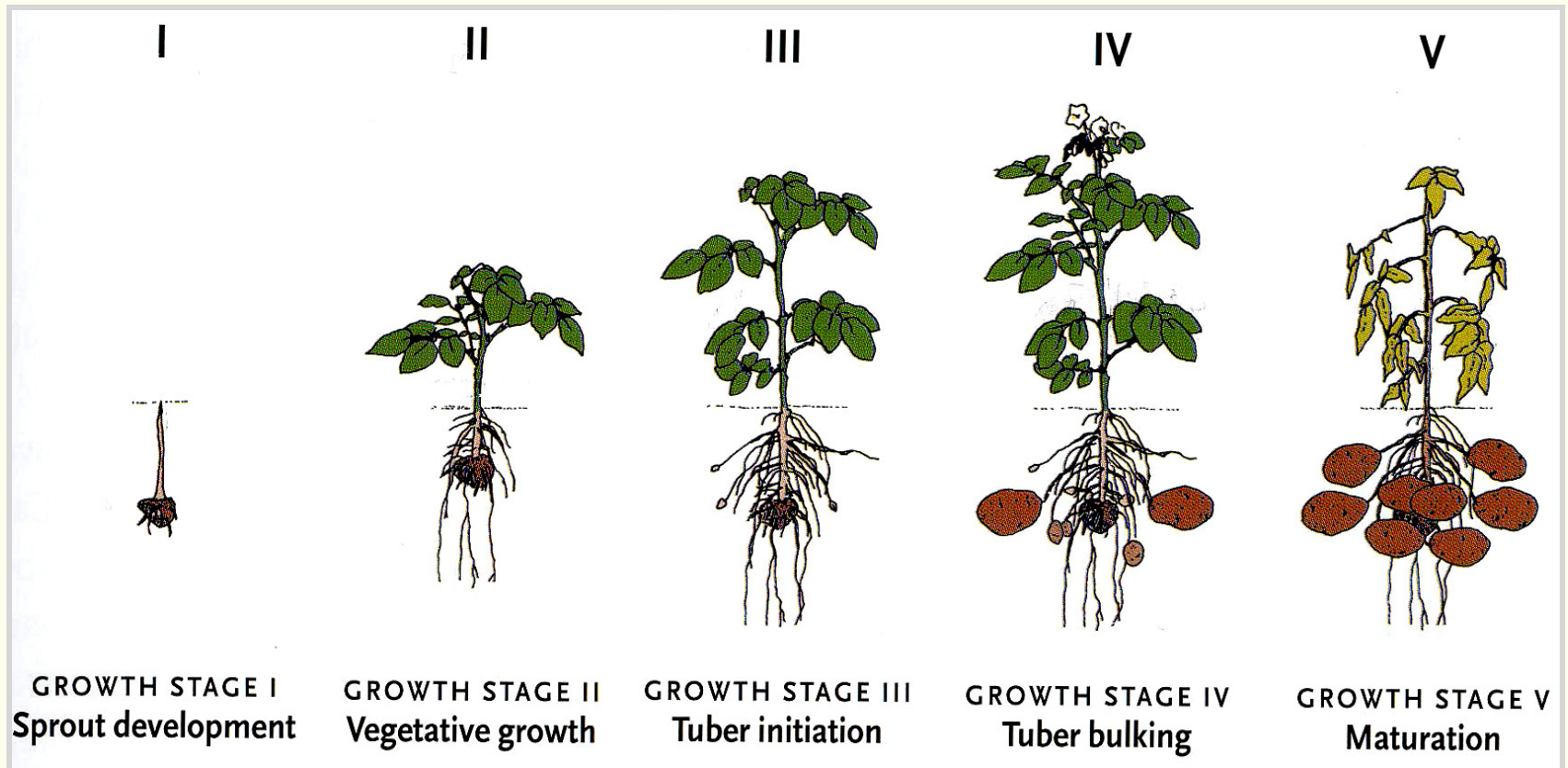


# Potato Growth and Development

## Dr. Mike Thornton

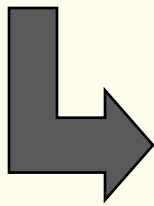
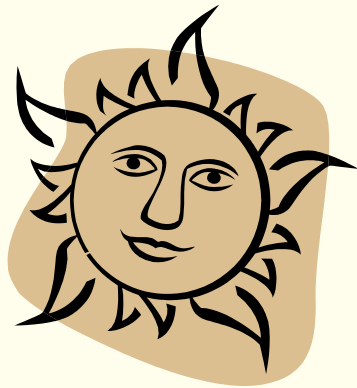


# Potato Growth Stages

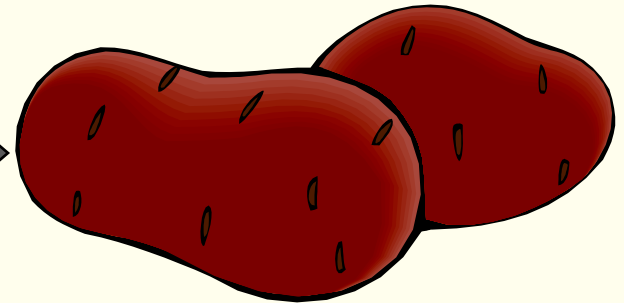
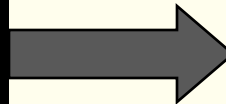


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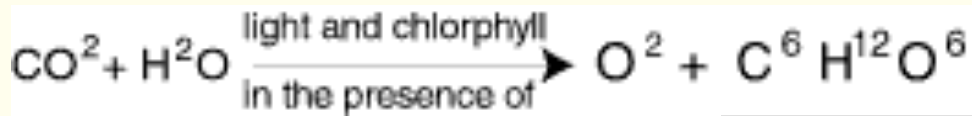
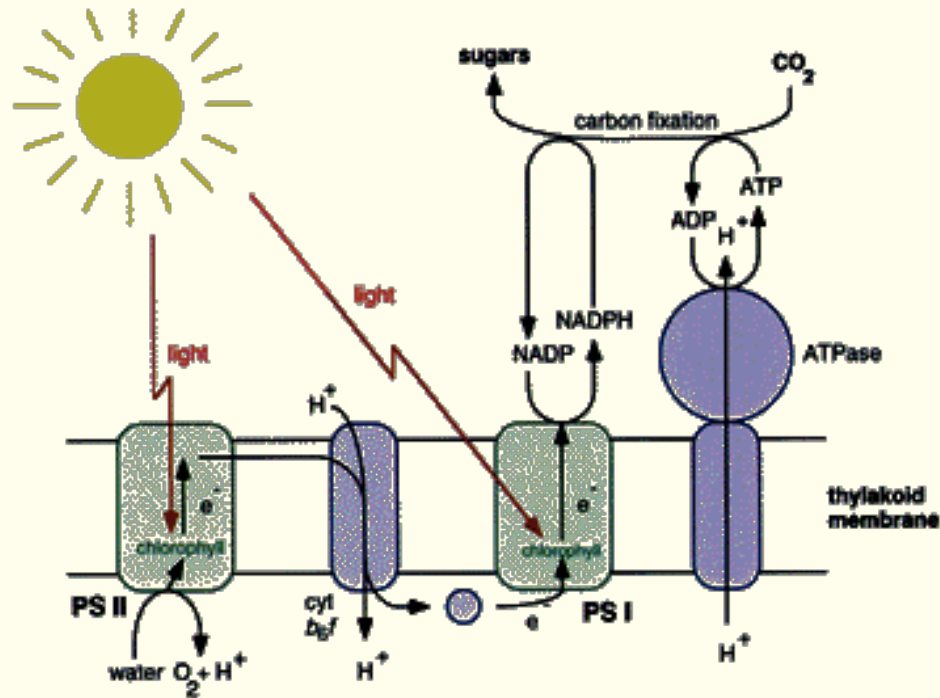
- The potato plant is basically a starch factory



