University of California

Nitrogen Management Training

for Certified Crop Advisers

Day 2 – Permanent Crops

Nitrogen Management Planning Exercise for Permanent Crops

University of California
Agriculture and Natural Resources

Session objectives

- Interactive exchange among Ag professionals on N management in permanent crops.
- Apply research-based knowledge and tools for determining reasonable N fertilizer needs and ways of supplying it efficiently.
- Collectively, build upon our working knowledge and tools for N management to support growers who are faced with increasing regulation.

Ground rules

- We will pose questions and site specific scenarios and ask for your thoughts and answers.
- We have provided hand-held “clickers” to poll your thoughts and answers. Aggregate responses will be projected for your viewing.
- We encourage small group interaction as you think about and respond to the various questions and scenarios.
- Questions are welcomed. To manage time effectively, we will offer opportunities to ask them as the session progresses. This will give you a chance to consider the collective responses as you formulate your questions.
- **Please keep track and return the polling clickers.**

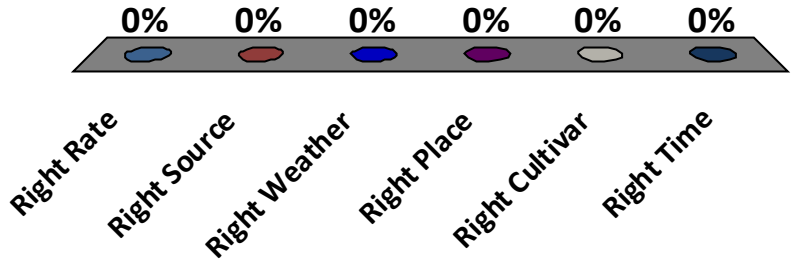
Part 1 of 4

Foundational Knowledge

growing ADVANTAGE™
The Almond Conference

What do the 4Rs of N fertilization stand for? Circle the four best answers.

A. Right Rate
B. Right Source
C. Right Weather
D. Right Place
E. Right Cultivar
F. Right Time



An alternative to remember the essential components of efficient N management.

Timing

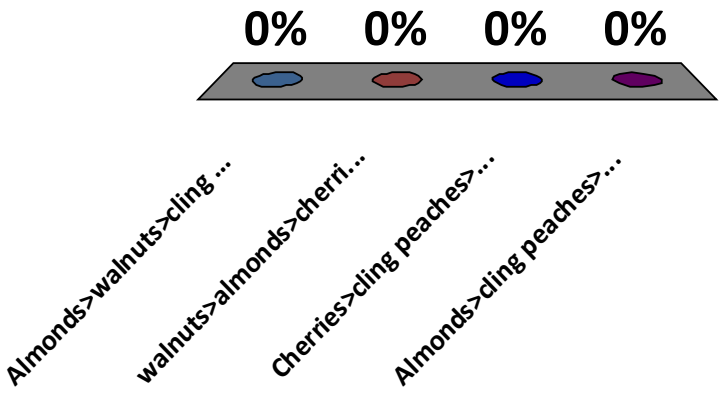
Rate

Application

Product

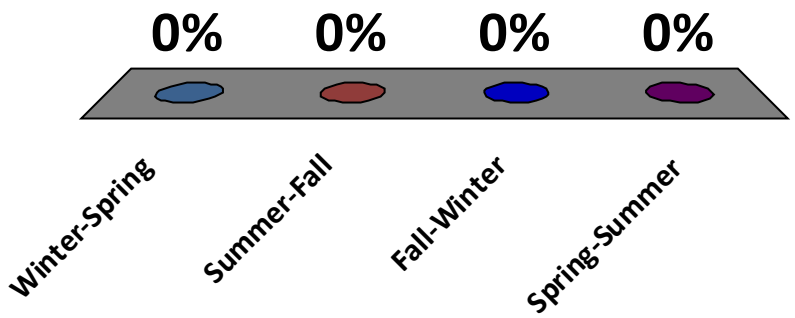
Which crop sequence best describes the annual N requirements from largest to smallest for these important permanent crops? Assume all crop types have good to excellent crop loads.

A. Almonds>walnuts>cling peaches>cherries
B. walnuts>almonds>cherries>cling peaches
C. Cherries>cling peaches>walnuts>almonds
D. Almonds>cling peaches>walnuts>cherries



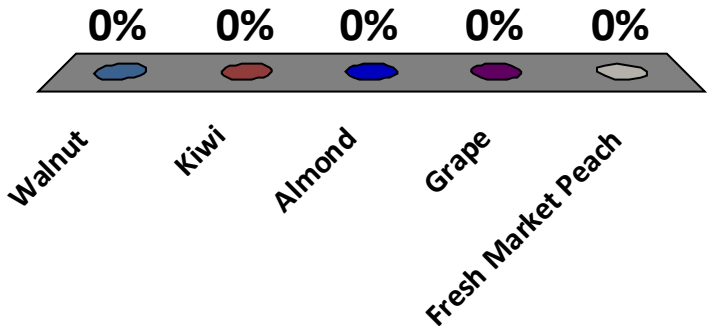
When is nitrogen demand the GREATEST in deciduous tree crops that harvest in summer (almonds, peaches, etc.)?

A. Winter-Spring
B. Summer-Fall
C. Fall-Winter
D. Spring-Summer



For a mature, highly productive planting, which crop would you expect to have the largest capacity to store nitrogen in the tree or vine?

A. Walnut
B. Kiwi
C. Almond
D. Grape
E. Fresh Market Peach



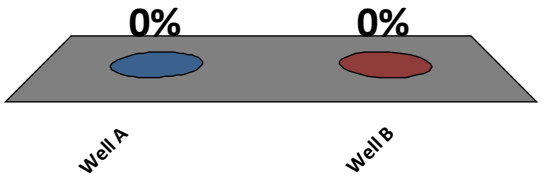
Know your N units

Well A has a nitrate concentration of 10 ppm.

Well B has a nitrate-nitrogen concentration of 10 ppm.

Which well contains more N per acre foot of water?

A. Well A
B. Well B



Which N fertilizer source is LEAST mobile <u>during an irrigation event</u>.

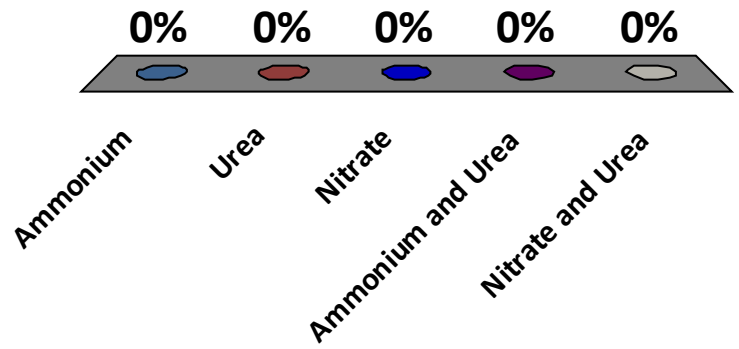
A. Ammonium

B. Urea

C. Nitrate

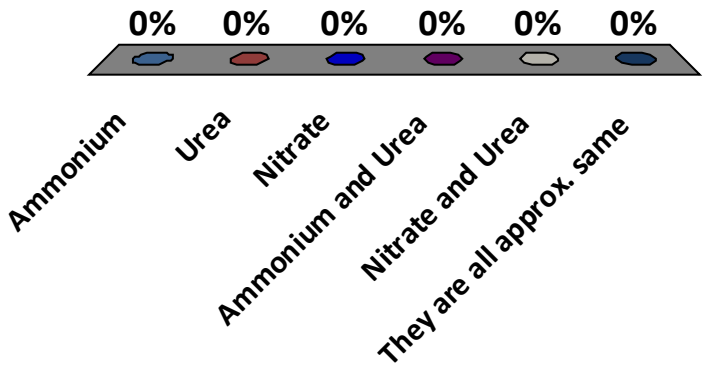
D. Ammonium and Urea

E. Nitrate and Urea



Which N fertilizer source is LEAST mobile <u>two weeks after</u> a summer irrigation event.

A. Ammonium
B. Urea
C. Nitrate
D. Ammonium and Urea
E. Nitrate and Urea
F. They are all approx. same



Questions concerning part 1?

