J.K. Dowdson

PHYSIOLOGIC RACE SURVEY

(CEREAL PATHOGENS)

1974 Annual Report

PHYSIOLOGIC RACE SURVEY (CEREAL PATHOGENS)

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Contents

The paper on yellow rust of wheat includes the identification of samples from the UK and Eire section of the International Survey of Factors of Virulence of Puccinia striiformis (formerly the European Yellow Rust Trials Project)

THE PHYSIOLOGIC RACE SURVEY OF CEREAL PATHOGENS

The Survey was commenced in 1967 following an unexpected epidemic of wheat yellow rust (Puccinia striiformis) that caused severe losses in the recently introduced but widely grown winter wheat cultivar Rothwell Perdix. This cultivar had previously been resistant to yellow rust and the epidemic was caused by a new physiologic race carrying previously unknown virulence genes.

OBJECTIVES

The principal objective is the detection of new virulence genes and gene combinations in the UK population of cereal pathogens.
Secondary objectives include the monitoring of virulence gene and gene combination frequencies, evaluating the compatibility of virulence genes with one another and measuring the effect of varietal changes on the pathogen population.

OPERATION

Each spring a list of cereal varieties from which disease samples are required is circulated to about 100 pathologists and agronomists in the UK. Samples are collected from field crops and cultivar trials (not at random) and sent by post to the three testing centres:

NIAB for yellow rust of wheat and barley
PBI for mildew of wheat and barley
WPBS for brown rust of wheat and barley, mildew and crown rust of oats and Rhynchosporium of barley.

About 1000 samples are received each year from which isolates are made for inoculation onto seedlings or leaf segments of standard differential cultivars under controlled environment conditions. At a later date these are assessed for resistance or susceptibility and the virulence factors in each isolate are determined.

RESULTS

An Annual Report (such as this) is prepared each May and about 150 copies are sent to NIAB personnel, MAFF advisors, BAPB members, ARC breeding Institutes, Universities and Colleges, and overseas Institutes. The Annual Report contains papers from the three testing centres about the nine diseases surveyed giving details of the isolates identified. In the case of some diseases, physiologic race and virulence gene frequencies in the pathogen population are also given.

UTILIZATION OF RESULTS

The information provided by the Survey is utilised in four ways:

(a) Isolates containing new virulence genes are used by the NIAB to evaluate the resistance of cereal cultivars under trial. There are many cases of cultivars not being recommended by the NIAB owing to their susceptibility to new isolates of cereal pathogens found by the Survey.

(b) These isolates are also distributed to plant breeders who use them to select new lines with adequate forms of resistance. Many breeding programmes have been terminated because of the presence in the pathogen population of isolates found by the Survey to contain previously unknown virulence genes.

(c) Advisory pathologists use the results of the Survey to supplement NIAB advice in recommending to farmers those cultivar combinations that minimise the risk of widespread heavy infections.

(d) Isolates are regularly supplied to universities and colleges to illustrate to students the principles of resistance in host-pathogen systems and for use in research projects in areas relating to the techniques of the Survey.

Much of the benefit resulting from (a) and (b) is not realised by farmers and consumers as these people never see the extremely susceptible lines and cultivars that are rejected by breeders or not recommended by the NIAB.

FUTURE DEVELOPMENTS

In order to realise its objectives the Survey actively supports research projects at the three testing centres. All the projects are aimed at improving our knowledge of the pathogen population and at present include the use of mobile nurseries, quantitative seedling infection measurements, detection of adult plant resistance genes, fungicide insensitivity and new analytical techniques.

SUMMARIES

A short summary of each paper is given.

Yellow rust of wheat

No new virulences or physiologic races were identified in 1974. The frequency of race 1,2,3 (41 E 136) has increased since 1973; that for race 2,3,4,6 (108 E 173) has decreased and that for 2,3,4 (104 E 137) is similar to 1973. The frequency of virulence factor 1 (ability to overcome Yr 1) has increased due to the selecting influence of Maris Templar, whereas the frequency of virulence factor 4 (ability to overcome Yr 3b + Yr 4b) has decreased owing to the lack of a widely grown variety positively selecting for this virulence in the pathogen population. A series of field experiments has been initiated in which spores of potential field variants (isolates from fields or crops with a substantially greater than expected yellow rust infection) are inoculated onto tussocks of NIAB Recommended List and Main Trial wheat varieties grown in polythene tunnels and later assessed for infection levels. Results have been obtained with 6 potential field variants collected in 1973 and a selection of the 33 potential variants collected in 1974 are being multiplied for inoculation in 1975. Some of the selected isolates are from the crops of Maris Huntsman in Northern and Yorks and Lancs ADAS Regions that were severely infected with race 1,2,3 (41 E 136) in July 1974.

Yellow rust of barley

Isolates virulent on Mazurka were found for the first time in 1974, both in the form of race 24MV (virulent on Mazurka) and race 24MVV (virulent on Mazurka and Varunda). Race 24 (frequency 78% in 1974) is still the dominant race with isolates of this race originating from many varieties including Astrix, Julia and Universe.

Brown rust of barley

Race 1 was the only race identified from the 1974 isolates. This race is virulent on Gold but avirulent on all the other differential varieties.

Brown rust of wheat

Two races were identified from the 1974 samples, WBR-74-2 and WBR-74-7 which differ only in their reaction to Maris Fundin. No indication of races specifically adapted to Maris Huntsman or Maris Nimrod has been found in seedling quantitative tests.

Crown rust of oats

Five races were identified from the 1974 samples, all of which had previously been identified. These were races 251, 265, 272, 275 and 296.

Mildew of barley

There was a considerable increase in Lyallpur-virulence in 1974, particularly on Mazurka. The increase was associated with an increased frequency of Akka (Monte Cristo)-virulence. Vada-virulence was obtained from a wide range of varieties, reflecting the increased deployment of this resistance, although it is still not regularly associated with severe infections. Infection of Julia showed a marked increase, which may be associated with an increase in combined Mlg and Vada virulence. Virulence for Mlg also increased on Lyallpur, Sultan and Vada-derivitives: generally this reflects an increase in the number of samples from varieties which have these resistances combined with Mlg. High frequency of Mlg virulence is usually associated with a high frequency of Mla-virulence; this was true for the samples from Vada-derivitives, but not for those from Lyallpur and Sultan-derivitives. Lyallpur and Sultan-virulence showed a consistently poor association in pathogen populations both on Lyallpur and on Sultan-derivitives. Ethirimol insensitivity occurred generally, although it did not show an obvious relationship with poor performance of the fungicide.

