Fertiliser Spreading: Getting the Mechanics Right

UAS/UFU/CAFRE
Annual Arable Conference, 2013

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AMAZONE

Outline

- **Why Consider Spreaders**
- **Spreading evenly**
  - The Machine
  - Fertiliser
  - Setting / Adjustment
  - Applying the correct rate
- **The cost of uneven spreading**

Why Consider Spreaders

- **Fertiliser is expensive:**
  - W.Wheat £364/ha,
  - S.Barley £247/ha,
  - Potatoes £567/ha
- **N and P quantities limited by legislation**
- **A 30% error in N**
  - £205 loss in grain (W.wheat)

Must apply <u>Accurately</u> and <u>Evenly</u>

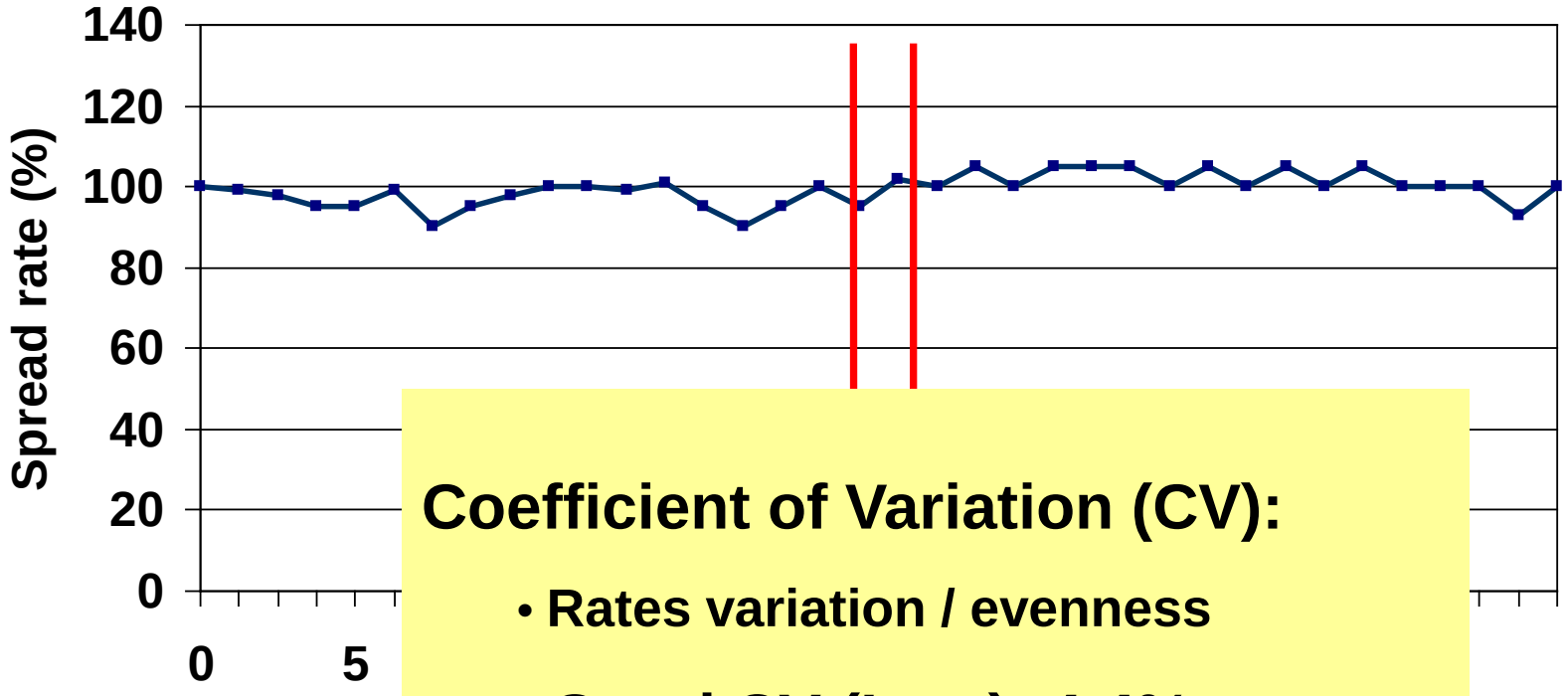
Why Consider Spreaders

- **100 ha Farm: Winter Wheat 9t/ha 8 years**

£6,000 Spreader → **£291,000 Fertiliser** → **£1,080,000 Wheat**

Spreaders must spread Evenly!

