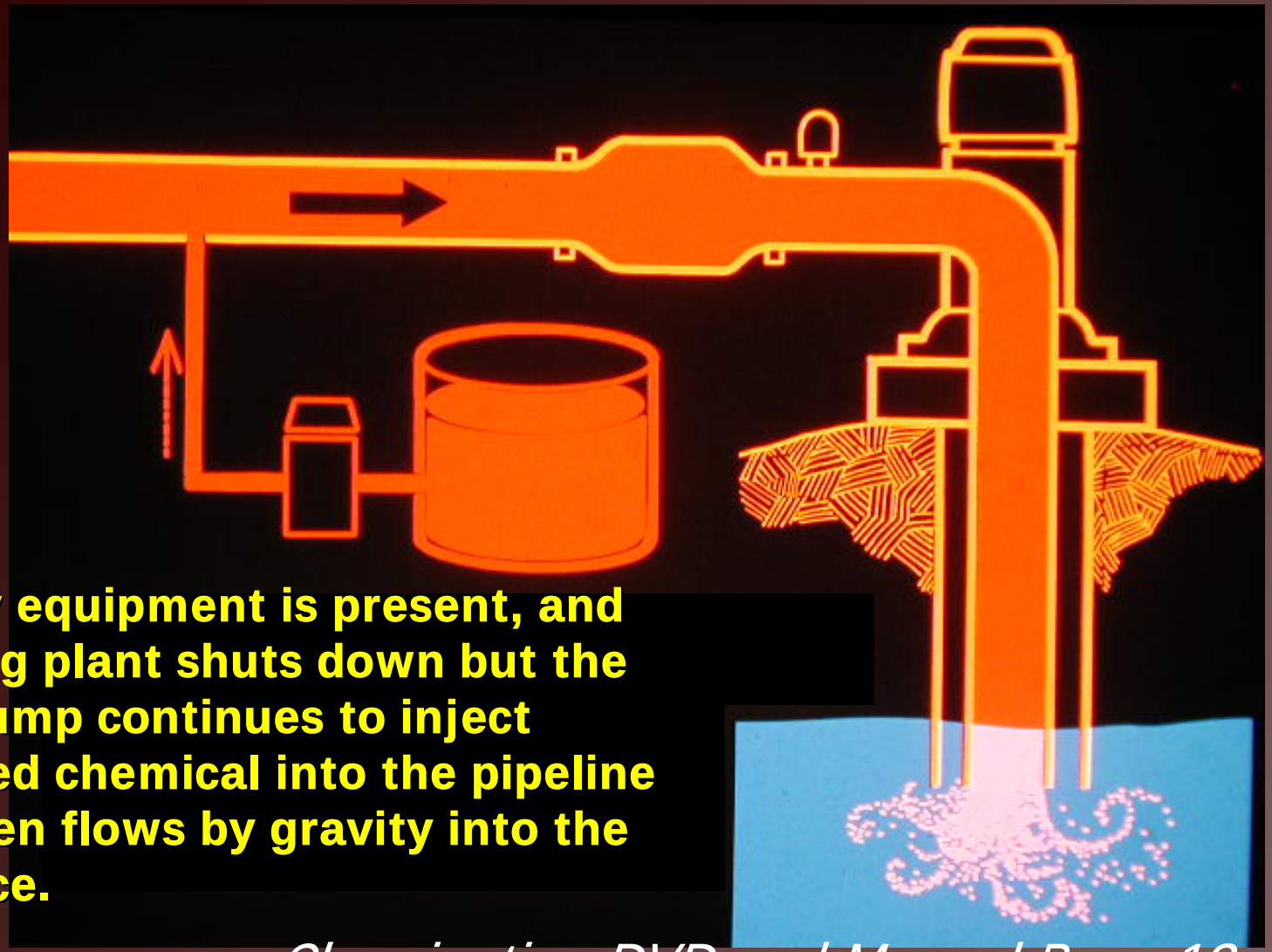
Nebraska Lincoln EXTENSION

Know how. Know **now.**

Chemigation Updates 2008

Chemigation Management

Biggest Hazard with Chemigation



If no safety equipment is present, and the pumping plant shuts down but the injection pump continues to inject concentrated chemical into the pipeline where it then flows by gravity into the water source.

Chemigation DVD and Manual Page 12

Routes of Entry

Orally through the mouth
Dermally through the skin
Inhalation by breathing into the lungs

Chemigation DVD and Manual Page 27

Wind Drift Considerations

Research conducted near Concord, NE indicated that wind of 14 mph transported insecticide up to 265 feet downwind of the center pivot

Chemigation Manual Page 2

In Case of a Spill

Control the leak by ceasing to chemigate and closing a valve or pinching off the hose

