Alternate Bearing: Review and Management

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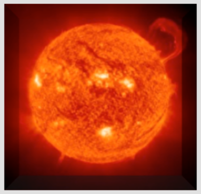
Alternate Bearing

I. Biology

II. Key Mitigating Horticultural Practices

A. Sunlight



B. Balancing 'Leaf Area:Fruit Ratio'

C. Tree Stress

Alternate bearing is a consequence of the interaction between flowering physiology and environmental factors

I. Biology
Flowering/Fruiting Stress !

- ***Fruiting Stress** :** *Reproduction* is 'costly'and 'detrimental' to tree health and longevity.
  - For >100 tree species *fruiting* causes complete loss of physiological function and *kills the tree* (i.e., senescence and death)
  - For most tree species (e.g., pecan), *fruiting kills shoot tips, shoots or small branches*.

*For all 'annual' and 'biennial' plants, fruiting is fatal (i.e., kills the plant) !

Same Year Influence of Fruiting on Shoots

‘Vegetative and reproductive’ parameters of ‘Pawnee’ pecan shoots as a function of shoot reproductive status.

Shoot type [z]	July fruit/ shoot (#) [y]	Sept. fruit/ shoot (#)	Sept. leaves/ shoot (#)	Sept. leaflets/ shoot (#)	Sept. total leaf area/ shoot (cm^2)	Sept. shoot length (cm)
Vegetative	0	0	10.0	116.8	2011.9	23.21
Fruiting	4.2	3.7	8.5	89.8	1486.8	17.38
F(P)	-	-	(0.0002)	(<0.0001)	(0.0003)	(<0.0001)
Change (±) due to fruiting (%)	-	-	-15	-23	-26	-25

[z] F-, non-fruiting shoot; F+, fruiting shoot

[y] Measurements taken in late June were just prior to the beginning of the rapid log-phase of fruit growth, whereas those taken in late September were at fruit ripening

[x] not statistically different at ≤0.05

Same Year Influence of Fruiting on Shoots

‘Vegetative and reproductive’ parameters of ‘Pawnee’ pecan shoots at fruit ripening, as a function of shoot reproductive state

Shoot type[z]	Stem dry weight (g)	Shoot leaf dry weight (g)	Total dry weight of vegetative portion of shoot (g)	Leaf weight per area (mg/cm^2)	Total dry weight of reproductive structures (g)	Total dry weight of all shoot organs (g)	June shoot cross-sectional area (mm^2)	Sept. shoot cross-sectional area (mm^2)
Vegetative Organs	3.02	21.54	24.56	1.07	0	24.56	72.82	81.46
Fruiting Organs	1.78	15.53	17.31	1.04	44.73	62.03	59.66	72.60
F(P)	(.0001)	(0.0004)	(<0.0001)	ns[x]	(<0.0001)	(<0.0001)	(0.0006)	(0.0330)
Change (±) due to fruiting (%)	-41	-28	-30	-	-	+153	-18	-10

[z] F-, non-fruiting shoot; F+, fruiting shoot

[Y] Measurements taken in late June were just prior to the beginning of the rapid log-phase of fruit growth, whereas those taken in late September were at fruit ripening

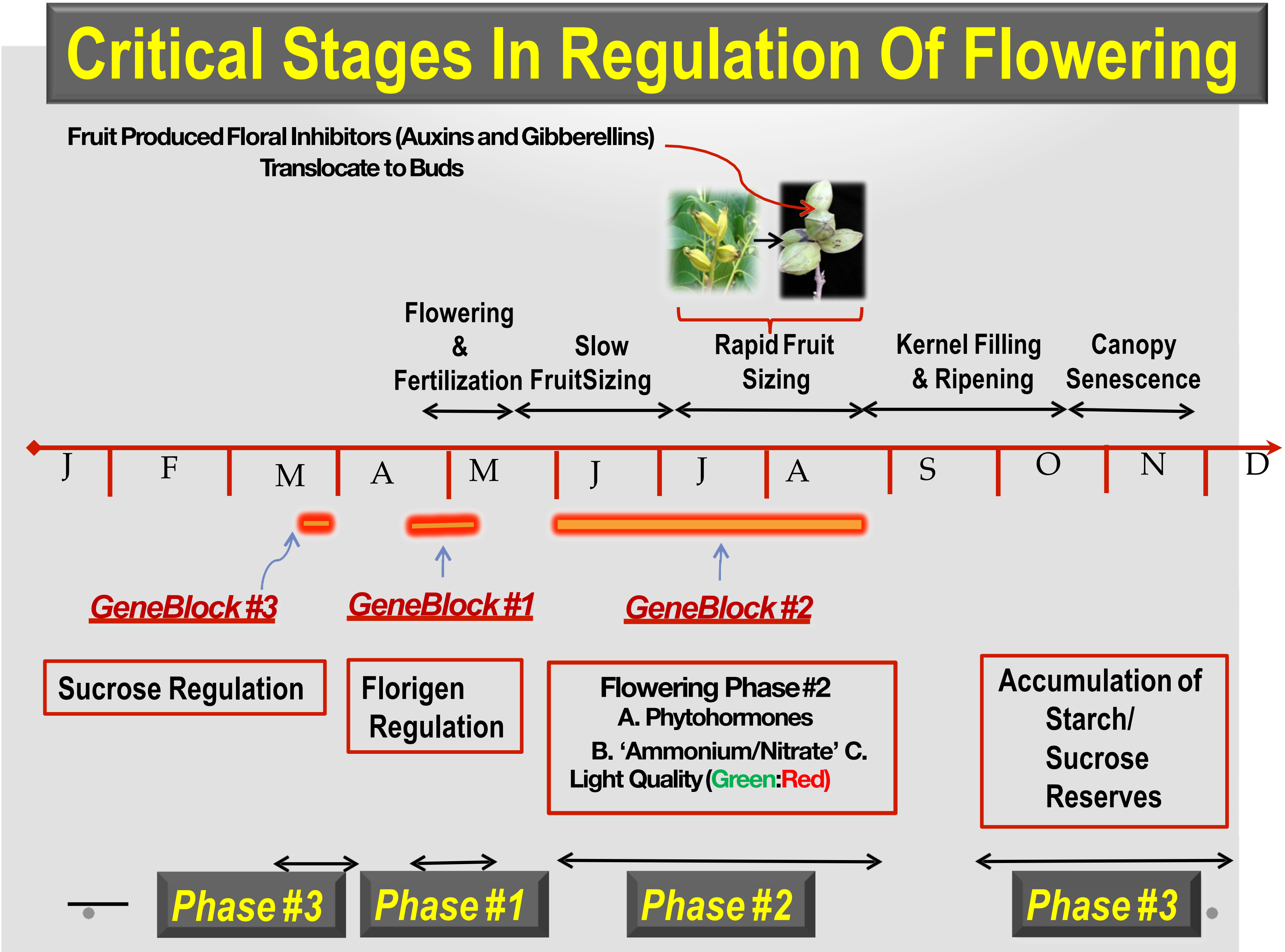
[x] not statistically different at ≤0.05

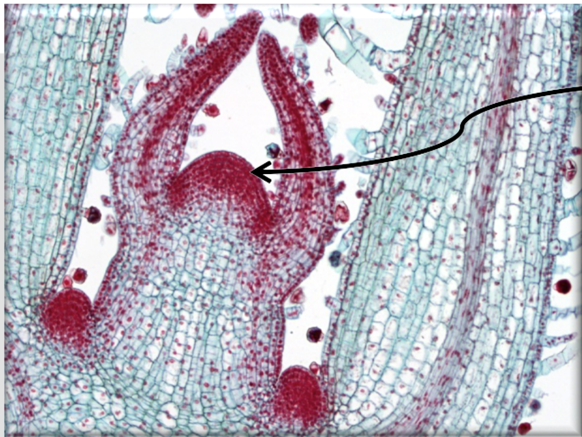
Fruiting: Impact on Trees

- **Increases:**
  - Demand for nutrient elements (e.g., N & P)
  - Sensitivity to drought
  - Sensitivity to cold
  - Susceptibility to most pests
  - Incidence of shoot death the followingspring
  - Tree ‘stress’

Fruiting: Impact on Trees

- **Decreases:**
  - Water use efficiency (more water used)
  - Canopy leaf area (greater canopy transparency)
  - Leaf chlorophyll content
  - Assimilate reserves
  - Root growth in ‘On’ years (less allocation ofassimilates)
  - Tree health (especially as the tree ages)
  - Tree size (growth and reproduction are inverse correlated)


Critical Stages In Regulation Of Flowering
Fruit Produced Floral Inhibitors (Auxins and Gibberellins) Translocate to Buds
Flowering & Fertilization
Slow FruitSizing
Rapid Fruit Sizing
Kernel Filling & Ripening
Canopy Senescence
J F M A M J J A S O N D
GeneBlock #3
GeneBlock #1
GeneBlock #2
Sucrose Regulation
Florigen Regulation
Flowering Phase #2
A. Phytohormones
B. 'Ammonium/Nitrate' C. Light Quality (Green:Red)
Accumulation of Starch/ Sucrose Reserves
Phase #3
Phase #1
Phase #2
Phase #3



The ***'Stem Cells'*** Within Axillary Buds of Pecan Shoots ***First*** Produce **'Leaf Primordia'** and Then Transition to Producing **'Floral Primordia'**

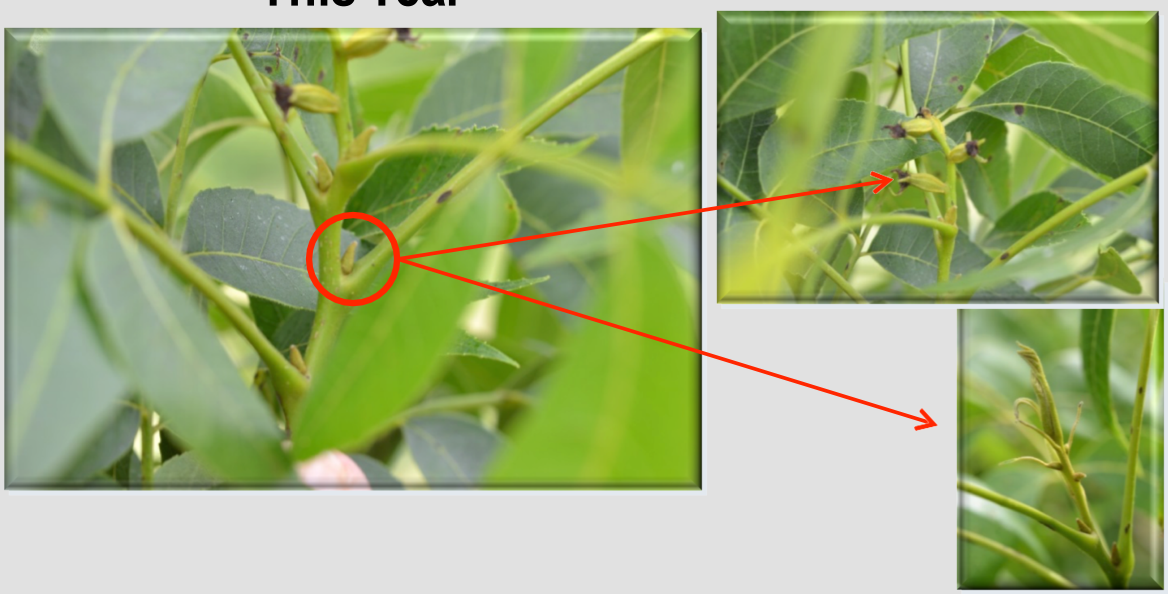
'Stem cells' of axillary buds usually produce ~8-12 leaf primordia ***before*** producing fruit primordia (~1-8)

What triggers the transition from 'leaf' to 'floral' primordial?

What Causes the 'Mother Stem Cell' Within the Several Axillary & Apical Buds Stop Producing Leaves and Start Producing Fruit?

This Year

Next Year



Reproductive?

