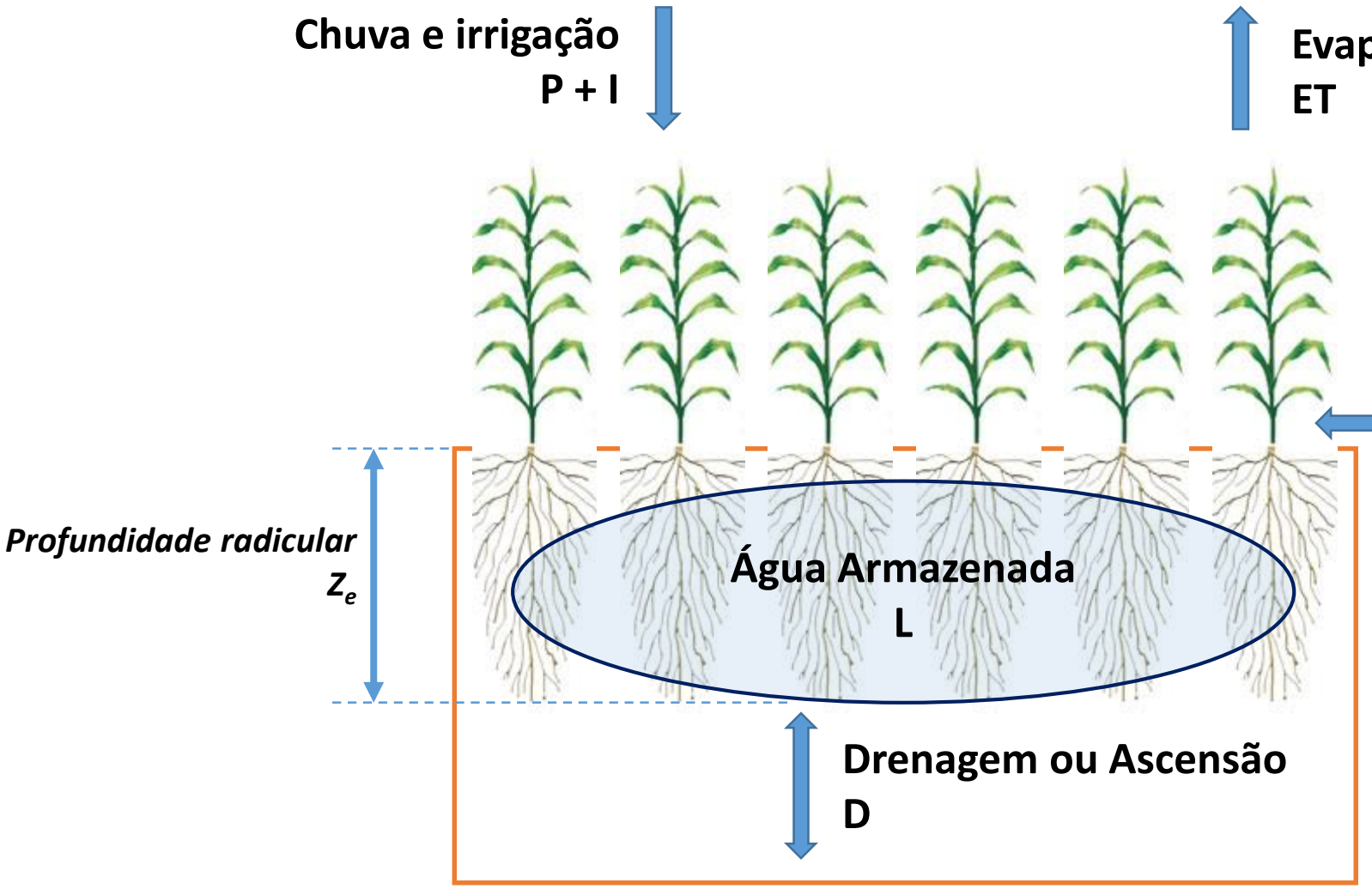
Balanço Hídrico do Solo

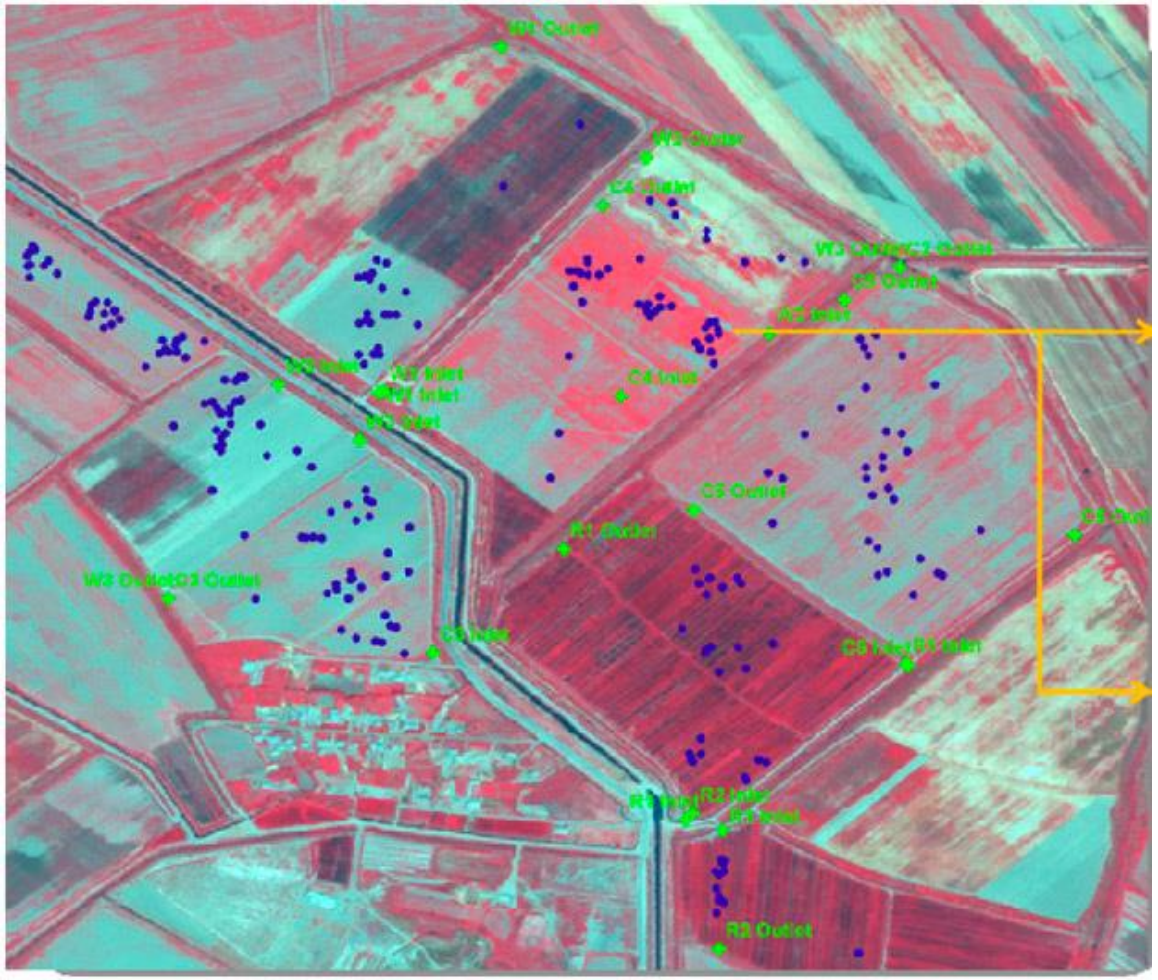


Todas as grandezas são lâminas

$m^3/m^2 = m$

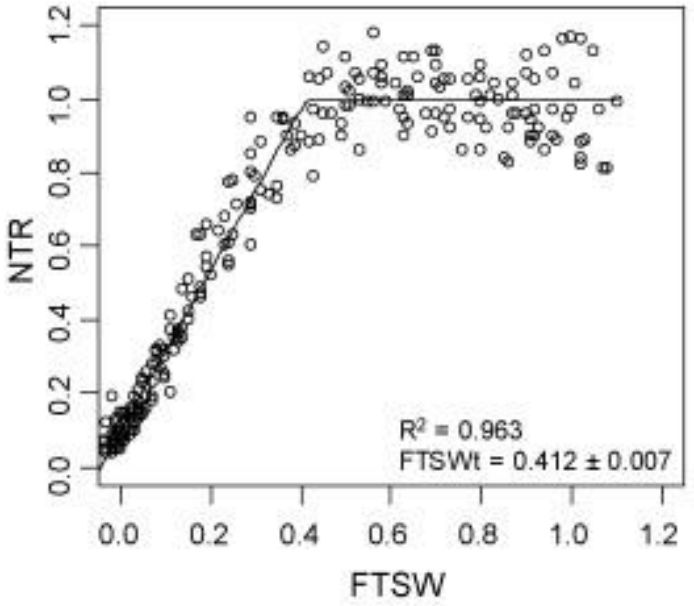
(ou: cm, mm)

