Season-long Use of Buried Drip Irrigation Implications for Surface Applied Fertilizer

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Single-use drip tape is now commonly used for crop establishment in the Salinas Valley

Eliminate sprinklers
Eliminate wind patterns
Eliminate surface run-off
Avoid soil crusting
High application uniformity
Less labor for tape removal and tape repairs

Specialized equipment can be used to save labor for extracting tape from the field

Custom services will install and remove single use drip tape

Single use tape and agricultural plastics can be recycled…

… into plastic pellets for manufacturing of new products

Such as building and garden materials, and even drip tape

Considerations for success:

- Soil type (best in sandy loam to silt loam soils)
- Tape needs a high application uniformity
- Need to inject the tape at a consistent depth (2.5 to 3 inches)

Effects of Tape Depth and Emitter Spacing on Germination and Water Movement

Treatment Description	Gravimetric Moisture[x]	Wetted Width[x]	Germination 11-Jun	Germination 13-Jun
	g/cc	inches	plants/10 ft	
---------- Depth ----------				
shallow (1.8 inches)	16.3	15.7	49.4	58.2
deep (3.1 inches)	15.0	14.3	44.6	57.5
F-test	0.056	0.027	NS[y]	NS
---------- Spacing ----------				
8 inches	15.8	14.9	48.0	59.8
12 inches	15.4	15.1	46.0	55.9
F-test	0.079	NS	NS	NS

[x] 1st irrigation, 6/06/2006

[y] not statistically signficant

Effects of Tape Discharge Rate and Bed Rolling on Germination and Water Movement

Treatment Description	Gravimetric Moisture[x]	Wetted Width[x]	Germination 11-Jun	Germination 13-Jun
	g/cc	inches	plants/10 ft	
---------- Tape Discharge Rate ----------				
0.3 gpm/100 ft	16.0	15.0	47.7	57.3
0.5 gpm/100 ft	15.3	15.1	46.3	58.4
F-test	0.003	NS[y]	NS	NS
---------- Rolling ----------				
1X	15.4	14.7	46.5	56.2
2X[z]	15.9	15.3	47.5	59.5
F-test	0.041	0.084	NS	NS