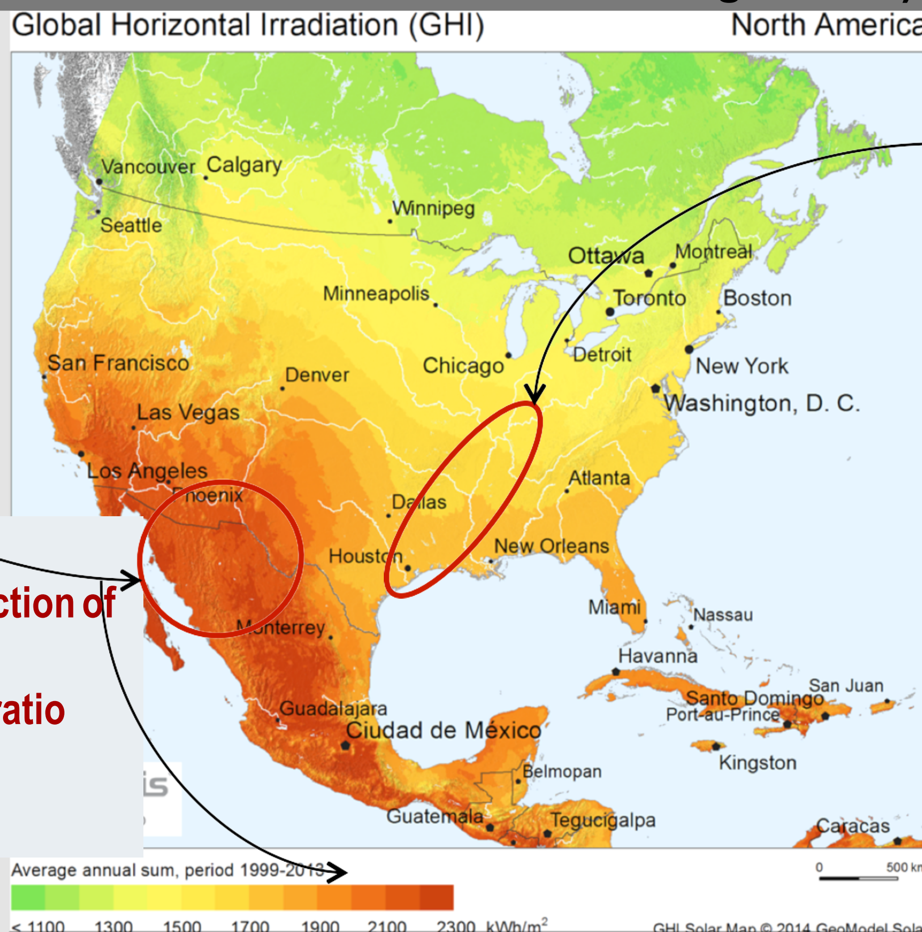
Vegetative?

A Special Type of Stress DevelopmentallyAlters 'Meristematic Stem Cells'!!!

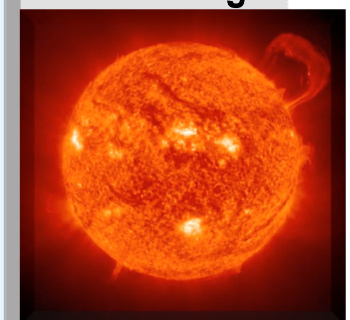
II. Key Mitigating Horticultural Practices

A. Sunlight Levels: Light Environment
(Affects 'Phase #2 and #3' Flowering Genes)

Flowering/yields are greatest when grown in higher sunlight zones 1900-2200 kWh/m^2 range



Native pecan has sunlight levels in the 1500-1700 kWh/m^2 range



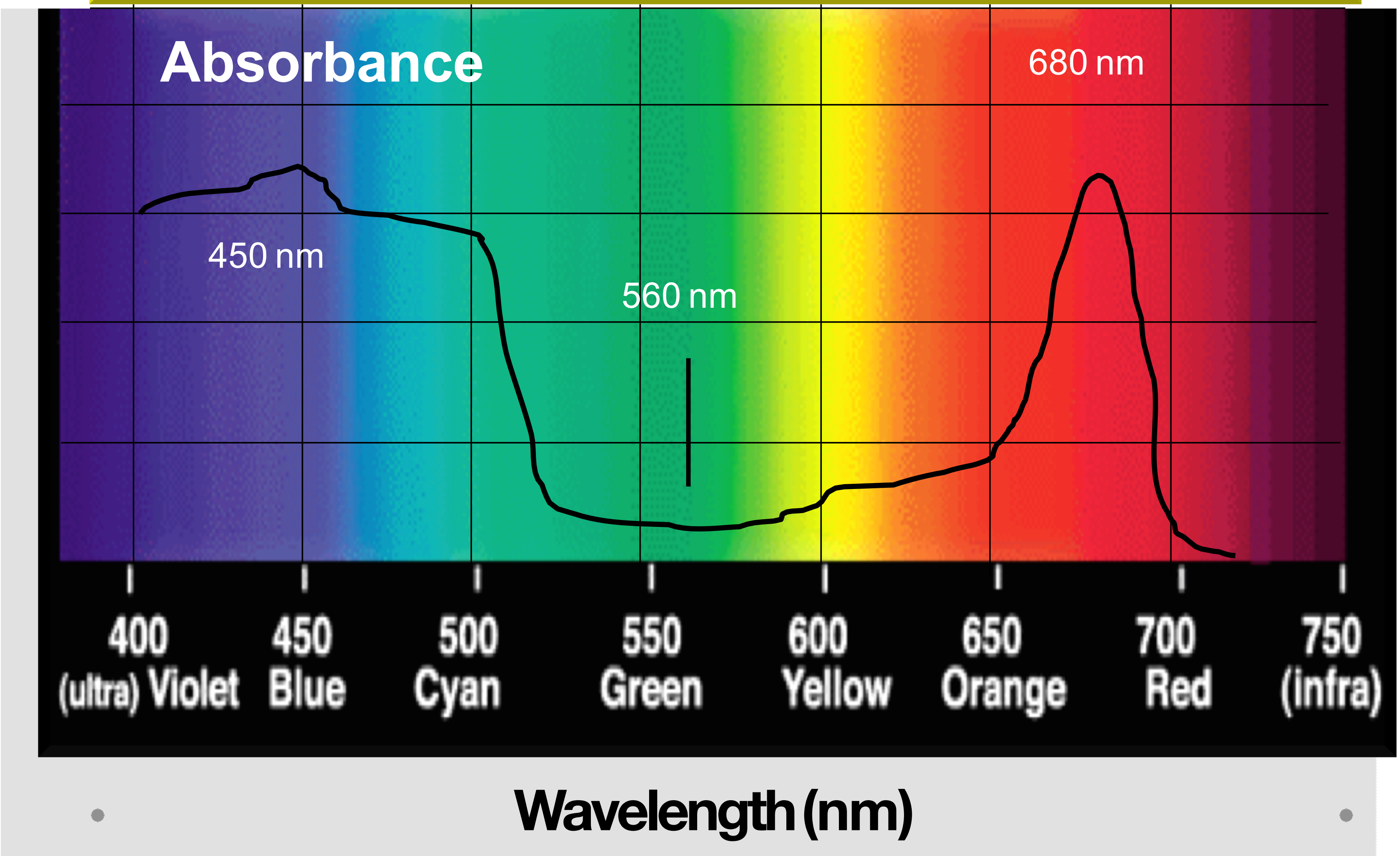
High Sunlight:

- Increases photo destruction of floral inhibitors (auxins)
- Shifts 'auxin:cytokinin' ratio
- Increases energy for photosynthesis (sugars)

- hJp://en.wikipedia.org/wiki/I
- nsolaMon#mediaviewer/
- FileSolarGIS-Solar-map-North-
- -America-en.png

Orchard Light Environment

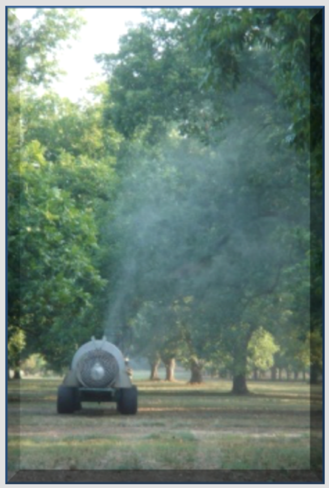
('Red:Green' Energy Ratio Affects TreePartitioning of Assimilates Into '*Reproductive* vs. *Vegetative*'Growth



Optimize 'Orchard Light Environment'

Crowded Orchards Cause Major Problems

(Especially When Trees Are Exposed to Excessive *Nitrate-N*)

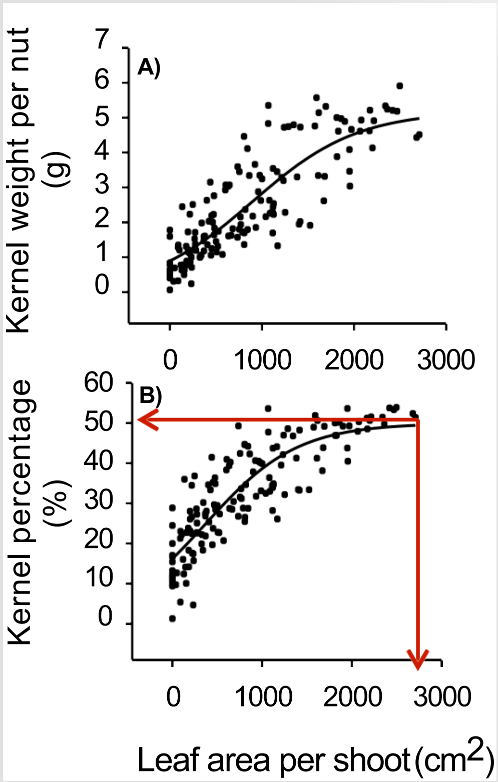


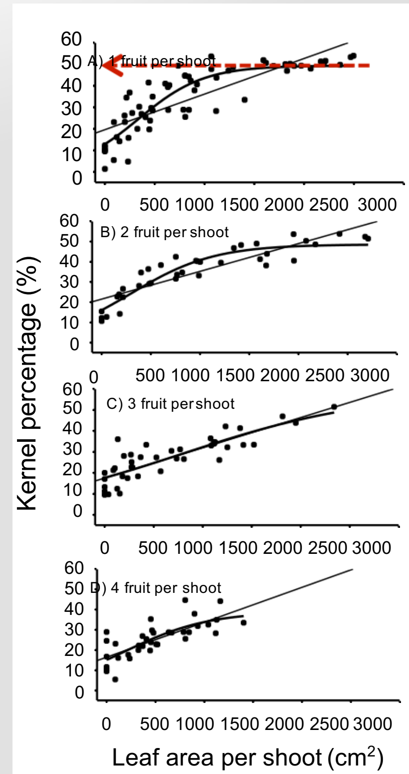
- Poor spray coverage
- Greater disease & insects pressure
- and susceptibility
- Greater alternate bearing
- Diminishing nut yield and quality

B. Balancing 'Leaf Area:Fruit Ratio'

Discrete Canopy vs. Hedgerow Hedging?
('Rule-of-thumb': at least 8-10 compound leaves supporting each fruit)

Phase#2 and #3: Leaf Area Per Fruit



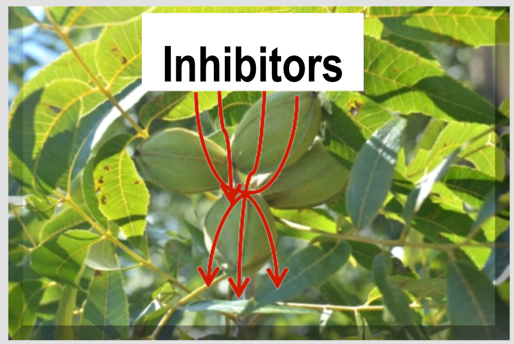


- A single **'Desirable'** fruit in GA* requires ~2800 cm^2 (i.e., *~8 compound leaves per fruit; or 509 cm^2 of leaf area per gram of kernel, or about 8.9 x 8.9 inches square of leaf area, per gram of kernel, or ~1.5 leaves/g kernel*) of supporting foliage (when under drip irrigation) to supply the necessary assimilates for maximum kernel development. *Note that due to much higher sunlight levels, and near absence of foliar pests and better water management, about one-half as much leaf area is likely required per gram of kernel (i.e., ~255 cm3/g) in the southwestern U.S., northeast Mexico and northwestern South Africa.
- In 'Desirable', in Georgia, fruit clusters of ≥ 2 fruit/shoot are likely importing assimilates from nearby vegetative shoots (usually laterals) unless there are ≥ 9 compound leaves per terminal.

Flowering Phase #2 Gene Block

(July-August) GeneBlock#2

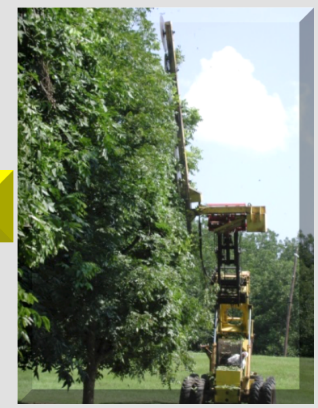
What Orchard *Management Tools are Available* for Reducing Bud Exposure to Floral Inhibitors?



