CLIMATIC MONITORING AND ANALYSIS TO OPTIMIZE RUBBER CULTIVATION

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Rubber growth and yield is affected by climate variability CLIMATIC ANOMALY

Climatic anomaly:

- EL NINO/La Nina
- INDIAN OCEAN DIPOLE

Amount of rainfall

THE IMPORTANCE OF CLIMATE OBSERVATION

- Data are used for land suitability assessment
- To know how great is climate fluctuation
- Relate climate fluctuation and crop performance
- Cultivation adjustment

Standard climatology station

AUTOMATIC WEATHER STATION

Automatic weather station (AWS)

- Sensor : radiation, UV, temperature, humidity, wind speed and wind direction, rainfall
- Data is transmitted (wireless) and recorded by console
- Climate condition can be seen on console screen
- Recording frequency can be chosen (5, 10, 30 minutes, etc)
- Equipped with Weather Link software (ET estimation)

Console is placed in office
Source energy : battery or electricity

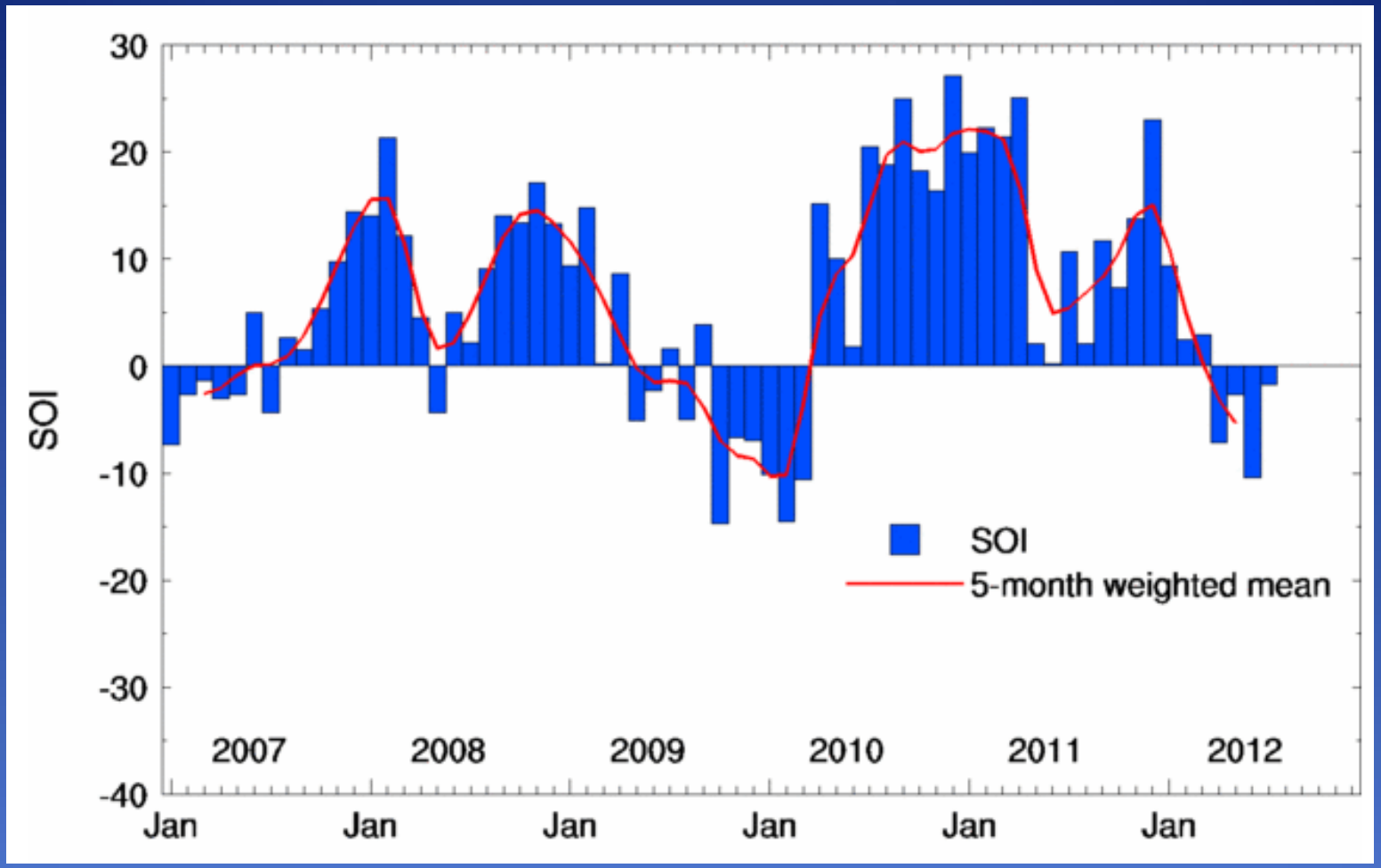
The advantage of AWS

- Data is more intensively recorded
- Data is stored in file, less human error
- Reduce limitation of officer (holidays, sickness, etc)
- Weather forecasting is given
- Less expensive
- Practical and moveable

