In the next sections we consider a constant environment E(n) = E.

## 4. Branching with Biomass and fruits

We aim to define the values of sink strengths for each organ when the plant is at equilibrium, that is to say when the biomass production is constant at each time step (i.e.  $\frac{E}{A} = 1$ )?

The total demand at cycle *n* is :  $D(n) = N_a(n)p_a + N_e(n)p_e + N_f(n)p_f$ 

 $N_a(n)$  = number of leaves at *n* cycle and  $p_a$  = sink strength of a leave  $N_e(n)$  = number of inter-nods at *n* cycle and  $p_e$  = sink strength of an inter-nod  $N_f(n)$  = number of fruits at *n* cycle and  $p_f$  = sink strength of a fruit with

$$N_{a}(n) = n_{a} N_{\varphi a}(n)$$
$$N_{e}(n) = n_{e} N_{\varphi e}(n)$$
$$N_{f}(n) = n_{f} N_{\varphi f}(n)$$

and

 $n_a$  = number of leaves for one phytomer (can vary from 1 to 3 in a tree) = 2 for coffee tree

 $n_e$  = number of internodes for one phytomer = 1

 $n_f$  = number of fruits for one phytomer (can vary from 0 to many)

 $N_{qa,e,f}(n)$  = total number of active phytomers bearing leaves (a), internodes (e) or fruits (f) at n cycle

If  $N_{oe}(n) = N_{oa}(n) = N_{of}(n) = N_{o}(n)$  we have

$$D(n) = N_{\varphi}(n) \left( n_a p_a + n_e p_e + n_f p_f \right)$$

Let  $d_{\varphi} = n_a p_a + n_e p_e + n_f p_f$  be the phytomer demand

then

$$D(n) = N_{\varphi}(n) d_{\varphi}$$

If we take the equation that links the total biomass at n cycle and total supply at n-1 cycle then

$$Q(n) = \frac{E}{r e} \frac{N_a(n) p_a}{D(n)} Q(n-1) = \frac{E}{r e} \frac{n_a N_{\varphi}(n) p_a}{N_{\varphi}(n) d_{\varphi}} Q(n-1)$$

By simplifying by  $N_{\varphi}(n)$  we obtain

$$Q(n) = \frac{E}{r e} \frac{n_a p_a}{d_{\varphi}} Q(n-1)$$
  
Let  $A = r e \frac{d_{\varphi}}{n_a p_a}$   
At equilibrium we have  $\frac{E}{A} = 1$  Then  $A = r e \frac{d_{\varphi}}{n_a p_a} = E$ 

From this relation the phytomer demand can be computed, leading to a linear relation between between internode and fruit sink strengths.

## Numerical applications

1. Roux model. Each phytomer stands for an internode bearing a leaf and a fruit on the trunk and on the branches. We aim to calculate the internode and fruit sink strengths at equilibrium ( we suppose is this example that sink strengths are balanced).

Let E = 1, r = 10, e = 0.05,  $p_a = 1$ . Equilibrium is supposed reached at cycle n = 10.

2. Coffee model. Each phytomer stands for an internode bearing 2 leaves and 4 fruits on the trunk and on the branches.

Let 
$$E = 1$$
,  $r = 13.33$ ,  $e = 0.05$ ,  $p_a = 1$ .

