2004/05 New Edition

Husbandry Guidelines

Einstein

Wheat Genius

Nickerson

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Introduction

The last twenty years have seen dramatic changes in wheat varieties in the United Kingdom. UK growers are leaders across Europe in recognising the value that newer varieties can bring to their farms. During the 1980s and early 1990s yield was paramount and breeders brought to the market varieties which had ever-increasing yield. More recently, with more sophisticated end use requirements breeders have adapted their programmes to develop varieties, for not only the domestic market, but also the increasingly important export market.

Einstein winter wheat represents the next step in this evolution of varieties. With volatile grain prices and farm incomes under pressure there has never been a time when the adage "grow for the market" has been more relevant. Einstein is a NABIM Group 2 winter wheat with potential for the domestic bread market, the export market and the domestic feed markets.

Growers have shown with the uptake of Group 3 varieties such as Consort and Claire - varieties preferred by importers including Italy, Spain and Portugal - that they understand the needs of the export markets. Growers also appreciate the need to have more than one option when selling grain. Einstein arrives at a time when a huge demand has built up in the export market for a variety with the required bread-making characteristics, combined with the appropriate agronomic type.

This booklet is an update to the first edition of the Einstein husbandry guidelines. As stated in previous booklets we do not see these guidelines as providing blueprints for growing the variety. Our objective is to provide sufficient agronomic support to maximise the opportunity for growers to achieve the genetic potential of this new and exciting variety.

Proven Track Record

...from the Nickerson programme led by Bill Angus

Consistent Performance

...through 5 years of intensive trialling

Outstanding Yield

... on a par with leading feed wheats

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EINSTEIN

Winter Wheat

Growers Guidelines

...backed up by on-farm agronomy trials

Ideal for the Market

...meets specifications for both export and domestic bread-making markets

Einstein - Its Place in the Market

Einstein winter wheat produces grain suitable for domestic bread production as well as export bread and blended flour markets. In order to understand these different end uses, and therefore the marketing of Einstein grain, some technical information is provided below.

Quality Requirements of Wheat for Bread-Making

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

However, the key requirements of a bread-making wheat variety are that it should have good milling properties and produce flour that, when made into dough, has a good balance of extensibility and elasticity. The flour should also have an acceptable capacity for the absorption of water. These characteristics are primarily determined genetically (i.e. by variety) and are explained in more detail below.

Millers require a high level of flour extraction from the grain in order to obtain the highest value from the wheat they have purchased. Additionally, the flour produced should be of good colour.

Though it sounds obvious, a white flour is desirable because of consumer preference for white bread. Many wheat varieties can produce flour with yellow pigments and some can have an unacceptable level of bran contamination at standard white flour extraction rates.

Extensibility (stretchiness) allows the dough to rise in response to yeast activity, whilst elasticity allows the gas produced by the yeast to be retained. This ensures that the baked loaf has a good volume and an acceptable internal crumb structure with an even distribution of fine-walled cells.

The water absorption capacity of a flour depends largely on whether the variety is hard or soft milling, though there is variation within each of these groups. Hard milling varieties produce high levels of "starch damage" when milled because the starch granules within the endosperm are broken up during the milling process. The opposite is true of soft milling varieties. The broken, or damaged starch from hard milling varieties is able to absorb much more water than the relatively intact starch granules found in flour from soft varieties. Flour for most bread-making purposes needs to have relatively high water absorption in order to increase bread yield and resistance to staling. This explains why hard milling varieties are preferred for the domestic UK bread market.

Bread-Making Quality of Einstein for the Domestic Market

Prior to Recommendation on the HGCA List, Einstein was thoroughly tested by end users and NIAB over the course of three (in some cases four) seasons. Einstein has been included in the NABIM wheat guide as a Group 2 variety.

Einstein produces good Hagberg falling numbers and specific weights. Protein content of some samples from trials has been below the optimum desired for bread-making grists because of its exceptionally high yield potential. This is a common problem with modern bread-making varieties but should not unduly concern a commercial grower, because a tailored program of nitrogen management has demonstrated that optimum protein specifications can be readily achieved. (See page 19 - Crop Nutrition)

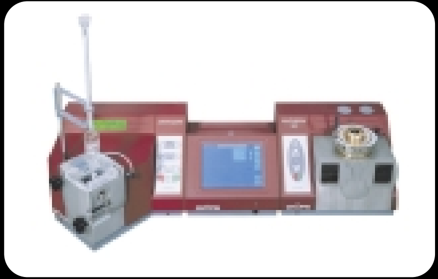
Einstein has demonstrated excellent milling characteristics, producing very white flours at very high levels of extraction. The rheological properties of Einstein (extensibility and elasticity) are acceptable for bread-making, although not exceptional, and this is one reason why Einstein has been placed in NABIM group 2.

The Export Market

The export market has become increasingly important as UK growers produce higher yields on farm, and of the 15 million tonnes of domestic production about 25% is exported. However in recent years it has become apparent that the UK industry is failing to exploit the full potential of these markets. Whilst there is very limited scope to increase our exports in the soft milling Group 3 sector, the huge overseas market for bread wheat remains virtually untapped by the UK. In fact 55% of the potential export market (amounting to at least 7m tonnes) is for bread wheat - but only about 30% of the wheat produced in the UK is of this type, of which the vast majority is used domestically. Higher quality Group 1 bread-making varieties are unlikely to be exported because of their high value and cost within the domestic market. However the area of wheat sown to Group 2 varieties is increasing, with varieties such as Einstein meeting the demands of this market.

The UK grower is well placed to exploit this market as the UK is used to trading grain on a variety basis and understands the need to store varieties separately. In contrast the major competitor for this market (France) has a policy of storing mixed grain lots, leading to variability in processing quality.

This represents a big opportunity for the UK grower - provided that varieties with suitable quality for these markets are available. In addition to the standard protein, Hagberg Falling Number, moisture and admixture specifications, the key test for export quality is the alveograph. For more information on the alveograph see **www.hgca.com/publications**. This test measures the strength (W) of dough and its relative extensibility (P/L). High W indicates strong elastic dough and low P/L signifies good extensibility. Varieties suitable for the blended export market have moderate W (greater than 150 is desirable) and low P/L (less than 0.8). Many UK bread-making varieties fail to meet the specification, usually because of high P/L and therefore have at best a restricted potential for this market. One notable exception is Charger, which was extremely popular in this sector and could have realised more of its potential were it not for its agronomic weaknesses and susceptibility to sprouting that limited its take up by growers. In quality terms Einstein has a very similar alveograph profile to Charger (see table 1) but has been selected from a different genetic background and has significantly higher yield potential.



Photograph courtesy of Chopin

The Chopin Alveograph is the key test for export quality

Table 1 - Export specifications for Blended Flour

	Blended Flour Specification	Einstein	Charger
W	≥ 150	**170**	175
P/L	≤ 0.8	**0.5**	0.5
Prot (%dmb)	11.0	**11.9**	11.9
Hagberg	230	**267**	209
SpWt.(kg/hl)	77.0	**77.4**	76.1

Einstein - Pedigree and Selection Mechanism

Einstein = (NHC49 x UK Yield Bulk) x (Haven x (Moulin x Galahad))

Plant breeding is a long-term process and the pedigree of Einstein gives an insight into how material can be combined from diverse sources to produce new varieties. The first crosses in the development of Einstein were made in the late 1970s when eyespot resistant material was incorporated into a pathology crossing programme. The donor material was from France but the UK variety used was Hustler - a very high yield potential UK variety. This formed the basis for the breeding line NHC 49 and explains Einstein's high eyespot resistance rating.

