2019 国际澳洲坚果发展年会暨临沧坚果文化节

2019 International Macadamia Annual R&D Conference & Lincang Nuts Culture Festival

Some insights into macadamia physiology澳洲坚果生理学探究

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Macadamia physiology澳洲坚果生理学

- Abscission脱落
- Productivity/water use 产量和用水
- Thermal time and Photothermal Quotient

  热时间和光热商

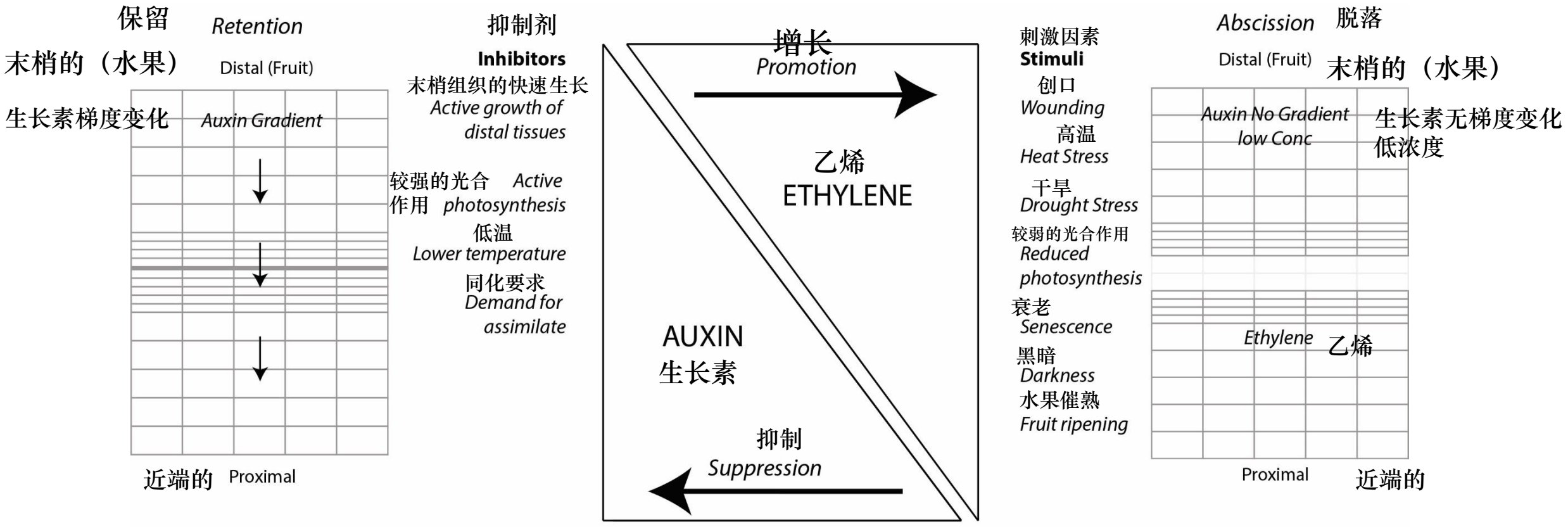
Shorter duration of macadamia harvest
更短的澳洲坚果采收时间

- More efficient harvest更有效的采收
- Higher quality nuts 更高质量的坚果
- Improves orchard scheduling post-harvest
  改进果园采后处理的时间安排
- Some evidence that earlier, shorter harvest improves yield in following season
  一些证据表明，较早、较短的采收可以提高下一季的产量
- Ethephon in use but results can be variable
  使用乙烯利效果也会不同

Current understanding of retention/abscission
当前对保留和脱落的理解

- Our knowledge of the retention/abscission is incomplete
  对保留和脱落的理解不完整
- Abscission occurs at predetermined 'abscission zone' (AZ)
  脱落发生在预订的脱落区
- Metabolically active organs such as leaves and fruits produce auxin
  代谢活性器官（如叶片和果实）产生生长素。
- While Auxin is being produced, AZ not responsive to ripening agents
  生长素产生时，脱落区对催熟剂没有反应
- Decline in synthesis and transport of auxin is followed by an elevation in ethylene and abscisic acid (ABA)生长素的合成和输送减少，脱落酸和乙烯就会提高
- Deceasing auxin thereby provides the stimulus for initiation of the abscission cascade生长素的减少会刺激脱落酸的合成