BREAK (30 MINUTES)

Please keep track of the Polling "Clickers"

Part 2 of 4

Developing a N Budget

growing ADVANTAGE™
The Almond Conference

What can you reasonably expect from a N budget?

More than one answer may apply.

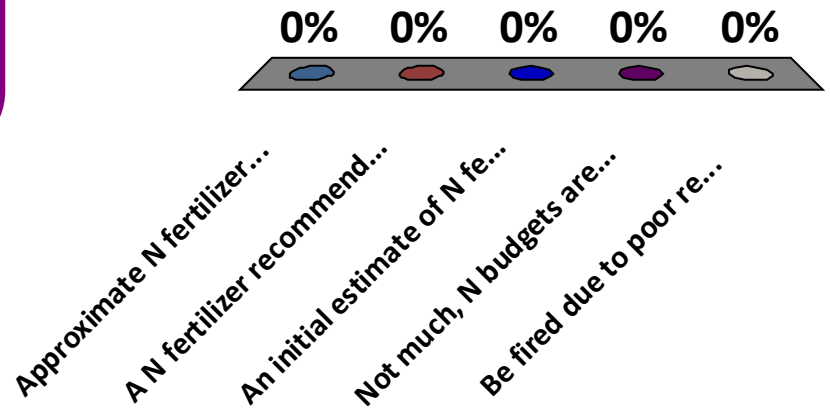
A. Approximate N fertilizer needs for specific orchards.

B. A N fertilizer recommendation that is valid for any orchard of the same cultivar.

C. An initial estimate of N fertilizer needs in a specific orchard that can be adjusted in season using yield estimates, leaf analysis (and maybe soil test) results.

D. Not much, N budgets are based upon to many uncertainties.

E. Be fired due to poor recommendations



The primary components of a N budget include:

1) Nitrogen demand based on current yield assessments
2) N credits (water, manure, compost, cover crop)
3) Amount of Nitrogen needed.

A. True

B. False

For every 1,000 lbs/ac of almond kernels harvested the orchard exports 68 lbs N/ac. How much N does the orchard need if your predicted yield is 3,000 lbs?

A. 68

B. 124

C. 204

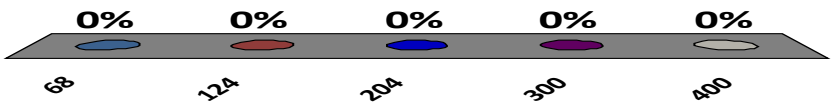
D. 300

E. 400

Nutrient removal Per 1000 lb Kernels

Growth Requirement

- Yield 2,000 to 4,000 = 0 lb N
- Yield 1,000 to 2,000 = 20 lb N
- Yield <1,000 = 30 lb N



For every 1,000 lbs/ac of in-shell walnuts harvested the orchard needs 20 lbs N/ac. How much N does the orchard export if your predicted yield is 6000 lbs? Assume 30 lbs/acre are needed for new vegetative growth.

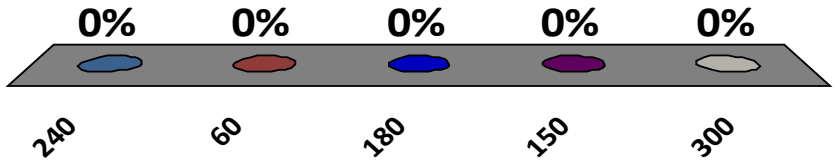
A. 240

B. 60

C. 180

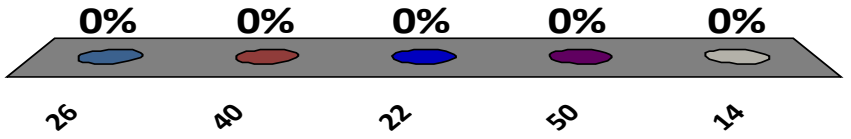
D. 150

E. 300



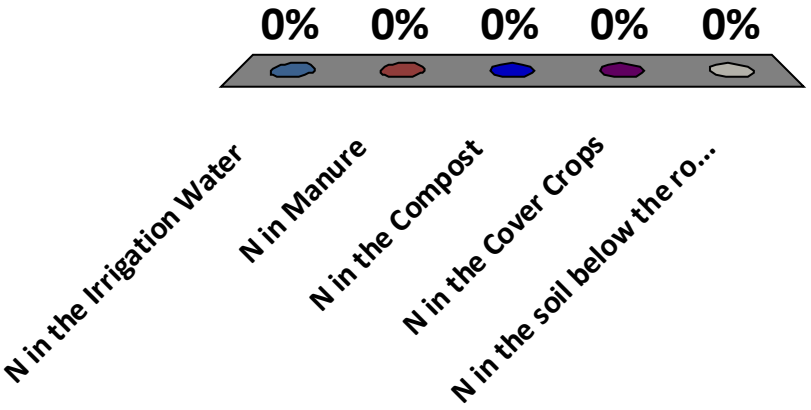
For every 1,000 lbs of wine grapes harvested the vines need 1 lbs N. How much N does the vineyard export if your predicted yield is 8 tons? Assume 18 lbs/acre are needed for new vegetative growth

A. 34
B. 40
C. 22
D. 50
E. 14



After estimating N demand, you need to account for all the N credits. Which of the following would <u>not</u> be considered a N credit? Circle all that apply.

A. N in the Irrigation Water
B. N in Manure
C. N in the Compost
D. N in the Cover Crops
E. N in the soil below the rooting zone



Your Irrigation Water Contains Nitrate:
Lab reports 10 ppm Nitrate or 2.27 ppm Nitrate-N and you apply 48 inches of water

The credit for Nitrate-N in this irrigation water is correctly calculated as 25 lbs N/acre?

A. True
B. False

To convert Nitrate in water to lbs of N

- Formula for Nitrate: Nitrate concentration (ppm) x inches irrigation applied x 0.052
- Formula for Nitrate-N: Nitrate-N concentration (ppm) x inches irrigation applied x 0.23

What do you think is a reasonable efficiency for recovering N present in the irrigation water?

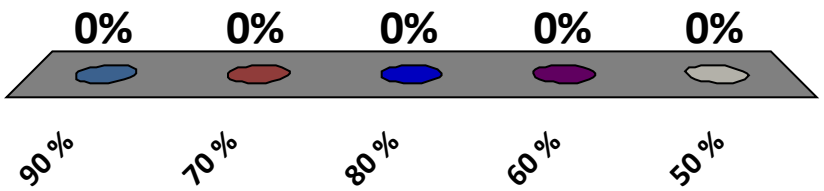
A. 90 %

B. 70 %

C. 80 %

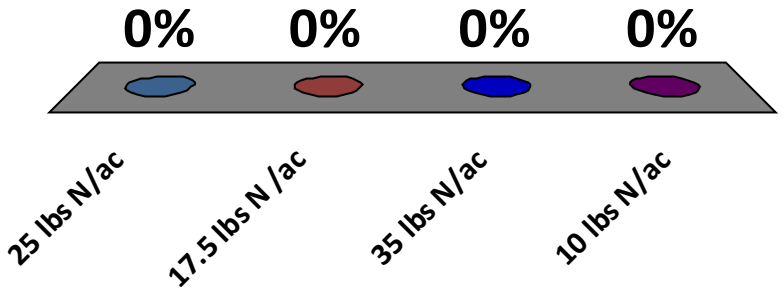
D. 60 %

E. 50 %



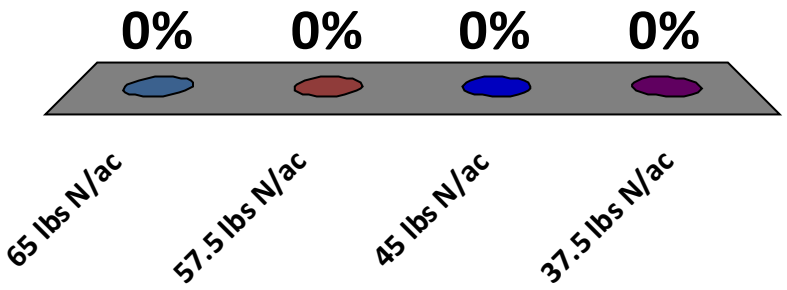
Based upon 70% efficiency, how much N fertilizer credits do we receive from the 25 lbs of N in the water?