**Over 90% of tuber dry matter comes from photosynthesis**



# Photosynthesis - only in leaves



Sugar – a form of stored energy

# Components of the potato “factory”

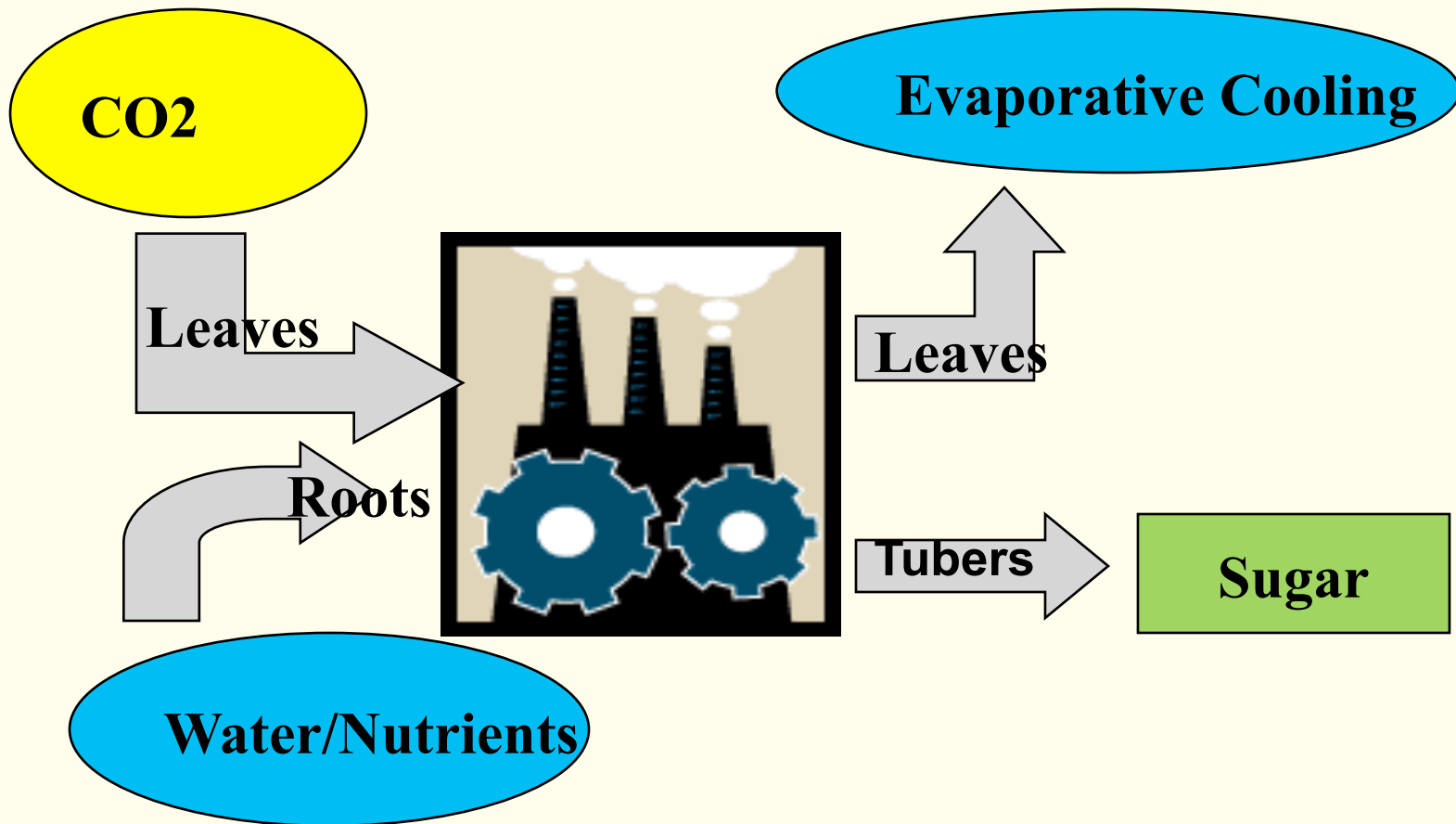
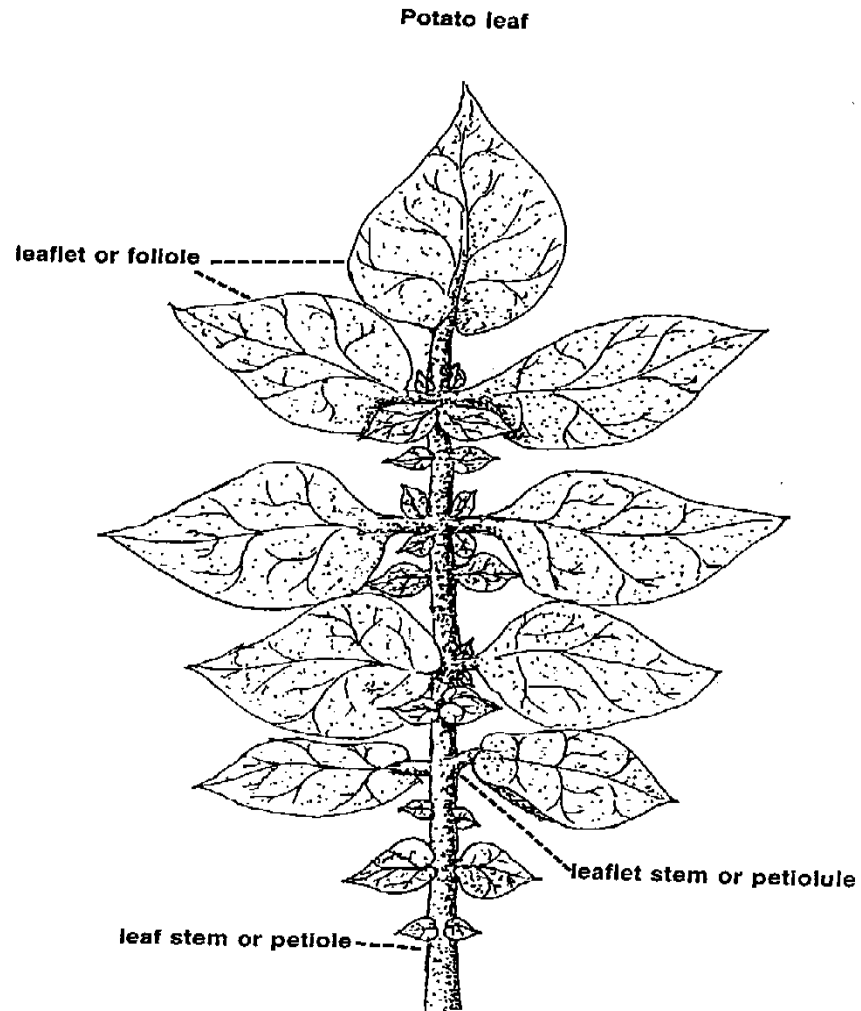
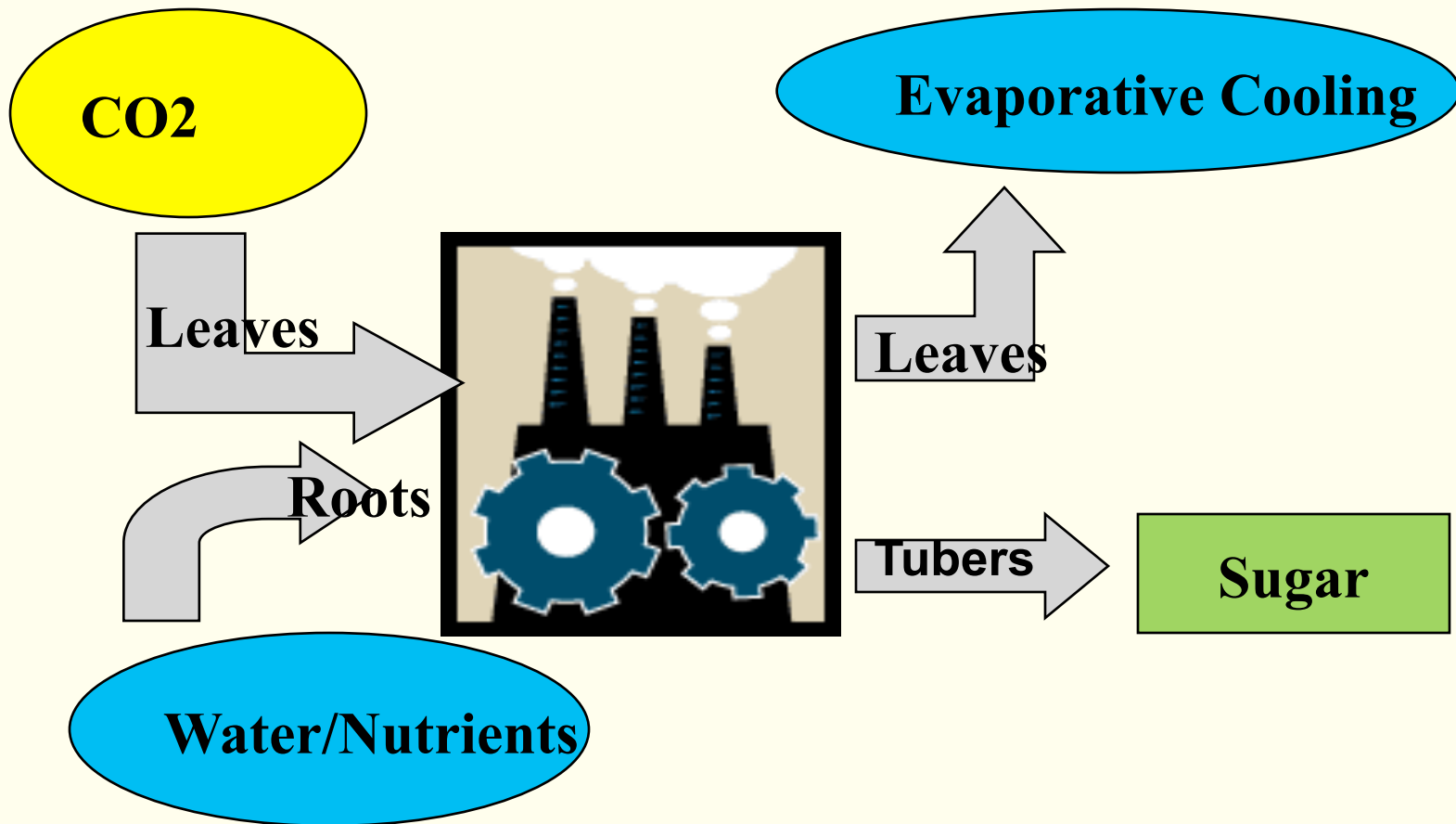


FIGURE 8. The leaf arrangement on a potato petiole.



# Components of the potato “factory”



# What do we know about potato root systems?

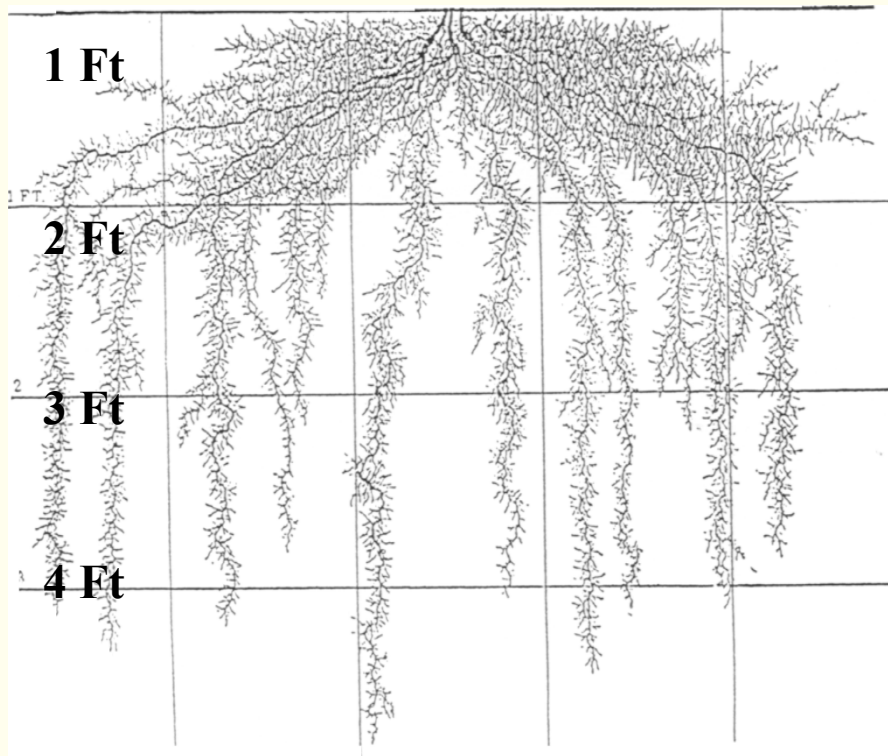
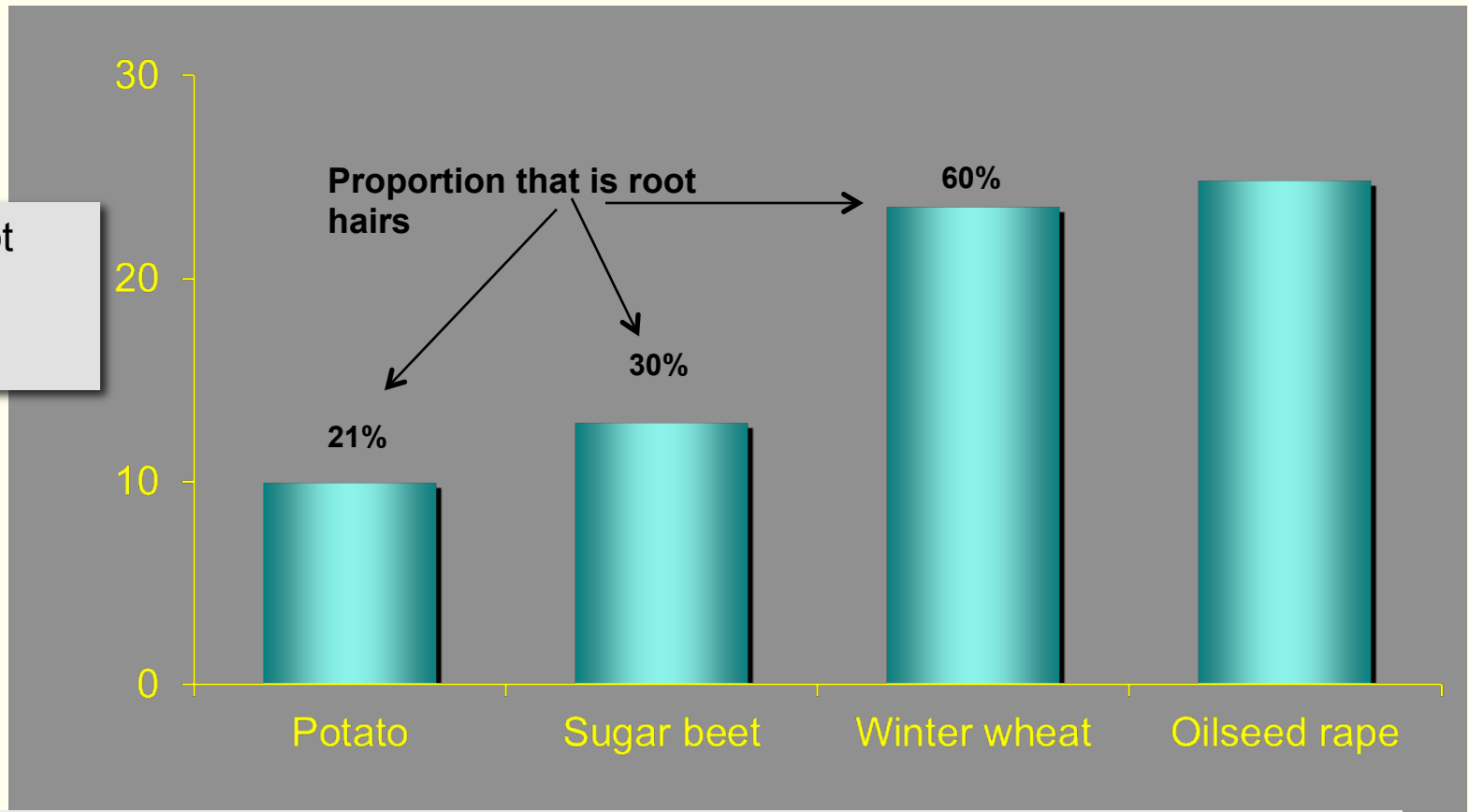


