in)	3.3	2.9	1.9	1.5	9.6

Sum of Tested N: 86 lb/acre N

4-Year Crop Rotation

Table 15. Continuous winter wheat, Field 1.

Soil pH	5.5			Phosphorus	16 mg/kg
Organic Matter	2.8% (56 lb/acre N credit for OM)			Ammonium N	8 lb/acre
	Soil Depth (in)				
	0–12	12–24	24–36	36–48	Total
Nitrate-N (lb/acre)	7	4	5	10	27
Sulfate-S (mg/kg)	16	13	15	--	44
Soil Water (in)	0.6	0.6	0.7	0.7	2.6

Sum of Tested N: 90 lb/acre N

Table 16. No-till fallow, Field 3.

Soil pH	6.4			Phosphorus	13 mg/kg
Organic Matter	2.5% (51 lb/acre N credit for OM)			Ammonium N	8 lb/acre
	Soil Depth (in)				
	0–12	12–24	24–36	36–48	Total
Nitrate-N (lb/acre)	13	6	7	17	43
Sulfate-S (mg/kg)	9	3	7	--	19
Soil Water (in)	3.1	2.9	2.2	1.9	10

Sum of Tested N: 102 lb/acre N

Table 17. Spring canola, Field 4.

Soil pH	6.2			Phosphorus	18 mg/kg
Organic Matter	3.0% (59 lb/acre N credit for OM)			Ammonium N	7 lb/acre
	Soil Depth (in)				
	0–12	12–24	24–36	36–48	Total
Nitrate-N (lb/acre)	12	14	13	8	46
Sulfate-S (mg/kg)	12	8	7	--	26
Soil Water (in)	2.9	2.7	2.0	1.6	9.3

Sum of Tested N: 112 lb/acre N

Table 18. Fallow-winter wheat, Field 6.

Soil pH	5.4			Phosphorus	23 mg/kg
Organic Matter	2.4% (49 lb/acre N credit for OM)			Ammonium N	7 lb/acre
	Soil Depth (in)				
	0–12	12–24	24–36	36–48	Total
Nitrate-N (lb/acre)	69	30	24	27	149
Sulfate-S (mg/kg)	16	15	7	--	38
Soil Water (in)	1.5	1.7	1.1	1.0	5.3

Sum of Tested N: 205 lb/acre N

Continuous Rotation

Table 19. Yellow mustard, continuous, Field 8.

Soil pH	5.9			Phosphorus	30 mg/kg
Organic Matter	2.3% (47 lb/acre N credit for OM)			Ammonium N	7 lb/acre
	Soil Depth (in)				
	0–12	12–24	24–36	36–48	Total
Nitrate-N (lb/acre)	8	7	8	16	38
Sulfate-S (mg/kg)	12	5	8	--	22
Soil Water (in)	2.9	2.4	1.5	1.4	8.3

Sum of Tested N: 92 lb/acre N

Table 20. Spring barley, Field 9.

Soil pH	5.9			Phosphorus	19 mg/kg
Organic Matter	2.9% (57 lb/acre N credit for OM)			Ammonium N	9 lb/acre
	Soil Depth (in)				
	0–12	13–24	25–36	37–48	Total
Nitrate-N (lb/acre)	11	8	10	13	42
Sulfate-S (mg/kg)	14	6	7	--	27
Soil Water (in)	3.0	2.7	2.0	1.2	8.8

Sum of Tested N: 108 lb/acre N

Table 21. Continuous winter wheat, Field 10.

Soil pH	5.8			Phosphorus	12 mg/kg
Organic Matter	2.4% (48 lb/acre N credit for OM)			Ammonium N	4 lb/acre
	Soil Depth (in)				
	0–12	12–24	24–36	36–48	Total
Nitrate-N (lb/acre)	6	2	2	4	14
Sulfate-S (mg/kg)	25	8	18	--	50
Soil Water (in)	0.6	0.8	0.6	0.7	2.7

Sum of Tested N: 65 lb/acre N

Soil pH and KCl Extractable Aluminum (Al)

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 is 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 above 5.0, and KCl Al ranged from 1.6 to 14.8 ppm (Table 22). At a depth of 3–6 inches, soil pH levels ranged from 5.2 to 5.7, and KCl Al ranged from 8.0 ppm in Field 9 to 52.6 ppm in Field 8. At a depth of 6–12 inches, pH ranged from 6.4 to 6.8, and KCl Al ranged from 0.0 to 1.5 ppm.