Model for fruit abscission
水果脱落模型



Research into abscission

对脱落的研究

- Research to better understand the process

  通过研究，更好的理解它的进程
- Does macadamia behave the same as other species

  澳洲坚果的脱落与其他物种脱落有相同的表症吗
- What is the source of the auxin

  生长素的源头是什么
- How can we make the AZ receptive to ripening agents

  如何让催熟剂与脱落区相适应
- Can we select for more synchronous nut drop

  可以选择同时脱落吗

Productivity of Macadamia orchards
澳洲坚果果园的产量

- Stephenson & Chapman (2012)

  斯蒂芬森和查普曼（2012）

- Compare Apples with Macadamia

  用澳洲坚果与苹果做对比

- Radiation input similar

  相似的辐射输入

- Apple HI = 0.65, Macadamia kernel =0.17 (NHI=0.53)

  苹果收获指数是0.65，澳洲坚果果仁=0.17，氮收获指数是0.53

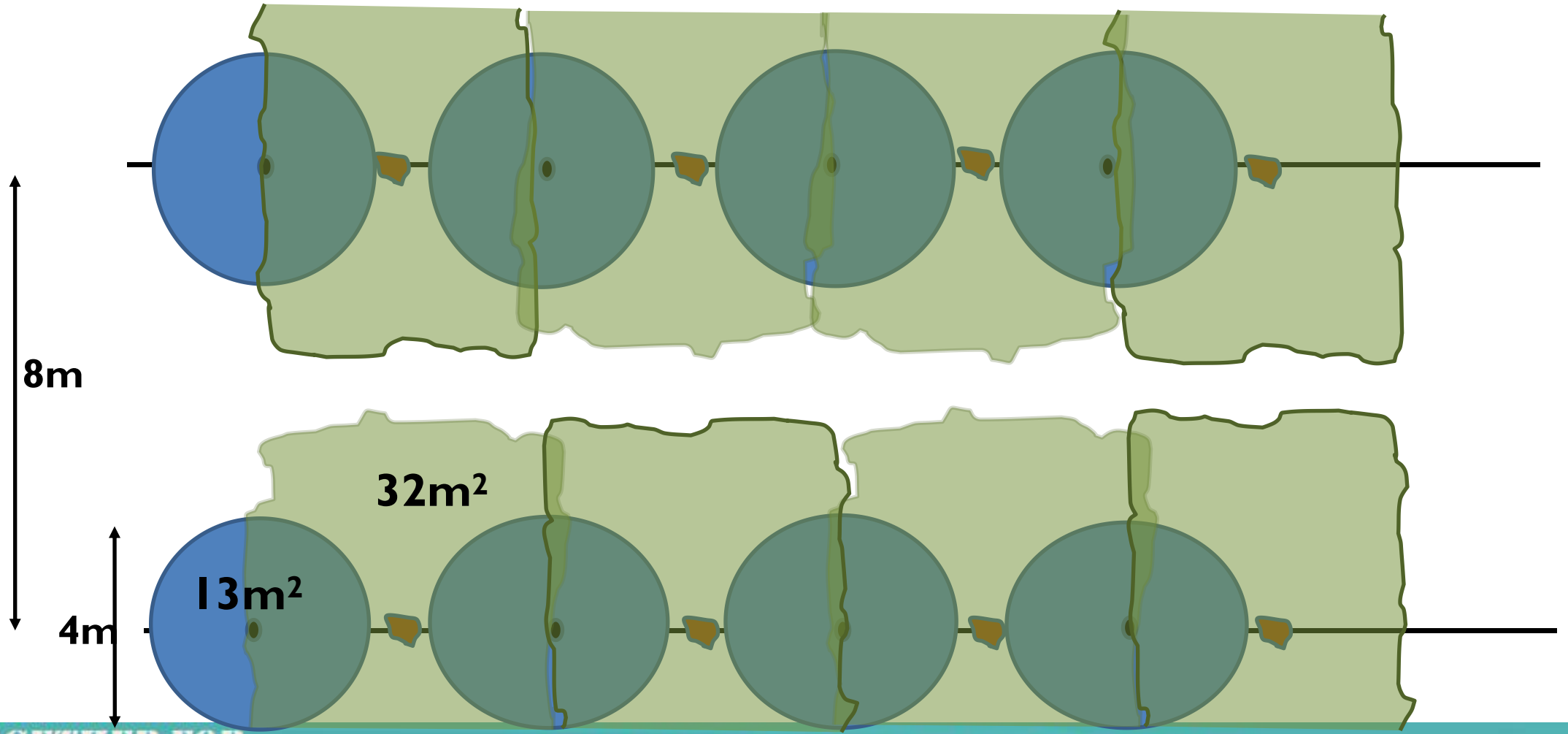
Comparative energy capture of tree crops作物的能量吸收的比较

