Preparing to Plant Potatoes

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Successful potato production

1. Build the factory quicker
2. Run the factory longer
3. Run it more efficiently

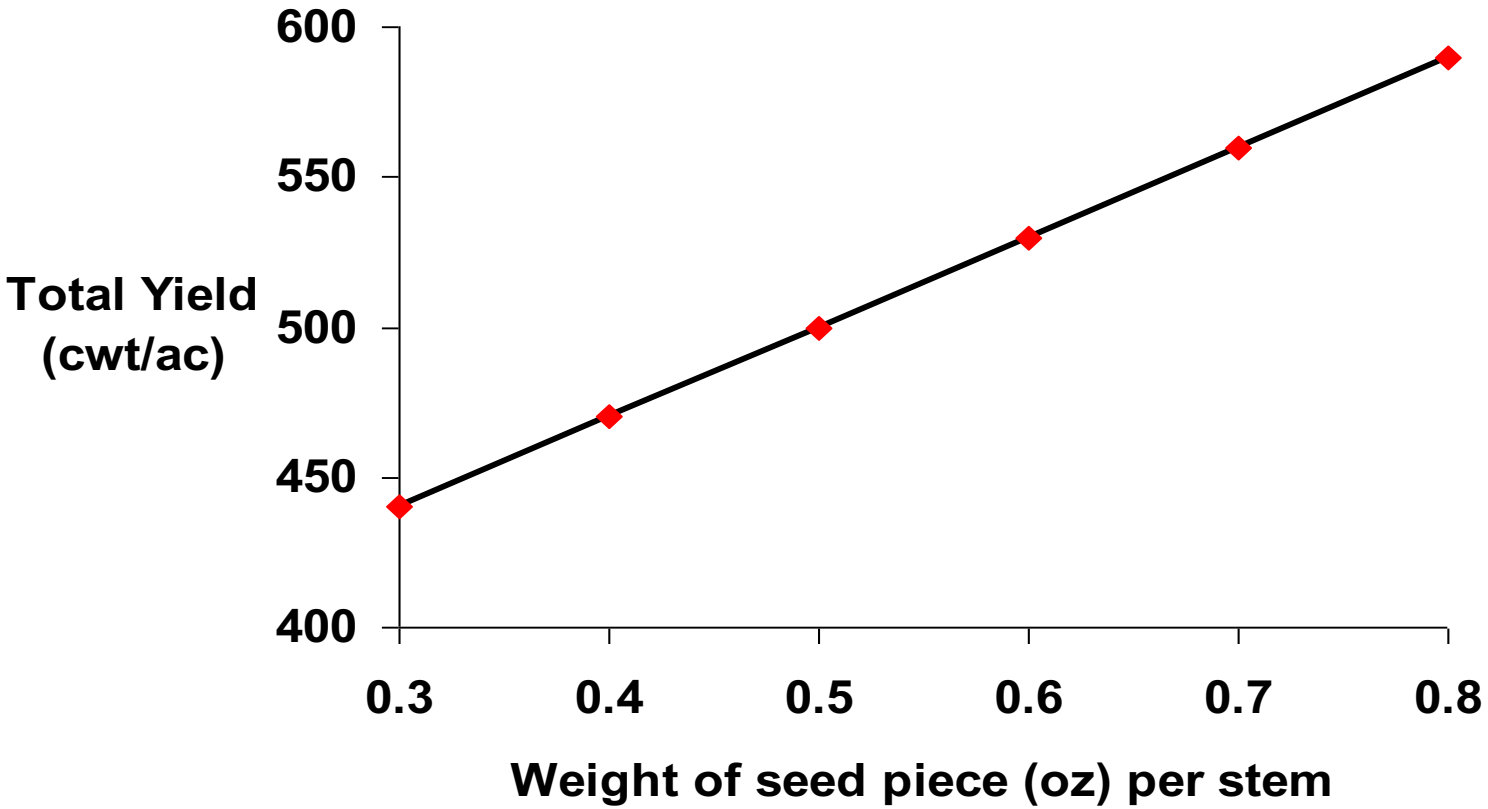
- Potato plant is basically a starch factory
  - Over 90% of tuber dry matter comes from photosynthesis

(Mike Thornton, 2014)

Purchasing Seed

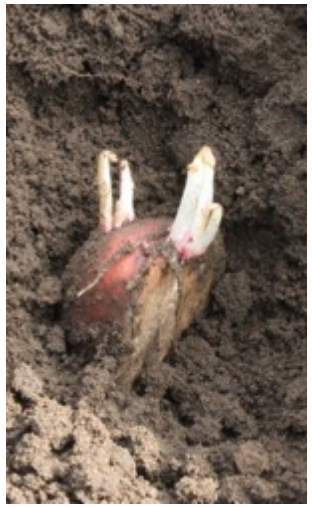
- A good crop starts with good seed.
  - Why? The same amount of fertilizer and pesticides will be used on poor or good seed.
- Choose seed that is physiologically and physically healthy.
  - Free from diseases, herbicide residues, virus (winter grow out results and lab tests)

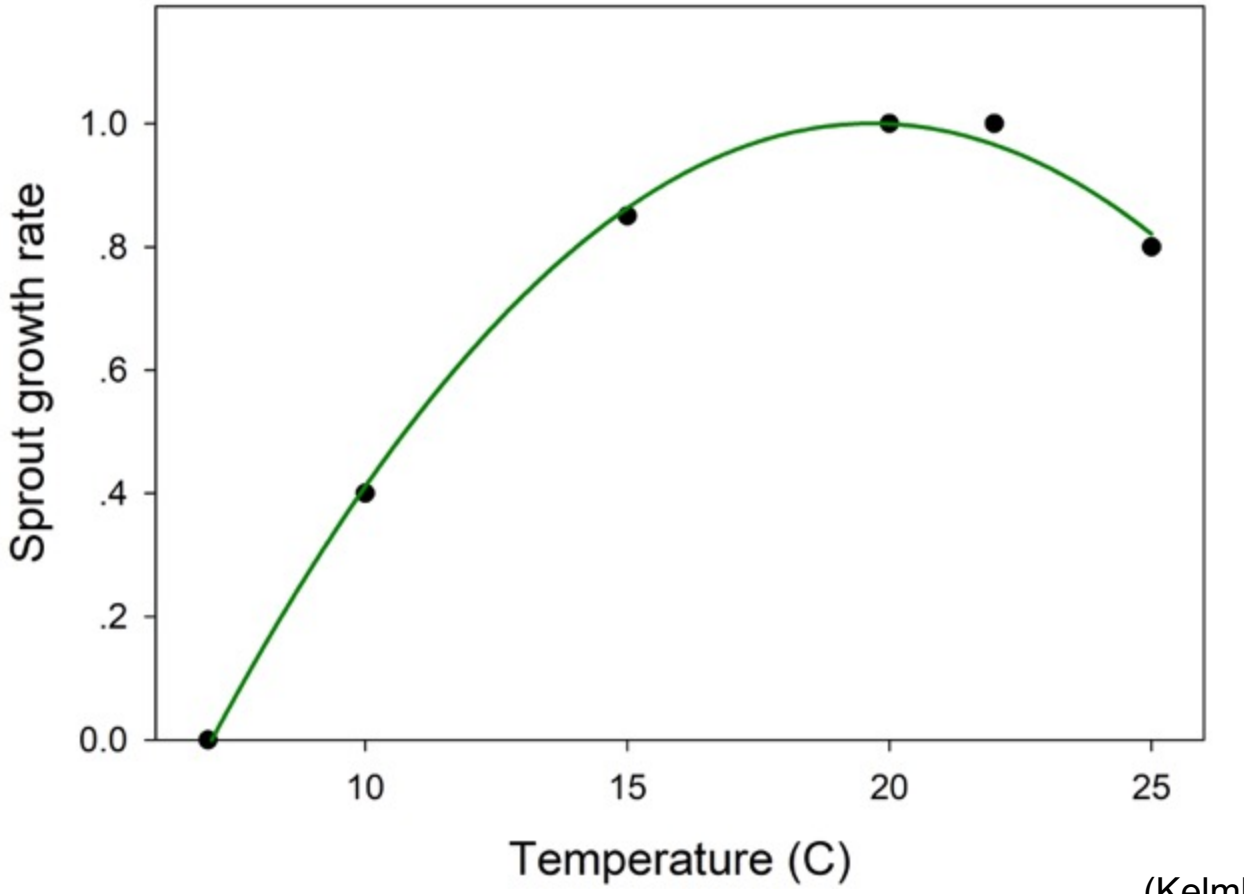
The first ~40 days the seed piece is the primary source of energy



