Husbandry Guidelines

CLAIRE

WINTER WHEAT

Introduction

It is now two years since Nickerson produced the first Claire husbandry guidelines. We have been much encouraged by the positive response received from growers and agronomists who have given us useful feedback to allow us to produce this new updated version.

Claire has been grown in our own trials for the last six years and as one would expect we have learned a great deal about how best to manage the variety. The fundamental principles of our agronomy advice have not changed - indeed our own experiences and those of many thousands of growers across the UK have reinforced the original concepts.

Some of the content of this update will be familiar to those who read the first booklet. In this second edition however, we have excluded some of the background information relating to end use markets in order to make room for more detailed husbandry information.

Award Winning

Proffessor Brian Legg of NIAB presenting the NIAB Cereals Cup to Bill Angus (Breeder of Claire) and Paul Canham (M.D. of Nickerson).

Highest Yield

No other fully recommended added value wheat produces higher yields

Our primary objective in producing the first husbandry guidelines was to disseminate information such that farmers would profit from growing Claire, albeit during difficult financial times. If popularity is a measure of profitability, then this has been a success, as we have seen Claire's market share rise from just 1% in 1999 to 15% in 2000 and to 25% for harvest 2001.

We hope that these updated guidelines will allow growers to reap the benefits from one of the most exciting varieties available.

No liability will be accepted for the use made of the information provided here or the interpretation placed upon it.

CLAIRE

WINTER WHEAT

Grain Quality

Soft milling grain ideal for biscuits, export and distilling

Highly Resistant to Lodging

Very stiff straw and good resistance to eyespot, offering increased security to growers

Unrivalled Disease Resistance

Best available resistance to 5 out of the 7 major diseases of wheat

Claire winter wheat was developed for the domestic and export biscuit markets as well as the blended flour export markets. In order to understand these markets and therefore the marketing of Claire grain, some technical information is provided below.

Quality Requirements of Wheat for Biscuit Making

In common with other end uses of wheat, grain destined for the production of biscuits must satisfy the basic specifications for Hagberg Falling Number (HFN), specific weight, protein level, moisture content, and freedom from admixture as determined by the end user.

The 'industry standard' equipment for measuring extensibility is the Extensograph.

However, the fundamental requirement of biscuit flour is that the dough produced from it must be highly extensible and relatively inelastic. Extensibility is the amount by which dough can be stretched before it breaks and elasticity is the measure of the resistance to the stretching process. In biscuit manufacture, a high level of extensibility allows the dough to be sheeted evenly and the low elasticity minimizes the potential for the dough to shrink, so that the biscuits retain their desired shape and thickness. These dough properties result largely from the natural gluten proteins that exist within the wheat grain and therefore depend mainly on the particular variety being grown. Claire has the genetic attributes to meet these requirements.

Endosperm Texture - the value of soft wheats

The water absorption of flour (the amount of water absorbed as a percentage of flour weight) is also an important determinant of end use quality. This characteristic depends largely on whether the variety is hard or soft milling. Hard milling varieties produce high levels of "starch damage" when milled, whilst soft milling varieties produce low starch damage. Biscuits are dry products and therefore soft milling varieties are preferred because the flour produced has relatively low water absorption.

Claire is ideally suited to a wide range of domestic and export markets

The Export Market

The export market has become increasingly important as UK growers produce higher yields on farm. From being a net importer of wheat in the 1970s the UK has become a significant exporter of grain. Of the 15 million tonnes of domestic production, more that 25% is exported - to more than 60 destinations. The biggest buyers of UK grain are Spain, Portugal and Italy. UK group 3 varieties, such as Claire, have found favour for blending with locally produced high quality bread making varieties. This market was opened up by the popular variety Riband and has been consolidated with the development of Consort.

Claire continues this development having very similar dough rheological properties to Consort.

Quality requirements are usually determined by alveograph specifications, as shown in Table 1.

Table 1: Quality requirements for the export biscuit market

	Export Specifications	Claire	Consort
W value	60-110	99	98
P/L value	< 0.5	0.24	0.23
Hagberg	min 250	310	277
Specific weight	76.0 kg/hl	77.8	77.1

Source: HGCA BCE

Claire was selected at Nickerson's Suffolk breeding station

Claire is the result of a cross between the Nickerson varieties Wasp (Boxer x Galahad) and Flame (Moulin x Boxer). This cross, made in January 1991, was designed to bring together the best characteristics of both parents. Table 2 highlights the strengths and weaknesses of both varieties and how careful selection was carried out to produce the required combination of traits in the resulting variety, Claire. Of key importance was the fact that Wasp had excellent biscuit making characteristics (derived from its parent Galahad). It was important to capture this very important trait and develop it in a background with stiff straw and high yield potential.