Table 22. Soil pH and KCl extractable aluminum in six fields at the WSU Wilke Research and Extension Farm in the spring of 2023.

	Field 2 (NTF)	**Field 3** (NTF)	**Field 4** (canola)	**Field 7** (SWSW)	**Field 8** (mustard)	**Field 9** (barley)
0–3 inches						
pH	5.6	6.6	5.8	5.7	5.5	5.4
KCl Al (ppm)	6.2	1.6	1.6	2.3	14.8	5.3
3–6 inches						
pH	5.5	5.6	5.7	5.3	5.2	5.5
KCl Al (ppm)	15.8	13.9	8.5	25.4	52.6	8.0
6–12 inches						
pH	6.7	6.8	6.7	6.8	6.4	6.7
KCl Al (ppm)	0.0	0.7	1.5	0.7	1.5	0.1

Production and Economic Performance

Nitrogen uptake efficiency (NUE) was at or above 50 percent for continuous soft white winter wheat (SWWW) in Field 10 (Table 23). For fields at or above 50 percent, 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. Field 6 was SWWW on fallow and Field 7 was soft white spring wheat (SWSW) which had NUE of 47 and 48 percent, respectively. Field 1 was continuous SWWW and Field 5 was SWWW on fallow and these fields had the lowest NUE at only 40 and 41 percent, respectively, which implies the crop was overfertilized or fertilizer timing could be adjusted. Above-average fertilizer should be available for next year's production. Soft white wheat traditionally requires 2.7 lb N/bu, and in 2023, across the farm, it ranged from 3.2 to 4.3 lb N/bu.

Table 23. 2023 nitrogen use efficiency.

	Field 1 (SWWW)	**Field 5** (SWWW)	**Field 6** (SWWW)	**Field 7** (SWSW)	**Field 10** (SWWW)
Soil Test Nitrogen*	75	214	185	51	59
Applied Nitrogen	86	50	49	88	89
Total Nitrogen	161	264	234	139	148
Grain Yield	37.4	72.0	73.4	38.7	45.2
Grain Protein	11.6%	10.0%	9.9%	11.5%	10.9%
lb N/bu	4.3	3.7	3.2	3.6	3.3
Nitrogen Uptake Efficiency	**40%**	**41%**	**47%**	**48%**	**50%**

*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 2023, before harvest, an estimated 20% of the SWWW crop was forward contracted, and no canola or barley was forward contracted. Market grades for each crop are provided as these also impact the final market price.

Average input costs per year at the WSU Wilke Farm were up 37% over the three-year average (2020–22). However, economic returns over input costs were down 10.4%. Tables 24–29 summarize the rotation, production, and economic performance of the three-year rotation, four-year rotation, and continuous cropping system at the Wilke Farm in 2023.

The three-year crop rotation returns above input costs averaged $120/acre, 21% less than the three-year average. The four-year crop rotation returns above input costs averaged $153/acre, 19% greater than the previous three-year average. The continuous cropping system returns above input costs averaged $191/acre, 7% greater than the previous three-year average. The WSU Wilke Farm is enrolled in the USDA 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 in the field summaries.

Table 24. Three-year cropping rotation sequence at the Wilke Farm from 2019 to 2024.

Year	Field 2	Field 5	Field 7
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	DNS Wheat (38.8 bu/acre)	No-till Fallow	Winter Wheat (77.5 bu/acre)
2023	**No-till Fallow**	**Winter Wheat/Canola (72 bu/acre; 1,053 lb/acre)**	**Spring Wheat (38.7 bu/acre)**
2024	Winter Wheat/Canola	Spring Cereal	No-till Fallow

Table 25. Three-year crop rotation production at the Wilke Farm, 2023.

