Constant Feed Fertigation

Timmy Mann
Agronomist
B.B. Hobbs, Inc
Liberty Acres Fertilizer Corp

Palmetto, Fl;
Darlington, SC; Clinton, NC

*South Carolina PE Registration only

Wisdom for the day

Gail Mann

“If you don’t get better, it’s gonna get worse!!!”

FACT IS:

IF WE DON’T GET BETTER, THINGS WILL GET WORSE!!!

WHAT THINGS CAN WE DO BETTER?

FERTIGATION

The practice of applying fertilizers directly through irrigation water.

In its simplest form it is just side dressing Nitrogen through the irrigation system

CONSTANT FEED FERTIGATION

- Fertigation where plant nutrient and water requirements are applied in short increments as the plant needs them, generally, with every irrigation.

"Feed and water the plants daily with

the precise required amount and types of nutrients

and

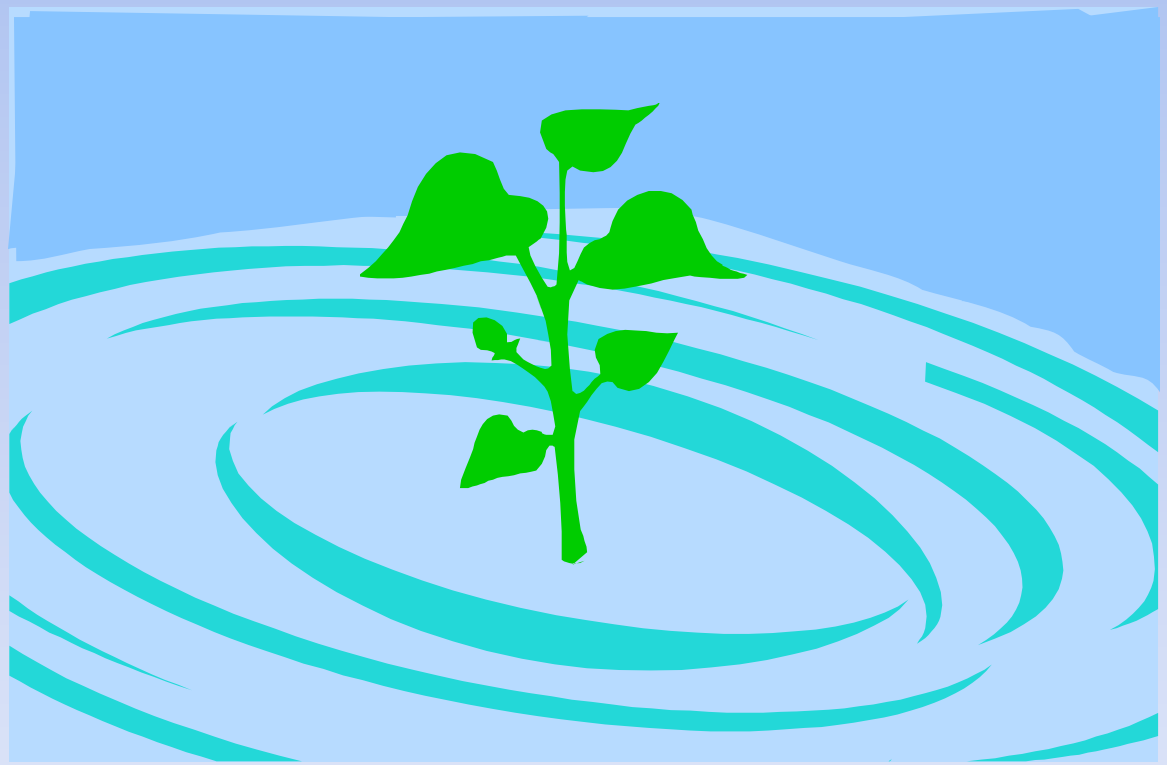
the precise required amount of irrigation water"

Basic assumptions:

- Nutrient uptake rates are crop- specific
- Plants need different quantities of the various nutrients at difference stages of their growth cycles.
  - Vegetative, Flowering, Fruit Development, Hardening, etc
- Each nutrient has a specific purpose and can limit production and-or quality if deficient at the time it is required.
- There is no such thing as “something for nothing”. If you want higher yields and better quality, higher, more efficient, or more timely inputs are required
- Nutrients should be available to the plants “Just-in-Time” to reduce leaching losses, salt stress, and avoid luxury feeding

Dynamics of nutrient uptake

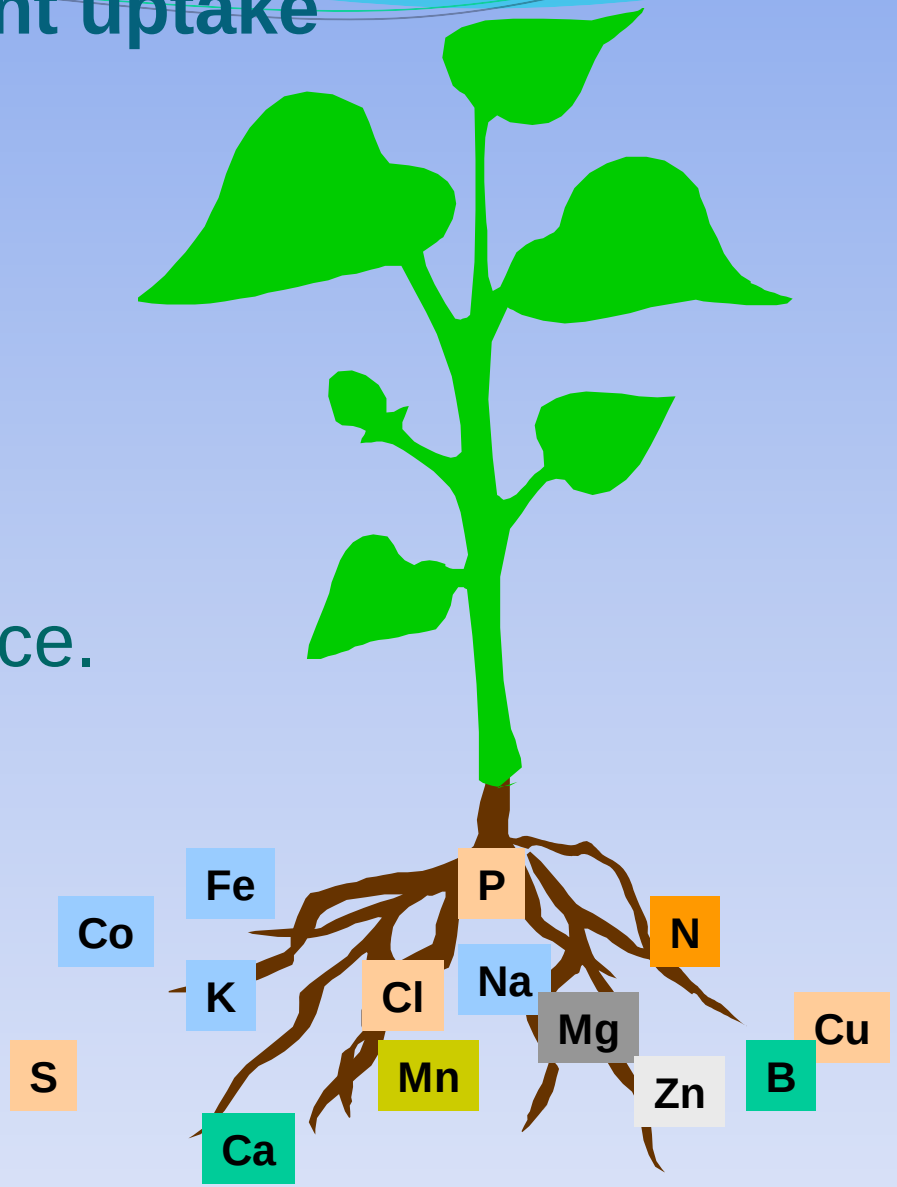
Of course, the plant can't handle it's entire annual water portion applied at once.



Dynamics of nutrient uptake

Same holds true for nutrients, too.

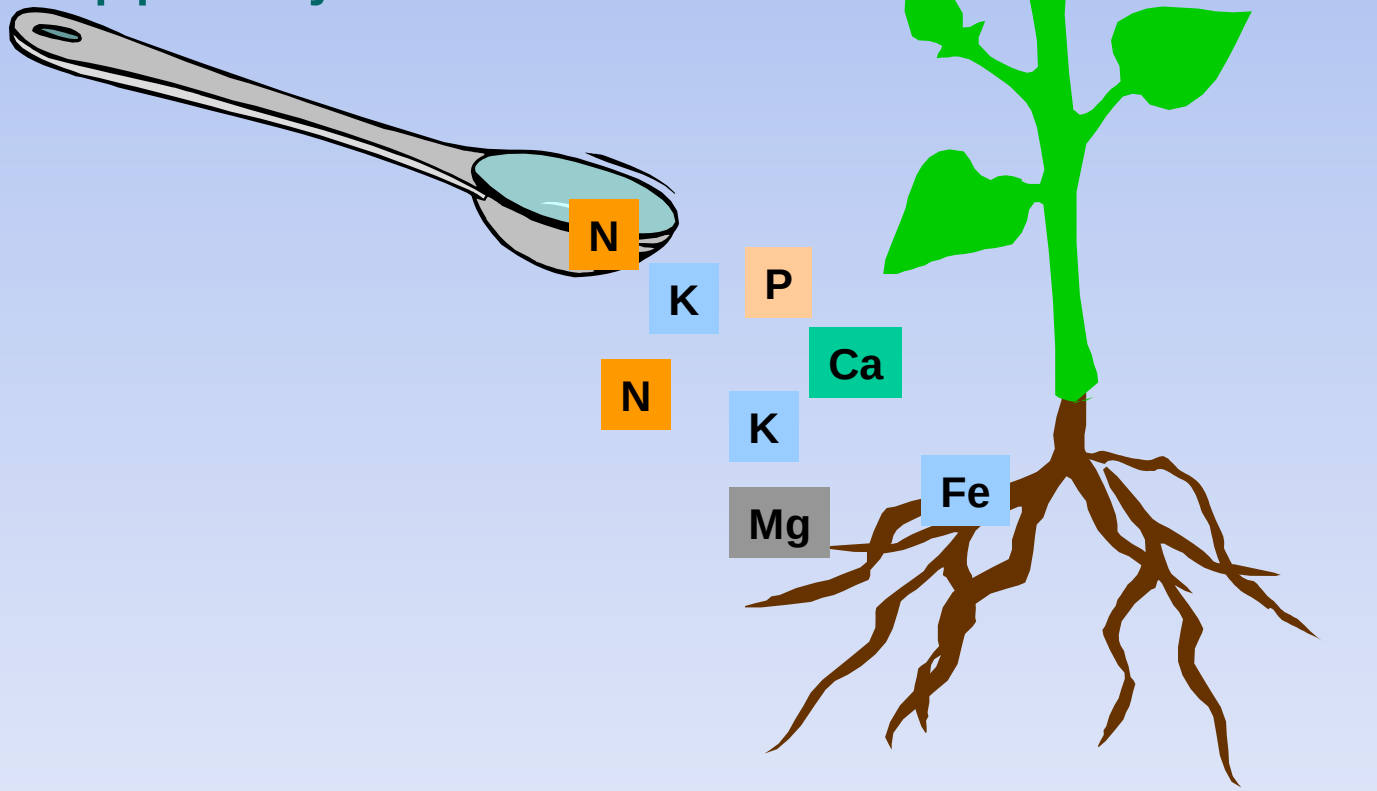
Nutrients should be applied according to their requirement pace.



Dynamics of nutrient uptake

Constant Feed Fertigation
= Teaspoon feeding.

Nutrients are supplied just-in-time.

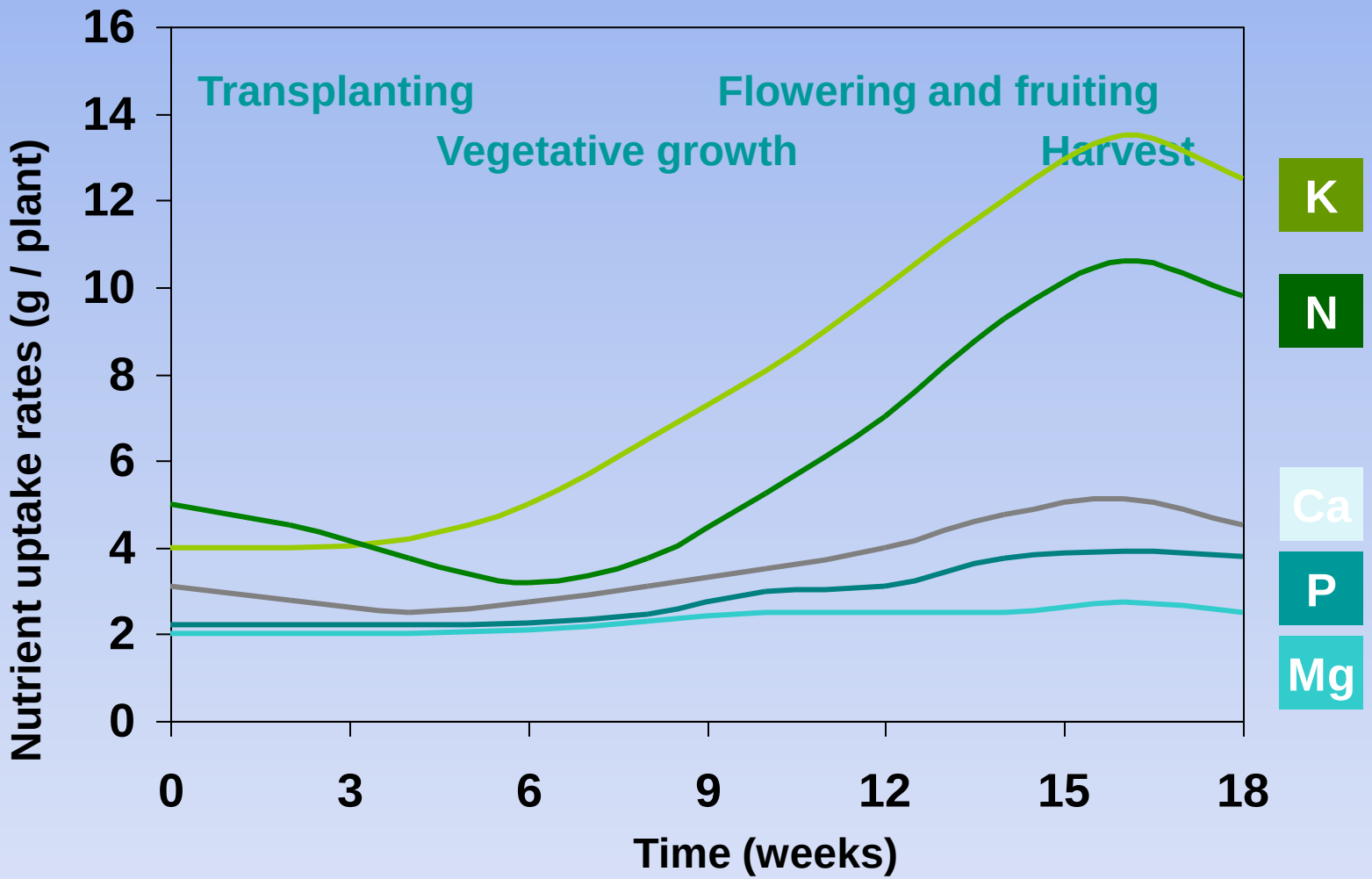


To Do Fertigation Right You Need to Understand:

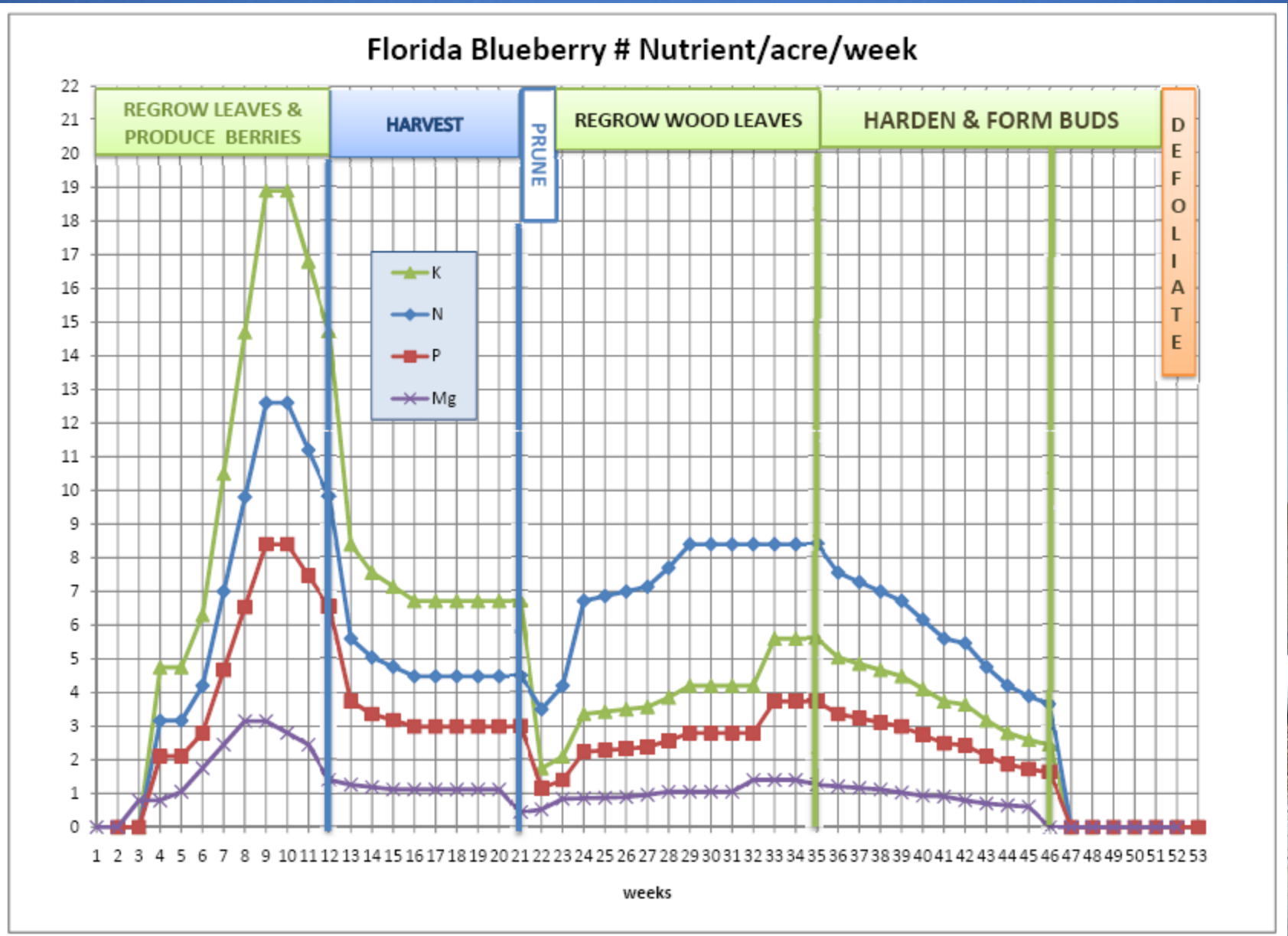
1. Nutrient uptake rates for the crop over its life span.
2. Water uptake rates for the crop over its life and how it varies with weather conditions.
3. How much water the soil will hold within the root zone.

Dynamics of nutrient uptake

Example Tomatoes



Source: Huett, 1985


Florida Blueberry # Nutrient/acre/week
REGROW LEAVES & PRODUCE BERRIES
HARVEST
PRUNE
REGROW WOOD LEAVES
HARDEN & FORM BUDS
DEFOLIATE
K
N
P
Mg
weeks

Watering Practices and Fertilizers

Cannot be separated from each other

ESPECIALLY

With shallow rooted crops

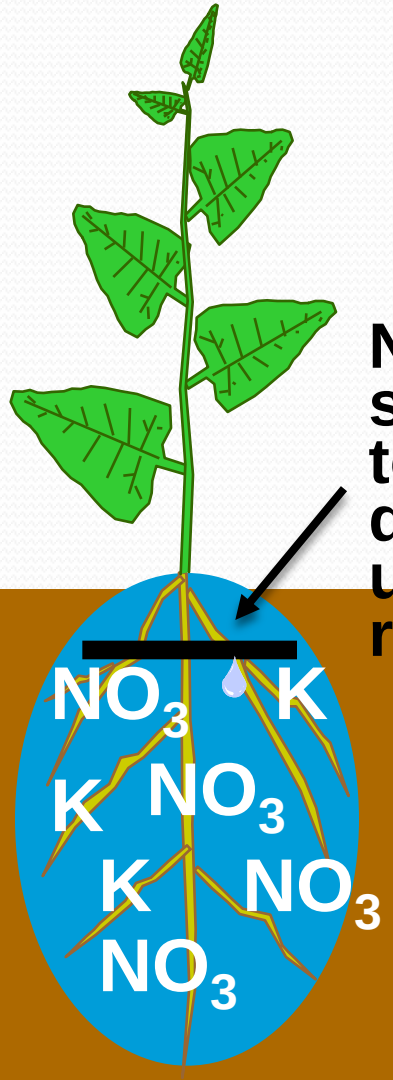
And

With soils or media with low water holding capacity

IF YOU OVERWATER YOU UNDER-FERTILIZE

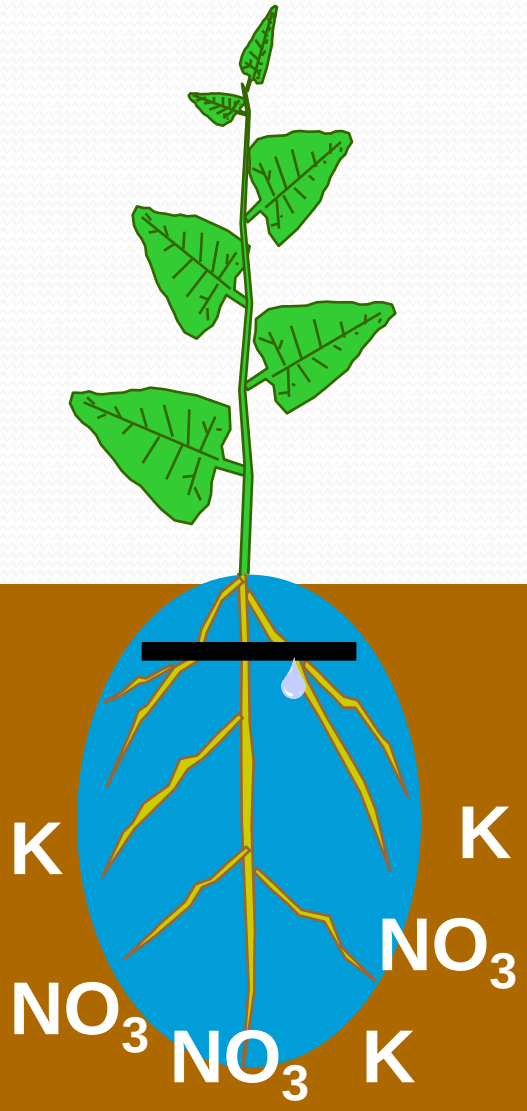
- **It is easy to leach fertilizers out of the root zone of low water holding capacity media with shallow rooted.**
- **Overwatering with overhead and dry fertilizers leach fertilizers easily PLUS can cause high salt conditions.**
- **With drip and conventional fertilizer practices, roots grow into the wet area while dry fertilizers are easily leached out of the wet area.**
- **With constant feed fertigation we can put what the plant needs into the "sweet spot" every day in small increments.**

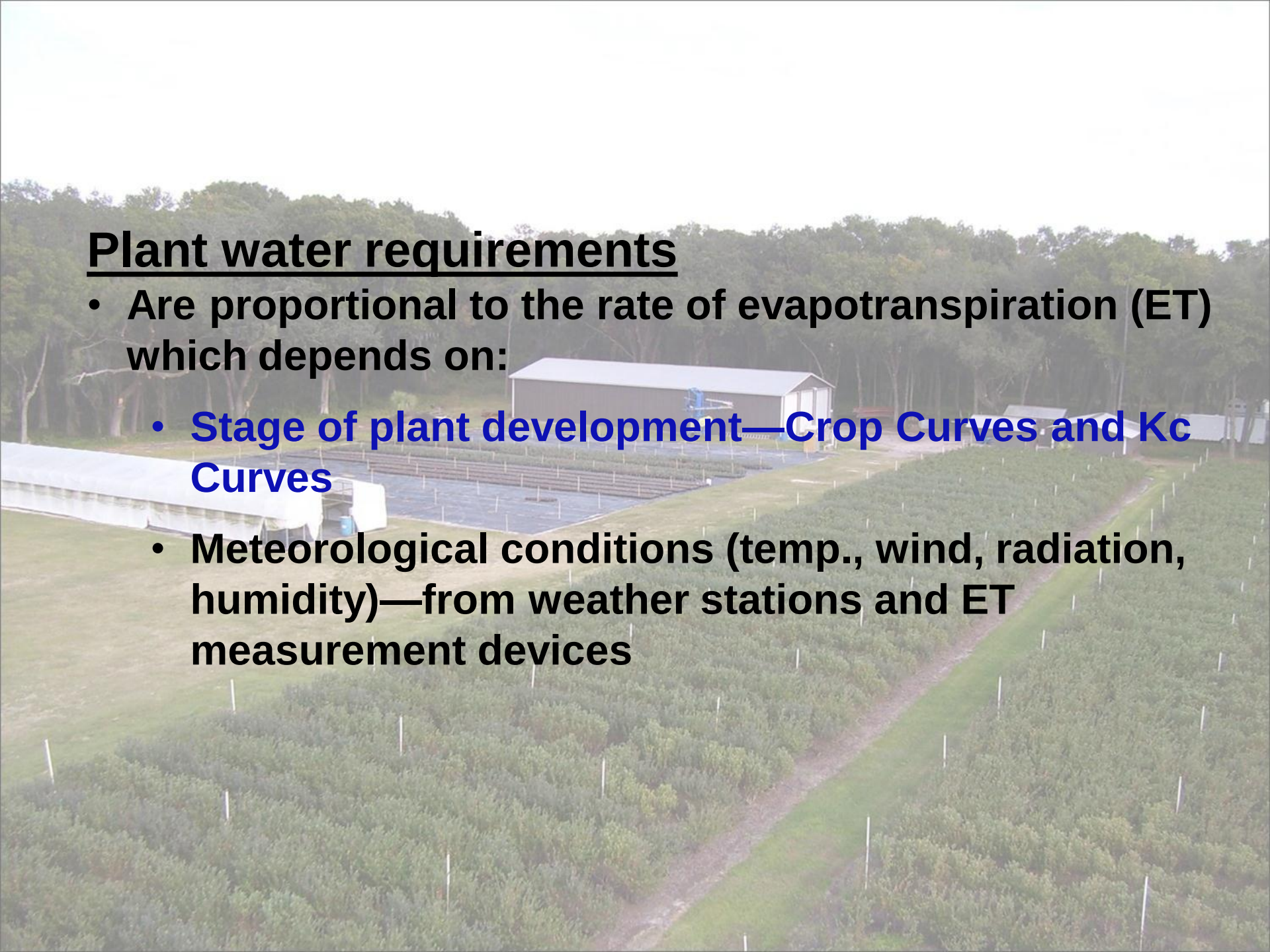
The Benefits of Fertigation: Fertilizer Savings and Efficient Utilization