(M. Thornton; Iritani and Thornton, 1984)

Sprout growth rate is related to soil temperature





(Kelmke and Moll, 1990)

Seed Age

- Chronological age: number of days that have passed since harvest
- Physiological age: internal age of the seed resulting from biochemical changes taking place in within the tuber

Physiological aging

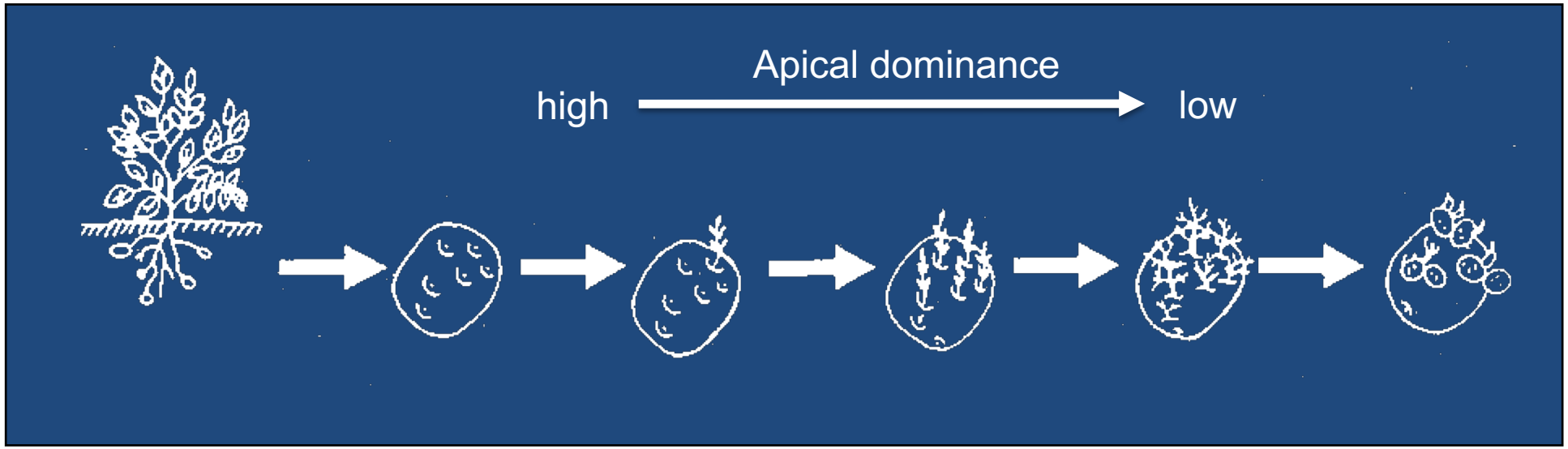
Increased over time and by stress

- Hot temperature
- Drought stress
- Fertility stress
- Disease pressure
- Poor storage conditions
- Bruising

Scale

- Dormant
- Young
- Middle age
- Old
- Potato no top / little tuber

Physiologic age and stages of sprouting



Tuber Initiation	Dormant Tuber	Apical Sprouting	Multiple Sprouting	Hairy Sprout	Little Tuber
	No Plant	Single Stem Plant	Multi-Stem Plant	Weak, Bushy Plant	No Plant
		Produces A Few Large Tubers	Large Set of Smaller Tubers	Low Yield	

Physiological age

Dormant

Young seed

Physiological age

Middle aged seed

Physiological age

Old seed

Physiological age

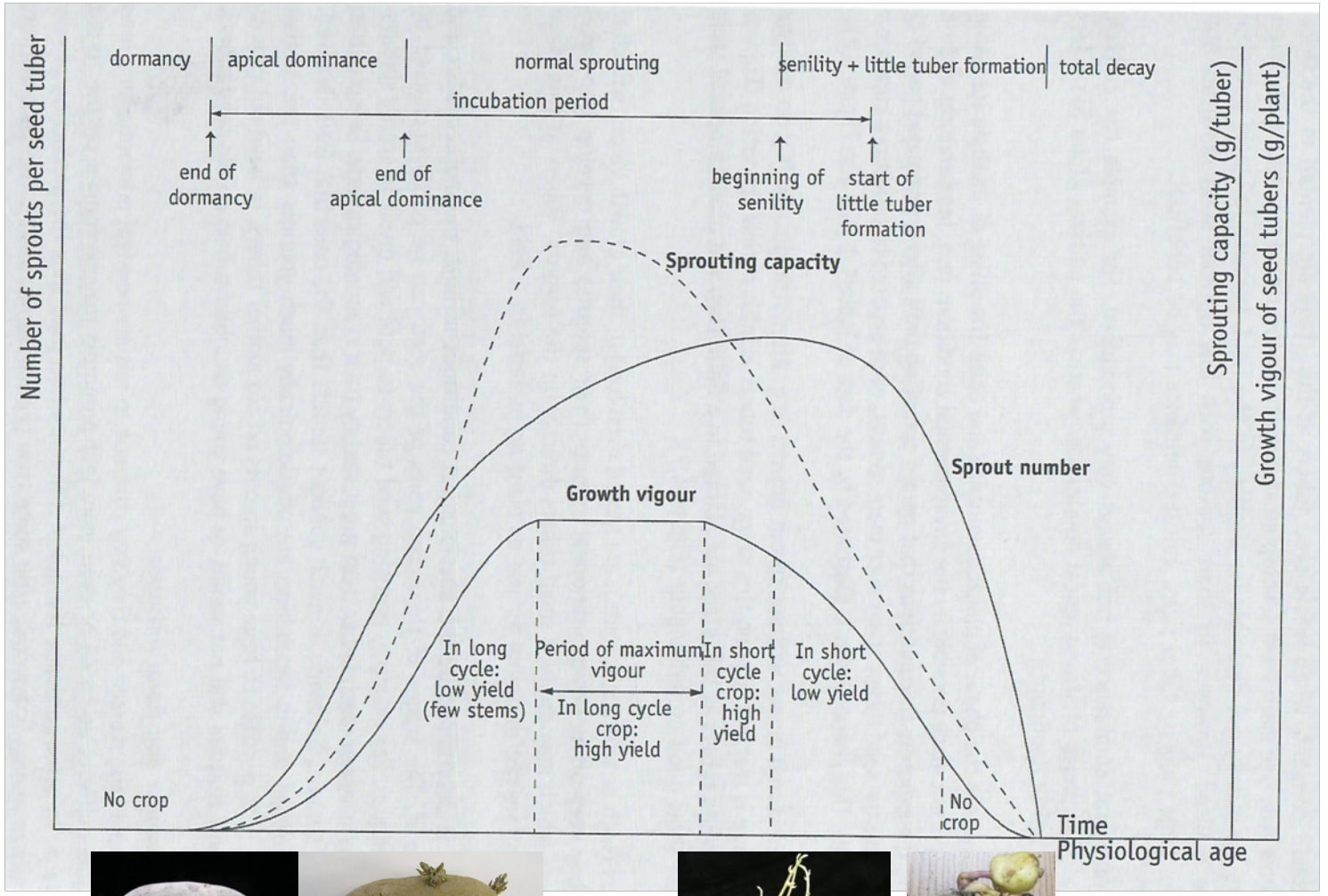
Potato no top

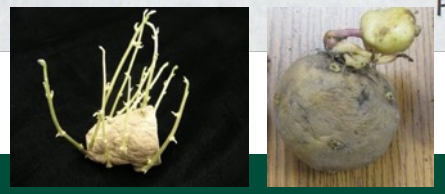
Characteristics of Young vs. Old Seed

Young Seed	Old Seed
Slow emergence	Rapid emergence
Fewer stems per hill	More stems per hill
Low tuber set	Higher tuber set
Longer tuber bulking period	Shorter tuber bulking period
Long tuberization period	Uniform tuber set
Larger tubers at harvest	Smaller tubers at harvest

(Iritani and Thornton, 1984)

Hypothetical scheme





(Struik and Wiersema, 1999)

