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Resilient dryland farming appropriation, 2020 – 2021 annual report: Cover crop trial

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Summary

The wheat-growing region of eastern Oregon averages only 8 to 16 inches of annual precipitation. Growers commonly practice fallow to store soil moisture for the next wheat crop. The winter wheat-summer fallow system yields one wheat crop with approximately 14 months of fallow. Although fallowing is important in storing soil water, it is associated with negative effects of increased erodibility and reduced soil carbon compared to perennial or annual cropped systems. The Resilient Dryland Farming Appropriation (RDFA), a product of a farmer-led initiative, supports research to develop resilient cropping systems that increase drought, heat, and disease tolerance; improve grain yield and quality; and enhance economic and environmental outcomes of dryland crop production systems. This RDFA project focuses on the intensification and integration of cover crops in the wheat-fallow system to improve soil health and reduce fertilizer and herbicide imputs. Preliminary data suggests that out of the 9 different cover crops tested, winter pea, spring barley, and a fall-seeded mix generally produced the most biomass at two sites receiving 6.5 in and 16 in of annual precipitation. In the low precipitation region, some of the winter cover crops failed to establish measurable biomass (e.g., winter lentil). Additionally, the different cover crops had variable effects on on residual soil moisture. This report includes preliminary data for the second of a three-year study.

Background

A cover crop trial with 10 treatments and four replications was established in two rainfall zones in the inland Pacific Northwest, where winter wheat is the predominant cash crop. The low rainfall location in Morrow County, Oregon, USA (45.59 N, -119.56 W) receives a 30-year average annual precipitation of 9 in, with only 6.5 in of annual precipitation accumulated in the crop year 2020-2021. The moderate rainfall location in Umatilla County, Oregon, USA (45.72 N, -118.62 W) receives a 30-year average annual precipitation of 16 in, with only 10 in of annual precipitation accumulated in the crop year 2020-2021. The Umatilla County location is Walla Walla silt loam soil type.The Morrow County location is Ritzville silt loam soil type.

Fall-seeded cover crop treatments included winter pea cv. ‘PS11300290W’, winter lentil cv. ‘Morton’, and a cultivar mix of winter barley cv. ‘Alba’, winter pea cv. ‘Austrian’, and yellow mustard (*Sinapsis alba*) cv. ‘Ida-Gold’. Fall-seeded cover crops were planted at the Morrow County site on 16 October 2020 and at the Umatilla County site on 2 November 2020. Spring-seeded cover crop treatments included tillage radish cv. ‘Nitro’, barley cv. ‘Steptoe’, lacy phacelia cv. ‘Super Bee’, yellow mustard cv. ‘Ida-Gold’, common vetch cv. ‘*variety not specified*’, and a cultivar mix of winter pea cv. ‘Austrian’, yellow mustard cv. ‘Ida-Gold’, spring barley cv ‘Steptoe’, lacy phacelia cv. ‘Super Bee’, tillage radish cv. ‘Nitro’, and common vetch

cv. '*variety not specified*'. Spring-seeded cover crops were planted at the Morrow County site on 9 March 2021 and at the Umatilla County site on 30 March 2021. A chemical fallow treatment served as the experimental control.

