

Dryland Winter Squash Farming in Montana

By Rachel Owen and Erin Jackson

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Intro to Dryland Farming

Vegetable production in Montana is often associated with irrigation, but some growers are experimenting with producing vegetables without supplemental water. In these systems, crops rely entirely on soil moisture stored from winter snowpack and spring precipitation, along with any rainfall that occurs during the growing season. This approach is often referred to as “dryland farming.”

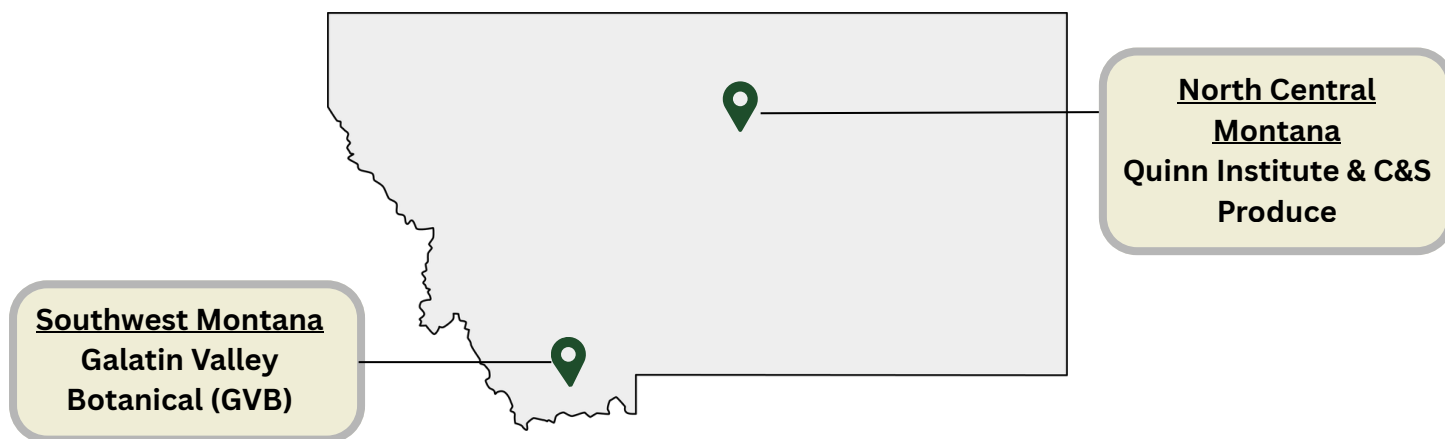
What is “dryland” farming?

Dryland farming is different from “dry farming,” although the terms are sometimes used interchangeably. Dryland farming generally refers to crop production without irrigation in regions where annual precipitation is less than 20 inches annually. Dry farming often describes farming without supplemental irrigation in regions that receive at least 20 inches of moisture each year. Both dryland and dry farming rely on specific moisture-conserving techniques such as wide plant spacing, careful tillage timing, and rotations that enable crop growth under water limitation.

Dryland Squash Case Studies

In Montana, dryland farming has historically focused on grain crops such as wheat and barley. However, some growers are beginning to test whether certain vegetables —particularly winter squash — can also be produced without irrigation.

This document highlights two case studies of dryland winter squash production in Montana. The first takes place in Big Sandy in North Central Montana, where two producers, Bob Quinn of the Quinn Institute and Charley Overbay of C&S Produce, grow winter squash without irrigation. The second case study comes from Southwest Montana, where producers Matt and Jacy Rothschiller experiment with dryland delicata squash on a portion of their land. Together, these examples show how growers in different parts of Montana are adapting planting methods, spacing, and crop selection to make vegetable production possible in dryland conditions.



Case Study 1: Big Sandy, Montana

Field Preparation

Field preparation in this region is designed to conserve moisture while managing weeds and preparing a suitable seedbed.

Winter squash is planted in a two-year rotation with a spring cover crop and summer fallow. Field preparation for the cover crop year begins in April with shallow (2-3 inch) chisel plowing and planting of a multi species cover crop. About 60 days later, in June, when the crop is flowering and before it sets seed, Charley tills it in with a disk about 4-6 inches deep. He aims to till when the rains end to minimize additional weed growth throughout the summer fallow period. Sometimes a second cultivation is needed if there are a lot of living plants still alive after the first disking of the cover crop.

