Row Crop Irrigation Scheduling Options

Wesley M. Porter
Ext. Precision Ag and Irrigation Specialist
University of Georgia

2022 Irrigation County Production Meeting Presentation

UNIVERSITY OF GEORGIA EXTENSION

GEORGIA Precision Ag

Irrigation Scheduling (2018)

- **A technique that involves:**
  - Determining how much water is needed
  - When to apply it to the field to meet crop demands.

Irrigation Scheduling Method	Entire US (%)	AL (%)	FL (%)	GA (%)	SC (%)	MS (%)
Visible Stress	78	86	83	87	89	86
Feel of Soil	40	42	36	27	22	41
Soil Moisture Sensor	12	8	16	11	12	27
Scheduling Service	8	1	5	4	3	4
Weather Report	7	1	5	8	1	4
Calendar Schedule	20	10	15	15	11	15
When Neighbor Irrigates	6	1	2	3	2	6

Irrigation Information

- **Where do farmer's get their info from??**

Irrigation Scheduling Method	Entire US (%)	AL (%)	FL (%)	GA (%)	SC (%)	MS (%)
University Extension	48	45	82	79	63	58
Private Consultant	58	34	66	36	51	66
Irrigation Equipment Dealer	41	66	47	39	35	48
Irrigation District	14	11	8	13	3	8

Cost of Pumping Irrigation

- Average Irrigation cost ~ $9.30/ac-in applied:
  - ~$7/ac-in for electric
  - ~$13.50/ac-in for diesel
- So for 500 acres of irrigated land @ 10 inches of irrigation:
  - $46,500
  - To look at it another way just two 1-inch (electric) irrigation events cost $14 per acre or $1,400 on a 100-acre field (diesel would be almost double).
- https://agecon.uga.edu/extension/budgets.html

Valid Irrigation Scheduling Tools

- Checkbook Methods- Corn, Cotton, Peanut, Soybean:
  - Published in each production guide, Free, requires minimal input from user, is very conservative, meaning they tend to over-irrigate in wet years, and can under-irrigate in dry years.
  - I would not consider these to be very advanced, this is just one step above irrigating a set amount a set number of times per week.
  - The checkbook methods are all developed based on a historical average crop water use and evapotranspiration (ET).

Valid Irrigation Scheduling Tools

- Computer Models:
  - **SmartIrrigation Apps/PeanutFARM/IrrigatorPro:**
  - Free, requires minimal input from user, uses real time daily data.
  - These use the checkbook as a backbone, but rely on daily real time data to make decisions. These methods also take soil type into consideration.
  - A localized computer model can be a very good option for a producer new to scheduling irrigation. It can help them keep a track of how much irrigation they need, and when to apply it based on current climatic conditions.

Valid Irrigation Scheduling Tools

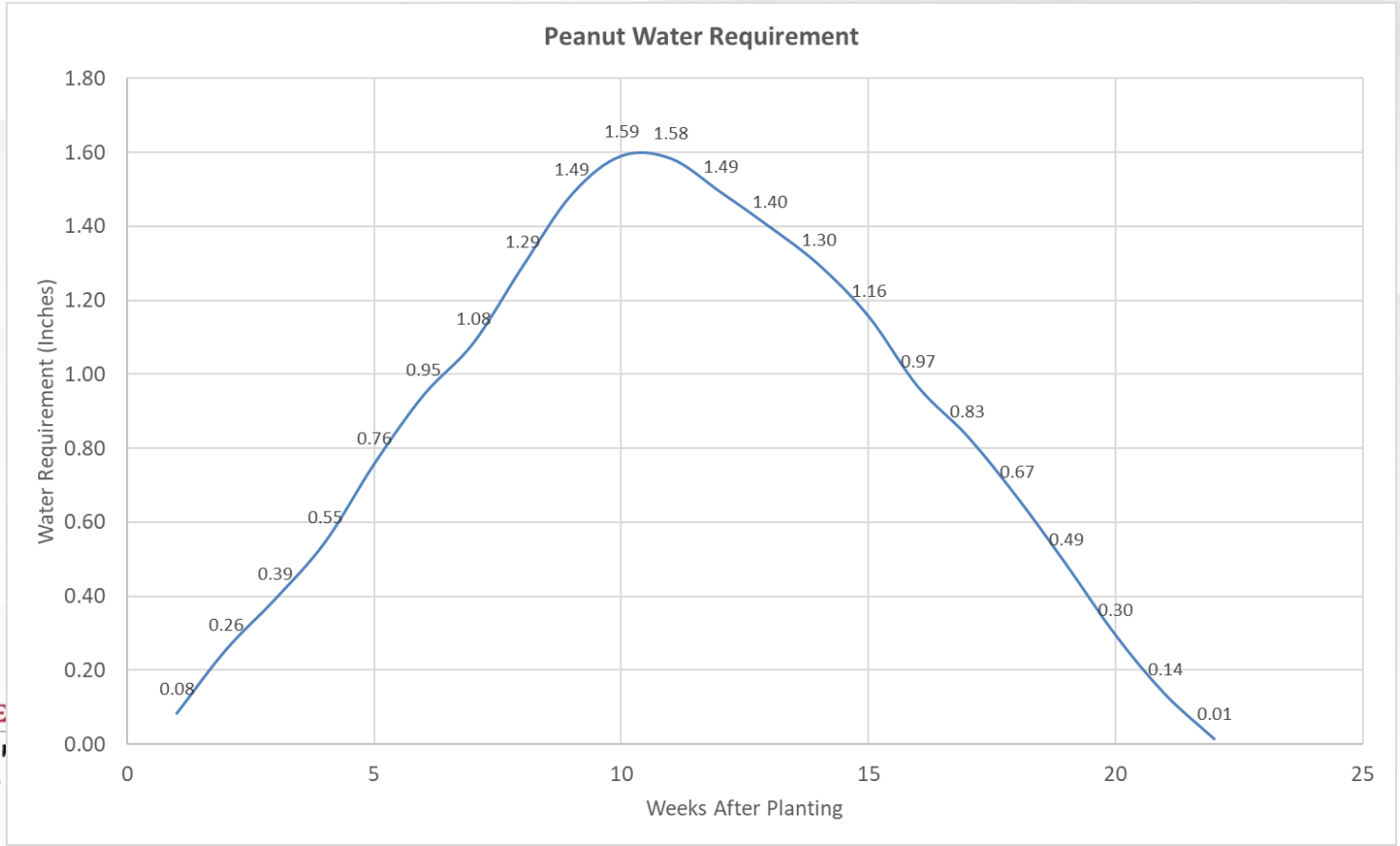
- Soil Moisture Sensors:
  - The are probably the most accurate way of scheduling irrigation currently available.
  - There are many types of soil moisture sensors on the market.
  - Range of costs from ~$500 up to ~2,500 per site, requires user input and utilization of data, are very accurate.
  - Provide current (usually hourly) data which can be used to make hourly to daily irrigation decisions.
  - The data can be difficult to interpret or make accurate decisions from.

