Washington State Department of Agriculture

Soil Management in Washington's Dryland Wheat:

WSDA Survey Results

Prepared by

Washington State Department of Agriculture
Natural Resources Assessment Section

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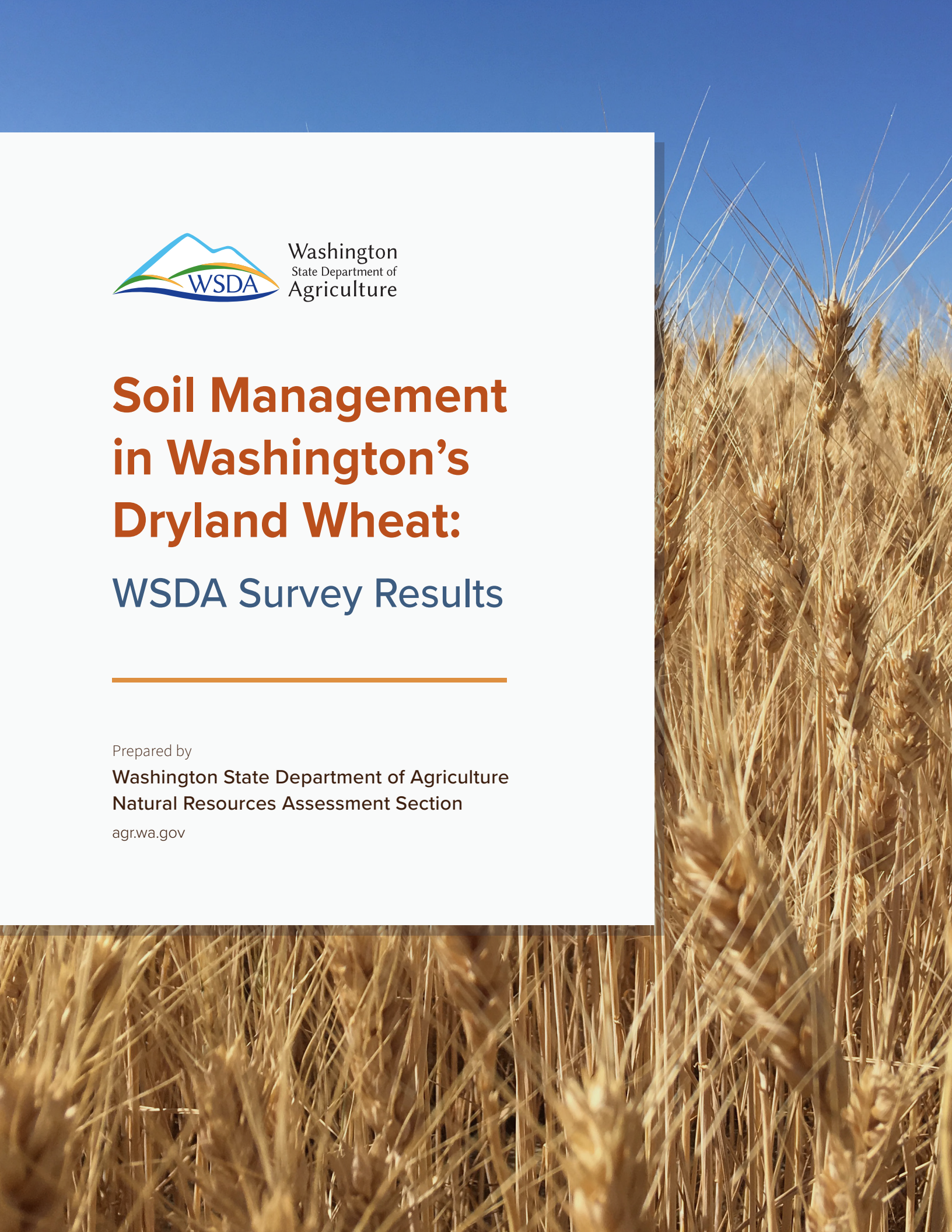

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Background

Wheat producers manage over 25% of Washington's agricultural land[i,ii] and contribute up to $1 billion to its economy every year[iii]. Washington wheat is primarily grown in low rainfall zones without supplemental irrigation. As such, it is vulnerable to the impacts of climate change including increased drought, heat, and extreme weather events. Studies show that soil management may play a role in increasing farm resilience and the ability for growers to adapt to climate change. Practices that can increase soil organic matter and improve soil health include reduced tillage, livestock integration, cover cropping, and adding organic matter. While these conservation practices may deliver benefits in some cases, results are not universal. Furthermore, multiple complex barriers may prevent conservation practice adoption, even when benefits are likely.