Mildew of wheat

Although many samples were received from varieties carrying various gene combinations from the Triticum timopheevi (CI 12633) source, none have so far given a consistently virulent reaction on Maris Huntsman or Maris Templar.

Mildew of oats

Three races were identified from the 1974 samples. These were race 2 (avirulent on 9065Cn and Cc4146), race 4 (virulent on Mostyn) and race 5 (virulent on 9065Cn and Cc4146).

Rhynchosporium of barley

The majority of the samples received in 1974 were identified as race UK1 with the remainder being UK 2.

YELLOW RUST OF WHEAT

BY R H PRIESTLEY, JULIA SMITH & P BYFORD

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1. Samples received

347 samples were received at the NIAB during 1974 of which 128 have been identified. Sampling was not carried out on a random basis and therefore the frequency of physiologic races and specific virulences shown by the Survey may not reflect that in the UK as a whole.

2. Identification of samples

Samples have been identified using the new UK list of differential cultivars (Table 1). Each cultivar contains a different resistance factor (numbered 1 to 10) and races are referred to by their corresponding virulence factors (eg 1,2,6). This system enables virulence factor frequencies to be determined in addition to the physiologic race frequencies. The race nomenclature of the 1,2,6 type supersedes the World and European nomenclature system (eg 104 E 137) although both nomenclatures have been used in this report. It is not envisaged that either of these systems should be used by advisors; they may find it more convenient to include variety names (eg the Maris Beacon race or the Maris Huntsman variant).

Table 1: UK list of differential cultivars for wheat yellow rust

Resistance factor	Cultivar	R gene loci
1	Chinese 166	Yr 1
2	Heine VII	Yr 2
3	Vilmorin 23	Yr 3a + 4a
4	Hybrid 46	Yr 3b + 4b
5	T spelta album	Yr 5
6	Heine Kolben	Yr 6
7	Lee 1	Yr 7
8	Compair	Yr 8
9	Moro	Yr PI 178383
10	Iíe besel 47/51	?

3. Physiologic race frequency

(a) 1974 samples

No new races were identified; those identified are shown (Table 2).

Table 2: Physiologic race frequencies in 1974

Physiologic race		No of samples	Frequency
0	(32 E 32)	2	2
2	(32 E 128)	1	1
3,4	(104 E 9)	1	1
1,2,3	(41 E 136)	55	43
2,3,4	(104 E 137)	14	11
3,4,6	(108 E 9)	5	4
1,2,3,6	(45 E 140)	5	4
1,2,3,7	(43 E 138)	4	3
2,3,4,6	(108 E 173)	17	13
race mixtures		24	19
total		128	101

(b) comparison with previous years

A comparison with the frequency of major races for the previous five years is shown (Table 3). Major races are those that have achieved a frequency of 10% or more in any single year.

Table 3: Physiologic race frequencies, 1969 - 1974

Physiologic race		1969	1970	1971	1972	1973	1974
3,4	(104 E 9)	53	20	5	0	0	1
1,2,3	(41 E 136)	7	2	21	19	23	43
1,2,6	(37 E 132)	13	7	1	0	1	0
2,3,4	(104 E 137)	9	38	57	42	13	11
3,4,6	(108 E 9)	4	22	2	1	1	4
2,3,4,6	(108 E 173)	0	0	0	20	27	13
minor races		5	9	5	3	6	10
mixtures		9	2	10	15	31	19
total		100	100	101	100	102	101

The frequency of race 1,2,3 (41 E 136) has increased (23% in 1973; 43% in 1974) to make it the most frequently identified race in 1974. The frequency of race 2,3,4,6 (108 E 173) has decreased (27% in 1973; 13% in 1974). The frequency of race mixture has also decreased (31% in 1973; 19% in 1974) from its highest ever frequency in 1973. The frequencies of the other races are similar to those measured in 1973.

4. Virulence factor frequency

The frequencies of the 10 virulence factors matching the resistance factors in the differential cultivars (Table 1) are shown (Table 4) in comparison with data calculated for previous years. Owing to the recent change to a new list of differential cultivars, virulence frequency data for factors 5,8,9 and 10 is unavailable for previous years.

Table 4: Virulence factor frequencies, 1969 - 1974

Virulence factor	1969	1970	1971	1972	1973	1974
1	24	9	24	23	40	62
2	34	57	91	99	97	91
3	85	93	97	99	98	97
4	72	82	71	76	59	35
5	.	.	.	.	.	0
6	19	30	3	26	47	26
7	.	.	0	2	1	4
8	.	.	.	.	.	0
9	.	.	.	.	.	0
10	.	.	.	.	.	0

The frequency of virulence factors 2 and 3 was very high in 1974 and has been so for at least four years. This indicates that almost all isolates have the ability to overcome resistance derived from Yr 2, Yr 3a and Yr 4a (see Table 1). The frequency of virulence factor 1 has increased over the last two years (23% in 1972; 62% in 1974), whereas that for factor 4 has decreased over the same period (76% in 1972; 35% in 1974). The population of isolates therefore seems to be gaining the ability to overcome resistance derived from Yr 1 at the expense of losing the ability to overcome resistance derived from Yr 4. By comparing the observed and expected frequencies of all possible combinations of virulence factors 1, 2, 3, 4 and 6 it has been demonstrated that the virulence combination (1,4) occurs less frequently than expected in every year from 1966 - 1974. This strongly suggests a disaffinity between these two

factors, so that if a commercial cultivar in widespread use is selecting for one of these two individual factors the frequency of the selected factor will increase whereas the frequency of the non-selected factor will decrease as a result of the same selecting pressure.

5. Variety - race interactions

The 128 isolates identified in 1974 were collected from 22 wheat varieties, the number of samples from each variety - race combination is shown (Table 5).