Inhibition of Floral Bud Development

Management Tools

Directly, Via Mechanical
Crop Load Thinning
(Thin as early in August as feasible)

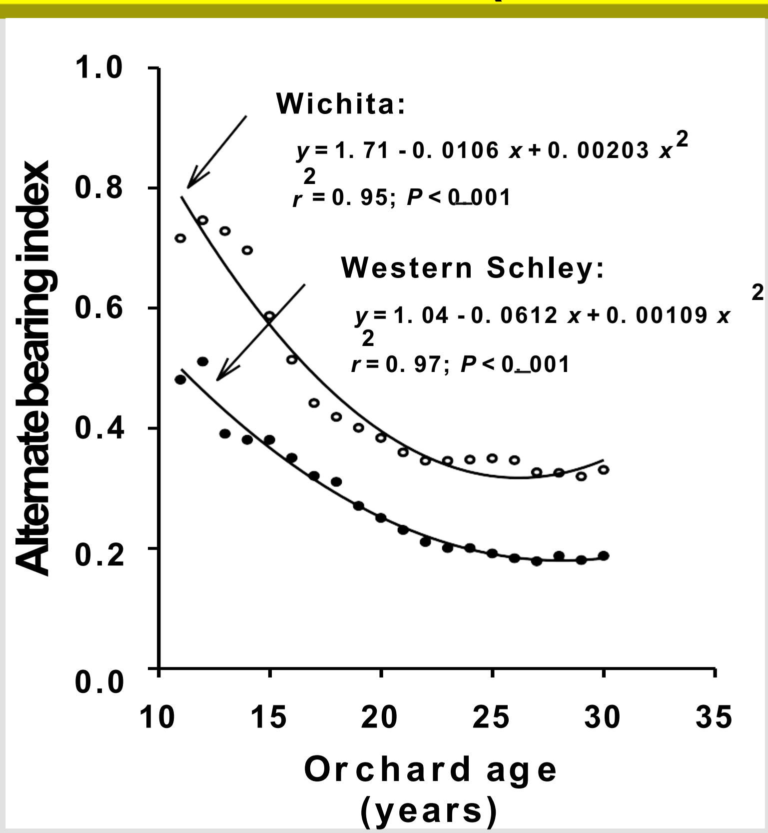


Indirectly, Via Pruning
(e.g., Mechanical Pruning/Topping)

Tool#1

--Hedging/Topping--

Tool #1:
Hedge Pruning/Topping Reduces Alternate Bearing of Trees and Mass Bearing of Orchards (Phase-II and Phase-III)



Wood, B.W. and D. Stahmann. 2004. Hedge Pruning Pecan. HortTechnology 14(1):63-72.

Tool #2:

Mechanical Fruit Thinning

Thinning is more effecMve at 50% ovule expansion than at 80–100% ovule expansion. The larger the fruit (nut) of the culMvar, the more Important it is to thin earlier.

#1 Tool:
Mechanical Fruit Thinning in 'On' Years (Phase--I)

Table 1. In--shell pecan yield, percentage of kernel, and crop value of 'Cape Fear' and 'Sumner' pecan trees mechanically fruit thinned in 2007.*

Year	Cultivar	Treatment	In-shell pecan yield (lb/tree)[z]	Kernel (%)	Crop value[y] ($/tree)
2007	Cape Fear	Thinned	186.5 b[x]	51.2 a	199.57 a
		Nonthinned	224.9 a	47.9 b	225.15 a
	Sumner	Thinned	164.5 a	53.8 a	186.74 a
		Nonthinned	163.3 a	52.3 a	180.20 a
2008	Cape Fear	Thinned	195.0 a	57.3 a	313.98 a
		Nonthinned	8.0 b	56.9 a	12.79 b
	Sumner	Thinned	183.2 a	54.7 a	278.58 a
		Nonthinned	10.2 b	56.1 a	15.91 b
Total (2007 + 2008)	Cape Fear	Thinned	381.5 a	—	513.55 a
		Nonthinned	232.9 b	—	237.94 b
	Sumner	Thinned	347.7 a	—	465.32 a
		Nonthinned	173.5 b	—	196.1 b
2-year avg	Cape Fear	Thinned	190.8 a	54.3 a	253.83 a
		Nonthinned	116.5 b	52.4 a	149.56 b
	Sumner	Thinned	173.9 a	54.3 a	231.35 a
		Nonthinned	86.8 b	54.2 a	115.26 b

+69%

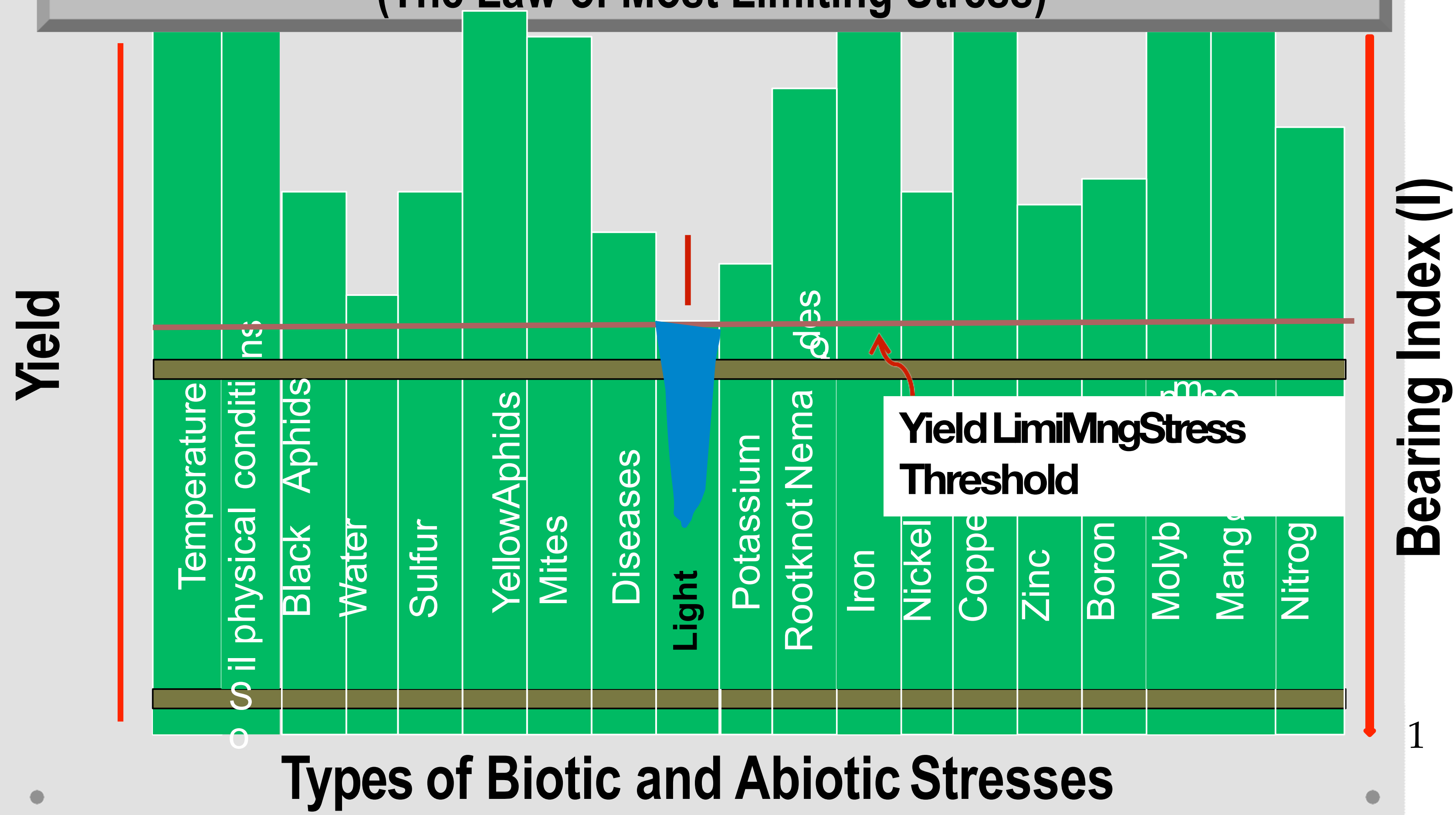
+101%

[z]1 lb = 0.4536 kg.
[y]Crop value = weight per tree × kernel price × percentage of kernel.
[x]Means followed by the same letter within column, year, and cultivar are not significantly different by Fisher's *F*-test at $P < 0.05$.

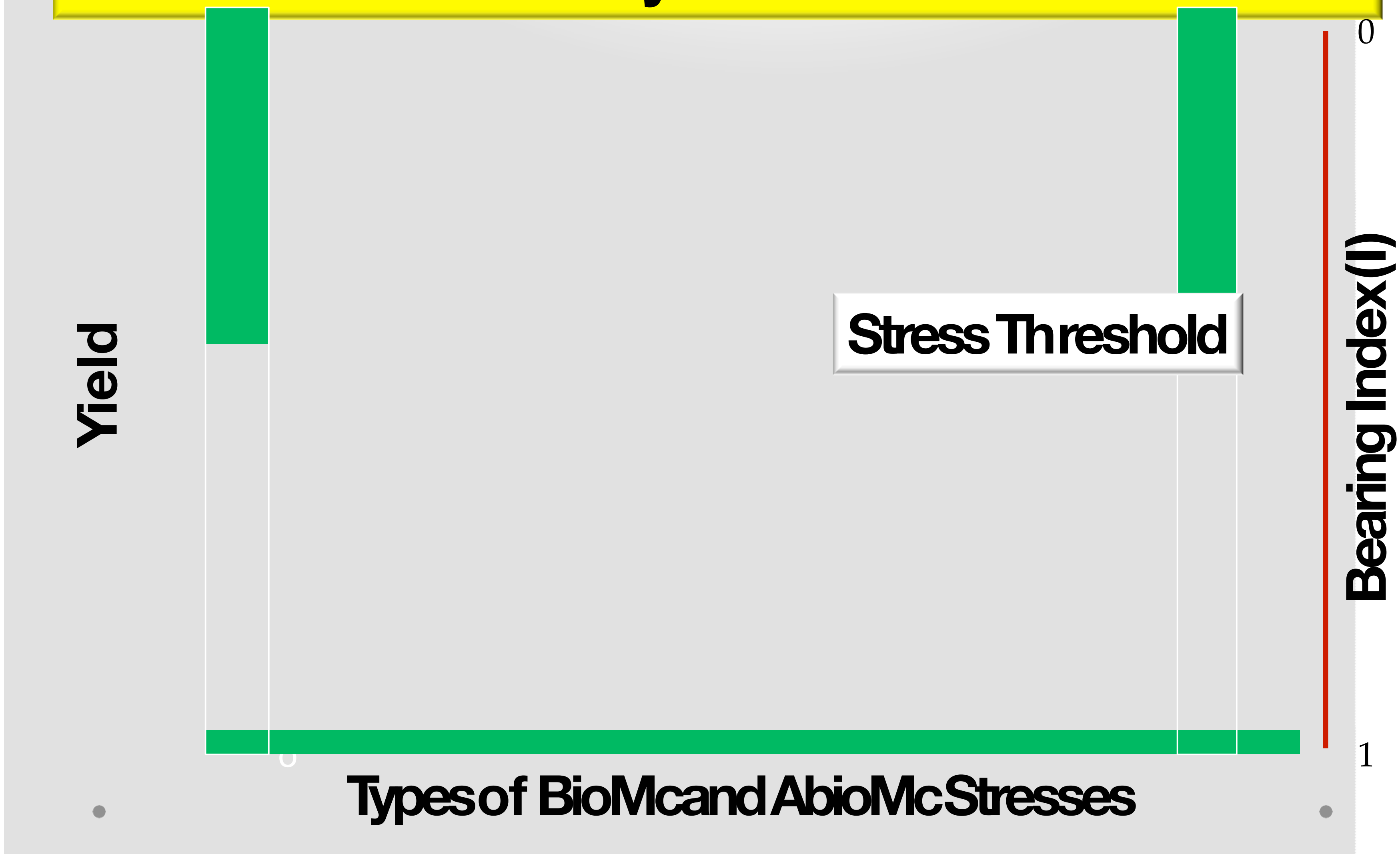
*Wells, et al. 2009. Profitability of Mechanical Fruit Thinning of 'Sumner' and 'Cape Fear' Pecan. HortTechnology. Mechanically thinned for 8 sby trunk shaking to remove ≈30%to 40%of the fruit on each tree on 1 Aug. IniMal crop load for all trees was excessivein 2007 with ≥85%of terminals bearing fruit on eachtree at the Mmeof thinning. Fruit werein the late liquid endosperm stageand the ovule wasfully expanded. Mechanicalthinning useda tree shakerwith a hydraulic shakerhead.

C. Minimize Overall Tree Stress:

Alternate Bearing Is Substantially Regulated by 'Tree Stress' and How it Affects Phytohormones and Resource Reserves (The Law of Most Limiting Stress)



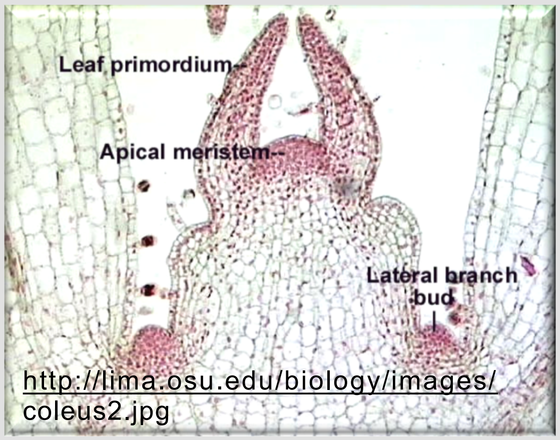
What are the 'top 5' most yield-limiting factors in your orchard ?