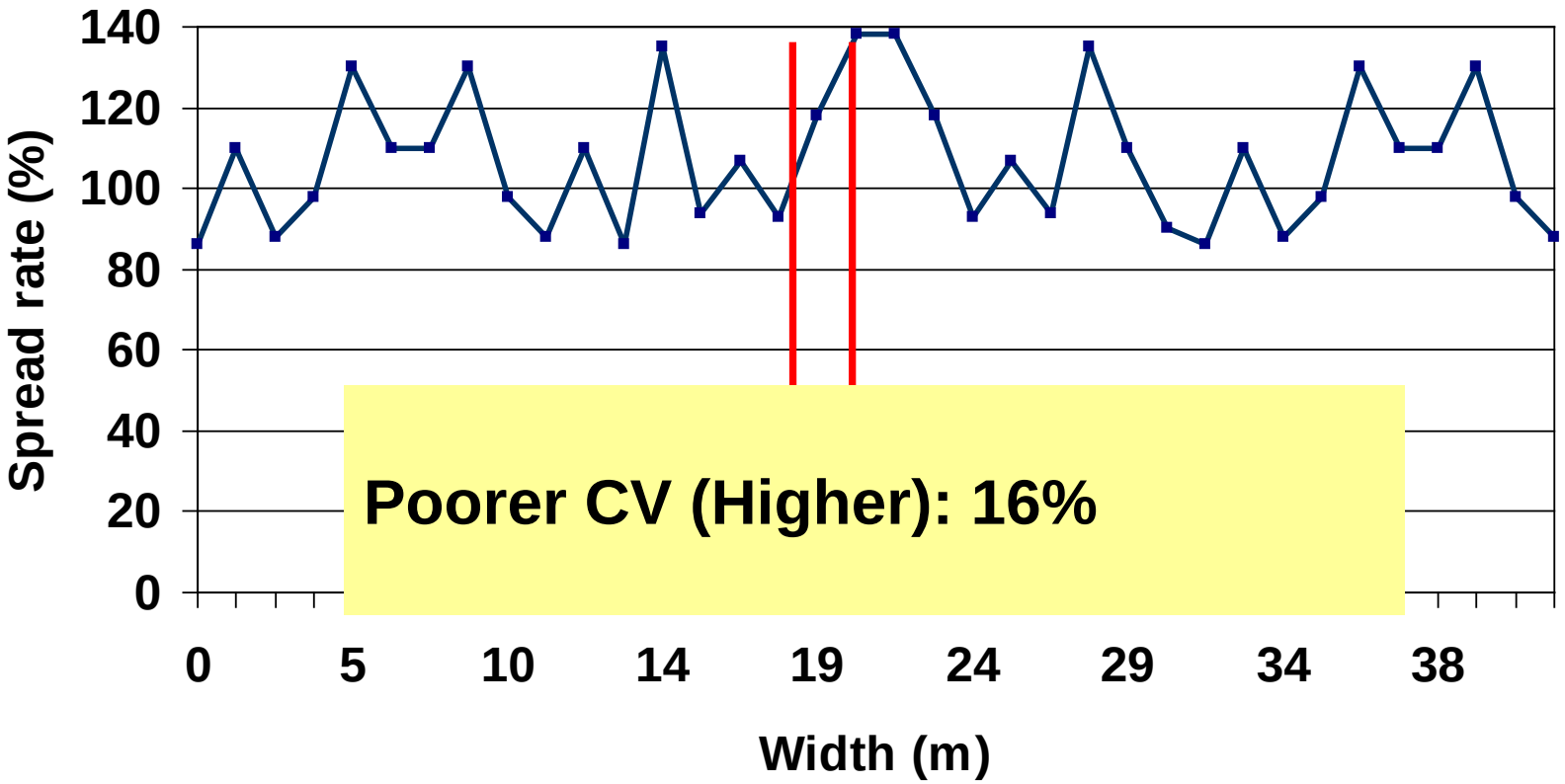
- **Evenly across bout width**



Coefficient of Variation (CV):

- **Rates variation / evenness**
- **Good CV (Low): 4.4%**

Spreaders must spread Evenly!



The Machine !

The Machine !

Spreading mechanisms

- **Twin Disc development dominates**
- **Single disc – one sided**
- **Reciprocating Spout limited to 9 – 12m**
- **Pneumatic**
  - Too expensive particularly >> 12m
  - Maintenance and corrosion issues
  - Test hall CVs no better
  - Windy conditions ++Advantage
  - Poor quality fertiliser - Better
  - Sharp shut-off – Research farms


bogballe


KRM


Agriaffaires
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KUHN
AXIS 50.1 W


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Spreading Evenly

- **Machine Design: Spreading elements**
  - Discs, Vanes, Fertiliser delivery point
- **Machine Setting - some of:**
  - Disc speed and type,
  - Vane type, length, number, angle
  - Fertiliser drop position
  - Disc angle and height over crop

➢ Depends on Machine type

➢ Determined by Fertiliser and Bout width

- **Absence of wear on spreading components**
- **Fertiliser characteristics**
- **Weather conditions**

Fertiliser

Fertiliser characteristics

- **Granule size, shape, density and strength**
- **Influences:**
  - Movement on disc
  - Throw off from vanes
  - Movement through air
- **Ideal:**
  - 80% of particles in 2-4mm range
  - Rounded and smooth
  - Blend components : mean particle size within 10% of mean
- **Move to ‘Bulk’ – deterioration in spread characteristics?**
- **Interaction between fertiliser and spreader**

Machine+ Fertiliser:

Evenness

Evenness testing

- **Test hall – indoor controlled environment –**

  0.25m^2 trays – Detailed pattern

  - Independent (Bygholm, CEMAGREF) and Manufacturers

- **CV values and Shape of spread pattern**
  - CV: less than 15% = acceptable but some <5%
- **Field full-testing – very little**
  - Poor repeatability
- **Field checking – 4-7 trays**
  - Basic pattern checking; Poor repeatability

Field performance: Poorer

- Weather conditions: +++Wind++++
- Angle of disc to crop
  - Top Link, Machine movement, Sinkage
- Uneve
- Variati
- Variati
- Incorre
- Wear i

TEST HALL CV of 5%

What Field CV ?

