## **Row Crop Irrigation Scheduling Options**

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#### **2021 Production Meetings**





### 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 ~ \$9.00/ac-in applied:
  - ~\$7/ac-in for electric
  - $\sim$  \$12.50/ac-in for diesel
- So for 500 acres of irrigated land @ 10 inches of irrigation:
  - \$45,000





- 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).





- 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.





- 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.





- 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 is one 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.



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### Water Requirements: Cotton



### Water Requirements: Cotton

	Growth Stage	DAP	Weeks after Planting	Inches/Week	Inches/Day
	Emergence	1 - 7	1	0.04	0.01
		8 - 14	2	0.18	0.03
	Emergence to First Square	15 - 21	3	0.29	0.04
		22 - 28	4	0.41	0.06
		29 - 35	5	0.56	0.08
		36 - 42	6	0.71	0.10
	First Square to	43 - 49	7	0.85	0.12
	riistriower	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
		120 - 126	18	0.51	0.07
		127 - 133	19	0.35	0.05
	First open boll	134 - 140	20	0.22	0.03
	Bolls	141 - 147	21	0.12	0.02
	20115	148 - 154	22	0.05	0.01
		155 - 161	23	0.02	0.00
UNIVERSITY OF GEOR	GIA	162 - 168	24	0.00	0.00
EXTENSIO	N	169 - 175	25	0.00	0.00





### Water Requirements: NFL





THIS FIGURE illustrates the most profitable fruiting positions on a cotton crop arise at main stem nodes 9 to 12. When a cotton crop is 80-percent open, open bolls will be found up to main stem node 16. Thus, at 80-percent open boll, the most profitable fruiting positions on a cotton crop are already open and weathering.

# Fruiting Position Value Georgia 2019 (3 location average)

Fruiting Location	Value
1 <sup>st</sup> Positions	72%
2 <sup>nd</sup> Positions	18%
3 <sup>rd</sup> Positions	5%
Vegetative	5%
Nodes ≤10	60%
Nodes 11-15	31%
Nodes $\ge 16$	9%





### Cotton Irrigation Scheduling 2013-14

	Method	Conservat	ion Tillage	Conventio	nal Tillage
		Lint Yield (lb/ac)	Irrigation (in)	Lint Yield (lb/ac)	Irrigation (in)
	Checkbook	1350	12.7	1150	12.2
	Cotton App	1485	3.0	1259	3.0
	CWSI	1430	5.0	1305	2.3
	Irrigator Pro	1455	2.8	1200	4.3
	Rainfed	1450	1.5	-	-
			2014		
	Checkbook			1596	16.8
	Cotton App			1573	10.1
	Limited Water	1050	3.81		
	Dryland	490	0.0		
univ F.X	ERSITY OF GEORGIA	2013	Rainfall = 27.4	in	

2014 Rainfall = 11.1 in



### Cotton Irrigation Scheduling 2015-16

Method	<b>Conservation Tillage</b>		Convention	al Tillage
	Lint Yield (lb/ac)	Irrigation (in)	Lint Yield (lb/ac)	Irrigation (in)
Checkbook	1560	6.5	1621	6.5
Cotton App	1643	5.0	1710	5.8
WaterMark (45 kPa)	1749	3.0	1661	7.8
Rainfed	1760	0.5	-	-
		2016		
Checkbook	909	8	724	8
Cotton App	1066	5.25	980	5.25
WaterMark (45 kPa)	1103	3.25	1233	2.25
Rainfed	1224	0.75		

2015 Rainfall = 22.6 in



2016 Rainfall = 25.8 in



## Cotton Irrigation Scheduling 2017

Method	<b>Conservation Tillage</b>		Conventior	nal Tillage
	Lint Yield (lb/ac)	Irrigation (in)	Lint Yield (lb/ac)	Irrigation (in)
Checkbook	1219	9.5	1162	9.5
Cotton App	1363	4.5	1387	4.5
WaterMark (45 kPa)	1334	1.75	1277	4.0
Rainfed	1300	0.5	-	

