

ADAS/CSL RESEARCH AND DEVELOPMENT

Winter wheat: a survey of diseases

- 1996 -

A survey to determine the incidence and severity of winter wheat diseases
in England and Wales

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Abstract

In 1996, 368 randomly selected fields of winter wheat were sampled and assessed for the incidence and severity of disease in a survey undertaken jointly by CSL and ADAS. The fields were identified using a farm list stratified by the area of wheat grown in each region. Samples were taken in July when crops were at the milky-ripe growth stage (GS 73-75). Mildew, at 0.3%, and *Septoria tritici*, at 2.1% area of the second leaf, were at higher levels than in 1995 (0.2 and 0.85 respectively). *Septoria tritici* was again the most severe foliar disease. *Septoria nodorum* was present at only trace levels on leaf two and the ears. Mildew affected 0.3% area of leaf 2 and was twice as severe as in 1995. In no region did the level of mildew exceed 0.5% of the area of leaf 2. Brown rust was recorded only at trace levels and yellow rust was absent from any sample. This was the first time since the survey began that yellow rust has not been recorded.

Levels of eyespot, at 4.8% stems affected with moderate and severe symptoms, was lower than in 1995 (9.1%). Sharp eyespot levels showed a similar fall with only 2.5% stems affected by moderate and severe symptoms compared with 4.6% stems in 1995. Fusarium diseases affected 26.3% of stem bases and 0.8% of ears, levels similar to 1995, itself the lowest year on record for ear disease. Take-all was present in 13% of crops and patches recorded in 4% of crops. Symptoms of BYDV were recorded in 8% of crops compared with 26% in 1995.

Riband was the most commonly sampled cultivar at 26% of crops, a position it held for the sixth successive year, followed by Brigadier (23%) and Hereward (10%). Brigadier carried the highest levels of mildew (0.4% area of leaf 2) and Hussar the highest levels of *S. tritici* (5.8% area of leaf 2). Levels of eyespot were lowest following grass and sharp eyespot following wheat. Moderate and severe levels of fusarium stem base diseases were highest following pulse. Take-all levels were lowest following oilseed rape or potatoes, but most severe following set-aside. Monoculture had little effect on levels of either eyespot or sharp eyespot, but internodal fusarium levels tended to be highest following a second or third wheat and take-all most severe in a third wheat. Mildew and *S. tritici* were most severe in crops drilled in mid-October. Eyespot, sharp eyespot and fusarium were most severe in crops drilled before October and take-all least in crops drilled after the end of October.

Fungicide sprays were used on 98% of the crops sampled, with 84% receiving two or more treatments. The most popular regime, applied to 31% of crops, was a two-spray programme with the first spray applied at GS 31 followed by a second spray at GS 39. Twenty four per

cent of crops received a three-spray programme. Crops received on average 2.2 fungicide spray applications, the same as 1995. Seventy nine per cent of crops were grown from certified seed with 95% of crops sown with fungicide treated seed. Insecticide products were applied on 312 occasions, 715 in the autumn, 11% from the spring to GS 37 and 18% from GS 38 to 75.

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Introduction

Plant pathologists at the Central Science Laboratory (CSL) and ADAS have conducted annual disease surveys of winter wheat crops since 1970 with the exception of 1983 and 1984. There is a continuing need to monitor crops in order to detect changes in the disease spectrum. These changes may be caused by the introduction of new cultivars with differing disease susceptibilities and by changes in husbandry practice and pesticide use.

This report contains the results of the survey of foliar, stem base and ear diseases of winter wheat for the 1995-1996 growing season.

The results, where appropriate, are compared with those from previous winter wheat surveys.

Methods

The 1996 survey of leaf, ear and stem-base diseases of winter wheat was carried out in late June to July when crops were at the early- to medium-milk growth stage (GS 73-75). A list of farm addresses was sent to ADAS staff responsible for collecting samples in the nine regional areas (Table 1). The distribution of addresses between regions was proportional to the regional area of winter wheat grown, except for Wales where additional addresses were requested in order to obtain meaningful figures for the area. The addresses were selected at random from the returns of the June 1995 MAFF agricultural census. A list of the counties within each region is given in Table 1.

Table 1. Key to regions referred to in the survey

Code	Region	County	ADAS Centre (previous centre in brackets)
NO(N)	North	Cleveland, Cumbria, Northumberland, Durham, N. Yorks (Northallerton), Tyne & Wear	High Mowthorpe (Newcastle)
NO(L)	North	Humberside, N. Yorks (Harrogate), S. Yorks, W. Yorks (Leeds)	High Mowthorpe (Leeds)
M&W	West Mids & East Mids	Cheshire, Derbyshire, Notts, Leics, Hereford & Worcester, Gr Manchester, Lancs., Merseyside, Shropshire, Staffordshire, Warwickshire, West Midlands.	Wolverhampton
EAST	East	Bedfordshire, Cambridgeshire Northants, Essex, Hertfordshire, Lincolnshire, Norfolk, Suffolk, Gr London (Eastern)	Boxworth, Kirton, Terrington, Arthur Rickwood (Cambridge)
SE(W)	South-East	Kent, Surrey, E. Sussex W. Sussex, Gr London (SE)	Arthur Rickwood (Wye)
SE(R)	South-East	Berkshire, Buckinghamshire Hampshire, Oxfordshire	Bridgets (Reading)
SW(B)	South-West	Avon, Dorset, Gloucestershire, Somerset, Wiltshire	Starcross (Bristol)
SW(S)	South-West	Cornwall, Devon	Starcross (Starcross)
Wales	Wales	All Welsh Counties	Pwllpeiran (Cardiff, Trawsgoed)

NOTE:- All figures for regional areas in the tables are means of the total number of samples assessed from those areas. All national figures are the mean of a stratified sample, within which the number of samples from each region is proportional to the area of winter wheat grown in the region.

Farms were visited by ADAS consultants at GS 73-75 when the dry matter of the grain is accumulating most rapidly. On each farm, a field was selected at random and a sample of 50 fertile tillers was collected at random from a diagonal traverse of the field. The samples were packed in polythene bags and dispatched immediately to CSL for assessment accompanied by a completed questionnaire giving agronomic details such as cultivar, sowing date and previous cropping, as well as details of all pesticide applications.

