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Take-all control with silthoifam (Latitude); Economic implications from a six-year rotation experiment

by

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CONTENTS

ABSTRACT

The aim of this project was to assess the effect of silthiofam (Latitude) seed treatment on a range of wheat crops grown in different rotational positions. Effects on disease progress, take-all decline, as well as on the economics of rotational options, were assessed.

Field experiments were undertaken in each of six harvest years 1998,1999, 2000, 2001, 2002, and 2003, at ADAS Rosemaund in Herefordshire, a site characterised by moderate to severe take-all infection.

In all experiments autumn plant population, grain yield, specific weight, and thousand grain weight were measured. Take-all incidence, index, shoot number and number of clean and infected roots, were also assessed at least four times each season, with the timing and intensity of monitoring depending on take-all progress. In the first five seasons cereals were grown both with and without Latitude seed treatment. In the last year all cereals were sown without Latitude to assess effects on take-all decline.

The results demonstrated the classical pattern of initial rapid yield loss and subsequent recovery when entering a long run of consecutive wheat crops. The initial yield loss at 3.5 t/ha was much greater than has been found in other work, the average yield loss in a second wheat compared to a first being closer to 1 t/ha. The subsequent yield recovery in 3rd and 4th wheat crops of about 1.5 t/ha still left a yield deficit compared to first wheat of 2 t/ha. The magnitude of the yield effects observed may be related to the use of Equinox, a variety considered to be a particularly poor non-first wheat.

Second wheat crops showed a consistent benefit from use of Latitude. In the four years when these crops were grown with and without Latitude, the seed treatment reduced take-all indices and increased yield by an average of 0.47t/ha. Some positive effects of Latitude on take-all progress and yield were observed in third and subsequent wheats, although these tended to be less consistent. Results indicated that take-all decline may be mediated by factors that only have a significant effect on the secondary phase of disease progress during the spring and summer. This contrasts with the timing of the effect of Latitude, which has been shown to impact solely on the very earliest 'primary' phases of the epidemic in the autumn. Results from the final season indicate little or no evidence of a direct or indirect effect of seed treatment on the development of take-all decline. It has previously been reported that a severe take-all infection is needed before significant take-all decline can develop. It may be that, as the effect of Latitude is to delay the take-all epidemic, there are sufficiently high levels of take-all late in the life of the crop for the development of take-all decline.

Substantial increases in take-all severity were observed where the third cereal in a run of four was winter barley. This contradicts other findings on which previous advice has been based - that suggests growing winter barley as the second and third cereal to avoid the worst take-all years and then reverting to wheat.

Making the decision whether or not to use Latitude will ultimately be a financial one. Given the average responses to Latitude use reported in this study of 0.19 t/ha for all non-first wheat crops the blanket use of Latitude would not be economic. A more targeted approach would, however, be economic and using Latitude on all second wheat crops where the average response was 0.47 t/ha would provide an average return of £14/ha. This work was conducted on the take-all prone, silty clay loams at ADAS Rosemaund. The economic benefits of Latitude use may be greater where non-first wheat is grown on lighter soils, as take-all epidemics may be expected have a greater impact on water availability and yield under these conditions.

SUMMARY

Introduction

Take-all is generally of greater importance for UK growers than for many continental competitors. Survey data for the UK, Germany and France shows that the percentage of non-first wheats at risk from take-all were 36-59%, 15-23% and 10-13% respectively for the years 1990 to 1995 (P. O'Reilley, Monsanto, pers. comm.). A survey of plantings made in the UK in autumn 2003 shows that of the 1.95m ha of wheat planted only 560,000 ha was non-first wheat, a record low level of 28%. However, set-aside, in the form of natural regeneration, has also been found to be an incomplete break from take-all (Jones *et al*., 1996). Thus first wheats following set-aside are also at risk.

Take-all is arguably the most significant constraint on the number of cereal crops grown within the rotation. The impact on crop performance has been described in previous HGCA-funded research which has shown that by reducing root function, take-all reduces the efficiency with which crop inputs are captured and/or utilised (Spink *et al*. 2002). These effects can, however, be ameliorated through choice of variety whereby specific genotypic traits can minimise the deleterious effects of root loss (Spink *et al*., 1998, & 2002).

Recently effective seed treatment fungicides have been introduced which offer some control of take-all. One of these (a novel fungicide molecule - silthiofam), the subject of this study, was commercially released (as Latitude) in the UK in 2001. Take-all control is likely to have a significant impact on the cereals industry, improving the profitability of a significant proportion of the UK wheat crop and reducing a major constraint on rotational planning.

Work by Monsanto has demonstrated that silthiofam shows a high level of specificity against the causal agent of take-all *(Gaeumannomyces graminis* var. *tritici*). Average yield responses to silthiofam seed treatment in field experiments carried out by Monsanto, on winter wheat in the UK, where visual symptoms of take-all where present, ranged from 1.0 to 3.2 t/ha. Across all experiments, the response to treatment averaged 0.8 t/ha on second wheats to 1.0 t/ha on third wheats. These average results agree with earlier calculations of yield loss attributable to take-all (Vaiydanathan *et al.*, 1987), but hide a wide range of variation, which arises from a number of interrelated processes, namely:

I. The progress of the epidemic
II. The effect of the epidemic on crop growth
III. The impact of variety, rotation and sowing date on take-all control.

These processes interact with genotype, environment and crop management decisions.

The effects of sowing date, rotation, and variety on the severity of take-all and likely yield loss have been extensively studied (eg Hornby, 1998). From this body of work has arisen best practice management of wheat crops at risk from take-all. Second or subsequent crops therefore, tend to be sown later than first wheats and where possible a take-all tolerant variety chosen. Recent HGCA-funded work has investigated how this 'best practice' should be altered when using a take-all seed treatment (Spink et al., 2002, Knight, 2001). Because seed treatments reduce take-all severity but do not control it completely this work has largely concluded that in order to optimise crop output, established best practice for non-first wheat should be maintained.

Take-all builds up in the soil through successive cereal crops and usually reaches most damaging levels in second to fourth cereal crops. Thereafter, disease severity diminishes due

to a phenomenon called 'take-all decline' (Rovira and Wildermuth, 1981). The yield of continuous wheat does not, however, return to the level obtained in first wheat. A one year break from susceptible cereal crops reduces the level of the disease, such that it has little or no impact on yield (Wiese, 1987), but also 'breaks' take-all decline.

Rotational strategies have been developed to reduce the impact of take-all, but these strategies limit a grower's ability to respond flexibly to changes in market demand and the gross margins of different crops. Typical arable rotations include a non-cereal break crop after 2 or 3 cereal crops, to prevent take-all impacting on the yield of the next wheat crop. An alternative approach is to grow wheat continuously and rely on take-all decline to minimise the effects of the disease.

The severity of take-all across a rotation depends on a dynamic balance between the pathogen and antagonistic / competitive soil micro-organisms. During a first wheat crop the level of the take-all organism in the soil is low, as it competes poorly in the absence of a susceptible host during the preceding break. Substantial disease development during subsequent crops in the rotation seems to be required before an antagonistic microflora can establish and initiate take-all decline.

The advent of seed treatments to diminish the impact of take-all has potentially significant effects on rotational decisions. This impact could arise from a simple change in the economics of growing a non-first wheat compared to a break crop. Given the changes to the Common Agricultural Policy proposed under the mid-term review, and the decoupling of production and support payments, the comparison may be between the economics of growing a non-first wheat and leaving the land uncropped. In addition to these purely economic decisions there are potential biological implications from their use. The seed treatment may have a direct effect on the antagonistic soil microflora, resulting in delayed development of take-all decline or its failure to develop at all. There are also potential indirect effects on take-all decline development. It has been suggested that before take-all decline can develop a crop must suffer a high level of take-all infection (Bateman, 1994). Therefore, the use of a seed treatment that suppresses take-all development may inhibit take-all decline development even in the absence of any direct fungicidal effect on the antagonistic microflora.

Aims and objectives

1. To investigate the impact of take-all control on rotational decisions and the financial implications of the inclusion of the chemical in arable cropping systems.
2. To investigate the implications of Latitude on take-all decline.

Materials and methods

Experimental design and treatments

The experiment was sited at ADAS Rosemaund in Herefordshire. The soil is a silty clay loam of the Bromyard series, which is deep, moisture retentive and of high yield potential, although moderately susceptible to yield loss due to take-all. Traditionally second wheat would be grown occasionally but usually barley is grown in preference for its greater tolerance to take-all Third and subsequent cereals would usually be avoided.

This experiment was designed to test the extent to which: (i) the use of silthiofam removes rotational constraints by preventing disease in second to fourth wheat crops, and (ii) control of take-all during the high risk part of a rotation interferes with the development of take-all decline, causing long-term dependence on chemical support for continuous wheat.
Three separate rotations were set up using winter wheat, winter barley and oilseed rape. The experiment was partially phased meaning that all bar 1 year of each rotation is represented in each year. The rotations were continuous winter wheat, a 3-course oilseed wheat rotation and a 4-course rotation with oilseed rape, 2 wheats and a barley crop. In each rotation all cereals were grown either with or without silthiofam.

Table 1. Experimental design.

Rotation	1997	1998	1999	2000	2001	2002	2003
1	ww1	ww2+	ww3+	ww4+	ww5+	ww6+	ww7
1	ww1	ww2-	ww3-	ww4-	ww5-	ww6-	ww7
1	ww1	ww2+	ww3+	ww4+	osr	ww1+	ww2
1	ww1	ww2-	ww3-	ww4-	osr	ww1-	ww2
1	ww1	ww2+	ww3+	osr	ww1+	ww2+	ww3
1	ww1	ww2-	ww3-	osr	ww1-	ww2-	ww3
1	ww1	ww2+	osr	ww1+	ww2+	ww3+	ww4
1	ww1	ww2-	osr	ww1-	ww2-	ww3-	ww4
1	ww1	osr	ww1+	ww2+	ww3+	ww4+	ww5
1	ww1	osr	ww1-	ww2-	ww3-	ww4-	ww5
2	ww1	ww2+	osr	ww1+	ww2+	osr	ww1
2	ww1	ww2-	osr	ww1-	ww2-	osr	ww1
2	ww1	ww2+	ww3+	osr	ww1+	ww2+	ww3
2	ww1	ww2-	ww3-	osr	ww1-	ww2-	ww3
2	ww1	osr	ww1+	ww2+	osr	ww1+	ww2
2	ww1	osr	ww1-	ww2-	osr	ww1-	ww2
3	ww1	wb+	osr	ww1+	ww2+	wb+	ww4
3	ww1	wb-	osr	ww1-	ww2-	wb-	ww4
3	ww1	ww2+	wb+	osr	ww1+	ww2+	ww3
3	ww1	ww2-	wb-	osr	ww1-	ww2-	ww3
3	ww1	ww2+	ww3+	wb+	osr	ww1+	ww2
3	ww1	ww2-	ww3-	wb-	osr	ww1-	ww2
3	ww1	osr	ww1+	ww2+	wb+	osr	ww1
3	ww1	osr	ww1-	ww2-	wb-	osr	ww1

WW = winter wheat
WB = winter barley including some winter malting varieties
OSR = Oilseed rape
+ = treated with silthiofam

This experiment was designed as a phased experiment to run for seven years looking at a sub-set of rotational combinable crop options with or without take-all control.

Each treatment was replicated four times. Treatments were also fully randomised within blocks, with a plot size of 3.5 m by 24 m. In order to minimise soil and inoculum movement between plots over the life of the study the experimental area was ploughed across the direction of the plots and secondary cultivations done in the same direction as the plots.

The wheat variety was cv. Equinox in all years. All rotational positions were given the same level of inputs which were according to good local practice. Latitude was applied to both wheat and barley at a rate of 25 g silthiofam per 100 kg seed, oilseed rape was always grown untreated with silthiofam. Both wheat and barley were grown for animal feed markets.

In the final year of the study all plots were sown with non-Latitude treated seed, to assess the impact of previous seed treatment use on take-all decline, and determine the implications of removing take-all control at any point within the rotation.

Measurements

Autumn plant populations were assessed after full emergence but prior to tillering by counting plant number in five 1m lengths of row per plot.

Detailed take-all assessments were also done on a minimum of four occasions in each season on a replicated sub-set of plots chosen to represent each rotational position present in that year. Each take-all assessment was done on a sample of 20-25 plants/plot taken from one 12m length of the plot. A take-all index (TAI) score was given to each plant, depending on the % of the root system colonised by the fungus using a modified form of that described by Clarkson and Polley (1981):

Scale	Category
0% = healthy roots	A
1-10%	B
11-30%	C
31-60%	D
61-100%	E

$$\frac{(0a+10b+30c+60d+100e)}{t} = \text{TAI}$$

where *a,b,c,d,e* represent the numbers of plants in each of the five categories A-E respectively and *t* is the total number of plants examined.

A measure of take-all incidence (% plants infected) was also made from the same data by expressing the sum of *b-e* as a percentage of *t*.

Additional counts of the number of clean and infected root axes per plant and shoot number per plant were made. These data allow the degree of take-all infection to be expressed as number of disease roots per plant or shoot. Conversely the same data can be used calculate the number of healthy roots per plant or shoot which may to indicate the likely tolerance to further root loss.

Grain yield was assessed by taking a 2.25 x 10m combine swath from the end of the plot which had not been previously destructively sampled. Grain yields were corrected for moisture and are expressed at 85% dm. Grain moisture and specific weight were assessed

using a Dickey-John GAC moisture meter. Thousand grain weight was assessed by counting accurately using a numigral seed counter and weighing approximately 500 seeds per plot.

Results

Take-all

1998

The take-all index going into winter was relatively high at 7.3% on the second wheat, but lower averaging 4.6% on the barley. Apparent disease severity declined in subsequent assessments in January and February, this may be due to root growth outstripping disease development resulting in an apparent reduction in disease. By March disease severity was beginning to increase on untreated crops but there was no apparent increase where Latitude had been used, resulting in a significantly lower severity. Disease incidence was at this time, relatively low at 30% on untreated wheat and again significantly lower on Latitude treated wheat at 15%. Through June both disease severity and incidence increased rapidly, by the end of the month the disease was present on 100% of wheat plants sampled. Final disease severity was relatively high at a Take-all Index (TAI) of 88% and 54% on untreated wheat and barley respectively. Significant improvements in disease control due to seed treatment were observed by the final disease assessment with Latitude-treated crops had final indices of 77% on the wheat and 43% on the barley ($p<0.001$, $df=49$) (figure 1).

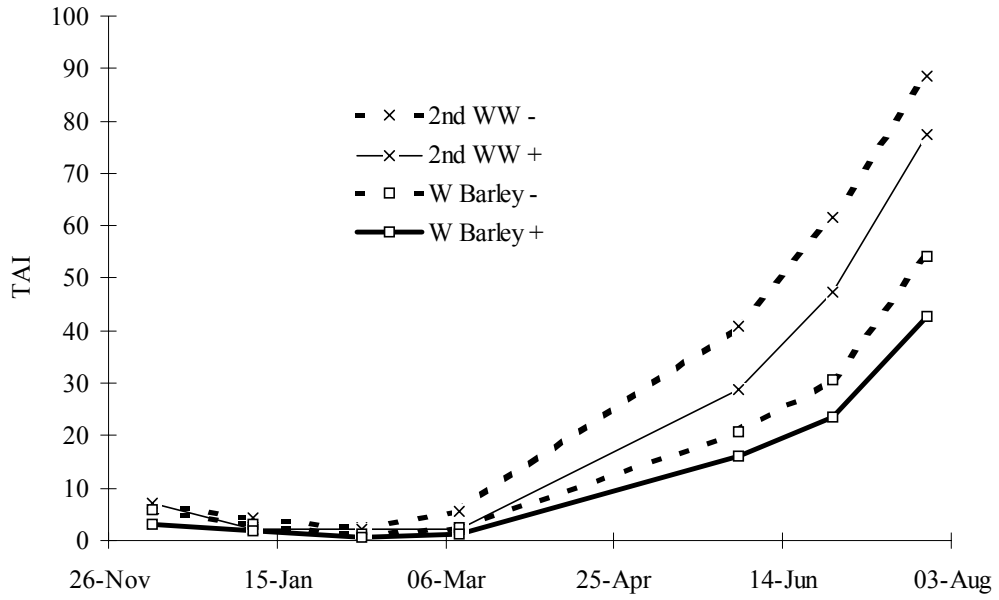

Figure 1 : Changes in take-all index with time in 1997-98

1999

Relatively high levels of take-all were observed in early spring with indices of 6.4-8.3%, and 64 – 78 % of plants infected. At this stage in the season there were no statistically significant differences between first or third wheat or barley, or indeed between Latitude treated or untreated. The disease continued to develop through the spring and summer reaching 100% incidence and a moderately high index of 46% on untreated third wheat by the start of July. In three of the four assessments made between April and July the barley had significantly lower take-all index and incidence than either of the wheat crops. There was a tendency for the first wheat to have less take-all than the third wheat but this was not statistically significant (figure 2).