Por que precisamos do balanço hídrico em modelagem da produtividade de culturas?

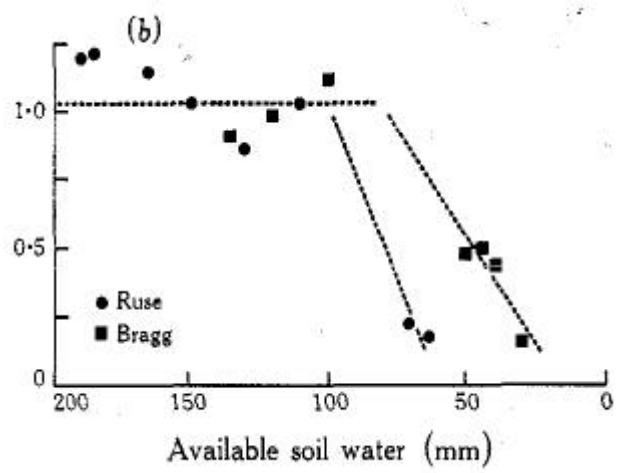


Transpiração e Teor de água no solo

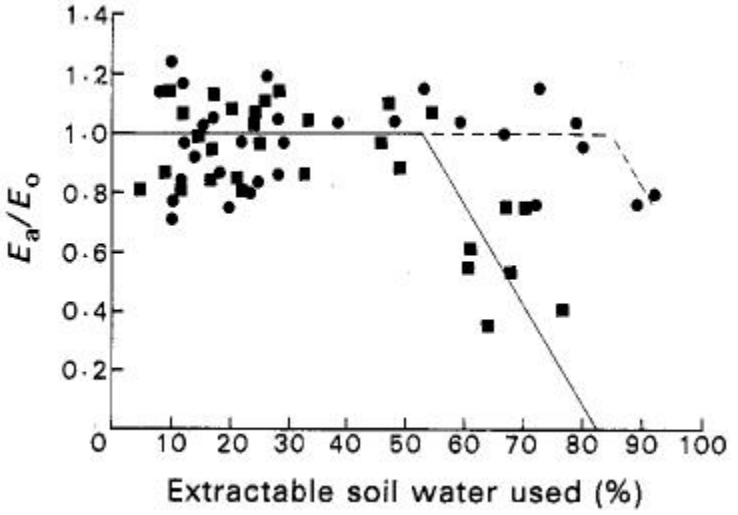
ETr = ETr(θ,h)