Sub-samples of 25 tillers were assessed on arrival at CSL. Leaf diseases were recorded as the percentage area of the flag and second leaves affected using standard area keys (Anon., 1976). Green leaf area and insect damage were similarly recorded.

Eyespot and sharp eyespot

Eyespot and sharp eyespot were recorded as the percentage of tillers affected in three categories:- slight, moderate and severe, after the method of Scott & Hollins (1974) below:

<i>slight</i>	lesions girdling less than half the circumference of the stem.
<i>moderate</i>	lesions girdling more than half the circumference of the stem.
<i>severe</i>	lesions girdling more than half the circumference of the stem, and tissue softened so that lodging would readily occur.

$$\text{Eyespot index} = \frac{\text{No. stems } \textit{slight} + 2(\text{No. stems } \textit{moderate}) + 3(\text{No. stems } \textit{severe})}{\text{Total number of stems in sample}} \times \frac{100}{3}$$

Take-all

Take-all was assessed in the field at the time of sampling using the following key:

<i>Category</i>	<i>Description</i>
0	no take-all seen
1	a scatter of plants showing premature ripening
2	occasional small patches (less than 5m across) showing premature ripening and/or stunting - less than 1% of field affected
3	many small or few large areas affected - 1% to 10% of field affected
4	many large areas affected - more than 10% of field area affected

(Examine the roots of a sample of plants showing symptoms to confirm the presence of blackening normally associated with take-all.)

Barley yellow dwarf virus

Barley yellow dwarf virus (BYDV) was assessed in the field at the time of sampling using the following key:

0	no BYDV seen
1	a scatter of plants showing BYDV symptoms (leaves, chlorotic with a bronze red extending downwards from their tips).
2	occasional small patches (less than 5m across) showing BYDV symptoms.
3	many small or a few large areas affected (1% to 10% of field area affected).
4	many large areas affected (more than 10% of field area affected).

Fusarium

The percentage of stems with slight, moderate and severe fusarium symptoms on the nodes and internodes was also recorded using the key shown below:

<i>Score</i>	<i>Nodes</i>	<i>Internodes</i>
00	no infection.	no infection.
01	"	slight streaks on stem base.
02	"	general browning on stem base.
03	"	stem base rotted - likely to cause lodging.
10	staining on one or more nodes but not covering the whole circumference of the stem.	no infection.
11	"	slight streaks on stem base.
12	"	general browning on stem base.
13	"	stem base rotted - likely to cause lodging.
20	staining on one or more nodes covering whole circumference of the stem.	no infection.
21	"	slight streaks on stem base.
22	"	general browning on stem base.
23	"	stem base rotted - likely to cause lodging.
30	one or more nodes rotted - likely to cause lodging.	no infection.
31	"	slight streaks on stem base.
32	"	general browning on stem base.
33	"	stem base rotted - likely to cause lodging.

Disease categories:

nodal: slight = 10,11,12,13 moderate = 20,21,22,23 severe = 30,31,32,33
internodal: slight = 01,11,21,31 moderate = 02,12,22,32 severe = 03,13,23,33

Combined categories (nodal + internodal):

slight = 01,10,11 moderate = 02,12,20,21,22 severe = 03,13,23,30,31,32,33

Fungicides

Tables providing information on fungicide use list the types of fungicides and their principal times of application. Throughout these tables, fungicides are grouped according to their mode of action using the following convention:

MBC - any product or mixture containing one or more of the following:
benomyl, carbendazim

DMI - any product or mixture containing one or more of the following:
cyproconazole, epoxiconazole, difenoconazole, fenbuconazole,
flusilazole, flutriafol, prochloraz, propiconazole, tebuconazole,
triadimefon, triadimenol

Morpholine - any product or mixture containing one or more of the following:
fenpropidin, fenpropimorph, tridemorph

Results and discussion

Selected data for the key diseases are presented in the following histograms, together with data from the previous four years to set the current results in context. The term disease incidence means either the percentage of crops, plants or stems affected; whereas disease severity refers to the percentage area of leaf or stems covered by disease symptoms. Data have not been subjected to statistical analysis.

A total of 441 samples were received and processed at CSL. The size of the stratified sample used to calculate national means was 368 (Table 2).

Table 2. Distribution of winter wheat in England and Wales and survey sample

Region	Area	ADAS Centre	% of area (1996 census)	No. of samples processed
NO(N)	North	High Mowthorpe	6.9	31
NO(L)	North	High Mowthorpe	10.7	46
M & W	E & W	Mids. Rosemaund	15.5	68
EAST	East	Boxworth, Terrington, Arthur Rickwood	42.8	162
SE(W)	S. East	Athur Rickwood	5.5	24
SE(R)	S. East	Bridgets	8.3	36
SW(B)	S. West	Starcross	8.3	37
SW(S)	S. West	Starcross	1.3	6
WALES	Wales	Trawsgoed	0.7	31
Total			100	441

The samples processed were taken from 4222 ha of winter wheat.

Severity of foliar and stem disease

Only two diseases, mildew, *Septoria tritici* were present at levels at more than 0.1% area leaf 2 affected (Fig. 1). *S. nodorum*, brown rust and *Didymella* were present at only trace levels and yellow rust was not recorded. Total foliar disease was higher than in the previous two years.