Table 2: Selection criteria for Claire winter wheat

Claire	Wasp	Flame
High yield	High yield	Moderate yield
Stiff straw	Weak straw	Stiff straw
Soft milling	Soft milling	Hard milling
Excellent biscuit	Excellent biscuit	Feed
Septoria resistant	*Septoria* resistant	*Septoria* resistant
Yellow rust resistant	Yellow rust resistant	Yellow rust resistant
Brown rust resistant	Brown rust susceptible	Brown rust resistant
Mildew susceptible	Mildew susceptible	Mildew susceptible
Good eyespot resistance	Good eyespot resistance	Moderate eyespot resistance
Good *Fusarium* resistance	Moderate *Fusarium* resistance	Good *Fusarium* resistance

Key: black = required trait

Nickerson place a high level of emphasis on breeding for disease resistance, and to this end, disease nurseries have been developed in high-risk situations both in the UK and across Europe over the last thirty years. Within the germplasm developed are some new and exciting resistance combinations. Claire brings together some of these traits in a well-adapted and high yielding genetic background. This section explains how this high level of resistance has been achieved and gives some insight into just a few aspects of the resistance mechanisms within Claire.

Yellow Rust and Septoria

Claire has excellent resistance to yellow rust (NIAB rating = 9) and the best available level of resistance currently available to both *Septoria* diseases i.e. *Septoria tritici* (NIAB rating = 7) and *Septoria nodorum* (NIAB rating = 7). Resistance to *Septoria* is essential for varieties growing in the maritime UK climate, as it is responsible for the biggest reductions in yield within wheat when uncontrolled. A detailed investigation of the pedigree of Claire shows that, back in the 1960s, Nickerson breeders made crosses between two German varieties to produce one of its great-grandparents. This particular ancestor, a sister line of Aquila, became the source of the excellent yellow rust resistance of Parade, Boxer, Buster, Dynamo and Zodiac. These varieties were also acknowledged for their very good general level of *Septoria* resistance.

The parents of Claire (Wasp and Flame) are both from this same group of related Nickerson varieties. Whilst not immune to yellow rust infection, Claire, like Wasp and Flame, has an excellent level of adult plant resistance. Claire is not at risk from races possessing virulence for the Yr17 resistance gene and the Yr6 + Yr17 gene combination or the recently discovered race virulent on Oxbow. Varieties in both the UK and the near continent that have similar adult resistance factors have shown durable resistance to yellow rust, suggesting that a rapid and marked increase in corresponding virulence is unlikely.

A striking example of the enormous value of good disease resistance.

Eyespot

Claire has very good eyespot resistance with a NIAB rating of 7, unrivalled by any other variety on the 2001 Recommended List. Claire does not have the VPM (Rendezvous) resistance but is believed to have the "Cappelle" resistance complemented by some other, unknown factor(s). This resistance has been used in UK varieties for over thirty years with no signs of breakdown.

Fusarium Ear Blight

With increasing interest in food safety, and in particular the effects of mycotoxins, good levels of resistance to *Fusarium spp* are becoming increasingly important. Claire has a high NIAB rating of 6, though our own experience suggests higher levels of field resistance. Precautions should be taken to supplement this resistance in high disease years by the use of targeted fungicides (see later section: Fungicide Use).

Brown Rust

Claire has the highest available rating for resistance to brown rust - a 9 on the 2001 UK Recommended List. This resistance was developed from its parent Flame. The origin of the resistance has not been fully characterised but field tests have shown Claire to be highly resistant to all known races.

Mildew

Claire's moderate rating of 4 for resistance to mildew on the Recommended List has attracted much comment, but in practical farm situations, Claire growers have reported few problems. This may be partly explained by the weather conditions in recent seasons, which have not been favourable for high levels of mildew to develop, but most of the credit should go to the farmers who have acted early with sensible mildew control strategies. Our advice has always been to use a prophylactic control programme with emphasis on prevention rather than cure. Quinoxyfen has been particularly successful, and has found favour with growers trying to combat the mildew problem (see later section: Fungicide Use).

Over the lifetime of a wheat variety, wide ranges of trials are carried out. In the early years, trial data is somewhat limited and it is often difficult to evaluate trends which become more obvious after further testing. Our philosophy has been to subject new breeding lines to extremes of agronomic inputs and environments in order to select the most robust varieties. Claire has been subjected to this testing regime. In the early years the variety was evaluated primarily 'in house' with more advanced testing arising after successful progression through the National List and Recommended List Trial series. Results from a range of trials from independent sources are presented below.

Nickerson trials are grown both with and without fungicide. The fungicide regime is that stipulated for the NL/RL trial matrix and is hence designed to exclude all disease. This protocol is not economic in the current climate of low grain prices but has value in providing a benchmark for measuring yield potential.

