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# Temporal and spatial distribution of Sclerotinia ascospores in canola

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# Outline

- Sclerotinia stem rot
- Carpogenic germination
- Aerobiology (temporal and spatial)
- Infection efficiency
- Summary

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# Sclerotinia stem rot of canola


***Sclerotinia sclerotiorum***

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# Sclerotinia stem rot of canola

- Patchy distribution of early-drying plants in the field
- Affected stem tissues appear bleached

# Carpogenic germination

- Sclerotia survives in soils > 3 years
- Biological activity and other factors affect survival
- Stipes grow < 4 cm

Effect of temperature on CG

| Temperature (°C) | Apothecia | |
|---|---|---|
| | Total | Days to first |
| 20 (constant) | 64 | 34 |
| 18 – 22 | 79 | 28 |
| 16 – 24 | 210 | 24 |
| 14 – 26 | 61 | 43 |
| 12 – 28 | 55 | 40 |

Source: Mila and Yang, 2008

# Carpogenic germination

## Soil water holding capacity

- Silty clay soils hold up to 2.5 times the amount of water than a sandy soil can

## Soil texture

- CG can occur in soil textures ranging from silty clay to sandy but is greater in sandy loam soils

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# Carpogenic germination

## Soil moisture

- Soil moisture is driving force for CG
- Greatest CG at constant 25% moisture saturation

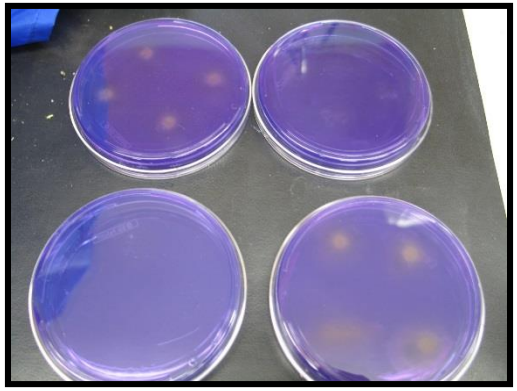
- Fluctuating soil moisture reduces and delays CG but does not prevent it
- Drying soils to 0% saturation resets biological clock
- Large soil moisture fluctuations are more detrimental than short ones

- Once CG is underway, 80% of apothecia will be formed within 3 weeks if moisture is kept constant and within 5-6 weeks if moisture fluctuates