Seed age effects

Younger seed

- Slower emergence
- Fewer stems
- More foliar production
- Later tuber initiation
- Fewer tubers per plant
- Larger tuber size
- Later plant senescence

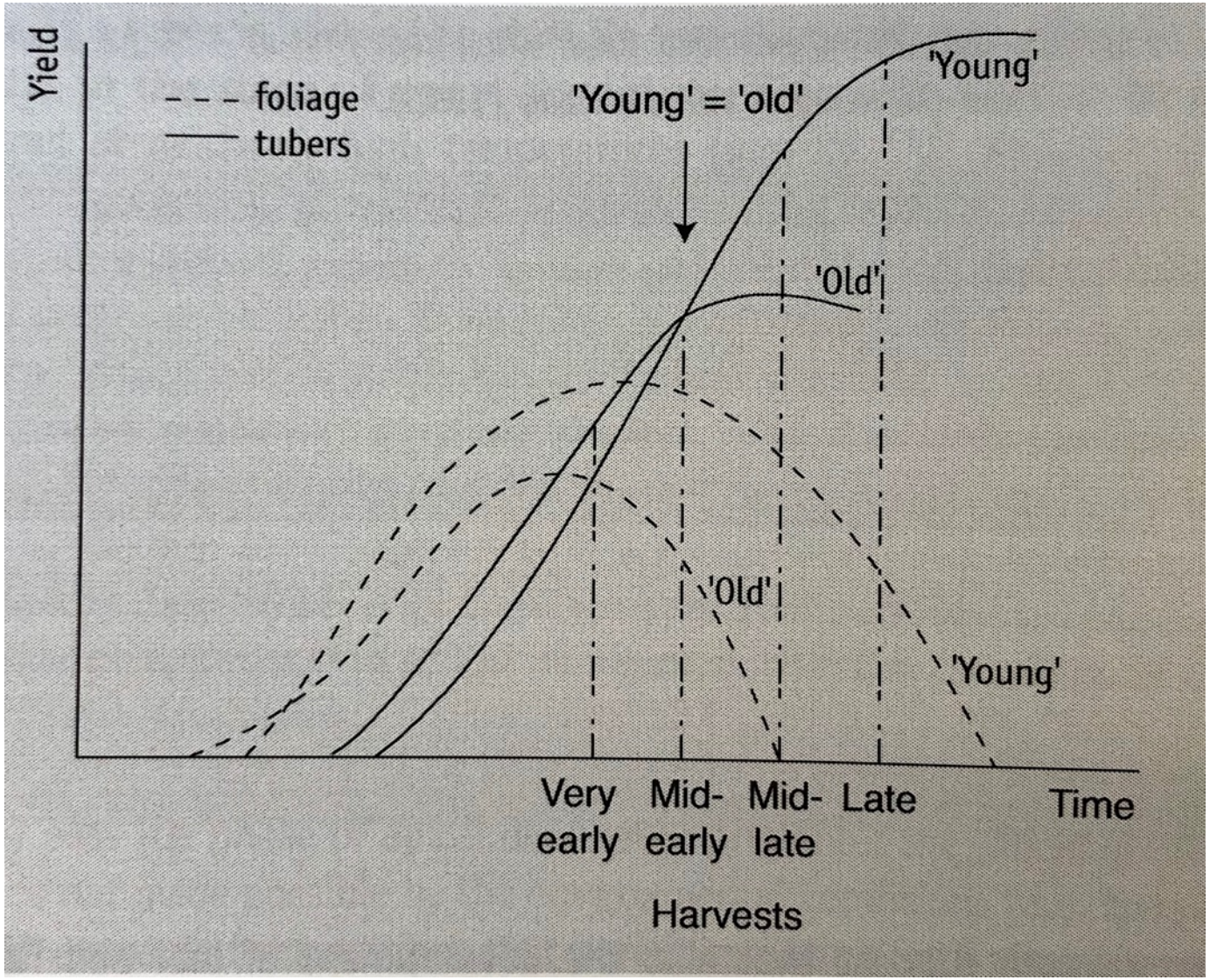
Older seed

- Faster emergence
- Multiple stems
- Less foliar production
- Earlier tuber initiation (at lower leaf index)
- More tubers per plant
- Smaller sized tubers
- Earlier plant senescence

Effects of old seed

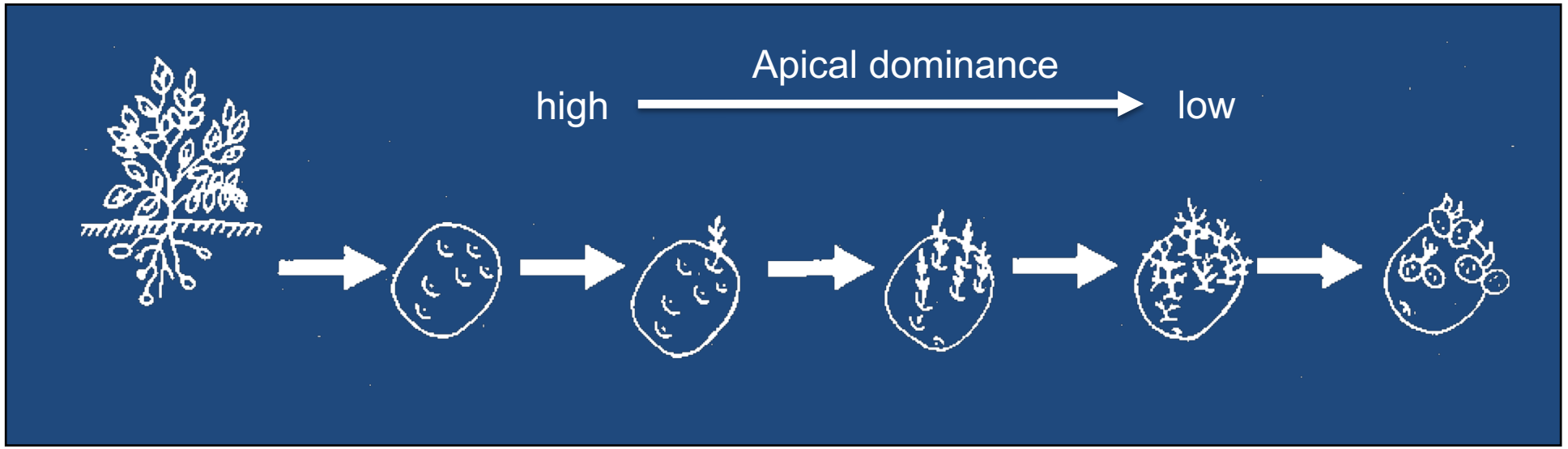
Old seed can lead to:

- Early emergence
- Earlier tuberization
- Reduced foliage
- Reduced yield
- Earlier maturity



(Struik and Wiersema, 1999)

Where do you want to be at?



Tuber Initiation | **Dormant Tuber** | **Apical Sprouting** | **Multiple Sprouting** | **Hairy Sprout** | **Little Tuber**

Physiological Age Influencers

- Growing conditions of the seed crop
  - Stresses cause aging of the seed
- Bruising of seed tubers
  - Increases respiration rate, accelerating aging
- Seed storage temperature
  - Seed held at 38 – 40 F ages slower than seed held at higher temperatures
- Cutting operation
  - Respiration rates increases after cutting (like bruising, but smooth cuts require less energy)

