Assignment 2

Samyuktha K - 102201003

1. Analyse the effect of deficit irrigation on the yield of banana cultivation in Pattambi, Palakkad. Compare different deficit irrigation scenarios with the full irrigation condition (till field capacity) in terms of yield. The scenarios that need to be considered are
    - Stress during different stages (initial, development, mid and end)
    - Stress in all stage
    - Control condition of irrigation (without stress).

2. Consider a water deficit scenario (take fixed percentage = 50 % while calculating the effective rainfall) where sufficient water is unavailable to irrigate at critical depletion. Develop an irrigation schedule based on the available water and determine the maximum level of depletion possible that does not affect the yield.

3. Plot soil water balance of banana for an optimal irrigation condition and write the inferences.

4. Also, develop an irrigation schedule for 20% reduction in the yield. The planting date is 1st June.

1.

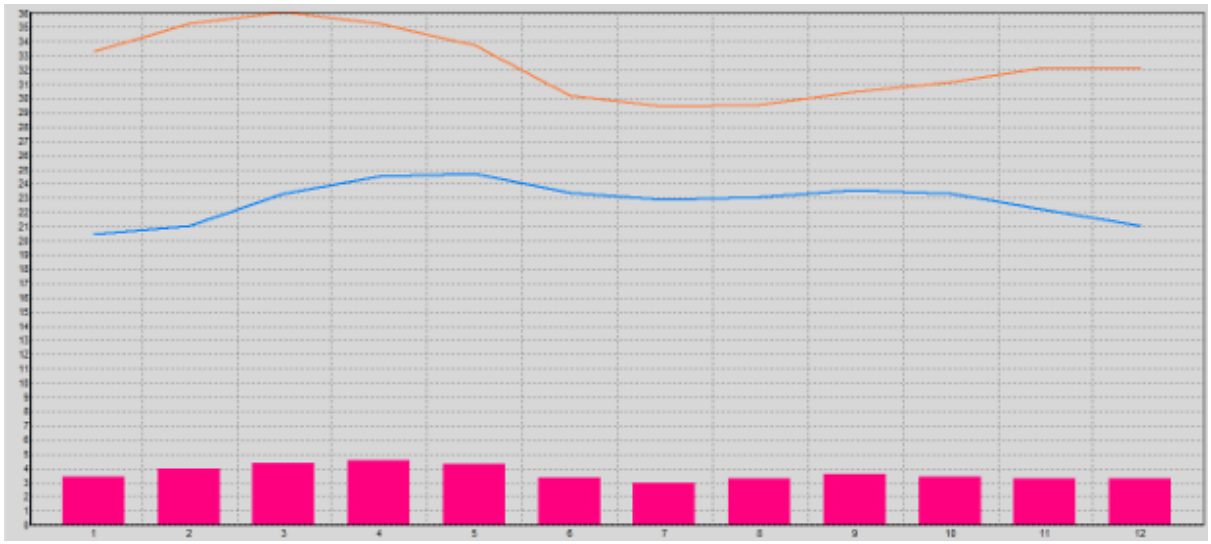
Monthly ETo Penman-Monteith:

Country: India Station: Pattambi

Altitude: 63 m. Latitude: 10.80 °N Longitude: 76.18 °E

Month	Min Temp	Max Temp	Humidity	Wind	Sun	Rad	ETo
	°C	°C	%	km/day	hours	MJ/m²/day	mm/day
January	20.5	33.3	58	6	8.6	19.8	3.44
February	21.1	35.3	61	5	8.9	21.6	3.99
March	23.4	36.1	62	4	8.5	22.2	4.38
April	24.5	35.3	72	3	7.9	21.7	4.54
May	24.7	33.8	77	3	7.3	20.4	4.33
June	23.4	30.2	85	3	4.5	15.9	3.36
July	22.9	29.4	83	3	3.4	14.3	2.97
August	23.1	29.6	83	4	4.4	16.1	3.28
September	23.6	30.5	80	3	5.8	18.1	3.64
October	23.3	31.2	79	2	5.6	17.0	3.39
November	22.2	32.2	73	3	6.7	17.3	3.31
December	21.0	32.1	69	5	7.8	18.2	3.31
Average	**22.8**	**32.4**	**74**	**4**	**6.6**	**18.6**	**3.66**

Climate/ETo/ Rain chart:

