

# Influence of Almond Spur Characteristics on Productivity

A close-up photograph of almond flowers on a branch. The flowers are light pink with darker pink centers and yellow stamens. The branch is grey and textured. The background is blurred, showing more flowers and a soft, natural light.

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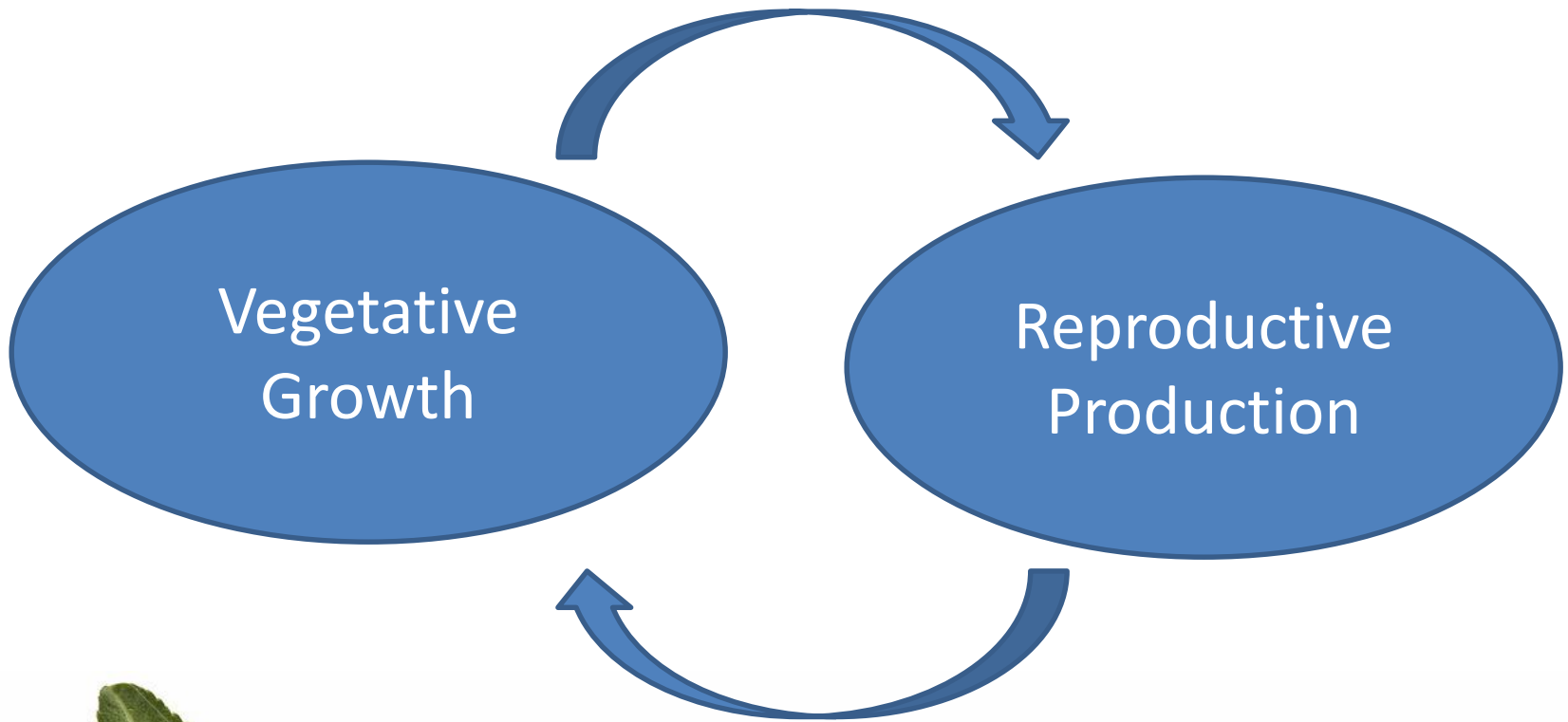