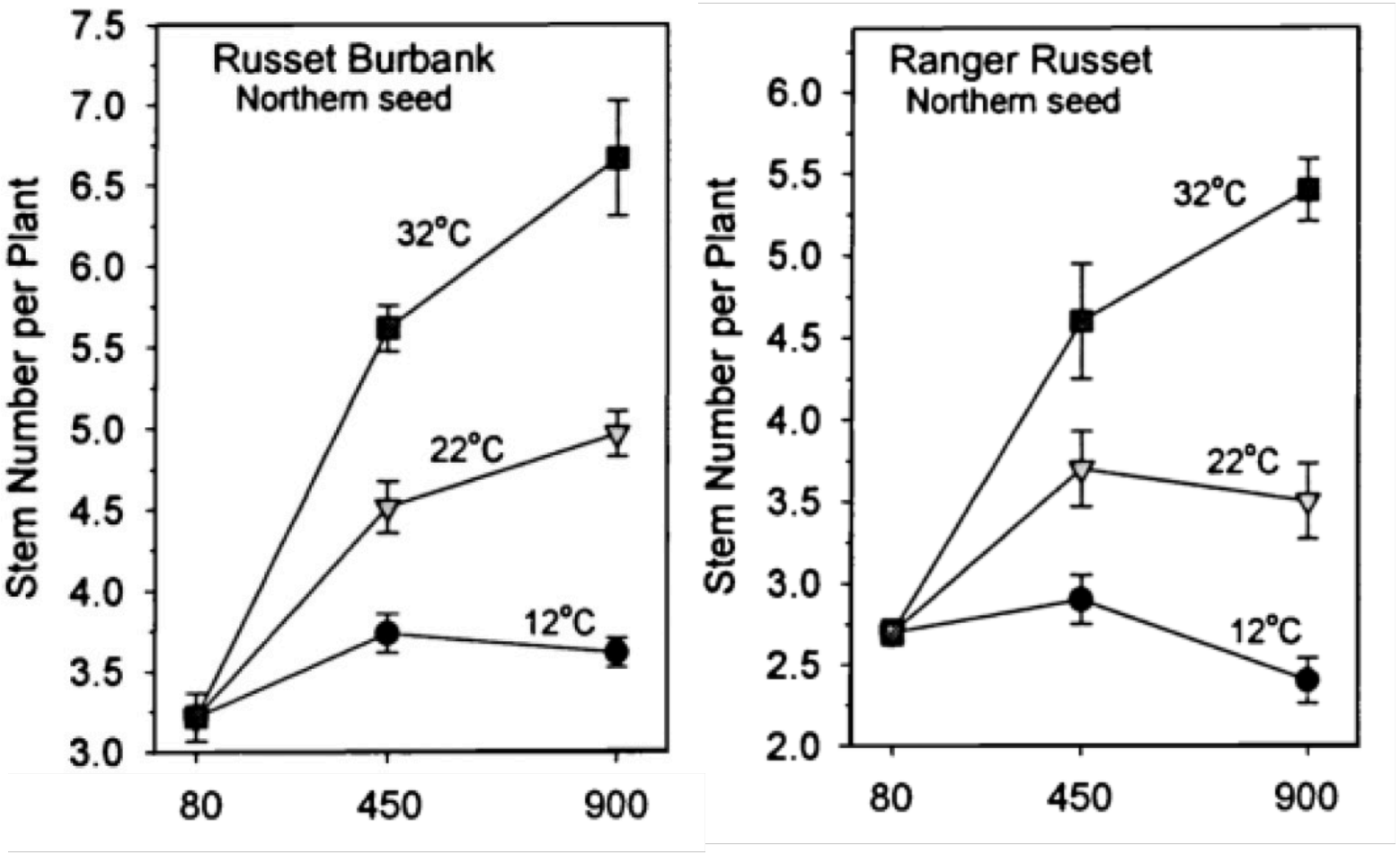
Storage Prior to Planting

- Physiologically young seed
  - Emerges slower and increases risk of seed piece decay and *Rhizoctonia*
  - Hold at warm storage temperature (50 F) until 2-3 eyes per seed piece have begun to grow
- Physiologically old seed
  - Hold at 38 F prior to planting, then warm seed to 45 F prior to cutting and planting

Storage temperature on stem number

- Seed aged at beginning of storage
- Warmer the storage = increase in stem number
- Know how well your seed is stored.

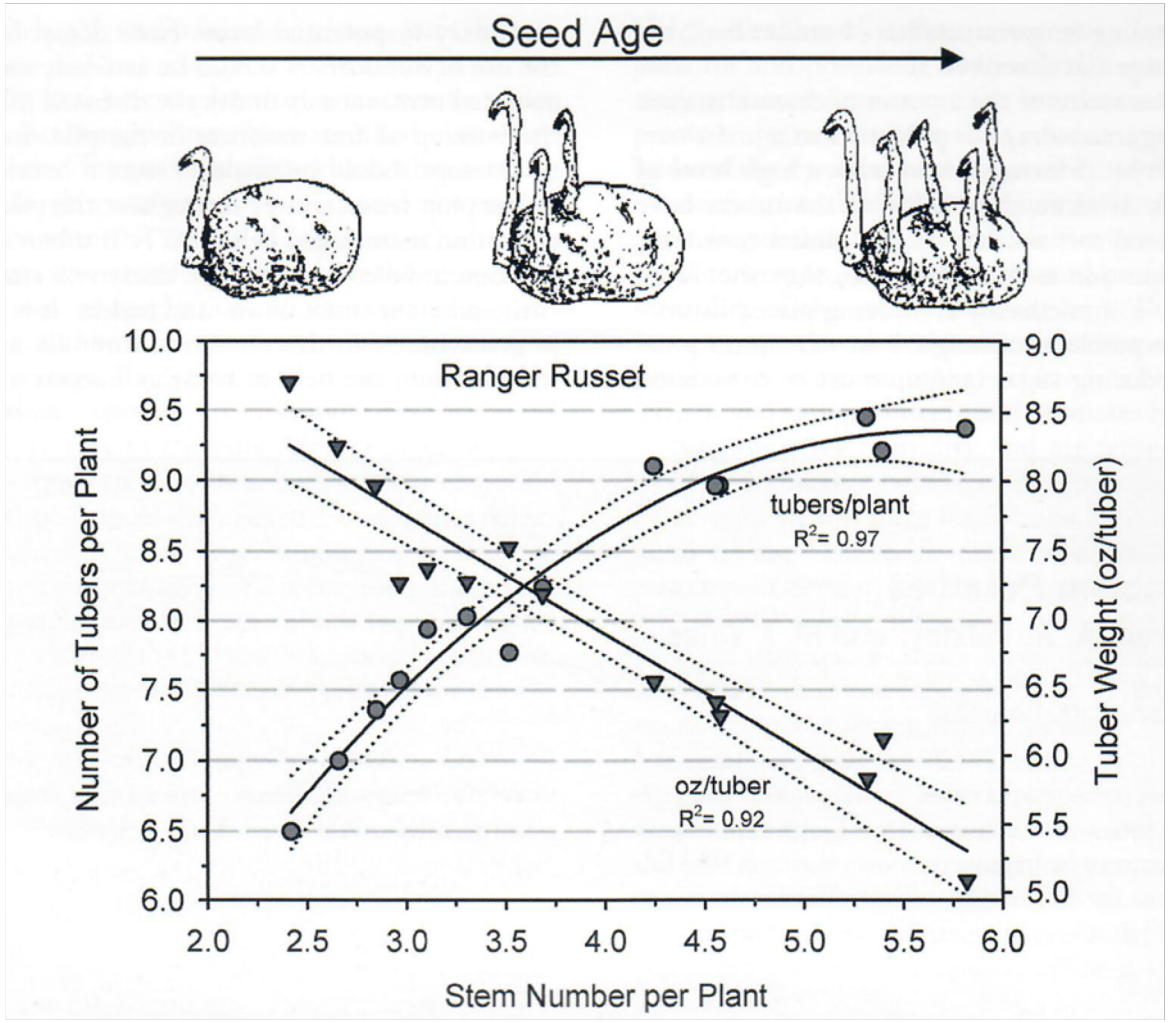
(Knowles and Knowles, 2006)



Stem numbers effects

- Aged seed = more stems = higher tuber count
- Increased tuber competition = smaller tubers

(Knowles and Knowles, 2006)



