

Research Note

Effect of Nitrogen and Irrigation on Blind Seed Disease in Perennial Ryegrass (*Lolium perenne* L.) cv. Grasslands Nui.

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ABSTRACT

The effects of irrigation and nitrogen application on perennial ryegrass (*Lolium perenne* L.) cv. Grasslands Nui seed germination and the incidence of blind seed disease caused by the pathogen *Gloeotinia granigena* (Quel.) T. Schumacher were investigated in a field trial conducted over the 1993/94 season. Two adjacent areas were sown, one of which was irrigated to maintain soil above 60% field capacity. Within each area, nitrogen (as urea) was applied at 0, 60, 120 or 180 kg N ha⁻¹. Blind seed infection occurred in both irrigated and non-irrigated plots. In the absence of nitrogen, seed from irrigated plots had the lowest germination (59%), and the highest blind seed infection (30%). Seed from irrigated plots which received nitrogen had an average germination of 87%, while blind seed infection averaged 8%. There was no significant difference in germination or level of blind seed infection among nitrogen rates of 60, 120 and 180 kg N ha⁻¹. For non-irrigated plots, seed germination (73-82%) and blind seed infection (12-19%) did not differ significantly among nitrogen treatments of 0, 60, 120 or 180 kg N ha⁻¹. As the inoculum source was external to the trial area, these results support the theory that plants which are able to utilise available nitrogen develop a greater capacity to resist blind seed infection.

Additional index words: *Gloeotinia granigena*, germination, seed quality.

EXPERIMENTAL AND DISCUSSION

Blind seed disease, caused by the pathogen *Gloeotinea granigena* (Quel.) T. Schumacher occurs infrequently in New Zealand perennial ryegrass (*Lolium perenne* L.) seed crops (Skipp and Hampton, 1996). The occurrence and incidence of the pathogen varies with season, region of production, cultivar and age of the crop (Hampton, 1994), but most of this variation is associated with environmental conditions in the spring (Hampton and Scott, 1980a). For example, following the very wet spring in 1992, *G. granigena* was detected in all seed lots from the 1993 harvest tested for the pathogen (Hampton, 1994), but after a relatively dry spring in 1994, very little blind seed was detected in seed lots from the 1995 harvest (Skipp and Hampton, 1996).

Both nitrogen fertilizer and irrigation can affect the incidence of blind seed disease. Hampton and Scott (1980b, 1981), Hampton (1987) and Mebalds (1993) have shown that spring application of nitrogenous fertilizers can reduce the incidence of the pathogen and significantly increase germination, although in Australia it was not always possible to achieve significant control by this method (Mebalds, 1993). Cool, wet conditions during anthesis are known to increase blind seed disease severity, and Mebalds (1993) demonstrated that irrigation increased the level of blind seed disease in a ryegrass seed crop. Rolston, Rowarth, DeFilippi and Archie (1994) reported the effects of irrigation and nitrogen application on seed yield of perennial ryegrass cv. Grasslands Nui.

In this research note we report the effects of those two management factors on the germination and incidence of blind seed disease in seed harvested from that trial.

Trial design and experimental management have been previously reported (Rolston *et al.*, 1994), but briefly, perennial ryegrass cv. Grasslands Nui was sown at 10 kg ha⁻¹ on 26 March 1993 at Lincoln (lat. 43°S) into an Eyre/Templeton complex soil from which a prior wheat crop had been harvested. Field capacity for this soil type occurs at 36% soil moisture, while permanent wilting point is at 15% soil moisture. Two adjacent areas were established, one of which received irrigation on three occasions (a total of 130 mm from 22 October to 19 November) to maintain the soil above 60% field capacity. The other area was not irrigated, and moisture stress occurred from late September (beginning of stem elongation) until just before anthesis. Regular rainfall then increased soil moisture in the non-irrigated area to around 24% at anthesis (*cf.* 33% for the irrigated area). Within each area, urea was applied at 0, 60, 120 or 180 kg N ha⁻¹ (as three split dressings on 8, 22 September and 6 October), each N treatment being replicated five times in a randomized block design. Seed was hand harvested at 42% seed moisture content, ambient air dried, threshed and cleaned. Germination was assessed using internationally agreed methodology (ISTA, 1993). Blind seed disease was recorded by examining non-germinated seeds at the end of the prescribed test period. The glumes were separated to expose the embryo and caryopsis, and the number of seeds with symptoms of the disease (caryopsis spotting