A. 25 lbs N/ac
B. 17.5 lbs N /ac
C. 35 lbs N/ac
D. 10 lbs N/ac



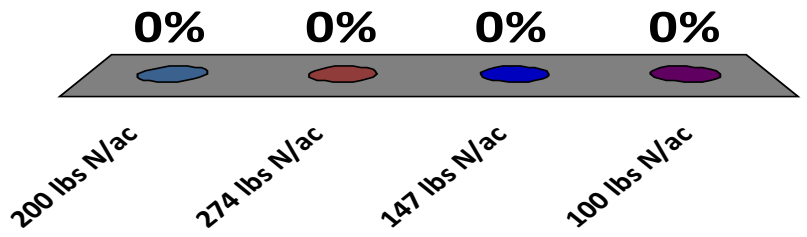
In addition to N from the irrigation water, assume 40 lbs N/ac was credited for compost. No manure or cover crop was involved. What is the total N Credit?

A. 65 lbs N/ac
B. 57.5 lbs N/ac
C. 45 lbs N/ac
D. 37.5 lbs N/ac



The yield estimate is 3000 lbs almonds/ac and the total N credit is rounded to 57 lbs N/ac, approximately how much N is needed?

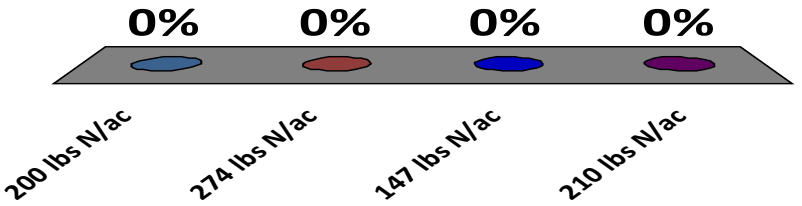
A. 200 lbs N/ac
B. 274 lbs N/ac
C. 147 lbs N/ac
D. 100 lbs N/ac



Hint: **For every 1,000 lbs/ac of almond kernels harvested the orchard needs 68 lbs N/ac.**

The yield estimate is 3000 lbs almonds/ac and the total N credit is rounded up to 58 lbs N/ac, approximately how much N FERTILIZER is needed?

A. 200 lbs N/ac
B. 274 lbs N/ac
C. 147 lbs N/ac
D. 210 lbs N/ac



Hint: **For every 1,000 lbs/ac of almond kernels harvested the orchard needs 68 lbs N/ac. To convert this crop N demand into units of fertilizer N required, divide by 0.70.**

After applying an N Budget to approximate a reasonable N fertilizer rate for the season, what should be the next consideration?

a) Timing

b) Rate

c) Application

d) Product

Right Time: When during the growing season should I apply the 210 lbs of N fertilizer? (Given 4 fertigation periods through year).

Date	% of Total	lbs of N
Early Spring	20	42
Fruit Growth	30	63
Kernel Fill	30	63
Fruit Maturity or Early Post-Harvest	20	42

+ 210 lbs of N

Now let's change the almond scenario and consider the effect on the N fertilizer rate and timing…

It is May 1st. You have already applied half of your planned fertilizer (by early Spring during fruit growth). You collected leaves in April and the model prediction for July was for "adequate N". You also re-estimate your yield and it is still 3,000 lbs.

You need to change your original fertigation plan:

A. True

B. False

It is May 1st. You have already applied half of your planned fertilizer (by early Spring during Fruit Growth). You collected leaves in April and the model prediction for July was for "adequate N". You also re-estimate your yield, but it is down from 3,000 to 2000 kernel lbs/ac.

You need to change your original fertigation plan:

A. True

B. False

Spring N was applied, so you can only reduce fertilization during kernel fill and fruit maturity/post-harvest period.

Reduce original fertilization estimated by 1000 lbs *0.068/0.70 = 97.2

-You planned for 3000 lbs/ac but only achieved 2000 lbs/ac

Your Original Fertilization total for Kernel Fill and Fruit Maturity/Post-Harvest was = 105 lbs. N

Right Time: When during the growing season should I apply the 210 lbs of N fertilizer? (Given 4 fertigation periods through year).

Date	% of Total	lbs of N
Early Spring	20	42
Fruit Growth	30	63
Kernel Fill	30	63
Fruit Maturity or Early Post-Harvest	20	42

+ 210 lbs of N

Spring N was applied, so you can only reduce fertilization during kernel fill and fruit maturity/post-harvest period.

Reduce original fertilization estimated by 1000 lbs *0.068/0.70 = 97.2

-You planned for 3000 lbs/ac but only achieved 2000 lbs/ac

Your Original Fertilization total for Kernel Fill and Fruit Maturity/Post-Harvest was = 105 lbs. N

This needs to be reduced by 97 lbs N/acre due to reduced yield estimate: 105–97= 8 lbs

8 lbs should be applied 60% and 40% in the remaining two fertigations. (Note: In a case such as this with very low application rates you may choose a foliar fertilization or to combine fertilizations.)

Kernel Fill = 0.60*8 = 4.8 (round to 5)
Fruit Maturity/Post-Harvest = 0.40 * 8 = 3.2 (round to 3)

Your new fertilization plan…

Date	% of Total	lbs of N Original Estimation	lbs of N New Estimation
Early Spring	20	42	42
Fruit Growth	30	63	63
Kernel Fill	30	63	5
Fruit Maturity or Early Post-Harvest	20	42	3

???

If this adjustment is not made your final efficiency will be < 50%!!

Continue to change the almond scenario:

It is September 15th (right after harvest). You have already applied 80% of your fertilization plan (Early Spring and Fruit Growth and Kernel Fill). You collected leaves in April and the model predicted July leaf levels of "adequate N". Crop yield was higher than expected. You predicted 3,000 lbs, however but harvested 3,500 lbs/acre.

You need to apply more N fertilizer than originally planned

A. True

B. False

You need to provide additional N for extra 500 lbs/ac. Yield. Equates to 500*0.068/0.70=49 lbs in addition to the planned 42 lbs. A total of 42+49=91 lbs N.

Date	% of Total	lbs of N Original Estimation	lbs of N New Estimation
Early Spring	20	42	42
Fruit Growth	30	63	63
Kernel Fill	30	63	63
Fruit Maturity or Early Post-Harvest	20	42	75

???

BEWARE: We do not recommend soil applications in excess of 75 lbs per acre Post Harvest. AND 75 lbs fertigated N can ONLY be applied if trees are healthy. You may consider foliar application.

Continue to change the almond scenario:

It is September 15th (right after harvest). You have already applied 80% of your fertilization plan (Early Spring and Fruit Growth and Kernel Fill). You collected leaves in April and the model predicted July leaf N levels of "adequate N". However, your actual yields were 500 lbs/acre less than originally predicted (actual yield = 2,500).

You need to reduce N fertilizer from the rate that was originally planned:

A. True

B. False

Your new fertilization plan…

Date	% of Total	lbs of N Original Estimation	lbs of N New Estimation
Early Spring	20	42	42
Fruit Growth	30	63	63
Kernel Fill	30	63	63
Fruit Maturity or Early Post-Harvest	20	42	0

You need to reduce the final fertilization to account for the lower yield. 500 lbs*0.068/0.70 = 49 lbs less N fertilizer. The planned Post-Harvest fertilization was 42 lbs. Then, 42-49= -7. Thus, this application may be eliminated (Cost Savings of $25 to $35 per acre!).

Take Home Messages:

- Consider your N credits, always.
- Get a good yield estimate.
- Re-estimate your N budget several times/season.
- Orchards use less N after harvest than before.
- The longer you wait to adjust your fertility plan, the smaller the chances of fixing a problem.
- Treat each orchard separately.

Questions concerning part 2?