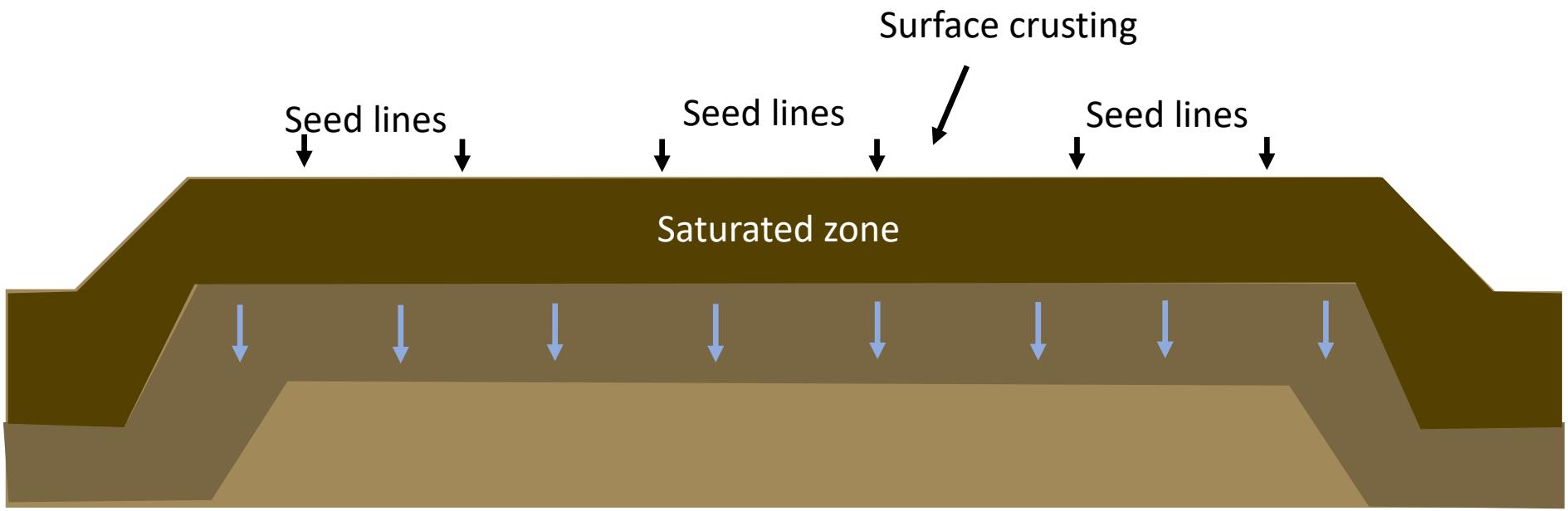
[x] 1st irrigation, 6/06/2006

[y] not statistically signficant

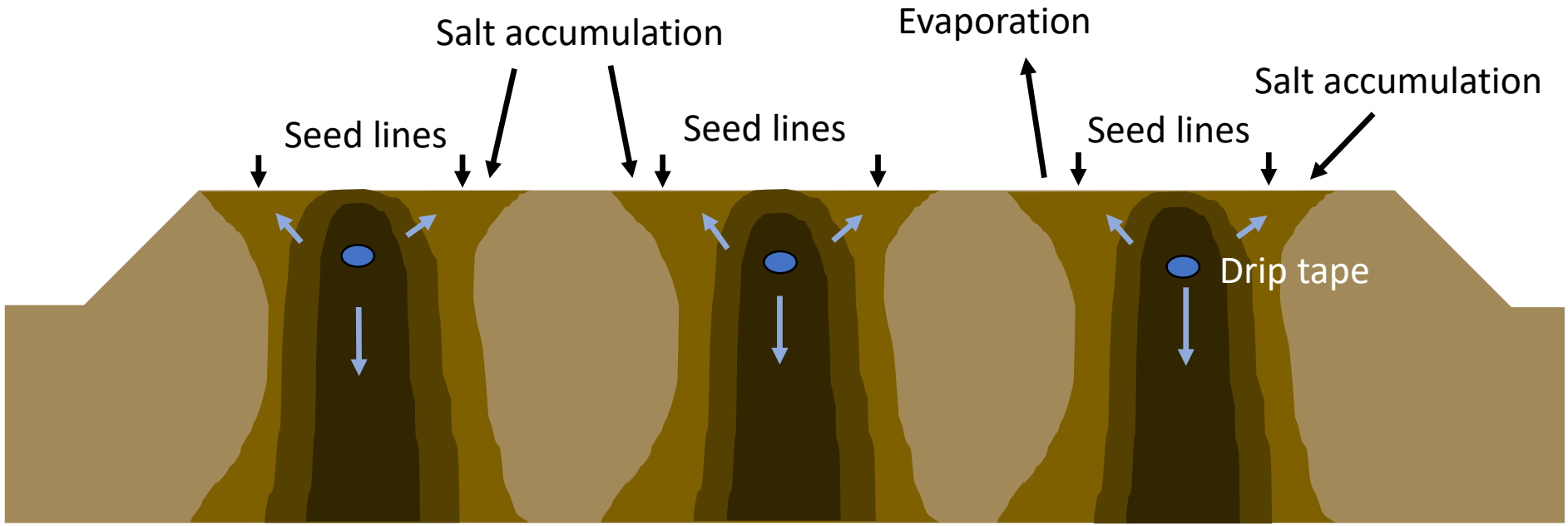
[z] 1st rolling was unweighted, 2nd rolling was weighted with water.

