UK PACE Scheme
Pesticide dose Adjustment to the Crop Environment

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Research sponsored by the UK Chemical Regulations Directorate
Introduction

- UK Regulators funded SRI & EMR to develop PACE (2001-2005)
  - Based on optimised dose adjustment
  - Rationale
    - Statutory Label Dose: “Maximum dose per hectare”
    - Became EU law in 2009 (Regulation 1107/2009)
    - Known to waste pesticide for orchard spraying
    - UK Grower Already making dose adjustments
    - Applied Dose = (Dose Adjustment ≤ 1) x (Statutory Label Dose)
  - This research needed a good model
    - Dose Adjustment = F(Canopy: Size and Density)
    - Canopy Size Dose Adjustment:
      AgChem Companies (1990’s) Favoured TRV
    - Canopy Density Dose Adjustment:
Introduction

• **1st PACE Scheme Roll-out (2005 – 2007)**
  - HDC factsheet 20/05 to help growers use PACE
    - Worked examples of dose adjustment for different pesticides
  - Presentations made to major UK grower groups
  - Grower feedback:
    - **Simplify** dose adjustment calculation
    - **Because** grower make mistakes
    - **Complicate** dose adjustment calculation
  - Dose scaling rules are not the same for all pesticide types
Introduction

• PACE calculator webpage (2008-2013)
  • http://www.pace pjwrc.co.uk

• Include different scaling rules for different pesticides
  • Scab fungicides & products with pre-blossom dose
    • Alignment with LWA scaling
    • Canopy density is less important than canopy size
  • All other pesticides
    • Canopy density & size are both important
    • Walklate & Cross Crop Protection 54 (2013) 65-73

• Grower demo trials (2012 - 2013)
  • Using PACE webpage calculator
Why is dose adjustment needed?
Dose adjustment is needed to obtain uniform deposit across different structures

Just one sprayer

Yes, just one
Traditional deposit measurements are a very time consuming and expensive way to determine dose adjustment.
Possible alternative: LiDAR crop structure measurements

- Sick LMS100 (2012-2018)
- Sick LMS200 (2001-2012)

Crop structure parameters for dose adjustment models:
Ex. LWA, TRV, PACE

LiDAR output

Range interception maps
Range Interception Probability Distributions
(PACE parameters: height, width, density, etc)

pre-blossom

full-leaf
LiDAR-PACE dose adjustment model: UK orchards
Scab fungicides

- **Pre-blossom**
  - Ratio of target height to row spacing, $h/s$
  - Dose adjustment, $D_{gal} / D_{gal}$
  - Maximum (Max.) at 1.0
  - Standard deviation (Std.) at 0.85

- **Full-leaf**
  - Ratio of target height to row spacing, $h/s$
  - Dose adjustment, $D_{gal} / D_{gal}$
  - Maximum (Max.) at 1.0
  - Standard deviation (Std.) at 0.85

**Comparison**
- **PACE** ➔ **LWA**
LiDAR-PACE dose adjustment model: UK orchards

“All other products”
(These exclude scab fungicides & products with pre-blossom dose)

pre-blossom

full-leaf

PACE $\rightarrow$ LWA

PACE $>\text{LWA}$
LiDAR-PACE dose adjustment model: UK orchards
“All other products”
Scenario test product re registered (max. label dose is reduced by a factor of 2)
PACE Dose Adjustment Calculator
Dose adjustment calculator
1. Set reference sprayer (one off process)

- Select the number of open nozzles for spraying the standard/ref orchard with a fully calibrated sprayer
  - Nozzles-open = 14
Dose adjustment calculator
4. Adjust dose for tree density

- Select growth-stage
- Select growth-rate model for predictive use
- Select branch-number (see chart below)
- Select row-spacing
Dose adjustment calculator

5. Adjust dose for tree height

- Select number of open nozzles
- appropriate for target tree height
6. Results: Example with post-blossom predictions

N.B. Further pruning may be required “Clover ley” orchard branch density set “high” gives significant under-dose at “full-leaf” with full label dose.

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<th>PACE results summary record: New 4(10/10/2018)</th>
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* Efficacy may be reduced.
Summary

• I’ve described PACE developments
  • HDC leaflet
  • A more comprehensive approach
    • web-page supported system
• I’ve shown how LiDAR measurements can be used
  • To improve PACE
  • To quickly record & process orchard structure
  • To examine dose adjustment rules for different pesticides
  • To manage crop density
• Related research is still funded at EMR
  • For precision orchard spraying developments
• PACE funding from UK Regulators ended at EMR in 2013
  • The following issues are key
Issue 1: UK pesticide usage for orchard spraying

- 45% dessert & culinary apples
- 38% cider apples
- 8% pears
- 9% plums, cherries & nuts

Data source:
Pesticide usage survey report 273
Orchards in the UK 2016
FERA
Issue 2: Liability

PACE Pesticide dose adjustment for orchards

Liability

- Though this software has been prepared based on the best information available from UK research, the author cannot accept any liability for loss, damage or injury that may result from reduction of the label recommended dose. Any decision to apply pesticide doses (or their equivalent volumes and concentrations) outside the label recommendations is at the user’s own risk.
- If a dose reduction is made with some products the manufacturer’s warranty on efficacy may be invalidated.
The End
Many thanks for your attention
Key Publications: Early PACE developments

- Origin of spray deposit measurements
  - Cross et al., Crop Protection (2001) 20: 13-30
  - Cross et al., Crop Protection (2001) 20: 333-343
  - Cross et al., Crop Protection (2003) 22: 381-394

- Spray deposit modelling based LiDAR crop structure measurements
  - Walklate et al., Biosystems Engineering (2002) 82 (3): 253-267
  - Walklate et al., Crop Protection (2006) 25: 1080-1086
Key Publications: Additional PACE developments


• Walklate P J. 2013. Internet portal for links to all versions of the PACE dose adjustment calculator and associated web pages. http://www.pace.pjwrc.co.uk