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Pullman Plant Materials Center

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Warm-Season Cover Crop Cultivar Performance in MLRA 9 Dryland Wheat-Fallow Systems: Emergence, Canopy Cover, Phenology, and Water Use

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ABSTRACT

Warm-season cover crops represent a potential opportunity to improve conservation within the wheat-fallow rotation common to MLRA 9 of eastern Washington. However, successful integration requires selecting cultivars that provide adequate ground coverage without depleting soil moisture reserves critical to subsequent crop establishment. This three-year (2023–2025) randomized complete block trial evaluated 30 warm-season cultivars from 14 species for establishment, canopy development, phenology, and soil moisture use at the USDA-NRCS Pullman Plant Materials Center. ‘Quickguard’ triticale ($\times$ *Triticosecale* Wittmack) and ‘Hayden’ spring oat (*Avena sativa*) achieved the highest emergence 15 days after planting (DAP), exceeding 90%, while all radish cultivars, grain sorghum, and ‘Coes’ forage sorghum (*Sorghum bicolor* (L.) Moench) established poorly, with emergence below 25%. Canopy coverage at 60 DAP ranged from less than 10% in radish cultivars to greater than 55% in VNS sorghum sudan (*Sorghum* $\times$ *drummondii*), ‘Laredo’ forage soybean (*Glycine max* (L.) Merr), VNS forage sorghum, ‘Tifleaf3’ pearl millet (*Cenchrus americanus*), ‘Horizon’ and ‘Plateau’ proso millet (*Panicum miliaceum* L), and ‘Peredovik’ sunflower (*Helianthus annuus*). Eleven cultivars reached 50% bloom within 75 days of planting, while six cultivars — including two forage soybean cultivars, did not reach reproductive maturity within the study period in any year, indicating phenological misalignment with MLRA 9 growing conditions. Soil volumetric water content (VWC) depletion over the growing season ranged from 11.0 percentage points with ‘Ground Hog’ radish (*Raphanus sativus*) to 21.5 percentage points with ‘Coes’ forage sorghum, with pearl millet and proso millet cultivars offering low-to-moderate depletion paired with acceptable canopy coverage. No single cultivar excelled across all measured traits, indicating that species and cultivar selection should align with the producer's primary management objective whether it be rapid establishment, weed suppression, early maturity, or conservation of soil moisture. Results provide cultivar-level performance data for warm-season cover crops in MLRA 9 and support regionally specific recommendations for integration into dryland wheat-fallow systems.

INTRODUCTION

While cover crops provide well-documented benefits including soil health improvement, weed suppression, and erosion control (Clark, 2012), adoption in dryland eastern Washington remains limited due to concerns about soil moisture depletion and potential interference with subsequent wheat establishment. Dryland wheat dominates agricultural production in MLRA 9 and producers must carefully manage soil moisture reserves to ensure adequate stand establishment of the following cash crop. A potential window exists within the wheat-fallow rotation that warm-season cover crops could fill; however, limited research has evaluated which species and cultivars perform best under the arid, hot summer conditions characteristic of eastern Washington (Crossley, 2021; Delgado & Gantzer, 2015). Cultivar-level performance data for this region is critically lacking, and their absence limits informed adoption decisions by producers and NRCS field staff.

Warm-season cover crops are not currently used to any significant extent in MLRA 9, yet numerous commercially available species grown elsewhere in the United States share climate tolerances that suggest potential adaptation to this area. If incorporated into crop rotations, these species would provide a variety of benefits, including enhancing soil health by adding a diversity of plant functional groups, providing weed/pest suppression, enhancing habitat for pollinators and beneficial insects, providing good quality supplemental livestock feed, and filling short periods between commercial crops (Clark, 2012). The following species are candidates for cover crops in this region: safflower, sunflower, radish, millet, sorghum, oat, triticale, and forage soybean. These species have beneficial attributes to support their adoption as cover crops such as drought tolerance, deep taproots, weed suppression, low water use, early maturity, nutrient scavenging and use as a forage (Brown, 2017; Curell, 2012; Green Cover, 2022; Hancock Seed, 2023; Jacobs, 2012; Montana State University, 2015; Shehan, 2014a; Shehan, 2014b, Shehan 2014c, Shehan 2014d; St. John et al., 2017).

The objective of this study was to evaluate the adaptation of various warm-season cover crop species and to identify management recommendations for implementing them into dryland climatic conditions of MLRA 9.

