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MANAGEMENT OF AUTUMN-SOWN RONGOTEA WHEAT FOR HIGH YIELD ON LIGHT SOILS IN CANTERBURY

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ABSTRACT

This three year study was initiated to establish the yield potential of Rongotea wheat on light Lismore soils and to formulate a management package for producing high yield milling quality wheat. Designed for advisory extension purposes, this trial provided large scale demonstrations of management techniques comparing the levels and interactions of nitrogen, irrigation and disease and pest control on yield components.

Grain yields ranged from 2.6 t/ha to 8.8 t/ha demonstrating the huge effect of management on crop performance. Nitrogen had the greatest influence on yield components and interacted strongly with disease and pest control, particularly for the kernel weight component. The highest yields were obtained at 200 kg N/ha under a preventative regime of disease and pest control. At lower rates of nitrogen (0,50 kg/ha), a curative disease and pest regime was as effective.

Irrigating at 50% available soil moisture depletion (a.s.m.) gave only small improvements in yield over irrigating at 75% depletion, this usually occurred at the high rates of nitrogen.

Grain protein and MDD bake score were strongly influenced by the amount of nitrogen applied.

The trial has demonstrated that average yields of 7.8 t/ha of milling grade Rongotea wheat can be consistently produced on light Lismore soils with the correct level of management.

Additional Key Words: Nitrogen, irrigation, disease and pest control, kernel weight, grain quality, ear number.

INTRODUCTION

The average yield of New Zealand wheat increased by only 10% (3.4 to 3.7 t/ha) during the period 1961 - 1979 compared to an increase in UK yields of 40% (3.6 to 5.2 t/ha) over the same period (Scott, 1979).

Scott (1979) suggested that one of the differences between the UK farmer and his NZ counterpart was a greater interest in, and knowledge of, crop husbandry and a competitive spirit which was largely kindled by commercial chemical firms such as ICI and the high competition field days held in the UK at that time.

Our response was to design and initiate a large scale cereal demonstration to identify efficient husbandry techniques for improving yield, and to help bridge the gap in yield which had developed between UK and NZ growers.

The study sought to determine the upper limits of cereal production on light soils in Canterbury and to provide a suitable extension platform at field days and crop walks to highlight and promote husbandry techniques which increase yields whilst maintaining acceptable grain quality.

The responsiveness of wheat on light soils in Canterbury to irrigation and nitrogen and their interdependence has been extensively reported (Drewitt, 1979). Further, the effects of foliar disease on grain yield and the benefits of foliar fungicides is well documented (Balasubramaniam and Gaunt, 1985). There has however been no field work undertaken in Canterbury examining the interactive responses of all these factors in one trial.

The results reported in this paper are from the winter-sown wheat component of the study. In it we examined the effect of four rates of nitrogen, two levels of irrigation and two regimes for the control of diseases and pests on yield and quality.

MATERIALS AND METHODS

Site

The study was carried out on a Lismore stony silt loam on a border-dyked site at Winchmore Irrigation Research Station over three consecutive years from 1984/85 to 1986/87. Site history and soil fertility data are given in Table 1.

The wheat, cultivar "Rongotea", was conventionally sown in early May at a rate calculated on kernel weight, germination percentage and estimated field emergence, to provide an established plant population of around 250 plants/m^2 (Table 2). Further details of the crop husbandry operations for each treatment factor are set out in Table 2, and seasonal rainfall in Table 3.

Treatment Factors

The following treatment factors were examined.

A **Disease and Pest Management**

(1) Curative regime. Fungicides and insecticides were applied to these treatments when the disease or insect level reached an a assessed economic threshold (McCloy, 1984).

(2) Preventative regime. Fungicides and insecticides were applied on a calendar basis from Spring and aimed to prevent infestation. The application frequency depended on the chemical used and the disease/pest pressure.

B **Irrigation**

(1) Irrigation 1. Irrigation at 75% depletion of available soil moisture (a.s.m.) equivalent to 15% soil moisture (sm).

(2) Irrigation 2. Irrigating at 50% depletion a.s.m. equivalent to 20% sm. Irrigations were applied by the border-strip method.

