Agricultural Water Management Basics

Plant Sciences & Natural Resources

Grade Level
7-12th Grades

Lesson Length
60-120 minutes

STEM Careers
- Irrigation Specialist
- Irrigated Farmer
- Engineer
- Agronomist
- Software Developer

Life Skills
- Reason, Make Decisions

Related Activities

Irrigation Careers Interview
Types of Irrigation

Learn More

water.unl.edu website
cropwatch.unl.edu website

Virtual Fun

Check out Nebraska Extension's Interactive Agricultural Water Management Guide!

- What is agricultural irrigation?
- What is the importance of water management in agricultural irrigation?

Learning Objectives

By the end of the lesson, students should be able to:

- Define basic irrigation terminology.
- Explain the importance of irrigation and water management in agriculture and factors that determine irrigation amounts.
- Identify problems associated with under- or over-irrigating crops and provide solutions to those problems.

Educational Standards Supported

Nebraska State Standards: SC.12.1.1.f

Materials List

- Access to the internet
- Sites to create infographics such as piktochart.com or canva.com OR markers/crayons to create an infographic by hand
- Journals or science notebook handouts
- 3-4 corn/soybean plants in containers: 1 healthy plant, 1 over-watered for about 3-4 days, 1 under-watered, and 1 starting to die. (If corn/soybean plants are not available, use 3-4 potted plants of some kind that you don't mind if they die.)
- Paper towels
- Handouts (following lesson)

Do Ahead

- Obtain three plants (preferably corn and/or soybeans, but any plant will work) in the same containers. A couple of weeks prior to the lesson, overwater one plant, properly water one plant and deprive the other plant of any water.

Introduction

The goal of **irrigation management** is to use water in the most profitable way at sustainable production levels. For production agriculture, this generally means supplementing precipitation with irrigation when crop water demand is high. For example, in recent years there have been declines in groundwater levels in Nebraska, almost statewide, and other High Plains states. Considerable areas of Nebraska are considered fully or over-appropriated. This means that in those **over-appropriated areas**, there will be no new development of irrigated acres. In **fully appropriated areas**, the water demand and use are relatively in balance and the basin or watershed cannot sustain additional water use development. Additional areas that are not considered fully or over-appropriated have established regulations limiting the expansion of irrigated acres.

Opening Questions

Why did irrigation first start?

To supplement the crop with needed water so it wouldn't die

Why is irrigation important?

It not only makes a significant contribution to the value of U.S. agricultural production, but also has implications on livestock production and consumer food prices and food security.

What careers work with irrigation?

Have youth brainstorm careers, then share as a group.

Possibilities include: farmer, agronomist, irrigation manufacturers, engineers, software developers, researchers, pivot and irrigation equipment sales, community planners, etc.

Experience - Activity One

Today we are agronomists. You will explore why irrigation is important and you will have the opportunity to determine factors that should be taken into consideration when irrigating. First, your friends want to know why farmers irrigate and why it is important.

Using resources such as the Agricultural Water Management Guide and other internet tools, create an infographic that illustrates the impact irrigation has on agriculture and society. Free internet resources such as piktochart.com or canva.com may be used to create an electronic version of your infographic. Youth also may draw infographics by hand in their notebooks or science journals, as applicable.

To gauge students' previous knowledge of irrigation, have them jot a few notes in their science notebook.

The **goal of irrigation management** is to use water resources to meet crop water requirements in the most profitable way at sustainable production levels.

Over-appropriated: There will be no development of irrigated acres

Fully appropriated area: The water demand and use are relatively in balance and the basin or watershed cannot sustain additional water use development

Did you know?

Efficient irrigation systems and water management practices can help maintain farm profitability in an era of increasingly limited and more costly water supplies.

Resource:

For the latest nationwide summary on irrigation and water use go to USDA'S Economic Research Service at http://www.ers.usda.gov/ (Search for irrigation)

FREE Infographic sites:

Piktochart.com

Canva.com

(This can be given as homework or worked on during class with teacher guidance and students can share their infographics if time allows.)

Experience - Activity Two

Now that you as an agronomist have explained the importance of agricultural irrigation, your client has three plants and it is your job to investigate if any problems have occurred with them. You will need to advise your client, a farmer, on how to effectively manage irrigation in his or her operation.

First, we need to define basic irrigation terms and concepts.
Share/Pair: With a partner jot down key concepts the following words possess or how they impact irrigation.