2017 Rainfall = 24.3 in





#### Cotton Irrigation/Plant Growth Snider (et al. study)



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#### Cotton Irrigation/Plant Growth Snider (et al. study)

#### **Earlier Maturity in Rainfed Treatment**



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## Cotton Irrigation/Plant Growth







#### Cotton Irrigation/Plant Growth Snider (et al. study)





#### 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.





#### Water Requirements: Peanuts

Peanut Irrigation Schedule					
	Weeks after				
Days after Planting	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 N FL





Irrigation Scheduling Method	Irrigation Amount (in)	Total Water (in)	Yield (lb/ac)
Dryland	0.40	12.73	465.2
WaterMark (45 kPa)	9.40	21.73	6052.3
SmartCrop	6.40	18.73	5642.0
EasyPan	11.65	23.98	5725.0
UGA ET Checkbook	15.02	27.35	5025.5
UF Peanut Farm	7.90	20.23	4802.5



Planted: May 20, 2014 Dug: October 10, 2014 Harvested: October 17, 2014 Rainfall: 12.33 inches





Irrigation Scheduling Method	Irrigation Amount (in)	Total Water (in)	Yield (lb/ac)
Dryland	0.50	23.30	5193.6
WaterMark (45 kPa)	4.45	27.25	5478.6
CWSI	3.55	26.35	5172.8
UGA ET Checkbook	12.50	35.30	5313.4
UGA EasyPan	5.20	28.00	5404.9
UF PeanutFarm	5.20	28.00	5327.3
IrrigatorPro	2.80	25.60	5542.6
50% Checkbook	6.76	29.56	5176.1

Planted: May 18, 2015 Dug: October 5, 2015 Harvested: October 12, 2015 Rainfall: 22.65 inches







Irrigation Scheduling Method	Irrigation Amount (in)	Total Water (in)	Yield (lb/ac)
Dryland	1.00	26.80	5249.0
WaterMark (45 kPa)	9.25	35.05	6292.0
SmartField CWSI	13.00	38.80	6019.0
PeanutFARM	7.75	33.55	6371.0
IrrigatorPro	10.00	35.80	6540.0
50% Checkbook	8.43	34.23	6367.0

Planted: May 13, 2016 Dug: October 8, 2016 Harvested: October 15, 2016 Rainfall: 25.80 inches





#### **Irrigation Timing and Frequency**



RGIA

Irrigation Scheduling Method	Irrigation Amount (in)	Total Water (in)	Yield (lb/ac)
Dryland	1.00	25.30	5875
WaterMark (45 kPa)	2.85	27.15	6396
Canopy Temp.	3.85	28.55	6229
PeanutFARM	5.50	29.80	5936
IrrigatorPro	4.00	28.30	6260
50% Checkbook	6.75	31.05	6262
Checkbook	10.50	34.80	5749
EasyPan	4.75	29.05	5979

Planted: May 16, 2017 Dug: September 28, 2017 Harvested: October 5, 2017 Rainfall: 24.3 inches





#### **Irrigation Timing and Frequency**



Irrigation Scheduling Method	Irrigation Amount (in)	Total Water (in)	Yield (lb/ac)
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
SSA Dynamic VRI	3.80	36.21	5866
PeanutFARM	4.80	37.18	5984



Planted: 5/11/2018 Dug: 9/27/2018 Harvested: 10/2/2018 Rainfall: 32.43



#### **Irrigation Timing and Frequency**



GIA

Irrigation Scheduling Method	Irrigation Amount (in)	Total Water (in)	Yield (lb/ac)
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
Irrigator Pro (Soil Temp)	6.30	41.91	5996
Checkbook	9.25	38.58	5650
50% Checkbook	5.92	36.66	5767
Irrigator Pro (Sensor)	4.00	38.91	5492