C **Nitrogen**

Three rates were compared in Year 1. These were: 100, 200 and 300 kg N/ha applied in the form of liquid urea. Four rates were compared in Years 2 and 3. these were; 0, 50, 100 and 200 kg N/ha applied in the form of solid urea. Each rate was split and applied in three separate dressings at different stages of crop growth (Table 2).

Table 1: Previous Crop History and Fertility of Trial Sites.

	1984/85	1985/86	1986/87
Previous crop (2 years)	ex Pasture 2 years	ex Pasture 2 years	ex Pasture 2 years
Soil Fertility (Quick test & SO_4)			
(pre-drill sampled)			
pH	5.9	5.7	6.2
Ca	11	7	11
K	8	12	9
P	11	12	22
Mg	11	10	13
Na	6	5	3
SO_4	6	13	6
Nitrogen			
Incubation Test (see text)			
Yo (prediction of wheat yield t/ha without N)	4.2	3.2	3.2
Data sampled	July 19	July 31	July 30

Trial Design

The design used large demonstration areas of crop rather than small plots. To achieve this, whilst keeping the total size of the trial manageable, factors were run across each other.

In 1984/85, six borders were used, for the single replicate of the irrigation level by nitrogen rate factorial. The upper half of the borders was allocated to the preventative disease and pest regime with the lower half allocated to the curative regime.

In 1985/86 and 1986/87, four borders were used for each of two replicates with irrigation levels applied to pairs of borders. Within the two borders making up an irrigation treatment, nitrogen treatments were randomised. In one replicate the curative regime was run across the top half of the borders, in the second replicate across the bottom half, ie the disease and pest control regimes were applied in a 2 x 2 latin square to units four borders wide and half a border long.

Statistical Analysis

Statistical analysis has been applied as though the trial design was a split plot for rates of nitrogen within irrigation level, with a separate analysis for the mean over disease and pest regimes and the difference between disease and pest regimes. This ensured that degrees of freedom were not over estimated. Thus the nitrogen effects were estimated most effectively, the irrigation levels less so, and the disease and pest regimes quite poorly. In order to obtain three year means over rates of nitrogen, values for missing treatments have been estimated simply as an additive model making minimal assumptions about interactions between years and treatment. Standard errors of differences in Tables 4, 5 and 6 are based on separate within years analyses and are quoted for comparison across or within irrigation levels but not across disease and pest regimes.

For the graphs, a realistic basis for contrasting curves involves interactions between years and treatments, which are rather ill defined. In the relationship between amount of nitrogen applied and method of disease and pest control (Figure 1), where the yield was averaged over 50 kg N/ha or more, preventative disease and pest control yielded more highly than curative. 5 comparisons out of 5. In ears/m^2(Figure 3), the 200 kgN/ha rate irrigated at 50% depletion recorded higher than 75% depletion, 8 times out of 10. With kernel weights (Figure 4), averaged over 50 kg N/ha or more preventative disease and pest control outweighed curative, 5 out of 5 times. The '5' represents 1 replicate in Year 1 and two replicates in Years 2 and 3.

Measurements

The site was soil sampled to a depth of 150mm, before drilling for quick test and sulphate analyses and in late July for nitrogen incubation analyses (Quin *et al.*, 1982).

Table 2: Crop Husbandry Programme

	1984/85	1985/86	1986/87
Sowing Date	May 4	May 8	May 8
Rate (kg/ha)	140	125	128
Plant Establishment (plants/m^2)	220	279	252
Fertilizer, Superphosphate (Basal)	300	300	310
Postassium Chloride (Basal)	150	150	150
Nitrogen (split into 3 appl'ns) *% of Total*			
1.25%	July 7 (2-3)	Aug. 1 (2)	Aug. 8 (2)
Date of application & GS (Feekes) 2.50%	Aug. 28 4-5)	Sept 13 (4-5)	Sept 9 (5)
3.25%	Oct. 7 (8)	Oct. 7 (8)	Oct. 30 (8)
Irrigation (No of Irrigations)			
IRR 1 (75% depletion)	4	1	2
IRR 2 (50% depletion)	6	1	5
Disease & Pest Control (number of fungicides/insecticides)			
D/P1 (Curative)	3/1	3/1	3/1
D/P2 (Preventative)	4/2	5/4	6/4
Harvest Date	Jan. 18	Jan. 3	Jan.19