	Field 2	Field 5	Field 5	Field 7
Cropping Specifics				
Acreage	25.2	17.6	8.3	34.0
Crop	No-till Fallow	'Piranha CL+' SWWW	'Plurax' Winter Canola	'Ryan' SWSW
Crop Production				
Yield	--	72.0 bu/acre	1,053 lb/acre	38.7 bu/acre
Mkt Grade	--	#1 SWH, 60.9, 0.3% dockage	#1 non-GMO canola, 4.6% dockage	#1 SWH, 60.7, 1.0% dockage
Gross Economic Return*				
Mkt Price	--	$6.30/bu	$0.227/lb	$6.24/bu
Crop Sales	--	$453.60/acre	$237.96/acre	$241.49/acre
Insurance	--	$110.00/acre	$222.89/acre	$36.05/acre
Total Return	--	$563.60/acre	$460.85/acre	$277.55/acre
Input Costs				
Seed	--	$27.62/acre	$34.00/acre	$22.22/acre
Fertilizer	--	$96.65/acre	$77.93/acre	$112.23/acre
Herbicides	$32.99/acre	$40.81/acre	$24.65/acre	$24.84/acre
Insurance	--	$41.12/acre	$32.41/acre	$41.12/acre
Total	$32.99/acre	$206.20/acre	$168.99/acre	$200.41/acre
Summary				
Return over Costs	-$32.99/acre	$357.40/acre	$291.86/acre	$71.14/acre
3-Year Rotation Return over Input Costs†			**$120/acre**	

*Revenue and costs include crop insurance.
†Costs do not include fixed costs associated with the farm.

Table 26. Four-year cropping rotation sequence at the Wilke Farm from 2019 to 2024.

Year	Field 1	Field 3	Field 4	Field 6
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	Spring Canola (1,290 lb/acre)	Winter Wheat (67.9 bu/acre)	Winter Wheat (90.4 bu/acre)	No-till Fallow
2023	Winter Wheat (37.4 bu/acre)	No-till Fallow	Spring Canola (1,600 lb/acre)	Winter Wheat (73.3 bu/acre)
2024	No-till Fallow	Winter Wheat	Winter Wheat	Broadleaf

Table 27. Four-year crop rotation production at the Wilke Farm, 2023.

	Field 1	Field 3	Field 4	Field 6
Cropping Specifics				
Acreage	18.1	27.5	25.2	25.5
Crop	'Sockeye CL+' SWWW	No-till Fallow	'Invigor L345PC' Spring Canola	'Piranha CL+' SWWW
Crop Production				
Yield	37.4 bu/acre	--	1,600 lb/acre	73.4 bu/acre
Mkt Grade	#2 SWH, 59.3, 0.8% dockage	--	#1 GMO canola, 1.6% dockage	#1 SWH, 61.8, 0.2% dockage
Gross Economic Return*				
Mkt Price	$6.26/bu	--	$0.227/lb	$6.30/bu
Crop Sales	$234.12/acre	--	$362.34/acre	$462.42/acre
Insurance	$173.17/acre	--	$0.00/acre	$111.01/acre
Total Return	$407.29/acre	--	$362.34/acre	$573.43/acre
Input Costs				
Seed	$32.22/acre	--	$68.65/acre	$27.62/acre
Fertilizer	$131.88/acre	--	$117.82/acre	$100.23/acre
Herbicides	$31.99/acre	$25.40/acre	$41.08/acre	$18.99/acre
Insurance	$41.20/acre	--	$35.35/acre	$41.20/acre
Total	$237.29/acre	$25.40/acre	$262.90/acre	$188.04/acre
Summary				
Return over Costs	$170.00/acre	-$25.40/acre	$99.44/acre	$385.39/acre
4-Year Rotation Return over Input Costs†			**$152.77/acre**	

*Revenue and costs include crop insurance.
†Costs do not include fixed costs associated with the farm.

Table 28. Continuous crop rotation sequence at the Wilke Farm from 2019 to 2024.