Contain the spill area by creating a dike around it or applying an absorbent

Contact your local NRD and the NDEQ immediately

Clean up the spill as specified by the **NDEQ**

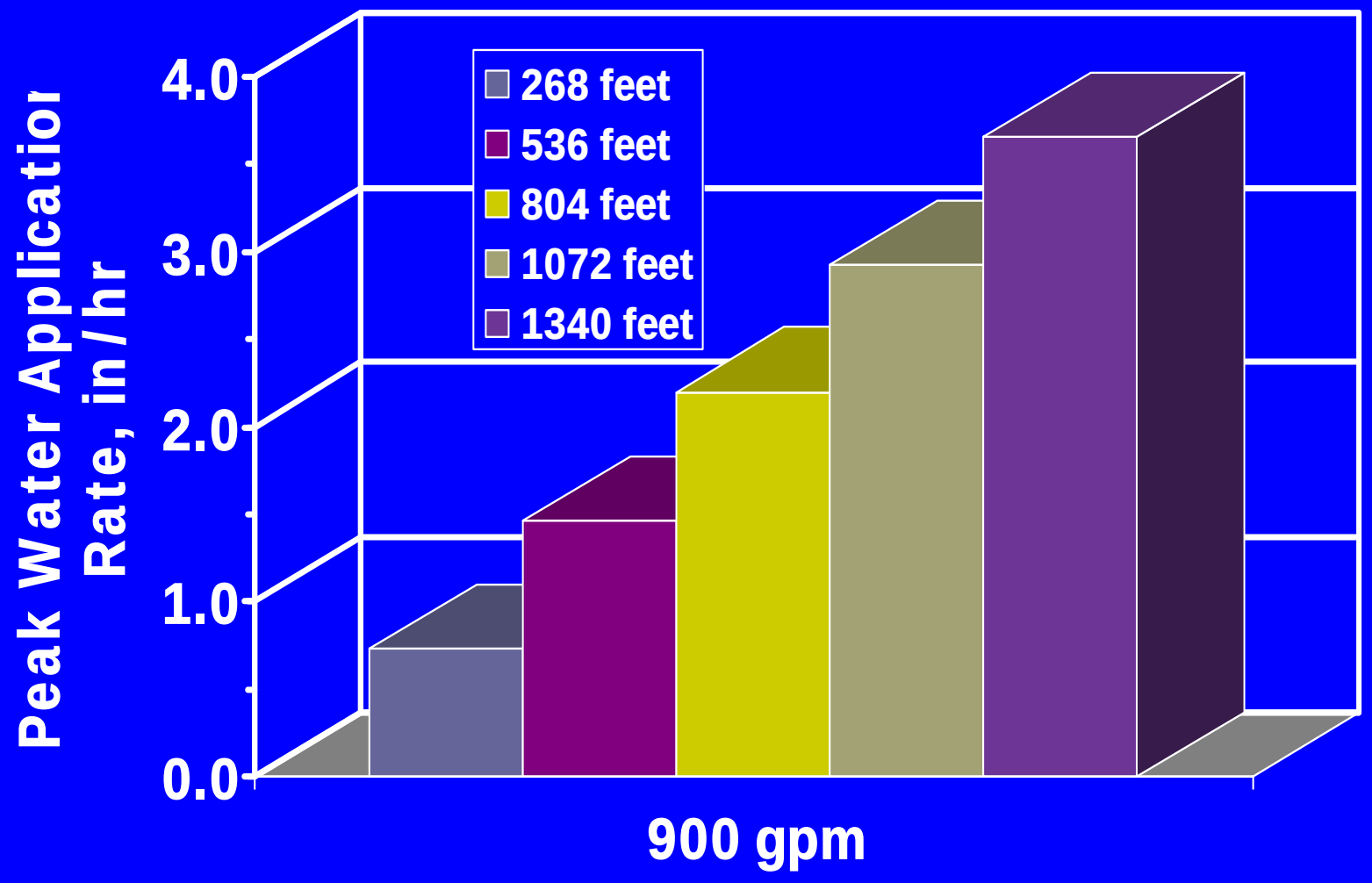
Chemigation Manual Page 28

Personal Safety

Research at UNL shows that hands are the most likely route of entry for those involved in monitoring chemigation application of insecticides

