

Comparative assessment of conventional and IoT(Internet of Things) based protected houses for *Cucumis sativus*(salad cucumber) under local conditions

AG/AT/2014/3770
DEPARTMENT OF AGRICULTURAL ENGINEERING
FACULTY OF AGRICULTURE
UNIVERSITY OF RUHUNA

Crop management

Condition		Germination		Vegetative	Reproductive	
No. of days		8 days		8-28	28-120	
Relative humidity		0-4days	4-8 days	65%-70%	55-65%	
	6AM-6PM	80-90%				
	5AM-6AM	50%	50%	45%-50%	50-55%	
Temperature		9PM-6AM		6AM-9AM	9AM-5PM	5PM-9PM
		15 °C		20 °C	25 °C	20 °C
pH		5.8-6.3				
Substrate moisture		550%-600%				

T1

3. One protected house was maintained according existing commercial scale management practices

Relative humidity



Wet and dry bulb thermometer

Temperature



Thermometer



Data Collection

Nursery Stage
Germination %
Time taken to 80% germination
Seedling height
Seedling base thickness
Chlorophyll content of 1 th leaf
Dry weight
Shoot and root length

Vegetative stage
Vine length
Inter nodal length
Base thickness
Time taken to emerge 5 th true leaf
Chlorophyll content of 5 th leaf
Time taken to emerge 14 th leaf
Chlorophyll of 14 th leaf
Number of leaves per vine per week

Reproductive phase
Time taken to 1 st flowering
Time taken to 1 st flower appearance
Time taken to 1 st harvest
Yield per vine per week
Number of aborted fruits per vine
Type of disease
Severity of each disease
Pests type and count

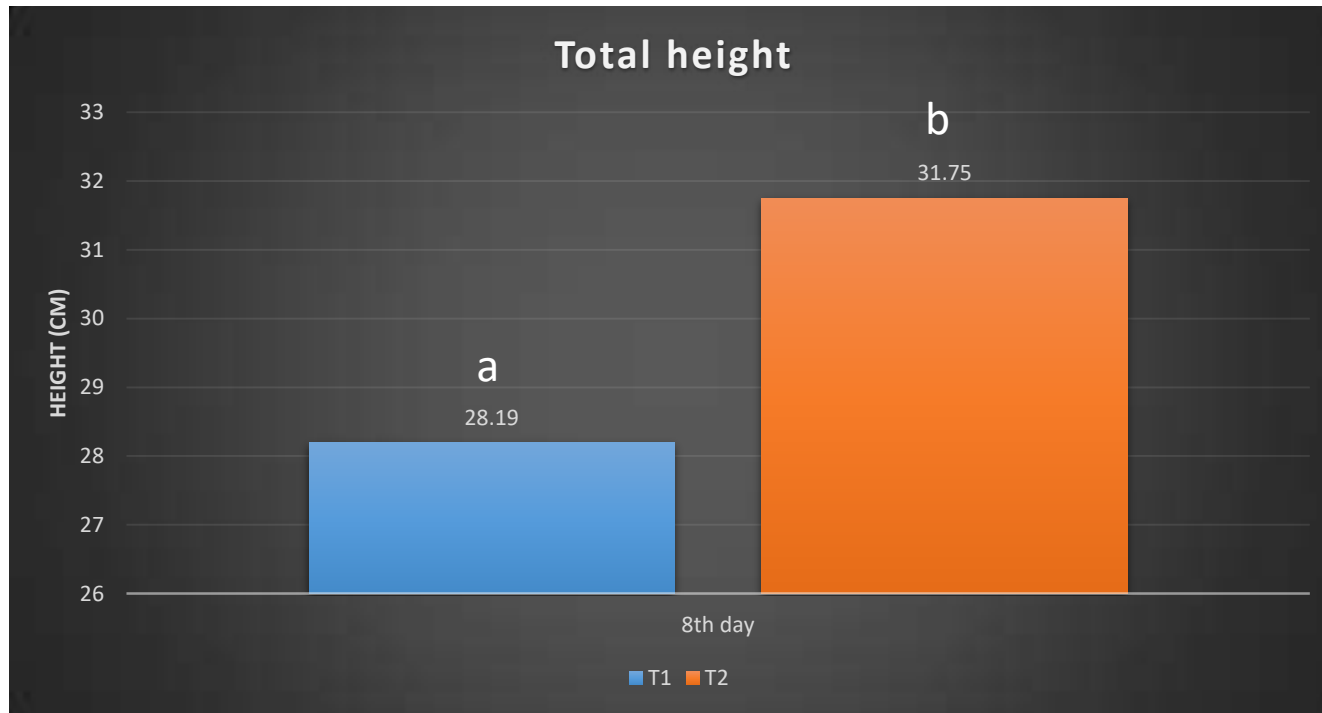
Data analysis

- Data was analyzed using
 - Pooled t test
 - Descriptive statistics like charts and graphs

Results and discussion

Objective 01

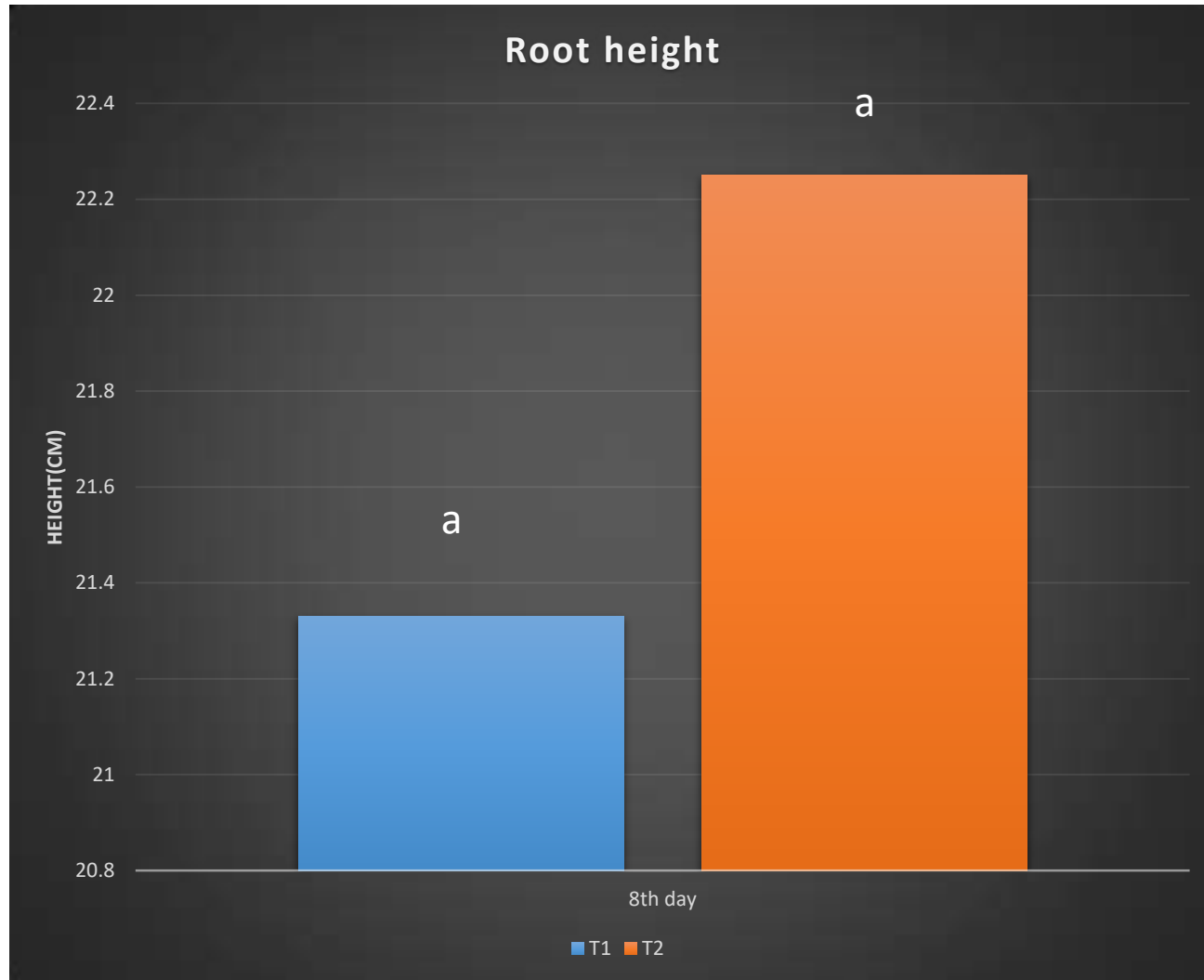
- Nursery stage - Total height



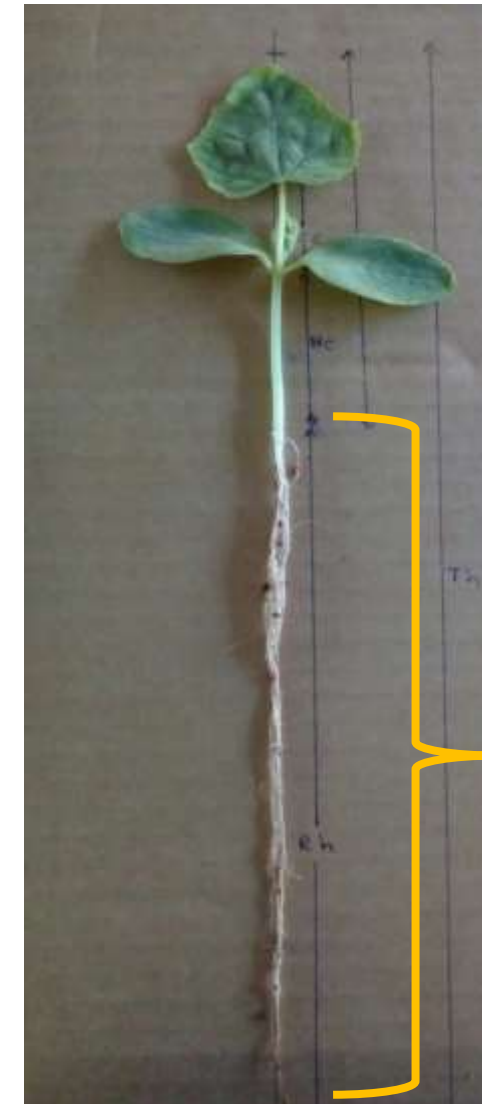
- The different apostrophe denotes significant difference between 2 treatments according to pooled t test
- Error bars show the standard error

Less height in a seedling is a prediction of less vine length in cucurbits (Grange and Hand, 2017).