Nutrients in solution & fed to the plants daily for ready uptake by the roots

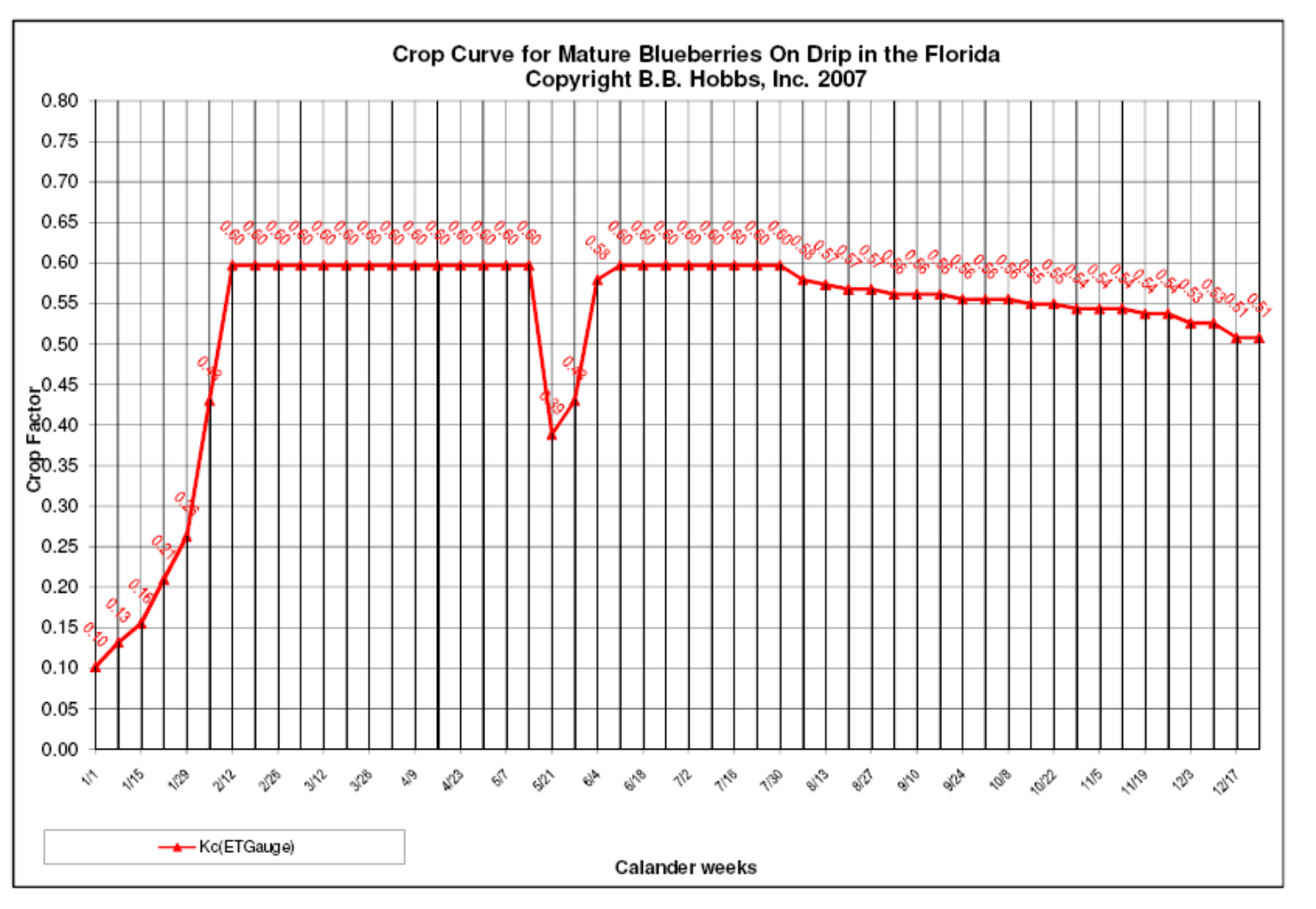
ÔWithout fertigation, drip tends to leach fertilizers out of the root zone to edges

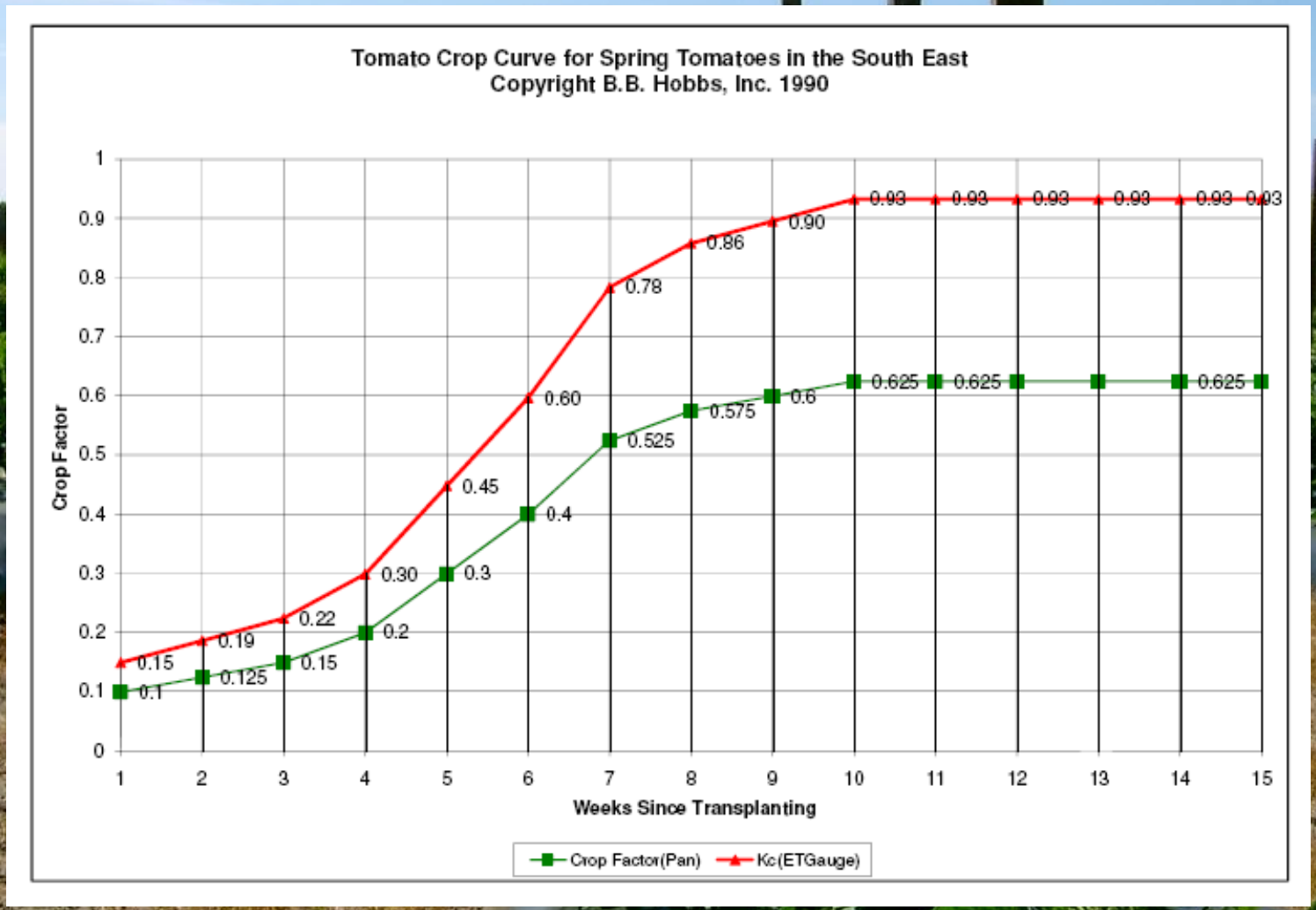




Plant water requirements

- Are proportional to the rate of evapotranspiration (ET) which depends on:
  - Stage of plant development—Crop Curves and Kc Curves
  - Meteorological conditions (temp., wind, radiation, humidity)—from weather stations and ET measurement devices

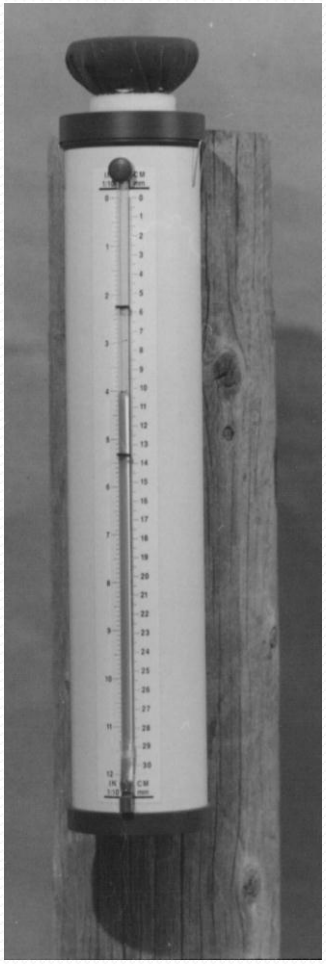

Crop Curve for Mature Blueberries On Drip in the Florida
Copyright B.B. Hobbs, Inc. 2007
Crop Factor
0.80
0.75
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
1/1
1/15
1/29
2/12
2/26
3/12
3/26
4/9
4/23
5/7
5/21
6/4
6/18
7/2
7/16
7/30
8/13
8/27
9/10
9/24
10/8
10/22
11/5
11/19
12/3
12/17
Kc(ETGauge)
Calander weeks


Tomato Crop Curve for Spring Tomatoes in the South East
Copyright B.B. Hobbs, Inc. 1990
Crop Factor
Weeks Since Transplanting
0.15
0.19
0.22
0.30
0.45
0.60
0.78
0.86
0.90
0.93
0.93
0.93
0.93
0.93
0.93
0.1
0.125
0.15
0.2
0.3
0.4
0.525
0.575
0.6
0.625
0.625
0.625
Crop Factor(Pan)
Kc(ETGauge)