Additional crosses using high yielding UK types Haven and Galahad allowed the introgression of high yield potential and good disease resistance. Bread-making quality was derived from the Moulin, and electrophoresis shows the inheritance of high molecular weight (HMW) protein glutenin subunits from this good bread-making source.

Einstein - Resistance to Disease

A major part of the Nickerson wheat breeding strategy is to develop varieties with high levels of adult plant resistance. Much attention is paid to developing varieties with good foliar as well as root disease resistance. When developing new varieties parents are used which are known, as far as possible, to have resistance factors which will not be overcome during the lifetime of the variety.

An alternative approach is to base disease resistance on single major genes that have yet to be matched by the disease. Such genes usually confer immunity or an exceptionally high level of resistance (often rated as 9 on the Recommended List). However, the underlying background resistance of varieties with this type of resistance is an unknown quantity and such varieties may represent a high level of risk to the grower. New races of mildew and rust capable of defeating major genes often appear and result in a dramatic rise in susceptibility of affected varieties. This strategy tends to be somewhat short term often leading to the well-known "boom and bust" cycle. Recent examples include yellow rust in Brigadier and mildew susceptibility in Shamrock. It is not always possible to avoid disease resistance breakdown but new and evolving biotechnological techniques should be able to highlight varieties at high risk.

The Nickerson strategy is to try to avoid the inherent dangers of breeding for total immunity to disease using novel major genes. Instead, varieties with good, but not perfect resistance to a range of current races are selected. Such resistance tends to be based on the additive effect of a number of minor genes and is therefore likely to be more durable. Einstein has come through an intensive system of testing in high disease situations and has shown good levels of resistance to the most common diseases of wheat.

Mildew
Einstein has a good level of mildew resistance (HGCA rating = 7). Collectively, UK wheat breeders have been successful in accumulating partial resistance effects to produce a general trend towards the better resistance of the safer, more durable type as described above. This resistance has proved to be effective over a wide range of environments, but under conditions of very high risk, additional fungicide protection would be appropriate.

Yellow and Brown Rust
Einstein has moderate resistance ratings for both the rust diseases (HGCA yellow rust rating = 5, HGCA brown rust rating = 6). These ratings are not expected to change dramatically during the life of the variety. Nickerson seedling tests indicate that Einstein is unlikely to be at risk from the current "Oxbow" and "Brock" races which are known to attack Robigus and Cordiale. With normal control measures in place, this reasonable level of genetic resistance should ensure that the grower does not experience rust problems in all but very high-risk situations.

Septoria
Breeding for resistance to *Septoria spp* is given high priority in the Nickerson programme. Over the years this has been exemplified by the development of varieties such as Claire, Deben, Exsept, Nijinsky and Istabraq. Whilst Einstein does not have quite such high levels of resistance as these varieties (HGCA *Septoria nodorum* rating = 6, HGCA *Septoria tritici* rating = 5), it does have a good level of adult plant resistance, derived from Haven and Galahad.
The rapid build up of strobilurin (QoI) insensitive strains of *Septoria tritici* has resulted in important changes in the recommendations for the use of strobilurin products (See page 29 - Response to Fungicide Use). As this fungus is potentially the most damaging disease in terms of yield reduction, additional control measures must be taken to complement the generally good levels of resistance found within Einstein.

Eyespot
Einstein is one of the lower risk varieties regarding eyespot infection (HGCA rating = 6). The genetic basis of Einstein's resistance is not fully understood but it has probably inherited resistance from its ancestors Haven and NHC49.
The old French variety Cappelle Desprez is thought to be a very important, original donor of good resistance to UK wheat breeding.

Ears Diseases - particularly *Fusarium spp*
Einstein is unusual in being a semi-dwarf with good levels of resistance to *Fusarium spp* (HGCA rating = 7). Many semi-dwarf varieties tend to have dense ears, which appear to be more vulnerable to ear diseases - probably associated with the microclimate around the ear and the relatively short distance between flag leaf and ear. Einstein has a more lax ear than many of its competitors. Not withstanding this, semi-dwarf varieties are notorious for their susceptibility to *Fusarium spp* and routine control measures should be used to ensure low levels of ear diseases. This is particularly relevant for crops destined for domestic bread and export markets as well as seed.

Einstein - Yield Potential

Einstein winter wheat has now undergone four years of statutory independent testing. Locations have been selected to evaluate how robust a variety will be in a range of environments. However breeders test material in their own trials for at least two years prior to this. Table 2 shows the full complement of trials carried out by Nickerson UK over a six-year period from harvest 1998 to 2003. Because of the regular changes in varieties and control varieties in trials, a range has been included. Variety comparisons are always difficult but this dataset does give all relevant varieties in all years tested.
It is quite clear that Einstein has produced consistently high yields over a wide range of years.

Table 2. Nickerson Treated Trials 1998 - 2003

	1998	1999	2000	2001	2002	2003	Mean 1998-2002
no of trials	2	4	4	4	9	5	**28**
Einstein	**114**	**109**	**102**	**105**	**105**	**103**	**106**
Claire	*	100	103	101	107	105	**103**
Consort	*	102	105	103	97	99	**(101)**
Option	*	*	*	102	100	101	**(101)**
Riband	112	102	95	102	95	97	**101**
Malacca	*	*	*	98	95	95	**(96)**
Charger	*	97	96	99	92	99	**(97)**
Hereward	94	94	91	93	92	97	**94**

* not in trial that year ( ) = incomplete dataset

Yields are expressed relative to official control varieties in each year

Table 3. Winter Wheat National and Regional Official Treated Yields

	UK	North	East (Dry)	West (Wet)
Einstein	**103**	**103**	**103**	**105**
Claire	100	98	101	102
Consort	99	100	100	99
Option	102	102	101	101
Malacca	96	96	96	96
Charger	98	97	98	97
Solstice	100	99	100	101

Yields expressed as the mean of the control varieties Claire, Consort, Malacca, Option and Tanker
Source HGCA Recommended List 2004

This is confirmed by its high yield ratings as presented on the 2004 HGCA Recommended List (table 3). This table also shows performance in regional trials, and again Einstein is shown to produce yields at the highest levels in all regions of the UK.

The Arable Group (TAG) trials provide another insight into variety performance. In contrast to HGCA trials, which are grown with very high fungicide input, TAG trials are grown with local farmer fungicide regimes. These often cost as little as 50% of the HGCA protocol and are therefore more indicative of the yield realised in a practical farm situation. Growers can use these databases to seek to identify varieties with least risk of failure.

Table 4 shows the yield performance of Einstein over a series of 18 widely contrasting locations, over two years.

Table 4. Winter Wheat Treated Yields TAG 2002-2003

	2002	2003	Mean 2002-2003
no. of trials	18	18	36
Einstein	**102**	**102**	**102**
Claire	101	102	102
Consort	97	96	97
Option	101	99	100
Malacca	94	93	94
Solstice	97	96	97

Yield expressed as mean of all varieties in trial

Table 5. Winter Wheat Untreated Yield Trials

	Nickerson	HGCA
Einstein	**112**	**110**
Claire	(113)	103
Consort	(93)	94
Option	(105)	105
Malacca	(101)	98
Riband	92	87
Hereward	108	98

() = incomplete dataset

Yields are expressed relative to official control varieties in each year.

In this series of trials Einstein was the highest yielding NABIM Group 2 variety in both years.