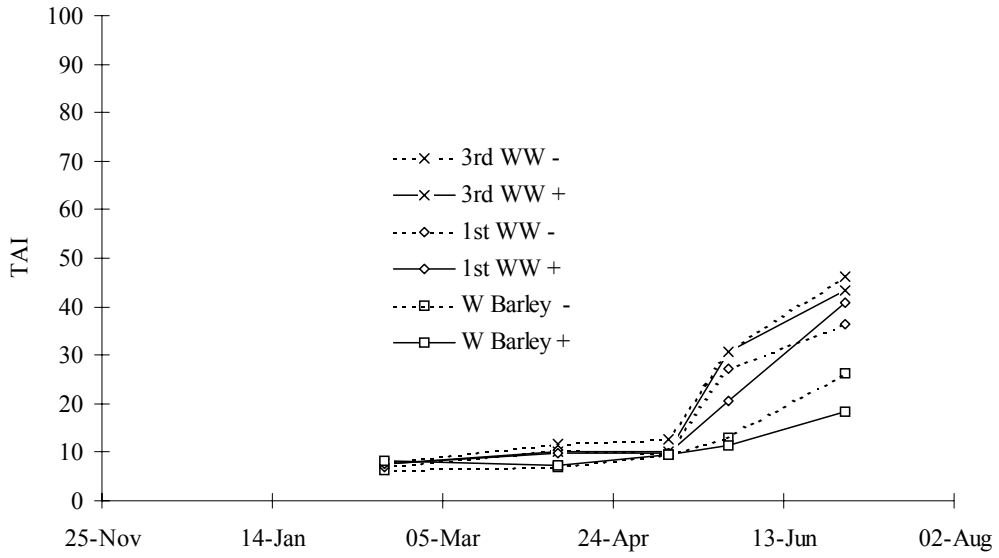

Figure 2: Changes in take-all index with time 1998-99

Assessments of healthy and disease root numbers per plant and shoot were made to see if this could provide a better explanation of responses to Latitude treatment. In this year, however, there were no significant effects of Latitude and the only consistent effect of rotation was lower root numbers per shoot in barley than wheat, due primarily to a greater number of shoots per plant.

2000

Take-all levels in the second and fourth wheat crops were comparable early in the season to the third wheat in the previous year. First wheat and barley crops had significantly lower take-all indices with levels less than half those of the second or fourth wheat crops. Take-all continued to develop in the second wheat crops ending up in July with a similar level to the third wheat the previous year. The fourth wheat having had comparable indices to the second wheat in December and March had significantly less in the May assessment, by then being statistically indistinguishable from either the first wheat or barley in terms of its index, but still comparable to the second wheat in terms of incidence. This may imply that take-all decline had been having an impact in the fourth wheat but that it was only significantly affecting the epidemic in the spring (figure 3).

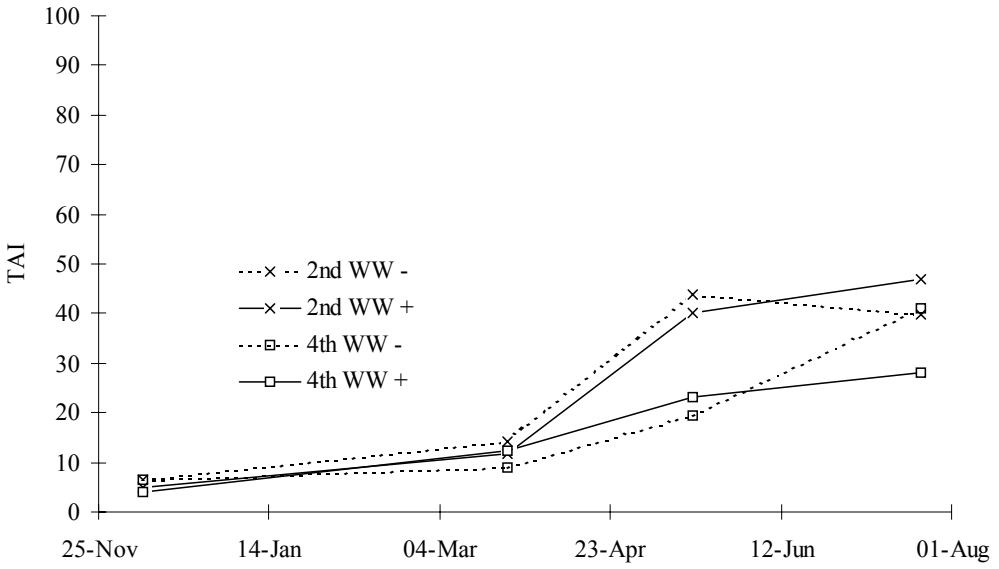

Figure 3: Take-all progress in 2nd and 4th wheat crops in 2000

By the final assessment in July the untreated fourth wheat had a disease severity similar to the second wheat; however there was significantly less disease in the Latitude-treated fourth wheat. Between May and July there had been no apparent increase in disease severity on the second wheat but it had continued to increase on the barley and first wheat.

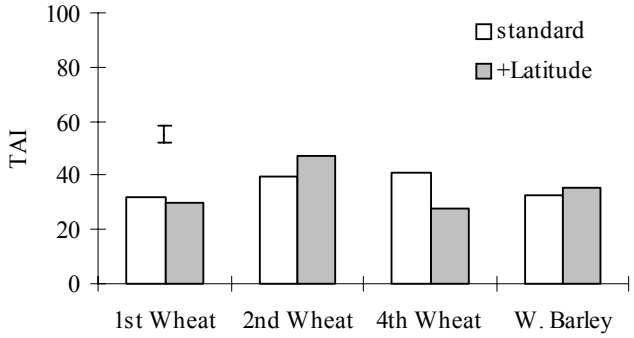

Figure 4. Take-all index scores in 2000, at the final assessment on 23 July. Error bar indicates the LSD at the 5% level for differences between seed treatments.

Root number assessments made at the first assessment showed that first wheat and barley had significantly fewer infected roots per plant than either the second or fourth wheat. With consecutively later assessments the number of infected roots per plant gradually increased on the second wheat whilst the number on the fourth wheat increased much more slowly until it was indistinguishable from the first wheat or barley. Perhaps indicating the development of take-all decline as a spring and summer phenomenon rather than having an effect in autumn and winter.

2001

Both take-all index and incidence were lower in the late winter/early spring than in the previous 2 years, perhaps due to the very wet and poor condition of the soil over winter. Take-all index remained relatively low through to May but incidence increased steadily reaching 98% on second third and fifth wheat crops by the end of May. There were no

statistically significant differences between either rotational positions or due to seed treatment in either take-all incidence or severity in the three assessments made between January and May. By the time of the final assessment on 16 July there had a rapid increase in take-all severity with indices of over 60% in both second and third wheat crops. The severity had also increased rapidly on the fifth wheat but less than on the second and third reaching just over 50% when untreated. There was less disease still in the barley with just over 40% and the least at less than 20% in the first wheat crops.

The rotational position had a significant effect on the level of take-all index ($P<0.001$ 25 df), with the first wheat having around 80% lower TAI scores compared to the second wheat.
There was also an apparent reduction in take-all severity in the third wheat of over 20% due to Latitude use, there was a slightly smaller reduction in the fifth wheat, but these differences were not statistically significant.

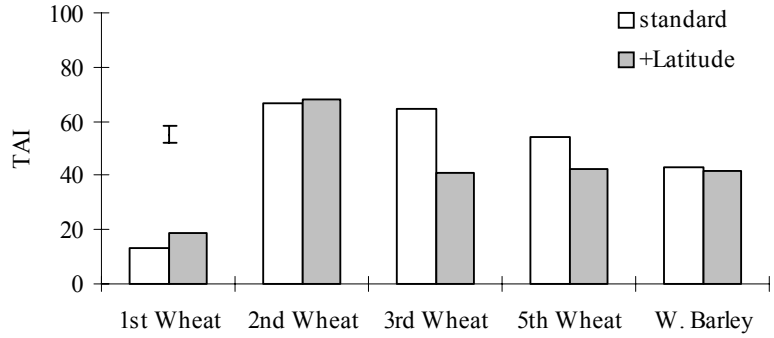

Figure 5. Take-all index scores in 2001, at the final assessment on 16 July. (Error bar represents LSD at 5% level for seed treatment differences).

2002

In 2002 there was a particularly early assessment of take-all was made on 28 November in conjunction with an early and severe take-all epidemic. This showed up significant differences between rotational positions in both incidence and severity of the disease, with the first wheat having significantly lower levels of both than other wheat positions or the barley, which in turn was lower than the non-first wheat crops. In almost every rotational position the use of Latitude resulted in a significantly reduced incidence and severity of the disease (figure 6 & appendix 2)

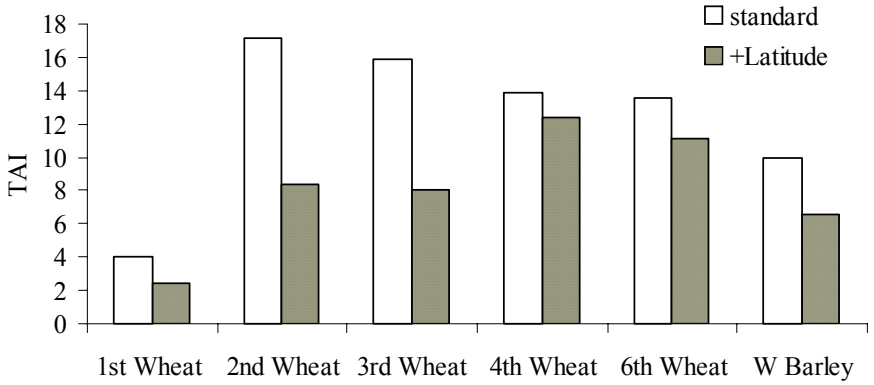

Figure 6. Take-all index scores in the 2001/02 season, at the first disease assessment on 28 November. (LSD at 5% level for seed treatment and rotation differences =1.94 and 3.36 respectively).

The disease epidemic continued to develop over winter and by the assessment in mid-January there were indices in excess of 20%. There was little development of the disease during early spring with little or no increase in disease severity between January and March. Between March and April disease incidence and severity again started to increase. Between mid-May and mid-June there was a rapid increase in disease incidence reaching 100% in all plots and disease severity reaching 80% in the untreated 4th wheat (figure 7). The differences between rotational positions and treatment with Latitude continued well into the late spring and early summer, in the case of the second wheat the Latitude effect persisted through to the final assessment.

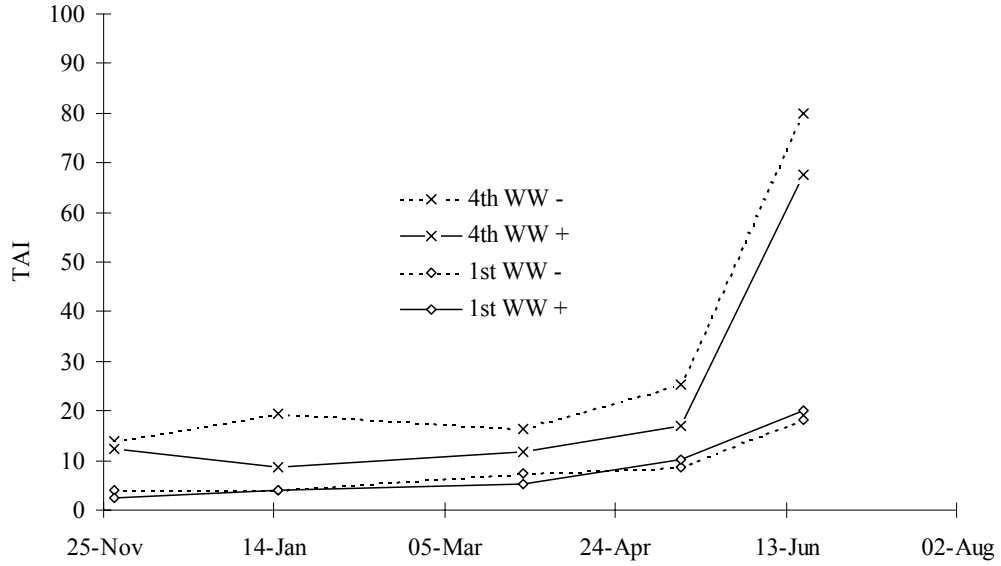

Figure 7. Disease progress in 1st and 4th wheat in 2001/2002

As well as reducing disease severity, at the first assessment Latitude also reduced the number of infected roots and increased the number of healthy roots per shoot or plant (figure 8). These effects persisted for most of the season but were no longer statistically significant by the end of the season when the differences were diminished.

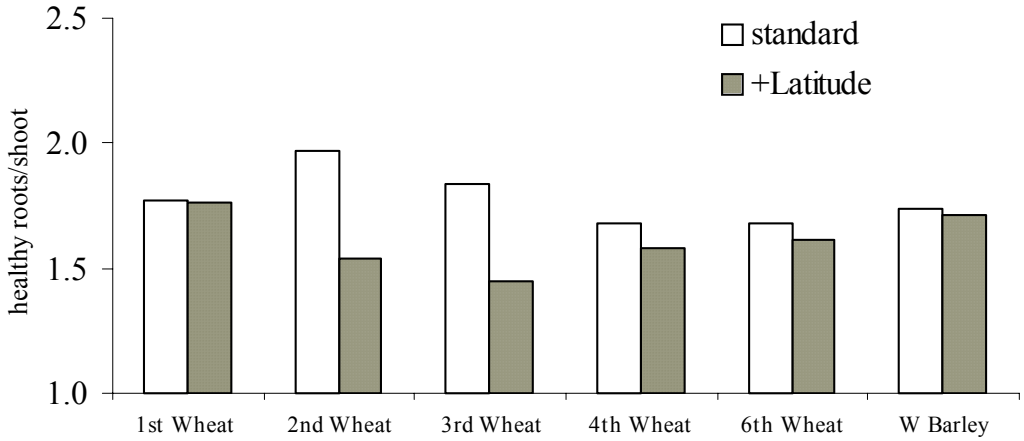

Figure 8: Healthy roots per shoot, in the 2001/02 season at the first disease assessment on 28 November (LSD at 5% level for seed treatment and rotation differences =0.316 and 0.548 respectively)

2003

There was again a fairly early take-all epidemic with indices up to 10% in early December. The highest disease severity occurred on the fourth wheat following winter barley. There was, however, no apparent residual effect of previous Latitude use.

Take-all severity expressed as an index was largely reflected in the number on infected roots per shoot or plant, with least in first wheat and most in wheat following winter barley (figure 9). Despite the high early disease levels the final take-all severity was not as high as in some previous seasons reaching a maximum index of 52%. During the season first wheat consistently had the lowest disease severity and until the final assessment the wheat following barley the highest. The wheat crops following other wheat crops started with very similar incidence but as the season progressed wheat in short runs particularly the second but also to a lesser extent the fourth, developed significantly higher disease severity than the crops following longer runs of wheat such as the seventh or fifth wheat.

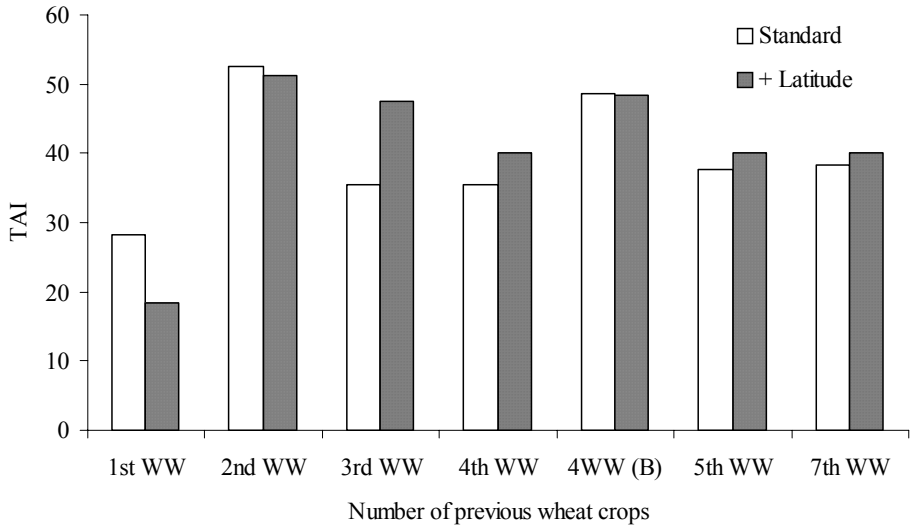

Figure 9: TAI on 12 August, as affected by rotational position and previous seed treatment use, 2003. (LSD at 5% level for seed treatment and rotation differences =7.33 and 13.72 respectively)

There was little evidence of any significant residual effect of Latitude of any great magnitude, assessments on 30 Jan, and 26 June indicated a significantly higher severity following Latitude use but these differences were numerically small.

Grain yield

1998

In the first year of the experiment as rotations were being phased in the only cereals grown were second wheat and barley. Untreated wheat yield was very low at 4.24 t/ha reflecting the very severe take-all epidemic where final take-all index reached 80%. There was a significant effect of seed treatment with the Latitude treated plots averaging a yield response of 0.58 t/ha. The barley was significantly higher yielding than the wheat with the untreated barley outyielding either untreated or treated wheat at 6.46 t/ha (figure 10). There was, however, no evidence of a yield response to Latitude seed treatment in the barley.

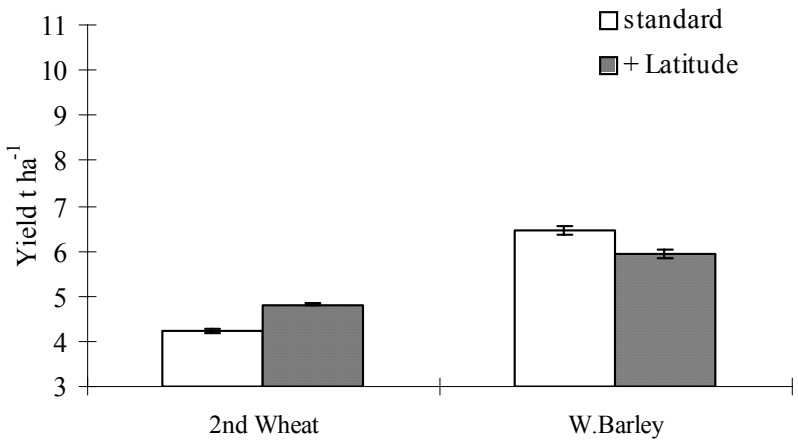

Figure 10: Yield as affected by rotational position and seed treatment use, 1998. Error bars indicate the SE of the mean.

1999

In 1999 the first wheat crops yielded 9.25 t/ha reflecting more closely the yield potential of the site than the previous year. Untreated third wheat was significantly lower yielding than the first at 8.05 t/ha and the barley lower still at 7.1 t/ha (figure 11). The better performance of the third wheat compared to the performance of the second wheat the previous year is a reflection of the lower take-all severity with a final index on the untreated of 51%, either as a result of a seasonally less severe epidemic or potentially due to the development of take-all decline.