There are some additional concerns about drip germination

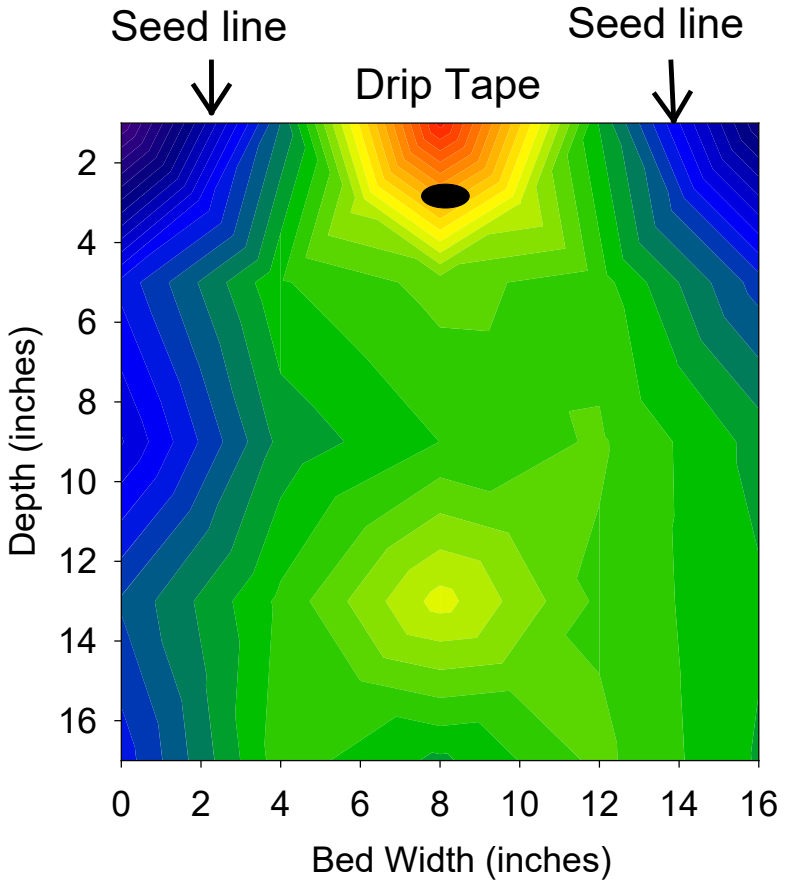
With sprinklers the soil surface becomes saturated as water infiltrates

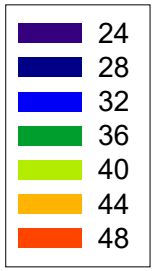


Subsurface drip water relies on capillary action to move the water to the surface



Moisture may not distribute laterally from drip tape in a well aggregated clay soil with a lot of macropores





Tape Discharge Rate = 0.34 gal/min/100 ft
Tape depth = 2.5 inches
Bulk Density = 0.86 g/cc,

Site Summary of Commercial Drip Fields (2006)

Site	Type	bed width	emitter spacing	tape discharge rate	tape depth average	bulk density (0-3 inches)	soil texture
		----- inches ----		gpm/100 ft	--- inches ---	g/cc	
1	head	40	12	0.53	2.62	1.13	Loam
2	head	40	12	0.34	3.36	1.03	Loam
3	romaine	80	12	0.32	3.22	0.97	Clay loam
4	romaine	40	8	0.34	2.50[x]	0.90	Clay
5	romaine	40	8	0.34	2.50[x]	1.09	Clay loam

[x] estimated depth

Is water conserved by using drip for germination?

	Sprinkler		Drip	
Site	area	applied water	area	applied water
	acres	inches	acres	inches
1	7.9	8.1	7.8	8.1
2	6.1	8.0	5.8	3.6
3	7.3	5.3	7.5	8.3
4	3.8	5.9	4.0	5.0
5	5.9	6.0	2.4	1.5
Average		6.6		5.3

Germination rates by drip were generally comparable with sprinkler

	Sprinkler		Drip	
Site	Average	S.D.	Average	S.D
	---------- plants/10ft ----------			
1	42.0	4.9	46.8	2.7
2	27.8	6.3	44.3	4.3
3	36.0	3.7	28.8	16.5
4[x]	12.1	1.1	10.6	1.8
5[x]	11.0	1.8	11.7	1.2

[x] planted to stand density of 12 plants per 10 ft

Nitrate loss in Drip and Sprinkler Germinated Fields (0-3 ft)

Site	Sprinkler	Drip
	% Soil Nitrate Loss	
1	45.9	81.9
2	12.8	5.4
3	30.4	17.7
4	71.3	-20.4
Average	40.1	21.1

Summary

Buried drip for season-long production can potentially improve water use efficiency and reduce nitrate leaching

Water savings are highest on medium textured soils and/or where wind and soil crusting affects germination with sprinklers

Season-long Use of Buried Drip Irrigation Implications for Surface Applied Fertilizer