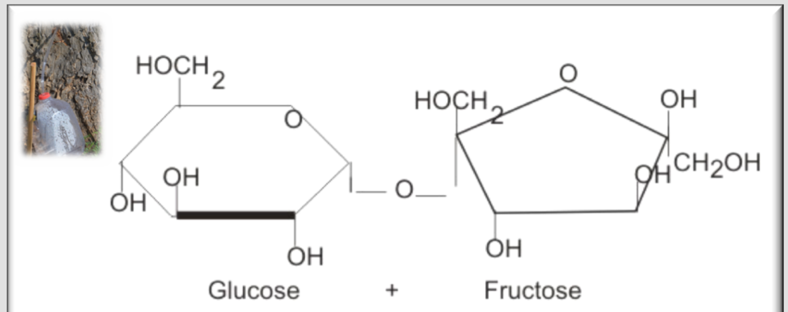


GeneBlock#3

Flowering Phase#3 Gene Block (March)

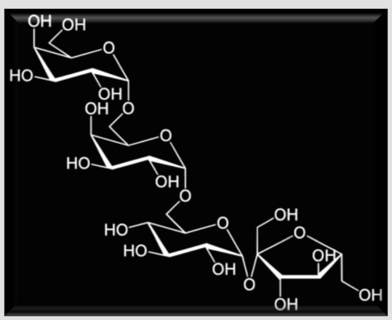
Regulated by Sucrose (a floral promoter)!





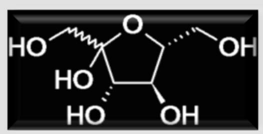
Sucrose

> ~95%



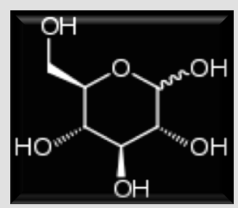
Stachyose

< ~0.5%



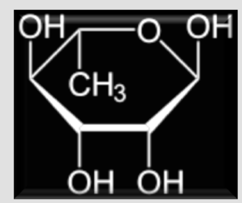
Fructose

< ~ 0.5%



Glucose

< ~0.5%

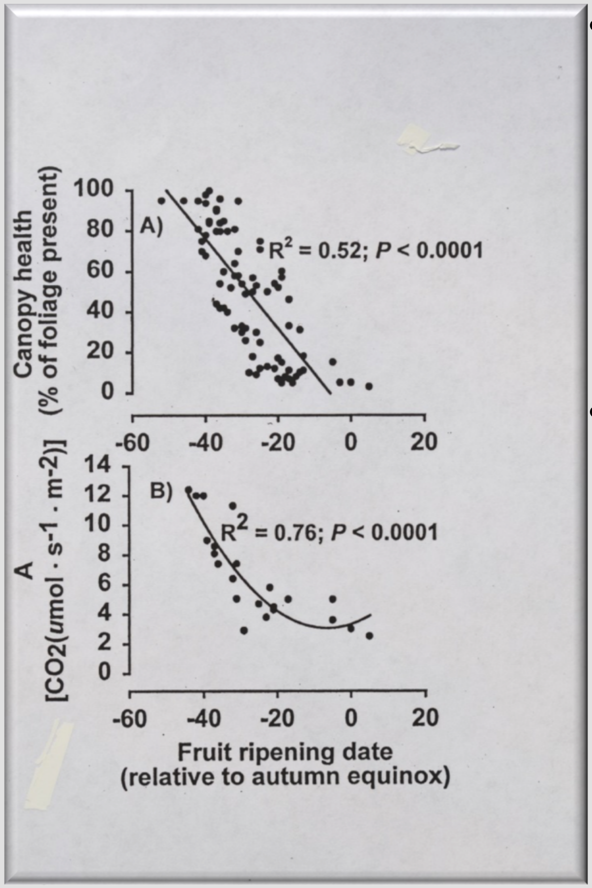


Rhaminose

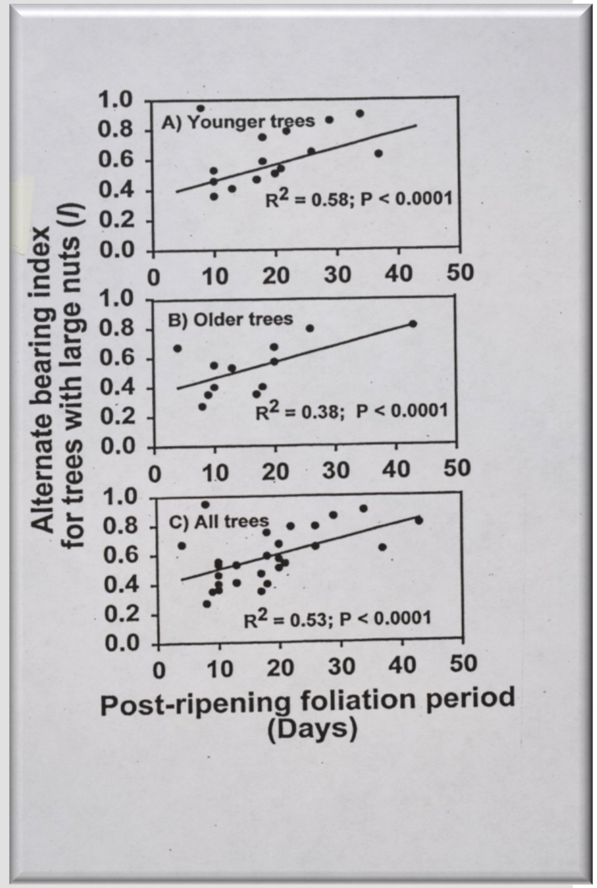
< ~0.5%

Flowering Phase #3

Late Season Canopy Health is Critical



- ★ ***Late ripening cultivars*** tend to retain a healthy canopy later into the growing season
- ★ ***Early ripening cultivars*** tend to exhibit a higher degree of alternate bearing and earlier loss of canopy



Flowering

Phase #3 (March)

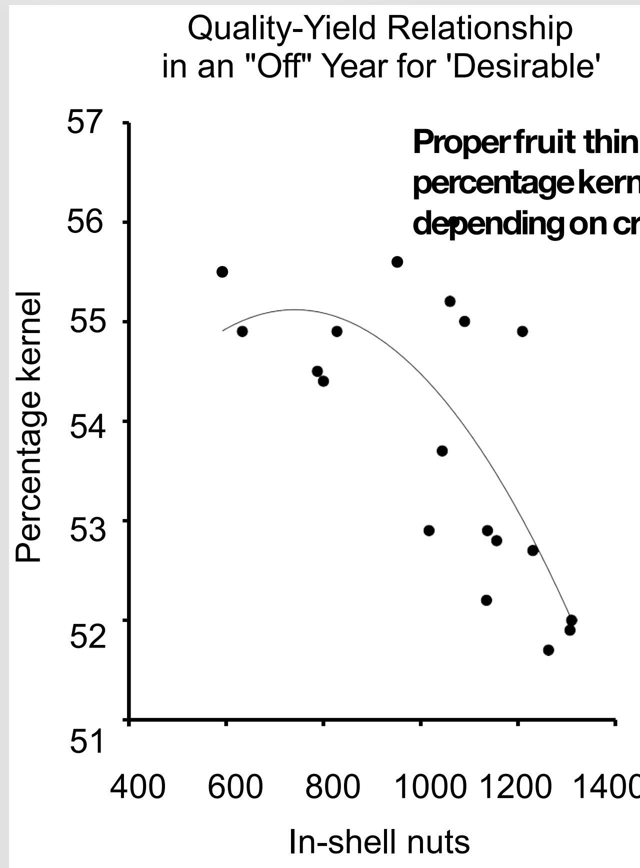
--Affected by Canopy Health--



- Do not tolerate macro- or micro-nutrient deficiencies during spring canopy expansion (esp. N, K, micros), nor during or after autumn fruit filling (esp. N, K)

Thanks!

Crop–load Affects Percentage Kernel and Kernel Quality



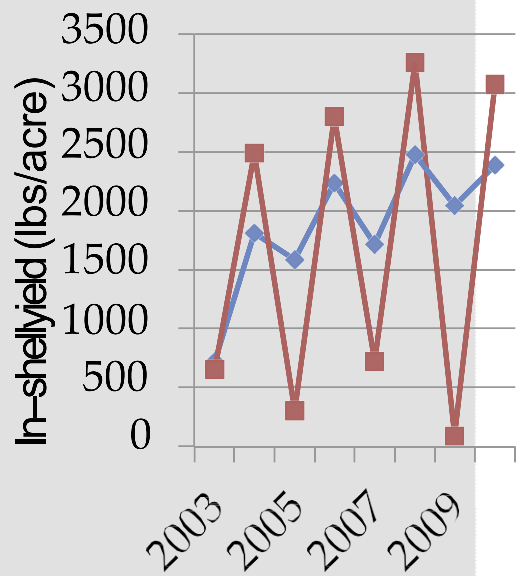
Proper fruit thinning can increase percentage kernel by ~3–10%, depending on crop load.

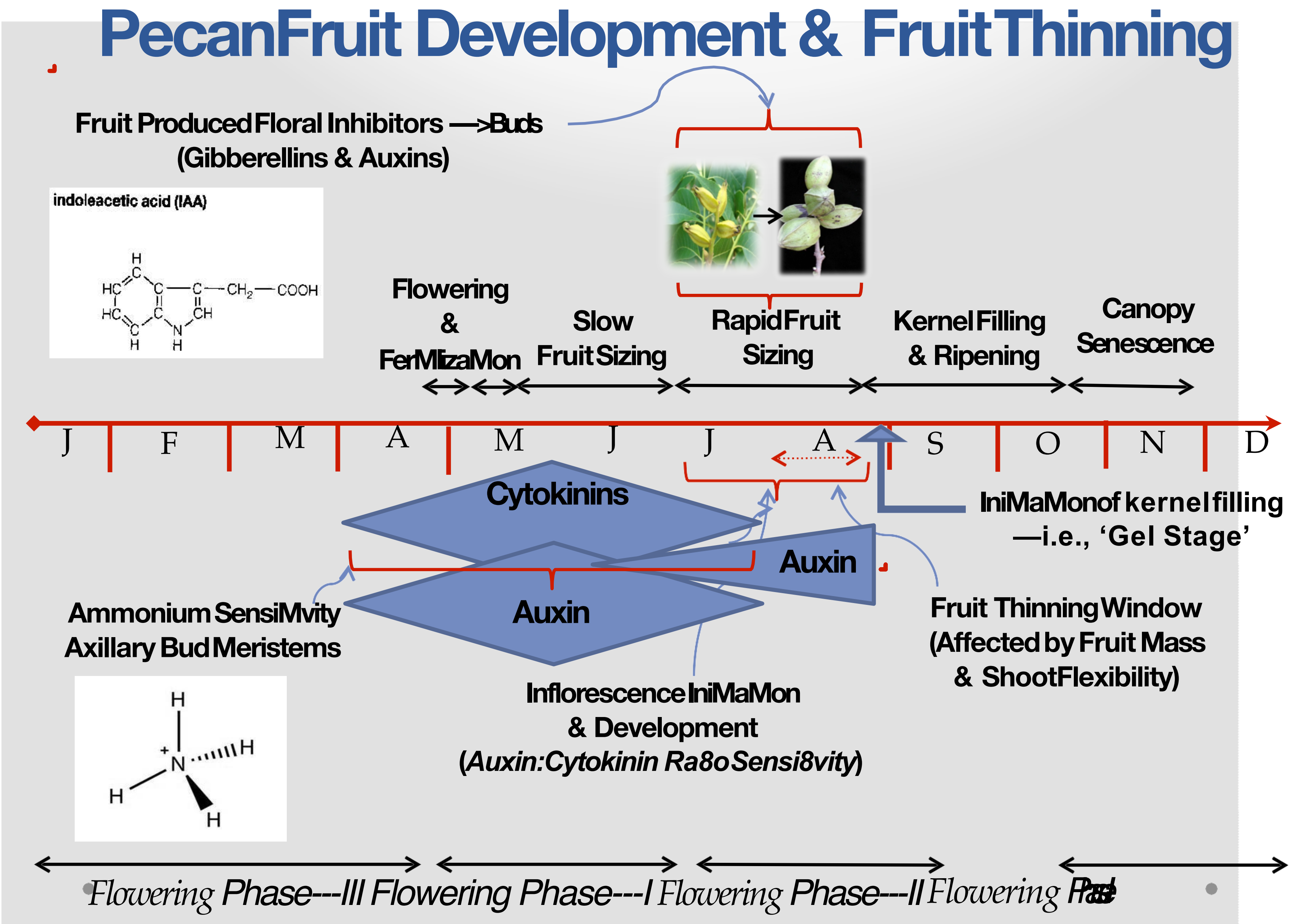
Percentage kernel and other kernel quality traits tend to decrease as per tree nut yield increases.

