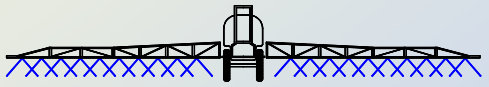


SCI meeting

Insect decline: the causes and the role of agriculture in mitigation

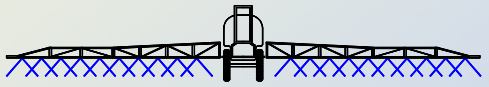
25th April 2012

Improvements in targeting sprays to crops

Paul Miller

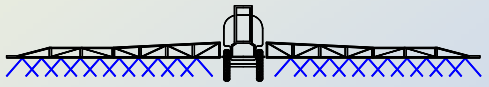
Silsoe Spray Applications Unit

(part of NIAB TAG)



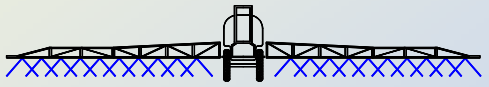
Targeting sprays to crops has components relating to:

- **Reduced spray drift**
  - à ***Particularly close to field boundaries***
- **Delivering sprays to identified targets**
  - à ***Patch spraying***
  - à ***Spot application***
- **Delivering sprays to the "right" part of the target canopy**
  - à ***e.g. to crop ears or to the base of the crop canopy***

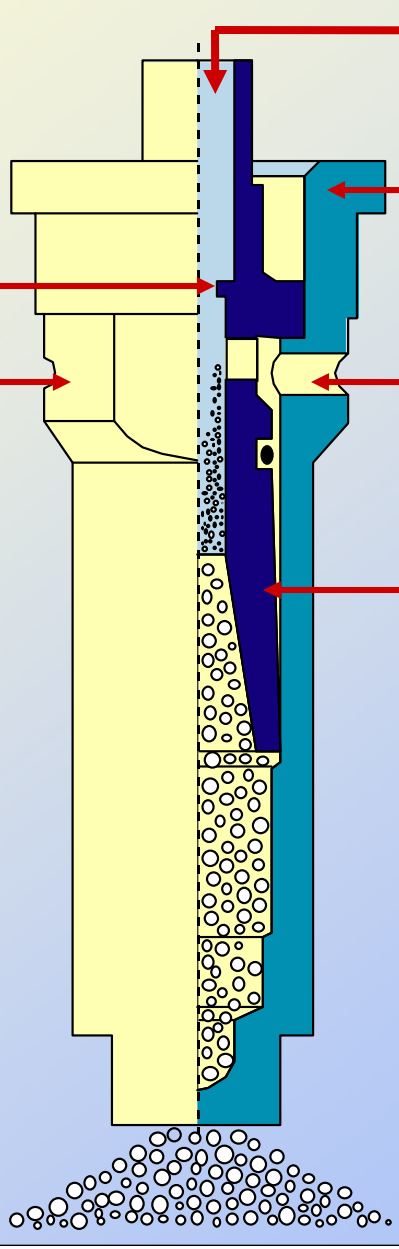


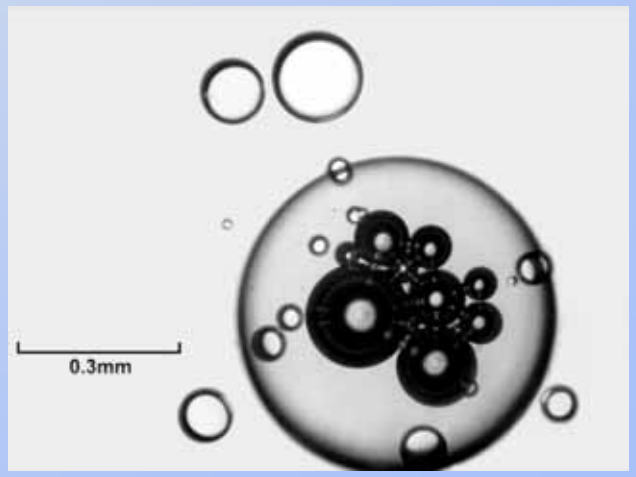
Reducing spray drift

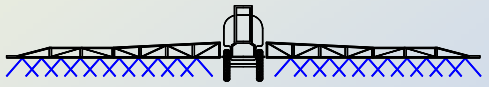
- **Has components relating to:**
  - *Nozzle design*
    - **Pre-orifice nozzles**
    - **Air-induction nozzles**
  - *Control of boom height*
    - **From a critical relationship between boom height and drift risk**
    - **Importance of boom suspension performance**