# Aerobiology

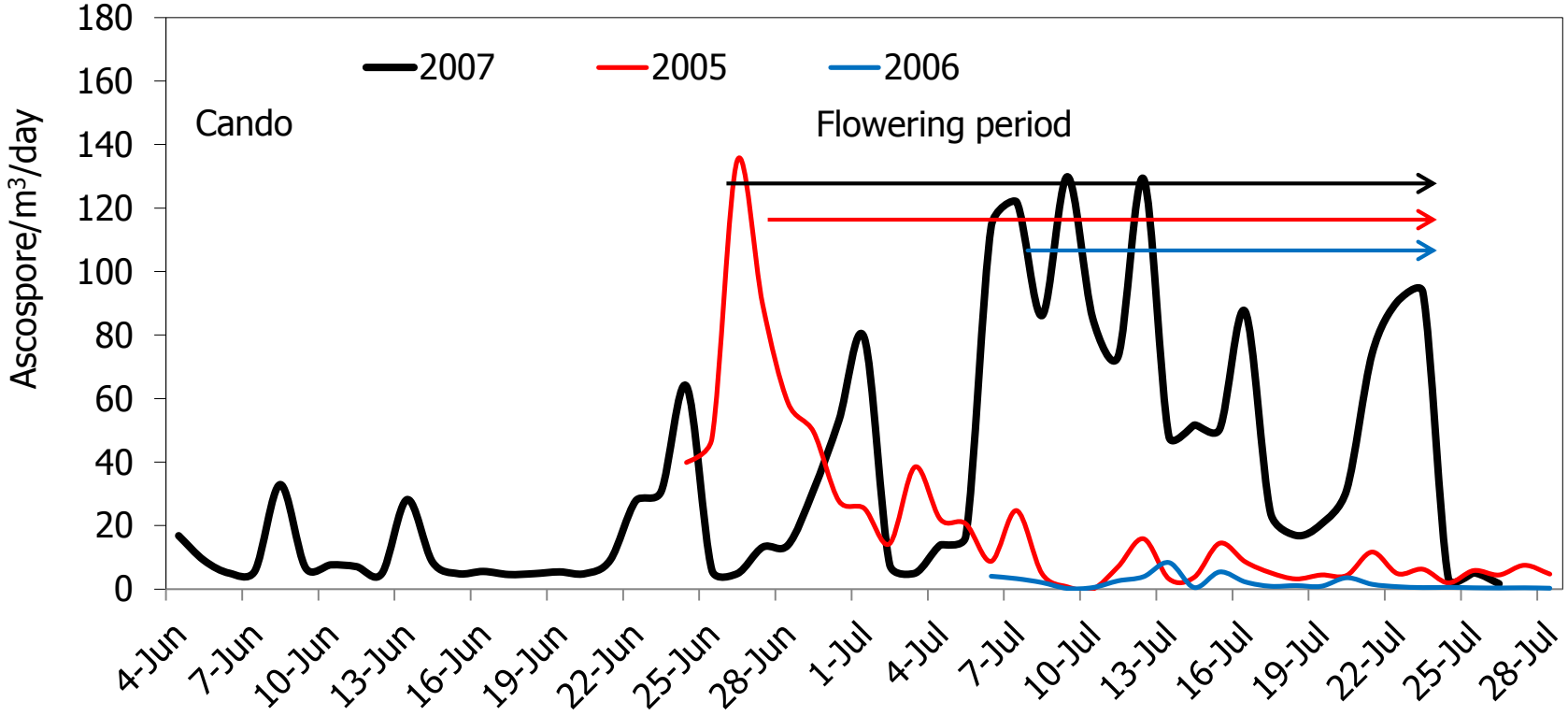
- Two locations, 3 years
- Three reps

- Hourly weather variables
- Blue medium under canopy



# Aerobiology

## Spore dispersal in time

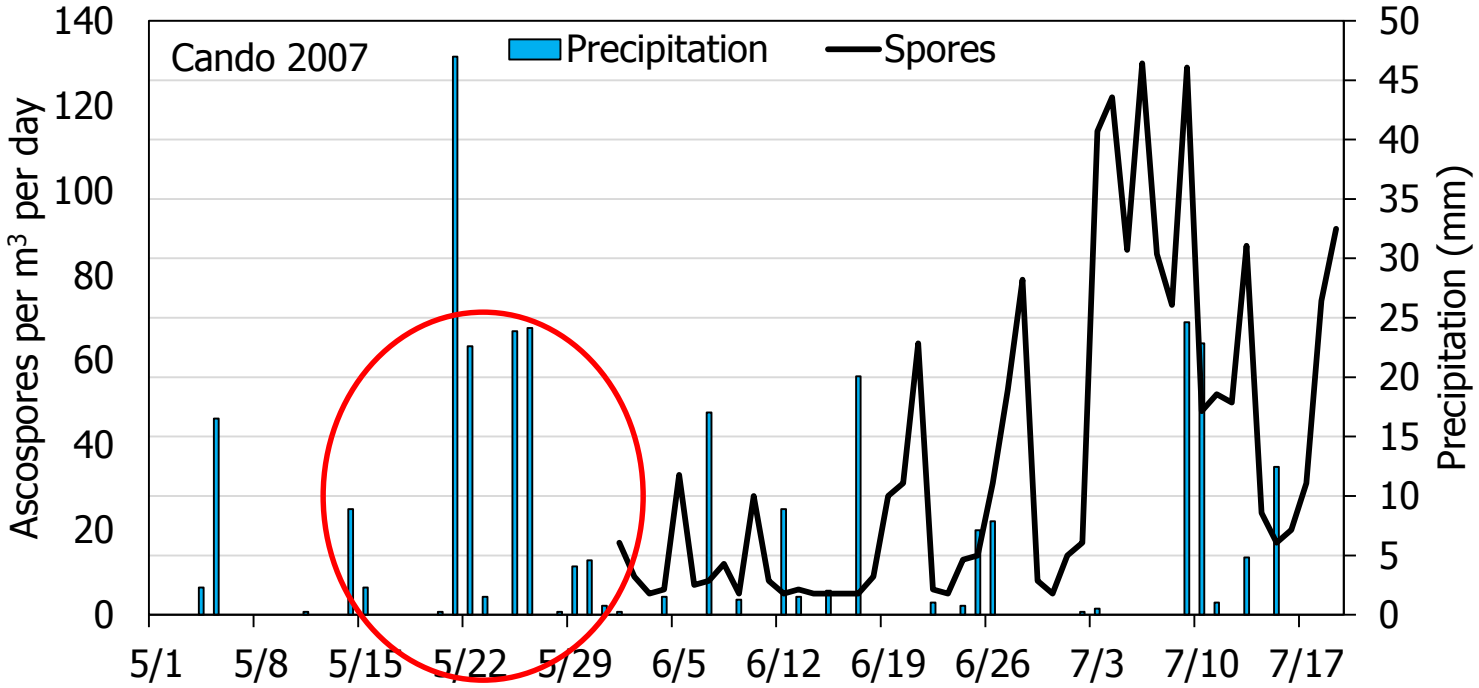



- Multiple ascospore showers with variable intensity
- Not necessarily associated with flowering