Part 3 of 4

The Connection between Nitrogen and Irrigation Management

growing ADVANTAGE™
The Almond Conference

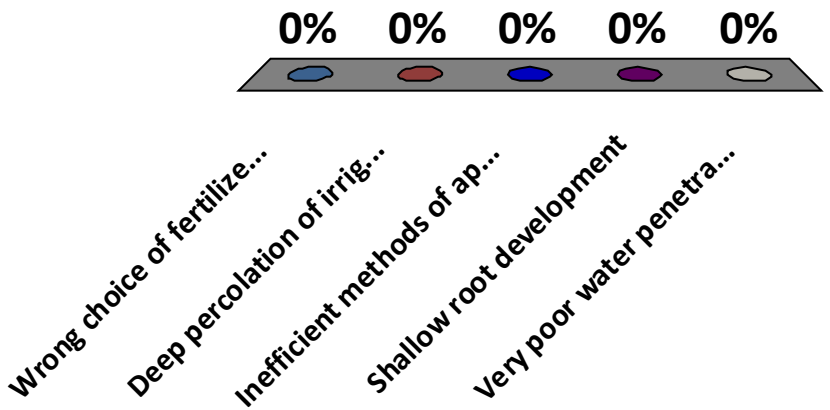
When choosing N application methods, fertilizer products, and managing irrigations, the primary management goal is to deliver the fertilizer in a manner that it remains in the root zone and available for uptake by the trees.

A. True

B. False

Which of the following are likely to reduce the uptake of N fertilizers by trees? Circle all that apply.

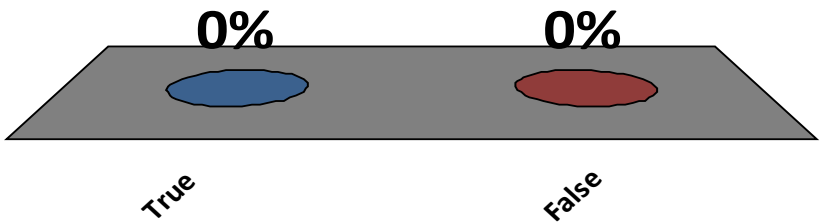
- ✓ A. Wrong choice of fertilizer product for field conditions
- ✓ B. Deep percolation of irrigation water following an N fertilizer application
- ✓ C. Inefficient methods of applying the fertilizer
- ✓ D. Shallow root development
- ✓ E. Very poor water penetration



In permanent crops, flood irrigation <u>can be</u> as efficient as drip and microsprinkler irrigation systems.

A. True

B. False



FLOOD IRRIGATION SCENARIOS

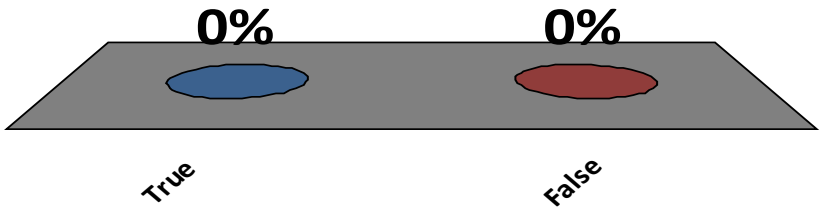
Assuming properly operating equipment, liquid fertilizer application by ground rig (dribble hose or "Tee-jet" application) can be more uniform than water run N applications.

A. True

B. False

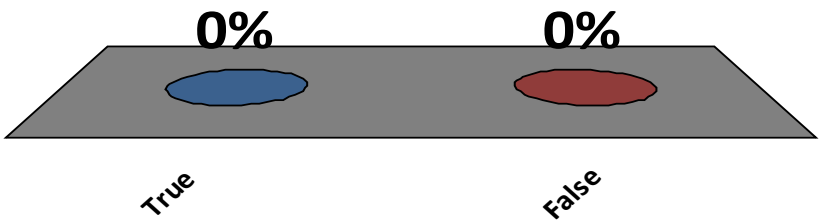
Tail-water return systems can minimize N leaching compared to fields with no tail-water return.

A. True
B. False



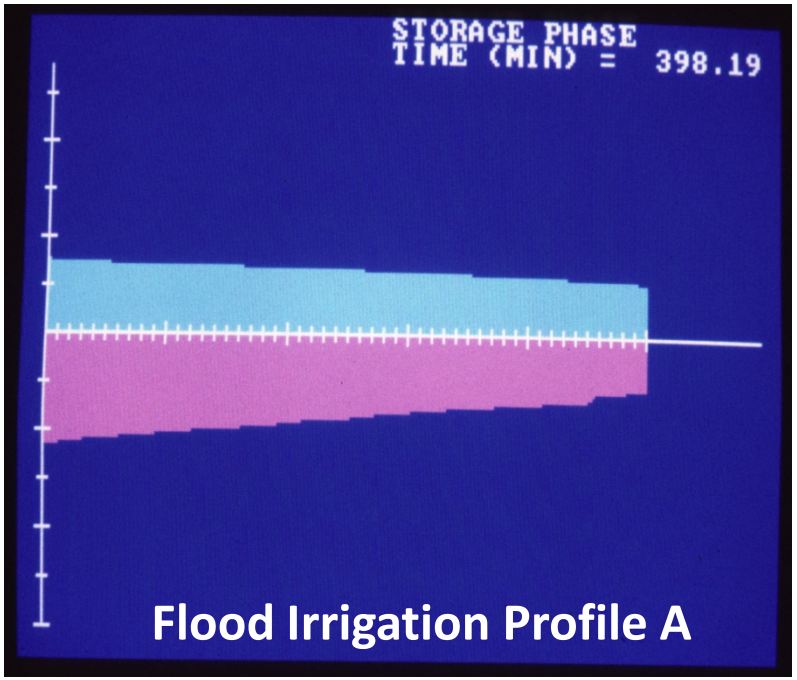
Irrigation uniformity and irrigation efficiency are the same thing.