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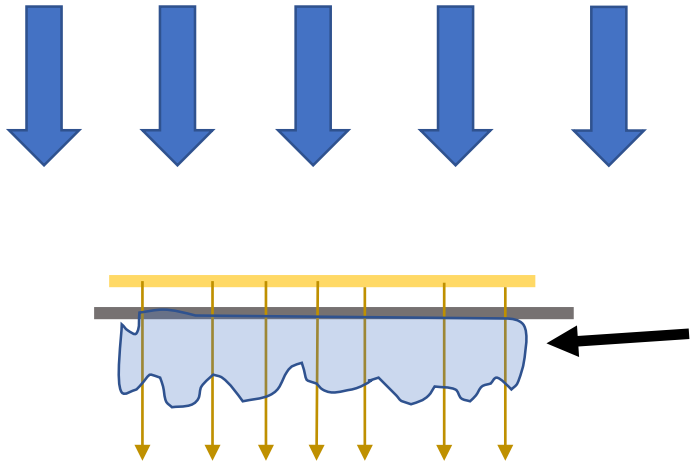
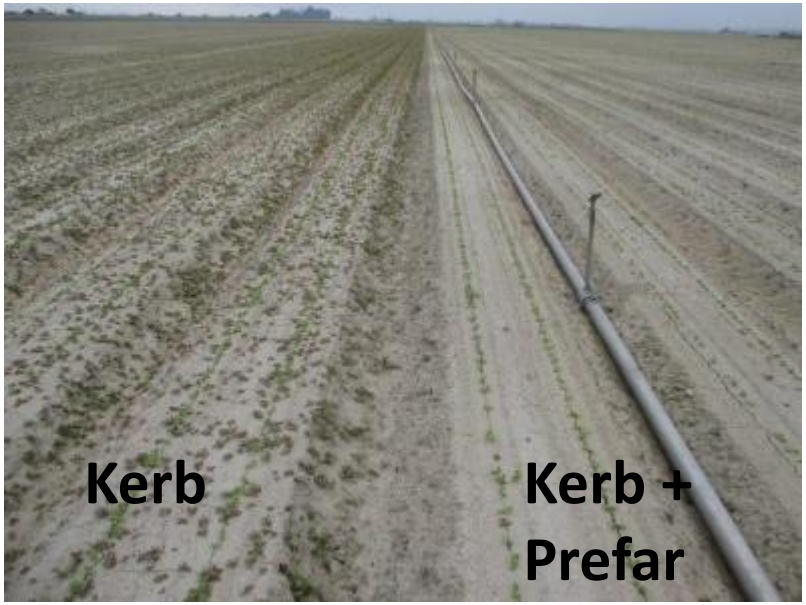
Sprinkler Irrigation