Source: Qandah and del Rio, 2011

# Aerobiology

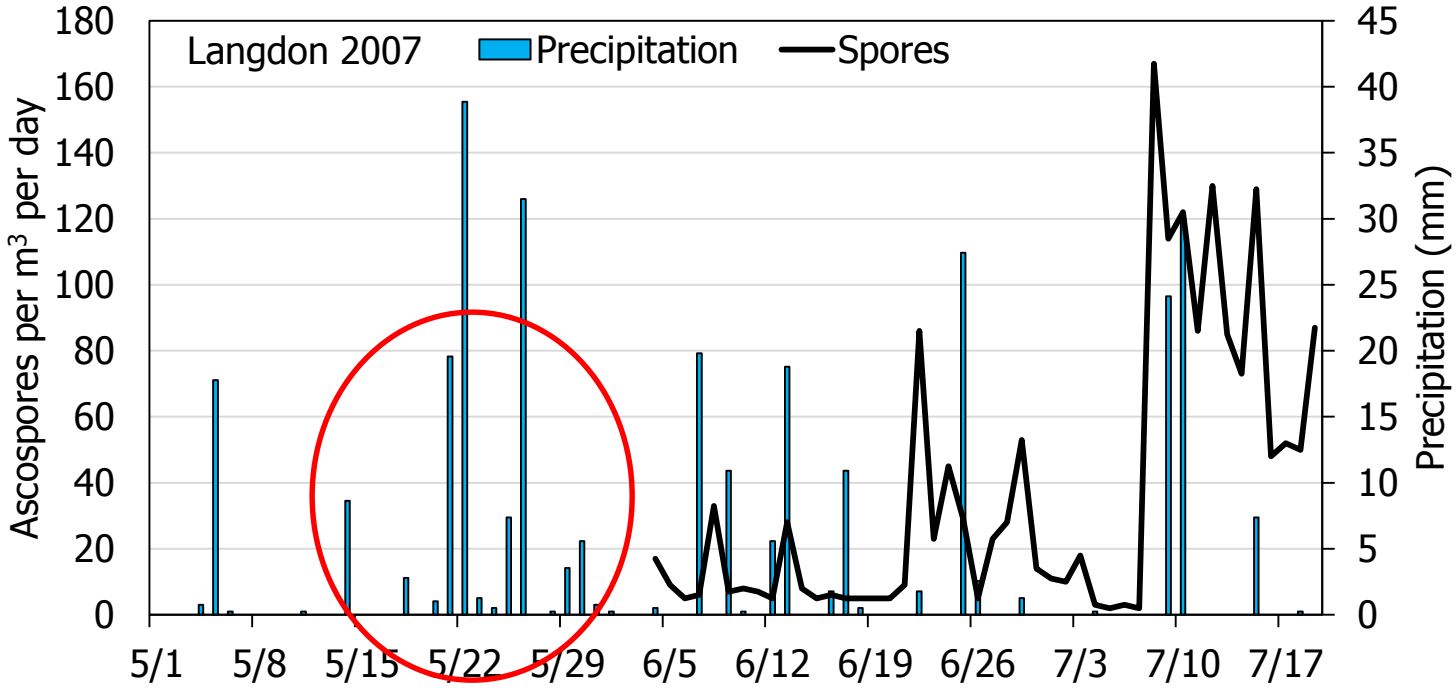
## Precipitation and CG




- CG may be influenced by earlier precipitation

# Aerobiology

## Precipitation and CG



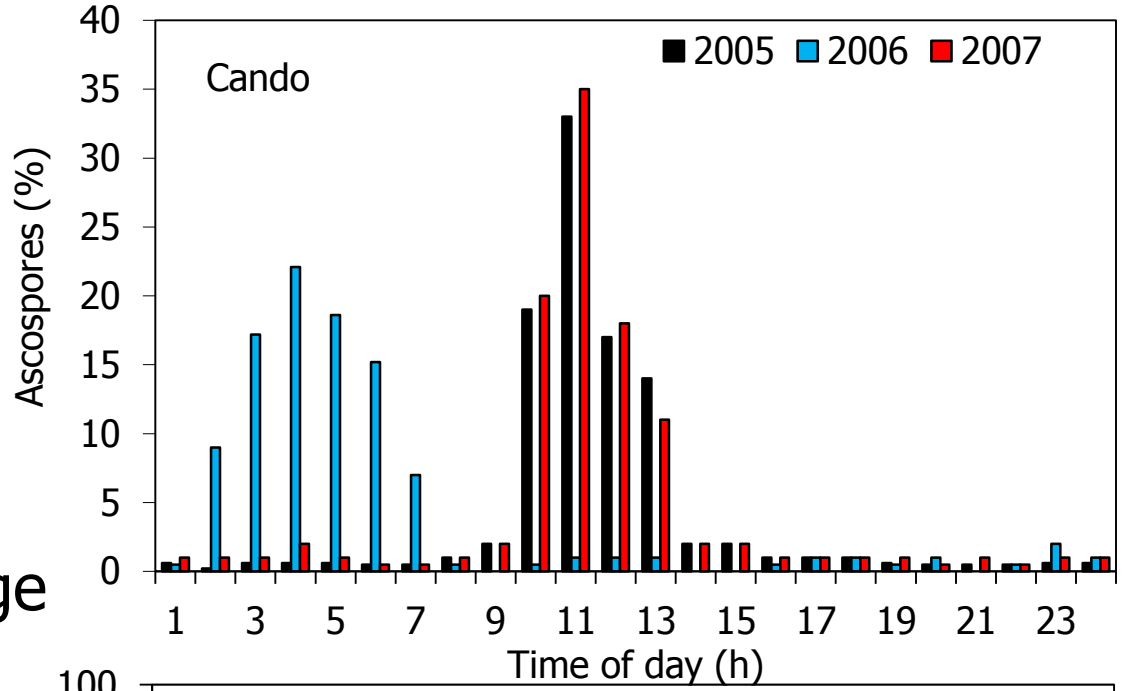

- Precipitation 3 weeks earlier associated with CG

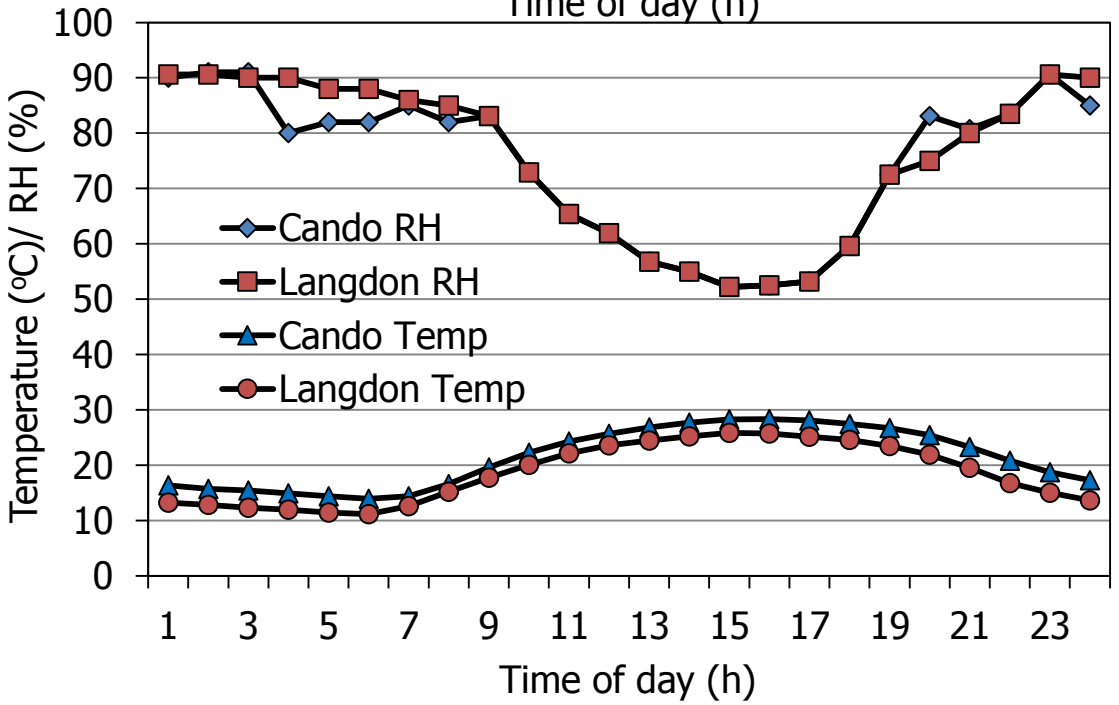