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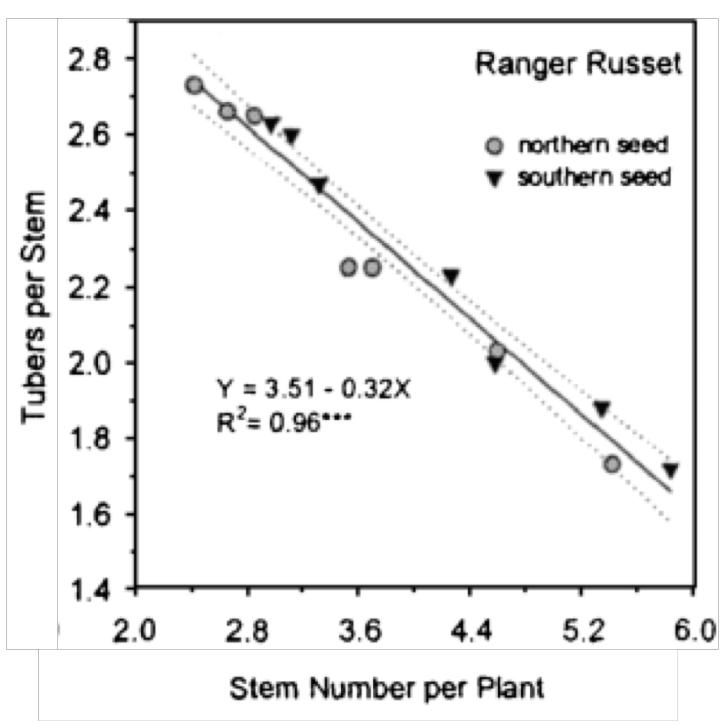
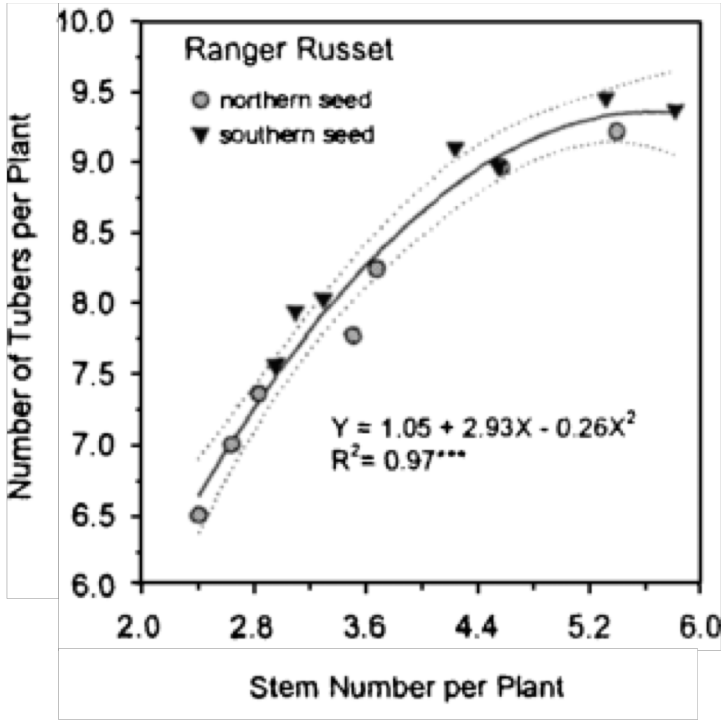
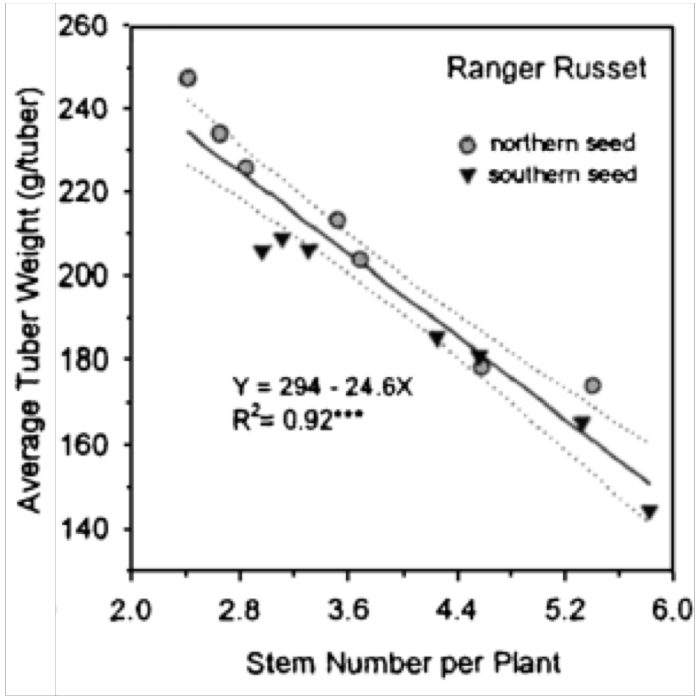
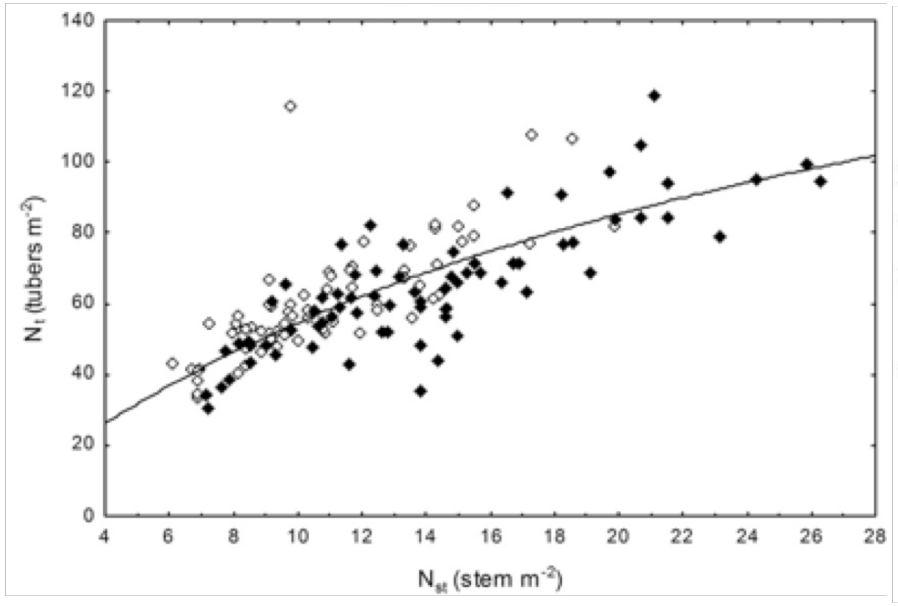


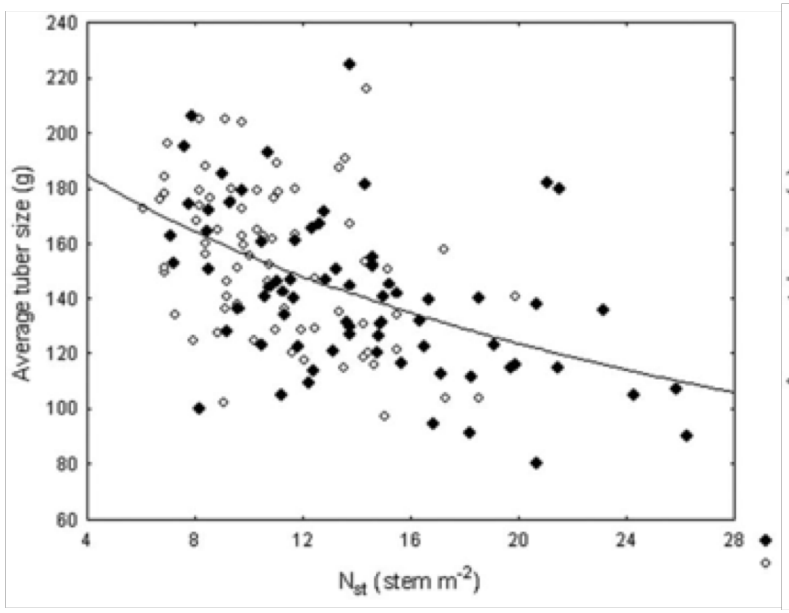


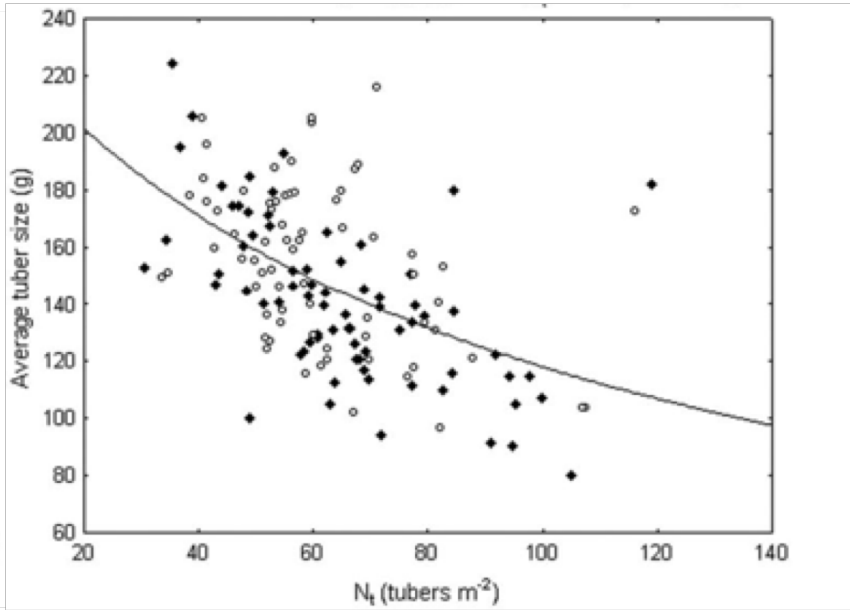


Ranger Russet (Knowles and Knowles, 2006)