Table 5: Physiologic race - variety analysis (1974 samples)

Variety	Physiologic race virulence combinations										
	0	2	34	123	234	346	1236	1237	2346	mixtures	total
M Huntsman	0	0	0	15	5	0	1	0	2	4	27
M Templar	0	0	0	12	0	0	1	2	1	2	18
Sappo	0	0	0	7	1	0	1	0	0	2	11
M Freeman	1	0	0	0	0	1	0	0	8	0	10
M Ranger	0	0	0	0	0	3	0	0	1	5	9
Cappelle	1	0	0	2	1	0	1	0	1	2	8
Chalk	0	0	0	3	1	0	0	0	0	2	6
M Nimrod	0	1	0	3	1	0	0	0	0	1	6
Clement	0	0	0	1	1	0	0	1	0	2	5
Champlein	0	0	0	2	0	1	0	0	0	1	4
Mega	0	0	1	2	1	0	0	0	0	0	4
M Widgeon	0	0	0	3	0	0	0	0	0	0	3
M Dove	0	0	0	0	0	0	0	0	3	0	3
Benoist 10483	0	0	0	0	0	0	0	1	0	1	2
Joss Cambier	0	0	0	0	2	0	0	0	0	0	2
Pride	0	0	0	2	0	0	0	0	0	0	2
M Fundin	0	0	0	1	0	0	0	0	1	0	2
Kolibri	0	0	0	0	1	0	0	0	0	1	2
Eclipse	0	0	0	0	0	0	0	0	0	1	1
Val	0	0	0	1	0	0	0	0	0	0	1
Reso	0	0	0	0	0	0	1	0	0	0	1
Winnetou	0	0	0	1	0	0	0	0	0	0	1
Totals	2	1	1	55	14	5	5	4	17	24	128

The number of samples from most varieties was so small that only a few conclusions could be drawn. Nearly 50% of the samples of race 1,2,3 (41E136) were collected from the varieties M Huntsman and M Templar and the number of samples of race 2,3,4,6 (108E173) from M Freeman was greater than expected.

Because of the rapidity of race and variety changes it is difficult to accumulate data to analyse interactions between individual varieties and races. This problem can to some extent be overcome by analysing the interactions between varieties and the individual virulence factors (see section 6).

6. Variety - virulence factor interactions

During the period 1966-74 (inclusive), there are 12 wheat varieties from which at least 30 samples of yellow rust have been identified. The number of samples varies considerably from variety to variety with a maximum of 198 samples from Joss Cambier identified during this period.

Taking each variety in turn, the frequencies of the individual virulence factors 1 to 10 (Table 1) were determined from the physiologic race nomenclatures (eg 1,2,3) of all the isolates identified from that variety (Table 6). The frequencies for virulences 0, 1, 2, 3, 4, 6, are calculated from data collected over the period 1966-1974; that for virulence 7 from data for 1971-1974 and that for virulences 5, 8, 9 and 10 from data for 1974 only. Although the frequencies of virulences 5, 7, 8, 9 and 10 were not monitored in some years, recent unpublished experimental data from isolates collected in those years indicate that these virulences were absent at that time.

Frequencies of 90% or more have been marked in Table 6. This is an arbitrary level that, when exceeded, indicates the variety is selecting strongly within the pathogen population for isolates with the given virulence factor (eg, Rothwell Perdix is selecting for virulence factors 1, 2 and 6) owing to the probable presence of the matching resistance factor in its genotype (eg. Rothwell Perdix genotype probably includes resistance at the Yr 1, Yr 2 and Yr 6 loci). The number of varieties selecting for the individual virulences differs; no varieties appear to be selecting for factors 5, 7, 8, 9 and 10 whereas all except one are selecting for factor 3. The recent increase in the frequency of virulence factor 1 (Table 4) is probably due to the selecting influence of M Templar as the only other variety selecting for this virulence (Rothwell Perdix) was virtually absent during the period 1972-1974. Similarly the decrease in the frequency of virulence factor 4 in recent years (Table 4) is probably due to the fact that only M Ranger of the three varieties selecting

Table 6: Variety - virulence factor frequencies

Variety	virulence factor										
	0	1	2	3	4	5	6	7	8	9	10
Cama	0	69	83	100	29	0	14	0	0	0	0
Champlein	0	12	37	98	82	0	6	0	0	0	0
Cappelle	1	22	92	96	28	0	7	0	0	0	0
Joss Cambier	0	17	95	94	81	0	7	1	0	0	0
M Nimrod	0	24	98	97	73	0	8	0	0	0	0
M Huntsman	0	51	94	94	40	0	6	0	0	0	0
Hybrid 46	0	0	1	100	100	0	1	0	0	0	0
M Beacon	0	5	82	100	95	0	4	0	0	0	0
M Ranger	0	8	70	98	91	0	54	0	0	0	0
M Templar	0	98	92	97	5	0	5	2	0	0	0
R Perdix	0	100	100	0	0	0	100	0	0	0	0
Cardinal	0	0	97	100	100	0	65	0	0	0	0

for this virulence has been widespread during this period. None of the presently widespread varieties appear to be selecting for virulence factor 6 although the frequency of this factor in isolates from M Ranger and Cardinal is of an intermediate value.

7. Geographical distribution of physiologic races

An analysis of the geographical distribution of 1386 isolates of yellow rust identified during the period 1967 - 1973 has indicated that the observed frequency of races in the 8 ADAS regions of England and Wales, Scotland, N Ireland and Eire differs significantly from the expected random distribution. Most of the difference is attributable to

race 1,2,3 (41 E 136) occurring less than expected in SE England

1,2,3 (41 E 136)	more	Scotland
2,3,4 (104 E 137)	less	Scotland

The cause of these deviations is being investigated; it is possibly due to a different spectrum of varieties being grown in the difference regions and/or differences in environmental sensitivity between races.

8. Field variants of yellow rust

A field variant of yellow rust is an isolate that cannot be distinguished easily from a standard race using seedling techniques but appears to be very different under field conditions. Variants adapted to Joss Cambier and Maris Bilbo are thought to be the cause of severe infections seen in recent years in crops or plots of these varieties.

