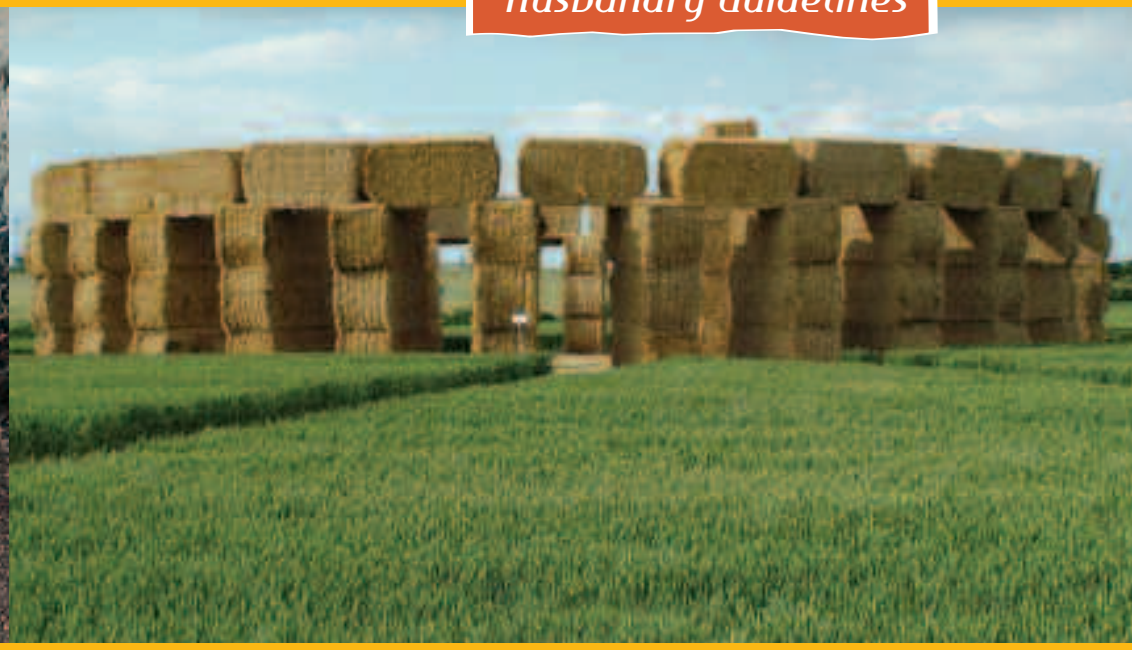
Husbandry Guidelines



NICKERSON

Nickerson (UK) Ltd,
Rothwell, Market Rasen, Lincolnshire, LN7 6DT
Tel: 01472 371471 Fax: 01472 371386
Web Site: www.nickerson.co.uk/solstice.html
E-mail: enquiries@nickerson.co.uk

SOLSTICE
Winter wheat

Solstice: Group 2 yield with Group 1 quality

- Good breadmaking quality
- Domestic and export markets
- Very stiff straw
- Good specific weight
- Easy to grow

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Solstice – An Established Variety

The milling and baking industry is conservative in its variety choice and the effect of this is apparent from an analysis of the current HGCA Recommended List.

There are 29 winter wheat varieties on the List. The average time on the List for the varieties in the different quality groups is:

Group 1	8.7 years
Group 2	4.2 years
Group 3	6.9 years
Group 4	2.3 years

The effect of this on farming businesses is that quality wheat growers tend to have varieties on their farms for more years than feed wheat growers. Avalon, Mercia, Hereward and to a lesser extent Malacca have served the industry for a considerable time in the high breadmaking quality market and it is now clear that Solstice will provide the industry with high quality breadmaking grain for the future.

Solstice was added to the HGCA Recommended List in 2002 so it has already been a recommended variety for four years. Solstice occupies almost 10% of the market for harvest 2006 and can realistically be called an established variety. The effect of this stability in the market place is that growers have become more confident and comfortable with the variety each year. Solstice is not difficult to grow, in fact it is easier than many other varieties, but nevertheless every variety can be nurtured into performing better when one becomes more familiar with it. By using the agronomic information produced from extensive trial work with Solstice, and by analysing the experiences gained by the variety being in the market for four seasons, it is possible to build an understanding of how best to farm Solstice to maximise both yield and grain quality.