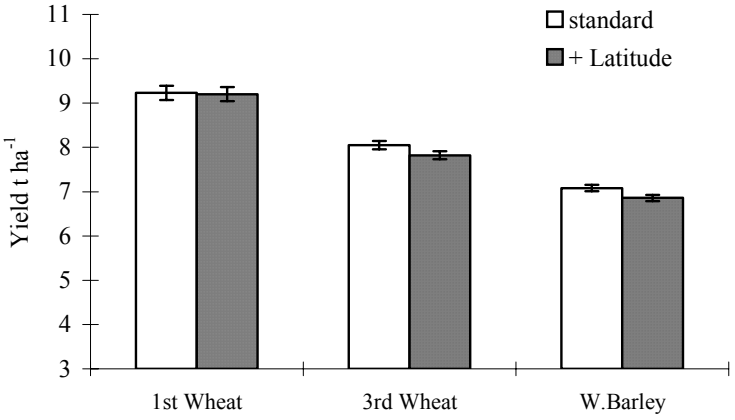

Figure 11: Yield as affected by rotational position and seed treatment use, 1999. Error bars indicate the SE of the mean.

2000

First wheat yields were slightly disappointing at 8.8 t/ha, and there were severe yield losses in second wheat crops which untreated average just under 5.8 t/ha. There was a significant yield response to Latitude treatment in the second wheat, which yielded on average 0.59 t/ha higher than the untreated. Untreated fourth wheat yielded nearly 1 t/ha higher than the second wheat

at 6.65 t/ha. This was close to the yield of the 3rd cereal, winter barley, which yielded 6.7 t/ha (figure 12). There was no evidence of a yield response to Latitude use in either the 4th wheat or the barley.

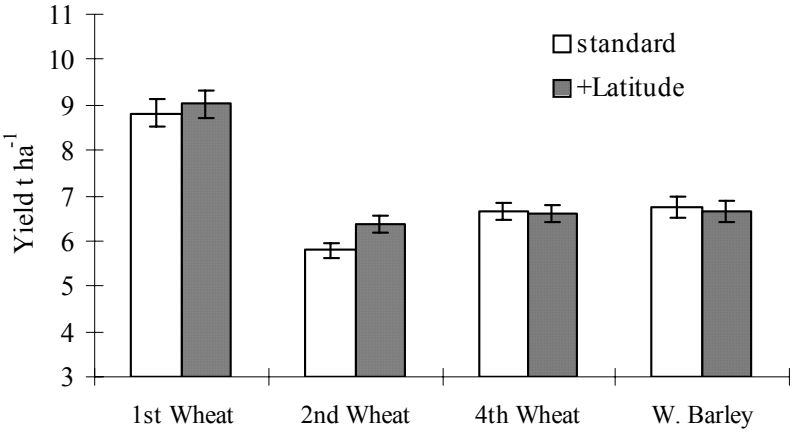

Figure 12: Yield as affected by rotational position and seed treatment use, 2000. Error bars indicate the SE of the mean.

2001

An increasing number of wheat crops were phased into the rotations with first, second, third and fifth wheat being represented, as well as, winter barley and oilseed rape. Yields generally were very disappointing even on first wheat crops largely reflecting the very poor establishment and over winter conditions in autumn 2000, monthly total rainfall for the months September through to December being 76, 91, 103 and 132 mm respectively. First wheat yields were a very disappointing 6.5 t/ha with no difference due to Latitude treatment. Even given the poor first wheat yield there was a significant yield loss in second wheat crops which averaged 4 t/ha when untreated. There was some recovery of this loss due to Latitude treatment of about 0.5 t/ha. Third and fifth wheat crops sowed some recovery compare to the second but were still significantly behind the first wheat at about 5 t/ha, there was, however, no evidence of a response to Latitude in either of these. Winter barley again grown as a third cereal yielded on a par with the first wheat at 6.5 t/ha, with some evidence of a response of about 0.3 t/ha to Latitude treatment (figure 13).

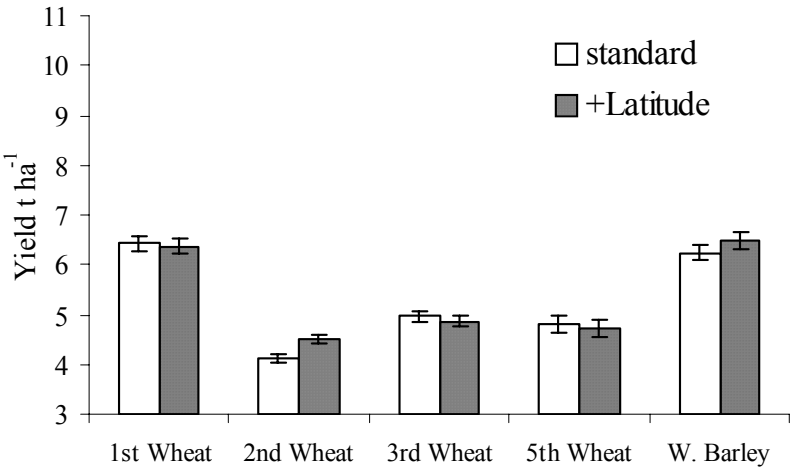

Figure 13: Yield as affected by rotational position and seed treatment use, 2001. Error bars indicate the SE of the mean.

2002

First wheat yields in 2002 were a better reflection of the potential of the site, with the first wheat producing an average of 10.8 t/ha. All non-first wheat crops showed a significant yield loss compared to the first wheat. Untreated second wheat yield was only just over 7 t/ha, a yield loss of over 3.5 t/ha compared to the first wheat. There was evidence of yield recovery in the 3rd and 6th wheat crops which yielded 0.5 – 1 t/ha higher than the second wheat although still significantly behind the first wheat. The 4th wheat however bucked this trend by yielding slightly less than the second wheat. In contrast to many of the previous years the winter barley showed no real advantage to the non-first wheats yielding slightly less that the second wheat. Again in contrast to previous years there was evidence of a significant yield improvement due to Latitude use in all the non-first wheat crops of about 0.3 t/ha (figure 14).

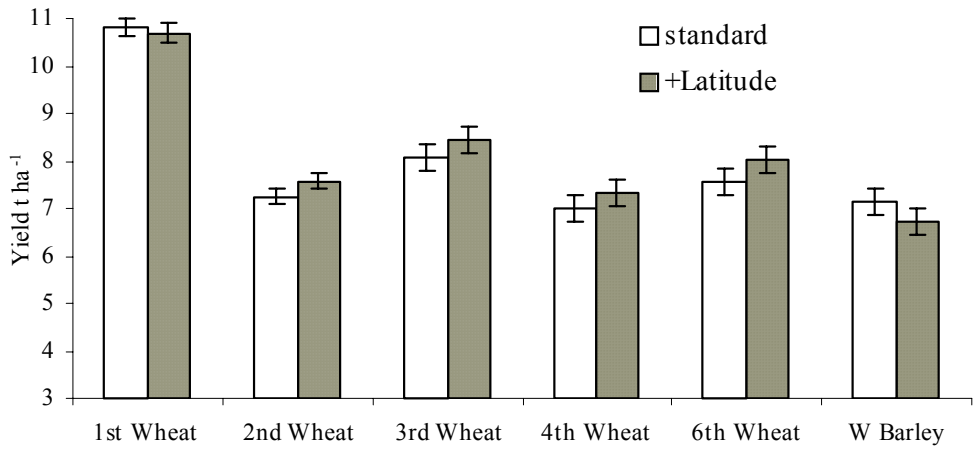

Figure 14 : Yield as affected by rotational position and seed treatment use, 2002. Error bars indicate the SE of the mean.

2003

In 2003 following the sequences of Latitude and non Latitude treated winter wheat crops, all treatments were sown with winter wheat with the same single purpose seed treatment, all yield differences were therefore a reflection of rotational position or the use of Latitude earlier in the rotation.

Yield of the first wheat crops was similar to the previous season at 10.76 t/ha, there was no evidence that the use of Latitude earlier in the rotation had any effect, although there had been a preceding untreated oilseed rape crop in both cases. As in previous years there was a dramatic loss in yield between first and second wheat crops, in this year the loss approaching 4 t/ha, and with the exception of the 4th wheat following barley, the 2nd wheat had the lowest yields averaging 7.19t/ha, with little or no effect irrespective of Latitude use in the preceding crop (figure 15).

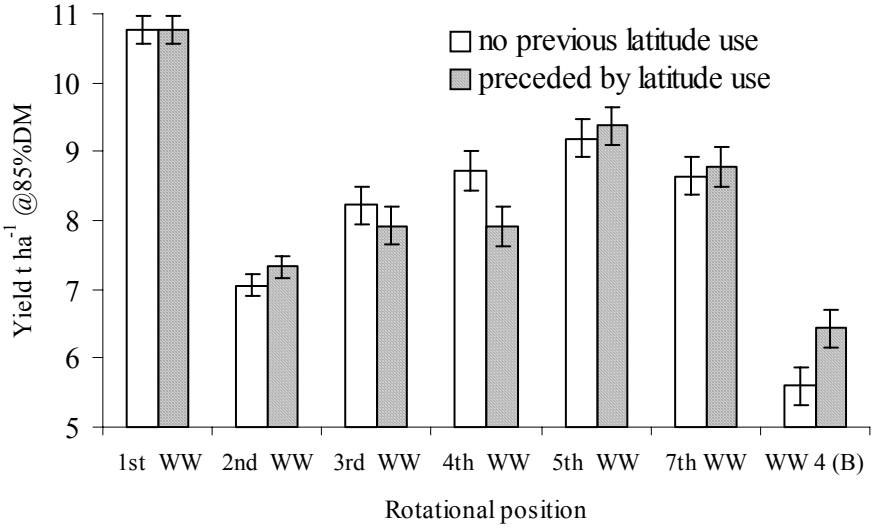

Figure 15: Yield as affected by rotational position and previous seed treatment use, 2003. Error bars indicate the SE of the mean.

Where barley preceded the 4th cereal, yield was significantly lower than the 4th wheat following wheat, and lower even that the second wheat. This suggests that when entering continuous wheat/cereal rotation, winter barley is not beneficial.

Yield achieved across the rotational positions reflected the classical pattern for the development of take-all and subsequent development of take-all decline, resulting in an initial significant yield depression followed by a partial recovery in yield. Whilst there was variation in the yield following previous Latitude use between rotational positions it was not consistent and the general pattern of initial yield decline followed by recovery was evident irrespective of previous seed treatment differences.

Effect of rotational position and Latitude across seasons

Where specific rotational positions were sown in more than one season it was possible to average yield data across seasons and provide more accurate indication of the mean yields obtained from different rotational positions and seed treatments (figure 16). First wheats both with and without Latitude (4 years data) had a mean yield of 8.82t/ha. Second wheats (4 years data) appeared more affected by rotational position that any other crop with yields averaging 5.81t/ha where Latitude was used, and 5.34t/ha where is was not.

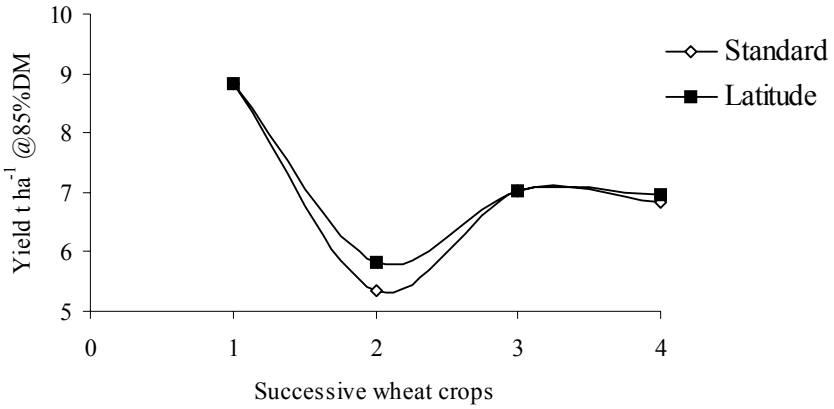

Figure 16: Mean yields from 4 successive wheat crops. 1st and 2nd wheat yields shown here are the mean values from 4 years, 3rd and 4th wheat yields are the means from 3 and 2 years respectively.

Average response to Latitude

Over the sequence of 6 seasons where Latitude was compared with non Latitude treatments, yield responses to Latitude over basis seed treatments varied both with the season and with the crop.

Using the mean data from all these seasons it is possible to gain and idea as to the yield effects of Latitude with subsequent crops. Yield benefits from Latitude within this experiment have ranged from 0 to 0.6t/ha. Second wheat crops have shown a consistent benefit from Latitude use, in the four years when second wheat crops were grown with and without Latitude, the seed treatment on average increased yield by 0.47t/ha (figure 17).

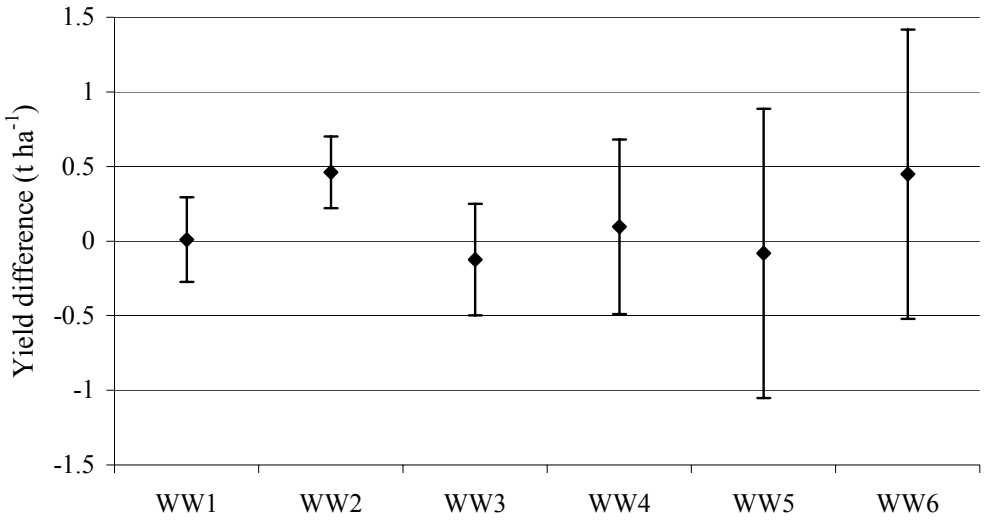

Figure 17. The yield advantage of Latitude treatment for crops of different rotational position. Error bars represent the 95% confidence limits for each yield difference.

95% confidence limits increased through the rotation due to the lower number of 4th 5th and 6th wheat crops over the 6 years of work

Grain Quality

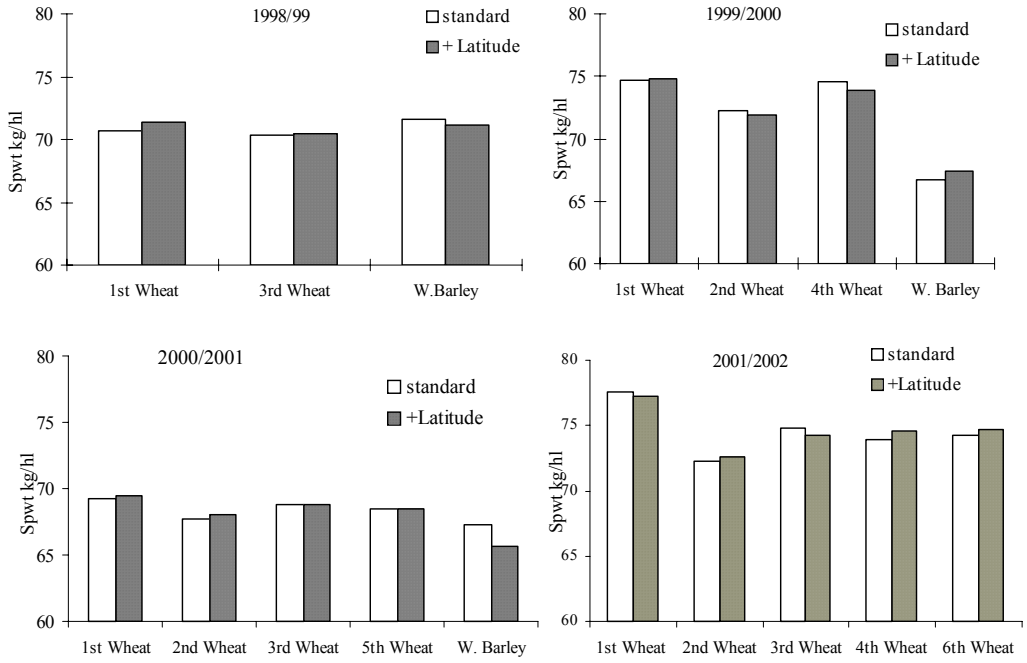

Figure 18: Specific weights (kg/hl) as affected by rotational position and previous seed treatment use, 1999-2003.

Grain quality in terms of specific weight (kg/hl) or thousand grain weight (tgw) (g) was generally best in firsts wheat, poorest in second wheat and intermediate in third and subsequent wheat, generally following a very similar pattern to yield. There was little evidence that there was any improvement in either specific weight or tgw to be gained from the use of Latitude (figure 18 and 19).