Tool #2:

Mechanical Fruit Thinning In 'On' Years (Phase--I)

Incidence and severity of fruit disorders such as 'shuck decline', 'water--stage fruit split', 'light kernels', and 'vivipary' greatly diminish with crop--load thinning




PecanFruit Development & FruitThinning
Fruit ProducedFloral Inhibitors —>Buds
(Gibberellins & Auxins)
indoleacetic acid (IAA)
Flowering
&
FerMlizaMon
Slow
FruitSizing
RapidFruit
Sizing
Kernel Filling
& Ripening
Canopy
Senescence
J
F
M
A
M
J
J
A
S
O
N
D
Cytokinins
Auxin
Auxin
IniMaMonof kernelfilling
—i.e., 'Gel Stage'
Ammonium SensiMvity
Axillary Bud Meristems
Fruit ThinningWindow
(Affected by Fruit Mass
& ShootFlexibility)
Inflorescence IniMaMon
& Development
(Auxin:Cytokinin Ra8oSensi8vity)
Flowering Phase---III Flowering Phase---I Flowering Phase---II Flowering Phase

Lateral Shoots Arise From Axillary Buds Located at Nodes of 1 Year Old Shoots

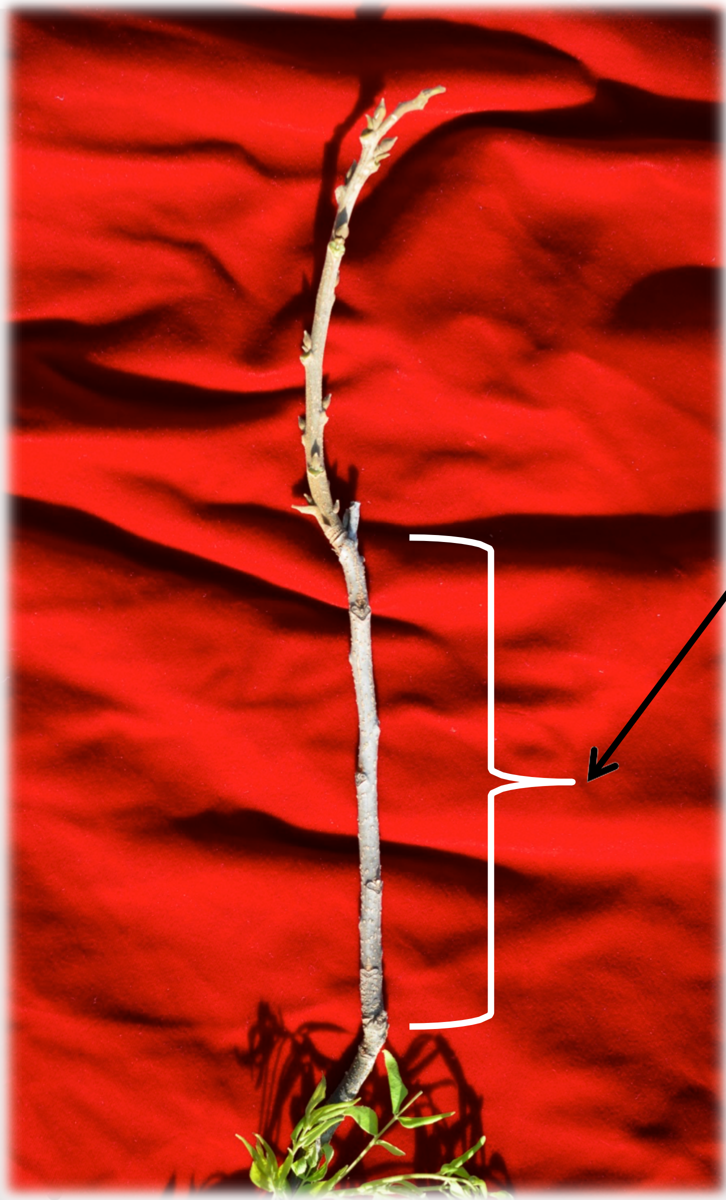
3 Fruiting 2 Fruiting 1 Fruiting

0 Fruiting 0 Vegetative 0 Vegetative

1 Vegetative 3 Vegetative

Lots of Variability Within the Same Branch

The Tree Produces Minimal Lateral Fruiting



- Shoots arising from primary buds at last year's shoot leaf nodes abort after shedding pollen, thus preventing lateral shoots and associated female flowers.

Nitrogen & NForm

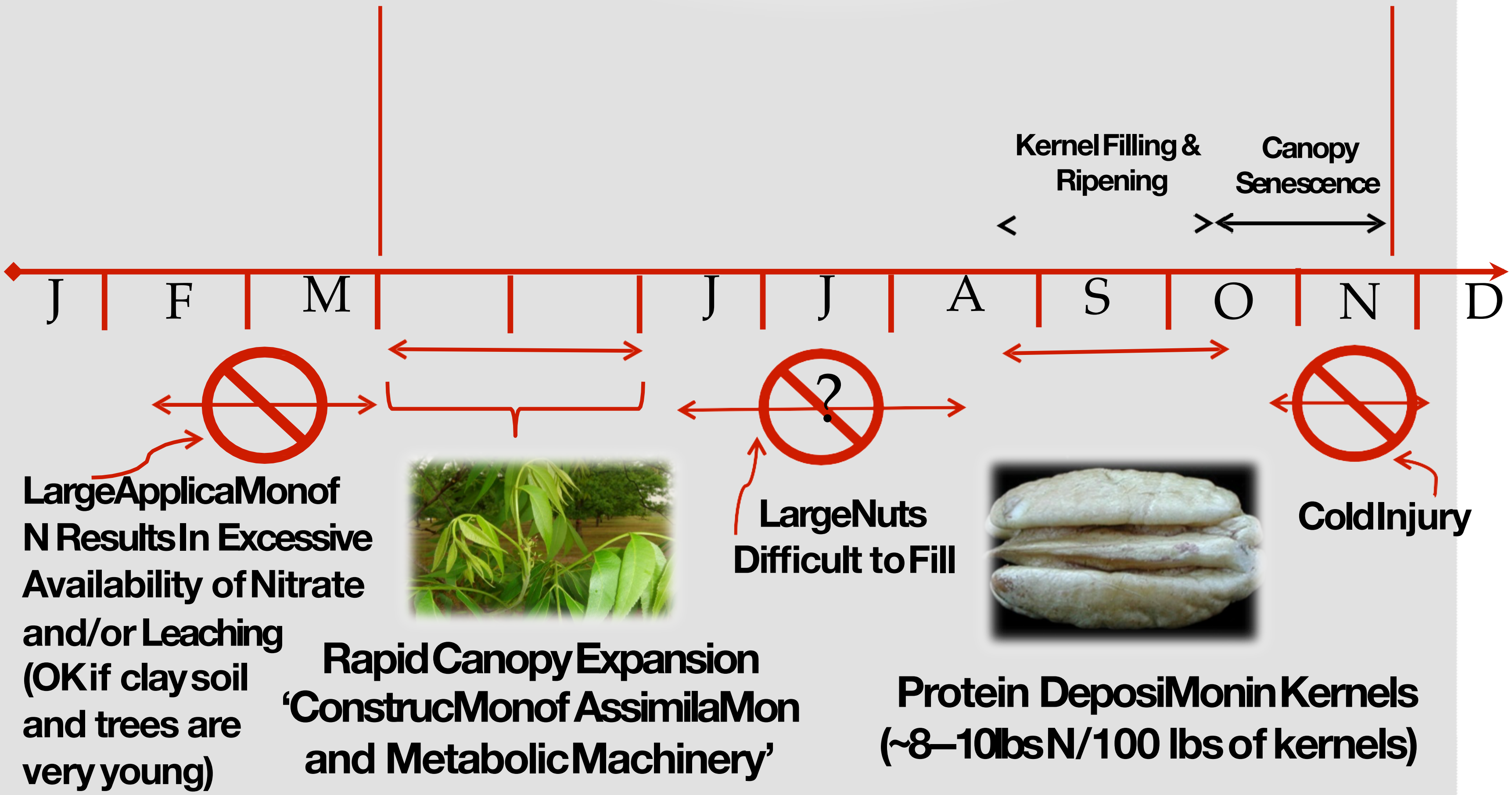
- **<u>Nitrogen</u> is often the most growth limiting nutrient element, and tree '*developmental phase*' is greatly influenced by N-form.**
  - **So, lots of nitrate-N favors vegetative growth (e.g., lots of nitrate is in rainfall during wet year; nitrate is a consequence of large N application of any N form)**
  - **So, a high 'ammonium-N:nitrate-N ratio' favors reproductive growth (e.g., dry year; spoon-feeding N as ammonium, urea, or organic forms)**

Oil Content of Kernels

- Excessivenitrogen, especiallynitrate--N,adversely affects kernelquality:
  - Reducingpercentage kernel and light weightmeats
  - Reducingoil (lipids)deposiMon
  - Altering the faJy acid composiMon[Monounsaturated faJy acids like 18:1 (oleic) !polyunsaturated faJy acidslike 18:2(linoleic)]
  - Increasingrate of rancidity development
  - Increasingincidence and severity of 'fuzzy'meats

Double bonds gives greater propensity for rancidity

Nitrogen DemandWindows



Sulfur*

Tree assimilaMon of N and S are Mghtly coordinated, with a *deficiency* of one element *repressing* the assimilatory pathways of the other.

►S deficiency can be due to other elements:

--low N

--low Ni, Cu, Fe, Mn

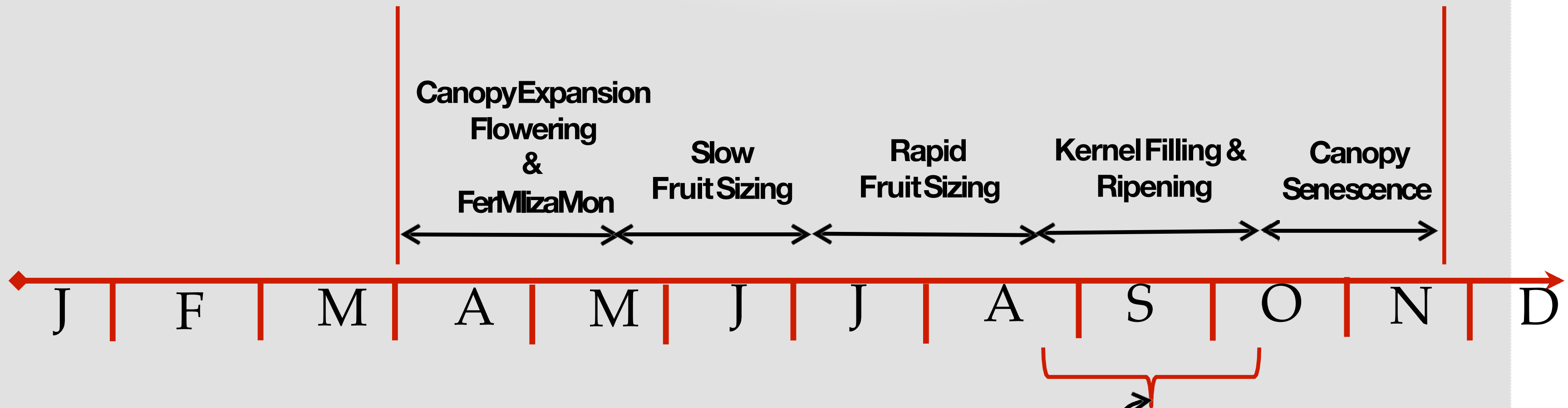
>400:1 C:S ratio

N:S ratio of 9–13:1?

* The most chemically versaMle element in biology

1–4 kg S/ha tank–mixed in sprayer!

III. Water



<u>**Moist soils during kernel filling is 'criMcal' for ensuring quality kernels and prevenMng early defoliaMon**</u>

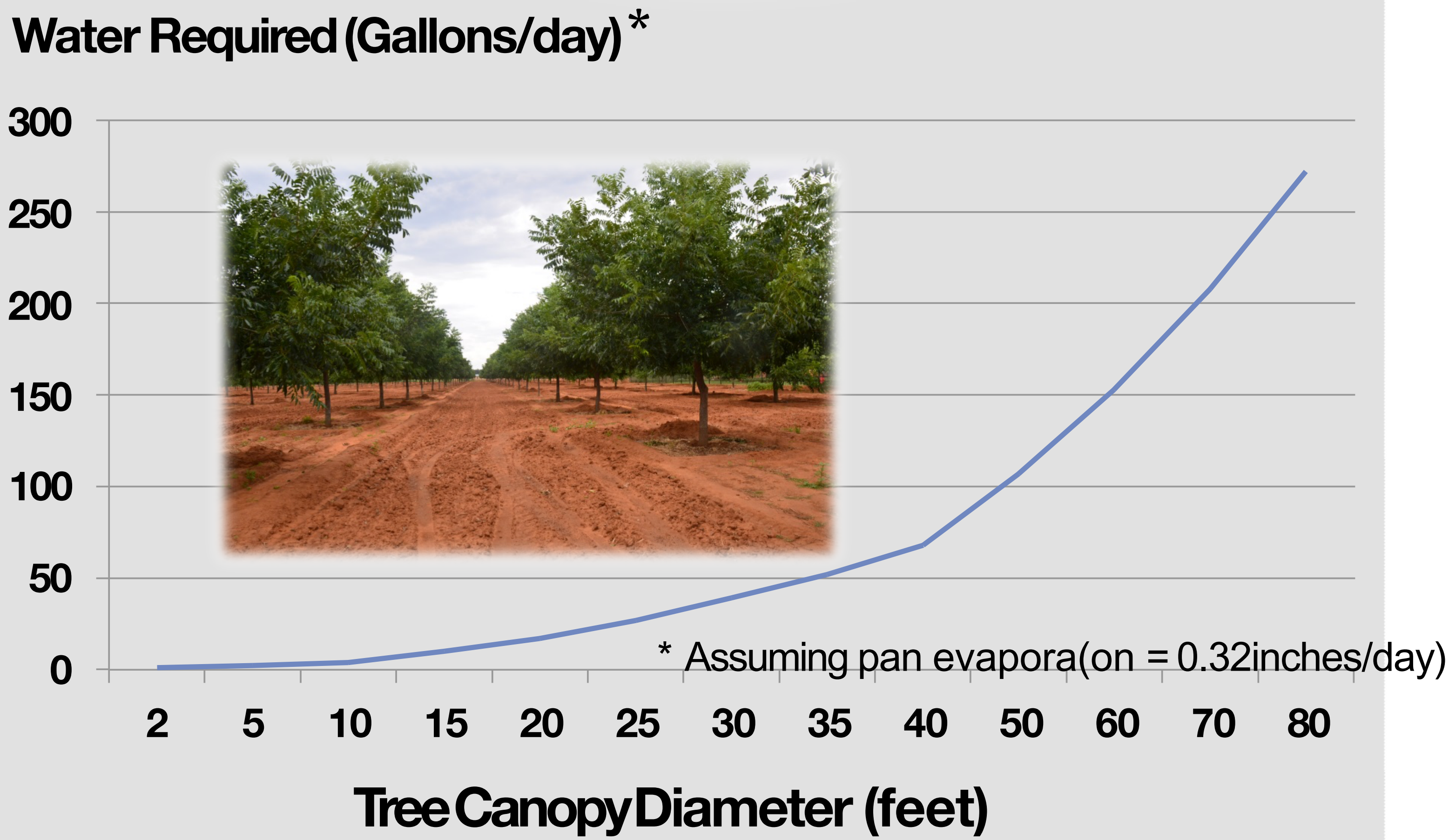
Less Oil,
Rancidity Prone

Defolia(on

Poorly Filled
(Light Halves)

Sprou(ng

Do not plant more trees than you will be able to irrigate once trees are large.