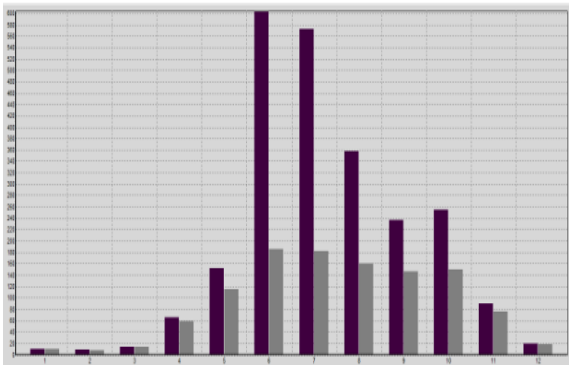


Monthly rain:

- Eff. rain method: USDA S.C. Method:

Station: Pattambi Eff. rain method: USDA S.C. Method

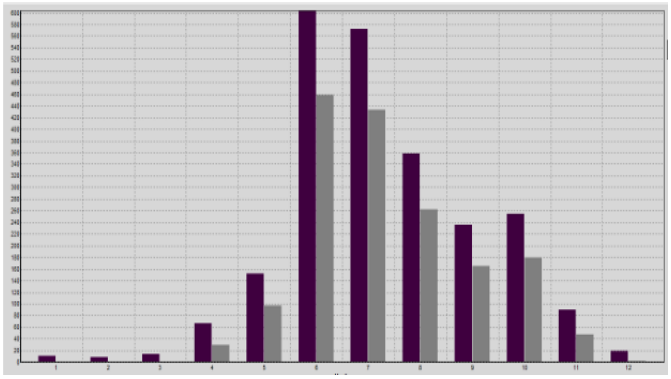
	Rain	Eff rain
	mm	mm
January	10.8	10.6
February	8.7	8.6
March	14.2	13.9
April	66.3	59.3
May	152.2	115.1
June	603.8	185.4
July	572.1	182.2
August	358.4	160.8
September	236.2	146.9
October	255.1	150.5
November	89.5	76.7
December	19.3	18.7
Total	2386.6	1128.7



- Eff. rain method: FAO/AGLW formula/Dependable rain:

Station: Pattambi Eff. rain method: FAO/AGLW formula

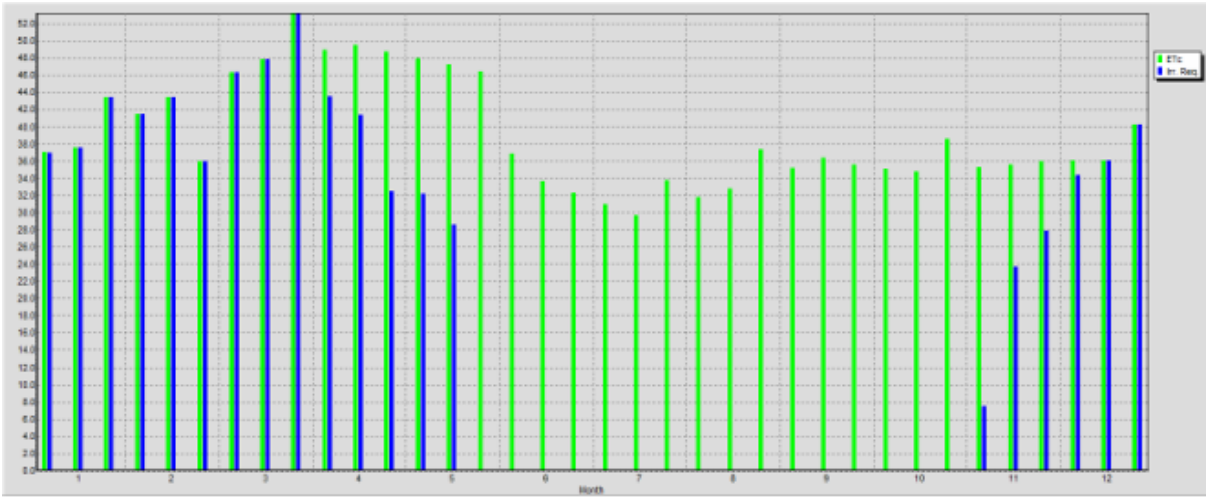
	Rain	Eff rain
	mm	mm
January	10.8	0.0
February	8.7	0.0
March	14.2	0.0
April	66.3	29.8
May	152.2	97.8
June	603.8	459.0
July	572.1	433.7
August	358.4	262.7
September	236.2	165.0
October	255.1	180.1
November	89.5	47.6
December	19.3	1.6
Total	2386.6	1677.2