Photo by M. Stalham, CUP

**Modified from Weaver (1926)**

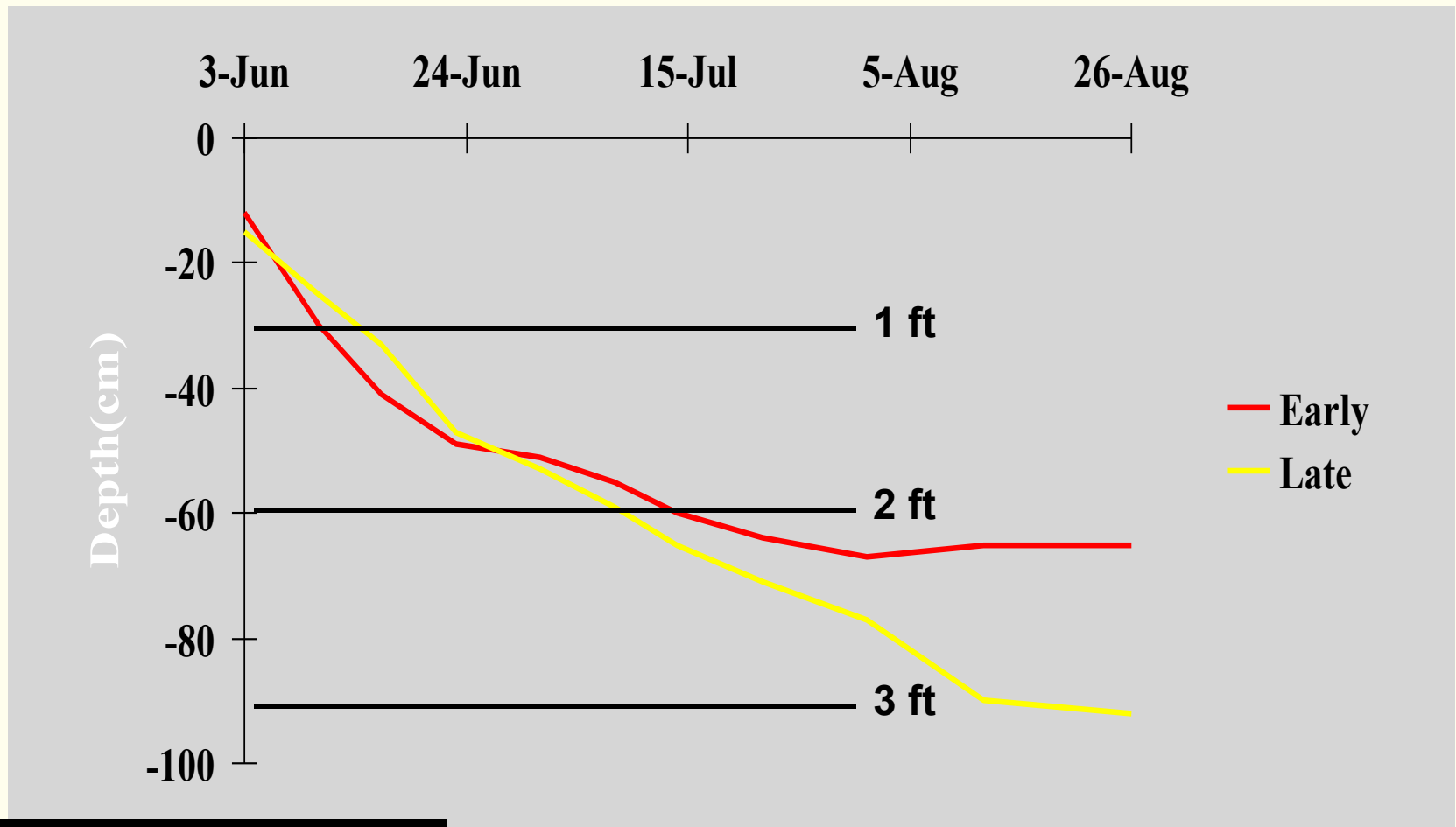


# Potato roots pose some challenges



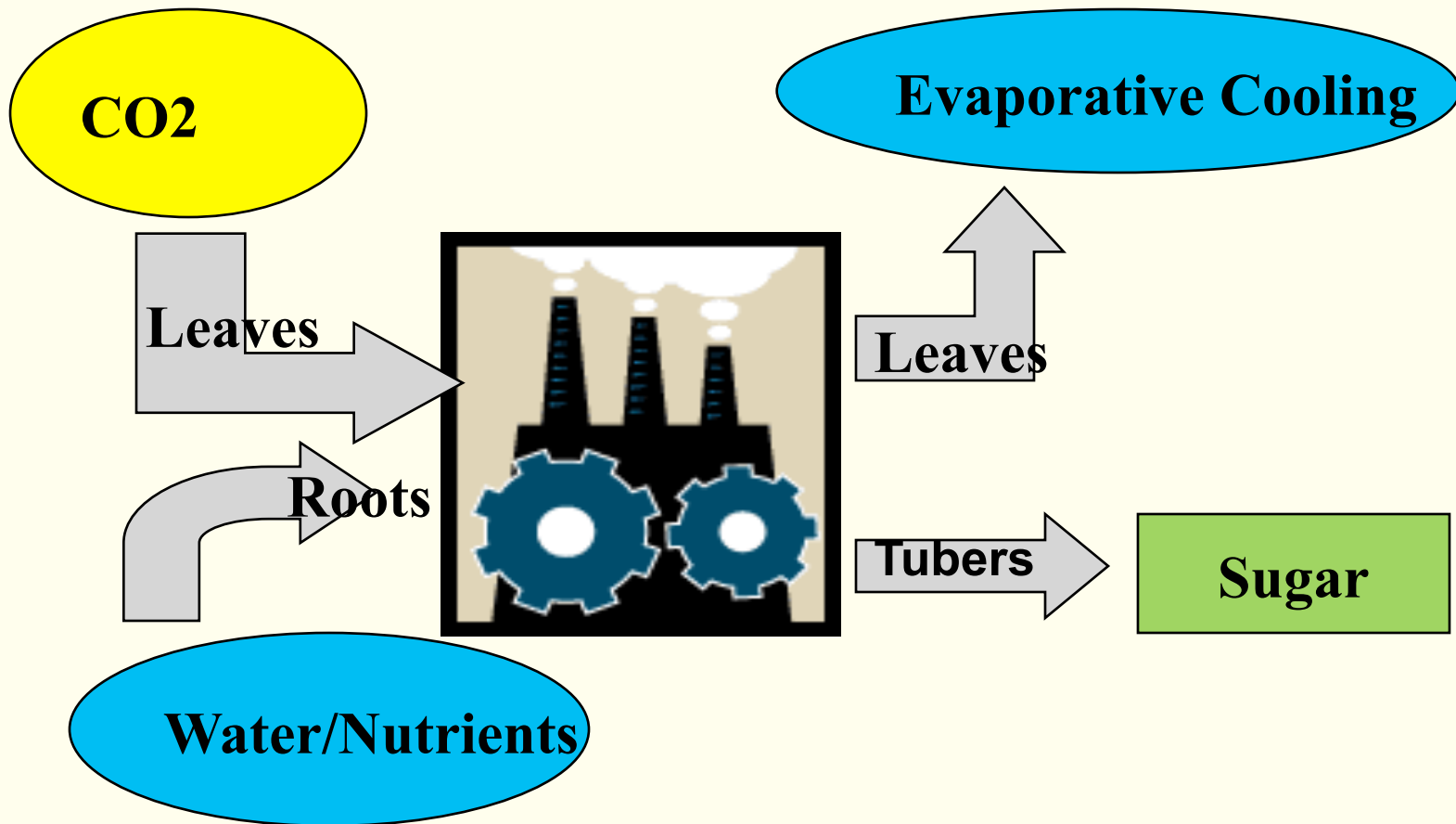
Adapted from: Stalham and Allen, 2001 and Yamaguchi, 2003