MATERIALS AND METHODS

Site Description

This study was conducted at the USDA-NRCS Pullman Plant Materials Center (PMC), Pullman, WA (46° 42'58" N, 117°08'14" W; elevation 2600ft) from 2023-2025. The Pullman PMC is in MLRA 9 of Land Resource designation B, with the majority of the soil a Palouse silt loam. The site has a climate typical for the Palouse region, with average yearly precipitation between 13 to 28 inches and average temperature between 47 to 54 degrees with an average freeze-free period of 165 days. About 70% of annual precipitation falls between October and March, while 25% falls between April and June. July through September is the driest period. Winter temperatures are cool to cold and

can drop to -24°C with occasional arctic cold winds from Canada.

Experimental Design

This trial included 30 cover crop cultivars (Table 1) arranged in a Randomized Complete Block Design (RCBD) with cultivar as the treatment and year and replicate as blocking factors. Individual plots were 8 ft by 50 ft and seeded with a Great Plains no-till drill equipped with a Kincaid cone seeder (Kincaid Equipment, Haven, KS) on 7.5" row spacing. Seeding rates for all species were based on industry recommendations and previously published NRCS Technical Notes (Green Cover, 2022; St. John et al., 2017; Young-Mathews et al., 2016). Prior to planting, legume seeds were inoculated with appropriate rhizobial bacteria. Weeds were controlled by spot treating with selective and non-selective herbicides or hand rogued.

Plots were planted between mid-May and mid-June, depending on rainfall and after the average last frost date for the area. No supplemental irrigation was applied throughout the trial. Precipitation and temperature were monitored using data from the on-site ClimaVUE 50 weather station (Campbell Scientific, Logan, UT). Plots were terminated when 50% or more of the plants reached 50% bloom using either chemical or mechanical methods. Plots were moved to a new field location each year to avoid contamination from the previous year. Cover crop species, cultivars, and seeding rates used in this trial are given in Table 1.

Table 1: Species, scientific name, cultivars, and seeding rates of annual, warm-season cover crops planted in spring 2023, 2024, and 2025 at the USDA NRCS Pullman, Washington Plant Materials Center.

Species	Scientific Name	Cultivar	Seeding Rate PLS lb/ac	Years Planted
Radish	<i>Raphanus sativus</i>	Deep-Till	12	2023, 2024
		Nitro	12	2023, 2024
		Ground Hog	12	2023, 2024
		Eco-Till	12	2023, 2024
Pearl millet	<i>Cenchrus americanus</i>	Tifleaf3	20	2023, 2024, 2025
		Exceed	20	2023, 2024, 2025
		Leafy 22	20	2023, 2024, 2025

Species	Scientific Name	Cultivar	Seeding Rate PLS lb/ac	Years Planted
Foxtail millet	<i>Setaria italica</i>	White Wonder	30	2023, 2024, 2025
		Siberian	30	2023, 2024, 2025
		German	30	2023, 2024, 2025
Proso millet	<i>Panicum miliaceum</i>	Horizon	30	2023, 2024, 2025
		Sunrise	30	2023, 2024, 2025
		Plateau	30	2023, 2024, 2025
		Dove	30	2023, 2024, 2025
Japanese millet	<i>Echinochloa esculenta</i>	VNS	25	2023, 2024, 2025
Browntop millet	<i>Urochloa ramosa</i>	VNS	20	2023, 2024, 2025
Forage sorghum	<i>Sorghum bicolor</i>	VNS	20	2023, 2024, 2025
		Coes	15	2025
Grain sorghum	<i>Sorghum bicolor</i>	VNS	6	2025
Sorghum sudan	<i>Sorghum × drummondii</i>	VNS	25	2025
Triticale	× <i>Triticosecale</i>	Quickguard	100	2023, 2024, 2025
Spring oats	<i>Avena sativa</i>	Hayden	100	2023, 2024, 2025

Species	Scientific Name	Cultivar	Seeding Rate PLS lb/ac	Years Planted
Forage soybean	<i>Glycine max</i>	Laredo	54	2023, 2024, 2025
		Tara	54	2023, 2024, 2025
		Derry	54	2023, 2024, 2025
		Tyrone	54	2023, 2024, 2025
		Colossus LJ	54	2023, 2024, 2025
		Hutcheson	54	2023, 2024, 2025
Safflower	<i>Carthamus tinctorius</i>	Baldy	25	2023, 2024, 2025
Sunflower	<i>Helianthus annus</i>	Peredovik	15	2023, 2024, 2025

Evaluation Protocols

We collected plot data and photographs using the Field Book app (Rife & Poland, 2014) on a Samsung Galaxy tablet. Percent canopy cover was measured using the Canopeo app (Oklahoma State University Soil Physics Research Group, 2015) on an Apple iPhone. The following data was collected:

Emergence: To evaluate stand establishment and seedling vigor across species we recorded the date of plant emergence and expressed total emergence as a percentage of total plot based on ocular assessment.