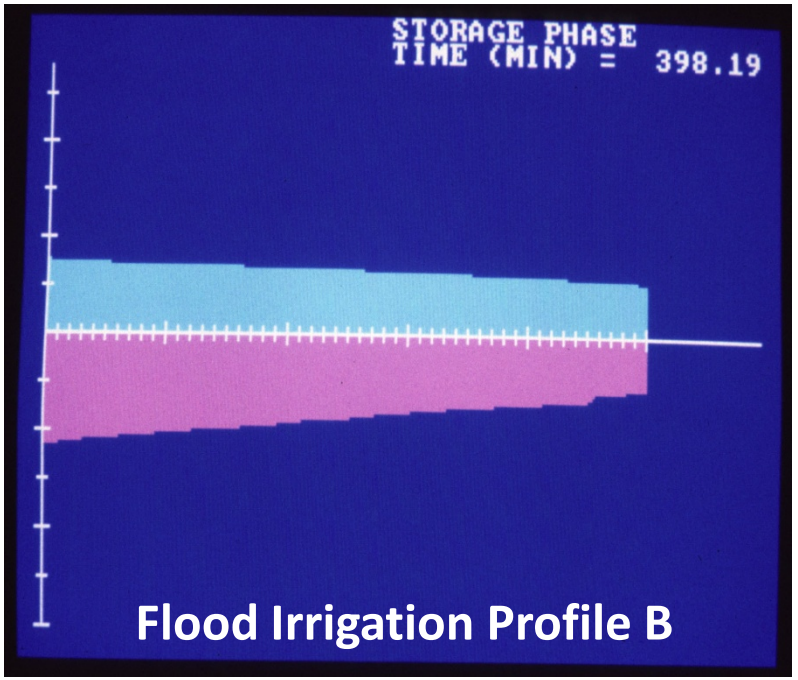
A. True
B. False



FLOOD IRRIGATION SCENARIOS

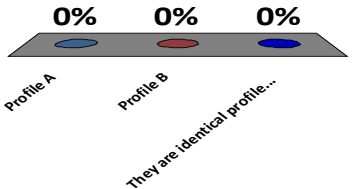
IRRIGATION UNIFORMITY VS EFFICIENCY





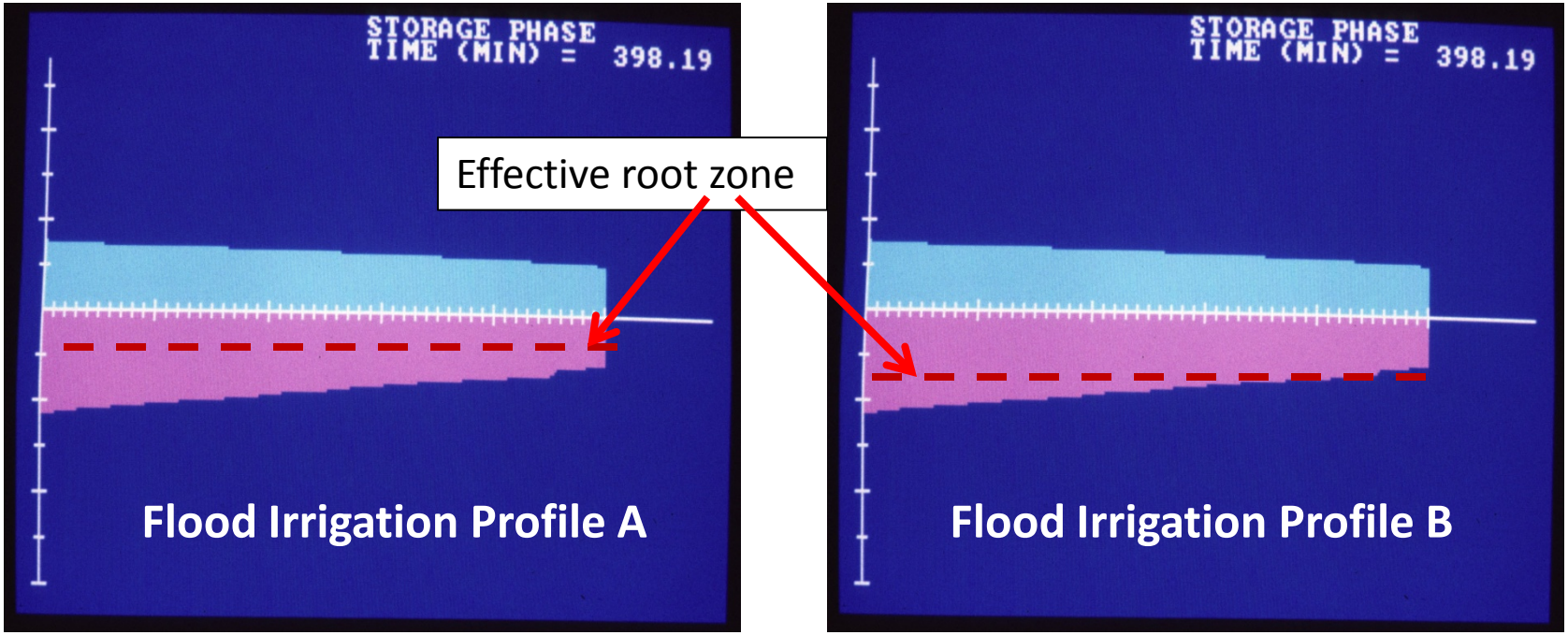
Which flood irrigation profile represents the most <u>uniform</u> irrigation?

A. Profile A
B. Profile B
C. They are identical profiles so the uniformity is the same.



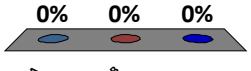
FLOOD IRRIGATION SCENARIOS

FERTIGATION vs. GROUND APPLIED APPLICATION



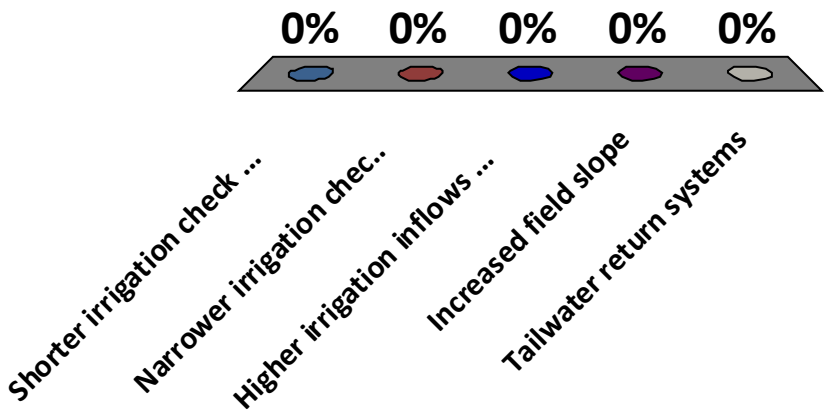
Which flood irrigation profile represents the most efficient irrigation and less chance of leaching nitrogen?

A. Profile A
B. Profile B
C. They are identical profiles so the uniformity is the same



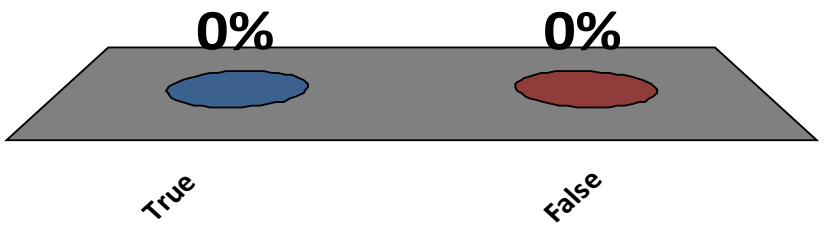
Among these flood irrigation design considerations, choose the two that <u>might</u> lead to the most improvement in irrigation and nitrogen efficiency.

A. Shorter irrigation check lengths and irrigation set times
B. Narrower irrigation checks of the same length and shorter irrigation set times
C. Higher irrigation inflows but no change to irrigation check length or width
D. Increased field slope
E. Tailwater return systems



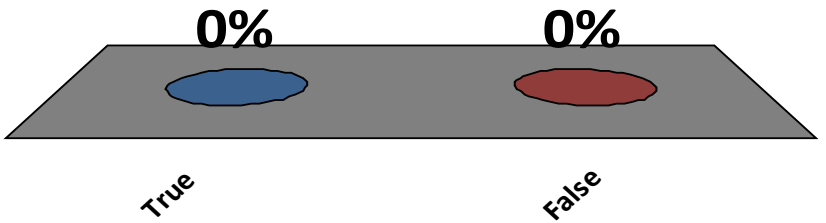
For some soils and slopes, conversion from flood to drip or microsprinkler irrigation is necessary to achieve higher water and nitrogen use efficiency.

A. True
B. False



With that said, drip and microirrigation systems are always more uniform and efficient than flood irrigation

A. True
B. False



DRIP AND MICRO IRRIGATION SCENARIOS

All of the items listed below are potential causes of poorly performing drip and microsprinkler irrigation systems. In turn, this can reduce nitrogen use efficiency.

- Deficiencies or shortcuts in irrigation system design
- Inadequate irrigation water filtration
- Failure to recognize and treat of water quality problems
- Insufficient and unreliable pressure regulation either with pressure regulators or pressure compensating emitters
- Infrequent maintenance such as flushing and repairs of broken pipes, hoses, and emission devices
- Mixing sizes of pressure regulators and emission devices

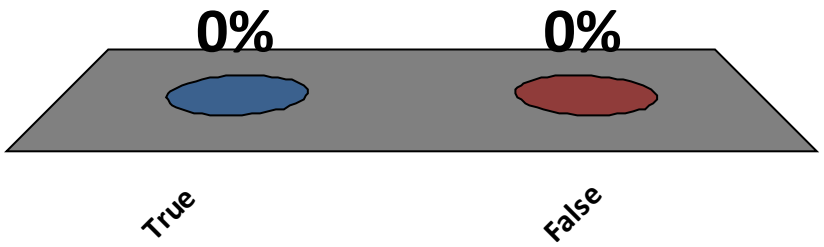
A. True

B. False

Irrigation management during and after fertigation influences nitrogen use efficiency.