Prior to fall seeding, both locations were treated with 64fl oz/ac GlyStar 5 Extra (*a.i.* glyphosate) (Albaugh LLC, MO). Applications were made directly after spring seeding, prior to crop emergence, and again at spring seedbed preparation with an 24fl oz/ac GlyStar 5 Extra. Plot dimensions were 14ft × 40ft and seeding was accomplished with a Fabro (Swift Current, Canada) no-till plot drill with 12 in spaced hoe-type openers. The following data were collected in the cover crop trial from each treatment plot: (i) fresh and dry cover crop biomass, (ii) fresh and dry weed biomass, (iii) amount of weed cover, and (iv) sensor-based soil moisture content to 40 in depth at 4, 8, 12, 16, 24, 40 in increments (PR2 profile probes with HH2 moisture reader; Delta-T Devices, Cambridge, UK). Winter-seeded cover crops were terminated in Morrow County on 11 May 2021 and in Umatilla County on 26 May 2021 with 64 fl oz/ac GlyStar 5 Extra. Spring-seeded cover crops were terminated in Morrow County on 21 May 2021 and in Umatilla County on 26 May 2021 with 48 fl oz/ac GlyStar 5 Extra. In-crop herbicides and fertilizers were not used in this cover crop trial in an effort to most closely replicate standard grower practice for cover crops in this region. The fallow control plot was managed the same as the cover crop plots but no cover crops were planted. Further details about the overall rationale, long-term vision, and funding for this project can be found in "*Designing Cover and Alternative Crops for Dryland Cropping Systems in Eastern Oregon*" by Singh et al., 2021 (link : https://extension.oregonstate.edu/crop-production/field-crops/designing-cover-alternative-crops-dryland-cropping-systems-eastern).

Plant biomass and weed cover: Data for cover crops and weed biomass accumulation (fresh and dry weight) are presented in Tables 1 and 2 for Umatilla and Morrow Counties, respectively. Among cover crops, the highest biomass was accumulated by winter pea followed by the fall mix. The lowest biomass was observed under the fallow control treatment in Umatilla County (Table 1). In Morrow County, biomass accumulation followed the trend: fall mix > spring barley > winter pea > spring mix = tillage radish = common vetch = winter lentil = lacy phacelia = yellow mustard = control (Table 2). It is noteworthy that crop year 2020-2021 was a record-breaking drought year. Therefore, biomass accumulation of several treatments was negligible (e.g., yellow mustard, lacy phacelia, and winter lentil), particularly at the Morrow County location (Table 2).

Table 1: Fresh and dry biomass accumulation by cover crops and dominant weed species in Umatilla County cover crop trials.

Treatments	Biomass (lbs/ac)							
	Cover crop		Downy brome		Volunteer wheat		Broadleaf weeds	
	Fresh	Dry	Fresh	Dry	Fresh	Dry	Fresh	Dry
Control	0 e*	0 f	0 d	0 d	0 b	0 b	0 a	0 a
Common vetch	212 de	65.3 def	573 cd	279 cd	330 b	157 b	12.2 a	2.39 a
Fall mix	1660 b	631 b	946 bc	489 bc	2605 a	1320 a	10.4 a	3.30 a
Yellow mustard	369 cde	93.7 def	687 cd	337 cd	892 b	49.7 b	24.0 a	6.11 a
Lacy phacelia	807 cd	162 de	438 cd	212 cd	92.8 b	46.4 b	39.2 a	11.1 a
Spring barley	1106 bc	434 c	323 cd	177 cd	95.5 b	47.7 b	5.53 a	1.56 a
Spring mix	253 de	37.6 ef	645 cd	509 abc	119 b	53.7 b	15.7 a	3.26 a
Tillage radish	114 bc	165 de	919 bc	456 bc	159 b	77.4 b	107 a	2.39 a
Winter lentil	1017 cde	213 d	1481 ab	753 ab	3560 a	1544 a	16.8 a	21.3 a
Winter pea	3658 a	845 a	1713 a	892 a	3265 a	1481 a	31.8 a	6.05 a

* Numbers followed by different lowercase letters within a column denote statistically different means based on Least Square Difference (LSD) at $p \leq 0.05$.

Table 2: Fresh and dry biomass accumulation by cover crops and dominant weed species in Morrow County cover crop trials.

Treatments	Biomass (lbs/ac)					
	Cover crop		Downy brome		Volunteer wheat	
	Fresh	Dry	Fresh	Dry	Fresh	Dry
Control	0 d*	0 d	0 c	0 c	0 c	0 c
Common vetch	59.0 d	24.4 d	506 ab	297 ab	295 bc	147 bc
Fall mix	849 a	400 a	378 ab	250 ab	624 b	316 b
Yellow mustard	28.6 d	8.17 d	388 ab	203 ab	431 bc	175 bc
Lacy phacelia	53.7 d	15.3 d	406 ab	236 ab	462 bc	192 bc
Spring barley	639 b	250 b	510 ab	283 ab	255 bc	113 bc
Spring mix	124 d	41.2 d	537 ab	360 ab	493 bc	252 bc
Tillage radish	84.9 d	17.2 d	340 b	185 bc	517 bc	245 bc
Winter lentil	57.4 d	30.6 d	661 a	397 a	1936 a	869 a
Winter pea	422 c	154 c	545 ab	320 ab	1570 a	702 a

* Numbers followed by different lowercase letters within a column denote statistically different means based on Least Square Difference (LSD) at $p \leq 0.05$.