Table 3: Nickerson UK Advanced Variety Trials 1995-2000

	1995 +	1995 -	1996 +	1996 -	1997 +	1997 -	1998 +	1998 -	1999 +	1999 -	2000 +	2000 -	Mean +	Mean -
Claire	**105**	**105**	**107**	**99**	**106**	**121**	**106**	**132**	**106**	**122**	**103**	**116**	**106**	**116**
Consort	104	105	103	102	-	-	-	-	104	99	105	93	104	100
Riband	103	103	102	96	101	95	104	87	105	101	95	87	102	95
No trials	6	4	6	2	6	3	5	2	3	2	4	2	30	15

Yields expressed as % controls in each year

Table 3 shows the results of Nickerson trials conducted over a six-year period, with and without fungicide. The very high level of consistency exhibited by Claire in fungicide treated trials over this period is clear from these trials. This is supported by official trials data which, shows Claire and Consort with similar treated yields (HGCA UK Recommended List 2001, Table 4).

Table 4: Claire yields across the UK in official NL/RL trials

	Mean	North East	North West	Central	South East	South West
Claire	**102**	**101**	**103**	**100**	**104**	**104**
Consort	102	103	103	101	102	101
Riband	101	102	100	99	101	100

Yields expressed as mean of control varieties: Consort/ Hereward/ Madrigal/ Rialto/ Savannah

One of the husbandary trials, surrounded by 100 acres of Claire in Suffolk

In untreated trials Claire has produced consistently high yields in both Nickerson trials (Table 3) and NIAB trials (Table 5).

Table 5. NIAB Untreated trials 1998-2000

	1998*	1999	2000	mean
Claire	**127**	**117**	**108**	**117**
Consort	101	93	93	96
Riband	89	83	86	86
no. of trials	24	23	21	68

Yields expressed as mean of controls in each year

The value of this disease resistance can be seen very clearly when the variety is grown commercially. Arable Research Centre (ARC) trials are conducted with a fungicide protocol which is dictated by "best local practice" i.e. trials are grown within commercial crops and results reflect the potential of each variety in that particular fungicide regime. In essence these trials reflect what is likely to happen in a normal farm situation. The value of having both NIAB and ARC data sets is that comparing the two gives an indication of both yield potential and the relative risk associated with growing each variety.

Claire has been grown in a total of 50 ARC trials over the last three years and has been consistently higher yielding than Consort (table 6). This is a clear reflection of its inherent disease resistance, which has been particularly important in the wet, disease prone years of 1999 and 2000.

Table 6. Arable Research Centre trials 1998-2000

	1998	1999	2000	mean
Claire	**105**	**102**	**104**	**104**
Consort	106	99	102	102
Riband	105	99	97	100
no. of trials	14	15	21	50

Yields expressed as mean of all varieties in trial in relevant years

Claire appears to tolerate the lower levels of fungicide used in these trials without incurring increased levels of risk. More disease prone varieties tend to be at a disadvantage when grown under more normal farmer practice than is currently used within the NIAB protocol. This is supported by NIAB data from trials where reduced rates of fungicides are applied. Table 7 shows the results from two years trials conducted by the NIAB.

Table 7. NIAB Reduced fungicide application trials

Treatment	Full		Half Rate		Quarter Rate		Untreated	
Approx Cost/Ha	£140	loss in yield %	£70	loss in yield %	£35	loss in yield %	£0	loss in yield %
Claire	**11.40**	**0**	**10.88**	**5%**	**10.43**	**9%**	**8.13**	**29%**
Consort	11.37	0	10.51	8%	9.94	13%	6.77	40%
Savannah	11.60	0	10.91	6%	10.40	10%	6.82	41%

Yields expressed in tonnes per Ha Mean of four sites in 1999 and 2000 Source: NIAB

In these trials, as well as a full fungicide programme (approximate cost £150 per hectare) reduced rates - half rate (approximately £75 per hectare) and quarter rate (approximately £37.50 per hectare) and a completely untreated programme are compared. The reduced rates equate to the approximate range of fungicide costs used on most farms. It is clear that under these regimes Claire consistently shows lower declines in yield than more disease-susceptible varieties. It is this facet (that of reducing the risk of growing wheat) that has made Claire such a sought after variety.

The following sections will give an insight into Nickerson's own experiences with a targeted approach to growing Claire.

They are not a blueprint into growing this variety but should be considered as a source of additional information. This will be of greatest value when put into the context of an individual's needs to ensure that the inherent yield potential of Claire is realised with reduced exposure of the grower to risk.

Standing Power

Claire has a high rating for standing power (NIAB 8). This character, which is considered to be second only to yield by the majority of wheat growers, must not be compromised by inappropriate management.

Standing power can be eroded in 4 ways

1. Drilling too early
2. Seed rate too high
3. Poor timing of Plant Growth Regulators
4. Inappropriate use or timing of nitrogen

1. Drilling Too Early

Early drilling will increase straw length as well as plant biomass. As a 'rule of thumb' early drilling will erode NIAB straw strength ratings by one point. Thus growers should be circumspect about when they drill wheat. In general, drilling can commence earlier in the north of the UK than in the south. A mid September sown crop in North Yorkshire will equate, approximately, to an end of September crop sown in East Anglia.