Stem number x tuber number







Russet Burbank (Bussan et al., 2007)

Determine stem number

Seed Piece Size & Physiological Age on Stem Number

Treatment	Spacing (in)	Seed cwt/acre	Stems/hill	Stems/acre
2 oz	9	24	3.1	60,016
2 oz aged	12	18	4.1	59,532
3 oz	12	27	3.9	56,628
3 oz aged	15	22	5.1	59,160
4 oz	12	36	4.2	60,980
4 oz aged	18	24	6.2	60,016

(Kleinkopf and Barta, 1991)

Determining planting density

$$\frac{Desired\ stems/acre}{Stem\ number/seed} = \text{Seed number/acre}$$

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$$\frac{60{,}000\ stems/a}{4.1\ stems/seed} = 14{,}634\ \text{seed pieces/acre}$$

Determining planting density

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$$\frac{60{,}000\ stems/a}{4.1\ stems/seed} = 14{,}634 \text{ seed pieces/acre}$$

$$\frac{60{,}000\ stems/a}{3.1\ stems/seed} = 19{,}355 \text{ seed pieces/acre}$$

Seed planting rate calculator

Seed potatoes required to plant one acre in cwt/a

Row spacing	Within-row spacing	Seed piece size (oz)				
		1.5	1.75	2	2.25	2.5
		cwt/acre of seed				
34	6	28.8	33.6	38.4	43.2	48.0
34	7	24.7	28.8	32.9	37.1	41.2
34	8	21.6	25.2	28.8	32.4	36.0
34	9	19.2	22.4	25.6	28.8	32.0
34	10	17.3	20.2	23.1	25.9	28.8
34	12	14.4	16.8	19.2	21.6	24.0
34	14	12.4	14.4	16.5	18.5	20.6
36	6	27.2	31.8	36.3	40.8	45.4
36	7	23.3	27.2	31.1	35.0	38.9
36	8	20.4	23.8	27.2	30.6	34.0
36	9	18.2	21.2	24.2	27.2	30.3
36	10	16.3	19.1	21.8	24.5	27.2
36	12	13.6	15.9	18.2	20.4	22.7
36	14	11.7	13.6	15.6	17.5	19.4
38	6	25.8	30.1	34.4	38.7	43.0
38	7	22.1	25.8	29.5	33.2	36.8
38	8	19.3	22.6	25.8	29.0	32.2
38	9	17.2	20.1	22.9	25.8	28.7
38	10	15.5	18.1	20.6	23.2	25.8
38	12	12.9	15.0	17.2	19.3	21.5
38	14	11.1	12.9	14.7	16.6	18.4

Plant population based on row and within-row spacing

Row spacing	Within-row spacing (inch)						
	6	7	8	9	10	12	14
	Plant population (number)						
34	30,748	26,356	23,061	20,499	18,449	15,374	13,178
36	29,040	24,891	21,780	19,360	17,424	14,520	12,446
38	27,512	23,581	20,634	18,341	16,507	13,756	11,791

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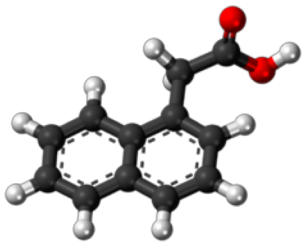
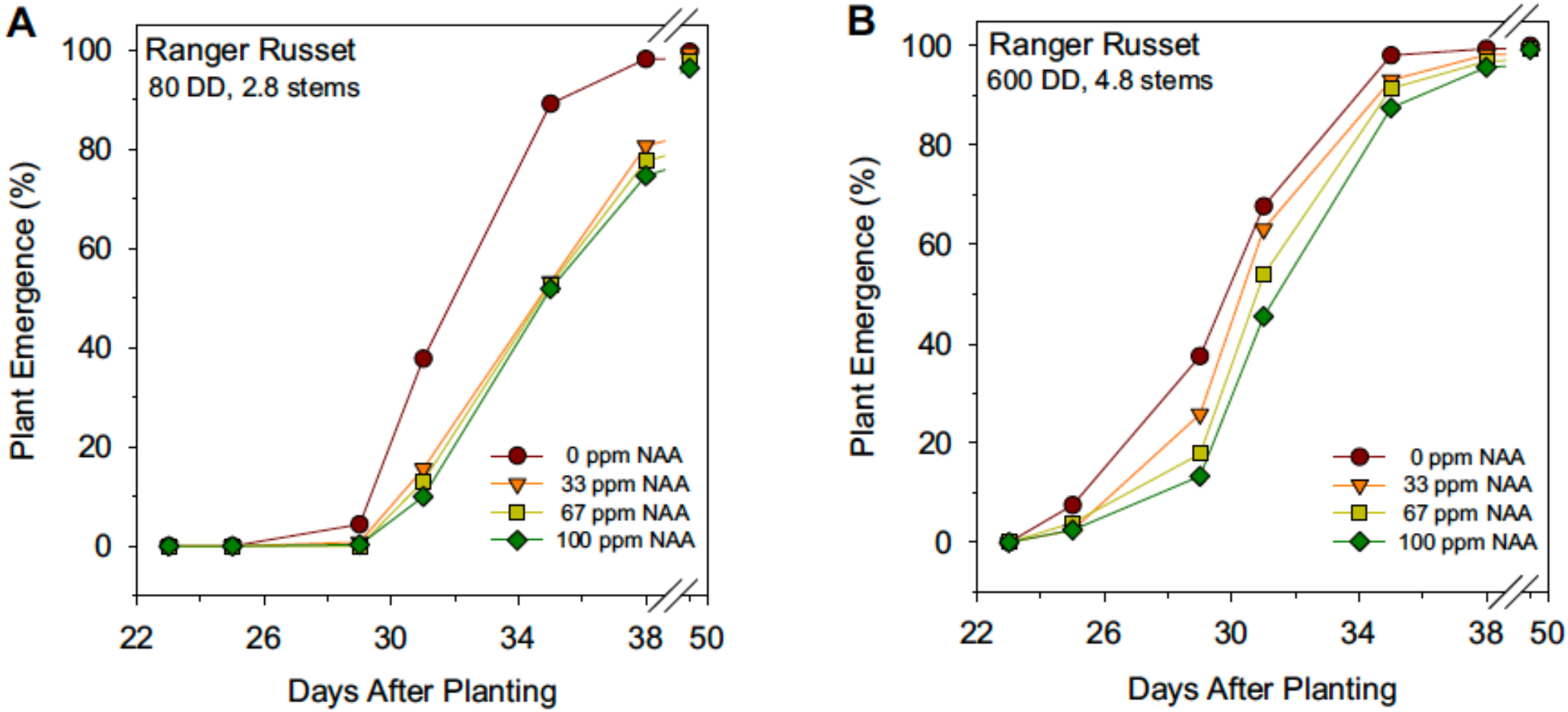
Download sheet:
z.umn.edu/seed

Other options for physiologically old seed



- NAA – naphthaleneacetic acid
- It is a rooting agent, often used for stem and leaf cuttings.
  - Induces root formation
- Causes growth inhibition
  - Prevents premature dropping of fruits (apples, olives, oranges)
- NAA producing potato plants will have larger root systems and stolons than run longer.

