

# Effects Of Foliar Diseases On Northern Region Grain Production In The 1998 Winter Cropping Season

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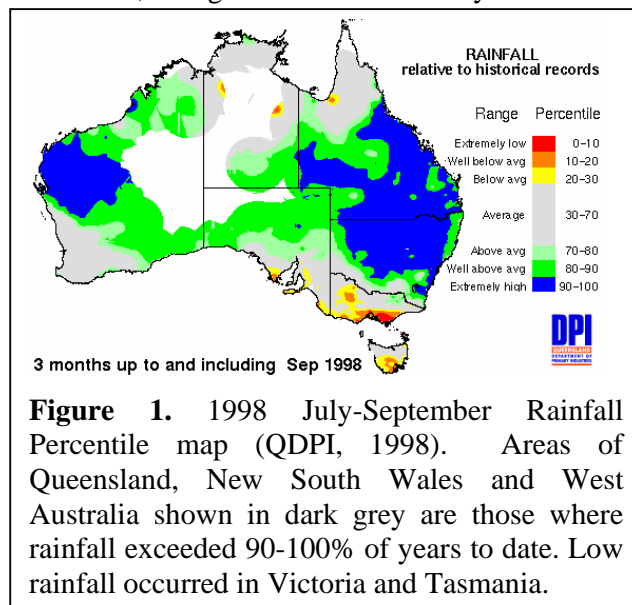
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## Summary

Severe foliar disease epidemics in commercial barley crops were the result of extreme seasonal conditions in the GRDC Northern Region during 1998. Data from Stage 4 trials and in-situ observations were used to examine the distribution and effects of barley blotch diseases. The data highlighted the large GxE interaction due to the disease epidemics and stressed the need for caution when extrapolating genotype performance. Variety reactions to the blotch diseases were assessed and damage to Northern Region barley crops estimated.

## Introduction

The Northern Region includes grain-growing areas of Eastern Australia north from latitude 33°S and produces approximately 15% of the Australian barley crop. However, in the early to mid 1990s, drought conditions severely restricted the Regional grain production. In 1998, the



prevailing "El Nino" weather pattern was reversed and winter rainfall in most parts of the Northern Region reached record levels (Fig. 1). The resulting mild, wet weather was perfect for the development and spread of stubble borne fungal pathogens of barley; in particular spot form net blotch (SNB) (*Pyrenophora teres* f. *maculata*), net form net blotch (NNB) (*P. teres* f. *teres*) and spot blotch (SB) (*Bipolaris sorokiniana*). It also caused widespread waterlogging. Because of the regularity of rainfall events, approximately 10 to 14 days apart, multiple generations of pathogens occurred and inoculum levels rapidly increased to produce major epidemics

throughout Queensland (Qld) and northern New South Wales (NSW). Rees et al (1999) reported that blotch/waterlogging interaction greatly reduced regional barley yields, with diseases causing crop losses worth \$50,000,000.

## Results and Discussion

During 1998, different distributions were observed for SNB, NNB and SB. The first report of SNB in the North occurred during 1995. Most commercial barley varieties were susceptible (Table I) and in 1998, it caused widespread damage throughout south Qld and northern NSW. Gilbert virulent NNB pathotypes caused major damage to barley trials and crops in south Qld, but were not obvious in NSW where Skiff virulent NNB was detected at relatively low levels. Gilbert and Skiff were, respectively, the main feed barleys in Qld and northern NSW. SB was mostly restricted to specific areas; namely the Dawson-Callide valleys, the central Qld highlands, the Qld/NSW border district and the NSW Northern Rivers area. SB distribution was most likely affected by localised climatic effects (as it requires higher ambient temperature than the NBs) and possibly a local supply of inoculum from ubiquitous grass species. As temperatures increased later in the season SB became widespread.