2. Seed Rates

Claire is a very high tillering variety, producing a prostrate winter habit, and many growers have found it necessary to reduce seed rates. Target seed rates are influenced by a number of variables that all need to be assessed and taken into account. Whilst many growers have achieved excellent stands of Claire with very much reduced seed rates, care must be taken to allow for any adverse factors that may reduce establishment. Under ideal sowing conditions, considerable scope exists for reducing seed rates, as shown in Table 8. Indicators of less favourable conditions include soil-type, altitude, aspect, seedbed conditions, slug populations, insect pests, bird populations, weed infestations, trash-borne and soil-borne diseases, etc, etc. Such factors should be taken fully into account before deciding on the seed rate applicable in each individual situation.

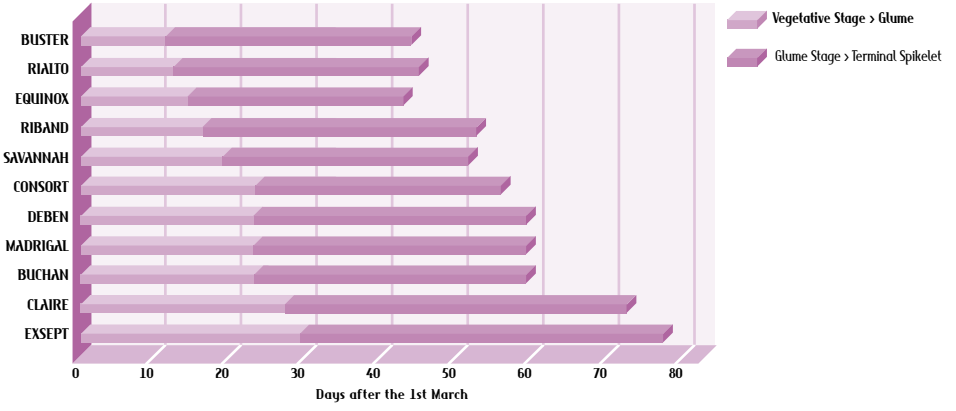
Table 8: Recommended seed rates for Claire winter wheat

Time of sowing	Seed rate (ideal conditions)	Seed rate (adverse conditions)
Sept 1st- 15th	120-160	160-250
Sept 16th - 25th	160-200	200-280
Sept 25th - Oct 5th	220-275	275-325
Oct 5th - Oct 31st	265-325	325-375
Nov 1st - Nov 30th	300-350	350-425
Dec 1st - Feb 28th	325-375	375-450

Rates expressed as viable seeds per sq. metre. Do not forget to adjust for % germination.

These rates represent relatively low risk. However, it is the responsibility of the grower to determine the level of risk he is prepared to take. The major benefit from reduced seed rates is the higher level of standing power achieved, but if excessive reduction in seed rate produces a "gappy" crop, the yield will be compromised.

Ear development in Claire is considerably later than many conventional varieties (Chart 1).



3. Timing of Plant Growth Regulators (PGRs)

Our evidence supports the concept of targeting PGRs at the "glume - lemma" stage. The best way to determine the development stage is by dissection but targeting PGRs when the first node is starting to move off the base (Zadoks 30) is acceptable for those unfamiliar with dissection techniques. If seed rates and nitrogen timing applications are in line with these guidelines, PGRs should not be necessary for crops with a yield potential of less than 8 tonnes per hectare. Growers may, however, wish to consider a reduced rate application as an insurance measure based on local experience.

CCC based products normally meet the demands of high output crops in terms of standing power. Crops with yield potential above 8 tonnes per hectare should be treated routinely with a $^{2}/_{3}$ rate application at the glume primordia stage, followed by a $^{1}/_{3}$ rate application at first node (Zadoks 31). For Claire, these applications will be later than for the majority of winter wheats being grown, because of its slow development habit. If the weather does not permit a split application, full rate CCC should be applied at Zadoks GS 31.

Early sown crops will be taller than those drilled at more conventional (October) drilling dates and thus straw shortening maybe a primary focus for growers in order to ease harvest. Very late applications of 2-chloroethylphosphonic acid + mepiquat chloride based products (e.g. Terpal) at high rates give some concerns as they may cause physiological problems which could affect yield potential.

4. Nitrogen Timings

Many growers have now witnessed the prolific tillering capacity of Claire. We have seen no evidence to suggest that the policy advocated previously for Claire - namely delaying spring applications - should be changed. Early sown crops will have been able to take up nitrogen from the soil and hence should not need early applications of spring nitrogen. The philosophy for nitrogen applications on well established Claire crops should be to limit the number of tillers surviving by delaying nitrogen. This policy should be applied even for low seed rate crops. Crops with an established population of 150 plants per sq.m. will require just 4 tillers per plant to achieve a target ear population of 600 ears per sq.m. Claire will tiller prolifically in this situation often producing more than 20 tillers per plant. The objective must be to reduce these tiller numbers.