Valid Irrigation Scheduling Tools

- Hybrid Systems:
  - Since soil moisture sensor data can be difficult to utilize there are some systems that incorporate plant physiological data and soil moisture information.
  - IrrigatorPro, CropX, and Valley Scheduling are examples of these systems, and can be used in multiple ways.
  - It can be used a soil water balance such as the computer models, it has an option where soil temperature and/or soil matric potential data can be manually entered, or it has an option where certain data from specific companies will automatically populate into the model.
  - The software then provides an irrigation recommendation for the end user.

Water Requirements: Peanuts

Due to data showing that the current UGA Peanut Checkbook tends to over-irrigate and reduce yields I have developed a new peanut water use curve and have been testing it.



UNIVE
EX

GEORGIA
Precision Ag

Water Requirements: Peanuts

Peanut Irrigation Schedule			
Days after Planting	Weeks after Planting	Inches per Week	Inches per Day
1 - 7	1	0.08	0.01
8 - 14	2	0.26	0.04
15 - 21	3	0.39	0.06
22 - 28	4	0.55	0.08
29 - 35	5	0.76	0.11
36 - 42	6	0.95	0.14
43 - 49	7	1.08	0.15
50 - 56	8	1.29	0.18
57 - 63	9	1.49	0.21
64 - 70	10	1.59	0.23
71 - 77	11	1.58	0.23
78 - 84	12	1.49	0.21
85 - 91	13	1.40	0.20
92 - 98	14	1.30	0.19
99 - 105	15	1.16	0.17
106 - 112	16	0.97	0.14
113 - 119	17	0.83	0.12
120 - 126	18	0.67	0.10
127 - 133	19	0.49	0.07
134 - 140	20	0.30	0.04
141 - 147	21	0.14	0.02
148 - 150	22	0.01	0.00

Water Requirements: Peanuts

Peanut Irrigation Schedule			
Days after Planting	Weeks after Planting	Inches per Week	Inches per Day
1 - 7	1	0.08	0.01
8 - 14	2	0.26	0.04
15 - 21	3	0.39	0.06
22 - 28	4	0.55	0.08
29 - 35	5	0.76	0.11
36 - 42	6	0.95	0.14
43 - 49	7	1.08	0.15
50 - 56	8	1.29	0.18
57 - 63	9	1.49	0.21
64 - 70	10	1.59	0.23
71 - 77	11	1.58	0.23
78 - 84	12	1.49	0.21
85 - 91	13	1.40	0.20
92 - 98	14	1.30	0.19
99 - 105			
106 - 112	16	0.97	0.14
113 - 119	17	0.83	0.12
120 - 126	18	0.67	0.10
127 - 133	19	0.49	0.07
134 - 140			
141 - 147	21	0.14	0.02
148 - 150	22	0.01	0.00

Peak Water Use

Water Use Declines

Irrigation Termination is Advised

UNIVERSITY OF GEORGIA
EXTENSION

GEORGIA
Precision Ag

Peanut Irrigation Scheduling 2014-2015

Irrigation Scheduling Method	Irrigation Amount (in)	Total Water (in)	Yield (lb/ac)
2014 Rainfall: 12.33			
Dryland	0.40	12.73	465
WaterMark (45 kPa)	9.40	21.73	6052
EasyPan	11.65	23.98	5725
UGA ET Checkbook	15.02	27.35	5025
UF Peanut Farm	7.90	20.23	4802
2015 Rainfall: 22.65			
Dryland	0.50	23.30	5193
WaterMark (45 kPa)	4.45	27.25	5478
UGA ET Checkbook	12.50	35.30	5313
UGA EasyPan	5.20	28.00	5404
UF PeanutFarm	5.20	28.00	5327
IrrigatorPro	2.80	25.60	5542
50% Checkbook	6.76	29.56	5176