**Table 1.** Variety Response to Infection with Net and Spot Form Net Blotches.

Test Disease Comments	1997 Nurseries Adult plants % Infection/Lesion type		1998 Glasshouse Screening Seedlings 1=Resistant, 10=Susceptible			1998 Yield Trial - Hermitage Adult plants 1=Low disease, 9=High disease; lesion type		
	NNB	SNB	NNB Isolate "A"	NNB Isolate "B"	SNB	NNB 7/9/98	SNB 7/9/98	NNB&SNB 25/9/98
Gilbert	100VS	65S	10	10	6.5	6.7	3.3	8.7 net
Lindwall	75S	75S	5	9	5	4.0	4.0	7.3 n&s
Skiff	45MR	65S	9	5.5	4	3.0	3.7	6.7 spot
Tallon	70S	60S	8.5	9.5	5	4.0	3.3	5.0 spot
Grimmett	80S	55SMS	10	10	5	7.0	3.0	8.0 net
Schooner	35R	45MSMR	7.5	6	3.5	1.7	2.7	3.3 spot
Kaputar	30R	70S	7	3.5	6	1.3	4.0	7.0 spot

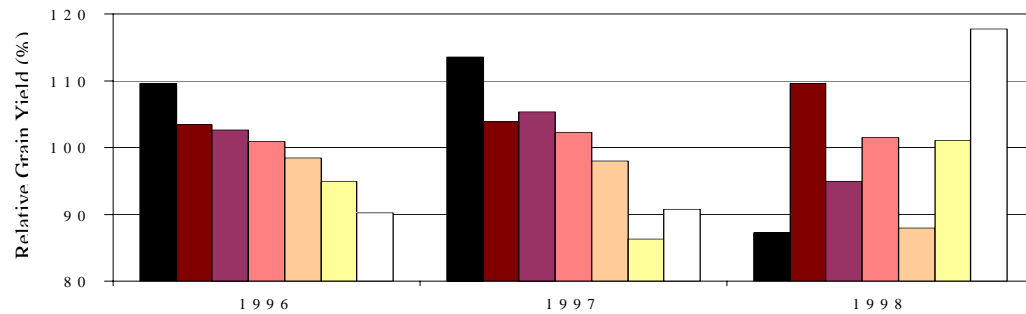
The varieties listed in Table 1 have been sown as controls in Northern Barley Improvement Program (NBIP) trials for several years. Figure 2 shows grain yield data for these varieties expressed as a percentage of the annual mean yield of all seven. In 1995 (not shown), 1996 and 1997 the response patterns were quite consistent for both Qld and northern NSW. However, the 1998 yields were distinctly different from the earlier seasons and between the two sub-regions. These different varietal responses were due to the epidemics and the occurrence of specific diseases within sub-regions and at individual trial sites.

Gilbert and Grimmett sustained heavy damage from NNB in most south Qld trials. Yield losses in Lindwall were also significant, mostly because of its higher susceptibility to SNB. Schooner, with moderate resistance to NNB and SNB suffered the least. Not all northern NSW sites were severely affected by disease. SNB and some late scald infection caused moderate to heavy damage at some NSW sites, with susceptible lines such as Skiff, Lindwall and Kaputar suffering the worst losses.

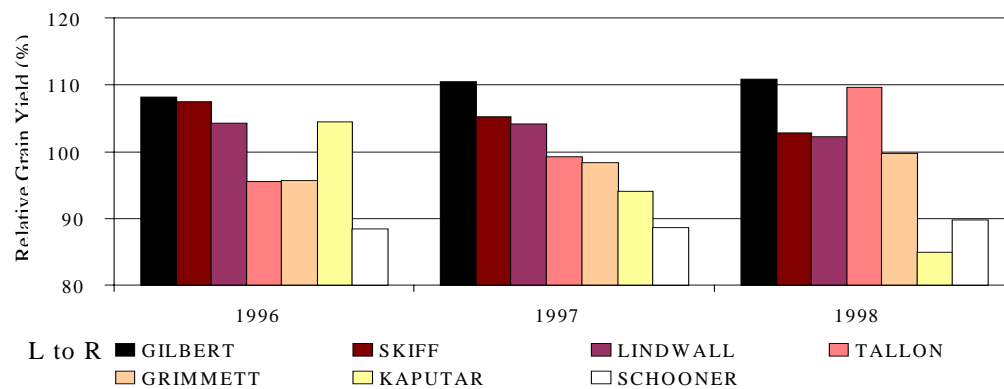
The yield differences due to disease related GxE interaction meant that caution needed to be applied in analysing and interpreting the 1998 NBIP trial data. Firstly, it was clear that the seasonal data set would be of little use in assessing true yield potential of breeding lines, but instead must be interpreted as only indicating line performance under the epidemic conditions. Secondly, the data pointed out the need for caution when using predictive tools to make