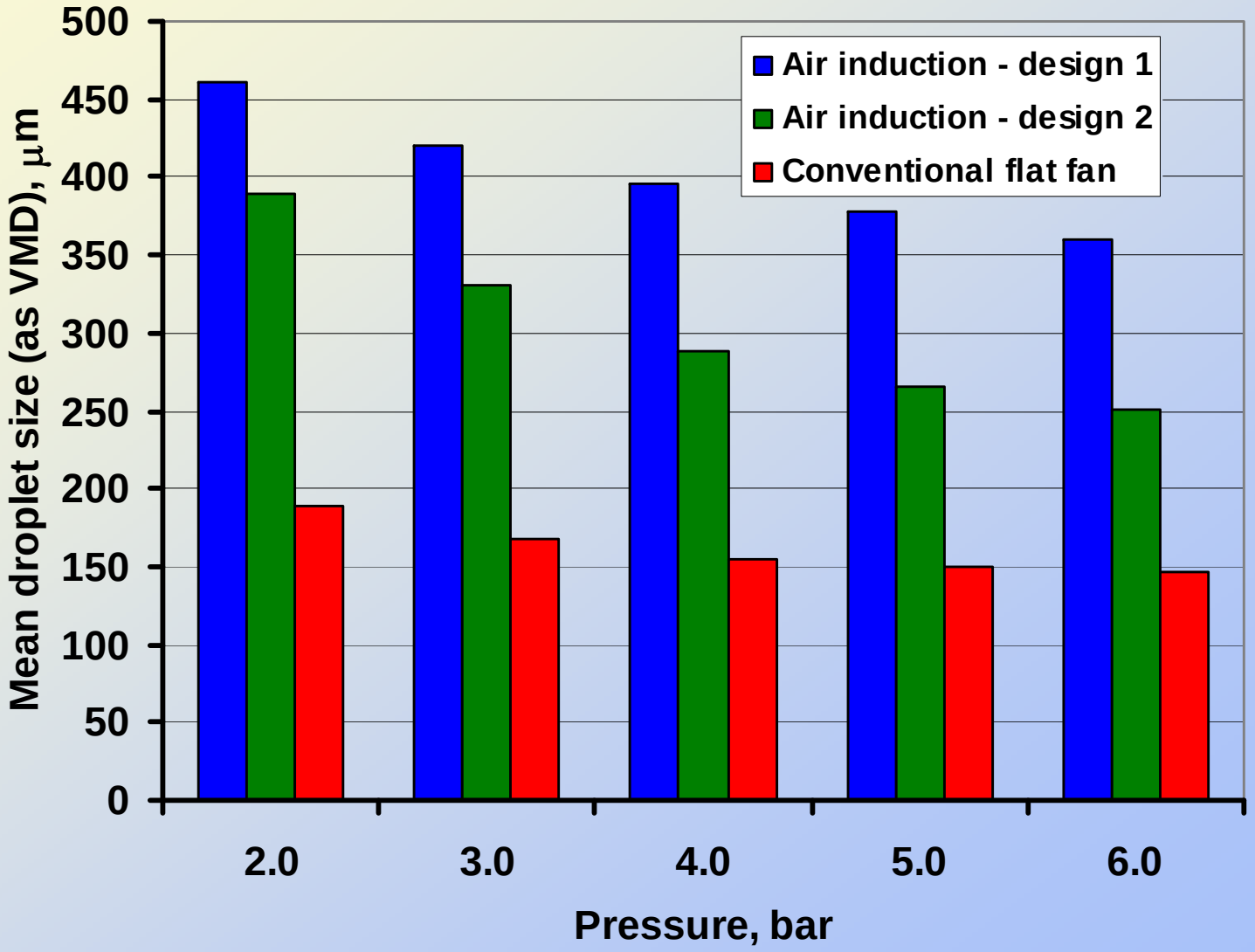
Typical air-induction nozzle design



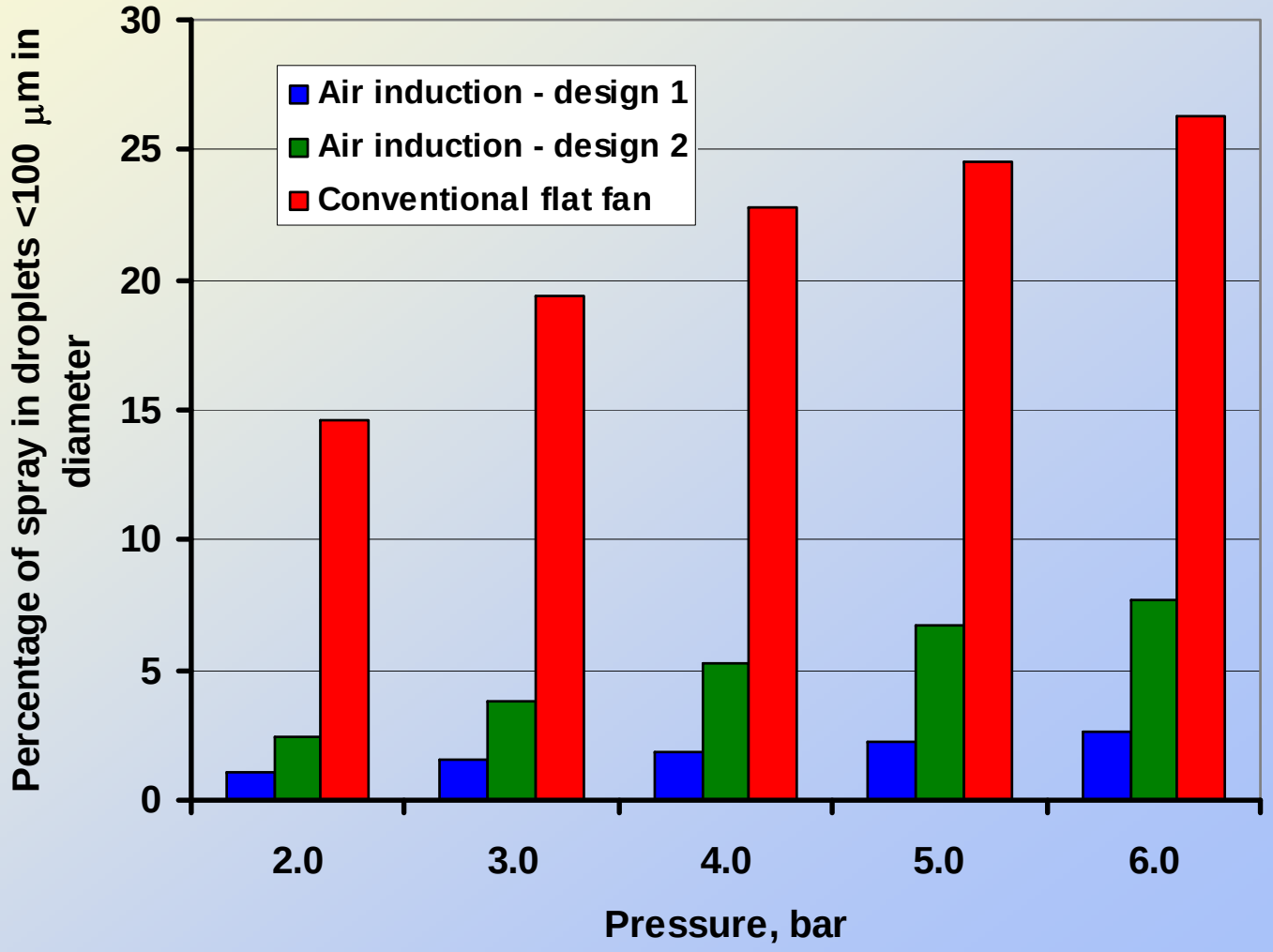




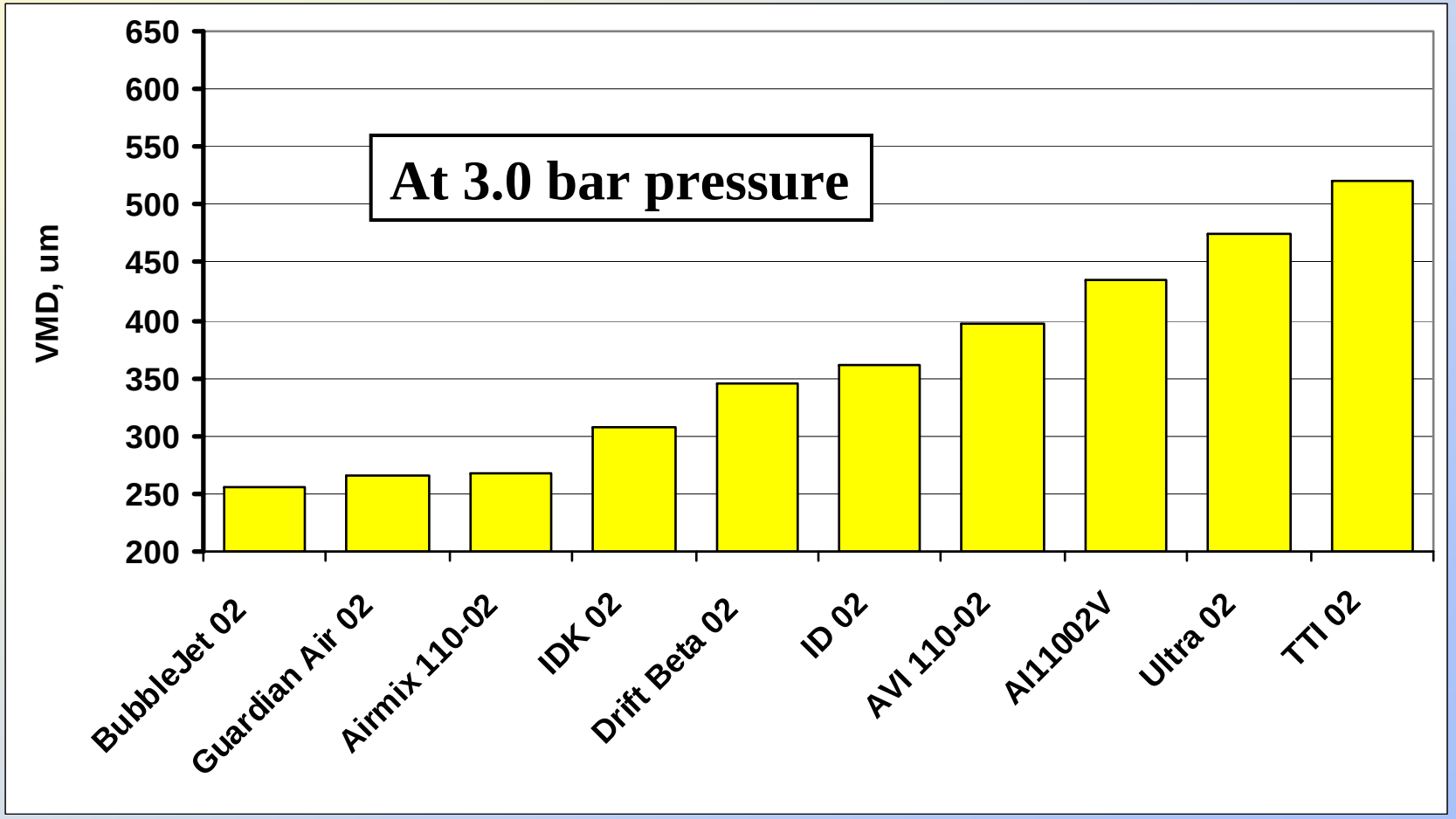
The effect of pressure on droplet size

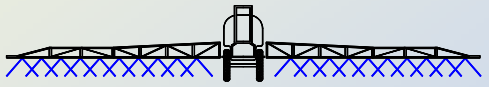


The effect of pressure on the small droplet component in a spray

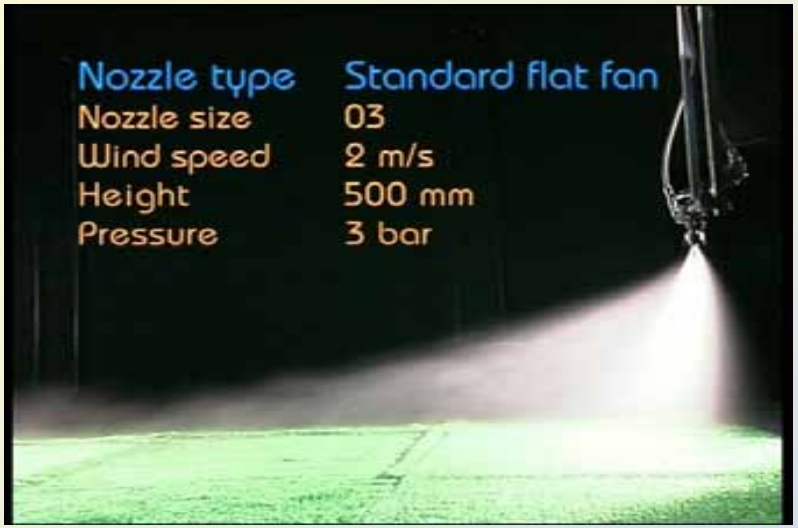


The variation in mean droplet size from different designs of air induction nozzle

