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IRRIGATED WHEAT FACT SHEET

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NORTHERN REGION

REDUCING LODGING RISK IN IRRIGATED WHEAT

Canopy management techniques are used around the world to decrease lodging risk and increase yield in high-yielding wheat crops, and were used in Queensland's first verified eight tonnes per hectare wheat crop.

KEY POINTS

- Lodging risk can be reduced by managing crops to limit canopy growth during tillering.
- The effectiveness of canopy management techniques varies with variety, soil type and region.

Lodging usually occurs when the top of the plant is so heavy and/or buffeted by wind that the stem buckles (stem lodging) or the root system is levered out of wet soil (root lodging).

Lodging is more likely to occur in crops with an extremely thick canopy at the beginning of stem elongation (GS31).

PHOTO: ALLAN PEAKE

Lodged wheat in a variety trial, Gatton, 2011.

Such crops tend to have weak stems and surface roots.

Lodging during flowering or early grain fill has the greatest impact on yield because it reduces the crop's ability to intercept sunlight efficiently, leading to fewer or smaller grains being set.

Severe lodging later in the season can reduce yield through shattering or increase costs by slowing harvest. Harvest delay can also increase the risk of sprouting.

Lodging risk

Weather conditions have a direct impact on lodging risk.

The risk of lodging can be reduced but can never be completely eliminated because of the chance of extreme weather events.

Most strategies to reduce lodging risk involve agronomic 'canopy management' techniques such as restricting nitrogen (N) inputs during early growth stages.

Canopy management refers to any method used to manage the way a crop canopy develops.

These techniques have not yet been widely tested on durum varieties, nor on every variety across every soil type or location, so growers are advised to test new agronomy or varieties on a small scale before committing to them.

Canopy management mechanisms

The risk of lodging in irrigated wheat crops can be reduced by limiting the amount of growth during tillering. This increases light penetration into the canopy, leading to greater stem strength and stronger surface roots.

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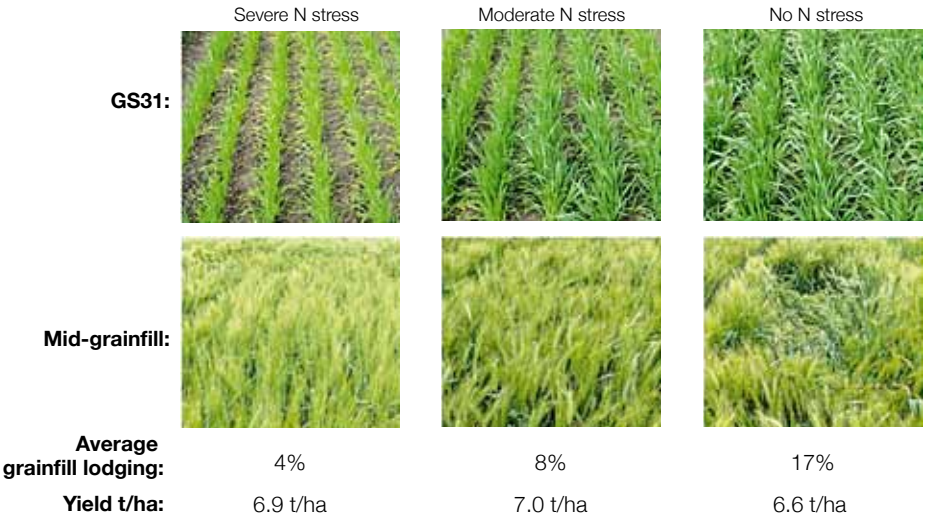
FIGURE 2 Crop canopy at GS31 and mid-grainfill, showing reduced lodging in N-stressed plots



Several canopy management techniques also restrict crop height, which decreases lodging risk by reducing leverage forces on the base of the plant.

Early growth and crop height can be controlled without reducing yield potential provided the crop has sufficient water and N after tillering, particularly in the lead up to flowering and grain fill.

In some circumstances where the risk of lodging is very high, such as in paddocks with high levels of N at seeding, there may be benefit from limiting yield to reduce the weight at the top of the plant.

Techniques for reducing lodging risk

1 Test for available soil N

Testing for soil N is the first step in managing a wheat crop to minimise lodging risk.

High levels of available soil N at sowing increase lodging risk (see Figure 1) by increasing tillering and shading in the young crop.

An 8 t/ha crop of irrigated wheat can be produced with 275 kg/ha of N, but in 2008 many lodged paddocks had 400 to 600 kg/ha of N available at sowing. In some of these paddocks growers applied further N at sowing, raising N levels to well beyond those needed to achieve the target yield.

2 Manage N levels

Bread wheat varieties can produce high yields with approximately 50 kg/ha of soil N at sowing and all fertiliser N applied in-season.