# Aerobiology

## Daily dynamics of spore release:

- Spores counted hourly
- Converted to percentage
- Weather variables under the canopy

- Ascospore release coincides with drop in RH and rise of T °




Source: Qandah and del Rio, 2011

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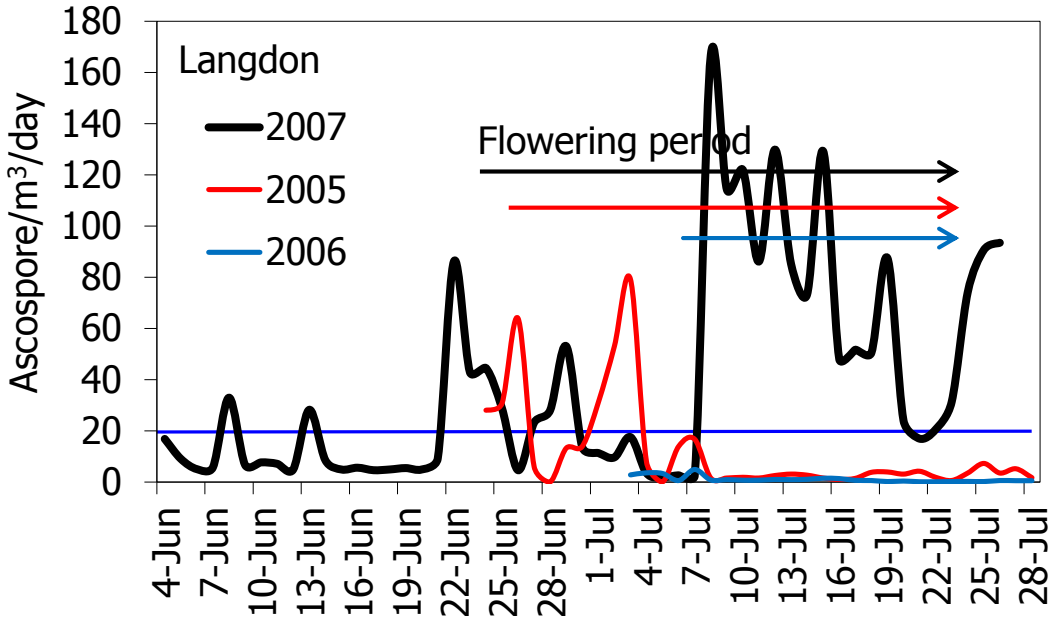
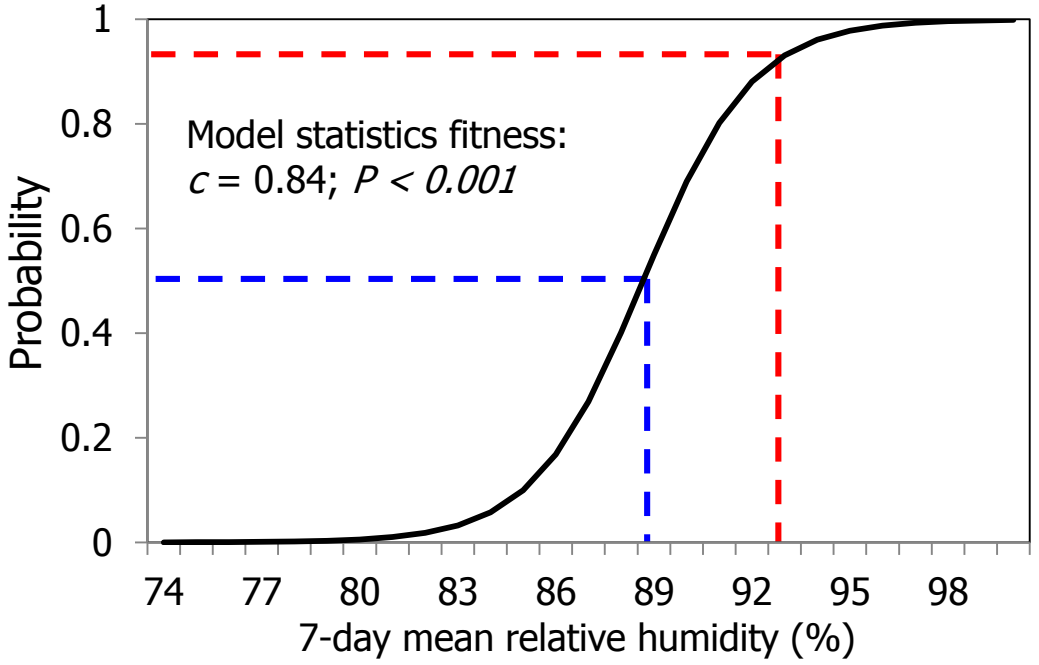
# Aerobiology