Peanut Irrigation Scheduling 2016-2015

Irrigation Scheduling Method	Irrigation Amount (in)	Total Water (in)	Yield (lb/ac)
2016 Rainfall: 25.80			
Dryland	1.00	26.80	5249
WaterMark (45 kPa)	9.25	35.05	6292
PeanutFARM	7.75	33.55	6371
IrrigatorPro	10.00	35.80	6540
50% Checkbook	8.43	34.23	6367
2015 Rainfall: 22.65			
Dryland	0.50	23.30	5193
WaterMark (45 kPa)	4.45	27.25	5478
UGA ET Checkbook	12.50	35.30	5313
UGA EasyPan	5.20	28.00	5404
UF PeanutFarm	5.20	28.00	5327
IrrigatorPro	2.80	25.60	5542
50% Checkbook	6.76	29.56	5176

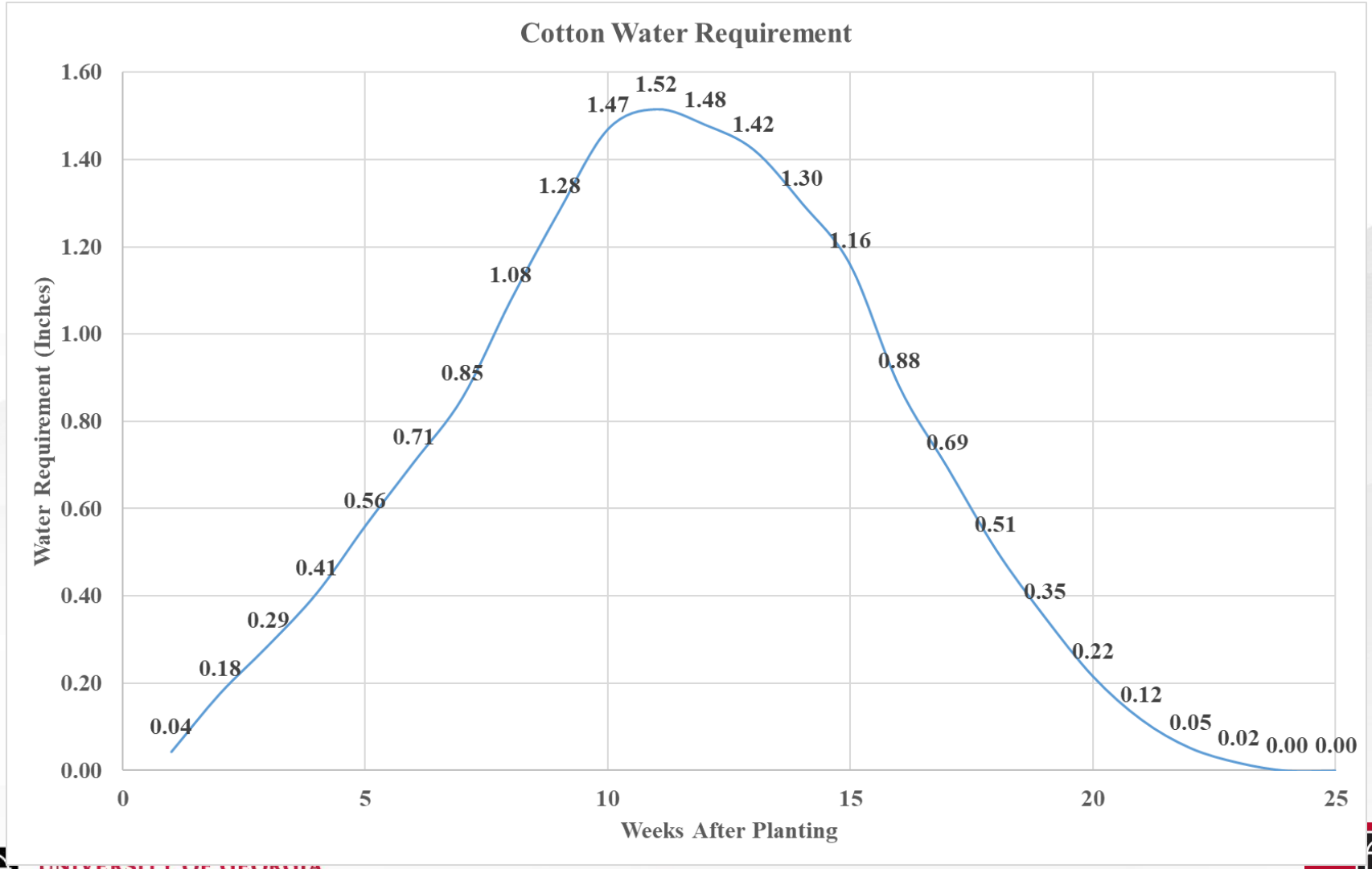
Peanut Irrigation Scheduling 2017-2018

Irrigation Scheduling Method	Irrigation Amount (in)	Total Water (in)	Yield (lb/ac)
2017 Rainfall: 24.30			
Dryland	1.00	25.30	5875
WaterMark (45 kPa)	2.85	27.15	6396
PeanutFARM	5.50	29.80	5936
Irrigator Pro	4.00	28.30	6260
50% Checkbook	6.75	31.05	6262
Checkbook	10.50	34.80	5749
EasyPan	4.75	29.05	5979
2018 Rainfall: 32.43			
Dryland	2.50	34.93	5591
WaterMark (45 kPa)	2.50	34.93	5849
Old Checkbook	7.80	40.18	6204
New Checkbook	6.70	39.13	6147
50% New Checkbook	4.00	36.45	6231
Irrigator Pro (Soil Temp)	6.30	38.68	5996
Irrigator Pro (Sensor)	3.30	35.68	6433
PeanutFARM	4.80	37.18	5984