Table 3: Seasonal Rainfall (MM)

PERIOD	1984/85	1985/86	1986/87
Winter (May-July)	128	180	228
Spring (Aug-Oct)	79	155	334
Summer (Nov-Jan)	133	240	120
Total for period	340	575	682

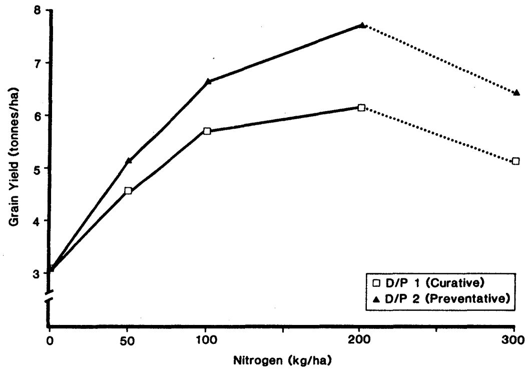

Figure 1. The Effect of Nitrogen and Disease/Pest Control on Grain Yield. (Rongotea 3 year mean, one seasons data only for N300)

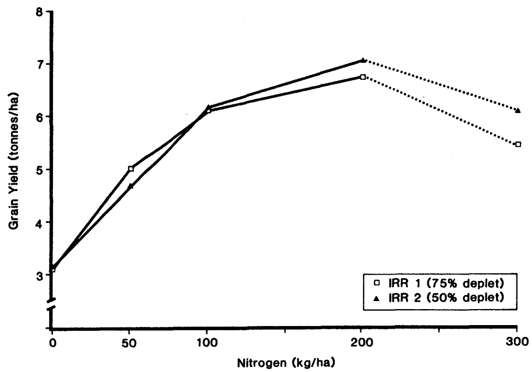

Figure 2. The Effect of Nitrogen and Irrigation on Grain Yield (Rongotea 3 year mean, one seasons data only for N300)

All plots were monitored at least weekly to determine growth stage, soil moisture and disease and pest levels. Treatments which had received 100 kg N/ha were used as indicator plots for timing of disease and pest treatments and irrigation treatments.

Plant counts were obtained by counting 20 randomly placed quadrats of 0.10 m^2 over the entire trial area when all plants had fully emerged.

Grain yields were obtained when the crop was ripe by

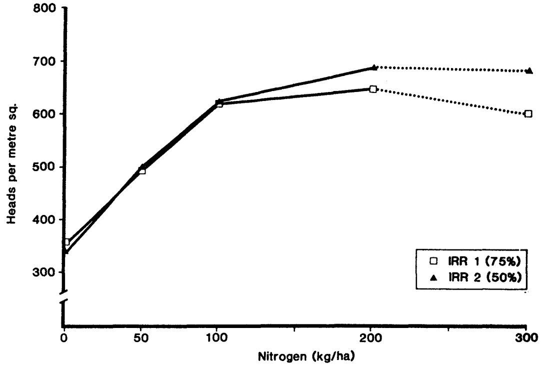

Figure 3. The Effect of Nitrogen and Irrigation on Ear Number (Rongotea 3 year mean, one seasons data only for N300)

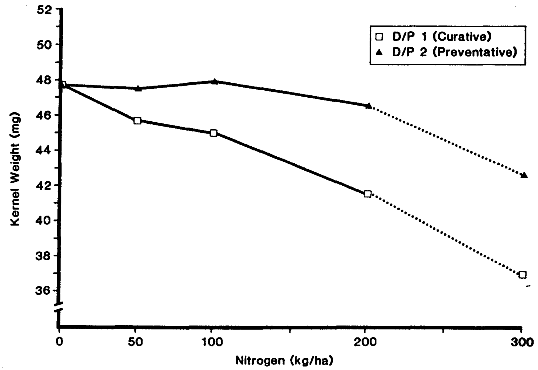

Figure 4 The Effect of Nitrogen and Disease/Pest Control on Kernel Weight. (Rongotea 3 year mean, one seasons data only for N300)