assumptions about variety performance between areas. For example, yield predictions made for northern NSW on the basis of Qld data would have been highly erroneous.

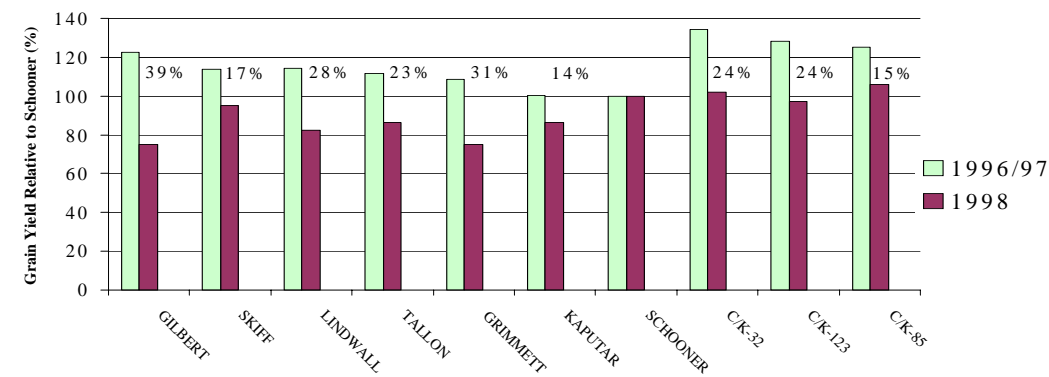
**Figure 2a.** Grain Yield Relative to the Mean of Seven Barley Varieties in South Queensland Stage 4 Trials, 1996-1998.



**Figure 2b.** Grain Yield Relative to the Mean of Seven Barley Varieties in Northern New South Wales Stage 4 Trials, 1996-1998.



**Figure 3.** South Queensland Yield Relative to Schooner – 1996 & 97 Vs 1998.



By comparing 1998 south Qld yield data with previous seasons, estimates of the average yield loss of individual varieties relative to Schooner, the variety most resistant to NB, could be made (Figure 3). It was estimated that Gilbert lost at least 39% of its grain yield relative to Schooner across south Qld. Furthermore, in a "normal" south Qld season (e.g. 1996),

Schooner's plump grain (>2.8mm) fraction averaged greater than 90%. It was much less in 1998 (Table 2). From this data, it would not be unreasonable to suggest that Schooner had suffered average yield losses of more than 10% under the heavy inoculum pressure. It is therefore proposed that the average yield loss in south Qld Gilbert trials was in excess of 50%. At the worst affected trial sites where many varieties were virtually defoliated by the NNB/SNB complex prior to anthesis, our estimates of yield loss in the most susceptible varieties exceeded 65%. These figures are likely to be consistent with commercial losses.

Although resistant to NNB, Skiff and Kaputar lost 25-35 % of their yield in south Qld trials because of their susceptibility to SNB . These data, plus the anecdotal evidence of heavy crop losses from SB in the Dawson-Callide, Northern Rivers and Qld/NSW border region highlight the need to breed for resistance to all three diseases in the Northern Region.