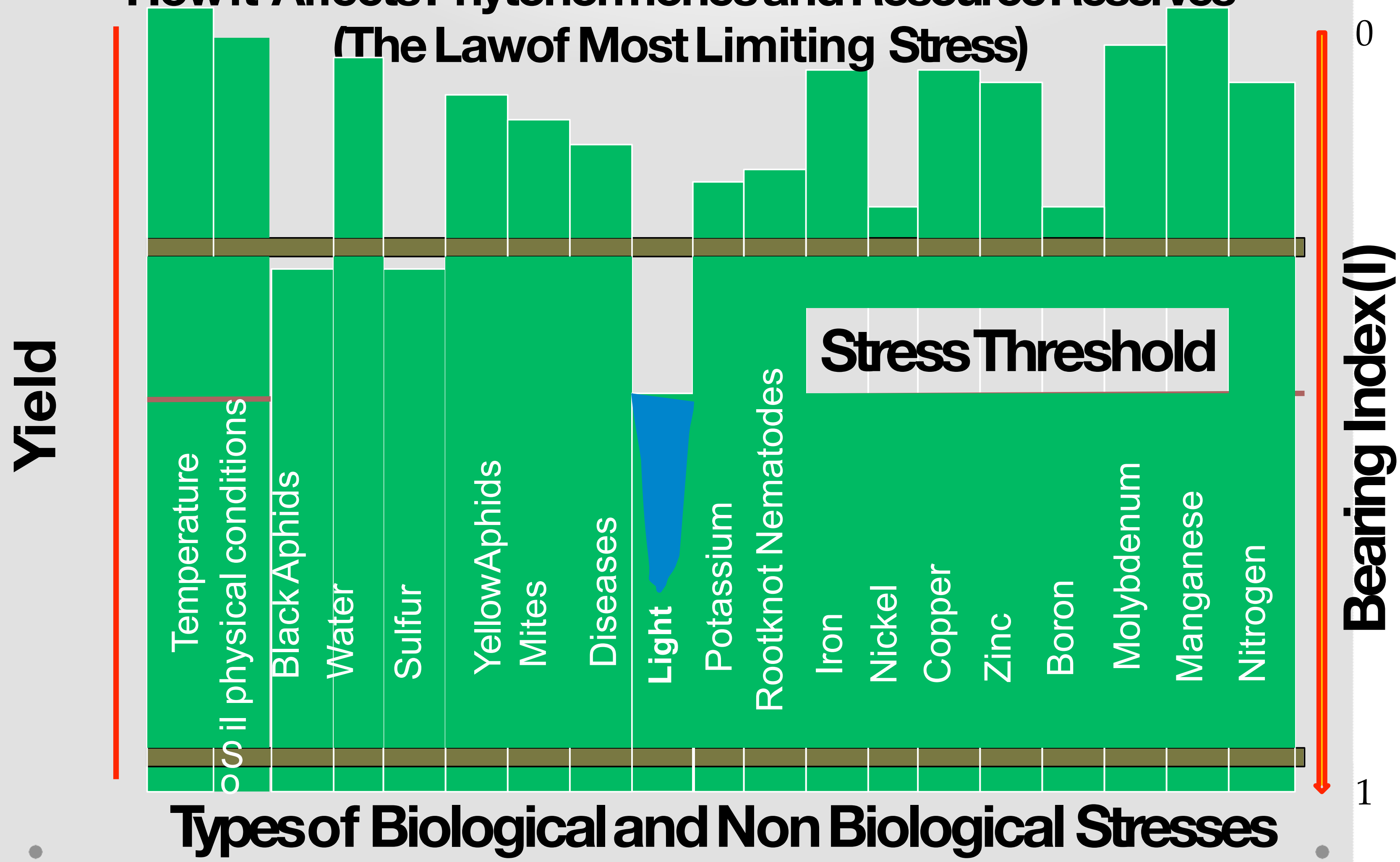
‘Timing/Amounts’ of Several Growth Regulatorsand Metabolites

- **Flowering is:**
  - ***Complex***
    - **With many regulating correlative process**
    - **Regulated by several independently initiated events occurring in sequence**
    - **This *order* of events is rigid**
    - **Several interacting growth regulators and metabolites exhibit quantitative and quantitative control over flowering**
    - **Time-dependent, affected by the sensitivity of ‘stem’ cells in meristems of developing buds**
  - ***Potentially ‘partial’ and‘reversible’***

IV. Tree Stress:

Alternate Bearing Is Substantially Regulated by '<u>tree stress</u>' and How it Affects Phytohormones and Resource Reserves

(The Law of Most Limiting Stress)



Allocation: Tree's Dilemma

- ***‘Principle of Allocation’:***

Resources within trees are ‘finite’; hence, allocation of resources to ‘reproduction’ (fruiting) must have a *commensurate negative* consequence to ‘growth processes’ (e.g., vegetative growth) and tree health.

Flowering: The Tree's Perspective

How Growers Can Manage Flowering

#2:
Optimize 'Leaf Area:Fruit Ratio' (i.e., Balancing 'Promoter:Inhibitor Ratio')

Mechanical Crop Load Thinning

Mechanical Pruning/Toppin

#3:

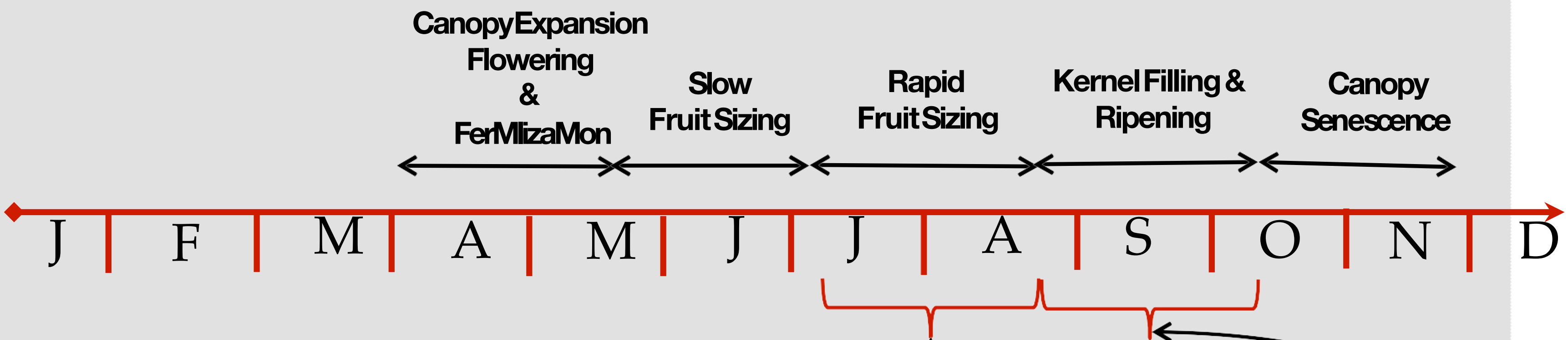
Maximize Canopy Area, Efficiency and Health

Water--stageFruitSplit

Moist soil is ‘criMcal’ during late ‘water stage’ of fruit development or can trigger ‘water--stage fruit split’

Split is triggered in ‘late water stage’ by rainfall, irrigaMon or cloudy day when tree is water stressed

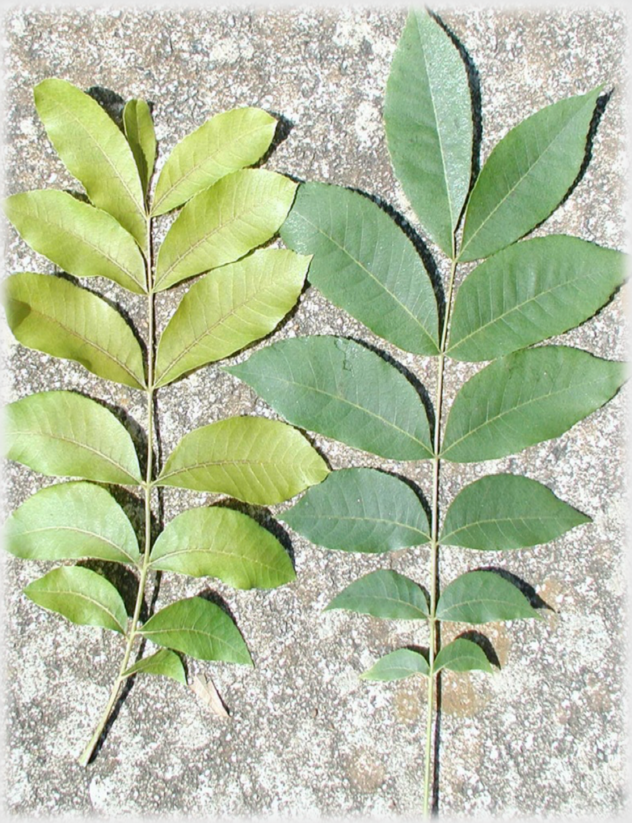
Phasesof Fruit Growth



If the tree is watered well during enMrefruit 'sizing' window, then it is especially important to also water well during kernel 'filling'

Fruit Sizing
(Water Stage)

IV. Nitrogen

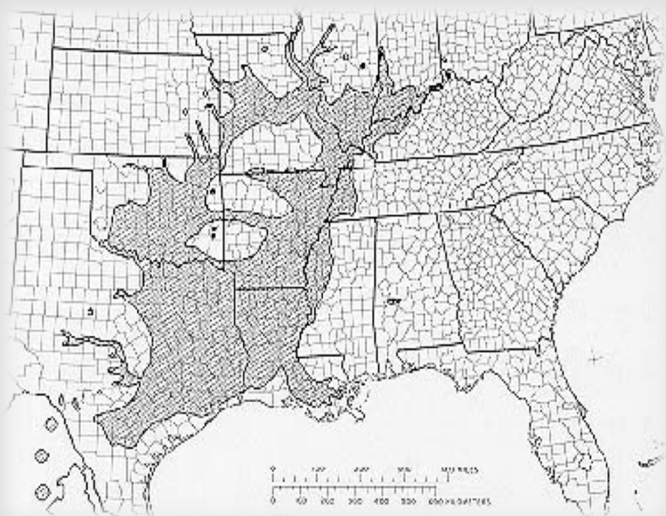


►Aleaf analysis staMng that N is 'sufficient' does not necessarily mean leaves possess 'good Nnutrimon'

►There canbe an apparent 'physiological' deficiency due to low availability of other elements: (e.g., low S,Ni, Cu,Fe, Mn, Zn, Mo)

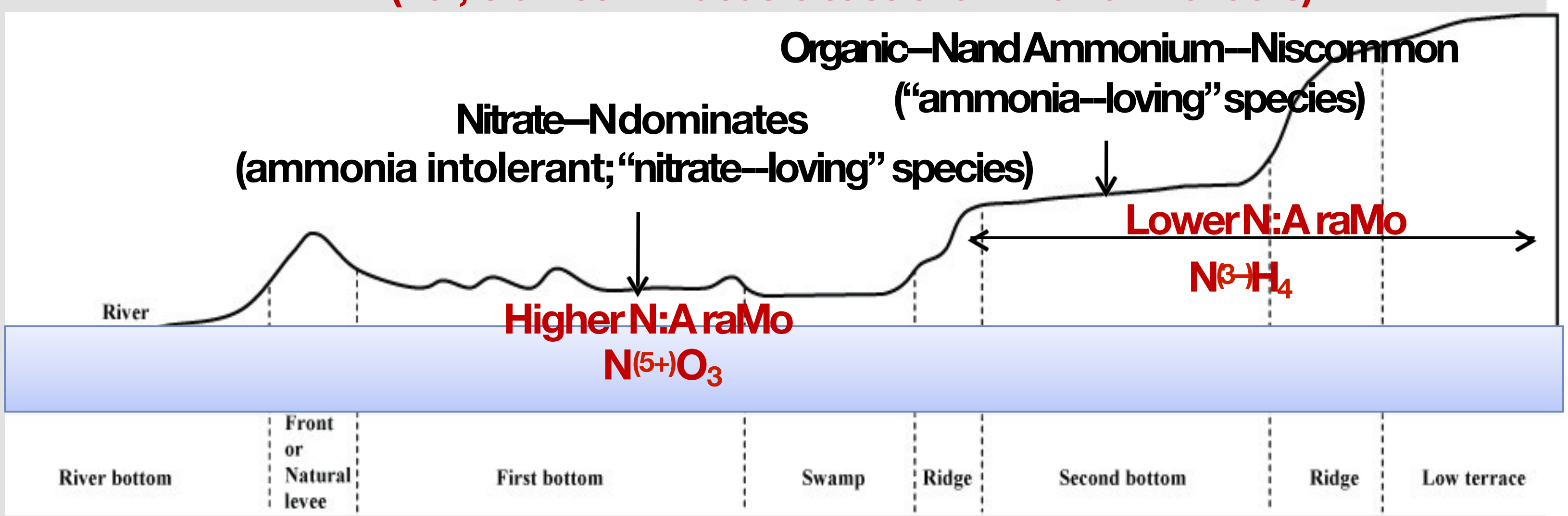
VI. How Is Nitrogen Management AffecMng Flowering, CropLoadand Nut Quality?