Solstice – Pedigree and Selection Mechanism

Pedigree: Rialto x Vivant

Suitable parents are carefully selected for crossing

Solstice was bred by Advanta Seeds UK Ltd, from a cross between the winter wheat varieties Rialto and Vivant.

Both parents were successful and had different attributes. Rialto had good yield potential with breadmaking quality that was ideally suited to a number of end markets. Vivant, on the other hand was a feed wheat with excellent all round disease resistance and very good straw strength. The result was a variety with good yield potential, excellent grain quality for breadmaking and good agronomic features. The cross captured the best characteristics of both varieties, improved on some of them, and produced an excellent variety that will remain a mainstay quality wheat for many years.

Solstice – Seed Rate and Sowing Date

There is no doubt that across the country sowing dates have crept earlier into September. Whilst spreading work load, and the possibility of higher yields, are realistic targets, earlier sowing can sometimes cause problems and growers who ignore the potential risks can come to regret their initial enthusiasm.

One of the first facts learnt by those drilling early was that seed rates had to be reduced. Reductions of almost 50% have been made by some growers and this has overcome some of the problems associated with the increased lodging threat presented by longer straw length - a result of early sowing.

All varieties become more susceptible to disease when sown earlier. Whilst this can be overcome by using a more robust early season fungicide programme, it does incur additional costs and undermines some of the reasons for seeking possible higher financial returns from earlier sown crops. The agronomic answer is to sow early only those varieties that possess good disease resistance, particularly to some of the early season diseases.

A third factor to consider when sowing early is the development pattern of the variety that has been selected. Development pattern is not the same thing as vernalisation, which describes the period of low temperature that cereals require during the winter months to ensure that their growing points (primordia) switch from leaf production (vegetative) to ear production (reproductive). If a wheat plant is not vernalised by low temperature it will continue to produce leaves throughout the season and no ears will appear. Different varieties have different vernalisation requirements and in the case of Solstice the vernalisation requirement will be satisfied from all autumn sowings. (Latest safe sowing date is the end of January.)

In contrast, the development pattern of the variety dictates how early it may be sown without compromising performance. It is vital to understand that not all winter wheat varieties are suited to early sowing.

Solstice develops quite rapidly in relation to some other winter wheat varieties and it is for this reason that is not an ideal candidate for early sowing. Rapid developers move through their different development stages influenced primarily by daylength and temperature. Early sown wheat will initiate vulnerable ear primordia earlier than those sown later. These primordia are vulnerable to damage during early spring and hence sowing a rapid developing variety too early could be detrimental. Poor seed set seen as a result of this situation will increase ear diseases as well as ergot levels.

Solstice is not suited to very early sowing. It should be sown at the traditional time for winter wheat - from mid September to the end of October, when it will normally perform extremely well. Growers drilling after the end of October would probably benefit more by sowing Xi19.

Table 1. Target sowing dates for a range of varieties

	Late August	Early September	Mid September	Late September	Early October	Mid October	Late October
Exsept	●	●	●	●	●	●	
Claire		●	●	●	●	●	●
Alchemy		●	●	●	●	●	●
Solstice			●	●	●	●	●
Xi19						●	●

Solstice – Disease Resistance

The first question often asked of any variety by a grower is "how good is it against *Septoria*?" What is actually meant is how resistant is the variety to *Septoria tritici*, the disease that consistently causes the most damage to wheat crops. The resistance of Solstice is good, similar to that of both Hereward and Malacca and they do not usually cause growers any unmanageable problems.

Disease control programmes are invariably built around *Septoria* threat so growers can benefit from the experience gained from many previous varieties with "good" resistance. Solstice does not therefore demand a high input fungicide programme to protect it from *Septoria tritici*, but like virtually all varieties it does need a sensible fungicide programme to ensure that its genetic potential for both yield and quality are protected. Whilst all growers wish that plant breeders could produce a variety that routinely would only require one fungicide application during the course of the season it has realistically only been achieved in practise with Exsept. All other wheat varieties benefit from at least two applications, and usually three, to ensure that they deliver their full genetic potential. What does this mean in practise for Solstice?

The starting point for any review of a fungicide strategy for a variety is a close look at the levels of resistance the variety has for each of the main diseases.

