



# DEVELOPING IRRIGATION STRATEGIES FOR IMPROVED PROFITABILITY WITH IRRIGATION CALENDARS

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South African Sugarcane Research Institute
Water Research Commission

## INTRODUCTION

- Appropriate irrigation scheduling not widely practiced despite availability of large number of tools
  - Water budget calculations as too much trouble and crop models perceived as too complex and difficult to use
  - Many farmers do not have easy access to such technologies
- Irrigation management practices should be simplistic and understandable to insure adoption
- Simple and easy to use irrigation scheduling tools
  - Irrigation charts or calendars based on LTM weather data


**INCREASING WATER USE EFFICIENCY OF IRRIGATED SUGARCANE BY MEANS OF SPECIFIC AGRONOMIC PRACTICES**

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**Deliverable 3**

Formulate IBMP for efficient and profitable use of irrigation water

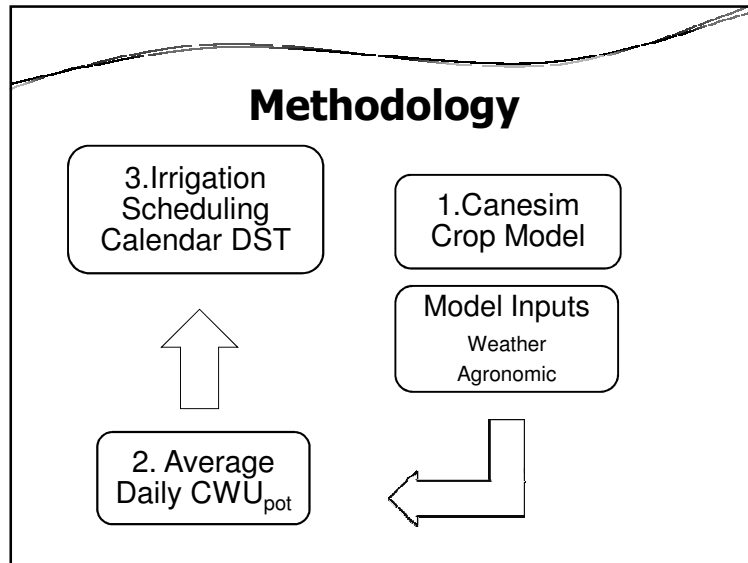
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**Irrigation Scheduling Calendar DST**

Month		Year	
Start	End	Start	End
1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16
17	18	19	20
21	22	23	24
25	26	27	28
29	30	31	32
33	34	35	36
37	38	39	40
41	42	43	44
45	46	47	48
49	50	51	52
53	54	55	56
57	58	59	60
61	62	63	64
65	66	67	68
69	70	71	72
73	74	75	76
77	78	79	80
81	82	83	84
85	86	87	88
89	90	91	92
93	94	95	96
97	98	99	100

## Objectives

- To develop a set of irrigation scheduling calendar guidelines to show recommended irrigation cycles for different months of the year:
  - Cutting date
  - Bare or trashed ground cover
  - Quick or slow canopy development rate
  - Single or tramline plant spacing arrangements
- Secondary objective to provide irrigation system design criteria information