--ConsiderPecan's Ecophysiology--



"Ammonium--loving" vs. "Ammonium intolerant "("Nitrate--loving") vs. N--Intermediatespecies. ("Ammonium--loving"= higher tolerance and greater physiological preference for ammonium relaMveto that by nitrate--loving species.)

Top soil zone is rich in decaying organic maJer
(i.e., slow conMnuous release of ammonium to roots)



Traits Exhibited By ‘Ammonium vs. Nitrate Loving’ Species

Characteris8c	*Nitrate–N loving species*	*Ammonium N– loving species*	*Pecan*
Pioneer species in forest succession	+		
Climax or Co–climax species		+	+
Diffuse–/semi–diffuse porous cambial growth	+		
Ring–/semi–ring porous cambial growth		+	+
Indeterminate shoot growth paJern	+		
Determinate shoot growth paJern		+	+
Early bud break in spring	+		
Late bud break in spring		+	+

Traits Exhibited By 'Ammonium vs. Nitrate Loving' Species

Characteris8c	*Nitrate–N loving species*	*AmmoniumN– loving species*	*Pecan*
Producessmall seeds	+		
Producesmedium to large seeds		+	+
Shade intolerant	+		
Shade tolerant		+	+
Small N storage pool in dormancy	+		
LargeN storage pool in dormancy		+	+
Annual bearing of seed	+		
Alternate bearing and seed masMng		+	+

Commercial Orchards Are ArMficial Pecan Habitats

We would like for orchards to possess the posiMve traits of their naMve habitats.

If:

– Lots of nitrate – N
– Good water management

Then:

– More vegetaMve growth
– Less reproducMve growth

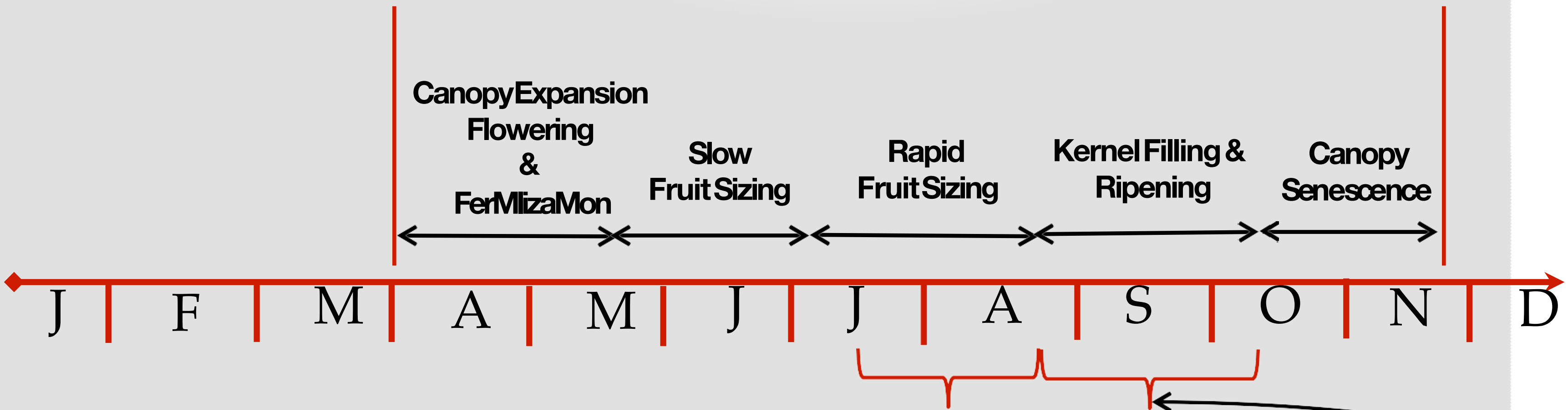
If:

– Judicious ammonium – N
– Good water management

Then:

– More reproducMve growth
– Less vegetaMve growth

Nitrogen & Fruit Sizing/Quality



Do not apply N during rapid fruit 'sizing' and only ammonium/urea N during kernel 'filling, or —

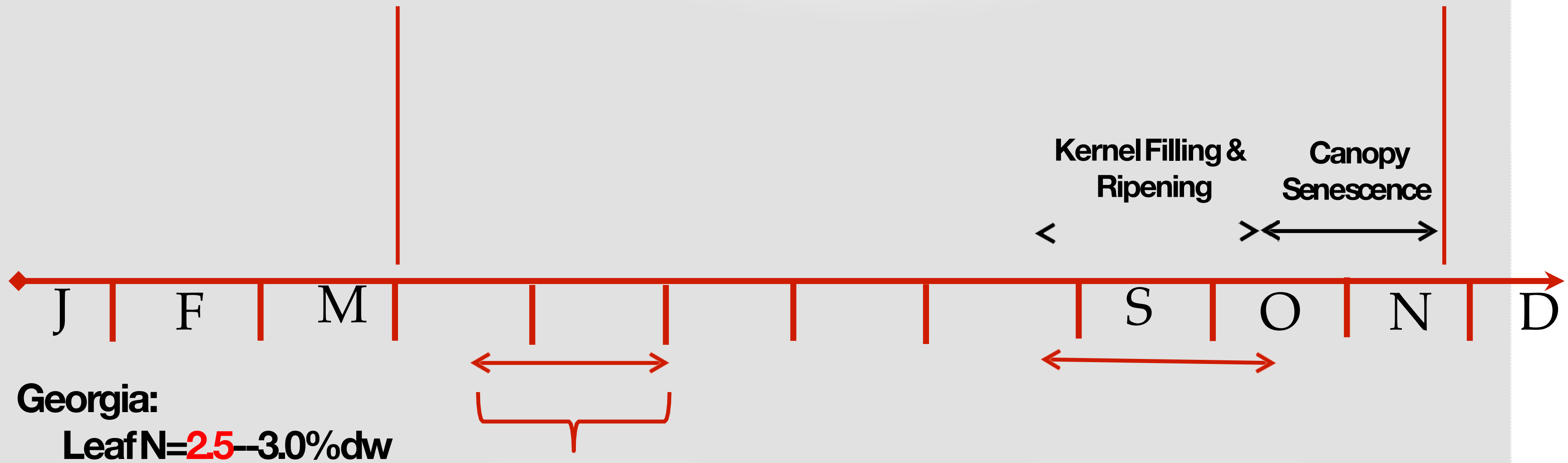
Less Oil,
Rancidity Prone

Fuzz Materials

Poorly Filled
(Light Halves)

Sprou(ng

Primary Demand Windows for 'Supplemental' Nitrogen

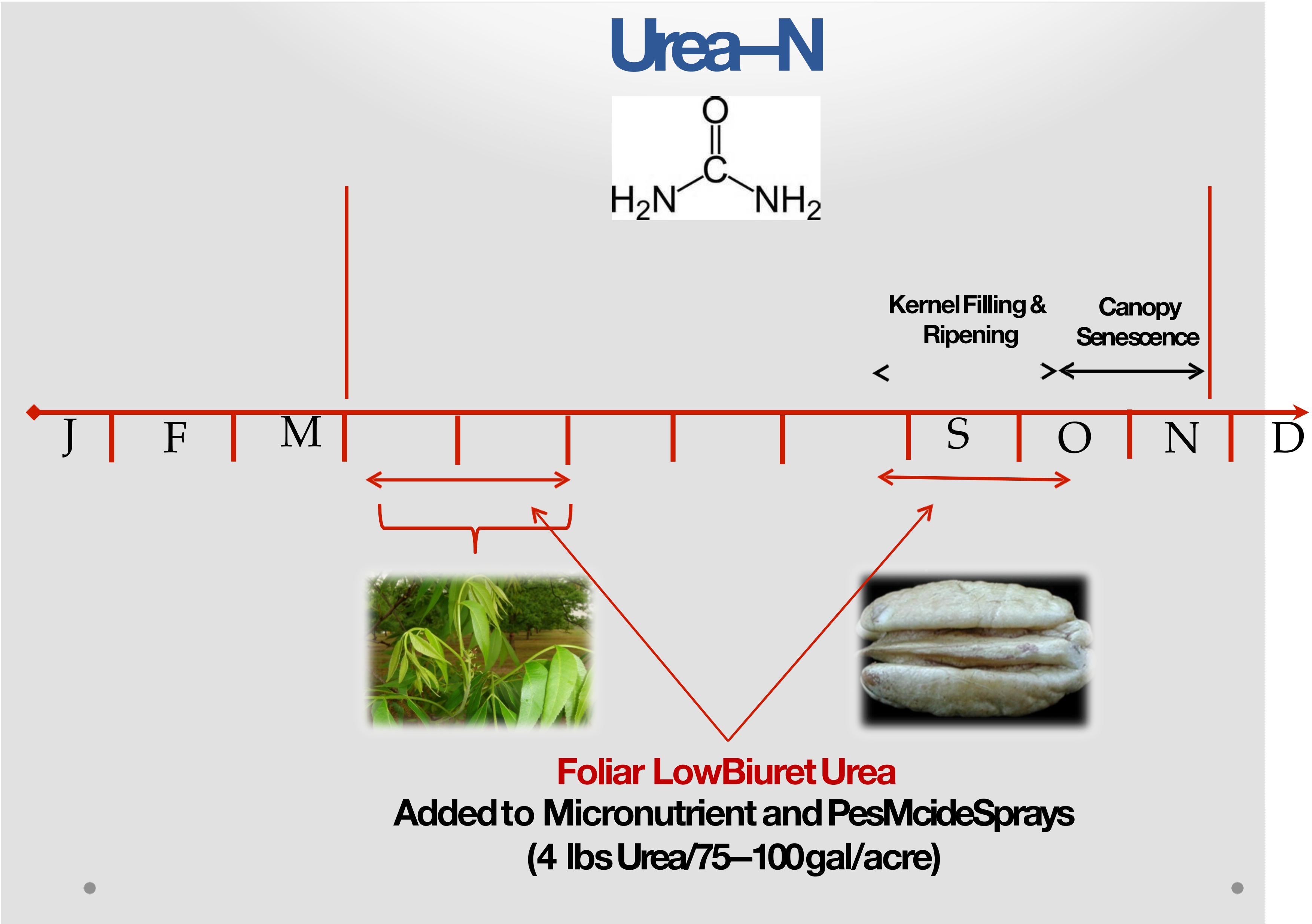


Georgia:
Leaf N=2.5--3.0%dw
Arizona:
Leaf N=2.05--2.96%dw

67%–75% of N Applied | **25%–33% of N Applied**

(Source = Soil Ammonium Sulfate, Ammonium Phosphate or Urea)

N Applied Via 'Strip', 'Band', 'Micro--sprinkler Zone', or 'FerMgaMon'


Urea–N
O
C
H_2N
NH_2
Kernel Filling &
Ripening
Canopy
Senescence
J
F
M
S
O
N
D
Foliar Low Biuret Urea
Added to Micronutrient and PesMcide Sprays
(4 lbs Urea/75–100 gal/acre)

Elemental Sufficiency ConcentraMons for Commercial Pecans

Macronutrient Element (% DW)	Georgia (Jones et al.)	Georgia (Wells)	Oklahoma (Smith)	Arizona (Walworth)
Nitrogen	2.70–3.50	2.50–3.00	2.40–3.00	2.05–2.96
Phosphorus	0.14–0.30	0.14–0.30	0.14–0.30	0.10–0.16
Potassium	1.25–2.50	≥1.25	1.00–2.50	1.00–1.59
Sulfur	–	≥0.20	0.20–0.35	0.14–0.20
Calcium	1.00–1.75	1.30–1.75	0.70–1.75	1.57–2.43
Magnesium	0.30–0.60	0.35–0.60	0.30–0.60	0.39–0.59
Chlorine	–	–	–	–

Smith, Rhola and Goff. 2012. HortScience 22:594–599.
Jones, Wolf and Mills. 1991. Plant Analysis Handbook, Athens, Ga.