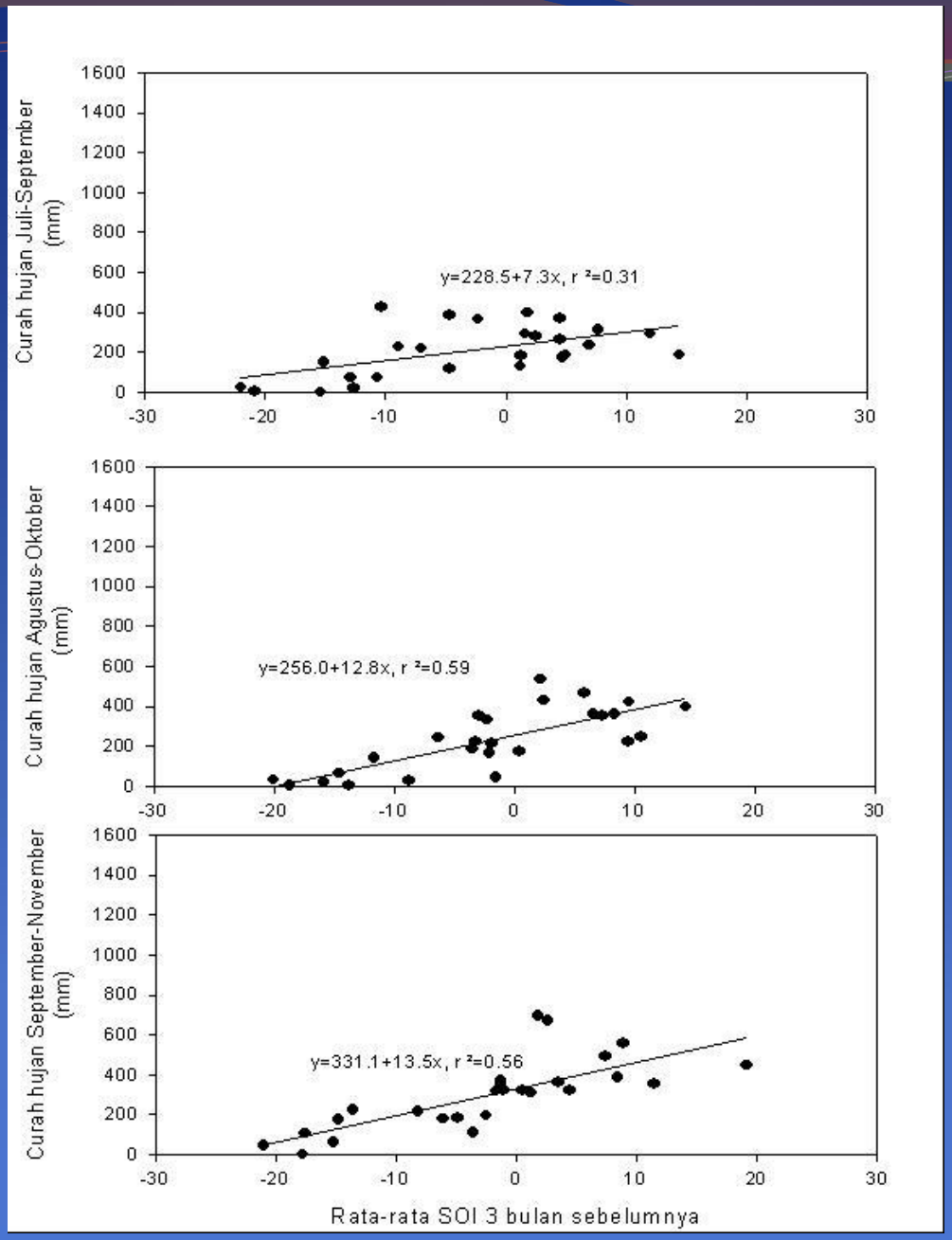
CLIMATIC DATA ANALYSIS AND USE

1. PREDICTION OF RAINFALL (el nino/la nina)

