KOOTENAY & BOUNDARY
FARM ADVISORS

Grab & Go Template for On-Farm Research

USING MULCHES TO REDUCE WATER USE

How To Use This Template For Your Own Research

The **Grab and Go Research Templates** provide a guide for how you can get started with on-farm research. Each template walks through how to set up a research trial that answers a specific research question. You can replicate the research outlined in the case study provided or modify the examples given to fit your particular needs.

This template introduces the value of using mulches to improve water conservation and then walks you through the steps to carry out a research trial on this topic.

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Using Mulches to Conserve Water Use

Outlined in this **Grab and Go Research Template** are steps to test improvements in water conservation through the use of hay mulch.

Soil water storage is critical for healthy crop development

Application of mulch is one of the most effective ways to conserve moisture during dry periods. Mulching has a number of other beneficial effects and should be considered a useful practice even in non-drought situations. There are many mulch materials available, but this template focuses on the use of organic mulches. Mulching has many benefits, such as:

- Reducing moisture loss and conserving water
- Improving soil structure
- Reducing soil temperature, allowing plants to grow better during the heat of the summer
- Preventing weed growth
- Reducing soil compaction
- Providing essential nutrients needed for good plant growth – once mulch starts to break down, nitrogen, potassium and some minor elements are made available for plant growth
- Keeping fruit clean
- Protecting plants from the cold when applied in the fall
- Providing a clean surface for caring for plants and harvesting fruit

In the following Case Study—*Knowledge: The biggest benefit of Creston orchardists' water management project*—a producer tested the effect of 20 cm of hay mulch on his drip irrigated cherry trees. The producer's goal was to improve soil moisture. While mulches have many benefits, for this producer the most intriguing benefit was the ability of mulch to reduce water loss.

Knowledge: The biggest benefit of Creston orchardists' water management project

Long-time orchardists Don and Susan Low have spent more than 25 years innovating and improving best practices on their cherry orchard in Creston, BC. Responsible water use is among their top priorities. Long ago, they moved away from rotary sprinklers towards drip lines and micro-sprinklers that minimize evaporation and better target water distribution. Still, they wondered if there was more they could do to manage water use while maximizing crop yield. While kicking over a clump of mowed grass, Don had an idea: could a thick layer of mulch hold in moisture, translating into lower irrigation requirements? The Lows decided to find out through an on-farm research project.

In 2019 and 2020, the Lows applied a 20 cm deep, 18-inch-wide swath of mulch on either side of their cherry trees in half of a one-acre block. Each week they took 10 soil moisture readings from each treatment, including untreated Controls, comparing rows where the trees had the mulch treatment to rows where they did not.

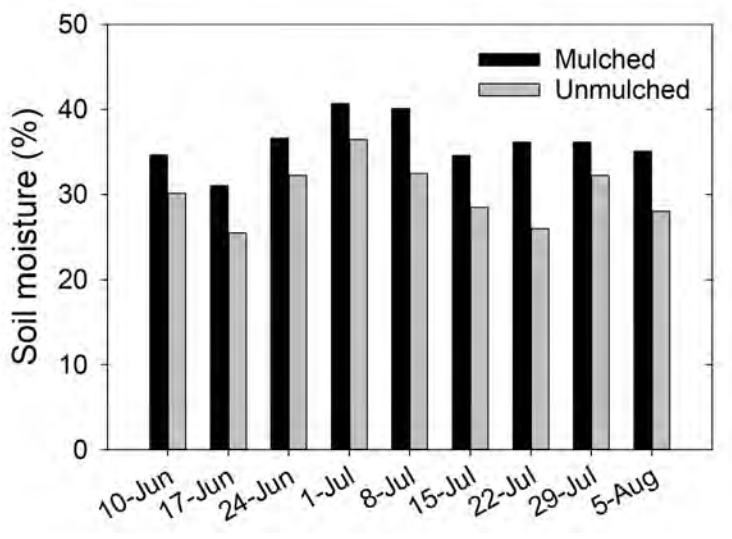


Figure 1 - A comparison of soil moisture between the mulched plot and the unmulched control plot.

CASE STUDY

Multiple factors pushed the Lows to consider the study. As chair of his local water distribution commission, Don is aware of the potential scarcity of water. He suspects that at some point in the future water will become expensive and responsible water use will be a vital business priority. Most importantly, however, he simply wants to do better.