## Modeling ascospore release

- Spore peaks: >20 ascospores/m$^3$/day
- Correlating peaks to 7-day mean weather variables
- Logistic regression

- RH under canopy provided best model



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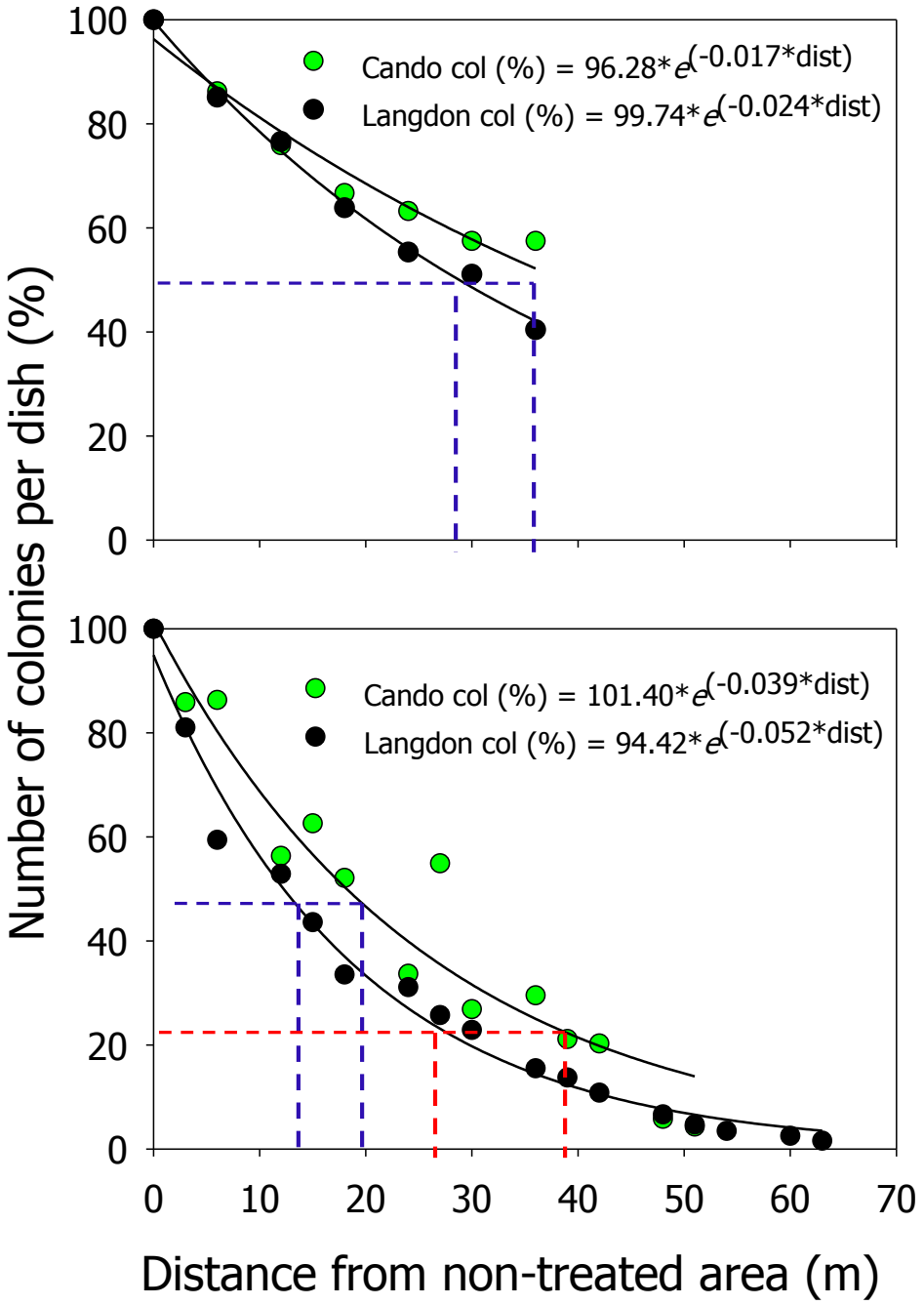
# Aerobiology

## Spore dispersal in space:

- Replicated trials at two locations
- Areas treated with Contans at 4 kg/ha and divided into quadrats
- Dishes with blue medium placed in quadrats