Delaying nitrogen will have other benefits. Disease pressure will be reduced (particularly mildew) and straw strength will be maintained. Experimental work at Nickerson has highlighted the fact that early applications of nitrogen will significantly increase the length of the first internode - thereby increasing lodging risk. Applications of nitrogen should be made just prior to the terminal spikelet stage, in order that the nutrient is available at this developmental stage. Two thirds of the total planned application can be made at this stage with the balance applied approximately four weeks later.

Late sown crops, crops sown on light, free draining soils, and second and continuous wheats are likely to benefit from a very small application of early nitrogen (late February / early March). However this will depend on the grower's experiences and target yields.

Many growers who have followed this philosophy have initially been concerned to see crops lose their green colour and turn slightly yellow. They have also been surprised at how quickly the crop recovers once nitrogen has been applied. The yellowing effect should not result in any yield losses.

Our philosophy is driven by the management benefits achieved by delaying nitrogen: primarily improved standing power and reduced disease threat. Growers may indeed be tempted to increase nitrogen rates on crops managed in this manner in order to take advantage of the improved standing power achieved.

Crops grown with the objective of very high yield potential may require additional nitrogen applications in order to ensure that yield potential is not compromised.

Claire - Seed Treatment

In first wheat situations a single purpose treatment should be applied as routine, as even healthy-looking grains can harbour disease in high-risk years. For early sown crops the application of a broad-spectrum seed dressing should be considered. This type of dressing is likely to improve early vigour, enhance disease resistance and improve standing power.

In second or continuous wheat situations or where take-all is likely to present a problem new fungicidal seed treatments such as Jockey (Aventis) or Mon 65500 (Monsanto) should be considered.

In early sown situations, particularly in the south and southwest, Barley Yellow Dwarf Virus (BYDV) seed treatments such as Secur (Bayer) should be considered. This treatment alone is unlikely to remove the need for additional insecticide sprays but will considerably reduce the risk of heavy BYDV attack.

Early sown crops are at high risk from foliar and root diseases and whilst Nickerson advocate the use of reduced seed rates some of the financial savings made should be re-invested in better quality seed and improved seed dressings.

Good quality seed with the appropriate seed treatment will produce the best results

Our views over the use of fungicide on Claire are based upon our own trial investigations and experiences as well as those from independent and commercial agro-chemical companies. As a company with no ties to the agro-chemical industry Nickerson are in the fortunate position of being able to provide results from a number of sources. We have no vested interest other than trying to secure the best performance possible from Claire winter wheat. We also stress that we are not seeking to establish a blue print for growing Claire and that detailed advice from local agronomists with experience of your region should be sought. Presented here is a summary drawn from a number of trials over a number of years and sites. Growers should take into account their own experiences as well as their own farming situation.

The concept that disease resistant varieties offer opportunities for reducing fungicidal inputs is valid but it is important that yield potential is not compromised by reducing fungicide inputs by too much. The most significant question must be "by how much can I reduce and what risk will this entail?". The NIAB reduced fungicide data (Table 7) shows clearly the benefits of disease resistance in high disease years (1999 and 2000). The primary advantage of growing disease resistant varieties lies in the flexibility for timing fungicides that these give as well as the 'insurance' factor. This latter point is of enormous importance. Time and again we have found from different trials and farmer experience that growers have obtained high yields from Claire even in high risk situations when fungicide timings have been less than optimal. The poor spraying conditions found in 2000 led to many growers spraying at less than optimal timings - resulting in yield loss on more disease susceptible varieties (primarily those susceptible to *Septoria spp*).

In addition we have found that those growers who invested heavily in fungicide programmes found a benefit with Claire, even though Claire is a 'low input' variety. Certainly a number of growers did obtain very satisfactory results from Claire when fungicide input costs were reduced but the question "would I have achieved more by maintaining fungicide rates?" was unresolved!

Mildew Control

Under conditions of relatively low to moderate risk, cheap control measures such as morpholines would be appropriate with the use of quinoxyfen being more suitable for high-risk situations. In many farming situations the use of quinoxyfen (Fortress - Dow chemicals) has become routine for Claire.

Septoria Control

Few growers have failed to adequately control *Septoria* on Claire. When these incidents have been investigated it is usually because growers have failed to use sufficient triazoles in their formulation and / or assume that Claire is totally resistant to infection. Claire has a high level of resistance to *Septoria* but this, as with all varieties, should be supplemented with adequate fungicidal control.