Reducing risk is paramount in today's uncertain grain market and growers are now seeking to reduce the risk of disease threats by choosing varieties with improved disease resistance. The significance of growing disease resistant varieties is best illustrated by examining yield results from trials that have had no fungicides. Table 5 shows the yield obtained from Nickerson untreated trials over the period 1998 to 2003, and the performance in HGCA funded trials over the four year period 2000 to 2003. Both untreated datasets present the same story - reliable performance under the range of disease pressures experienced over this period. Whilst few growers are likely to grow wheat without fungicides these results do give some insight into the potential risks of missed timings, inappropriate chemicals / doses or poor weather conditions. In essence disease resistance is insurance, and having high levels of disease resistance provides a very valuable benefit.

Einstein is proven in 5 years of trials over a wide range of sowing dates, soil types, and rotational situations.

Einstein - Place in the Rotation

Table 6. Einstein First Wheat Yields - Treated Trials 1998 - 2003

	1998	1999	2000	2001	2002	2003	Mean 1998-2003	HGCA RL2004
Einstein	**116**	**109**	**102**	**105**	**104**	**103**	**107**	**103**
Hereward	97	94	91	93	92	96	94	91
Riband	115	102	95	102	93	98	101	98
Claire	*	101	103	101	106	107	(104)	101
Consort	*	102	105	103	98	98	(102)	99

* not in trial that year   ( ) = incomplete dataset

First Wheats
Einstein is ideally suited to first wheat situations as seen from table 6. This table shows a summary of Nickerson UK trials over the period 1998-2003 alongside the yield figure from the 2004 HGCA Recommended List. Einstein has performed consistently well over a range of years and sites.

Second / Continuous Wheats
In addition to its value as a first wheat, Einstein has produced excellent results when grown as a second / continuous wheat. The database for this difficult rotational slot has been strengthened by an increased number of HGCA Recommended List Trials being sown as second wheats. Einstein has produced consistently good results in this slot - 5% higher than Consort, a variety preferred by many growers as a second wheat. Nickerson data is provided in table 7 alongside HGCA figures.

Table 7. Nickerson Second/Subsequent Wheat Trials 2002-2003

	2000	2001	2002	2003	Mean 2000-2003	HGCA RL2004
Einstein	**113**	**113**	**105**	**104**	**109**	**105**
Consort	102	106	102	99	102	100
Claire	97	100	98	99	99	99
Deben	113	110	110	105	110	105
Malacca	96	100	102	96	99	96
Option	97	109	96	104	102	102
Tanker	104	96	96	102	100	103

* not in trial that year   ( ) = incomplete dataset

Many growers have utilised this difficult rotational slot to grow bread-making varieties. With yields likely to be lower than first wheat situations there is a good prospect of realising protein contents desirable for bread-making intake tests. Within the bread-making sector (NABIM Groups 1 and 2) there are few varieties with good levels of eyespot resistance - an essential trait required for any second wheat. Einstein has a good level of resistance (HGCA rating 6) and growers can thus utilise this variety as a second wheat, and optimise their prospects for meeting bread-making specifications

Table 8. Winter Wheat Late Sown Nickerson Trials

	2001	2002	2003	Mean 2001-2003
Einstein	**101**	**104**	**102**	**102**
Claire	103	104	105	104
Consort	*	91	99	(95)
Option	102	91	100	98
Malacca	98	92	94	95
Solstice	99	98	104	100

( ) = incomplete dataset

Yields expressed relative to official controls varieties in each year

Late Drilling
It is inevitable that some wheat drilling has to be carried out after the optimal drilling window of September / October. Einstein should not be sown after the end of January but can be safely sown until that time. Again growers can take advantage of delayed sowing dates to maximise protein content. Table 8 & 9 show the results from Nickerson and HGCA trials drilled late in the autumn. This trial summary represents a range of sowing dates but nevertheless there is good evidence to show that Einstein performs at the highest yield levels.

Einstein is a true semi-dwarf utilising the Rht2 dwarfing gene, which is prevalent throughout UK semi-dwarf varieties. The variety has short stiff straw and responds well to plant growth regulator (PGR) inputs.

Drilling Date

Einstein has a high vernalisation requirement and should not be drilled after the end of January. Ear development studies show that once the vernalisation requirement has been satisfied primordia development is rapid, with ear emergence just prior to standard varieties such as Riband or Malacca. This rapid development is probably driven by increasing day length during the spring.

Optimal drilling dates in East Anglia would be mid September onwards with earlier parts of the UK, south and south-west areas, being one week later. Further north optimal dates are likely to be one week earlier. Bear in mind the potential pitfalls of drilling early (See page 25 - Maintenance of Grain Quality).

Einstein can be sown safely until the end of January and has produced some very high yields from these sowing dates. Nickerson data (table 8) confirm results from HGCA trials (table 9).

Seed Rates

Einstein has moderate tillering capacity - similar to Consort - and produces a high proportion of primary tillers. Seed rates should be adjusted according to thousand grain weight, which tends to be high. Table 10 gives proposed seed rates for both ideal and adverse seed bed conditions.

Table 9. Late Sown Winter Wheat Trials Harvest 2002-03 (HGCA - Funded)

	2002	2003	Mean 2002-2003
Einstein	**115**	**101**	**108**
Claire	106	100	103
Option	108	101	105
Malacca	106	95	101
Solstice	105	101	103
Chablis (C)	108	104	106
Paragon (C)	98	96	97
Imp (C)	94	*	(94)
Ashby (C)	*	100	(100)

(C) = Control variety   * not in trial that year   ( ) = incomplete dataset

Yields expressed relative to official control varieties in each year

Table 10. Seed Rates Einstein Winter Wheat (seeds per sq.m)

Time of Sowing	Seed Rate (Ideal conditions)	Seed Rate (Adverse Conditions)
Sept 16th - Sept 25th	160-220	200-250
Sept 26th- Oct 5th	200-260	250-320
Oct 6th- Oct 25th	260-350	320-380
Oct 26th - Nov 5th	350-380	380-400
Nov 6th- Jan 31st	380-400	400+

Table 10 should be used as a guideline only, as weather and soil conditions can change the level of establishment radically. As growers have become accustomed to lower seed rates it is important not to sow too high a seed rate during September and early October. Lush thick crops at these drilling dates will be prone to lodging - primarily as a result of taller crops. As drilling progresses into October crop establishment is delayed, and eventual crop height (and hence lodging pressure) is reduced. Einstein has the potential to produce high grain quality, but this opportunity will be severely eroded should lodging take place (See page 17 - Response to Growth Regulators).

Seed Treatment

In first wheat situations a single purpose seed dressing should be applied as routine, as even healthy looking seed can harbour disease. In early drilled situations a broad spectrum seed dressing (such as Baytan) should be considered as this will help protect against lodging. In high risk situations measures should be taken to protect against BYDV infection by using products such as Secur.

Einstein has a high level of resistance to eyespot and may not benefit significantly from the addition of products such as Latitude or Jockey. Take-all is a sporadic disease both in seasonal and location, so use of in these products on Einstein should be restricted to high risk situations.

Herbicide Use

Field tests by Makhteshim Agan (**www.mauk.co.uk**) indicate that Einstein can be sprayed safely with Alpha Chlortoluron 500 (Dicurane).

Maturity

Einstein is an early maturing variety and as with all premium potential varieties should be harvested early. Einstein grown for export or for bread-making should be stored separately from all other varieties. Varieties in NABIM Group 2 differ in their quality attributes and mixing varieties is likely to compromise sales opportunities.

