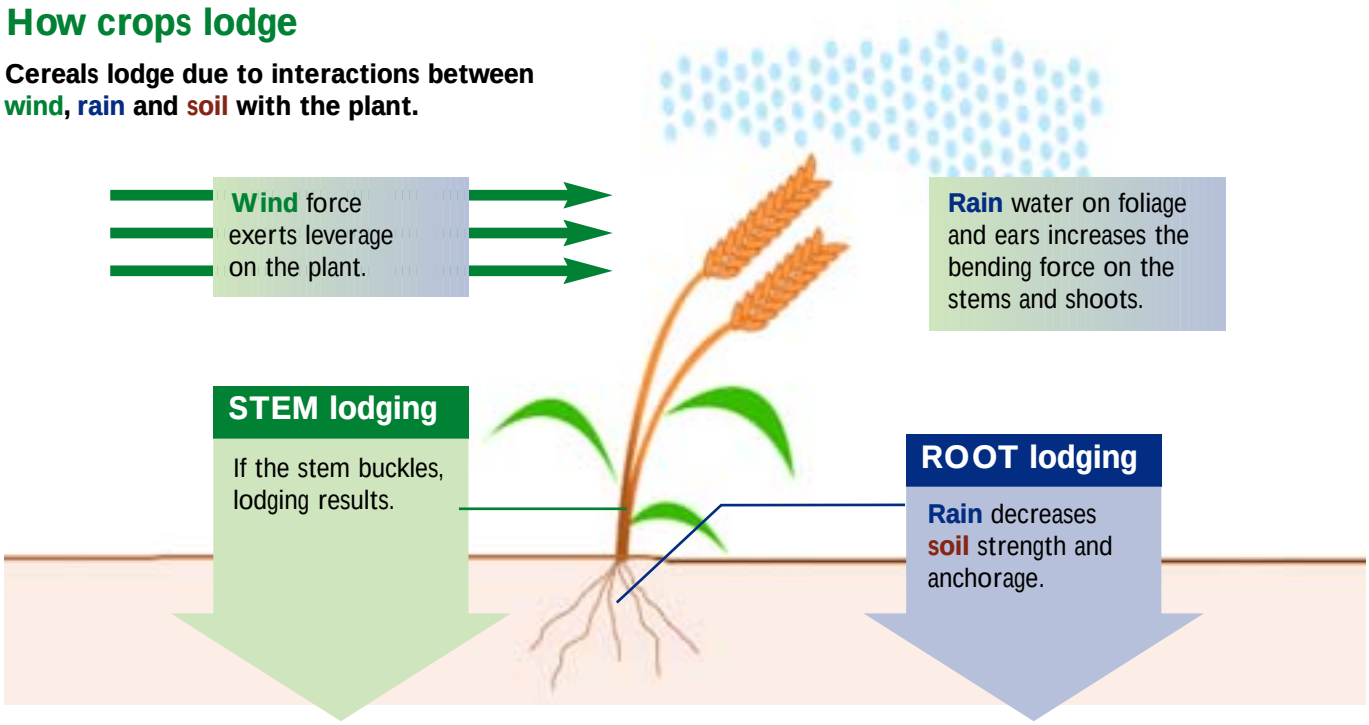
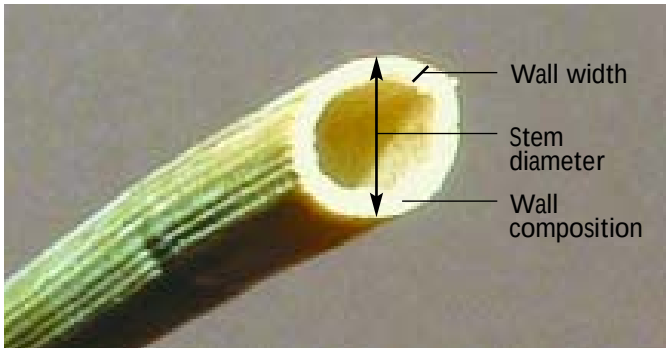
Background

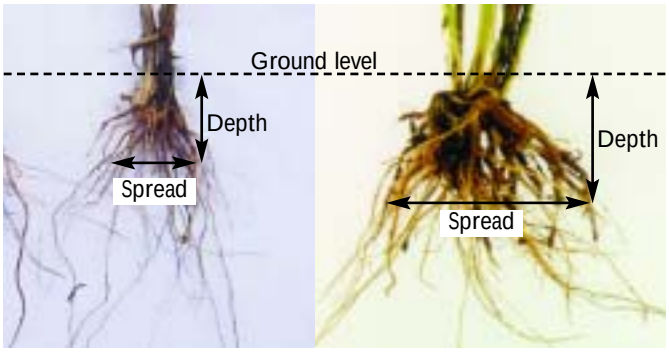
How crops lodge

Cereals lodge due to interactions between wind, rain and soil with the plant.