In order to increase our knowledge of the effect of field variants on commercial wheat varieties, a system is being developed whereby isolates from fields or plots with a greater than expected yellow rust infection are multiplied and inoculated in the following year onto tussocks of about 20 important wheat varieties grown in polythene tunnels. One isolate is used per tunnel and the tunnels prevent cross contamination, reduce the risk of naturally occurring yellow rust confounding the results and ensure a favourable environment for the development of yellow rust. The varieties are scored on a number of occasions between GS 10 and 11.1 and isolates can be compared for differences in specific virulence on adult wheat plants. It is hoped that comparisons of results from different years will be possible in order to investigate the possibility of the gradual erosion of adult plant resistance of some varieties.

The scheme was first operated in 1974 using isolates collected in 1973 and some standard race isolates.

(a) 1973 isolates

Of the 233 samples received in 1973, 6 were from fields or plots with a greater than expected infection:

isolate 73/58	from M Huntsman	in N Region	with 10% leaf area infected
73/95	M Nimrod	SW	5-25%
73/108	M Huntsman	EM	10% (foci)
73/143	M Nimrod	Scotland	25%
73/225	Mega	Scotland	10% (foci)
* 73/A7	M Bilbo	NIAB	25%

* from plots at NIAB inoculated with isolate PBI72/23 supplied by Dr Johnson

These isolates along with 2 control isolates of race 104 E 137 and 1 of each of races 41 E 136 and 108 E 173 were inoculated onto tussocks of 17 winter wheat varieties in 10 polythene tunnels.

The tussocks were scored on 4 occasions using the International Scale and the Scale values were converted to PA (percent attack = percent leaf area infected) and thence to $\log_{10}$PA (Table 7). The conversion to a logarithmic scale was used because Zadoks had previously shown that P. striiformis increases logarithmically during an epidemic.

Table 7: Conversion of International Scale assessments to $\log_{10}$PA

International Scale value	PA	$\log_{10}$PA
10	100	+2.00
9	75	+1.88
8	50	+1.70
7	25	+1.40
6	10	+1.00
5	5	+0.70
4	1	0.00
3	0.1	-1.00
2	0.01	-2.00
1	0.001	-3.00
0	less than 0.001	-4.00

A mean $\log_{10}$PA value was calculated for each of the 170 isolate-variety combinations and for each variety in turn the maximum $\log_{10}$PA value for any isolate and the mean $\log_{10}$PA value for all isolates was determined (Table 8).

Table 8: Maximum and mean $\log_{10}$PA values for 17 winter wheat varieties

Variety	Maximum (mean) $\log_{10}$PA value
M Bilbo	+1.76 (+0.85)
Joss Cambier	+1.70 (+1.26)
M Ranger	+1.44 (-0.30)
M Templar	+1.40 (-0.18)
M Freeman	+1.23 (-0.53)
M Nimrod	+1.17 (+0.20)
Mega	+0.81 (-1.22)
M Widgeon	+0.59 (-0.30)
Reso	+0.58 (-0.33)
M Huntsman	+0.28 (-0.41)
Val	+0.18 (-1.59)
Champlein	-0.08 (+1.55)
West Desprez	-0.42 (-1.64)
Flinor	-0.47 (-1.90)
Atou	-0.64 (-1.88)
Bouquet	-0.68 (-1.60)
M Fundin	-1.13 (-1.86)

The varieties are arranged in descending order of their susceptibility as measured by the maximum $\log_{10}$PA value to any isolate.

Similar measurements will be made in 1975 on potential field variants collected in 1974, and also in subsequent years. Data will be compared to determine if any erosion of adult plant resistance is occurring in commercial wheat varieties due to increases in specific virulence in the pathogen population.

(b) 1974 isolates

Of the 310 samples received, 33 were classified as potential field variants being from fields or plots with a greater than expected infection. The region and varieties from which the samples were collected are shown (Table 9).

Table 9: Potential field variants collected in 1974

Variety	Region SW	SE	WM	EM	E	YL	N	WAL	SC	Total
H Huntsman	2	0	0	3	0	7	6	1	0	19
Chalk	2	0	0	2	4	0	0	0	0	8
Mega	0	0	0	0	0	0	3	0	0	3
Bouquet	0	1	0	0	0	0	0	0	0	1
Cappelle	1	0	0	0	0	0	0	0	0	1
H Nimrod	0	0	0	0	0	0	1	0	0	1
Total	5	1	0	5	4	7	10	1	0	33

More potential field variants were collected from Maris Huntsman than from any other variety and these were mainly from the Northern and Yorks & Lancs ADAS regions of England.

11 of the samples included ears and all of these were identified by the PBI as being indistinguishable from the variety sampled. Thus the possibility of incorrect variety sampling or ear off-types can be largely discounted.

A selection of these samples are being multiplied for inoculation onto tussocks of 21 winter wheat varieties in 20 polythene tunnels in 1975.

9. Summary for major physiologic races

race 1,2,3 (formerly 41 E 136)

The most frequently identified race in 1974 and common since 1971. First identified in 1967. This race has the ability to infect varieties with resistance derived from Yr 1, Yr 2, Yr 3a and Yr 4a and thus with the exception of Maris Ranger and Maris Freeman is capable of infecting all the varieties on the 1975 NIAB Recommended list of winter wheat varieties. The variety Maris Templar (not recommended by NIAB) appears to be strongly selecting for this race within the pathogen population and the recent increase in frequency of this race may be attributable to a large degree to farmers growing this variety. The majority of the samples from severely infected crops of Maris Huntsman in the Northern and Yorks & Lancs ADAS regions of England in 1974 have been identified as this race.

race 2,3,4 (formerly 104 E 137)

This race has decreased in frequency in each of the last three years. First identified in 1969. This race has the ability to infect varieties with resistance derived from Yr 2, Yr 3a, Yr 3b, Yr 4a and Yr 4b and thus with the exception of Maris Ranger and Maris Freeman can infect all the varieties on the 1975 Recommended list of winter wheat varieties. None of the present widely grown commercial varieties appear to be selecting for this race within the pathogen population.

race 2,3,4,6 (formerly 108 E 173)

This was the most frequently identified race in 1973 but its frequency has declined in 1974. First identified in 1972, this race has the ability to infect varieties with resistance derived from Yr 2, Yr 3a, Yr 3b, Yr 4a, Yr 4b and Yr 6 and can thus infect all the varieties on the 1975 NIAB Recommended list of winter wheat varieties. This race willnot infect Maris Templar (not recommended by NIAB). Maris Ranger may be selecting for this race within the pathogen polulation and if this is the case it appears that the selective force of the Maris Templar acreage for race 1,2,3 is stronger than that of the Maris Ranger acreage for 2,3,4,6. The spring wheat Cardinal may also select for this race but insufficient is known about the effect of selection by spring wheat varieties on the population which mainly exists on winter wheat varieties.