Planted: 5/11/2018 Dug: 9/27/2018 Harvested: 10/2/2018 Rainfall: 32.66



Irrigation Scheduling Method	Irrigation Amount (in)	Total Water (in)	Yield (lb/ac)
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
New Checkbook	13.19	32.9	6561
Old Checkbook	15.76	35.5	6607
Irrigator Pro (Sensor)	9.91	29.7	6497



Planted: 5/11/2019 Dug: 9/19/2019 Harvested: 9/23/2019 Rainfall: 19.74



#### **Irrigation Timing and Frequency**





#### 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

#### Water Requirements: Corn



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#### Water Requirements: Corn N FL





Irrigation	Planted	Conserva	tion Tillage	Conventional Tillage	
Scheduling Method	Population (seeds/acre)	Yield (bu/ac)	Water Use (in)	Yield (bu/ac)	Water Use (in)
	50,000	210	17	208	17
CHECKDOOK	34,000 211 17	200	17		
50% Checkbook	50,000	210	9.3		
	34,000	210			
Irrigator Dra	50,000	136	8.3	143	7.6
ingator Pro	34,000	167		172	
Wator Mark	50,000	179	6.1	185	7.6
wateriviark	34,000	169		217	7.0
Decagon EC-5	50,000	175	0.9	194	9.3
	34,000	186	9.8	198	

SIRP Rainfall = 15.0 in





Planted		<b>Tifton Field</b>		Camilla Field		
Population (seeds/ac)	Tillage	Yield (bu/ac)	Irrigation Applied (in)	Yield (bu/ac)	Irrigation Applied (in)	
09V	Strip	281.5	20.11	251.5	11.2	
28K	Conventional	309.0		291.1	5.2	
34K	Strip	305.9		258.4	10.5	
	Conventional	290.3		275.6	7.5	
40K	Strip	308.8		244.0	10.5	
	Conventional	320.6		282.4	11.2	
54K	Strip	279.0		282.2	11.5	
	Conventional	284.3		282.0	9.7	

Tifton Rainfall = 15.3 in

Camilla Rainfall = 21.8 in





Planted		Tifto	Tifton Field		Camilla Field	
PopulationTillage(seeds/ac)	Yield (bu/ac)	Irrigation Applied (in)	Yield (bu/ac)	Irrigation Applied (in)		
28K	Strip	268		229	14.0	
	Conventional	261	18.85	233	8.75	
34K	Strip	298		274	11.0	
	Conventional	292		261	13.25	
40K	Strip	308		264	9.50	
	Conventional	287		290	14.0	
54K	Strip	310		273	8.75	
	Conventional	313		279	10.25	

Tifton Rainfall = 24.8 in

Camilla Rainfall = 23.2 in





Planted		Tifto	on Field	Camilla Field		
PopulationTillage(seeds/ac)	Tillage	Yield (bu/ac)	Irrigation Applied (in)	Yield (bu/ac)	Irrigation Applied (in)	
28K	Strip	227		257	9.30	
	Conventional	235	13.45	262	10.80	
34K	Strip	232		228	8.55	
	Conventional	259		268	10.05	
40K	Strip	218		258	8.55	
	Conventional	264		282	11.55	
54K	Strip	230		257	7.05	
	Conventional	249		277	10.80	

Tifton Rainfall = 19.15 in

Camilla Rainfall = 27.86 in

Camilla Dryland:

Strip: 182





Treatment	Irrigation Applied (in)	Yield (bu/ac) Hybrid 1	IWUE H1 (bu/in)	Yield (bu/ac) Hybrid 2	IWUE H2 (bu/in)
Dryland <sup>D</sup>	1.57	79	50.4	77	49.0
UGA Checkbook <sup>c</sup>	15.62	191	12.3	190	12.1
SI Corn App AB	9.84	203	20.6	214	21.7
Irrigator Pro <sup>A</sup>	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 <sup>ABC</sup>	14.87	198	13.3	207	13.9
50 kPa <sup>AB</sup>	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



#### 2020 Timing



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# **THANKS!**

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