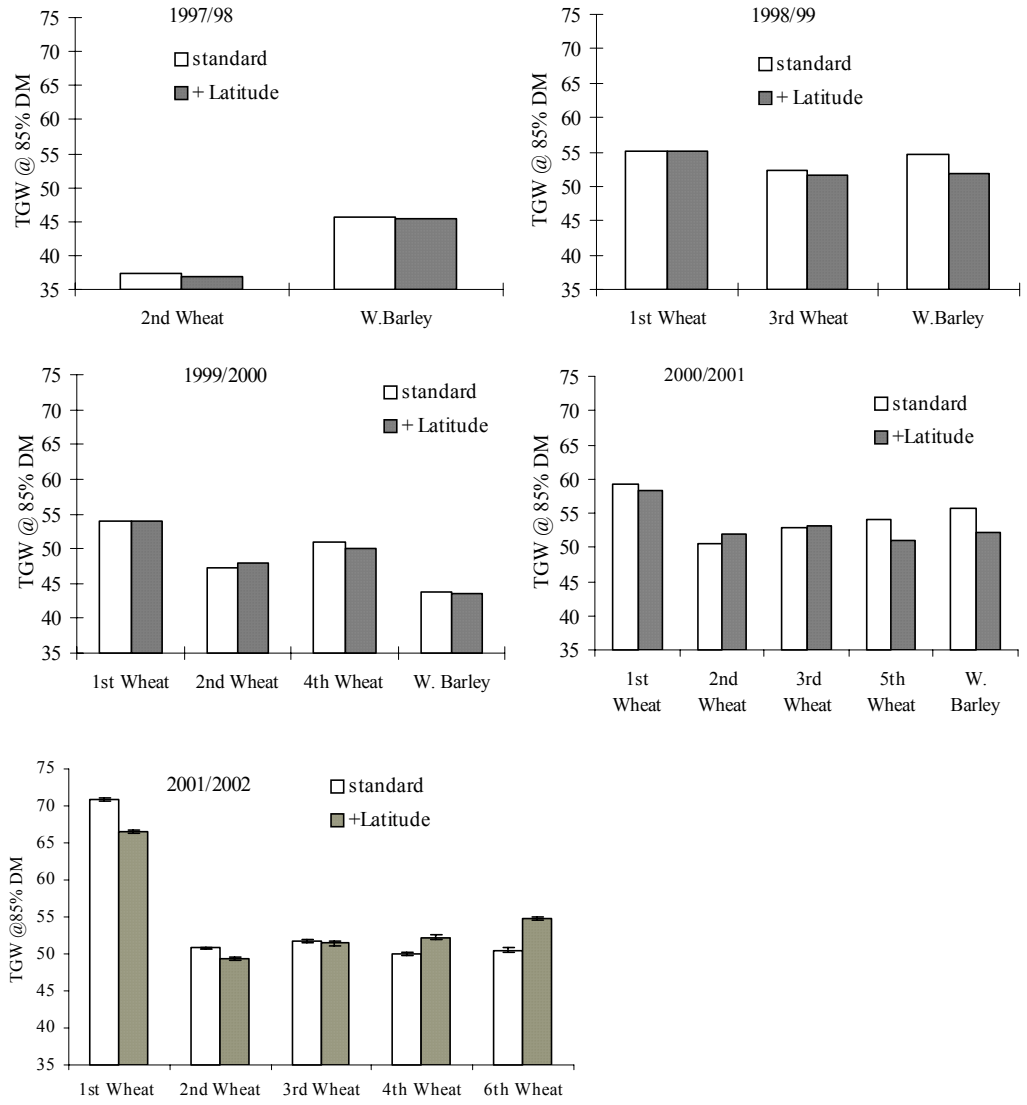

Figure 19: Thousand grain weights (@ 85% DM) as affected by rotational position and previous seed treatment use, 1999-2003.

In the final year of the project there was similarly little evidence of a residual effect of previous Latitude use on grain quality expressed in terms of its specific weight (figure 20), however previous Latitude use did result in improved tgw in third and subsequent wheat crops (figure 21).

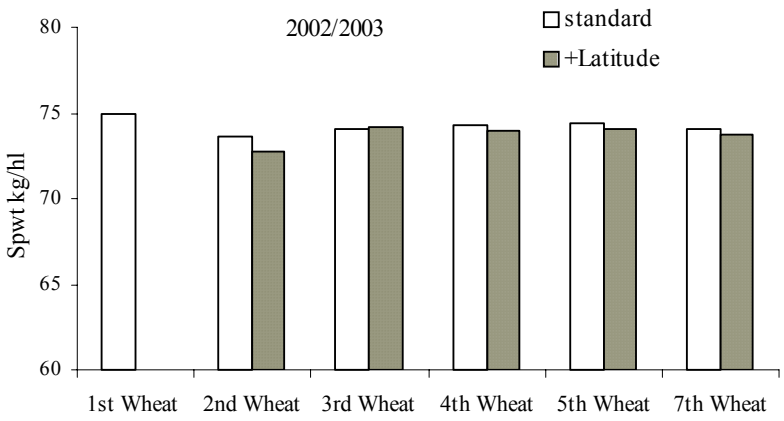

Figure 20: Specific weight as affected by rotational position and previous seed treatment use, 2003.

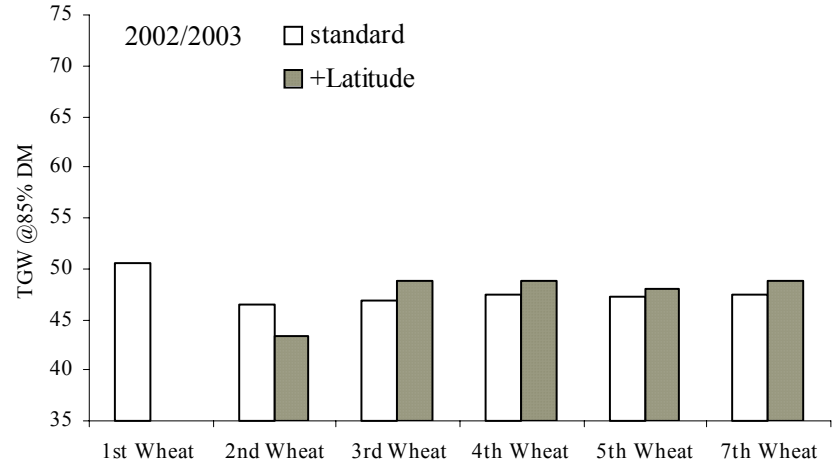

Figure 21: Specific weight as affected by rotational position and previous seed treatment use, 2003.

Discussion

This experiment has demonstrated the classical pattern of initial rapid yield loss and subsequent recovery when entering a long run of consecutive wheat crops. The magnitude of the initial yield loss at 3.5 t/ha was much greater than has been found at many sites, the average yield loss in a second wheat compared to a first being closer to 1 t/ha e.g. Vaidyanathan *et al*. (1987). There was a subsequent yield recovery in 3rd and 4th wheat crops of about 1.5 t/ha; this still however left a yield deficit compared to first wheat of 2 t/ha. The magnitude of this effect may be in part due to the use of Equinox as the variety which since the start of this work has been shown to be a particularly poor non-first wheat.

The improved yield in wheat crops following a number of previous crops could be explained by the lower take-all severity late in the season. It is interesting that there was rarely any evidence of lower take-all severity in early season assessments. Two phases of take all decline are known to occur. The primary phase occurs in the autumn, and involves the infection of the roots of the crop with inoculum from previous crop residues, or other susceptible plant species. Low over winter temperatures prevent further development until spring, however as temperatures rise in the spring and summer a secondary phase of infection occurs, with take-all spreading from root to root in the existing crop. It appears that take-all decline may be mediated by factors that only have a significant effect on disease progress during this secondary phase. This contrasts with the timing of the effect of Latitude which has been shown to impact solely on the very earliest phases of the epidemic. If the impact of take-all decline is only visible in the later phases of the within season disease epidemic then there may be implications for the decision making process in relation to the use of foliar applied fungicides to minimise take-all severity. This will be particularly important if the foliar applied products have a direct effect on the take-all decline microflora.

One of the primary objectives of this experiment was to investigate the impact of Latitude use on the development of take-all decline. This was tested largely in the final year on the experiment when the whole trial area was drilled with seed untreated with Latitude. There was little or no evidence of a direct or indirect effect of seed treatment on the development of take-all decline. It has previously been reported that a severe take-all infection is needed before significant take-all decline can develop. It may be that as the effect of Latitude is to delay the epidemic, there are sufficiently high levels of take-all late in the life of the crop for its development.

The final year of the experiment lends support to work from Rothamsted (Jenkin pers. comm.) which reported that breaking a run of wheat crops with spring barley resulted in a subsequent increase in take-all. There was a similar substantial increase in take-all severity here where the third cereal in a run of four was a winter barley crop. These results contradict previous advice for entering a continuous wheat rotation, this suggested growing winter barley as the second and third cereal to avoid the worst take-all years and then revert to wheat. Given the effects of Latitude shown here it would seem a better option would be to use Latitude in the worst years on winter wheat and once take-all decline is established cease its use.

Making the decision whether or not to use Latitude will ultimately be a financial one. Assuming a price for Latitude seed treatment of £155/t, and a seed rate of 150kg ha^{-1} (300 seeds m^{-2} at a TGW of 50g) the cost of Latitude treatment is approximately £22.5/ha. Given a wheat price of £80/t, a yield response of 0.3t/ha is required to cover the cost of treatment.

Given the average responses to Latitude use reported in this study (figure e) of 0.19 t/ha for all non-first wheat crops the blanket use of Latitude would not be economic. A more targeted approach would, however, be economic and using Latitude on all second wheat crops where the average response was 0.47 t/ha would provide an average return of £14/ha. This work was

conducted on Bromyard series soils at ADAS Rosemaund. This silty clay loam is prone to moderate to severe take-all epidemics, however its water retentive nature does, on occasion, buffer the impact of take-all on yield. The economic benefits of Latitude use may be greater where non-first wheat is grown on lighter soils. Under these circumstances take-all epidemics can more severely restrict water availability, as such, larger yield effects may be expected as a result of control.

This relatively simplistic analysis ignores the potential implications of Latitude use on altering choice of crop and crop rotations. Given the large yield loss in this study from growing a second or subsequent crop compared to a first wheat almost any rotation that maximises the number of first wheat crops will prove to be the most profitable. Where the yield loss due to non-first wheat is smaller it may be worthwhile entering continuous wheat in order to avoid having to grow what may be less profitable break crops.

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Appendix 1

Sowing dates and 50% Emergence dates 1997-2003

Year		Sowing date	50% Emergence
1	1997-98	14 October	04 November
2	1998-99	29 September	12 October
3	1999-2000	09 October	24 October
4	2000-2001	19 October	15 November
5	2001-2002	28 September	10 October
6	2002-2003	07 October	25 October

Appendix 2:

Take-all and roots assessment tables 1998-2003

1998 TAKE -ALL ASSESSMENTS 1-6

SEED TREATMENT	ROTATION	CROP	09-Dec-97		06-Jan-98		09-Feb-98		10-Mar-98		01-Jun-98		29-Jun-98	
			Incidence	Index	Incidence	Index	Incidence	Index	Incidence	Index	Incidence	Index	Incidence	Index
LATITUDE	3	WW2	58.70	7.25	30.00	2.25	17.50	2.25	15.00	2.25	88.70	28.80	100.00	47.50
	11	WB	31.10	3.12	17.50	1.75	7.50	0.75	6.20	1.12	75.00	16.00	95.00	23.60
LATITUDE	AVERAGE		45.00	5.19	18.80	2.00	12.50	1.50	10.60	1.69	81.90	22.40	97.50	35.60
STANDARD	3	WW2	57.50	7.25	45.80	6.44	20.00	2.50	30.00	5.50	92.50	40.70	100.00	61.50
	11	WB	50.00	6.00	28.80	3.12	12.50	1.25	16.30	2.37	81.20	20.60	88.70	30.60
STANDARD	AVERAGE		53.70	6.62	37.30	4.78	16.30	1.87	23.10	3.94	86.90	30.70	94.40	46.10
ROTATION MEAN	3	WW2	58.10	7.25	32.90	4.35	18.80	2.37	22.50	3.87	90.60	34.70	100.00	54.50
	11	WB	40.60	4.56	23.10	2.44	10.00	1.00	11.30	1.75	78.10	18.30	91.90	27.10
P	SEED TREATMENT		0.271	0.218	0.060	0.062	0.493	0.581	0.021	0.015	0.434	0.154	0.511	0.225
	ROTATION		0.044	0.035	0.285	0.177	0.130	0.065	0.033	0.020	0.071	0.013	0.109	0.008
	SEED TREATMENT x ROTATION		0.213	0.218	0.419	0.308	0.817	0.853	0.589	0.217	0.842	0.508	0.511	0.674
LSD	SEED TREATMENT		16.890	2.445	19.490	2.953	11.890	1.481	10.110	1.704	13.820	12.090	10.340	18.220
	ROTATION		16.890	2.445	19.490	2.953	11.890	1.481	10.110	1.704	13.820	12.090	10.340	18.220
	SEED TREATMENT x ROTATION		23.880	3.472	27.560	4.176	16.810	2.095	14.290	2.410	19.550	17.100	14.620	25.760
cv%			30.2	36.7	61.5	77.0	73.1	77.6	53.0	53.6	14.5	40.3	9.5	39.5
Residual df.			9	9	9	9	9	9	9	9	9	9	9	9

1998 TAKE-ALL ASSESSMENT 7 **27-Jul-98**

SEED TREATMENT	ROTATION	CROP	27-Jul-98	
			INCIDENCE	INDEX
LATITUDE	1	WW2	100.00	80.70
	2	WW2	100.00	86.90
	3	WW2	100.00	69.50
	4	WW2	100.00	72.10
	6	WW2	100.00	75.70
	7	WW2	100.00	81.60
	9	WW2	100.00	70.50
	10	WW2	100.00	81.90
	11	WB	100.00	42.80
LATITUDE	AVERAGE		100.00	73.50
STANDARD	1	WW2	100.00	89.20
	2	WW2	100.00	83.20
	3	WW2	100.00	84.50
	4	WW2	100.00	94.10
	6	WW2	100.00	91.20
	7	WW2	100.00	86.10
	9	WW2	100.00	85.90
	10	WW2	100.00	92.40
	11	WB	100.00	54.30
STANDARD	AVERAGE		100.00	84.60
ROTATION MEAN	1	WW2	100.00	85.00
	2	WW2	100.00	85.10
	3	WW2	100.00	77.00
	4	WW2	100.00	83.10
	6	WW2	100.00	83.50
	7	WW2	100.00	83.90
	9	WW2	100.00	78.20
	10	WW2	100.00	87.10
	11	WB	100.00	48.50
P	SEED TREATMENT		-	<0.001
	ROTATION		-	<0.001
	SEED TREATMENT x ROTATION		-	0.655
LSD	SEED TREATMENT		0.000	5.780
	ROTATION		0.000	12.250
	SEED TREATMENT x ROTATION		0.000	17.330
cv%			0.0	15.4
Residual df.			49	49

1999 TAKE-ALL ASSESSMENT 1, (16/02/99)

SEED TREATMENT	ROTATION	CROP	INCIDENCE	INDEX	TILLERS	ROOTS/SHOOT			ROOTS/PLANT		
						TOTAL	CLEAN	INFECTED	TOTAL	CLEAN	INFECTED
LATITUDE	1	WW3	78.00	7.50	4.13	2.86	2.48	0.38	11.71	10.17	1.54
	5	WW1	75.00	7.70	4.41	2.53	2.18	0.35	11.08	9.57	1.51
	10	WB	77.50	8.23	7.09	1.62	1.39	0.23	11.65	10.04	1.61
LATITUDE	AVERAGE		76.80	7.91	5.21	2.34	2.02	0.32	11.48	9.93	1.55
STANDARD	1	WW3	76.00	8.00	4.34	2.82	2.43	0.38	12.02	10.40	1.62
	5	WW1	69.00	7.10	4.67	2.38	2.11	0.27	11.01	9.77	1.24
	10	WB	64.00	6.40	7.31	1.71	1.55	0.16	12.41	11.24	1.17
STANDARD	AVERAGE		69.70	7.17	5.44	2.30	2.03	0.27	11.81	10.47	1.34
ROTATION MEANS	1	WW3	77.00	7.90	4.24	2.84	2.46	0.38	11.86	10.29	1.58
	5	WW1	72.00	7.40	4.54	2.45	2.15	0.31	11.04	9.67	1.38
	10	WB	70.70	7.31	7.20	1.67	1.47	0.19	12.03	10.64	1.39
P	SEED TREATMENT		0.109	0.177	0.265	0.079	0.917	0.207	0.356	0.207	0.203
	ROTATION		0.454	0.622	<0.001	<0.001	<0.001	0.003	0.080	0.185	0.507
	SEED TREATMENT x ROTATION		0.540	0.309	0.994	0.749	0.696	0.584	0.633	0.543	0.411
LSD	SEED TREATMENT		8.980	1.119	0.426	0.274	0.261	0.078	0.747	0.879	0.336
	ROTATION		11.000	1.370	0.521	0.336	0.319	0.095	0.915	1.077	0.412
	SEED TREATMENT x ROTATION		15.550	1.937	0.737	0.476	0.451	0.134	1.295	1.523	0.582
cv%			14.0	16.9	9.1	13.5	14.7	30.2	7.3	9.8	26.5
Residual df.			14	14	14	14	14	14	14	14	14