Peanut Irrigation Triggers 2018-2019

Irrigation Scheduling Method	Irrigation Amount (in)	Total Water (in)	Yield (lb/ac)
2018 Rainfall: 32.43			
Dryland	2.50	35.16	**5591**
WaterMark (20 kPa)	6.25	38.91	**5847**
WaterMark (30 kPa)	5.50	38.16	**5729**
WaterMark (40 kPa)	4.00	36.66	**5900**
WaterMark (50 kPa)	4.75	37.41	**6047**
WaterMark (60 kPa)	4.75	37.41	**5862**
2019 Rainfall: 19.74			
Dryland	2.50	22.2	**5874**
WaterMark (20 kPa)	15.18	34.9	**6572**
WaterMark (30 kPa)	11.41	31.2	**6779**
WaterMark (40 kPa)	6.93	26.7	**6834**
WaterMark (50 kPa)	9.18	28.9	**7076**
WaterMark (60 kPa)	5.41	25.2	**6798**

Water Requirements: Cotton



Water Requirements: Cotton

Growth Stage	DAP	Weeks after Planting	Inches/Week	Inches/Day
Emergence	1 - 7	1	0.04	0.01
Emergence to First Square	8 - 14	2	0.18	0.03
	15 - 21	3	0.29	0.04
	22 - 28	4	0.41	0.06
	29 - 35	5	0.56	0.08
First Square to First Flower	36 - 42	6	0.71	0.10
	43 - 49	7	0.85	0.12
	50 - 56	8	1.08	0.15
First Flower to First Open Boll	57 - 63	9	1.28	0.18
	64 - 70	10	1.47	0.21
	71 - 77	11	1.52	0.22
	78 - 84	12	1.48	0.21
	85 - 91	13	1.42	0.20
	92 - 98	14	1.30	0.19
	99 - 105	15	1.16	0.17
	106 - 112	16	0.88	0.13
	113 - 119	17	0.69	0.10
First open boll to >60% Open Bolls	120 - 126	18	0.51	0.07
	127 - 133	19	0.35	0.05
	134 - 140	20	0.22	0.03
	141 - 147	21	0.12	0.02
	148 - 154	22	0.05	0.01
	155 - 161	23	0.02	0.00
Harvest	162 - 168	24	0.00	0.00
	169 - 175	25	0.00	0.00

Water Requirements: Cotton

Growth Stage	DAP	Weeks after Planting	Inches/Week	Inches/Day
Emergence	1 - 7	1	0.04	0.01
Emergence to First Square	8 - 14	2	0.18	0.03
	15 - 21	3	0.29	0.04
	22 - 28	4	0.41	0.06
	29 - 35	5	0.56	0.08
First Square to First Flower	36 - 42	6	0.71	0.10
	43 - 49	7	0.85	0.12
	50 - 56	8	1.08	0.15
First Flower to First Open Boll	57 - 63	9	1.28	0.18
	64 - 70	10	1.47	0.21
	71 - 77	11	1.52	0.22
	78 - 84	12	1.48	0.21
	85 - 91	13	1.42	0.20
	92 - 98	14	1.30	0.19
	99 - 105	15	1.08	0.15
	106 - 112	16	0.88	0.13
	113 - 119	17	0.69	0.10
First open boll to >60% Open Bolls	120 - 126	18	0.51	0.07
	127 - 133	19	0.35	0.05
	134 - 140	20	0.20	0.03
	141 - 147	21	0.12	0.02
	148 - 154	22	0.05	0.01
	155 - 161	23	0.02	0.00
Harvest	162 - 168	24	0.00	0.00
	169 - 175	25	0.00	0.00