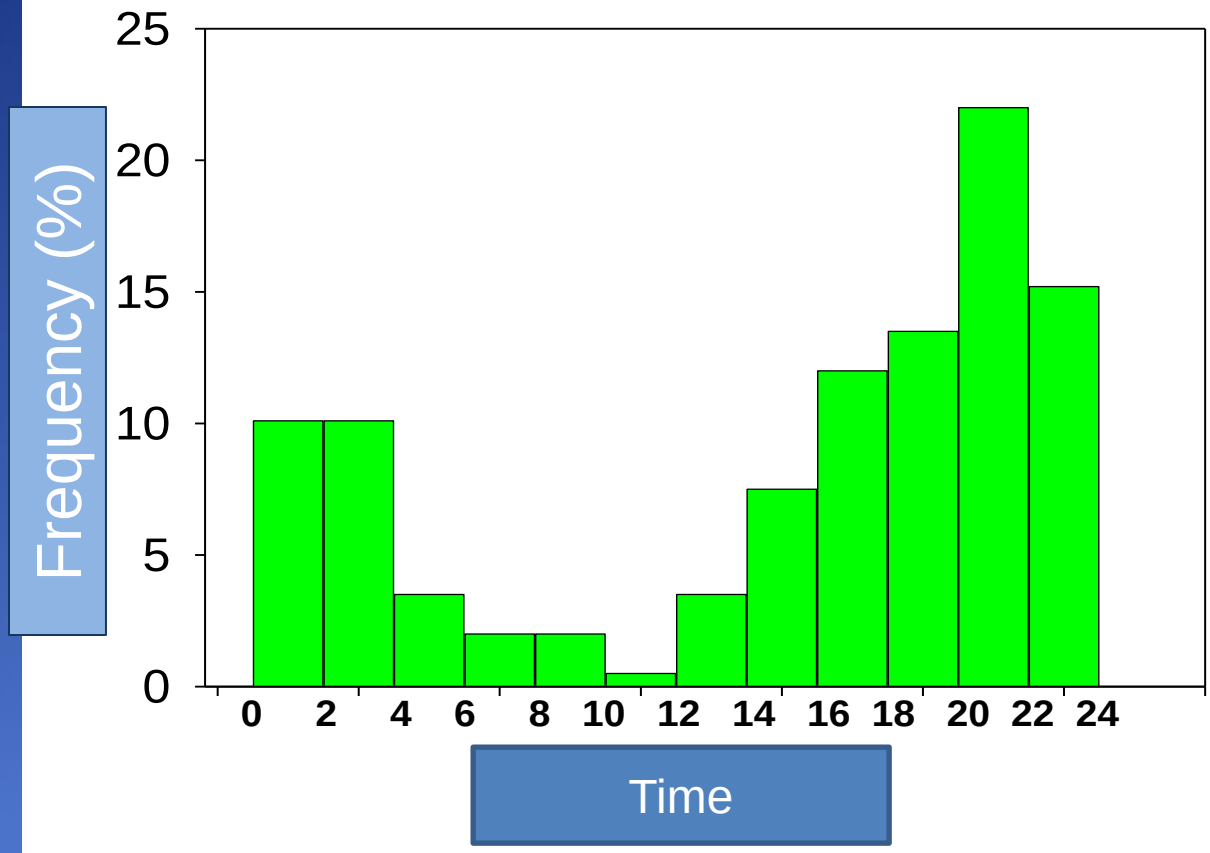
Regression between three monthly SOI with rainfall data 3 monthly ahead