Appendix: Identification of isolates from the UK and Eire section of the International Survey of Factors of Virulence of Puccinia striiformis Westend (formerly the European Yellow Rust Trials Project.

1. Trial sites

Seed of 51 wheat and barley cultivars were sent by Ir Stubbs (IPO, Wageningen) to 25 sites in the UK and Eire:

England	17
Scotland	3
Eire	2
Channel Is	1
N Ireland	1
Wales	1

Percent attack and Infection Type data for natural infections with yellow rust of wheat (Puccinia striiformis) were received from 11 sites (7 in England, 1 in Scotland, Eire, Channel Is, N Ireland). Data on the performance of individual varieties at these sites is available on request.

2. Identification of samples

Samples were requested from 9 wheat cultivars that are resistant to all UK races and 13 samples were received. 5 samples failed to establish and the remainder were identified as:

Variety	Location	Physiologic race
Clement	Rothwell, Lincs	1,2,3,7 (43 E 138)
Mildress	Rothwell, Lincs	1,2,3,(7) (41 E 136 + 43 E138)
Kavkaz	Duns, Scotland	1,2,3 (41 E 136)
T spelta album	Morley, Norfolk	1,2,3 (41 E 136)
Compair	Jersey, Channel Is	tests in progress

virulence factors in parentheses (eg (7)) indicate partial virulence probably due to a mixture of isolates.

All isolates were avirulent when inoculated back onto the source variety. All the races had previously been identified so that no new virulences were detected.

Three samples were received from Orca; two were identified as race 2,3,4,6 (108 E 173) and one failed to establish. This variety had erroneously been classified as resistant to all UK races, but is in fact susceptible to a number of races.

YELLOW RUST OF BARLEY

BY R H PRIESTLEY, JULIA SMITH & P BYFORD

National Institute of Agricultural Botany, Cambridge

1. Samples received

310 samples were received at the NIAB during 1974 of which 111 have been identified. Sampling was not carried out on a random basis and therefore the frequency of physiologic races shown by the Survey may not reflect that in the UK as a whole.

2. Identification of samples

Samples have been identified using the following differential cultivars: Astrix, Bigo, Cambrinus, Varunda, Mazurka, Sultan and Zephyr. The genetics of these cultivars are not fully understood and so the race nomenclature should be treated as temporary.

3. Physiologic race frequency

(a) 1974 samples

Races 24MV (Mazurka virulent) and 24MVV (Mazurka and Varunda virulent) were identified for the first time in 1974 (Table 1).

Table 1. Physiologic race frequencies in 1974

Physiologic race	No of samples	Frequency
24	86	77
24VV	5	5
24MV	9	8
24MVV	9	8
mixtures	2	2
total	111	100

(b) comparison with previous years

A comparison with the frequency of races in 1973 is given (Table 2). During the period 1972 - 74 the frequency of race 24 has been decreasing and the frequency of variants of race 24 (24VV, 24MV and 24MVV) has been increasing. Race 23 has remained at a low frequency during this period.

Table 2. Physiologic race frequencies, 1972 - 1974

Physiologic race	1972	1973	1974
23	7	1	0
24	89	81	77
24VV	4	15	5
24MV	0	0	8
24MVV	0	0	8
mixtures	0	2	2

4. Variety - race interactions

The 111 samples identified in 1974 were collected from 43 barley varieties; the number of samples from each variety - race combination is shown (Table 3).

Table 3. Physiologic race - variety analysis

Variety	24	24VV	24MV	24MVV	Mixtures	Total
Astrix	12	0	0	0	1	13
Universe	10	1	1	1	0	13
Julia	9	0	0	1	0	10
Berac	4	1	0	0	0	5
Abacus	3	0	0	1	0	4
Aramir	2	0	0	0	1	3
Lofa Abed	3	0	0	0	0	3
Rif	2	0	1	0	0	3
Cossack	2	1	0	0	0	3
M Otter	2	0	1	0	0	3
Miranda	3	0	0	0	0	3
Zephyr	2	0	1	0	0	3
31 varieties with 1 or 2 samples from each	32	2	5	6	0	45

Because of the dominance of race 24 in the pathogen population, little could be determined about the relationship between the other races and individual varieties. More samples were identified from Astrix, Universe and Julia than from other varieties.

5. Geographical distribution of physiologic races

The number of samples identified of each race in each region is shown (Table 4).

Table 4. Regional distribution of physiologic races

Region	24	24VV	24MV	24MVV	Mixtures	Total
EM	21	1	2	1	0	25
E	20	0	2	0	0	22
Sc	11	1	2	4	0	18
N	7	2	2	0	2	13
WM	6	0	1	0	1	8
YL	8	0	0	0	0	8
SW	5	1	0	0	1	7
SE	4	0	0	2	0	6
W	3	0	0	0	0	3
NI	1	0	0	0	0	1

Regions are ADAS areas for England & Wales, plus Scotland and N Ireland

Most of the samples identified were collected in the East Midlands, East, Scotland and Northern areas. In each of the areas, race 24 was the most frequently identified race. Little could be determined about the distribution of the other races owing to the low frequency of these races.

6. Summary for individual physiologic races

race 23

Absent in 1974, its frequency has been declining for some years.

race 24

The most frequently identified race in 1972, 1973 and 1974 and widespread in distribution. This race can infect a very large number of both winter and spring barley varieties and has frequently been identified from Astrix, Universe and Julia. This race cannot infect Mazurka or Varunda.

race 24VV

First identified in 1972, this race is virulent on Varunda and all varieties on which race 24 is virulent. The frequency of this race appears to have declined from its peak frequency in 1973.

race 24MV

First identified in 1974, this race is virulent on Mazurka and all varieties on which race 24 is virulent.

race 24MVV

First identified in 1974, this race is virulent on both Varunda and Mazurka and all varieties on which race 24 is virulent.