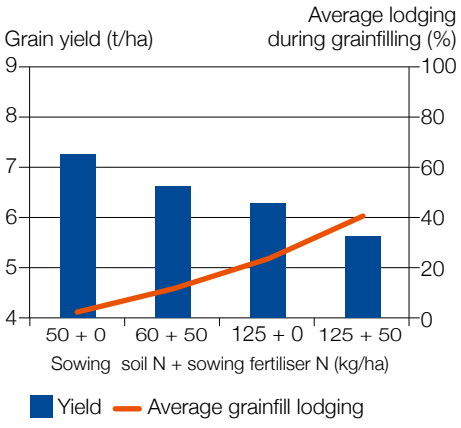
Crops managed in this way show moderate N stress (see Figure 2) during late tillering but can still achieve maximum yield provided N is applied and incorporated by early stem elongation (GS31).

To obtain a clear picture of the growth stage of a crop, select the main stem from five to 10 plants and split them with a knife to reveal the position of the embryo head and the length of the internodes underneath. The growing point separates from the stem base at GS31.

Applying N in crop makes it easier to achieve high grain protein levels (see Figure 3) because it ensures N is available during grain fill. Excessive early-season N is used by the crop to produce unnecessary biomass, increasing the risk of lodging and reducing the amount of N available for protein during grain filling.

The optimum timing and rate of N applied in-crop depends on variety, soil type, irrigation system and in-season rainfall. However, as a general rule, a high-yielding irrigated wheat crop should have

FIGURE 1 Average yield and lodging from a nitrogen rate trial on Kennedy(D), at Gatton, 2009. Fertiliser was applied at GS31 such that all treatments had equal, non-limiting N available for the rest of the season, and the crop was fully irrigated to ensure maximum N uptake in low N treatments.



Root lodging in a paddock at St George, October, 2008.

PHOTO: ALLAN PEAKE

50 to 100 kg/ha of N available at sowing.

The lower the soil N at sowing, the more critical it is to apply and incorporate N at GS31. Incorporation of applied N is important to ensure it is available to the crop.

Growers are advised to apply sufficient N at GS31 to bring the total N available to the crop at that stage to at least 200 kg/ha, then apply another 75 kg/ha of N when the flag leaf emerges.

When using this 'split' approach it is important to ensure that in-crop N is applied on time. This is likely to mean top-dressing before any imminent rain event or ensuring that aircraft or water-run application can be used if conditions make it impossible to get the spreader into the paddock.

FIGURE 3 Grain protein % for different timings of N application under irrigation for LongReach Crusader$^{\Phi}$ and Kennedy$^{\Phi}$, at Gatton 2011.

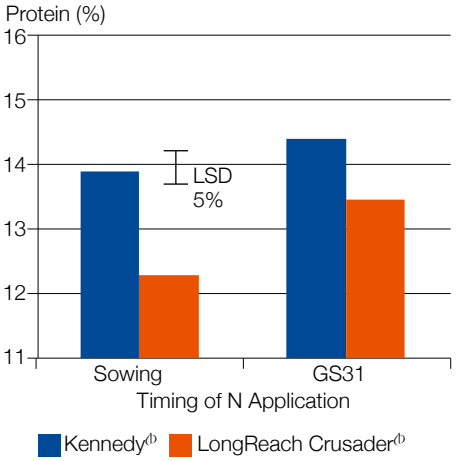
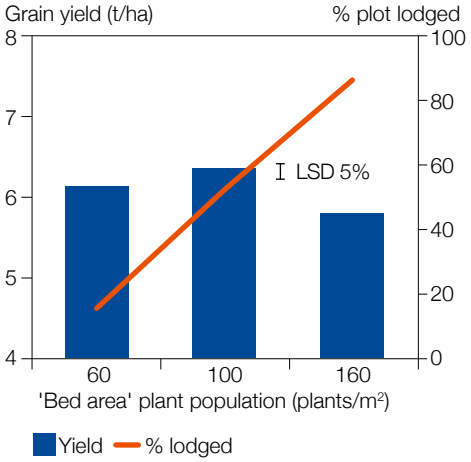


FIGURE 4 Grain yield and lodging % in three plant populations for Hyperno$^{\Phi}$ grown at Boggabri on a high N paddock (300 units N to 90 cm soil depth), 2009.



3 Grow lodging-resistant, short-season cultivars

Longer-season varieties tend to be more susceptible to lodging. This is probably because they have an extended tillering phase, making them more susceptible to excessive canopy growth under good growing conditions. They also tend to be taller and are prone to topple in a lodging event.

The worst lodging observed in 2008 was in crops of the long-season bread wheat varieties Strzelecki$^{\Phi}$, Baxter$^{\Phi}$ and EGA Gregory$^{\Phi}$.