Weather Stations & ET Gauges

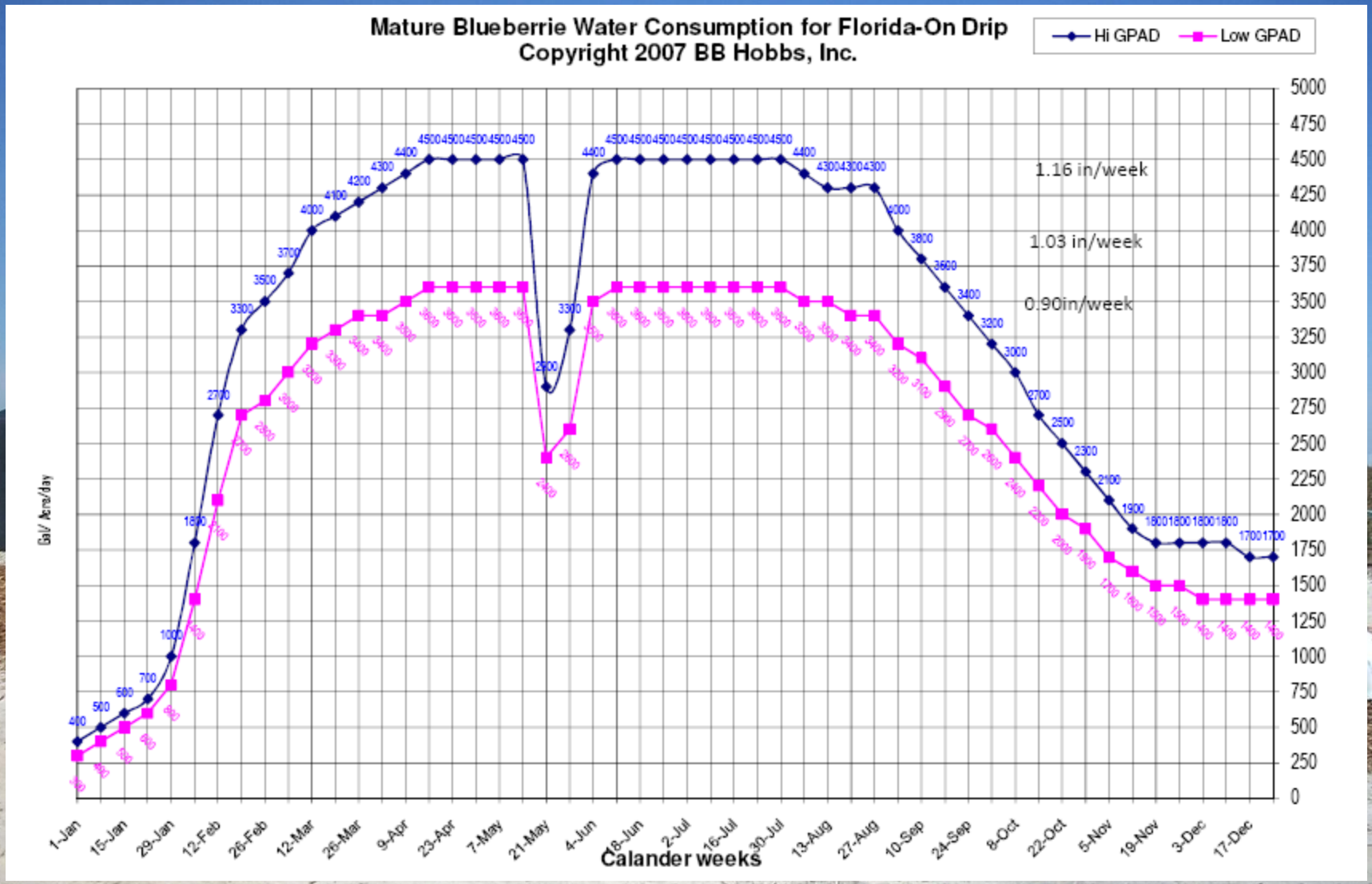
Weather Stations

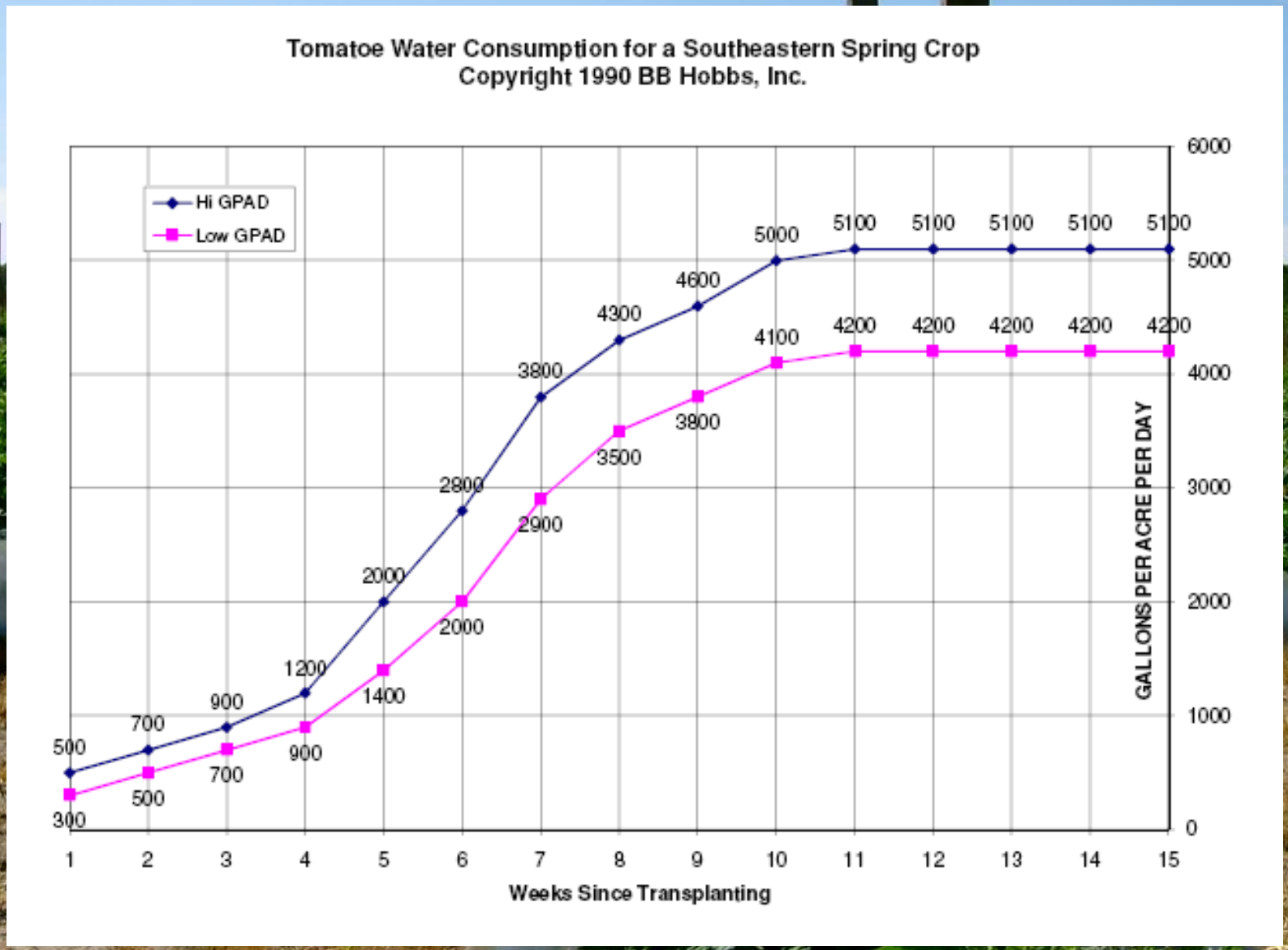
- Extensive Research shows that Evaporation data is proportional to crop water use.



ET Gauge

Both measure evaporation in Inches per day


Mature Blueberrie Water Consumption for Florida-On Drip
Copyright 2007 BB Hobbs, Inc.
Hi GPAD
Low GPAD
1.16 in/week
1.03 in/week
0.90in/week
Gal/ Acre/day
Calander weeks
1-Jan
15-Jan
29-Jan
12-Feb
26-Feb
12-Mar
26-Mar
9-Apr
23-Apr
7-May
21-May
4-Jun
18-Jun
2-Jul
16-Jul
30-Jul
13-Aug
27-Aug
10-Sep
24-Sep
8-Oct
22-Oct
5-Nov
19-Nov
3-Dec
17-Dec


Tomatoe Water Consumption for a Southeastern Spring Crop
Copyright 1990 BB Hobbs, Inc.
Hi GPAD
Low GPAD
500
700
900
1200
2000
2800
3800
4300
4600
5000
5100
5100
5100
5100
5100
300
500
700
900
1400
2000
2900
3500
3800
4100
4200
4200
4200
4200
4200
GALLONS PER ACRE PER DAY
0
1000
2000
3000
4000
5000
6000
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Weeks Since Transplanting

A good Fertigation program is based on proper water management, considering:

- Soil types and their characteristics

Irrigation of Blueberries on Bark and Light Soils

Net Application per Irrigation at 60% Available Moisture for various root depths.

		FC %	PWP%	Avail Moist %	Diameter spread	irrigation level	root zone ft	gallons per acre single 10	gallons per acre Double 5
New Bark ---(similar to loamy sand)	Drip	0.13	0.04	0.08	1	0.4	0.75	500	900
	Overhead	**0.13**	**0.05**	**0.08**	**3.5**	**0.4**	**0.75**	**2800**	**8000**
Old Bark--(similar to Sandy Loam)	Drip	0.21	0.10	0.11	1.25	0.4	0.75	700	1400
	Overhead	**0.21**	**0.10**	**0.11**	**3.5**	**0.4**	**0.75**	**3800**	**10857**
sand-	**Drip**	**0.09**	**0.02**	**0.07**	**1**	**0.4**	**1.5**	**700**	**1400**
	Overhead	0.09	0.02	0.07	4	0.4	1.5	5500	
Loamy Sand	**Drip**	**0.14**	**0.04**	**0.10**	**1.25**	**0.4**	**1.5**	**1300**	**2500**
	Overhead	0.14	0.04	0.10	4	0.4	1.5	7900	
sandy loam	**Drip**	**0.23**	**0.09**	**0.14**	**1.5**	**0.4**	**1.5**	**2100**	**4200**
	Overhead	0.23	0.09	0.14	4	0.4	1.5	11000	
sandy loam-OM	**Drip**	**0.29**	**0.1**	**0.19**	**2**	**0.4**	**1.5**	**3800**	**7500**
	Overhead	0.29	0.1	0.19	4	0.4	1.5	14900	
Loam	**Drip**	**0.34**	**0.12**	**0.22**	**4**	**0.4**	**1.5**	**8700**	**17300**
	Overhead	0.34	0.12	0.22	4	0.4	1.5	17300	

Automation with Drip is practically a must for success

Constant Feed Fertigation vs. Controlled Release Fertilizers

Problems with Controlled Release Fertilizers

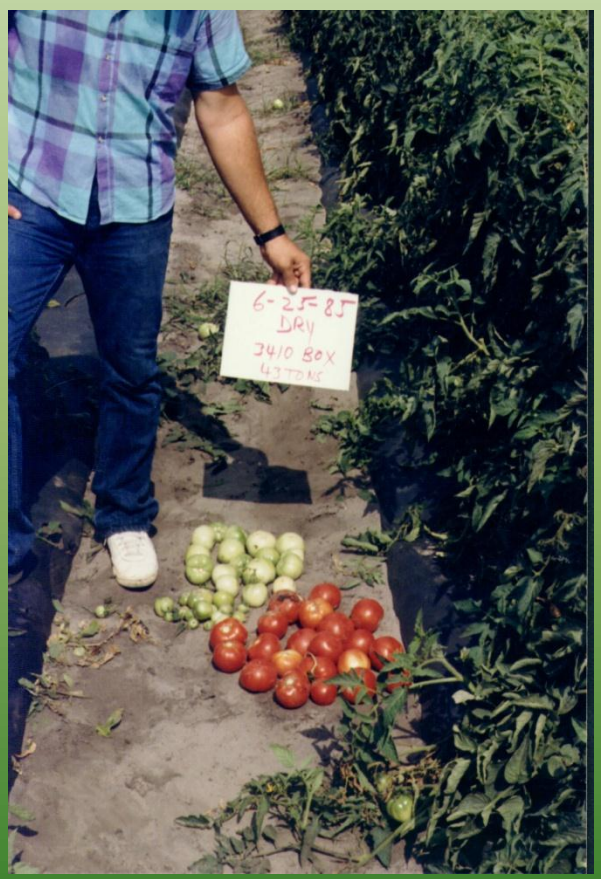
- **Expensive: 3 – 5 times more costly than conventional materials**
- **Usually only addresses nitrogen**
- **The “control” is in the hands of the manufacturer, the weather and other climatic conditions**

The Benefits of Constant Feed Fertigation

Advantages for the plant:

- Nutrients are directed to the active root zone.
- Uniform and precise distribution of nutrients
- Nutrients are already dissolved, hence ready for uptake by the roots
- Plant enjoys continuous nutrition. No temporary deficiency should occur.
- Less salt stress—NEVER a high Salt level because of spoon feeding
- Higher Yields and Quality

Yield Differences Can Be Seen



Dry Fertilizer & Traveler

Same Farmer, 3 days younger, Drip & Fertigation

Yield Results of SC Tomatoes

mid 1980s when converted

Type	Yields 25 # Average	High
Dry	900	1400
Sprinkler	1350	1550
Drip	1400	1600
Fertigated	2000	2800

Similar results on Florida Tomatoes----2006

Crop of Florida 47s in 2006. All fertigated on old plastic

5-2-07

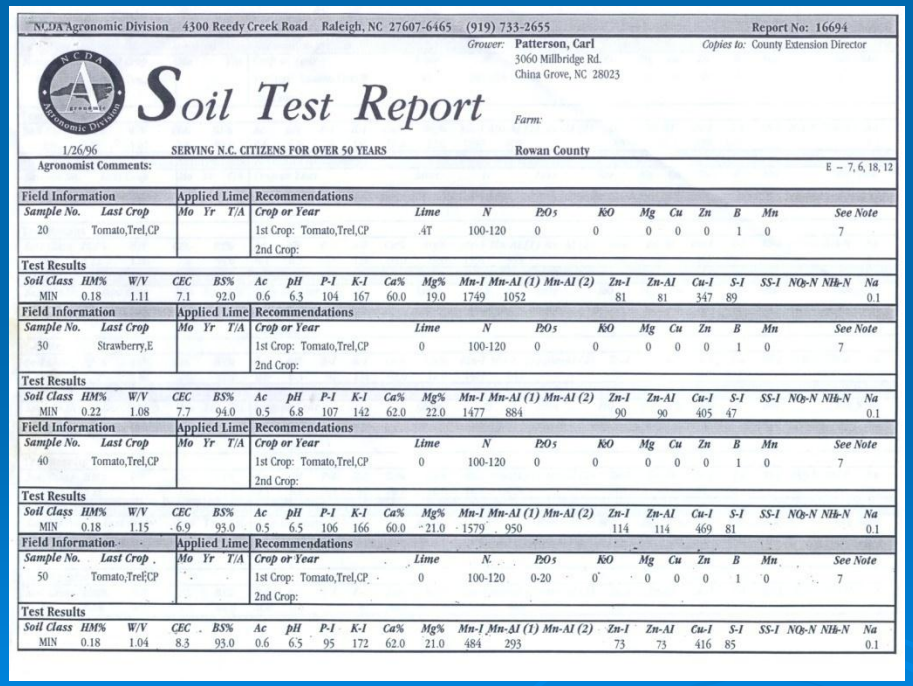
9-24-07

5-2-07

9-24-07

Fertigation Basics

- Soil Samples tied to GPS Maps



NCDA Agronomic Division 4300 Reedy Creek Road Raleigh, NC 27607-6465 (919) 733-2655 Report No: 16694

Soil Test Report

Grower: Patterson, Carl
3060 Millbridge Rd.
China Grove, NC 28023

Copies to: County Extension Director

Farm:

1/26/96 SERVING N.C. CITIZENS FOR OVER 50 YEARS Rowan County

Agronomist Comments: E – 7, 6, 18, 12

Field Information		Applied Lime		Recommendations											
Sample No.	Last Crop	Mo	Yr	T/A	Crop or Year	Lime	N	P_2O_5	K_2O	Mg	Cu	Zn	B	Mn	See Note
20	Tomato,Trel,CP				1st Crop: Tomato,Trel,CP	4T	100-120	0	0	0	0	0	1	0	7
					2nd Crop:										

Test Results																	
Soil Class	HM%	W/V	CEC	BS%	Ac	pH	P-I	K-I	Ca%	Mg%	Mn-I	Mn-AI (1)	Mn-AI (2)	Zn-I	Zn-AI	Cu-I	S-I	SS-I	NO_3-N	NH_4-N	Na
MIN	0.18	1.11	7.1	92.0	0.6	6.3	104	167	60.0	19.0	1749	1052		81	81	347	89				0.1

Field Information		Applied Lime		Recommendations											
Sample No.	Last Crop	Mo	Yr	T/A	Crop or Year	Lime	N	P_2O_5	K_2O	Mg	Cu	Zn	B	Mn	See Note
30	Strawberry,E				1st Crop: Tomato,Trel,CP	0	100-120	0	0	0	0	0	1	0	7
					2nd Crop:										

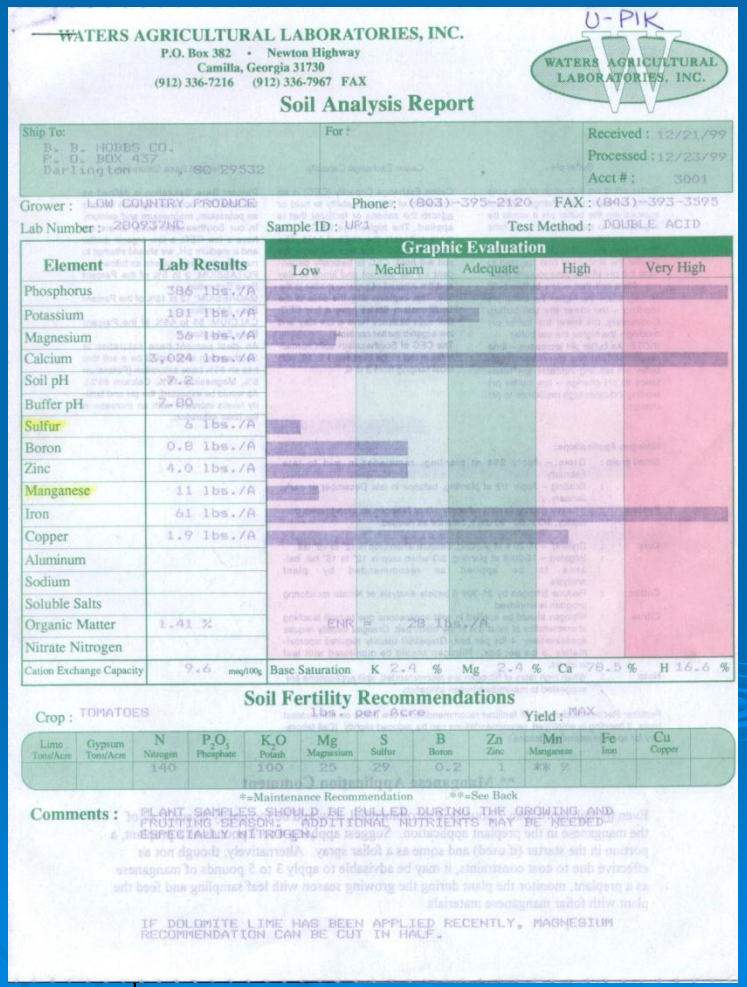
Test Results																	
Soil Class	HM%	W/V	CEC	BS%	Ac	pH	P-I	K-I	Ca%	Mg%	Mn-I	Mn-AI (1)	Mn-AI (2)	Zn-I	Zn-AI	Cu-I	S-I	SS-I	NO_3-N	NH_4-N	Na
MIN	0.22	1.08	7.7	94.0	0.5	6.8	107	142	62.0	22.0	1477	884		90	90	405	47				0.1