CASADEBAIG ET AL., 2008



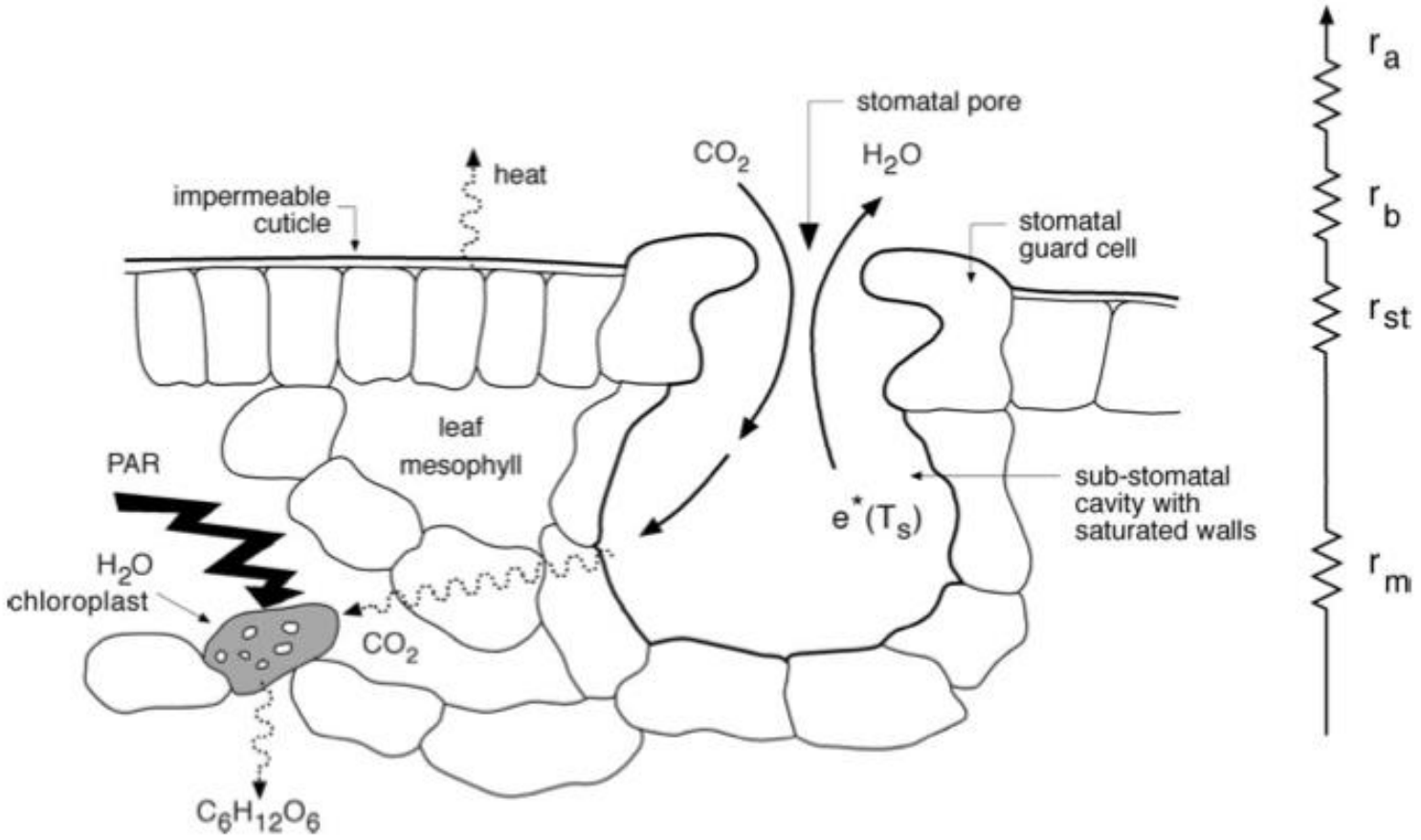
BURCH ET AL., 1980



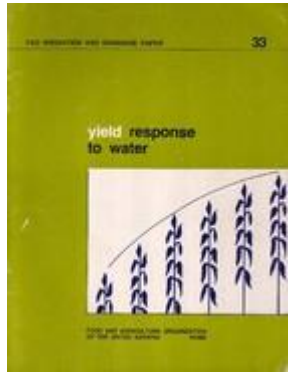
WRIGHT & SMITH, 1983

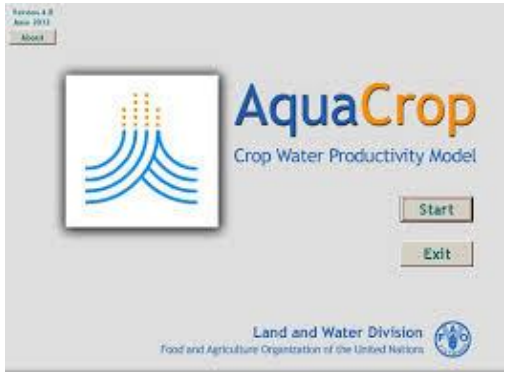
Produtividade
limitada por água

$$P_a = \frac{T_a}{T_p} P_p$$

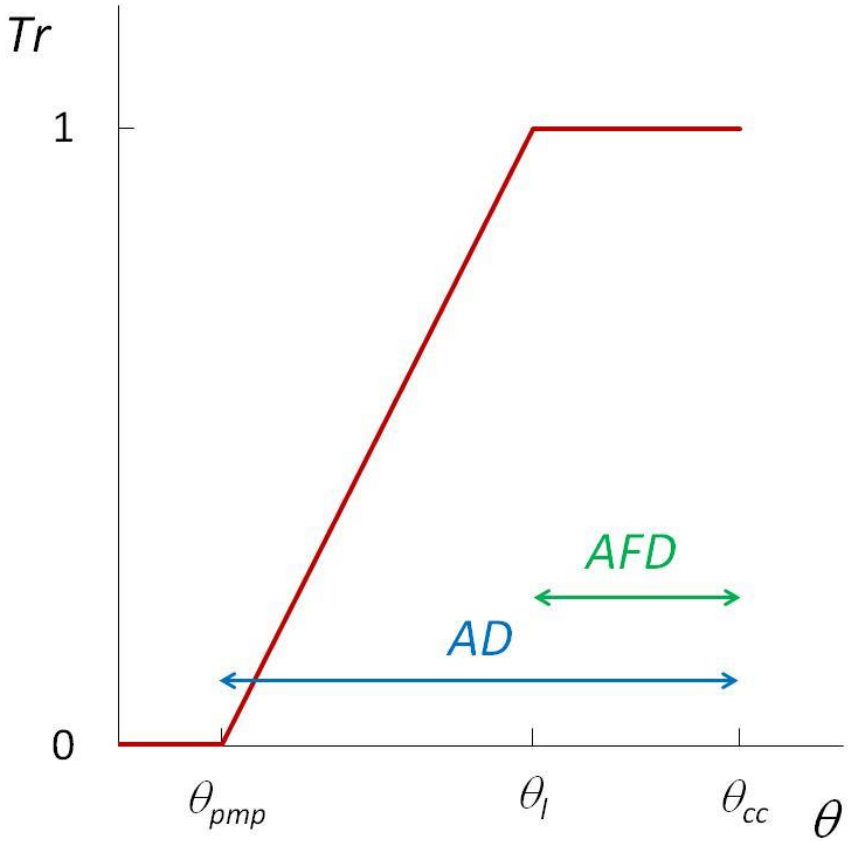


Relações empíricas para ETr(θ,h)