Green Canopy Cover: Percentage of canopy cover taken 30 days DAP, 60 DAP, and at termination to determine growth rates and area where the soil is more protected.

Phenology: Dates of each major developmental growth stage for each entry were recorded until 50% bloom to estimate how long the crop could remain on the soil for cover or potential forage.

Soil Moisture: Volumetric water content is the volume of liquid water per volume of soil. It is usually expressed as a percentage. For example, 25% VWC means 0.25 cubic inch of water per

cubic inch of soil. We measured %VWC at planting and termination for each cultivar using a HydroSense II Handheld Soil Moisture Sensor (Campbell Scientific, Logan, UT) to estimate how much water each cultivar used.

RESULTS AND DISCUSSION

Weather

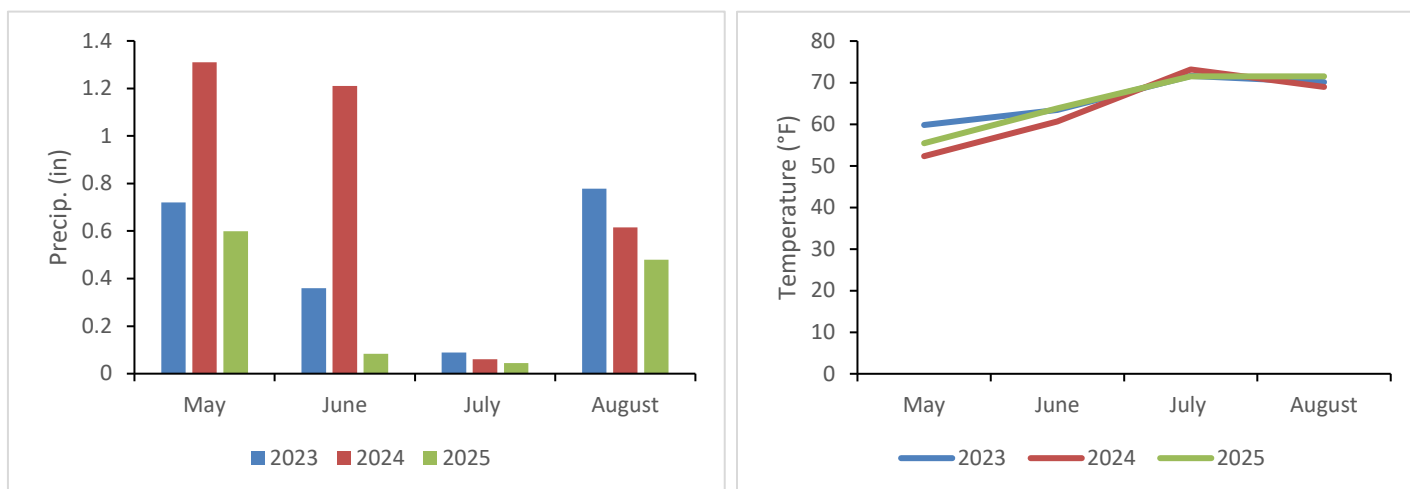


Figure 1: Weather data for the warm season cover crop trial (May to August) in 2023, 2024, and 2025 measured with the ClimaVUE 50 weather station at the Pullman, Washington Plant Materials Center. Precipitation is presented in inches and temperature is in Fahrenheit.

In 2023, the trial was planted on May 18th. The total precipitation throughout the trial was 1.95 inches, and the average temperature for the first 15 days after planting was 61.59 °F. In 2024, the trial was planted on June 14th. The total precipitation throughout the trial was 3.20 inches, and the average temperature for the first 15 days after planting was 60.75 °F. In 2025, the trial was planted on May 9th. The total precipitation throughout the trial was 1.21 inches, and the average temperature for the first 15 days after planting was 51.60 °F. Climate variability over time could contribute to larger standard errors and lead to fewer statistically significant differences in the data.

Emergence

Figure 2 and Table 2 show the percent emergence for each cultivar taken 15 days after planting. Hayden spring oats and Quickguard triticale had the highest percent emergence, both greater than 90%, while radishes, grain sorghum, and Coes forage sorghum were the lowest, below 25%. Sorghum was planted only for one year, so it was not included in the statistical analysis.