	水果能量 Energy in fruit (10^{10} J t^{-1})	最高的商业产量 Highest commercial yields (t ha^{-1})	每年的水果能量 Annual energy in fruit (10^{10} J ha^{-1} $year^{-1}$)	基于能量捕获的相关产量 Relative yield based on energy capture
Orange 橙子	0.26	100	26.0	1.0
Apple 苹果	0.22	100	22.0	0.85
Avocado 牛油果	0.67	38.3	25.7	0.99
Mango 芒果	0.27	28	7.6	0.29
Custard Apple 番茄枝	0.31	14.7	4.6	0.17
Macadamia kernel	3.00	2.5	7.5	0.29

澳洲坚果果仁

Stephenson et al 2013 斯蒂芬森2013

Estimating tree water use
果树用水估算



Estimating tree water use
果树用水估算

- 70L of water per tree per day, summer months

  夏季，每天每棵树70L水
- Equivalent to 5.6mm on the wet soil area

  相当于土壤潮湿5.6mm
- But only 2.3mm based on the canopy area (1.7mm ground area)

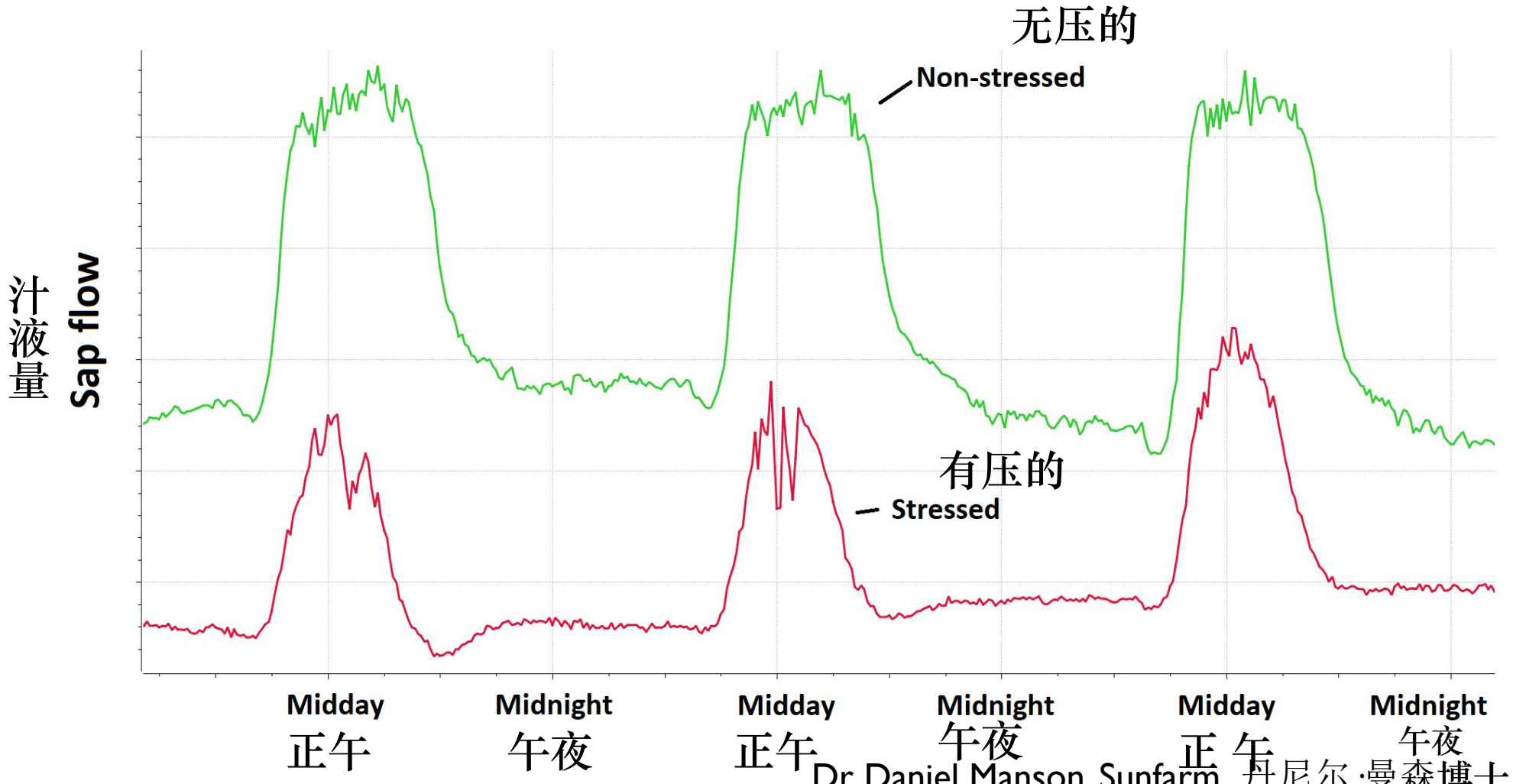
  但是，在树冠区仅是2.3mm（地面区是1.7mm ）
- Pan evaporation typically 5.0mm per day, VPD 2.0kPa