During the winter and early spring, infection levels on Claire may not be very different from those on more disease susceptible varieties such as Consort, as the plants are growing too slowly to outpace these early infections. As the season progresses, Claire will grow away from the early infections whilst in more susceptible varieties, *Septoria* closely follows the growth of the plant, and soon appears on the flag leaf. In Nickerson trials, Opus (BASF) has given very effective control of *Septoria* on Claire.

Yellow and Brown Rust

These may appear during the late autumn or early spring on very early sown Claire crops at the juvenile stage in very high-risk areas. Control measures are unlikely to be cost effective as the crop will grow away from the symptoms as adult plant resistance mechanisms take over.

Eyespot

This is likely to occur in very early sown crops and is worse in second / continuous wheat situations. Control measures using cyprodinil (Unix - Syngenta) have proved to be effective on Claire.

Ear Diseases - Primarily Fusarium

Claire has a high level of resistance to *Fusarium spp* but as with most genetic resistance this should be supported by the targeted use of appropriate fungicides. Preliminary work within Nickerson suggests that the combination of the strobilurin Amistar (Syngenta) and the triazoles Folicur (Bayer) or Caramba (BASF) give good control.

The Role of Strobilurins

Since 1998 an enormous number of trials have been carried out with a range of varieties. In 1998 (a relatively low disease year) there was very little difference between the triazole programmes used and the strobilurin treatments in Nickerson trials.

In the same year, trials conducted by ARC showed an increase in performance of strobilurins over triazoles of 9% and 23% at two sites. Since then, a number of trials have been conducted with a range of results. Overall, the pattern clearly shows that strobilurins are likely to enhance yield performance with Claire, and that these should form part of the fungicide regime for the variety. It is also important that yield potential is not compromised by applying insufficient nitrogen to sustain the high yields associated with these crops.

Timings of Strobilurins

With the current FRAC guidelines advising just two applications of strobilurin chemistry, growers must decide where they perceive that the greatest risk lies - either early foliar disease pressure or from later ear diseases. Once T1 and T2 applications of strobilurins have been made there is no flexibility to use a strobilurin at T3. The strategy to be applied will depend primarily on the risk perceived. This is often associated with drilling date, and may vary significantly from region to region.

Early Sown Crops

As well as providing very high yield potential, these crops also represent the highest level of risk in terms of disease. Levels of eyespot and *Septoria tritici* will be increased. In order to complement the disease resistance spectrum of Claire, growers should seek to support the control of these diseases by products such as Unix (for eyespot control) and Opus (primarily for *Septoria tritici* control). If mildew is likely to be a threat then morpholines can be used to control relatively low levels of infection with products such as quinoxyfen (Fortress) reserved for high risk situations. Some growers may seek enhanced disease control using strobilurin chemistry at this stage but Nickerson do not consider this necessary for Claire.

The T2 spray is potentially the most beneficial and strobilurin chemistry should be introduced as routine.

If strobilurins have not been used as a T1 spray, robust rates should be used with half to three quarter rates used as a minimum. Nickerson trials have shown high response levels from both Landmark (BASF) and Twist (Bayer) with Twist giving a superior level of *Septoria* control.

The decision for the T3 spray will depend on your location, and prevailing weather conditions. A hot dry period following high fungicide applications can lead to excessive transpiration losses, which is obviously a higher risk in the south. Nickerson experience today mirrors that of other workers, indicating that low rate Amistar combined with a triaziole such as Folicur (Bayer) or Caramba (BASF) will provide clean ripening ears as well as a degree of control of *Fusarium spp*. A synergistic action between these two chemical groups, combined with Claire's inherently good resistance, will reduce levels of *Fusarium* attack significantly.

Late September / October Sown Crops

Crops drilled at 'traditional times' present a lower risk of disease. Eyespot is unlikely to be a serious threat in well established Claire crops and control measures are likely to be unnecessary in first wheat crops. Mildew control measures should be taken as for early sown crops and the use of a robust triazole programme will be beneficial. Management decisions can be taken in line with earlier sown crops thereafter.

Late Sown Crops

These crops are likely to be more thickly sown and present different management decisions to Claire growers. The threat of eyespot in later sown first wheat crops is very low, and *Septoria* levels are likely to be much lower than in earlier sown crops. Mildew will carry a larger threat as seedling leaves will be lush and will not be hardened off from winter weathering. In addition many growers will have been tempted to apply early nitrogen which will raise tiller numbers and exacerbate any mildew threat. Growers should consider the use of quinoxyfen (Fortress) as routine. In order to enhance biomass production growers should consider the use of triazole/ strobilurin chemistry to maintain leaf survival.

T2 sprays should be used to minimise any check to growth and thus strobilurins will have a significant role at this important stage. Again it is important to recognise that Claire will respond to higher rates of strobilurin chemistry and thus rates used should reflect this.

Later sown crops will present growers with potentially later maturing crops. Strobilurin chemistry applied at the T3 stage would only add to this effect and thus low rates of triazole chemistry should be considered in place of strobilurins.