- Dispersal gradient followed negative exponential model




Source: Qandah and del Rio, 2012

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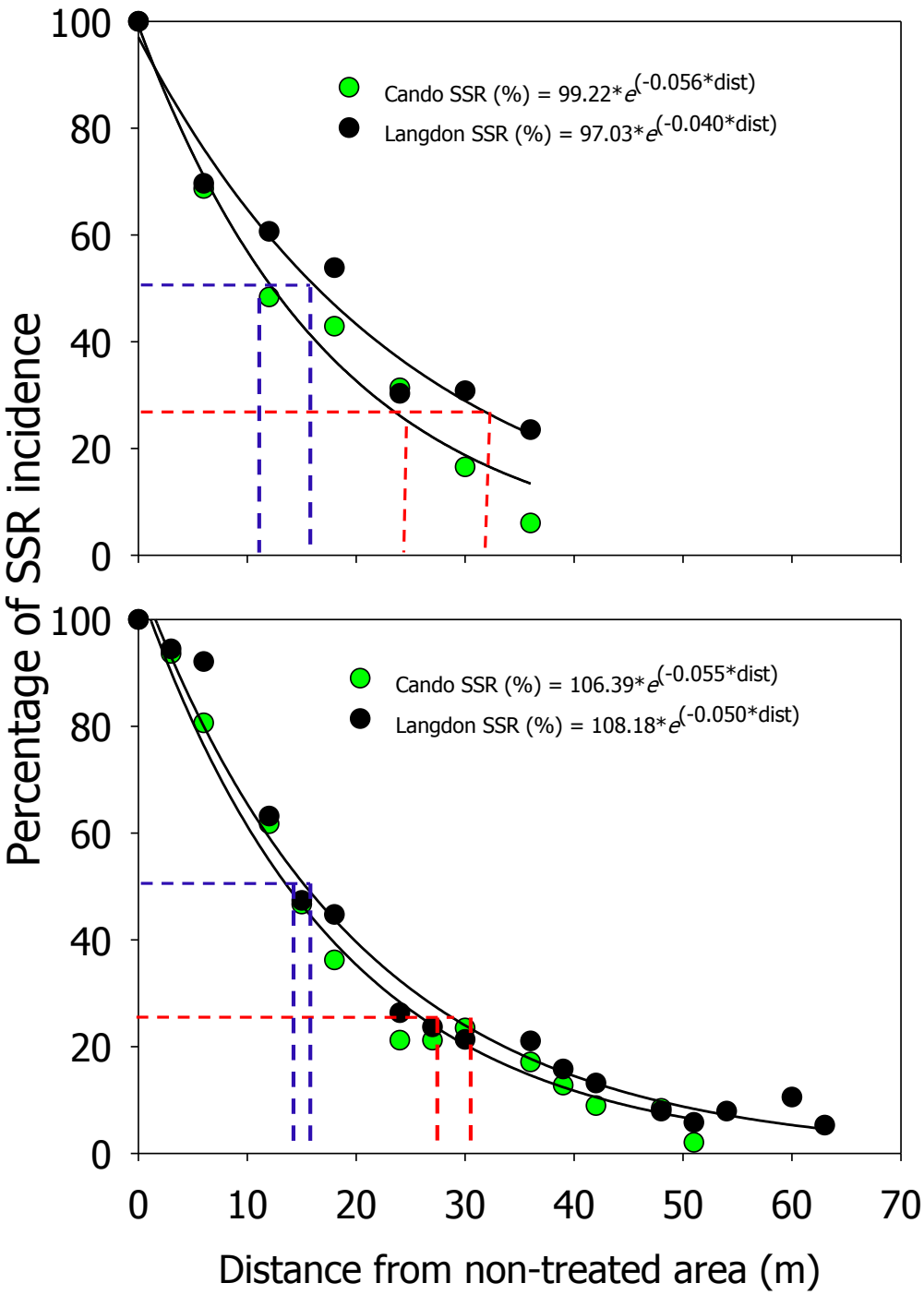
# Aerobiology

## Disease gradients:

- SSR monitored in same quadrats
- SSR gradients followed a negative exponential model
- SSR decreased by 50% within 20 m from source
- and by 75% within 35 m from source




