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Resilient Dryland Farming Alliance, 2021 – 2022 annual report: Cover crop trial

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Summary

The eastern Oregon dryland wheat production region receives only 8-16 in of annual precipitation, which led to adoption of wheat-fallow rotation systems. Despite reliable yields under this cropping system, the practice of fallowing agricultural land is associated with adverse effects on soil erosion, soil organic matter and overall soil health, mainly due to low crop biomass, crop diversity, and soil cover. Therefore, the grower-led Resilient Dryland Farming Alliance (RDFA) is focused on developing intensified and diversified cropping systems using an array of potential cover and alternative crops. Further details about the overall rationale, objectives, 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. This annual report presents the data from the third year of the cover crop trials.

Background

RDFA cover crop trials were started at two rainfall zones in the eastern Oregon region where wheat-fallow is the predominant cropping system. 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 13.7 in accumulated during the crop year from September 1, 2021 – July 31, 2022. The intermediate rainfall location in Umatilla County, Oregon, USA (45.72 N, -118.62 W) receives a 30-year average annual precipitation of 16 in, with 18.3 in accumulated during the crop year from September 1, 2021 – July 31, 2022. The Umatilla County location has a Walla Walla silt loam soil type. The Morrow County location has a Ritzville silt loam soil type. The cover crop trial included 10 treatments (9 cover crops and 1 fallow control) with four replications (Table 1) planted in a randomized complete block design. Plot dimensions were 14 ft × 40 ft.

To replicate standard grower practice most closely for cover crops in this and other regions, fertilizer and in-crop herbicides were not applied. Prior to fall seeding, the entire trial area was prepared with 64 fl oz/ac GlyStar 5 Extra (*a.i.* glyphosate; Albaugh LLC, MO) at both locations. Spring-planted cover crops and the fallow plots received an additional application of 24 fl oz/ac

GlyStar 5 Extra at both locations prior to seeding. Seeding was accomplished with a Fabro (Swift Current, Canada) no-till plot drill with 12 in spaced hoe-type openers. Fall-planted cover crops were seeded on October 28, 2021 at the Morrow County site and on November 3, 2021 at the Umatilla County site. Spring-planted cover crops were seeded on March 14, 2022 and March 29, 2022 at the Morrow and Umatilla County sites, respectively. Termination of fall-planted cover crops occurred on May 20, 2022 at the Morrow County site and on May 12, 2022 at the Umatilla County site with 64 fl oz/ac GlyStar 5 Extra. Spring crops were terminated on May 26, 2022 at both locations with 64 fl oz/ac GlyStar 5 Extra.

The following data were collected: (i) fresh and dry cover crop biomass, (ii) fresh and dry weed biomass, and (iii) amount of ground cover by cover crops and weeds. Soil moisture and soil nutrient results are forthcoming.

Table 1: List of cover crops, varieties, and seeding time.

Cover crops	**Varieties**	**Seeding time**
Winter pea	PS11300290W	Fall
Winter lentil	Morton	Fall
Tillage radish	Nitro	Spring
Spring barley	Steptoe	Spring
Phacelia	Super Bee	Spring
Yellow mustard	Ida Gold	Spring
Common vetch	VNS*	Spring
Fall cover crop mix		Fall
Winter barley	Lightning	
Austrian pea	VNS*	
Mustard	Ida Gold	
Spring cover crop mix		Spring
Austrian pea	VNS*	
Mustard	Ida Gold	
Spring barley	Steptoe	
Phacelia	Super Bee	
Tillage radish	Nitro	
Common vetch	VNS*	