1999 TAKE-ALL ASSESSMENT 2, (08/04/99)

SEED TREATMENT	ROTATION	CROP	INCIDENCE	INDEX	TILLERS	ROOTS/SHOOT			ROOTS/PLANT		
						TOTAL	CLEAN	INFECTED	TOTAL	CLEAN	INFECTED
LATITUDE	1	WW3	96.00	10.20	4.19	4.92	4.29	0.63	20.58	17.91	2.67
	5	WW1	96.00	9.80	4.06	5.02	4.36	0.66	20.34	17.68	2.66
	10	WB	71.70	7.20	6.05	3.54	3.31	0.23	21.61	20.11	1.50
LATITUDE	AVERAGE		87.90	9.07	4.77	4.49	3.98	0.51	20.84	18.57	2.81
STANDARD	1	WW3	98.00	11.60	4.28	4.67	3.98	0.70	19.96	17.02	2.94
	5	WW1	96.00	10.50	4.39	4.85	4.16	0.69	21.17	18.16	3.01
	10	WB	71.00	7.10	5.35	3.70	3.40	0.31	19.68	18.08	1.60
STANDARD	AVERAGE		88.30	9.73	4.67	4.41	3.84	0.57	20.27	17.75	2.52
ROTATION MEANS	1	WW3	97.00	10.90	4.24	4.80	4.13	0.67	20.27	17.46	2.81
	5	WW1	96.00	10.15	4.23	4.93	4.26	0.68	20.75	17.92	2.84
	10	WB	71.30	7.15	5.70	3.62	3.35	0.27	20.64	19.09	1.55
P	SEED TREATMENT		0.886	0.211	0.583	0.490	0.238	0.183	0.2660	0.1100	0.1850
	ROTATION		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.7090	0.0380	<0.001
	SEED TREATMENT x ROTATION		0.933	0.500	0.056	0.337	0.365	0.917	0.1100	0.1350	0.8320
LSD	SEED TREATMENT		6.520	1.090	0.514	0.249	0.244	0.089	1.0610	1.0210	0.3688
	ROTATION		7.990	1.335	0.430	0.305	0.299	0.109	1.3000	1.2500	0.4516
	SEED TREATMENT x ROTATION		11.300	1.887	0.609	0.431	0.423	0.154	1.838	1.768	0.639
cv%			8.5	13.2	8.5	6.4	7.1	18.9	5.9	6.4	17.6
Residual df.			14	14	14	14	14	14	14	14	14

1999 TAKE-ALL ASSESSMENT 3, (10/05/99)

SEED TREATMENT	ROTATION	CROP	INCIDENCE	INDEX	TILLERS	ROOTS/SHOOT			ROOTS/PLANT		
						TOTAL	CLEAN	INFECTED	TOTAL	CLEAN	INFECTED
LATITUDE	1	WW3	90.00	10.20	3.73	5.67	4.99	0.68	20.57	18.07	2.50
	5	WW1	93.00	9.70	3.87	5.48	4.90	0.58	21.03	18.82	2.21
	10	WB	81.90	9.64	3.15	6.16	5.26	0.90	18.66	15.79	2.87
LATITUDE	AVERAGE		88.30	9.85	3.58	5.77	5.05	0.72	20.09	17.56	2.53
STANDARD	1	WW3	97.00	12.60	3.53	6.03	5.20	0.83	21.26	18.29	2.97
	5	WW1	93.00	9.70	4.07	5.29	4.70	0.59	21.36	18.98	2.38
	10	WB	86.00	9.60	4.09	4.94	4.33	0.60	20.20	17.73	2.47
STANDARD	AVERAGE		92.00	10.63	3.90	5.42	4.74	0.67	20.94	18.33	2.61
ROTATION MEANS	1	WW3	93.50	11.40	3.63	5.85	5.09	0.75	20.91	18.18	2.73
	5	WW1	93.00	9.70	3.97	5.38	4.80	0.59	21.19	18.90	2.29
	10	WB	84.00	9.62	3.62	5.55	4.80	0.75	19.43	16.76	2.67
P	SEED TREATMENT		0.355	0.442	0.196	0.228	0.253	0.501	0.3280	0.2540	0.8020
	ROTATION		0.111	0.287	0.394	0.413	0.570	0.103	0.2200	0.0500	0.4770
	SEED TREATMENT x ROTATION		0.762	0.533	0.160	0.096	0.218	0.049	0.8370	0.4680	0.5240
LSD	SEED TREATMENT		8.270	2.132	0.495	0.597	0.547	0.145	1.8060	1.3950	0.6670
	ROTATION		10.130	2.611	0.607	0.731	0.671	0.178	2.2110	1.7080	0.8160
	SEED TREATMENT x ROTATION		14.330	3.692	0.858	1.034	0.948	0.252	3.127	2.416	1.154
cv%			10.5	23.8	15.1	12.2	12.8	23.8	10.1	8.9	29.7
Residual df.			14	14	14	14	14	14	14	14	14

1999 TAKE-ALL ASSESSMENT 4 (28/05/99)

SEED TREATMENT	ROTATION	CROP	INCIDENCE	INDEX	TILLERS	ROOTS/SHOOT			ROOTS/PLANT		
						TOTAL	CLEAN	INFECTED	TOTAL	CLEAN	INFECTED
LATITUDE	1		100.00	30.70	3.04	10.98	8.24	2.74	32.90	24.40	8.53
	5		98.00	20.60	2.92	11.71	8.34	3.37	34.20	23.90	10.29
	10		95.67	11.30	5.03	8.61	7.86	0.75	42.80	39.10	3.74
LATITUDE	AVERAGE		97.89	20.90	3.66	10.43	8.15	2.28	36.70	29.10	7.52
STANDARD	1		99.00	30.80	3.05	10.54	7.54	3.00	31.90	22.90	9.02
	5		98.00	27.10	3.07	10.55	8.05	2.50	32.50	24.90	7.58
	10		86.00	12.90	4.08	8.81	7.63	1.18	35.80	31.10	4.77
STANDARD	AVERAGE		94.33	23.60	3.40	9.97	7.74	2.23	33.40	26.30	7.12
ROTATION MEANS	1		99.50	30.70	3.05	10.76	7.89	2.87	32.40	23.70	8.77
	5		98.00	23.80	3.00	11.13	8.19	2.93	33.30	24.40	8.93
	10		90.83	12.10	4.56	8.71	7.75	0.96	39.30	35.10	4.26
P	SEED TREATMENT		0.051	0.467	0.293	0.491	0.540	0.928	0.232	0.234	0.844
	ROTATION		0.002	0.003	<0.001	0.020	0.850	0.035	0.096	0.002	0.128
	SEED TREATMENT x ROTATION		0.063	0.762	0.165	0.703	0.949	0.657	0.600	0.285	0.714
LSD	SEED TREATMENT		3.571	7.870	0.520	1.408	1.389	1.338	5.570	4.920	4.256
	ROTATION		4.374	9.640	0.637	1.724	1.702	1.638	6.830	6.020	5.213
	SEED TREATMENT x ROTATION		6.186	13.630	0.901	2.439	2.407	2.317	9.650	8.520	7.372
cv%			4.2	40.4	16.8	15.8	20.0	67.7	18.2	20.3	66.4
Residual df.			14	14	14	14	14	14	14	14	14

1999 TAKE-ALL ASSESSMENT 5, (01/07/99)

SEED TREATMENT	ROTATION	CROP	INCIDENCE	INDEX	INFECTED SEMINAL ROOTS	INFECTED CROWN ROOTS
LATITUDE	1	WW3	100.00	43.20	2.98	5.53
	2	WW3	99.79	53.20	3.13	6.21
	3	WW3	100.00	53.90	3.46	6.71
	5	WW1	100.00	40.80	2.68	5.66
	7	WW3	100.00	53.10	3.24	5.63
	8	WW1	96.00	39.20	2.71	4.94
	9	WW3	100.00	52.70	3.36	5.86
	10	WW2	89.21	18.50	1.44	2.46
	12	WW1	100.26	56.70	3.21	6.29
LATITUDE	AVERAGE		98.36	45.70	2.91	5.48
STANDARD	1	WW3	99.00	46.10	2.69	5.89
	2	WW3	100.22	51.80	3.04	6.49
	3	WW3	100.00	55.80	3.86	6.72
	5	WW1	100.00	36.50	2.75	5.43
	7	WW3	99.59	54.80	3.38	7.80
	8	WW1	99.87	44.60	2.69	5.80
	9	WW3	100.00	59.80	3.51	7.23
	10	WW2	96.00	26.40	2.41	3.61
	12	WW1	99.00	49.30	2.62	6.45
STANDARD	AVERAGE		99.30	47.20	2.99	6.16
ROTATION MEANS	1	WW3	99.50	44.70	2.84	5.71
	2	WW3	100.01	52.50	3.09	6.35
	3	WW3	100.00	54.90	3.66	6.71
	5	WW1	100.00	38.70	2.72	5.54
	7	WW3	99.80	54.00	3.31	6.72
	8	WW1	97.94	41.90	2.70	5.37
	9	WW3	100.00	56.30	3.44	6.54
	10	WW2	92.60	22.50	1.92	3.04
	12	WW1	99.63	53.00	2.91	6.37
P	SEED TREATMENT		0.265	0.579	0.613	0.033
	ROTATION		0.002	<0.001	<0.001	<0.001
	SEED TREATMENT x ROTATION		0.360	0.922	0.597	0.697
LSD	SEED TREATMENT		1.673	5.550	0.327	0.624
	ROTATION		3.548	11.770	0.693	1.323
	SEED TREATMENT x ROTATION		5.018	16.640	0.980	1.871
cv%			3.6	25.1	23.3	22.6
Residual df.			43	43	43	43

2000 TAKE-ALL ASSESSMENT 1, (08/12/99)

SEED TREATMENT	ROTATION	CROP	INCIDENCE	INDEX	TILLERS	ROOTS/SHOOT			ROOTS/PLANT		
						TOTAL	CLEAN	INFECTED	TOTAL	CLEAN	INFECTED
LATITUDE	1	WW4	37.00	4.10	2.26	2.84	2.62	0.22	6.40	5.91	0.49
	4	WW1	19.60	2.50	2.26	2.77	2.64	0.22	6.23	5.95	0.28
	5	WW2	44.40	4.91	2.37	2.76	2.50	0.26	6.54	5.91	0.63
	9	WB	26.00	2.80	2.63	2.53	2.38	0.16	6.59	6.21	0.38
LATITUDE	AVERAGE		31.70	3.58	2.38	2.73	2.54	0.19	6.44	5.99	0.45
STANDARD	1	WW4	52.00	6.60	2.05	3.15	2.70	0.46	6.04	5.25	0.79
	4	WW1	11.80	1.60	2.42	2.56	2.49	0.07	6.17	6.00	0.17
	5	WW2	61.00	6.50	2.27	2.75	2.38	0.38	6.20	5.34	0.86
	9	WB	17.00	1.90	2.24	2.94	2.84	0.10	6.44	6.21	0.23
STANDARD	AVERAGE		35.40	4.15	2.25	2.85	2.60	0.25	6.21	5.70	0.51
ROTATION MEANS	1	WW4	44.50	5.35	2.16	3.00	2.66	0.34	6.22	5.58	0.64
	4	WW1	15.70	2.05	2.34	2.66	2.56	0.10	6.20	5.98	0.23
	5	WW2	52.70	5.71	2.32	2.76	2.44	0.32	6.37	5.62	0.75
	9	WB	21.50	2.35	2.44	2.74	2.61	0.13	6.52	6.21	0.31
P	SEED TREATMENT		0.54	0.46	0.20	0.43	0.63	0.31	0.05	0.04	0.52
	ROTATION		<0.001	0.00	0.29	0.47	0.67	0.01	0.19	0.01	0.00
	SEED TREATMENT x ROTATION		0.27	0.30	0.30	0.47	0.33	0.23	0.73	0.15	0.31
LSD	SEED TREATMENT		12.37	1.58	0.21	0.32	0.27	0.12	0.23	0.28	0.21
	ROTATION		17.49	2.23	0.30	0.46	0.38	0.17	0.33	0.39	0.30
	SEED TREATMENT x ROTATION		24.73	3.16	0.42	0.65	0.54	0.24	0.46	0.55	0.43
cv%			49.9	55.4	12.3	15.7	14.4	74.9	4.9	6.4	60.4
Residual df.			20	20	20	20	20	20	20	20	20

2000 TAKE-ALL ASSESSMENT 2, (24/03/00)

SEED TREATMENT	ROTATION	CROP	INCIDENCE	INDEX	TILLERS	ROOTS/SHOOT			ROOTS/PLANT		
						TOTAL	CLEAN	INFECTED	TOTAL	CLEAN	INFECTED
LATITUDE	1	WW4	76.00	12.40	3.56	4.21	3.69	0.52	14.95	13.10	1.85
	4	WW1	50.00	6.80	5.27	3.54	3.31	0.23	16.46	15.41	1.05
	5	WW2	64.00	11.87	4.17	4.05	3.49	0.56	16.32	14.02	2.30
	9	WB	52.00	6.20	6.39	2.64	2.49	0.15	16.47	15.50	0.97
LATITUDE	AVERAGE		60.50	9.32	4.85	3.61	3.24	0.36	16.05	14.51	1.54
STANDARD	1	WW4	68.00	9.00	3.84	4.34	3.90	0.44	15.16	13.72	1.44
	4	WW1	49.00	5.90	4.91	3.59	3.40	0.20	16.25	15.33	0.92
	5	WW2	77.00	14.20	3.82	4.53	3.99	0.54	15.81	14.05	1.76
	9	WB	51.00	7.80	6.68	2.60	2.41	0.19	17.14	15.83	1.31
STANDARD	AVERAGE		61.20	9.23	4.81	3.77	3.42	0.34	16.09	14.73	1.36
ROTATION MEANS	1	WW4	72.00	10.70	3.70	4.27	3.79	0.48	15.06	13.41	1.64
	4	WW1	49.50	6.35	5.09	3.57	3.35	0.22	16.36	15.37	0.99
	5	WW2	70.50	13.04	3.99	4.29	3.74	0.55	16.06	14.03	2.03
	9	WB	51.50	7.00	6.53	2.62	2.45	0.17	16.81	15.67	1.14
P	SEED TREATMENT		0.923	0.962	0.950	0.667	0.584	0.781	0.893	0.518	0.484
	ROTATION		0.083	0.070	0.006	0.012	0.028	0.004	0.004	<0.001	0.037
	SEED TREATMENT x ROTATION		0.794	0.709	0.950	0.961	0.935	0.950	0.549	0.888	0.644
LSD	SEED TREATMENT		15.640	3.974	1.134	0.753	0.670	0.158	0.627	0.715	0.540
	ROTATION		22.120	5.620	1.604	1.064	0.647	0.223	0.887	1.011	0.763
	SEED TREATMENT x ROTATION		31.280	7.947	2.268	1.505	1.339	0.315	1.255	1.430	1.079
cv%			34.8	21.1	31.8	27.7	27.2	60.4	5.3	6.6	50.5
Residual df.			20	20	20	20	20	20	20	20	20

2000 TAKE-ALL ASSESSMENT 3, (14/05/00)

SEED TREATMENT	ROTATION	CROP	INCIDENCE	INDEX	TILLERS	ROOTS/SHOOT			ROOTS/PLANT		
						TOTAL	CLEAN	INFECTED	TOTAL	CLEAN	INFECTED
LATITUDE	1	WW4	90.00	23.10	3.20	7.82	6.57	1.25	24.72	20.82	3.90
	4	WW1	64.00	15.10	3.13	8.79	7.76	1.03	27.63	24.26	3.37
	5	WW2	97.00	40.00	3.44	8.14	5.78	2.36	27.24	18.77	8.47
	9	WB	68.00	13.10	3.61	7.47	6.86	0.60	26.87	24.67	2.20
LATITUDE	AVERAGE		79.70	22.80	3.34	8.06	6.74	1.31	26.62	22.13	4.49
STANDARD	1	WW4	93.00	19.40	3.18	8.02	6.55	1.47	24.85	20.30	4.55
	4	WW1	75.00	16.10	3.87	7.60	6.78	0.82	29.23	26.13	3.10
	5	WW2	96.00	43.90	2.91	9.27	6.52	2.76	26.24	18.27	7.97
	9	WB	82.00	22.40	3.54	7.83	6.62	1.21	26.90	22.76	4.14
STANDARD	AVERAGE		86.50	25.50	3.37	8.18	6.62	1.56	26.81	21.86	4.94
ROTATION MEANS	1	WW4	91.50	21.30	3.19	7.92	6.56	1.36	24.79	20.56	4.22
	4	WW1	69.50	15.60	3.50	8.19	7.27	0.93	28.43	25.19	3.23
	5	WW2	96.50	42.00	3.17	8.71	6.15	2.56	26.74	18.52	8.22
	9	WB	75.00	17.80	3.58	7.65	6.74	0.91	26.89	23.71	3.17
P	SEED TREATMENT		0.148	0.465	0.883	0.778	0.746	0.240	0.783	0.697	0.513
	ROTATION		<0.001	<0.001	0.413	0.375	0.267	<0.001	0.011	<0.001	<0.001
	SEED TREATMENT x ROTATION		0.627	0.623	0.222	0.312	0.496	0.562	0.607	0.280	0.584
LSD	SEED TREATMENT		9.380	7.330	0.433	0.900	0.815	0.433	1.413	1.396	1.420
	ROTATION		13.270	10.360	0.613	1.273	1.153	0.613	1.999	1.975	2.008
	SEED TREATMENT x ROTATION		18.770	14.650	0.867	1.800	1.631	0.867	2.826	2.793	2.840
cv%			15.3	41.2	17.5	15.0	16.6	40.9	7.2	8.6	40.9
Residual df.			20	20	20	20	20	20	20	20	20