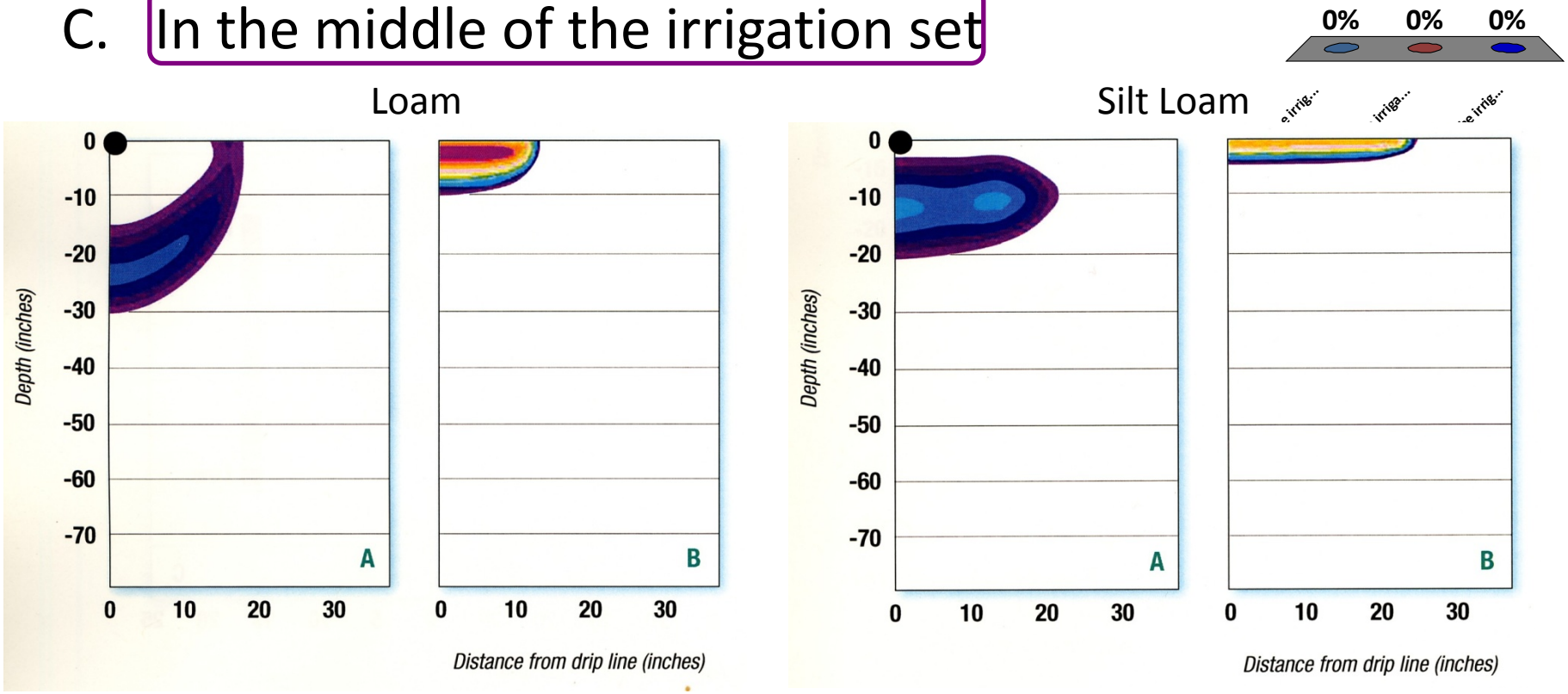
A. True

B. False



When during drip irrigation is it most efficient to inject nitrogen fertilizers?

A. Near the start of the irrigation set
B. Near the end of the irrigation set
C. In the middle of the irrigation set



2 hour injection near start of 27 to 36 hour Irrigation

2 hour injection near end of 27 to 36 hour Irrigation

2 hour injection near start of 27 to 36 hour Irrigation

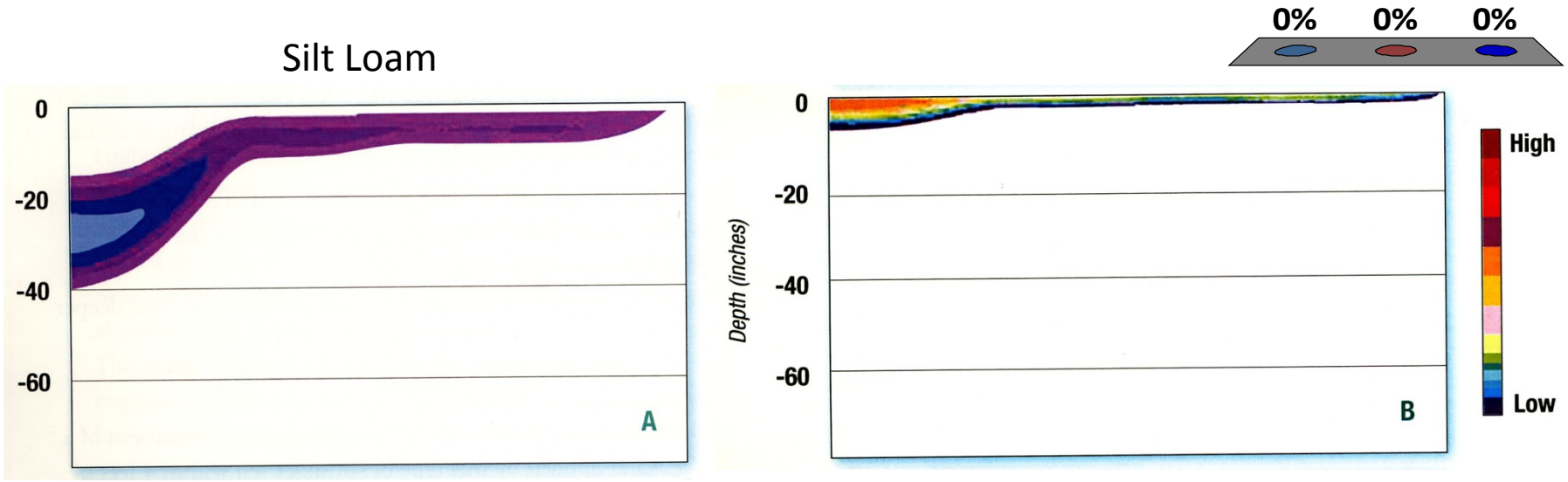
2 hour injection near end of 27 to 36 hour Irrigation

Surface Drip

From: Blaine Hanson, "Fertigation with Microirrigation"

When during microirrigation is it most efficient to inject nitrogen fertilizers?

A. Near the start of the irrigation set
B. Near the end of the irrigation set
C. In the middle of the irrigation set



2 hour injection near start of Irrigation

2 hour injection near end of Irrigation

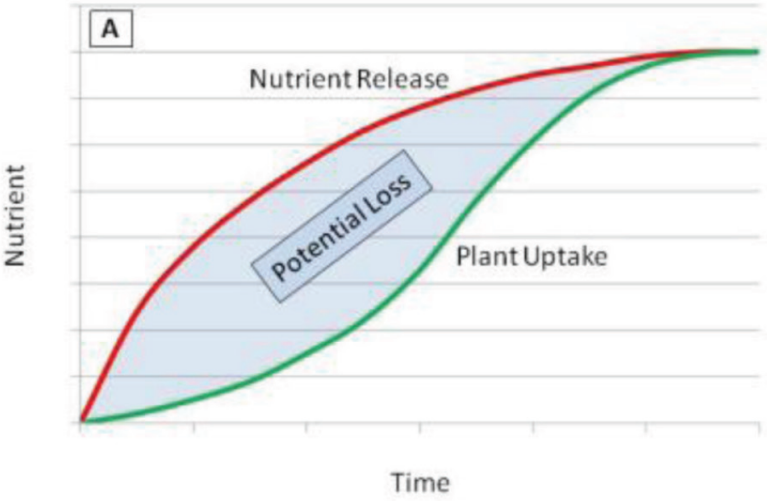
Microsprinklers

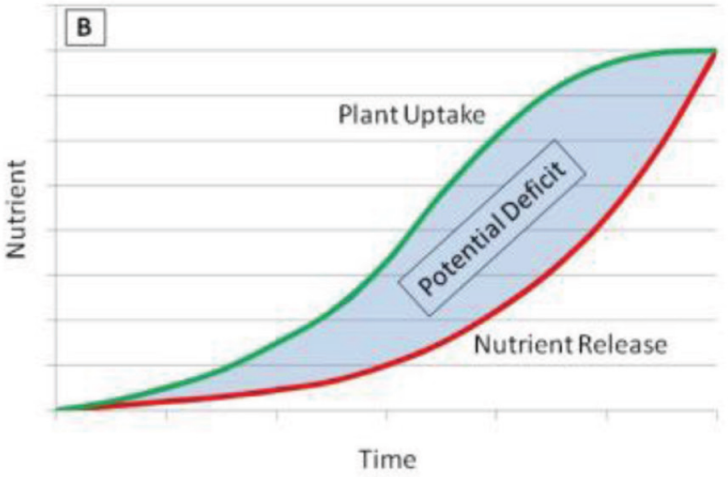
From: Blaine Hanson, "Fertigation with Microirrigation"

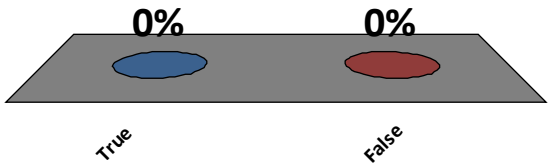
The source of N fertilizer influences nitrogen use efficiency.