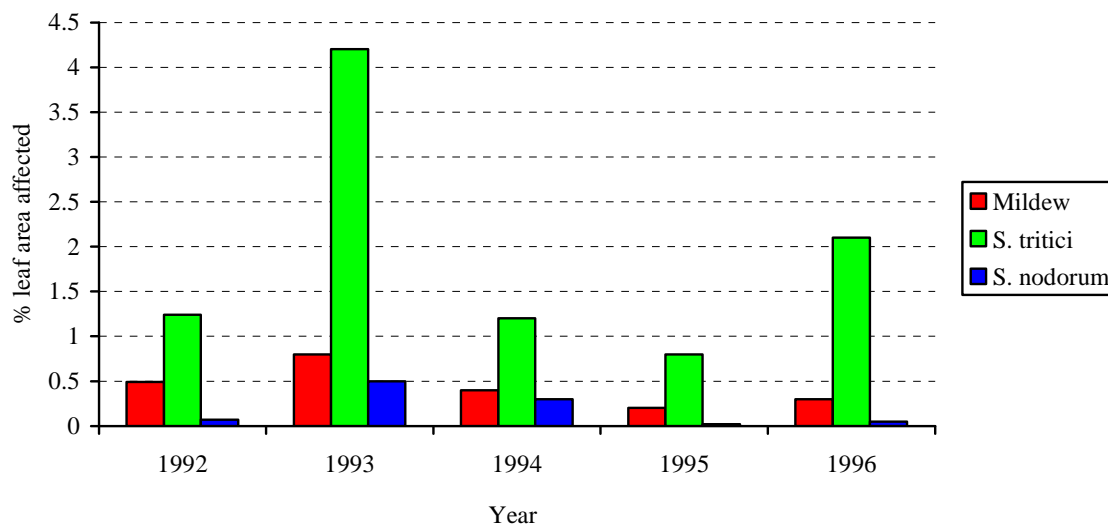


Fig. 1 National foliar disease levels (mean % area leaf 2 affected)

Eyespot was present in 82% of crops, but moderate and severe infections were low (Fig. 2). Levels were broadly similar to those recorded in the previous two years.

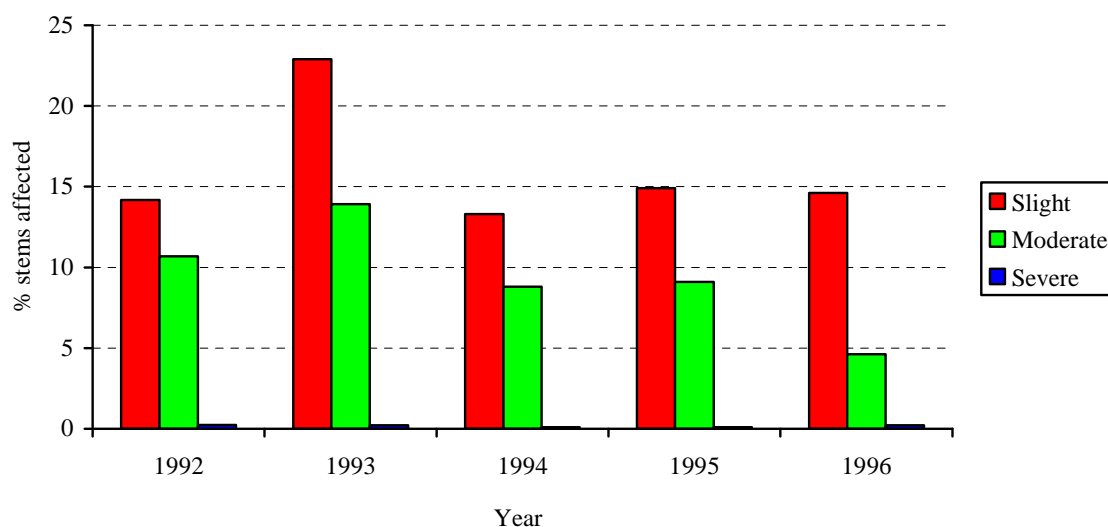


Fig. 2 National levels of eyespot (mean % stems affected)

Sharp eyespot was present in 61% of crops but moderate and severe levels were low (Fig. 3). Levels of sharp eyespot in the slight category have shown a steady increase since 1993, but levels of moderate plus severe symptoms were lower than in 1995.

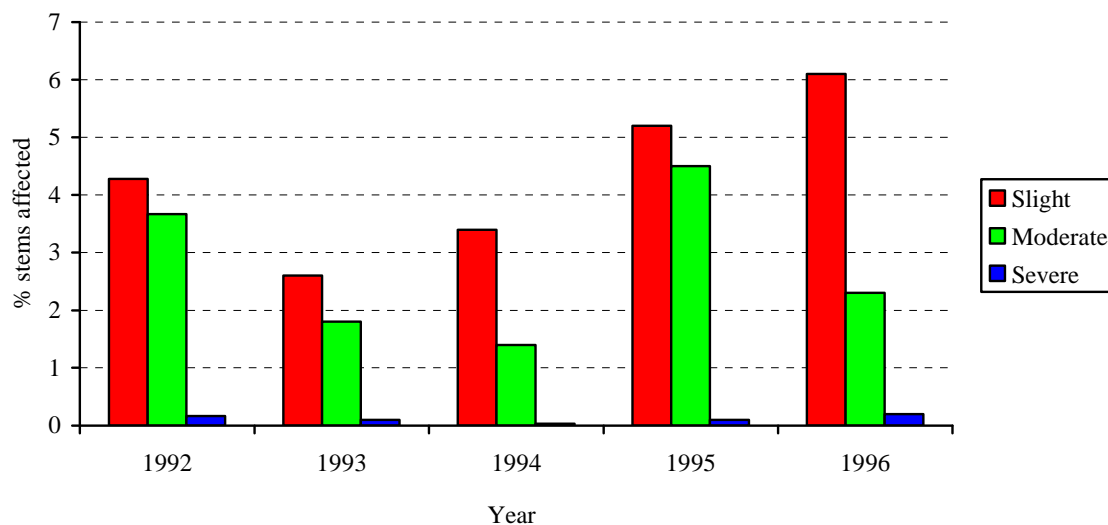


Fig. 3 National levels of sharp eyespot (mean % stems affected)

Stem base fusarium levels affected 26% of stems. Levels of fusarium ear blight and glume spot were low and similar to 1995, but were lower than early years (Fig. 4).