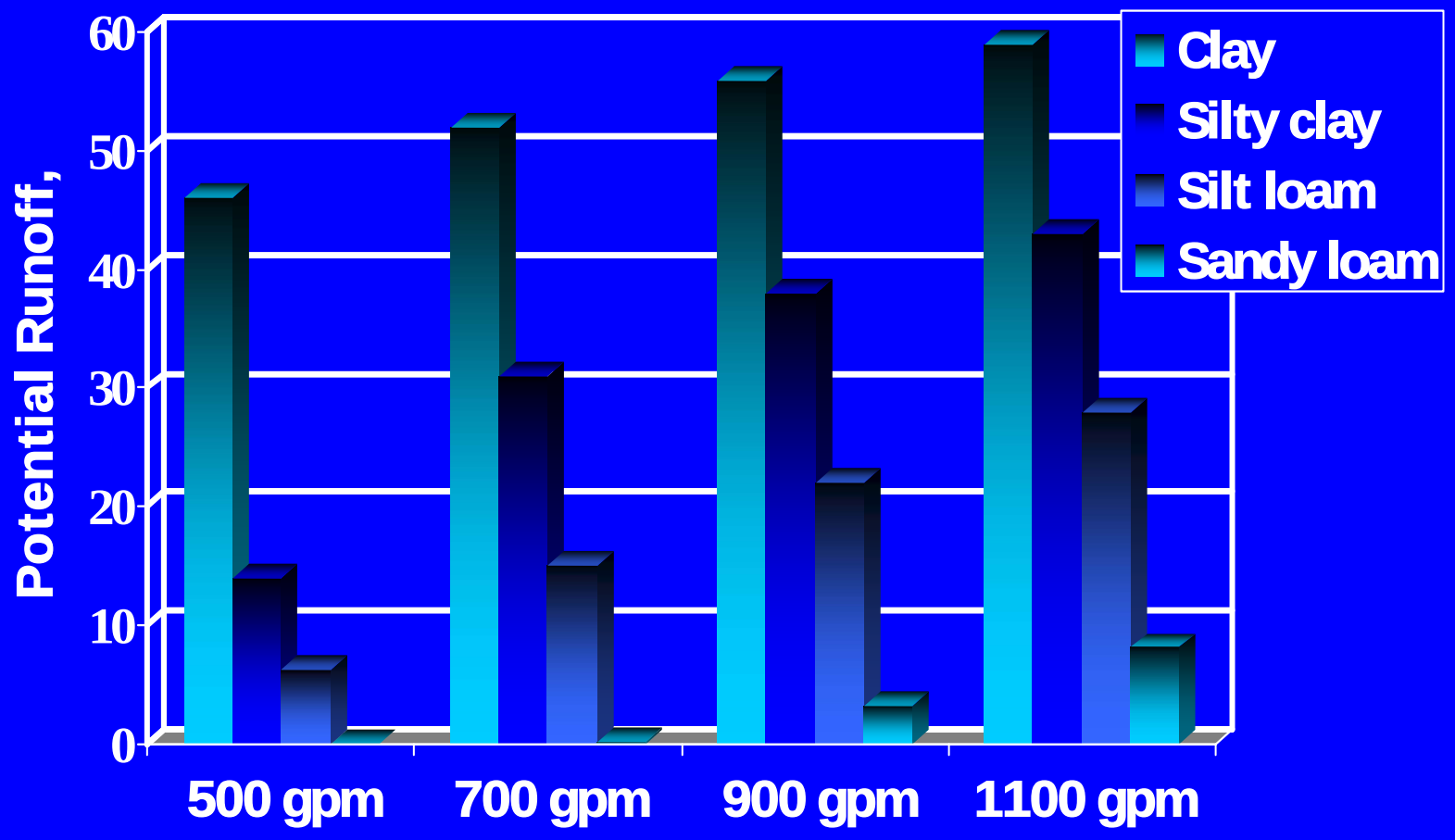
Chemigation DVD and Manual Page 28

Distance From Pivot Point



Chemigation DVD and Manual Page 6

Soil Infiltration Rate

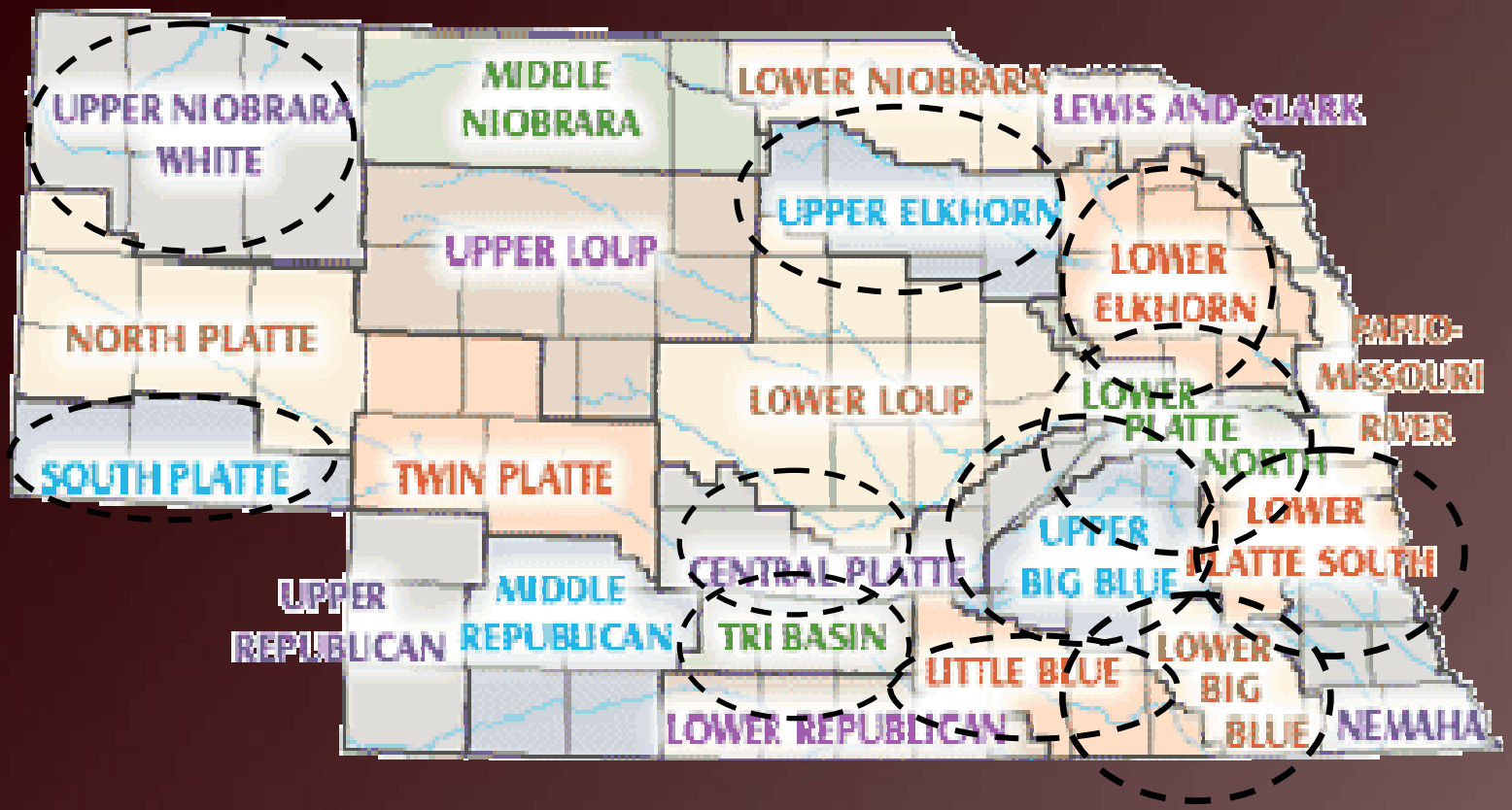


Chemigation DVD and Manual Page 2-3

Irrigation management tools

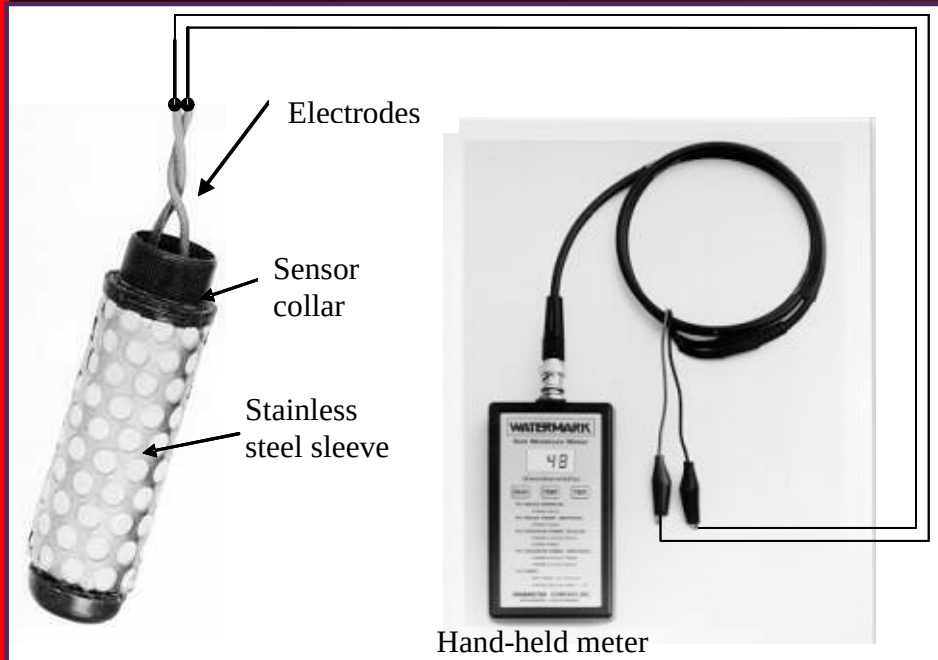
Agricultural Water
Management Demonstration
Network

Our NRD partners as of 2007 and we invite others!



Slide developed by Dr. Suat Irmak

Watermark soil water sensors



Slide developed by Dr. Suat Irmak

Hansen AM400 Data Logger

Slide developed by Dr. Suat Irmak

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How to use Watermark sensors?

