Irrigation & climate

Lodging in rice

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Key findings

- Lodging is becoming a significant problem in rice as growers push for maximum grain yields, but some varieties are more prone to lodging than others.
- Management practices such as drill sowing, reduced sowing rate, reduced pre-permanent water nitrogen rate and draining on time reduce the potential for lodging.

Introduction

As growers push for maximum grain yield, lodging is becoming a significant factor in rice production, increasing the time and cost of harvest and often resulting in significant yield loss and reduced grain quality.

Several factors influence lodging susceptibility including seasonal weather, variety, sowing method, nitrogen rate and timing, plant density, water depth, time of draining and wind or rain as the crop nears maturity. Some of these factors can be managed, thus providing the opportunity to reduce crop lodging potential.

Factors that influence lodging susceptibility

Variety

Rice varieties vary considerably in their physical plant structural characteristics, which directly influence their lodging potential. Plant characteristics such as plant height, stem strength, sturdiness of the lower part of the plant and potential grain yield influence their ability to stand up at maturity, even with high grain yields.

Data collected on rice varieties in the 2015–16 and 2016–17 seasons show that varieties that are more prone to lodging are generally taller and have thinner stems as shown by decreased stem weight per centimetre (Table 1). Varieties such as Doongara, Topaz$^{\Phi}$ and Reiziq$^{\Phi}$ are relatively tolerant to lodging while Koshihikari and YRK 5 are highly susceptible (Table 1).

Sowing method

Aerial-sown crops are more prone to lodging than drill-sown crops, with delayed permanent water the most tolerant to lodging. Published research has found the lodging resistance under drill sowing was due to better root anchorage in the soil, as well as resistance to stem bending and breaking.

Water management also affects lodging resistance as crops that are fully flooded from germination grow taller and have thinner stems than rice crops grown with intermittent irrigation during the establishment and tillering periods.

Varieties that are very sensitive to lodging such as Koshihikari and YRK 5, should not be aerial sown.

Table 1. Average lodging score (1 = standing, 10 = fully lodged), plant height (cm) and stem weight (g/cm), for current rice varieties collected from experiments in the 2015–16 and 2016–17 seasons.

Variety	Lodging score (1 = less lodging)	Plant height (cm)	Stem weight (g/cm)
Doongara	1.0	75	0.028
Topaz	1.0	81	0.022
Reiziq	1.1	80	0.024
Sherpa	1.2	83	0.022
Opus	2.0	81	0.022
Langi	2.1	86	0.022
Viand	2.6	85	0.019
YRK 5	5.6	93	0.018
Koshihikari	6.1	91	0.018

Plant density

Higher plant densities can lead to increased lodging. Recent research on Viand and YRK 5 varieties has shown that higher plant densities (150 kg/ha seed ~ 250 plants/m^2) tend to be more prone to lodging than lower plant densities (50 kg/ha seed ~ 100 plants/m^2).

To reduce lodging potential it is important not to use higher than recommended sowing rates, especially for the small grain varieties, which also have many more seeds per kilogram.

Table 2 shows the recommended sowing rates for rice varieties, based on seed size and average varietal establishment percentages from field experiments. The smaller seed size varieties (e.g. Opus$^{\Phi}$) have many more seeds per kilogram so should be sown at a lower rate to achieve the same plant population.

Table 2. Sowing rates (kg/ha) required to meet plant population recommendations based on seed size and average varietal establishment percentages.

Variety	Sowing rate (kg/ha)
Reiziq, Illabong, Topaz	150
Sherpa, Langi, Doongara, Viand	130
Opus, Koshihikari, YRK 5	120

Nitrogen rate and timing

Nitrogen is very important in achieving high grain yields, but excessive nitrogen applied pre-permanent water (PW) increases lodging, especially for lodging-susceptible varieties.

Straw breaking strength and bending stress are both reduced due to lower stem cellulose and lignin content at higher nitrogen rates. High nitrogen rates also result in increased lodging susceptibility in rice by increasing tiller numbers, the length of lower internodes and plant height.

A nitrogen rate and timing experiment conducted on drill-sown YRK 5 at Finley in 2016–17 highlighted the effect that high rates of nitrogen applied pre-PW have on increasing lodging in susceptible rice varieties (Figure 1).

For varieties that are very susceptible to lodging (Koshihikari and YRK 5) it is important to reduce the rate of nitrogen applied pre-PW by up to 50% of the normal application for a Reiziq$^{\Phi}$ crop grown in the same field.

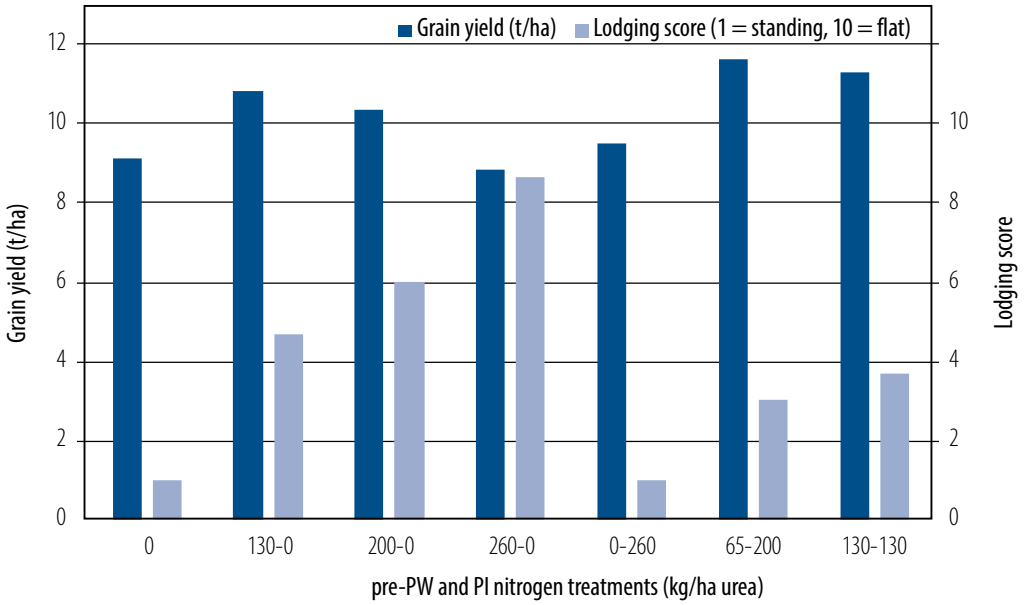

Figure 1. YRK 5 nitrogen rate and timing experiment grain yield (l.s.d. (P<0.05) = 3.8) and lodging score (l.s.d. (P<0.05) = 1.07) results for a range of pre-PW and panicle initiation (PI) nitrogen treatments (kg/ha urea). First number is pre-PW and second number PI applied urea (kg/ha).

Water depth during establishment

The need for the seedling to emerge from the water and intercept sunlight for photosynthesis, combined with the buoyancy provided by the water, result in taller and weaker plants in deeper water. It is important to keep water depth shallow during establishment and through to mid-tillering so plant height is not increased, which will increase crop lodging potential.

Draining

When to drain the water from a rice crop for harvest is a very important and difficult decision. If the field is drained too early, not providing sufficient soil moisture to take the plants to physiological maturity, the crop will 'hay off'. Haying off makes the stem very weak, resulting in considerable lodging, reducing grain yield and whole grain millout.

Weather

A high yielding crop is often finely balanced as it nears maturity, so anything that upsets the balance such as heavy rain or strong winds can cause it to lodge. You cannot control the weather, but harvesting as soon as the crop is mature helps to reduce the chance of lodging and also ensures good grain quality.

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