Einstein - Response to Growth Regulators

Einstein winter wheat is highly responsive to Plant Growth Regulators (PGRs). Because Einstein is a semi-dwarf variety, height reductions will be smaller than those experienced with taller varieties. However PGRs play a key role in stiffening straw and should be used routinely on Einstein. As a high yielding, potential bread-making variety, Einstein should be grown using higher rates of nitrogen than standard feed or biscuit wheats. This means that lodging pressure will be increased and growers are advised to use robust PGR rates. In line with other Nickerson varieties our advice is that PGRs should be applied according to apical development stages, with the key timing for CCC based products at the “glume-lemma” stage. The best way to determine this 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.

Chart 1. EAR PRIMORDIA DEVELOPMENT

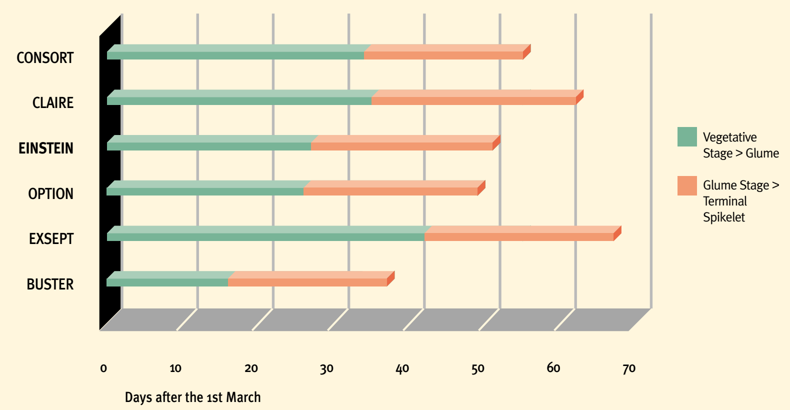
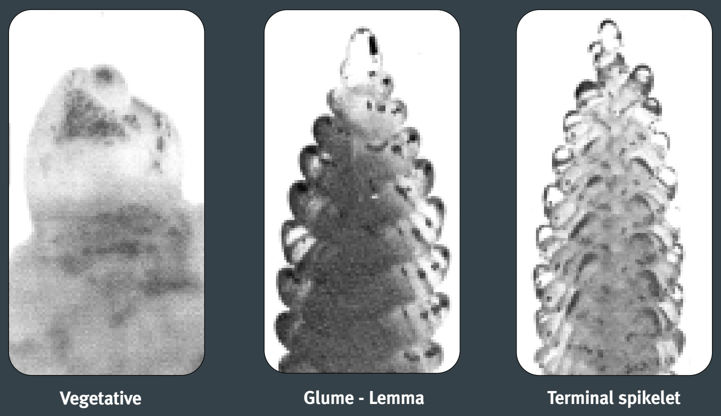


Chart 1 shows the primordia development patterns of a range of winter wheats. Einstein has an earlier development pattern than many other varieties, such as Claire for example. This information should be used to determine the key stages for PGR application. Crops should be treated routinely with a 2/3rd rate of a CCC based product at such as New 5c Cycocel the glume-lemma primordia stage followed by a 1/3rd rate at first node (Zadoks 31). If weather conditions do not permit a split application then a full rate CCC + Moddus (Syngenta) application should be made at Zadoks GS31.



Primordia development stages in wheat.

Used by kind permission of R.A.S.E.

Growers should also consider the use of Meteor (chlormequat + imazaquin, BASF) in combination with CCC at the glume - lemma primordia stage.

Note that with similar drilling dates the optimal time for CCC based PGR applications for Claire and Einstein may be up to 10 days apart.

An application of trace elements should also be considered at this stage, as this will benefit nitrogen uptake and improve the response to PGRs.

Nitrogen rates should reflect Einstein’s potential to produce very high yields of grain suitable for domestic and export bread-making markets. (See page 19 - Crop Nutrition) and this may increase lodging risk. If seed rates, nitrogen use and early PGR applications are in line with the guidelines in this booklet only crops at very high risk of lodging should require additional treatment with applications of 2-chloroethylphosphonic acid + mepiquat chloride based products (e.g. Terpal).

Einstein - Crop Nutrition

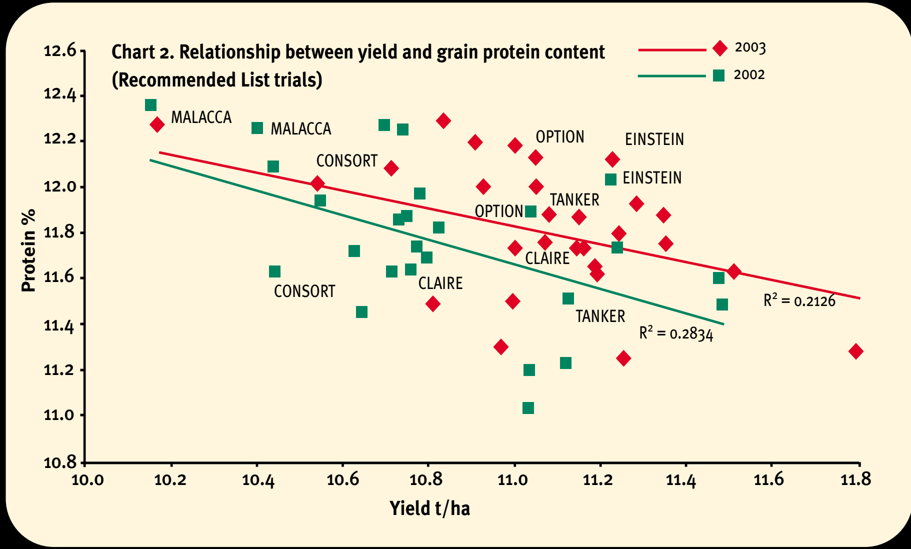
Einstein requires high levels of N to maintain protein content in high yielding situations.

Einstein produces very high yields of good quality grain suitable for bread-making. This results in an increased requirement for nutrients. However it is important to view the needs of the crop in a more holistic way - considering the effect of all nutrients. If growth at any stage is limited by nutrient supply then grain yield may be compromised. It is with this in mind that we have developed a strategy which will improve the prospects of growers achieving the goal of high grain yield, coupled with grain which will meet the end users requirements.

Nitrogen

Nitrogen rates have not increased significantly with rates of use in 2002 very similar to those of 25 years ago.

This is despite the fact that average yields have increased in this period from 5.9 tonnes per hectare to 8.0 tonnes per hectare. The reason for this is partly environmental (the need to reduce nitrate contamination of water courses), economic (the decline in grain prices in the late 1990s), but most importantly the recognition that higher nitrogen rates can increase lodging potential. As a rule of thumb, 23kg of nitrogen will be required for every tonne of grain produced.
This does not however take into account the requirement for an elevated protein content. Traditionally growers have tended to look at nitrogen in isolation, but the Nickerson philosophy considers the use of other essential elements that may be required in greater quantities



as nitrogen rates are increased.

As the potential yield of Einstein is similar to that of feed wheat varieties, additional nitrogen will be required to enhance yield performance as well as improve protein content. Chart 2 shows the relationship between protein content and yield, from varieties tested in HGCA Recommended List trials over the two year period 2002 and 2003. There is a clear inverse relationship between yield and protein content. Einstein has in both years, produced higher protein contents than most other varieties in this high yield potential group.