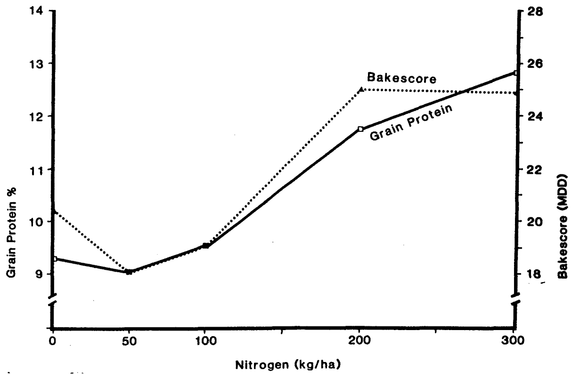

Figure 5 The Effect of Nitrogen on Bake Score (MDD) and Grain Protein. (Rongotea 3 year mean, one seasons data only for N300)

Table 4: Yield and Quality Components, 1984/85

	Yield (t/ha)		Kernel Wt. (mg)		Ears/m^2		Bake Score [MDD]		Protein % [Grain]	
TREATMENTS	D/P1	D/P2	D/P1	D/P2	D/P1	D/P2	D/P1	D/P2	D/P1	D/P2
Irrigation 1										
N100	6420	7550	43.9	43.5	680	669	18	22	10.1	10.7
N200	6130	7628	36.8	41.4	701	659	24	28	13.1	12.3
N300	5000	6936	31.7	39.3	661	629	26	24	14.0	14.3
Irrigation 2										
N100	6520	8040	41.5	45.4	696	691	20	20	10.7	10.6
N200	6020	7970	35.5	44.5	715	683	28	23	12.6	11.0
N300	5980	7230	34.6	38.7	728	717	27	26	12.9	13.1
S.E.D. ★	410	410	-	-	-	-	-	-	-	-

★ Based on a combined analysis involving the same treatments from other crops in the study.

Table 5: Yield and Quality Components, 1985/86

	Yield (t/ha)		Kernel Wt. (mg)		Ears/m^2		Bake Score [MDD]		Protein % [Grain]	
TREATMENTS	D/P1	D/P2	D/P1	D/P2	D/P1	D/P2	D/P1	D/P2	D/P1	D/P2
Irrigation 1										
NO	3170	3010	48.4	50.3	407	314	23	25	11.3	9.7
N50	4760	4770	46.5	48.4	507	467	27	22	11.8	9.4
N100	4370	5690	44.2	49.3	564	615	27	21	11.6	10.3
N200	4220	6100	40.1	44.3	607	688	29	25	13.8	12.9
Irrigation 2										
NO	2990	2890	49.9	50.7	350	336	24	23	10.9	.7
N50	3820	4450	45.9	49.8	490	468	22	21	10.9	.7
N100	4630	5370	44.4	49.4	575	538	22	24	10.8	10.1
N200	4460	6760	39.8	47.3	643	716	25	26	12.7	12.3
S.E.D.	450	450	2.1	2.1	52	52	-	-	-	-

harvesting with a 'Hege' plot header. In 1984/85, two strips each 1.25 m x 25 m were harvested from a total plot size of 8 m x 30 m. In 1985/86 and 1986/87, one strip 1.25 m x 25 m was harvested from a total plot size of 4 m x 30 m.

Hand harvested samples were removed from each plot at harvest for estimation of yield components. In 1984/85, four quadrats of 0.375 m^2 were removed and in 1985/86 and 1986/87, two quadrats were removed. From these samples ear numbers were obtained and 25 ears were retained for spikelet and grains per ear analysis. The grains per ear data has been omitted from this paper because of the large variation and questionable accuracy of these data.

Grain yields presented have been machine dressed (2 mm screen) and adjusted to 12% moisture. kernel weight is measured from a thousand grains derived from the machine dressed sample. Grain protein was determined by analysing grain nitrogen by the Kjeldahl method and converting to protein on a 14% moisture basis. Bake tests were carried out at the Wheat Research Institute in Christchurch. Baking score is the sum of loaf volume and texture scores after baking by the MDD (mechanical dough development) process.

RESULTS

1984/85

Seedling establishment was below our target of 250 plants/m^2 (Table 2). Despite this the plants established strongly over a relatively dry mild winter (Table 3), and tillered well to produce a high number of ears at harvest.