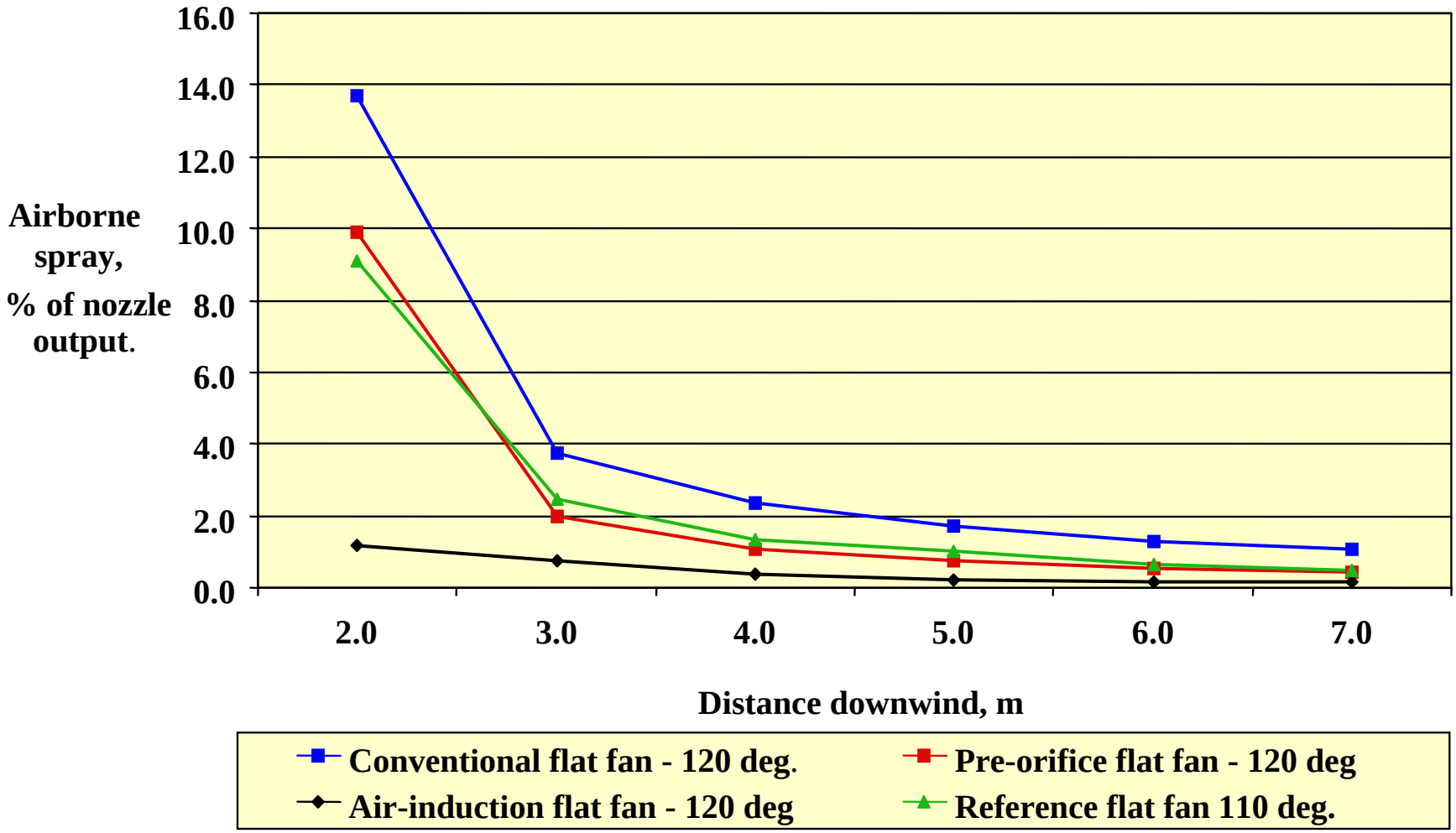




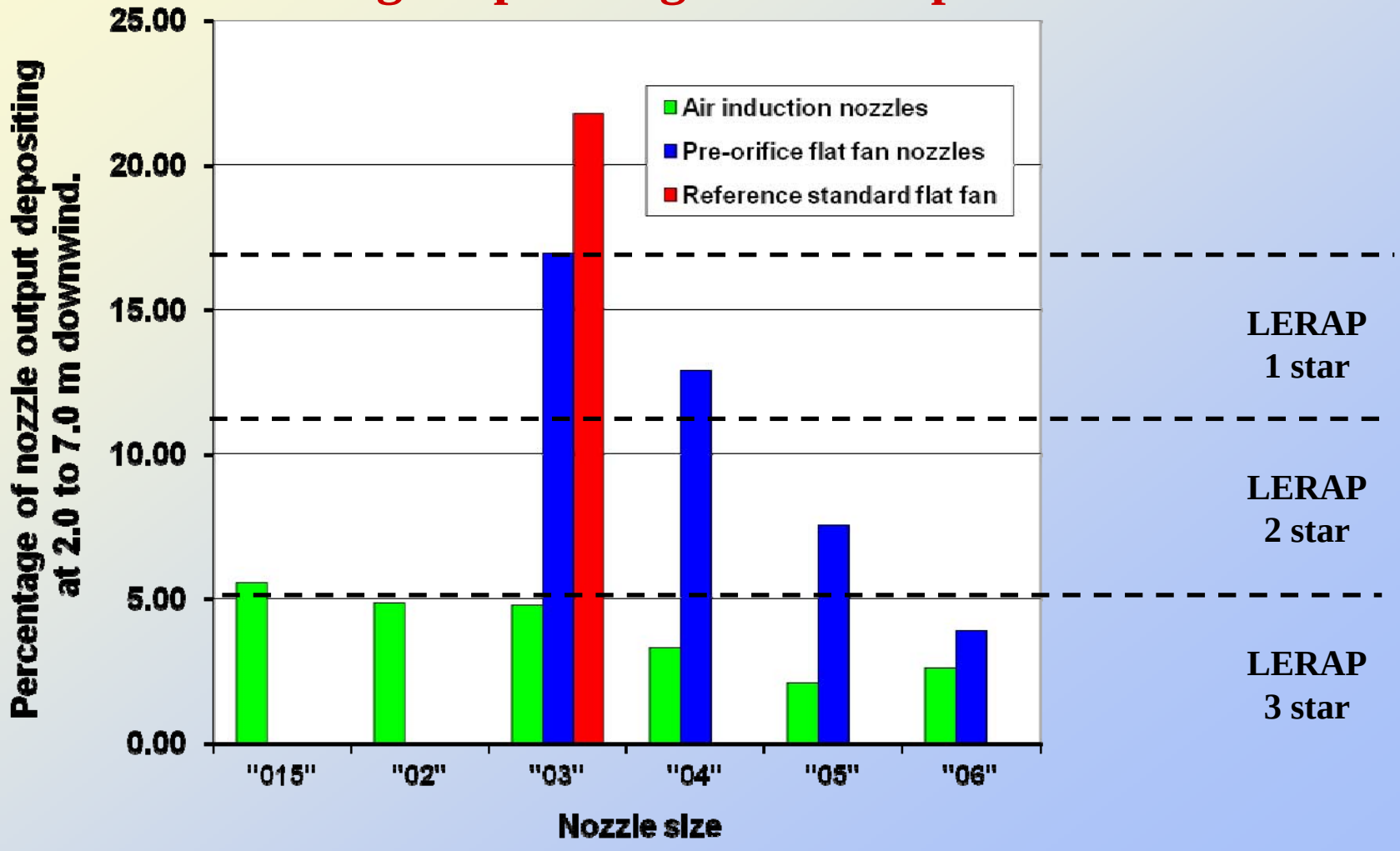
The effect of nozzle type on the risk of drift

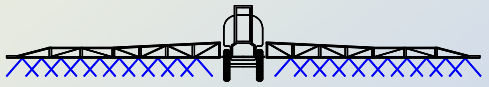


Horizontal airborne spray profiles for different designs of flat fan pressure nozzle

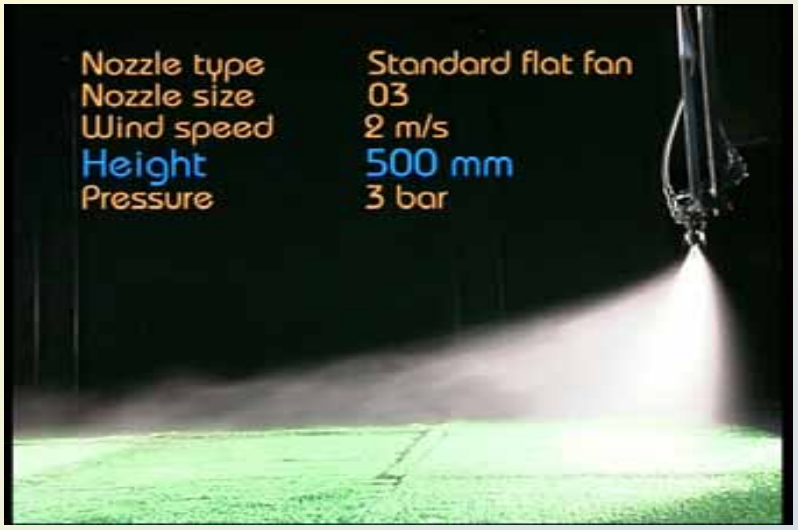


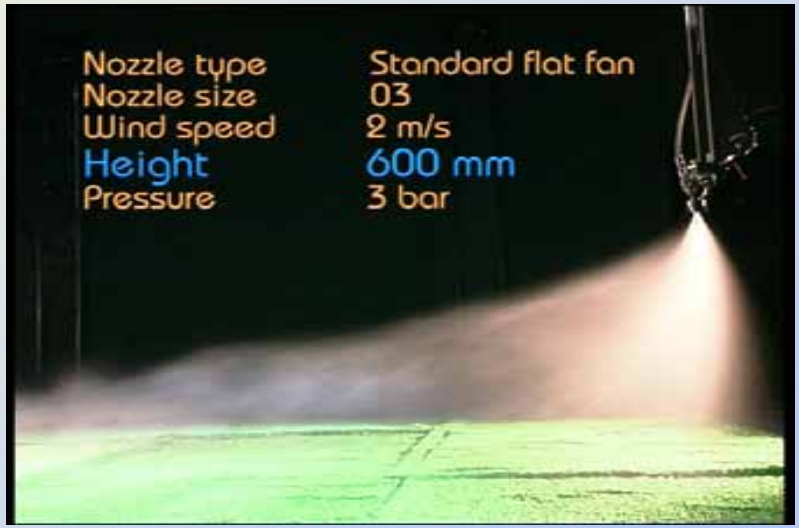
Drift sedimentation at between 2.0 and 7.0 m downwind of a single nozzle in wind tunnel tests with different designs operating at 3.0 bar pressure