Many growers fail to achieve the potential yields of many modern varieties by over-cautious use of nitrogen. Few operate at the peak of the response

curve to nitrogen for fear of lodging. If lodging pressure is under control - by ensuring seed rates are not too high and nitrogen is not applied too early - then growers should be able to increase nitrogen use with relatively low risk. This is particularly so for Einstein, which is already stiff, and responds well to PGRs. As yield potential rises so will the requirement for additional nitrogen. In both first and second wheat situations it is advised that an additional 50kg/Ha of nitrogen should be applied, with more adventurous growers looking to raise rates further if necessary.

Nitrogen requirement must not be viewed in isolation and careful consideration should be given to other nutrients including potassium, sulphur, phosphorous and trace elements. It is also important to recognise that the use of strobilurin chemistry will raise yield potential and place further demands on the nutrient requirements of the crop (See page 23 - Trace Elements).

Growers should bear in mind that early sown crops will have benefited from nitrogen latent in the soil. This residual should be taken into account when deciding total amounts to be used. In order to calculate nitrogen requirements growers should consult the DEFRA "Fertiliser recommendations for agricultural and horticultural crops" (RB209) (**www.defra.gov.uk/environ/pollute/rb209**). These guidelines may underestimate the requirement for Einstein, bearing in mind the need to optimise both grain yield and protein content. Additional advice should be sought from companies specialising in fertiliser supply such as Kemira Growhow (**www.kemira-growhow.co.uk**) or Terra (**www.terranitrogen.co.uk**).

The first application of nitrogen should be applied to first wheats just prior to the terminal spikelet stage so that the nutrient is available at this stage. It is recommended that two thirds of the total planned application be made at this stage with the remainder applied approximately four weeks later.
By delaying nitrogen until this stage growers will decrease the risk of disease and enhance standing power. Crops may turn slightly yellow prior to these late applications but experience shows that, subject to adequate plant numbers, yield will not be compromised. Unlike barley, wheat has the capacity to increase grain number per spikelet with additional florets setting seed in low tillering crops. Preliminary evidence does not support the concept of delaying nitrogen until flowering. Evidence from Nickerson trials indicates that it is the total amount that is applied which is of importance - rather than the timing.

In second / continuous wheat situations or light land sites a policy of applying a small amount of nitrogen early in the spring is likely to be beneficial. These soils are often deficient in nitrogen and again growers should take this into account when deciding nitrogen usage. Growers in nitrogen sensitive areas (NSAs) will be restricted in the amounts of nitrogen that can be applied, but the "little and often" approach is likely to be more appropriate to the environmental concerns of these areas.

Sulphur

Sulphur dioxide emissions in the UK have been reduced by 80% since 1970. There has been much speculation as to the effect that this has had on crop production. Certainly oil seed rape is now treated routinely by many growers to overcome the effect of sulphur deficiencies with consequential improvement in seed yield. Insufficient sulphur supply will result not only in decreased crop yield and quality, but also a reduced nitrogen efficiency. This may limit yield potential as well as increase nitrogen losses by leaching.

Additional sulphur improves grain quality as well as yields

One area of particular concern is the effect that sub-clinical deficiencies in sulphur will have on bread-making quality of grain. There is a wealth of evidence to show that reduced levels of sulphur will have a negative effect on bread-making quality, primarily reducing loaf volume.

Nitrogen fertiliser will not be fully utilised if sulphur is deficient. Experiments have shown that sulphur should be applied between early March and early May. Sites at greatest risk from sulphur deficiency are chalky or sandy soils. Medium soils can be at risk following sulphur-hungry crops such as oilseed rape. Like nitogen applied as nitrate, sulphur applied as sulphate is immediately available to the crop but can also be easily leached. Hence only small quantities should be applied - approximately 25-30kg/ha. Topic sheet 54 from the HGCA (**www.hgca.com/research/topicsheets**) reviews the current requirements for sulphur.

A routine application of sulphur in the form of sulphate (504) should be applied to all Einstein crops destined for bread-making.

Phosphate and Potassium

It has long been recognised that adequate reserves of phosphorus (P) and potassium (K) are required to maintain soil fertility. There has been a gradual reduction in the application of these products by growers as grain prices fell. In 2001/2 only 60% of the UK wheat area received a P or K application compared with 70-75% five years earlier. Growers should seek guidance on the status of P and K levels in their soils as deficiencies will lead to reduced grain yields.

Potassium is essential for normal plant functions such as photosynthesis, protein formation and water use. Plants cannot complete a normal life cycle without sufficient potassium. With the exception of nitrogen, plants require more potassium than any other nutrient. When potassium is deficient, translocation of nitrates, phosphates, calcium, magnesium and amino acids is depressed. Potassium is required for every major step of protein synthesis. When potassium is not available, proteins are not synthesised despite an abundance of nitrogen. This may explain why in certain situations both protein level and yeild response to increased nitrogen input may be limited. It is therefore important that Einstein growers are aware of any imbalance that may be present.

Phosphorus

Phosphorus is an essential nutrient for wheat and an adequate supply is required for optimum growth and reproduction. Phosphorus is required for photosynthesis: the process in which light energy is used to fuel the synthesis of simple sugars from carbon dioxide and water. These sugars are the building blocks for plant growth and grain yield. When phosphorus is limited, plants suffer from reduced leaf expansion and surface area. These symptoms can easily be overlooked in the field.

Phosphorus requirement is often underestimated as growers assume that a high P index is sufficient for the crop. Approximately 25% of UK soils are deficient, and only approximately 15% of applied P is available within the season of application. This is due to the many restrictions placed on phosphorus availability within the soil, e.g. low soil temperature, low soil oxygen, water-logging, low organic matter, pH effects, limited movement within the soil, and soil interactions “locking up” P to reduce its availability. The plant requires phosphorus throughout its growing cycle as it is the “energy element” but it is required in high amounts at key times, e.g. emergence, establishment, rapid growth, onset of flowering, grain formation and maturity. During these periods the soil cannot release enough P into the soil solution from its reserves (even in high P index soils) to satisfy this demand and “transient deficiencies” occur which are not normally visible in the field but will affect yield and quality.

Trace Elements

There has been a multitude of trials on various trace element formulations over the years, often with contradictory results. Our own experience has been similar, with the exception of one product, Multimin. This has given consistently good results over a wide range of environments. We suspect that the reasons for the positive responses may be different from year to year.

Other products currently under evaluation in Nickerson agronomy trials include Multimax and Grainset. Initial indications are that these products often produce an economic return. As described earlier, Einstein represents a new generation of high yielding bread-making varieties which demand higher levels of nutrient supply. This is particularly important in second wheat situations where the crops are subject to higher levels of stress.

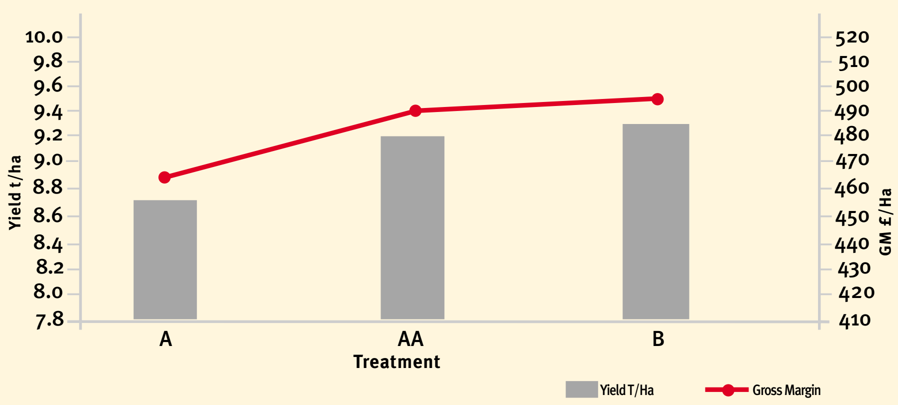
Foliar applications of P and K will stimulate crucial areas of plant metabolism, enhancing nutrient utilisation. Significant improvement in uptake of nitrogen, sulphur, calcium and a broad range of micro nutrients, e.g. copper, boron, manganese, magnesium and zinc, have been seen. This has very large implications when these nutrients are limiting or when the plant has high demand periods at critical growth phases, such as root growth, moisture or temperature stresses, and flowering.