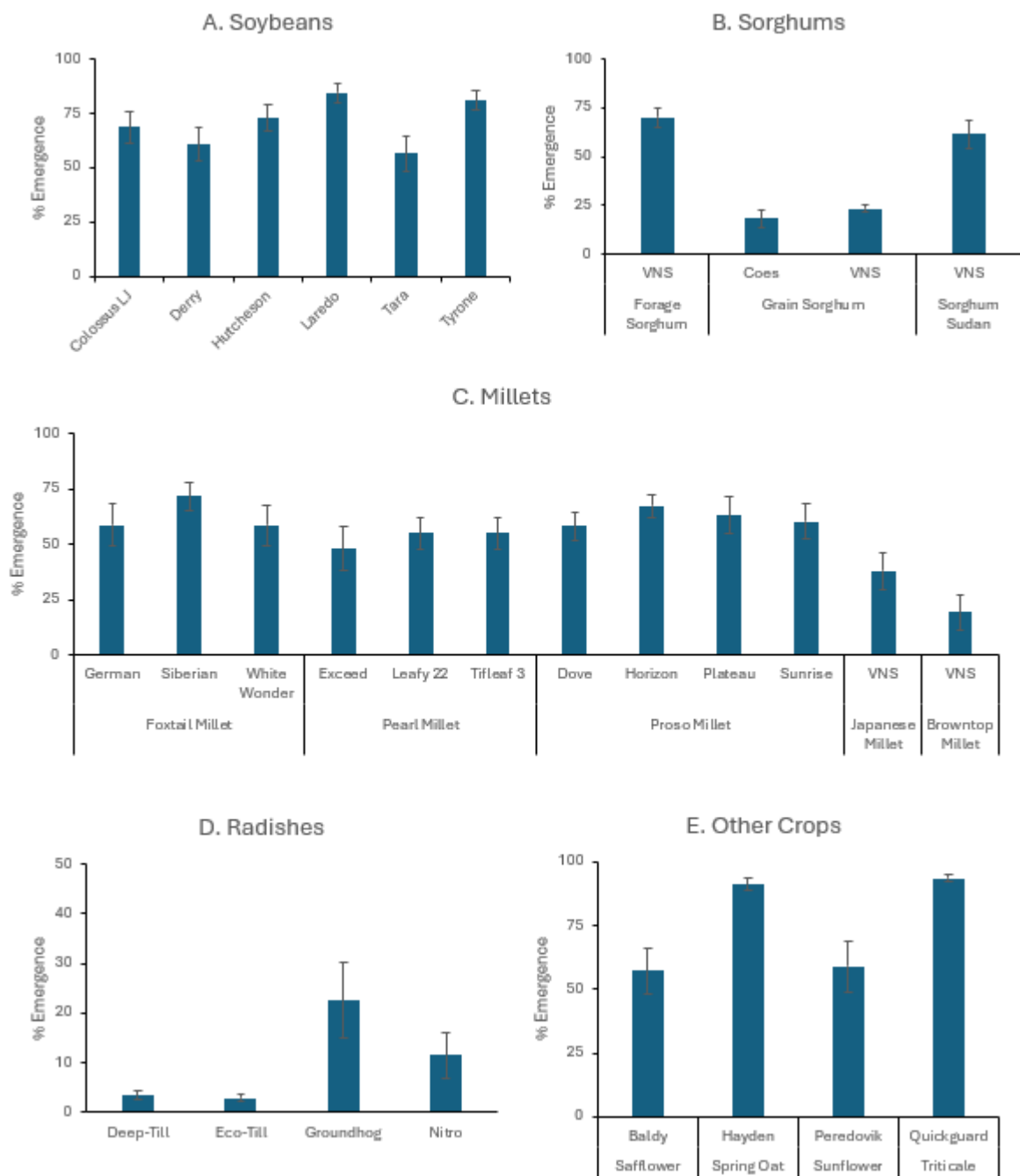


Figure 2: Average percent emergence for all cultivars, separated by species, recorded at 15 days after planting in the 2023-2025 warm season cover crop trial at Pullman, Washington Plant Materials Center.

Table 2: Average percent emergence for all cultivars, separated by species, recorded at 15 days after planting (DAP) in the 2023-2025 warm season cover crop trial at Pullman, Washington Plant Materials Center. Means within the same column followed by the same letter are not significantly different with Tukey HSD means comparisons. ‘ns’ next to these entries refers to no statistics.