2. FAO HANDBOOK 33 E AQUACROP, DSSAT, ...



$$Tr = 1; \quad \theta_l < \theta$$

$$Tr = \frac{\theta - \theta_{pmp}}{\theta_l - \theta_{pmp}}; \quad \theta_{pmp} \le \theta \le \theta_l$$

$$Tr = 0; \quad \theta < \theta_{pmp}$$

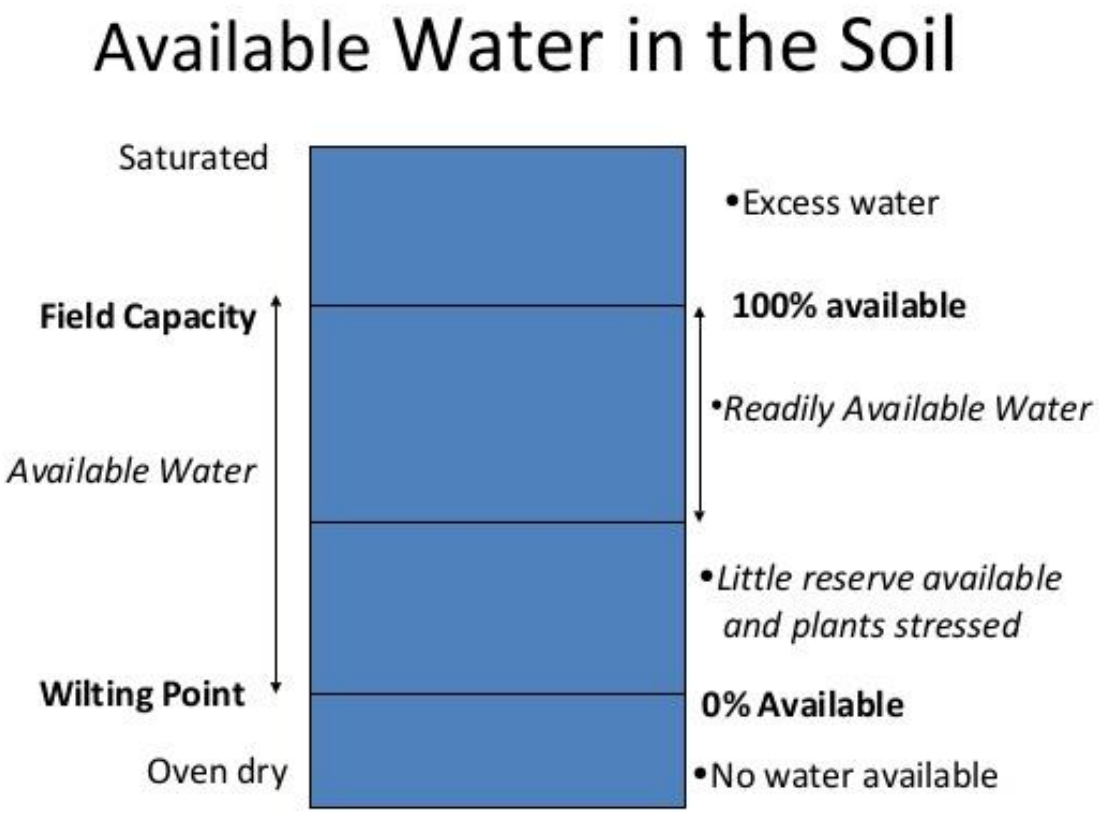
$$\theta_l = \theta_{pmp} + (1 - p)(\theta_{cc} - \theta_{pmp})$$

Fração de água disponível

Modelo simples da disponibilidade de água no solo para as plantas

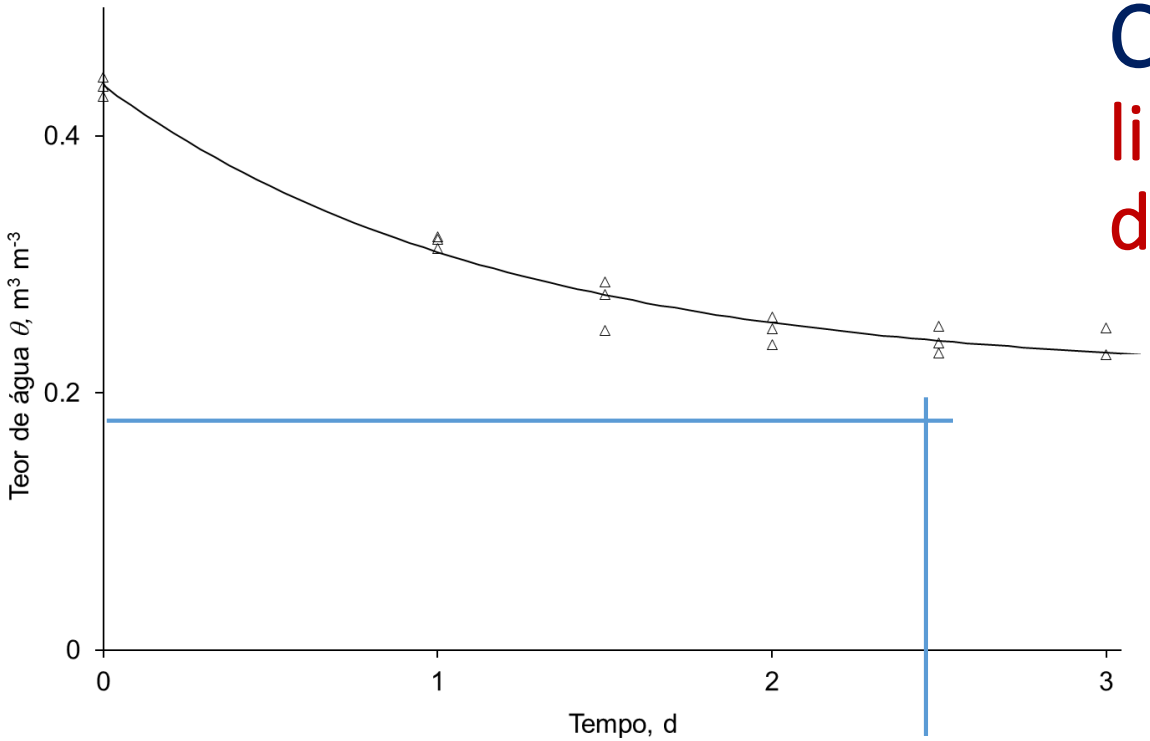
Capacidade de campo (CC)