- **Root height**

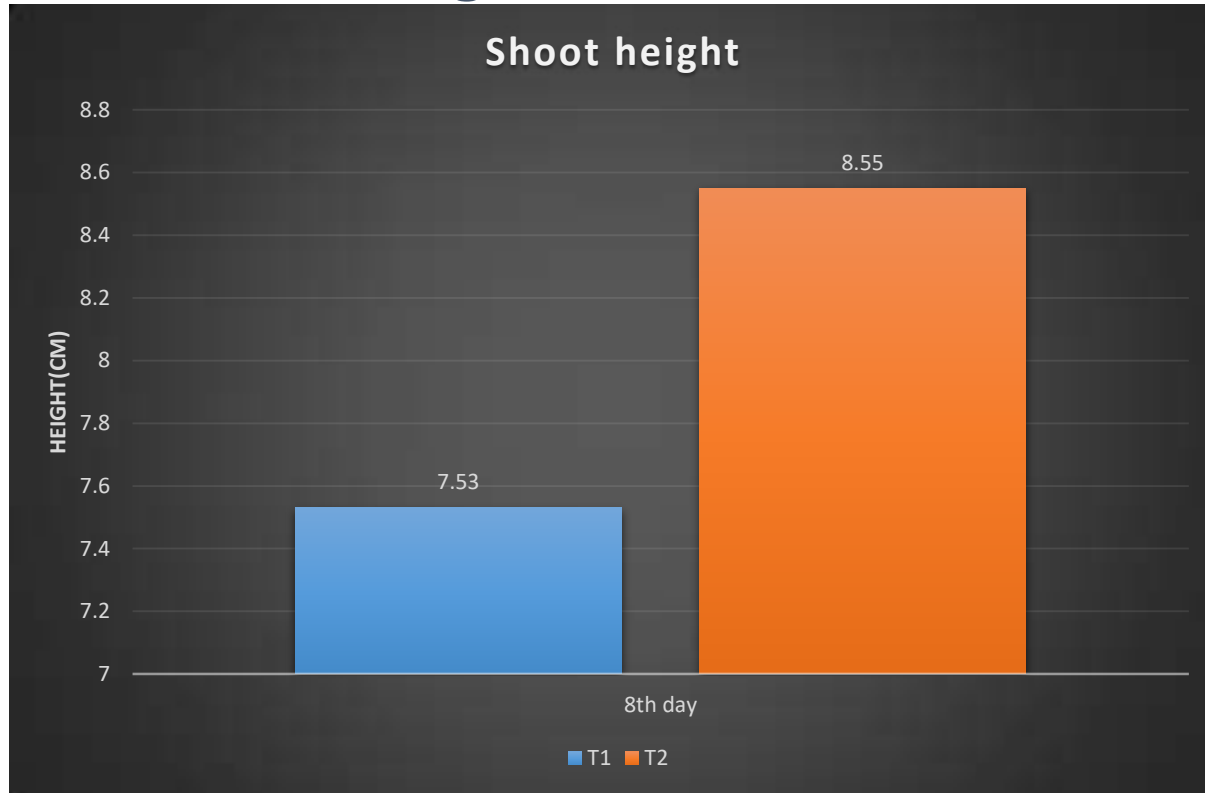


The same apostrophe denotes no any significant difference between two treatments in pooled t test



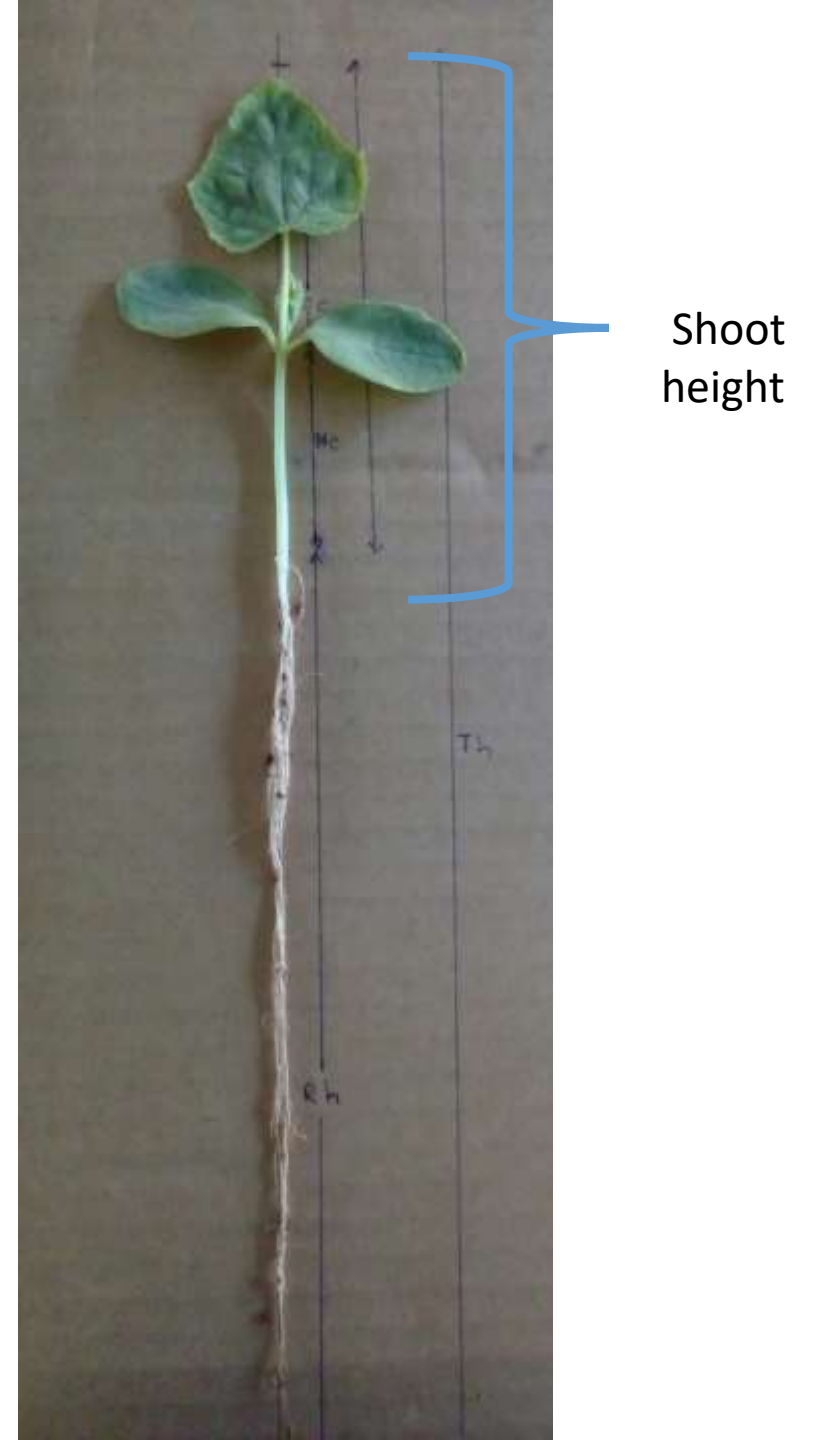
Root height

- Shoot height

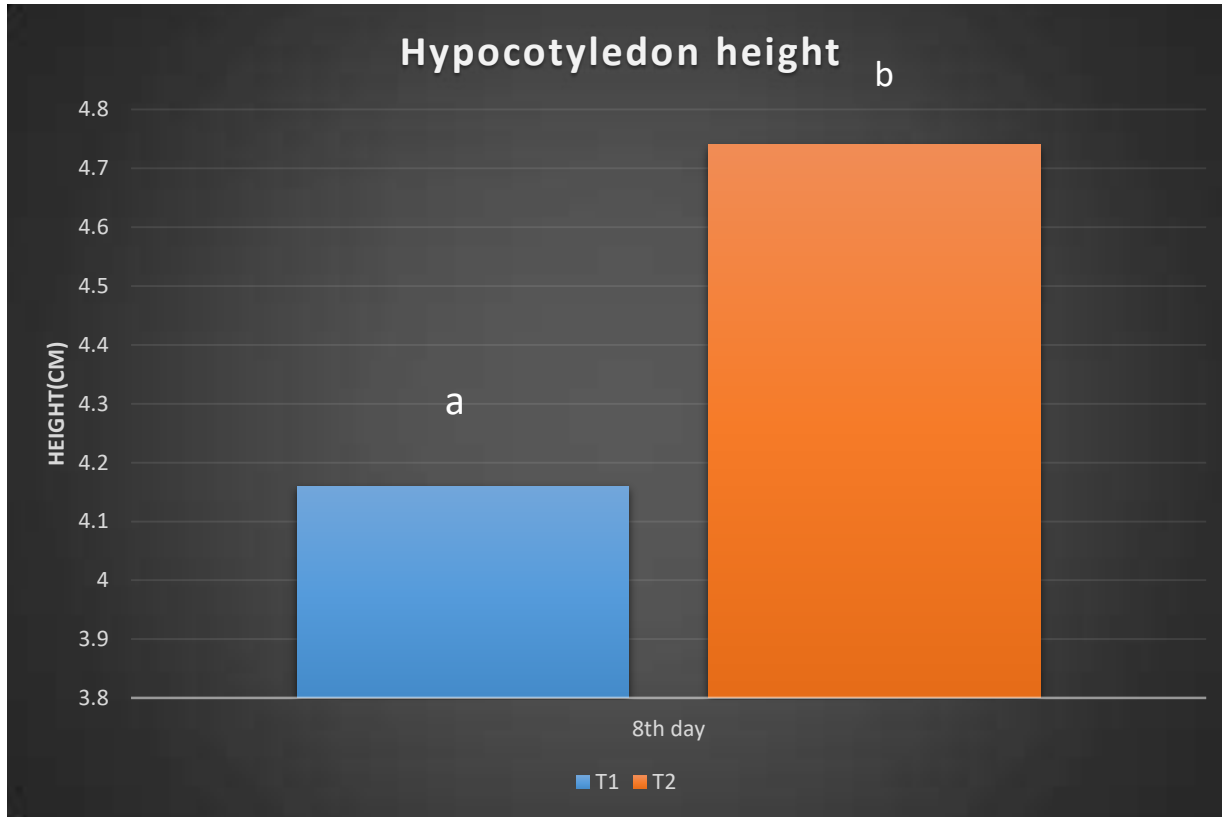


Less shoot height in a seedling is a prediction of less vine length in cucurbits (Hat and Prueger, 2015).

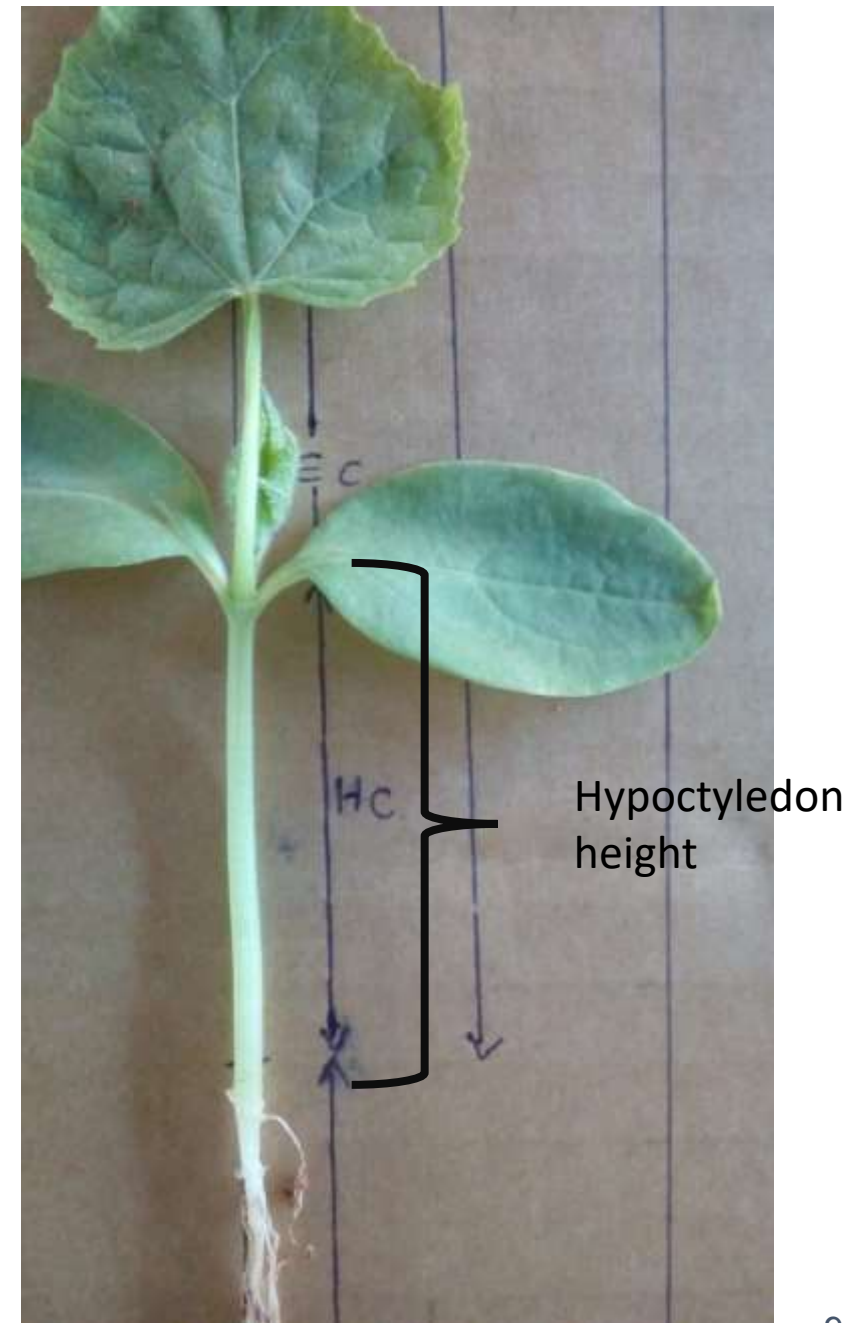
The different apostrophe denotes significant difference between two treatments according to pooled t test