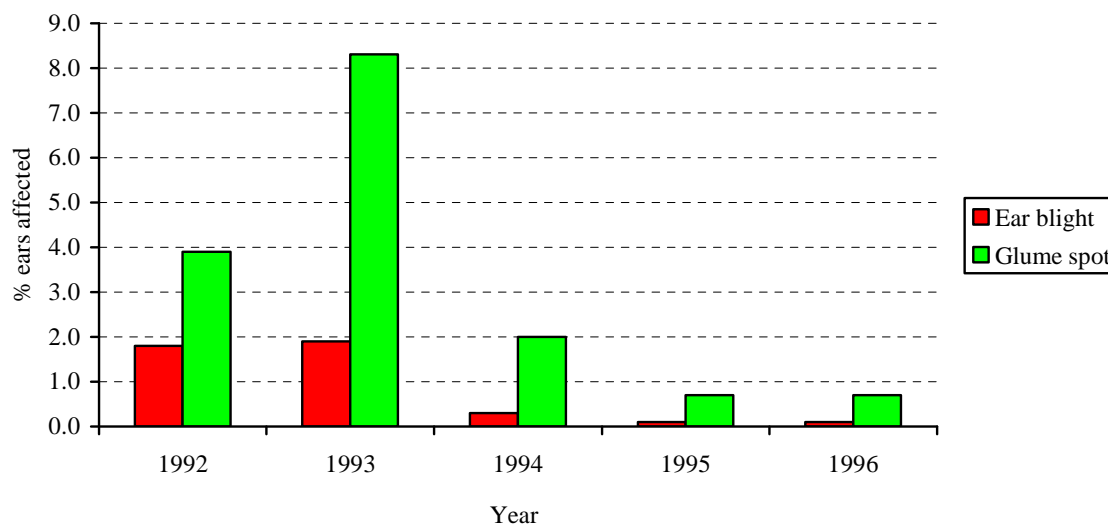


Fig. 4 National levels of fusarium on the ears (% ears affected)

The incidence and severity of take-all was lower than in 1995, with only 4% of crops showing patches of the disease compared with 6% in 1995 (Fig 5).

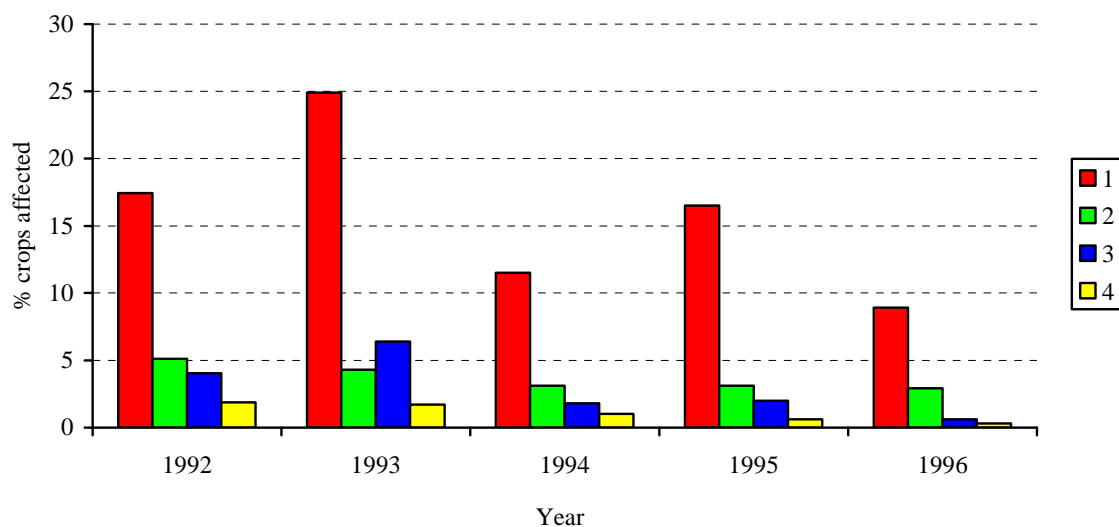


Fig. 5 National levels of take-all (% crops in each category)

The incidence and severity of BYDV was lower than in the previous four years, with only 1% of crops showing patches (Fig. 6).

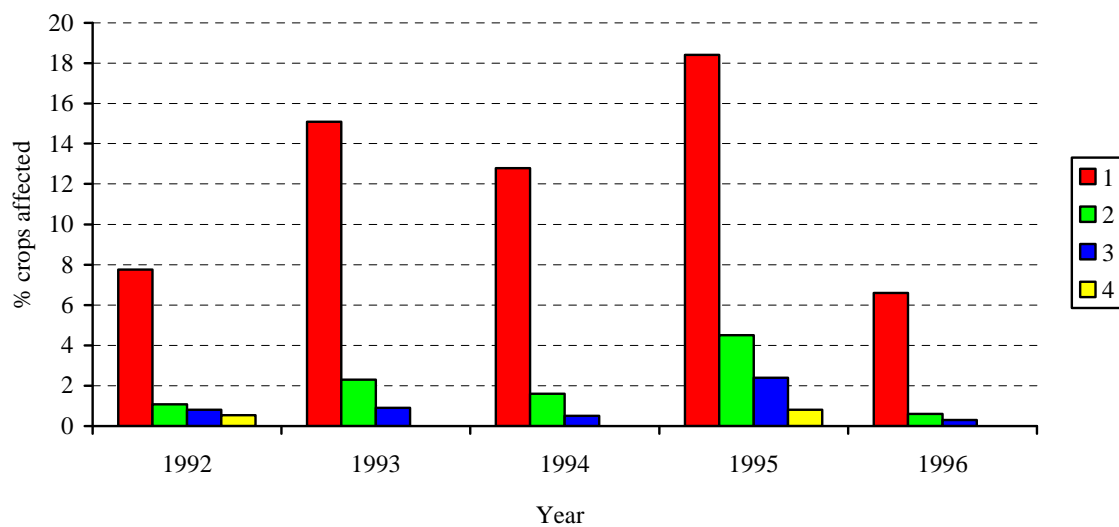


Fig. 6 National levels of BYDV (% crops in each category)

Regional disease incidence

The dominant disease was *S. tritici*, with the highest levels occurring in the South West (Starcross). The highest levels of *S. tritici* were also recorded in the North (Leeds). Mildew was recorded at less than 0.5% and *S. nodorum* only at 0.1% in South East (Wye). Yellow rust was not recorded in any region and brown rust only at trace levels in the East and South East (Reading) (Fig. 7).