This is particularly important for copper and boron, which are required to maintain good flowering biology. Should these elements be limited, ear fertility will be compromised with consequential increased levels of ergot and ear diseases.

Nutrition Summary

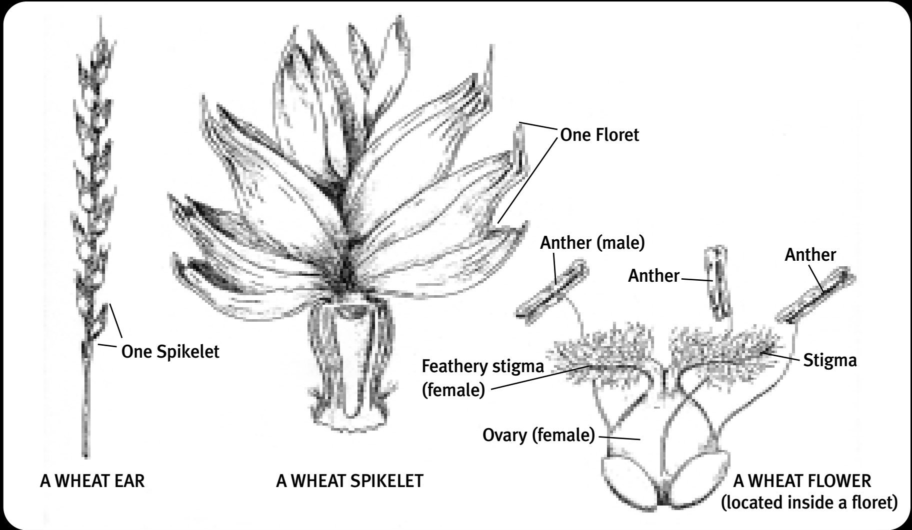
- Einstein winter wheat will demand increased nitrogen to optimise grain yield and grain quality.
- Sulphur should be applied routinely with the first application of nitrogen.
- Trace elements should be applied with the first plant growth regulator application as well as with the fungicide application at T2, prior to the critical ear development phase. This is particularly important under stress situations - notably second or continuous wheat crops.

Chart 3. Nickerson Agronomy Trials 2002
Nitrogen v Trace Element Interaction



A	240KG / HA Nitrogen (Control)	
AA	240KG / HA Nitrogen PLUS MULTIMIN	The trace element treatments were applied
B	240KG / HA Nitrogen PLUS GRAINSET	at the T1 and T2 Growth Stages at 0.5 L / Ha

Einstein - Maintenance of Grain Quality



Detailed structure of an ear of wheat.

Grain quality and saleability can be compromised by a number of factors. Many of the problems associated with grain quality can actually be attributed to problems associated with flowering biology. It is important that growers read through the following sections in order that they can see the implications of putting stress upon the crop - which may result in poor flowering biology.

Wheat and Flowering Biology

The ear of wheat is made up of many small flowers (florets), groups of which are arranged around the rachis of the ear within spikelets. Ear initiation takes place during early spring and the sexual organs of the flowers are developed during April and May, culminating in the production of pollen and ova at the end of May / early June. The developing ear passes through a number of critical cell division cycles many weeks prior to flowering. During this phase it is important that the crop does not undergo stress. Major changes in environmental conditions can be traumatic for the crop. These could be situations such as nutrient deficiencies, drought, or major diurnal changes in temperatures (e.g. warm days followed by cold nights). In addition chemical inputs may place stress upon the crop - for example high rates of late applied growth regulators.

Major stresses can reduce pollen production or induce “asynchrony” (when the female parts of the developing flower are not synchronised with pollen production). The signs of this in the field are gaping florets - often disregarded in wheat because of the multi-floret nature of the ear but very obvious in crops such as two row winter barley. The consequences of disrupted flowering biology are then seen in the developing grain, and it is in the light of this background information that conserving grain quality is now discussed.

The following are areas of concern to many growers and guidelines are given which should minimise exposure to risk.

Fusarium spp

Fusarium can seriously affect both grain yield and grain quality. The condition is exacerbated by poor flowering conditions - notably wet weather during the flowering process. In addition, pests such as orange blossom midge can carry the disease to individual florets; and because they visit a number of florets during egg laying they induce the disease even when conditions may not appear to be ideal. Crops at higher levels of risk will include second wheats and crops within minimum tillage situations.
A wide range of genetic variability exists for resistance to *Fusarium* but there is no immunity as such. All varieties will be infected but many semi-dwarf varieties appear to be severely infected. This is probably associated with ear morphology, with longer, more lax ears being less prone to infection. Einstein, though a semi-dwarf variety, tends to produce a longer and more lax ear. The variety carries a high rating for resistance to *Fusarium spp* (HGCA rating =7) but this will need additional fungicide protection to avoid damage caused by this common disease. (See page 29 - Fungicide Use).

Ergot

Ergot is a complex pathogen and it is important that growers are aware of the biology of the problem before control can be understood. Ergot *(Claviceps purpurea)* infection will result in the developing grain being “replaced” by ergot bodies (sclerotia). Pieces of ergot lying dormant in the soil germinate in the late spring to produce mushroom like structures. These release spores, which are carried by wind currents to open florets of wheat. Infection causes the development of “honeydew” - a shiny sticky liquid that oozes from infected florets and which contains large numbers of ergot spores. The spores are spread to adjacent florets and ears by visiting insects and rain splash.

The association with flowering biology is obvious. Should flowering biology have been disrupted then there will be a larger proportion of open florets for infection.

There has been much speculation as to whether there are significant differences between varieties. Some varieties, for example Rialto, have been cited as being worse than others.

Einstein was developed from a different genetic background to the majority of the Group 2 winter wheats currently in the market. Whilst ergot infection has not been seen as a problem to date, no variety is immune, so growers should minimise risk by considering the following:

Early drilling places new demands on the crop. Wheat will pass through critical developmental stages earlier and any major stresses may retard or diminish pollen development - leading to a higher number of blind florets.

These will in turn be prone to ergot infection. It is thus important that growers do not drill Einstein before the dates advised earlier (See page 14 - Drilling Dates).

Minimum cultvation will result in ergot sclerotia from previous wheat crops remaining near the surface. This contrasts to ploughing where they would normally be buried. Sclerotia will not germinate if buried 2.5cm or more below the soil surface.

Farm saved seed will increase the risk of continued infection if not scrutinised and cleaned using gravity separation.

"Conservation headlands" will favour the continued growth of grass weeds - particularly Blackgrass and Annual Meadow Grass which will act as hosts to the ergot fungus and provide a source of inoculum for the future.

Reductions in the use of insecticides prior to and during flowering will intensify the opportunity for insects to carry the ergot spores. This is particularly pertinent with regard to orange blossom midge, which may visit up to 20 florets each during their short life span.

To date chemical control measures for ergot are not available, though standard T3 applications of strobilurin-triazole chemistry may have some minor benefit. Growers will need to be vigilant with regard to the risks outlined above and plan accordingly. Fortunately Einstein is a variety with a relatively low risk of infection, and will reduce the growers risk of exposure to ergot infection compared to some other Group 2 varieties available.