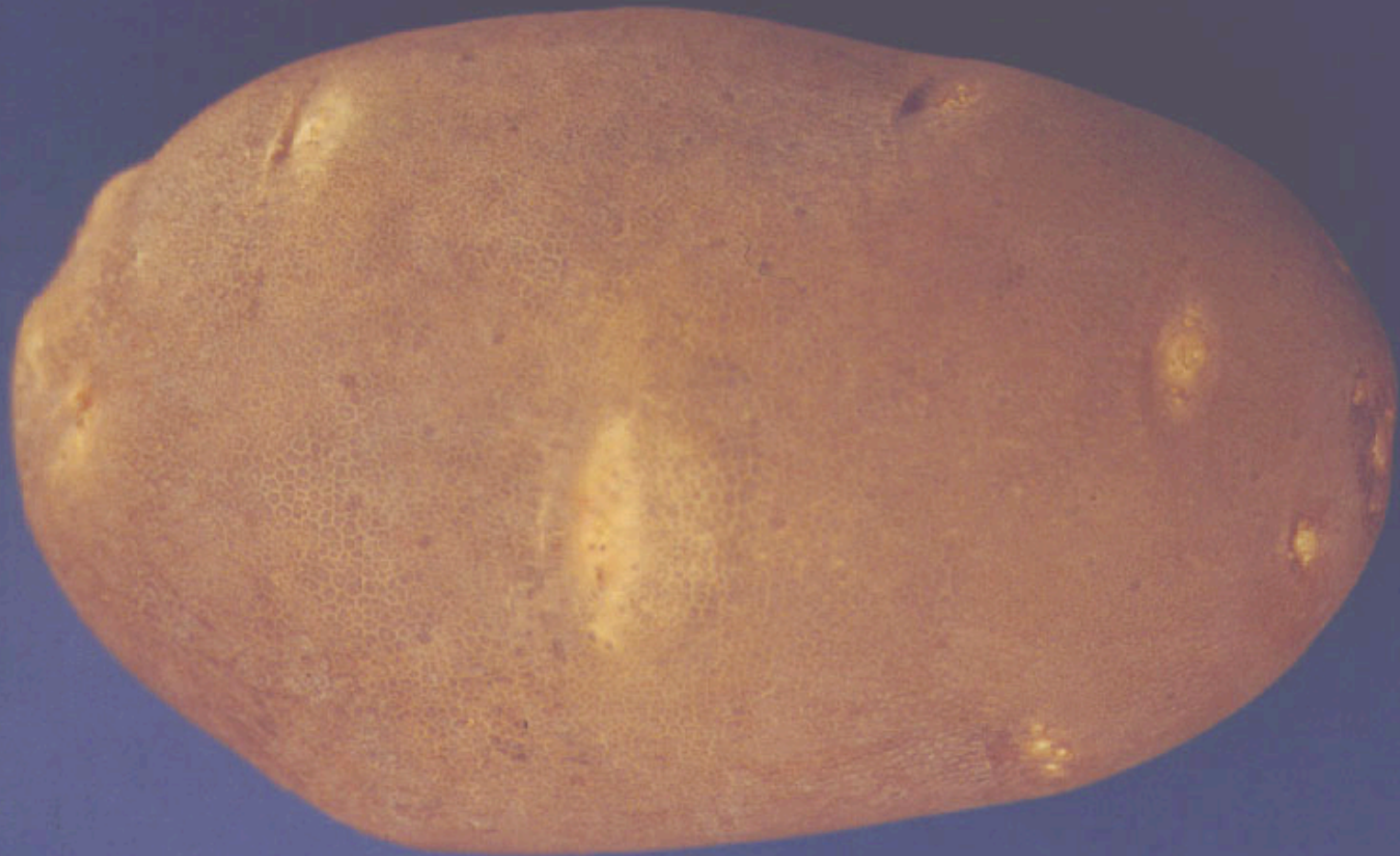
# Cultivar differences in rooting depth



Source: Stalham, 2002

# Components of the potato “factory”





# Sprouting



## Why do so many defects show up on the stem end?

- Stolon (vascular system)
- Composition (cell size, no of starch granules, sugars, enzymes)
- Age