BROWN RUST OF BARLEY

BY B C CLIFFORD & R B CLOTHIER

Welsh Plant Breeding Station, Aberystwyth

Forty seven samples of barley brown rust were received. The majority came from Southern England with other samples from SW England, Eastern England, Wales and Scotland. Most of the samples were from recommended list varieties and varieties in NIAB trials.

A very high proportion, 50% failed to culture. The identifications of samples are given in Table 1.

The set of differential varieties has been changed and now includes Gold, Estate, Cebada Capa, Aim, Gondar, Rika x F_1 (Baladi 16 x Rika No 7), Forrajera Klein x Rika No 7, La Estanzuela 75a, CI 1243, CI 12201 and H 2212.

All of the differentials other than Gold are resistant to present races of barley brown rust in Britain and therefore only one race has been identified in 1974 viz virulent on Gold.

Table 1 Race identification of brown rust of barley samples

Code	Sender	Collection Date	Location	Variety	Severity	Race
BRS-74-1	M C Kemp	5/2/74	Morley, Norfolk	Banteng		1
2	"	"	" "	Maris Otter		FTC
3	"	"	" "	Maris Trojan		1
4	R M Habgood	30/4/74	WPBS, Dyfed	13192 Co	5-10%	1
5	M Bourne	5/7/74	Wimborne, Dorset	Julia	40%	1
6	Mrs M Carter	8/7/74	Drewsteignton,Devon	Lofa Abed	Tr	FTC
7	M C Kemp	8/7/74	Morley, Norfolk	Abacus	0.1%	FTC
8	"	"	" "	Mazurka	1%	1
9	"	"	" "	Midas	10%	1
10	"	"	" "	Wing	1%	1
11	R Griffiths	11/7/74	Llanon, Dyfed	6-row winter	2%	1
12	R J Cook	12/7/74	Goodnestone,Kent	Aramir		1
13	"	"	" "	Armelle		FTC
14	"	"	" "	Zephyr		1
15	"	"	" "	SJ 678060		1
16	"	11/7/74	Hickstead, Sussex	Armelle		1
17	"	"	" "	Berac		1
18	"	"	" "	Julia		FTC
19	"	"	" "	Mazurka		1
20	"	"	" "	Universe		FTC
21	"	"	" "	Zephyr		FTC
22	"	17/7/74	Ellens Green,Sussex	Julia	5	FTC
23	"	"	" "	Universe	5	FTC
24	D J Yarham	17/7/74	Buntingford, Herts	Tern		1
25	"	"	" "	Zephyr		FTC
26	"	"	" "	Varunda		FTC
27	"	"	" "	Maris Mink		FTC
28	"	"	" "	Julia		FTC
29	"	"	" "	Mazurka		FTC
30	"	"	" "	Proctor		1

Table 1. Race identification of brown rust of barley samples (cont'd)

Code	Sender	Collection Date	Location	Variety	Severity	Race
BRS-74-31	D J Yarham	17/7/74	Buntingford, Herts	Abacus		FTC
32	"	"	" "	Aramir		FTC
33	"	"	" "	SJ 678060		FTC
34	"	"	" "	Armelle		FTC
35	"	"	" "	Universe		FTC
36	A Frost	20/7/74	Swindon, Wilts	Abacus		FTC
37	"	"	" "	Julia		1
38	R B Clothier	23/7/74	WPBS, Dyfed	Julia	1%	FTC
39	"	26/7/74	"	San Carlos	5%	1
40	R Megginson	31/7/74	Murrays, E Lothian	Aramir	5-10%	FTC
41	"	"	" "	Golden Promise	5-10%	1
42	"	"	" "	Maris Canon	1%	FTC
43	"	"	" "	Mazurka	1%	FTC
44	"	"	" "	Proctor	5%	FTC
45	"	"	" "	Union	5%	FTC
46	R B Clothier	8/8/74	WPBS, Dyfed	Vada	20%	1
47	R Davies	12/8/74	" "	Cebada Capa		1

BROWN RUST OF WHEAT

BY B C CLIFFORD & R B CLOTHIER

Welsh Plant Breeding Station, Aberystwyth

Of the thirty one samples received, seventeen were from Maris Huntsman and five from the sister line Maris Nimrod. The remaining eight samples came from Maris Fundin, Maris Widgeon, Flinor, Atou and Score. Two samples failed to culture.

The cultures were tested on the Recommended List varieties plus Hybrid 46, Professor Marchal, Maris Halberd and Clement. The identification of samples are given in Table 1.

Table 1 Race identification of brown rust of wheat samples

Code	Sender	Collection Date	Location	Variety	Severity	Race
VBRS-74-1	M,C.Kemp	8/7/74	Morley, Norfolk	Maris Freeman	0.1%	FTC
2	"	"	" "	Maris Huntsman	0.1%	74/2
3	R. Johnson	10/7/74	" "	" "		74/2
4	W.R.Williams	15/7/74	Cambridge	" "	30%	74/2
5	S.C. Melville	15/7/74	Torrington Devon	" "	10-15%	74/7
6	" "	"	" "	Maris Nimrod	10-15%	74/2
7	L.V. Davis	16/7/74	" "	Maris Huntsman		74/7
8	" "	"	Cirencester, Glos	" "		74/2
9	D.M. Taylor	17/7/74	Stokenchurch, Bucks	" "		74/2
10	J.L. Jemmett	17/7/74	Newton Abbot, Devon	Flinor		74/7
11	" "	"	" "	Maris Fundin		74/7
12	" "	"	" "	Score		74/7
13	R.H. Priestley	15/7/74	Kings Lynn, Norfolk	Maris Huntsman		74/2
14	J.H. Bant	18/7/74	Driffield, Yorks	" "	5%	74/2
15	M.C. Kemp	17/7/74	Morley, Norfolk	Maris Fundin	25%	74/7
16	L.V. Davis	17/7/74	North Petherton,Som	Maris Huntsman	50%	74/2
17	D.J. Yarham	17/7/74	Buntingford, Herts	Maris Nimrod		74/2
18	B.C. Clifford	19/7/74	WPBS. Dyfed	Maris Fundin		74/7
19	A. Frost	20/7/74	Swindon, Wilts	Atou	0.5%	FTC
20	"	"	" "	Maris Nimrod	0.25%	74/2
21	L.V. Davis	22/7/74	Corston, Som	Maris Huntsman		74/2
22	" "	23/7/74	Devizes, Wilts	Maris Nimrod		74/2
23	" "	24/7/74	Bagborough, Som	Maris Huntsman		74/2
24	" "	25/7/74	Glos	" "	60%	74/2
25	" "	"	"	" "	30-40%	74/2
26	B.C. Clifford	31/7/74	Sodbury, Wilts	" "		74/2
27	" "	"	" "	Maris Widgeon		74/2
28	" "	"	Swindon, Wilts	Maris Nimrod	50%	74/7
29	N.H. Chamberlain	6/8/74	Wainfleet, Lincs	Atou	25-50%	74/2
30	" "	"	" "	Maris Huntsman	75-100%	74/2
31	N.H. Chamberlain	2/9/74	Freeze dried culture			74/7

