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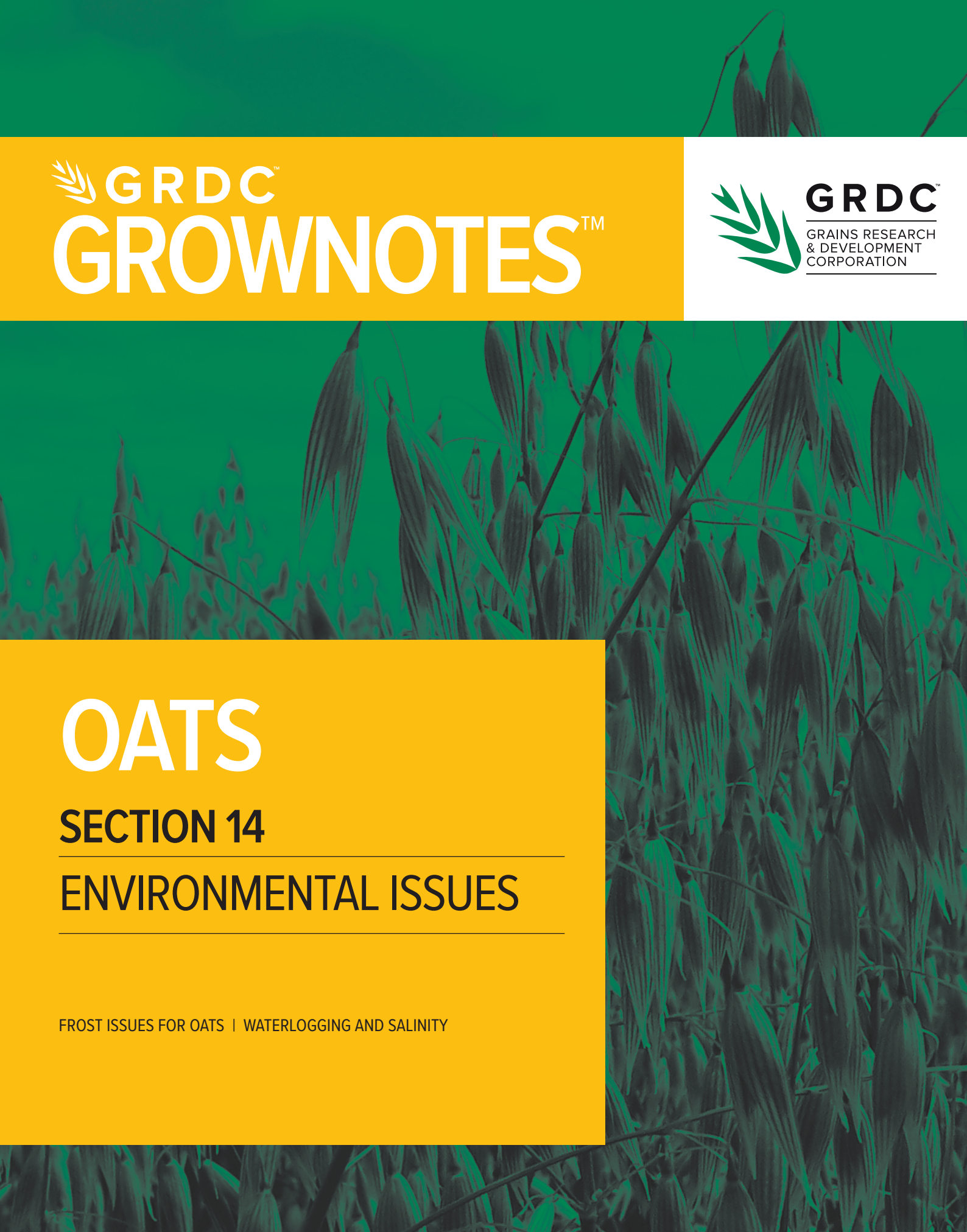

OATS

SECTION 14

ENVIRONMENTAL ISSUES

FROST ISSUES FOR OATS | WATERLOGGING AND SALINITY

SECTION 14

Environmental issues

More information

R Malik, B Paynter, C Parsons and A McLarty (2015) Growing oats in Western Australia for hay and grain, ResearchGate Bulletin 4798, DAFWA

http://www.grdc.com.au/GRDC-FS-FrostRisk

14.1 Frost issues for oats

Frost occurs on clear nights in early spring when the air temperature drops to 2°C or lower. Damage to crops from frost may occur at any stage of development but is most damaging at and around flowering. Symptoms of frost damage can occur as sterility and stem damage. Physical damage to the plant occurs when ice forms inside the plant tissue, as expanding ice bursts membranes, resulting in mechanical damage and dehydration injury. Frost damage can reduce both grain yield and quality. [1]

14.1.1 Industry costs

The real cost of frost is a combination of the actual cost, due to both reduced yield and quality, and the hidden cost of management tactics used to try to minimise frost risk. The hidden costs associated with conservative management to minimise frost risk include:

- delayed sowing and its associated yield reduction
- sowing less profitable crops such as barley and oats
- avoiding cropping on the valley floors, which also contain some of the most productive parts of the landscape.