# How do we make the factory more productive?

---



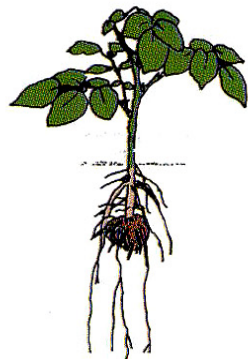
**Build it faster!**

# Potato Growth Stages

## Building the factory



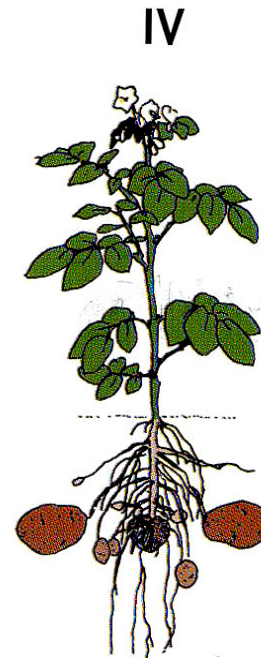
GROWTH STAGE I  
Sprout development



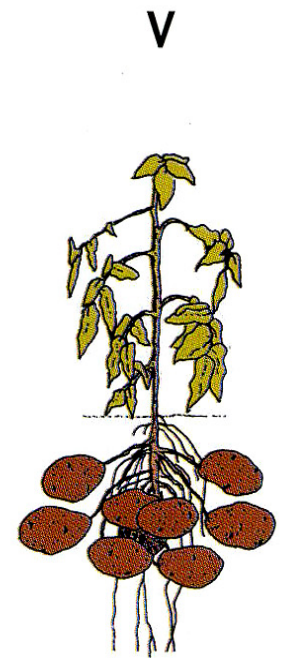
GROWTH STAGE II  
Vegetative growth



GROWTH STAGE III  
Tuber initiation



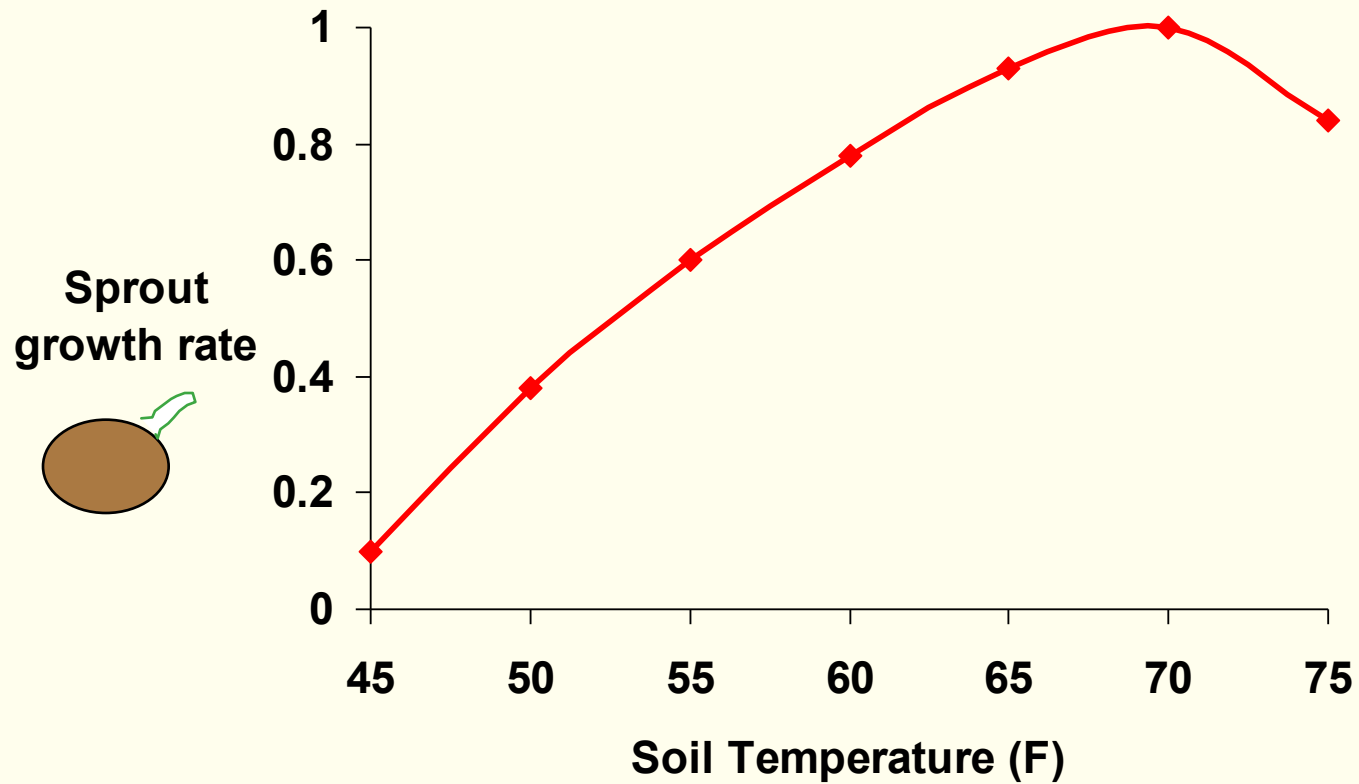
GROWTH STAGE IV  
Tuber bulking



GROWTH STAGE V  
Maturation

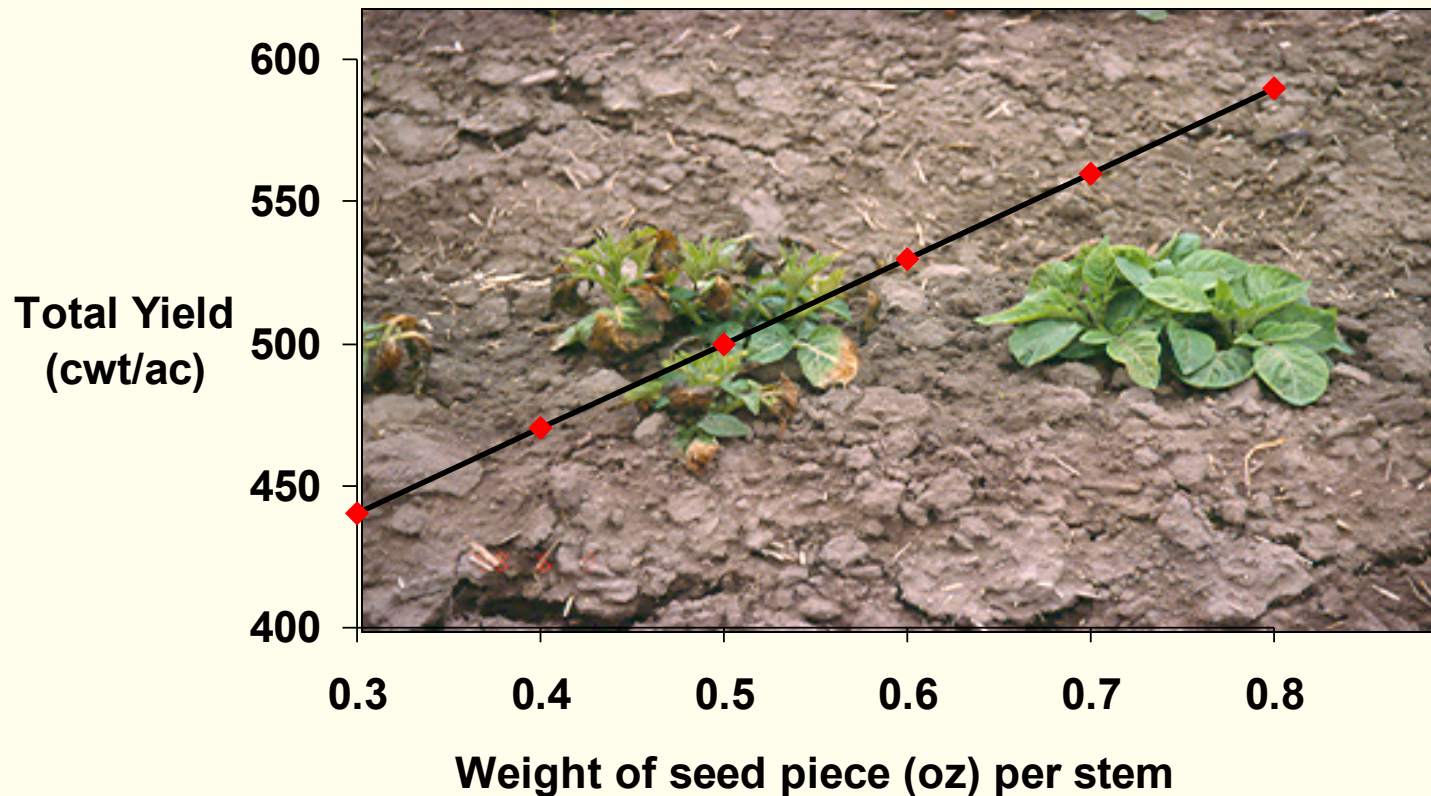


# ***Sprout growth rate is directly related to soil temperature***



Source: Kelmke and Moll, 1990

**For the first ~40 days the seed piece is the primary source of energy for the factory**



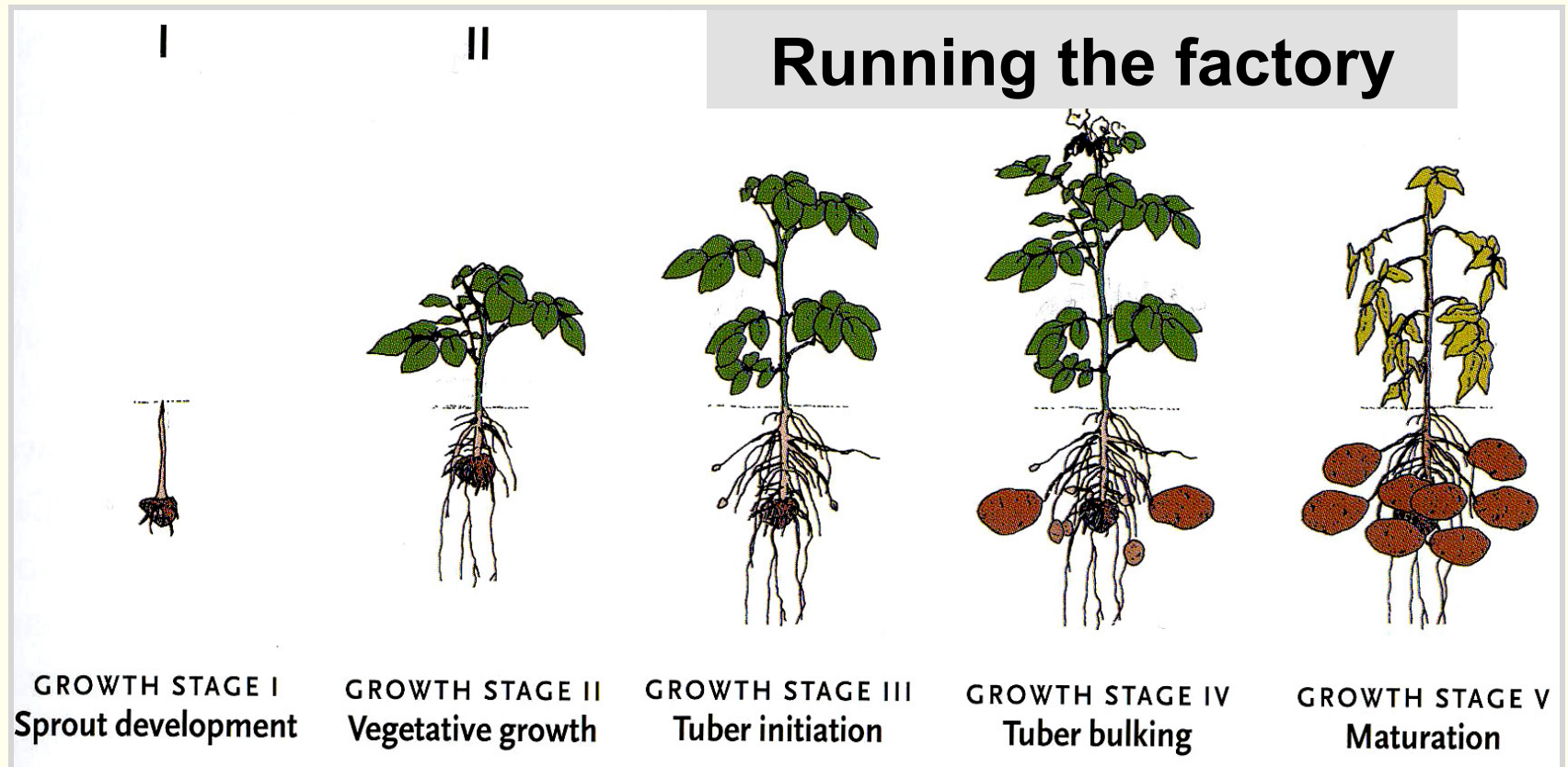
**Source: Iritani and Thornton, 1984**

# How do we make the factory more productive?



**Run it longer!**

# Potato Growth Stages



Reprinted from Potato Production Systems, University of ID

# Yield Components

$$\text{Yield} = \frac{\text{Production per day}}{\text{Number of days}}$$

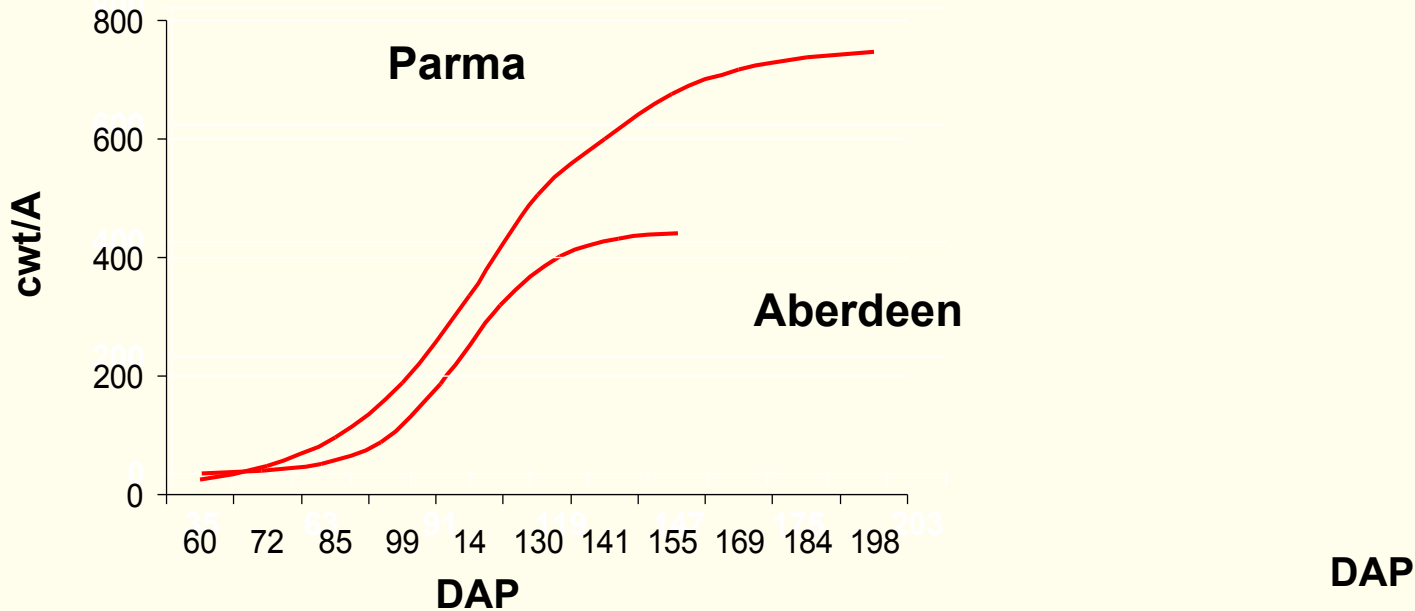
**Example 1: 10 cwt/day X 50 days = 500 cwt**