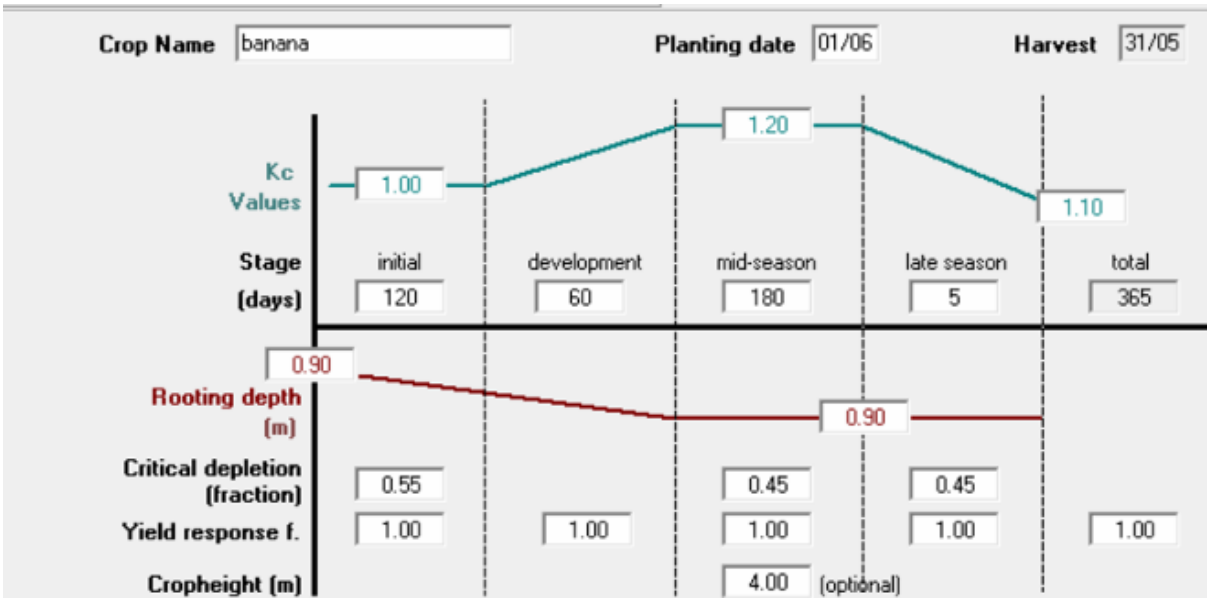
Crop Water Requirements:

ETo station	Pattambi	**Crop**	banana
Rain station	Pattambi	**Planting date**	01/06