Wheat Orange Blossom Midge (WOBM)

Wheat Orange Blossom Midge has become a major problem in certain regions - particularly East Anglia and Southern England. Difference between varieties in terms of susceptibility to this pest has been evaluated in a DEFRA LINK project (**www.defra.gov.uk/Science/LINK/Publications/Project**). It has now been established that there are significant differences between varieties in terms of susceptibility. Varieties such as Claire, Deben and Einstein falls into a group considered to have a high level of tolerance.


Picture courtesy of ADAS

Orange blossom midge.

WOBM is a major pest and has detrimental effects on both grain yield and grain quality. Control of this pest is essential for quality wheats and growers should be vigilant with regard to the threat. WOBM is opportunistic and will infect crops only when conditions are suitable. Following rain, (which will moisten the soil and hence allow midge to hatch from their cocoons) midge will infect suitable ears on varieties at the correct growth stage (GS55-59).

Table 11. Percentage Yield Response to Chlorpyrifos *Source: Nickerson Trials*

	2002	2003	Mean 2002-2003
EINSTEIN	5	2	4
Claire	2	1	2
Consort	17	5	11
Option	0	21	11
Malacca	1	9	5
Savannah	5	2	4

Yields expressed as percentage increase in yield over untreated

Midge flights tend to take place on still evenings when the air temperature is 15°C or above. Eggs hatch within the florets and develop into larvae that feed on the developing grain.This results in smaller, shrivelled grain as well as an increased incidence of sprouting (and hence reduced Hagberg Falling Numbers).

A major problem with the pest is deciding the threshold at which to spray. Current guidelines indicate that for bread-making varieties the presence of one midge per six ears would indicate that a spray application would be appropriate. No account is taken of variety sensitivity in this guideline, though recent experience would suggest that this target might underestimate the threat. The only product with clearance for control of WOBM is chlorpyrifos (Dursban - Dow AgroSciences). This product has the necessary persistence to control hatching midge over a period of several days.

Attempted control using pyrethroids may depress numbers of the natural enemies of wheat blossom midge - hymenopterous parasitoids - and thus may exacerbate the problem. Growers should also recognise the threat of ergot and *Fusarium* from uncontrolled midge, transferring inoculum in high risk situations. Growers should seek advice from Dow AgroSciences (e-mail: fhihotl@dow.com or freephone 0800 689 8899) regarding the use of their chlorpyrifos based products.

Einstein has been tested under conditions of high WOBM presence and shows an average yield response of 4%, over two years in Nickerson trials (see table 11). This was in a high WOBM pressure environment and suggests that Einstein does have a high level of tolerance. Bearing in mind the need to conserve grain quality it is important that growers are alert to the problem, and monitor crops diligently prior to and during ear emergence.

Harvest and Storage

Einstein has specific quality attributes and ideally should not be stored with any other varieties. At harvest, growers should inspect conservation headlands to determine the level of any weed or ergot contamination. If in doubt growers should harvest these headlands separately and set aside for sale into a lower quality market.

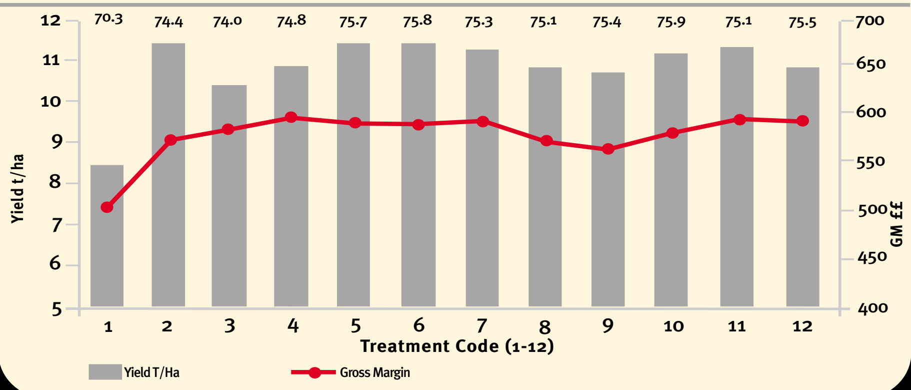
Einstein - Response to Fungicide Use

Table 12. Variety Fungicide Trial. Site: Suffolk 2002

TREATMENT CODE	FUNG. TIMING T1 (GS 31 / 32) CHEMICAL	L/Ha	FUNG. TIMING T2 (GS 39) CHEMICAL	L/Ha	FUNG. TIMING GS 55 (STRETCH) CHEMICAL	L /Ha	FUNG. TIMING T3 (GS 61 / 65) CHEMICAL	L /Ha	TOTAL CHEM COST	TRAVEL COST £5 / Ha	TOTAL COST OF TREATMENT
1	UNTREATED		UNTREATED		UNTREATED		UNTREATED		0	0	0
2	UNIX OPUS AMISTAR	1 KG/HA 0.75 0.6	LANDMARK	1			FOLICUR	0.75	£97.55	£15	£112.50
3	OPUS	0.5	OPUS	0.5			FOLICUR	0.3	£25.10	£15	£40.10
4	LANDMARK	0.5	LANDMARK	0.5			FOLICUR	0.3	£36.10	£15	£51.10
5	OPERA	0.75	OPERA	1.2			AMISTAR CARAMBA	0.3 0.5	£78.52	£15	£93.52
6	OPERA	0.75	OPERA	1.2			BAS 507	0.75	£79.12	£15	£94.12
7	OPERA	0.75	UNTREATED		OPERA	1.2	UNTREATED		£63.37	£10	£73.37
8	ACANTO OPUS	0.5 0.3	AMISTAR OPUS	0.75 0.4			FOLICUR	0.3	£52.72	£15	£67.72
9	BRAVO OPUS	1 0.3	AMISTAR OPUS	0.75 0.4			AMISTAR FOLICUR	0.3 0.3	£49.87	£15	£64.87
10	TWIST OPUS	0.8 0.4	TWIST OPUS	1.2 0.5			AMISTAR FOLICUR	0.3 0.3	£61.75	£15	£76.75
11	TWIST OPUS	0.8 0.4	TWIST OPUS	1.2 0.5			FOLICUR	0.5	£57.50	£15	£72.50
12	TWIST OPUS	0.5 0.2	UNTREATED		OPERA	0.75	UNTREATED		£36.12	£10	£46.12

GS 31/321st node/ 2nd node detectable GS 39Flag leaf ligule visible GS 55 50% Ears emerged GS 61/ 65 Start of anthesis

Chart 4. Variety Einstein
Gross Margin Comparison v Yield t/ha 2002



The "evolution" of strains of *Septoria tritici* resistant to strobilurin chemistry has been a significant development in the UK and Ireland. This group of fungicides has given growers a valuable tool in overcoming the most damaging of foliar diseases in wheat. New strategies must be taken to keep *Septoria tritici* under control. This is particularly important for a variety such as Einstein, which has moderate resistance to both *Septoria tritici* and *Septoria nodorum*.