Disease Control - Summary

1. Control strategies should take into account the genetic resistance factors within Claire but also how these can be complemented by the array of chemicals available to growers.

2. Growers should see the very high levels of disease resistance present in Claire as valuable insurance - reduced rates are less likely to lead to significant yield penalties compared with other more disease-prone varieties.

3. Claire will respond positively to strobilurin chemistry and these compounds should be considered as routine.

4. Robust rates of strobilurin products should be used to gain the maximum potential from Claire.

5. Triazole chemistry will still play a significant role in early sown crops. Early applications of strobilurin will reduce the range of options for T2/ T3 applications, if FRAC guidelines are to be maintained.

6. Early applications of strobilurins will normally be advantageous for late sown crops, but T3 applications should be avoided in later maturing situations, as this could lead to further delay in harvesting.

7. T3 applications of triazoles should be considered for all crops destined for seed or human food use.

Early drilling has become fashionable for some and essential for others. As farm labour is reduced it has become essential to ensure that winter wheats are established before the onset of winter. The main driving force behind early drilling therefore must be the avoidance of late drilling.

Early Drilling

The term 'early drilling' will mean different things to growers in different parts of the UK. Early drilling in the southwest may be considered to be the beginning of October whilst in the north of England, late August / early September would be considered early. In essence, the problems facing these crops are similar - hence we have not divided this section by calendar date.

We recognise that a large proportion of the Claire "on farm" has been drilled early. Nickerson do not advocate this policy with Claire but accept that it is arguably the most suitable variety within the current range available for this difficult rotational position.
The established winter wheat variety Buchan and the new variety Exsept are even better suited to early drilling than Claire and should be considered seriously for the earliest sites. Table 9 shows the results of four ARC trials carried out during 2000.

Table 9. Arable Research Centres early drilling trials
Mean of four trials harvest 2000

	100 seeds/sq.m	200/250 seeds/sq.m	350/400 seeds/sq.m
Claire	**127**	**117**	**108**
Consort	101	93	93
Riband	89	83	86
Mean yield (t/Ha)	24	23	21

Yields expressed as % of site mean yield
Source: Arable Research Centres

These results confirm the value of reduced seed rates. Lower seed rates produced the highest yields over all the four sites, with lodging being a major factor in reduced yields - particularly at the higher seed rates.

Early sown crops of Claire will be under high disease and lodging pressure. These crops will present high risks to growers but with the potential for high rewards. Management skills need to be high, with timing of inputs more critical than for later sown crops. It is essential that these crops are established in well-prepared, moist seedbeds with low seed rates. Table 10 shows an example of a trial drilled in early October but grown under very high lodging pressure - continuous fertilization with farm yard slurry - in many ways representative of an early drilled crop. For this comparison, the variety Buchan has been used. This variety is well suited to early drilling having very stiff straw as well as a late primordia development pattern. It is interesting to see that even Buchan succumbs to lodging at the higher seed rate of 300 seeds per sq.m. No lodging is recorded at 200 seeds per sq.m.

Table 10. Claire yield performance - high fertility site 2000

	Yield	Lodging%
Claire 300 seeds/sq.m	98	55
Buchan 300 seeds/sq.m	99	50
Claire 200 seeds/sq.m	93	45
Buchan 200 seeds/sq.m	104	0
Claire 100 seeds/sq.m	**101**	**0**
Buchan 100 seeds/sq.m	**102**	**0**

Yields expressed as mean of the five NIAB controls Consort, Hereward, Madrigal, Rialto and Savannah

Claire shows significant lodging at both 200 and 300 seeds per sq.m. but no lodging at all at 100 seeds per sq.m. It is at this lowest seed rate that Claire gives the best yield performance - a reflection of the fact that the entire crop is standing.

BYDV is a potential threat, particularly in the southwest and consideration should be given to early plant protection with the use of products such as Secur (Bayer). There is a clear conflict between the principle of reduced seed rates and the efficacy of Secur. Growers must determine the level of risk which they wish to accept and hence fix their seed rates accordingly. This is likely to be determined as much by their own experiences, their location and the inherent risks of lodging and/or BYDV attack.

Late primordia development is a key attribute for early sown crops. Chart 1 shows the development patterns in a range of varieties. Early development of the primordia can place varieties at risk from late spring frosts with consequential damage to the delicate flowering biology. Claire has a very late development pattern.

Early sown Claire crops will tiller prolifically and will tend to form a very prostrate habit during the winter and early spring. These crops should be treated as advised earlier (see Standing Power section) with later applications of nitrogen and targeted PGRs.