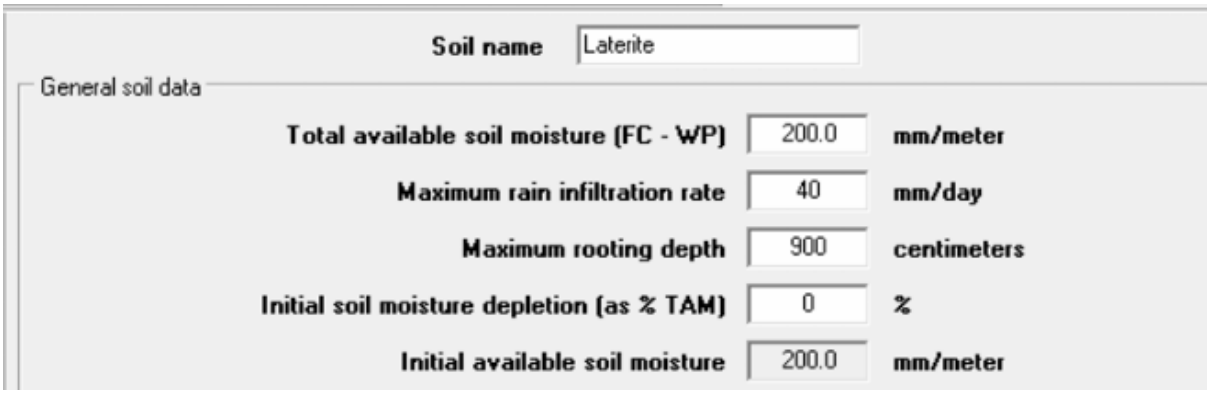
Month	Decade	Stage	Kc	ETc	ETc	Eff rain	Irr. Req.
			coeff	mm/day	mm/dec	mm/dec	mm/dec
Jun	1	Init	1.00	3.68	36.8	125.1	0.0
Jun	2	Init	1.00	3.36	33.6	171.4	0.0
Jun	3	Init	1.00	3.23	32.3	162.4	0.0
Jul	1	Init	1.00	3.10	31.0	152.0	0.0
Jul	2	Init	1.00	2.97	29.7	151.5	0.0
Jul	3	Init	1.00	3.07	33.8	130.2	0.0
Aug	1	Init	1.00	3.18	31.8	104.3	0.0
Aug	2	Init	1.00	3.28	32.8	84.1	0.0
Aug	3	Init	1.00	3.40	37.4	74.4	0.0
Sep	1	Init	1.00	3.52	35.2	62.3	0.0
Sep	2	Init	1.00	3.64	36.4	49.6	0.0
Sep	3	Deve	1.00	3.56	35.6	53.1	0.0
Oct	1	Deve	1.01	3.51	35.1	63.0	0.0
Oct	2	Deve	1.03	3.48	34.8	67.0	0.0
Oct	3	Deve	1.04	3.51	38.6	50.0	0.0
Nov	1	Deve	1.06	3.53	35.3	27.9	7.4
Nov	2	Deve	1.07	3.55	35.5	11.8	23.7
Nov	3	Mid	1.09	3.60	36.0	8.1	27.9
Dec	1	Mid	1.09	3.61	36.1	1.7	34.4
Dec	2	Mid	1.09	3.61	36.1	0.0	36.1
Dec	3	Mid	1.09	3.66	40.2	0.0	40.2
Jan	1	Mid	1.09	3.71	37.1	0.1	36.9
Jan	2	Mid	1.09	3.75	37.5	0.0	37.5
Jan	3	Mid	1.09	3.95	43.5	0.0	43.5
Feb	1	Mid	1.09	4.15	41.5	0.0	41.5
Feb	2	Mid	1.09	4.35	43.5	0.0	43.5
Feb	3	Mid	1.09	4.49	35.9	0.0	35.9
Mar	1	Mid	1.09	4.64	46.4	0.0	46.4
Mar	2	Mid	1.09	4.78	47.8	0.0	47.8
Mar	3	Mid	1.09	4.84	53.2	0.1	53.1
Apr	1	Mid	1.09	4.89	48.9	5.4	43.5
Apr	2	Mid	1.09	4.95	49.5	8.1	41.4
Apr	3	Mid	1.09	4.87	48.7	16.3	32.4
May	1	Mid	1.09	4.80	48.0	15.7	32.2
May	2	Mid	1.09	4.72	47.2	18.6	28.6
May	3	Late	1.05	4.22	46.4	63.4	0.0
					1409.0	**1677.7**	**734.0**



Dry crop:



Soil:



Crop irrigation schedule:

ETo station	Pattambi	Crop	banana	Planting date	01/06	Yield red.	
Rain station	Pattambi	Soil	Laterite	Harvest date	31/05	0.0 %	

Table format
- (•) Irrigation schedule
- ( ) Daily soil moisture balance

Timing: Irrigate at critical depletion
Application: Refill soil to field capacity
Field eff. 70 %