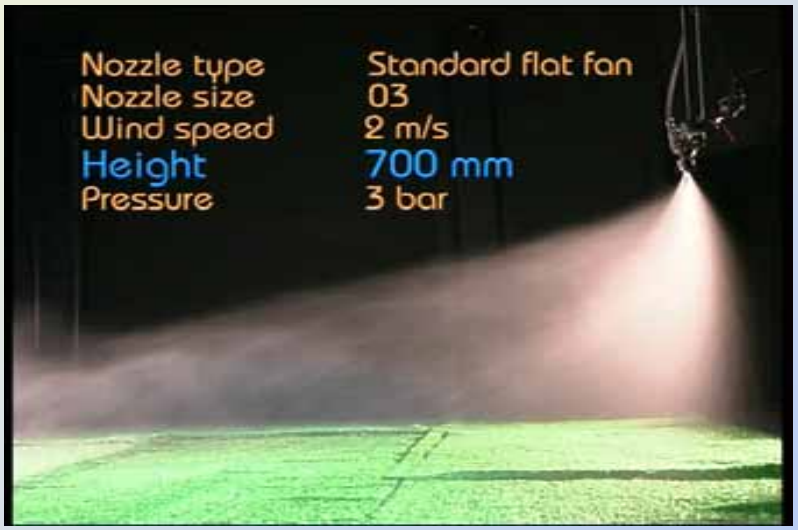


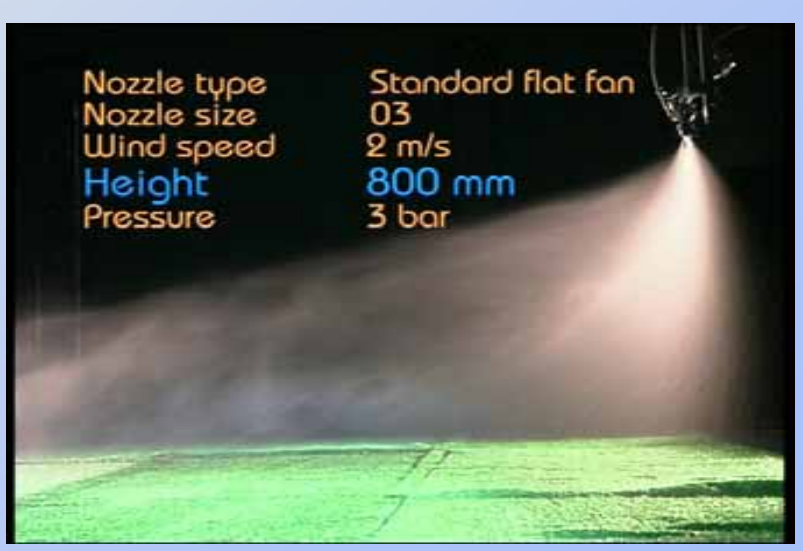


Increasing boom height increases drift

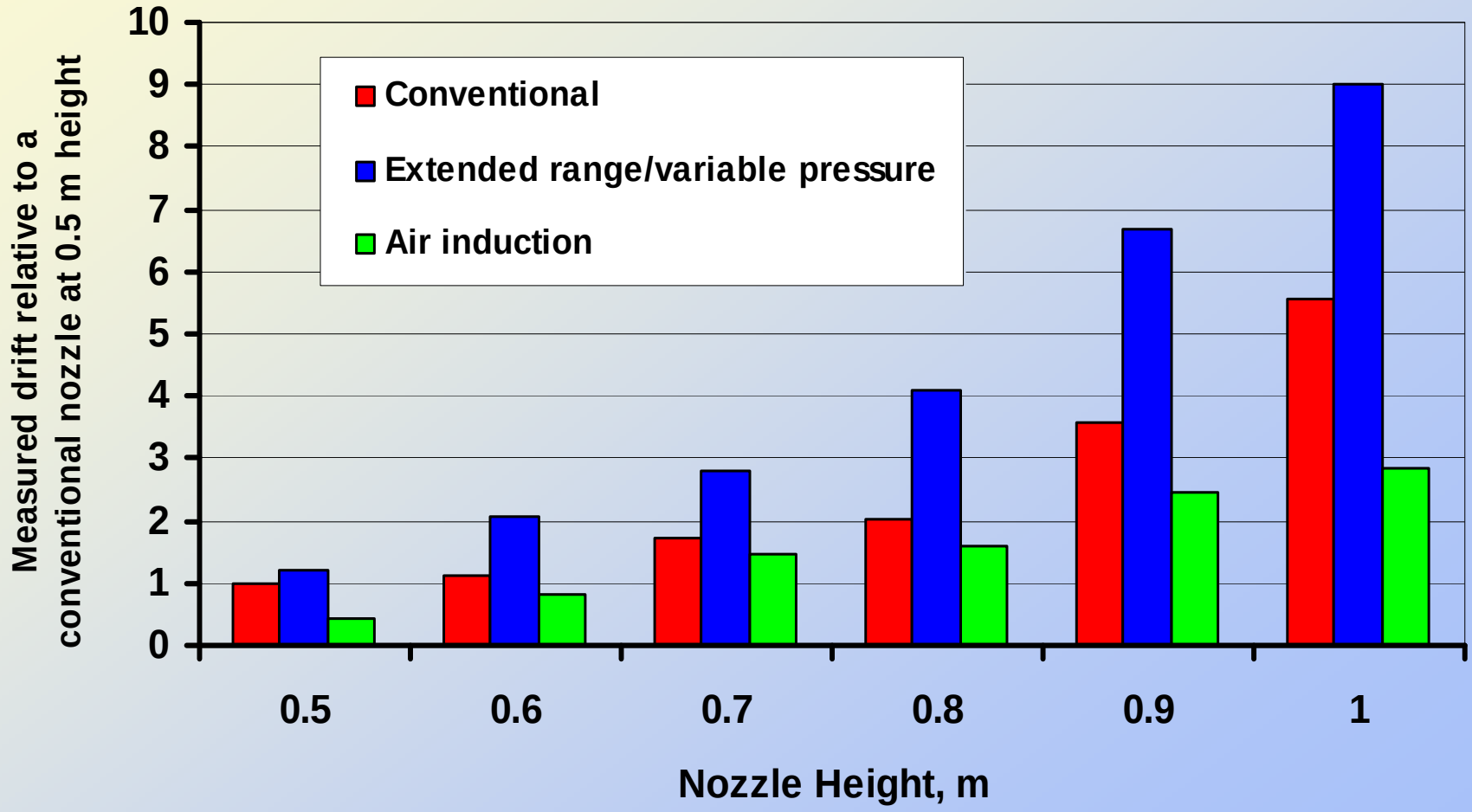




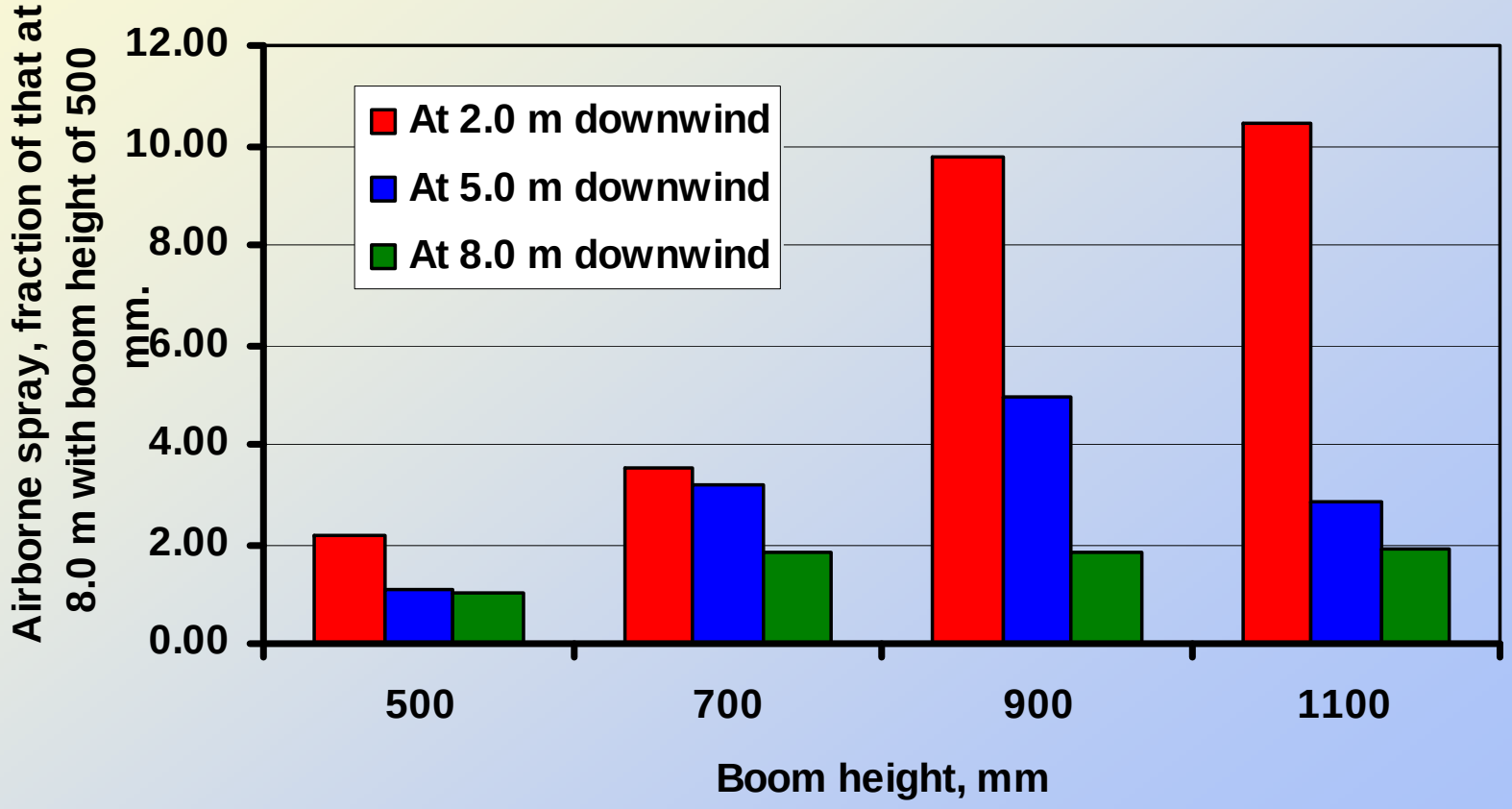


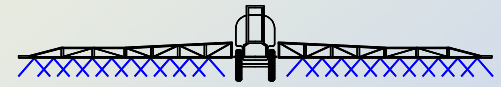


The effect of nozzle type and boom height on drift measured at 5.0 m in a wind tunnel