IANR

Nebraska Lincoln EXTENSION

EC783

Watermark Granular Matrix Sensor to Measure Soil Matric Potential for Irrigation Management

Suat Irmak, Irrigation and Water Resources Engineer; Jose O. Payero, Irrigation Engineer; Dean E. Eisenhauer, Hydrologic and Irrigation Engineering; William L. Kranz, Irrigation Specialist; Derrel L. Martin, Irrigation and Water Resources Engineer; Gary L. Zoubek, Extension Educator; Jennifer M. Rees, Extension Educator; Brandy VanDeWalle, Extension Educator; Andrew P. Christiansen, Extension Educator; Dan Leininger, Water Conservationist, Upper Big Blue NRD

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Irrigation trigger levels for different soil types

Soil matric potential (kPa)	Soil type, depletion in inches per foot associated with a given soil matric potential value measured by the Watermark sensors, and available water holding capacity for different soil types							
	Silty clay loam topsoil, Silty clay subsoil (Sharpsburg)	Silt-loam topsoil, Clay loam subsoil (Keith)	Upland silt loam topsoil, Silty clay loam subsoil (Hastings, Crete, Holdrege)	Bottom land silt-loam (Wabash, Hall)	Fine sandy loam	Sandy loam	Loamy sand (O'Neill)	Fine sand (Valentine)
0	0	0	0	0	0	0	0	0
20	0	0	0	0	0.20	0.30	0.30	0.30
33	0.20	0.14	0	0	0.55	0.50	0.45	0.55
50	0.45	0.36	0.32	0.30	0.80	0.70	0.60	0.70
60	0.50	0.40	0.47	0.44	1.0	0.80	0.70	0.70
70	0.60	0.50	0.59	0.50	1.10	0.80	0.80	0.80
80	0.65	0.55	0.70	0.60	1.20	1.00	0.93	1.00
90	0.70	0.60	0.78	0.70	1.40	1.20	1.04	-
100	0.80	0.68	0.85	0.80	1.60	1.40	1.10	-
150	0.90	0.86	1.08	1.20	-	-	-	-
200	1.00	0.95	1.20	1.20	-	-	-	-
Available water capacity (in/ft)	1.8-2.0	1.8-2.0	2.2	2.0	1.8	1.4	1.1	1.0

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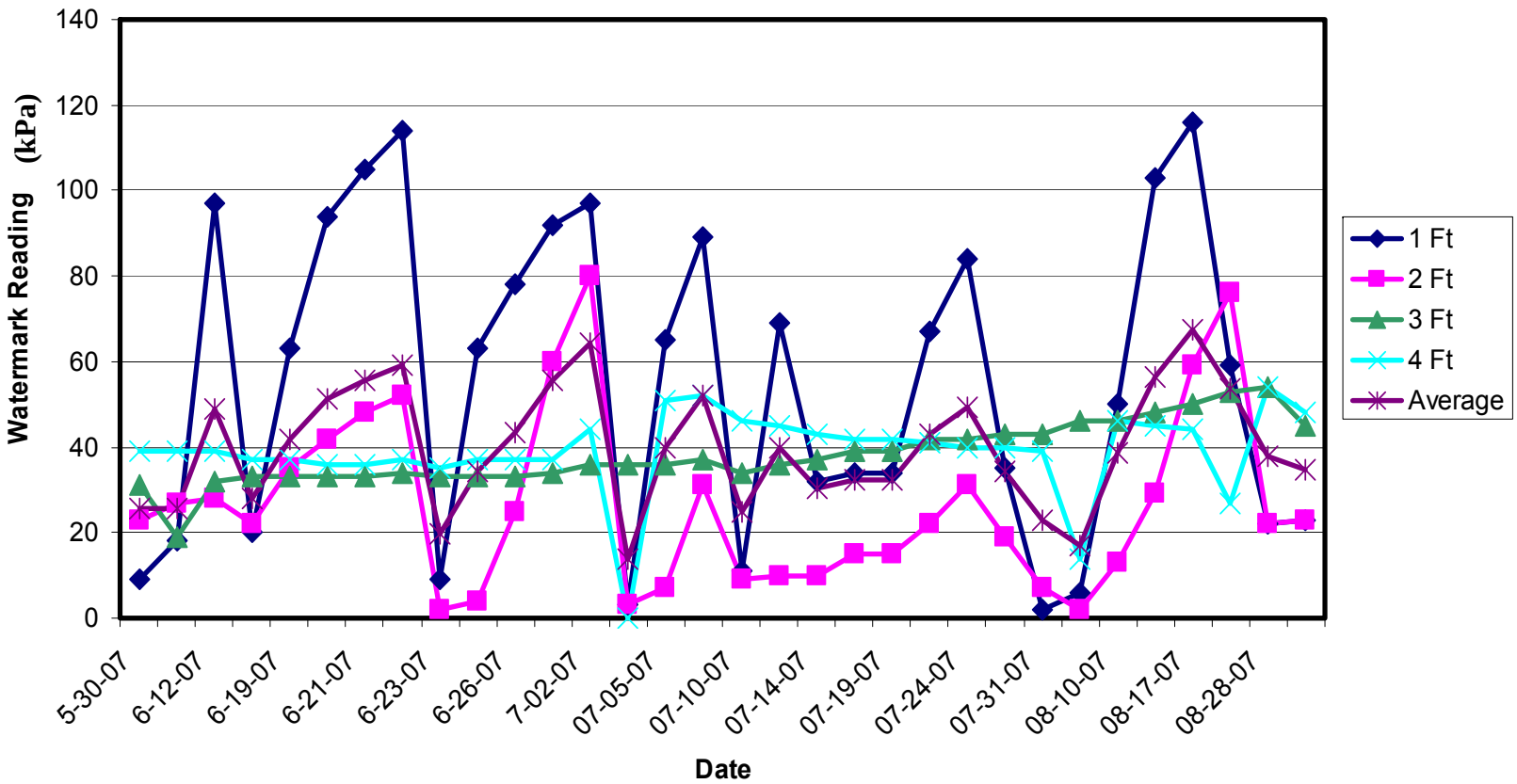
Example: change in soil water status