Table 2. Disease ratings for Solstice

	Solstice	Hereward	Malacca
Mildew	4	6	7
Yellow Rust	9	5	9
Brown Rust	5	6	7
Septoria nodorum	6	7	7
Septoria tritici	5	5	5
Eyespot	4	5	4
Fusarium Ear Blight	6	5	6

Source: HGCA Recommended List 2006/7*

The situation with *Septoria tritici* has already been addressed, Solstice has good resistance so requires control to be targeted at T1 and T2 fungicide timings.

Resistance to yellow rust is excellent and with this high level of inherent resistance, routine fungicide applications targeting other diseases should more than suffice.

The resistance levels for both mildew and eyespot are slightly below average but before rushing to the chemical store, let us put these two diseases in perspective.

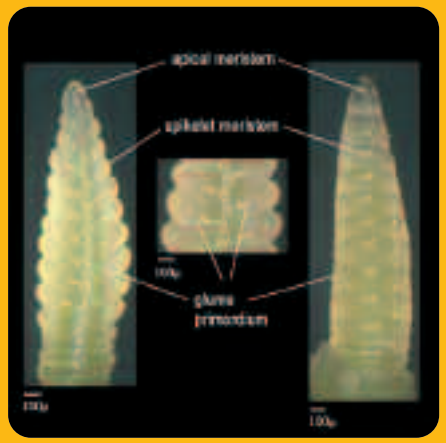
The resistance to mildew is similar to that of Claire and the new variety Brompton. Many growers with long memories can recall mildew being a damaging disease, but that is generally not the case today. Mildew is encouraged by thick crops and high humidity within crops and present management methods have almost eliminated these situations. Lower seed rates and later nitrogen timings in the spring have dramatically reduced crop densities, ensuring that the conditions which encourage mildew infection occur very rarely. If the disease does develop then most routine fungicide approaches will control it and if necessary, specific mildew treatments are also easily available.

Eyespot is a disease that needs to be monitored. Penetrating eyespot lesions, found near the base of tillers, can weaken tillers and reduce yield, and increase risk of lodging. However, all too often growers will tend to over react and treat dark smudges on the tiller bases when in fact it is not penetrating eyespot. Crops on lighter soils rarely get eyespot and even on medium and heavy soils damaging eyespot infections are less frequent than many growers believe. In the event of penetrating lesions being identified in a crop, specific fungicide treatments are available. The eyespot resistance of Solstice is similar to that of both Malacca and Xi19.

Growers are advised to keep the importance of the different diseases in perspective and make sure that they are not tempted to over react and spend more money than planned.

Brown rust tends to be a localised disease, parts of the country having outbreaks more frequently than other areas. A good example is the South East, particularly Kent, where later season attacks of brown rust are quite common. Again an easy solution is on hand: the T3 spray, which should be a routine application on any quality wheat crop, should contain a strobilurin component to ensure good brown rust control.

The final disease threat that any wheat grower should consider is *Fusarium* ear blight. Solstice has good resistance to this problem, better than Hereward and a resistance equal to that of Malacca.



Primordia development stages in wheat
(Image: Wheat - The Big Picture)

Having considered the individual disease resistances in relation to Solstice it is possible to develop a fungicide strategy to optimise the performance of the variety.

T0

This fungicide treatment timing was unheard of a few years ago but increasing disease pressure, particularly from *Septoria*, and earlier drilling dates has made it an important decision in some crops. Whilst Solstice should not be drilled too early, there may be some situations where a low level of early season mildew is noticed. If this is the case then consider mildew specific products like Fortress, Talius or Flexity as they will give good protection.
As Solstice is targeted for sowing dates from mid September it is unlikely that many crops will need, or benefit from, a T0 application.

T1

The ideal spray application at this timing is a reduced rate triazole with some chlorothalonil. This will give very good all round disease control. Virtually all triazoles give good mildew control so long as they hit the disease early. If a more robust approach is required then consider quinoxyfen (Fortress), cyprodinil (Unix), Talius or Flexity.
Solstice has a mildew rating similar to that of Claire so again it should be no problem to manage.

If the threat appears to be Eyespot then control is now available from a wider range of products such as cyprodinil (Unix), prothioconazole (Proline) or boscalid + epoxiconazole (Tracker).