Stem strength depends on stem diameter and the composition and width of the stem wall.



Anchorage depends on the spread and depth of the root plate and the strength of surrounding soil.

Stem lodging occurs when the stem base has insufficient strength to hold the shoot up against leverage.

Root lodging occurs when the root system has insufficient anchorage to hold the plant up against leverage.

Costs of lodging

On average, every three or four years widespread lodging occurs on up to 20% of the UK winter wheat area. Lodging has serious economic effects; yield is reduced and quality impaired, while combining and drying costs increase.

Economic loss is greatest when crops lodge early. Up to 75% of yield can be lost if crops lodge at ear emergence. Later lodging has less effect on yield, but will impair quality characters such as Hagberg falling number. Lodged crops often require extra drying which can cost £3–£7.50/tonne.

HGCA

Avoiding lodging in winter wheat

– practical guidelines

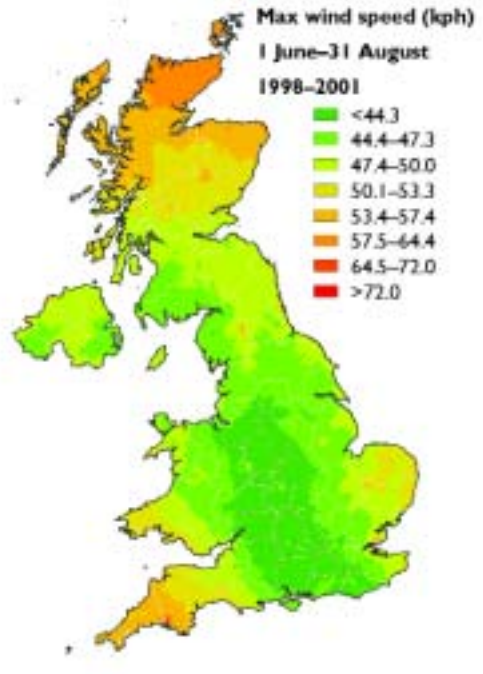
February 2005

Factors affecting lodging

These guidelines describe how lodging risk, or standing power, is altered by the environment and crop management. Lodging risk is scored on the 1–9 scale used in the *HGCA Recommended List*® for winter wheat.

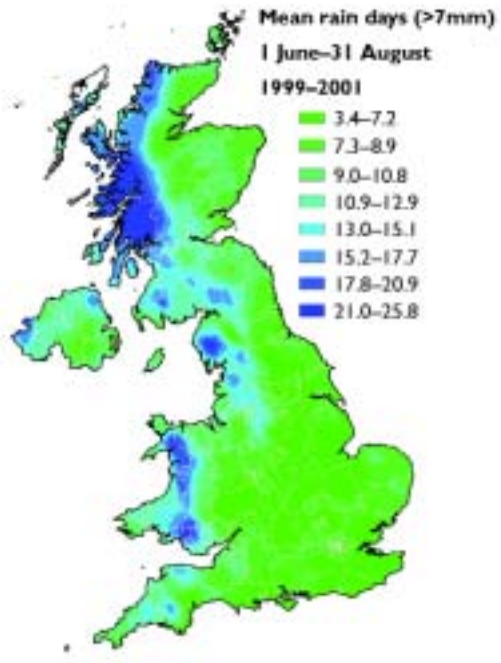
Environmental factors

Wind speed



Lodging risk increases as the wind leverage exerted on shoots rises. A 5kph increase in the maximum wind speed has the effect of reducing the varietal lodging resistance score by 1.

Rainfall



Just 6–11mm of rain in a day reduces soil surface strength and significantly increases the risk of root lodging. In a season with four extra days (compared with the farm's average) when rainfall exceeds 7mm, the varietal lodging resistance score will effectively be reduced by 1.