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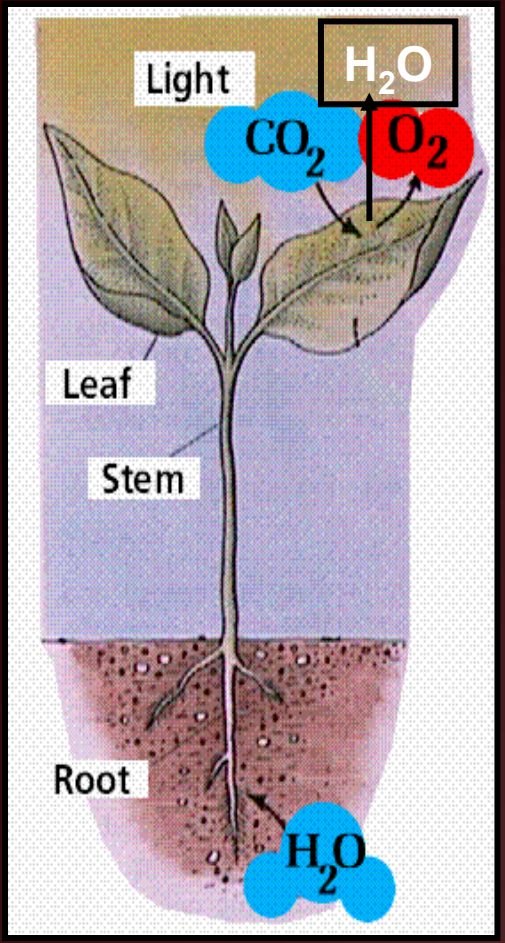
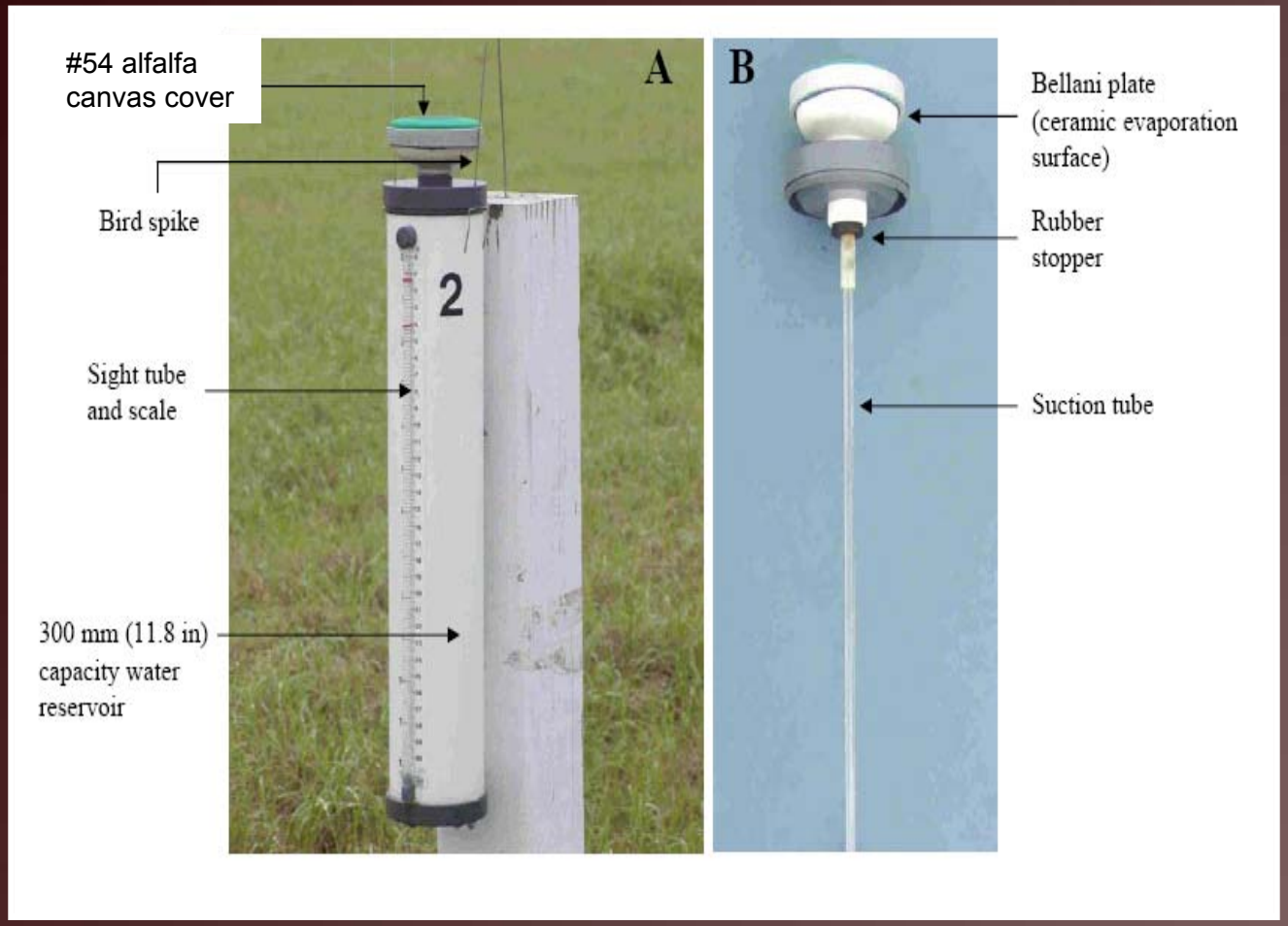
ATMOMETER (ETgage)





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Nebraska Lincoln EXTENSION

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Using an ETgage for irrigation management

IANR NebGuide Nebraska Lincoln

Published by University of Nebraska–Lincoln Extension, Institute of Agriculture and Natural Resources

G05-1579

Using Modified Atmometers (ET_{gage}®) for Irrigation Management

Suat Irmak, José O. Payero and Derrel L. Martin
Extension Water Resources /Irrigation Engineers

This NebGuide describes the atmometer (evapotranspiration gage) and explains how it can be used for irrigation scheduling. Examples are provided to show how information collected with an atmometer can be used to estimate crop water use for corn and soybean.

Slide developed by Dr. Suat Irmak

Crop coefficient (Kc)

Table I. Alfalfa-based crop coefficients (Kc) at the beginning of each growth stage for corn, soybean, and wheat (High Plains Regional Climate Center, 2005).

Corn		*Soybean*		*Wheat*	
Growth Stage	*Kc*	*Growth Stage*	*Kc*	*Growth Stage*	*Kc*
2 leaves	0.10	Cotyledon	0.10	Emergence	0.10
4 leaves	0.18	First Node	0.20	Visible Crown	0.50
6 leaves	0.35	Second Node	0.40	Leaf Elongation	0.90
8 leaves	0.51	Third Node	0.60	Jointing	1.03
10 leaves	0.69	Beginning Bloom	0.90	Boot	1.10
12 leaves	0.88	Full Bloom	1.00	Heading	1.10
14 leaves	1.01	Beginning Pod	1.10	Flowering	1.10
16 leaves	1.10	Full Pod	1.10	Grain Fill	1.10
Silking	1.10	Beginning Seed	1.10	Stiff Doug	1.00
Blister	1.10	Full Seed	1.10	Ripening	0.50
Dough	1.10	Beginning Maturity	0.90	Mature	0.10
Beginning dent	1.10	Full Maturity	0.20		
Full dent	0.98	Mature	0.10		
Black layer	0.60				
Full maturity	0.10				

Slide developed by Dr. Suat Irmak

Example

Corn is at 12-leaf growth stage and the water level in the ETG (with a No. 54 canvas cover) sight tube decreased 1.30 inches during the 7-day period since the last irrigation. Determine the actual crop ET (ETc), net irrigation requirement (NIR), and the gross irrigation requirement (GIR) if irrigation is applied with a center pivot with an application efficiency of 85% (AE = 0.85). Rainfall = 0.