Testing of a limited set of bread-wheat varieties under high-yielding conditions in 2011 indicated that the APH varieties Kennedy$^{\Phi}$ and LongReach Crusader$^{\Phi}$ have good levels of lodging resistance and high yield potential under irrigation, provided diseases are controlled.

LongReach Crusader$^{\Phi}$ was significantly less susceptible to lodging than Kennedy$^{\Phi}$ in high-N paddocks.

However, Kennedy$^{\Phi}$ produced significantly better protein levels than LongReach Crusader$^{\Phi}$ at Gatton (see Figure 3), highlighting the importance of testing variety and management changes ahead of large-scale adoption.

PHOTO: ALLAN PEAKE

Irrigated wheat on one metre beds at St George, 2008.

4 Calculate seeding rates for the sown area

Lodging risk increases with higher plant populations, as observed in a crop of Hyperno$^{\Phi}$ at Boggabri in 2009 (see Figure 4).

A maximum of about 100 plants per square metre is needed to achieve yield potential in paddocks with medium to high N at sowing, however, many paddocks that lodged in 2008 had plant populations of 150 to 300 plants/m^2.

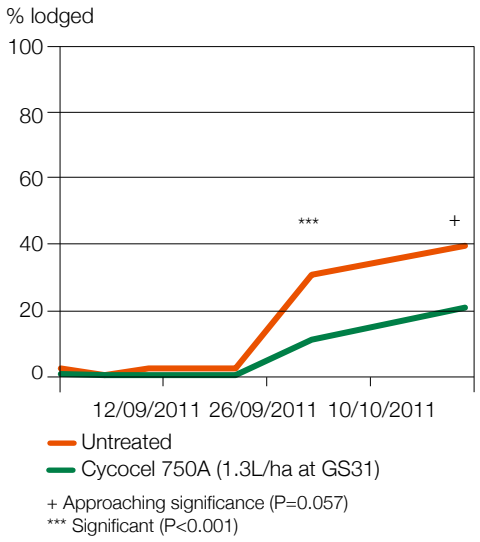
Plant densities up to 150 plants/m^2 should only be used to maximise yield potential in paddocks with very low levels of starting soil N or in late-sown paddocks.

Seeding rates need to be calculated on the actual area sown, not the paddock area.

Some of the high plant populations observed in 2008 were due to growers and contractors not adjusting seeding rates to allow for the unplanted furrows between the cropping beds.

A grower with 50 cm-wide unplanted furrows between 50 cm-wide beds sown to wheat would end up with double the target crop density if seeding rate was calculated on total paddock area instead of the actual area sown, which is half the paddock area.

FIGURE 5 The effect of Cycocel 750A on lodging in Kennedy$^{\Phi}$, at Gatton, 2011.



+ Approaching significance (P=0.057)
*** Significant (P<0.001)

5 Plant growth regulators (PGRs)

PGRs have been shown to reduce lodging risk by decreasing crop height but have not been readily available in the northern region.

Chlormequat chloride (Cycocel 750A) is currently registered for use in NSW and may soon be registered for use in Queensland. An experimental product from Syngenta might also be registered in Queensland.

Chlormequat chloride will reduce lodging risk in some circumstances (see Figure 5) and should be considered as part of a control package on high-nitrogen paddocks. However, it may have more effect on some varieties than on others.

In the comparison in Figure 5, chlormequat chloride reduced lodging but did not significantly improve yield, probably because the lodging occurred too late to affect yield.

6 Manage yield potential

Reducing yield potential by sowing late or applying less water could be the best strategy for growers who want to grow wheat in a paddock with high levels of N at sowing or who decide to grow a lodging-susceptible variety.

Sowing at a later than ideal time lowers lodging risk by reducing yield and crop height. Less yield means less weight at the top of the plant after grain fill. A shorter crop is less likely to be affected by wind and reduces the 'lever' between the head and the roots.

With extremely late-sown crops there is less need to employ other lodging-reduction techniques, such as delaying N application, because lodging risk is already reduced by the impact of later sowing.

Irrigation management can also reduce lodging risk by limiting yield. Some of the best-performing paddocks in 2008 were provided with sufficient water to produce 6 t/ha but not enough to achieve the highest yields possible. The result was high-yielding, profitable crops with no lodging.

USEFUL RESOURCES

Agronomy for high yielding cereal environments: varieties, agronomic strategies and case studies
Peake, *et al.* (2012), GRDC Northern Region Grains Research Updates, Goondiwindi, 6-7 March, 2012

Available online at:
http://www.grdc.com.au/Research-and-Development/GRDC-Update-Papers

MORE INFORMATION

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