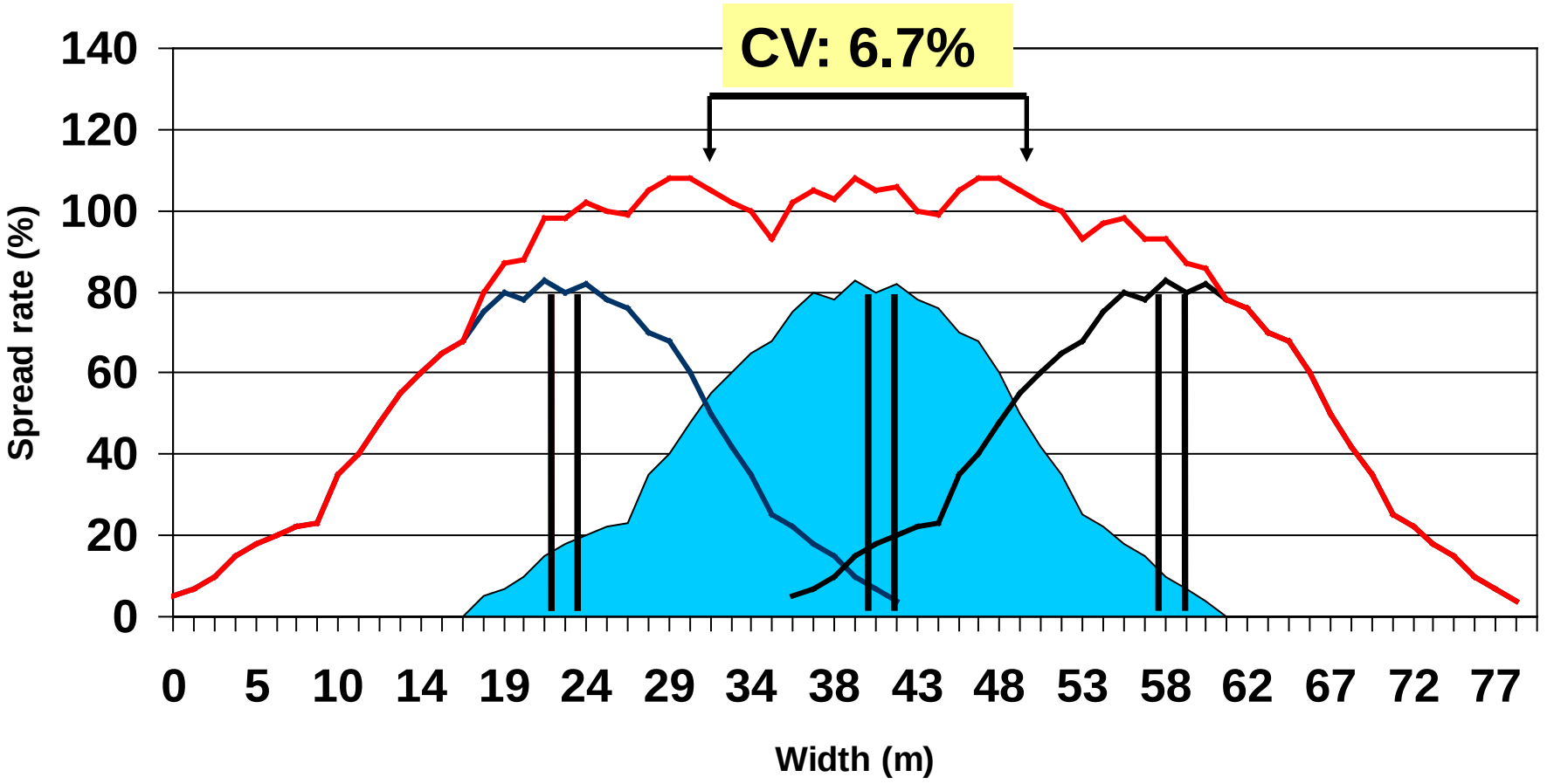
- **10% , 20% or 30% (striping)**

- **RISK: Develop machines for test hall!**

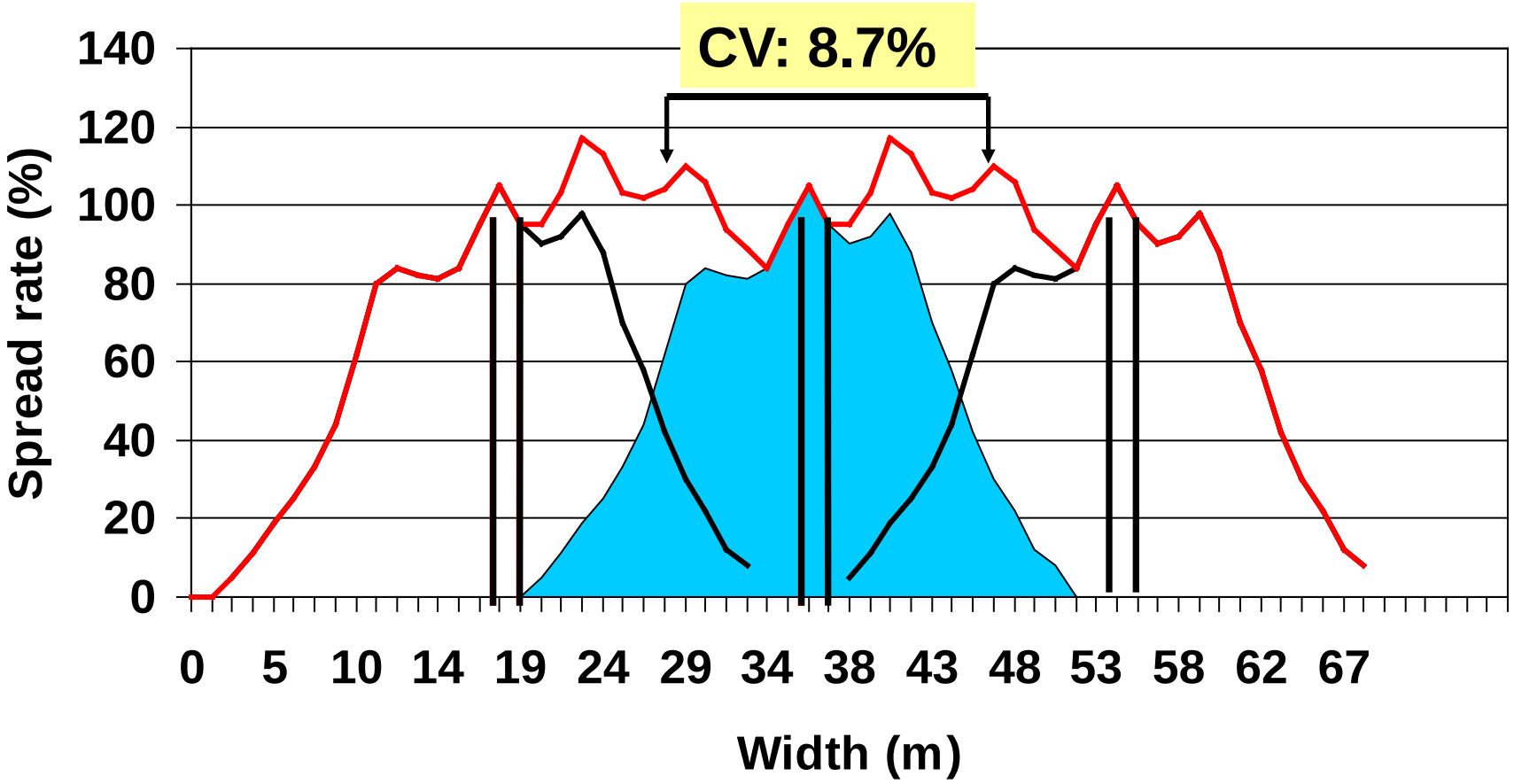
1999 -2000 tests

- Test Hall tests
- Independent at Bygholm Demmark
- All major twin-disc machines tested
- Very comprehensive
- Many Widths and Fert types
- Influenced Fert spreader development
- Little since !!!