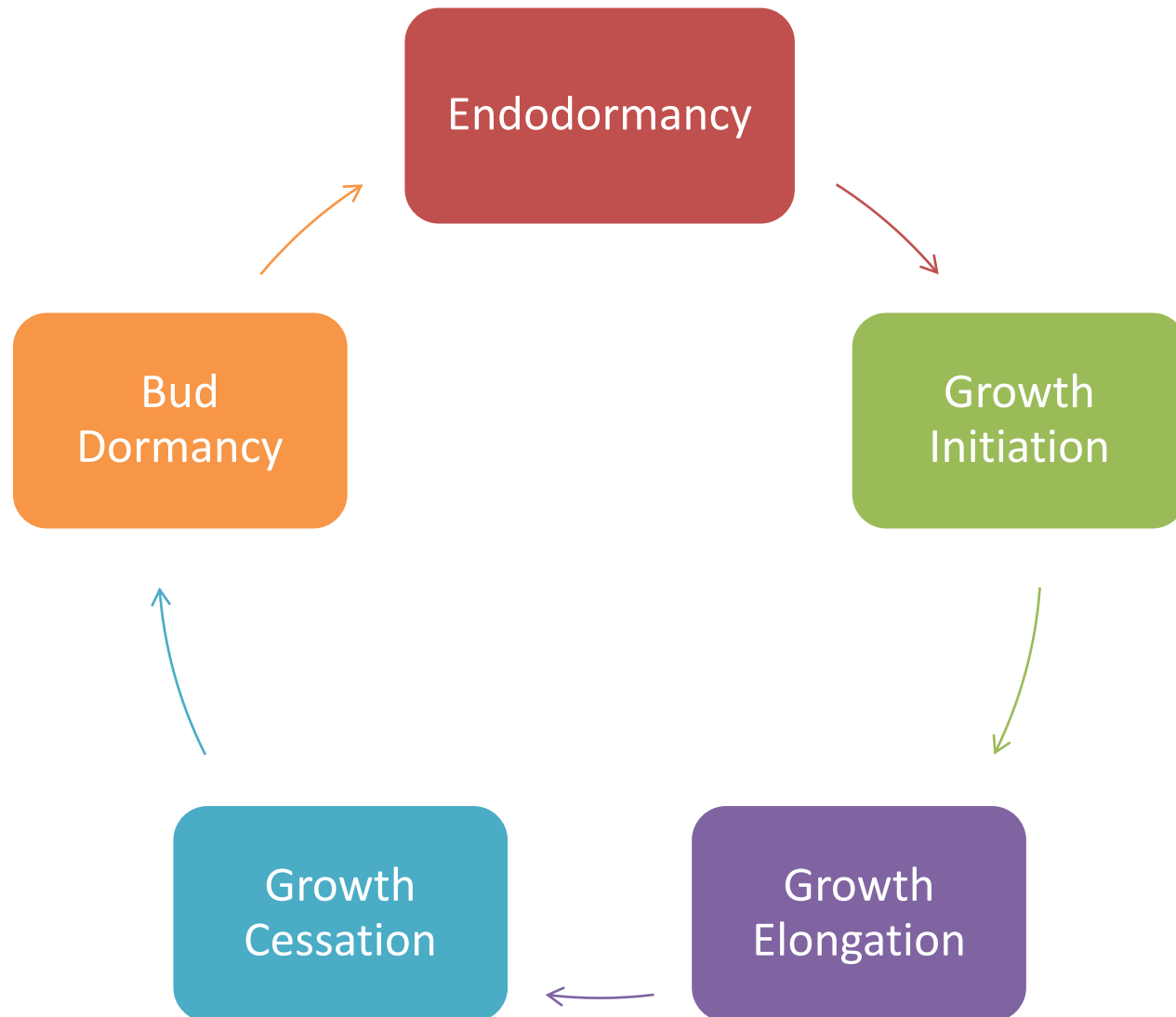
Photo: B. Lampinen



All buds in the current year were formed the prior summer



# Shoot Growth and Development: 5 stages



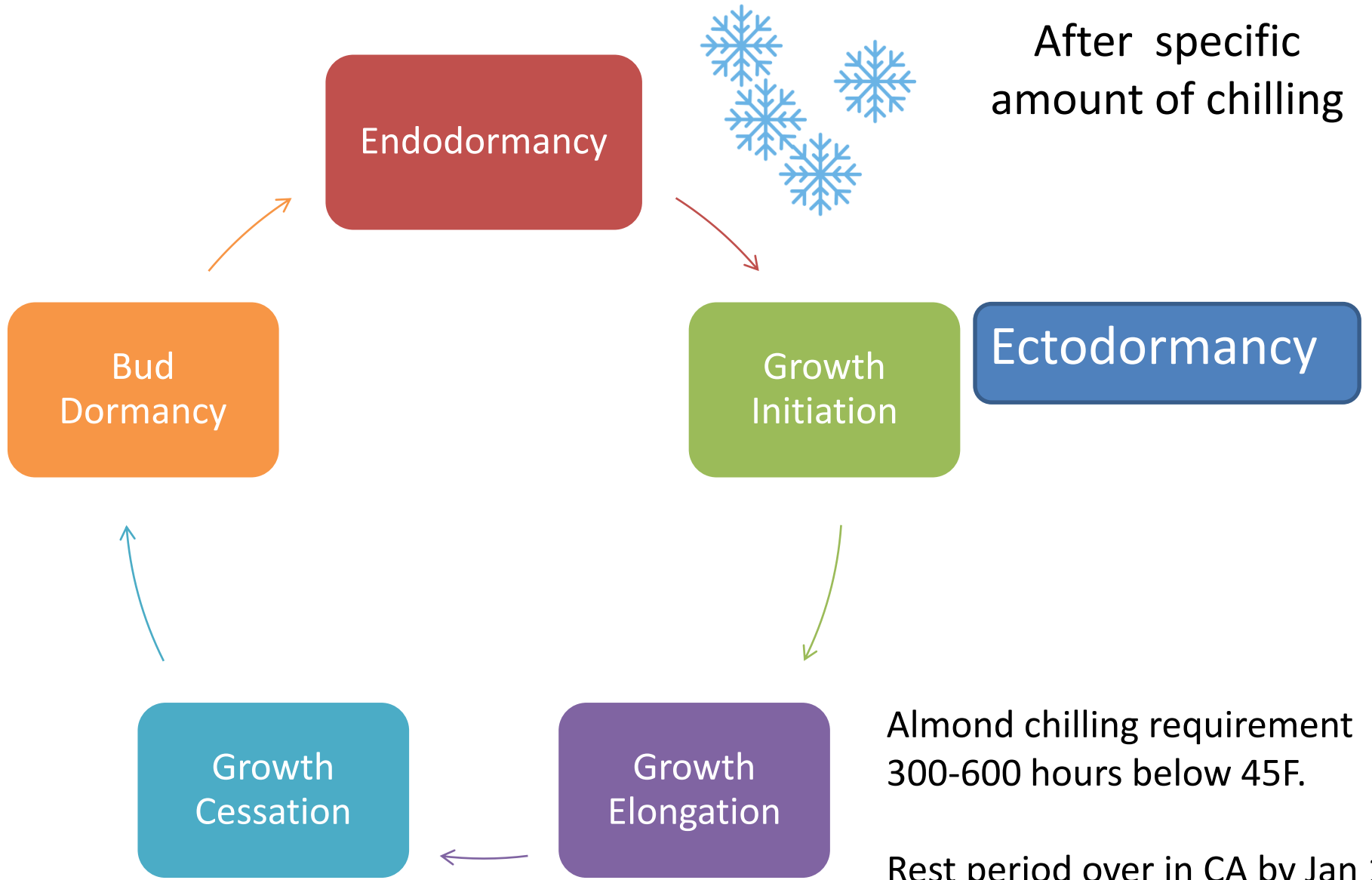
Endodormancy  
“Rest Period”

A state of arrested development  
(late October-mid-December)

During Endodormancy:

- Buds will not emerge even during warm weather
- Buds are resistant to freeze and other stresses