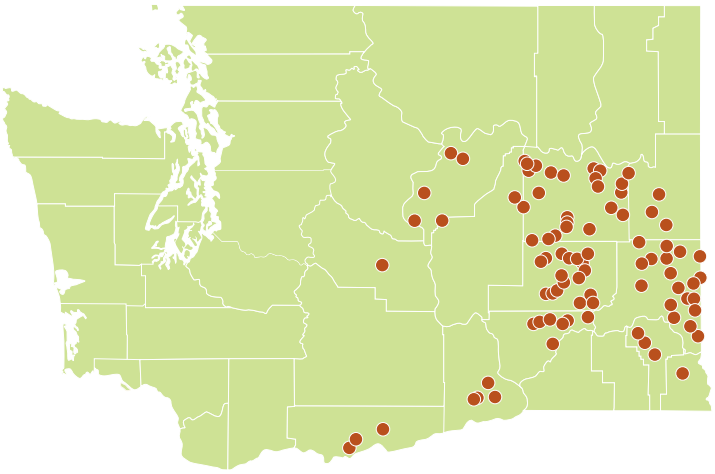
Methods

In Spring 2022 the Washington State Department of Agriculture (WSDA) conducted an anonymous survey of dryland wheat producers as part of the Washington Soil Health Initiative (WaSHI)[v]. The online survey was distributed widely through industry, university, and government listservs. Questions were asked about a producer's current and historic wheat production strategies, soil management challenges, the costs and benefits of conservation practices, and the impacts of the 2021 drought.

Objectives

WSDA issued this survey to better understand the "how and why" of soil management in Washington's dryland wheat, in order to:

1. Communicate with stakeholders and policymakers about the impacts of drought on dryland production;
2. Learn more about how soil management relates to operational resilience; and
3. Identify ways to better support dryland producers during future extreme weather events.



Results

WSDA received 97 responses from producers in 12 counties (Figure 1), collectively managing over 450,000 acres across diverse rainfall zones and farm sizes.

Figure 1. Location of wheat producers who responded to the WSDA soil management survey.

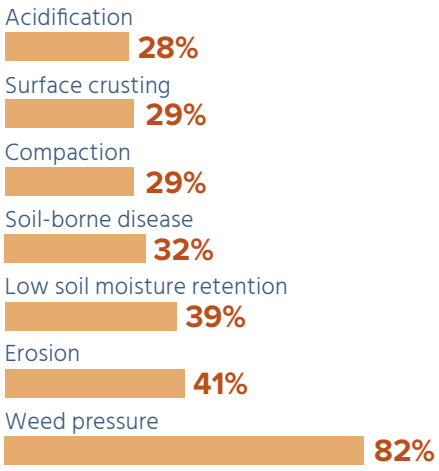
Drought impacts and soil management challenges

The impacts of the 2021 drought were near universal across dryland wheat producing regions. Washington wheat yields were down by over 40%, from the 5-year historic average of 152.2 million bushels per year, to 87.2 million bushels in 2021[vi]. These hardships were reflected in the survey responses. Reduced crop yield was experienced by an overwhelming majority of respondents (97%), as was reduced crop quality (84%). Total crop loss was experienced by 21%. Reduced topsoil and subsoil moisture (95% and 92%, respectively) and increased weed pressure (48%) appeared to be larger drivers of yield and quality outcomes than increased disease (6%) or pest (8%) pressure. Crop growth challenges were experienced in the form of delayed plant emergence (65%), delayed plant growth (66%), and poor grain fill (80%). Increased soil erosion was reported by 11% of respondents. While this is a relatively small number, even minor increases in erosion can have serious consequences for food production, water quality, and air quality. Independent of drought conditions, producers identified the following baseline soil management challenges in their systems: Weed pressure (82%), erosion (41%), low soil moisture retention (39%), soil-borne disease (32%), compaction (29%), surface crusting (29%), and acidification (28%).