Spreader A Std 18m: Good pattern

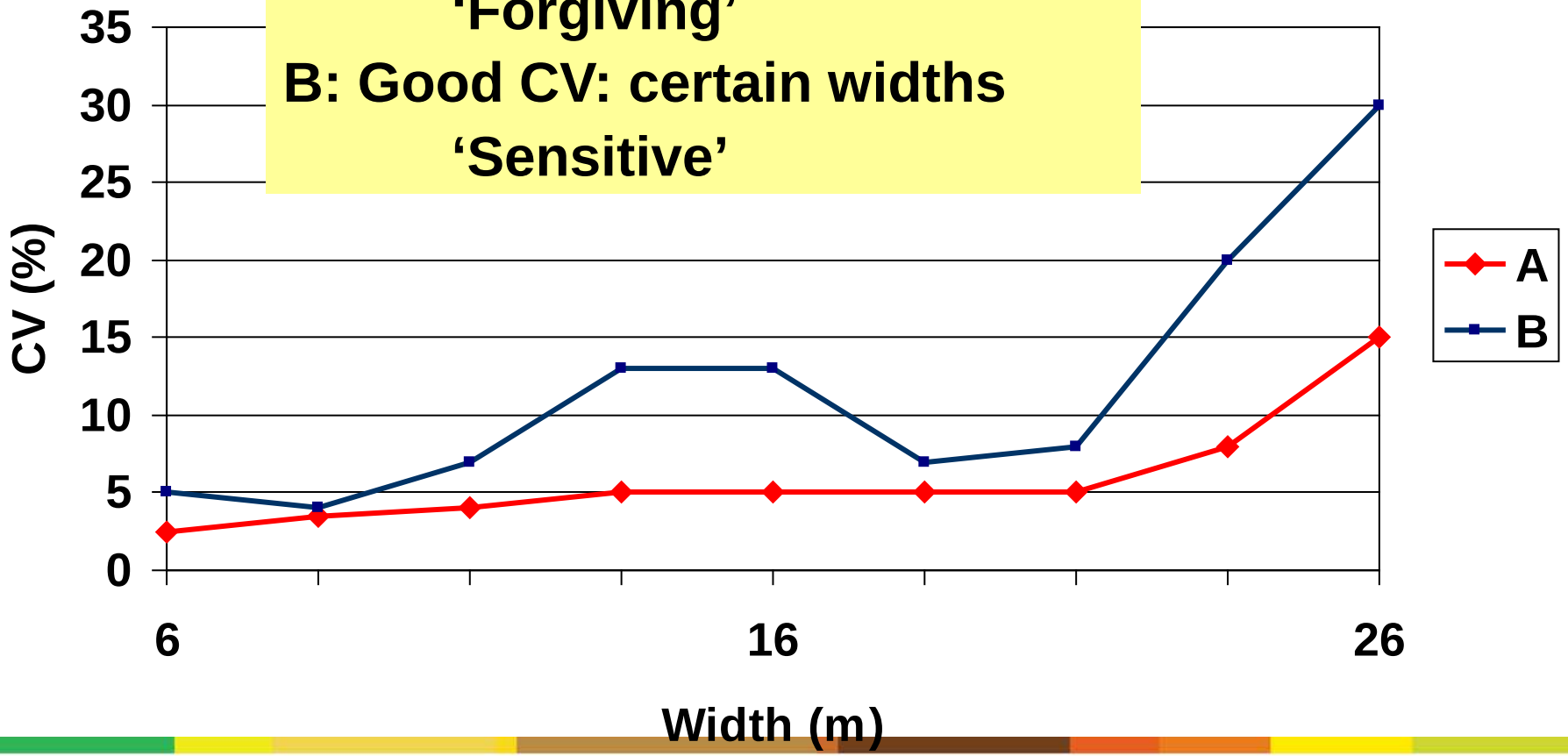


Spreader B Std 18m: Shouldered

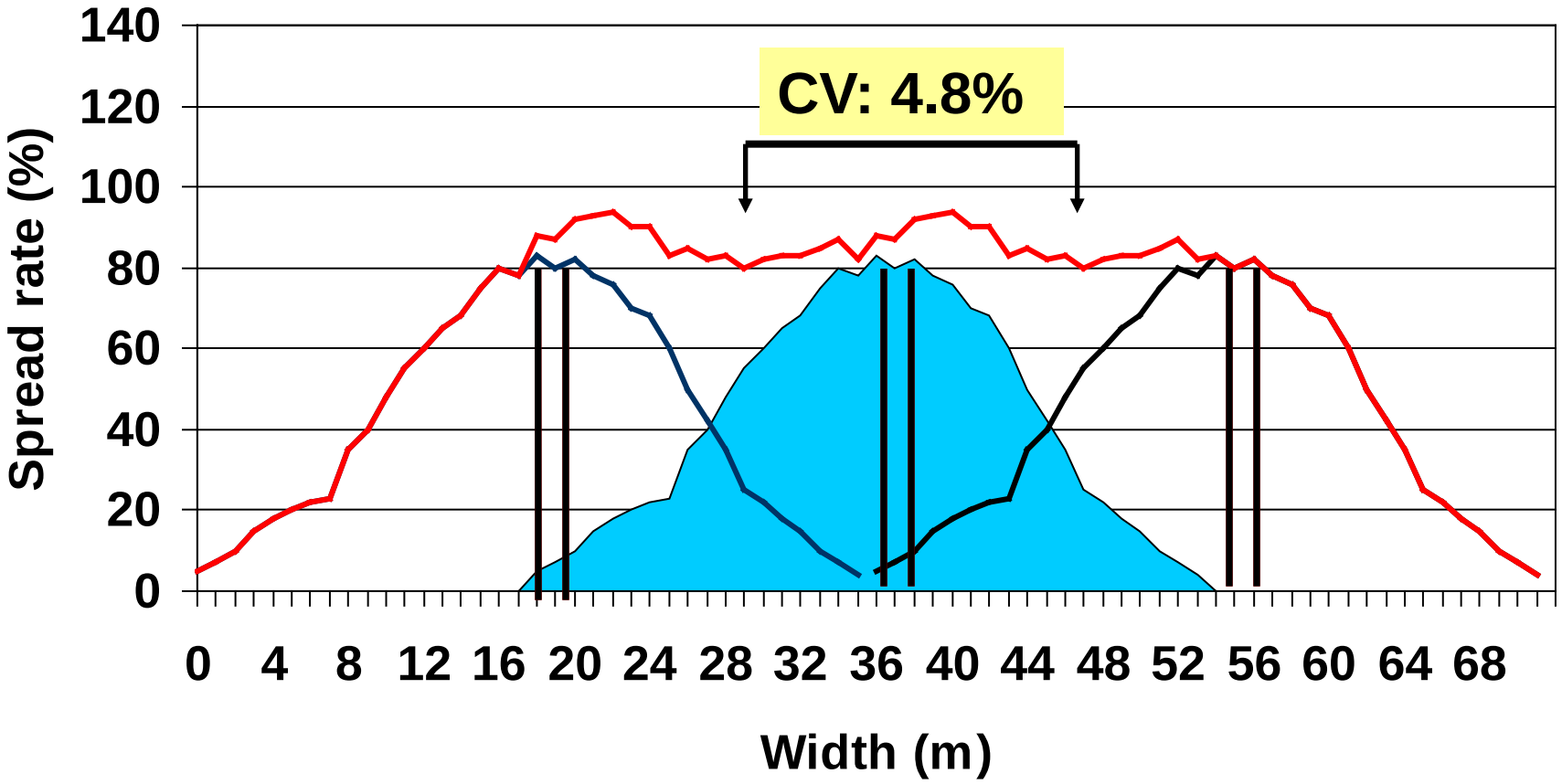