Species	Cultivar	% Emergence 15 DAP	SE Mean
Radish	Deep-Till	3.50 ^d	1.02
	Nitro	11.5 ^{dg}	4.62
	Ground Hog	22.5 ^{defg}	7.61
	Eco-Till	2.92 ^d	0.76
Pearl millet	Tifleaf3	55.0 ^{abef}	6.92
	Exceed	48.1 ^{aefg}	10.2
	Leafy 22	55.2 ^{abef}	7.18
Foxtail millet	White Wonder	58.6 ^{abcef}	9.28
	Siberian	71.6 ^{abc}	6.19
	German	58.8 ^{abcef}	9.88
Proso millet	Horizon	67.2 ^{abc}	5.11
	Sunrise	60.3 ^{abcef}	7.79
	Plateau	63.0 ^{abce}	8.31
	Dove	58.4 ^{abcef}	6.35
Japanese millet	VNS	37.9 ^{aefg}	8.28
Browntop millet	VNS	19.1 ^{defg}	8.07

Species	Cultivar	% Emergence 15 DAP	SE Mean
Sorghum sudan	VNS	61.7 ^{ns}	7.26
Forage sorghum	VNS	70.2 ^{ns}	5.05
	Coes	18.3 ^{ns}	4.41
Grain sorghum	VNS	23.3 ^{ns}	1.67
Triticale	Quickguard	93.6 ^c	1.43
Spring oats	Hayden	91.2 ^{bc}	2.17
Forage soybean	Laredo	84.4 ^{abc}	4.20
	Tara	56.6 ^{abcef}	8.33
	Derry	60.9 ^{abcef}	7.40
	Tyrone	80.9 ^{abc}	4.55
	Colossus LJ	68.8 ^{abc}	7.37
	Hutcheson	72.9 ^{abc}	6.10
Safflower	Baldy	57.3 ^{abcef}	9.00
Sunflower	Peredovik	59.1 ^{abcef}	10.09

Green Canopy Cover

Figure 3 and Table 3 illustrate the average percent canopy cover across all years of the study for each cultivar. Data was collected at 30 and 60 days after planting, as well as at termination. The cultivars with the highest canopy cover 30 days after planting were the proso millets, VNS forage sorghum, and Quickguard triticale (>14% cover). The cultivars with the greatest canopy cover at 60 days after planting were VNS sorghum sudan, Laredo forage soybean, VNS forage sorghum, Tifleaf3 pearl millet, Horizon and Plateau proso millet, and Peredovik sunflower (>55%). Finally, the cultivars with the highest canopy cover at termination included the forage soybeans, VNS forage sorghum, Horizon proso millet, VNS browntop millet, and Hayden spring oat (>75%).