T2

The most appropriate fungicide application at this stage is Opus plus chlorothalonil. This is an extremely reliable combination of products.
If any brown rust control is required at this stage then a low rate of either Amistar or Comet could be included.

T3

An essential treatment for all quality wheat crops. Use Swing Gold or Amistar plus a low rate of triazole. This application will control the ear diseases and give brown rust control if required.

Solstice – Agronomic Characteristics

Solstice has a ripening date similar to that of Hereward and has excellent resistance to sprouting, a valuable asset for any quality wheat variety. It has longer straw than either Hereward or Malacca but, and this is most important, it has excellent standing ability. Again, good straw strength is a very desirable attribute for any quality wheat variety.

Table 3. Agronomic Characteristics

	Solstice	Hereward	Malacca
Resistance to Lodging (no PGR)	8	8	7
Resistance to Lodging (with PGR)	9	9	8
Straw Height (cm) untreated	97	89	87
Ripening Date (+/- Claire)	+1	+1	-1
Sprouting Resistance	8	6	6

Source: HGCA Recommended List 2006/7*

Many growers like to use a small amount of plant growth regulator, usually a chlormequat type product, early in the season to give some insurance against possible lodging. Whilst it is difficult to justify agronomically in all circumstances it is also difficult to argue against the insurance principle in situations of high yield potential, particularly if the crop is targeted for quality wheat production. A split application, usually GS 30 followed by GS31, is ideal for Solstice but it should be stressed that it should not be considered to be a routine requirement.

Quality wheat production requires a carefully targeted fungicide programme

Solstice – Nitrogen and Sulphur Management

Nitrogen management

The RB209 nitrogen application guidelines suggest that the majority of wheat crops following break crops have N requirements of 100 to 200 kg/ha depending upon soil type. Crops grown for bread making end use do have higher nitrogen requirements than feed wheat as they must endeavour to produce both yield and grain protein and this is allowed for in the guidelines. RB209 suggests that any feed wheat recommendation can be increased by 40kg/ha N if one is growing a crop for breadmaking.

However with increasing scrutiny of N application levels it is imperative that growers can justify exactly why they have used certain input levels. Crops grown as successive cereals can go as high as 240kg/ha N (shallow soils over chalk). This therefore gives an upper level of 280kg/ha N for a Solstice crop in that situation. Remember that if you genuinely believe that the guidelines are too low for your situation then you can exceed them as long as you are confident that you have supporting evidence (preferably from locally generated trial data) to justify your decision.

A three-split N application is more reliable than a two-split approach. The target applications should be early March, mid April and just at flag leaf emergence. These roughly coincide with GS30, GS31/32 and GS 37.

The amount of N application in each of the three splits, using an example of a target of 240kg/ha N, would be

First application - up to 50kg/ha N. This would be reduced if the crop was in a fertile situation where too much early N would be detrimental. In some 2nd and 3rd wheat crops, where a possible threat from take-all exists, an increased first N application would be desirable to reduce the impact of any take-all infection that might occur.

Second application - this is the main N application and should be in the region of 100kg/ha N

Third application - this application delivers the remainder of the N required for maximum yield plus the N that will improve grain protein levels. In this example it would therefore be 50kg + 40kg giving a total of 90kg/ha N.

In simple terms this usually works out as a 25% / 50%/ 25% split with the additional 40kg/ha N added to the 3rd application.

A three-split N application is more reliable than a two-split approach (Image: Amazone Ltd)

A common approach to quality wheat nitrogen management is to add the extra 40 or 50 kg/ha N to the crop as a late foliar application at around GS69 to GS79. This is quite a reliable method of increasing grain protein levels, an important intake assessment when delivering grain to end users. Check with your buyer as to which, if any, of the approaches they favour as it would be a pity to adopt the wrong approach if they have a specific preference.

Sulphur Management

It is now well accepted that sulphur deficiency is present in many soils in the country and therefore sulphur applications are desirable or essential on most crops. Sulphur is an essential element in in the production of protein, so it is very important that crops designated for bread making are not sulphur deficient. Crops at highest risk from sulphur deficiency are those grown on lighter soils (chalks or sands) but deficiency is becoming so common that it appears most crops will benefit from a sulphur application.

The best approach is as follows

- apply 15 - 20 kg/ha S
  This equates to
  38 - 50 kg/ha SO_3
- apply the S preferably with the 1st N application or alternatively split between the 1st and 2nd applications.