> **The impacts of the 2021 drought were near universal across dryland wheat producing regions.**

> **Reduced crop yield was experienced by an overwhelming majority of respondents (97%), as was reduced crop quality (84%). Total crop loss was experienced by 21%.**

Baseline soil management challenges



Conservation practice adoption

The use of conservation practices reported in this survey is consistent with national and statewide estimates of cover crop and reduced tillage adoption provided by the United States Department of Agriculture (USDA)[vii,viii]. Trends in additional soil management practices are described in Appendix A.

Of the more than 450,000 acres managed by survey respondents:

72% are cultivated using reduced or no-till

13% receive organic matter amendments

5% are grazed by livestock

3% are cover cropped

37% of respondents reported using two or more of these practices together.

Conservation practice benefits

Severe drought impacts and soil management challenges were reported by respondents across all soil management strategies. **However, respondents overwhelmingly reported benefits from the use of conservation practices (Table 1). The quantity and magnitude varied by practice, though benefits include those with positive economic impacts such as increased yield or decreased fertilizer, pesticide, labor, or equipment costs. Benefits also included those with climate change adaptation potential, such as increased soil moisture retention or decreased runoff and erosion.** Table 1 summarizes the prevalence of each benefit, organized by the four conservation practices focused on in this study.

Table 1. Reported benefits in soil health and cost savings from using conservation practices

Benefit	Reduced or no-till (n = 77)	Livestock integration (n = 18)	Cover cropping (n = 10)	Adding organic matter (n = 28)
% reporting benefit from the use of above conservation practice				
↑ yield	46.8%	22.3%	20.0%	57.1%
↑ soil moisture	71.5%	x	60.0%	32.2%
↓ runoff and erosion	88.3%	x	60.0%	21.4%
↓ compaction	44.5%	x	50.0%	14.3%
↓ fertilizer use	27.3%	11.1%	30.0%	35.7%
↓ pesticide use	5.2%	11.1%	50.0%	14.3%
↓ labor costs	71.5%	11.1%	10.0%	3.6%
↓ equipment use	89.5%	16.7%	30.0%	7.1%
↓ equipment maintenance	55.9%	16.7%	20.0%	3.6%
n = number of survey respondents using each practice; x = question was not asked for this practice				

Conservation practice costs

While soil health benefits and cost savings were widely reported by those using conservation practices — including those that may increase operational resilience through climate change — adoption of most practices remains low, both nationally and in Washington[vii]. Respondents described multiple barriers to practice adoption, and challenges in maintaining practices. Table 2 summarizes select barriers and challenges, along with the percentage of adopters receiving cost share payments.

Table 2. Reported challenges and barriers to implementing or maintaining conservation practices

	Producers using practice				Producers not using practice		
Conservation Practice	**n**	**Costs are a challenge**	**Lack of info is a challenge**	**Received cost share**	**n**	**Costs are a barrier**	**Lack of info is a barrier**
Reduced or no-till	77	81.8%	10.4%	54.5%	20	50.0%	5.0%
Livestock integration	18	44.4%	11.1%	11.1%	79	15.2%	8.9%
Cover cropping	10	60.0%	40.0%	60.0%	87	25.3%	19.5%
Adding organic matter	28	25.0%	10.7%	0%	69	66.7%	27.5%
n = number of survey respondents in each category							

Reduced tillage is the most prevalent conservation practice in dryland wheat. However, the majority of producers who practice reduced-till cited equipment costs as a challenge to using the practice (82%). Of the 20 producers who self-identified as using conventional till, 50% cited reduced-till equipment costs as one reason why. Reduced-till producers most commonly reported purchasing the following equipment (Table 3): higher horsepower tractors (62%), additional drills (65%), mowers (51%), and self-propelled sprayers (49%). In total, this equipment can cost a single producer well over $1 million.

> The majority of producers who practice reduced-till cited equipment costs as a challenge to using the practice.