Effect of NAA on emergence

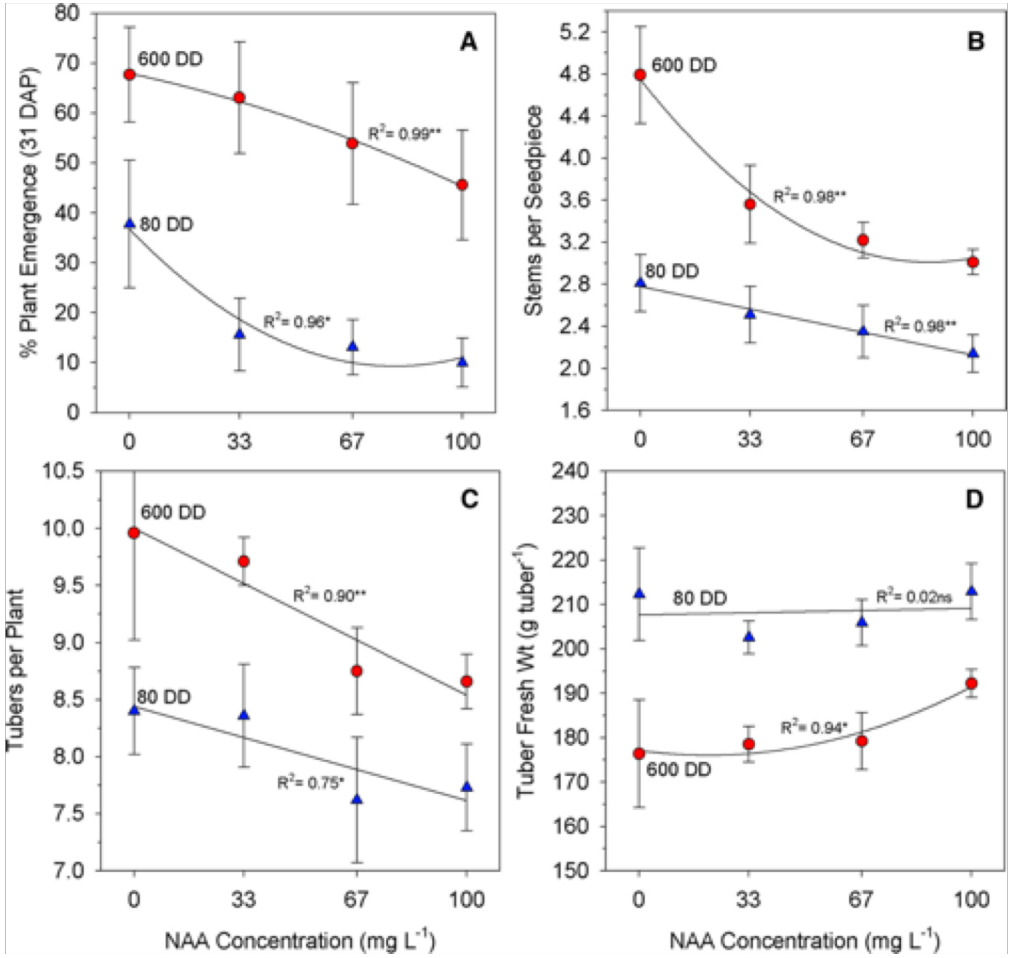


(Knowles and Knowles, 2016)

Effects of NAA seed treatment

- NAA seed treatment can decrease stem number.
  - Works better on old seed
- Stem number decreased as did tubers per plant.

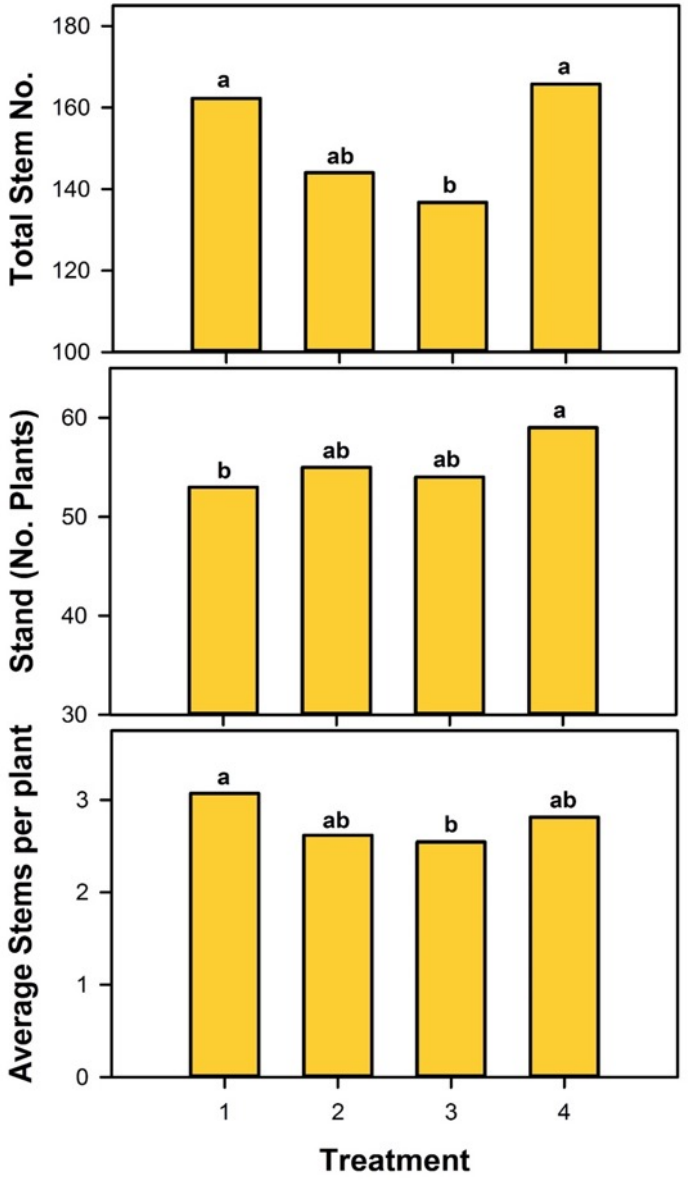
(Knowles and Knowles, 2016)