# Ectodormancy

## **Beginning of shoot initiation**

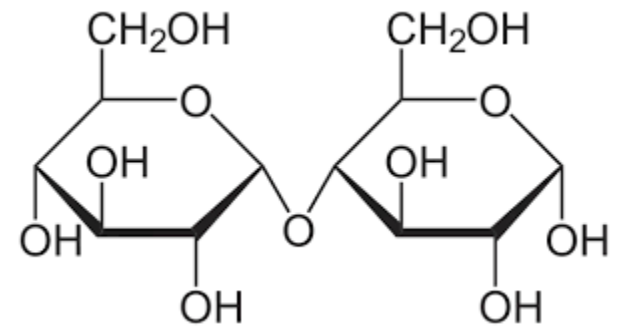
- Induced by external causes (ie. unfavorable temperatures)
- Duration of warm temps needed for bud growth

No longer “arrested development”



## Growth Initiation

Early bud growth based on (mostly localized) carbohydrate storage



Extension of pre-formed tissue

Approximately 3-10 leaves per spur

Approximately 8 leaves per vegetative shoot



# Vegetative buds

Pointed

Triangular

Covered with dark brown fringed scales

Give rise to long shoots and spurs



## Long vegetative shoot growth (~10 inches):

- prominent growth on young trees.
- on mature trees, develop under high vigor, low crop, or enhanced light interception (ie. from broken branch)



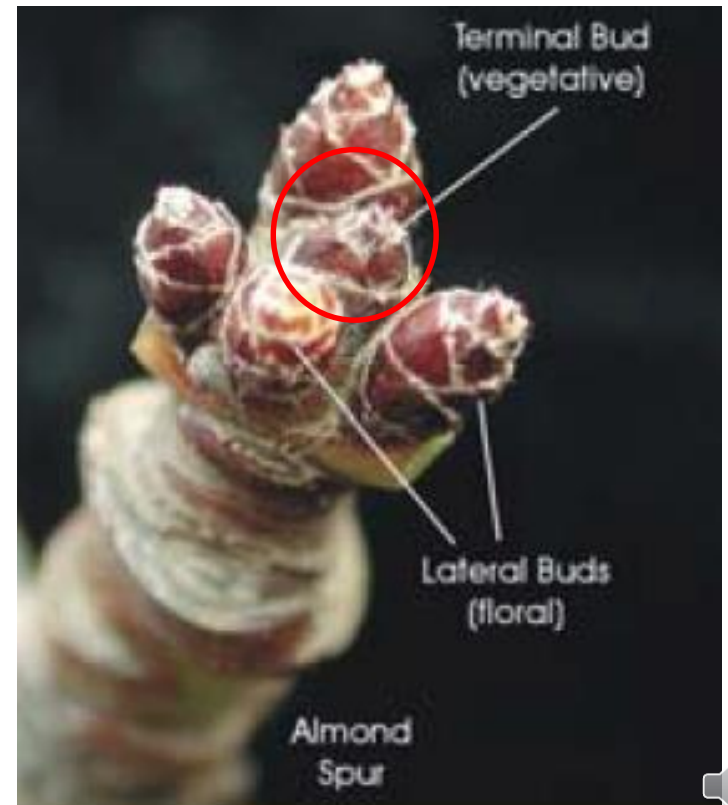
Spurs arise on vegetative shoots.



Maintaining healthy spur populations is key to yield optimization.

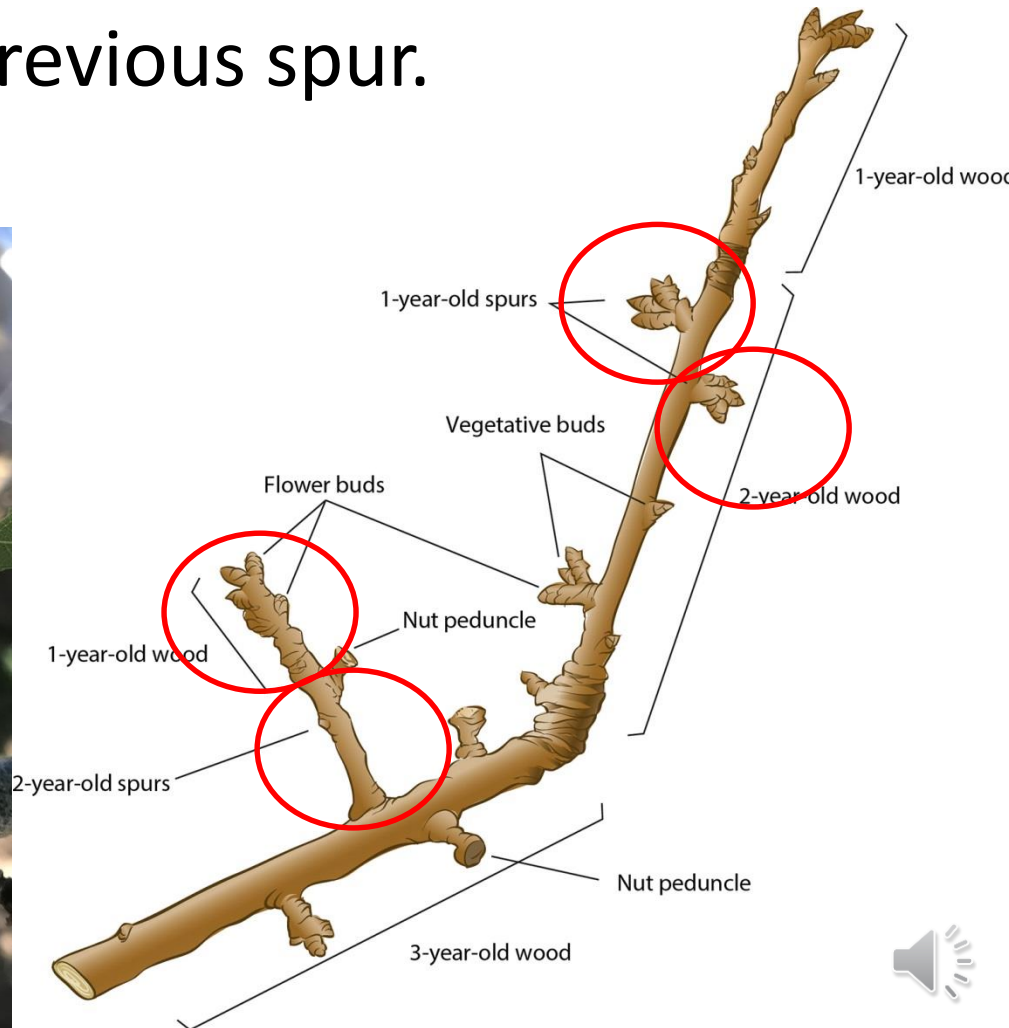
# Mature trees produce >80% of their total yield on spurs

- Spurs always have a vegetative terminal bud, and lateral buds that can be vegetative or reproductive*



# What is a spur?

- Short/compact shoots (0.5-2 inches)
- Grow from lateral buds on long shoots.
- Terminal extension of previous spur.