Visual assessment of weed cover (%) in cover crop treatments are shown in Table 3. Downy brome and volunteer wheat were the most dominant weed species in both counties in cover crop treatments. However, the fallow control treatment had no weed infestation despite similar managements to cover crop treatments (Tables 1, 2, and 3). Although some broadleaf weeds (e.g., prickly lettuce) were found at the Umatilla County trial, the weed biomass was almost negligible and there were no statistical differences among treatments. Based on visual assessments, winter lentil treatment had the most weed cover (downy brome and volunteer wheat) among cover crops at both sites (Table 3). Despite lower cover crop biomass accumulation, spring planted cover crops generally had lower weed cover as compared to winter planted cover crops.

Table 3: Visual assessment of weed cover (%) in cover crop treatments at the time of termination at Umatilla and Morrow counties.

Treatments	Weed cover in cover crops (%)			
	Umatilla county		Morrow County	
	Downy brome	Volunteer wheat	Downy brome	Volunteer wheat
Control	0 e*	0 d	0 c	0 e
Common vetch	22.9 cd	6.75 c	28.1 b	5.81 de
Fall mix	29.8 bc	24.8 ab	25.5 b	16.4 c
Yellow mustard	21.9 cd	2.88 cd	23.8 b	6.62 de
Lacy phacelia	13.9 d	2.38 cd	31.0 b	8.00 cde
Spring barley	13.0 d	1.88 cd	23.6 b	9.44 cd
Spring mix	22.8 cd	4.31 cd	25.3 b	8.50 cde
Tillage radish	29.0 bc	3.06 cd	19.5 b	9.38 cd
Winter lentil	41.8 a	31.3 a	50.5 a	50.0 a
Winter pea	38.9 ab	21.6 b	33.3 b	31.4 b

* Numbers followed by different lowercase letters within a column denote statistically different means based on Least Square Difference (LSD) at $p \leq 0.05$.

Soil moisture following termination: The amount of soil moisture (%) at each depth following cover crop termination are shown in Figure 1 (Umatilla County) and Figure 2 (Morrow County). The effects of different cover crops on soil moisture were evaluated at six distinct depths in the soil profile: 4, 8, 12, 16, 24, and 40 in. Overall, soil moisture levels were higher in Umatilla County. Despite growing spring cover crops, moisture levels were statistically similar to the fallow control treatment after cover crop termination (Figure 1). Winter planted cover crops (winter pea and fall mix) produced relatively higher crop biomass and showed statistically lower soil moisture after termination. Interestingly, despite producing high biomass (Table 1), the spring barley treatment did not lower the moisture and remained statistically similar to the fallow control at all soil depths (Figure 1). After termination at Morrow County, the cover crop treatments of common vetch, spring mix, lacy phacelia, and yellow mustard showed statistically similar soil moisture levels to fallow control treatment (Figure 2). Winter pea and fall mix produced higher biomass and showed consistently lower soil moisture than the fallow control after termination. Despite producing considerably higher biomass as compared to the fallow control, spring barley showed similar soil moisture to fallow control, except for the shallower depths at 4 and 8 in Morrow County (Figure 2).

Summary statement: The data presented here are preliminary and report only the second replication of a three-year study. Since this year was a record drought year, results could vary from a normal rainfall year. Finalized data and observations will be released in future as peer-reviewed studies, reports, and extension articles.

