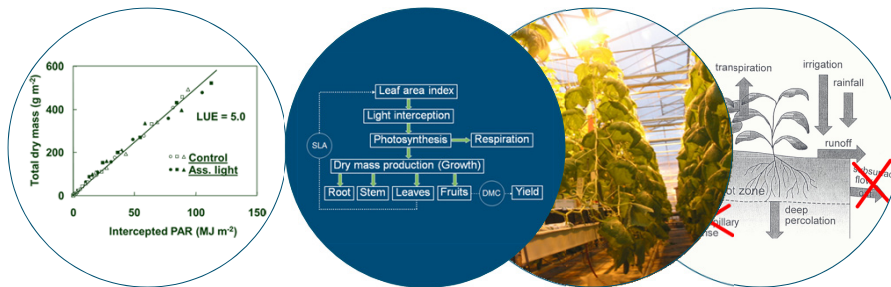
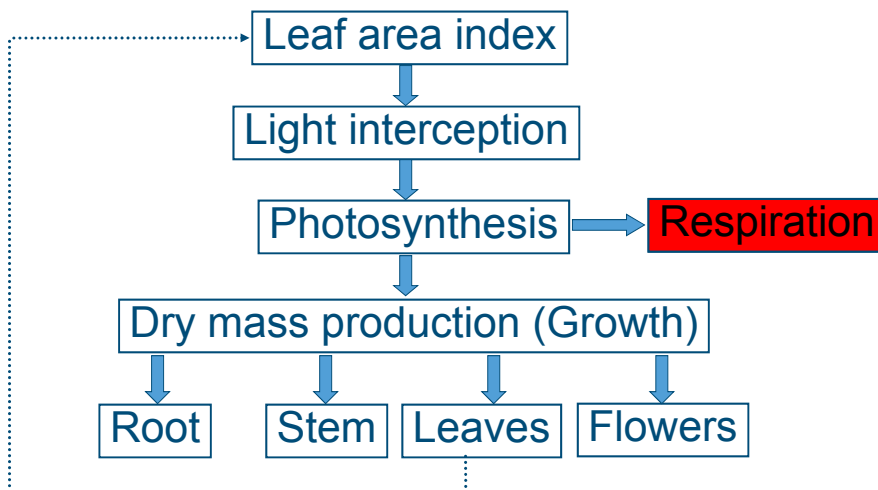


Simulation of biomass production

Respiration



The processes: step by step - Respiration



Simulation of biomass production

Dry matter production: explanatory crop growth model

$$dW/dt = C_f (P_{gd} - R_m)$$

dW/dt = Crop Growth Rate (g DM m⁻² d⁻¹)

P_{gd} = Crop gross Assimilation Rate (g CH₂O m⁻² d⁻¹)

(In the model all leaves have identical photosynthetic properties)

R_m = Maintenance Respiration Rate (g CH₂O m⁻² d⁻¹)

(Depends on Organ Dry Weight, Temperature, RGR)

C_f = Conversion Efficiency (g DM g⁻¹CH₂O)



Simulation of biomass production

- Maintenance respiration (R_m) -

$$dW/dt = C_f (P_{gd} - R_m)$$

R_m = Coef. × dry weight

Coef. = Coef. at 25°C × Q₁₀^{{(temp.-25)}/10}

Example:

Question: Assume at 25°C, Coef. is 0.014 g(CH₂O)g⁻¹(DM) and Q₁₀=2.0. What is Coef. at 15°C ? And at 20°C ?

Answer:

0.007g(CH₂O)g⁻¹(DM) and 0.010g(CH₂O)g⁻¹(DM)



Simulation of biomass production

– Maintenance respiration (R_m) cont. –

$$dW/dt = C_f (P_{gd} - R_m)$$

- R_m is assumed to have priority above growth
- R_m results from maintenance processes like protein turnover and ion fluxes over membranes

If $R_m > P_{gd}$ then R_m is set equal to P_{gd} ;
→ growth is zero.



Simulation of biomass production

– Growth respiration –

$$dW/dt = C_f (P_{gd} - R_m)$$

C_f = growth conversion efficiency (g DM g⁻¹ CH₂O)

Growth respiration depends on chemical composition
(costs of turning sugars into fats, organic acids, etc.,
& costs for ion uptake)



Simulation of biomass production

- *Glucose requirements* -

Average amount of glucose required (G; gCH₂O g⁻¹DM) to produce 1 gram of the following biochemical groups

| | G |
|---------------|------|
| Carbohydrates | 1.24 |
| Proteins | 2.70 |
| Lipids | 3.11 |
| Lignin | 2.17 |
| Organic acids | 0.93 |
| Minerals | 0.05 |



Simulation of biomass production

- *Glucose requirements (cont.)* -

Glucose requirement (G; gCH₂O g⁻¹DM) and conversion efficiency (C_f; gDM g⁻¹CH₂O)

| | G | C _f |
|--|-------|----------------|
| Young leaf (carbohydrates + proteins) | 1.656 | 0.60 |
| Oil rich seed (fats and proteins) | 2.572 | 0.39 |
| Woody stem (carbohydrates + lignin) | 1.569 | 0.64 |
| Root sugar beet (carbohydrates) | 1.271 | 0.79 |



❖ NB: $G * C_f = 1$