# What is a spur?

Non-fruiting



Photo: Saa

- Have leaves and flowers/fruits.
- Almonds are borne on spurs
- 1-5 flower buds per spur



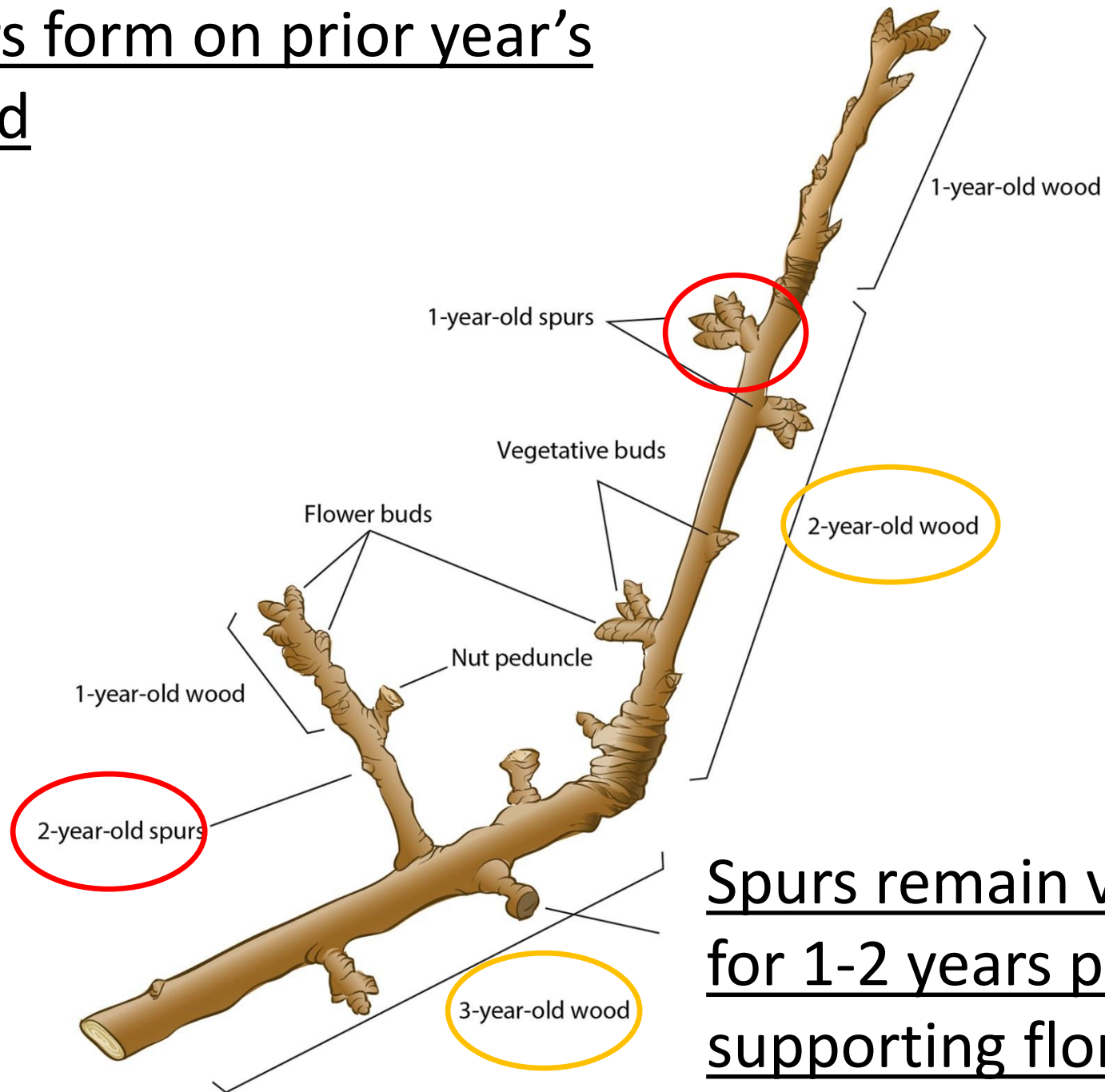
Single fruit-bearing



Multiple fruit-bearing



# Spurs form on prior year's wood



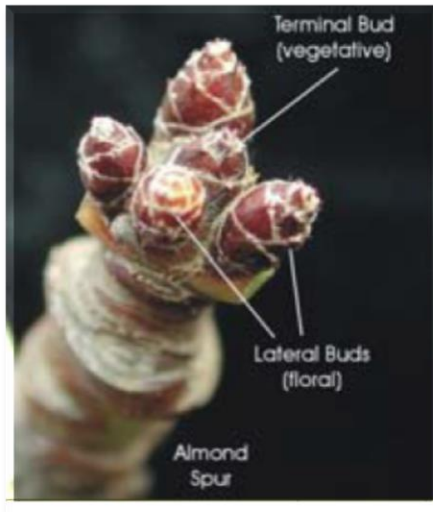
Spurs remain vegetative for 1-2 years prior to supporting floral buds



## Growth Elongation

Spur growth is short and stops by April/early May

Young almond: shoot growth uniform through summer.



Bud formation occurs in May/June  
Transition to flower buds-mid August

## Growth Cessation

Heat Dormancy of Vegetative Buds: July-September



# Determination of spur dynamics influencing productivity

## Key Principles:

1) Spurs are semi-autonomous with respect to carbon supply

- rely on their own ability to provide and store nutrients.
- localized source/sink relationship.

2) Process of supporting fruit to maturity demands a heavy carbohydrate load.