**Example 2: 10 cwt/day X 70 days = 700 cwt**

**6-10 cwt/day is typical for ID**

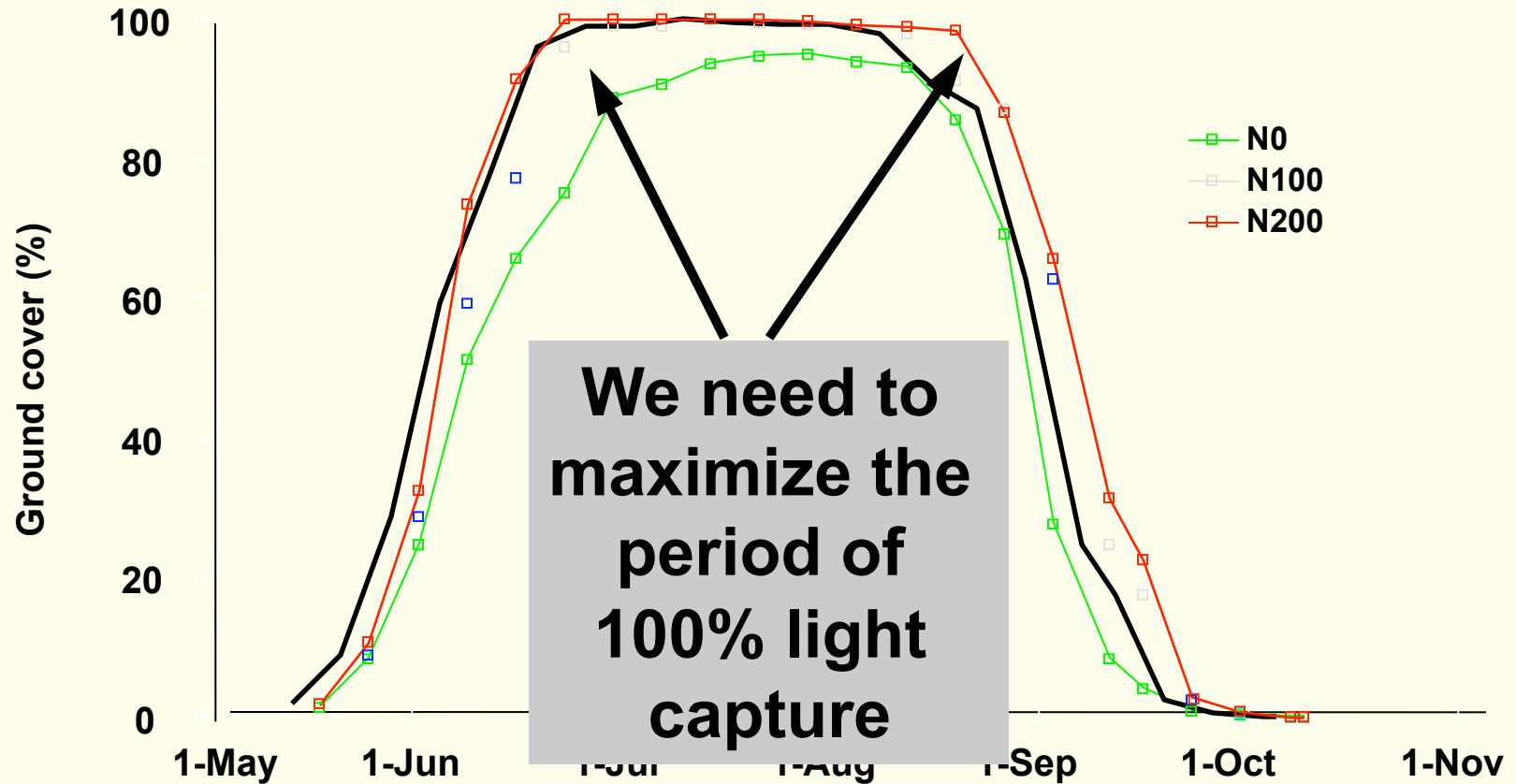


# Effect on location on bulking rate

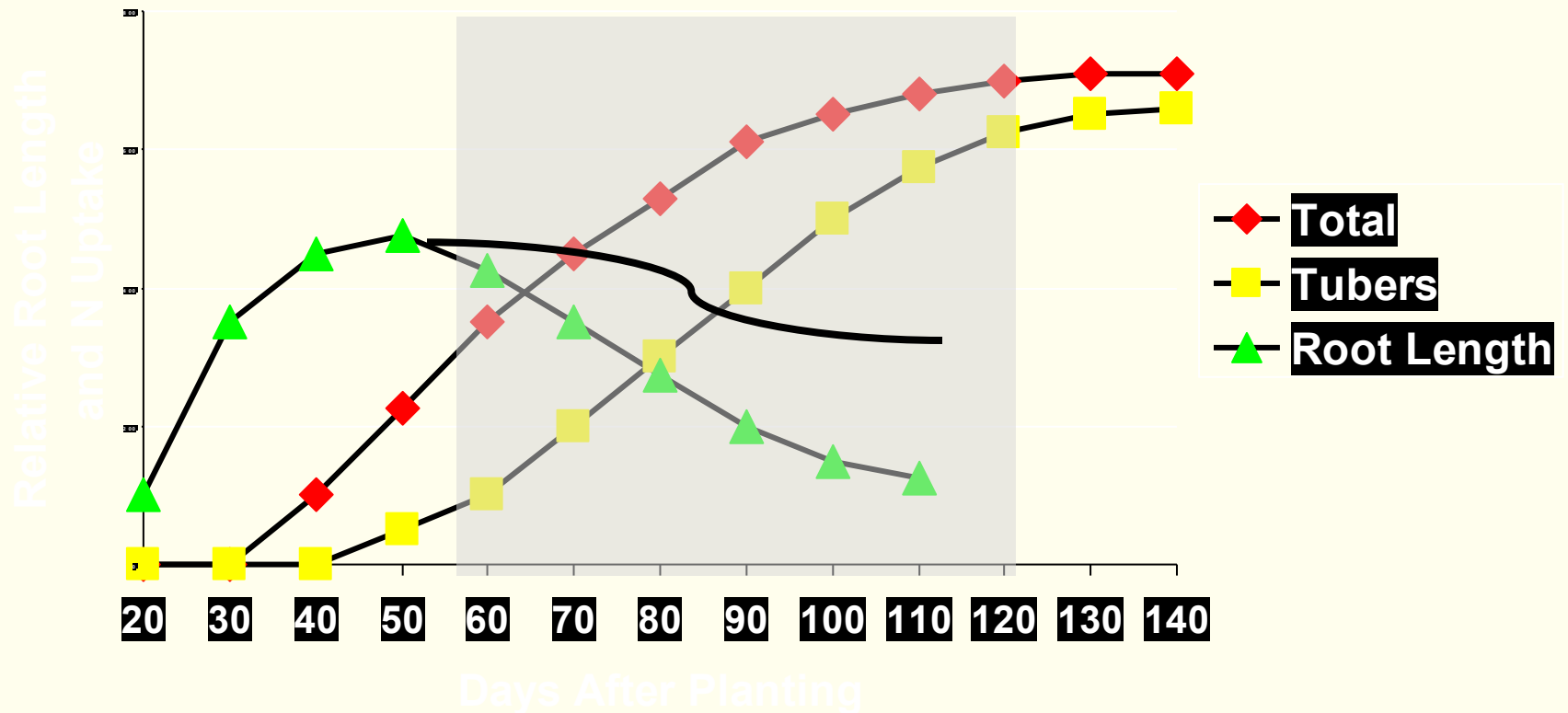


Location	Length of Linear Bulking	Rate of Linear Bulking
	Period (days)	Rate (cwt/A/day)
<b>Parma</b>	<b>118</b>	<b>5.9</b>
<b>Aberdeen</b>	<b>51</b>	<b>7.4</b>

# Effect of N fertilizer on ground cover of Russet Burbank



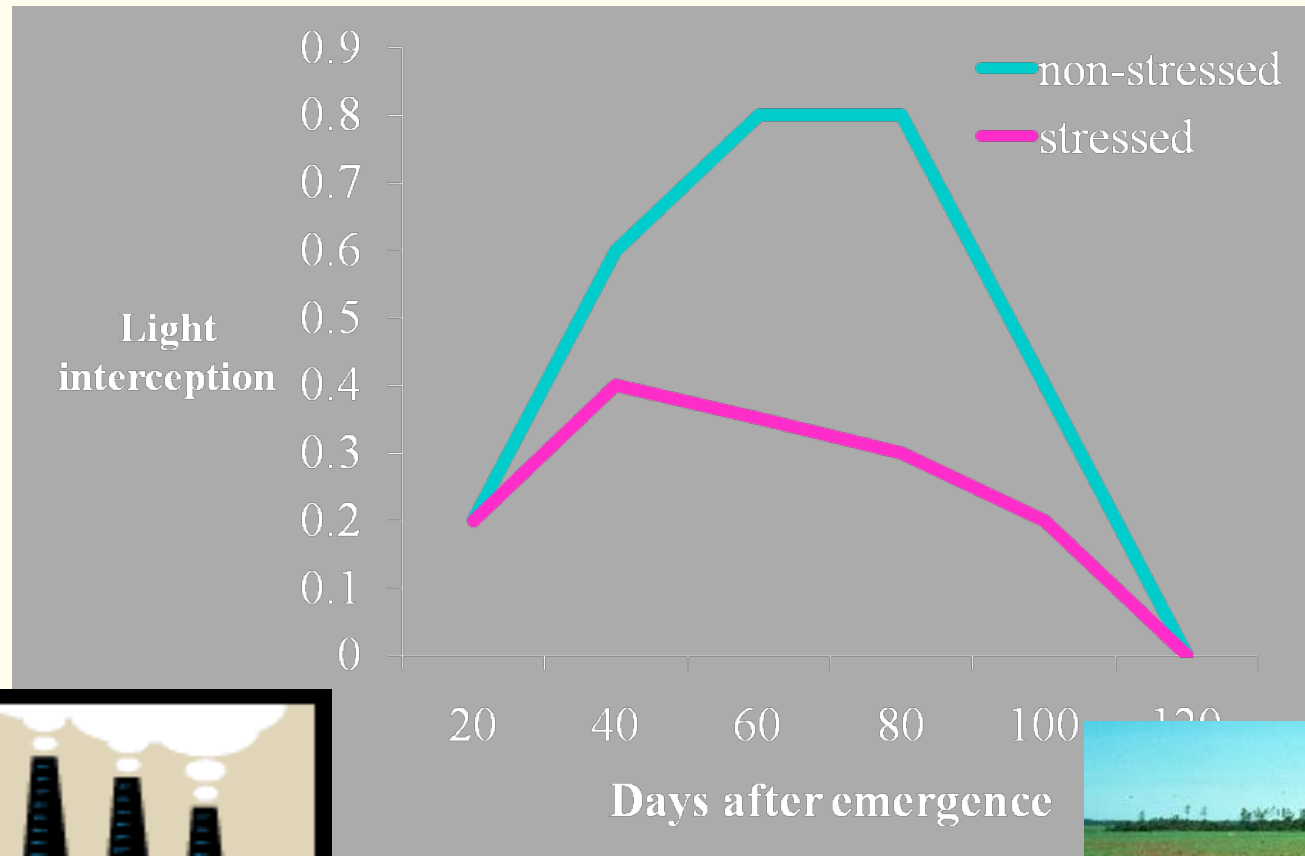
# Potato Root Growth in Comparison to Nutrient Uptake (Russet Burbank)



Source: Pan, 1994



# You can't run the factory at full capacity without intercepting sunlight



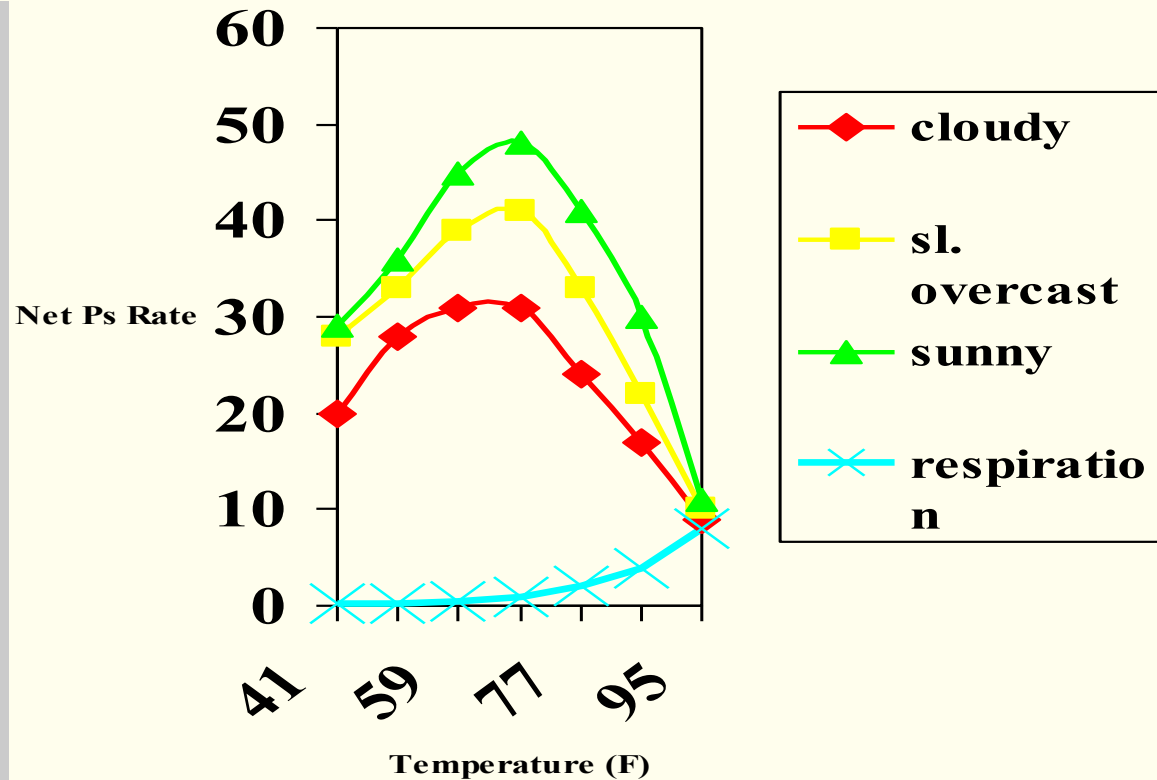
# How do we make the factory more productive?