The effect of boom height with conventional nozzles measured in the field





Active and passive boom suspensions

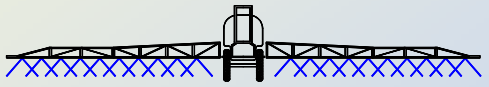
Height Sensor

Inclinometer

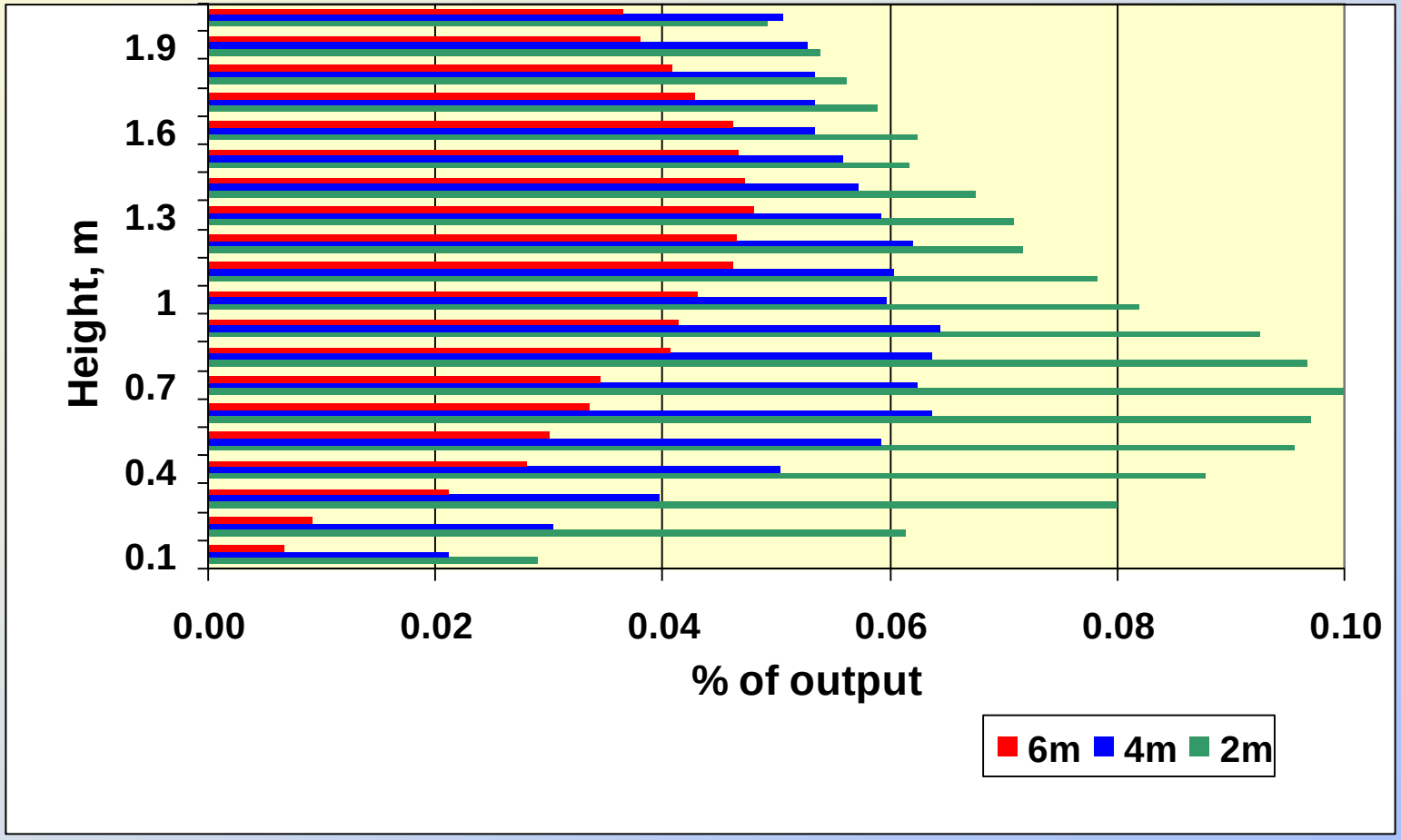
Knight

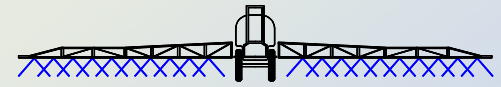
Active levelling helps keep boom height to a minimum

Field boundary and crop vegetation can influence drift risk

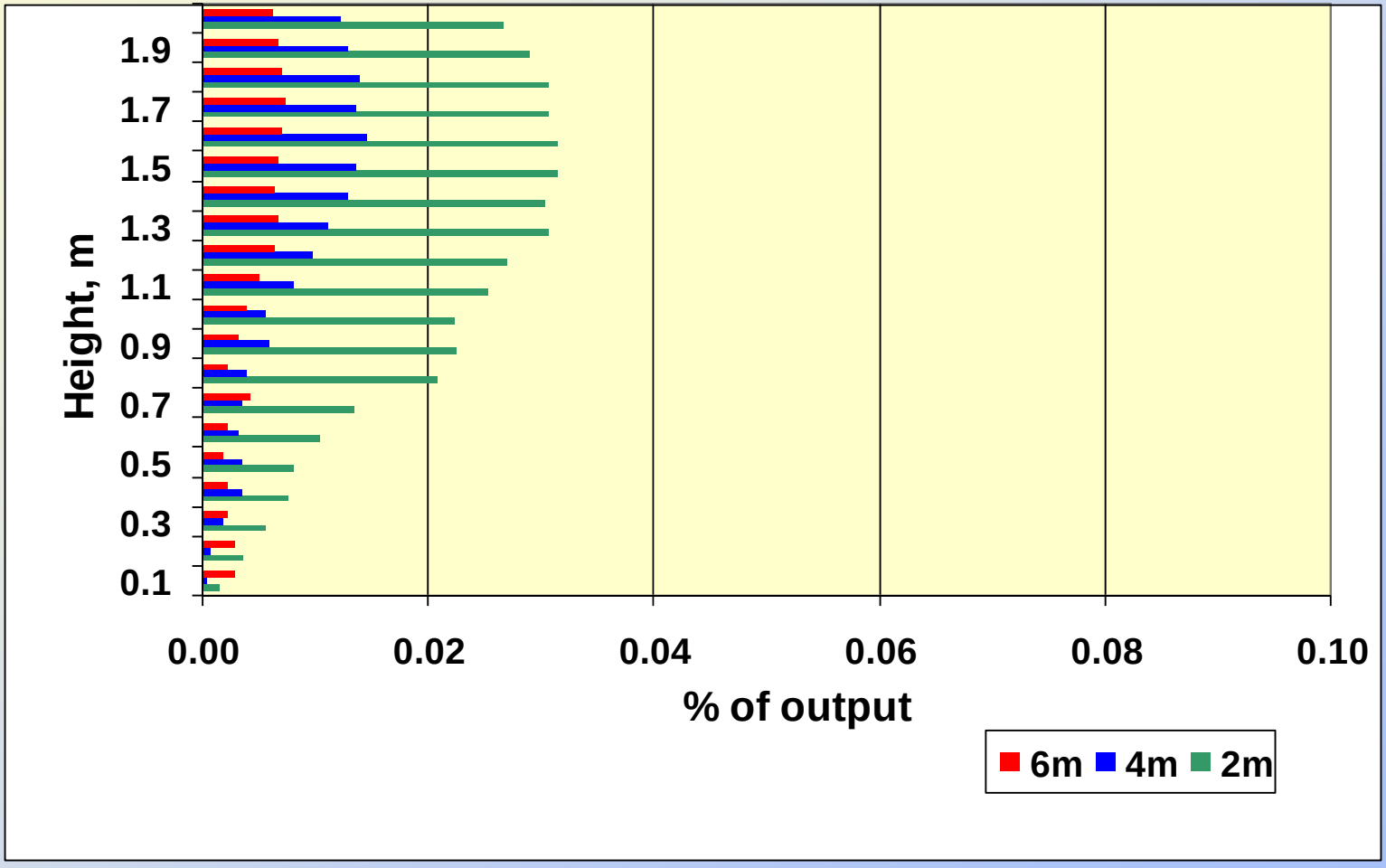


Airborne spray profile - cut management plot

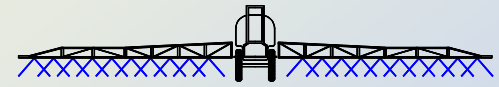




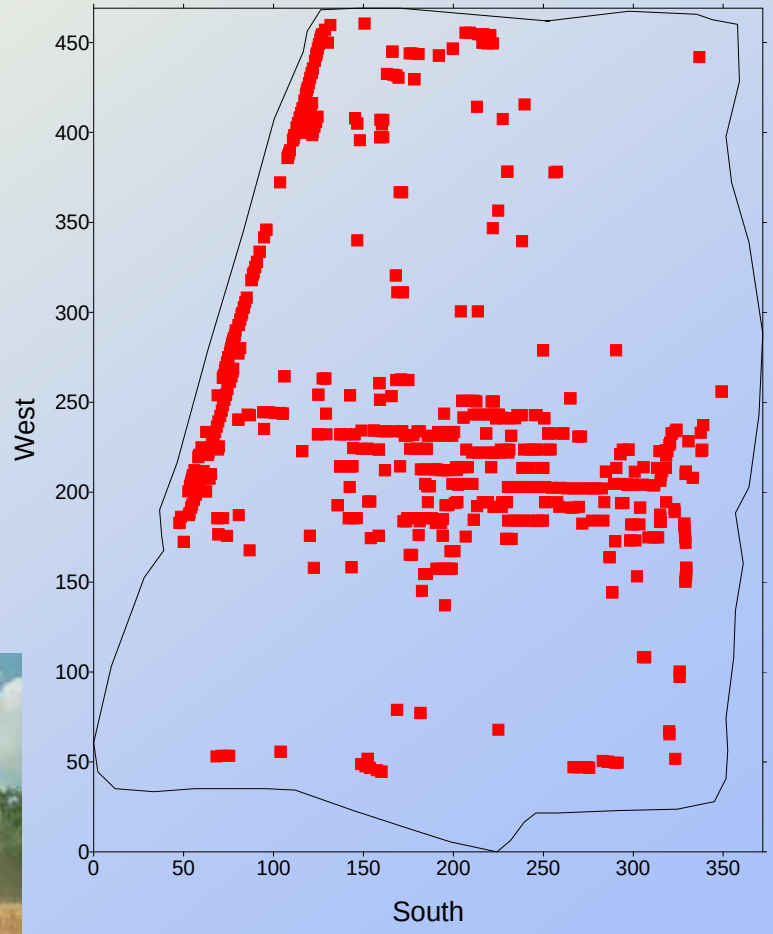
Airborne spray profiles - tall grass plot