Mildew (*Erysiphe graminis*), the only disease detected in the crop during the season was particularly severe and persisted in the curative regime from early September through until late December. Complete protection was obtained under the

Table 6: Yield and Quality Components, 1986/87

	Yield (t/ha)		Kernel Wt. (mg)		Ears/m^2		Bake Score [MDD]		Protein % [Grain]	
TREATMENTS	D/P1	D/P2	D/P1	D/P2	D/P1	D/P2	D/P1	D/P2	D/P1	D/P2
Irrigation 1										
NO	2600	2650	49.7	49.6	332	289	16	15	7.5	7.4
N50	4350	5144	48.7	49.3	427	481	13	13	7.3	6.9
N100	5870	6740	47.6	49.9	591	601	15	14	7.5	7.4
N200	7560	8780	47.0	50.2	617	619	26	22	10.5	10.1
Irrigation 2										
NO	2850	2510	50.5	47.6	287	297	18	16	7.6	7.7
N50	4570	4870	49.3	49.3	475	483	12	11	7.1	6.8
N100	6230	6290	48.4	49.8	637	591	13	13	7.7	7.1
N200	8330	8840	50.2	51.3	652	724	21	23	9.8	9.9
S.E.D.	250	250	1.3	1.3	55	55	-	-	-	-

preventative regime.

Aphids were not a significant problem, with only one infestation of Rose-grain, (*Metopolophium dirhodum*) detected during the season.

Yields ranged from 5 t/ha to 8 t/ha, and were largely influenced by disease and pest control. Increases in yield in excess of 1500 kg/ha were obtained using a preventative rather than a curative regime (Table 4). Maximum grain yield was produced when 100 kg N/ha was applied. Applications beyond this generally depressed yields, particularly at the maximum rate of 300 kg N/ha. kernel weight similarly decreased as the rate of nitrogen applied increased.

Grain quality was strongly influenced by the amount of nitrogen applied. Grain protein consistently increased as the amount of nitrogen applied increased. Baking score followed a similar pattern, though not as consistently.

Irrigating at 50% depletion when combined with the preventative disease and pest regime increased grain yield, kernel weight and ear number. Grain protein, was however reduced slightly at this irrigation level.

1985/86

A high seedling establishment was recorded following a mild autumn early winter period (Table 3). Mildew and stripe rust (*Puccinia striiformis*) were particularly severe and persistent. Mildew was detected in early September and stripe rust in late October. Despite using a preventative regime this did not prevent a small infestation of stripe rust <5% incidence) occurring on the preventative treatments.

The very wet summer period (Table 3) prolonged the infestations of stripe rust and mildew on the curative treatments which spread to the ears, these conditions encouraged secondary infections of fungi (*Alternaria* and *Fusarium*).

As in 1984/85, aphids were not a significant problem with only one infestation, observed in late October.

The maximum yield recorded this year (Table 5) was considerably lower than in 1984/85 (6.8 t/ha cp 8.0 t/ha). large yield responses to nitrogen were recorded, from a very low yield without nitrogen (see YO Table 1) up to the maximum rate of 209 kg N/ha. However this response was strongly influenced by disease and pest control. There was little difference in yield between disease and pest treatments at 0 or 50 kg N/ha applied but a widening margin of response to the preventative regime at 100 and 200 kg N/ha applied.

Kernel weight was markedly influenced by nitrogen and disease and pest control. Overall, applied nitrogen reduced kernel weight, and the preventative disease and pest regime increased it. Interactively as the rate of nitrogen applied increased the margin of response between the preventative and curative regime widened.

Nitrogen had the greatest effect on ear numbers with up to a two fold increase from 0 to 200 kg N/ha applied. This factor also had the most influence on grain protein and bake score.

Irrigating at 50% depletion, although improving yields and ear numbers at 200 kg N/ha applied, reduced grain protein and bake score, the latter to a lesser degree.

1986/87

Good plant establishment was achieved despite a wet winter period (Table 3).

Stripe rust, the most persistent of the diseases recorded during the season, was first detected in late October. Mildew although present early in the season unlike the 1984/85 and 85/86 seasons, did not spread or persist to the same extent. Snow Mould (*Fusarium nivale*) became established in early November and, where not controlled, remained active until early December. Aphids were more prevalent this year particularly over the November/December period when Rose grain aphid was the dominant species.