Soil water *(Ground water is subsurface water in sufficient quantity that wells or springs can use it.)*
Available soil water *(The amount of water held by the soil between field capacity and permanent wilting point.)*
Excess soil water or gravitational water *(Since drainage takes time, plants may use part of the excess water before it moves out of the root zone.)*
Field capacity *(The amount of water remaining in a soil after the soil has been saturated and allowed to drain freely for approximately 24 hours.)*
Permanent wilting point *(When plants have removed all of the available water from a given soil, they wilt and will not recover.)*

Show youth the following picture, or draw it out to illustrate the concept of available water, field capacity, and permanent wilting point. Hand out field capacity and permanent wilting point to put in their science notebook.

Terms

Soil water: water contained within or flowing through the soil profile. Surface water must infiltrate the soil profile to become soil water.

Excess soil water or gravitational water: water that drains or readily percolates below the active root zone by the force of gravity.

Available soil water: water that is retained in the soil and can be extracted by the plant. The available soil water is most important for crop production.

Field capacity: the water content of a soil at the upper limit of the available soil water range

Permanent wilting point: the lower limit of the available soil water range.

***Fact**: Agricultural water users can optimize water use efficiency and protect the quality of water resources by applying basic and research-based information about irrigation systems, crop water use, and management practices.*

Discuss… 

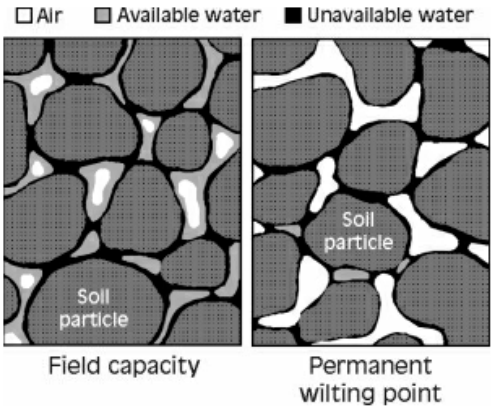

Figure 3.1. Illustration of field capacity and permanent wilting point.

What happens to crops that receive excess water?
They will "drown" because they need oxygen to survive.

The impact of excess water on crop growth and yield is influenced by crop type, soil characteristics, duration of excess water or flooding, initial soil water and nitrogen status of the soil before flooding, crop stage, air temperature, etc.

Experience - Activity Three

(Put the plants where youth can see them, but not necessarily touch the soil or see it. Soybeans work well for hiding the soil surface.)

The farmer calls you, the agronomist, out to look at these three plants that represent three fields. Plants are the same hybrid and variety with similar soil types.

What are the differences between these plants?
One should be healthy, the others should be stressed, yellowed, dying, or possibly even dead.
What types of conditions do you think were present for each plant?
One was flooded, one had optimal water conditions, and one had very little water.
What can we learn from these three plants/fields?
Plants require a certain amount of water to thrive.

Adopting proper irrigation management strategies can reduce negative impacts of over-irrigation and provide a balance between the crop water requirements and available water. Over-irrigation leads to water loss, increases energy use for pumping, causes leaching of nitrogen and other micronutrients and wastes time.

What factors will affect the amount of irrigation water applied? Jot these down in your science notebooks.
Measure soil water status, rainfall, irrigation water applied, estimating crop water use, type of crop, and stage of crop growth. Take into account weather related factors such as humidity, temperature, and wind, etc.

Resource:
Irmak, S. and W.R. Rathje. (2014). Plant Growth and Yield as Affected by Wet Soil Conditions Due to Flooding or Over-Irrigation. Extension NebGuide, G1904. University of Nebraska-Lincoln Extension.

Fact: *One acre can grow 100-300 bushels of corn, with 200 bushels being an average.*

Reflection

- What is the importance of irrigation management?
- What is the definition of irrigation management?
- What are key terms related to irrigation?
- What are problems associated with under- or over-irrigating crops?
- What are careers related to irrigation?
- As an agronomist or farmer, why is it important to effectively manage water?

Apply/Generalize to Your Life

So now you are all agronomists! What are some things you learned about irrigation?

How do science, technology, engineering, and math relate to irrigation? What STEM skills did you use in this lesson?

How can you use skills used today in different situations?

As you can see, STEM skills and careers are all around us and you were able to experience some of those skills and careers.

Evaluation Link

Coming Soon

References

Irmak, S., and Rathje, W.R. (2008). Plant Growth and Yield as Affected by Wet Soil Conditions Due to Flooding or Over-Irrigation. Extension NebGuide, G1904. University of Nebraska-Lincoln Extension.

