

Increasing Production with Precision Agriculture

Name _____

Activity 1: How does water use efficiency vary within the field?

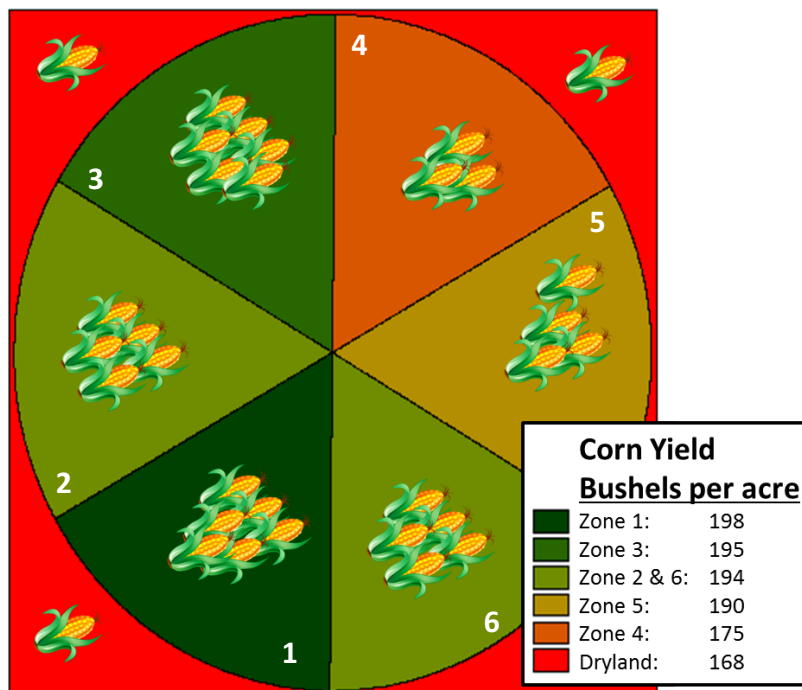
Yield data was collected during harvest. Sensors in the harvest equipment monitored the amount of corn harvested in each location of the field and recorded the data in a yield map. An average of the yield in each section was calculated to measure water use efficiency (WUE) in each section.

Overall field yield:

Irrigated yield: 190 bushels/acre
 Dry land yield: 168 bushels/acre
 Irrigation: 10 inches

$$WUE = \frac{\text{Irrigated Yield} - \text{Dry land Yield}}{\text{Irrigation (in)}}$$

Calculate WUE for the zones of the irrigated field:



$$WUE = \frac{190 \frac{\text{bushels}}{\text{acre}} - 168 \frac{\text{bushels}}{\text{acre}}}{10 \text{ in}}$$

$$WUE = 2.20 \frac{\text{bushels}}{\text{acre} \cdot \text{in}}$$

Increasing Production with Precision Agriculture (continued)

Calculate the WUE for each zone of the irrigated field. Show your work.

$$WUE = \frac{\text{Irrigated Yield} - \text{Dry land Yield}}{\text{Irrigation (in)}}$$

Zone 1 calculations

$$= \frac{198 - 168}{10} \quad WUE = 3.0 \text{ bu/ac}\cdot\text{in}$$

Zone 2 calculations

$$= \frac{194 - 168}{10} \quad WUE = 2.6 \text{ bu/ac}\cdot\text{in}$$

Zone 3 calculations

$$= \frac{195 - 168}{10} \quad WUE = 2.7 \text{ bu/ac}\cdot\text{in}$$

Zone 4 calculations

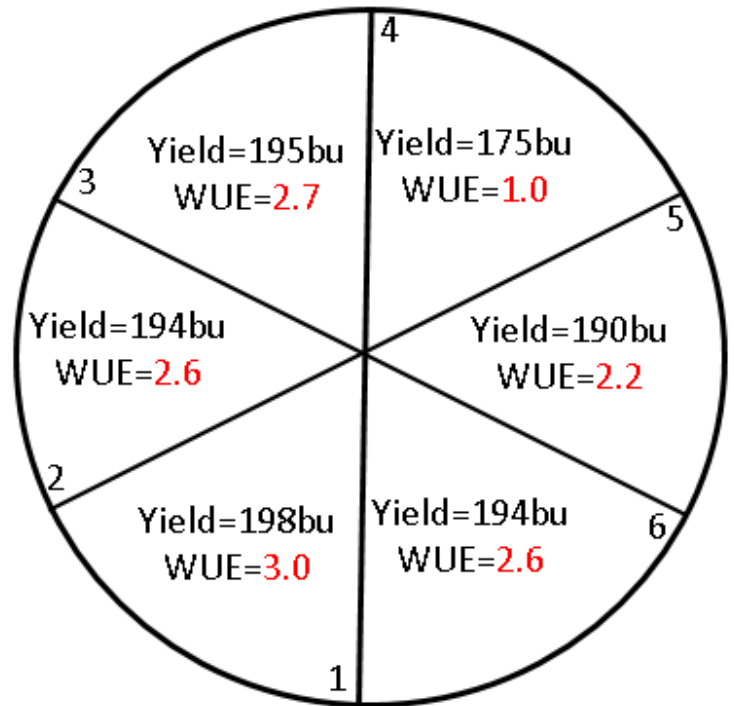
$$= \frac{175 - 168}{10} \quad WUE = 1.0 \text{ bu/ac}\cdot\text{in}$$