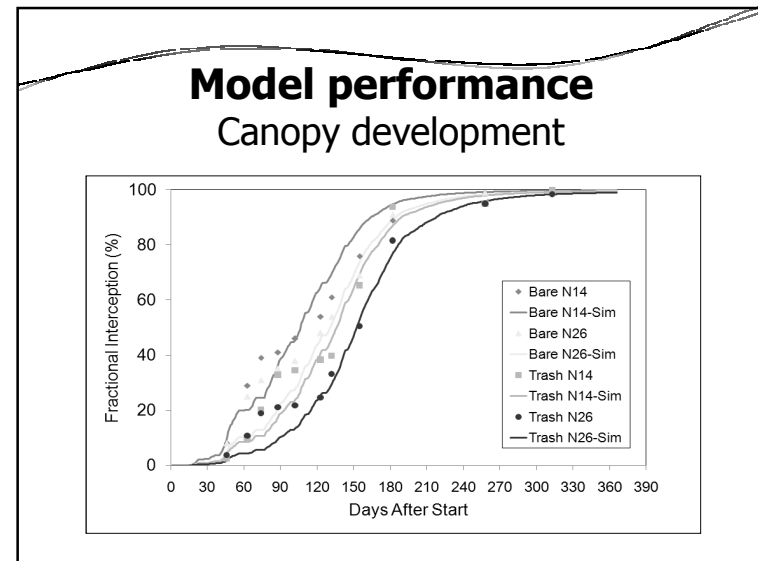
### Weather data

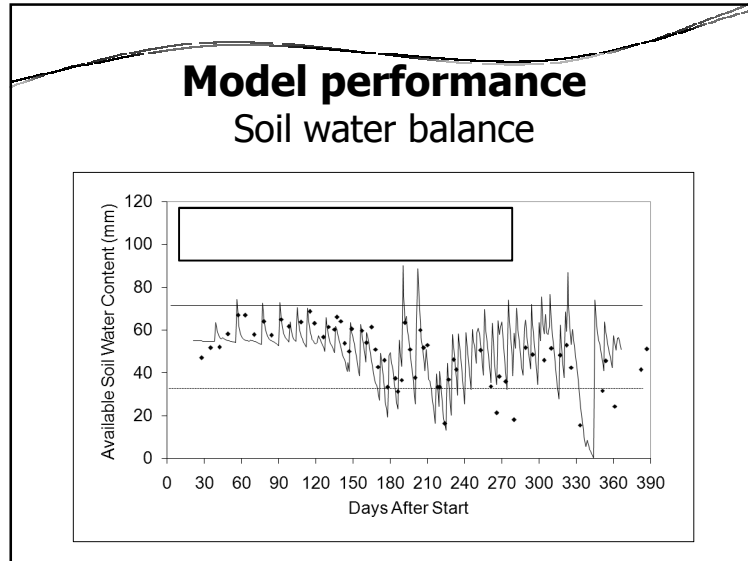
AWS name	Location (Lat and Long)	Altitude (m)	Data record (Years)
<b>Southern Irrigated Area (Northern KwaZulu-Natal)</b>			
Empangeni	28° 43' S 31° 53' E	102	5
Heatonville	28° 43' S 31° 48' E	200	10
Mtubatuba	28° 27' S 32° 13' E	15	9
Pongola	27° 24' S 31° 35' E	308	11
<b>Northern Irrigated Area (Mpumalanga)</b>			
Coopersdal	25° 33' S 31° 57' E	170	7
Komatipoort	25° 22' S 31° 55' E	200	8
Malelane	25° 29' S 31° 31' E	301	8

### Agronomic inputs

Model variable	Value
Irrigation system	Dragline
Stand time	12 hour / 35mm net (42mm gross)
Refill level	Field capacity
Minimum irrigation cycle	6 days
Plant or Ratoon crop	Ratoon
Soil surface cover	Bare or Trash
Row spacing	1.5 m single 1.2 m x 0.6 m tramline
Variety	N14 (fast canopy) N26 (slow canopy)

- Harvest season - April start and December finish
- Crops usually harvested at age of 12 months
- Crop cycles are so called 'dry cycles' – assumption made that rainfall was equal to zero





### Average daily pot CWU

Southern irrigated area (Pongola):  
N14 single row (1.5 m) - For a range of crop cycles under burnt conditions

Harvest Date	1	2	3	4	5	6	7	8	9	10	11	12	Annual total
Mar:	0.77	1.44	1.73	1.75	2.16	3.06	3.89	4.69	5.41	5.87	5.72	4.87	1255
Apr:	0.49	0.41	0.71	0.92	1.91	3.22	4.17	5.42	5.73	5.63	4.85	3.89	1135
May:	0.40	0.21	0.22	0.90	2.37	3.72	5.02	5.87	5.62	4.83	3.87	3.08	1099
Jun:	0.38	0.23	0.46	2.18	3.61	4.98	5.65	5.77	4.82	3.87	3.05	2.63	1146
Jul:	0.44	0.43	1.90	3.47	4.89	5.64	5.61	4.97	3.87	3.08	2.62	2.58	1203
Aug:	0.58	1.14	3.08	4.73	5.55	5.58	4.80	3.99	3.05	2.62	2.57	3.03	1239
Sep:	0.73	2.00	4.26	5.38	5.48	4.77	3.84	3.12	2.61	2.57	3.02	3.79	1264
Oct:	0.86	3.10	4.94	5.37	4.70	3.82	3.05	2.69	2.55	3.01	3.78	4.50	1286
Nov:	1.09	3.77	5.02	4.59	3.77	3.00	2.58	2.62	3.00	3.75	4.51	4.91	1292
Dec:	1.47	3.96	4.31	3.66	2.97	2.55	2.50	3.05	3.72	4.45	4.87	5.67	1307

### Average daily pot CWU

Southern irrigated area (Pongola):  
N14 single row (1.5 m) - For a range of crop cycles under trash conditions