Positive SOI related to high rainfall in southern part of Indonesia


Curah hujan Juli-September (mm)
y=228.5+7.3x, r ²=0.31
Curah hujan Agustus-Oktober (mm)
y=256.0+12.8x, r ²=0.59
Curah hujan September-November (mm)
y=331.1+13.5x, r ²=0.56
Rata-rata SOI 3 bulan sebelumnya

2. Time of rainfall



Rainguard application

wet

Effective in protecting tapping panel from stem flow

dry

La Nina

Month	The number of day without tapping in 2010 (La Nina)		Total tapping days	The number of day without tapping in 2009 (normal year)		Total tapping days
	Due to rain	Due to public holidays		Due to rain	Due to public holidays	
January	1	2	28			26
February		1	27	4	1	23
March	1	1	29	3	1	27
April		2	28		1	29
May	1	2	28		1	30
June		1	29		1	29
July		2	29		2	29
August	1	3	27		2	29
September		6	24	1	6	23
October		1	30	1	1	29
November	2	2	26	1	2	27
December	1	1	29	3	1	27
Total	7	24	334	16	21	328

3. Anticipation in leaf disease attack

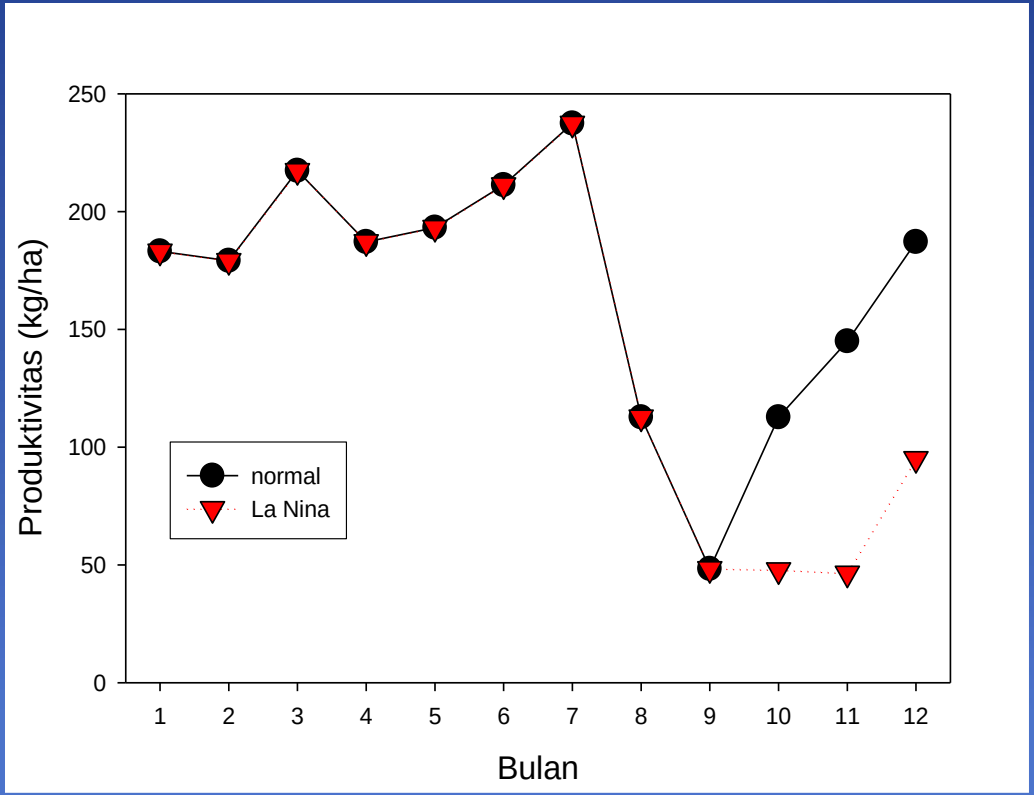
Factors affecting the development of *Colletotrichum* leaf disease

- Temperature
  - 25-28ºC spore growth
  - 26-32ºC infection
  - 28-30ºC distribution
- Humidity
  - 95%, spore germination
  - ≥96%, infection