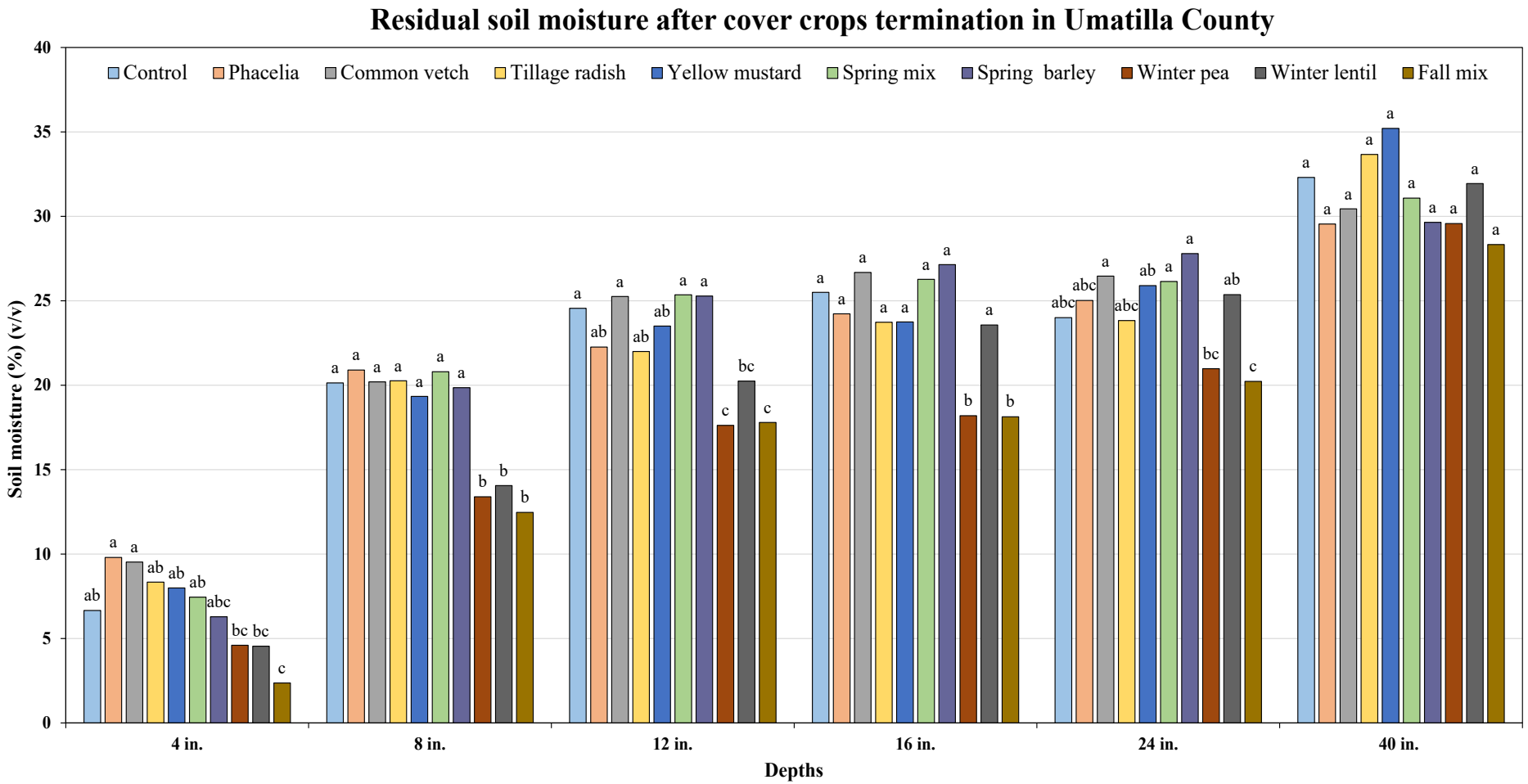

Figure 1: Residual soil moisture levels at different depths after cover crop termination in Umatilla County, Oregon, USA. Different letters denote statistically different means within each depth based on Least Square Difference (LSD) at $p \leq 0.05$.