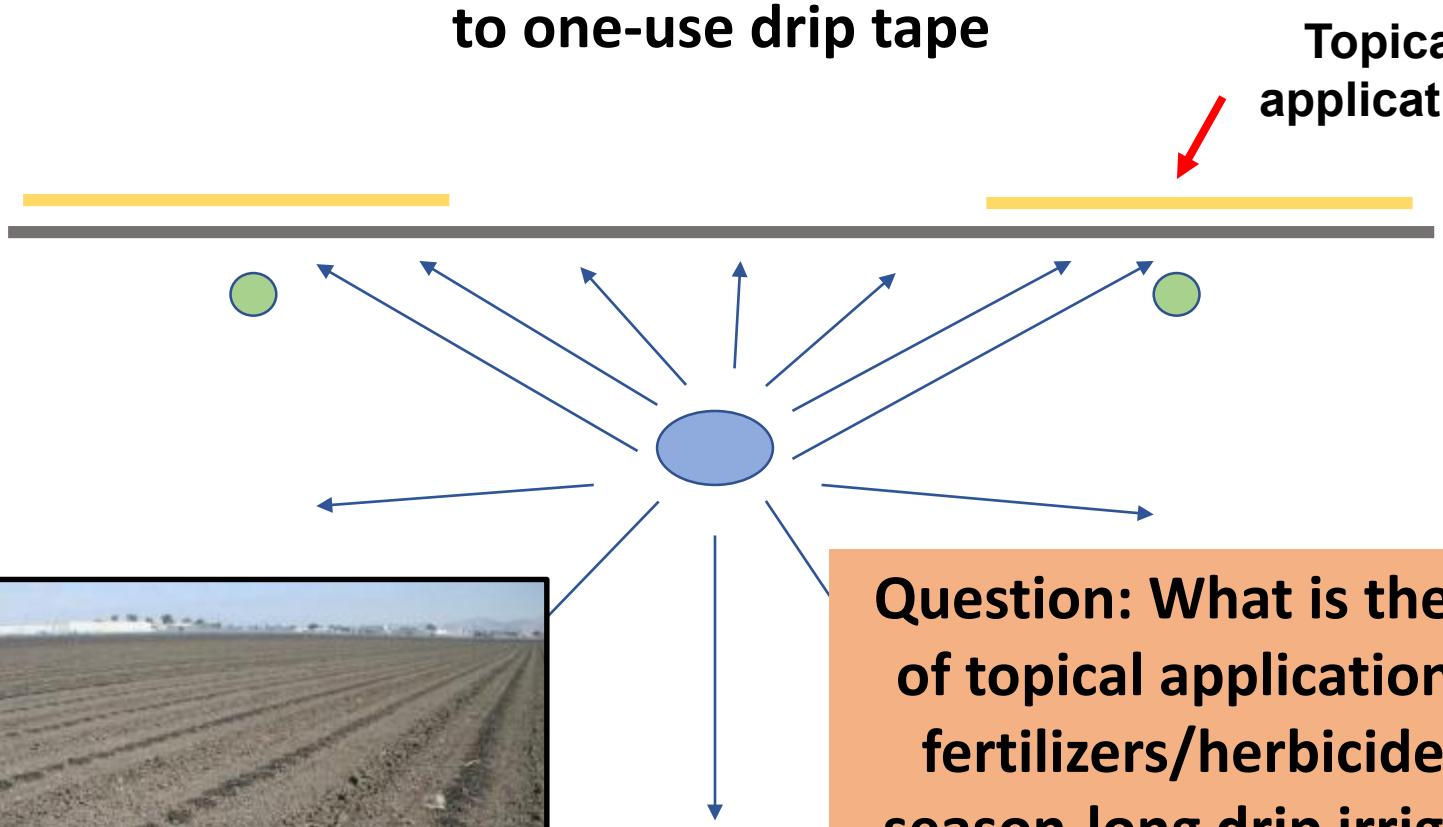
Sprinkler irrigation moves herbicides and fertilizers into the soil. Depth depends on the amount of water applied (e.g. 1.5 to 3.0 inches)

In the case of an herbicide like Kerb it may be pushed too deep to be effective; in the case of an anti crustant fertilizer it generally activates adequately