Peak Water Use

Water Use Declines

Irrigation Termination is Strongly Advised

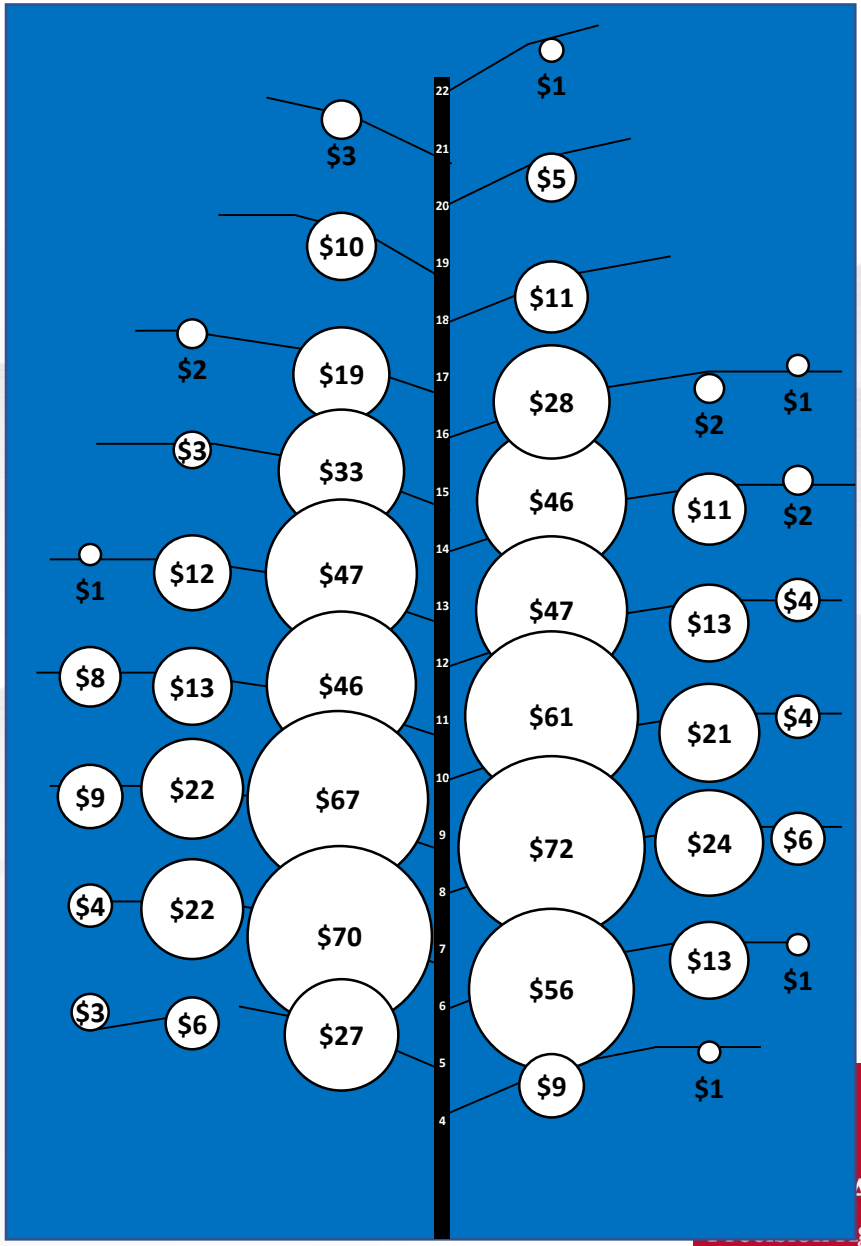
UNIVERSITY OF GEORGIA EXTENSION

GEORGIA Precision Ag

Fruiting Position Value

Georgia 2019 (3 location average)

Fruiting Location	Value
1st Positions	72%
2nd Positions	18%
3rd Positions	5%
Vegetative	5%
Nodes ≤10	60%
Nodes 11-15	31%
Nodes ≥ 16	9%



UNIVERSITY OF GEORGIA
EXTENSION

2020 Results

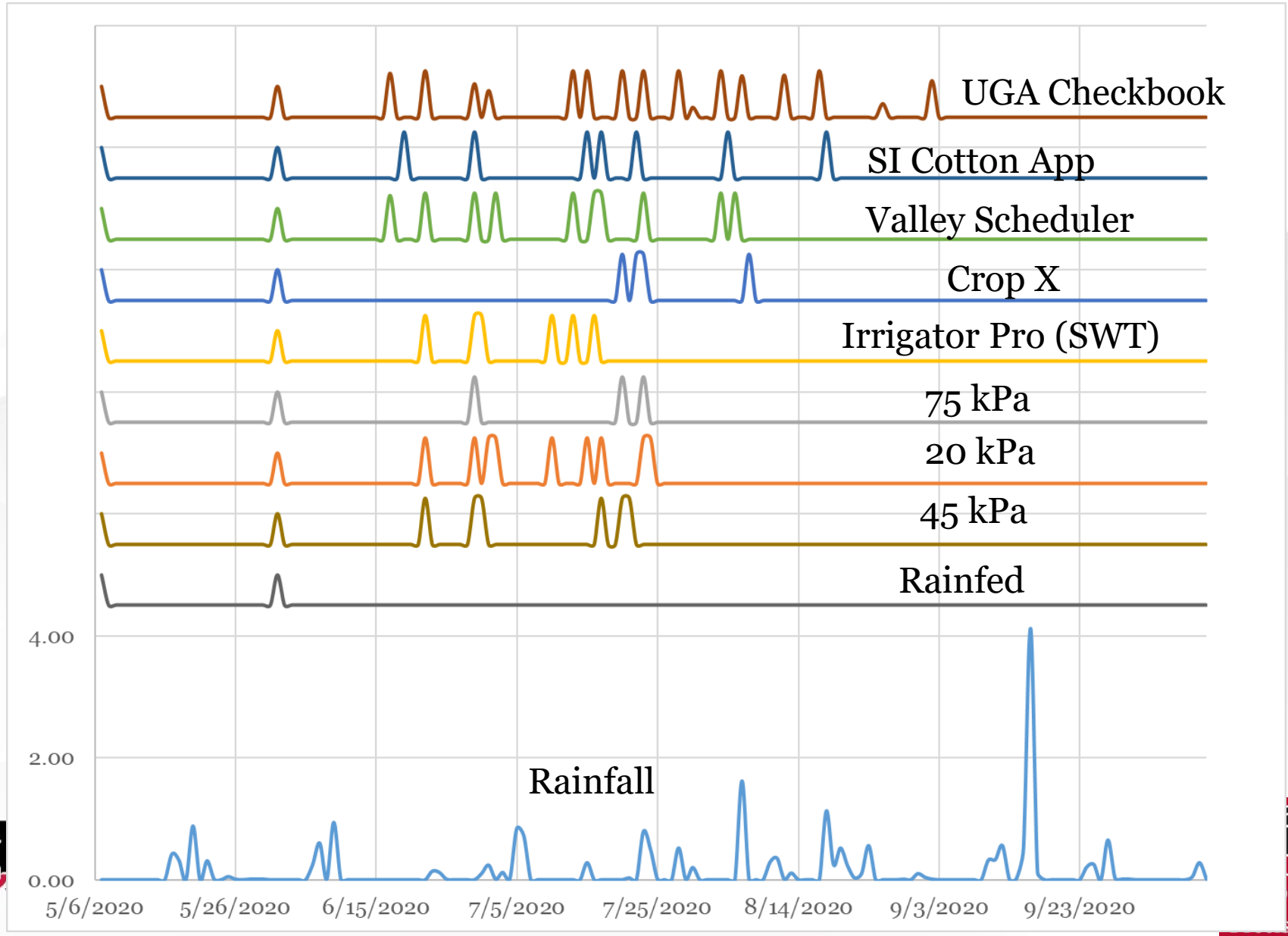
Treatment	Irrigation (in)	Total Water (in)	Lint Yield (lb/ac)	IWUE (lb/in)	Profit for $7/ac-in @ $0.79 Cotton	Profit for $12/ac-in @ $0.79 Cotton
Rainfed	1.0	22.4	795	N/A	621	616
45 kPa	5.5	26.9	1304	237	992	964
20 kPa	7.75	29.1	1293	167	967	928
75 kPa	3.25	24.6	1129	347	869	853
Irrigator Pro	5.5	26.9	1245	226	945	918
CropX	4.0	25.4	1113	278	851	831
Valley Scheduler	8.5	29.9	1240	147	920	878
SI Cotton App	6.25	27.6	1270	203	960	928
Checkbook	11.0	32.4	1196	109	868	813