*VNS; Variety not stated

Plant biomass and ground cover: Data for biomass accumulation (fresh and dry weight) and percentage cover for cover crops and weed species are presented in Tables 2 and 3 for Umatilla and Morrow Counties, respectively. In general, fall-planted cover crops accumulated greater fresh and dry biomass compared to spring-planted cover crops due to the longer growing period. At the Umatilla County site, the fall mix accumulated the greatest fresh biomass and spring barley accumulated the least. Dry biomass accumulation followed similar trends as fresh biomass

accumulations, except for spring mix having lower, but non-significant, dry biomass than spring barley (Table 2). Based on biomass accumulation, dominant weed species at the Umatilla County site were downy brome, volunteer wheat, and various broadleaf weed species (e.g. Russian thistle, prickly lettuce). Biomass of downy brome and broadleaf weed species did not vary among tested cover crops and fallow control. Volunteer wheat accumulated the greatest fresh and dry biomass under winter lentil, followed by winter pea, and was the least under spring mix. At the Morrow County site, fall-planted cover crops such as winter pea accumulated the greatest biomass, followed by the fall mix, while spring-planted cover crops like phacelia and mustard accumulated the least biomass (Table 3). Like the Umatilla County site, downy brome, volunteer wheat, and various broadleaf weeds were also the dominant weed species at the Morrow County site.

Table 2: Fresh and dry biomass accumulation by cover crops and dominant weed species in the Umatilla County cover crop trial.

Treatments	Fresh biomass (lbs/ac)				Dry biomass (lbs/ac)			
	Cover crop	Downy brome	Volunteer wheat	Broadleaf weeds	Cover crop	Downy brome	Volunteer wheat	Broadleaf weeds
Fall mix	9085 a	415 a	444 bc	229 a	1677 a	129 a	120 bc	39.6 a
Winter pea	4284 b	1957 a	663 b	779 a	788 b	546 a	179 b	134 a
Tillage radish	3511 bc	575 a	36.1 c	348 a	454 c	200 a	8.79 c	63.0 a
Phacelia	3026 bcd	529 a	22.5 c	618 a	387 c	149 a	6.74 c	131 a
Winter lentil	2581 bcd	726 a	1503 a	460 a	534 bc	212 a	406 a	79.1 a
Mustard	2135 cd	394 a	22.1 c	607 a	357 c	110 a	4.44 c	96.1 a
Spring mix	1856 cd	760 a	4.86 c	540 a	300 c	233 a	1.16 c	110 a
Common vetch	1842 cd	844 a	11.1 c	489 a	388 c	257 a	2.81 c	86.5 a
Spring barley	1736 d	641 a	119 c	86.0 a	339 c	197 a	35.1 c	14.0 a
Fallow control	0 e	81.6 a	0 c	189 a	0 d	34.2 a	0 c	46.0 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 3: Fresh and dry biomass accumulation by cover crops and dominant weed species in the Morrow County cover crop trial.

Treatments	Fresh biomass (lbs/ac)				Dry biomass (lbs/ac)			
	Cover crop	Downy brome	Volunteer wheat	Broadleaf weeds	Cover crop	Downy brome	Volunteer wheat	Broad leaf weeds
Winter pea	21614 a	224 a	864 a	2.25 a	4894 a	63.5 abc	200 b	0.578 c
Fall mix	18102 b	138 abc	451 b	0.713 a	3937 a	45.5 abcd	127 b	0.312 c
Winter lentil	2411 c	258 a	937 a	7.61 a	639 b	103 a	306 a	1.70 bc
Common vetch	1677 cd	28.6 c	5.49 c	22.8 a	513 b	15.5 cd	2.19 c	5.71 abc
Spring mix	1555 cd	178 ab	27.1 c	12.9 a	349 bc	84.0 ab	9.84 c	4.51 abc
Tillage radish	1481 cde	60.6 bc	7.81 c	20.4 a	237 cd	31.3 bcd	3.17 c	5.82 abc
Spring barley	1206 cde	37.4 bc	0 c	27.6 a	455 bc	31.7 bcd	0 c	7.58 ab
Phacelia	751 de	74.5 bc	0 c	49.5 a	169 d	34.5 bcd	0 c	10.6 a
Mustard	382 de	45.7 bc	0 c	37.1 a	92.3 e	20.2 cd	0 c	8.03 ab
Fallow control	0 e	0.09 c	0 c	36.3 a	0 f	0 d	0 c	6.98 ab