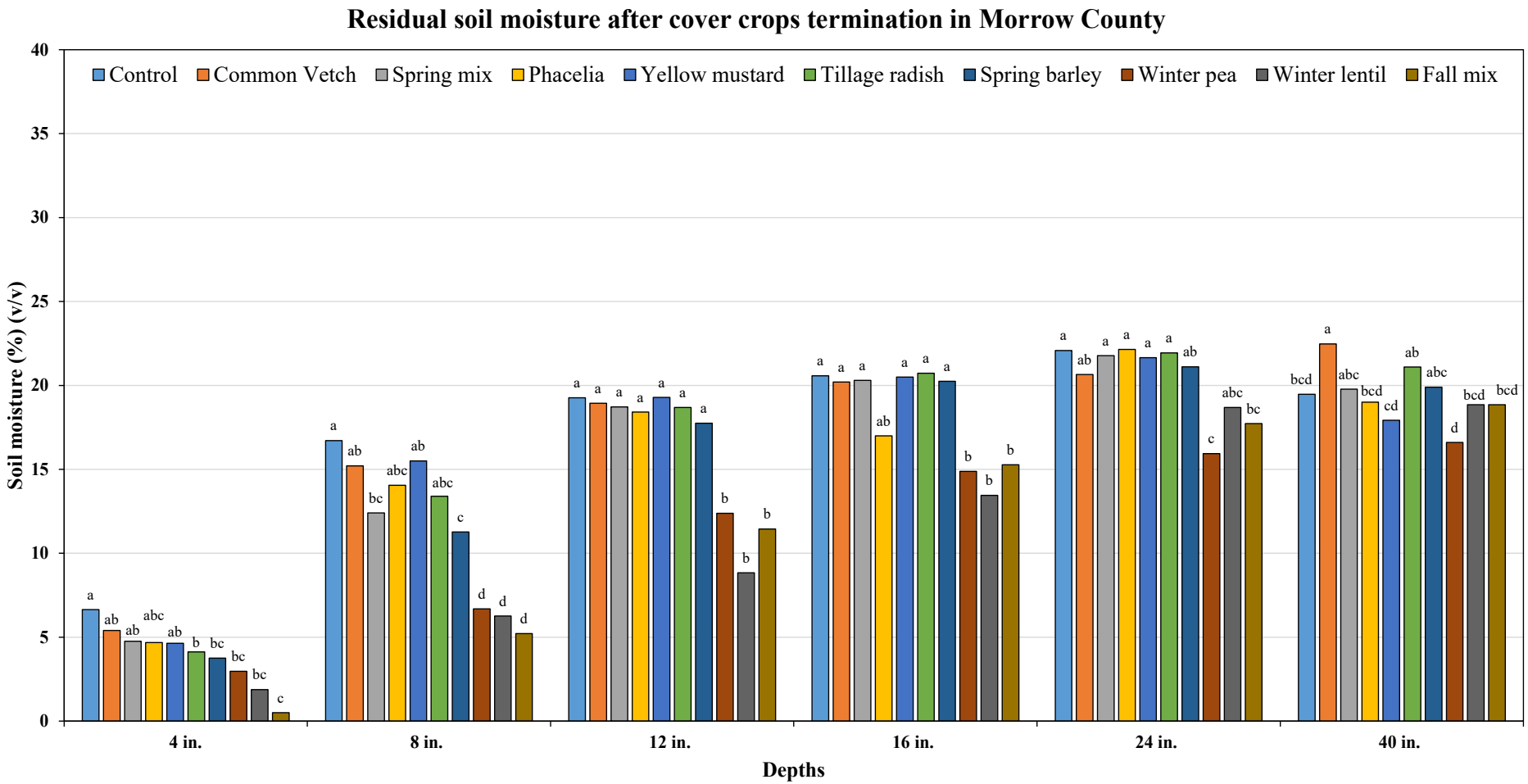

Figure 2: Residual soil moisture levels at different depths after cover crop termination in Morrow County, Oregon, USA. Different letters denote statistically different means within each depth based on Least Square Difference (LSD) at $p \leq 0.05$.