Beam models for tap root systems in plants

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With an increasing global population and climate change, food security has become a concern to mankind. Maize, a plant with a tap root system, is one of the popular cereal crops with the highest yield and consumption. Nevertheless, a need to increase the yield of a harvest is important. The following experimental results are reported in *The Mechanics of Root Anchorage, A.R Ennos, Advances in Botanical Research vol 33, 2000.* "As the plant is pushed over the tap root is bent and rotates about a point some way below the soil surface, the top moving leeward and the bottom to the windward. These movements are resisted by two components of anchorage; the compressive resistance of the soil to lateral motion; and the bending resistance of the tap root itself. $\cdots$ the exact mode of failure depends on the soil properties. Soft, wet soil fails readily in compression and the plant rotates underground pushing the soil sideways and eventually leaning over permanently [known as lodging]. In stronger, drier soil, in contrast the tap root or even stem are more likely to fail". In this talk, an adapted Timoshenko beam model is presented to study the reaction of a plant with a tap root system, to lateral static and dynamic loads. Numerical experiments are done on the model using mixed finite element method. The results obtained are used to investigate the deflection with various values for relevant parameters for instance, wind load.