- individual spurs tend to alternate bear
- few flower the year after bearing



# Determination of spur dynamics influencing productivity



- Studies follow tagged spurs over years
- Different parameters measured by different research groups.



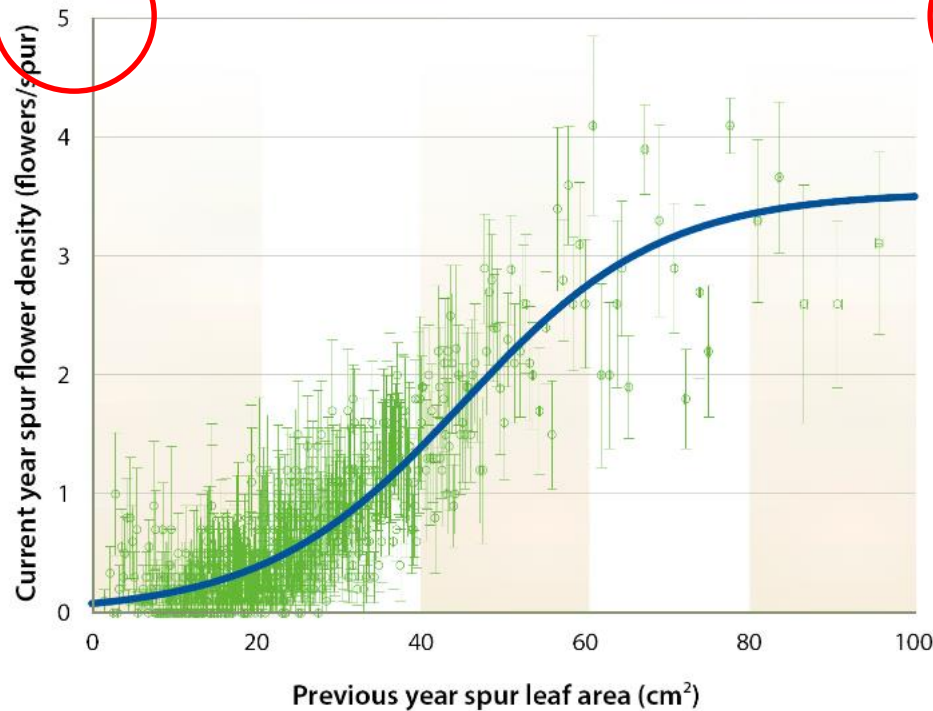
- Leaf number
- Leaf area
- Spur growth
- Return bloom
- Nut Set
- Foliar N
- Spur survival

ie: Lampinen, et al. 2011  
Valdebenito, et al. 2017

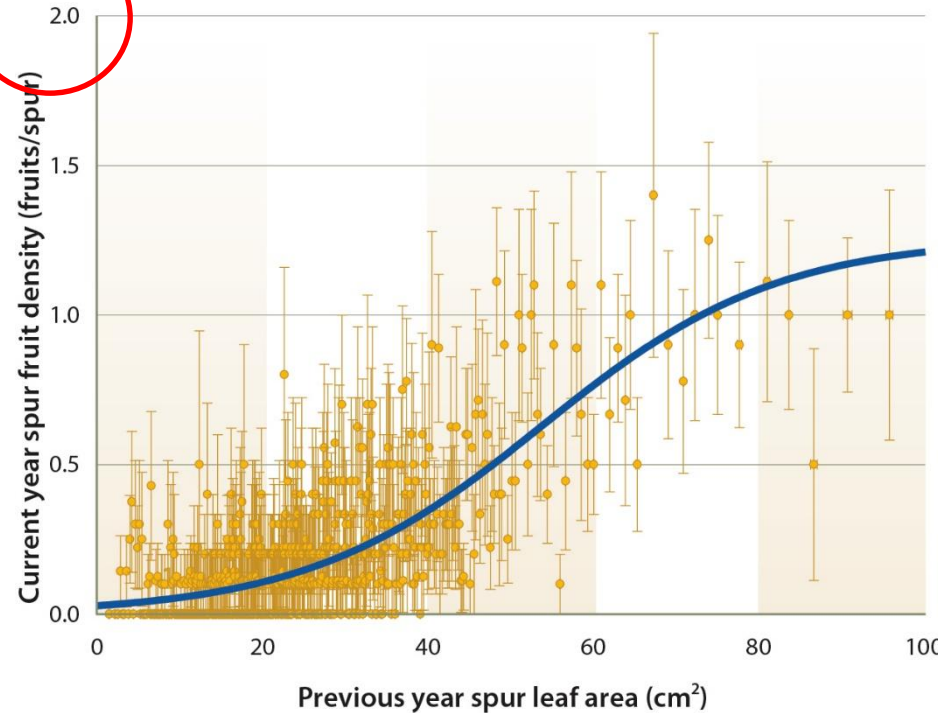


# Floral Density and Fruit Density on Spurs is positively related to prior year spur leaf area

## Spur Flower Density



## Spur Fruit Density



Prior year spur leaf area

Only a fraction of flowers set fruit.

- Approximately 30% of flowers set fruit (up to 40%)
- In spur dynamics studies, set range: 18-36%

(Kester and Griggs, 1959)  
(Tombesi, et al. 2017)





Bearing Spur



Non-Bearing Spur

## Bearing Spurs

- Show earlier leaf fall
- Exhibit less spur growth
- Have lower foliar N concentration
- Have less starch
- Exhibit lower return bloom