Field Information		Applied Lime		Recommendations											
Sample No.	Last Crop	Mo	Yr	T/A	Crop or Year	Lime	N	P_2O_5	K_2O	Mg	Cu	Zn	B	Mn	See Note
40	Tomato,Trel,CP				1st Crop: Tomato,Trel,CP	0	100-120	0	0	0	0	0	1	0	7
					2nd Crop:										

Test Results																	
Soil Class	HM%	W/V	CEC	BS%	Ac	pH	P-I	K-I	Ca%	Mg%	Mn-I	Mn-AI (1)	Mn-AI (2)	Zn-I	Zn-AI	Cu-I	S-I	SS-I	NO_3-N	NH_4-N	Na
MIN	0.18	1.15	6.9	93.0	0.5	6.5	106	166	60.0	21.0	1579	950		114	114	469	81				0.1

Field Information		Applied Lime		Recommendations											
Sample No.	Last Crop	Mo	Yr	T/A	Crop or Year	Lime	N	P_2O_5	K_2O	Mg	Cu	Zn	B	Mn	See Note
50	Tomato,Trel,CP				1st Crop: Tomato,Trel,CP	0	100-120	0-20	0	0	0	0	1	0	7
					2nd Crop:										

Test Results																	
Soil Class	HM%	W/V	CEC	BS%	Ac	pH	P-I	K-I	Ca%	Mg%	Mn-I	Mn-AI (1)	Mn-AI (2)	Zn-I	Zn-AI	Cu-I	S-I	SS-I	NO_3-N	NH_4-N	Na
MIN	0.18	1.04	8.3	93.0	0.6	6.5	95	172	62.0	21.0	484	293		73	73	416	85				0.1



WATERS AGRICULTURAL LABORATORIES, INC.
P.O. Box 382 • Newton Highway
Camilla, Georgia 31730
(912) 336-7216 (912) 336-7967 FAX

U-PIK

Soil Analysis Report

Ship To: B. B. HOBBS CO. P. O. BOX 437 Darlington, SC 29532

For :

Received : 12/21/99
Processed : 12/23/99
Acct # : 3001

Grower : LOW COUNTRY PRODUCE Phone : (803)-395-2120 FAX : (843)-393-3595

Lab Number : 28093NC Sample ID : UP1 Test Method : DOUBLE ACID

Element	Lab Results	Graphic Evaluation: Low / Medium / Adequate / High / Very High
Phosphorus	386 lbs./A	
Potassium	181 lbs./A	
Magnesium	56 lbs./A	
Calcium	3,024 lbs./A	
Soil pH	7.2	
Buffer pH	7.80	
Sulfur	6 lbs./A	
Boron	0.8 lbs./A	
Zinc	4.0 lbs./A	
Manganese	11 lbs./A	
Iron	61 lbs./A	
Copper	1.9 lbs./A	
Aluminum		
Sodium		
Soluble Salts		
Organic Matter	1.41 %	
Nitrate Nitrogen		
Cation Exchange Capacity	9.6 meq/100g	Base Saturation K 2.4 % Mg 2.4 % Ca 78.5 % H 16.6 %

ENR = 28 lbs./A

Soil Fertility Recommendations

Crop : TOMATOES Yield : MAX

Lime Tons/Acre	Gypsum Tons/Acre	N Nitrogen	P_2O_5 Phosphate	K_2O Potash	Mg Magnesium	S Sulfur	B Boron	Zn Zinc	Mn Manganese	Fe Iron	Cu Copper
		140		100	25	29	0.2	1	** 9		

*=Maintenance Recommendation **=See Back

Comments : PLANT SAMPLES SHOULD BE PULLED DURING THE GROWING AND FRUITING SEASON. ADDITIONAL NUTRIENTS MAY BE NEEDED ESPECIALLY NITROGEN.

IF DOLOMITE LIME HAS BEEN APPLIED RECENTLY, MAGNESIUM RECOMMENDATION CAN BE CUT IN HALF.

Soil Sample

Data Manager — **Boundary Map**

Grower: Blueberry Farms
Field: New West Field
Farm: Brushy Creek
Acres: 29.18

Liberty Acres Fertili ...
1340 Harry Byrd Hwy
P.O. Box 437
Darlington, SC 29540
PHONE: 800-597-8903
FAX: 843-393-3595

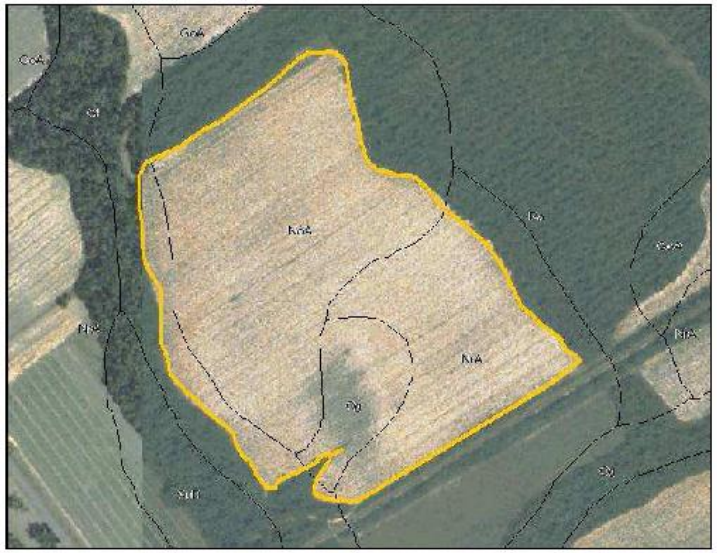
Aerial with GPS Boundary

ISSUED: 5:28pm EST Jan 7, 2009
A Product of Agfleet Version 3.00

Zone Maker — **Zone Creation Map**

Grower: Blueberry Farms
Field: New West Field
Farm: Brushy Creek
Acres: 29.18
Layer Data:

Liberty Acres Fertili ...
1340 Harry Byrd Hwy
P.O. Box 437
Darlington, SC 29540
PHONE: 800-597-8903
FAX: 843-393-3595



Overlay Soil Types

ISSUED: 4:52pm EST Jan 7, 2009
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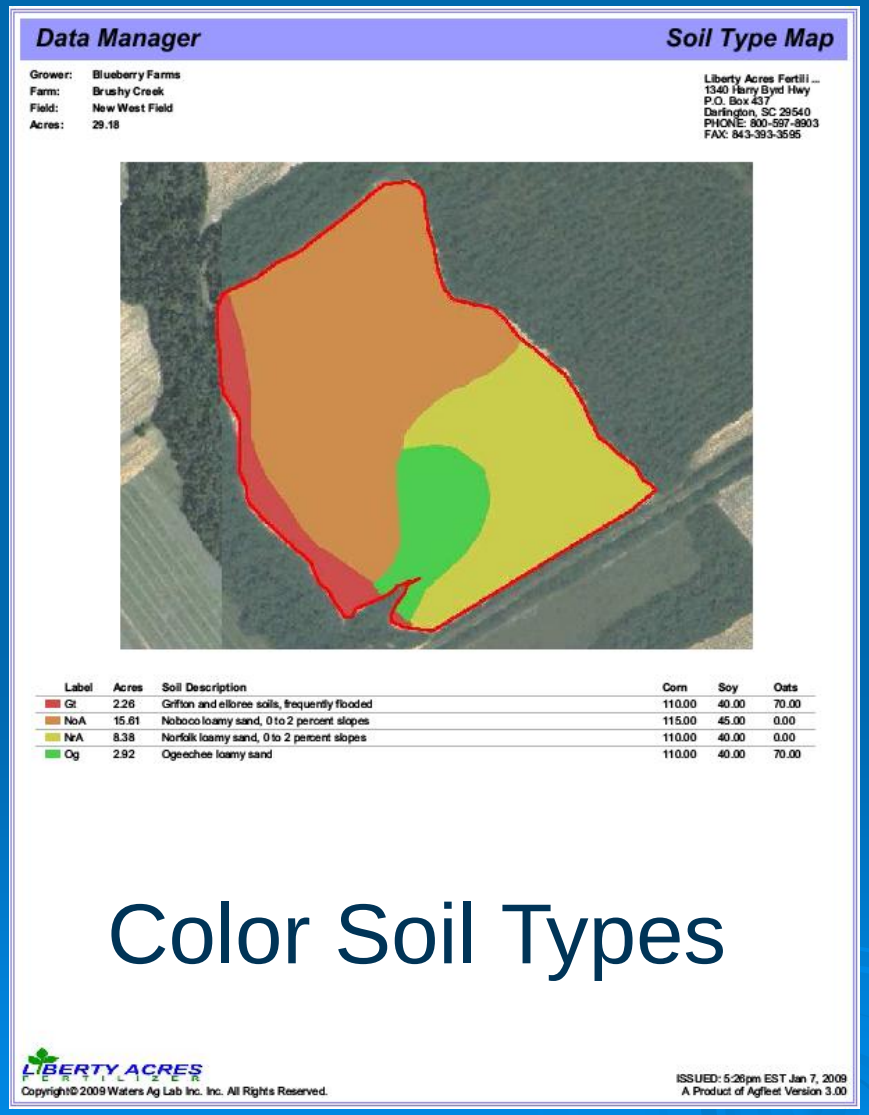
Soil Sample



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Field: New West Field
Acres: 29.18

Liberty Acres Fertili ...
1340 Harry Byrd Hwy
P.O. Box 437
Darlington, SC 29540
PHONE: 800-597-8903
FAX: 843-393-3595

Label	Acres	Soil Description	Corn	Soy	Oats
Gt	2.26	Grifton and elloree soils, frequently flooded	110.00	40.00	70.00
NoA	15.61	Nobocо loamy sand, 0 to 2 percent slopes	115.00	45.00	0.00
NrA	8.38	Norfolk loamy sand, 0 to 2 percent slopes	110.00	40.00	0.00
Og	2.92	Ogeechee loamy sand	110.00	40.00	70.00

LIBERTY ACRES FERTILIZER

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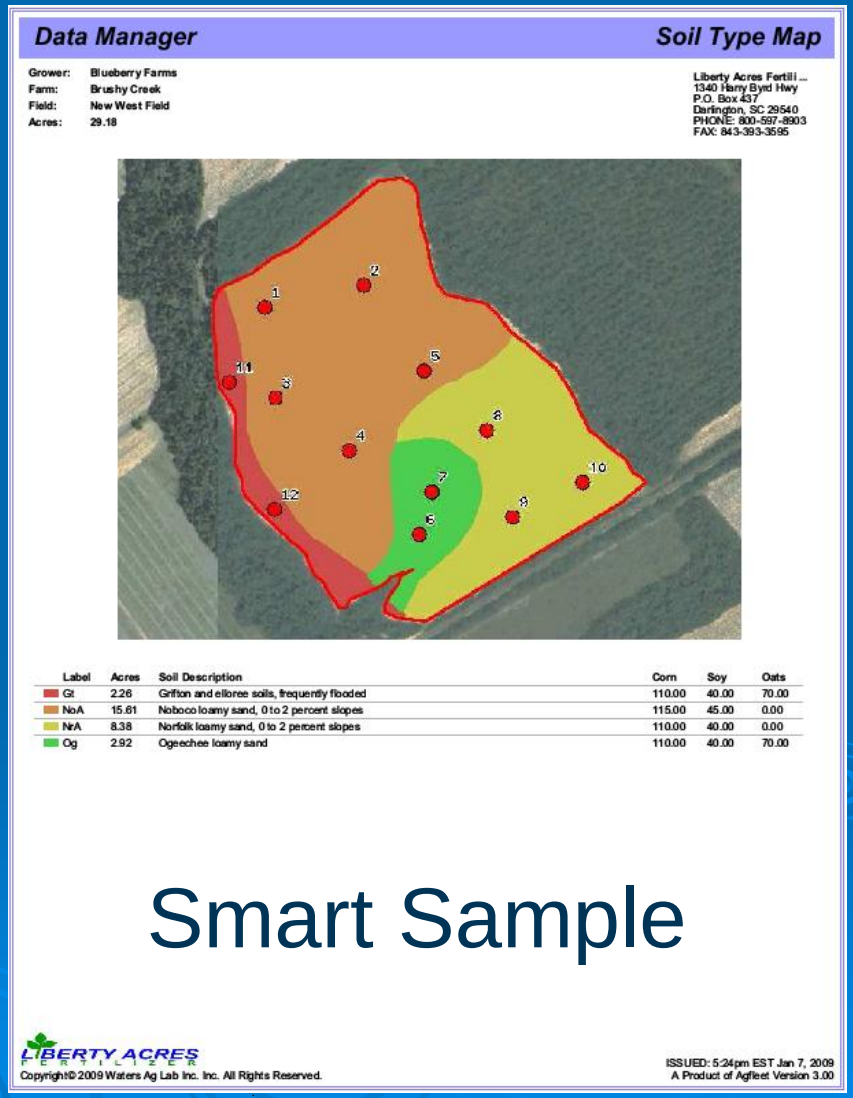
Color Soil Types



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Farm: Brushy Creek
Field: New West Field
Acres: 29.18

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1340 Harry Byrd Hwy
P.O. Box 437
Darlington, SC 29540
PHONE: 800-597-8903
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Og	2.92	Ogeechee loamy sand	110.00	40.00	70.00

LIBERTY ACRES FERTILIZER

ISSUED: 5:24pm EST Jan 7, 2009
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Smart Sample