A. True

B. False







Questions concerning part 3?

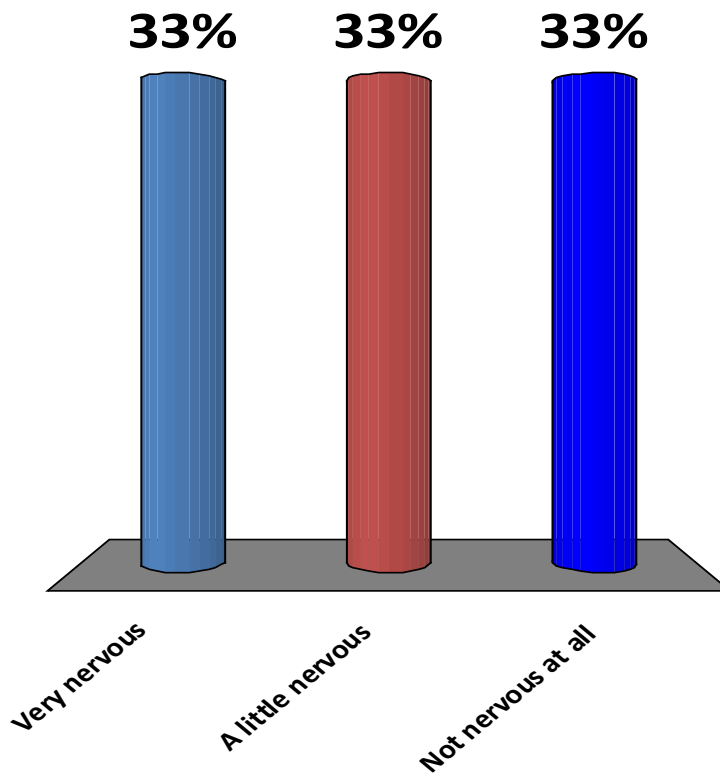
Part 4 of 4

Building Confidence

growing ADVANTAGE™
The Almond Conference

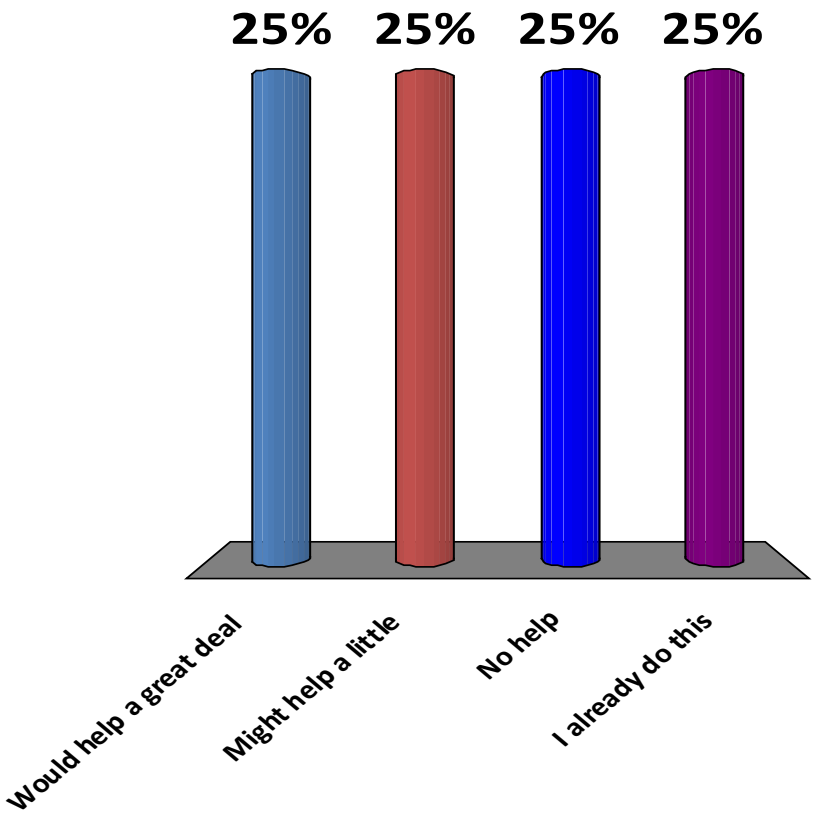
When a grower is accustomed to applying around 250 lbs N/ac to grow a profitable crop but nitrogen budgeting indicates he/she could use less N/acre, how nervous does that make you, their CCA, that yield and/or quality will suffer with less N?

A. Very nervous
B. A little nervous
C. Not nervous at all



How much would/does routine N tissue testing and occasional soil sampling for residual soil nitrate in the root zone help you -- a CCA -- manage N more efficiently?

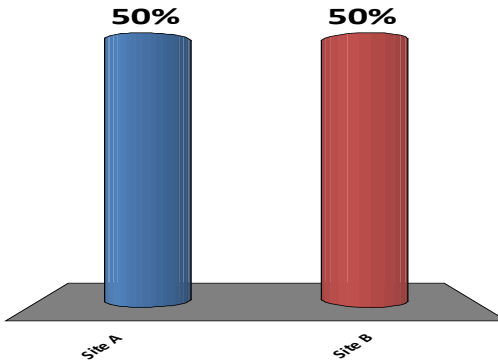
A. Would help a great deal
B. Might help a little
C. No help
D. I already do this



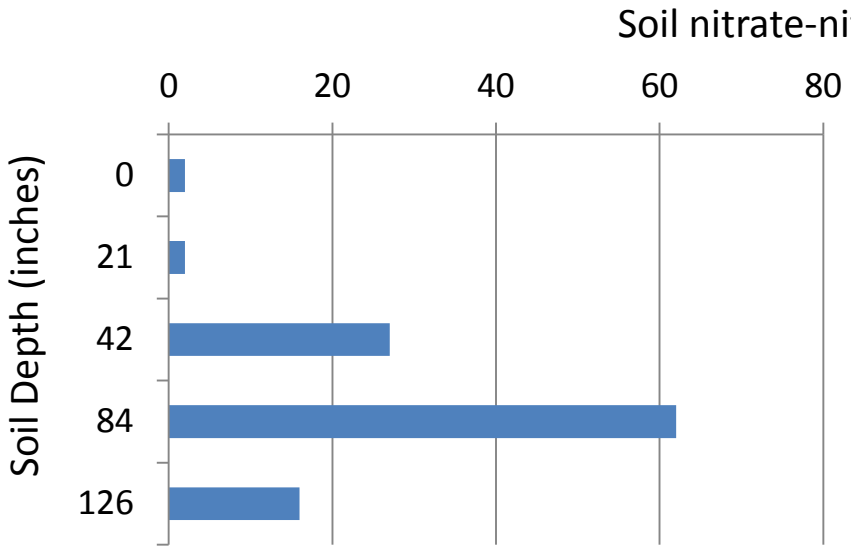
Below are two nitrate-nitrogen soil profiles from similar orchards. Nitrogen budgets have recently been developed for these orchards and indicate potential to cutback on N fertilization. Which orchard might benefit more from attention to nitrogen management?