Table 3. Equipment purchased by producers who practice reduced or no-till, and associated costs

Equipment	Percentage of respondents (n=77)	Estimated price range
Higher horsepower tractor	62.3%	$300,000 - $750,000
Additional drills	64.9%	$50,000 - $140,000
runoff and erosion	50.6%	$21,000 - $50,000
compaction	49.4%	$150,000 - $480,000
n = number of survey respondents practicing reduced or no-till		

Depending on the cover crop seeding rate and species mix, seed costs were estimated between $40 and $240 per acre for respondents in this survey. However, the majority of cover crop producers received incentive payments to cover these costs (60%), and did not report purchasing new equipment (70%). This indicates that economics are not likely the primary explanation for low cover crop adoption across Washington dryland wheat.

However, costs appeared to be one important driver of whether producers adopted other practices. The majority of producers who do not add organic matter to their soils reported it is too expensive (67%), while 15% who do not integrate livestock reported the same.

Other challenges and barriers

Survey respondents frequently reported barriers and challenges that may be greater to overcome than economics. For example, producers who do not cover crop cited their annual precipitation is too low (74%), there is not enough relevant information for their area (20%), or cover cropping conflicts with the terms of their crop insurance (14%). Producers who do not add organic matter similarly cited a lack of information (28%) as well as limited access to required equipment (29%). Producers who do not integrate livestock also cited a lack of access to livestock and necessary equipment (27%).

Producers who do not cover crop cited:

74% their annual precipitation is too low

20% there is not enough relevant information for their area

14% cover cropping conflicts with the terms of their crop insurance

Producers who do not add organic matter cited:

28% lack of information

29% limited access to required equipment

Producers who do not integrate livestock cited:

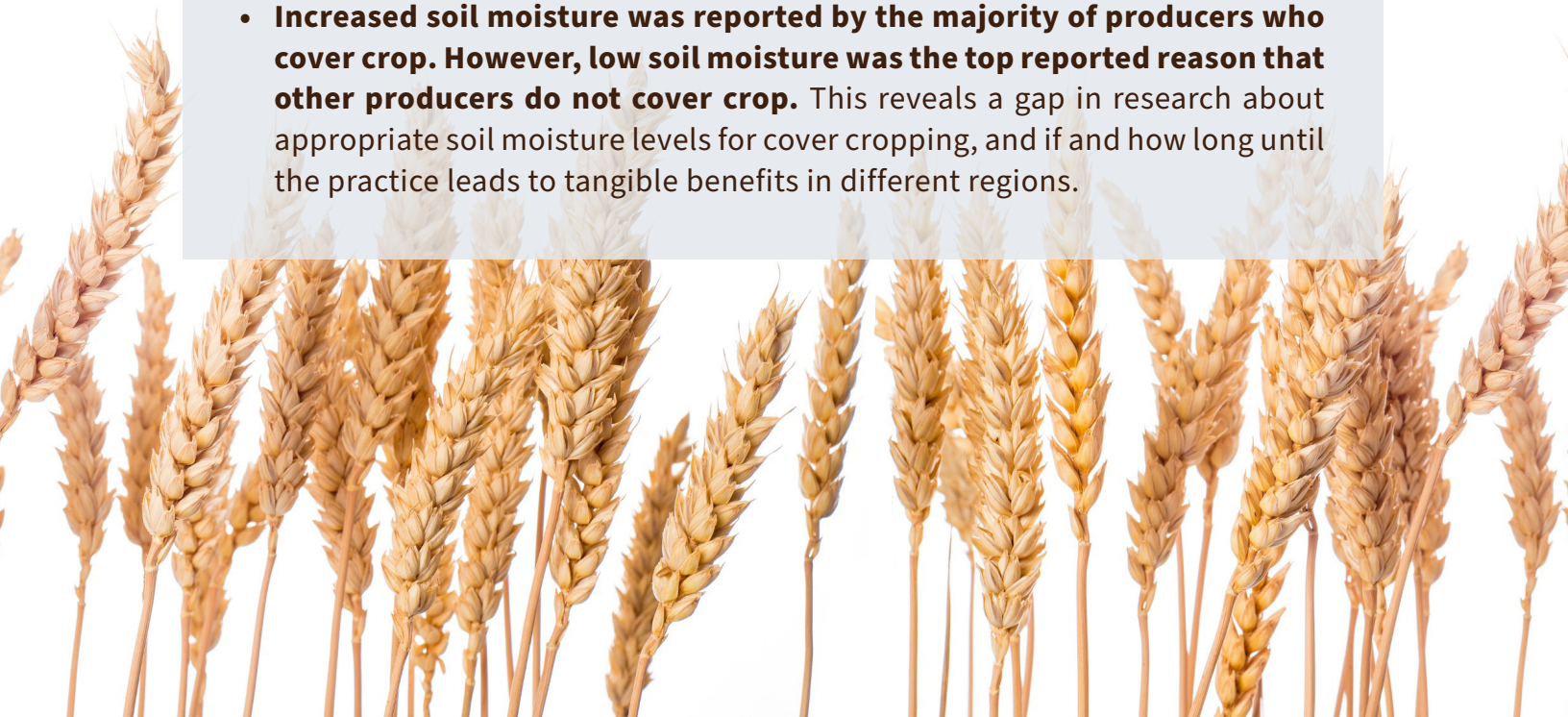
27% a lack of access to livestock and necessary equipment