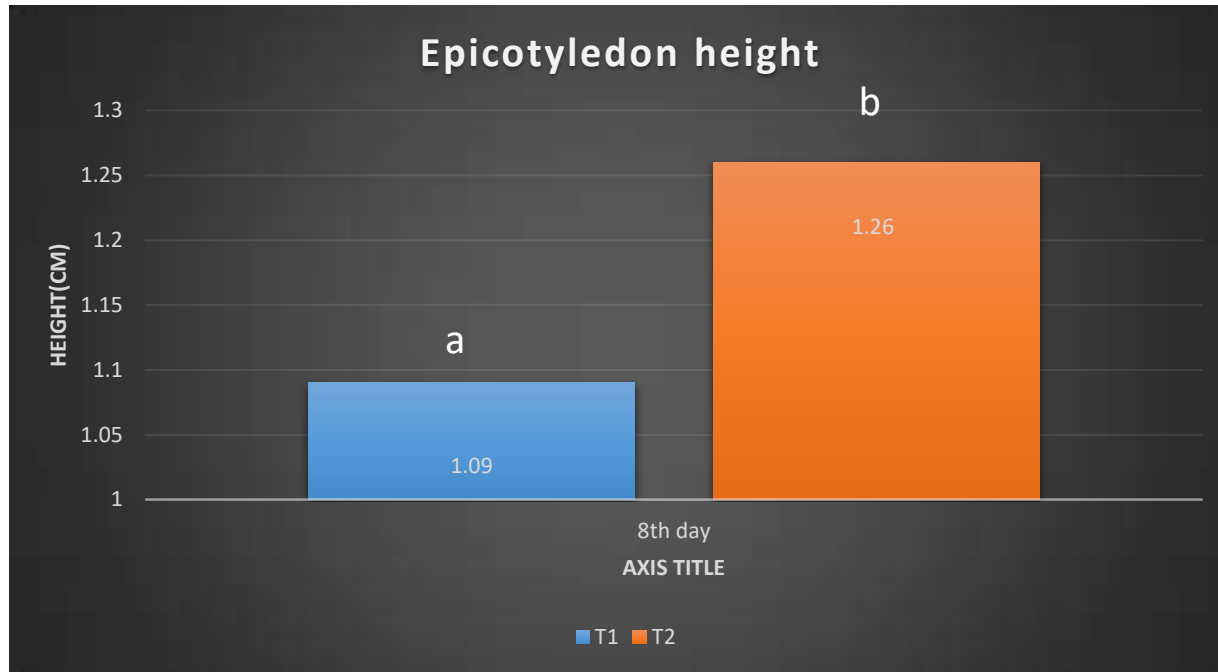
- Hypocotyledon height



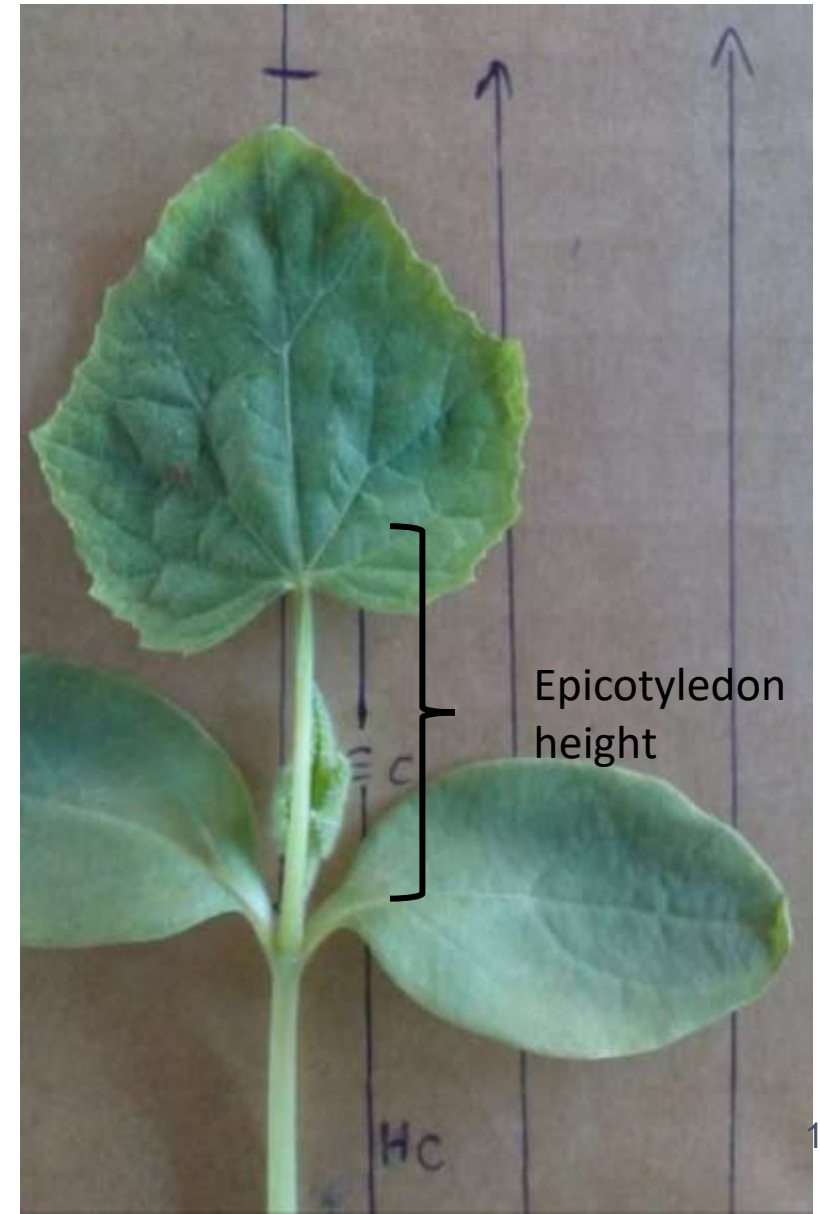
Less hypocotyledon height result a plant with more stability (Hat and Prueger, 2015)



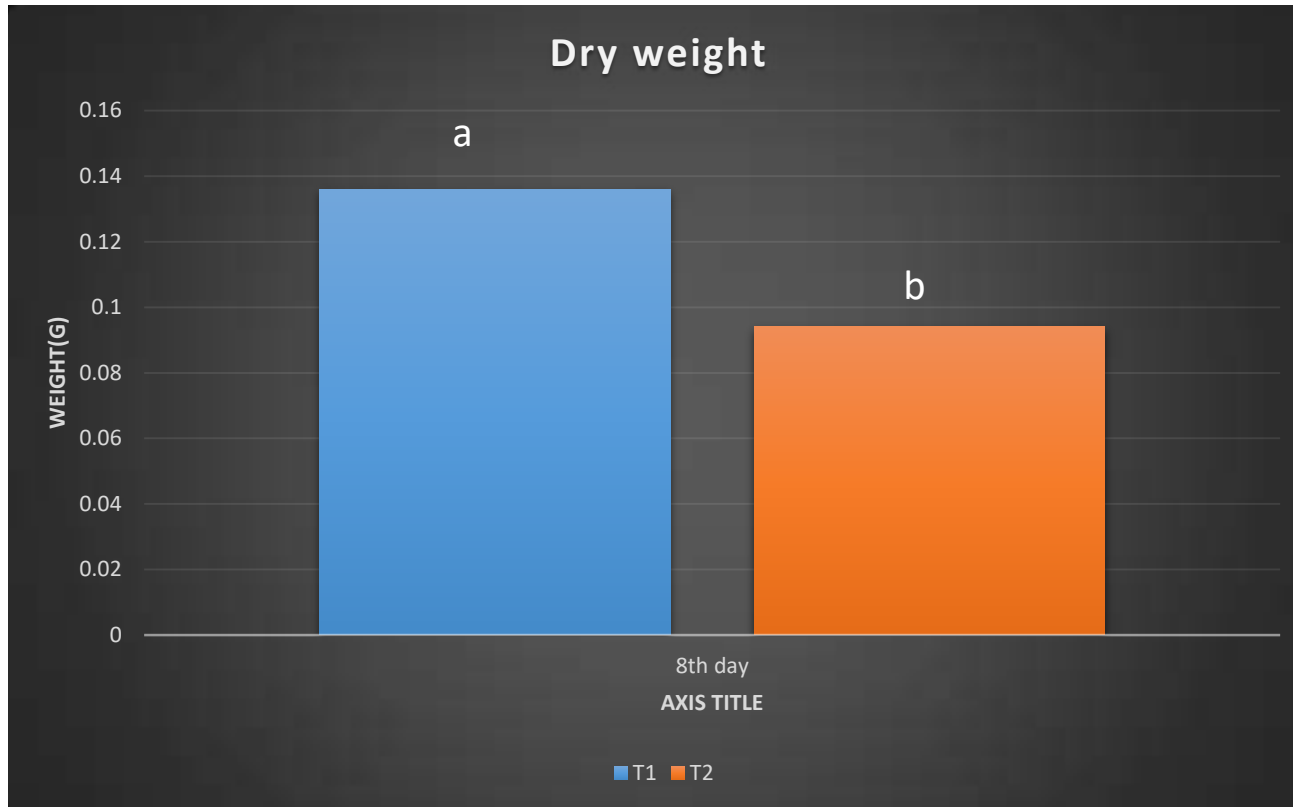
- Epicotyledon height



Low epicotyledon length result a less intermodal length in grown up plant (Smit and Skinner, 2002).