UNIVERSITY OF GEORGIA EXTENSION

Planted: May 9, 2020
Picked: October 26, 2020
2020 Rainfall = 21.36 in

GEORGIA Precision Ag

2020 Results



2021 Results

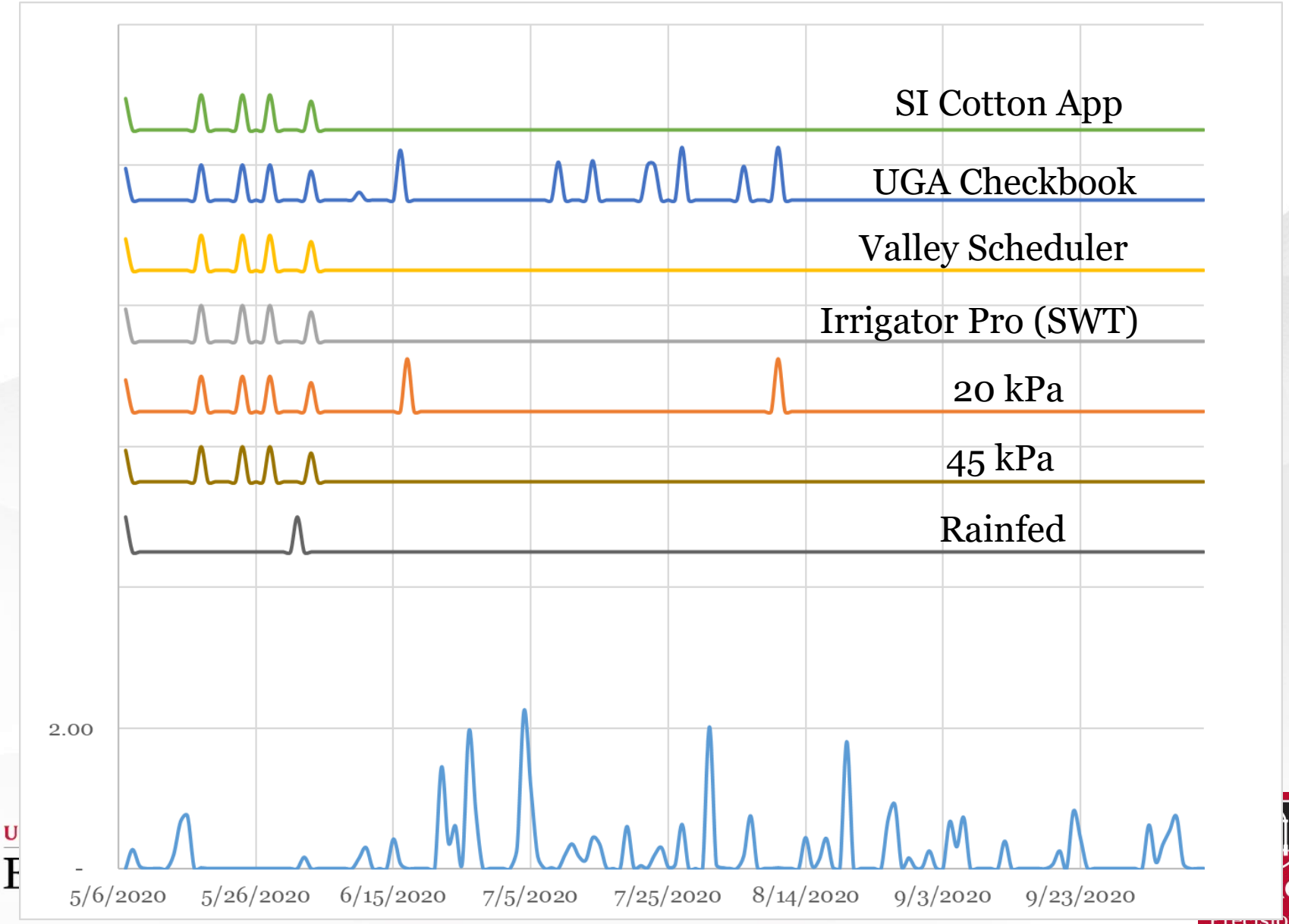
Treatment	Irrigation (in)	Total Water (in)	Lint Yield (lb/ac)	IWUE (lb/in)	Profit for $7/ac-in @ $1.00 Cotton	Profit for $12/ac-in @ $1.00 Cotton
Rainfed	1.0	30.66	1119	N/A	1112	1107
45 kPa	2.36	32.1	1191	505	1175	1162
20 kPa	3.86	33.6	1197	310	1170	1151
Irrigator Pro	2.36	32.1	1175	498	1159	1147
Valley Scheduler	2.36	32.1	1148	486	1131	1120
SI Cotton App	2.36	32.1	1164	493	1148	1136
Checkbook	7.26	37.0	1177	162	1126	1090

