Review of soil formation and development

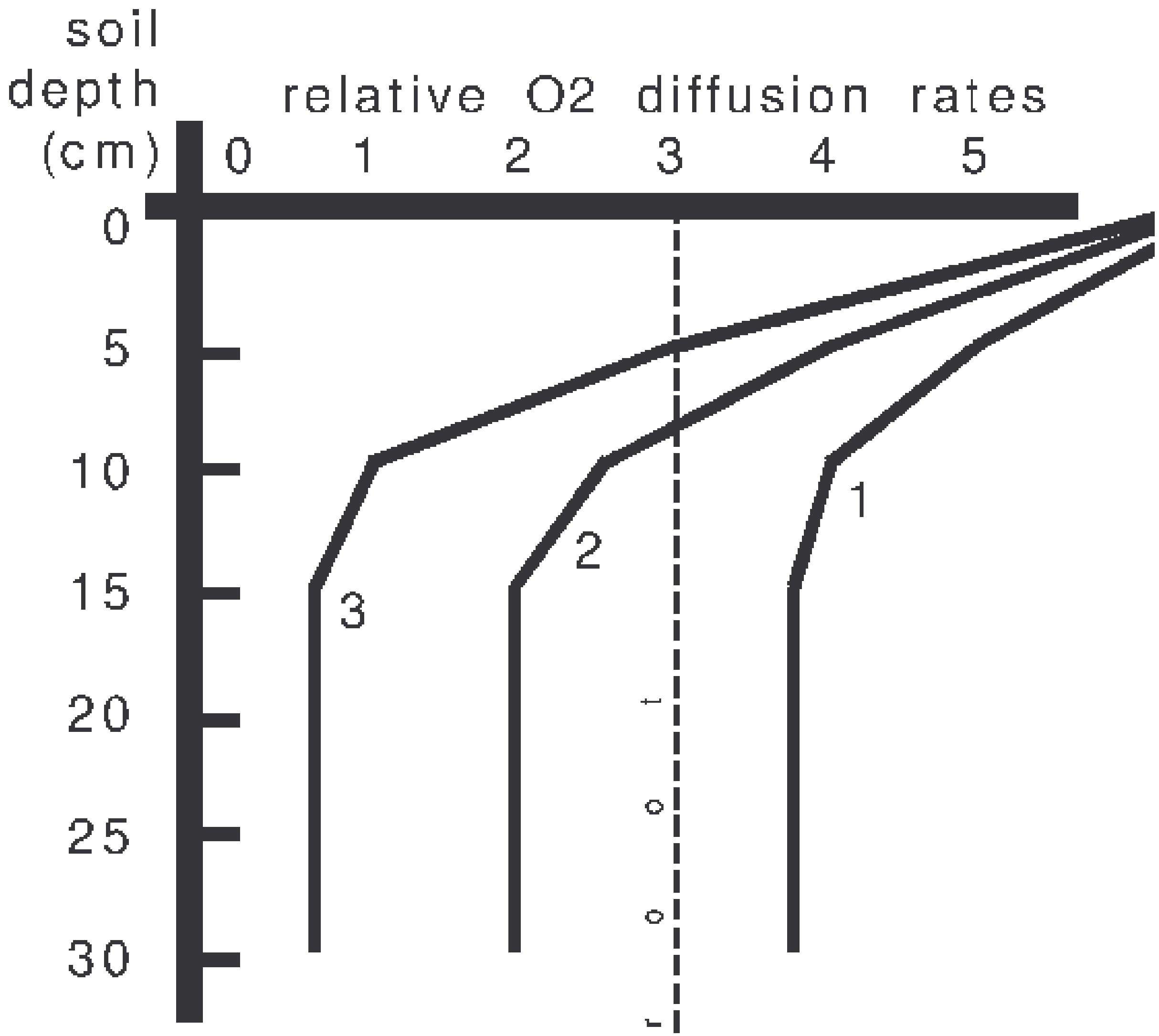
- Nutrient supplier; base of food and vegetation; reservoir

- Weathering of rocks (mechanical and chemical)
  - Water essential
  - Carbonation weathering (geological time scale)
  - Organic acid weathering (geological and shorter time scales)
- Climate and vegetative cover important
  - Cool, “wet” climates, forested environment à podzolization
  - Warm, seasonally dry climates, grasses à biomass accumulation
  - Tropical climates à silicate removal, mixed Fe_2O_3/SiO_2 Al_2O_3/SiO_2 soils
- O, A, B, C Layering à soil history + current development
- Texture an important soil parameter

Root growth limiting air-pore space values by soil texture.

soil texture	root-limiting % pores normally filled with air
sand	24
fine sand	21
sandy loam	19
fine sandy loam	15
loam	14
silt loam	17
clay loam	11
clay	13

Effect of compaction on soil aeration



Soil Organic Matter (SOM)

- Product of plant residue (leaves, branches/twigs, roots) (microbial) decomposition
- Several percent of soil mass depending on soil type
- Interaction with mineral soil (mostly clay fraction)
- Affects soil aeration and water holding capacity
- Important carbon reservoir
- Soil Life and nutrient turnover/cycling

- http://www.humintech.com/001/articles/article_definition_of_soil_organic_matter.html

Table 6.1 Percentage of the Annual Requirement of Nutrients for Growth in the Northern Hardwoods Forest at Hubbard Brook, New Hampshire, That Could Be Supplied by Various Sources of Available Nutrients[a]

Process	N	P	K	Ca	Mg
Growth requirement (Kg ha^{-1} yr^{-1})	115.4	12.3	66.9	62.2	9.5
Percentage of the requirement that could be supplied by:					
Intersystem inputs					
Atmospheric	18	0	1	4	6
Rock weathering	0	1	11	34	37
Intrasystem transfers					
Reabsorptions	31	28	4	0	2
Detritus turnover (includes return in throughfall and stemflow)	69	67	87	85	87

[a] Calculated using Eqs. 6.2 and 6.3. Reabsorption data are from Ryan and Bormann (1982). Data for N, K, Ca, and Mg are from Likens and Bormann (1995) and for P from Yanai (1992).