Fertigation Basics

2008 Fert Program-Plan 1-01-08 (version 1) Fert Program 3/10/2008

DATE	Week	Stage		#N/ac/wk	#N/ac/day	[illegible]	Analysis N	Analysis P	Analysis K	$/ton	#/ac/wk N	#/ac/wk P	#/ac/wk K	Urea	Nitrate	Running NPK BBHI Program N	P	K	Tons/Total acres	$/week
BB Hobbs Inc																				
Clearsprings Blueberry Fertilizer Program										Target N									Acres	
2008										280									200	
1/1/08	1	grow leaves-develop fruit		0.0	0.0	0	6	0	0	$ 265	0.0	0.0	0.0	0.0	0.0	0	0	0	0.0	$ -
1/8/08	2	grow leaves-develop fruit		0.0	0.0	0	6	0	0	$ 265	0.0	0.0	0.0	0.0	0.0	0	0	0	0.0	$ -
1/15/08	3	grow leaves-develop fruit		3.2	0.5	205	6	4	9	$ 265	3.2	2.1	4.7	2.0	1.2	3	2	5	5.3	$ 1,397
1/22/08	4	grow leaves-develop fruit		3.2	0.5	149	6	4	9	$ 265	3.2	2.1	4.7	2.0	1.2	6	4	9	5.3	$ 1,397
1/29/08	5	grow leaves-develop fruit		4.2	0.6	139	6	4	9	$ 265	4.2	2.8	6.3	2.6	1.6	11	7	16	7.0	$ 1,855
2/5/08	6	grow leaves-develop fruit	Bloom	7.0	1.0	127	6	4	9	$ 265	7.0	4.7	10.5	4.4	2.6	18	12	26	11.7	$ 3,092
2/12/08	7	grow leaves-develop fruit	Bloom	9.8	1.4	115	6	4	9	$ 265	9.8	6.5	14.7	6.2	3.6	27	18	41	16.3	$ 4,328
2/19/08	8	grow leaves-develop fruit	Bloom	12.6	1.8	116	6	4	9	$ 265	12.6	8.4	18.9	7.9	4.7	40	27	60	21.0	$ 5,565
2/26/08	9	grow leaves-develop fruit	Bloom	12.6	1.8	107	6	4	9	$ 265	12.6	8.4	18.9	7.9	4.7	53	35	79	21.0	$ 5,565
3/4/08	10	grow leaves-develop fruit	Bloom	11.2	1.6	88	6	4	9	$ 265	11.2	7.5	16.8	7.0	4.2	64	42	96	18.7	$ 4,947
3/11/08	11	grow leaves-develop fruit	Bloom	9.8	1.4	72	6	4	9	$ 265	9.8	6.5	14.7	6.2	3.6	74	49	110	16.3	$ 4,328
3/18/08	12	HARVEST		5.6	0.8	39	6	4	9	$ 265	5.6	3.7	8.4	3.5	2.1	79	53	119	9.3	$ 2,473
3/25/08	13	HARVEST		5.0	0.7	34	6	4	9	$ 265	5.0	3.4	7.6	3.2	1.9	84	56	126	8.4	$ 2,226
4/1/08	14	HARVEST		4.8	0.7	31	6	4	9	$ 265	4.8	3.2	7.1	3.0	1.8	89	59	133	7.9	$ 2,102
4/8/08	15	HARVEST		4.5	0.6	28	6	4	9	$ 265	4.5	3.0	6.7	2.8	1.7	93	62	140	7.5	$ 1,979
4/15/08	16	HARVEST		4.5	0.6	27	6	4	9	$ 265	4.5	3.0	6.7	2.8	1.7	98	65	147	7.5	$ 1,979
4/22/08	17	HARVEST		4.5	0.6	26	6	4	9	$ 265	4.5	3.0	6.7	2.8	1.7	102	68	154	7.5	$ 1,979
4/29/08	18	HARVEST		4.5	0.6	26	6	4	9	$ 265	4.5	3.0	6.7	2.8	1.7	107	71	160	7.5	$ 1,979
5/6/08	19	HARVEST		4.5	0.6	25	6	4	9	$ 265	4.5	3.0	6.7	2.8	1.7	111	74	167	7.5	$ 1,979
5/13/08	20	HARVEST		4.5	0.6	25	6	4	9	$ 265	4.5	3.0	6.7	2.8	1.7	116	77	174	7.5	$ 1,979
5/20/08	21	Prune		3.5	0.5	30	12	4	6	$ 315	3.5	1.2	1.8	3.1	0.4	119	78	175	2.9	$ 919
5/27/08	22	Grow Wood-leaves		4.2	0.6	32	12	4	6	$ 315	4.2	1.4	2.1	3.7	0.5	124	80	178	3.5	$ 1,103
6/3/08	23	Grow Wood-leaves		6.7	1.0	37	12	4	6	$ 315	6.7	2.2	3.4	6.0	0.8	130	82	181	5.6	$ 1,764
6/10/08	24	Grow Wood-leaves		6.9	1.0	36	12	4	6	$ 315	6.9	2.3	3.4	6.1	0.8	137	84	184	5.7	$ 1,801
6/17/08	25	Grow Wood-leaves		7.0	1.0	36	12	4	6	$ 315	7.0	2.3	3.5	6.2	0.8	144	87	188	5.8	$ 1,838
6/24/08	26	Grow Wood-leaves		7.1	1.0	37	12	4	6	$ 315	7.1	2.4	3.6	6.3	0.8	151	89	191	5.9	$ 1,874
7/1/08	27	Grow Wood-leaves		7.7	1.1	39	12	4	6	$ 315	7.7	2.6	3.9	6.8	0.9	159	92	195	6.4	$ 2,021
7/8/08	28	Grow Wood-leaves		8.4	1.2	42	12	4	6	$ 315	8.4	2.8	4.2	7.4	1.0	167	94	199	7.0	$ 2,205
7/15/08	29	Grow Wood-leaves		8.4	1.2	41	12	4	6	$ 315	8.4	2.8	4.2	7.4	1.0	176	97	204	7.0	$ 2,205
7/22/08	30	Grow Wood-leaves		8.4	1.2	41	12	4	6	$ 315	8.4	2.8	4.2	7.4	1.0	184	100	208	7.0	$ 2,205
7/29/08	31	Grow Wood-leaves		8.4	1.2	40	12	4	6	$ 315	8.4	2.8	4.2	7.4	1.0	193	103	212	7.0	$ 2,205
8/5/08	32	Grow Wood-leaves		8.4	1.2	41	9	4	6	$ 274	8.4	3.7	5.6	7.1	1.3	201	107	218	9.3	$ 2,557
8/12/08	33	Grow Wood-leaves		8.4	1.2	41	9	4	6	$ 274	8.4	3.7	5.6	7.1	1.3	209	110	223	9.3	$ 2,557
8/19/08	34	Grow Wood-leaves		8.4	1.2	41	9	4	6	$ 274	8.4	3.7	5.6	7.1	1.3	218	114	229	9.3	$ 2,557
8/26/08	35	Grow Wood-leaves		7.6	1.1	36	9	4	6	$ 274	7.6	3.4	5.0	6.4	1.2	225	117	234	8.4	$ 2,302
9/2/08	36	Harden-form buds		7.3	1.0	37	9	4	6	$ 274	7.3	3.2	4.9	6.2	1.1	233	121	239	8.1	$ 2,216
9/9/08	37	Harden-form buds		7.0	1.0	37	9	4	6	$ 274	7.0	3.1	4.7	5.9	1.1	240	124	243	7.8	$ 2,131
9/16/08	38	Harden-form buds		6.7	1.0	37	9	4	6	$ 274	6.7	3.0	4.5	5.7	1.0	246	127	248	7.5	$ 2,046
9/23/08	39	Harden-form buds		6.2	0.9	36	9	4	6	$ 274	6.2	2.7	4.1	5.2	0.9	252	129	252	6.8	$ 1,875
9/30/08	40	Harden-form buds		5.6	0.8	34	9	4	6	$ 274	5.6	2.5	3.7	4.7	0.9	258	132	256	6.2	$ 1,705
10/7/08	41	Harden-form buds		5.5	0.8	35	9	4	6	$ 274	5.5	2.4	3.6	4.6	0.8	264	134	259	6.1	$ 1,662
10/14/08	42	Harden-form buds		4.8	0.7	33	9	4	6	$ 274	4.8	2.1	3.2	4.0	0.7	268	136	263	5.3	$ 1,449
10/21/08	43	Harden-form buds		4.2	0.6	31	9	4	6	$ 274	4.2	1.9	2.8	3.6	0.6	272	138	265	4.7	$ 1,279
10/28/08	44	Harden-form buds		3.9	0.6	32	9	4	6	$ 274	3.9	1.7	2.6	3.3	0.6	276	140	268	4.3	$ 1,185
11/4/08	45	Harden-form buds		3.6	0.5	32	9	4	6	$ 274	3.6	1.6	2.4	3.1	0.6	280	142	270	4.0	$ 1,108
11/11/08	46	Harden-form buds		0.0	0.0	0	9	4	6	$ 274	0.0	0.0	0.0	0.0	0.0	280	142	270	0.0	$ -
11/18/08	47	Harden-form buds		0.0	0.0	0	9	4	6	$ 274	0.0	0.0	0.0	0.0	0.0	280	142	270	0.0	$ -
11/25/08	48	Harden-form buds		0.0	0.0	0	9	4	6	$ 274	0.0	0.0	0.0	0.0	0.0	280	142	270	0.0	$ -
12/2/08	49	Harden-form buds		0.0	0.0	0	9	4	6	$ 274	0.0	0.0	0.0	0.0	0.0	280	142	270	0.0	$ -
12/9/08	50	Harden-form buds		0.0	0.0	0	9	4	6	$ 274	0.0	0.0	0.0	0.0	0.0	280	142	270	0.0	$ -
12/16/08	51	Harden-form buds		0.0	0.0	0	9	4	6	$ 274	0.0	0.0	0.0	0.0	0.0	280	142	270	0.0	$ -
12/23/08	52	defoliate		0.0	0.0	0	9	4	6	$ 274	0.0	0.0	0.0	0.0	0.0	280	142	270	0.0	$ -
annual				280							280	142	270	215	65	280	142	270	354	$ 97,918
														77%	23%				1.77	$ 489.59
			Nutrient	N	P	K	S	Ca	Mg	B	Cu	Mn	Mo	Fe	Zn					
			Percent	7.8%	4.0%	7.6%	0.03	0.00	0.30	0.023	0.013	0.05	0.001	0.05	0.023					
			#/acre	280	142	270	1.1	0.0	10.6	0.8	0.5	1.6	0.0	1.8	0.8					

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- Have a plan to follow
- But be ready to modify it by:
  - Visual observations
  - Tissue samples

Fertigation Success Is Not Automatic

- There is really no recipe
- Hard work and close attention to the crop is required.
- There is always a lot of learning to do with each new soil and crop.
- Proper water management is a must

Wisdom for the day…

By Arthur Schopenhauer

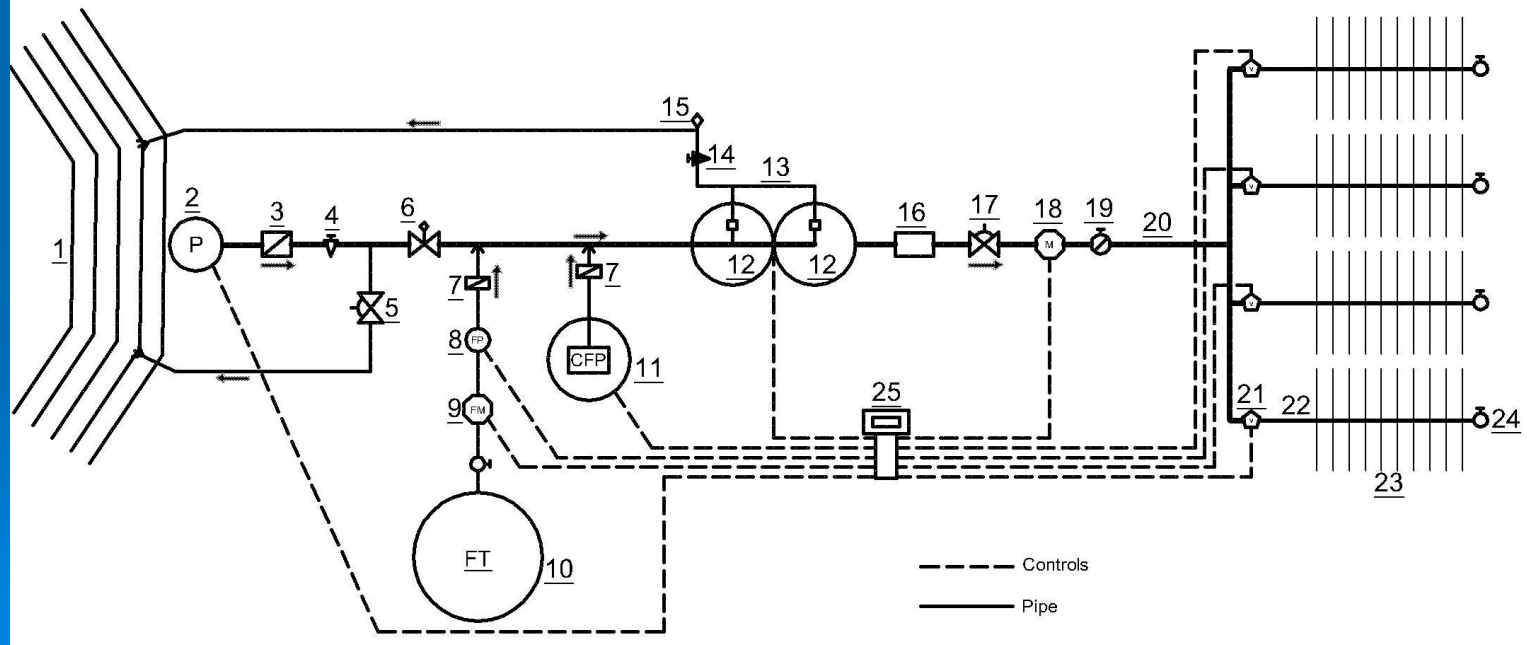
"All truth passes through three stages:
First, it is *ridiculed*.
Second, it is *violently opposed*.
Third, it is *accepted as being self-evident*."