Later applications of S may not be as effective in eliminating the consequences of S deficiency in crops.

Testing for breadmaking quality at Woolpit, Suffolk

Quality

When Solstice was added to the HGCA Recommended List in 2002 it was placed in Group 2 by NABIM (National Association of British and Irish Millers) who suggested that it was a variety that "exhibits breadmaking potential, but not suited to all grists".

The decision to place Solstice in Group 2 rather than in Group 1 was based on information generated from the 2000 harvest when the variety was at National List 2 stage of assessment. In a year of low proteins, a sample of Solstice did not perform as well as expected in some of the aspects of the breadmaking evaluations. Solstice has lived with this unfortunate problem ever since.

The majority of the industry now firmly believes that Solstice produces a Group 1 sample. In fact in 2004 TAG, in their review of wheat varieties for sowing in autumn 2005 said "Solstice could be considered a Group 1 in Group 2 clothing". Perhaps it would now be more relevant to summarise the variety as "a variety that has the quality of a Group 1 and the yield of a Group 2".

Growers strive for high % protein levels in wheat grain, and contracts are geared to higher quantity of protein , but that is not always what millers and bakers require. Baking companies require flour with good protein levels and also good quality protein. This quality is often referred to in the industry as functionality, meaning the flour has the ability to make good bread. Good functionality is provided by the breeder and by the agronomist and some of the best examples are found in Hereward and Solstice.

The NABIM Wheat Guide 2006 describes Solstice as "one of the best performing Group 2 varieties. The price achieved in the market place will tend to reflect the local demand for this variety, and, depending on performance, can command a price equivalent to Group 1 varieties".

The HGCA Survey of grain production, which analysed grain from the 2005 harvest and was published in November 2005, indicates the high quality of Solstice from that harvest (Table 4).

Table 4. Data from HGCA Grain Survey

	Specific Weight (kg/hl)	Hagberg Falling Number	% Protein
Solstice	**78.2**	**280**	**13.0**
Malacca	75.9	307	13.5
Hereward	79.5	272	14.1

Source: HGCA Recommended List 2006/7*

This survey demonstrates the excellent specific weight and HFN characteristics of Solstice. The survey also allows regional information to be considered in addition to the national average data presented in the above table. The information on % protein content for five regions is presented in Table 5.

Table 5. HGCA Survey (2005) - Solstice % protein levels on a regional basis

	% Protein
East	13.2
Midlands	13.0
South East	13.3
South West	13.0
North	12.4

Source: HGCA Recommended List 2006/7*

Quality wheat production has always been considered more difficult in the North and this survey data demonstrates one aspect of that difficulty. However the survey does not address functionality so it is actually only confirming that Solstice, like all quality wheat varieties, produces a range of % protein levels that are lower in the North.

The Arable Group (TAG) have for a number of years conducted trial comparisons of quality wheat varieties by growing them under nitrogen regimes typically used on farm for quality wheat production. These involve higher levels of nitrogen than would be used for feed wheat production and also more of that nitrogen being applied later in the season. The % protein levels from these trials for the past four seasons are presented in Table 6.

Table 6. % protein levels in TAG quality wheat trials (2002 - 2005)

	2002	2003	2004	2005
Solstice	**13.1**	**14.1**	**13.5**	**13.7**
Malacca	13.2	13.9	13.5	14.0
Hereward	13.6	14.2	13.8	14.5

Source: TAG

Notice that whilst the range in % protein between the three varieties was 0.8% in 2005 it was only 0.3% in both 2003 and 2004.

Seasonal variation in % protein levels can be marked but it must be remembered it is not the major determinant of suitability for breadmaking. It is also worth noting that % protein levels do have a relationship with yield. The lower protein levels of Solstice reflect the fact that it has higher yield potential than Malacca or Hereward.

Solstice - Yield

Solstice is clearly considered by many to be equivalent to a Group 1 variety in breadmaking quality, even though, for the reasons outlined earlier, it lies in the Group 2 category. It is therefore relevant to explore the yield potential of Solstice against that of other varieties that are competing for a Group 1 premium. The obvious comparisons are therefore with Malacca and Hereward.