Nickerson husbandary information is made available to wheat growers worldwide

Mildew is usually present to some extent in dense early sown crops of most winter wheat varieties. Autumn applied fungicides are unlikely to be cost effective in this situation unless infection levels are very severe. Early sown crops of Claire may also show significant levels of *Septoria tritici* during the winter but the variety will grow away from this during the early spring. In high risk regions both yellow rust and brown rust may appear in juvenile crops of Claire. Again, fungicides are unlikely to be economically viable, as the variety will grow away from the problem. Claire carries very good adult plant resistance to these diseases (NIAB rating of 9 for each). Fungicide management of these crops is discussed more fully in the section 'Fungicide Use'.

Late Drilling

Inevitably the weather will prevent all seed from being drilled at the ideal time. Late sown Claire will still produce high yields (Table 11) but will need a different management strategy.

Table 11. Late sown trials 1999, 2000

	1999	2000	NIAB 2000
Chablis	99	104	103
Hereward	98	91	99
Rialto	104	96	102
Claire	**110**	**108**	**112**
no sites	1	2	5

Claire has a relatively low vernalisation requirement and can be sown safely until the end of February, the only Fully Recommended variety on the NIAB Recommended List with this flexibility.

Seed rates for late sown crops are less critical. The threat for these crops is not reduced standing power but the vagaries of establishing over a long period of time in cold and often wet seedbeds. Slug and bird damage become significant problems and thus seed rates should be used which will ensure a well established crop, Claire will however still tiller well from these situations and early spring nitrogen is unlikely to be beneficial unless the crop is excessively backward or poorly established. Indeed a combination of higher seed rates and early nitrogen applications will tend to encourage mildew infection. Later sown crops tend to be more prone to mildew attack and growers should be vigilant to this problem. Other diseases, such as *Septoria tritici* and juvenile yellow rust and brown rust, are unlikely to be significant.

These crops will already have lost considerable yield potential, by virtue of reduced biomass, and lodging is unlikely to be a significant threat.

Second and Continuous Wheat Situations

With more and more wheat being grown, the number of second and continuous wheats will continue to increase. In this section we have not differentiated between second and continuous wheats - the threats that they face are similar. There has always been speculation as to what actually 'makes a good second wheat'. Certainly high levels of eyespot resistance are important but this is not the whole answer. There appears to be a complex of root diseases, which undermine yield performance with the most damaging disease annually being eyespot, but with sporadic very damaging attacks of 'take all'. We have collated data from as many sources as possible to determine just how flexible Claire is, in terms of this difficult rotational position. Table 12 shows an analysis of 28 trials over the five-year period 1996-2000.

Table 12 Claire in second / continuous wheat situations

	1996	1997	1998	1999	2000	Mean*	NIAB
Claire	**106**	**108**	**103**	**101**	**101**	**102**	**102**
Consort	107	98	106	101	103	103	100
Riband	100	102	105	101	100	101	100
No of trials	3	2	4	10	9	28	13

**Mean weighted according to number of trials in each year*
Yields expressed as mean of NIAB controls relevant to each year

These 28 trials represent 6 Nickerson trials, 9 ARC trials and 13 NIAB trials. The comparison has been made with Consort and Riband - both considered to be 'good' second wheats. There is no significant difference between all three varieties suggesting that Claire is as suitable for this difficult rotational slot as the other two established varieties. This appears to be supported by NIAB data, which gives a ranking for Claire similar to Consort (HGCA UK Recommended List 2001).

Instances have been reported where Claire has performed less well than experience would suggest in a second wheat situation, and yet we have also seen Claire produce much higher yields as a second wheat than we would have expected. This indicates that the question of performance as a second wheat is a complicated issue which is not yet fully understood.

Whiteheads are often wrongly misdiagnosed as eyespot - leading to speculation about Claire's high NIAB rating for this disease. Nickerson have seen no evidence to suggest that the NIAB rating is incorrect. All varieties within the Nickerson breeding programme are subjected to evaluation under high natural levels of eyespot leading to selection for superior levels of resistance. Claire has proved to show a more than satisfactory level of eyespot resistance, based upon that inherited from Cappelle Desprez, but this should be supplemented in early sown crops (even first wheats) and second/ continuous wheats with foliar applications of Cyprodinil (Unix).

Soil-Borne Wheat Mosaic Virus (WSBMV)

This disease, which is widespread in Europe, North America and Asia has been found in isolated pockets within the UK. Symptoms include stunting of plant growth and consequential yield penalties can be very severe, with losses of up to 74% being calculated from trials grown in France (HGCA Topic Sheet - Soil Borne Wheat Mosaic Virus). No chemical control measures are available with the only solution for growing wheat on infected soils being the use of resistant varieties. Claire has been extensively tested in France and the UK for this damaging disease and has been found to carry high levels of resistance.

A message from the team that bred Claire

Claire has become an established and leading winter wheat in the UK in just over three years. It meets the demands of key markets such as biscuit, export and feed. With lower grain prices growers must seek to control costs to reduce the unit cost of grain production. These guidelines, in conjunction with local knowledge and experience, will be of great value in supporting this concept.

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