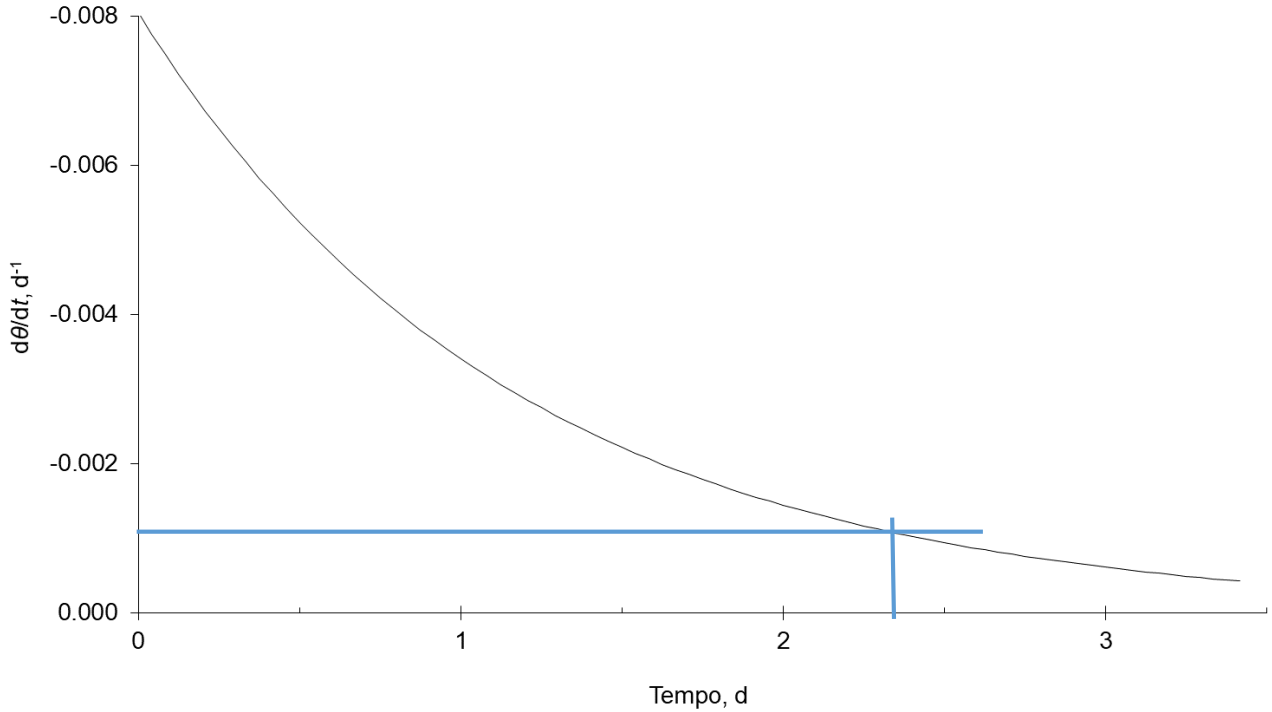
Ponto de murcha permanente (PMP)



Capacidade de campo (CC)

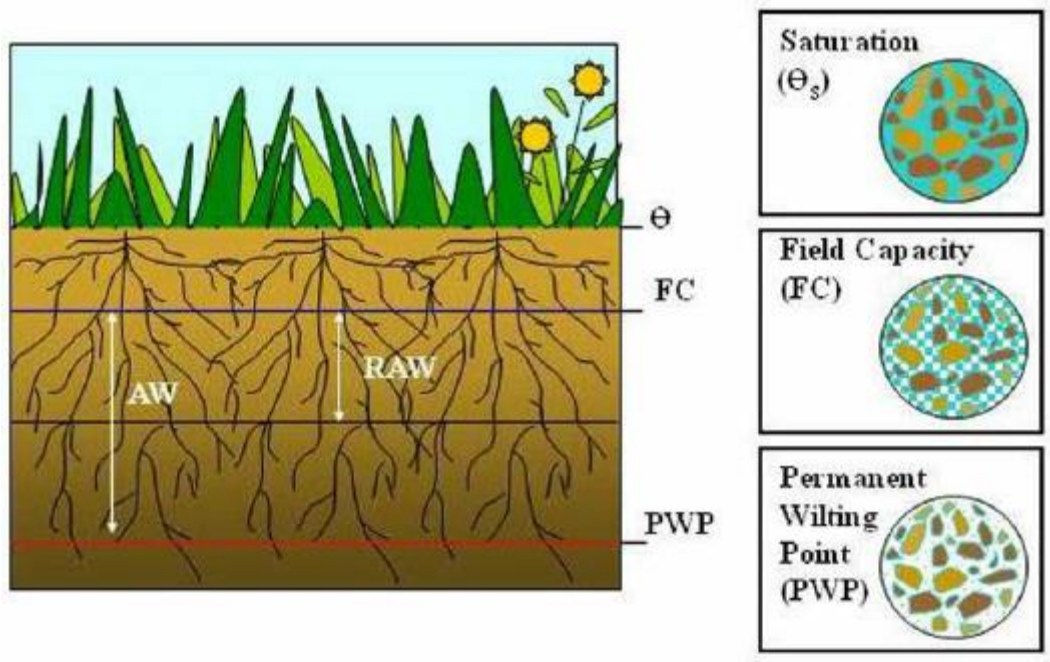
limite superior da disponibilidade de água às plantas