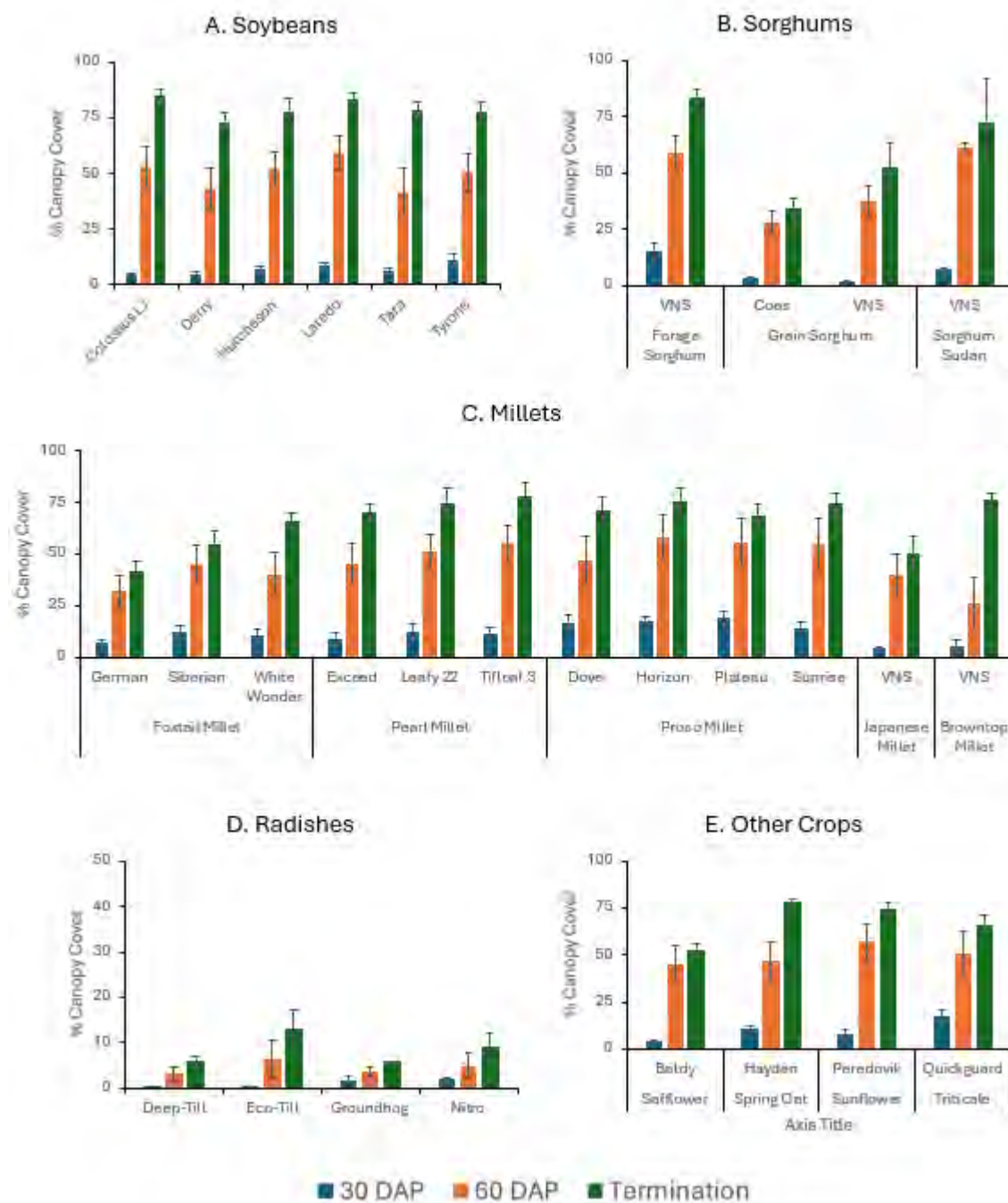


Figure 3: Average percent canopy cover for all cultivars, separated by species at 30 and 60 days after planting (DAP), as well as at termination, which varied per species in the 2023-2025 warm season cover crop trial at Pullman, Washington Plant Materials Center.

Table 3: Average percent canopy cover averaged from all years of the study for all cultivars at 30 and 60 days after planting (DAP), as well as at termination, which varied per species in the 2023-2025 warm season cover crop trial at Pullman, Washington Plant Materials Center. Means within the same column followed by the same letter are not significantly different with Tukey HSD means comparisons.

Species	Cultivar	% Canopy Cover 30 DAP	SE Mean	% Canopy Cover 60 DAP	SE Mean	% Canopy Cover Termination	SE Mean
Radish	Deep-Till	0.06 ^a	0.06	3.10 ^a	1.50	5.87 ^b	1.87
	Nitro	1.92 ^{ab}	0.50	5.0 ^{ab}	2.62	9.21 ^b	4.07
	Ground Hog	1.56 ^{ab}	1.02	3.62 ^{ab}	1.07	5.91 ^b	0.13
	Eco-Till	0.24 ^a	0.24	6.47 ^{ab}	3.99	12.9 ^b	6.15
Pearl millet	Tifleaf3	11.7 ^{abcd}	2.33	55.2 ^{ab}	8.66	77.9 ^{acd}	7.81
	Exceed	8.77 ^{abcd}	2.95	44.9 ^{ab}	9.95	70.3 ^{acde}	4.45
	Leafy 22	12.4 ^{abcd}	3.34	51.6 ^{ab}	8.19	74.9 ^{acd}	8.29
Foxtail millet	White Wonder	10.4 ^{abcd}	3.09	40.3 ^{ab}	10.1	65.8 ^{acde}	4.94
	Siberian	12.4 ^{abcd}	2.45	44.9 ^{ab}	8.95	54.5 ^{cde}	7.74
	German	6.75 ^{abc}	1.77	31.8 ^{ab}	7.92	41.2 ^{be}	6.74
Proso millet	Horizon	17.4 ^{cd}	1.76	57.9 ^{ab}	11.0	75.4 ^{acd}	8.01
	Sunrise	14.1 ^{bcd}	2.53	54.5 ^{ab}	12.7	74.5 ^{acd}	6.33
	Plateau	18.8 ^d	3.45	55.5 ^{ab}	11.9	68.5 ^{acde}	7.24
	Dove	16.9 ^{cd}	3.30	46.5 ^{ab}	11.7	70.7 ^{acde}	8.73
Japanese millet	VNS	4.26 ^{ab}	0.84	39.8 ^{ab}	10.4	50.4 ^{cde}	7.94
Browntop millet	VNS	5.48 ^{ab}	2.81	25.9 ^{ab}	12.7	76.1 ^{cde}	3.47