- Smaller leaves

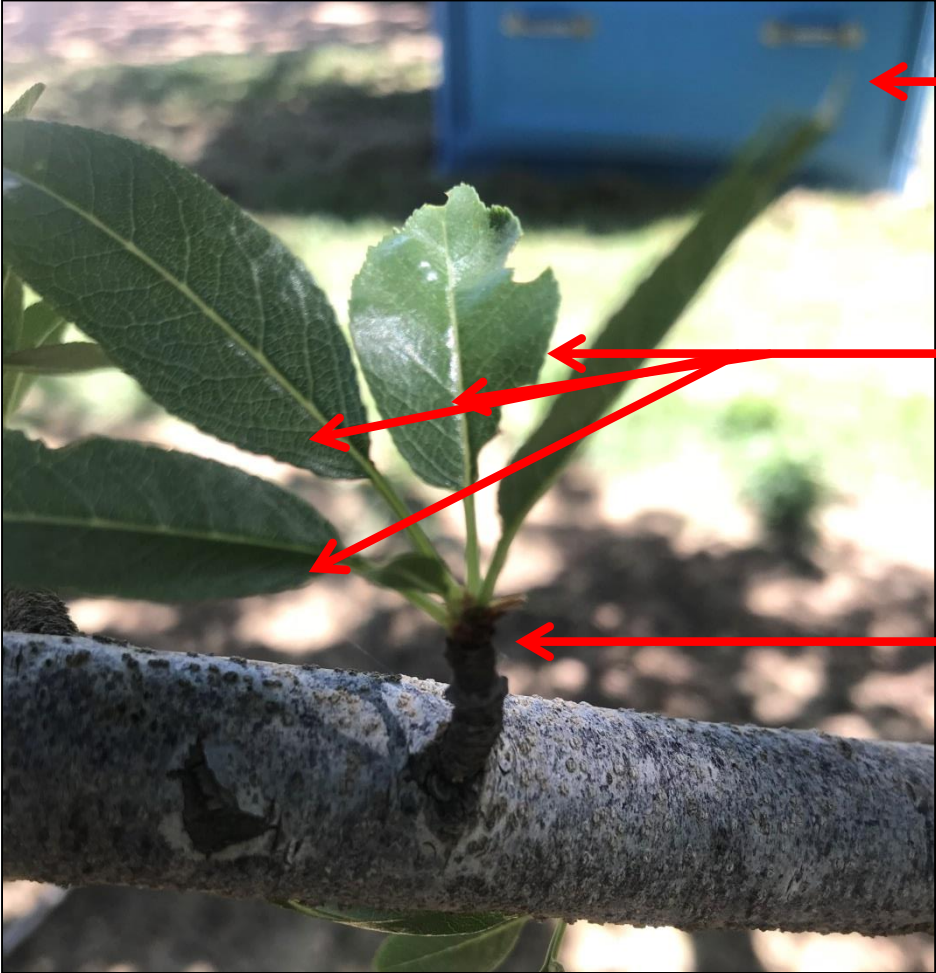
Hereema et al., 2009

Saa et al, 2017

Vandebenito, et al. 2017



# Non-bearing spurs



← 'Porta Potty'

← Leaves

← Spur



## Non-bearing spurs

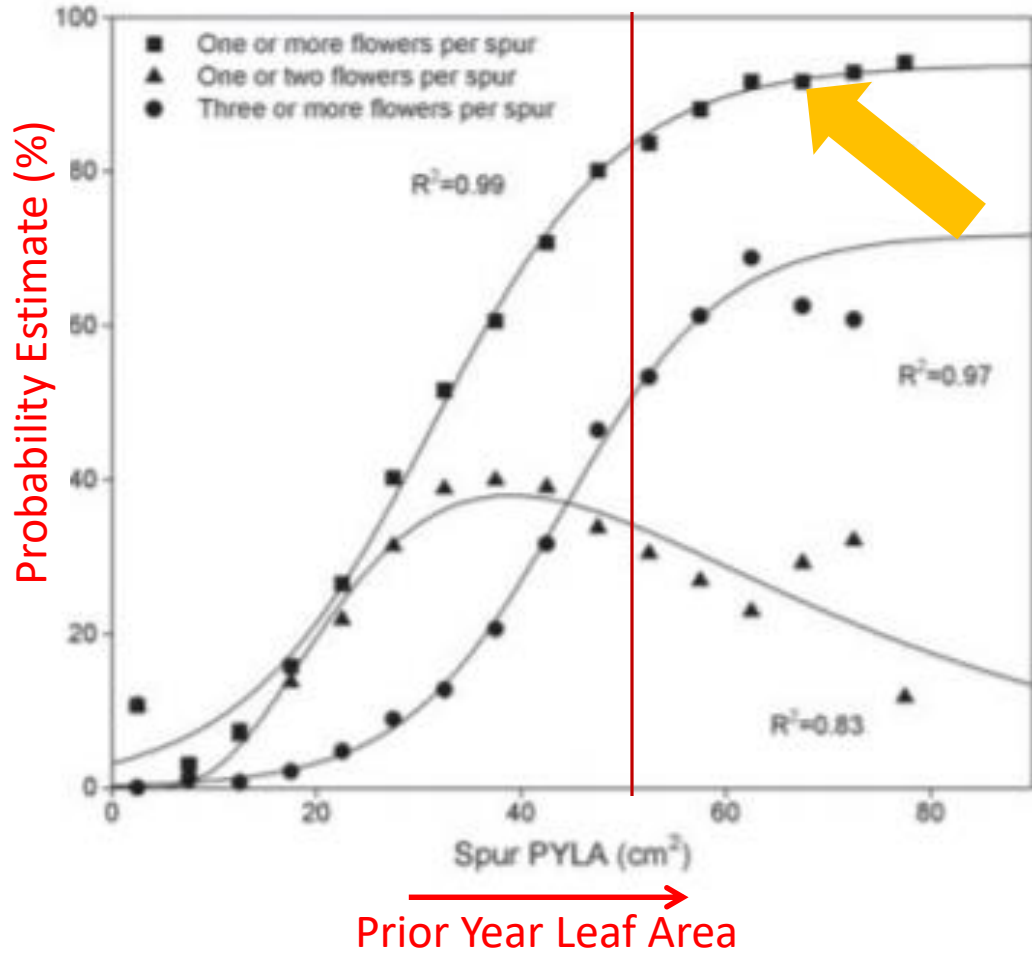


Over 80% of spurs are vegetative each year.

These spurs are producing the annual leaf area to support fruit production in a subsequent year.



# Non-bearing spurs in previous season



Non-bearing spurs with > 50 cm<sup>2</sup> leaf area in prior season have over 80% probability of flowering the following year.