Ponto de murcha permanente (PMP)

limite inferior da disponibilidade de água às plantas



Balanço hídrico

modelo simples baseado na capacidade de campo

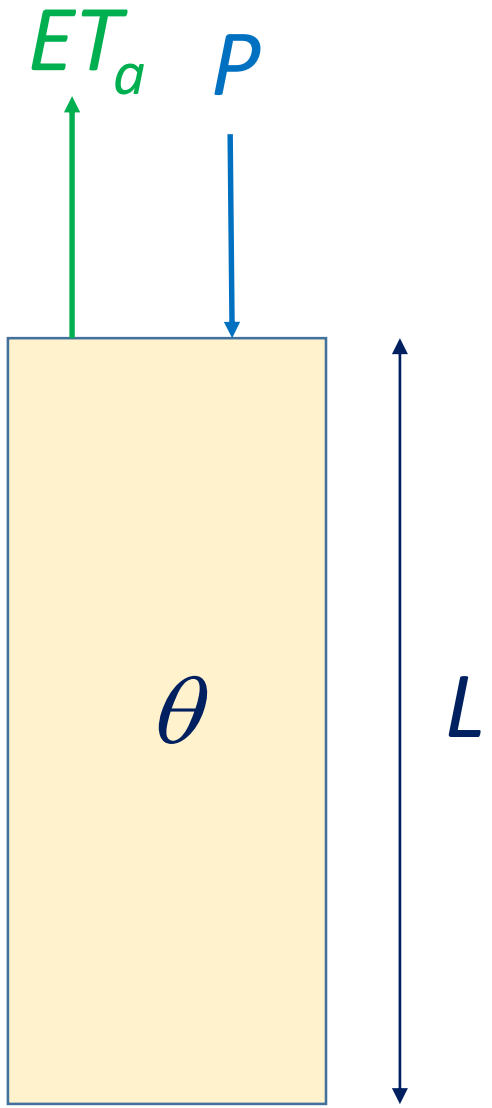
P=chuva (dados meteorológicos)

ET_a=evapo(transpi)ração por método de estimativa meteorológico

$$S_i = \theta_i L$$

$$S_{i+1} = S_i + P - ET_a$$

$$\theta_{i+1} = \frac{S_{i+1}}{L}$$



Umidade θ (m^3/m^3)

Arm = θ L

θ = Arm / L

Armazenagem (mm)

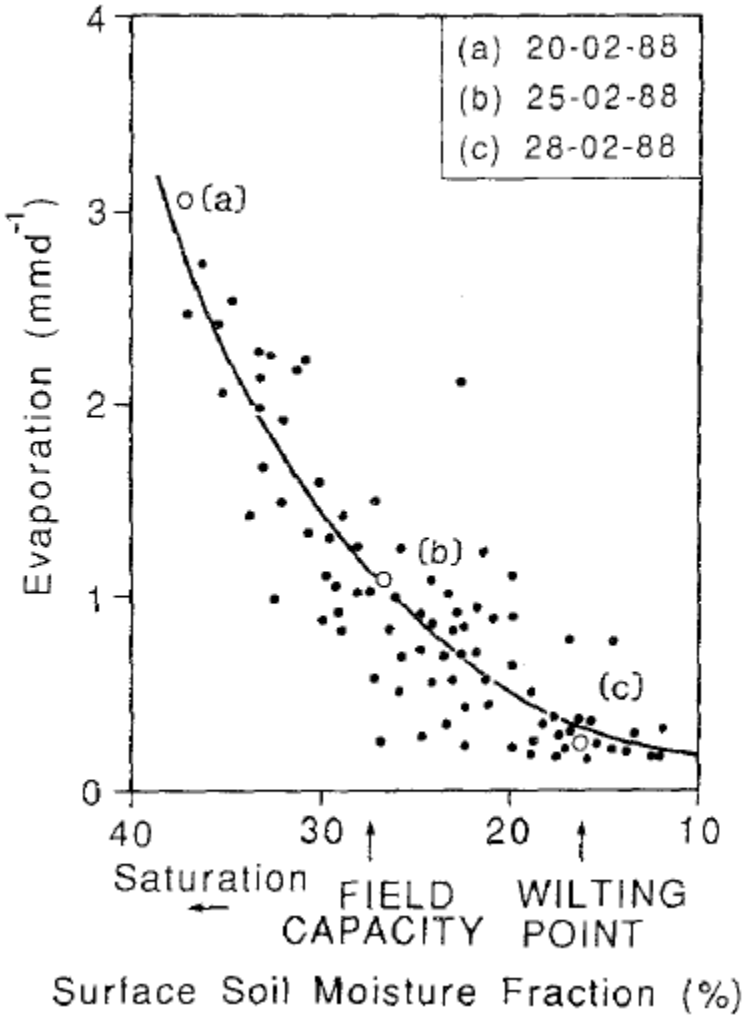
Arm = θ L

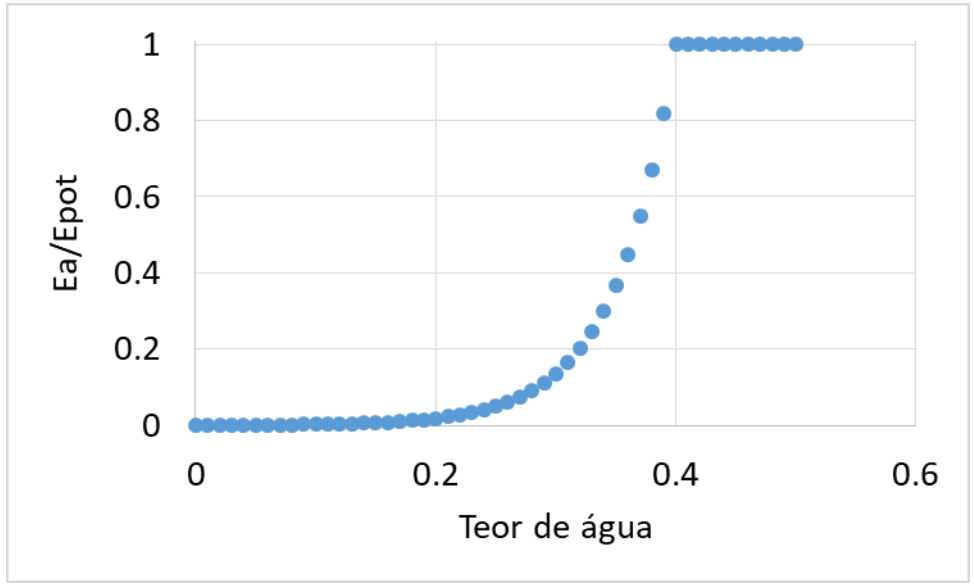
θ = Arm / L

Estimativa da **Evaporação**

$$E_{pot} = a_1 T_{med} + a_2 w + a_3 \left(e_{sat} - e \right)$$

Evaporação real E_a versus potencial E_{pot}





$$E_a = E_{pot} \exp\left[a\left(\theta - \theta_{crit}\right)\right]$$

Desenvolver um modelo simples para o balanço hídrico sem cultura (solo nu)

Componentes?