Planted: May 7, 2021
Picked: October 20, 2021
2021 Rainfall = 29.66 in

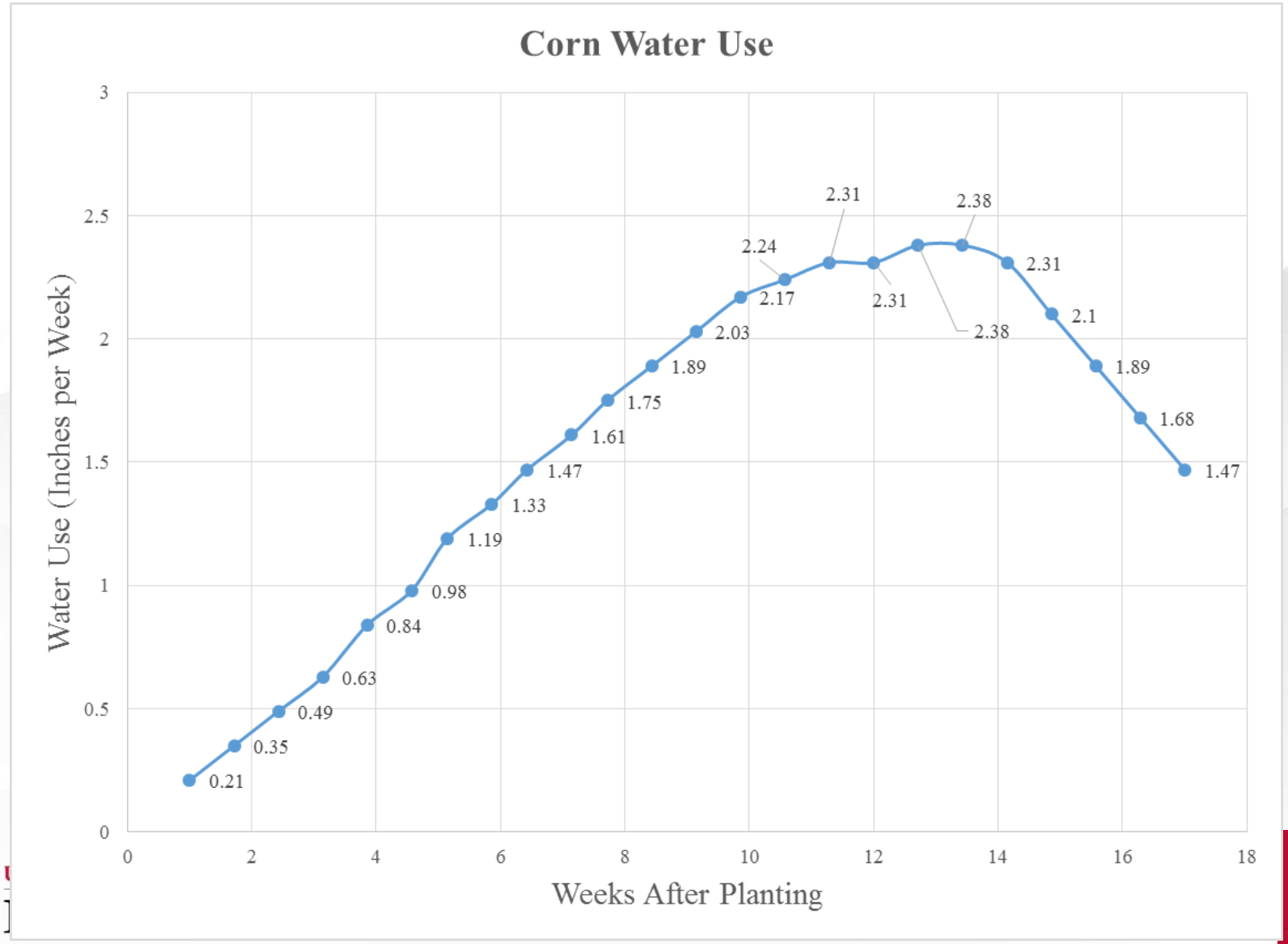
UNIVERSITY OF GEORGIA EXTENSION

GEORGIA Precision Ag

2021 Results



Water Requirements: Corn



GEORGIA
Precision Ag

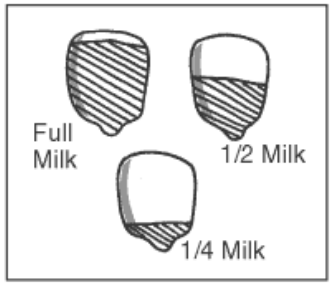
Water Requirements: Corn

Growth Stage	Days After Planting	Inches Per Day
Emergence and primary root developing.	0-7 8-12	.03 .05
Two leaves expanded and nodal roots forming.	13-17 18-22	.07 .09
Four to six leaves expanding. Growing point near surface. Other leaves and roots developing.	23-27 28-32 33-36	.12 .14 .17
Six to eight leaves. Tassel developing. Growing point above ground.	37-41 42-45	.19 .21
Ten to twelve leaves expanded. Bottom 2-3 leaves lost. Stalks growing rapidly. Ear shoots developing. Potential kernel row number determined.	46-50 51-54	.23 .25
Twelve to sixteen leaves. Kernels per row and size of ear determined. Tassel not visible but about full size. Top two ear shoots developing rapidly.	55-59 60-64	.27 .29
Tassel emerging, ear shoots elongating.	65-69	.31
Pollination and silks emerging.	70-74 75-79	.32 .33
Blister stage.	80-84	.33
Milk stage, rapid starch accumulation.	85-89	.34
Early dough stage, kernels rapidly increasing in weight.	90-94	.34
Dough stage.	95-99	.33
Early dent.	100-104	.30
Dent.	105-109	.27
Beginning black layer.	110-114	.24
Black layer (physiological maturity).	115-119	.21

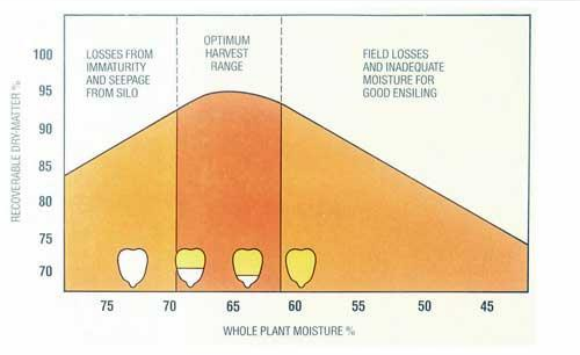
Irrigation Termination

Is Corn Ready to Chop?

Use the "Milk Line" Test.



Use the position of the milk line to determine the moisture content of the corn. Immature corn starts at "full milk." As the corn ripens, the milk line moves toward the tip of the kernel. The line is about halfway up from the kernel tip at 70 percent moisture, and a quarter of the way up at 60 percent.



UNIVERSITY OF GEORGIA EXTENSION

GEORGIA Precision Ag

2020 Results