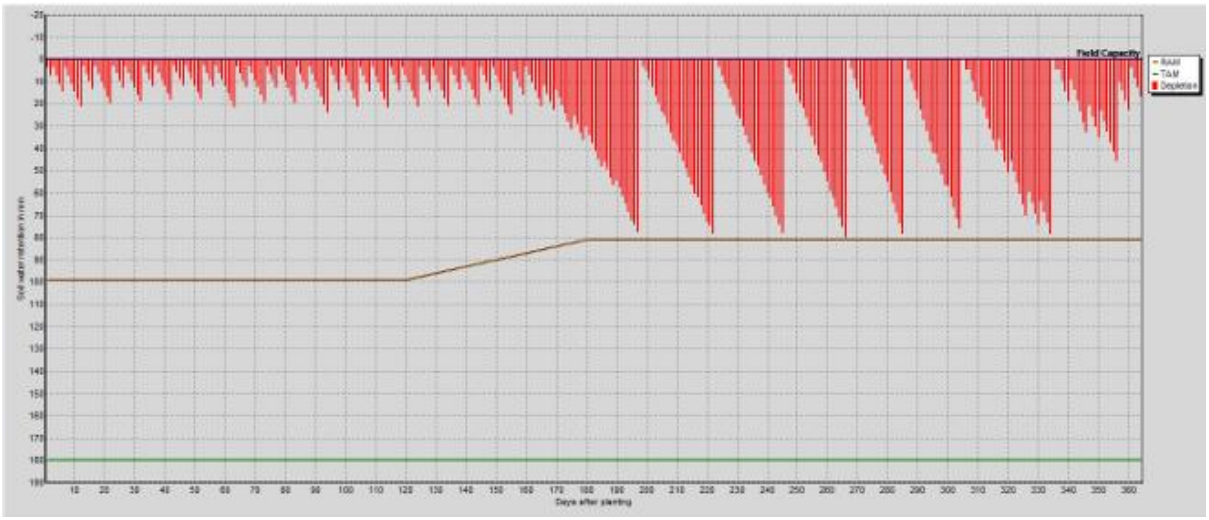
Date	Day	Stage	Rain	Ks	Eta	Depl	Net Irr	Deficit	Loss	Gr. Irr	Flow
			mm	fract.	%	%	mm	mm	mm	mm	l/s/ha
15 Dec	198	Mid	0.0	1.00	100	45	81.4	0.0	0.0	116.2	0.07
9 Jan	223	Mid	0.0	1.00	100	46	82.0	0.0	0.0	117.1	0.54
1 Feb	246	Mid	0.0	1.00	100	46	82.3	0.0	0.0	117.6	0.59
22 Feb	267	Mid	0.0	1.00	100	47	84.3	0.0	0.0	120.4	0.66
13 Mar	286	Mid	1.3	1.00	100	46	82.1	0.0	0.0	117.3	0.71
1 Apr	305	Mid	0.0	1.00	100	45	81.2	0.0	0.0	116.1	0.71
1 May	335	Mid	0.0	1.00	100	46	83.3	0.0	0.0	119.1	0.46
31 May	End	End	0.0	1.00	0	9					

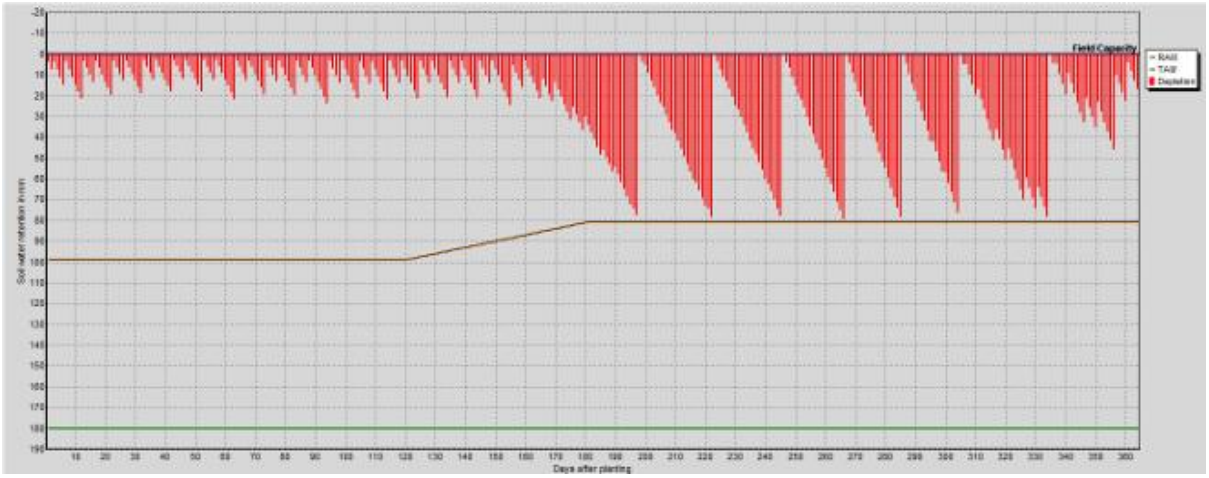
Totals

Total gross irrigation	823.8	mm	Total rainfall	2387.2	mm
Total net irrigation	576.6	mm	Effective rainfall	816.0	mm
Total irrigation losses	0.0	mm	Total rain loss	1571.2	mm
Actual water use by crop	1404.8	mm	Moist deficit at harvest	16.9	mm
Potential water use by crop	1404.8	mm	Actual irrigation requirement	588.8	mm
Efficiency irrigation schedule	100.0	%	Efficiency rain	34.2	%
Deficiency irrigation schedule	0.0	%			

