

“My soil doesn’t drain. How can I grow crops all season long?”

A Problem Based Learning Challenge in Narrative Form

Kennebec Valley Community College

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Real World Problem

At the KVCC Farm, the soils in our vegetable fields lack sufficient drainage for proper tilling and planting. They are slow to dry out in the spring, and after a rain event of >1”, they take upwards of 7 days to drain. At times in July, there is standing water in the paths due to insufficient drainage. This is problematic when timing is critical for tilling and planting in the spring and summer, and the wetness prohibits the tractor from entering the field. It also becomes uncomfortable at best, and hazardous at worst, when student interns are on the farm facing inches deep mud, or missing out on an opportunity to work in the fields altogether. Finally, crop growth is affected by the wetness and is clearly evident by stunted, diseased, and/or pest-ridden crops in the wettest sections. This problem is also directly related to many of the students, as Maine has an abundance of clay soils, high ledge and water tables, and affordable land that isn’t appropriately suited for agriculture but is inhabited for homesteading purposes.

Activity: In the winter, the Ag students can walk the snowy contour of the fields to get a sense of the topography. In the classroom, they can look at a large poster of the farm soils, and also learn how to locate the farm and soil maps on the NRCS Web Soil Survey. They can spend time in class learning about the soil types on the farm, and researching how each type is made and its various characteristics. In the spring, summer and fall, students can spend time working on the farm to get a visceral sense of how the soil feels, where water pools and where it drains, and get a visual of crop health and soil texture. They will know what the mud feels like on their boots, and have strong motivation to remediate the situation.

Introduction

Drainage is a universal problem among vegetable farmers. Sandy soils tend to drain too quickly, leading to dessicated crops unless proper irrigation is employed. Clay soils tend to drain too slowly, leading to leached nutrients and stunted plants, along with an impaired ability to work the soil, unless proper drainage and soil improvement is employed. The soils on a particular farm are determined by the parent material, or bedrock formations in the area, and there is little any farmer can do to change their given soil type. Drainage problems can be a function of more than just soil type however. Hard pans caused by tractor tires driving repeatedly over the same piece of ground or implements tilling the soil at a consistent depth can result in poor drainage. Ledge that is close to the soil surface is a common problem on Maine farms and can cause poor drainage. Sloping and bare ground can mean water flows off the field, taking soluble nutrients with it, or cause water to pool in low areas of the fields, rendering those areas inhospitable for human or vehicular traffic and plant growth alike. If a farmer is faced with poorly drained fields, it becomes his or her job to asses the fields to determine what

factor or factors is/are causing the water issues and devise a solution that is both ecologically sound and economically viable.

Resources:

- NRCS Web Soil Survey: <http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm>
- “How to Care for Wet Spring Soils” from Oregon State University: <http://smallfarms.oregonstate.edu/compaction/ponding-plugging-amp-pugging-how-care-wet-spring-soils>
- University of Minnesota Extension article on Soil Compaction: <http://www.extension.umn.edu/agriculture/tillage/soil-compaction/index.html>

Organization Overview

The Kennebec Valley Community College Farm is a 600 acre property located in Hinckley, ME. It is comprised of 120 open acres, 3 of which are planted in vegetable and cover crops, 1 of which is dedicated to covered agriculture, and 116 of which are hayed pasture. The remaining 480 acres are carefully managed woods, trails and roads. The farm sits in a historically agricultural area, and the farm has raised dairy cows and agronomic crops from at least 1960-2012 while under the ownership of the Good Will Hinckley school. The ground is certified organic by the Maine Organic Farmers and Gardeners Association and raises crops primarily for student consumption and use in the Culinary Arts Program. The Farm owns a variety of earth working equipment, including a 75 hp tractor, a 45 hp tractor, a two bottom plow, and chisel plow, a Perfecta cultivator, and Williams cultivator, a bush hog, a rototiller, a bed former/mulch layer, and a transplanter. In the summer months, the Farm hosts Sustainable Agriculture student interns, a variety of paid jobs, and numerous visitors and tours. The focus of the farm is on sustainable food production, pedagogy, and student and campus engagement.

Resources:

- KVCC Farm home page: <http://www.kvcc.me.edu/pages/farm/farm-home>
- KVCC Center for Farm to Table Innovation Facebook page: <https://www.facebook.com/kvccfarm>

Problem Statement

The soils on the KVCC Farm are poorly drained, resulting in standing water in the field for days after it rains. Student interns need access to the fields without facing inches of mud, crops need well drained soil in order to reach their genetic potential, and the soil needs to be stable for the tractor to drive on it at opportune times in order to meet the season schedule. What is causing the poor drainage, and what can we do about it?