Rainfall

- >3000 mm/year
- Radiation
- Wind

Colletotrichum leaf disease due to La Nina



Forecasting Colletotrichum leaf disease

Climatic condition (average first 10 days of new leaf formation)			Biological observation in the field		Forecasting	Measure control
Rainfall (mm/day)	**Rainy days**	**Sunshine duration (hours/day)**	**Spore density in air (spore/mm2)**	**Attack intensity (%)**		
≥14	**6-8**	**3**	**>17**	**>35**	**Heavy attack in the next 10 days**	**Applied fungicide with 1 or 2 time dosage**
≥11	**3-5**	**5**	**9-17**	**5-35**	**Light attack in the next 10 days.**	**Applied fungicide with low dosage**
<11	**<3**	**>5**	**<9**	**<5**	**No attack in the next 10 days**	**No need to apply fungicide**

WE ARE NOW WORKING ON CLIMATIC DATA RELATED TO PESTALOTIOPSIS

4. Water requirement in ground nursery

$$Et = kc \times ETp$$

In general, there is no water stress when Avialable water > 50%

Etp can be extimated from pan evaporation measurement or Penman method

Water balance

For example available water in soil = 60 mm, 50% of available water = 30 mm

Rainfall	Etp x kc (ETP from pan class A)
1. 0	2 mm
2. 0	3
3. 0	3
4. 0	2
5. 0	2
6. 0	3
7. 0	3
Total	18

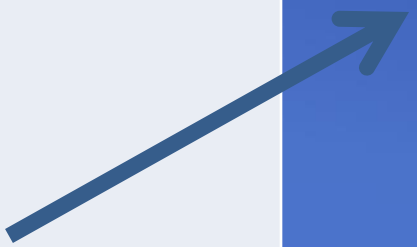
Water is used 18 mm, remaining Available water = 30-18 =22 mm Need irrigation so get Available water > 30 mm

5. Time of planting

- Water deficit = 0, when rainfall >ETP, and soil is moist enough

- Mean rainfall is not good to be used for making decision
- Rainfall with min 75% of probability occurrence will be better to anticipate climatic anomaly

Month	Mean rainfall (mm)	Rainfall with probabilty 75% (mm)
January	221.6	121.6
February	173.9	116.3
March	311.6	191.1
April	243.6	121.6
May	157.1	79.7
June	85.5	24.4
July	101.1	55.0
August	97.6	43.1
September	123.6	41.7
October	211.3	67.3
November	299.3	216.0
December	231.6	158.6



Planting time

6. CROP MODEL

-Is needed to know the potency of growth of rubber tree by using input of soil and climate data (rainfall, radiation, temperature)