**Run it more  
efficiently!**

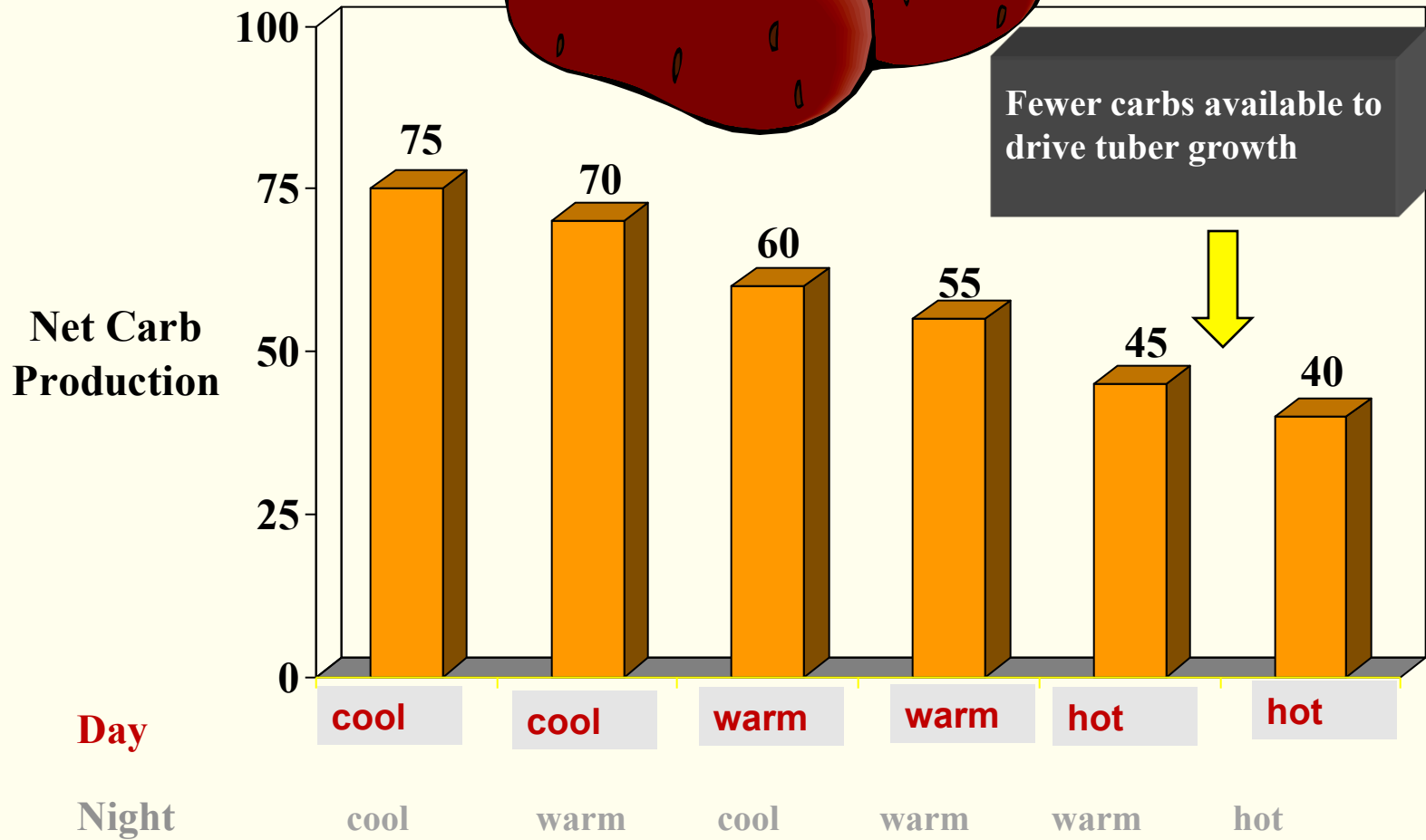
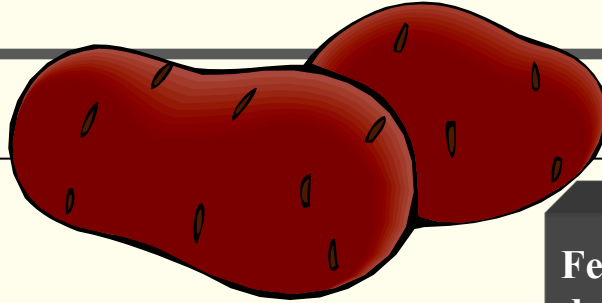
# The factory has several critical processes

- The temperature optimum for Photosynthesis (energy production) is around 75° to 80° F , Respiration (energy use) continues to increase with temperature

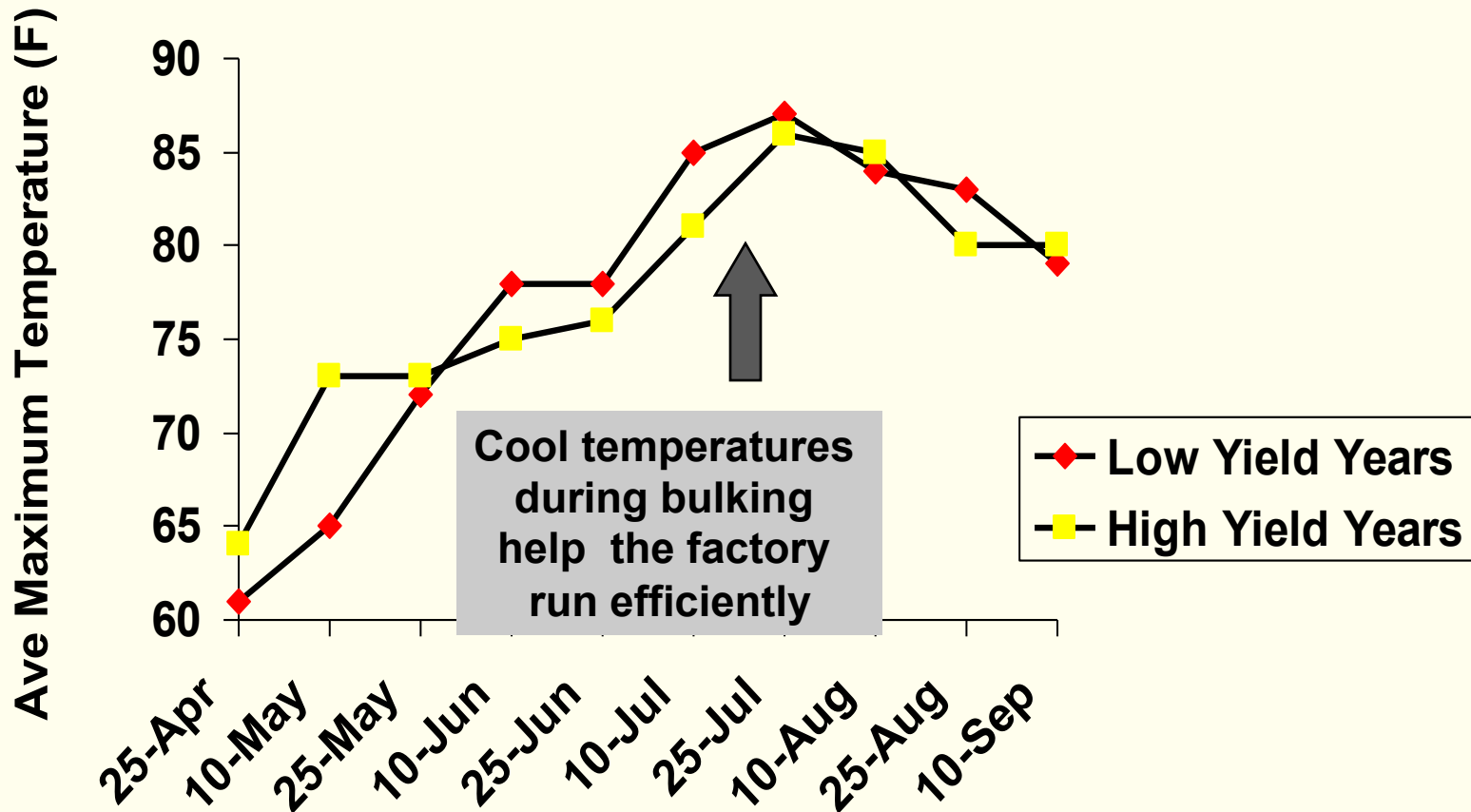


Source: Winkler, 1961

# Carbohydrate production is the critical process

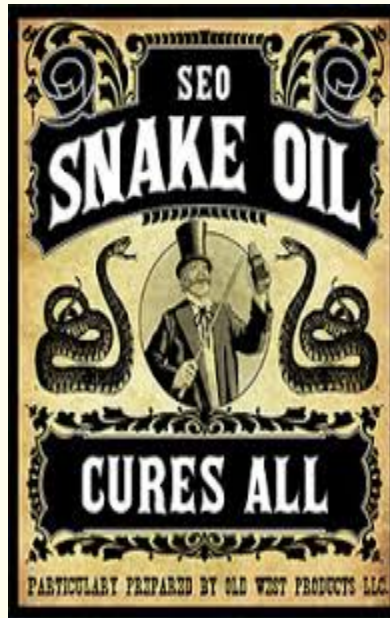


**Once the factory is running, sunny but cool (70 to 80 F) conditions help make it more efficient**



Source: Iritani, 1984

- 
- What about “silver bullet” products that claim to improve yield and quality?



Any product that is going to increase yield has to:



- Build the factory quicker!

OR

- Run the factory longer!

OR

- Run it more efficiently!

# Methods to improve skin color

- **Waxing (popular in the 1950's)**
- **Production regions (soils and climate)**
- **New varieties (ongoing)**
- **Growth regulators (use of 2,4-D described in 1949)**

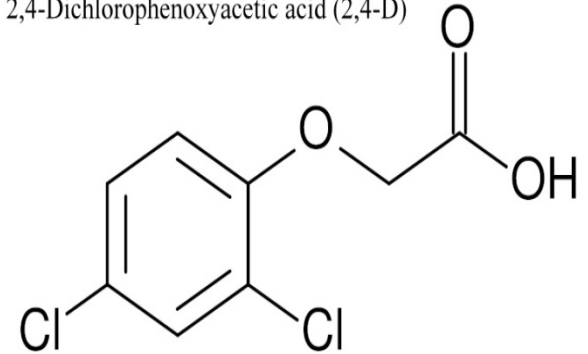




# What do we know about 2,4-D?

- ✓ Auxin-like compound
- ✓ Herbicide: broadleaved weeds
- ✓ Stimulate cell growth in phloem
- ✓ Blockage  $\Rightarrow$  starvation  $\Rightarrow$  death
- ✓ Stimulate ethylene synthesis in potato\*
  - Could be direct or indirect

2,4-Dichlorophenoxyacetic acid (2,4-D)