Two independent sources of yield are used here to describe the relative performance of varieties. The HGCA Recommended List is funded by the levy collected from cereal growers. The trials are conducted with high levels of fungicide input, usually considerably more than most growers would use in a season, but they are designed to ensure disease exclusion. This does therefore give a true measure of the genetic potential of varieties. In contrast variety trials conducted by TAG favour "best farmer practise", using levels of fungicide input which can cost 50% less than the programmes adopted in the HGCA trials. The TAG fungicide inputs therefore reflect the types of fungicide input levels that would be found on the majority of farms.
Both approaches have their benefits and neither is wrong! What they do provide however is a useful insight into variety performance at different levels of input management.

HGCA Recommended List comparisons (Table 7) from 2001 to 2005 clearly demonstrate the yield superiority of Solstice over both Malacca and Hereward.

Table 7. Solstice outyields Malacca by 5.6% and Hereward by 8% over 5 years

	Solstice outyields Malacca	Solstice outyields Hereward
2001	4%	6%
2002	4%	7%
2003	7%	8%
2004	5%	7%
2005	8%	12%

Source: HGCA Recommended List 2006/7*

Across five years of trials the data indicates that Solstice outyields Malacca by 5.6% and Hereward by 8%.

National figures give an overview of variety performance but regional data can often be more revealing. The HGCA Recommended List for 2006/07 (Table 8) presents performance in three regions, North, East (dry) and West (wet).

Table 8. Yields (as % of controls in three regions)

	North	East	West
Solstice	**100**	**100**	**102**
Malacca	97	95	95
Hereward	90	93	93

Source: HGCA Recommended List 2006/7*

The yield advantage of Solstice over Malacca is greater in the West and East than in the North. This is also confirmed by information from The TAG Descriptive Lists in the 2004 and 2005 seasons from their three regions, Table 9.

Table 9. Yields (% of site mean yields) for 2004 and 2005

	2004			2005		
	North	East	South and West	North	East	South and West
Solstice	**94.9**	**97.2**	**97.6**	**97.5**	**98.0**	**95.4**
Malacca	91.3	90.6	90.5	91.6	90.9	86.2

Source: TAG

The yield advantage of Solstice over Malacca reached 9.2% in the South and West region in 2005 but was only 3.6% in the North region in 2004. This is an interesting and important point. It is very clear from HGCA Wheat Quality Survey data that growing quality wheat in the North of the country is a more challenging and less reliable enterprise than in the South, East or West of the country. As Solstice is also less suited to the North from a yield perspective then unless clear individual circumstances prevail it would be best grown in other parts of the country.

Solstice has excellent physical grain characteristics

It is also possible to compare the yield performances of Solstice and Malacca across different soil types in both the HGCA and TAG data bases. Data specifically from trials on either light or heavy soils that is available in the HGCA Recommended List 2006/07, shows that Solstice outyields Malacca by 4% on light soils, but by an even bigger margin (6%) on heavy soils.(Table 10).

Table 10. Yields (% of controls) on light and heavy soils

	Light	Heavy
Solstice	**100**	**101**
Malacca	96	95

Source: HGCA Recommended List 2006/7*

The soil type response is even more marked in the TAG trials, (Table 11).

Large scale trials throughout the UK

TAG breadmaking wheat trials, are subjected to higher levels of nitrogen input, which reflect the higher N levels used on farm when growers are striving for higher protein content. For the last four years they have included the variety Hereward for comparison. N application levels are clearly site dependent and across the TAG locations (up to five in some seasons) they were as high as 300kgN/ha in 2002, 290kgN/ha in 2003, 275kgN/ha in 2004 and 304kgN/ha in 2005. However within one season not all locations had that level on N input

The relative yields are presented in Table 12.