  蒸发皿蒸发量每天是5.0mm，每日变化是2.0kPa
- Well-watered trees are only using ~50% of Pan Evap.

  浇灌良好的树木，用水量仅为50%
- Leaves are 2-4°C hotter than ambient temperature

  叶片的温度比环境的温度高2-4°C

Macadamia tree water use
澳洲坚果果树用水



Dr Daniel Manson, Sunfarm 丹尼尔·曼森博士 太阳农场

Research into productivity
产量的研究

- Increasing the assimilation of macadamia

  增加澳洲坚果的同化作用
- Macadamia stomatal response to VPD and/or stomatal frequency

  澳洲坚果气孔对每日变化的反应 和/或 气孔频率的反应
- Open stomates use more water but cools leaves and leads to higher assimilation

  开放的气孔需要更多的水，但冷却叶片会导致更高的同化率
- Stomatal frequency on leaves

  叶片上的气孔频率
- Canopy architecture to promote better light relations

  树冠的架构改变光照的情况
- Thinner shell, higher kernel recovery

  更薄的果壳，更高的出仁率

Why Photothermal Quotient

为什么要考虑光热商

$$光热商 PTQ = \frac{Daily\ Radiation}{(Max°C + Min°C)/2 - Base°C}$$

每日辐射量

（最高温+最低温）/2-基础温度

- Surrogate for the assimilate supply available to the crop per unit of development.

  在发展的每一个过程中，能指定同化物

- Can be used to investigate critical growth periods that affect yield.