A. Site A

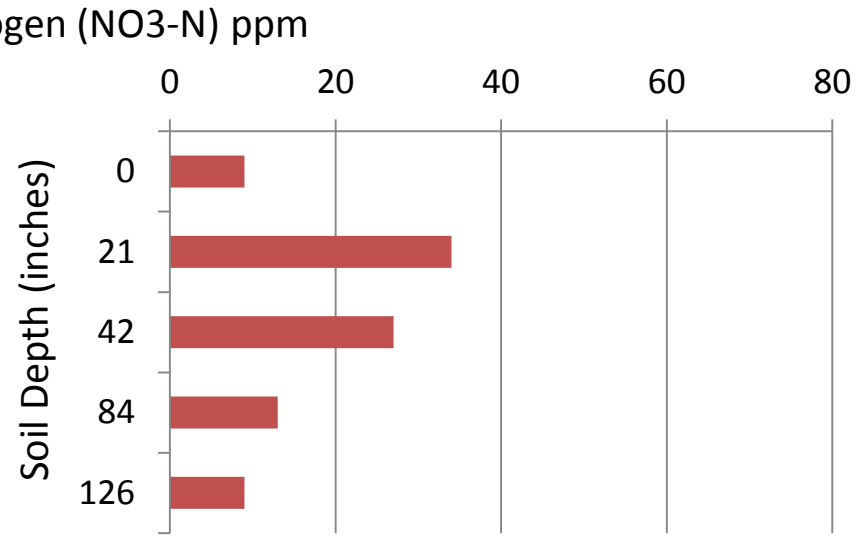
B. Site B



Site A



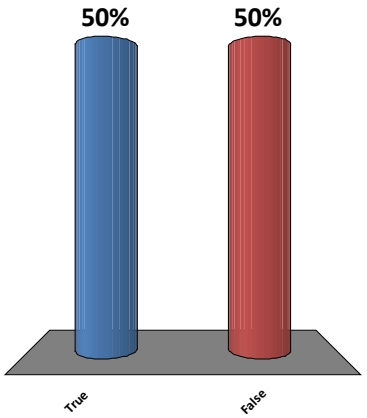
Site B



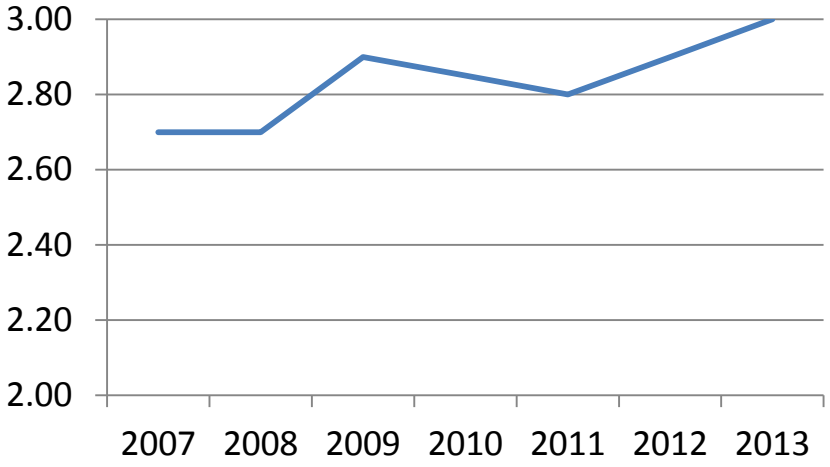
Below are historic trend lines of mid-summer leaf tissue levels in two bearing almond orchards. The nitrogen budgets for these orchards suggest N fertilization may be reduced in Orchard 1 and may need to be increased in Orchard 2. The trends in mid-summer N Leaf tissue levels confirm the recommendations from the N budgets.

A. True

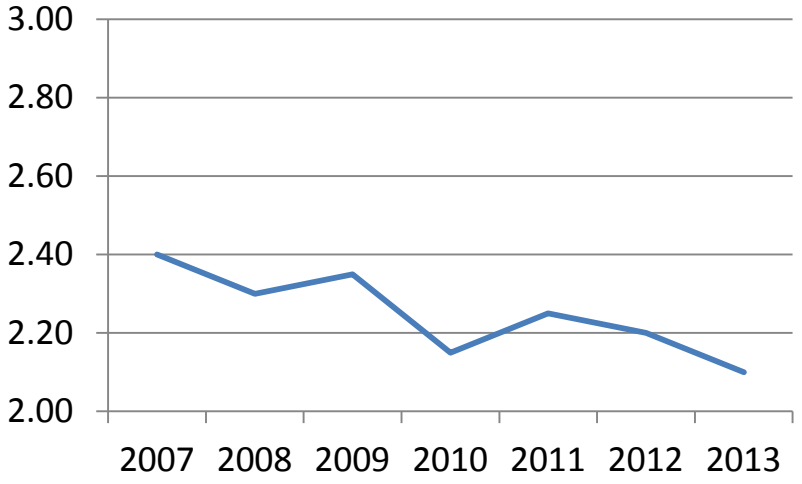
B. False



Orchard 1 - Trends in mid-summer N Leaf Tissue Levels



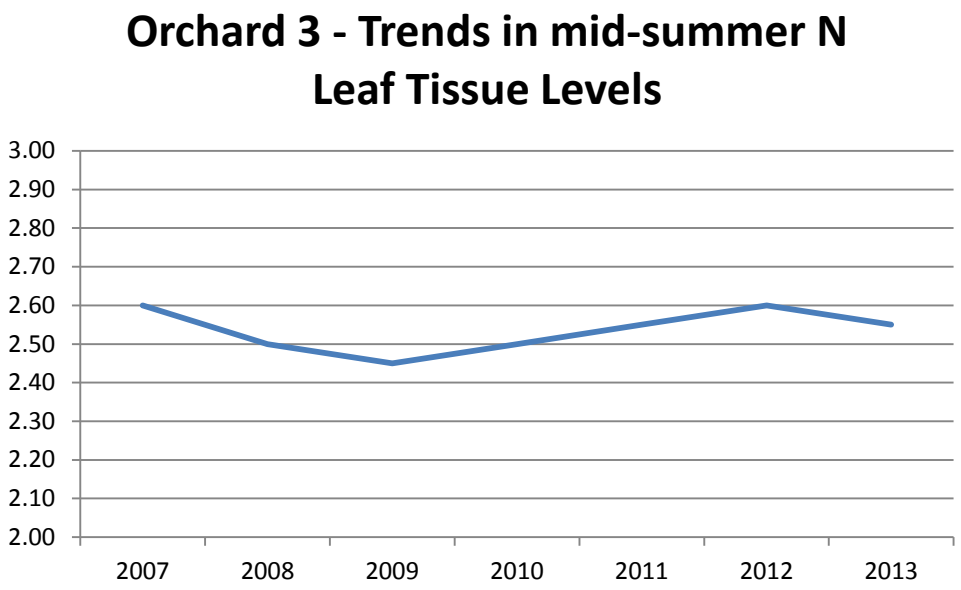
Orchard 2 - Trends in mid-summer N Leaf Tissue Levels

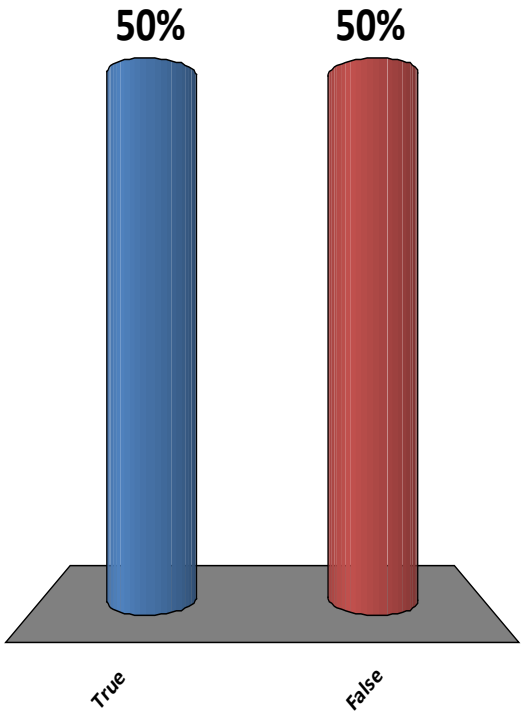


Below is the historic trend line of mid-summer leaf tissue levels in a third bearing almond orchard. The nitrogen budget for this orchard appears to be working well and sustaining the orchard nitrogen nutrition at sufficient levels.

A. True

B. False





Questions concerning part 4?

Please return the polling clickers to one of the collection boxes at the exits.

THANK YOU!

This Concludes the N Management Planning Exercise for Permanent Crops








Thank You! We greatly appreciate your attention and participation!



University of California

Nitrogen Management Training

for Certified Crop Advisers

Course materials available at:

ciwr.ucanr.edu/NitrogenManagement

Contributing partners:

University of California
Agriculture and Natural Resources
web: ucanr.edu
Twitter: @ucanr

California Institute for Water Resources
University of California
Agriculture and Natural Resources
web: ciwr.ucanr.edu
Twitter: @ucanrwater

California Department of Food & Agriculture (CDFA)
Fertilizer Research and Education Program
web: www.cdfa.ca.gov
Twitter: @CDFAnews

California Association of Pest Control Advisers (CAPCA)
web: capca.com

University of California
Agriculture and Natural Resources