- **Dry weight**

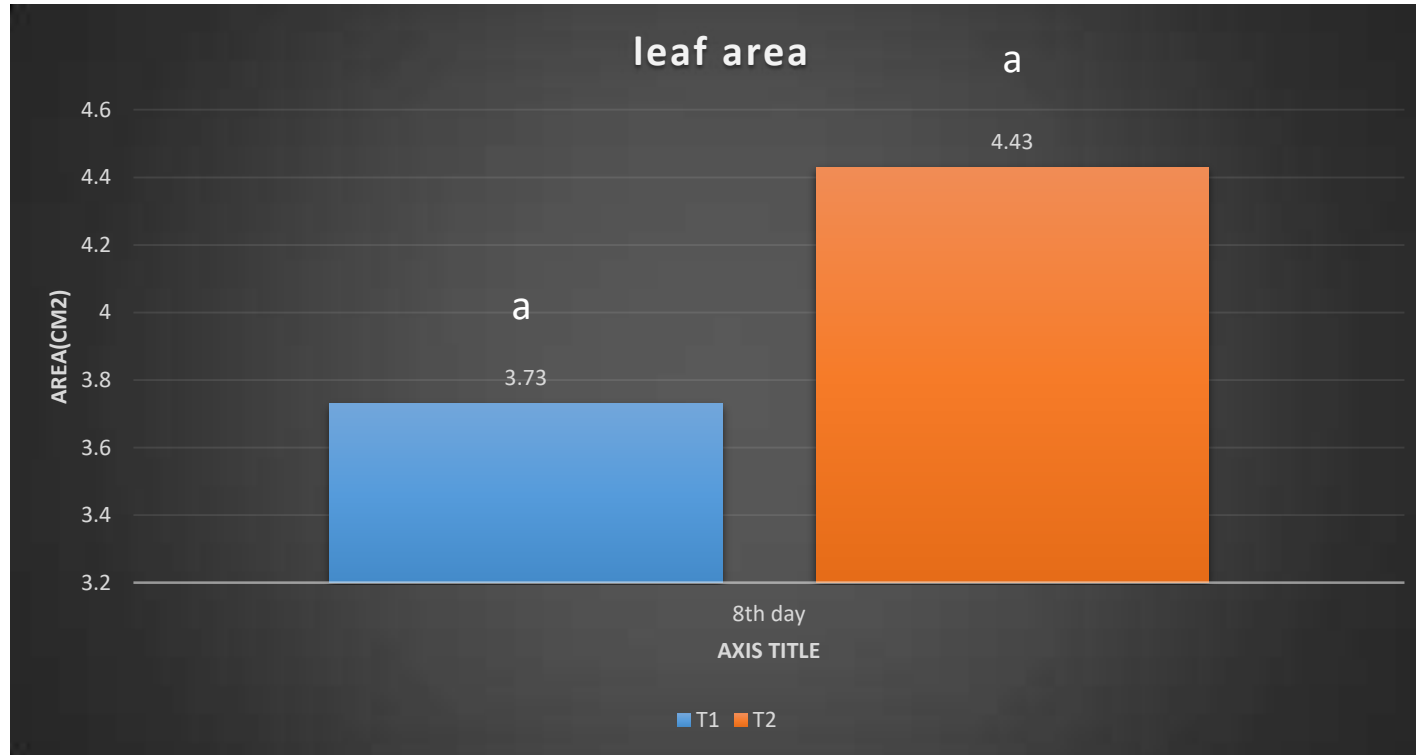


Increased dry weight

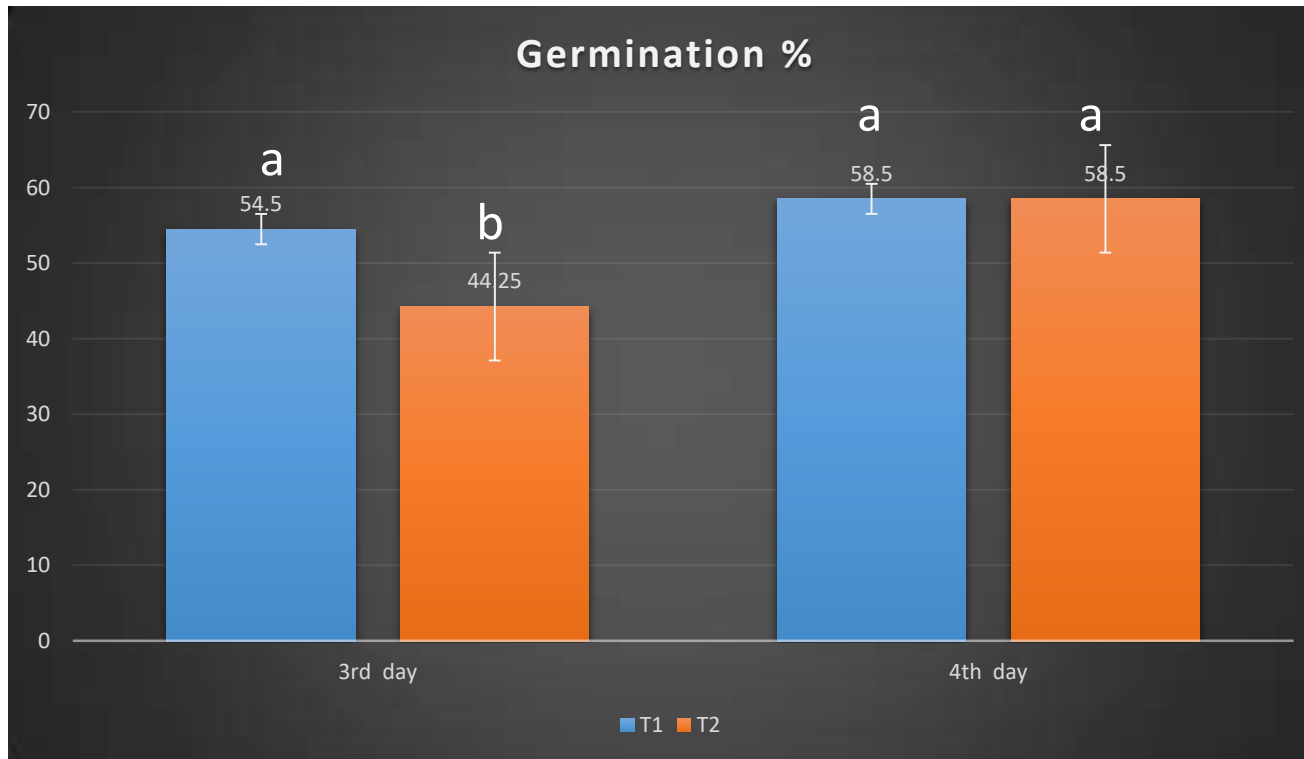


high photosynthesis rate
high net accumulation rate
Low respiration
(Smit and Skinner, 2002).

- Leaf area



● Germination percentage



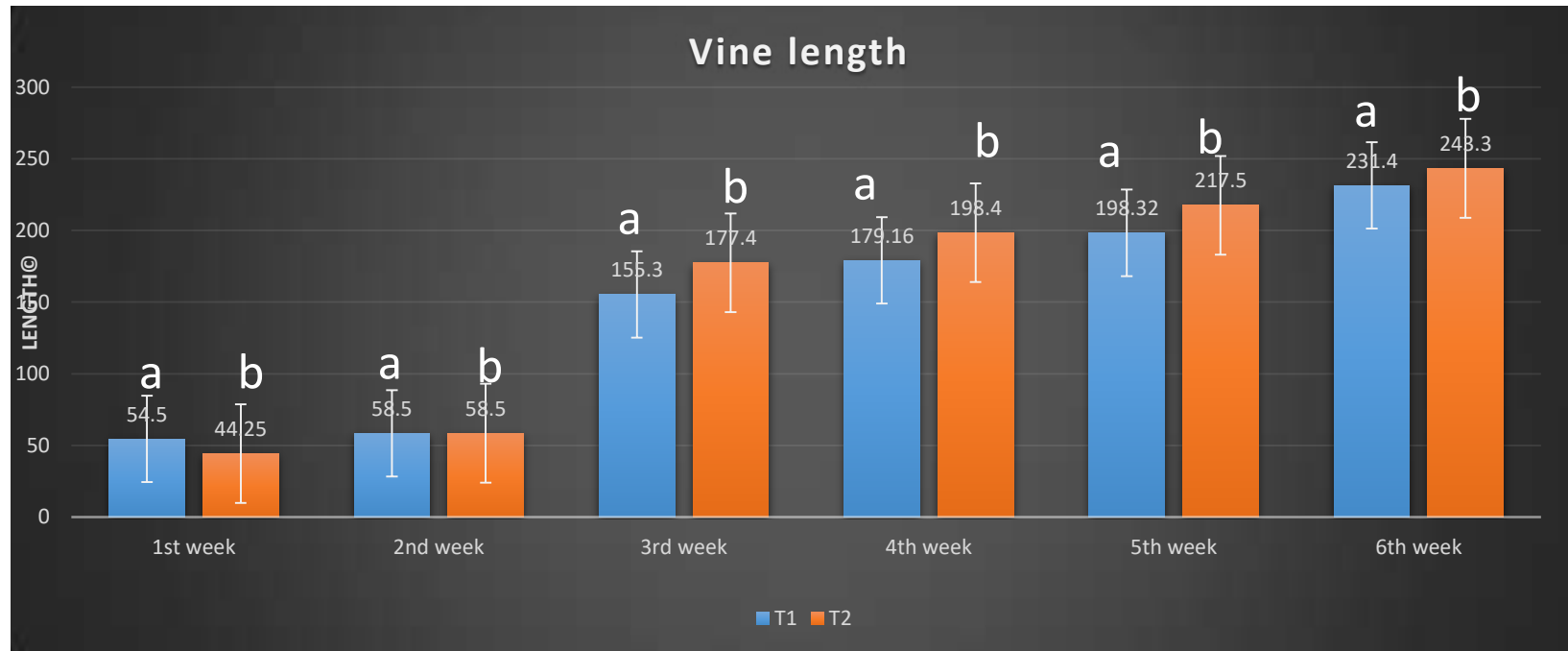
Early germination result a lengthy harvesting cycle in cucurbits.

(Khanna and Zilberman, 1997)