Year	Field 8	Field 9	Field 10
2019	Winter Wheat (63.6 bu/acre)	Spring Wheat (44.1 bu/acre)	Spring Wheat (44.1 bu/acre)
2020	Spring Wheat (59.5 bu/acre)	Spring Wheat (49.6 bu/acre)	Spring Wheat (49.6 bu/acre)
2021	No-till Fallow	Spring Canola (705 lb/acre)	Spring Wheat (20.3 bu/acre)
2022	Winter Wheat (83.9 bu/acre)	Winter Wheat (51.7 bu/acre)	Spring Canola (1,336 lb/acre)
2023	**Yellow Mustard (755 lb/acre)**	**Spring Barley (1.43 ton/acre)**	**Winter Wheat (45.2 bu/acre)**
2024	Winter Wheat	Broadleaf	Spring Cereal

Table 29. Continuous crop rotation production at the Wilke Farm, 2023.

	Field 8	Field 9	Field 10
Cropping Specifics			
Acreage	27.0	30.0	35.9
Crop	'IdaGold' Yellow Mustard	'Lenetah' Spring Barley	'Sockeye CL+' Winter Wheat
Crop Production			
Yield	755 lb/acre	1.43 ton/acre	45.2 bu/acre
Mkt Grade	--	#1 Barley, 49.0, 0.2% dockage	#2 SWH, 59.1, 0.7% dockage
Gross Economic Return*			
Mkt Price	$0.57/lb	$160/ton	$6.26/bu
Crop Sales	$430.24/acre	$228.80/acre	$282.95/acre
Insurance	$0.00/acre	$28.83/acre	$172.98/acre
Total Return	$430.24/acre	$257.63/acre	$455.93/acre
Input Costs			
Seed	$28.63/acre	$25.73/acre	$32.22/acre
Fertilizer	$79.61/acre	$112.54/acre	$133.36/acre
Herbicides	$23.22/acre	$26.04/acre	$30.41/acre
Insurance	$13.22/acre	$19.57/acre	$41.20/acre
Total	$144.68/acre	$183.88/acre	$237.19/acre
Summary			
Return over Costs	$285.56/acre	$73.75/acre	$218.74/acre
Continuous Rotation Return over Input Costs†		**$191.37/acre**	

*Revenue and costs include crop insurance, unlike previous years' publications.
†Costs do not include fixed costs associated with the farm.

Summary

Weather data in 2023 (Table 19) and 2022 (Table 20) are provided. 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 (2021 to 2023), the three-year rotation, four-year rotation, and continuous cropping rotation have averaged returns above input costs of $150, $191, and $191 per acre, respectively. Over the last six years, the continuous rotation and four-year rotation have averaged returns above input costs of $168 and $163 per acre, respectively, and are not significantly different. The three-year rotation has averaged $136/acre return above costs during this period and is significantly less than both the continuous rotation and the four-year rotation.

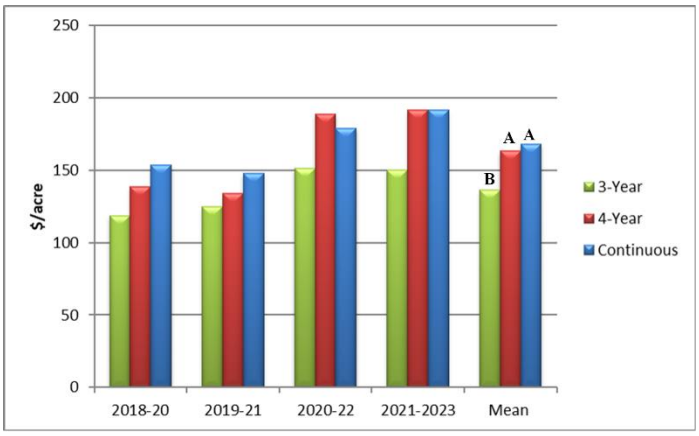

Figure 2. Three-year average economic return over input costs of three-year, four-year, and continuous cropping systems at the WSU Wilke Research and Extension Farm. Costs do not include fixed costs associated with the farm. Means within columns assigned different case letters are significantly different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

WSU Wilke Research Summary

Research and outreach are a large component of the farm. In 2022–23, there were 10.9 acres of Farm Service Agency (FSA) certified research plots in the fall and an additional 6.2 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