Soil strength

Soil shear strength has a large impact on anchorage strength and has most effect on root lodging risk. Soils with good crumb structure, low clay content or high organic matter tend to provide less anchorage and hence crops are at a higher lodging risk.

Soil strength also reduces significantly as moisture content increases.

Other factors

Long growing seasons, high fertility sites or eyespot infection can increase lodging risk. The varietal lodging resistance score decreases by 0.5 points for each 1t/ha yield increase.

Crops grown in fields with light and drought-prone soils tend to lodge less.

Latitude influences sowing date and length of growing season which affects lodging risk (see table).

Predicting lodging

Crop condition in spring can indicate future lodging risk.

- **Root lodging** risk increases when plant population exceeds 200 plants/m^2.
- **Stem lodging** risk increases when the canopy at GS31 is large (green area index of 2 or more, or ground cover of >60%) as such crops tend to be weak-stemmed.

Assessing and managing risk... ...stem a

To assess the likely threat of lodging to a specific crop, start with the resistance to lodging score for the variety i

Factor	Impact
Variety The HGCA Recommended List® provides a combined root and stem lodging resistance rating for each variety. Recent research shows that husbandry affects root and stem lodging to different extents.	A variety's risk of lodging is given on a 1–9 score. Varieties with a score without PGR of 7 or less can be considered "at risk".
Soil residual nitrogen The amount of nitrogen left in the soil after a previous crop can significantly affect lodging risk. See 'Further information' for references to RB209 and T516 which provide details on calculating crop N need and soil residual nitrogen.	High levels of soil N (SNS index 3 or above) promote thick, dense crop canopies that are more susceptible to stem lodging. Each unit increase on the soil nitrogen supply (SNS) index reduces stem lodging resistance score by 1.5. The effect on root lodging is about 0.75. Early-sown crops (before October) are affected most by high soil N levels.
Sowing date Early sowing leads to taller crops with a higher risk of both root and stem lodging. They also have denser canopies and often weaker stems. Adjustments (see right) are for central England. In northern Britain treat score for end September as zero.	For each week's delay in sowing, between mid-September and early November, a crop's lodging resistance score increases by 0.5.
Plant population Crops grown at higher plant populations have an increased risk of root lodging due to reduced anchorage strength. Stem strength is also reduced to some extent.	At plant populations of 200–400 plants/m^2, each increase of 50 plants/m^2 reduces stem lodging resistance score by 0.5 and root lodging by 1.0. Effects are greater below 200 plants/m^2.

Use stem and root lodging totals to identify how you can avoid either type of lodging.

Spring management action

	Total lodging resistance score Lodging risk
Fertiliser nitrogen Early (pre–GS31) or excessive applications of nitrogen increase tiller numbers and reduce stem strength. This increases the risk of both stem and root lodging. Nitrogen applications should always seek to optimise yield and quality.	A canopy management approach to nitrogen use (delayed and reduced applications) increases both root and stem lodging resistance by 0.5 points. Delaying the first split where soil fertility is moderate or high is unlikely to affect yield.
Plant growth regulators Tall crops are more prone to root and stem lodging. Plant growth regulators shorten crops to reduce both lodging risks to similar extents.	A single PGR application can increase both root and stem lodging resistance by 0.5 to 1.5, depending on variety and conditions.
Spring rolling Loosely-structured soils provide weak anchorage for crops. Spring rolling, in appropriate conditions, consolidates such soils to reduce root lodging risk.	Spring rolling before GS30 increases the root lodging resistance score by 1. Rolling after GS30 can damage the growing point.

nd root lodging may need different actions

n the field and then adjust that score for the crop's soil residual nitrogen, sowing date and plant population.

Look up your lodging resistance score without PGR from HGCA Recommended List®. Write that same score in both boxes 'A'.