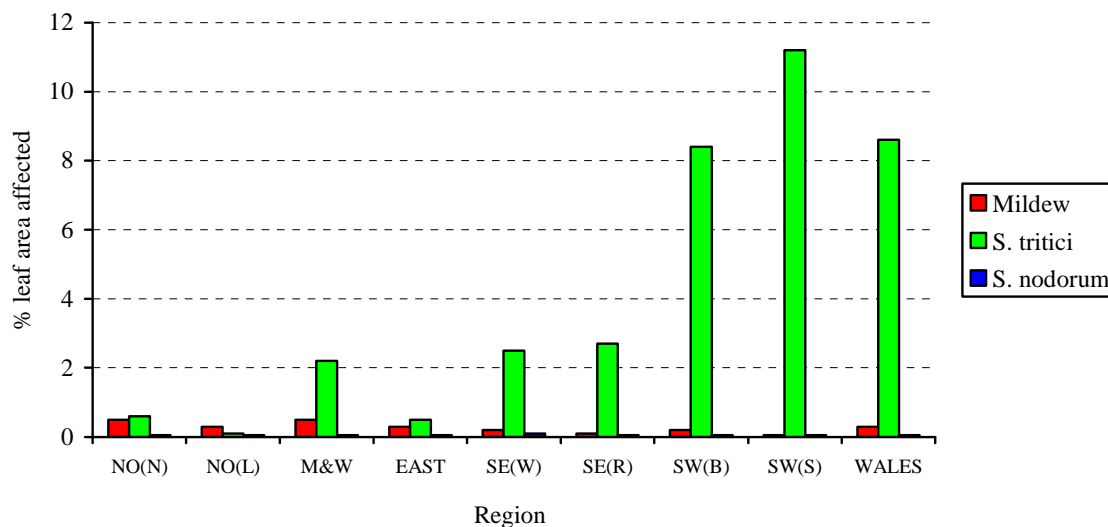


Fig. 7 Regional foliar diseases levels (mean % area leaf 2)

Eyespot was more common on samples from the North, but the disease was more severe in samples from the South West (Starcross) and Midlands & Western (Fig. 8).

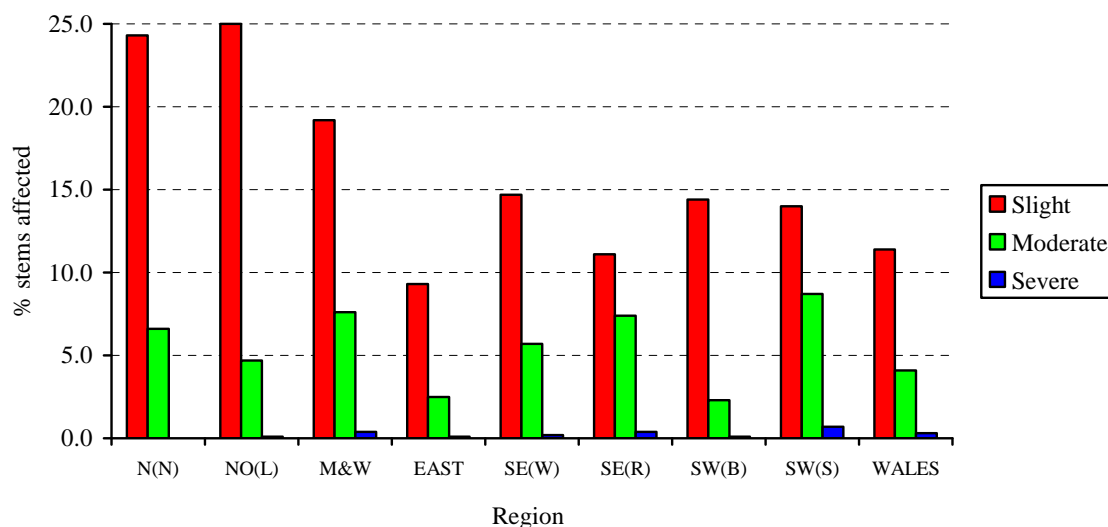


Fig. 8 Regional eyespot levels (mean % stems affected)

Sharp eyespot was most common in the South West (Starcross), with the lowest levels being recorded in samples from the East (Fig. 9).

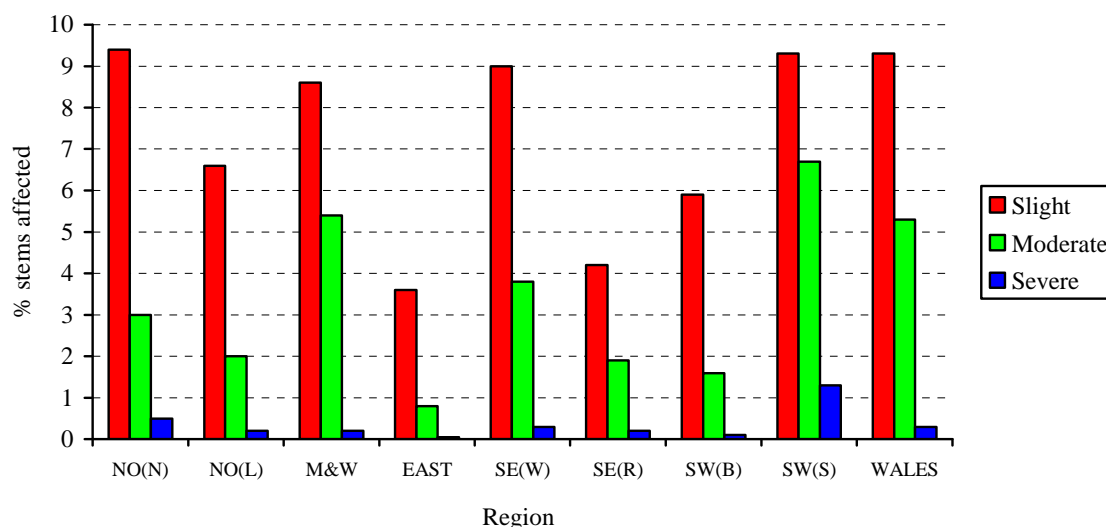


Fig. 9 Regional levels of sharp eyespot (mean % stems affected)

Effect of cultivar in disease severity

Mildew levels were low on all the main cultivars, with the highest level of 0.4% leaf area being recorded on Brigadier. *S. tritici* was the dominant disease. The highest level was recorded on Hussar at 5.8% and the lowest level on Hereward at 0.7%. *S. nodorum* was present at only trace levels. Yellow and brown rust were absent from all the main cultivars (Fig. 10).