In May of the cash crop year, fields are chisel plowed and squash seeds are planted directly into the moist soil. Flame weeding may be used prior to crop emergence to reduce early weed pressure. Mulch may be applied after early cultivation passes to suppress weeds and reduce surface moisture loss.

If it is a wet, warm spring, a first cultivation may occur in April to terminate early weeds that might be getting big by mid-May.



Quinn Institute and C&S Produce

FARM SIZE

700 dryland acres (600 in crop production, 28 acres leased to C&S Produce)

AVERAGE ANNUAL PRECIPITATION

13 inches

SOIL TYPE

Clay Loam, 2.3% organic matter

DRYLAND CROPS

Delicata, Carnival, Sapagheti Lower Salmon, Buttercup, Lakota, and Black Futzu winter squash; corn; beans



Case Study 1: Big Sandy, Montana

Planting and Spacing

Bob and Charley direct seed dryland winter squash, relying on stored soil moisture for germination. Planting occurs between mid-May and early June, guided by soil temperature and seasonal cues, such as the blooming of chokecherries. Both producers space rows 9 feet apart. Bob plants hills of two plants at 6 feet spacing, while Charley plants seeds 3 feet apart to minimize wind damage to the plants.

Season Maintenance

Season maintenance is relatively low input, but early season weed control is critical to prevent competition for limited moisture.

About 3 weeks after transplant, when squash plants are well established but still small, Charley cultivates between the rows and weeds around the plants using a hoe and finger weeder to reduce weed pressure during this critical growing period. Depending on rain, he may cultivate a second time before the vines start to spread.

Few weeds sprout after the rain stops in early July, so weeding is minimal for the rest of the season.

Harvest

Harvest timing for squash is influenced by crop maturity and autumn temperatures. Marketable delicata squash should have cream-colored skin with dark green stripes, firm rinds, and a cylindrical shape. Proper spacing and management help maintain quality, with mature fruits measuring 3-4 inches in diameter and 8-10 inches long. Harvest occurs between September 15

and October 15 before temperatures drop below 32°F to prevent frost damage. Squash are stored and sold throughout the winter and early spring.

On average, dryland delicata squash in Big Sandy yields 2 lbs per plant. Weed pressure and drought reduce yields, while enhanced soil fertility and above average rainfall result in higher yields. In summer 2025, following soil additions of manure and safflower mash prior to cover cropping, average yields doubled, at 4.2 lbs per plant. With proper management and innovation, viable yields can be achieved under dryland conditions.



Quinn Institute and C&S Produce Main Challenges

The most significant challenges facing dryland winter squash production in North Central Montana are moisture limitation and rainfall variability. Both growers emphasized that, due to a lack of supplemental irrigation, stored soil moisture and in-season precipitation completely determine crop outcomes. As Bob explained, “In this country, you’re always farming the moisture first.” This framing underscores the reality that crop choice, spacing, rotation, and timing must all help maximize water availability in this semi-arid environment.

Bob further noted that wide spacing is not optional but essential under dryland management in their region, explaining that plants must have access to the water in a larger soil volume to compensate for limited rainfall. Even with careful planning, however, rainfall timing can override management decisions. He described years when squash performed exceptionally well and others when yields were significantly reduced due to late-season dryness or an unusually cool summer. This unpredictability introduces financial risk, especially for vegetable crops that do not have the same established dryland production history as small grains in the region, as there is no crop insurance for dryland vegetable production.

Charley echoed similar concerns about moisture and weed competition. He explained that early-season weed control is critical because “you can’t afford to have weeds taking the water your crop needs.” Without irrigation to compensate for lost moisture, early competition can permanently reduce plant vigor and fruit development. This makes timely cultivation and careful field preparation particularly important.

Another key challenge identified by both growers is crop suitability. Not all vegetables are appropriate for dryland production in North Central Montana. Bob emphasized that experimentation has been necessary to determine which crops can reliably mature without irrigation. Winter squash has shown promise, but success depends heavily on selecting varieties that can complete their life cycle within the available moisture window and before the normal time for the first killing frost.