Treatment	Irrigation Applied (in)	Yield (bu/ac) Hybrid 1	IWUE H1 (bu/in)	Yield (bu/ac) Hybrid 2	IWUE H2 (bu/in)
Dryland [D]	1.57	79	N/A	77	N/A
UGA Checkbook [C]	15.62	191	12.3	190	12.1
SI Corn App [AB]	9.84	203	20.6	214	21.7
Irrigator Pro [A]	11.35	210	18.5	218	19.2
Valley Scheduler [ABC]	12.08	195	16.1	206	17.1
30 kPa [ABC]	9.09	203	22.3	199	21.9
10 kPa [ABC]	14.87	198	13.3	207	13.9
50 kPa [AB]	10.59	211	19.9	204	19.3

Rainfall = 14.9 in
Planted: 3/19/20
Harvested: 8/3/20
Hybrid 1: Pioneer 1442
Hybrid 2: Pioneer 1662

UNIVERSITY OF GEORGIA EXTENSION

GEORGIA Precision Ag

2021 Results

Treatment	Irrigation Applied (in)	Yield (bu/ac) Hybrid 1	IWUE H1 (bu/in)	Yield (bu/ac) Hybrid 2	IWUE H2 (bu/in)
Dryland[C]	0.50	71	N/A	81	N/A
UGA Checkbook[A]	15.90	218	13.7	236	14.9
Crop Metrics[AB]	10.75	193	18.0	226	21.0
SI Corn App[AB]	7.00	199	28.4	214	30.6
Irrigator Pro[A]	7.25	227	31.3	232	32.1
Valley Scheduler[AB]	8.50	214	25.2	223	26.3
30 kPa[A]	8.50	229	27.0	238	28.0
10 kPa[B]	20.50	221	10.8	226	10.9
50 kPa[AB]	8.00	231	28.8	227	28.4

UNIVERSITY OF GEORGIA EXTENSION

Rainfall = 31.9 in
Planted: 3/25/21, Harvested: 9/3/20
Hybrid 1: Pioneer 1442, Hybrid 2: Pioneer 1662

GEORGIA Precision Ag

2021 Results

Treatment	Pioneer 1442 Additional Net Revenue Per Acre @ $5.50/bu	Pioneer 1442 Additional Net Revenue Per Acre @ $6.50/bu	Pioneer 1662 Additional Net Revenue Per Acre @ $5.50/bu	Pioneer 1662 Additional Net Revenue Per Acre @ $6.50/bu
Dryland	($674.52)	($820.96)	($722.85)	($878.08)
UGA Checkbook	Base Comparison			
Crop Metrics	($93.05)	($117.93)	($10.74)	($20.65)
SI Corn App	($28.43)	($47.36)	($43.36)	($65.00)
Irrigator Pro	$125.03	$134.40	$54.05	$50.50
Valley Scheduler	$43.68	$40.19	($7.59)	($20.40)
30 kPa	$125.55	$136.94	$74.31	$76.39
10 kPa	($181.59)	($207.49)	($235.66)	($271.40)
50 kPa	$7.47	($3.38)	($37.48)	($56.50)

Wesley M. Porter • wporter@uga.edu • UGA -Tifton

THANKS!

Follow us on Facebook and Twitter at @GeorgiaPrecisionAg