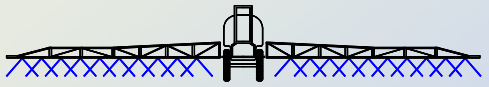



SPATIALLY VARIABLE
HERBICIDE APPLICATION



Visual mapping – weed patches

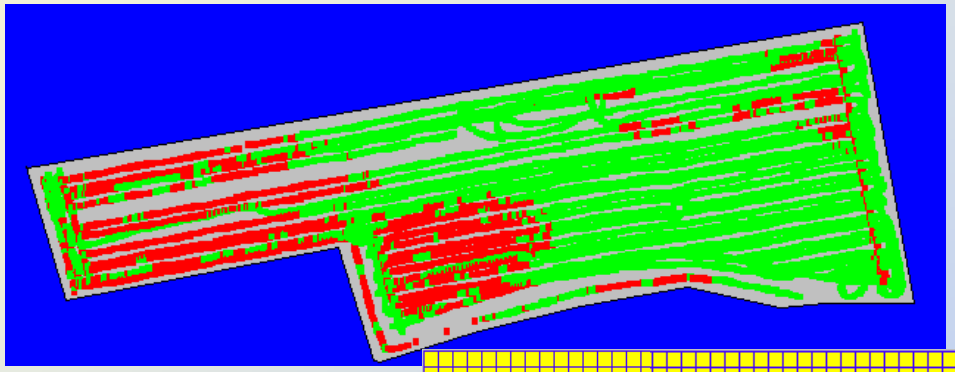


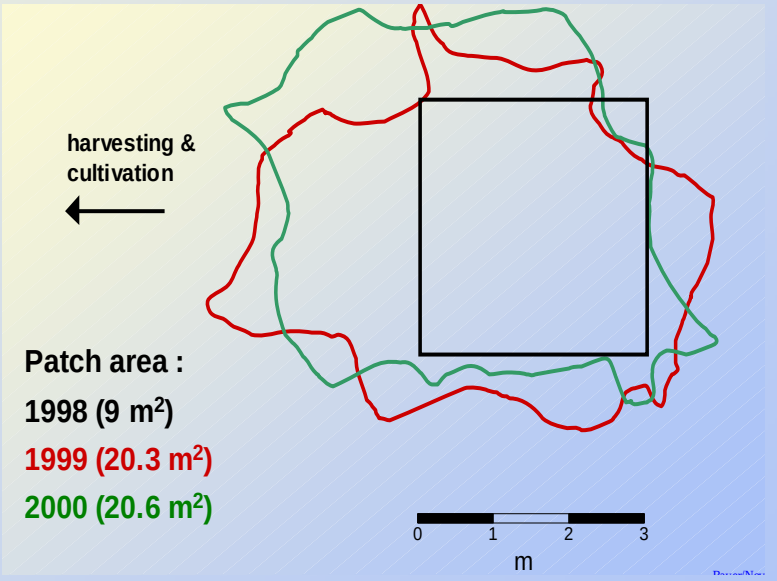


Interpretation and decision making

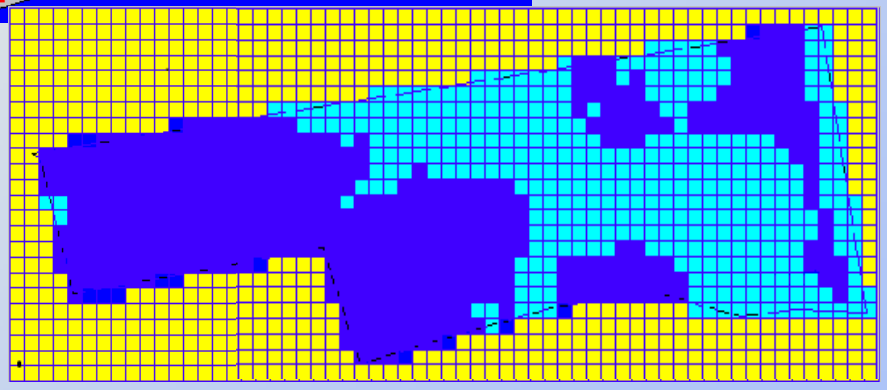
Accounting for factors such as weed seed movement and application accuracy

Initial weed map

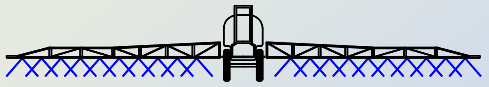




Treatment map for sprayer controller



With an interface to decision support systems

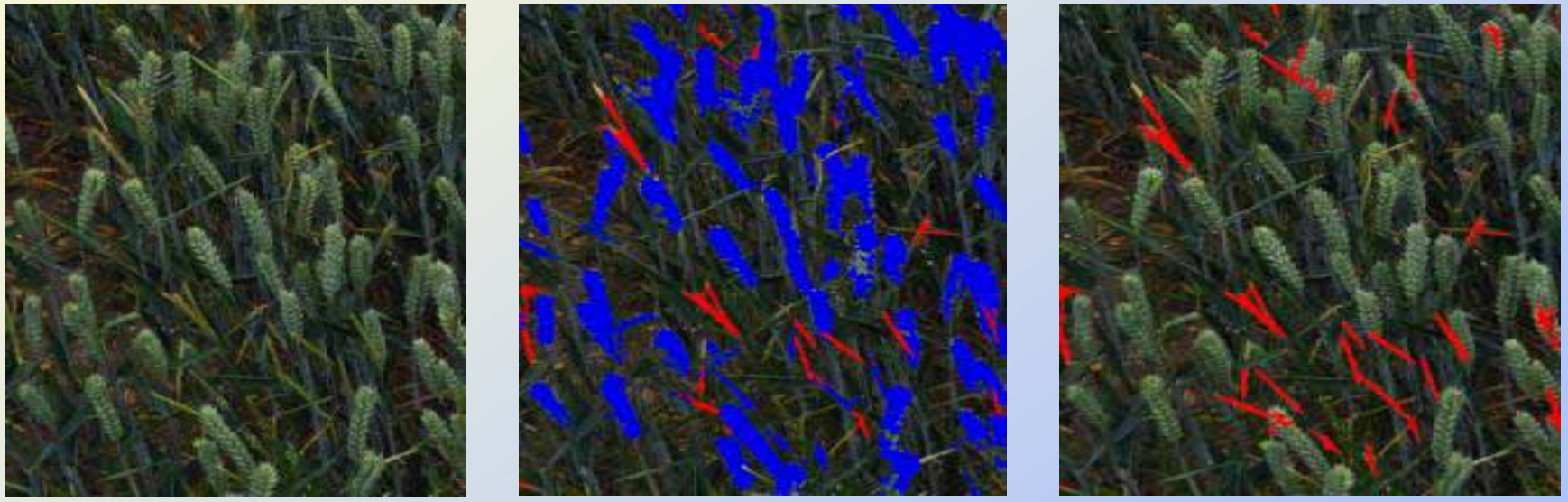


Herbicide - patch spraying

- **Weed patch detection is crucial**
  - à ***Manual mapping is costly, time consuming and can lack accuracy***
  - à ***BUT – in the future – sensors will detect and predict weed distributions automatically***
- **KEY future developments relate to sensor developments and interfaces with decision support tools particularly relating to:**
  - à ***Weed detection***
  - à ***Disease prediction***
  - à ***Crop development***

Weed identification by image analysis and pattern recognition

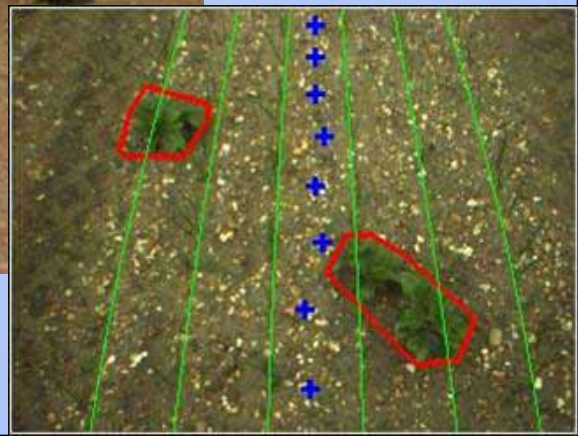
- **e.g. Black-grass in a wheat crop**



For detection (of control failure) in one season for treatment in a subsequent season

[From Murdoch, de la Warr et al., 2011]

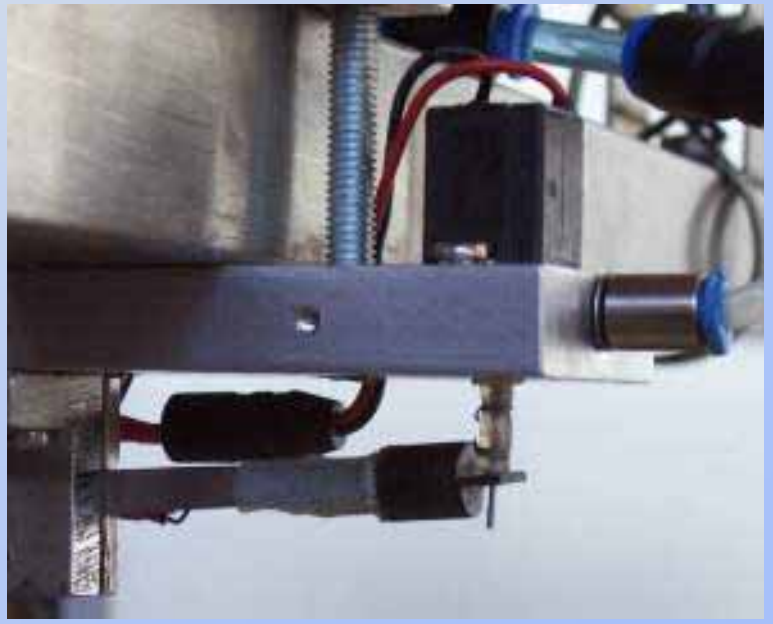
Detection of individual weeds by image analysis



- **Particularly for specific applications – e.g. Volunteer potatoes in vegetable crops**

Nozzle options used experimentally

- **A new nozzle design from Hypro EU Ltd (The "Alternator" nozzle) – oscillating liquid stream generated from within a nozzle body**
- **An oscillating needle nozzle**
- **"Latching solenoid mounted close to nozzle**
  - à ***Minimum dead volume***
  - à ***Low power consumption***