The historical incidence of frost varies strongly across the agricultural regions of Western Australia (WA), with greatest occurrence in the central, eastern and southern regions. Northern and coastal regions in general have a lower risk. [2]

14.1.2 Impacts

Frost does not have any direct off-site impact on resource, biosecurity, economy or industry.

Frosts can have quite a large social impact as it happens so suddenly, unlike drought, which growers can adapt to mentally and financially by reducing further inputs as it unfolds. [3]

14.1.3 Frost tolerance of crops

Growers can lower frost risk in paddocks that frequently experience frost by growing either frost-tolerant crops or growing more pastures. If a grower wishes to sow a crop in a high-risk paddock, either for rotational or price reasons, they can choose a more frost-tolerant crop, as this will help reduce losses from frost damage. [4]

1 DAFWA (2016) Frost and cropping, https://www.agric.wa.gov.au/frost/frost-and-cropping

2 DAFWA (2016) Frost and cropping, https://www.agric.wa.gov.au/frost/frost-and-cropping

3 DAFWA (2016) Frost and cropping, https://www.agric.wa.gov.au/frost/frost-and-cropping

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More information

DAFWA (2016) Frost and cropping, https://www.agric.wa.gov.au/frost/frost-and-cropping

DAFWA (2000) Cereals: frost identification guide, Bulletin 4375, https://www.grdc.com.au/~/media/922066B417/21409E9EFC6014A333769B.pdf

DAFWA (2016) Growing oaten hay on frost-prone paddocks, https://www.agric.wa.gov.au/frost/growing-oaten-hay-frost-prone-paddocks

Frost-tolerant crops

Oats is regarded as the cereal crop least susceptible to frost damage, followed by cereal rye, barley, wheat and triticale. Oats is thought to be about 4°C more tolerant than wheat, while barley is thought to be about 2°C more tolerant. [5]

Table 1: Order of frost tolerance of cereal crops

Crop in order of tolerance (highest to lowest)	Notes
Oats	About 4°C more tolerant than wheat
Cereal rye	
Barley	About 2°C more tolerant than wheat
Wheat	
Triticale	

Canola is quite susceptible to frost and least tolerant to frost damage from flowering to the clear watery stage (about 60% moisture).

Field peas are the most frost-susceptible pulse crop, followed by faba beans and lupins.

14.1.4 Growing oaten hay on frost-prone paddocks

Growing oaten hay on frost-prone paddocks minimises the frost risk as it is cut soon after flowering, avoiding the frost-sensitive period. If severe frost damage does occur to other crops, baling them for hay may reduce economic loss. Oats are much more tolerant than other cereals to frost events that occur during vegetative growth and flowering. [6]

Figure 1: Growing hay on frost-prone paddocks can benefit farming systems and whole farm profitability. (Photos. DAFWA)

[5] DAFWA (2016) Frost and cropping, https://www.agric.wa.gov.au/frost/frost-and-cropping

[6] DAFWA (2016) Frost and cropping, https://www.agric.wa.gov.au/frost/frost-and-cropping

Costs:

- Growing hay is a capital-intensive enterprise.
- Hay is a high-risk enterprise as time of cutting and baling is critical for maintaining hay quality.
- Late spring rains, which benefit grain crops, can be detrimental to hay quality and ultimately returns.
- Transport can be expensive, depending on your location.
- The price of hay is highly volatile and depends on supply and quality each season.
- Hay removes large quantities of nutrients, particularly potassium, that need to be replenished for the following crop, increasing input costs. [7]

Benefits:

- Oats are generally more frost tolerant than wheat and barley so the likelihood of frost damage is reduced.
- Farm enterprises (and risk) become more diversified.
- Frost-prone paddocks usually have highly productive soils in frost-free seasons and growing hay capitalises on the production potential while minimising frost risk.
- Oaten hay provides a break crop to manage weeds. [8]

Management options

By sowing oats in frost-prone paddocks, the expectation is that frost damage will occur if a severe frost event is experienced after ear emergence.

Sustainability and off-site impacts

Hay crops remove greater amounts of potassium (about 10 kg/t) than other cereals harvested for grain. If potassium deficiency is diagnosed in a crop, applying 40 to 80 kg/ha as muriate of potash near seeding may give an economic yield increase if applied early enough.