ETr = 1.30 inches (reference ET from the ETG)

Kc = 0.88 (from table for 12-leaf stage)

ETc = ETr x Kc ETc = 1.30 inches x 0.88 = 1.1 inches

NIR = ETc – Rainfall NIR = 1.1 inches – 0 = 1.1 inches

GIR = NIR / IE GIR = 1.1 inches / 0.85 = 1.3 inches

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Equipment Considerations

- **Check sprinkler operation prior to the first chemigation event**
  - look for pressure regulator leaks
  - look for sprinkler rotation and water distribution problems
  - replace sprinklers and regulators with ones appropriate for the location on the system

Chemigation Manual Page 26

In-Canopy Nozzle Packages

- **Where water goes the chemical goes**
  - Portion of the canopy may not be wet during an chemigation event
  - Water application rate increased due to reduced wetted diameter
  - Potential for runoff increases with a decrease in wetted diameter
  - To maintain uniformity, nozzle spacing must be 7.5 feet or less

Equipment Considerations

- **Epoxy coated mainline check valves are rusting through and failing the no leakage test.**
  - Consider galvanized valve models for future purchases

NRD Inspector reports

Equipment Considerations

Rodents find their way in

Cover low pressure drain and vacuum relief valve outlets with screen or similar material

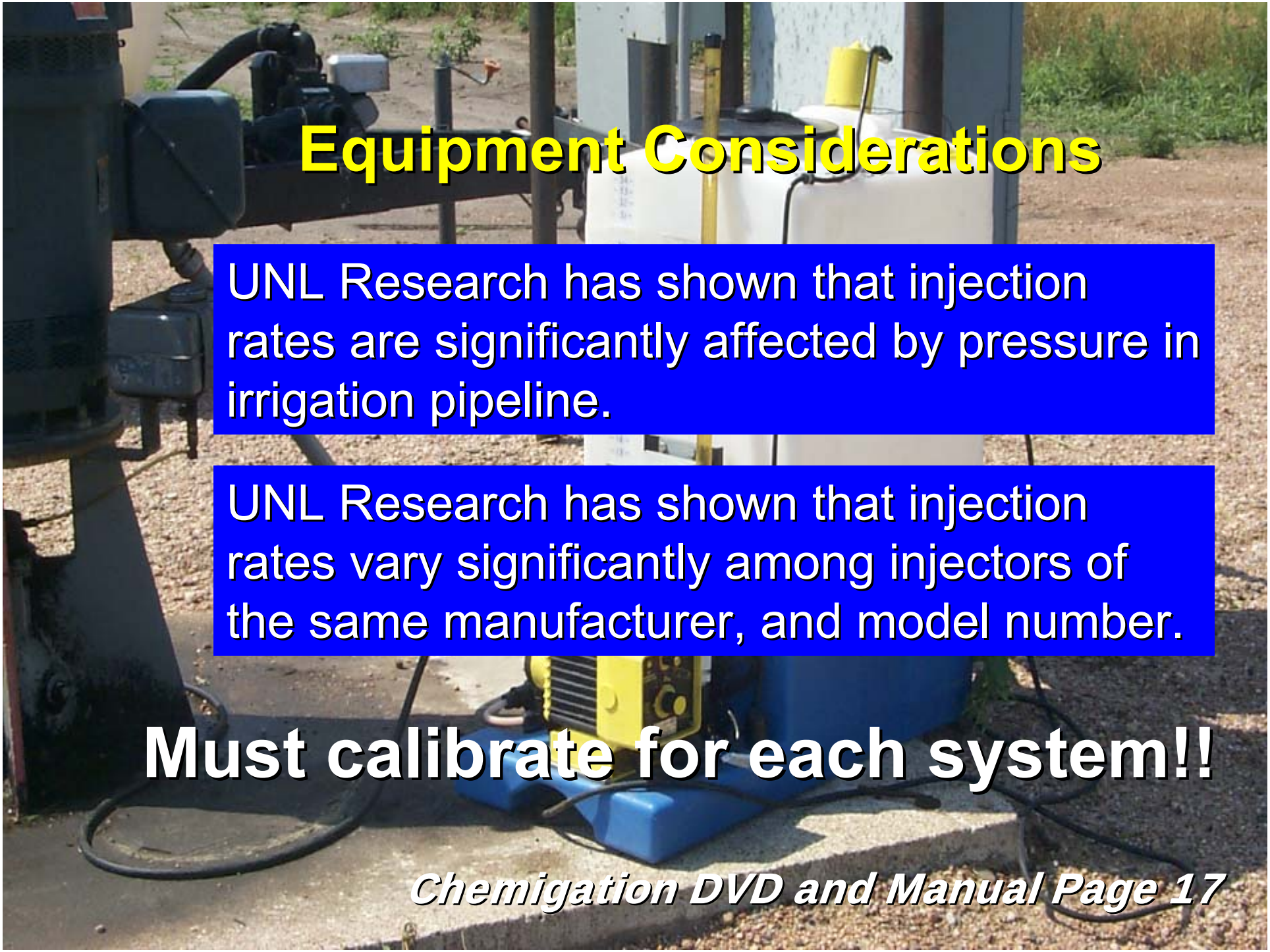
Irrigator reports

Each manufacturer of corner systems adjusts the operation of the main system differently as the corner arm engages.

Example: Slow down the main system to keep the acres irrigated per hour constant. Flow rate into the system increases.

Land under the main system and corner system gets same amount of chemical but area under the main system gets more water.

Chemigation Manual Page 5



Equipment Considerations

UNL Research has shown that injection rates are significantly affected by pressure in irrigation pipeline.

UNL Research has shown that injection rates vary significantly among injectors of the same manufacturer, and model number.

Must calibrate for each system!!

Equipment Considerations

- Bridge type low pressure drains require more than 25 psi to close. Thus, will not close with some low pressure systems.
  - Consider new plunger type valves for new purchases
  - Remember that plumbing may need to be adjusted for the new drains

As shown in the Chemigation DVD

Equipment Considerations

- **In-line check valves may not pass inspection. Salt buildup on the valve seat is the main issue.**
  - thoroughly flush the valve after each use
  - clean valve seat often and prior to winter storage