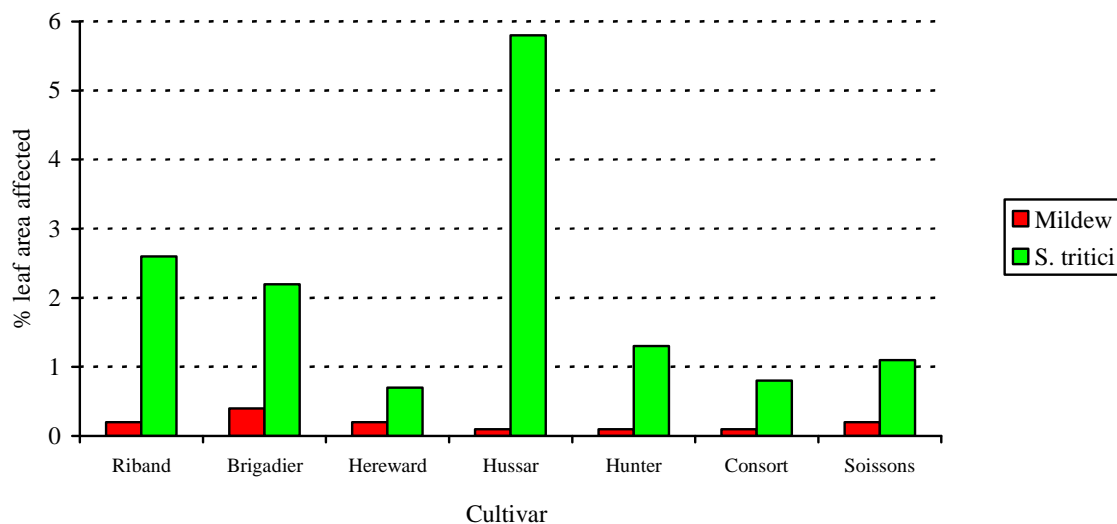


Fig. 10 Foliar diseases on main cultivars (mean % area leaf 2)

Fungicide use

The majority of crops were sprayed at GS 31 (77%) followed by GS 39 (70%) and at GS 59 onwards (44%) (Fig. 11). This 1993 there has been a slight decline in the proportion of crops sprayed from GS 59 with a concomitant increase in crops sprayed both at GS31 and GS 39.

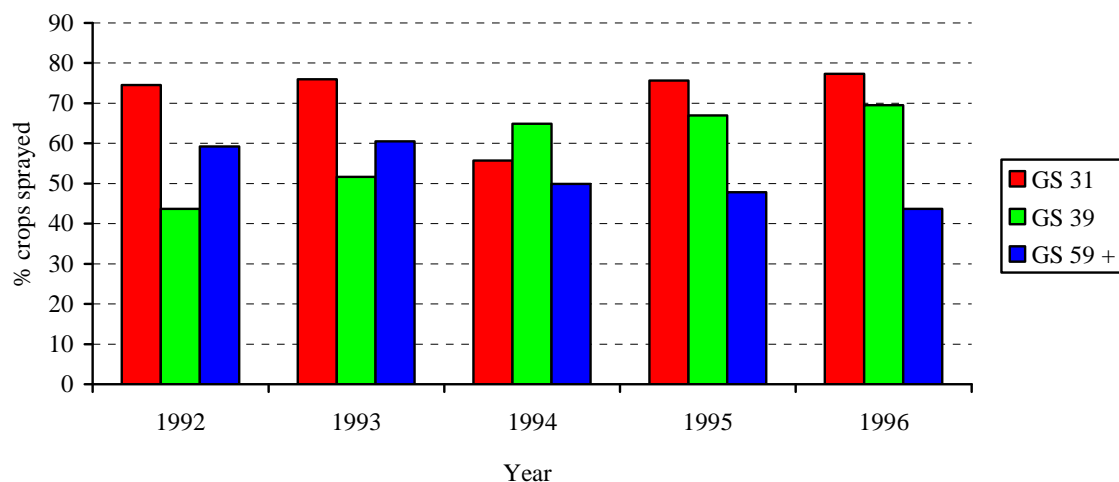
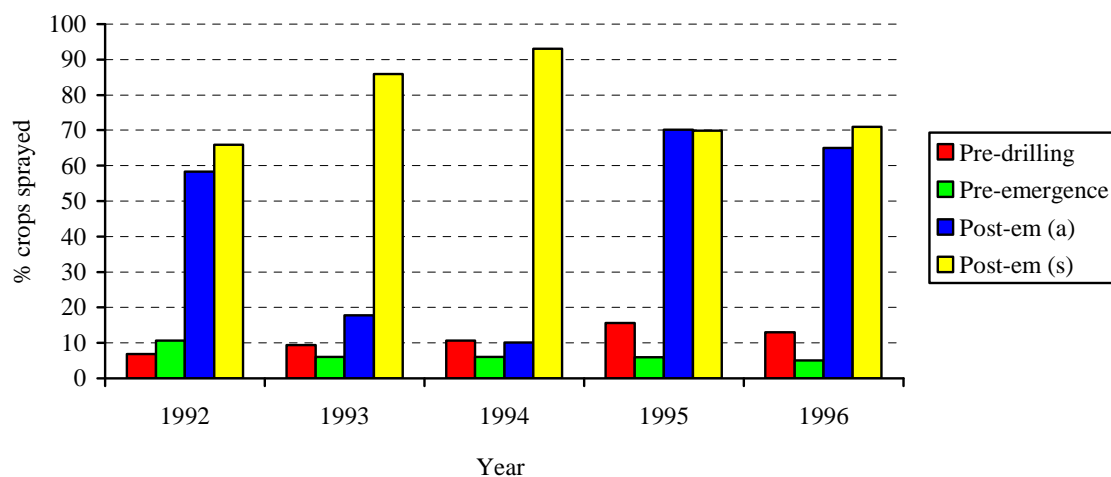


Fig. 11 Per cent crops sprayed at GS 31, GS 39 and at GS 59 onwards

Herbicide use

The majority of crops received a herbicide in the spring (73%) (Fig. 12). There has been a dramatic increase in the number of crops sprayed with a post-emergence herbicide in the autumn since 1994, a reflection of the wet autumns of 1992 and 1993.