Species	Cultivar	% Canopy Cover 30 DAP	SE Mean	% Canopy Cover 60 DAP	SE Mean	% Canopy Cover Termination	SE Mean
Forage Sorghum	VNS	15.5 ^{ns}	3.66	58.9 ^{ns}	7.23	83.8 ^{ns}	3.24
	Coes	3.33 ^{ns}	0.33	28.3 ^{ns}	4.41	34.3 ^{ns}	4.63
Grain Sorghum	VNS	2.33 ^{ns}	0.33	37.7 ^{ns}	6.98	52.3 ^{ns}	11.4
Sorghum Sudan	VNS	7.33 ^{ns}	0.67	61.7 ^{ns}	1.45	72.7 ^{ns}	18.9
Triticale	Quickguard	17.0 ^{cd}	3.34	50.8 ^{ab}	11.6	66.1 ^{acde}	8.41
Spring Oats	Hayden	10.9 ^{abcd}	1.69	46.6 ^{ab}	10.6	78.1 ^{acde}	2.57
Forage Soybean	Laredo	8.97 ^{abcd}	0.97	59.0 ^b	7.63	83.5 ^{ac}	2.76
	Tara	6.47 ^{abc}	1.49	41.9 ^{ab}	10.4	78.4 ^{acd}	4.95
	Derry	4.90 ^{ab}	0.86	43.1 ^{ab}	9.05	73.0 ^{acd}	4.34
	Tyrone	11.4 ^{abcd}	2.98	50.4 ^{ab}	8.29	77.7 ^{acd}	4.26
	Colossus LJ	4.69 ^{ab}	0.57	52.8 ^{ab}	9.48	85.4 ^a	2.37
	Hutcheson	7.9 ^{abcd}	1.54	52.3 ^{ab}	7.71	77.9 ^{acd}	5.45
Safflower	Baldy	4.48 ^{ab}	0.56	45.2 ^{ab}	9.40	52.7 ^{de}	3.88
Sunflower	Peredovik	8.24 ^{abcd}	1.90	57.2 ^{ab}	9.53	74.8 ^{acd}	4.06

Phenology

Radishes, triticale, and spring oats flowered less than 60 DAP. Plateau proso millet, Siberian foxtail millet, Sunrise proso millet, Ground Hog radish, Eco-Till radish, Coes forage sorghum, VNS grain sorghum, Hayden spring oats, Quickguard triticale, Baldy safflower, and Peredovik sunflower reached 50% bloom within 75 days after planting. Phenology data is shown in Table 4.

Table 4: Average days to initial bloom and 50% bloom for each cultivar arranged by group and in ascending order of days to 50% bloom in the 2023-2025 warm season cover crop trial at Pullman, Washington Plant Materials Center. Some cultivars did not reach 50% bloom before termination, and this is noted with “n/a”.

Species	Cultivar	Avg. Days to Initial Bloom	Avg. Days to 50% Bloom
Radish	Deep-Till	59	n/a
	Nitro	59	n/a
	Ground Hog	59	63
	Eco-Till	59	65
Pearl millet	Tifleaf3	85	93
	Exceed	80	n/a
	Leafy 22	82	93
Foxtail millet	White Wonder	77	90
	Siberian	66	72
	German	76	86
Proso millet	Horizon	71	76
	Sunrise	68	74
	Plateau	61	69
	Dove	87	n/a
Japanese millet	VNS	86	90
Browntop millet	VNS	74	83
Forage sorghum	VNS	79	89
	Coes	71	75

Species	Cultivar	Avg. Days to Initial Bloom	Avg. Days to 50% Bloom
Grain sorghum	VNS	72	72
Sorghum sudan	VNS	79	105
Triticale	Quickguard	58	68
Spring oats	Hayden	56	63
Forage soybean	Laredo	86	89
	Tara	74	82
	Derry	88	90
	Tyrone	n/a	n/a
	Colossus LJ	n/a	n/a
	Hutcheson	79	83
Safflower	Baldy	64	73
Sunflower	Peredovik	66	74