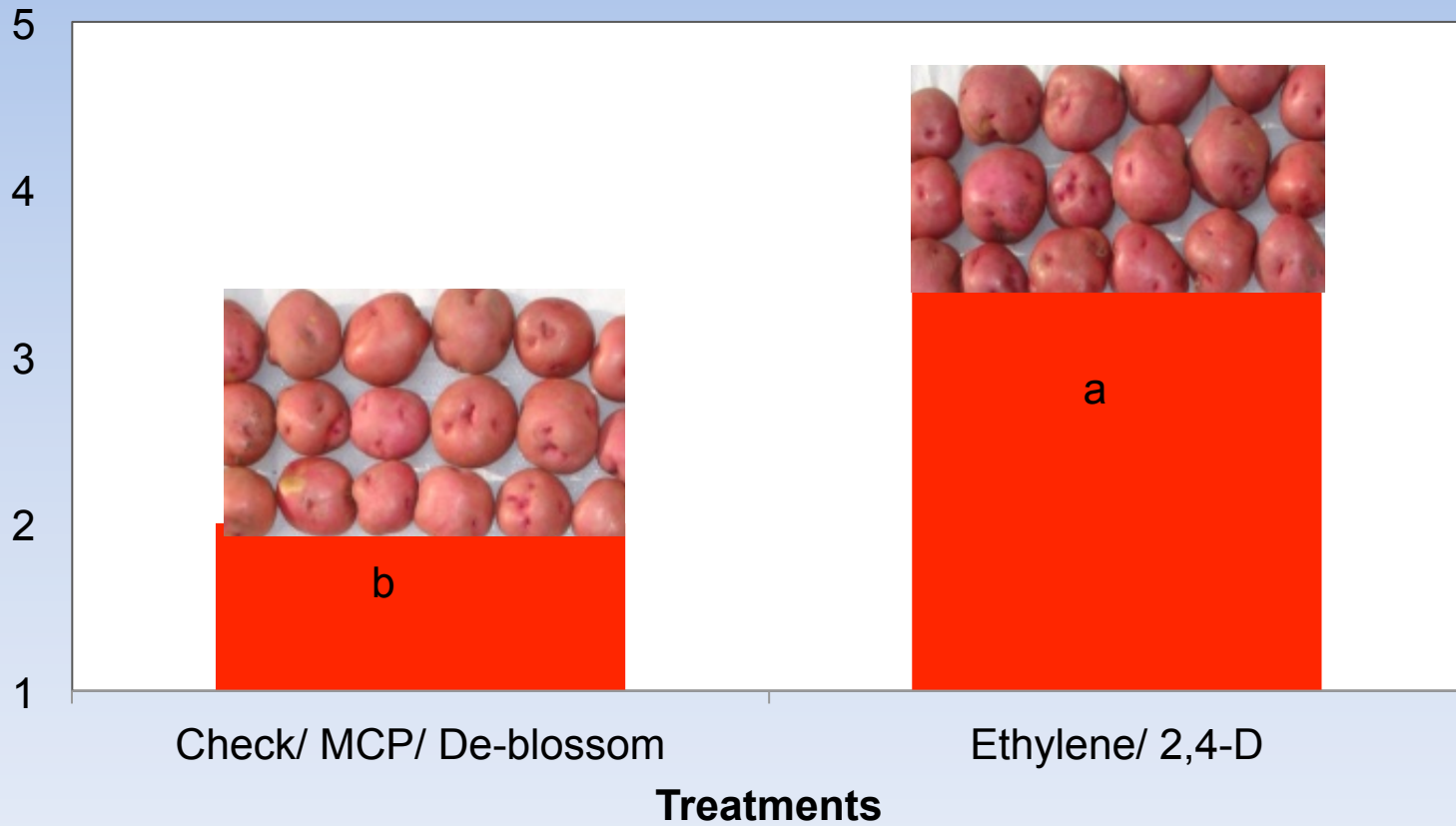


# Mechanism of color enhancement

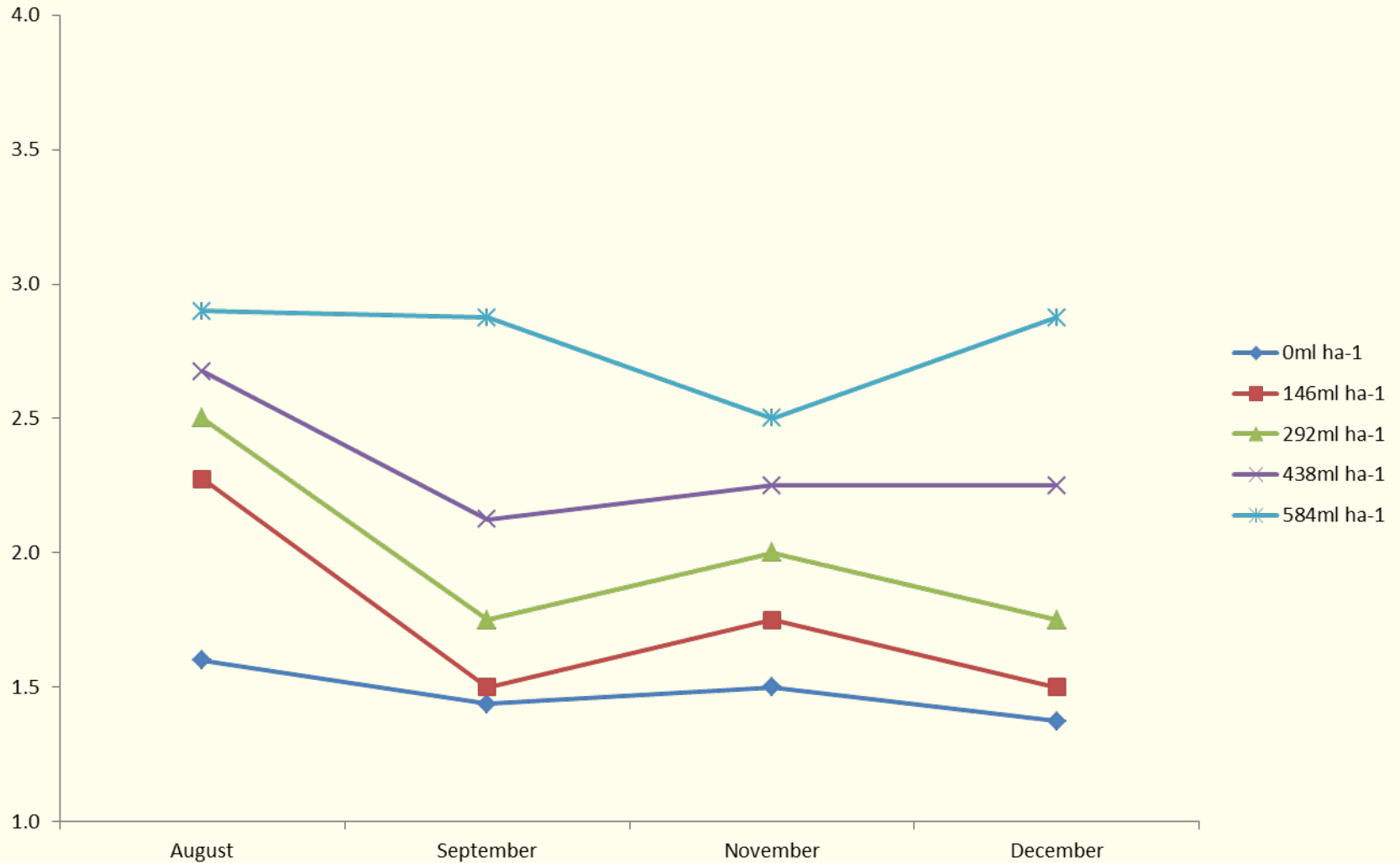
“Mechanism of 2,4-D enhancement of red color in potato periderm is not known.” (Rosen, et. al, 2004)\*



**Influence of foliar applications of growth regulators on skin color for the cultivar Red LaSoda. Color rated on a scale from 1-5(darkest).**



# The darker color going into storage – the darker they come out of storage



# Specialty varieties

Red Lasoda



Purple Pelisse



Yukon Gold



Terra Rosa



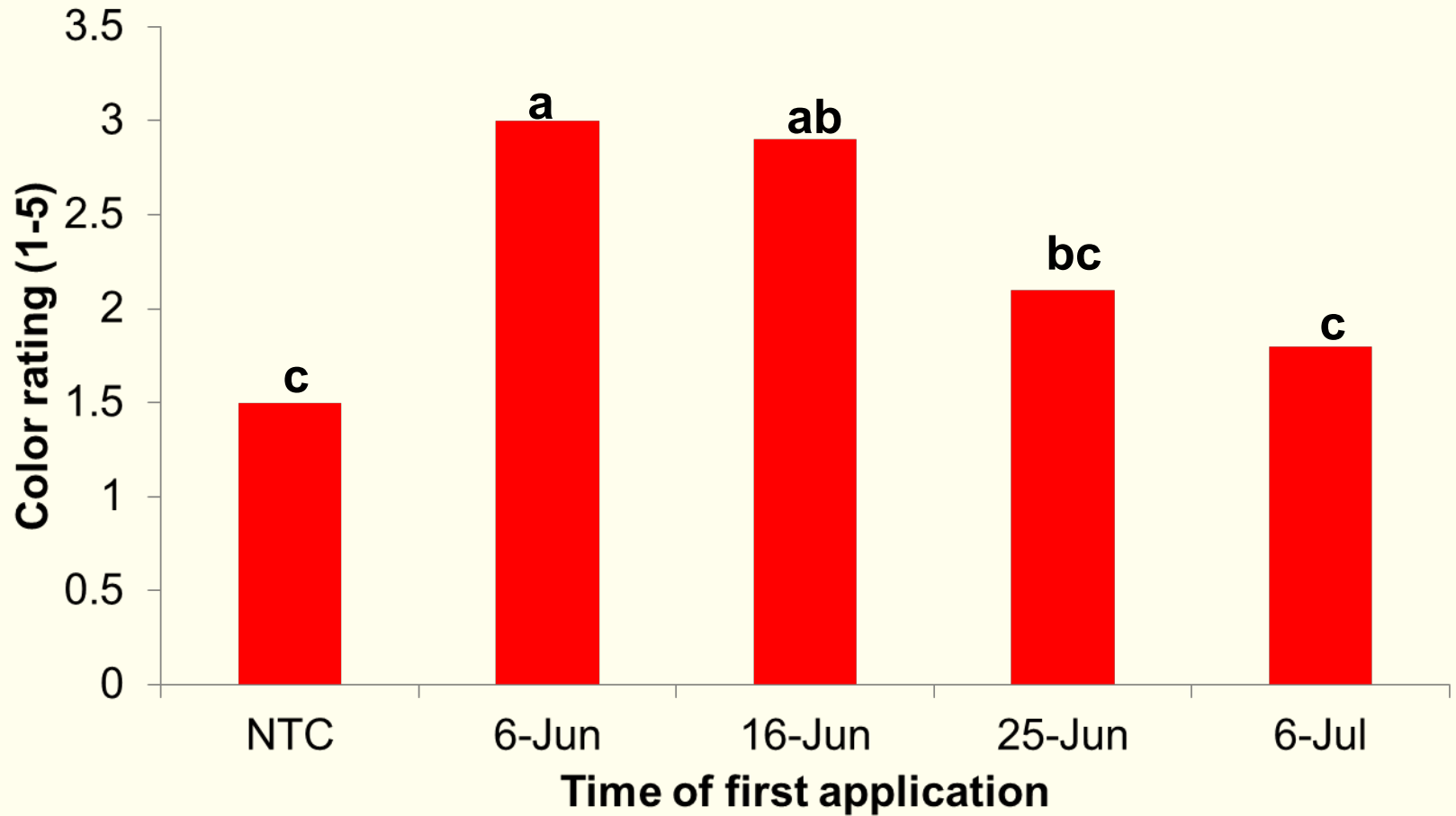
All Blue



Bintje



## Effect of application timing on skin color or Red Lasoda



# Acknowledgements