[Post em(a) post-emergence in the autumn, Post-em (s) - post-emergence in the spring]

Fig. 12 Timing of herbicide applications (% crops sprayed)

Insecticide use

The majority of crops received an aphicide in the autumn for the control of aphids (Fig. 13). There was a slight increase in sprays applied in the autumn and a dramatic fall in crops treated in the summer, a consequence of low aphid populations on the ears.

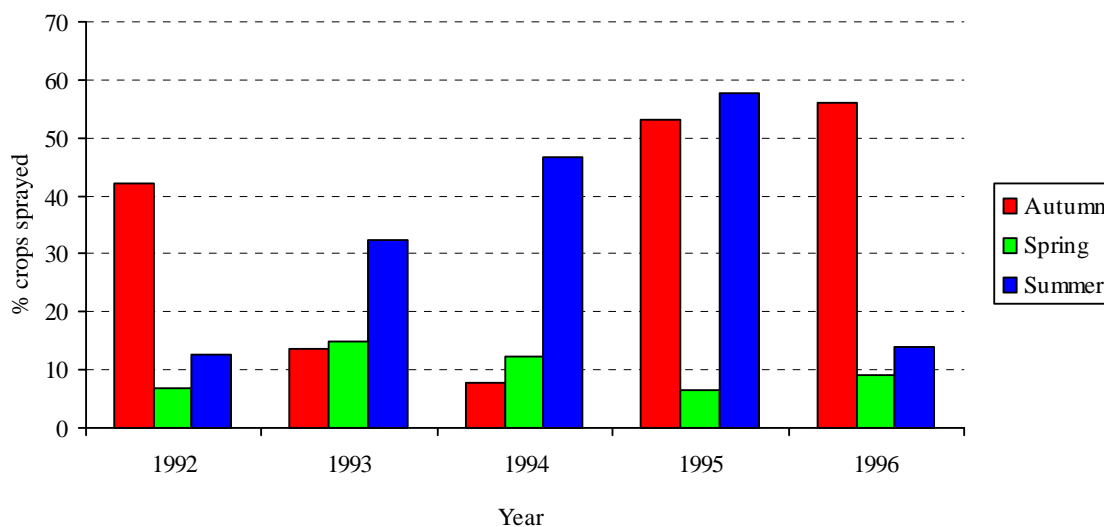


Fig. 13 Percentage crops treated with an insecticide in autumn, spring or summer

There were slightly fewer patches of BYDV infected plants in crops which had received an application of pyrethroids in the autumn (Fig. 14).

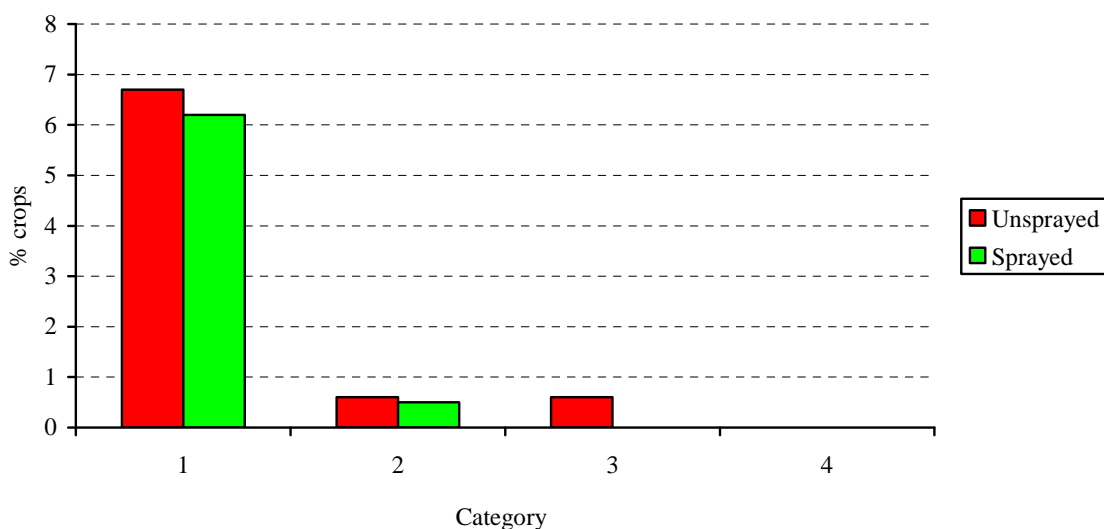


Fig. 14 Effect of pyrethroids applied in the autumn on BYDV

Drilling dates

The majority of crops were drilled before October (36%). Only 15% were drilled after the middle of October (Fig. 15). This was a similar distribution to 1995.