Spreaders A, B: CV at bout widths

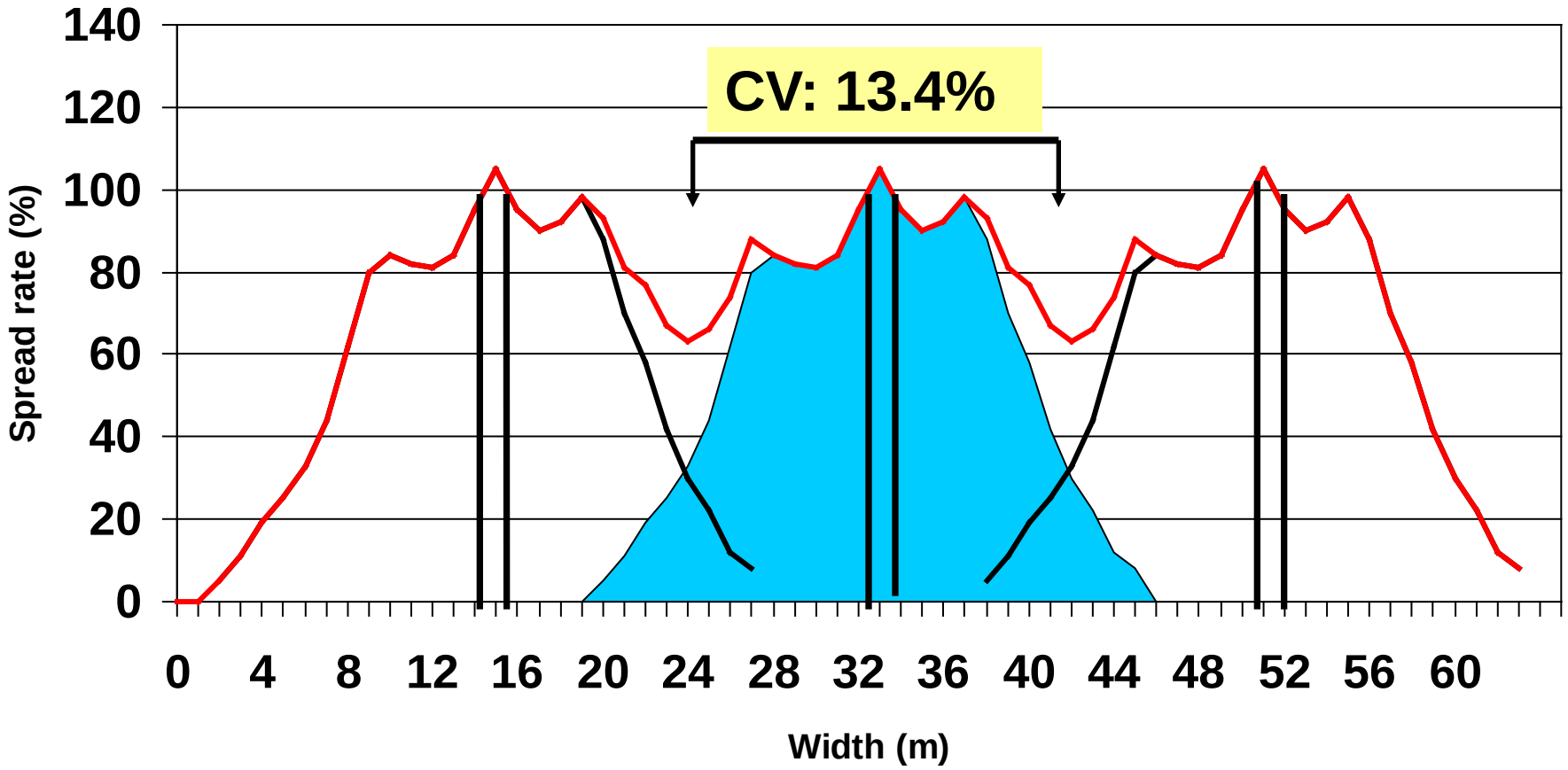
A: Excellent CV: 6m to 24m
'Forgiving'
B: Good CV: certain widths
'Sensitive'