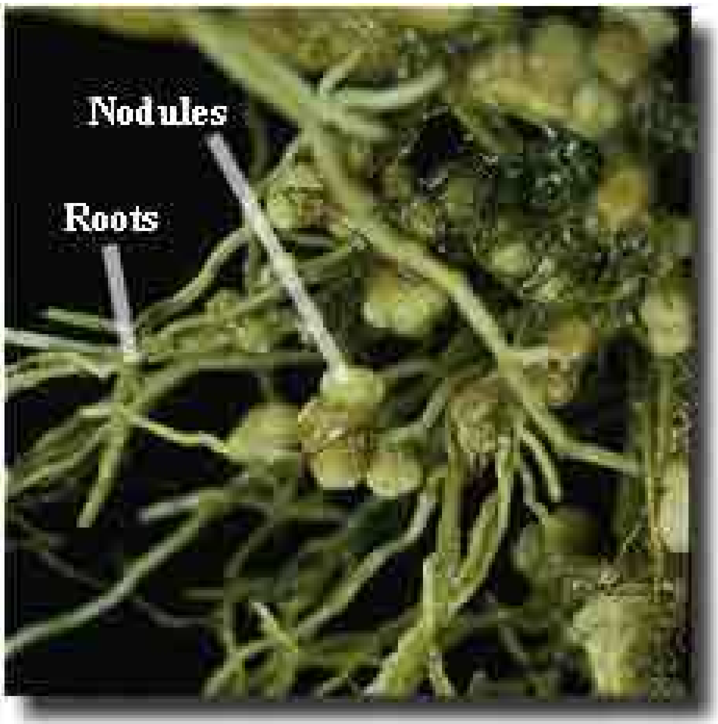

Nodules
Roots

Table 6.3 Effects of Mycorrhizae and N-Fixing Nodules on Growth and Nitrogen Fixation in *Ceanothus velutinus* Seedlings[a]

	Control	+Mycorrhizae	+Nodules	+Mycorrhizae and nodules
Mean shoot dry weight (mg)	72.8	84.4	392.9	1028.8
Mean root dry weight (mg)	166.4	183.4	285.0	904.4
Root/shoot	2.29	2.17	0.73	0.88
Nodules per plant	0	0	3	5
Mean nodule weight (mg)	0	0	10.5	44.6
Acetylene reduction (mg/nodule/hr)	0	0	27.85	40.46
Percent mycorrhizal colonization	0	45	0	80
Nutrient concentration (in shoot, %)				
N	0.32	0.30	1.24	1.31
P	0.08	0.07	0.25	0.25
Ca			1.07	1.15

[a] From Rose and Youngberg (1981).

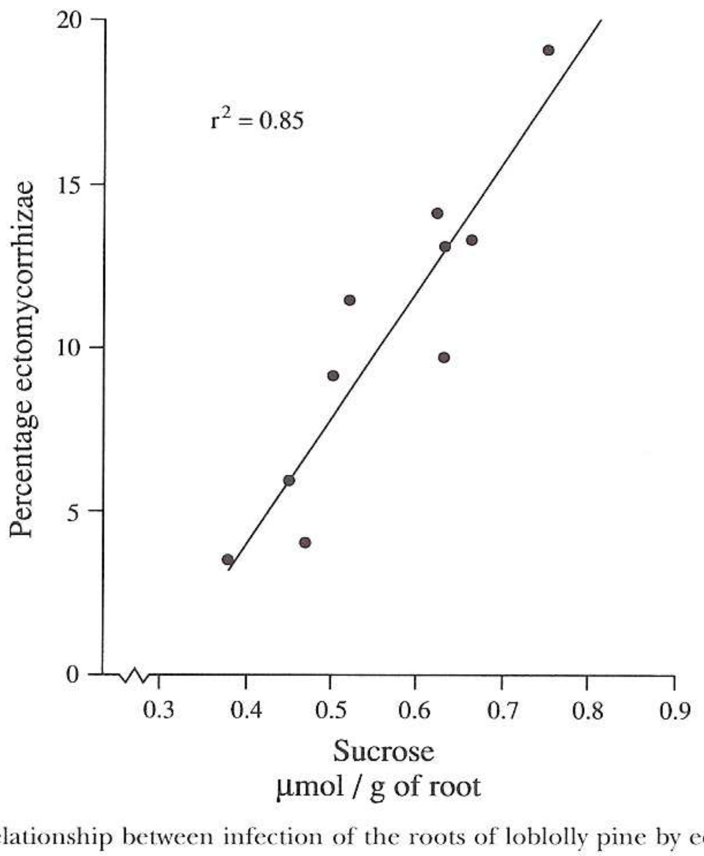


Figure 6.5 Relationship between infection of the roots of loblolly pine by ectomycorrhizal fungi and the sucrose concentration in the root. From Marx et al. (1977).