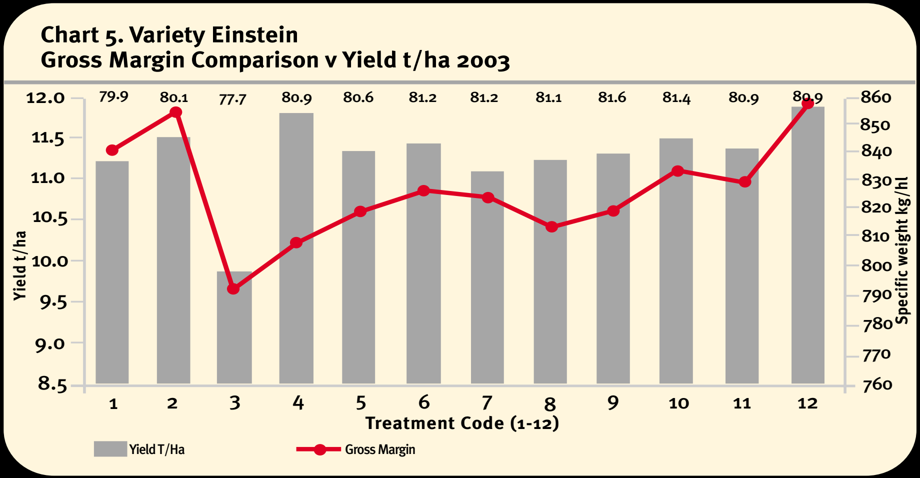
Fungicide trials were carried out in 2002 and 2003. These were contrasting years in terms of weather patterns, and hence the results give some insight into disease control and economic returns for Einstein.

Table 12 shows the 12 treatments applied in 2002. Treatment 1 was an untreated control used to calculate fungicide response. Chart 4 shows the yields obtained from the various treatments and the gross margin, calculated per hectare. Of particular interest are treatments 3 and 4. These two treatments contrast as treatment 3 is primarily a triazole regime (Opus-BASF) (**www.agricentre.co.uk**) whereas treatment 4 is a strobilurin (Landmark - BASF) programme. These two treatments gave some of the most economic returns - primarily because the higher yielding treatments involving Opera included the use of higher cost chemicals. Treatment 11 - based on Twist (Bayer) (**www.bayercropscience.com**) also gave high yields and a high economic return. This is in agreement with previous years results.

Table 13 shows the treatments applied in 2003. In this year treatment 3 was untreated, with treatments 1 and 2 similar to the previous year's triazole v strobilurin comparison. Strobilurin-resistant *Septoria*

Table 13. Variety Fungicide Trial. Site: Suffolk 2003

TREATMENT CODE	FUNG.TIMING T1 (GS 31 / 32) CHEMICAL	L / Ha	CHEM. COST £	FUNG. TIMING T2 (GS 37 / 39) CHEMICAL	L /Ha	CHEM. COST £	FUNG. TIMING STRETCH (GS 55) CHEMICAL	L / Ha	CHEM. COST £	FUNG. TIMING T3 (GS 61 / 65) CHEMICAL	L / Ha	CHEM. COST £	TOTAL CHEM. COST	TRAVEL COST £7 / Ha	COST OF TREATMENT £ / Ha
1	OPUS	0.5	10.5	OPUS	0.75	15.75				FOLICUR	0.5	£7.75	£34	£21	£55
2	LANDMARK	0.5	14.75	LANDMARK	0.75	22.13				FOLICUR	0.5	£7.75	£44.63	£21	£65.63
3	UNTREATED		0	UNTREATED		0	UNTREATED		0	UNTREATED		0	0	0	0
4	UNIX OPUS AMISTAR	1.0 KG/Ha 0.75 0.6	22.2 15.75 14.82	OPERA	1.5	42.75				FOLICUR	0.75	£11.62	£107.14	£21	£128.14
5	LANDMARK	0.5	14.75	OPERA	1.2	34.2				CARAMBA	0.75	£12.56	£61.51	£21	£82.51
6	OPUS BRAVO	0.5 1.0	10.5 3.2	OPERA	1.2	34.2				SWING GOLD	0.75	£14.8	£62.7	£21	£83.7
7	LANDMARK	0.5	14.75				OPERA	1.2	34.2				£48.95	£14	£62.95
8	ACANTO OPUS BRAVO	0.6 0.4 1.0	16.26 8.4 3.2	AMISTAR OPUS	0.75 0.4 BRAVO	18.52 8.4 1.0	3.2			FOLICUR	0.4	£6.2	£64.18	£21	£85.18
9	OPUS BRAVO	0.5 1.0	10.5 3.2	AMISTAR OPUS BRAVO	0.75 0.4 1.0	18.52 8.4 3.2				AMISTAR FOLICUR	0.4 0.4	£9.88 £6.2	£59.9	£21	£80.9
10	ACANTO OPUS BRAVO	0.6 0.4 1.0	16.26 8.4 3.2	OPUS BRAVO	0.75 1.0	15.75 3.2				AMISTAR FOLICUR	0.4 0.4	£9.88 £6.2	£62.89	£21	£83.89
11	TWIST OPUS	0.8 0.5	12.16 10.5	TWIST OPUS	1.2 0.5	18.24 10.5				FOLICUR	0.5	£7.75	£59.15	£21	£80.15
12	TWIST OPUS BRAVO	0.8 0.5 1.0	12.16 10.5 3.2	TWIST OPUS BRAVO	1.2 0.5 1.0	18.24 10.5 3.2				FOLICUR	0.5	£7.75	£65.55	£21	£86.55



tritici was present at this site. It is interesting to see that this treatment again gave high yields and good gross margins (Chart 5). Of particular interest is the higher gross margin return from the strobilurin treatment (Landmark). In addition treatment 12 - a Twist treatment, fared well. Contrasting treatments 11 and 12 give an insight into the potential benefits of chlorothalonil (Bravo - Syngenta) (**www.syngenta.com**) when used in combination with Twist / Opus. Despite an increased chemical cost this resulted in an improvement in grain yield as well as gross margin.

Turning to T3 applications, comparison for treatments 1 and 2 indicate that the yield improvement is also associated with an improvement in specific weight.

The best specific weight resulted from treatments 6, 8 and 9 - all T3 applications of strobilurins + triazoles: Amistar (Syngenta) + Folicur (Bayer) or Swing Gold (BASF). This trend again supports previous years results whereby benefits accrue from the use of strobilurin + triazole fungicides as T3 sprays.

Despite the emergence of strobilurin resistant *Septoria* the case for the continued use of strobilurins is strong. The longer leaf area duration resulting from the use of these products will enhance yield and grain quality. It is however important that robust rates of both triazoles and strobilurins are used in Einstein disease control strategies. The value of epoxiconazole (Opus, BASF) cannot be underestimated, either alone or in combination with a strobilurin. It is important that strobilurins are not used without a complementary triazole partner and again robust rates should be used. The 2003 trial also gives credence to the use of chlorothalonil (Bravo, Syngenta) as a partner chemical - potentially valuable at both T1 and T2.

Landmark has consistently produced high yields over the years in Nickerson trials. Twist should also be considered as an alternative. The choice of product will depend on price but growers may wish to use the results outlined here to aid their decision making.

Disease Control Summary

- Disease control strategies should take into account the genetic disease resistance profile of Einstein as well as specific disease threats in any particular location or year.
- Whilst Einstein has a very good disease resistance profile “robust” rates of strobilurin and triazole fungicides should be applied. Despite the emergence of strobilurin resistant *Septoria tritici* strobilurins should still be applied to enhance yield and grain quality.
- Bearing in mind that only two applications of strobilurin chemistry can be made, Nickerson trials suggest that these would be best used at T2 and T3.
- In second and continuous wheat situations eyespot control measures should be used to complement Einstein’s inherently high resistance.
- Conservation of grain quality is of paramount importance and growers should use fungicide strategies to minimise the effect of *Fusarium*, and other diseases that will have detrimental effects (See page 27 - Maintenance of Grain Quality).