Zone 5 calculations

$$= \frac{190 - 168}{10} \quad WUE = 2.2 \text{ bu/ac}\cdot\text{in}$$

Zone 6 calculations

$$= \frac{194 - 168}{10} \quad WUE = 2.6 \text{ bu/ac}\cdot\text{in}$$



Irrigation=10 in
Dry land Yield=168bu/ac

Water use efficiency (WUE) values above the field average (2.2 bu/ac·in) correspond to greater yields. For instance, Zone 1 has an additional 3 bushels per acre for every inch of irrigated water compared to dry land, but the irrigated field average only has an increase of 2.2 bushels per acre.

Increasing Production with Precision Agriculture (continued)

Could we use our water more efficiently?

Assuming yield stays constant, how much water should be used in each section to match overall WUE? Calculate the irrigation for each zone of the irrigated field. Show your work.

$$\text{Irrigation (in)} = \frac{\text{Irrigated Yield} - \text{Dryland Yield}}{\text{WUE}}$$

Zone 1 calculations

$$= \frac{198 - 168}{2.2} \quad I = 13.6 \text{ in}$$

Zone 2 calculations

$$= \frac{194 - 168}{2.2} \quad I = 11.8 \text{ in}$$

Zone 3 calculations

$$= \frac{195 - 168}{2.2} \quad I = 12.3 \text{ in}$$

Zone 4 calculations

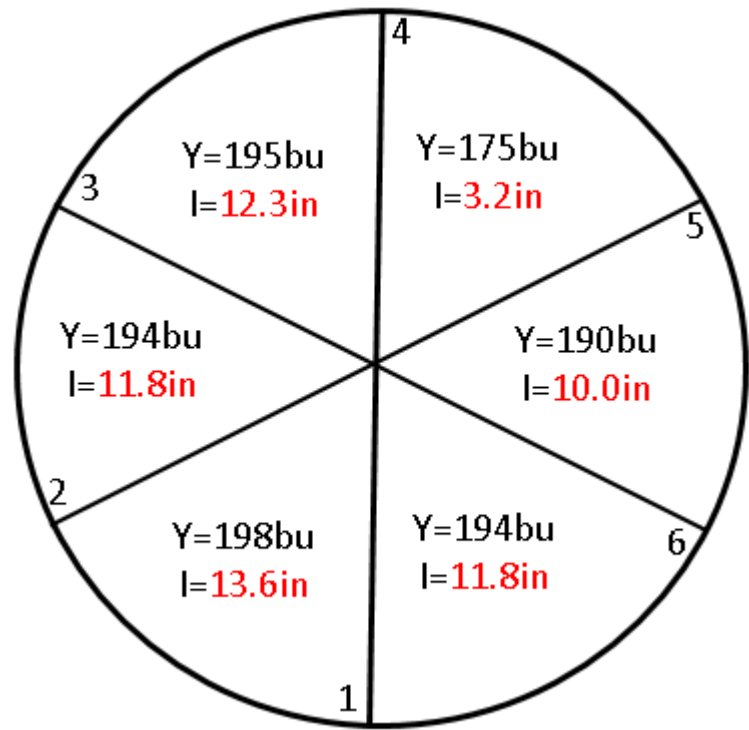
$$= \frac{175 - 168}{2.2} \quad I = 3.2 \text{ in}$$

Zone 5 calculations

$$= \frac{190 - 168}{2.2} \quad I = 10.0 \text{ in}$$

Zone 6 calculations

$$= \frac{194 - 168}{2.2} \quad I = 11.8 \text{ in}$$



Dryland Yield=168bu/ac

If yield is assumed to be constant, adding extra water (beyond 10 inches) will not have a positive effect. However, if some sections could produce the same yield with less water we could reduce the amount of water used for irrigation.

How many gallons of water could be saved from the under-producing zone?

Useful information:

- Each section is 23.3 acres
- 1 acre = 43,560 ft²
- 1 gallon = 0.1337 ft³

Increasing Production with Precision Agriculture (continued)

How can we construct a device to vary water flow using the engineering design process?

<p><u>Problem and Objective</u> Ex. Need to construct a device to vary water flow</p>	<p><u>Brainstorming</u> Ex. Differences in straw diameters will play a factor</p>
<p><u>Constraints and Criteria</u> Ex. Allowed to use only 2 materials (limited resources)</p>	
<p><u>Testing</u> Ex. Water flowed into amounts of 5fl oz, 5 fl oz, 6 fl oz</p>	<p><u>Potential Solutions</u> Ex. Need to use different types of straws</p>
	<p><u>Final Solution</u></p>

Increasing Production with Precision Agriculture (continued)

How accurate was your design? Record the amount of water that went into each cup.



Was your design successful?

What could you do to improve your design?

Why do you think that varying water amounts is useful?