Yield reductions

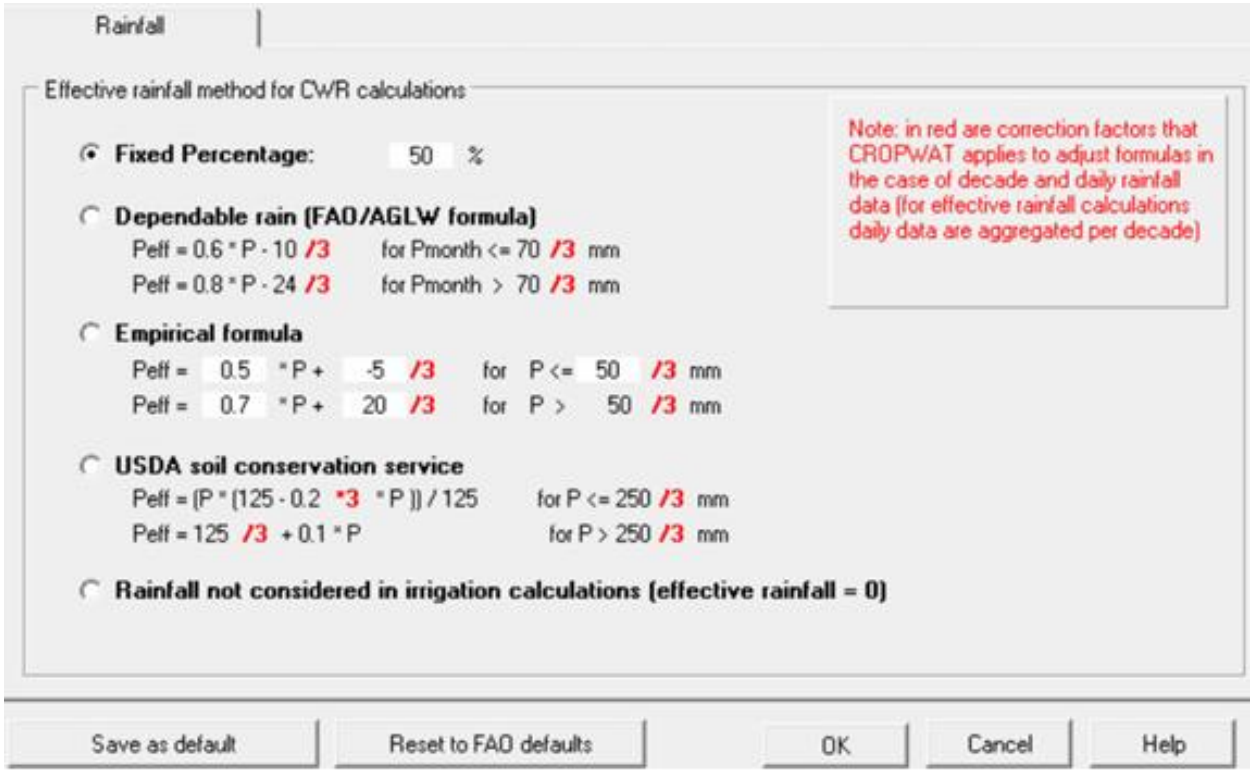
Stagelabel	A	B	C	D	Season	
Reductions in ETc	0.0	0.0	0.0	0.0	0.0	%
Yield response factor	1.00	1.00	1.00	1.00	1.00	
Yield reduction	0.0	0.0	0.0	0.0		%
Cumulative yield reduction	0.0	0.0	0.0	0.0	0.0	%





	Yield reduction (%)
Full irrigation	0
Stress in initial stage	1
Stress in developmental stage	1
Stress in mid-season stage	34.1
Stress in late season stage	1
Stress in all stages	34.1

2.