Equipment Considerations

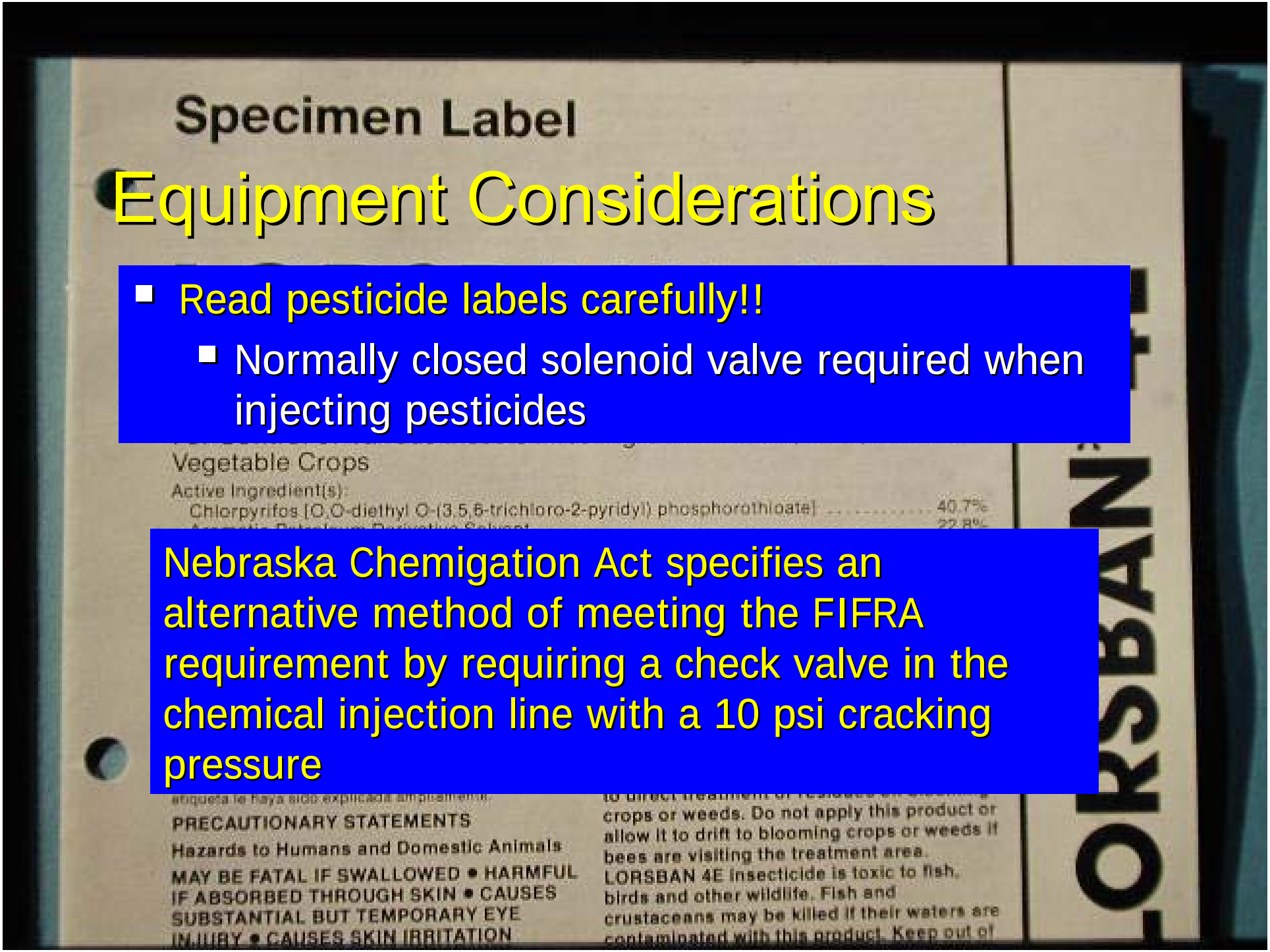
- **Polyethylene delivery hoses become degraded with time and will crack easily**
  - replace all delivery hoses every year or two
  - purchase hoses that are less affected by sunlight

Irrigator reports

Equipment Considerations

- Read pesticide labels carefully!!
  - Normally closed solenoid valve required when injecting pesticides

Nebraska Chemigation Act specifies an alternative method of meeting the FIFRA requirement by requiring a check valve in the chemical injection line with a 10 psi cracking pressure



Subsurface Drip Irrigation Systems

Title 195 -- Nebraska Chemigation Act
DOES apply if chemicals are injected.

- Safety equipment required
- Chemigation Permit required
- Inspections required
- Operator must be certified

Subsurface Drip Irrigation Systems

Drip systems are treated like leach fields for residential septic treatment. Thus, an Underground Injection Control Permit must be approved before construction begins.

Rules are covered in Title 122

Contact your local NRD or NDEQ for Underground Injection Control Permit materials

Review of the Nebraska Chemigation Act

Definition of Chemical

- *Chemical* - is any fertilizer, fungicide, herbicide, or pesticide mixed with the water supply.
- The definition was incorrect in some versions of the summary of the law section.

Chemigation DVD and Manual Page 41

Rule Change

- Wording on sign for restricted use chemicals was changed to:

KEEP OUT CHEMICAL APPLICATION THROUGH IRRIGATION SYSTEM

Chemigation DVD and Manual Page 47-48

Injection Location

Point at which the chemical is added to irrigation water

Chemigation Permit

Needed for every injection location

except

No Permit for Open Discharge Systems

Chemigation DVD and Manual Page 41

Permit Holder

Owner or Operator of land who is legally responsible for the use of chemigation on the land