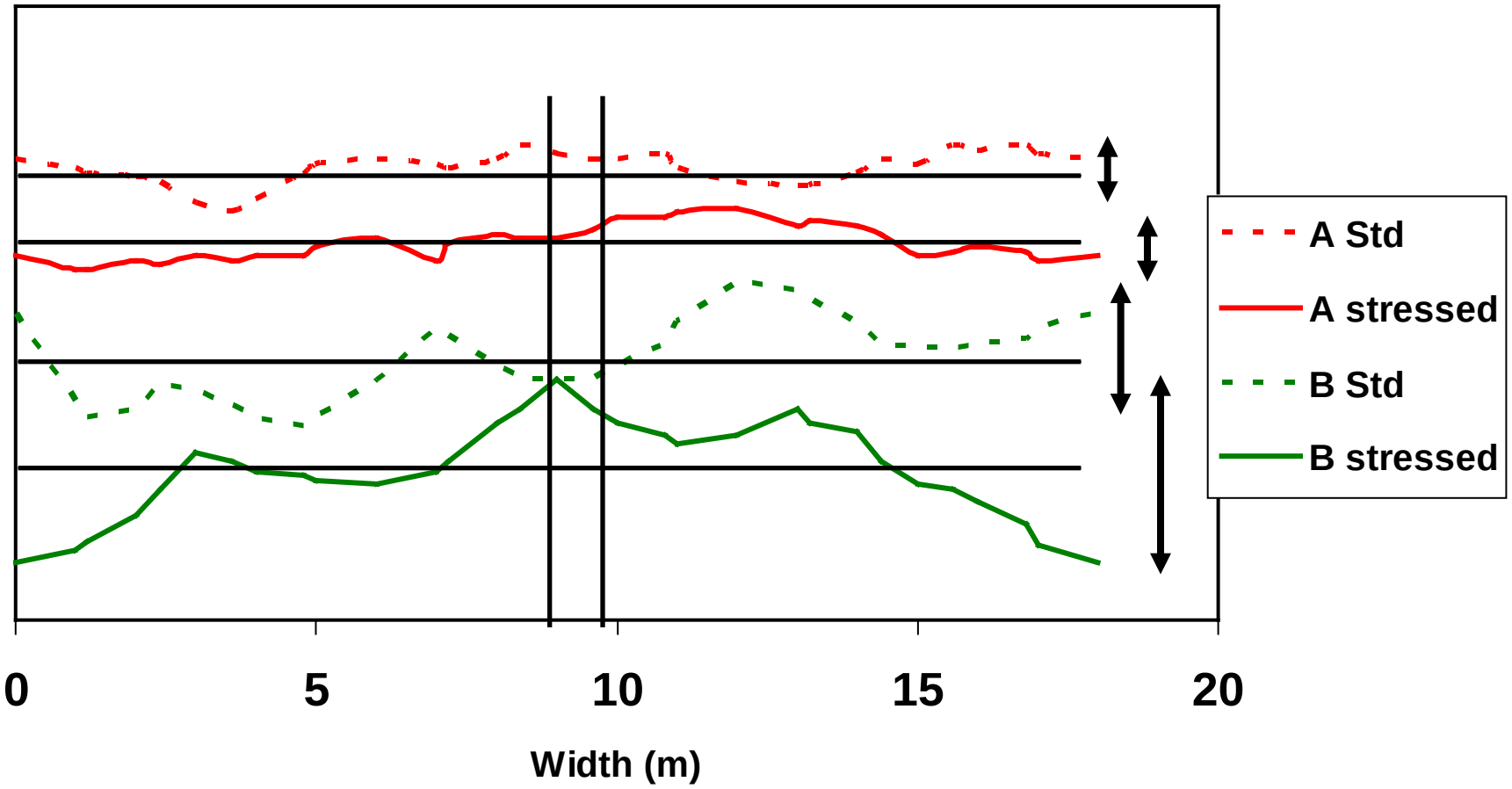
Spreader A: Stress tested



Spreader B: Stress tested



Stress tested:
Spreader A-Robust pattern less variation




bogballe

Direction of disc rotation

- Inward turning discs towards centre:
  (e.g Lely, Bogballe, Bredal)
  - Strong overlapping of disc patterns
  - More forgiving pattern
  - Less ability to shut-off part width
  - Not a guarantee of good spread!!
- Others – spread out from centre
  - More careful setting required

Settings for evenness

- **Determined by:** fertiliser characteristics and bout width
- **Adjustments depend on machine:**
  - Discs, speeds, angles, vanes, drop point
- **Manufacturers** charts / websites / databases
- **Sieve /strength /density tests** to characterise fertiliser
- **Simple tray tests** to check pattern

Getting the Rate Right:

Calibration

Applying the correct rate

- **Fertiliser Flow characteristics vary**
  - Between fertiliser types
  - Between batches
  - Depending on weather conditions
- **Individual machine settings can vary**
- **Calibration essential**
  - Fertiliser flow rate
  - Tractor forward speed
  - Correct bout width

Without calibration – errors likely

Farmer with 40ha in 5 fields

- Start with ‘last years’ settings or poor ‘book’ value
- Spread the first field at 20% more than intended
- Adjust: 2nd field at 15% less than intended rate
- Adjust: 3rd field at 5% more than intended
- Adjust: Last 2 fields correct
- Overall farm rate correct but 40% of area incorrect

Calibration practice

- **Manufacturers support**
  - Rate charts
  - Web based material
  - Tests of Irish fertiliser
  - Test kits (sieve test and ID charts)
  - Flow testers
  - Calibration procedures and kits
  - On-board weighing and automatic calibration

Calibration practice-2

- **Calibration**
  - **Flow Rate measurement**
    - Time flow, and weigh
    - Discs removed, or stopped + calibration kit
    - Varies with machine – easy best
  - **Driving speed check (wheelslip – 20% ploughed)**
  - **Bout width check (GPS, measure)**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Active rate control

- **Constant rate with:**
  - Variable forward speed
  - Variable flow rate
- **Can change application rate 'on the go'**
  - Manually
  - Variable rate Precision Ag type system
- **Controlled headland operation**
  - Graduated shut off for angled headland etc
  - Using GPS to determine position