Vegetative phase

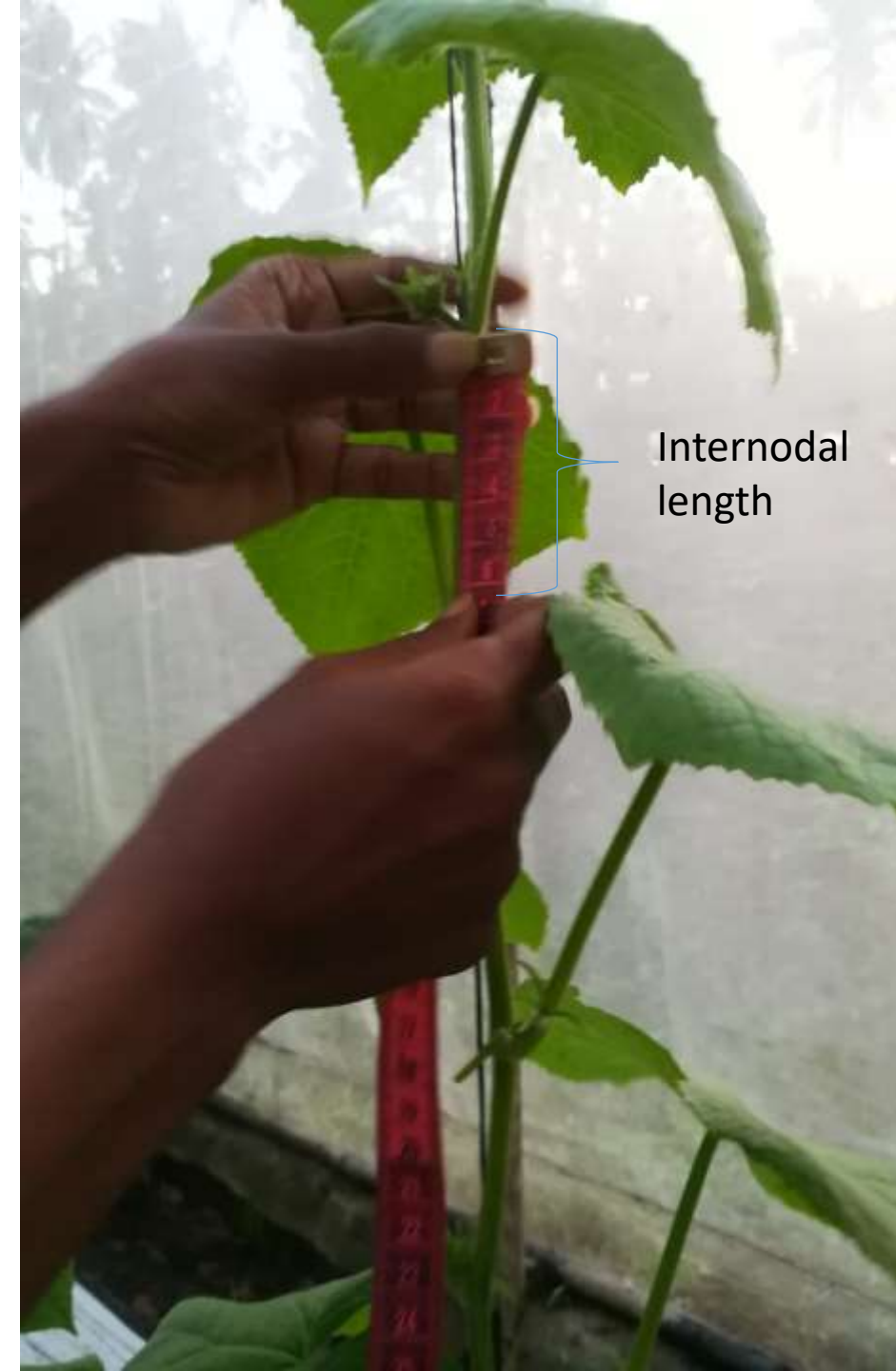
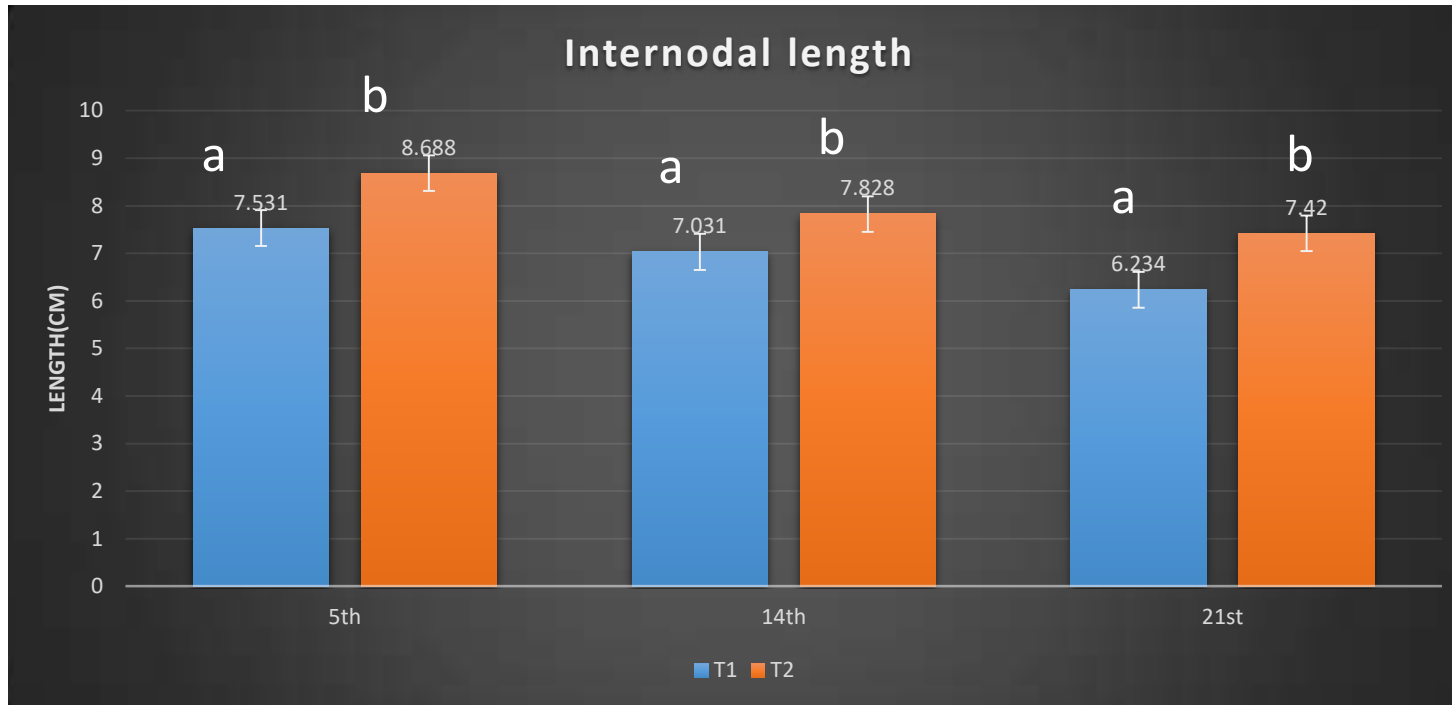
- **Vine length**



Increased vine length

- management practices become hard
 - low energy for reproductive phase
 - High energy consumption in vegetative phase result
 - Reduction of length of harvesting cycle
- (Barker and Mill, 2017)

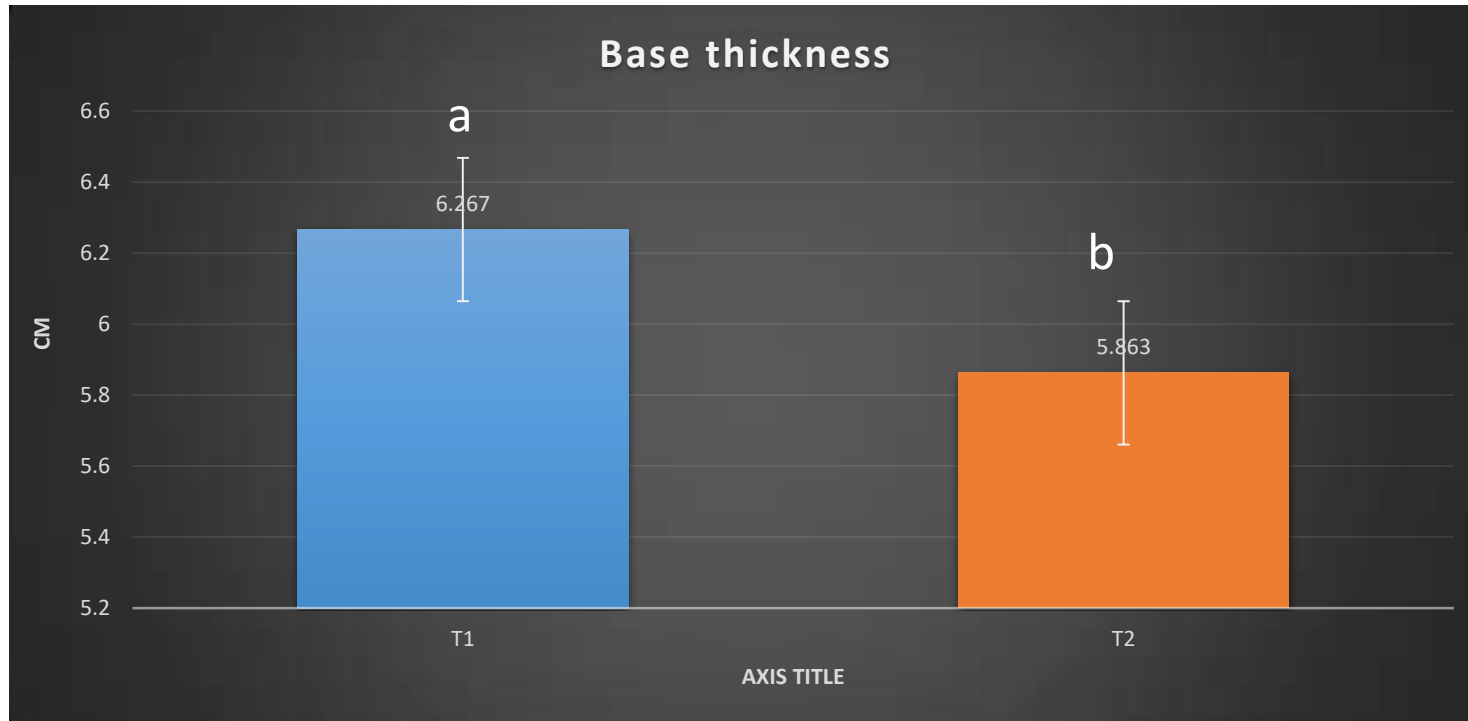
- Internodal length



Increased internodal length → Sign of stress undergone by plant

(Prakash, Sajeena and Lakshminarayana, 2017)

- **Base thickness**

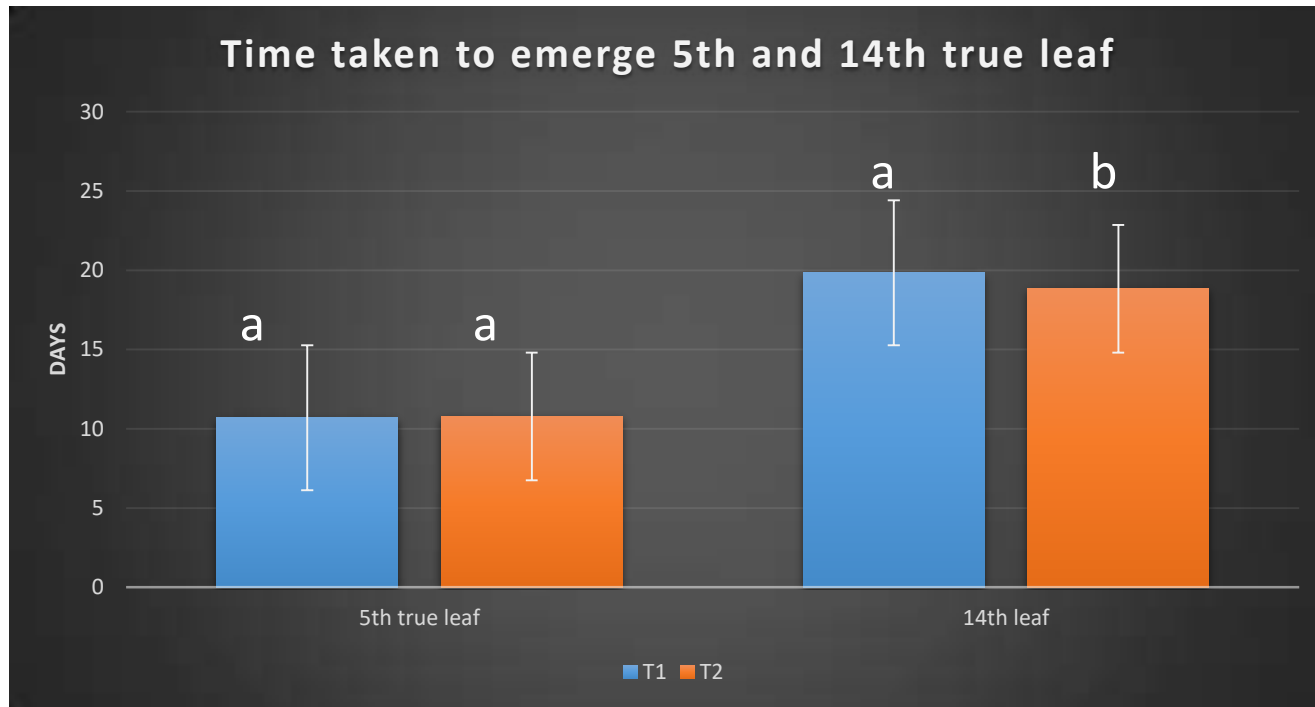


Increased base thickness  more vigorous plant

(Grange and Hand, 2017)