## Non-bearing spurs in shaded position



Within the tree:

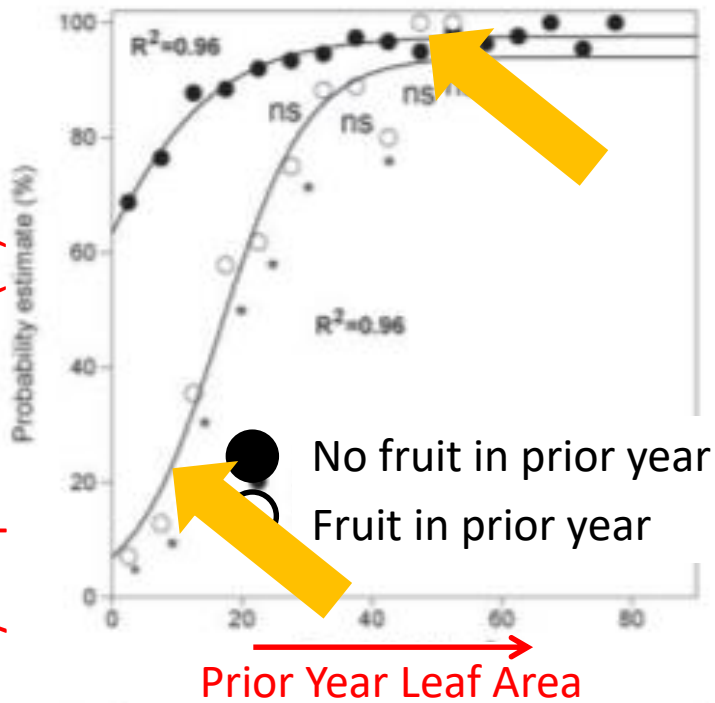
Nitrogen is re-allocated from spurs in shaded positions to those in light positions.



(DeJong and Doyle 1985, DeJong et al. 1989, Rosati et al. 1999).



Probability of spur survival (%)



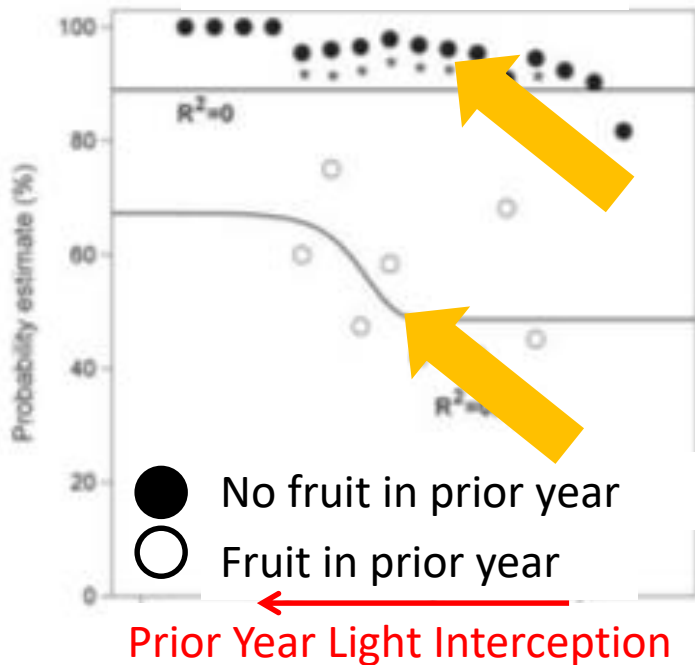
## Survival potential of bearing and non-bearing spurs

A) Spurs bearing fruit the prior year exhibit lower survival potential than non-bearing spurs with lower prior year leaf area.

B) Spurs with higher leaf areas the prior year exhibit similar survival potential, regardless of bearing status.

C) Survival of non-bearing spurs is not related to prior year light interception.

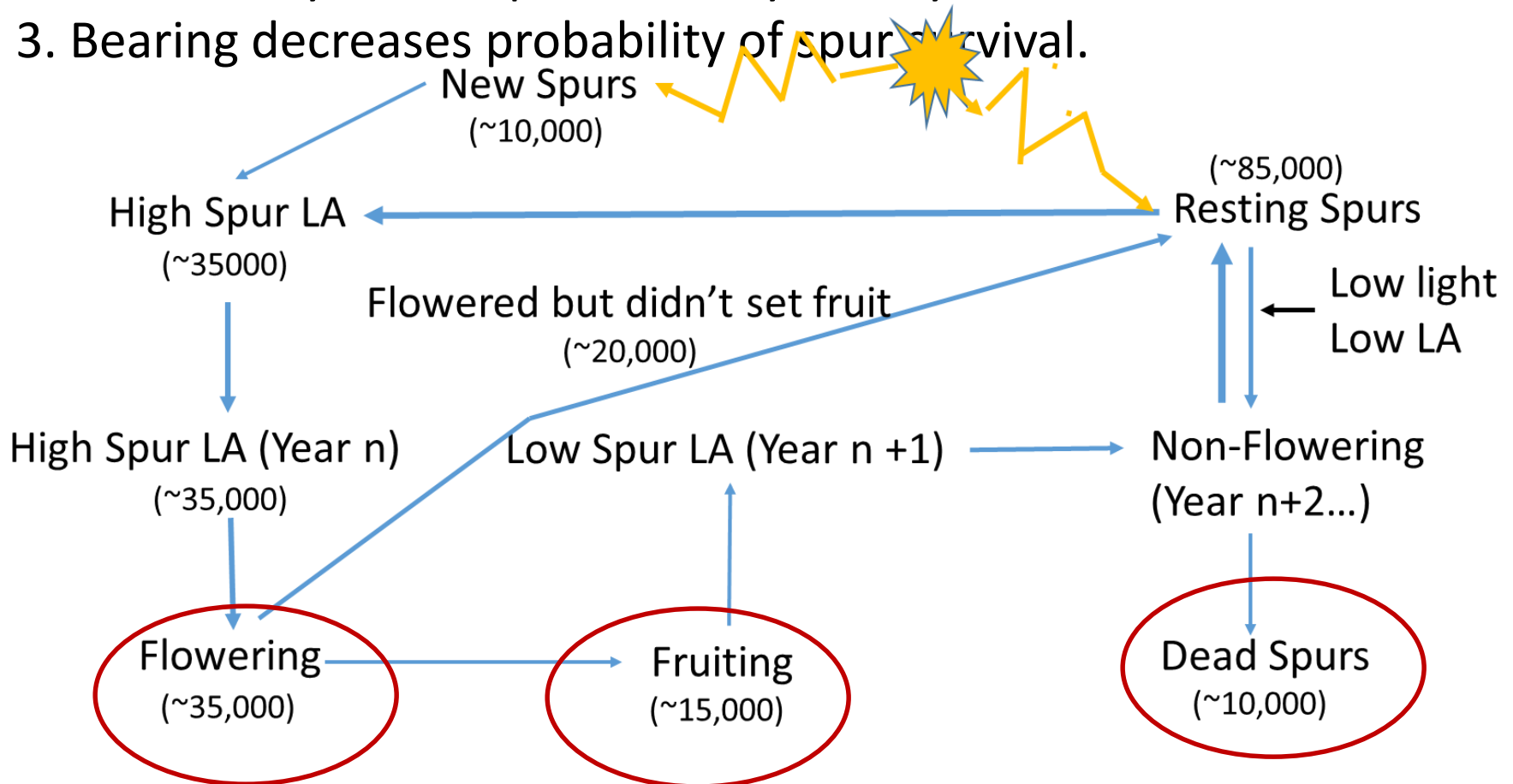
D) Bearing spurs are more likely to survive into following year if they are in a lighted position in the canopy