> "I want to be a better water steward. Why use more water than I actually need?" Don says.

Certain benefits are clear from the project's first two years. Don says he could feel significantly more soil dampness in the mulched rows. His observations are reflected in the higher soil moisture readings taken through out the study. Don notes improved soil colour (darkness) and is confident the soil's health is improving below the mulch. Arguably, the most important outcome is how the project is changing Don's approach to water management.

"I knew if I took on a water use project it would force me to pay more attention to water use in general in my orchard," says Don. "And it did: I spent more time monitoring my moisture levels in that block. I put in better semi-automated valves. I just did a better job of watering that block."

Don plans to use some of what he's learned on a larger scale. He's already purchased a flail mower with a side chute to direct alleyway grass clippings onto the cherry rows. Don is planning to semi-automate all his sprinkler systems, change any remaining spitters to drip, and install more moisture meters.

"You gotta always be looking at what you're doing, how you're doing it, and whether you can do it better," Don says.

Was the project worthwhile?

"Knowing what I know now, I would absolutely do it all over again," Don says. "And, I'm going to keep working on it. What we've done so far was just a start."

Follow the step-by-step instructions on the next pages to conduct your own on-farm research related to conserving water.

1 Getting Started

Before undertaking on-farm research it is critical to assess your resources: time, land, machinery, and funds. Set aside time for planning as well as time and land for conducting the research. Ensure you have the appropriate equipment, or access to equipment, and money for any additional expenses that may be required to carry out the research.

Some Planning

- What equipment is required?
- Do I need to rent specialized equipment?
- What is the expense or availability of this resource?
- Who could I borrow this from?
- What labour resources are required?
- Will I need extra help?
- How much time is required for the research?
- How much land can I risk?
- How many acres should I allocate?
- Which fields should I use?
- What if the project fails?
- What supplies do I need to purchase for the research?
- What is the cost of these supplies?

Use the PLANNING WORKSHEET on page 13 to track your resources and expenses.

2 Determining What to Test

There is no 'one size fits all' for crop production. In the accompanying Case Study, the producer used locally sourced spoilt hay as it was readily available and free. Talk with a consulting agrologist or your Regional Agrologist at the Ministry of Agriculture, Food and Fisheries to discuss the pros and cons of various mulch options. Then consider what is readily available and affordable.

More Planning – What to Test

An example of how you might fill out your planning table. Find the **WHAT TO TEST WORKSHEET** *on page 14*

Crop to be Tested	*cherries*
Mulch Type	*alfalfa-grass hay*
Mulching Rate	*20 cm*
Mulching Date	*early May*
Premulch Treatments	*No premulch treatments required*

3 Finding The Best Location For Your Test Plots

When considering where on your farm to locate your test plots make sure to choose a location that is representative of the majority of your farm. This will ensure your results will be transferrable to the bulk of your farm. For example, do not pick the section of your farm with clay soils if 80% of your farm is sandy loam.

4 Laying Out Your Plots

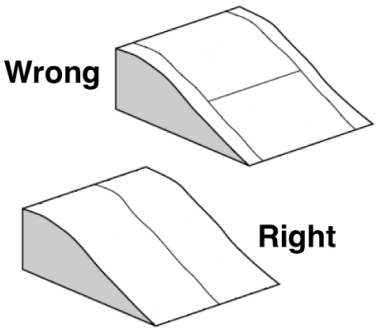
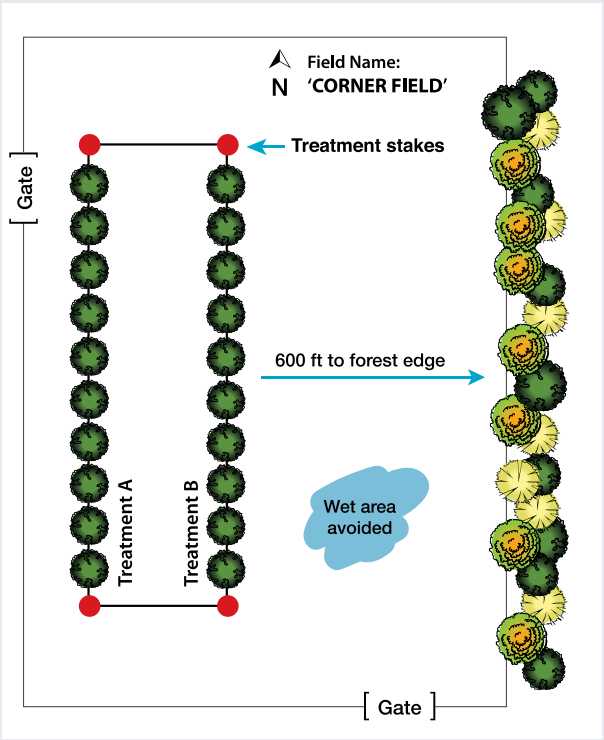