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and shrunken embryos; Matthews, 1980) recorded.

Blind seed infection occurred in both the irrigated and non-irrigated plots (Table 1). The incidence did not differ among nitrogen treatments for the non-irrigated plots, but for irrigated plots, the addition of nitrogen significantly reduced the incidence of blind seed. However, there were no differences among the three rates of applied nitrogen. Germination did not differ among the non-irrigated nitrogen treatments, but was significantly increased when nitrogen was applied to irrigated plots (Table 1).

As the seed sown was free of the pathogen, the previous crop was a cereal, and no apothecia were observed within the trial area, presumably the inoculum source was outside the trial field and the primary ascospore inoculum was wind borne. Apothecial production, subsequent ascospore release, and secondary conidial spread are favoured by wet, humid conditions during anthesis and seed development (Hampton and Scott, 1980a), and the difference between the germination and blind seed data for the irrigated versus non-irrigated plots in the absence of nitrogen therefore seems logical. However Rolston *et al.* (1994) reported that regular rainfall occurred at the trial site from anthesis until harvest, so that environmental conditions at the time the inoculum was carried into the trial area and during secondary spread presumably did not differ for the irrigated and non-irrigated plots. Ascospore inoculum obviously reached all plots; what is not known is why in the non-irrigated plots, secondary infection was apparently not as great as it was for the irrigated plots which did not receive nitrogen. This requires investigation.

In irrigated plots, nitrogen application reduced blind seed disease, a result previously reported (Hampton and Scott 1980b; Hampton 1987). However the mechanism for this response is still not clear. Hampton and Scott (1980b) proposed that nitrogen reduced blind seed disease by changing the physiological susceptibility of the plant to attack. An alternative explanation is that lodging induced by nitrogen application creates a physical barrier to the movement of inoculum (Gorman, 1940). Lodging began pre-anthesis in irrigated plots and by anthesis had reached a score of around 5 (on a scale of 0 = no lodging to 10 = completely flat) for plots that had received nitrogen. Lodging was minimal in the non-irrigated plots (Rolston *et al.*, 1994). However, while lodging may conceivably create a barrier to the upward movement of ascospore inoculum (Gorman, 1940), the inoculum for this trial came from outside the trial area. While upright seed heads in the non-lodged non-irrigated plots may have been more

accessible to wind-borne inoculum, lodging in the irrigated plots was not so severe that inoculum would have been prevented from making contact with the seed heads during anthesis.

Mebalds (1993) considered that his results supported the theory that nitrogen improved the plant's capacity to resist infection rather than creating a physical barrier of leaves which prevented ascospores landing on florets. The results from this trial also suggest that the plant's ability to utilize nitrogen in the absence of moisture stress (Rolston *et al.*, 1994) improved resistance to the incoming wind-borne inoculum and subsequent secondary spread. However this is speculative and requires further detailed study before any firm conclusions could be drawn.

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Table 1. Effect of nitrogen application and irrigation on the germination and incidence of blind seed disease in seeds of perennial ryegrass cv. Grasslands Nui.

Nitrogen kg ha ⁻¹	Irrigated		Non-irrigated	
	germination (%)	blind seed disease (%)	germination (%)	blind seed disease (%)
0	59	30	73	19
60	84	10	81	13
120	88	8	82	12
180	89	6	81	13
LSD P<0.05	9.7	7.8	9.6	8.5

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