The Cost of Poor Spreading

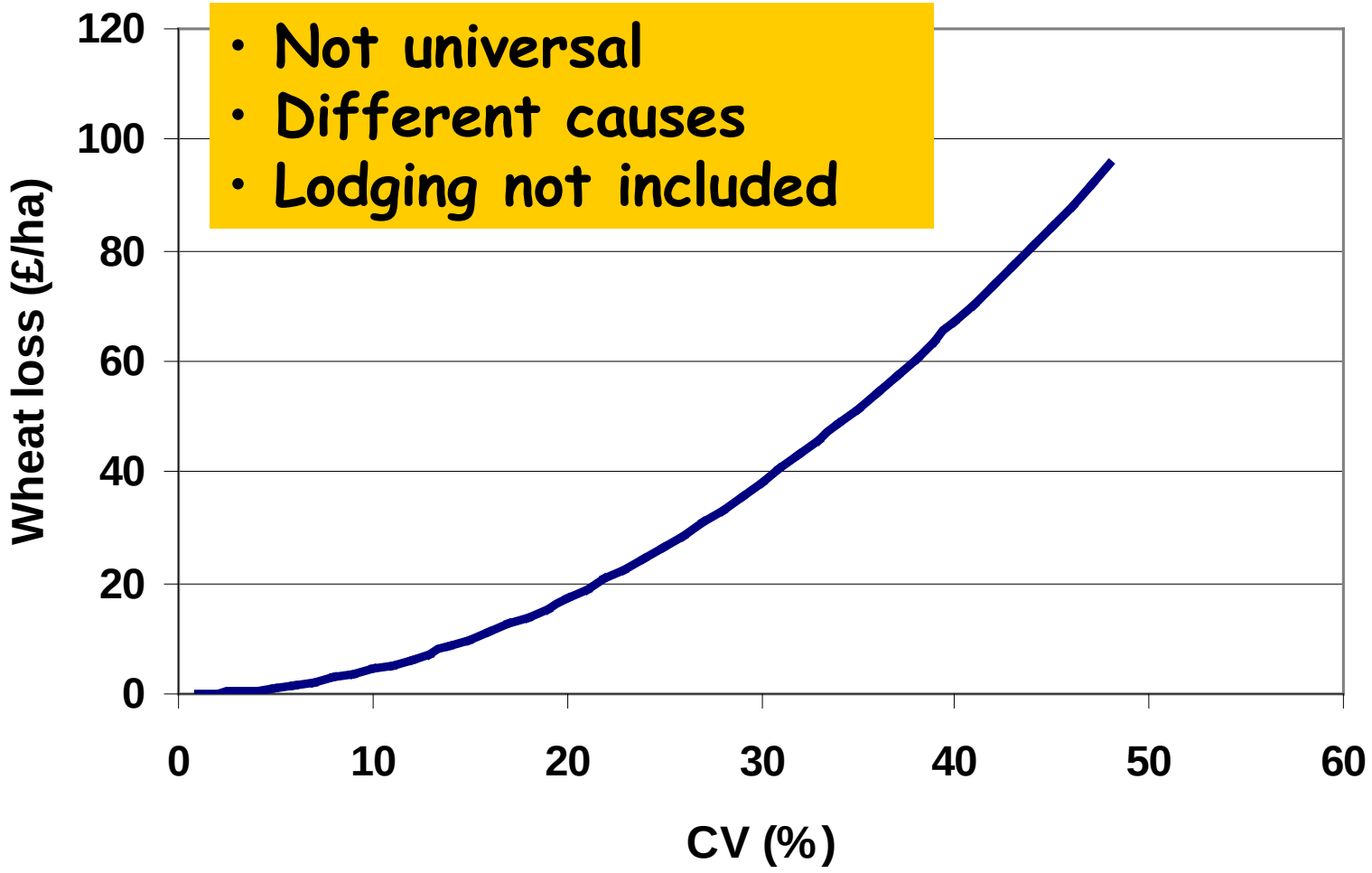
Cost of poor spreading

- **Two factors contribute**
  - Spread quality on farms – unknown
  - Cost of poor spread quality
- **Some research**
  - Frequently theoretical studies
  - Millar et al most recent – 2009
  - Effect of problem patterns modelled
    - Impact on CV and Cost (W.Wheat)

6 pattern defects studied

Problem	CV range	Cost(€/ha)
A	6 – 21	1 - 18
B	5 – 27	1 - 31
C	5 – 50	1 – 100
D	7 – 57	2 – 183
E	7 – 55	2 – 101
E	8 – 41	3 - 64

CV & Wheat loss(€/ha): Sample



Likely losses

- **Poor spreading:**
  - If visible CV= 30% - 50% ?
  - Loss in WW: £38 - £100/ha
  - 5% to 10% = £3.20/ha
- **Lodging and quality**
  - Lodging – big loss potential
  - Quality – malting barley, milling wheat, all

Focus on improving ‘field’ performance

100 ha Farm: Winter Wheat 9t/ha 8 years

£6,000 Spreader → **£291,000 Fertiliser** → **£1,080,000 Wheat**

- **CV= 10%** **£2,560 loss in life**
- **CV= 30%:** **£30,800 loss in life**

Practical considerations

- **Spreader choice:**
  - **Even spreading:** CV + robust pattern must have priority
  - **Correct spec:** hopper, control systems, calibration equip etc**.**
- **Fertiliser choice:**
  - Actively look for good spread quality
- **Use Manufacturers resources:**
  - Instruction manuals / Web resources
  - Calibration and fert test equipment
- **Calibrate** the spreader, tractor and bout width
- **Maintain** and check for wear

Finally

- **Fertiliser spreading**
  - **hugely important technical task**
    - Must get it right
    - Also true of contract spreading
- **Researchers / Manufacturers**
  - Must focus on field performance
  - Ensure test hall CVs reflect good field performance

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