  可用来调查影响产量的关键生长期

- Higher value = conditions are more favourable to growth

  更高的价值=情况更适于生长

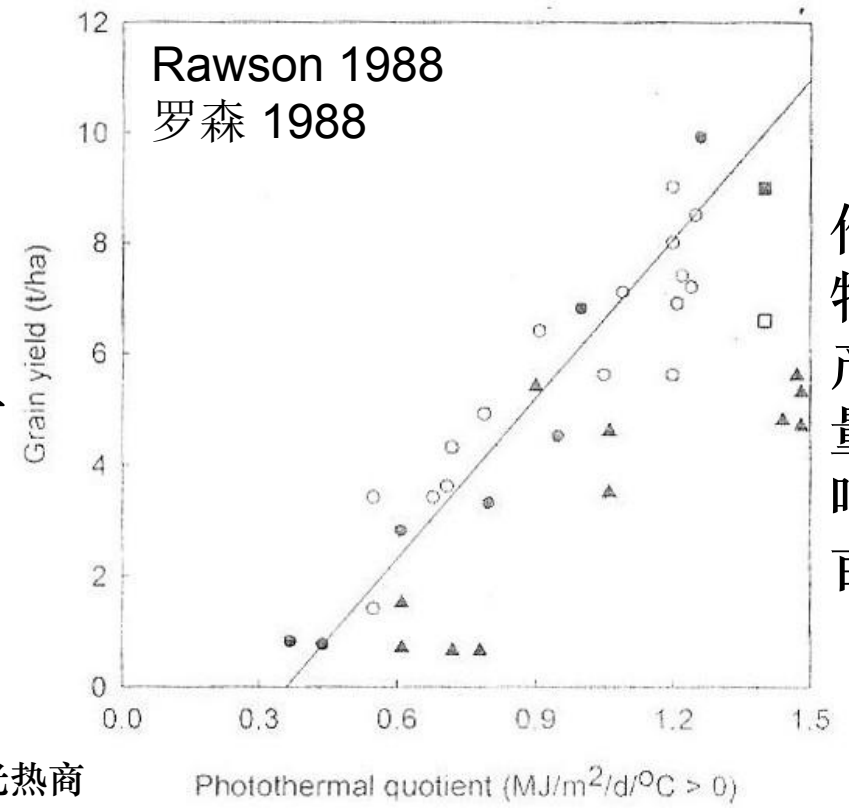
- Validation in Broadacre crops e.g. Fischer 1985; Rawson 1988, Peake & Angus (2009)

  阔叶作物认证，例如 费希尔1985、罗森1988、皮克和安格斯(2009)

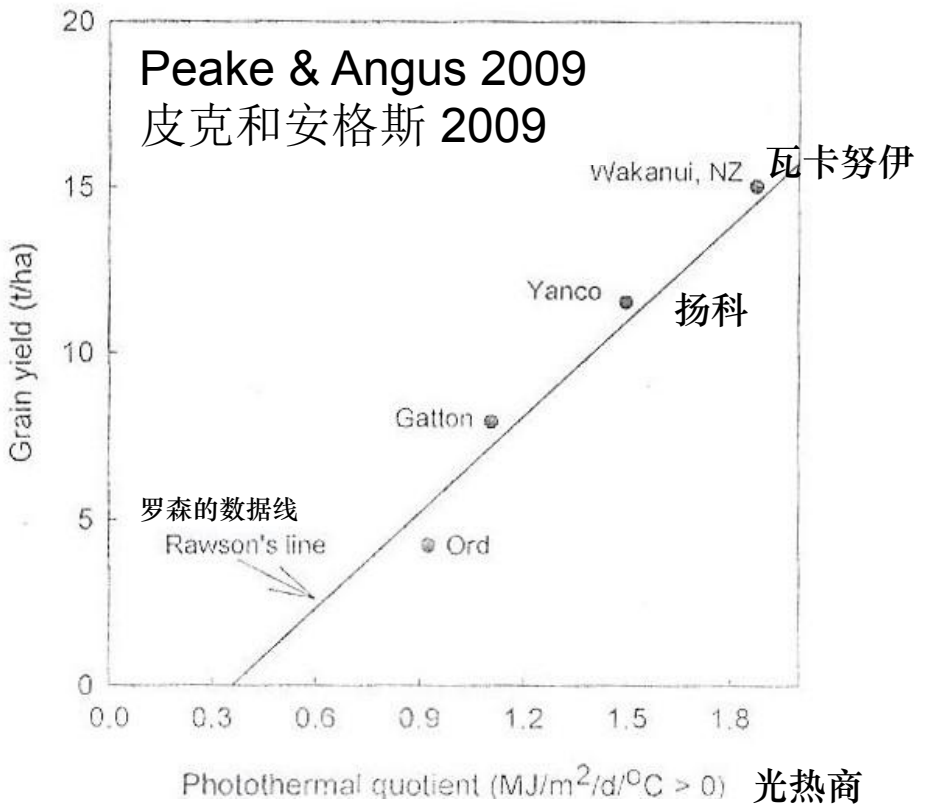
PTQ used in Broadacre crop to explain yield variation