Putting it all together

The 2021 drought had severe consequences for Washington's dryland producers. Unfortunately, climate change is projected to increase such conditions over time, with extreme weather events to include increased drought, heat, and storm severity[ix]. Data collected as part of this survey provided valuable information for WSDA and WaSHI to better support dryland producers under these conditions. Lessons inform current and future policies and programs, and help WSDA communicate with stakeholders and policymakers.

Important lessons include:

- Drought impacts were reported across Washington's dryland wheat producers, irrespective of soil management strategies. **While conservation practices can play a role in increasing operational resilience, they should be used in combination with other adaptation strategies where possible.**
- **Reduced or no-till adoption is high in Washington wheat**, while the use of other conservation practices such as cover cropping, livestock integration, and adding organic matter remains low.
- **Producers using conservation practices overwhelmingly reported benefits**, including increased yields, cost savings, and increased farm resilience in the form of improved soil moisture retention and erosion resistance.
- **Decisions about using conservation practices are complex, with unique considerations for every farm.** Barriers to adoption include the costs of implementing conservation practices, as well as a lack of technical assistance about how to access equipment and knowledge for specific regions.
- **The largest barrier to reducing tillage appears to be equipment costs.** By contrast, cover crop usage may be hindered by a lack of information about how to do so, especially in low rainfall zones.
- **Increased soil moisture was reported by the majority of producers who cover crop. However, low soil moisture was the top reported reason that other producers do not cover crop.** This reveals a gap in research about appropriate soil moisture levels for cover cropping, and if and how long until the practice leads to tangible benefits in different regions.



What's next

More research is needed on:

01.

The conditions in which conservation practices lead to economic and environmental benefits;

02.

If and how long until conservation practices yield a return on investment; and

03.

How to better support practice adoption in the appropriate contexts, and mitigate the costs of transition periods.

To that aim, multiple efforts are currently underway within WaSHI that encompass research, technical assistance, policy support, financial incentives, and economic development:

WASHINGTON SOIL HEALTH INITIATIVE

- The Washington State Conservation Commission (SCC) offers grants through Sustainable Farms and Fields (SFF), an incentive program which makes it easier and more affordable for farmers and ranchers to experiment with new practices and projects. Through SFF, participants may receive free services – such as on-farm consultations, climate-smart farm plans, and other technical expertise – and financial assistance to help cover expenses such as no-till equipment or cover crop seeds.
- Washington State University (WSU) organizes a free, annual conference called SoilCon, which brings together innovative growers, researchers, and decision makers dedicated to soil health in Washington. The goal of this conference is to collectively explore soil management challenges and solutions, for Washington's economic and environmental viability. Visit the WSU YouTube page to view past conference sessions, and stay tuned for upcoming events.
- A long-term research site has been funded at the WSU Wilke Farm. This experiment will investigate the impact of grazing and cover cropping on dryland wheat yields, economics, and soil health, over time and in a changing climate.