The malting variety Tallon appears to possess some adult plant resistance to NB. Seedling tests show Tallon to be very susceptible to most Gilbert virulent NNB pathotypes (Table I). However, 1998 field observations suggested reduced infection and slower disease development of NNB and, possibly, SNB in Tallon compared to susceptible varieties. Tallon appeared to maintain green leaf area for longer, consequently suffering less yield loss than NNB susceptible varieties (Figures 2 & 3). Although this resistance was insufficient to stop damage to crops under very heavy inoculum pressure, it is possible that under lighter disease it may offer useful protection. The resistance appears to be heritable as, several lines from Tallon crosses demonstrated lower disease levels than either parent. Similar resistance appeared to be operating in Cameo/Koru breeding lines, especially Cameo/Koru-85, despite both parents having been tested as susceptible to NNB.

**Table 2.** Barley Yield and Grain Size Measurements from Four 1998 Stage 4 Trial Sites.

	Grain Yield (T/Ha)					Plump Grain (% >2.8mm)					Screenings (% <2.2mm)				
	1998					1996	1998				1996	1998			
	Mean	Kmbl	Bkst	Kbun	Pirn		Mean	Kmbl	Bkst	Kbun		Pirn	Mean	Kmbl	Bkst
<b>Gilbert</b>	2.38	1.57	2.69	2.95	2.32	71.2	13.4	17.4	1.9	9.9	2.7	7.4	13.7	42.4	10.7
<b>Lindwall</b>	2.67	1.54	3.10	2.87	3.17	75.2	1.3	1.5	1.3	11.6	3.3	22.7	26.8	29.8	13.5
<b>Tallon</b>	2.88	1.60	3.17	3.32	3.44	81.8	10.7	16.9	11.5	35.9	2.3	21.0	8.2	14.2	2.4
<b>Grimmett</b>	2.50	1.74	2.42	2.97	2.88	85.3	7.1	10.9	5.5	16.2	1.3	16.7	18.6	14.5	16.2
<b>Kaputar</b>	2.67	1.75	2.91	2.78	3.23	90.3	3.6	3.1	2.4	26.8	1.0	30.0	18.4	25.6	10.9
<b>Schooner</b>	3.32	2.09	3.75	3.20	4.23	93.3	35.4	38.0	34.3	33.8	1.0	3.1	5.5	4.0	9.0
<b>Mean</b>	2.74	1.71	3.00	3.02	3.21	82.8	11.9	14.6	9.5	22.4	1.9	16.8	15.2	21.8	10.5
<b>LSD (5%)</b>		0.27	0.36	0.32	0.60										

Grain size distribution of hand harvested quadrats was assessed using a SORTIMAT grain separator (Table II). All varieties demonstrated very large reductions in grain size as compared to the more typical 1996 season. Kurumbul (Kmbl) received over 750mm of rain during the growing season and was severely waterlogged. The plants did not tiller well under those conditions and poor growth restricted yield potential. A moderately heavy infection of SNB and SB further reduced grain size. Brookstead (Bkst), Kaimkillenbun (Kbun) and Pirrinuan (Pirn) were typical of most remaining south Qld sites, in that favourable growing conditions gave crops with exceptionally high yield potential prior to disease infection. Pirrinuan was the first planted of these three sites and initially grew very well but became heavily infected with NNB and some SNB just after anthesis. Lodging was severe. Kaimkillenbun was moderately to heavily infected with NNB and SNB prior to anthesis. Brookstead was planted last and had more SNB than NNB, with the infection occurring post-

anthesis. Variety yield and grain size data reflect the combined effects of planting time, duration and timing of disease infection and degree of susceptibility to the dominant disease/s. As most crop infections took place post-tillering, reduced grain size appears to have been the main factor contributing to barley yield losses during 1998.

The data thus obtained by the NBIP during the 1998 season has led to a better understanding of the effects and epidemiology of the barley blotch diseases. It has also enabled useful assessment of blotch resistance in commercial and experimental lines and an understanding of the levels of resistance needed to protect the Northern barley crop.

### **Acknowledgments**

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### **References**

Rees R.G., Strong W.M. and Neale T.J. (1999) The Effects of Foliar Diseases on the Production of Wheat and Barley in the Northern Region in 1998. Report to the GRDC Northern Panel.

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