Stem number x tuber number & size

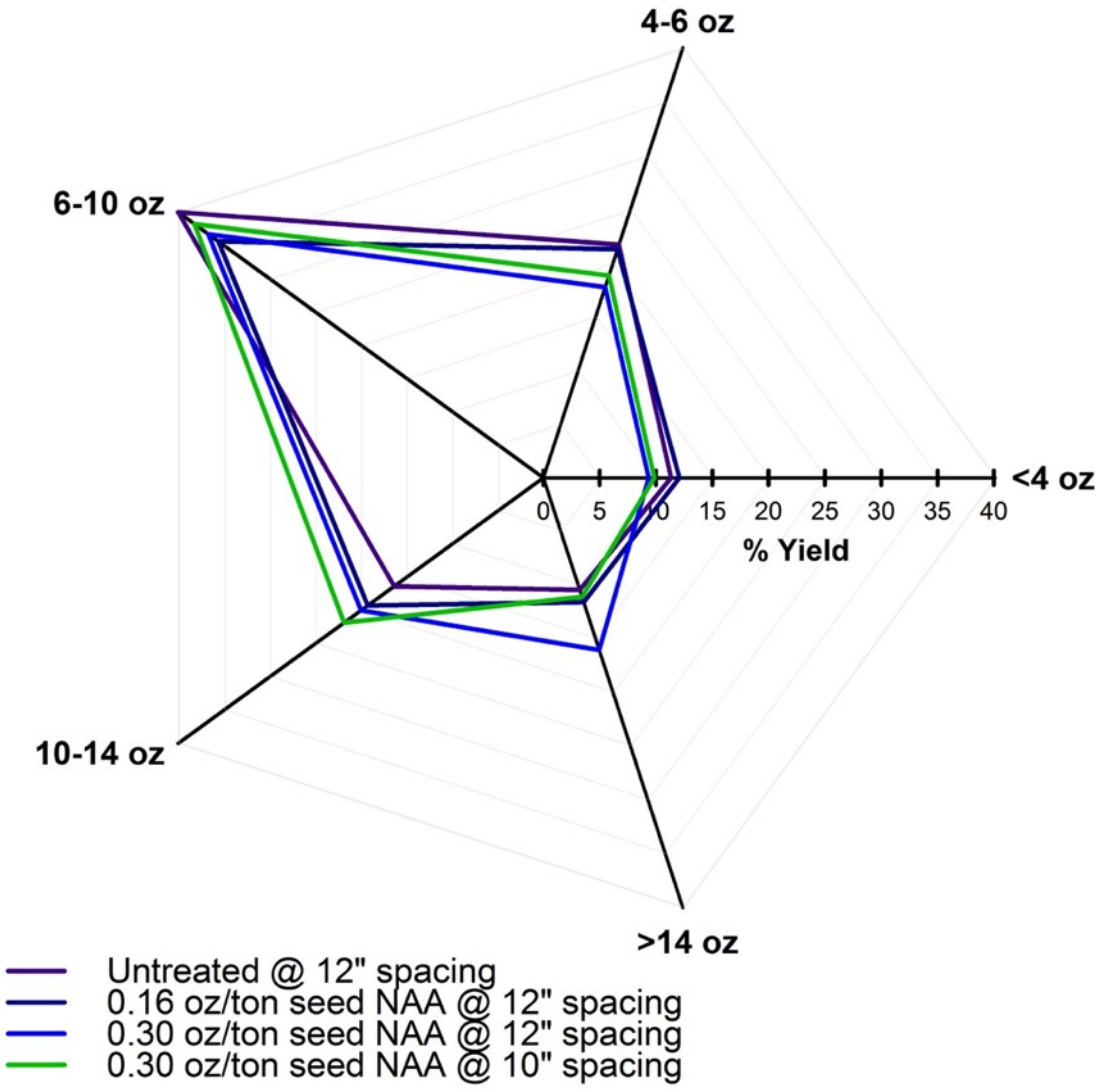
NAA on seed

- NAA can reduce stem number on physiologically old seed.
- RB treated with 1) non-treated, 2) 0.16 oz/ton seed at 12 in within-row spacing, 3) 0.30 oz/ton seed at 12 in within-row spacing and 4) 0.30 oz/ton seed at 10 in within-row spacing

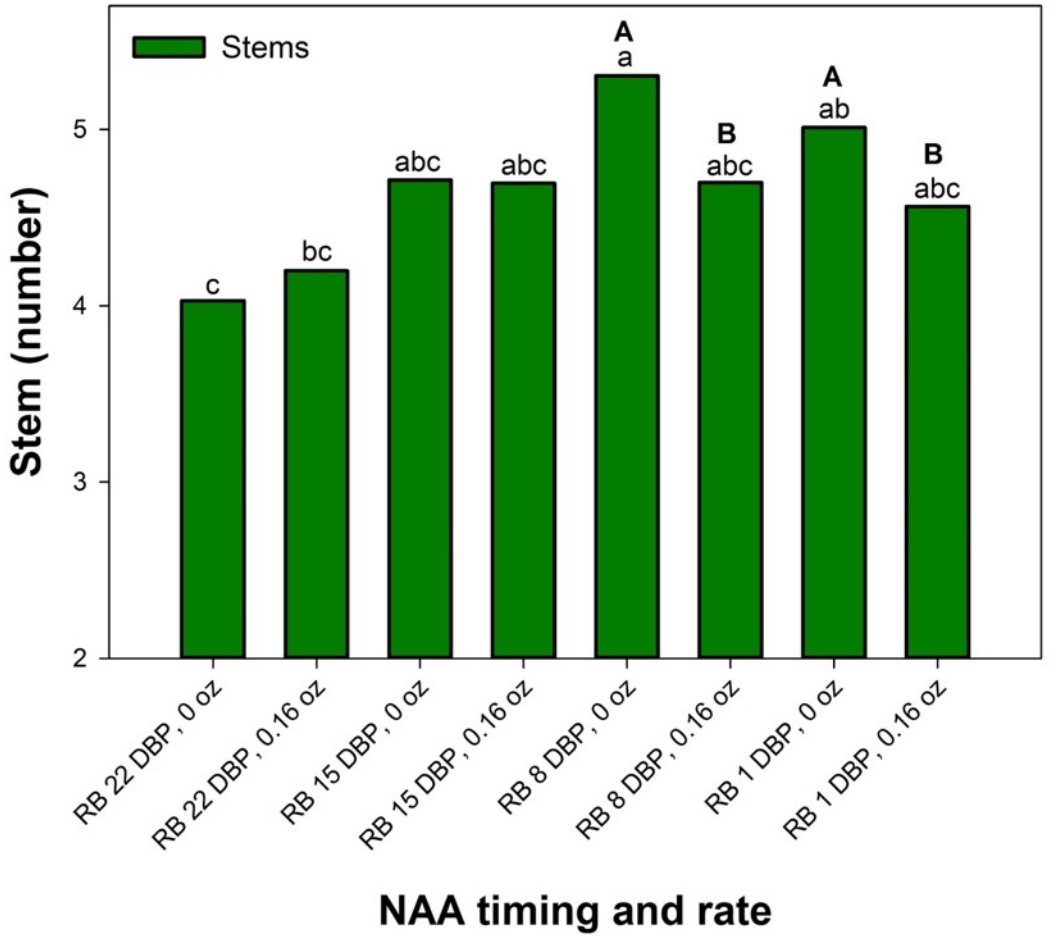


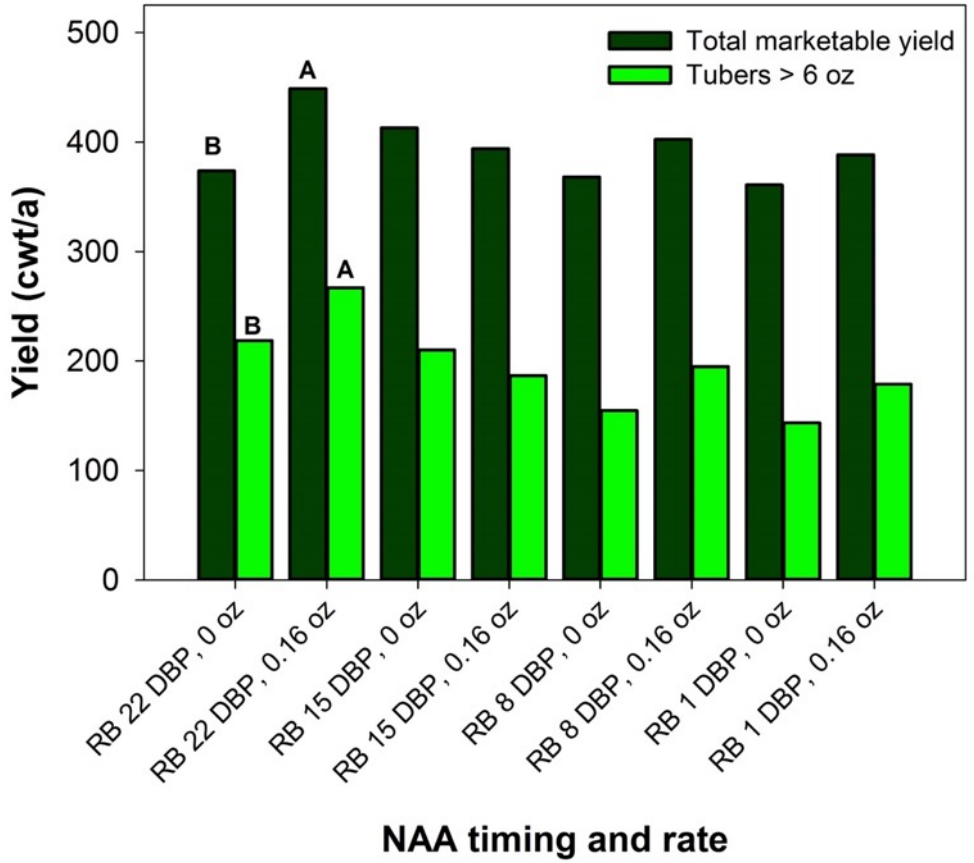
NAA on yield

- NAA did not have a significant effect on US #1 yield.
- Tuber size profile changed when 0.30 oz/ton seed NAA was applied at 10 or 12” spacing.
- NAA did manipulate tuber size profile.



NAA timing on Russet Burbank





What to do if seed is physiologically old

- Ensure seed is stored properly.
- Increase spacing between seed pieces.
  - Determine average stem number and calculate seed/acre based on this information.
- Treat seed with NAA to reduce stem number
  - If using NAA only applied as seed treatment closing to planting.

Thank you