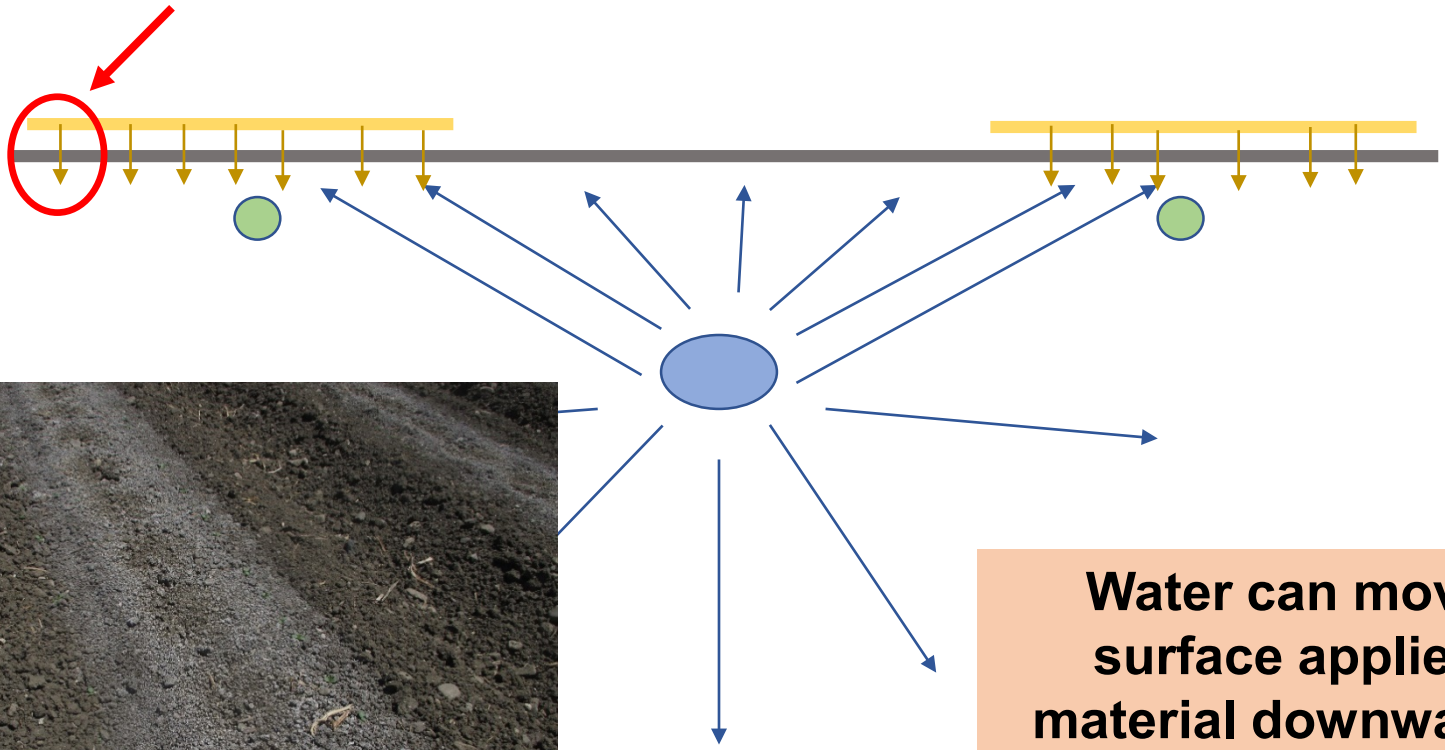
Drip Germination

Drip germination of lettuce has become more common due to one-use drip tape



Question: What is the fate of topical applications of fertilizers/herbicide in season-long drip irrigated fields. Does it solubilize and move into the rootzone

Movement of Water from Drip Tape Buried 2-3 inches Deep



Salts on soil surface from subsurface drip

Water can move surface applied material downwards by diffusion or wicking upwards by evaporation from the soil surface