Nitrogen ApplicaMon to the Herbicide Strip

N applied asAmmonium Sulfate, or Ammonium Phosphate will eventually lead to acidificaMon of acid soil, which can be parMally compensated for by occasional liming of the strip

ReducedN rate at 70--100lbsN/acre/year

N applied at a reduced rate within the herbicide strip, or zones within the strip, are as efficacious as normal N rates broadcast to the orchard floor (Wells, 2012, 2013)

No Luxury ConsumpMonof Sulfur Like There is for Nitrate

- SO_4^{2-}: Tree roots must expend energy to take up sulfate (a very stable form of sulfur), and then must expend 'tremendous' amounts of energy to assimilate S into proteins (and enzymes)—assimilaMon occurs in leaves
  - ConverMng $S^{(6+)}O_4^{2-}$ to cysteine–$S^{(-4)}$ costs <u>14 ATPs</u> (compared to <u>12 ATP</u> for $N^{(5+)}O_3^{1-}$ to glutamine--$N^{(-3)}$), so tree roots do not take up soil S unMl it is needed (via an acMve uptake process, using a glutathione signal) or it can convert to sulfuric acid and kill the plant, so there is no luxury consumpMon of S like there is N
- S^0 (elemental--S) sprayed onto foliage must be absorbed (difficult, unless <u>also using urea</u>) and then a lot of energy expended for reducMon to cysteine
  - Within the Gulf Coast Coastal Plain (acidic sandy soils), one of the most limiMng factors to tree S uptake and assimilaMon is most likely insufficient Mo (a key cofactor in nitrate reductase, which causes down--stream regulaMon of sulfate uptake by roots) and Ni

‘S≥0.20% DW’

‘N:S RaMoof~13:1’
<13:1 =potenMal N deficiency
>13:1 =potenMal S deficiency

- L. Wells, 2012: Spraying canopies with ‘S’ (1 lb/acre) appears to increase nut size in many orchards! —and gives
- greener foliage (B. Wood)

Macro–and Micronutrient Stresses(e.g., Nickel)

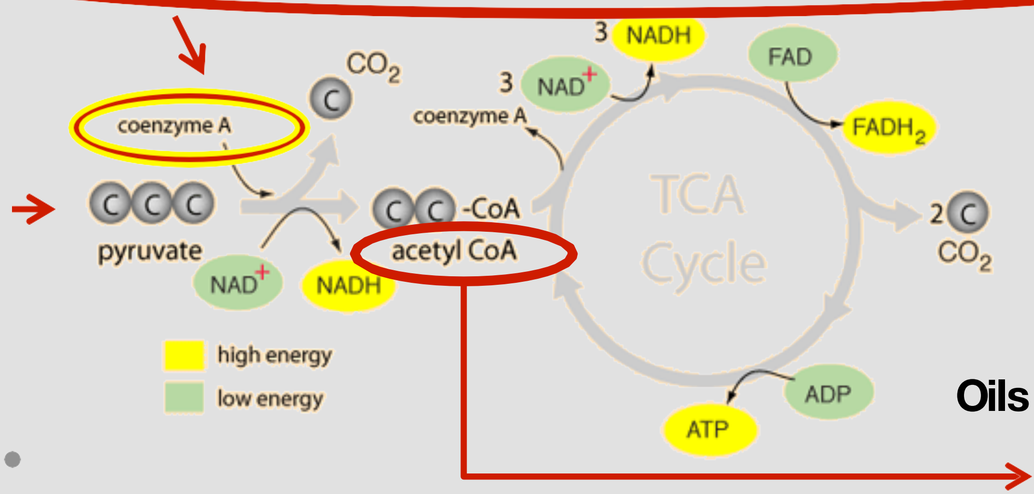
'Acetyl CoA'is required for making:

--Auxins,gibberellins, brassinosteroids, faJy acids and oils

--Cellular energy sources

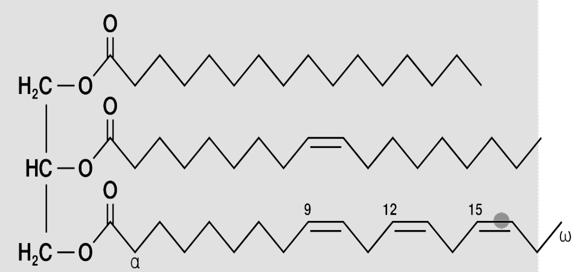
Coenzyme–A Synthase likely 'requires nickel (Ni^{2+})'

Photosynthesis



Ni probably has a wide concentra8on range in which hidden hunger occurs before visual symptoms appear

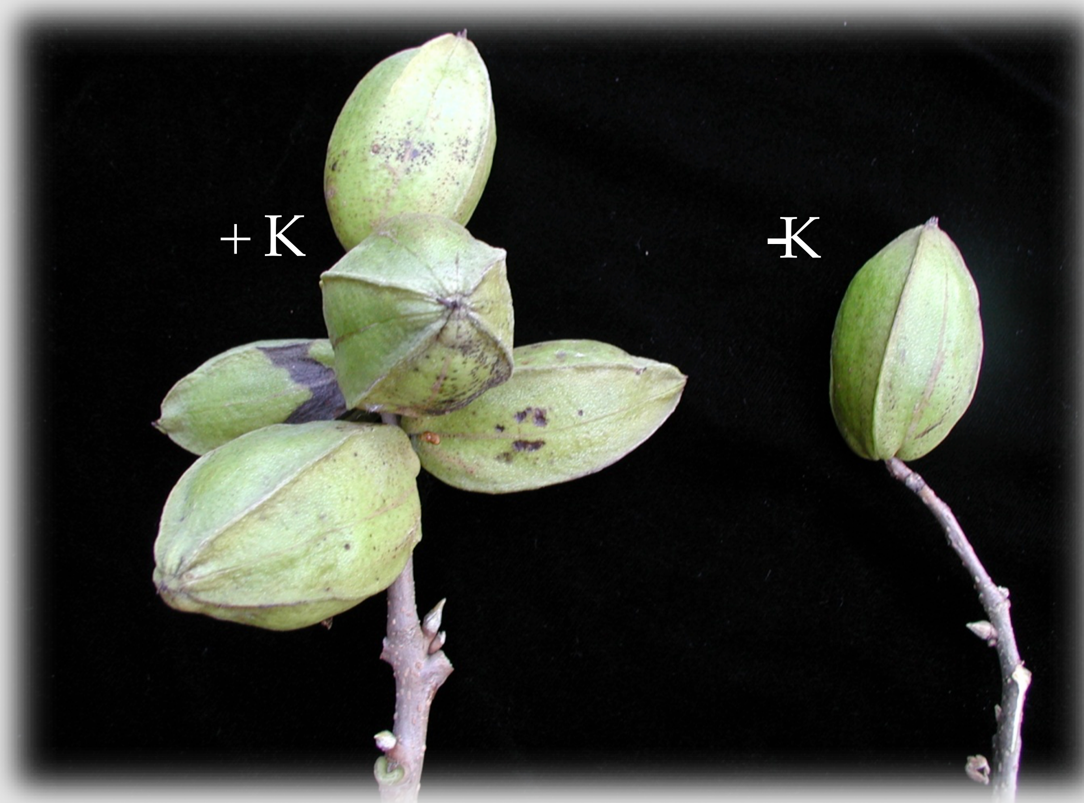
Oils



V. Potassium

Pecantree accessto soil Kis limited by excessivesoil N, Ca,and Mg in the soil, and by dry soils.

Increasing K+ Can Reduce Fruit--drop and Increases Kernel Quality



‘Desirable’ Leaf K = ≥1.25% dw Reduces ‘June--drop’
‘N:K RaMo’ = ~2.0–2.5

Fruit--drop, Kernel Filling and Phloem Mobility of Key Nutrient Elements*

Mobile	*Variable Mobility*	*Condi8onal Mobility*
N	Fe	Ca
P	Zn	B
K	Cu	Mn
S	Mo	
Mg	Co	
Cl	Ni	

Fruit drop | **Poor kernel filling and/or fruit–drop**

***In most plants, xylem vessels either do not connect, or only poorly connect, the rest of the plant with the developing seed/nut. For most of these nutrients, phloem mobility is linked to electrostaMc bonding to organic ligands.**

Potassium

CanopyExpansion
Flowering
&
FerMlizaMon

Slow
Fruit Sizing

Rapid
Fruit Sizing

Kernel Filling &
Ripening

Canopy
Senescence

J | F | M | A | M | J | J | A | S | O | N | D

LowKduring fruit sizing
leads to fruit drop

LowKduring kernelfilling
causeslow %meat

Georgia:
Leaf K= ≥1.25% dw

Arizona:
Leaf K=1.00–1.59%dw

Soil Banding ApplicaMon:
- Potassium Chloride
- Potassium Sulfate
- Potash–magnesium

Poorly Filled
(Light Halves)

LessOil

'Soil Banding' of Fertilizers

Have not observed root/foliage damage in clay soils due to Cl, SO_4, or NH_4. There could be Damageunder sandy soil condiMons.

Potash and/or Zinc Sulfate

Di–or mono–ammonium phosphate or ammonium phosphate sulfate)

Boron (B)

- 50–100ppm dw
- Visual deficiency symptoms <~1–2ppm
- Probably the “most common micronutrient deficiency” in pecan
  - Best ‘disguised’ visible symptoms of any element
- ‘Hidden hunger’ from ~2–40ppm
- A prominent visual symptom is ‘inelasMc vs. elasMc’ foliage when foliage is young

Water--stage Fruit Split


Ni =5--15ppm; Mn =100--800ppm; Cu=6--30ppm; B=50--100ppm

…is influenced greatly by crop load, water management, cloud cover, and B (turgor pressure of liquid endosperm regulated by K as influx/eflux by membrane B); and by Ni, Cu, Mn (as they affect lignificaMon and hardening of the shell)

Thanks——andgoodluck!!!

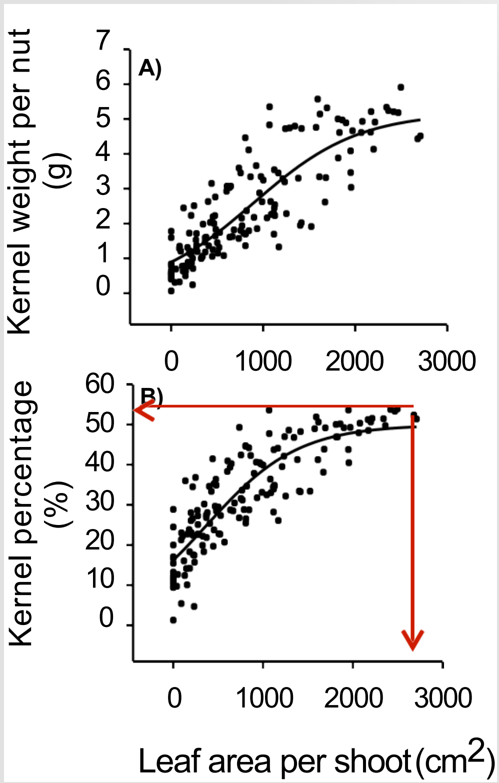
h^p://st.depositphotos.com/1454700/3010/i/950/depositphotos_30103807–South–African–Rand–Notes–Bundles–Stack–Extreme–Close.jpg

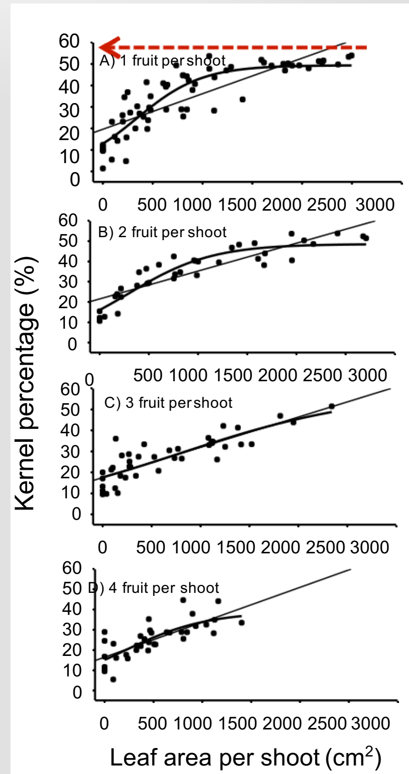
Flowering & Alternate Bearing:

<u>HorMculture</u>

Why don’t all terminal and lateral shoots produce fruit (or nuts) every year?

How Much Leaf Area Per Fruit?





- A single 'Desirable' fruit requires about 2800 cm²(i.e., ~8 compound leaves/fruit) of supporMng foliage to supple the necessary assimilates for maximum kernel development.
- Clusters of ≥2 fruit/shoot appear to be imporMng assimilates from other shoots (laterals) unless there are ≥9 compound leaves per terminal.