Source: Qandah and del Rio, 2012

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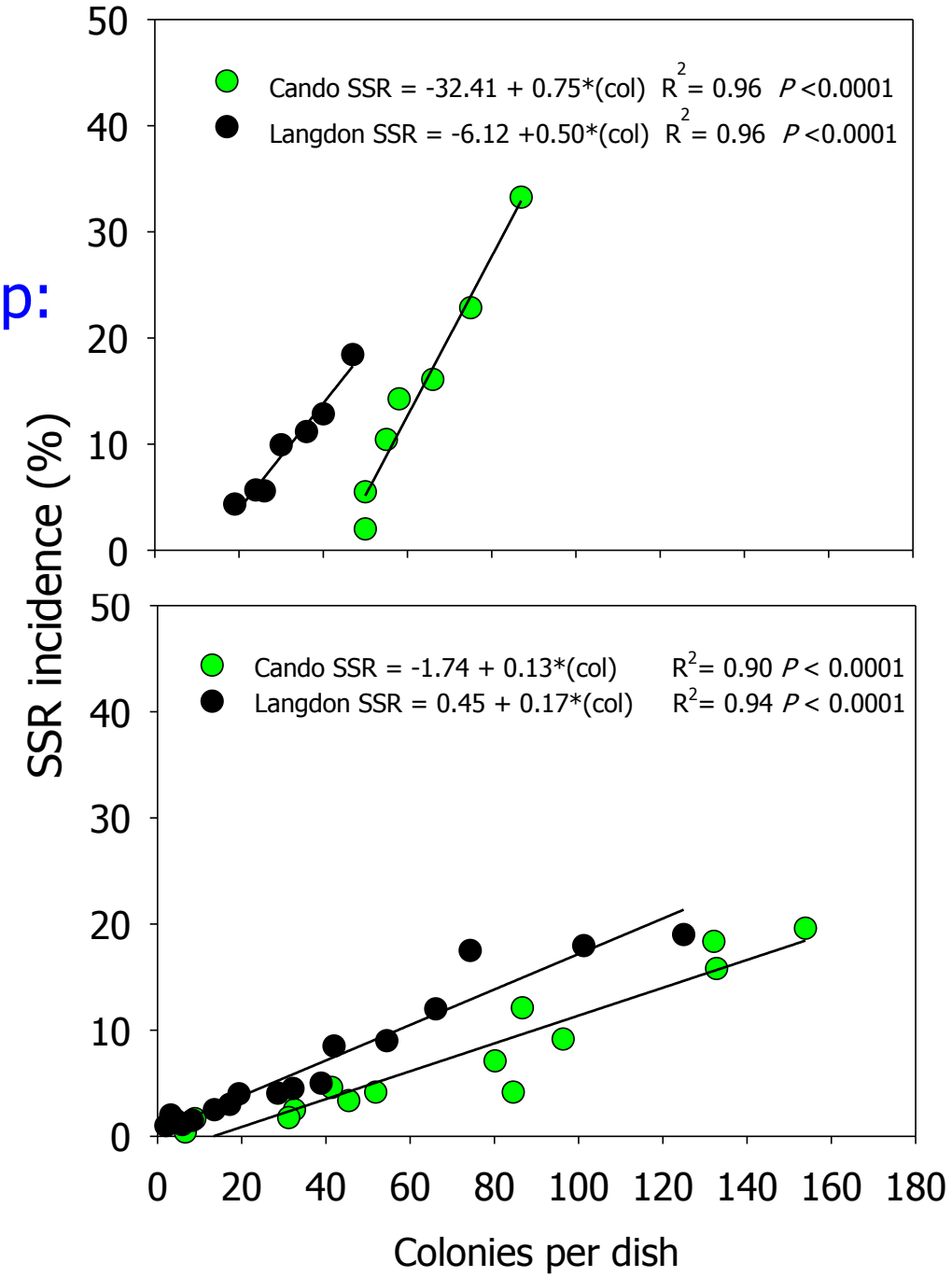
# Aerobiology

## Disease-inoculum relationship:

- Statistically significant association detected in all years and locations
- Within-field inoculum is more important than incoming inoculum




Source: Qandah and del Rio, 2012

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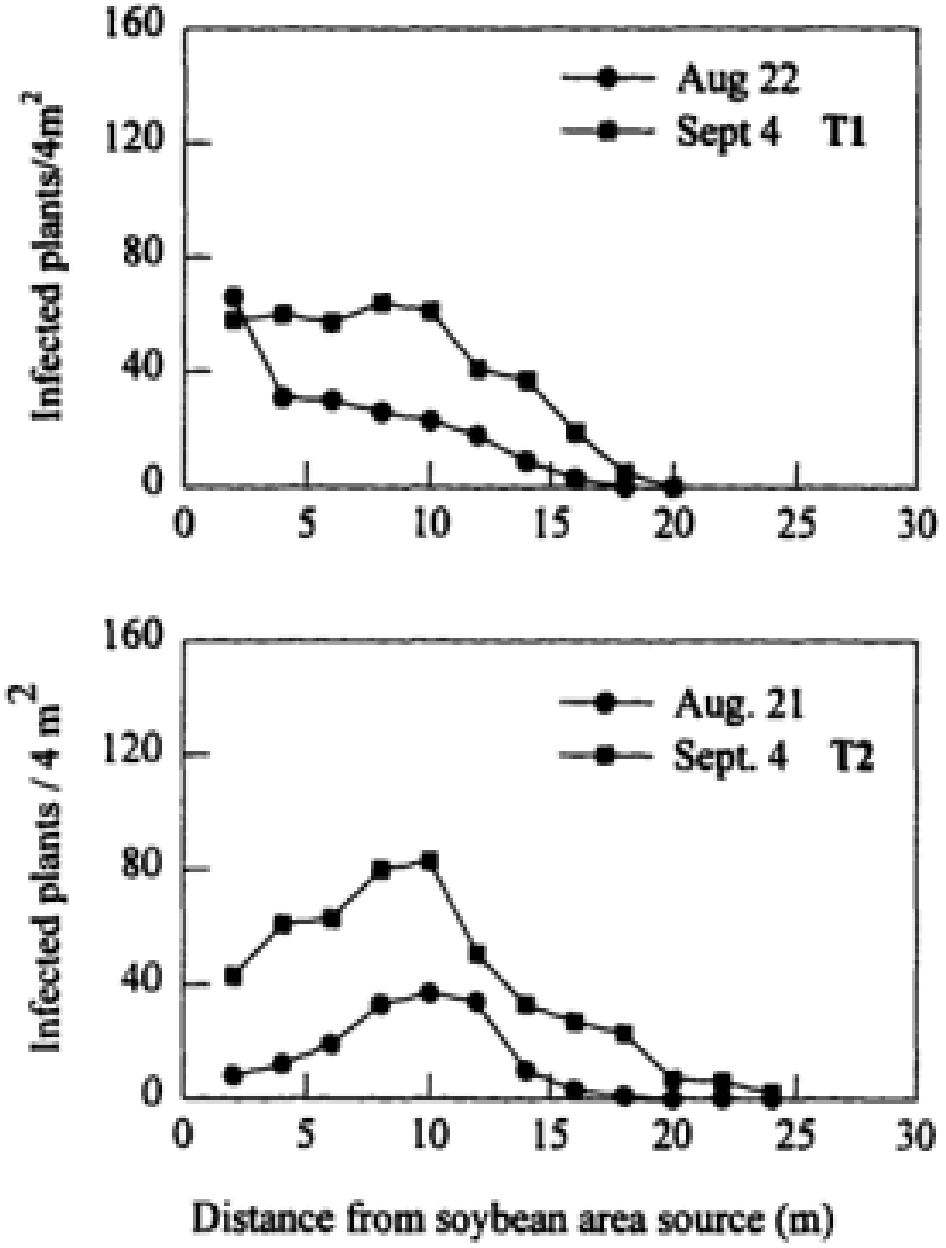
# Aerobiology