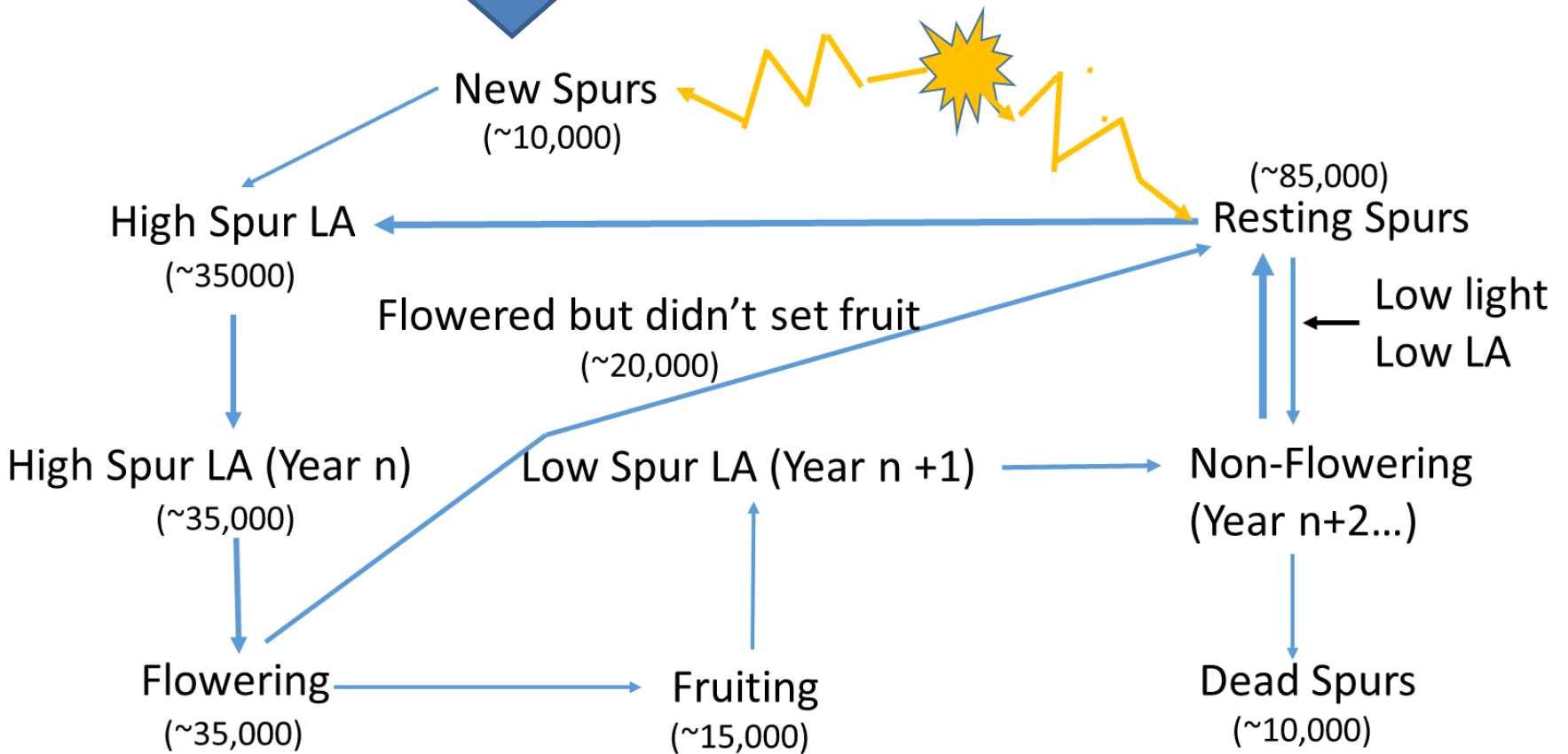
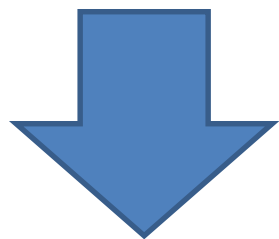
# Key Spur Facts:

Assume 100,000 spurs/mature tree

1. Spurs generally viable 3-5 years
2. A proportion of spurs die each year (approx: 5-27%)
  - Only 2/3 of spurs live beyond 3 years.
3. Bearing decreases probability of spur survival.



Management Goal: generate new spurs annually



# Promotion of viable spur population

## 1) Manage water and nutrition.

- Consider that excess growth may enhance shading

## 2) Promote modest annual vegetative shoot growth

- new spurs grow on these shoots
- be patient; the spurs remain vegetative for 1-2 years and form on prior wood.

## 3) Prune to reduce shading

- Remove dead or overlapping branches that impede light interception.



## Acknowledgements

*Photos and content*

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S. Saa, Almond Board of CA

Questions?

Thank you Bruce Lampinen