Station Pattambi **Eff. rain method** Fixed percentage

	Rain	Eff rain
	mm	mm
January	10.8	5.4
February	8.7	4.3
March	14.2	7.1
April	66.3	33.1
May	152.2	76.1
June	603.8	301.9
July	572.1	286.1
August	358.4	179.2
September	236.2	118.1
October	255.1	127.5
November	89.5	44.8
December	19.3	9.7
Total	**2386.6**	1193.3

ETo station: Pattambi | Crop: banana | Planting date: 01/06 | Yield red.: 0.0 %

Rain station: Pattambi | Soil: Laterite | Harvest date: 31/05

Table format
- (•) Irrigation schedule
- ( ) Daily soil moisture balance

Timing: Irrigate at critical depletion
Application: Refill soil to field capacity
Field eff. 70 %

Date	Day	Stage	Rain	Ks	Eta	Depl	Net Irr	Deficit	Loss	Gr. Irr	Flow
			mm	fract.	%	%	mm	mm	mm	mm	l/s/ha
15 Dec	198	Mid	0.0	1.00	100	45	81.4	0.0	0.0	116.2	0.07
9 Jan	223	Mid	0.0	1.00	100	46	82.0	0.0	0.0	117.1	0.54
1 Feb	246	Mid	0.0	1.00	100	46	82.3	0.0	0.0	117.6	0.59
22 Feb	267	Mid	0.0	1.00	100	47	84.3	0.0	0.0	120.4	0.66
13 Mar	286	Mid	1.3	1.00	100	46	82.1	0.0	0.0	117.3	0.71
1 Apr	305	Mid	0.0	1.00	100	45	81.2	0.0	0.0	116.1	0.71
1 May	335	Mid	0.0	1.00	100	46	83.3	0.0	0.0	119.1	0.46
31 May	End	End	0.0	1.00	0	9					

Totals

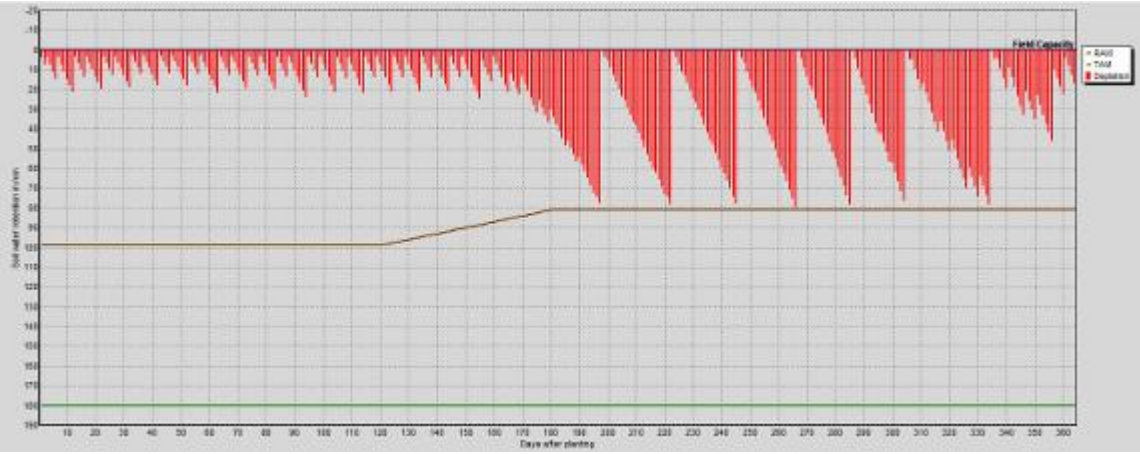
Total gross irrigation	823.8	mm	Total rainfall	2387.2	mm
Total net irrigation	576.6	mm	Effective rainfall	816.0	mm
Total irrigation losses	0.0	mm	Total rain loss	1571.2	mm
Actual water use by crop	1404.8	mm	Moist deficit at harvest	16.9	mm
Potential water use by crop	1404.8	mm	Actual irrigation requirement	588.8	mm
Efficiency irrigation schedule	100.0	%	Efficiency rain	34.2	%
Deficiency irrigation schedule	0.0	%			

Yield reductions

Stagelabel	A	B	C	D	Season	
Reductions in ETc	0.0	0.0	0.0	0.0	0.0	%
Yield response factor	1.00	1.00	1.00	1.00	1.00	
Yield reduction	0.0	0.0	0.0	0.0		%
Cumulative yield reduction	0.0	0.0	0.0	0.0	0.0	%

The maximum level of depletion possible that does not affect the yield = 90 mm.