* 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 plant cover for cover crops and dominant weed species are shown in Table 4. At both sites, fall-planted cover crops had greater plant cover compared to spring-planted cover crops. At the Umatilla County site, plant cover followed the trend: fall mix > winter pea > winter lentil > spring barley = mustard = common vetch = phacelia = spring mix = tillage radish > control. Plant cover of downy brome and broadleaf weeds did not vary among cover crop treatments, while volunteer wheat plant cover was greater under winter lentil. At the Morrow County site, plant cover of cover crops followed the trend of winter pea > fall mix > winter lentil > spring barley > spring mix > tillage radish ≥ phacelia ≥ mustard > control. Among fall-planted cover crops, downy brome and volunteer wheat had greater plant cover in winter lentils as compared to winter pea and fall mix at the Morrow County site. Broadleaf weeds plant cover was greatest in mustard and least in winter pea at the Morrow County site.

Table 4: Visual assessment of plant cover (%) in cover crops at time of termination at Umatilla and Morrow Counties.

Cover crop treatments	Plant cover (%)							
	Umatilla County				Morrow County			
	Cover crop	Downy brome	Volunteer wheat	Broadleaf weeds	Cover crop	Downy brome	Volunteer wheat	Broadleaf weeds
Fall mix	58.8 a	7.44 a	3.5 b	3.56 a	80.5 b	1.94 bc	0.750 b	0.250 e
Winter pea	48.6 b	24.4 a	5.38 b	5.56 a	92.9 a	1.51 cd	2.31 b	0.188 e
Winter lentil	40.7 b	15.8 a	10.6 a	7.50 a	40.3 c	4.63 a	9.81 a	0.625 de
Spring barley	14.6 c	9.56 a	0.188 c	3.50 a	19.1 d	3.00 b	0.375 b	1.69 cd
Mustard	13.8 c	6.44 a	0.063 c	3.81 a	5.25 g	1.75 bc	0.063 b	3.19 a
Common vetch	13.6 c	9.69 a	0.125 c	4.69 a	19.8 d	1.38 cd	0.813 b	2.00 bc
Phacelia	13.0 c	7.44 a	0 c	6.94 a	7.50 fg	2.00 bc	0.188 b	3.00 ab
Spring mix	12.9 c	8.06 a	0.125 c	4.56 a	15.5 e	2.69 bc	0.813 b	1.88 c
Tillage radish	11 c	8.56 a	0.375 c	5.19 a	9.19 f	2.19 bc	0.125 b	2.19 abc
Fallow control	0 d	7.06 a	0.063 c	7.63 a	0 h	0.25 d	0 b	2.25 abc

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

Summary: This report presents the data from the third year of a three-year study. In this relatively wet season, fall-planted cover crops, particularly winter peas and the fall mix, produced substantial biomass and provided season-long ground cover. Spring-planted cover crops had insufficient time to grow before termination was necessary and did not produce substantial biomass. Downy brome and volunteer wheat were the dominant weed species at both locations in most treatments. This could be due to the relatively wide row spacing (12 in) that left gaps for weed seed germination and development. Despite greater biomass production, fall-planted cover crops had more weed pressure than spring cover crops mainly due to a longer growing period without herbicides. Observationally, by the end of May, weed infestation in the fall mix at the Umatilla County site was similar to the infestation in fallow but without the spring pre-plant application of herbicide. It is also noteworthy that winter peas alone competed with and controlled weeds similarly to the fall mix at the Morrow County site.

Reference: Singh, S., J. Barroso, F.J. Calderon, C.H. Hagerty, C.L. Reardon, and S. Machado. 2021. *Designing cover and alternative crops for dryland cropping systems in eastern Oregon*. Oregon State University Extension Service. Available at: https://extension.oregonstate.edu/crop-production/field- crops/designing-cover-alternative-crops-dryland-cropping-systems-eastern..