Harvest Date	1	2	3	4	5	6	7	8	9	10	11	12	Annual total
Mar:	0.09	0.53	0.81	0.93	1.17	1.87	2.81	3.80	4.73	5.41	5.43	4.69	977
Apr:	0.03	0.09	0.15	0.24	0.65	1.60	2.77	4.33	5.03	5.20	4.60	3.75	862
May:	0.01	0.01	0.03	0.18	0.82	2.08	3.66	4.95	5.10	4.54	3.71	2.98	852
Jun:	0.01	0.01	0.10	0.64	1.86	3.51	4.70	5.20	4.52	3.70	2.95	2.54	904
Jul:	0.02	0.07	0.52	1.68	3.38	4.63	5.02	4.65	3.69	2.97	2.54	2.50	963
Aug:	0.03	0.26	1.26	3.03	4.43	4.93	4.45	3.79	2.93	2.53	2.48	2.94	1005
Sep:	0.05	0.55	2.27	3.94	4.68	4.36	3.62	2.98	2.52	2.47	2.92	3.67	1033
Oct:	0.07	1.02	3.03	4.27	4.17	3.54	2.88	2.56	2.44	2.88	3.64	4.36	1057
Nov:	0.12	1.46	3.35	3.81	3.38	2.78	2.42	2.47	2.82	3.58	4.32	4.75	1068
Dec:	0.20	1.79	3.09	3.09	2.65	2.32	2.30	2.82	3.47	4.19	4.67	5.49	1091

### Irrigation Scheduling Calendar DST

Optimum "no rain" times for first and second irrigation water applications (number is days from month start)

Harvest Date	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov		
Mar		25																					
Apr			4																				
May				1																			
Jun					25																		
Jul						10																	
Aug							0																
Sep								17															
Oct									9														
Nov										12													
Dec											0												

Optimum "no rain" cycle-time guidelines for third and subsequent irrigation water applications

Harvest Date	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	
Mar	19	20	23	19	14	11	9	7	7	7	8											
Apr		30	23	16	12	10	7	7	7	8	10											
May			18	12	10	7	7	7	7	8	10	13										
Jun				25	13	10	7	7	7	8	10	13	17									
Jul					15	10	7	7	7	8	10	13	17	21								
Aug						11	8	7	7	8	10	13	17	21	18							
Sep							15	8	7	8	10	13	17	21	17	13						
Oct								10	7	8	10	13	17	21	18	13	11					
Nov									9	8	10	13	17	20	17	13	11	9				
Dec										9	9	10	13	17	21	17	14	11	9			7

Calendars\_reun\_calculator b (2) [Compatibility Mode] - Microsoft Excel

**SELECT OPTIONS**

Canopy Development Rate	Quick
Row Spacing	Single
Ground cover	Burnt
Nearest Weather Station	Komatipoort
Irrigation Application Amount (mm)	35

Optimum "no rain" times for first and second

Harvest Date	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Mar	After Cutting	28							
Apr		After Cutting	No Irrig	17					
May			After Cutting	No Irrig	No Irrig	9			
Jun				After Cutting	No Irrig	27			

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Optimum "no rain" cycle-time guidelines for t

Harvest Date	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Mar		20	20	21	14	9	7	6	6
Apr				36	20	11	7	6	6
May						15	8	7	6
Jun						26	9	7	6
Jul							10	7	6
Aug							15	8	6
Sep								10	7
Oct									8
Nov									

Calendars\_reun\_calculator b (2) [Compatibility Mode] - Microsoft Excel

**SELECT OPTIONS**

Canopy Development Rate	Quick
Row Spacing	Tramline
Ground cover	Burnt
Nearest Weather Station	Komatipoort
Irrigation Application Amount (mm)	35

Optimum "no rain" times for first and second

Harvest Date	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Mar	After Cutting	22							
Apr		After Cutting	No Irrig	1					
May			After Cutting	No Irrig	No Irrig	2			
Jun				After Cutting	No Irrig	17			

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Optimum "no rain" cycle-time guidelines for t

Harvest Date	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Mar		16	17	18	13	8	7	6	6
Apr				27	16	9	7	6	6
May						12	7	6	6
Jun						17	8	6	6
Jul							9	6	6
Aug							11	7	6
Sep								8	6
Oct									7
Nov									

**SELECT OPTIONS**

Canopy Development Rate	Quick
Row Spacing	Tramline
Ground cover	Trash
Nearest Weather Station	Komatipoort
Irrigation Application Amount (mm)	35