- **Growth index:**

- *GI = MI x TI x LI*

GI = growth index

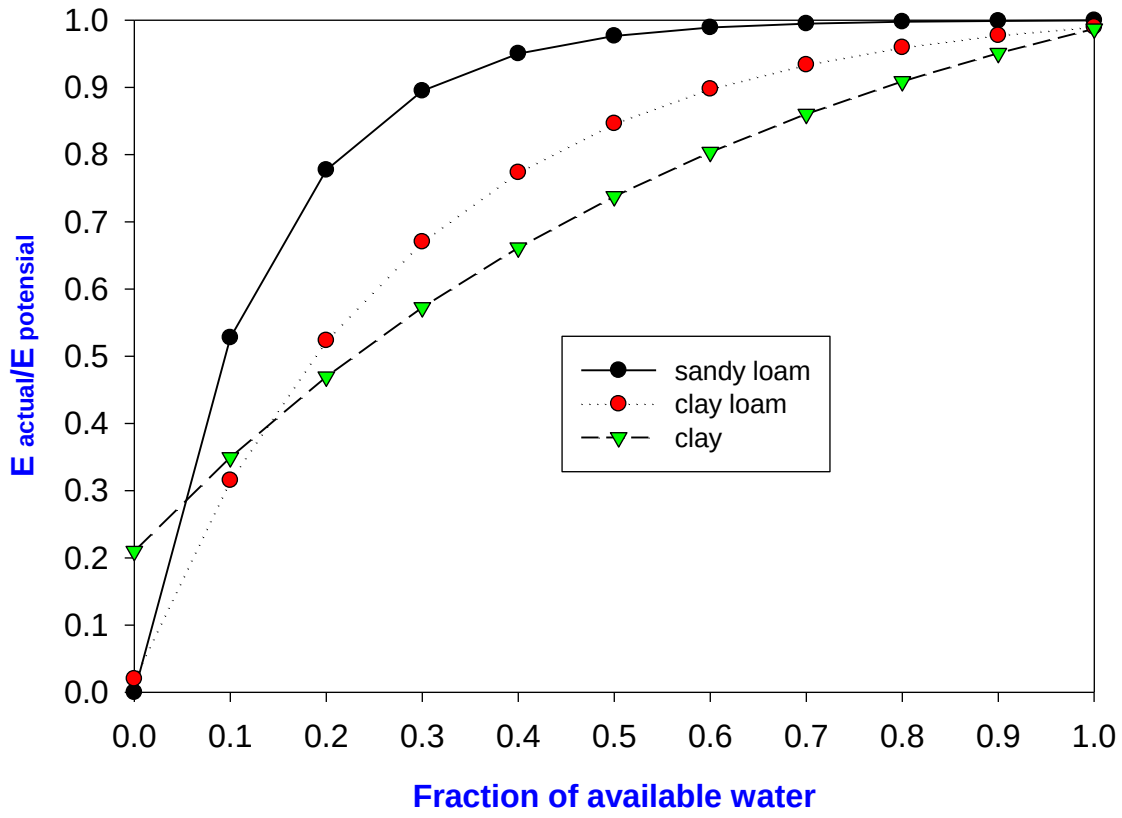
MI =moisture index

TI = thermal index

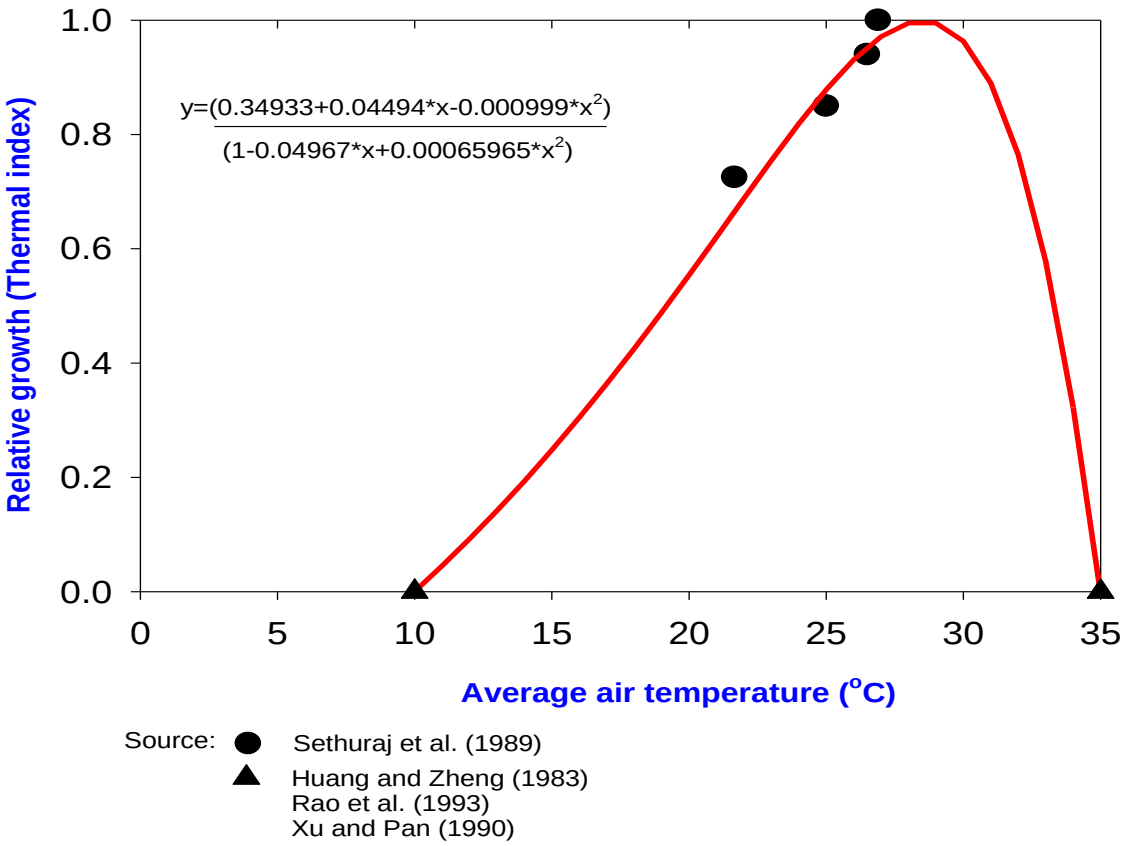
LI = light index

- **GI = 0 →no growth**
- **GI =1 →optimum growth**

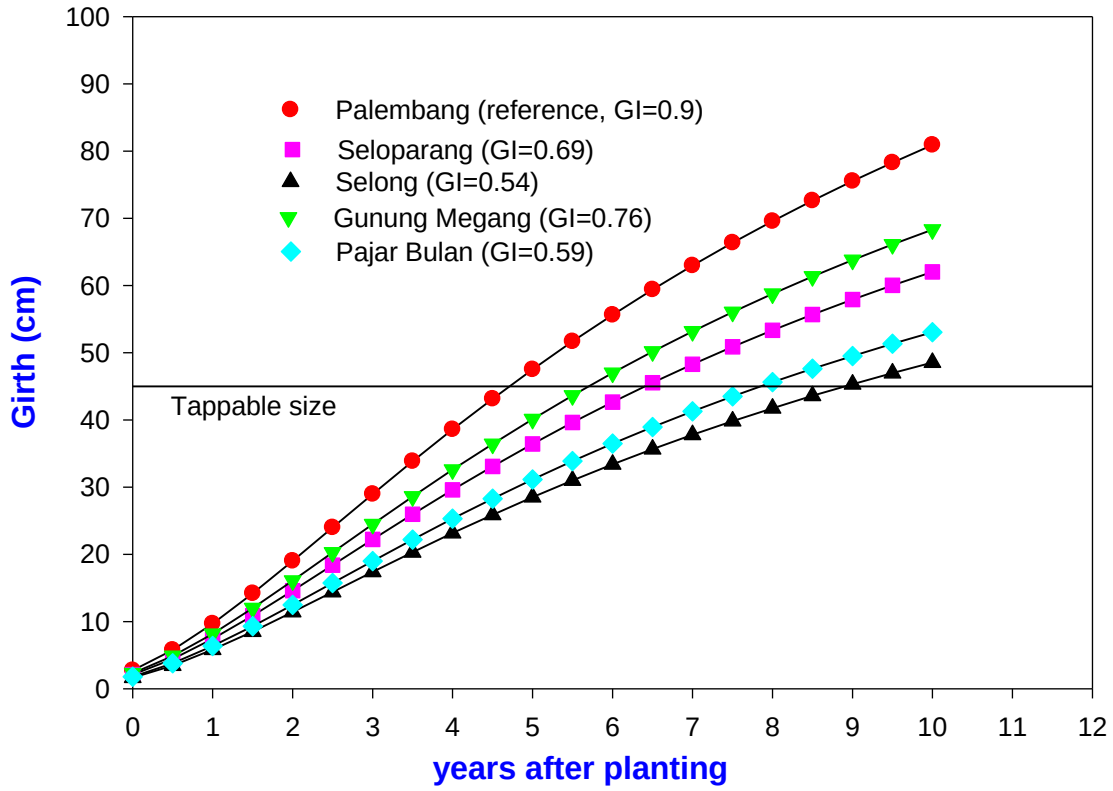
Moisture index



Thermal index



$G=[175.81\ e^{\wedge(-9.54/(x+2.29)}\ ]$ x GI/GI ref



CONCLUSION

Climate data can be used for

- Prediction and control leaf disease
- Rainfall monitorig can assist in yield prediction and tapping management
- Monitoring ETP can be used for irrigation guidance
- Planting time decision
- Prediction of growth in new planting area based on model based on climatic data