Figure 3 - Make sure slope is incorporated into both test plots.

If you choose a sloping field, make sure you incorporate the slope into both test plots, if one half is sloping and the other half is flat you will have very different results; not because of your research, but because of the sloped land. Conversely, if you lay your plots cross-wise across a slope, the top will be dry and the bottom will be wet (see Figure 3).

A good rule of thumb is to make sure your test area has at least 10 measurements per treatment. In the associated Case Study, the Producer had 10 soil moisture measurements per date within the Control row and the Mulched row. Use highly visible stakes with labels to mark the ends of each treatment row, especially if you are only treating a portion of a row. Make sure your plots are away from treelines, fences and any high use areas.

5 Heading To The Field – Draw Your Test Plots



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6 Applying Your Treatments

Once your study area is ready to go, **service and calibrate all your equipment**. Make sure that your mulching rates (depth) are equal across all test plots so that you are certain your results are a direct result of your treatments, not faulty equipment or sloppy hand application of mulch.

7 Wait

Do not tamper with your test plots. Do not add any variables like fertilizer, herbicides or equipment unless you subject ALL test plots to the same variables and rates. Allow the test plots to remain as undisturbed as possible so that you can clearly see the effects of your mulching treatments.

8 Collecting Your Data

Time to see how soil moisture is affected by the mulch treatment. Once the mulch is in place, measurements can begin the next day. If you irrigate your crop then you will need to take your measurements at the same time and the same distance from the drip emitter. For the producer in our Case Study, measurements were collected weekly, 4 hours after the drip irrigation had ended and always 10 cm from the drip emitter. You will need just one piece of equipment – a soil moisture probe.

Data Collection - An example of how to record soil moisture data

Find the DATA COLLECTION WORKSHEET ON PAGE 15

Make sure all soil moisture measurements use the same distance from the emitter and are collected at the same time post-irrigation

Date: July 28	Percent Soil Moisture										Total	Average	Range
Sample #	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*		*(/10)*	
Mulch	*32*	*30*	*39*	*30*	*32*	*32*	*32*	*33*	*34*	*35*	*329*	*32.9% moisture*	*39-30 = 9% moisture*
Control	*24*	*34*	*25*	*25*	*25*	*27*	*27*	*21*	*26*	*25*	*259*	*25.9% soil moisture*	*21-34 = 13% moisture*

At the same time after irrigation, use a soil moisture probe to collect at least 10 measurements per treatment. In an orchard, the simplest measurement would be at the base of each tree, 10 cm from the emitter. Be sure to clear the mulch away so that the soil moisture probe can be completely inserted into the ground the full depth of the metal probes. The base of the probe must be touching the soil surface. It only takes a few seconds for the probe to display the soil moisture measurment.

9 Harvesting Yield Samples

Within an orchard environment it may be difficult to collect accurate yield measurements as variability from tree to tree may be too great and collecting fruit from each tree independently may not be feasible. However, if you are working within a row crop—such as lettuce, strawberries or beans—it is wise to take yield measurements because water conservation is closely linked to plant growth. Gather the equipment you will need for your data collection: at least 20 large paper bags, a metre stick, a sharpie, a rice knife (hand sickle) or long-handled shears, and a digital scale.

To take yield measurements of row crops it is easiest to use a metre stick to measure out a section and then harvest and weigh the contents within the metre. The metre stick needs to sample the field randomly with at least 10 measurements per treatment. Do not pre-select sites, let the metre stick fall 'where it may' then line up the metre stick alongside the row and harvest the crop that is rooted within the metre. The only time to re-measure is if the metre stick falls on an unusual place—such as a road, a deep rut or a rock pile.