	Example Claire

STEM LODGING

1	2	3	4	5	6	7	8	9	
Resistance score without PGR				A					6

SNS Index						
4	3	2	1	0	SNS 1	
-3	-1.5	0	+1.5	+3		
Adjustment for your SNS index				B		+0.75

Mid Sept	End Sept	Mid Oct	End Oct	Nov onwards	End Sept	
-2	-1	0	+1	+2		
Adjustment for your sowing date				C		-1

Plants/m²					175	
>400	400–300	300–200	200–150	<150		
-1.75	-1	0	+0.75	+1.5		
Adjustment for your plant population				D		+1.5
Total Use this total in the table below for guidance about reducing lodging risk				A+B+C+D		7.25

below 5	5–6.8	7–8.8	9–10	over 10
v. high	high	medium	low	very low
Delay & reduce N	Delay & reduce N	Delay N		
Full PGR	Full PGR	Single PGR	PGR if high yield forecast	

ROOT LODGING

1	2	3	4	5	6	7	8	9	
Resistance score without PGR				A					6

SNS Index						
4	3	2	1	0	SNS 1	
-1.5	-0.75	0	+0.75	+1.5		
Adjustment for your SNS index				B		+0.75

Mid Sept	End Sept	Mid Oct	End Oct	Nov onwards	End Sept	
-2	-1	0	+1	+2		
Adjustment for your sowing date				C		-1

Plants/m²					175	
>400	400–300	300–200	200–150	<150		
-3.5	-2	0	+1.5	+3		
Adjustment for your plant population				D		+1.5
Total Use this total in the table below for guidance about reducing lodging risk				A+B+C+D		7.25

below 5	5–6.8	7–8.8	9–10	over 10
v. high	high	medium	low	very low
Reduce N	Reduce N			
Full PGR	Full PGR	Single PGR	PGR if high yield forecast	
Roll	Roll	Roll		

For very high risk situations, preventative techniques may not always be sufficient to prevent lodging. Alterations to variety and cropping strategy may be required.

Plant growth regulator products

PGRs are generally most effective in good growing conditions. Splitting applications increases the chance of matching application timing with appropriate growing conditions. Chlormequat residues in grain are reduced when applications are made earlier.

Consult your buyer or processor before applying any PGR.

Applying a sequence of a gibberellic acid inhibitor followed by an ethylene producer (see below) will usually have at least an additive effect. In some instances, sequences may have more than the additive effect of individual treatments.

Before use, always read the label. If in doubt consult a BASIS-registered advisor.

Products include	Active ingredients	Mode of action		Application timing+
		gibberellic acid inhibitor	ethylene producer	
Meteor	chlormequat + imazaquin	3		Up to and including GS31
3C Chlormequat	chlormequat	3		Up to and including GS39
5C Chlormequat	chlormequat	3		Up to and including GS32
Stronghold	chlormequat + mepiquat chloride	3		Up to and including GS32
Moddus	trinexapac-ethyl	3		GS30–GS39
Upgrade	chlormequat + 2-chloroethylphosphonic acid	3	3	GS30–GS45
Cyclade	chlormequat + 2-chloroethylphosphonic acid + mepiquat chloride	3	3	From GS32 to GS39 Must be before GS47*
Cerone	2-chloroethylphosphonic acid		3	GS32–GS45
Terpal	2-chloroethylphosphonic acid + mepiquat chloride	3	3	From GS32 to GS39 Must be before GS47*

+ Application timings and rates vary between products. Always check product labels before use. * Timing varies with rate.

Acknowledgments

These guidelines were funded by HGCA and are based on recent R&D information provided by John Spink and Pete Berry, ADAS. HGCA is grateful to the following people for their comments on the guidelines: Hazel Doonan, AIC; Colin Mountfield-Smith, BASF; Dr Jim McVittie, HGCA; and Peter Harding, Mandops.

The guidelines were edited by Dr Clive Edwards, HGCA and Geoff Dodgson, Chamberlain.

Design by Chamberlain.

Further information

HGCA Recommended List® for wheat (annual)

Fertiliser Recommendations for Agricultural and Horticultural Crops (RB209). MAFF (now Defra) (2000), TSO, London Tel: 0207 242 6393

Nitrogen Recommendations for Cereals, Oilseed Rape and Potatoes, Technical note T516 (available from SAC) Tel: 01315 354000

HGCA Project Reports

(available from HGCA at cost or at www.hgca.com)

No. 169. Research to understand, predict and control factors affecting lodging in wheat

No. 234. Prediction of optimum plant population in winter wheat

No. 235. Reducing winter wheat production costs through crop intelligence information on variety and sowing date, rotational position, and canopy management in relation to drought and disease control

No. 305. To establish separate standing power ratings for stem and root lodging in the UK

No. 332. Minimising chlormequat residues in harvested grain

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