2000 TAKE-ALL ASSESSMENT 4, (23/07/00)

SEED TREATMENT	ROTATION	CROP	INCIDENCE	INDEX	TILLERS	ROOTS/SHOOT			ROOTS/PLANT		
						TOTAL	CLEAN	INFECTED	TOTAL	CLEAN	INFECTED
LATITUDE	1	WW4	90.00	28.10	2.14	13.55	10.15	3.40	28.75	21.62	7.13
	4	WW1	100.00	30.20	2.51	11.39	8.20	3.18	27.76	20.11	7.65
	5	WW2	100.00	46.90	2.63	11.25	6.74	4.51	29.27	17.59	11.67
	9	WB	100.00	35.10	2.49	10.06	6.48	3.58	25.13	16.40	8.73
	11	WW1	92.00	16.90	3.00	9.35	7.41	1.94	27.21	21.95	5.27
LATITUDE	AVERAGE		96.40	31.40	2.55	11.12	7.80	3.32	27.63	19.54	8.09
STANDARD	1	WW4	100.00	41.20	2.49	11.63	7.30	4.33	28.70	18.70	10.00
	4	WW1	100.00	32.20	2.38	11.70	7.76	3.94	27.90	18.44	9.45
	5	WW2	100.00	39.90	2.11	13.54	8.95	4.58	28.34	18.71	9.63
	9	WB	98.00	32.60	2.90	7.92	4.82	3.10	22.97	14.04	8.93
	11	WW1	98.00	23.50	2.32	11.93	9.11	2.82	27.40	20.83	6.56
STANDARD	AVERAGE		99.20	33.90	2.44	11.34	7.59	3.75	27.06	18.14	8.92
ROTATION MEANS	1	WW4	95.00	34.60	2.31	12.59	8.72	3.87	28.72	20.16	8.56
	4	WW1	100.00	31.20	2.45	11.54	7.98	3.56	27.83	19.28	8.55
	5	WW2	100.00	43.40	2.37	12.39	7.85	4.55	28.80	18.15	10.65
	9	WB	99.00	33.80	2.70	8.99	5.65	3.34	24.05	15.22	8.83
	11	WW1	95.00	20.20	2.66	10.64	8.26	2.38	27.31	21.39	5.92
P	SEED TREATMENT		0.232	0.421	0.462	0.671	0.690	0.171	0.710	0.387	0.156
	ROTATION		0.414	0.001	0.408	<0.001	0.008	0.003	0.282	0.168	<0.001
	SEED TREATMENT x ROTATION		0.445	0.270	0.104	0.016	0.019	0.535	0.985	0.940	0.098
LSD	SEED TREATMENT		4.700	6.130	0.311	1.070	1.053	0.628	3.083	3.251	1.163
	ROTATION		7.430	9.690	0.492	1.692	1.664	0.993	4.874	5.141	1.838
	SEED TREATMENT x ROTATION		10.510	13.710	0.695	2.393	2.354	1.404	6.893	7.271	2.600
cv%			7.4	28.9	19.2	14.7	21.1	27.3	17.4	26.6	21.1
Residual df.			20	20	20	20	20	20	20	20	20

2001 TAKE-ALL ASSESSMENT 1, (29/01/01)

SEED TREATMENT	ROTATION	CROP	INCIDENCE	INDEX	TILLERS	ROOTS/SHOOT			ROOTS/PLANT		
						TOTAL	CLEAN	INFECTED	TOTAL	CLEAN	INFECTED
LATITUDE	1	WW5	20.00	2.00	1.96	3.47	3.32	0.15	6.79	6.49	0.30
	4	WW2	14.00	1.40	2.12	3.26	3.18	0.08	6.86	6.68	0.17
	5	WW3	15.10	1.82	1.86	3.70	3.62	0.08	6.74	6.57	0.19
	10	WW1	12.00	1.42	1.95	3.51	3.49	0.02	6.81	6.77	0.07
	12	WB	17.00	1.90	1.91	3.60	2.56	1.04	6.76	5.03	1.73
LATITUDE	AVERAGE		15.60	1.71	1.96	3.51	3.23	0.27	6.79	6.31	0.49
STANDARD	1	WW5	14.00	1.80	1.84	3.72	3.58	0.13	6.79	6.53	0.26
	4	WW2	23.00	2.50	1.97	3.55	3.38	0.16	6.97	6.64	0.33
	5	WW3	14.00	1.40	1.94	3.43	3.36	0.08	6.51	6.36	0.15
	10	WW1	17.00	2.30	1.99	3.53	2.99	0.54	6.97	6.01	0.26
	12	WB	34.00	3.80	1.94	3.64	3.35	0.29	6.82	6.25	0.57
STANDARD	AVERAGE		20.40	2.36	1.94	3.57	3.33	0.24	6.81	6.36	0.31
ROTATION MEANS	1	WW5	17.00	1.90	1.90	3.60	3.45	0.14	6.79	6.51	0.28
	4	WW2	18.50	1.95	2.05	3.40	3.28	0.12	6.91	6.66	0.25
	5	WW3	14.50	1.61	1.90	3.57	3.49	0.08	6.62	6.47	0.17
	10	WW1	14.50	1.86	1.97	3.52	3.24	0.28	6.89	6.39	0.16
	12	WB	25.50	2.85	1.93	3.62	2.95	0.66	6.79	5.64	1.15
P	SEED TREATMENT		0.187	0.167	0.765	0.661	0.689	0.873	0.870	0.909	0.568
	ROTATION		0.292	0.502	0.746	0.884	0.650	0.418	0.701	0.593	0.223
	SEED TREATMENT x ROTATION		0.306	0.493	0.851	0.757	0.499	0.462	0.911	0.680	0.613
LSD	SEED TREATMENT		7.260	0.944	0.164	0.294	0.495	0.436	0.283	0.876	0.626
	ROTATION		11.490	1.493	0.260	0.465	0.783	0.690	0.448	1.385	0.991
	SEED TREATMENT x ROTATION		16.240	2.112	0.368	0.657	1.108	0.975	0.634	1.959	1.401
cv%			61.9	71.3	13.0	12.8	23.2	260.9	6.4	21.2	239.20
Residual df.			25	25	25	25	25	25	25	25	25.00

2001 TAKE-ALL ASSESSMENT 2, (11/04/03)

SEED TREATMENT	ROTATION	CROP	INCIDENCE	INDEX	TILLERS	ROOTS/SHOOT			ROOTS/PLANT		
						TOTAL	CLEAN	INFECTED	TOTAL	CLEAN	INFECTED
LATITUDE	1	WW5	40.00	4.20	3.41	4.19	3.97	0.22	14.00	13.28	0.72
	4	WW2	61.00	6.50	3.43	4.56	4.20	0.35	15.57	14.36	1.21
	5	WW3	46.00	6.15	3.06	4.64	4.30	0.34	14.08	12.99	1.08
	10	WW1	57.60	6.32	3.10	4.68	4.23	0.45	14.13	12.80	1.33
	12	WB	30.00	3.20	3.52	3.97	3.80	0.17	13.46	12.98	0.48
LATITUDE	AVERAGE		46.90	5.27	3.30	4.41	4.10	0.31	14.25	13.28	0.97
STANDARD	1	WW5	57.00	6.10	3.16	4.88	4.54	0.33	15.19	14.15	1.04
	4	WW2	67.00	7.70	3.26	4.69	4.29	0.40	15.25	13.93	1.32
	5	WW3	60.00	6.40	3.87	3.93	3.56	0.38	14.90	13.55	1.35
	10	WW1	60.00	6.60	3.36	4.76	4.34	0.42	14.81	13.64	1.17
	12	WB	37.00	3.70	3.32	4.21	4.01	0.20	12.82	12.26	0.56
STANDARD	AVERAGE		56.20	6.10	3.39	4.49	4.15	0.35	14.59	13.51	1.09
ROTATION MEANS	1	WW5	48.50	5.15	3.28	4.53	4.26	0.28	14.60	13.72	0.88
	4	WW2	64.00	7.10	3.34	4.62	4.25	0.38	15.41	14.15	1.27
	5	WW3	53.00	6.28	3.46	4.29	3.93	0.36	14.49	13.27	1.22
	10	WW1	58.80	6.46	3.23	4.72	4.28	0.44	14.47	13.22	1.25
	12	WB	33.50	3.45	3.42	4.09	3.91	0.18	13.14	12.62	0.52
P	SEED TREATMENT		0.129	0.274	0.680	0.747	0.838	0.541	0.266	0.487	0.479
	ROTATION		0.033	0.037	0.960	0.560	0.675	0.159	0.002	0.059	0.044
	SEED TREATMENT x ROTATION		0.932	0.943	0.494	0.586	0.461	0.971	0.286	0.373	0.910
LSD	SEED TREATMENT		12.180	1.520	0.447	0.546	0.457	0.134	0.627	0.651	0.353
	ROTATION		19.260	2.403	0.706	0.863	0.723	0.213	0.991	1.030	0.558
	SEED TREATMENT x ROTATION		27.230	3.398	0.999	1.220	1.022	0.301	1.402	1.457	0.789
cv%			36.3	41.0	20.5	18.8	17.0	63.3	6.7	7.5	52.7
Residual df.			25	25	25	25	25	25	25	25	25

2001 TAKE-ALL ASSESSMENT 3, (29/05/01)

SEED TREATMENT	ROTATION	CROP	INCIDENCE	INDEX	TILLERS	ROOTS/SHOOT			ROOTS/PLANT		
						TOTAL	CLEAN	INFECTED	TOTAL	CLEAN	INFECTED
LATITUDE	1	WW5	98.00	12.90	3.41	7.65	5.99	1.66	25.90	20.26	5.64
	4	WW2	93.00	11.40	3.52	7.11	5.83	1.28	25.01	20.39	4.62
	5	WW3	90.60	9.43	3.20	7.34	6.00	1.34	23.58	19.16	4.41
	10	WW1	94.90	12.82	1.10	6.02	4.95	1.06	23.59	19.18	4.41
	12	WB	86.00	9.20	3.54	7.11	6.00	1.11	24.71	20.90	3.81
LATITUDE	AVERAGE		92.50	11.15	3.55	7.05	5.76	1.29	24.56	19.98	4.58
STANDARD	1	WW5	90.00	10.60	3.44	7.36	6.18	1.19	24.72	20.81	3.91
	4	WW2	97.00	12.10	3.15	7.91	6.09	1.83	24.72	18.96	5.76
	5	WW3	98.00	12.90	3.95	6.58	5.17	1.41	25.82	20.23	5.59
	10	WW1	93.00	9.90	3.89	6.44	5.46	0.98	25.19	21.38	3.81
	12	WB	81.00	9.50	3.51	6.73	5.91	0.82	23.67	20.78	2.89
STANDARD	AVERAGE		91.80	11.00	3.59	7.01	5.76	1.25	24.82	20.43	4.39
ROTATION MEANS	1	WW5	94.00	11.75	3.43	7.51	6.09	1.42	25.31	20.53	4.78
	4	WW2	95.00	11.75	3.34	7.51	5.96	1.55	24.86	19.68	5.19
	9	WW3	94.30	11.17	3.57	6.96	5.59	1.38	24.70	19.70	5.00
	10	WW1	93.90	11.36	3.99	6.23	5.21	1.02	24.39	20.28	4.11
	12	WB	83.50	9.35	3.53	6.92	5.95	0.97	24.19	20.84	3.35
P	SEED TREATMENT		0.818	0.818	0.857	0.892	0.983	0.766	0.800	0.543	0.759
	ROTATION		0.103	0.142	0.250	0.072	0.234	0.096	0.967	0.816	0.315
	SEED TREATMENT x ROTATION		0.464	0.003	0.411	0.485	0.560	0.315	0.774	0.619	0.467
LSD	SEED TREATMENT		6.080	1.332	0.390	0.623	0.542	0.321	2.158	1.522	1.242
	ROTATION		9.610	2.106	0.617	0.984	0.858	0.508	3.411	2.406	1.964
	SEED TREATMENT x ROTATION		13.590	2.978	0.873	1.392	1.213	0.718	4.824	3.402	2.777
cv%			10.1	18.5	16.8	13.6	14.5	38.9	13.4	11.6	42.5
Residual df.			25	25	25	25	25	25	25	25	25

2001 TAKE-ALL ASSESSMENT 4, (16/07/01)

SEED TREATMENT	ROTATION	CROP	INCIDENCE	INDEX	TILLERS	ROOTS/SHOOT			ROOTS/PLANT		
						TOTAL	CLEAN	INFECTED	TOTAL	CLEAN	INFECTED
LATITUDE	1	WW5	99.00	42.30	3.12	9.16	4.86	4.31	28.15	14.48	13.67
	4	WW2	100.00	68.30	3.10	9.13	2.74	6.39	28.24	8.45	19.79
	5	WW3	100.28	41.10	3.04	9.43	5.19	4.24	28.31	15.28	13.02
	10	WW1	97.51	18.80	3.24	8.65	6.57	2.09	27.91	21.52	6.40
	12	WB	100.00	42.00	3.33	8.11	4.08	4.03	26.57	13.55	13.02
LATITUDE	AVERAGE		99.36	42.50	3.17	8.90	4.69	4.21	27.84	14.66	13.18
STANDARD	1	WW5	99.00	54.20	2.85	10.11	4.62	5.49	28.58	12.90	15.68
	4	WW2	100.00	66.40	3.18	9.10	2.44	6.67	28.70	7.71	20.99
	5	WW3	100.00	64.70	3.25	8.98	3.00	5.98	29.18	9.57	19.61
	10	WW1	97.00	13.20	3.24	8.54	6.96	1.58	27.24	22.13	5.11
	12	WB	100.00	42.80	4.48	6.79	3.67	3.12	30.14	15.80	14.34
STANDARD	AVERAGE		99.20	48.30	3.40	8.70	4.14	4.57	28.77	13.62	15.15
ROTATION MEANS	1	WW5	99.00	48.20	2.99	9.63	4.74	4.90	28.37	13.69	14.68
	4	WW2	100.00	67.30	3.14	9.12	2.59	6.53	28.47	8.08	20.39
	9	WW3	100.14	52.90	3.15	9.20	4.10	5.11	28.74	12.43	16.32
	10	WW1	91.25	16.00	3.24	8.60	6.76	1.83	27.58	21.82	5.75
	12	WB	100.00	42.40	3.91	7.45	3.87	3.58	28.35	14.68	13.68
P	SEED TREATMENT		0.821	0.248	0.094	0.496	0.226	0.375	0.261	0.466	0.195
	ROTATION		0.066	<.001	0.002	<0.001	<0.001	<0.001	0.919	<.001	<.001
	SEED TREATMENT x ROTATION		0.999	0.335	0.028	0.182	0.447	0.207	0.560	0.471	0.564
LSD	SEED TREATMENT		1.414	10.030	0.277	0.575	0.912	0.813	1.669	2.878	3.041
	ROTATION		2.236	15.850	0.437	0.909	1.441	1.285	2.640	4.551	4.807
	SEED TREATMENT x ROTATION		3.162	22.420	0.618	1.286	2.038	1.817	3.733	6.436	6.799
cv%			2.2	33.9	12.9	10.0	31.7	28.4	9.1	31.3	33.0
Residual df.			25	25	25	25	25	25	25	25	25

2002 TAKE-ALL ASSESSMENT 1, (28/11/01)

SEED TREATMENT	ROTATION	CROP	INCIDENCE	INDEX	TILLERS	ROOTS/SHOOT			ROOTS/PLANT		
						TOTAL	CLEAN	INFECTED	TOTAL	CLEAN	INFECTED
LATITUDE	1	WW6	75.00	11.10	5.02	1.97	1.68	0.29	9.88	8.42	1.46
	4	WW3	59.00	8.10	4.75	2.14	1.83	0.31	10.05	8.66	1.39
	5	WW4	73.30	12.44	5.20	1.95	1.68	0.26	10.07	8.70	1.37
	9	WW1	24.00	2.40	5.27	1.83	1.77	0.06	9.51	9.21	0.30
	10	WW2	67.60	8.36	4.79	2.20	1.97	0.23	10.47	9.38	1.08
	11	WB	52.00	6.60	5.71	1.90	1.74	0.16	10.76	9.86	0.90
LATITUDE	AVERAGE		58.50	8.17	5.12	2.00	1.78	0.22	10.12	9.04	1.08
STANDARD	1	WW6	75.00	13.60	5.27	1.95	1.61	0.34	10.25	8.49	1.76
	4	WW3	81.00	15.90	5.69	1.76	1.45	0.32	10.02	8.21	1.81
	5	WW4	80.30	13.87	5.23	1.93	1.58	0.35	9.99	8.15	1.84
	9	WW1	70.00	4.00	5.19	1.86	1.77	0.10	9.52	9.03	0.49
	10	WW2	86.00	17.10	5.39	1.90	1.54	0.36	10.17	8.23	1.94
	11	WB	64.30	9.99	5.43	1.96	1.72	0.24	10.48	9.22	1.26
STANDARD	AVERAGE		71.10	12.41	5.37	1.89	1.61	0.28	10.07	8.56	1.52
ROTATION MEANS	1	WW6	75.00	12.35	5.15	1.96	1.65	0.31	10.07	8.46	1.61
	4	WW3	70.00	12.00	5.22	1.95	1.64	0.31	10.04	8.44	1.60
	5	WW4	76.80	13.15	5.22	1.94	1.63	0.31	10.30	8.42	1.61
	9	WW1	32.00	3.20	5.23	1.84	1.77	0.08	9.52	9.12	0.40
	10	WW2	76.80	12.73	5.09	2.05	1.76	0.29	10.32	8.81	1.51
	11	WB	58.20	8.30	5.57	1.93	1.73	0.20	10.62	9.54	1.08
P	SEED TREATMENT		0.011	<0.001	0.144	0.047	0.005	0.027	0.678	0.004	0.004
	ROTATION		<0.001	<0.001	0.617	0.363	0.547	<0.001	<0.001	<0.001	<0.001
	SEED TREATMENT x ROTATION		0.777	0.123	0.280	0.071	0.121	0.859	0.653	0.324	0.811
LSD	SEED TREATMENT		9.540	1.939	0.330	0.104	0.114	0.057	0.248	0.316	0.286
	ROTATION		16.520	3.358	0.571	0.179	0.198	0.098	0.430	0.548	0.495
	SEED TREATMENT x ROTATION		23.360	4.749	0.808	0.254	0.280	0.139	0.608	0.775	0.700
cv%			25.0	32.0	10.7	9.0	11.4	38.3	4.2	6.1	37.3
Residual df.			30	30	30	30	30	30	30	30	30