Topical Applications

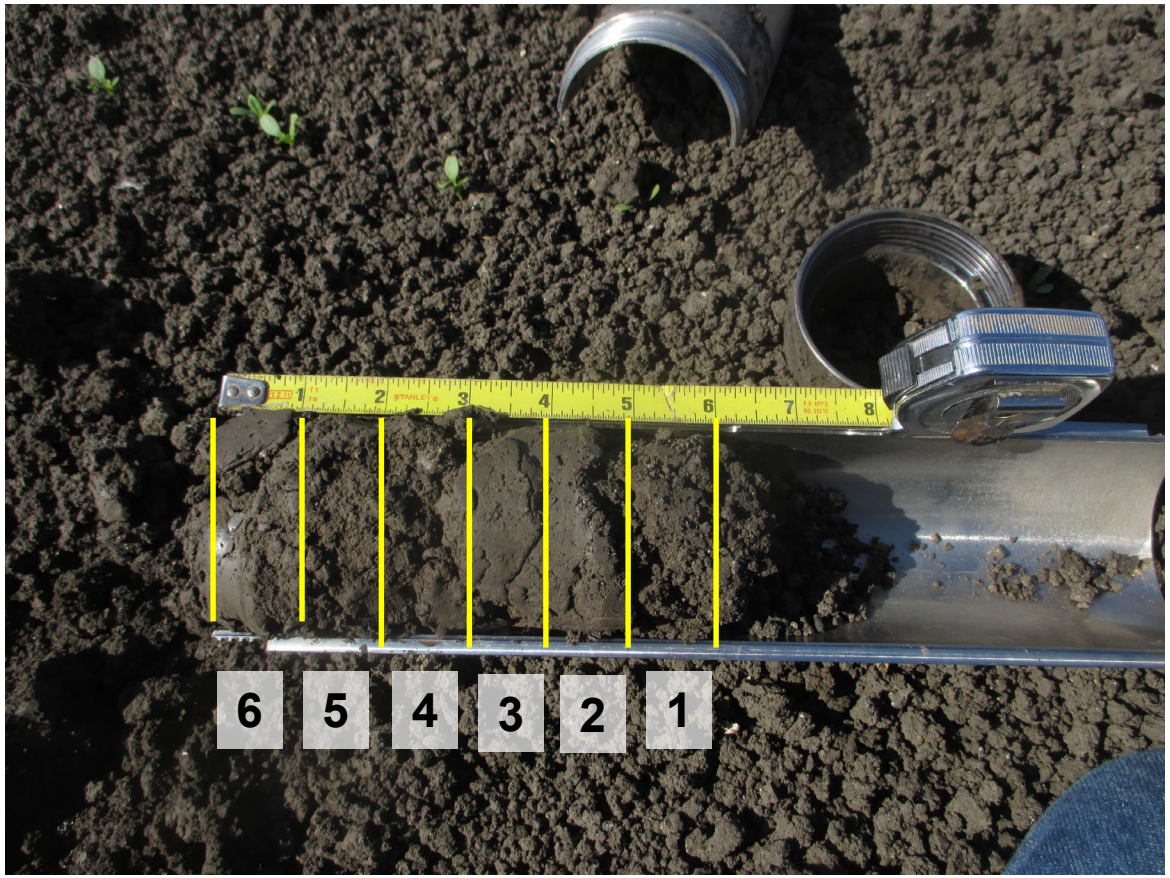
Anti crustant
at planting
10-15 lbs N/A

Auto thinners using
nitrogen fertilizer
20-25 lbs N/A

Fate of Topical Applications with Drip Irrigation

- If an anticrustant is used along with auto thinning, 30-40 lbs of nitrogen can be applied to the soil surface
- What is the fate of this material?

Sampling Procedure: Soil Sampler that Splits Open



Cut sample into 1 inch sections and analyze separately

Concentration of Nitrate + Ammonium in soil following autothinner application – Field 1

Inches deep	May 22[1]	May 24 (1)	May 28 (5)	June 6 (14)
1	46	373[2]	461	335
2	17	25	49	11
3	14	15	15	3
4	10	11	14	3
5	12	12	13	4
6	14	13	15	5

1 – Autothinner application applied May 23 – days after auto thinner application in parenthesis

2 – ammonium-N = 215; nitrate-N = 158

Concentration of Nitrate + Ammonium following application 20 gallons/A of 14-0-0-5 - Field 2

Inches deep	July 31 (17)[1]	Aug 6 (23)	Aug 19 (36)[2]
1	415	632	572
2	39	89	42
3	51	53	26
4	45	44	23
5	50	31	20
6	62	37	17

1 – Autothinner application applied July 14 – days after application in parenthesis

Movement of Topically Applied Materials

- It appears that the herbicide Kerb is moved sufficiently and efficiently by the germination water from buried drip irrigation (only need to move a few millimeters)
- However, topical applications of fertilizer were observed to basically stay in the top inch of soil for 5 weeks
- Interestingly, even ammonium levels stayed quite high over that period of time indicating that there is little biological activity at this depth of soil (too dry)

Soil Nitrate-N Levels by Depth

Implications for Soil Nitrate Sampling

Inches deep	Field 1	Field 2
0-2”	---	930
0-12”	23	121
2-12”	11	13

It has long been recommended to scrape off the top inch or two of soil when collecting soil samples for nitrate analysis. In the cases where a high concentration of nitrate may be at the soil surface it is critical to not over estimate of the amount of N that is actually available to the crop

Issues with Nitrate Stratified in the Top Inch of Soil

- Growers are required to report applied nitrogen to the Regional Water Quality Control Board
- Nitrogen remaining on the soil does not contribute to crop growth
- More nitrogen would need to be added to keep up with the N demand of the crop if 30-40 lbs is basically not contributing to crop growth

What is the fate of the nitrate in the top inch of soil

- It would be disced into the soil and and would become part of the residual soil nitrate pool that comes from crop residues and other unused crop fertilizer
- It can be recovered by subsequent crops or would be at risk during the winter fallow

Issues with Nitrate Stratified in the Top Inch of Soil

- It would be advantageous to have a low or no-nitrogen containing thinning material
- Shark is available
  - The rate needs to be selected carefully and it needs to be used carefully to avoid collateral damage to the keeper lettuce plants
- Other fertilizer materials were evaluated this summer, but none were totally acceptable by themselves
- More research is ongoing