The maximum yield achieved this year was similar to that in 1984/85 although the range in yields were far greater. Nitrogen had a huge effect on yield giving over a three fold increase from 0 to 200 kg N/ha applied. The very low yields without nitrogen point to a lower soil nitrogen status than was measured (Table 1). The high recorded rainfall in spring after the sampling date suggests a high level of nitrogen leaching probably occurred over this period.

Disease and pest control treatments interacted with nitrogen in a pattern similar to that recorded in 1985/86. There was no yield difference between disease and pest control treatments at 0 kg N/ha, a small response at 50 kg N/ha to the preventative regime increasing in margin up to 200 kg N/ha applied. Kernel weight was also influenced by the three factors interactively. Nitrogen combined with the curative regime and irrigating at 75% depletion depressed kernel weight as the rate applied increased, however the reverse occurred under a preventative regime at the same irrigation level. As in 1984/85 and 1985/86 the overall tendency of the preventative regime was to increase kernel weight. Nitrogen had a large effect on ear numbers producing a two fold increase between rates of 0 and 200 kg N/ha.

Grain protein and bake scores were considerably lower than in the 1984/85 and 1985/86 seasons, though similar trends were apparent with nitrogen having a major effect. Bake scores were comparatively similar and very low at rates 100 kg N/ha and below. There was however a large increase in bake score between rates of 100 and 200 kg N/ha applied.

There were no consistent differences between the irrigation levels. Irrigating at 50% depletion gave small increases in yield and ear numbers at 200 kg N/ha and overall increased kernel weight, but tended to reduce grain protein slightly.

COMBINED ANALYSIS (Mean of all years)

Figure 1 demonstrates the responsiveness of grain yield to nitrogen rates and most importantly the influence of disease and pest control.

Yields ranged from 3.1 t/ha with no applied N up to 7.7 t/ha peaking at 200 and declining at 300 kg N/ha applied. The preventative disease and pest control regime was most effective at high rates of applied N, producing 1500 kg/ha more grain than the curative regime at 200 kg N/ha applied. There was no difference between disease and pest regimes with no applied nitrogen, however as the rate of applied nitrogen increased the margin of response in favour of a preventative regime increased progressively up to 200 kg N/ha.

Responses to irrigation levels did not vary greatly with nitrogen rates. The combined data (Figure 2) indicated a slight depression to irrigating at 50% depletion at 50 kg N/ha and a small response at 200 kg N/ha. This response tended to be greater under a preventative disease and pest regime.

Figure 3 demonstrates the huge effect of nitrogen on ear numbers. Irrigation levels influenced ear numbers only at nitrogen rates of 200 and 300 kg/ha. This is consistent with the grain yield response shown on Figure 2. There were no major or consistent differences between disease and pest regimes on ear numbers.

Kernel weight (Figure 4) was the component most influenced by disease and pest control and interacted with nitrogen consistent with the pattern of grain yield response observed in Figure 1.

The overall effect of nitrogen was to reduce kernel weight. This reduction was greater and occurred at lower nitrogen rates under the curative regime. A preventative regime maintained kernel weights up to 100 kg N/ha applied and recorded minimal depression at 200 kg N/ha.

Nitrogen had a major effect on grain quality (Figure 5). Both bake score and grain protein are presented and show good agreement in their response pattern. A slight decline in quality was recorded with the addition of 50 kg N/ha, and a slight increase with a further 50 kg N but overall no significant change occurred with rates up to 100 kg N/ha. The major shift in quality occurred between nitrogen rates of 100 and 200 kg/ha, in which both bake score and grain protein increased markedly. Grain protein continued to increase above 200 kg N/ha applied, while bake score remained static.

DISCUSSION

Firstly we must emphasize that the primary objective of the trial was for extension purposes, to provide a demonstration of management combinations which influence grain yield and quality. Within the constraints of this design we have compared the agronomic response of various components of yield in wheat to nitrogen, irrigation and disease and pest control treatments and the interdependence of these factors.

The high yields and degree of response to applied nitrogen achieved on this trial are considerably higher than previously recorded (Drewitt pers comm). There could be many reasons for this outside the factors examined. However it would appear that disease control has contributed largely to these differences. The component data presented, ear number and kernel weight give very good indications on how these yields were achieved and how management factors influence final yield.