2002 TAKE-ALL ASSESSMENT 2, (15/01/02)

SEED TREATMENT	ROTATION	CROP	INCIDENCE	INDEX	TILLERS	ROOTS/SHOOT			ROOTS/PLANT		
						TOTAL	CLEAN	INFECTED	TOTAL	CLEAN	INFECTED
LATITUDE	1	WW6	84.00	14.77	5.78	2.02	1.71	0.31	11.60	9.84	1.76
	4	WW3	83.00	11.30	6.22	1.93	1.68	0.25	11.97	10.41	1.56
	5	WW4	71.70	8.78	6.50	1.92	1.70	0.21	12.34	10.95	1.38
	9	WW1	35.40	4.14	6.37	1.73	1.65	0.09	11.01	10.45	0.56
	10	WW2	87.60	11.71	6.04	1.92	1.63	0.29	11.65	9.88	1.77
	11	WB	83.00	13.50	6.89	1.74	1.51	0.23	11.89	10.36	1.53
LATITUDE	AVERAGE		74.10	10.70	6.31	1.88	1.65	0.23	11.74	10.32	1.43
STANDARD	1	WW6	89.80	21.44	6.07	1.96	1.54	0.42	11.90	9.33	2.57
	4	WW3	87.60	14.73	6.59	1.90	1.59	0.31	12.48	10.42	2.06
	5	WW4	93.00	19.30	6.76	1.83	1.45	0.38	12.26	9.72	2.54
	9	WW1	39.00	3.90	6.73	1.67	1.59	0.08	11.23	10.66	0.57
	10	WW2	87.00	18.04	6.48	1.91	1.57	0.34	12.32	10.15	2.17
	11	WB	84.30	11.62	7.15	1.70	1.47	0.24	12.12	10.46	1.66
STANDARD	AVERAGE		80.10	14.84	6.63	1.83	1.53	0.30	12.05	10.12	1.93
ROTATION MEANS	1	WW6	86.90	18.10	5.93	1.99	1.63	0.37	11.75	9.59	2.17
	4	WW3	85.30	13.02	6.41	1.92	1.64	0.28	12.23	10.42	1.81
	5	WW4	82.30	14.04	6.63	1.87	1.58	0.29	12.30	10.34	1.96
	9	WW1	37.20	4.02	6.55	1.70	1.62	0.09	11.12	10.56	0.57
	10	WW2	87.30	14.87	6.28	1.92	1.60	0.32	11.98	10.02	1.97
	11	WB	83.70	12.56	7.02	1.72	1.49	0.23	12.00	10.41	1.60
P	SEED TREATMENT		0.039	0.005	0.054	0.351	0.015	0.006	0.077	0.270	<0.001
	ROTATION		<0.001	<0.001	0.014	0.015	0.446	<0.001	0.005	0.029	<0.001
	SEED TREATMENT x ROTATION		0.280	0.125	1.000	0.998	0.705	0.254	0.853	0.124	0.127
LSD	SEED TREATMENT		5.680	2.815	0.330	0.106	0.090	0.045	0.345	0.350	0.260
	ROTATION		9.830	4.875	0.571	0.183	0.156	0.078	0.597	0.606	0.450
	SEED TREATMENT x ROTATION		13.900	6.895	0.807	0.259	0.221	0.110	0.844	0.857	0.636
cv%			12.5	37.4	8.6	9.7	9.6	28.9	4.9	5.8	26.3
Residual df.			30	30	30	30	30	30	30	30	30

2002 TAKE-ALL ASSESSMENT 3, (27/03/02)

SEED TREATMENT	ROTATION	CROP	INCIDENCE	INDEX	TILLERS	ROOTS/SHOOT			ROOTS/PLANT		
						TOTAL	CLEAN	INFECTED	TOTAL	CLEAN	INFECTED
LATITUDE	1	WW6	87.00	12.20	3.60	5.42	4.68	0.74	19.25	16.65	2.60
	4	WW3	86.00	11.60	3.65	5.53	4.88	0.65	20.05	17.73	2.32
	5	WW4	79.30	11.65	4.27	4.84	4.26	0.58	20.00	17.73	2.27
	9	WW1	49.00	5.10	3.88	5.34	5.08	0.25	20.65	19.67	0.97
	10	WW2	95.30	17.61	4.44	4.86	4.05	0.82	20.47	17.11	3.36
	11	WB	83.00	10.10	5.30	3.86	3.45	0.41	19.76	17.79	1.97
LATITUDE	AVERAGE		79.90	11.38	4.19	4.98	4.40	0.58	20.03	17.78	2.25
STANDARD	1	WW6	97.00	19.60	3.75	5.34	4.37	0.98	19.75	16.18	3.57
	4	WW3	93.00	14.60	3.60	5.76	4.88	0.88	20.75	17.63	3.12
	5	WW4	94.00	16.30	3.48	5.73	4.70	1.03	19.93	16.30	3.62
	9	WW1	63.00	7.40	4.25	5.04	4.71	0.33	21.38	19.95	1.42
	10	WW2	97.00	18.70	3.83	5.83	4.80	1.03	22.27	18.33	3.95
	11	WB	90.40	16.90	3.93	5.10	4.26	0.84	19.87	16.67	3.20
STANDARD	AVERAGE		89.10	15.58	3.81	5.47	4.62	0.85	20.66	17.51	3.15
ROTATION MEANS	1	WW6	92.00	15.90	3.68	5.38	4.52	0.86	19.50	16.41	3.09
	4	WW3	89.50	13.10	3.63	5.65	4.88	0.76	20.40	17.68	2.72
	5	WW4	86.70	13.97	3.87	5.28	4.48	0.81	19.96	17.02	2.95
	9	WW1	56.00	6.25	4.06	5.19	4.90	0.29	21.01	19.81	1.20
	10	WW2	96.20	18.15	4.13	5.35	4.43	0.92	12.37	17.72	3.65
	11	WB	86.70	13.50	4.62	4.48	3.85	0.63	19.81	17.23	2.59
P	SEED TREATMENT		0.004	0.005	0.026	0.009	0.111	0.002	0.134	0.550	0.001
	ROTATION		<0.001	0.001	0.017	0.016	0.001	<0.001	0.089	0.004	<0.001
	SEED TREATMENT x ROTATION		0.795	0.744	0.040	0.092	0.047	0.735	0.817	0.584	0.896
LSD	SEED TREATMENT		5.910	2.864	0.334	0.360	0.273	0.160	0.831	0.921	0.521
	ROTATION		10.240	4.961	0.579	0.623	0.472	0.276	1.440	1.595	0.902
	SEED TREATMENT x ROTATION		14.480	7.017	0.819	0.881	0.668	0.391	2.036	2.256	1.275
cv%			11.9	36.0	14.2	11.7	10.3	38.0	6.9	8.9	32.7
Residual df.			30	30	30	30	30	30	30	30	30

2002 TAKE-ALL ASSESSMENT 4, (13/05/02)

SEED TREATMENT	ROTATION	CROP	INCIDENCE	INDEX	TILLERS	ROOTS/SHOOT			ROOTS/PLANT		
						TOTAL	CLEAN	INFECTED	TOTAL	CLEAN	INFECTED
LATITUDE	1	WW6	98.00	19.10	2.96	11.60	8.35	3.25	34.12	24.60	9.53
	4	WW3	95.00	16.30	3.05	11.84	8.89	2.96	35.77	26.94	8.83
	5	WW4	99.08	17.03	3.31	11.36	8.33	3.03	37.33	27.45	9.88
	9	WW1	88.00	10.10	3.19	11.00	9.54	1.47	35.07	30.38	4.69
	10	WW2	95.08	12.62	2.95	12.00	9.20	2.80	35.18	26.89	8.29
	11	WB	97.50	11.92	4.06	8.93	7.06	1.86	35.91	28.43	7.48
LATITUDE	AVERAGE		95.44	14.51	3.25	11.12	8.56	2.56	35.57	27.45	8.12
STANDARD	1	WW6	100.00	25.60	3.16	11.55	7.39	4.16	36.42	23.30	13.12
	4	WW3	98.00	17.90	3.05	11.35	8.26	3.09	34.61	25.19	9.43
	5	WW4	98.00	25.30	3.28	11.81	7.69	4.12	38.49	25.19	13.30
	9	WW1	81.00	8.70	3.42	10.68	9.36	1.32	36.28	31.81	4.47
	10	WW2	99.00	22.10	3.35	11.29	7.81	3.48	37.63	26.31	11.32
	11	WB	96.76	11.13	3.93	8.99	7.15	1.84	35.16	27.97	7.21
STANDARD	AVERAGE		95.46	18.46	3.36	10.95	7.94	3.00	36.43	26.63	9.81
ROTATION MEANS	1	WW6	99.00	22.35	3.06	11.57	7.87	3.70	35.27	23.95	11.32
	4	WW3	96.50	17.10	3.05	11.60	8.57	3.02	35.19	36.07	9.13
	5	WW4	98.54	21.17	3.29	11.58	8.01	3.57	37.91	36.32	11.59
	9	WW1	94.50	9.40	3.30	10.84	9.45	1.39	35.68	31.10	4.58
	10	WW2	97.04	17.36	3.15	11.65	8.51	3.14	36.40	26.60	9.80
	11	WB	97.13	11.52	3.99	8.96	7.10	1.85	35.55	28.20	7.34
P	SEED TREATMENT		0.992	0.055	0.253	0.488	0.014	0.140	0.279	0.379	0.047
	ROTATION		<0.001	0.004	<0.001	<0.001	<0.001	<0.001	0.362	0.004	<0.001
	SEED TREATMENT x ROTATION		0.514	0.456	0.586	0.806	0.534	0.748	0.691	0.890	0.521
LSD	SEED TREATMENT		3.567	4.035	0.191	0.514	0.483	0.593	1.611	1.886	1.671
	ROTATION		6.178	6.989	0.331	0.891	0.836	1.027	2.790	3.267	2.893
	SEED TREATMENT x ROTATION		8.738	9.884	0.438	1.259	1.183	1.452	3.946	4.621	4.092
cv%			6.3	41.4	9.8	7.9	9.9	36.1	7.6	11.8	31.5
Residual df.			30	30	30	30	30	30	30	30	30

2002 ASSESSMENT 5, (18/06/02)

SEED TREATMENT	ROTATION	CROP	INCIDENCE	INDEX	TILLERS	ROOTS/SHOOT			ROOTS/PLANT		
						TOTAL	CLEAN	INFECTED	TOTAL	CLEAN	INFECTED
LATITUDE	1	WW6	100.00	61.60	2.80	11.49	2.72	8.77	31.50	7.68	23.82
	4	WW3	100.00	58.90	2.74	13.55	3.98	9.57	36.57	10.52	26.05
	5	WW4	100.00	67.70	2.91	13.14	5.54	7.60	37.76	17.15	20.60
	9	WW1	100.00	20.20	2.85	13.80	9.20	4.60	38.27	25.46	12.81
	10	WW2	100.00	56.00	2.95	12.17	2.97	9.20	35.50	8.41	27.09
	11	WB	100.00	39.80	3.04	6.12	1.62	4.50	25.66	7.94	17.72
LATITUDE	AVERAGE		100.00	50.70	2.88	11.71	4.34	7.37	34.21	12.86	21.35
STANDARD	1	WW6	100.00	64.70	2.91	10.87	2.14	8.72	31.10	6.23	24.87
	4	WW3	100.00	53.00	2.67	12.75	4.23	8.53	33.95	10.96	23.00
	5	WW4	100.00	79.80	2.95	11.86	1.01	10.85	34.67	3.46	31.22
	9	WW1	100.00	18.30	3.20	11.61	7.36	4.26	36.77	23.23	13.55
	10	WW2	100.00	72.00	2.85	12.21	2.46	9.75	34.15	7.20	26.95
	11	WB	100.00	39.90	3.14	9.82	4.50	5.32	29.04	13.36	15.68
STANDARD	AVERAGE		100.00	54.60	2.95	11.52	3.62	7.90	33.28	10.74	22.55
ROTATION MEANS	1	WW6	100.00	63.10	2.85	11.18	2.43	8.75	31.30	6.95	24.35
	4	WW3	100.00	55.90	2.70	13.15	4.10	9.05	35.26	10.74	24.53
	5	WW4	100.00	73.80	2.93	12.50	3.28	9.22	36.22	10.30	25.91
	9	WW1	100.00	19.20	3.03	12.71	8.28	4.43	37.52	24.34	13.18
	10	WW2	100.00	64.00	2.90	12.19	2.72	9.47	34.83	7.80	27.02
	11	WB	100.00	39.80	3.09	7.97	3.06	4.91	27.35	10.65	16.70
P	SEED TREATMENT		-	0.366	0.656	0.753	0.184	0.444	0.477	0.219	0.433
	ROTATION		-	<0.001	0.784	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	SEED TREATMENT x ROTATION		-	0.660	0.970	0.120	0.013	0.567	0.743	0.067	0.150
LSD	SEED TREATMENT		0.000	8.730	0.324	1.229	1.085	1.398	2.626	3.449	3.064
	ROTATION		0.000	15.130	0.561	2.130	1.879	2.421	4.549	5.974	5.308
	SEED TREATMENT x ROTATION		0.000	21.390	0.793	3.012	2.657	3.424	6.433	8.448	7.506
cv%			0.0	28.1	18.8	18.0	46.3	31.0	13.2	49.6	23.7
Residual df.			30	30	30	30	30	30	30	30	30

ROTATIONAL TRIAL 2003 ASSESSMENT 1, (01/12/02)

SEED TREATMENT	ROTATION	CROP	INCIDENCE	INDEX	TILLERS	ROOTS/SHOOT			ROOTS/PLANT		
						TOTAL	CLEAN	INFECTED	TOTAL	CLEAN	INFECTED
PRECEDED BY LATITUDE	1	WW7	15.0	1.70	2.26	2.90	2.82	0.08	6.55	6.37	0.18
	4	WW4	42.0	5.20	2.67	2.82	2.59	0.24	7.39	6.81	0.58
	5	WW5	50.9	5.68	2.40	2.83	2.20	0.64	6.61	5.04	1.57
	6	WW1	25.3	2.74	2.80	2.80	2.66	0.14	7.19	7.44	0.38
	9	WW2	52.0	7.00	2.71	2.65	2.35	0.30	7.00	6.26	0.74
	10	WW3	35.9	3.95	2.63	2.64	2.46	0.18	6.85	6.38	0.47
	11	WW4(B)	71.8	10.21	2.62	2.93	2.45	0.48	7.74	6.38	1.25
PRECEDED BY LATITUDE	AVERAGE		41.8	5.21	2.58	2.80	2.50	0.29	7.12	6.38	0.74
NO PREVIOUS LATITUDE	1	WW7	43.7	6.50	2.62	2.67	2.44	0.23	6.95	6.36	0.59
	4	WW4	49.0	6.50	2.36	2.89	2.56	0.33	6.69	5.93	0.76
	5	WW5	44.0	5.20	2.41	2.97	2.73	0.24	7.11	6.54	0.57
	6	WW1	16.0	1.80	2.52	2.73	2.66	0.07	6.80	6.62	0.18
	9	WW2	50.0	6.60	2.46	2.87	2.54	0.34	6.94	6.16	0.78
	10	WW3	43.0	5.70	2.71	2.72	2.50	0.22	7.24	6.68	0.56
	11	WW4(B)	62.7	7.73	2.93	2.76	2.41	0.35	7.74	6.74	1.00
NO PREVIOUS LATITUDE	AVERAGE		44.1	5.72	2.56	2.80	2.55	0.25	7.07	6.43	0.64
ROTATION MEANS	1	WW7	29.3	4.10	2.44	2.78	2.63	0.16	6.75	6.37	0.39
	4	WW4	45.5	5.85	2.52	2.86	2.57	0.28	7.04	6.37	0.67
	5	WW5	47.4	5.44	2.41	2.90	2.47	0.44	6.86	5.79	1.07
	6	WW1	20.7	2.27	2.66	2.77	2.66	0.11	7.31	7.03	0.28
	9	WW2	51.0	6.80	2.59	2.76	2.44	0.32	6.97	6.21	0.76
	10	WW3	39.4	4.83	2.67	2.68	2.48	0.20	7.04	6.53	0.51
	11	WW4(B)	67.3	8.97	2.73	2.84	2.43	0.41	7.69	6.56	1.13
P	SEED TREATMENT		0.475	0.302	0.693	0.966	0.605	0.405	0.781	0.815	0.410
	ROTATION		<0.001	<0.001	0.073	0.733	0.634	0.004	0.172	0.159	0.004
	SEED TREATMENT x ROTATION		0.024	0.009	0.043	0.596	0.175	0.076	0.233	0.105	0.108
LSD	SEED TREATMENT		6.210	0.982	0.129	0.147	0.168	0.096	0.379	0.446	0.253
	ROTATION		11.620	1.837	0.241	0.275	0.314	0.180	0.708	0.835	0.473
	SEED TREATMENT x ROTATION		16.430	2.598	0.340	0.388	0.444	0.255	1.001	1.181	0.669
cv%			26.7	33.1	9.2	9.7	12.3	64.8	9.8	12.9	68.0
Residual df.			36	36	36	36	36	36	36	36	36

ROTATIONAL TRIAL 2003 ASSESSMENT 2 (30/01/03)

