The effects of cultivations and rainfall on crop anchorage (optimising the shear strength of soils to reduce the incidence of lodging)

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Project Summary: The permanent displacement of plant stems from the vertical, known as lodging, affects all cereal species and is a major limiting factor on grain production worldwide. Two forms of lodging are recognised: stem lodging (when the stem base buckles) and root lodging (when the root-soil system fails). The anchorage strength of a cereal crop is important as varieties' lodging susceptibility is related to it. Improving anchorage strength, therefore, either by improving the anchorage root system or by increasing the shear strength of the soil will improve lodging resistance. Whilst the properties of the plant and the conditions which cause lodging are well researched, little attention has been made directly to investigate how anchorage can be improved by enhancing the physical properties of the top 10 cm of soil (the region which contributes to anchorage strength). This project will focus on how anchorage strength can be improved by increasing the shear strength of soil. Much is already known about soil physics and cultivations, but not specifically concentrating on the surface soil properties later in the growing season (when lodging is most likely to occur).

The Project will investigate the following objectives:

1-Effect of soil compaction, soil type and soil moisture on soil shear and anchorage root growth and lodging susceptibility.
2-Temporal variation in characteristics associated with lodging, between years and varieties.
3-Quantify effects of different cultivation machinery on soil physical properties and anchorage root development.
4-Manipulation and management of soil conditions to improve lodging resistance.
5-Effects of soil cultivation on oil seed rape root development.

http://www.uky.edu/Ag/GrainCrops/Briefs/FreezeDamageImagesApril2007.htm

http://www.fao.org/DOCREP/006/X8234E/x8234e08.htm

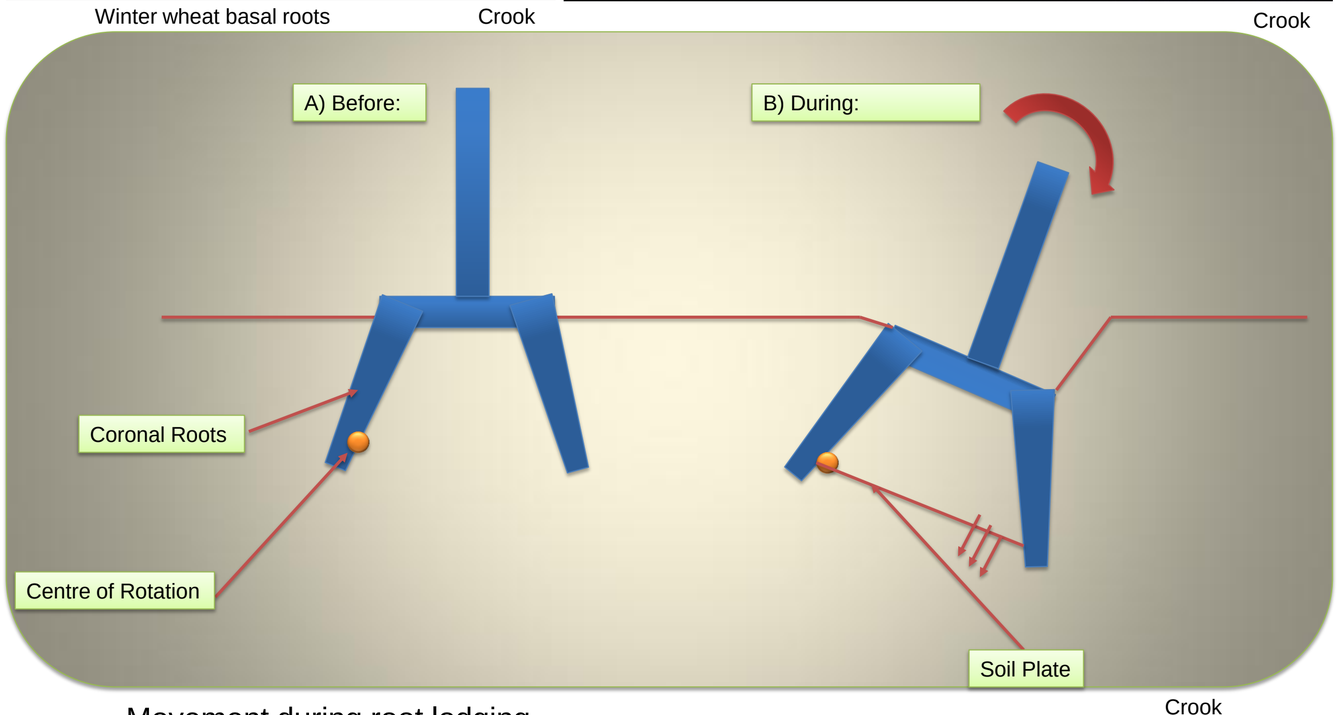
Crook

Methodology:
1-In the spring, poly tunnel/glasshouse based experiment using spring wheat grown in pots will begin. This will investigate the effect of soil compaction, soil type and soil moisture on soil shear and anchorage root growth and lodging susceptibility.
2-Temporal variation in characteristics associated with lodging, between years and varieties: Understanding and quantifying the variation between years is required to make recommendations for soil management with regard to identifying the optimal soil shear strength for plants to maximise their lodging resistance.
3-The effects of nine different cultivation treatments on plant development will be assessed throughout the year. *
4-Manipulation and management of soil conditions to improve lodging resistance.
*The nine treatment distribution will be as follows:

Control traffic	Low pressure Traffic	Conventional tyre traffic
Direct drilling (DD)	Direct drilling (DD)	Direct drilling (DD)
Minimum tillage (50-150 mm) MT	Minimum tillage (50-150 mm) MT	Minimum tillage (50-150 mm) MT
Deep tine tillage (150-250 mm) DT	Deep tine tillage (150-250 mm) DT	Deep tine tillage (150-250 mm) DT

Winter wheat basal roots Crook

Crook



Movement during root lodging Crook

Project Development: There has been extensive research on cultivations and their effect on both soil properties and crop development, factors that contribute to lodging susceptibility of a crop, and soil and water management. However, an area in which there has been relatively little investigation is how soil properties directly affect anchorage root development. This project will identify how cultivations and growing conditions influence anchorage strength (and hence lodging resistance), from the effect on direct anchorage root growth and also upon the effects on the shear strength of the soil. Quantifying these parameters under a range of growing conditions will increase understanding of the agronomy requirements to improve anchorage strength, thereby reducing the incidence of lodging.

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