- Time taken to emerge 5th true leaf and 14th leaf

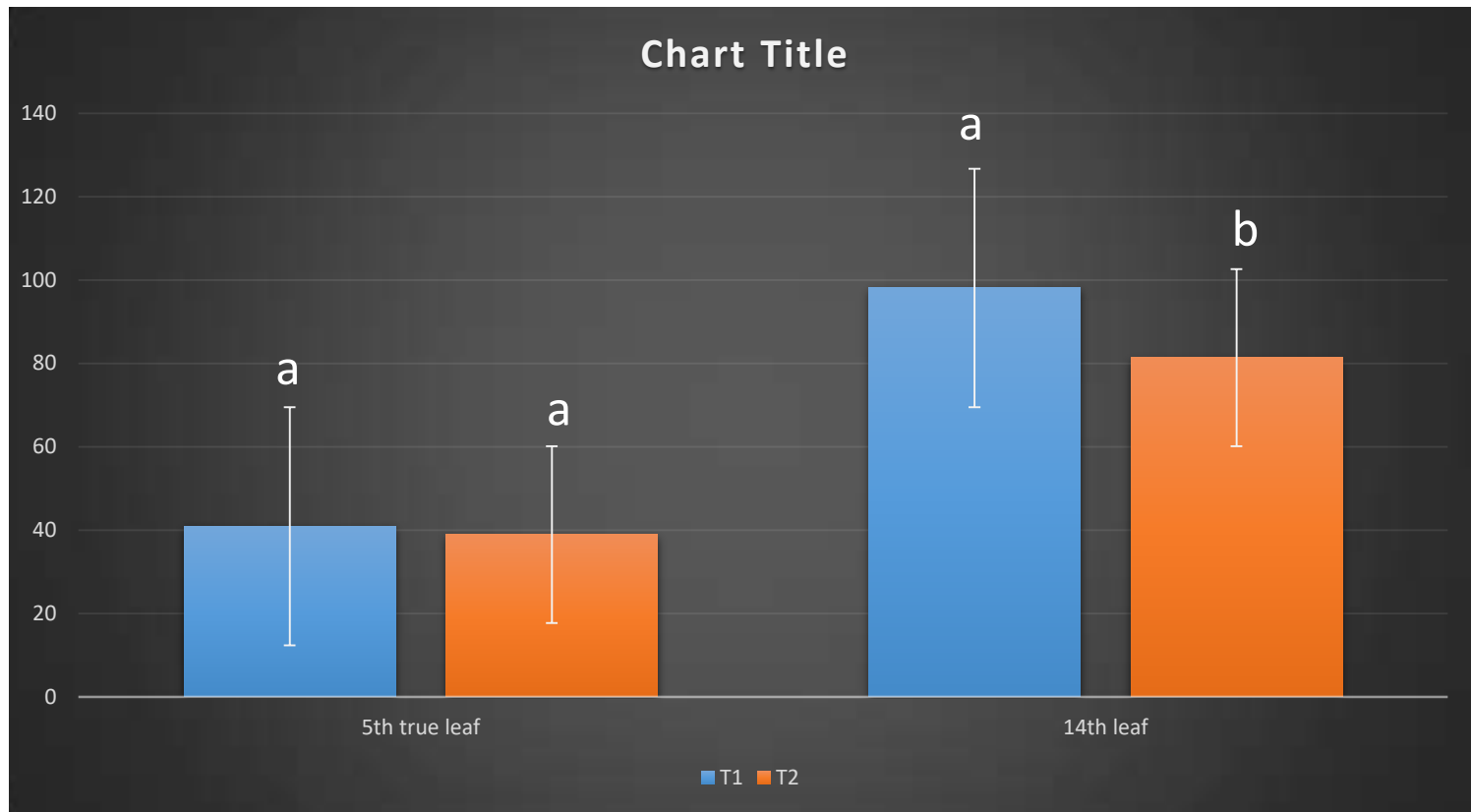


Early leaf emergence

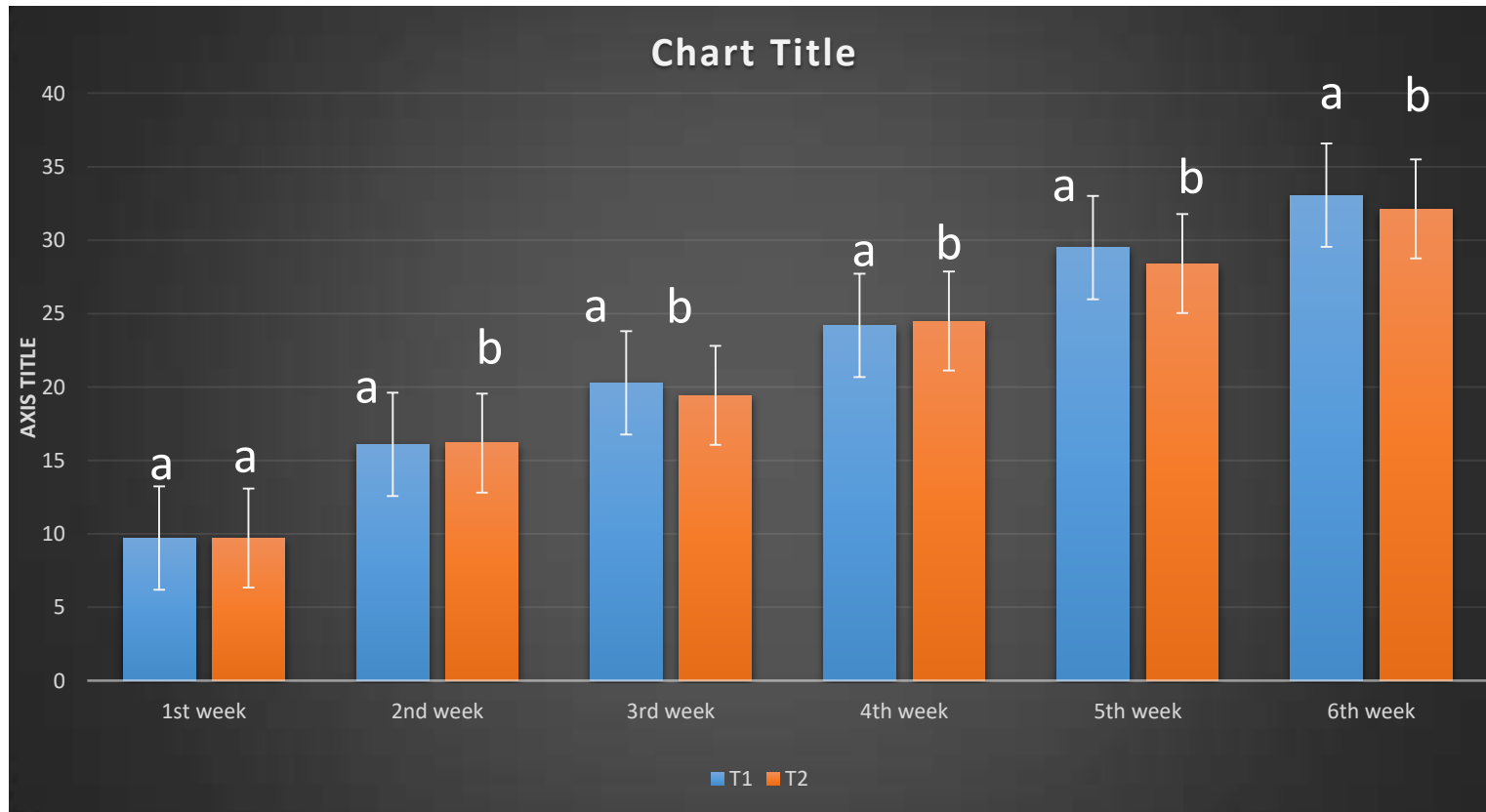


indicator of high temperature
Reduce harvesting period
(Mortensen, 2000)

- Chlorophyll content of 5th true leaf and 14th leaf



- Number of leaves per unit length of vine



More number of leaves per unit length of vine

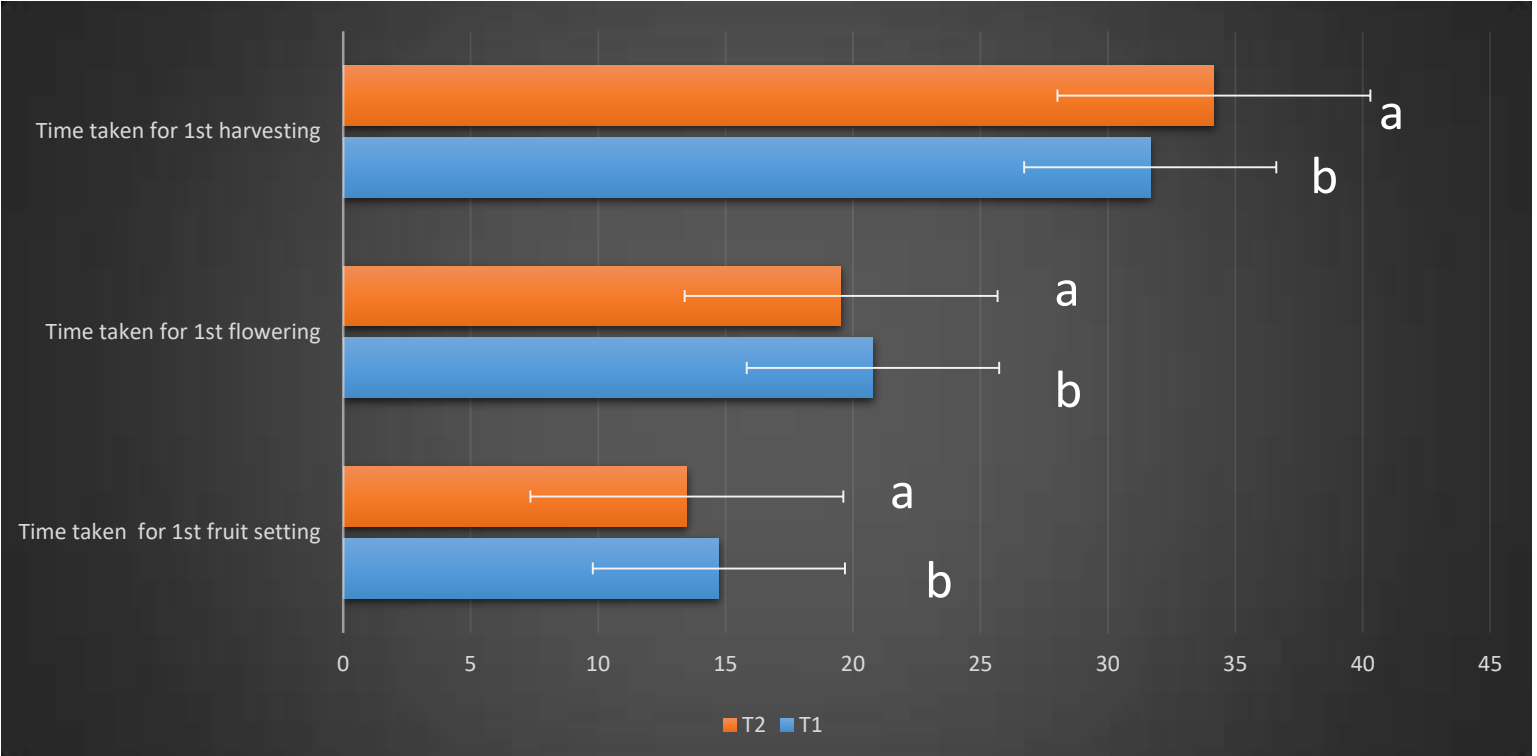


more nodes per unit length
more fruits per unit length
(Mortensen, 2000)