Resources:

- Photos of the farm during wet times of the season (need to take).
- Poster of soil types on the KVCC Farm.
- Soil test results from UMaine (on file).
- Soil profile analysis results from Soil Science class (ongoing).
- Tensiometer (for use in spring/summer/fall).

- Penetrometer (need to purchase).

Discussion (guiding questions for in-class groups)

- What steps can we take to assess what is causing the problem?
 - Dig a pit to look at the soil profile, find out where ledge is
 - Use a tensiometer to help determine the soil's water holding capacity
 - Use a penetrometer to determine how compacted the soil is
 - Find out about past tractor use on the farm fields
 - Look at soil maps to determine what types of soils are on the farm
 - Walk the property to determine the topography; where water naturally flows and pools.
- What are the existing attributes of the property and farm business affecting the problem?
 - Slope?
 - Lots of space?
 - Limited space?
 - Pond?
 - Trees?
 - Equipment?
 - Time?
 - Money?
- What are the tools we have in our toolbelt to remediate poorly drained soil, depending on the cause?
 - Drainage ditches/tiles
 - Deep plowing with chisel plow or subsoiler
 - Deep rooted cover crops
 - Working in organic matter
 - Avoid the wet areas altogether
 - Choose perennial plants that can tolerate wet soil for the wet areas
 - Bring in sand/loam
 - Build permanent raised beds
 - Terrace the property if on a slope
- How will we know if our solution is working?
 - Water drains from field within a day or two of a rain or heavy irrigation
 - Crops are vibrant and healthy, yields are within acceptable range
 - No standing water in the field, no mud
 - Water flows away from fields
- What else can we try if our first solution doesn't work?
 - Short-term approaches
 - Long-term approaches
 - Cheap approaches
 - Expensive approaches
 - Labor intensive approaches
 - Easy approaches

Resources:

- Videos on installing a drainage pipe: <https://www.youtube.com/watch?v=1UflgbadQXE>
<https://www.youtube.com/watch?v=O1eRVVPJOE>
- Video on aerating clay soil: https://www.youtube.com/watch?v=_ATpA3bovgE&spfreload=1
- Article on soil compaction from Colorado State University: <http://www.ext.colostate.edu/mg/Gardennotes/215.html>
- Article on chisel plow from Ohio State University: http://ohioline.osu.edu/b760/b760_8.html
- Article on subsoilers from USDA: <http://www.fs.fed.us/t-d/pubs/pdfpubs/pdf08342828/pdf08342828dpi72.pdf>
- Book: Managing Cover Crops Profitably by Sustainable Agriculture Network
- Book: Crop Rotation and Cover Cropping by NOFA-VT/Seth Kroeck
- Article about adding sand to clay soil: http://puyallup.wsu.edu/~linda%20chalker-scott/horticultural%20myths_files/Myths/Amendments%202.pdf

Solution

The KVCC Farm is taking a long-term approach to wet soil remediation. From analyzing the soil maps, digging pits to look at the soil profile, and observing the flow of water around the fields, we know that the soil is poorly drained because of soil type, topography, and past tractor use, to a limited extent. We are using a combination of deep tillage, varied tillage depth, cover crops, amending with organic matter, and avoiding the wettest areas. Since the KVCC Farm has more open acreage than is needed for our planting needs, we have the option of moving the planting fields to another section of the farm. However, we are first trying long-term, proven methods of remediating the situation.

- Alfalfa, cereal rye, and forage turnips are cover crops we're using with long and extensive root systems that can break up hardpan
- Tilling in organic matter in the form of compost and cover crops is aerating the soil each season and with each tillage
- Making the beds in alignment with the natural slope of the land is facilitating drainage
- Using the chisel plow once per season to deeply aerate the soil and penetrate compacted areas is breaking up hardpans
- Making a habit of using different tillage methods during the season, such as deeper tillage with the rototiller and shallow tillage with one of the field cultivators, and varying the depth at which the implement is set is avoiding creating new hardpans
- Avoiding the wettest areas altogether, or planting summer crops in the section of field that are slow to drain in the spring, and fall crops in areas that are well drained in the summer is allowing us to avoid the problem while remaining productive

Resources:

- Photos of the progress of the cover crops and health of the crops as the seasons progress.
- Compiled results of tensiometer and penetrometer readings throughout the seasons.