Optimum "no rain" times for first and second

Harvest Date	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Mar	After Cutting	No Irrig	15						
Apr		After Cutting	No Irrig	No Irrig	27				
May			After Cutting	No Irrig	No Irrig	No Irrig	3		
Jun				After Cutting	No Irrig	No Irrig	14		

Optimum "no rain" cycle-time guidelines for t

Harvest Date	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Mar			27	26	17	10	8	6	6
Apr					37	16	9	7	6
May							12	8	7
Jun							16	9	7
Jul							20	9	7
Aug								11	7
Sep								19	9
Oct									15
Nov									

**SELECT OPTIONS**

Canopy Development Rate	Quick
Row Spacing	Tramline
Ground cover	Trash
Nearest Weather Station	Komatipoort
Irrigation Application Amount (mm)	20

Optimum "no rain" times for first and second

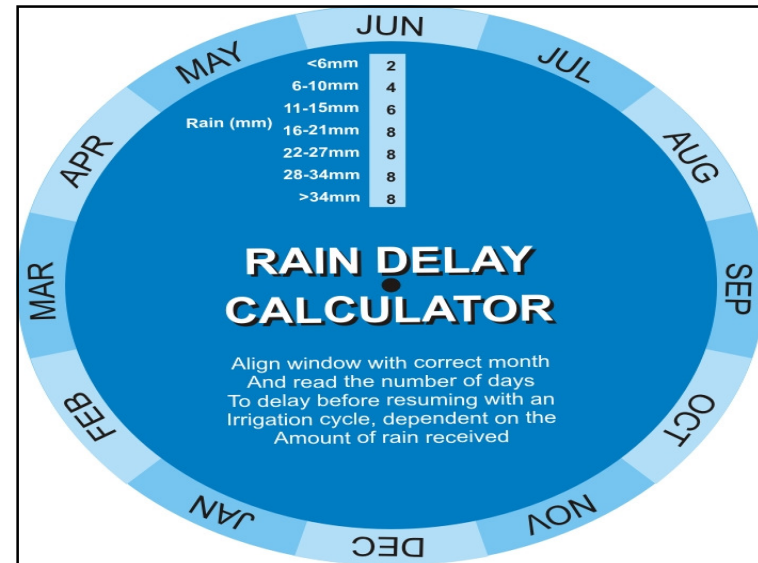
Harvest Date	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Mar	After Cutting	No Irrig	15						
Apr		After Cutting	No Irrig	No Irrig	27				
May			After Cutting	No Irrig	No Irrig	No Irrig	3		
Jun				After Cutting	No Irrig	No Irrig	14		

Optimum "no rain" cycle-time guidelines for t

Harvest Date	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Mar			16	15	10	6	4	4	3
Apr					21	9	5	4	3
May							7	5	4
Jun							9	5	4
Jul							11	5	4
Aug								6	4
Sep								11	5
Oct									9
Nov									

## Accounting for rainfall 'Rainfall rule'

- Number of delay days = Rainfall amount / Average daily  $ET_{ref}$
- Should be limited to
  - 6 days - Nov to Feb
  - 7 days - Mar, Sep, Oct
  - 8 days - Apr to Aug



**Irrigation Scheduling Guidelines**

Month	ET (mm)	Rain (mm)	Delay (days)
Jan	10	10	0
Feb	10	10	0
Mar	10	10	0
Apr	10	10	0
May	10	10	0
Jun	10	10	0
Jul	10	10	0
Aug	10	10	0
Sep	10	10	0
Oct	10	10	0
Nov	10	10	0
Dec	10	10	0

## Cost savings

	Farm Practice	ISCDST Burn	ISCDST Trash
Total (mm)	1870	1510	1230
Number of applications	61	37	31
Cost (R/ha)	5049	4077	3321
R1.50/mm water cost R1.20/mm energy cost			

- Irrigation requirement reduced by 19% (360mm)
- Quantify saving in terms of opportunity cost of water

## **Conclusions**

- The ISCDST is an easy to use tool that can be used to provide simple but appropriate guidelines to schedule irrigation water applications
- The handheld “Rain delay calculator” can be used to further adjust predetermined irrigation cycles to account for the effect of rainfall
- Irrigation calendars potentially have a very wide user base
  - Used to facilitate wide scale improvement in commercial agriculture, but small-scale grower communities should also be able to benefit from water saving practices and associated increases in profitability

## **Acknowledgements**

- Water Research Commission
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- SASRI scientific and technical staff

**Thank You**