Typical Micro-Irrigation System

Typical Micro-Irrigation System

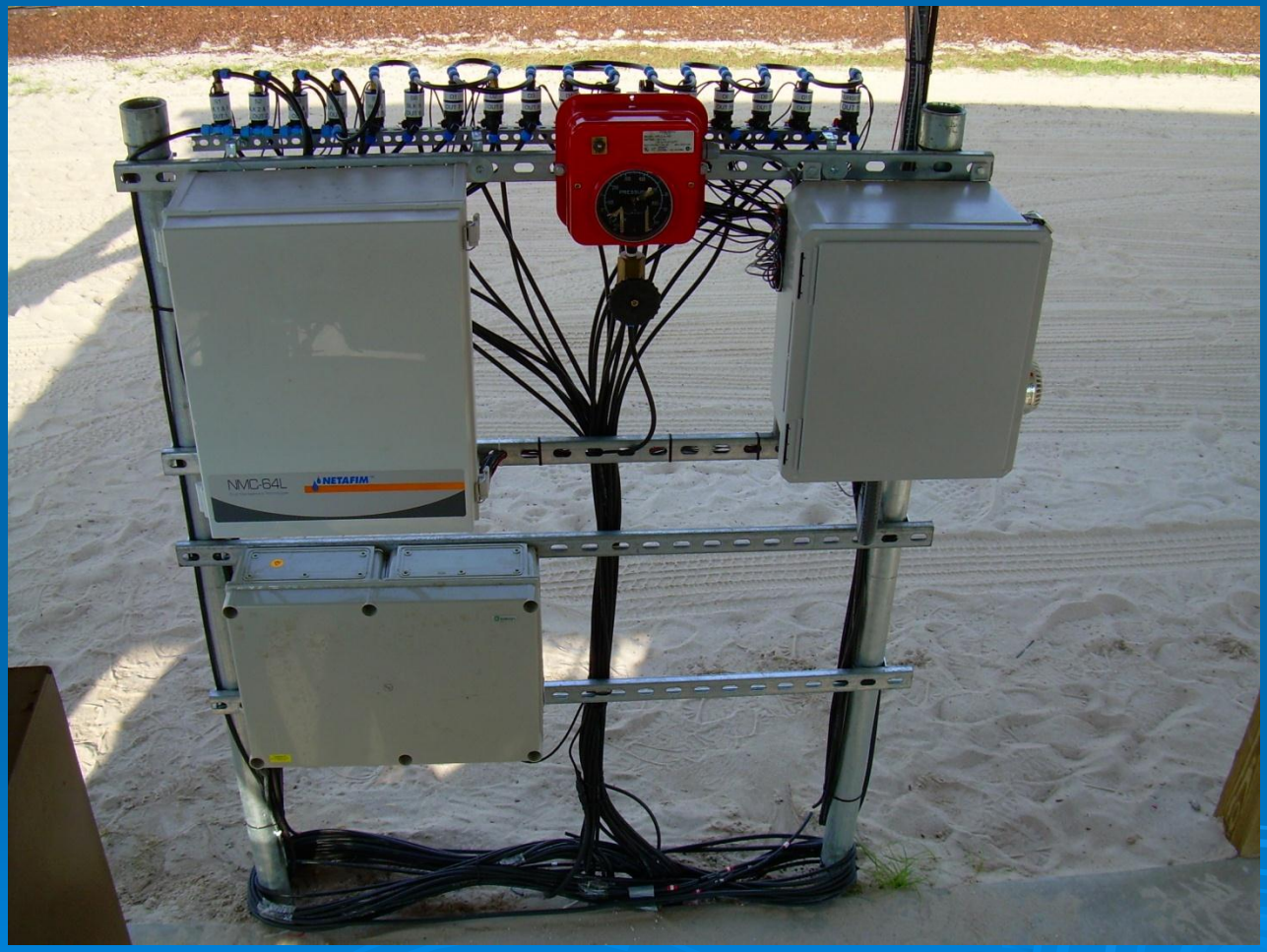
Legend

#	Item	#	Item	#	Item
1.	Water Source	9.	Fertilizer Meter	18.	Water Meter
2.	Pump	10.	Fertilizer Tank	19.	Main Shutoff Valve
3.	Check Valve	11.	Chemical Feed Pump and Tank	20.	Mainline
4.	Throttling Valve	12.	Main Filter	21.	Field Valves
5.	Pressure Relief or Sustaining Valve	13.	Back Wash Assembly	22.	Submain
6.	Chemigation Valve or Back Flow Preventer	14.	Back Wash Trhottling Valve	23.	Laterals
7.	Antisyphon Fertilizer Injector Valve	15.	Back Wash Airvent	24.	Submain Flush Valves
8.	Fertilizer Pump	16.	Back Up Filter	25.	Controller
		17.	Pressure Sustaining and/or Reducing Valve (As Necessary)		



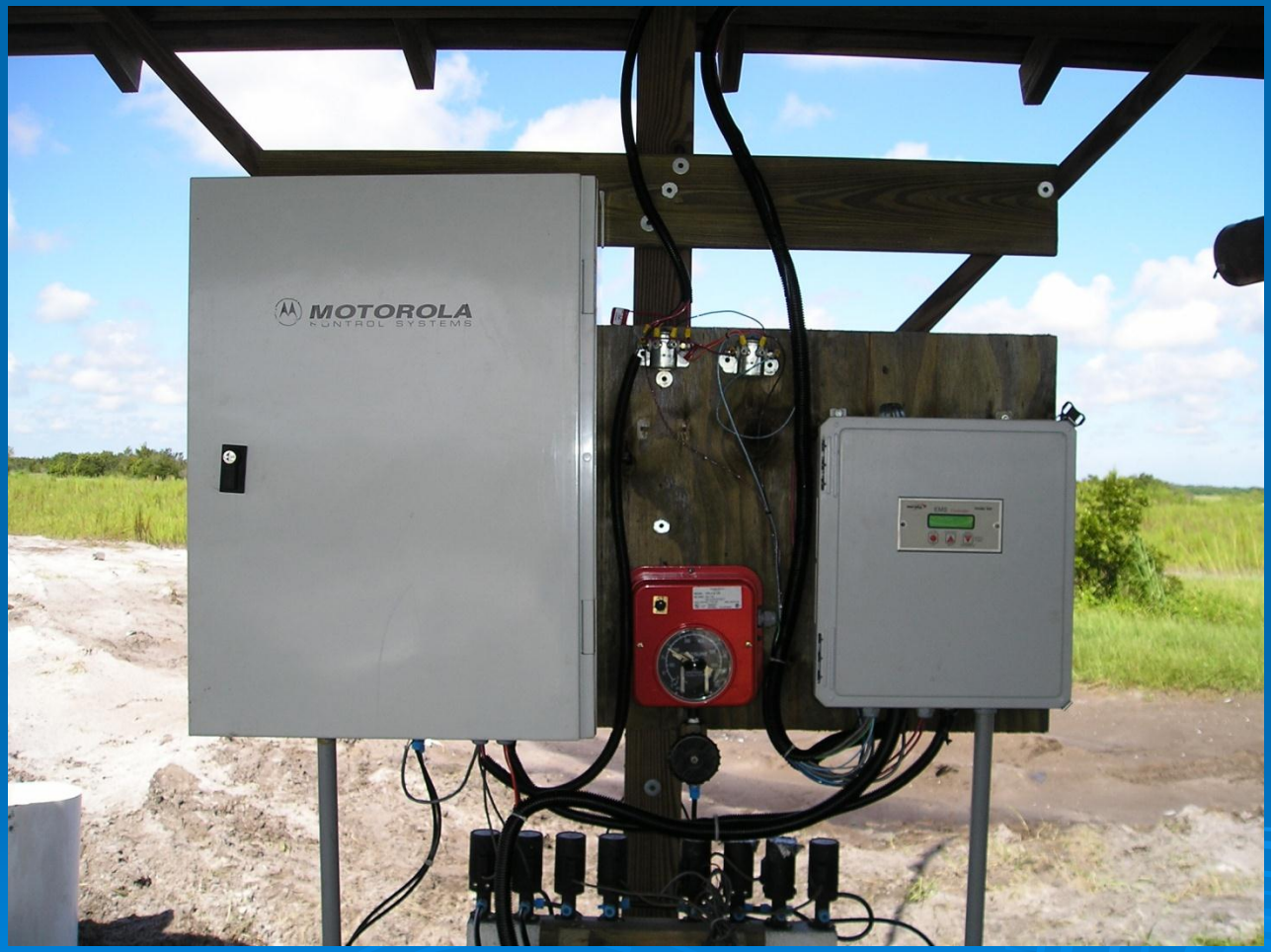
Drip Irrigation Systems

Fertigation Controller



Fertigation Controller

Fertigation Controller



Automatic Diesel Engine

Automatic Diesel Engine

Safety Interlocks and BFPs

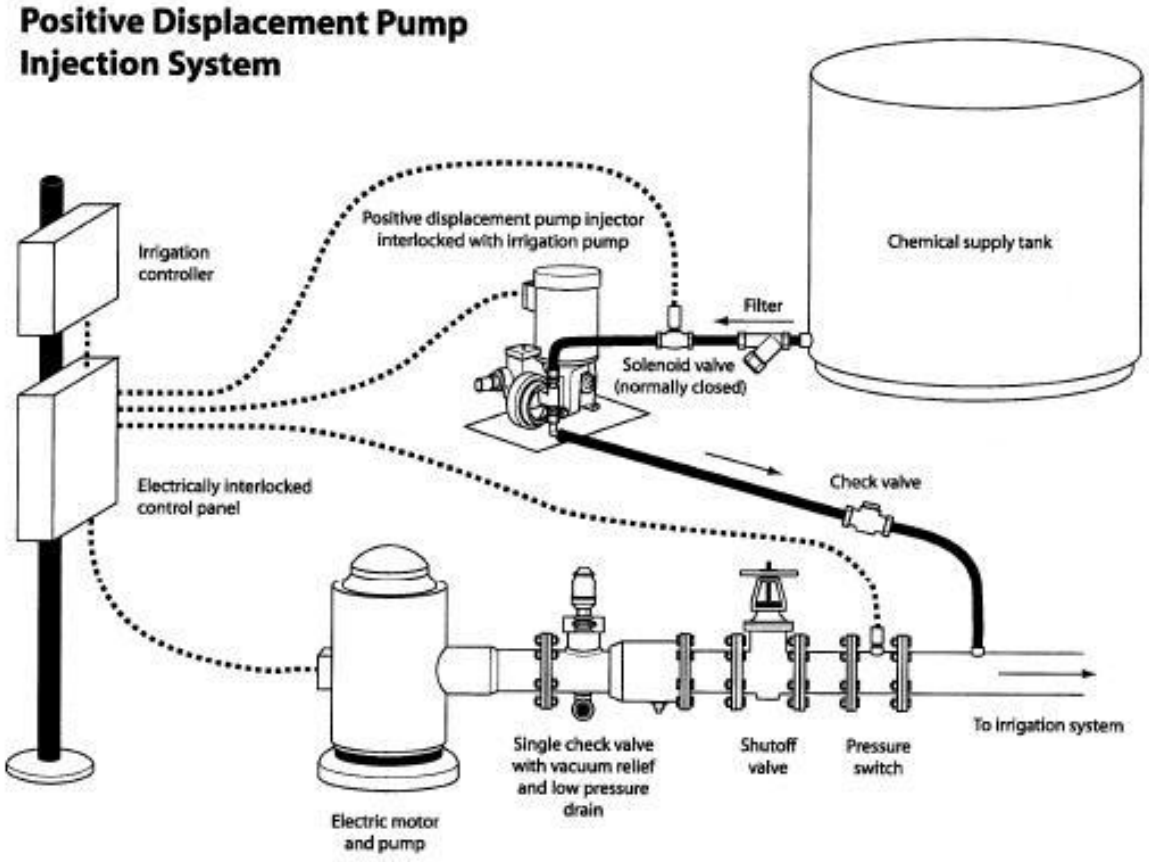


Figure 4. Typical layout for an injection system showing many of the safety interlocks and backflow prevention devices required to prevent contamination of the environment. (Courtesy of L.J. Schwankl, Univ. of California-Davis).

Chemigation Valve, NC Valve & Fert Meter

FERTILIZER INJECTORS

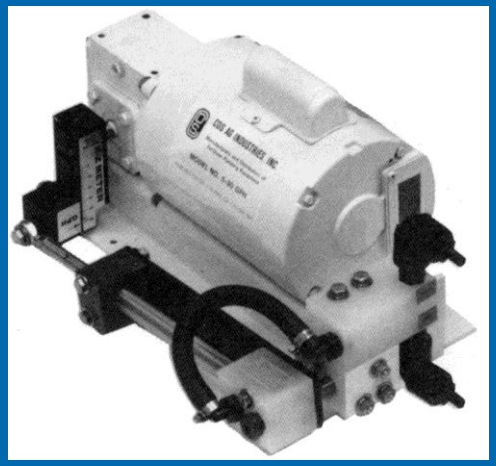
- Water driven pumps
- Positive displacement pumps
- Venturi injectors

- All fertilizer pumps give some trouble!!!!
- Easy to maintain and parts is the key.