Reproductive phase

- Time taken to 1st fruit setting, 1st flowering and 1st harvest



1st flowering

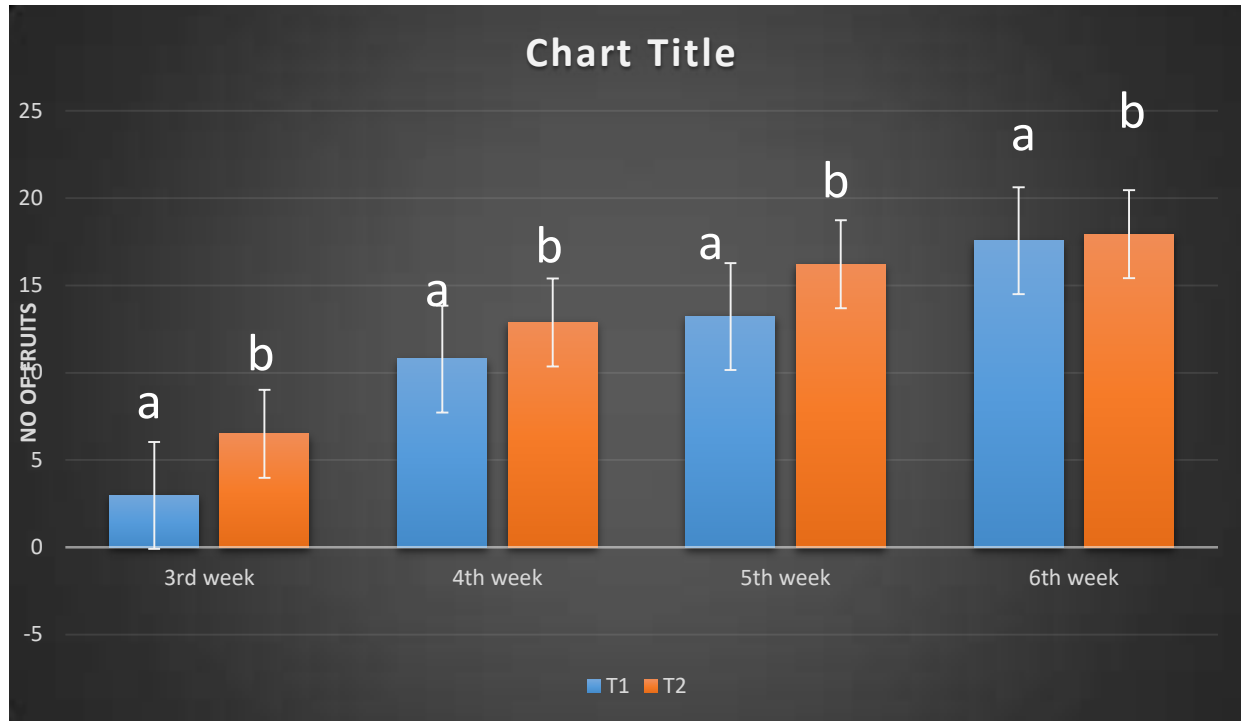


1st flower appearance

Early flower appearance & early first flower appearance
sign of stress

Early first harvest → sign of a lengthy harvesting cycle
(Mortensen, 2000)

- Aborted fruits per vine

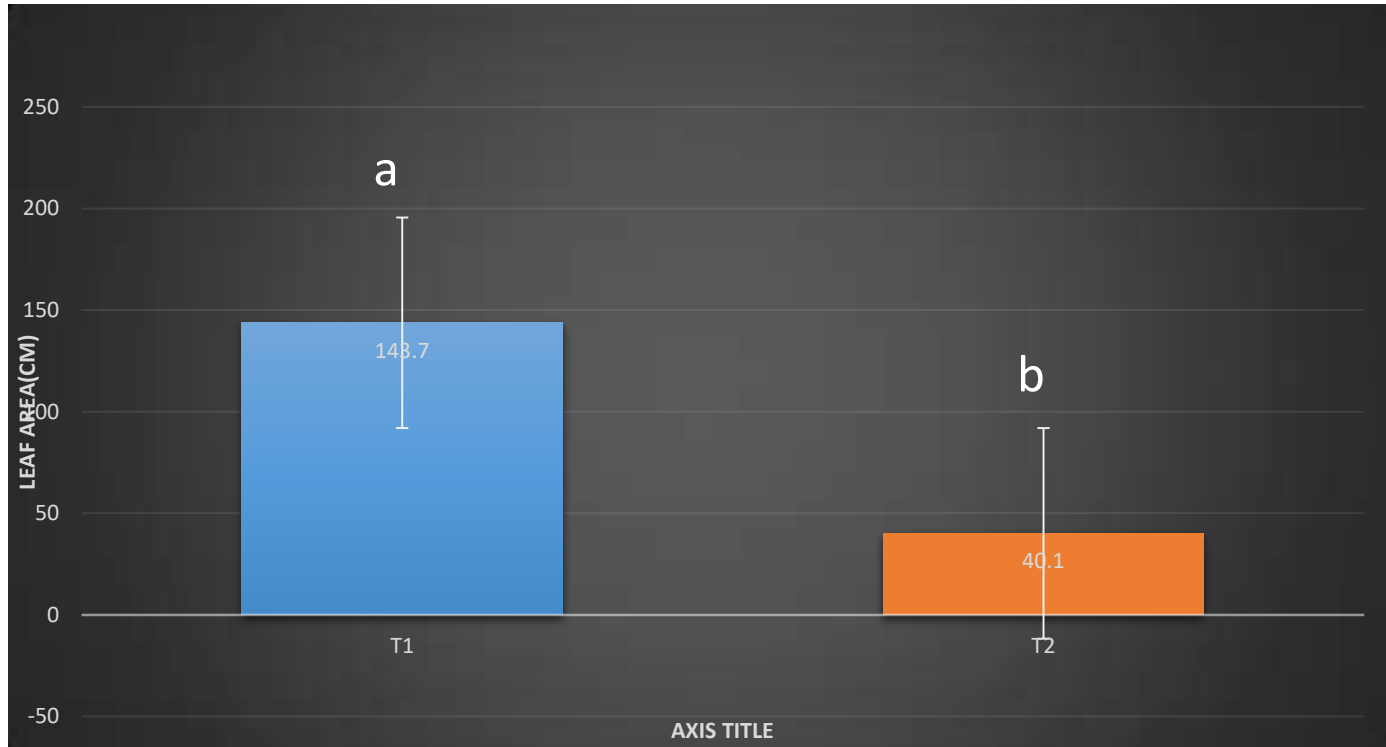


More aborted fruits → sign of inadequate microclimatic conditions during reproductive phase

(Shamshiri and Ismail, 2013)

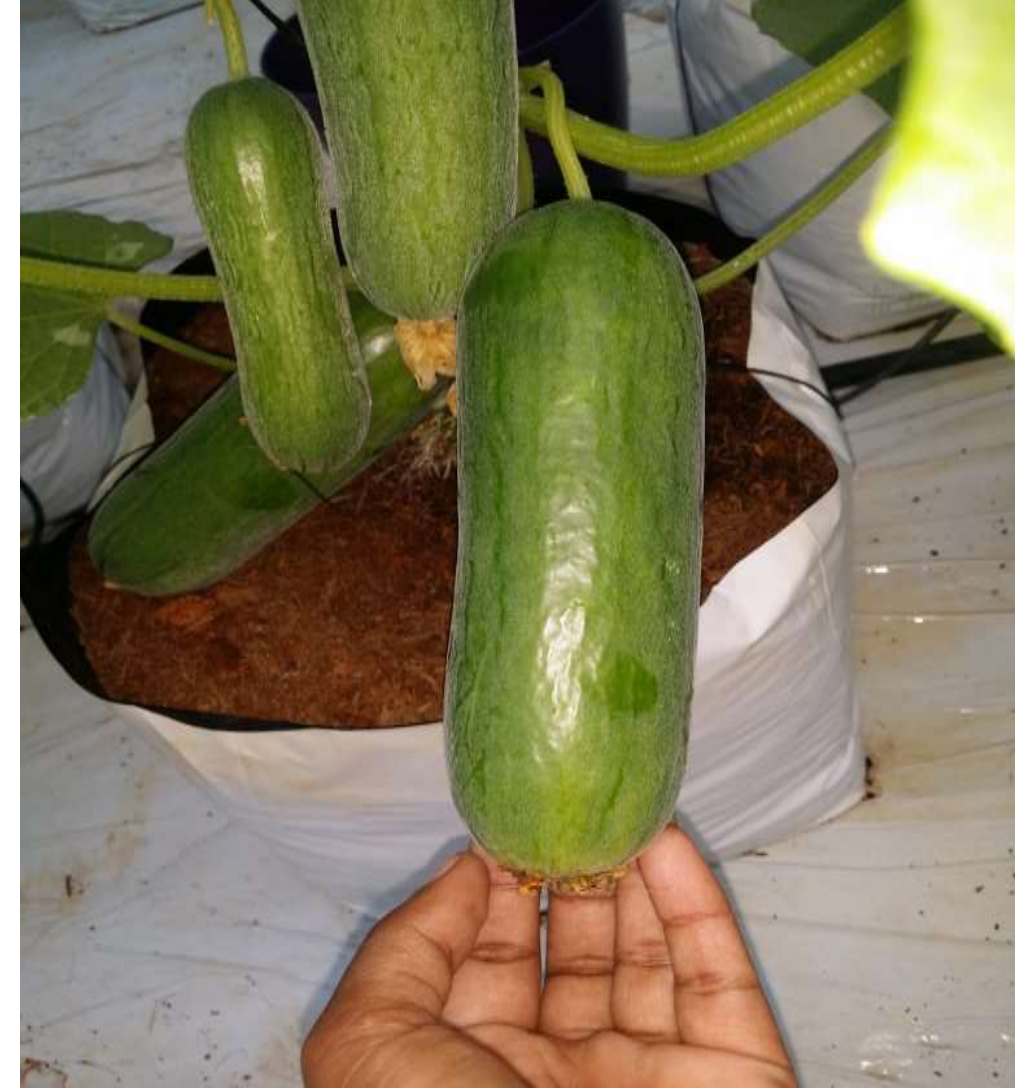
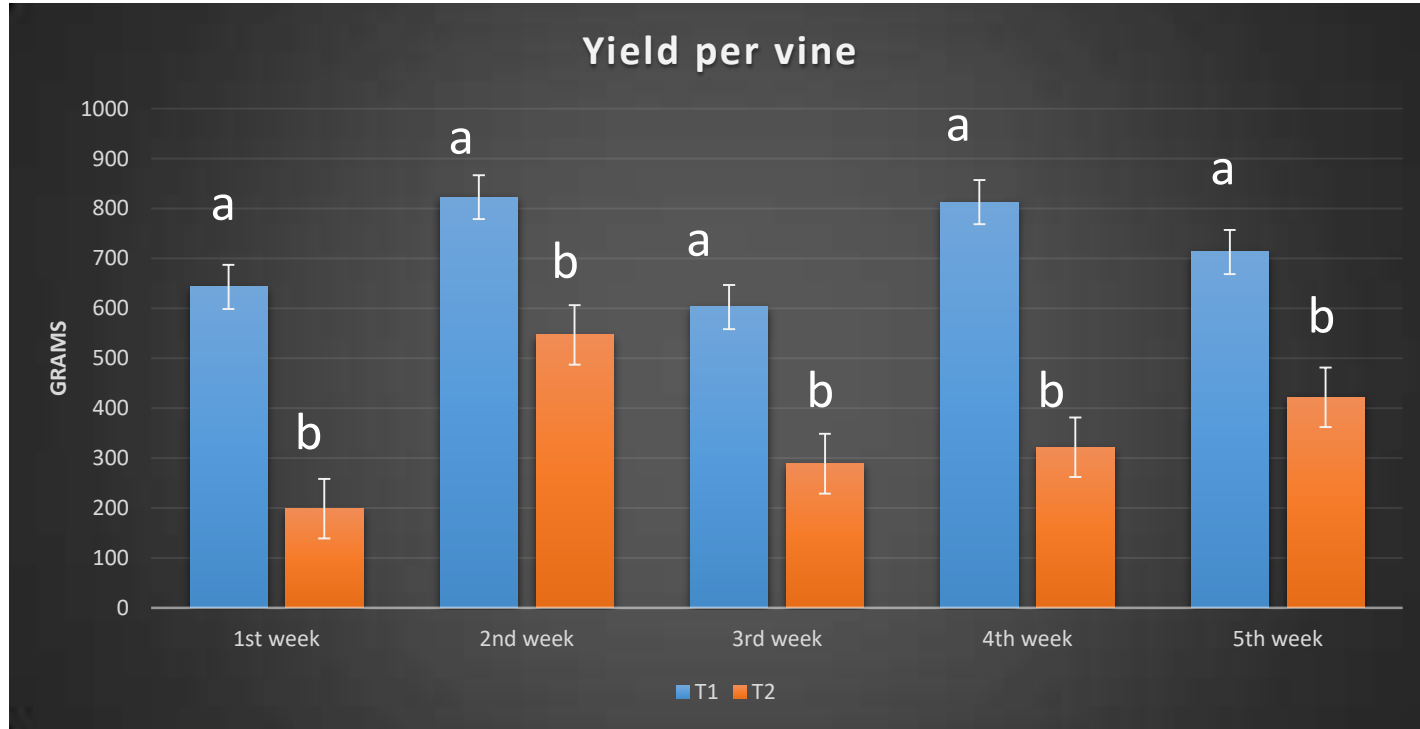