- As part of the State of the Soils Assessment, WSDA has collected hundreds of soil samples and management surveys from diverse regions and cropping systems across Washington. The goals are to: 1. Assess baseline soil health in Washington; 2. Understand how climate, crop type, and management impact soil health; 3. Develop cost-effective ways for producers to assess their own soil health; and 4. Develop crop-specific decision-support tools.
- Saving Tomorrow's Agricultural Resources (STAR) is coming to Washington! This free, voluntary grower certification program allows producers to brag about their conservation practices, chart a path to improvement, and generate economic valuation for their efforts. STAR enrollment begins through WSDA in June 2024.
- In 2023, a drought preparedness program was established via SHB 1138. This program will be led by the Department of Ecology, and provide public entities with grants for projects that increase resiliency and mitigate the impacts of drought.

To learn more about ongoing efforts, visit the WSDA WaSHI webpage or subscribe to the WaSHI quarterly newsletter.

Appendix A

Additional soil management trends were captured as follows:

Fallowing: Of the more than 450,000 acres managed by survey respondents, 38% are reported fallow in an average year - 76% stated this is typical, while 16% said this is lower than usual and 7% said this is higher. Of the 22 farmers who reported changes, the following reasons were most cited: Change in cropping patterns (77%), tillage patterns (46%), and climate and precipitation (32%).

Planting date: Of the 97 survey respondents, 61% reported their planting date has not changed, while 27% plant earlier in the year and 11% plant later. Of the 37 farmers who reported changes, the following reasons were most cited: Change in tillage patterns (60%), precipitation (54%), equipment (51%), and temperature (35%).

Stubble management: Wheat stubble was reportedly managed as follows: Left standing in the soil (43%), tilled into the soil (41%), mowed and left on the soil surface (11%), burned (1%), baled and removed (1%), and grazed (1%).

Soil testing: 93% of respondents report making fertilizer decisions based on at least one soil test per year.

Additional knowledge gaps surfaced as the result of the survey:

Definition of no-till: Respondents reported the following number of tillage passes per year:

Tillage passes per year	% of respondents (n=97)
Zero	17%
1 to 2	17%
3 to 5	59%
6 to 8	7%
9 or more	0%
n = number of survey respondents	

When asked if respondents considered their practices "no-till, reduced-till, direct seed, or conservation till" there was a split in perception. All producers using 0 to 2 passes selected Yes. However, 72% of producers using 3 to 5 passes said Yes, and 38% said No. Producers using 6 to 8 passes were also split, with 57% selecting Yes, identifying these practices as "no-till, reduced-till, direct seed, or conservation till," while 43% selected No. This reveals a gap in knowledge about contemporary definitions of no-till, which can vary based on regional norms, as well as the speed, type, and depth of tillage[x]. More work is needed to engage growers on standardizing definitions.

Compaction: The survey asked respondents to identify whether conservation practices were delivering specific benefits. For each benefit included, producers were asked to select Yes, No, or Unsure. Unsure was selected most often for whether compaction was improved by cover cropping (50%) or no-till (21%). This reveals a knowledge gap about how to assess and manage for compaction in dryland wheat systems.

Endnotes

[i] https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Volume_1,_Chapter_1_State_Level/Washington/

[ii] https://nras.maps.arcgis.com/apps/webappviewer/index.html?id=3d61db30686d467ea6f5e0197be32b25

[iii] https://www.nass.usda.gov/Statistics_by_State/Washington/Publications/Current_News_Release/2022/VOP_WA_2021.pdf

[iv] https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/soils/soil-health

[v] The Washington Soil Health Initiative is a partnership between WSDA, Washington State University, and the Washington State Conservation Commission. For more information, see: https://agr.wa.gov/departments/land-and-water/natural-resources/soil-health

[vi] https://quickstats.nass.usda.gov/

[vii] https://cra.missouri.edu/wp-content/uploads/2021/04/Soil-Health-Census-Report.pdf

[viii] https://www.ers.usda.gov/webdocs/publications/100551/eib-222.pdf?v=5621.1

[ix] https://cig.uw.edu/wp-content/uploads/sites/2/2020/12/snoveretalsok2013sec11.pdf

[x] https://www.nrcs.usda.gov/sites/default/files/2022-11/CEAP-Croplands-2008-Methodology-SoilTillageIntensityRating.pdf