Applicator

Person actively engaged in the application of chemicals via chemigation

The permit holder and the applicator do not have to be the same person

Chemigation DVD and Manual Page 41

Permit

Permit expires on June 1 of the year following issuance

Emergency permit good for 45 days

Applicator Certification

Certification expires on January 1 4 years after being issued

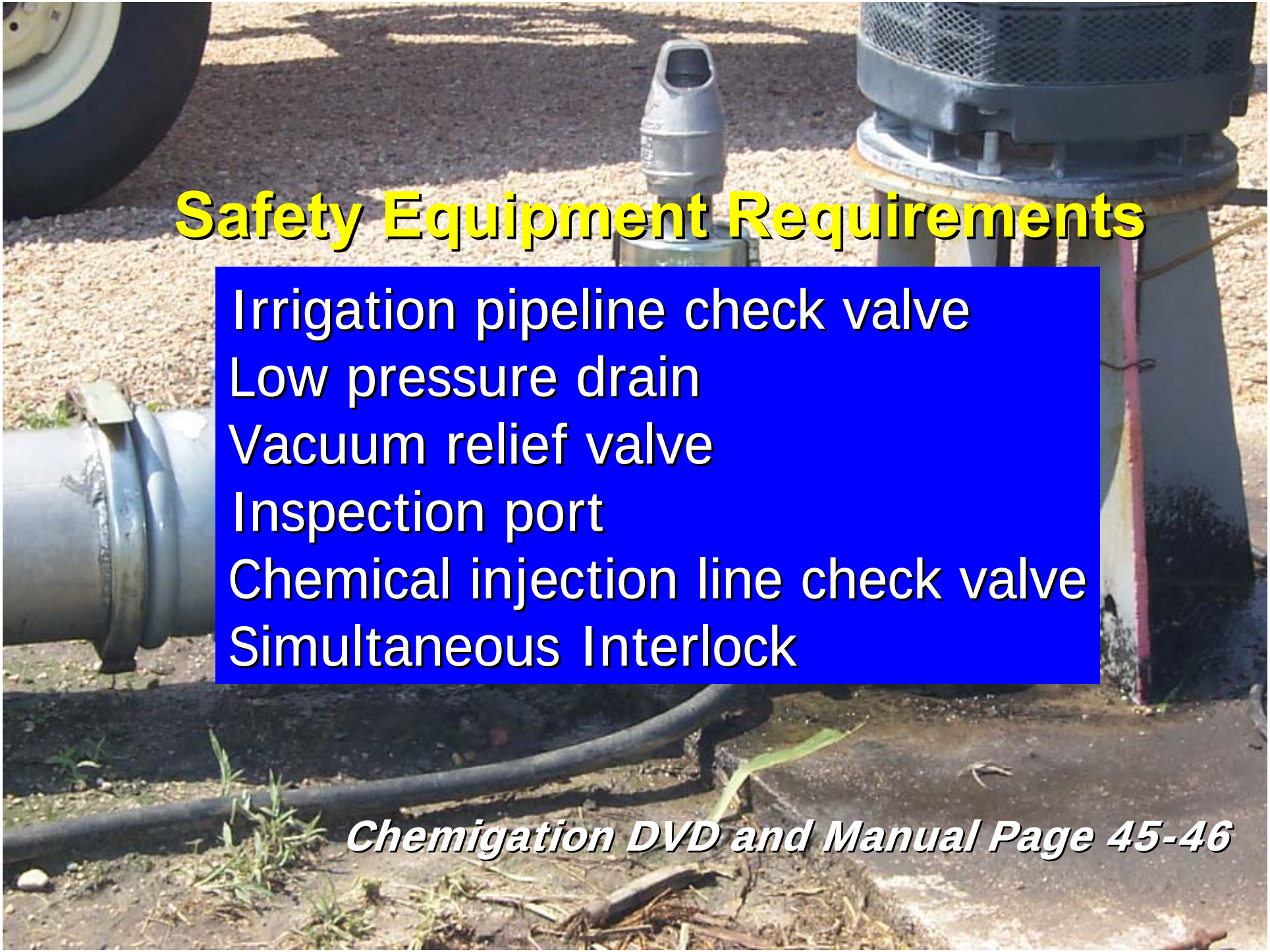
Chemigation DVD and Manual Page 43 & 48

Permit Information Changes

Different certified applicator
Must notify the NRD within 10 days

Safety equipment was replaced
Must notify the NRD within 72 hours

Chemigation DVD and Manual Page 42 & 46



Safety Equipment Requirements

- Irrigation pipeline check valve
- Low pressure drain
- Vacuum relief valve
- Inspection port
- Chemical injection line check valve
- Simultaneous Interlock

Chemigation DVD and Manual Page 45-46

Rules and Regulations in Title 195

Report a actual or suspected spill within 24 hours to your local

Natural Resources District
and
Nebraska Department of Environmental Quality

Phone: (402) 471-2186

Chemigation DVD and Manual Page 49 & 28

Chemigation Calibration

Example 1: A parcel of land is irrigated by a center-pivot with a length of 1,290 feet (pivot point to the last sprinkler). The water throw of the last sprinkler is an additional 25 feet beyond the end of the last sprinkler. There is no end gun. How many acres are irrigated if the center pivot makes a complete circle.

WR = length to last sprinkler + throw of last sprinkler
= 1290 ft + 25 ft
= **1315 ft**

Area = π x WR x WR

$$\frac{3.14 \times (1{,}315\ \text{ft})^2}{43{,}560\ \text{sq ft/acre}} = \frac{3.14 \times (1{,}315 \times 1{,}315)}{43{,}560}$$

= **124.6 acres**

Calibration Workbook Page 11

Example 1: A parcel of land is irrigated by a center-pivot with the distance from the pivot point to the last wheel track of 1,265 feet. The speed of the pivot at the last wheel track is 9.0 feet per minute when the percentage timer is set at 100%. How long does it take the system to make one revolution when it is run at 100%.

Circumference $= 2 \times \pi \times r$

$= 2 \times 3.14 \times 1265$ ft

$=$ **7944 ft/rev**

Revolution time $= \dfrac{\text{circumference in feet}}{\text{travel speed in ft/min}}$

Revolution time $= \dfrac{7944 \text{ ft/rev}}{9.0 \text{ ft/min}}$

$=$ **883 min or 14.7 hrs**

Calibration Workbook Page 11

Example 2: A parcel of land is irrigated by a center-pivot that is 1,290 feet from the pivot point to the last tower. On the overhang of the system there is a sprinkler 20 foot beyond the last tower. The water throw of the last sprinkler is an additional 25 feet beyond the end of the last sprinkler. There is no end gun. If the application rate is 10 gallons per acre what is the injection rate when the system is run at 5 feet per minute

Part 1:

Circumference = $2 \times \pi \times r$

= $2 \times 3.14 \times 1290$ ft

= **8101 ft/rev**

Revolution time = $\frac{\text{circumference in feet}}{\text{travel speed in ft/min}}$

Revolution time = $\frac{8101 \text{ ft/rev}}{5.0 \text{ ft/min}}$

= **1620 min or 27 hours**

Example 2: A parcel of land is irrigated by a center-pivot that is 1,290 feet from the pivot point to the last tower. On the overhang of the system there is a sprinkler 20 foot beyond the last tower. The water throw of the last sprinkler is an additional 25 feet beyond the end of the last sprinkler. There is no end gun. If the application rate is 10 gallons per acre what is the injection rate when the system is run at 5 feet per minute

Part 2:

WR = length to last tower + overhang + throw of last sprinkler
= 1290 ft + 20 ft + 25 ft
= **1335 ft**

Area = π x WR x WR

$$\frac{3.14 \times (1{,}335\ \text{ft})^2}{43{,}560\ \text{sq ft/acre}} = \frac{3.14 \times (1{,}335 \times 1{,}335)}{43{,}560}$$

= **128.4 acres**

Example 2: A parcel of land is irrigated by a center-pivot that is 1,290 feet from the pivot point to the last tower. On the overhang of the system there is a sprinkler 20 foot beyond the last tower. The water throw of the last sprinkler is an additional 25 feet beyond the end of the last sprinkler. There is no end gun. If the application rate is 10 gallons per acre what is the injection rate when the system is run at 5 feet per minute

Part 3:

Irrigation Rate = Area Irrigated / Irrigation Time
= 128.4 acres / 27 hours
= 4.75 acres/hour

Injection Rate = Irrigation Rate x Application Rate

Injection Rate = 4.75 acres/hour x 10 gal/acre

= **47.5 gal/hour or 101 oz/min**

Chemigation Information

Internet

- Department of Environmental Quality
  http://www.deq.state.ne.us
- University of Nebraska Extension
  http://nerec.unl.edu/calendar.shtml#Chemigation

or

http://nerec.unl.edu/chemigation.shtml

University of Nebraska–Lincoln Extension

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