- **Disease severity**



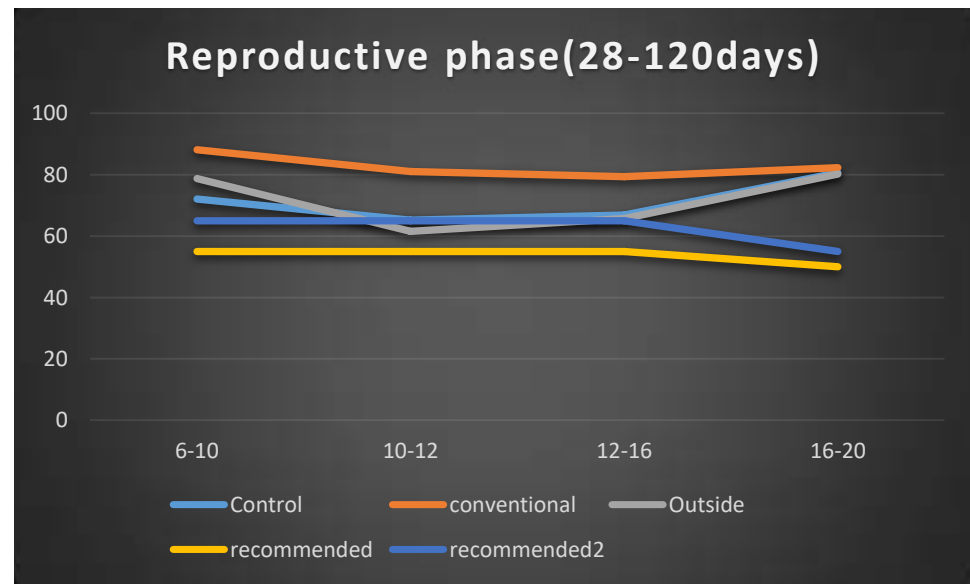
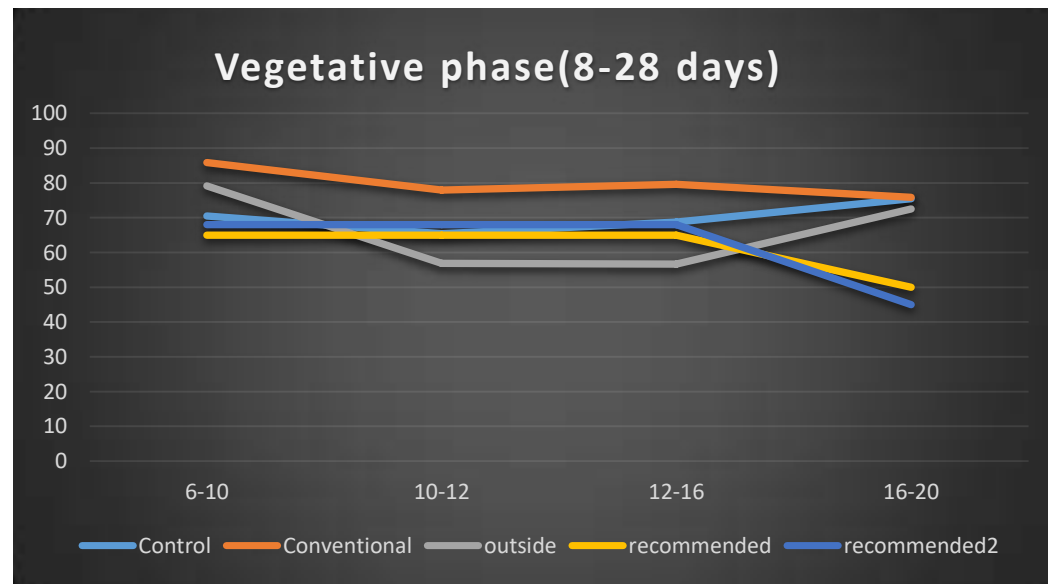
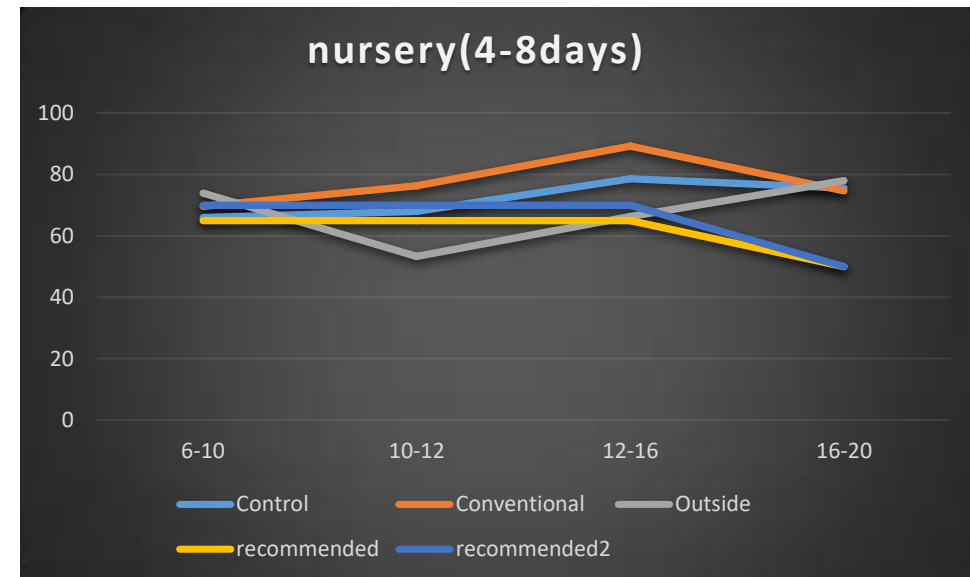
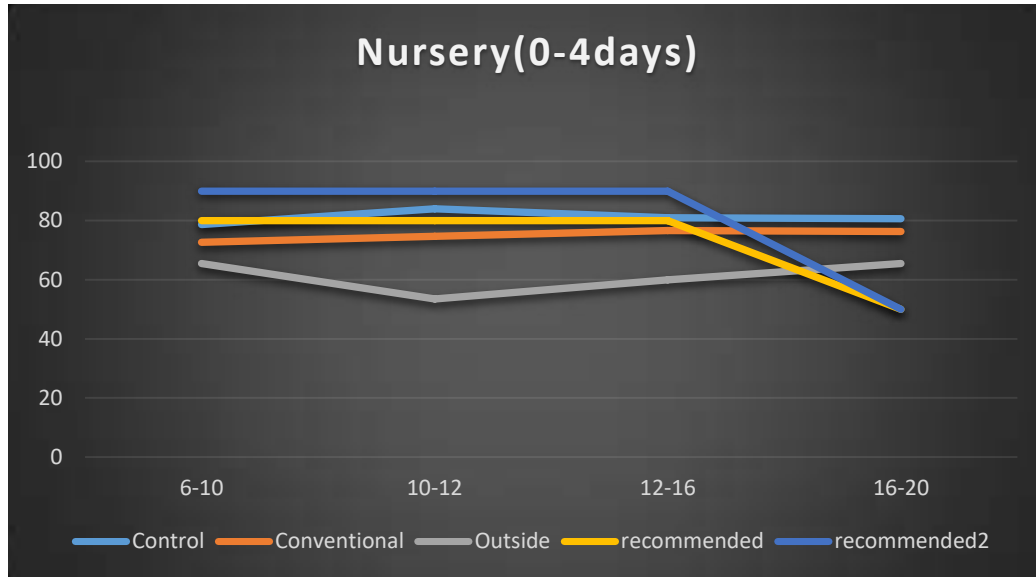
Downy mildew

- Yield per vine

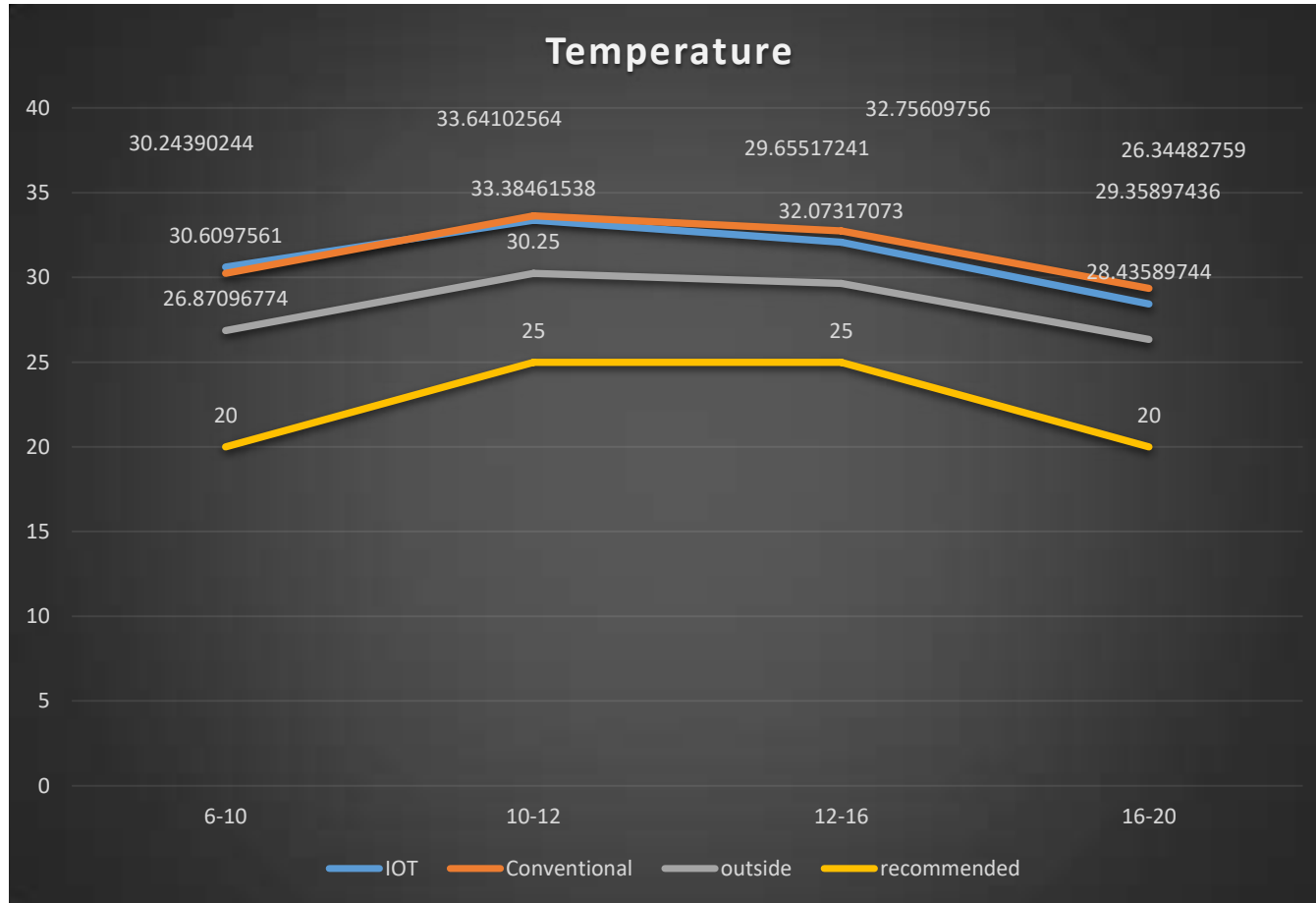


Objective 02

- Relative humidity



• Temperature



Conclusion

- The growth parameters showed a positive effect on yield increment in IoT based protected house when compared with the conventional protected house.
- There was a average 41.6% yield increment of in IoT protected house that that of conventional protected house.
- The microclimatic conditions were able to maintain in a range which has a positive impact on yield and growth parameters of Salad cucumber.
- The IoT based protected house is economically feasible.