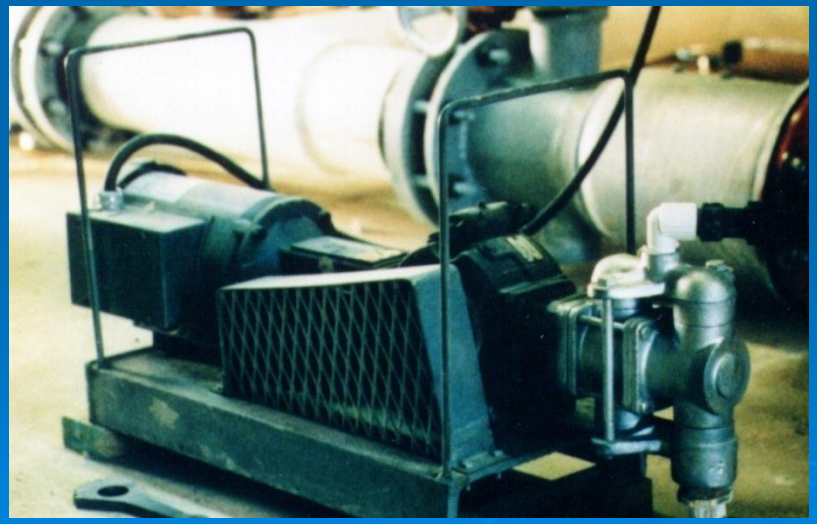
Water Driven Fertilizer Pumps

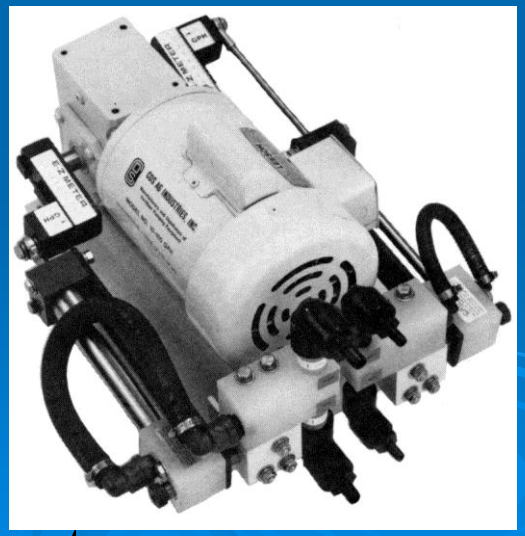
- No power requirements
- Economical
- Easy to install
- Pressure sensitive
- Maintenance required

Electric Positive Displacement Pumps

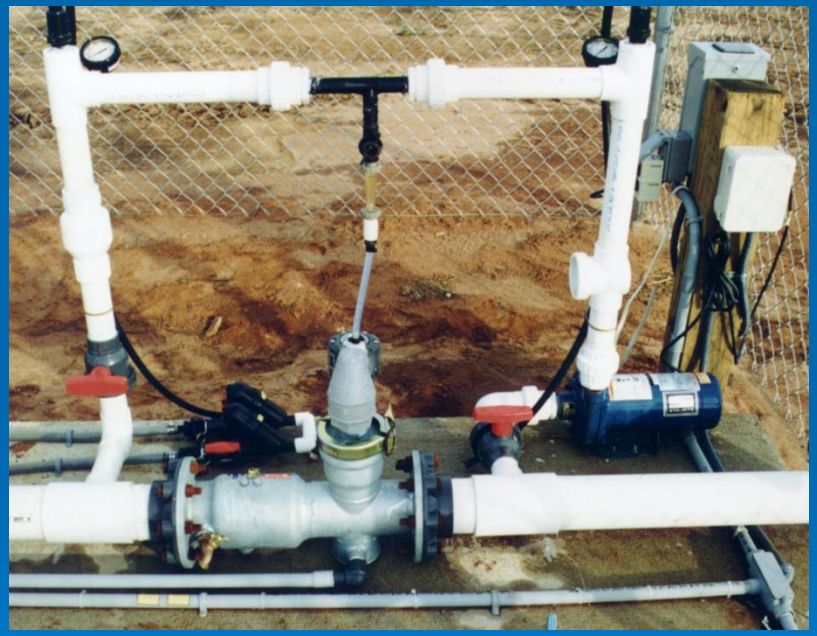


- Large Volume
- Easy to maintain
- Maintenance required

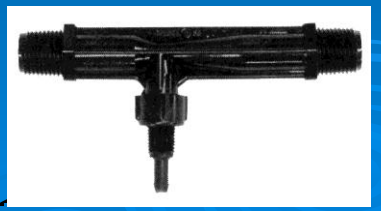




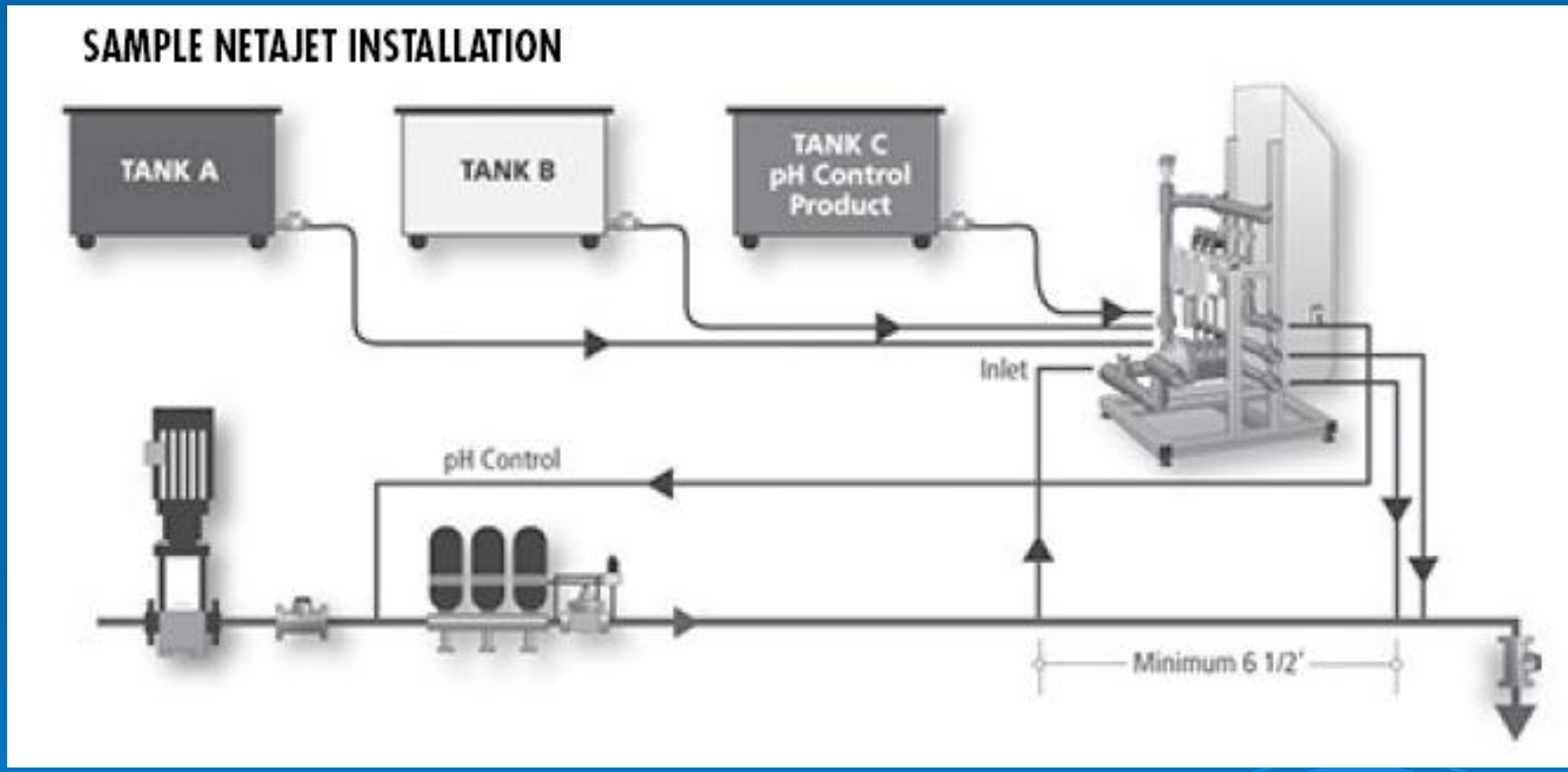
Venturi Fertilizer Pumps



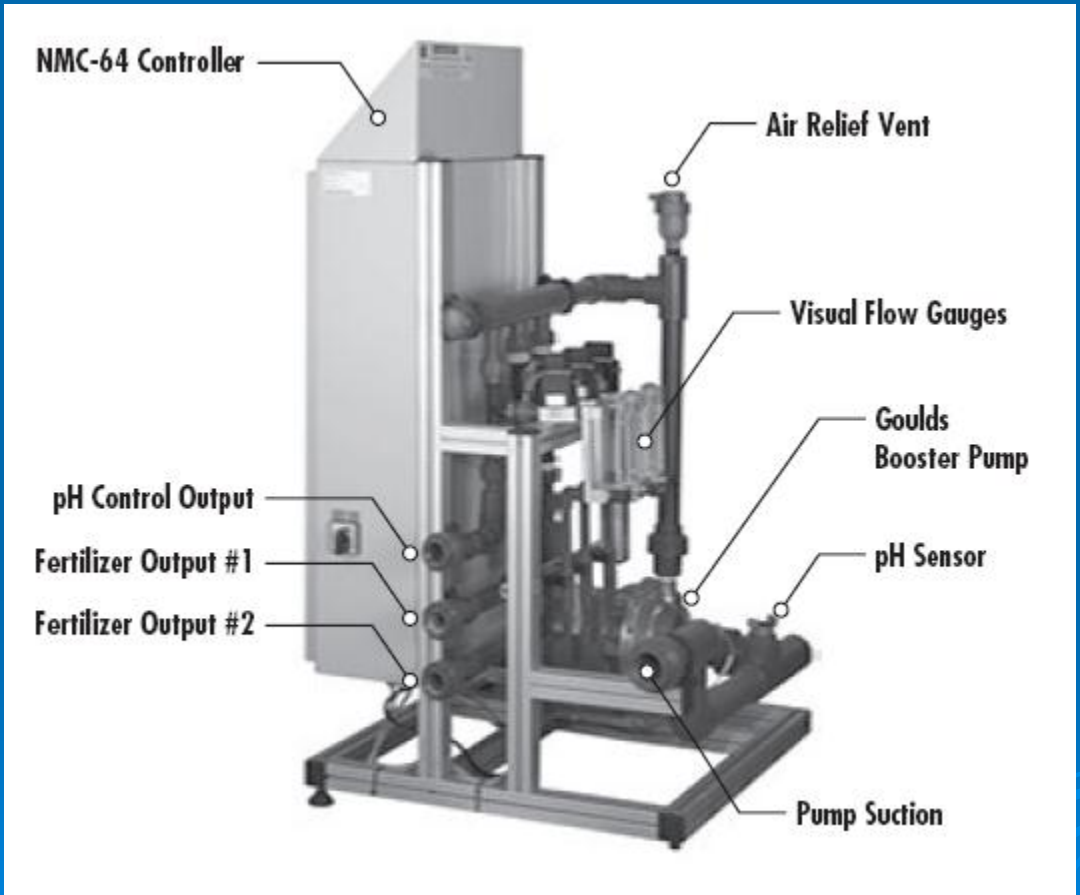
- Inexpensive
- 15 psi differential required.
- Should use with booster pump for best economy



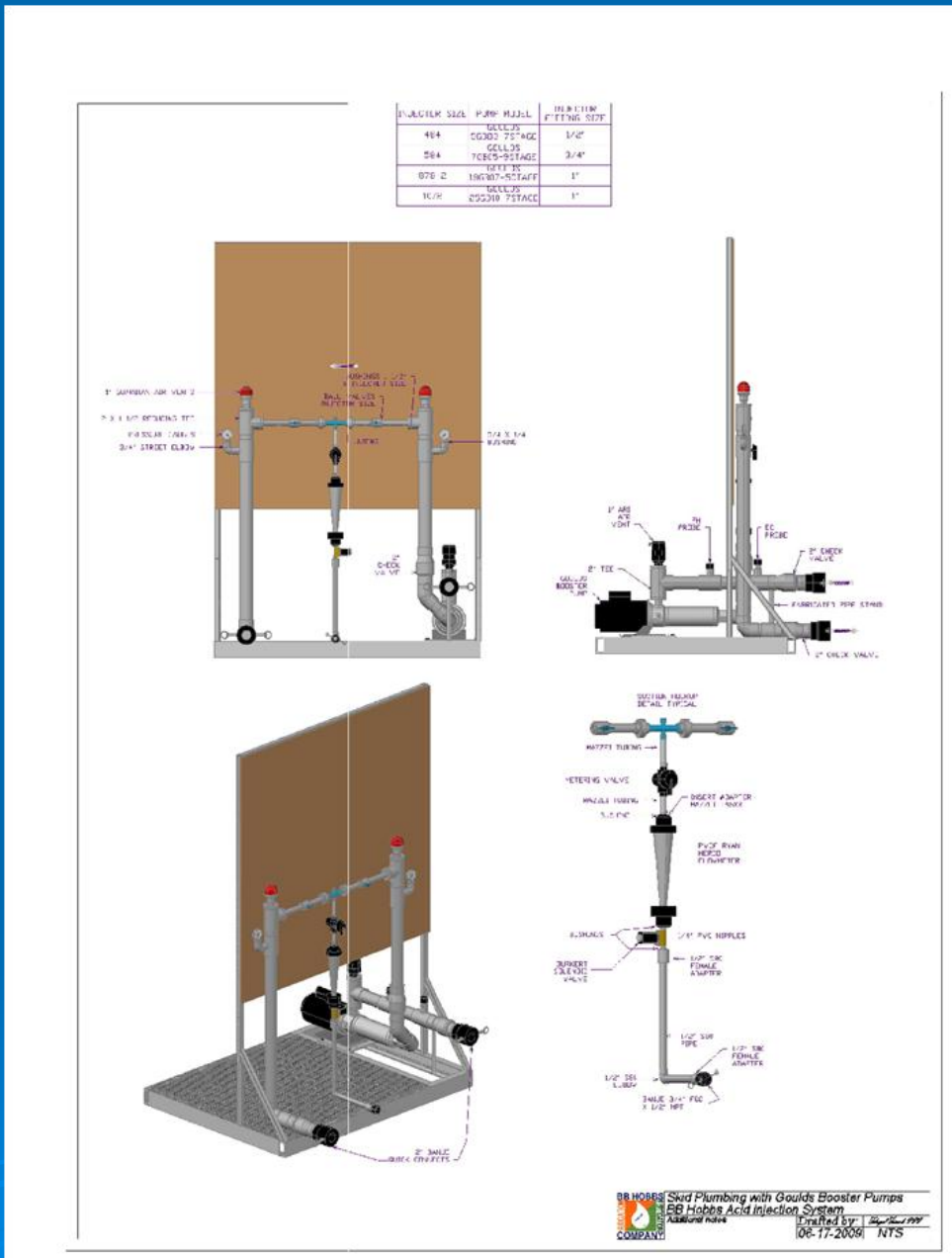
pH Control System



pH control system



pH control system



Fertigation Maintenance

- Maintain pumps per manufacturers recommendations.
  - Seals
  - Weep holes.
- Check fert meters by comparing tank withdrawal with computer count.
- Salt out. Liquids will salt out. Make provisions to easily flush crystals from lines.

B. B. Hobbs, Inc.

So neither he who plants nor he who waters is anything, but only God who makes things grow.

1 Corinthians 3:7 NIV