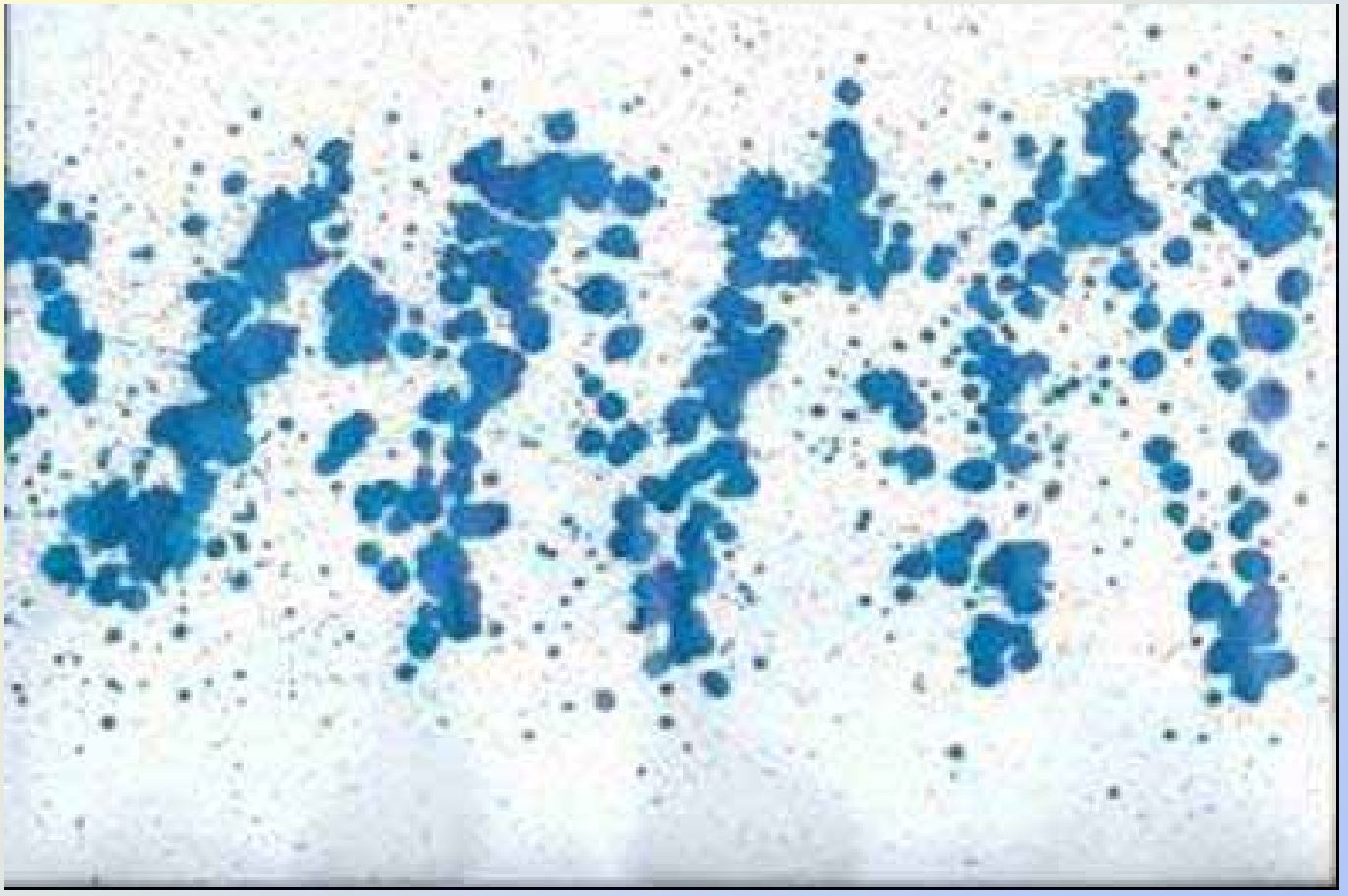


Oscillating liquid stream from both nozzle designs

Output from the "Alternator" nozzle

Output from the oscillating needle nozzle

Visualisation of spray patterns



Pressure = 0.5 bar

Height = 0.5 m

Speed = 2.10 m/s

Pattern from a version of the “Alternator” nozzle

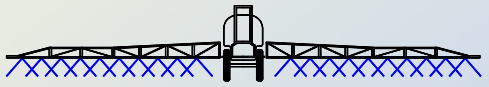
Targeted application by machine vision

Before

After

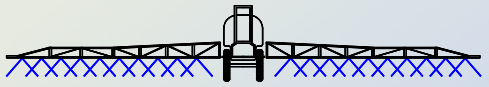
Targeted application by machine vision

In a crop of onions – a small plant with large weeds

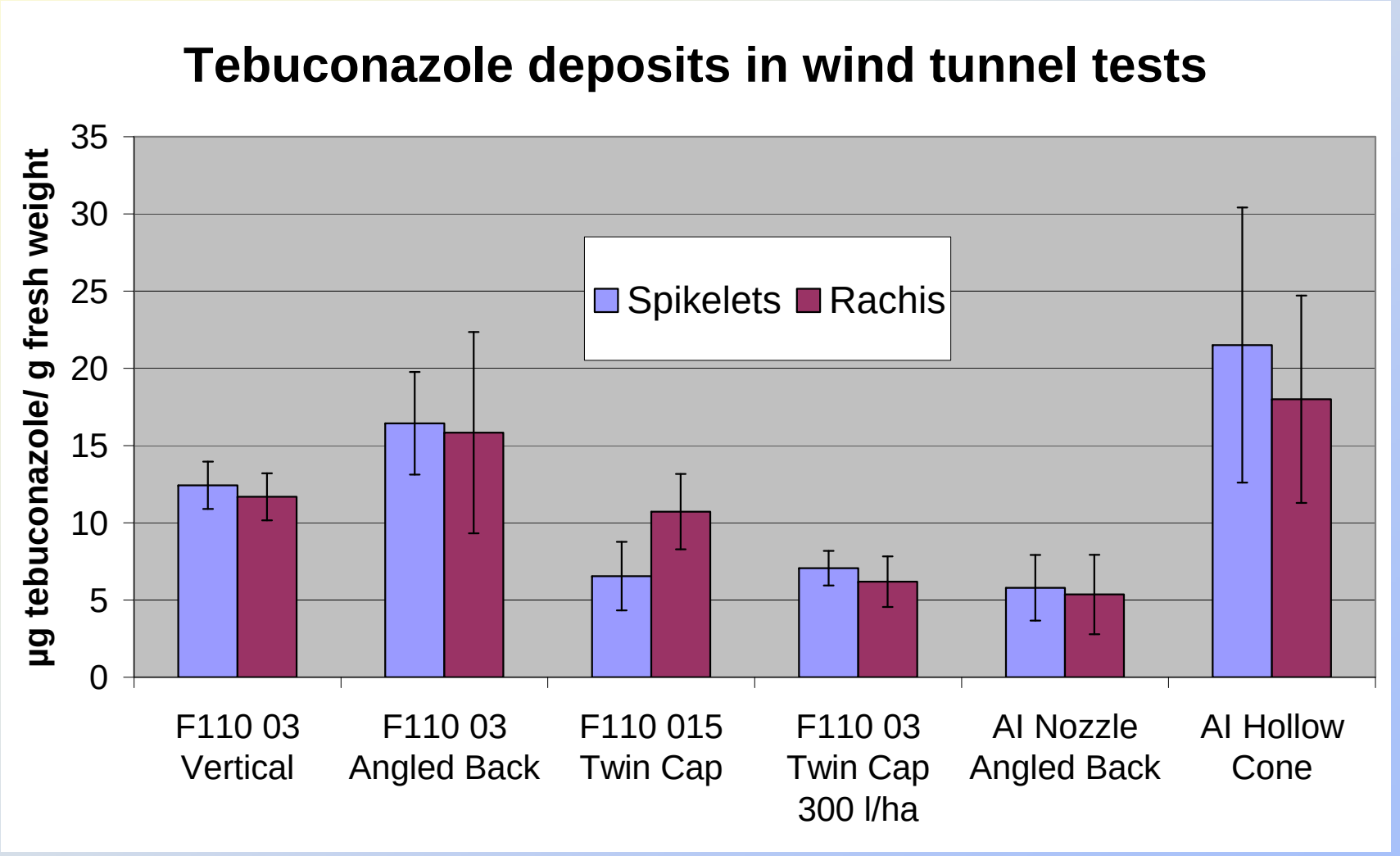


Deposits within crop canopies

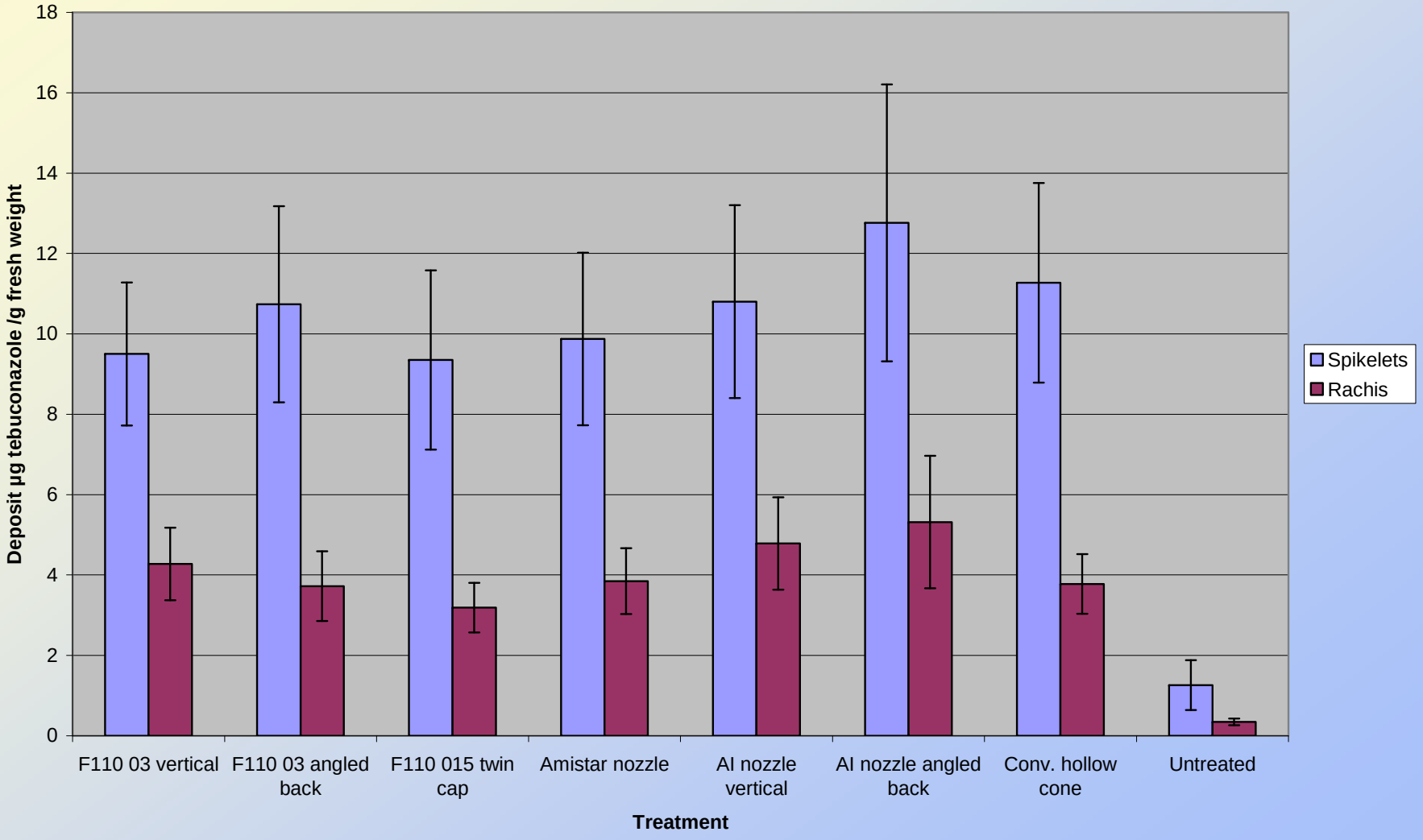
- **Most applications aim to maximise deposition on crop canopy or target weeds**
- **Manipulate deposition to give:**
  - à ***Increased deposits on crop ears (for ear disease control)***
  - à ***Penetration into the crop canopy (stem base diseases)***