3.



Inferences -

- Effective irrigation management keeps soil moisture levels near field capacity, which helps prevent water stress throughout all stages of crop growth.
- By maintaining an ideal soil water balance, crops experience less stress, ultimately maximizing yield.
- Thoughtful irrigation scheduling not only minimizes water waste but also guarantees that crops receive the necessary moisture for healthy development.
- Keeping the root zone adequately hydrated enhances nutrient uptake and supports the overall health of the crops.

4.

ETo station	Pattambi	Crop	banana	Planting date	01/06	Yield red.	
Rain station	Pattambi	Soil	Laterite	Harvest date	31/05	19.0 %	

Table format
- (•) Irrigation schedule
- ( ) Daily soil moisture balance

Timing: Irrigate at given ETcrop reduction per stage
Application: Refill soil to field capacity
Field eff. 70 %

Date	Day	Stage	Rain	Ks	Eta	Depl	Net Irr	Deficit	Loss	Gr. Irr	Flow
			mm	fract.	%	%	mm	mm	mm	mm	l/s/ha
7 Mar	280	Mid	1.3	0.11	79	94	169.3	0.0	0.0	241.9	0.10
28 Apr	332	Mid	0.0	0.62	79	67	121.3	0.0	0.0	173.2	0.39
31 May	End	End	0.0	1.00	0	9					

Totals

Total gross irrigation	415.1	mm	Total rainfall	2387.2	mm
Total net irrigation	290.6	mm	Effective rainfall	834.9	mm
Total irrigation losses	0.0	mm	Total rain loss	1552.3	mm
Actual water use by crop	1137.7	mm	Moist deficit at harvest	16.9	mm
Potential water use by crop	1404.8	mm	Actual irrigation requirement	569.9	mm
Efficiency irrigation schedule	100.0	%	Efficiency rain	35.0	%
Deficiency irrigation schedule	19.0	%			

Yield reductions

Stagelabel	A	B	C	D	Season	
Reductions in ETc	0.0	0.0	34.4	0.0	19.0	%
Yield response factor	1.00	1.00	1.00	1.00	1.00	
Yield reduction	0.0	0.0	34.4	0.0		%
Cumulative yield reduction	0.0	0.0	34.4	34.4	19.0	%

ETo station	Pattambi	Crop	banana	Planting date	01/06	Yield red.	
Rain station	Pattambi	Soil	Laterite	Harvest date	31/05	20.9 %	

Table format
- (•) Irrigation schedule
- ( ) Daily soil moisture balance

Timing: Irrigate at given ETcrop reduction per stage
Application: Refill soil to field capacity
Field eff. 70 %

Date	Day	Stage	Rain	Ks	Eta	Depl	Net Irr	Deficit	Loss	Gr. Irr	Flow
			mm	fract.	%	%	mm	mm	mm	mm	l/s/ha
10 Mar	283	Mid	0.0	0.10	78	95	170.8	0.0	0.0	244.0	0.10
11 May	345	Mid	0.0	0.57	78	70	126.7	0.0	0.0	180.9	0.34
31 May	End	End	0.0	1.00	0	9					

Totals

Total gross irrigation	424.9	mm	Total rainfall	2387.2	mm
Total net irrigation	297.4	mm	Effective rainfall	797.4	mm
Total irrigation losses	0.0	mm	Total rain loss	1589.7	mm
Actual water use by crop	1111.8	mm	Moist deficit at harvest	16.9	mm
Potential water use by crop	1404.8	mm	Actual irrigation requirement	607.4	mm
Efficiency irrigation schedule	100.0	%	Efficiency rain	33.4	%
Deficiency irrigation schedule	20.9	%			

Yield reductions

Stagelabel	A	B	C	D	Season	
Reductions in ETc	0.0	0.0	37.7	0.0	20.9	%
Yield response factor	1.00	1.00	1.00	1.00	1.00	
Yield reduction	0.0	0.0	37.7	0.0		%
Cumulative yield reduction	0.0	0.0	37.7	37.7	20.9	%