- 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.
- University of Idaho. “Winter Canola Variety Plots.” This project helps companies bring the best canola genetics to market and helps farmers with selecting the best genetics.
- Arron Carter, WSU. “Soft White Wheat Breeding Plots.” These are the advanced generation selections for the intermediate rainfall zone.
- Aaron Esser, WSU. “Winter Canola Stand Establishment Study.” Evaluating the feasibility of seed-applied, water-absorbent material to improve stand establishment and yield.
- Aaron Esser, WSU. “Enhanced Wireworm Control in Spring Wheat.” 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 fungicidal seed-applied products to reduce disease and improve yield.
- 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.
- Ian Burke, WSU. “Herbicide Evaluation.” This project is examining many different compounds for weed control in predominate wheat production systems.
- Michael Pumphrey, WSU. “Liming and Aluminum Tolerant Varieties of Wheat Interaction.”
- Garett Heineck, USDA/ARS. “Kernza Perennial Cropping System.”
- Don Llewellyn, WSU Extension. “Forage Evaluation for Dryland Agriculture.”

Large Plots

- Aaron Esser, WSU. “Benefits of Spring Fungicide and Pi-Dust Application in Winter Wheat Production.”
- Jesse Ford, 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.
- Aaron Esser, WSU. “Cover Crop Feasibility as a Replacement for Summer Fallow Systems.”
- Haly Neely, Shikha Singh, Don Lewellen, and Aaron Esser. “Long-Term ‘Cow Chow’ Cover Crop Feasibility.”

Weather Data

The following tables provide weather data for Davenport, Washington, in 2023 (Table 30) and 2022 (Table 31), respectively.

Table 30. Weather data for Davenport, Washington, in 2023 (crop year summary: Sept. 1, 2022, to Aug. 31, 2023).

	Temperature (°F)			Degree	Rain	Rain
Month	**High**	**Low**	**Mean**	**Days***	**Fall (in.)**	**Days**
9	76.2	48.2	62.2	905	0.40	4
10	65.7	40.5	52.3	654	0.37	4
11	32.8	18.5	25.7	20	0.79	9
12	24.5	14.0	20.4	7	2.90	7
1	32.9	23.7	28.7	26	1.56	12
2	37.3	21.3	28.6	45	0.36	4
3	43.8	26.4	34.6	122	0.67	10
4	54.5	31.9	43.5	336	1.74	11
5	72.5	47.5	60.4	868	0.89	9
6	76.0	49.1	63.8	916	0.66	5
7	85.8	54.5	71.6	1,181	0.27	2
8	83.1	55.1	69.8	1,151	0.48	7
Total				**6,232**	**11.09**	**84**

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

Table 31. Weather data for Davenport, Washington, in 2022 (crop year summary: Sept. 1, 2021, to Aug. 31, 2022).

	Temperature (°F)			Degree	Rain	Rain
Month	High	Low	Mean	Days*	Fall (in.)	Days
9	72.3	44.9	58.7	798	0.92	7
10	58.6	35.3	45.9	436	0.71	8
11	43.7	30.6	37.1	185	1.98	17
12	29.8	19.1	25.0	34	0.38	7
1	28.9	20.5	25.8	2	1.23	8
2	35.2	20.5	27.6	34	0.89	8
3	49.3	31.4	39.8	270	0.88	7
4	50.2	29.0	39.7	232	1.09	11
5	59.3	37.4	48.5	507	1.46	13
6	69.4	47.7	59.2	797	2.10	13
7	86.5	55.4	72.2	1,207	0.45	5
8	88.9	57.7	73.9	1,280	0.12	3
Total				**5,782**	**12.21**	**107**

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

Special Thanks:

BASF, spring canola seed donation.

AGWEATHERNET STATION located at the Wilke Research and Extension Farm.

You can access Wilke weather data at AgWeatherNet | Washington State University (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.

By
Aaron Esser, Wilke Farm Management Committee Chair, Washington State University
Derek Appel, Wilke Farm Manager, Washington State University

WSU PEER REVIEWED

TB100E

WASHINGTON STATE UNIVERSITY
EXTENSION