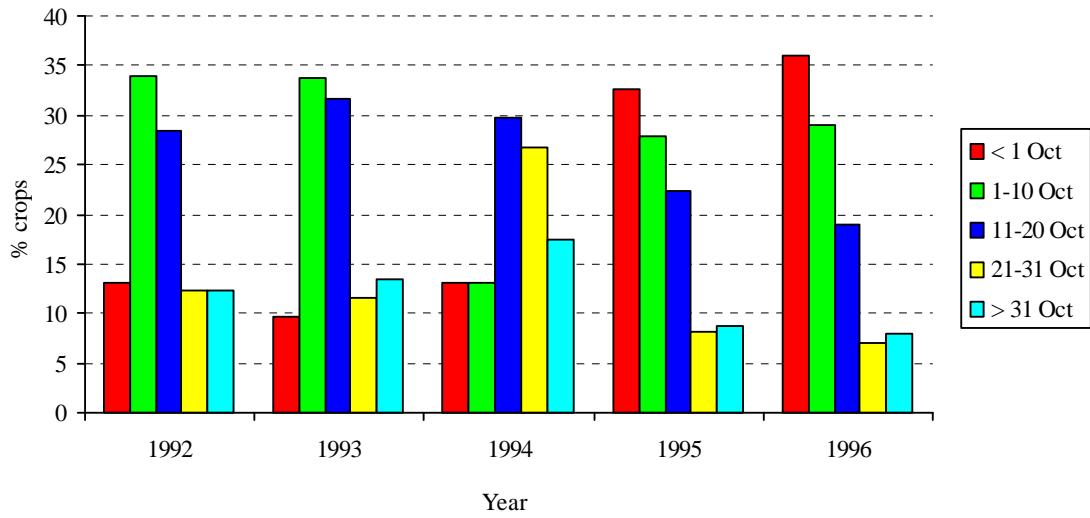


Fig. 15 Drilling dates for crops

Conclusions

1. Foliar diseases were slightly more severe than in 1995. *Septoria tritici* was the most common foliar disease for the sixth consecutive year, occurring in 64% of crops and affecting on average 2.1% of the second leaf. The disease was most damaging in the South West (Starcross) where 11.2% of leaf 2 was affected.
2. *S. nodorum* was at its lowest level for 6 years. It was seen in only 11% of crop samples, affecting on average less than 0.1% of leaf 2. The highest level was recorded in the South East (Wye) where 0.1% of leaf 2 was affected.
3. Mildew was recorded in 53% of crops, affecting 0.3% of leaf 2. The highest levels were recorded in the North (Newcastle) and Midland and Western.
4. Brown rust was recorded in only 0.5% of crops, affecting less than 0.1% of leaf 2. It was only recorded in samples from the East and South East (Reading).
5. Yellow rust was not recorded in any sample for the first time in the history of the survey.
6. Eyespot was recorded in 82% of samples. Both incidence and severity levels were lower than those recorded in 1995, with 4.8% of stem bases having moderate and severe symptoms. Levels were highest in the South West (Starcross).
7. Sharp eyespot was recorded in 61% of samples compared to 69% in 1995. Moderate and severe symptoms totalled 2.5% stems affected. The disease was most severe in the South West (Starcross).
8. Stem base fusarium symptoms were recorded in over 89% of samples, the severity of symptoms was low with moderate nodal symptoms affecting only 2.4% of stems and moderate internodal symptoms 1.1%. Severe symptoms of brown foot rot were rare. Only 1.9% of samples were affected by ear blight, a similar incidence to that recorded in 1995.
9. Take-all was seen in only 13% of crops, fewer than in 1995. Only 4% of crops had take-all patches, fewer than in any previous year. Take-all patches were most common in the South-East (Wye).

10. BYDV was less prevalent than in 1995, being recorded in 8% of crops. Patches of plants with BYDV symptoms were seen in 1% of crops compared to 8% in the previous year.
11. Riband maintained its position as the most popular cultivar for the sixth consecutive year, accounting for 26% of the stratified sample. The second most widely grown cultivar was Brigadier at 23% crops, up 2% from 1995.
12. The highest level of *S. tritici* was recorded on Hussar. The lowest level was recorded on Hereward. Mildew was most severe on Brigadier, which also had the highest level of *S. nodorum*.
13. Thirty nine per cent of the crops in the stratified survey followed a cereal crop with 32% of fields having been in wheat in the previous season. Levels of eyespot were lower in crops following grass. Levels of sharp eyespot were lower in crops following wheat. Take-all was least severe in crops following pulse or potatoes.
14. Eyespot was less severe in third or subsequent wheat crops than in first or second wheat crops. Take-all was most severe in second wheat crops.
15. Good autumn drilling conditions resulted in a high proportion of early-drilled crops, with 36% being sown during September and 77% being drilled before mid-October. *S. tritici* was less severe in crops drilled after the end of October, as were eyespot and take-all.
16. Fungicides were used on 98% of crops, with 84% receiving two or more sprays usually applied at GS 31 followed by further sprays at either GS 39 or GS 59 or both. The most popular, applied to 31% of crops, was a two-spray programme with the first spray applied at GS 31 followed by a second spray at GS 39. Nineteen per cent of crops received a three-spray programme consisting of a first spray at GS 31, followed by a further two sprays at or around GS 39 and GS 59. Crops sampled in the survey received, on average, 2.2 fungicide sprays each.
17. MBCs were applied to 8.3% of crops treated with a fungicide at or around the first node stage (GS 31). They were usually applied with a fungicide from another group either tank-mixed or as part of a commercial product. DMIs were applied to 94% of crops treated with a fungicide at GS 31 and morpholines to 37%.

18. Fungicides in the DMI group were used on almost all the crops (98%) sprayed at or around flag leaf emergence (GS 39). Fifty eight per cent of crops were treated with a morpholine at this growth stage and 3% with an MBC.
19. DMI fungicides were applied to 94% of crops which received a fungicide treatment from ear emergence onwards (>GS 59). Morpholines were applied to 46% of crops treated during this period, and MBC's to 27%.
20. Seventy nine per cent of crops in the survey were grown from certified seed and 20% from farm-saved seed, with 95% of all crops grown from fungicide treated seed. The most popular product was Sibutol (bitertanol plus fuberidazole).
21. Pre-drilling herbicides, mainly glyphosate, were applied to 13% of the fields included in the stratified survey, and pre-emergence herbicides were used on 5% of crops. Tri-allate and trifluralin were the most commonly used active ingredients applied pre-emergence.
22. Sixty-five per cent of crops received a post-emergence herbicide spray in the autumn, a similar proportion to 1995. Most of the herbicide treatments were composed of two or more active ingredients with isoproturon being the most frequently used, occurring in 85% of all autumn herbicide applications.
23. Seventy-one per cent of crops were treated with a herbicide from January onwards. This was the first herbicide treatment for 26% of crops, compared to 23% in 1995 and 81% in 1993. Fluroxypyr was the most frequently used active ingredient, being included in 36% of the herbicide treatments applied after 1st January. Metsulfuron-methyl was included in 28% of sprays applied at this time, fenoxaprop-P-ethyl in 10%, isoproturon in 19%, bromoxynil + ioxynil in 10% and mecoprop or mecoprop-P in 11%.
24. Growth regulators were applied to 79% of crops. The market was dominated by products containing chlormequat at 77% of the crops generally applied between GS 29 and GS 35
25. Sixty-seven per cent of crops received an insecticide treatment. Fifty per cent of crops received a single insecticide spray, 15% received two sprays and 2% three or more sprays. Seventy two per cent of insecticide applications were made in the autumn, primarily to control the aphid vectors of BYDV. There was a slightly reduced level of BYDV symptoms in crops receiving an autumn insecticide.

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Acknowledgements

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