Dados de entrada?

Desenvolver um modelo simples para o balanço hídrico sem cultura (solo nu), BHSimples

Arquivos de entrada

Meteo (pira2014.csv)

	A	B	C	D	E	F	G	H	I
1	DD	MM	YYYY	Rad	Tmin	Tmax	Hum	Wind	Rain
2	*	KJ/m2	C	C	kPa	m/s	mm		
3	1	1	2014	21234.4	23	30.5	3.056	1.6	10.8
4	2	1	2014	23742.4	20.8	31.5	2.815	0.9	1.3
5	3	1	2014	23951.4	20.9	34	2.782	1.1	1.1
6	4	1	2014	28382.2	22	34	2.91	2.6	12
7	5	1	2014	28424	20.6	32.9	2.811	1.9	2
8	6	1	2014	24369.4	20.2	33.9	2.396	2.4	0
9	7	1	2014	24662	18.8	33.8	2.087	1.3	0
10	8	1	2014	25832.4	19	33.1	2.023	2.4	0
11	9	1	2014	24954.6	20.6	34.5	2.246	1.9	0
12	10	1	2014	32520.4	20	34.4	2.056	1.1	0
13	11	1	2014	25121.8	20.3	33.9	2.474	1.3	0
14	12	1	2014	19562.4	19.9	31.7	2.558	1.3	6.5
15	13	1	2014	12790.8	19.7	28.1	2.788	1.5	26.6
16	14	1	2014	22404.8	17.8	32.4	2.517	1.8	2.4
17	15	1	2014	20064	19	32.5	2.65	1.1	0.8
18	16	1	2014	16720	19	27.1	2.282	2.4	14.8

Solo (soildata.prn)

SoilData.prn

```
3    Number of layers (max 20)
Thickness of each layer (mm)
200
150
250
Field Capacity and Wilting Point for each layer
0.23  0.14
0.32  0.18
0.28  0.17
Initial Water content for each layer
0.20
0.25
0.21
```

Continuar com o modelo simples para o balanço hídrico, incluindo uma cultura

Arquivos de entrada

Planta (cropdata.prn)

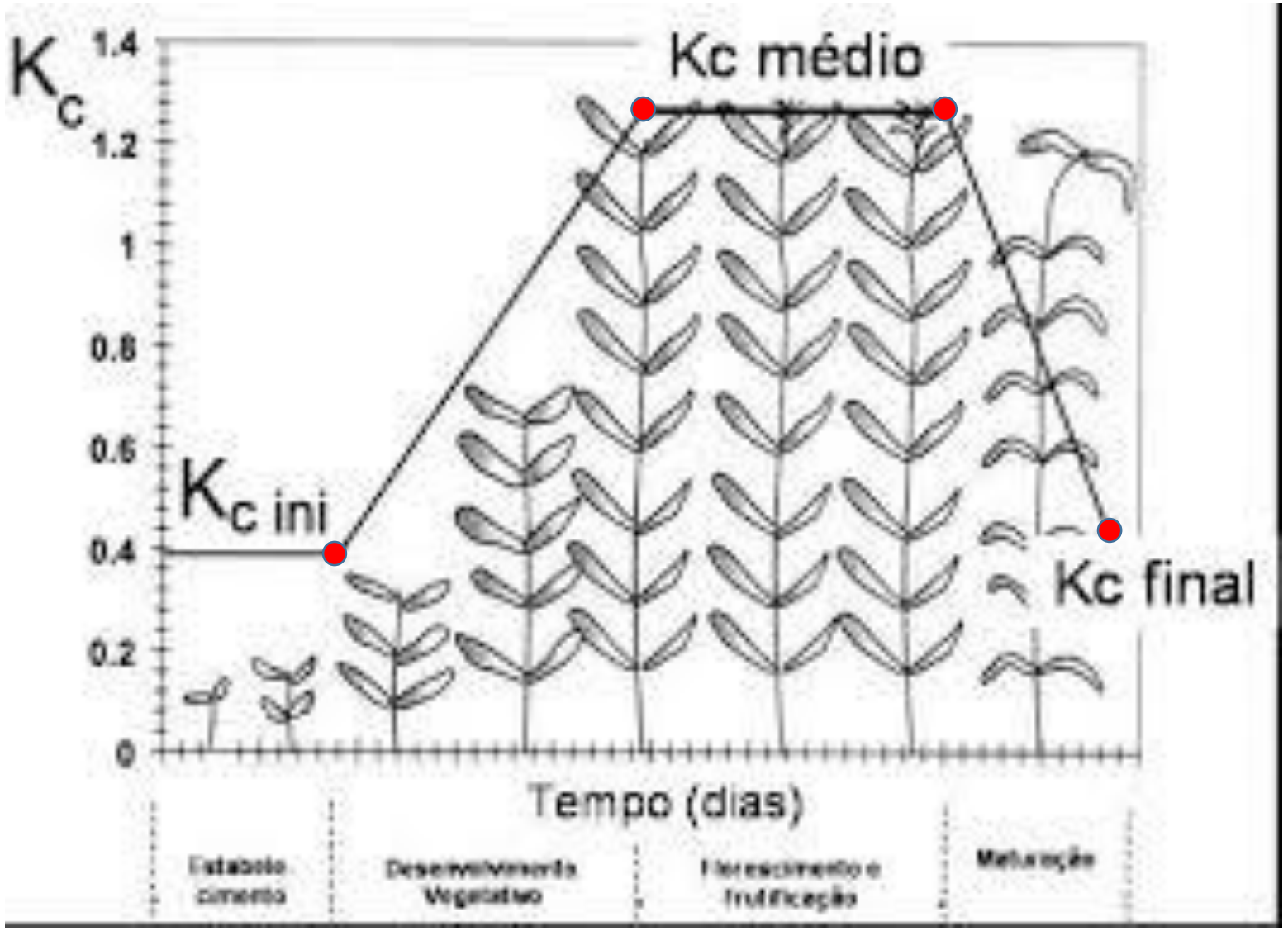
Que precisamos saber da cultura?