用应用于阔叶作物的光热商来解释产量的变化

作物产量吨/亩



作物产量吨/亩



罗森 1988； 产量与光热商有密切影响，数据来自于各地和各季节
皮克和安格斯 2009；澳大利亚和新西兰产量变化

Rawson 1988; Yield positively related to PTQ, data across sites and seasons
Peake & Angus 2009; Yield variation across Australian and New Zealand locations

Studies using thermal time in Macadamia
对澳洲坚果使用热时间的研究

- Trouhoulias and Lahav (1983). Base Temperature for Macadamia growth is between 10-15 °C
  特鲁豪利亚和拉哈夫（1983）澳洲坚果生长的基础温度介于10-15℃之间
- Moncur et al (1985). Base temperature for Raeceme development 12.5 °C

  蒙克尔等（1985）适合总状花序生长的基础温度是12.5 °C

总状花序长度

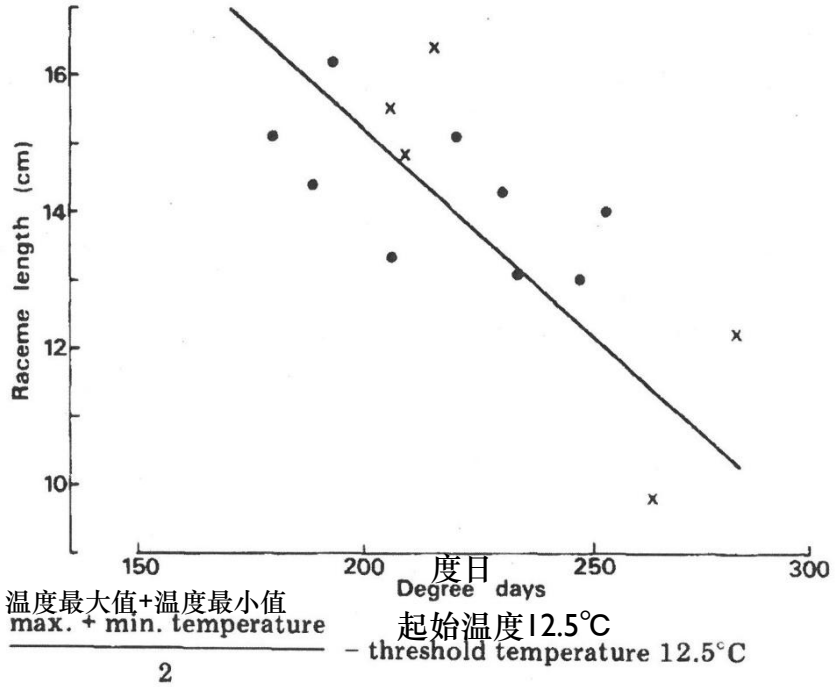


Fig. 3. Relationship between final raceme length and accumulated day degrees during the elongation phase for Hawaiian (●) and Australian (x) cultivars. R^2 = 0.75.

数据3：夏威夷品种和澳洲品种的最终的总状花序长度和在延长期的累计日之间的关系。R^2=0.75

Can PTQ help explain yield variation
光热商可以帮助解释产量差异吗

- Multiple years in one location – Commercial yield data across seasons.

  多年在一个地方-各季节的商业产量数据

- Multiple years in Multiple locations – RVT across sites and seasons.

  多年在多个地方-跨站点和跨季节RVT的计算

- Connect to projects like crop forecasting an orchard intensification to develop awareness and scope investment opportunities

  与作物预测相联系，来帮助果园进行预测，增加投资机会

- Model to explain floral initiation and time to flowering

  建立模型来解释花蕾形成和开花时间

Possible limitations of PTQ in macadamia

澳洲坚果光热商可能存在的局限性

- Macadamias stomatal response to VPD
  澳洲坚果气孔对每日变化（VPD）的反应
- Effect of previous season(s) on current crop
  当前作物受过去气候的影响
- With or without irrigation
  灌溉过或者未灌溉过
- Local differences in canopy management
  在树冠管理上各地有不同方法
- Nutrient management
  营养管理

THANKS

感 谢 聆 听

国际澳洲坚果大会委员会
International Macadamia Symposium Committee

临沧市人民政府
Lincang Municipal People's Government

云南坚果行业协会
Yunnan Macadamia Society