VanDeWalle, B., Nygren, A., Burr, C., Zoubek, G., Irmak, S. (2016) Agricultural Water Management Guide. Extension Publication. University Of Nebraska–Lincoln Extension.

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Reviewed by Nebraska Extension's STEM Careers Team

EXTRA REVIEW

Create a chart labeled What We Learned in your Science Notebook, which might include: irrigation management goal, terms defined, careers related to irrigation, impacts of over/under irrigation, etc.

Connect via tweeter
@bvandewalle2
#NAWMN

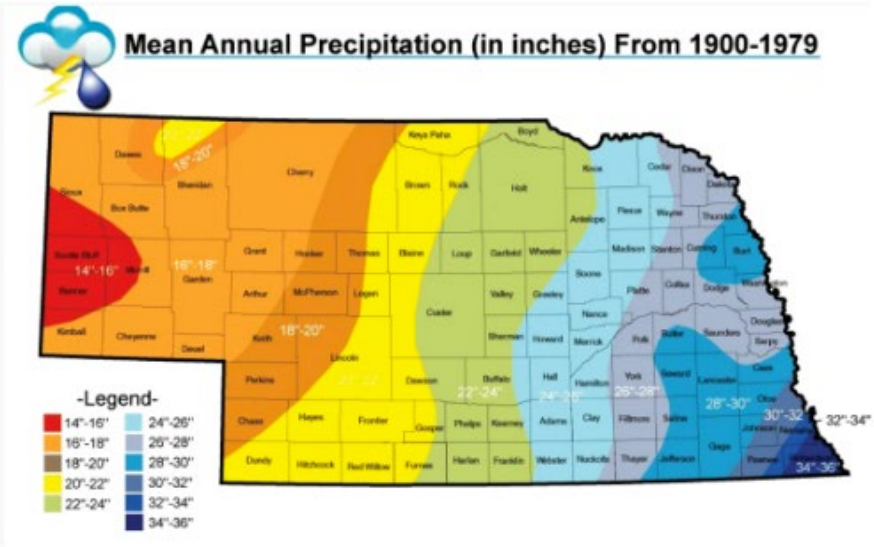
Check out
CropWatch.unl.edu/youth
webpages

Supplemental Information on Nebrask

a Facts

DID YOU KNOW?

There is more variation in precipitation from the southeast corner of Nebraska to the northwest corner than there is from Nebraska to the east coast of the US!



Research Opportunity

See what areas are fully or over-appropriated at http://www.dnr.ne.gov/iwm/fully-appropriated-and-overappropriated-surface-water-in-nebraska

Science Notebook

Thoughts about irrigation….

The goal of **irrigation management** is…..

Over-Appropriated:

Fully Appropriated:

Careers involved in irrigation include:

Irrigation is important!

Water Management Basics

Science Notebook

Key concepts with irrigation include:

Soil Water

Available Soil Water

Excess soil water or gravitational water

Field Capacity

Permanent Wilting Point

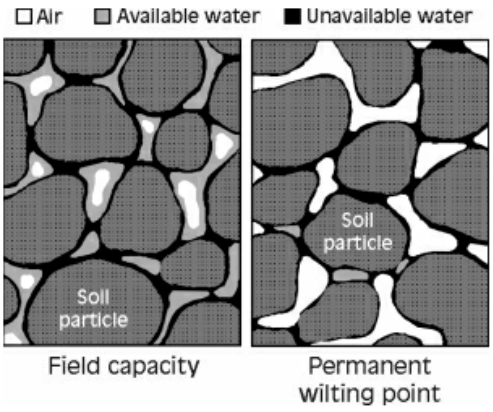


Figure 3.1. Illustration of field capacity and permanent wilting point.

Water Management Basics

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Science Notebook

As an agronomist, examine the three plants. What are the differences between the plants? What types of conditions do you think were present for each plant?

What can we learn from these three plants?

What I have learned from this lesson…….

Other Lessons to Follow

- History of irrigation and present irrigation

- Irrigation types: Surface, Sprinkler, Trickle/Drip
- Irrigation management strategies
    - Soil types
    - Limited or deficit
    - Irrigation timing
- Tools used to irrigate
    - ETgage
    - Watermark Sensors
- Variable rate irrigation and future of irrigation
- Nebraska Ag Water Management Network (tie to citizen scientist)
- Resources Page
- Apps
- Agricultural Water Management Guide