The Shoot Apical Meristem and the leaf series in grasses: the new model SAFMAC

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The leaves of grass tillers begin their life on the shoot apical meristem (SAM) as primordia. Each leaf elongates from an intercalary meristem followed by an extension zone only and by the mature zone. The complete elongation of a leaf takes place in the sheath of the previous leaf. Durand *et al*. (1999) implemented a model of leaf elongation based on the conservation and growth equations relating the tissues fluxes between the three compartments. With time, the proportion of tissues leaving the intercalary meristem and the extension only zone increases. In a further version of that model, Durand *et al.* (2000) implemented the response to temperature and water deficits in order to simulate the response of the grass tiller morphogenesis to dry conditions in summer. Also they used the morphological observations by Skinner *et al* (1994) on a series of leaves at different stages of development to introduce coordination rules between the successive leaves on the tiller. When leaf *n* length was equal to the length of the including sheath, *i.e.* when the tip of leaf *n* emerged, the intercalary meristem started producing sheath cells only. At the same time, the leaf *n+ 2* started to elongate from the shoot apical meristem. That supposed the existence of a primordium with no explicit consideration to the functioning of the SAM itself. In the work exposed here, we further introduced a new compartment to simulate the shoot apical meristem, in order to simulate the production of primordia, adding a new condition to- or replacing the coordination rule described above. In the new version of the model, the SAM is supposed to grow at a rate, which is proportional to the rate of other meristems, and similarly sensitive to environment. A part of the tissues produced by the SAM accumulates in a compartment, simulating the gradual production of successive primordia. Every time the length of meristematic tissues accumulated reach the length of a primordium, the appearance of the n-2 leaf allows for the elongation of the newly formed leaf. In this version, two conditions must be met to start the elongation of leaves: production of a primordium *n+2* and emergence of leaf *n*. The rate at which the SAM grows, is used to build a new primordium and the length of a primordium are related using allometric relationships reducing the number of parameters involved and insuring the consistency of the tiller architecture. A first set of parameters were derived from *ex situ* observations of SAM on vegetative tillers of perennial ryegrass. A first verification of the consistency of the model was tested using experimental data of successive leaves elongation on tall fescue in the field.

References

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