Repeat this process at least 10 times in Treatment A and then move onto Treatment B.

10 Weighing the Samples

Set up a scale on a flat surface in a location with no wind. If your interest is just total yield then you can weigh the bags (take the bag weight first) and compare Treatment A versus Treatment B. If you are interested in assessing marketable versus culled yields you will need to separate out the marketable crop from the culled crop and weigh them separately per bag. In this case, each bag will have two measurements – marketable and culled.

Data Collection - An example of how to fill out yield data

Find the DATA COLLECTION WORKSHEET ON PAGE 15

Mulch	Crop (g)*	Culled (g)*
M1	*335*	*10*
M2	*350*	*16*
M3	*347*	*41*
M4	*413*	*60*
M5	*291*	*0*
M6	*338*	*24*
M7	*401*	*40*
M8	*448*	*83*
M9	*360*	*33*
M10	*335*	*17*
AVERAGE	***362***	***32***
CONTROL	**Crop (g)***	**Culled (g)***
C1	*280*	*65*
C2	*190*	*66*
C3	*265*	*21*
C4	*230*	*58*
C5	*260*	*163*
C6	*180*	*14*
C7	*280*	*117*
C8	*190*	*73*
C9	*210*	*27*
C10	*220*	*124*
AVERAGE	***231***	***73***

Take a Closer Look

11 Analyzing the Data

Once you have collected 10 samples from each treatment area it is time to analyze your data. The first analysis is a simple average. Add up all of the weights and divide by 10. The next thing to look at is the data range—that is the difference between the highest and lowest values. Subtract your lowest value from your highest value. Data range gives an indication of yield variability. In the example above, the soil moisture range with mulch was only 9% versus 13% for the untreated Control. The lower the range indicates that the data is more consistent and uniform. We see a similar result with yields. The average yield of the crop is higher with mulches. In addition, the range is much lower for the crop and culled yields. The lower cull rate could be a result of a larger, cleaner, and/or less damaged crop. Assessing culled fruit is important to gain a complete picture of the effects of mulching.

12 Interpreting the Results

Average soil moisture through the growing season and final yield is clearly the most important indication of the effect of mulching. In the Case Study, the producer was able to increase average soil moisture over the growing season, and reduce the range of soil moisture by using mulch. The lower range means less fluctuations in soil moisture that stress plants. While the producer was not able to collect yield measurements in his orchard, growers often see greater yields, less culled crop, and reduced weed pressure with the use of mulches.

13 Where Do I Go From Here?

Sometimes the answer is obvious—the use of mulches increased soil moisture content over the growing season. However, sometimes the answer is not so clear. What if there are no differences between treatments? Could it be that one practice is more expensive than the other? In that case, the most economical option is the best choice. Perhaps the practice needs to be repeated for multiple years to net a significant treatment effect. It is important to take the time to carefully consider what your results may be indicating, sometimes change comes slowly.

If you are having a hard time interpreting your results consider contacting your Regional Agrologist at the BC Ministry of Agriculture, Food and Fisheries or the Kootenay Boundary Farm Advisors for assistance.

For a more comprehensive guide to conducting your own on-farm research you can consult the **Guide to On-Farm Demonstration Research** published by the BC Forage Council at: **bcforagecouncil.ca/projects/#1**

WORKSHEETS

Planning Worksheet

Resources	Expense/availability
EQUIPMENT Renting specialized equipment	Rental cost: Borrow from who:
LABOUR Extra time needed for research Do I need to hire help?	Hours:
LAND How much land can I risk? What if the project fails? What field or rows to use?	Acres allocated: Field to use:
SUPPLIES What do I need to purchase for the research?	Cost:

WORKSHEETS

Planning Worksheet - What to Test

Crop to be Tested	
Mulch Type	
Mulch Depth	
Mulching Date	
Preplant Treatments	

WORKSHEETS

Data Collection Worksheets

Date	Soil Moisture										Total	Average	Range
Sample	1	2	3	4	5	6	7	8	9	10		(/10)	
Mulch													
Control													

Mulch Treatment Samples	Marketable (g)*	Culled (g)*
AVERAGE		

Control Treatment Samples	Marketable (g)*	Culled (g)*
AVERAGE		

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Climate & Agriculture Initiative BC

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Canadian Agricultural Partnership

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