SEED TREATMENT	ROTATION	CROP	INCIDENCE	INDEX	TILLERS	ROOTS/SHOOT			ROOTS/PLANT		
						TOTAL	CLEAN	INFECTED	TOTAL	CLEAN	INFECTED
PRECEDED BY LATITUDE	1	WW7	46.00	5.40	2.84	3.29	3.07	0.22	8.98	8.35	0.63
	4	WW4	58.00	8.60	2.91	3.27	2.92	0.36	9.55	8.50	1.05
	5	WW5	45.90	5.87	2.63	3.59	3.33	0.26	9.44	8.77	0.67
	6	WW1	18.00	2.00	3.31	2.60	2.53	0.07	8.51	8.26	0.25
	9	WW2	48.00	8.10	2.99	3.18	2.93	0.24	9.49	8.75	0.74
	10	WW3	54.30	9.62	2.99	3.29	2.90	0.39	9.65	8.49	1.16
	11	WW4(B)	71.00	10.60	2.78	3.44	2.90	0.54	9.49	8.03	1.46
PRECEDED BY LATITUDE	AVERAGE		48.70	7.17	2.92	3.24	2.94	0.30	9.30	8.45	0.85
NO PREVIOUS LATITUDE	1	WW7	32.00	3.60	2.89	3.48	3.35	0.13	9.69	9.30	0.39
	4	WW4	45.00	5.70	2.61	3.58	3.32	0.27	9.24	8.51	0.73
	5	WW5	44.00	5.80	2.92	3.27	3.04	0.23	9.28	8.61	0.67
	6	WW1	22.00	2.20	3.10	2.92	2.81	0.11	8.74	8.43	0.31
	9	WW2	55.00	7.70	3.19	2.76	2.49	0.28	8.82	7.93	0.89
	10	WW3	43.00	4.90	3.08	3.18	3.01	0.18	9.78	9.23	0.55
	11	WW4(B)	60.60	10.23	3.40	2.85	2.48	0.37	9.69	8.47	1.22
NO PREVIOUS LATITUDE	AVERAGE		42.80	5.73	3.03	3.15	2.93	0.22	9.32	8.64	0.68
ROTATION MEANS	1	WW7	39.00	4.50	2.86	3.39	3.21	0.18	9.34	8.83	0.51
	4	WW4	51.50	7.15	2.76	3.43	3.12	0.31	9.39	8.50	0.89
	5	WW5	44.90	5.83	2.78	3.43	3.19	0.25	9.36	8.69	0.67
	6	WW1	20.00	2.10	3.21	2.76	2.67	0.09	8.63	8.35	0.28
	9	WW2	50.50	7.90	3.09	2.97	2.71	0.26	9.16	8.34	0.82
	10	WW3	48.60	7.26	3.04	3.25	2.95	0.28	9.71	8.86	0.85
	11	WW4(B)	65.80	10.42	3.09	3.14	2.69	0.45	9.59	8.25	1.34
P	SEED TREATMENT		0.130	0.043	0.242	0.395	0.898	0.037	0.891	0.267	0.069
	ROTATION		<0.001	<0.001	0.065	0.005	0.006	<0.001	0.007	0.313	<0.001
	SEED TREATMENT x ROTATION		0.692	0.437	0.138	0.095	0.090	0.332	0.229	0.134	0.348
LSD	SEED TREATMENT		7.770	1.390	0.180	0.201	0.196	0.068	0.284	0.343	0.185
	ROTATION		14.530	2.601	0.336	0.375	0.366	0.127	0.532	0.642	0.347
	SEED TREATMENT x ROTATION		20.550	3.678	0.475	0.531	0.518	0.180	0.752	0.908	0.491
cv%			31.3	39.8	11.1	11.6	12.3	48.3	5.6	7.4	44.6
Residual df.			36	36	36	36	36	36	36	36	36

ROTATIONAL TRIAL 2003 ASSESSMENT 3, (04/04/03)

SEED TREATMENT	ROTATION	CROP	INCIDENCE	INDEX	TILLERS	ROOTS/SHOOT			ROOTS/PLANT		
						TOTAL	CLEAN	INFECTED	TOTAL	CLEAN	INFECTED
PRECEDED BY LATITUDE	1	WW7	69.00	11.40	2.85	6.37	5.89	0.49	17.49	16.20	1.29
	4	WW4	60.00	8.90	3.09	5.59	5.24	0.37	17.26	16.11	1.15
	5	WW5	57.40	8.74	2.86	6.04	5.68	0.38	17.16	16.03	1.13
	6	WW1	49.00	7.40	3.12	5.74	5.47	0.28	17.86	17.04	0.82
	9	WW2	76.00	17.60	2.96	5.77	4.91	0.88	17.07	14.52	2.55
	10	WW3	65.10	10.17	2.72	6.42	5.89	0.55	17.39	15.94	1.45
	11	WW4(B)	73.00	13.50	2.89	6.05	5.41	0.65	17.41	15.51	1.89
PRECEDED BY LATITUDE	AVERAGE		64.20	11.10	2.93	6.00	5.48	0.52	17.36	15.91	1.47
NO PREVIOUS LATITUDE	1	WW7	55.00	8.50	3.06	5.71	5.34	0.36	17.44	16.34	1.10
	4	WW4	64.00	10.90	2.39	6.85	6.25	0.59	16.09	14.72	1.37
	5	WW5	68.00	11.20	2.86	5.97	5.46	0.49	16.61	15.28	1.33
	6	WW1	50.00	7.80	2.82	5.91	5.49	0.41	16.48	15.33	1.15
	9	WW2	65.90	13.53	3.14	5.58	4.86	0.70	17.49	15.35	2.14
	10	WW3	47.50	7.76	3.01	5.92	5.59	0.32	17.49	16.59	0.90
	11	WW4(B)	89.50	25.90	2.75	6.37	5.27	1.08	17.44	14.61	2.83
NO PREVIOUS LATITUDE	AVERAGE		62.80	12.18	2.86	6.05	5.48	0.56	17.01	15.46	1.55
ROTATION MEANS	1	WW7	62.00	9.95	2.96	6.04	5.62	0.42	17.47	16.27	1.20
	4	WW4	62.00	9.90	2.74	6.22	5.74	0.48	16.67	15.41	1.26
	5	WW5	62.70	9.97	2.86	6.01	5.57	0.44	16.89	15.66	1.23
	6	WW1	49.50	7.60	2.97	5.83	5.48	0.35	17.17	16.18	0.99
	9	WW2	70.90	15.56	3.05	5.68	4.88	0.79	17.28	14.94	2.34
	10	WW3	56.30	8.97	2.86	6.17	5.74	0.43	17.44	16.27	1.18
	11	WW4(B)	81.30	19.54	2.82	6.22	5.34	0.87	17.42	15.06	2.36
P	SEED TREATMENT		0.751	0.491	0.524	0.777	0.997	0.521	0.204	0.262	0.694
	ROTATION		0.013	0.002	0.734	0.535	0.109	0.003	0.691	0.327	<0.001
	SEED TREATMENT x ROTATION		0.294	0.135	0.155	0.086	0.272	0.225	0.568	0.490	0.438
LSD	SEED TREATMENT		8.770	3.153	0.207	0.342	0.333	0.152	0.582	0.796	0.390
	ROTATION		16.410	5.899	0.386	0.639	0.623	0.285	1.088	1.490	0.730
	SEED TREATMENT x ROTATION		23.200	8.342	0.547	0.904	0.880	0.403	1.539	2.107	1.032
cv%			25.5	50.0	13.2	10.5	11.2	52.0	6.2	9.4	47.7
Residual df.			36	36	36	36	36	36	36	36	36

ROTATIONAL TRIAL 2003 ASSESSMENT 4, (03/05/03)

SEED TREATMENT	ROTATION	CROP	INCIDENCE	INDEX	TILLERS	ROOTS/SHOOT			ROOTS/PLANT		
						TOTAL	CLEAN	INFECTED	TOTAL	CLEAN	INFECTED
PRECEDED BY LATITUDE	1	WW7	80.00	18.40	2.40	9.48	8.20	1.28	22.83	19.78	3.05
	4	WW4	88.00	20.90	2.49	10.18	8.82	1.36	25.35	21.94	3.41
	5	WW5	78.00	18.10	2.34	9.91	8.74	1.16	23.20	20.42	2.79
	6	WW1	50.00	5.60	2.73	9.68	9.28	0.40	26.00	24.96	1.04
	9	WW2	98.00	31.30	2.45	10.03	7.95	2.08	24.50	19.42	5.08
	10	WW3	82.00	22.10	2.45	10.80	9.48	1.32	26.17	23.01	3.16
	11	WW4(B)	99.00	41.40	2.28	11.31	6.83	4.48	25.67	15.61	10.06
PRECEDED BY LATITUDE	AVERAGE		82.10	22.50	2.45	10.20	8.47	1.76	24.82	20.73	4.08
NO PREVIOUS LATITUDE	1	WW7	83.70	22.00	2.41	10.48	8.96	1.52	25.27	21.54	3.73
	4	WW4	82.00	15.70	2.33	9.85	8.70	1.15	23.02	20.39	2.63
	5	WW5	81.00	13.60	2.51	9.60	8.72	0.89	24.17	21.93	2.24
	6	WW1	62.00	7.70	2.56	9.74	9.26	0.47	24.83	23.59	1.24
	9	WW2	100.00	30.60	2.59	10.31	8.31	2.00	26.67	21.58	5.09
	10	WW3	80.00	18.90	2.59	10.49	9.26	1.23	27.10	23.99	3.11
	11	WW4(B)	83.40	27.10	2.45	11.09	9.35	1.74	27.09	22.71	4.39
NO PREVIOUS LATITUDE	AVERAGE		81.70	19.40	2.49	10.22	8.94	1.28	25.45	22.25	3.20
ROTATION MEANS	1	WW7	81.90	20.20	2.40	9.98	8.58	1.40	24.05	20.66	3.39
	4	WW4	85.00	18.30	2.41	10.01	8.76	1.26	24.19	21.17	3.02
	5	WW5	79.50	15.80	2.43	9.75	8.73	1.02	23.69	21.17	2.52
	6	WW1	56.00	6.60	2.65	9.71	9.27	0.44	25.42	24.28	1.14
	9	WW2	99.00	30.90	2.52	10.17	8.13	2.04	25.59	20.50	5.08
	10	WW3	81.00	20.50	2.52	10.64	9.37	1.28	26.64	23.50	3.14
	11	WW4(B)	91.20	34.20	2.37	11.20	8.09	3.11	26.38	19.16	7.22
P	SEED TREATMENT		0.902	0.141	0.489	0.919	0.175	0.084	0.280	0.074	0.138
	ROTATION		<0.001	<0.001	0.239	0.007	0.302	<0.001	0.050	0.029	<0.001
	SEED TREATMENT x ROTATION		0.442	0.370	0.535	0.617	0.339	0.045	0.273	0.138	0.093
LSD	SEED TREATMENT		6.670	4.280	0.126	0.431	0.682	0.506	1.170	1.668	1.177
	ROTATION		12.470	8.000	0.235	0.806	1.275	0.947	2.189	3.121	2.203
	SEED TREATMENT x ROTATION		17.640	11.310	0.332	1.140	1.804	1.339	3.095	4.413	3.115
cv%			15.0	37.7	9.4	7.8	14.4	62.0	8.6	14.3	59.6
Residual df.			36	36	36	36	36	36	36	36	36

ROTATIONAL TRIAL 2003 ASSESSMENT 5, (16/06/03)

SEED TREATMENT	ROTATION	CROP	INCIDENCE	INDEX	TILLERS	ROOTS/SHOOT			ROOTS/PLANT		
						TOTAL	CLEAN	INFECTED	TOTAL	CLEAN	INFECTED
PRECEDED BY LATITUDE	1	WW7	89.00	26.30	2.26	13.64	10.46	3.18	30.85	23.51	7.34
	4	WW4	97.96	40.70	2.29	14.33	9.74	4.59	32.62	22.24	10.38
	5	WW5	89.70	26.40	2.10	13.37	10.00	3.37	27.88	21.10	6.77
	6	WW1	78.92	11.90	2.43	14.53	12.91	1.61	34.79	30.89	3.90
	9	WW2	100.00	56.20	2.37	14.39	8.09	6.30	33.90	18.88	15.02
	10	WW3	99.49	49.30	2.22	15.11	8.06	7.06	33.63	18.13	15.51
	11	WW4(B)	100.00	62.80	2.20	15.23	7.53	7.70	33.48	16.58	16.90
PRECEDED BY LATITUDE	AVERAGE		93.58	39.10	2.27	14.37	9.54	4.83	32.45	21.62	10.83
NO PREVIOUS LATITUDE	1	WW7	87.00	24.50	2.40	13.12	10.42	2.70	31.25	24.76	6.49
	4	WW4	97.62	43.20	2.28	13.44	8.44	5.00	30.68	19.23	11.46
	5	WW5	94.87	32.00	2.38	14.08	10.40	3.68	32.71	24.32	8.39
	6	WW1	73.00	13.60	2.49	11.94	10.63	1.31	29.94	36.68	3.26
	9	WW2	100.00	37.00	2.48	10.82	6.42	4.39	27.18	16.20	10.98
	10	WW3	96.00	34.80	2.35	13.91	9.66	4.25	32.62	22.66	9.96
	11	WW4(B)	99.79	41.60	2.59	13.81	8.83	4.98	35.64	22.76	12.87
NO PREVIOUS LATITUDE	AVERAGE		92.61	32.40	2.42	13.02	9.26	3.76	31.43	22.37	9.06
ROTATION MEANS	1	WW7	88.00	25.40	2.33	13.38	10.44	2.94	31.05	24.14	6.92
	4	WW4	97.79	42.00	2.28	13.88	9.09	4.80	31.65	20.73	10.92
	5	WW5	92.29	29.20	2.24	13.73	10.20	3.53	30.29	22.71	7.58
	6	WW1	75.96	12.70	2.46	13.23	11.77	1.46	32.37	28.78	3.58
	9	WW2	100.00	46.60	2.43	12.60	7.26	5.34	30.54	17.54	13.00
	10	WW3	97.75	42.10	2.29	14.51	8.86	5.65	33.13	20.39	12.73
	11	WW4(B)	99.90	52.20	2.40	14.52	8.18	6.34	34.56	19.67	14.89
P	SEED TREATMENT		0.618	0.038	0.058	0.008	0.616	0.008	0.417	0.578	0.053
	ROTATION		<0.001	<0.001	0.724	0.327	0.003	<0.001	0.529	0.002	<0.001
	SEED TREATMENT x ROTATION		0.883	0.113	0.863	0.324	0.421	0.107	0.218	0.269	0.239
LSD	SEED TREATMENT		3.902	6.310	0.163	0.970	1.136	0.771	2.515	2.723	1.793
	ROTATION		7.301	11.810	0.304	1.815	2.126	1.442	4.704	5.094	3.355
	SEED TREATMENT x ROTATION		10.325	16.700	0.430	2.567	3.006	2.039	6.653	7.205	4.745
cv%			7.7	32.6	12.8	13.1	22.3	33.1	14.5	22.8	33.3
Residual df.			36	36	36	36	36	36	36	36	36

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SEED TREATMENT	ROTATION	CROP	INCIDENCE	INDEX	TILLERS	ROOTS/SHOOT			ROOTS/PLANT		
						TOTAL	CLEAN	INFECTED	TOTAL	CLEAN	INFECTED
PRECEDED BY LATITUDE	1	WW7	99.00	40.10	2.21	13.42	7.51	5.91	29.64	16.60	13.04
	4	WW4	90.00	40.00	2.18	14.34	9.01	5.34	30.89	20.10	10.78
	5	WW5	101.90	40.10	2.29	14.50	8.85	5.64	32.50	20.12	12.37
	6	WW1	89.00	18.30	2.57	12.88	9.22	3.66	32.73	23.81	8.92
	9	WW2	93.00	51.30	2.26	13.31	6.28	7.03	29.92	14.33	15.58
	10	WW3	87.20	47.60	2.33	13.96	6.75	7.21	31.15	15.99	15.16
	11	WW4(B)	69.00	48.50	2.29	21.51	3.97	8.54	28.56	9.25	19.31
PRECEDED BY LATITUDE	AVERAGE		89.90	40.80	2.30	13.56	7.37	6.19	30.77	17.17	13.60
NO PREVIOUS LATITUDE	1	WW7	94.00	38.30	2.34	13.90	8.29	5.61	31.62	19.69	11.93
	4	WW4	100.50	35.50	2.32	13.89	8.47	5.42	31.52	19.68	11.84
	5	WW5	97.00	37.70	2.41	13.50	8.36	5.14	32.24	20.16	12.08
	6	WW1	93.00	28.30	2.59	21.21	8.42	3.78	31.13	21.42	9.71
	9	WW2	99.00	52.50	2.43	13.72	6.90	6.82	33.07	17.04	16.03
	10	WW3	90.00	35.50	2.29	13.68	8.88	4.80	31.15	20.54	10.61
	11	WW4(B)	85.00	48.60	2.38	13.37	6.03	7.35	31.93	14.43	16.50
NO PREVIOUS LATITUDE	AVERAGE		94.10	39.50	2.39	13.47	7.91	5.56	31.67	18.99	12.67
ROTATION MEANS	1	WW7	96.50	39.20	2.28	13.66	7.90	5.76	30.63	18.15	12.49
	4	WW4	95.30	37.70	2.25	14.11	8.74	5.38	31.21	19.89	11.31
	5	WW5	99.40	38.90	2.35	14.00	8.61	5.39	32.37	20.14	12.23
	6	WW1	91.00	23.30	2.58	12.54	8.82	3.72	31.93	22.62	9.32
	9	WW2	96.00	51.90	2.34	13.52	6.59	6.92	31.49	15.68	15.81
	10	WW3	88.60	41.50	2.31	13.82	7.82	6.00	31.15	18.27	12.88
	11	WW4(B)	77.00	48.60	2.34	12.94	5.00	7.94	29.74	11.84	17.91
P	SEED TREATMENT		0.207	0.712	0.165	0.787	0.118	0.091	0.280	0.062	0.163
	ROTATION		0.017	0.006	0.181	0.173	<0.001	<0.001	0.705	<0.001	<0.001
	SEED TREATMENT x ROTATION		0.593	0.817	0.979	0.752	0.113	0.524	0.728	0.305	0.221
LSD	SEED TREATMENT		6.650	7.330	0.131	0.695	0.682	0.738	1.660	1.921	1.318
	ROTATION		12.440	13.720	0.246	1.301	1.276	1.381	3.105	3.593	2.466
	SEED TREATMENT x ROTATION		17.590	19.400	0.348	1.839	1.804	1.953	4.391	5.081	3.488
cv%			9.7	33.6	10.3	9.5	16.5	23.2	9.8	19.6	18.5
Residual df.			35	35	35	35	35	35	35	35	35