References

R Malik, C Parsons, A McLarty (2010) Growing oats in Western Australia for hay and grain. Bulletin 4798. Department of Agriculture and Food, Western Australia.

M Rebbeck, G Knell (2009) Early season planning to minimise frost risk, Ground Cover Issue 79, March–April 2009. Grains Research and Development Corporation, Canberra.

MA Rebbeck, G Knell G (2007) 'Managing frost risk: a guide for southern Australian grains', D Reuter (ed)Grains Research and Development Corporation, South Australian Research and Development Institute, Adelaide.

14.2 Waterlogging and salinity

14.2.1 Diagnosing waterlogging and salinity in oats

Waterlogging and salinity often occur together. Oats are very tolerant of waterlogging but are more susceptible to salinity damage than wheat and barley.

[7] DAFWA (2016) Frost and cropping, https://www.agric.wa.gov.au/frost/frost-and-cropping

[8] DAFWA (2016) Frost and cropping, https://www.agric.wa.gov.au/frost/frost-and-cropping

Figure 2: Nitrogen deficiency symptoms. (Photo: DAFWA)

Figure 3: Old leaf discolouration and brown seminal root. (Photo: DAFWA)

Figure 4: Old leaf browning, necrosis from waterlogging and mild salinity. (Photo: DAFWA)

Figure 5: Water-stressed plant in saline patch. (Photo: DAFWA)

What to look for

Paddock

Poor germination or pale plants, in water collecting areas, particularly on shallow duplex soils.

Wet soil and/or water-loving weeds or salt-tolerant plants only as salinity increases.

Nitrogen-deficient plants with more leaf necrosis and premature death in more saline areas.

Plant: waterlogging symptoms

Plants are particularly vulnerable from seeding to tillering with seminal roots being more affected than later forming nodal roots. Waterlogged seed will be swollen and may have burst.

Seedlings may die before emergence or be pale and weak.

Waterlogged plants appear to be nitrogen deficient with pale plants, poor tillering, and older leaf death. If waterlogging persists, roots (particularly root tips) cease growing, become brown and then die.

Seminal roots are important for accessing deep subsoil moisture. If damaged by waterlogging the plants may be more sensitive to spring drought.

Plant: salinity symptoms

Plants have a harsh droughted appearance, and may be smaller with smaller dull leaves.

Old leaves develop dull yellow tips and die back from the tips and edge.

Premature death.

What else could it be?

Condition	Similarities	Differences
Diagnosing nitrogen deficiency in oats	Similar foliar symptoms	No root browning and less old leaf necrosis and symptoms are not confined to wet or saline areas.

Where does it occur?

Waterlogging occurs when there is insufficient oxygen in the soil pore space for plant roots to adequately respire.

Root-harming gases such as carbon dioxide and ethylene also accumulate in the root zone and affect the plants.

A number of situations increase the damage caused by waterlogging damage.

Deeper sown crops

Water accumulating or poorly drained areas such as valleys, at the change of slope or below rocks. Duplex soils, particularly sandy duplexes with less than 30 cm sand over clay.

Low-nitrogen-status crops

In very warm conditions when oxygen is more rapidly depleted in the soil.

Salinity affects growth by reducing plant root ability to extract water from the soil, and chloride toxicity.

Primary salinity occurs naturally in heavy-textured, high-alkaline and usually well-drained soils with high levels of salt in the subsoil. Most common are morrell-blackbutt loams on the edge of major valleys or greenstone soil and Dowak clay in the Esperance mallee. Oats yield poorly on these soils.

Secondary salinity has been caused by salt accumulation from saline water tables or seepages that have increased after land clearing.

Salinity is frequently accompanied by waterlogging in autumn and winter, which greatly increases plant damage.

Management strategies

Avoid sowing on saline areas.

Sow as early as possible with a higher seeding rate if there is a waterlogging risk.

On waterlogged sites treating crops with liquid UAN is a quicker and more efficient way to help the plants recover than using urea. This is due to a small amount of leaf uptake of nitrogen and that 50% of the nitrogen is in the nitrate form ready for root uptake.

Drainage may be appropriate on sandy duplex soils on sloping sites.

How can it be monitored?

Water levels can be monitored with bores or observation pits, but water tables can vary greatly over short distances.

Plants can be waterlogged if there is a water table within 30 cm of the surface and no indication of waterlogging at the surface. Observe plant symptoms and paddock clues and verify by digging a hole. [9]

[9] DAFWA (2015) Diagnosing waterlogging and salinity in oats, https://www.agric.wa.gov.au/mycrop/diagnosing-waterlogging-and-salinity-oats