Soil Moisture

The cultivars with the smallest difference between % VWC at planting and % VWC at termination (least amount of soil moisture lost) included all the radishes, Sunrise and Dove proso millets, and Leafy 22 and Tifleaf 3 pearl millets. The cultivars with the largest difference between % VWC at planting and % VWC at termination (the greatest amount of soil moisture lost) included Baldy safflower, VNS sorghum sudan, and Coes forage sorghum. The average %VWC used in a fallow plot adjacent to the trial was 8.4 %. This shows less water used in the fallow than the cover crop cultivars; however, in this study we are comparing water use efficiencies of various cover crop cultivars. Soil moisture data is shown in Table 5.

Table 5: Average percent of volumetric water content measured at planting and at termination for all cover crop cultivars in the 2023-2025 warm season cover crop trial at Pullman, Washington Plant Materials Center. The final column shows the difference between %VWC at termination and %VWC at planting, in ascending order from least water used to most. Data was averaged for all 3 years.

Species	Cultivar	% VWC at Planting	% VWC at Termination	% VWC Used
Radish	Deep-Till	17.9	5.7	12.2
	Nitro	18.7	4.1	14.6
	Ground Hog	16.9	5.9	11.0
	Eco-Till	18.5	6.2	12.3
Pearl millet	Tifleaf3	18.9	4.4	14.5
	Exceed	21.1	5.1	16.0
	Leafy 22	19.1	4.6	14.5
Foxtail millet	White Wonder	20.5	3.3	17.2
	Siberian	19.3	2.9	16.4
	German	22.0	3.1	18.9
Proso millet	Horizon	19.4	3.1	16.3
	Sunrise	16.8	3.2	13.6
	Plateau	18.8	3.4	15.4
	Dove	17.0	3.0	14.0
Japanese millet	VNS	21.6	3.4	18.2
Browntop millet	VNS	18.4	2.4	16.0

Species	Cultivar	% VWC at Planting	% VWC at Termination	% VWC Used
Forage sorghum	VNS	20.3	3.8	16.5
	Coes	25.7	4.2	21.5
Grain sorghum	VNS	23.9	5.3	18.6
Sorghum sudan	VNS	26.1	4.9	21.2
Triticale	Quickguard	19.1	3.3	15.8
Spring oats	Hayden	19.3	2.4	16.9
Forage soybean	Laredo	21.9	3.9	18.0
	Tara	21.9	4.1	17.8
	Derry	21.8	4.2	17.6
	Tyrone	21.3	4.0	17.3
	Colossus LJ	21.3	3.4	17.9
	Hutcheson	21.5	4.1	17.4
Safflower	Baldy	22.7	3.7	19.0
Sunflower	Peredovik	21.9	4.0	17.9

CONCLUSION

This 3-year study provides information on agronomic performance of 30 cultivars from 14 species grown for cover crops in MLRA 9 in eastern Washington. Different cultivars revealed strengths in different functional categories. For example, Hayden spring oats and Quickguard triticale reached > 90% emergence by 15 DAP however, reduced the %VWC more than some proso millets. Triticale, proso millets, and forage sorghum (VNS) produced the highest canopy cover within the first month of growth, but at termination other millets had produced more canopy cover. For later-season

success, forage soybeans, forage sorghum, sorghum sudan, spring oats, Tifleaf3 pearl millet, and VNS browntop millet would be the best candidates due to their higher percent canopy cover.

The quickest cultivars to reach 50% bloom were Plateau proso millet, Siberian foxtail millet, Sunrise proso millet, Ground Hog radish, Eco-Till radish, Coes forage sorghum, VNS grain sorghum, Hayden spring oat, Quickguard triticale, Baldy safflower, and Peredovik sunflower. All these cultivars reached maturity in 75 days or less. Timing information is often critical for crop rotation windows and crop insurance termination guidelines, though our planting dates were slightly late for what regional producers typically choose for spring planting.

Regarding water usage, the crops with the smallest difference in %VWC between planting and termination were all the radishes, two proso millets (Sunrise and Dove), and two pearl millets (Leafy 22 and Tifleaf 3). The cultivars with the largest difference (most amount of soil moisture lost) included Baldy safflower, VNS sorghum sudan, and Coes forage sorghum. Further research can be conducted to determine more precise water-use efficiencies for these crops. Results of this study and future studies will help producers in MLRA9 select the right cultivars for their resource concerns

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