Table 11. Yields (% of site mean yields) on light and heavy soils

	Light	Heavy
Solstice	**93.0**	**97.2**
Malacca	91.7	90.3

Source: TAG

Table 12. Yields (% of site mean yields) in TAG Breadmaking wheat trials

	2002	2003	2004	2005
Solstice	**102**	**98**	**102**	**101**
Malacca	96	97	98	93
Hereward	95	93	95	91

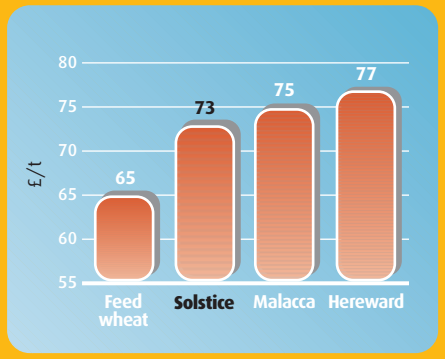
Source: TAG

When grown under normal management inputs for breadmaking wheat production Solstice outyielded Malacca by 1% to 8% and Hereward by 4.7% to 10%. In many respects these are the most useful yield results to consider as they reflect the responses of the varieties when grown as 'quality' wheats. Averaged across the four seasons of trials they indicate that under N regimes for breadmaking Solstice outyields Malacca by 5% and Hereward by 8%.

Solstice – Financial Returns

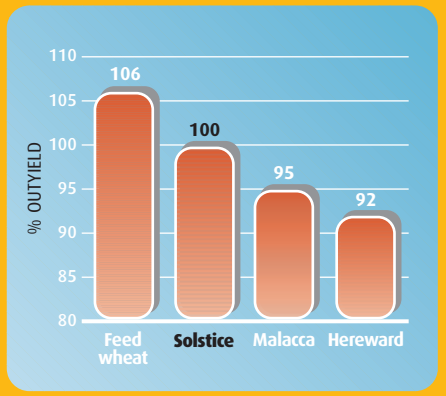
It is possible, using the relative yield performance values from the previous section and financial information from the 2005 season, to produce an overview of possible returns from growing Solstice in relation to other varieties.

Based on a feed wheat price of £65/tonne, the quality premium for Group 1 breadmaking wheat varied from about £14/t in August 2005 down to £8/t in January 2006. This was a typical premium for Malacca or Xi19 but the premium for Hereward was marginally higher. The Group 1 premium could be therefore be reasonably estimated at about £10/t with Hereward slightly higher at £12/t. Group 2 wheats would generally have been between £4 and £8/t lower than the Group 1 premium but Solstice, in its preferred position with the milling industry, would only have a £2/t discount against Group 1 wheats. This would therefore give the following assumptions;



Always obtain the best advice to maximise gross margins

The yield figures presented previously would suggest the following yield relationship between the three quality varieties (a feed wheat figure has been added for comparison.) The value of 6% yield improvement over the yield of Solstice is derived from the HGCA Recommended List 2006/07 where the highest yielding feed varieties (Glasgow and Alchemy) outyield Solstice by 6%.



Using these two sets of assumptions it is possible to calculate the financial returns from crops at different yield levels (Table 13). Variable costs have been estimated as £324/ha for breadmaking wheat production (allowing for extra N) and £299/ha for feed wheat production. These are the only costs deducted from the gross output figures derived from the above data.

Table 13. Margins (£/ha) based upon yield and grain price assumptions

	Solstice Yield (100%)	Malacca Yield (95%)	Hereward Yield (92%)	Feed Wheat Yield (106%)
(t/ha)	**8.0**	7.60	7.36	8.48
Price (£/t)	**73**	75	77	65
Margin (£/ha)	**260**	**246**	**243**	**252**
(t/ha)	**9.0**	8.55	8.28	9.54
Price (£/t)	**73**	75	77	65
Margin (£/ha)	**333**	**317**	**314**	**321**
(t/ha)	**10.0**	9.50	9.20	10.60
Price (£/t)	**73**	75	77	65
Margin (£/ha)	**406**	**389**	**384**	**390**

The excellent yield performance of Solstice combined with its ability to secure a premium higher than that of other Group 2 varieties, and only just below that of Group 1 varieties, ensures that it provides some of the best financial returns for growers. The margins per hectare presented in Table 13 demonstrate that a 9t/ha crop of Solstice, with a premium of £8/t gives a margin that is £12/ha better than a feed wheat yielding 6% more. In fact the financial returns from Solstice are consistently better than those of Malacca, Hereward or the higher yielding feed wheat at all yield levels.

In the past, growers have not had the opportunity to grow for quality and also have the ability to capture higher yields at the same time. Quality has always been associated with lower yield potential. Solstice has broken that relationship and presents opportunities to secure better financial returns across a wide range of soil types and geographic locations.

The full HGCA Recommended List Database can be consulted at **www.hgca.com**