## Disease gradients in soybean fields:

- SSR monitored in narrow soybean fields
- sharp SSR decreased by 50% within 10 m from source
- and by 75% within 15-20 m from source

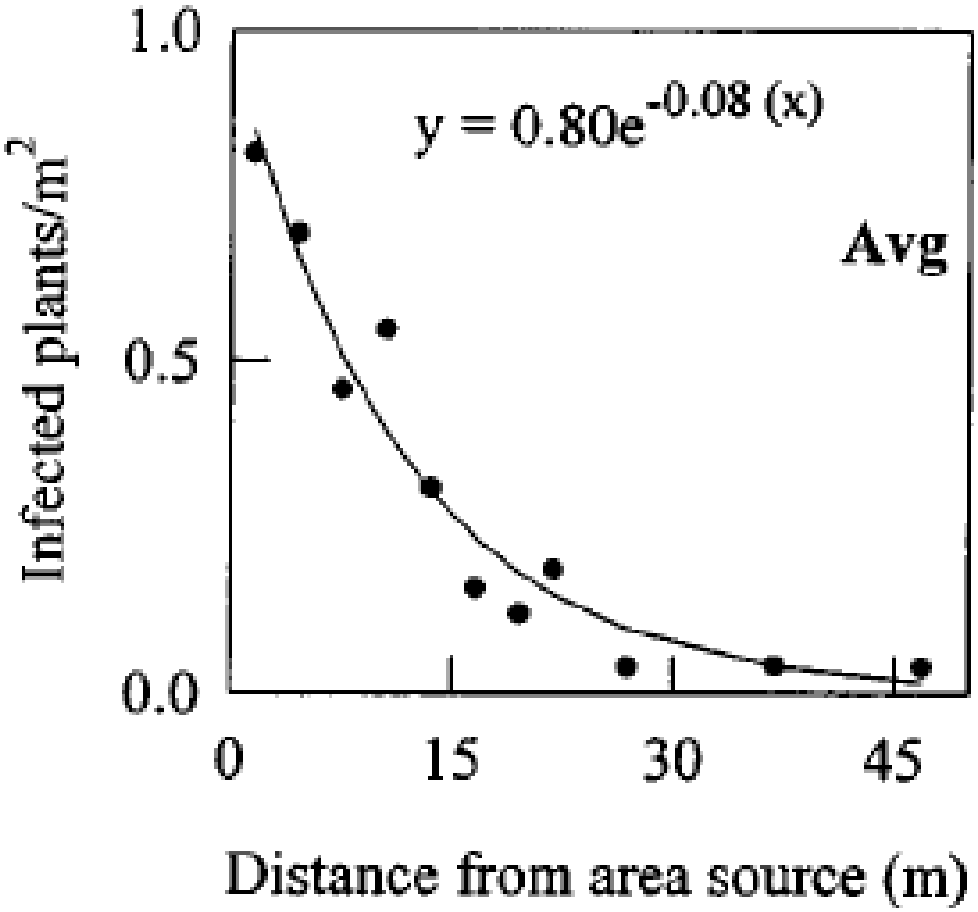



Source: Wegulo et., 2000

# Aerobiology

## Disease gradients in soybean field:

- SSR gradients followed a negative exponential model
- Inoculum produced within field is more important thar incoming inoculum




Source: Wegulo et., 2000

# Infection efficiency

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# Infection efficiency

## Temperature

- Optimum at 20$^{o}$C with minimum damage at 30$^{o}$ C
- Lesions expand twice as fast at 20$^{o}$ C than at 15$^{o}$ C or at 25$^{o}$ C

## Moisture

- Spores start germinating within two hours of being in water
- Once germination starts, drying spores is lethal

- Lesion development is delayed by drying periods but not stopped
- Accumulation of 66 h leaf wetness in 6 consecutive days is required for disease development (mean temps at 18$^{o}$ C)

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# Summary

- SSR is monocyclic disease (control sclerotia)
- Soil moisture drives CG (rain 3 weeks before flowering)
- Highest CG in constant moisture
- Significant CG in fluctuating moisture (25-75% saturation
- Drying the soil completely resets biological clock (doubles time to first apothecia)

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# Summary

- Multiple ascospores showers per season
- Showers favored by 7-days with >90% RH
- Ascospores concentrations and SSR reduced by 50% within 30 m from source
- Within-field inoculum is more important
- SSR best at 20°C (range 15-25°C)
- SSR favored by >11 h leaf wetness per day
- SSR stopped when leaf wetness <10 h/day

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