The importance of nitrogen in crop growth and development is well documented. Langer (1979) stated that ear number at harvest was the most important component influencing final yield. Feyter and Cossens (1977) demonstrated that applied nitrogen increased ear number which was closely related to final yield. Our results which demonstrate the extreme responsiveness of ear number to applied nitrogen and the close relationship between this component and final yield, agree with these findings. We can assume from this that the potential yield for each nitrogen treatment was established quite early in plant development, and that the subsequent differences which were measured, occurred during grain filling. Yield losses can usually be analysed by changes in individual components determined at various stages of growth (Kirby, 1974, 19770. Kernel weight is often depressed by nitrogen applications during early growth although increases can be expected if nitrogen applications are left until the late boot stage (Drewitt, 1985). Nitrogen applications on these trials were applied in split dressings with a large proportion applied early.

The main effect of increasing rates of nitrogen in our results was to depress kernel weight. There was however a strong interaction between nitrogen rate and disease and pest regime which highlights the sensitivity of this component and the importance of disease control during the grain filling phase. Under a curative disease and pest regime, kernel weight was depressed markedly by increasing nitrogen, in a pattern commonly reported. This depression was much less under a preventative regime and in fact minimal depression occurred when up to 200 kg of nitrogen was applied per hectare.

Scott (1981) suggested that the depression in kernel weight normally associated with the addition of early nitrogen is presumably due to competition among the increased number of grains for assimilates and nitrogen.

Our results indicate that disease possibly reduced photsynthesis thereby restricting the supply of assimilates to the grain during filling, and as the rate of nitrogen applied increased the crop biomass, the margin between demand for assimilates and ability to supply increased. This is often referred to as source limitation (Scott, 1981). We observed a marked difference in terms of flag leaf disease between the disease and pest regimes. The flag leaf remained healthy and green during grain fill under a preventative regime, while premature senescence often occurred under a curative regime.

Irrigating to a level of less than 75% soil moisture depletion does not appear justified. Small increases were recorded to the higher irrigation level particularly when a high yield potential had been established, however the extra number of irrigations required to maintain the crop at 50% depletion is unlikely to be economically viable.

The influence of nitrogen on baking quality and the relationship between grain protein and bake score has been extensively reviewed (Scott, 1981). A common finding has been the positive response of grain nitrogen to applied nitrogen, though many factors such as levels of soil organic nitrogen, timing of nitrogen and cultivar can influence this. Baking score follows a similar pattern although it is considerably more variable. Our results demonstrate a close relationship between grain protein and bake score which is strongly linked to applied nitrogen and subsequent yield.

Scott (1981) stated that the nitrogen supply available during grain filling determined grain protein and that for a given amount of nitrogen available, the final concentration within the grain is inversely related to the yield. This pattern logically fits the results obtained here. The grain yield response for the first 100 kg N/ha was almost three times greater than the response to the second 100 kg N/ha. Stevenson (1986) demonstrated that surplus nitrogen (the difference between source and sink) largely influenced grain portein levels. This suggests that a nitrogen surplus, sufficient to provide acceptable millng quality grain, consistently required a nitrogen application of 200 kg/ha under these conditions.

As mentioned earlier the primary objective of the trial was for extension purposes and to this end it was very successful. The large scale demonstrative design was extremely well received by farmers and advisors, indicated by high attendances at the regular crop walk field days.

This work has demonstrated the potential for increasing the yield and quality of Rongotea and may have a common application for the management of medium quality cultivars of moderate disease susceptibility. To realise this potential requires both high levels of nitrogen and disease control.

In the current economic climate for wheat growing, these inputs greatly increase the costs of growing Rongotea, and it is being superceded by cultivars of inherently higher quality and greater disease resistance.

CONCLUSIONS

★ The achieveable yield of wheat on light Lismore soils under good management (7 -7.8 t /ha) is considerably higher than previously thought.

★ The results have highlighed the importance of disease control, and the interdependence of the various management factors, reinforcing the need to maintain a correct balance of management inputs.

★ Rongotea can be managed to consistently produce high yields of milling quality grain, however it requires high levels of both nitrogen and disease control to achieve this.

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