1. …
2. …
3. …

CropData.prn

```
100    Sowing date ((Julian day)
120    Crop cycle duration (d)
***********************
day     Kc
20      .2
50      1.2
80      1.2
100     0.4
***********************
Root system
50  (mm) Initial rooting depth
500 (mm) Maximum rooting depth
8   (mm/d) Root growth per day
```

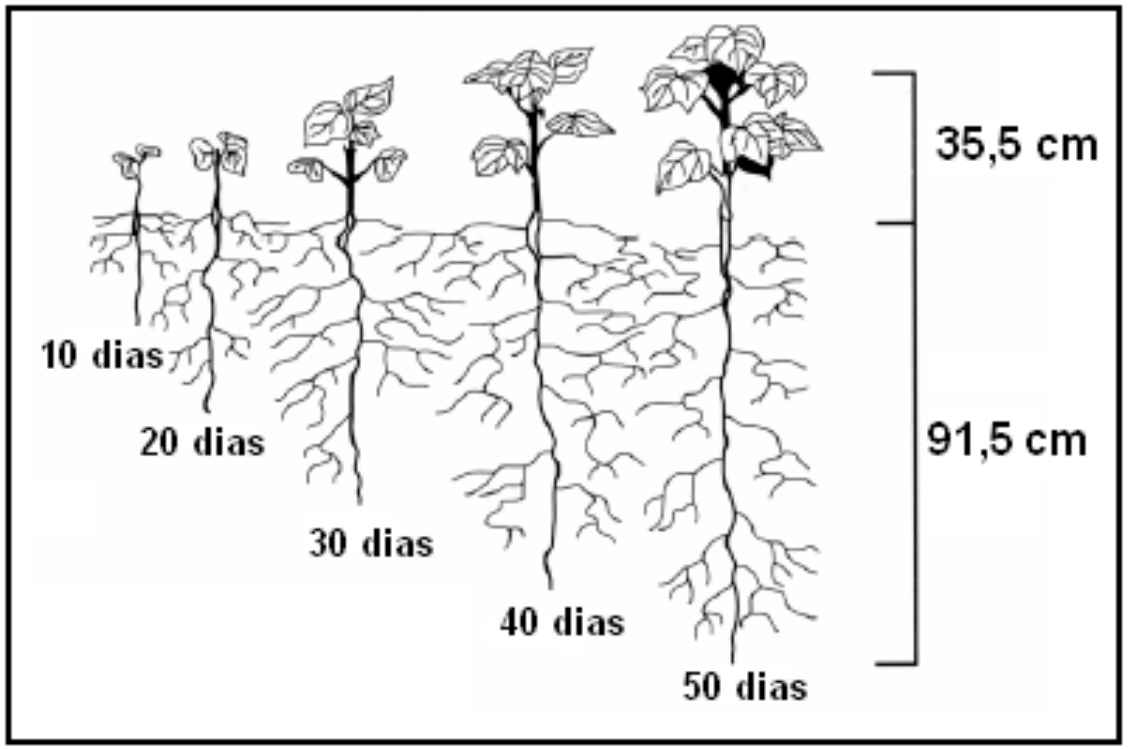
Coeficiente de cultura Kc



CropData.prn

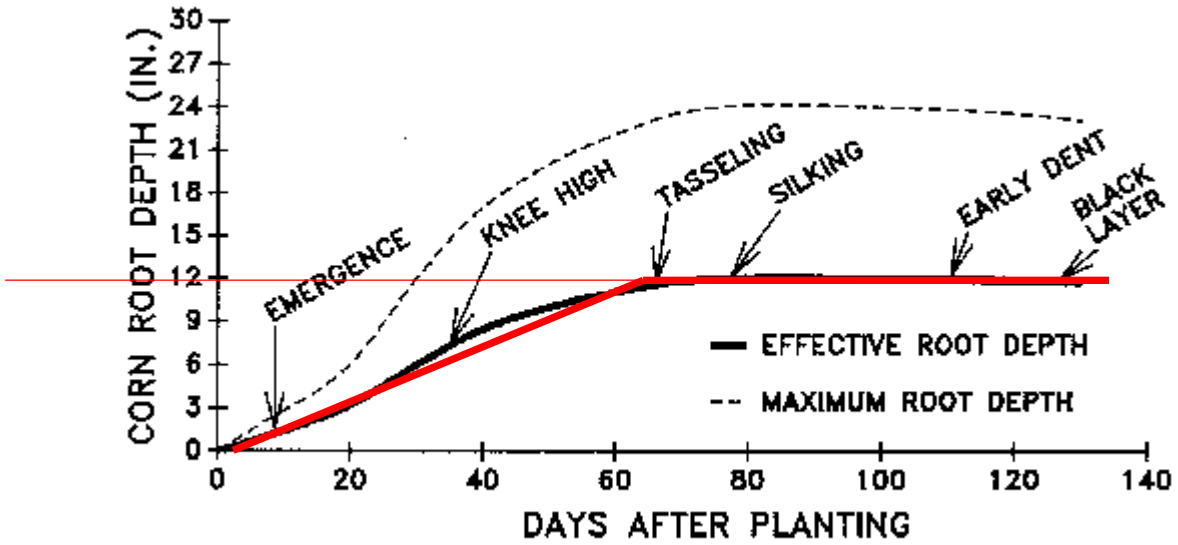
```
100    Sowing date ((Julian day)
120    Crop cycle duration (d)
**********************
day      Kc
20       .2
50       1.2
80       1.2
100      0.4
**********************
Root system
50  (mm) Initial rooting depth
500 (mm) Maximum rooting depth
8   (mm/d) Root growth per day
```

Crescimento radicular



CropData.prn

```
100   Sowing date ((Julian day)
120   Crop cycle duration (d)
**********************
day     Kc
20      .2
50      1.2
80      1.2
100     0.4
**********************
Root system
50  (mm) Initial rooting depth
500 (mm) Maximum rooting depth
8   (mm/d) Root growth per day
```



Transpiração *versus* Evaporação