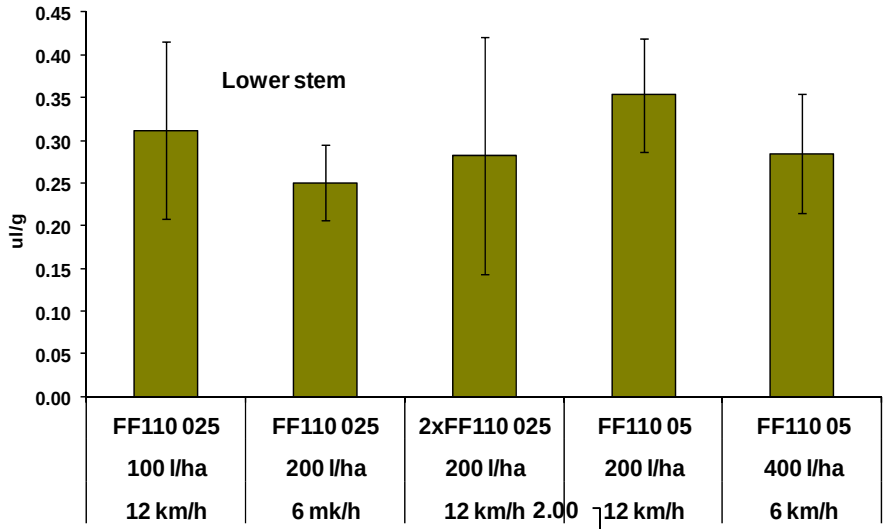
Spray deposits on wheat ears

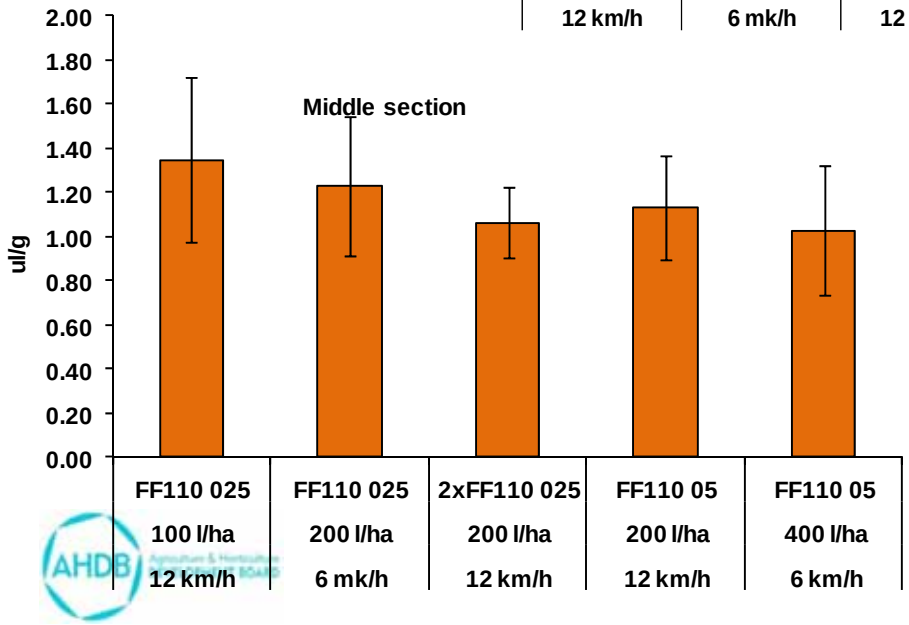


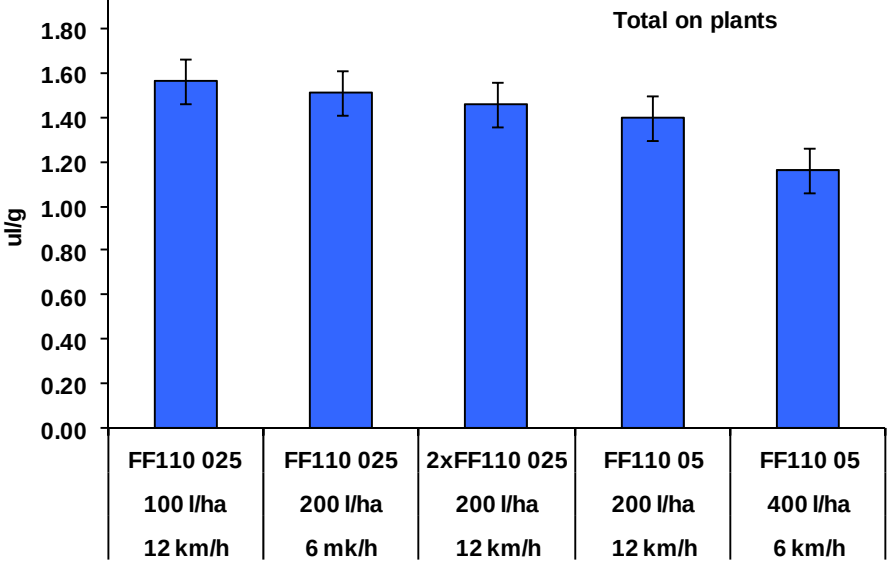
Tebuconazole deposits on wheat ears in field trial



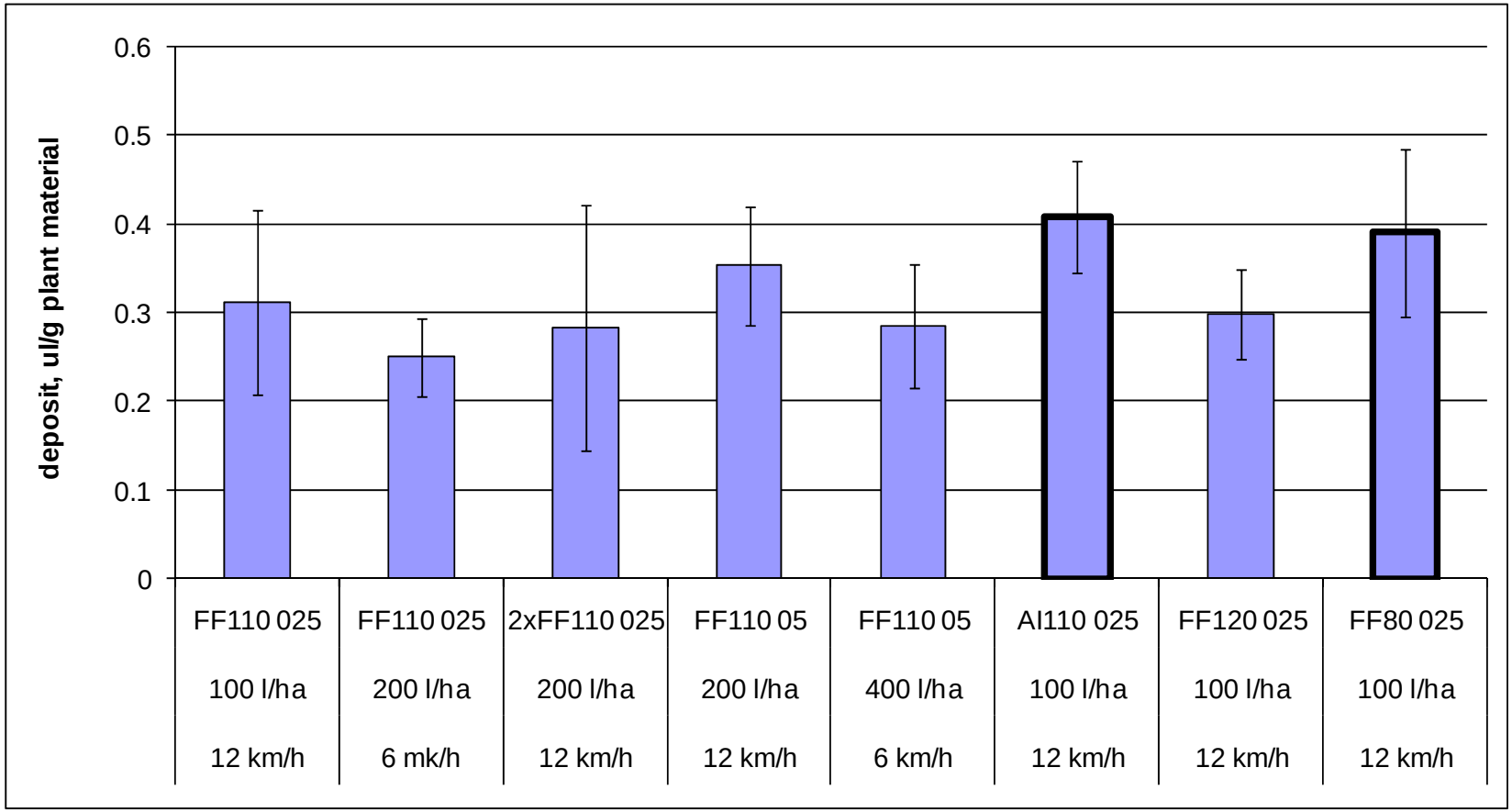
Effect of volume on distribution in canopy

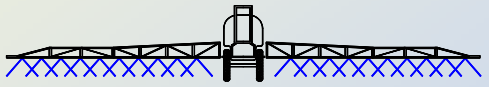






Deposit on lower stem (< 80 mm)





Conclusions

- **Improved application of pesticides can help protect insect species by:**
  - *Reducing drift into field boundaries*
    - **With air-induction nozzles**
    - **Good control of boom height**
  - *Improved targeting of sprays and reduced use*
    - **Patch application**
    - **Spot application**
  - *Manipulating deposits within the canopy to target weed/pest/disease and minimise effects on non-target species*
    - **With limitations**

Thanks to:

- **my colleagues at Silsoe Spray Applications Unit for help in preparing this presentation**
- **the conference organisers for the invitation to be here and their help**
- **You for listening**