“In this country, you’re always farming the moisture first.”

Together, these growers’ experiences highlight that dryland vegetable production in North Central Montana requires adaptive management, careful varietal selection, and a deep understanding of soil-water relationships. As Bob summarized, success ultimately depends on working within the limits of the environment rather than trying to override them.



Case Study 2: Bozeman, Montana

Field Preparation

Matt and Jacy's field preparation for dryland squash aligns with their crop rotation plan, focusing on rotational diversity and soil cover instead of fallow periods. Dryland squash follows cover crops like oats and peas or previous plantings of corn and beans, with future rotations including winter wheat and peas to support soil health and disrupt pests. They emphasize continuous living roots and residue cover to prevent soil erosion and maintain biological activity, contrasting with traditional methods that use fallow for moisture. Minimal external fertility inputs are applied, relying mainly on the site's high organic matter and a small amount of fish fertilizer at transplanting.

Planting and Spacing

Matt and Jacy grow winter squash using transplants. Seedlings are started in 72-cell trays in a greenhouse for about two weeks before being transplanted in late May to early June, once soil temperatures reach over 55°F. A water wheel transplanter is used, providing each seedling with one-quarter cup of water mixed with fish fertilizer. Beds are spaced 60 inches apart with 1-foot spacing in rows, and no additional irrigation is applied after transplanting in dryland conditions.

Season Maintenance

After transplant establishment, season maintenance is minimal. Depending on weed pressure, Matt and Jacy may cultivate with a tractor between rows while plants are still small. The dryland fields are partially experimental, so they do not allocate significant staff labor to maintain the crop between planting and harvesting. Continued management focuses primarily on monitoring crop development, intermittent weeding, and minimizing wildlife damage.

Harvest

Harvest occurs in mid-to-late September, prior to a hard frost. Marketable delicata squash is 3-4 inches in diameter and 8-14 inches long, featuring cream or yellow skin with green stripes. Matt and Jacy save seed from their dryland delicata to plant the following year for food system resilience. In summer 2025, their dryland squash yielded 2 fruits per plant, averaging 1.1 lbs. About a third of plants were outcompeted by thistle and did not yield fruit.

Gallatin Valley Botanical

FARM SIZE

50 acre diversified-- 2 acres dryland, 12 irrigated acres in production, 6 irrigated acres cover cropped

AVERAGE ANNUAL PRECIPITATION

20 inches

SOIL TYPE

Clay, 6.6% organic matter

DRYLAND CROPS

Delicata and buttercup winter squash; corn; beans



Gallatin Valley Botanical Main Challenges

Weather variability is the most significant challenge in Southwest Montana. Although irrigation water is available on other acreage, the dryland squash relies entirely on soil moisture stored prior to transplanting and any in-season precipitation. Cool spring conditions can delay transplanting, while uneven rainfall can limit fruit sizing and overall yield.

Weeds and wildlife pressure present additional challenges. Canada thistle is prevalent in the field, and in the absence of plastic mulch or regular weeding, it outcompetes the crop. Managing the thistle with minimal labor is an ongoing challenge. Rodent and deer damage can reduce the proportion of marketable fruit, particularly in fields that are not protected by fencing. Because dryland systems do not have the buffering effect of irrigation to compensate for plant stress, any damage—whether from drought, frost, or wildlife—can have a proportionally larger impact on final yields.

Another challenge involves balancing experimentation with economic viability. Allocating acreage to dryland production requires accepting greater variability in

output. However, this risk is weighed against the long-term benefits of developing resilient systems that are less dependent on irrigation infrastructure. For the Rothschillers, dryland squash is both a commercial crop and an investment in adaptive capacity for future climatic uncertainty.



WHERE TO FIND MORE INFORMATION

Contact: erin.jackson@colostate.edu
charleyoverbay@gmail.com

Western SARE project GW25-018 report:
Investigating Potential for Dryland Winter
Squash Production for Food Systems
Resiliency in the Northern Great Plains

www.drylandag.org