Two races were identified, WBR-74-2 and WBR-74-7, differing only in their reaction to Maris Fundin. With the exception of Sappo, all of the other Recommended List varieties were found to be susceptible. Cultures capable of attacking Sappo and Maris Halberd but not Maris Fundin have been identified from the 1973 survey (Table 2).

Table 2. Reactions of wheat cultivars to isolates of brown rust of wheat

	WBR-74-2	WBR-74-7	WBR-73-3
Maris Nimrod	S	S	S
Champlein	S	S	S
Maris Ranger	S	S	S
Cappelle Desprez	S	S	S
West Desprez	S	S	S
Maris Widgeon	S	S	S
Maris Huntsman	S	S	S
Atou	S	S	S
Val	S	S	S
Bouquet	S	S	S
Maris Freeman	S	S	S
Maris Fundin	R	S	R
Flinor	S	S	S
Mega	S	S	S
Maris Dove	S	S	S
Kleiber	S	S	S
Kolibri	S	S	S
Sappo	R	R	S
Maris Butler	S	S	S
Sirius	S	S	S
Cardinal	S	S	S
Hybrid 46	S	S	S
Prof. Marchal	S	S	S
Maris Halberd	R	R	S
Clement	R	R	R

Quantitative tests

The object of the tests was to investigate whether the high incidence of P.recondita observed on Maris Huntsman in the field was due to differential specialization of the pathogen on that variety.

A procedure similar to that described for P.hordei on barley (Clifford and Clothier 1974) was followed. Eight replicates of Maris Huntsman, Maris Nimrod and Val were inoculated with 5mg of uredospores in a settling tower and incubated in a dew chamber for 16h at 17±2°C. After 7 days leaf segments were cut and floated on 50ppm benzimidazole for a further 7 days after which the assessments were carried out. These consisted of measurements spores/cm^2, pustules/cm^2 and spores/pustule.

The results showed there was no indication of races specifically adapted to Maris Huntsman or Maris Nimrod. Seedling tests may not be an indication of adult plant reaction and therefore adult plant tests are in progress and further field tests are planned for this summer.

CROWN RUST OF OATS

BY B C CLIFFORD & R B CLOTHIER

Welsh Plant Breeding Station, Aberystwyth

Eleven samples of crown rust were received, seven from Dyfed, one each from Anglesey, Devon, Somerset and Wiltshire. From these samples five races were isolated all of which have previously been identified (Table 1). Race 251 (7 samples from W.P.B.S. and Trawscoed, Dyfed), race 265 as a mixture with race 251 (WPBS) race 272 (WPBS), race 275 (Somerset and Anglesey) and race 296 (Devon).

Table 1 Race identification of crown rust of oats samples

Code	Sender	Collection Date	Location	Variety	Severity	Race
CRS-74 -1	J.L. Jennett	17/7/74	Newton Abbot, Devon	Peniarth	25%	296
2	R.B. Clothier	25/7/74	WPBS. Dyfed	Nelson	1%	251+ 265
3	"	"	" "	06521Cn3/22	20%	251
4	"	"	" "	06522Cn1/4	15%	251
5	"	"	" "	06522Cn1/6	10%	251
6	"	"	" "	06524Cn2/1	0.5-1%	251
7	B.C. Clifford	31/7/74	Sedbury, Wilts	Peniarth		251
8	R.C. Davis	1/8/74	Minehead, Som.	Peniarth		275
9	H.W. Roderick	6/8/74	Trawscoed, Dyfed	Mostyn	Tr	251
10	R. Davies	14/8/74	WPBS. Dyfed	Pendrwn		272
11	I.A. Cragg	29/8/74	Llangwyllog, Anglesey	Maris Oberon	20%	275

MILDEW OF BARLEY

BY M S WOLFE & SUSAN WRIGHT

Plant Breeding Institute, Cambridge

1. A total of 282 isolates were received, including 44 from varieties with no known resistance, and 16 from winter barleys. The numbers of isolates from each major variety are listed below in the appropriate tables.

2. New virulences: Specific virulence for Maris Canon was isolated for the first time. The results indicated that Maris Canon combines Mlg with Mla6 (as in Impala) and part of the Vada resistance.

Isolates were found which exhibited specific resistance in Clermont and Golden Promise.

Normally rare virulences, for Algerian, Picardo and H0R 1036, were reisolated from 1974 material.

All of these records were obtained from 'Mobile Nursery' material.

3. Vada derivatives:

Source of tested isolates	Differential hosts: 41/145 Mlh	CP127422 Mlg	Concord Mla6	Sultan Mla5	Vada	1063	Wing Lyallpur	Akka Monte cristo	No of Isolates received
Lofa (Caythorpe)	x	x	x		x				4
(Docking)	x	x							
Lud (Moulton)	x	x	x						6
(Evanton)	x	x	x		x				
Abacus (NIAB)	x	x	x						15
(Dulnain Br)	x	x			x				
(Codford)	x	x	x		x				
Sundance (Codford)	x	x			x				6
Georgie (Cockle Pk)	x	x							5
Virulence frequency	9	9	5	0	5	0	0	0	14
Relative frequency	100	100	56	0	56	0	0	0	(others)

There was an increase in the number of isolates with combined Vada and Mlg-virulence, entirely due to the influence of varieties with the combined corresponding resistance, such as Abacus, Sundance and Georgie. Because of the strong association between Va6 and Vg in the pathogen, this also caused an increase in the frequency of Va6 on Vada derivatives.

Detailed tests suggest that the Abacus resistance is dominated by the Vada resistance component whereas that of Sundance and Georgie is dominated by the Mlg resistance component. All three varieties possess elements of both resistances.

4. Lyallpur Derivatives:

Source of tested isolates	Differential varieties: 41/145 Mlh	CP127422 Mlg	Concord Mla6	Sultan Mla5	Vada	H1063 Lyallpur	Wing	Akka Monte Cristo	No of isolates received
Wing (Moulton)	x	x				x	x		10
(Codford)	x	x				x	x		
(Cockle Pk)	x	x		x		x	x		
Mazurka (ICI)	x	x				x	x		32
(Driffield)	x	x				x	x		
(Eastling)	x	x		x		x	xx		
(WPBS)	x	x			x	x	x		
(WPBS)	x	x				x	x	x	
(Codford)	x	x				x	x	x	
(Groggan Bank)	x	x				x	x	x	
(Moulton)	x	x	x			x	x	x	
(E Lothian)	x	x		x		x	x	x	
Ark (Caythorpe)	x	x				x	x	x	1
Royal						x	x		
	13	13	1	3	1	13	13	5	23
	100	100	8	23	8	100	100	23	(others)

There was evidence of a general increase in Lyallpur virulence particularly on Mazurka and some crops were heavily infected. The increase in virulence on Akka (Monte Cristo) is probably a reflection of the increased Lyallpur-virulence, with which it is related, rather than being due to a change in the Akka acreage, which remains small. As previously observed, there was a high frequency of Mlg-virulence and low frequencies of Vada and Concord-virulence associated with these varieties. There was, however, a slight increase in the frequency of Sulton-virulence. One crop situation in which an unusually high frequency of Sultan-virulence occurred was noted in an epidemic on Tern. This appears to be related to the fact that the Tern had been ethirimol-treated and was therefore selecting out isolates which combined Tern-virulence with ethirimol-insensitivity and Sultan-virulence.

5. Mlg - derivatives

Source of tested isolates	Differential varieties: 41/145 Mlh	CP127422 Mlg	Concord Mla6	Sultan Mla5	Vada	H1063 Lyallpur	Wing	Akka Monte Cristo	No of isolates received
Zephyr (Beverley)	x	x							7
Mosane (Holme-on-Spalding Moor)	x	x	x						2
(Pocklington)	x			x					
Berac (Eastling)	x	x	x						5
(Westwell)	x	x			x				
Armelle (Codford)	x	x	x						4
(Caythorpe)	x	x	x						
Julia (Caythorpe)	x	x	x						8
(Moulton)	x	x	x		x				
(Grantham)	x	x	x		x				
Union (E Lothian)	x	x		x					1
	11	10	7	2	3	0	0	0	4
	100	91	64	18	27	0	0	0	(others)

The pattern of virulence frequency was almost identical with previous years, the high frequency of Concord-virulence apparently being maintained as a relic from the late 1960's when Impala imposed a severe selection for the combination of Mlg + Mla6 virulence. One of only two Sultan-virulent isolates was non-virulent on Mlg and Mla6.

One change which has occurred, however, is the increased amount of infection on Julia clearly evident in the foliar disease Survey data from Harpenden. We believe this to be due to specific adaptation in the pathogen, possibly through a combination of Mlg with Vada virulence since it now seems that the resistance of Julia may be related to that of Vada. There is a tendency for Vada virulence to occur at a higher frequency in Julia than in other Mlg varieties.

6. Sultan-derivatives

Source of isolates tested	Differential varieties: 41/145 Mlh	CP127422 Mlg	Concord Mla6	Sultan Mla5	Vada	H10063 Lyallpur	Wing Lyallpur	Akka Monte Cristo	No of isolates received
A. Sultan resistance only									
Sultan (Dulnain Br)				x					8
(Aberdeen)	x	x		x					
Hassan (Codford)	x			x					13
(Aberdeen)	x			x					
	3	1	0	4	0	0	0	0	
B. Sultan + Mlg resistance									
FD 090/20 (Evanton)	x	x	x	x					5
Aramir (E Lothian)	x	x		x					13
(Moulton)	x	x	x	x					
(Codford)	x	x				x	x		
M Mink (Moulton)	x	x		x	x				19
(Codford)	x			x					
(Whitchurch)	x	x	x	x	x				
	7	6	3	6	2	1	1	0	

As with Vada virulence, there was an increase in combined virulence for Sultan and Mlg, due to the increase in the number of varieties with the combined corresponding resistance Mlg + MlaS.

The only Lyallpur-virulent isolate was found to be Sultan non-virulent. This corresponds with the low frequency of Sultan-virulent isolates found on Lyallpur derived varieties.

Although many isolates with combined Mlg and Sultan virulence do occur, Aramir and Maris Mink remain resistant: in all comparative tests, Aramir was slightly more susceptible than Maris Mink to the virulent isolates.

7. Mla6 - derivatives

One isolate tested out of 5 received from Midas proved to be virulent against both Mlg and Mla6, as in previous years.

8. Ethirimol insensitivity

Ethirimol and tridemorph response in the pathogen was monitored in 1974 in a co-operative experiment with ADAS and the Scottish advisers, using 'mobile nurseries' of untreated and treated seedlings, grown and assessed in different regions.

The response in the pathogen population to ethirimol was clearly evident: the response to tridemorph was less clear and is still under investigation.

The ethirimol response varied with time and was most clearly evident in mid-season. There was a tendency towards a decline in the frequency of insensitivity towards the end of the season, but not all all sites. The decline was probably due to migration into treated crops, late in the season, of sensitive forms, the effect being possibly enhanced by greater competitiveness of the sensitive forms.

There appears to be a varietal effect with ethirimol insensitivity being more apparent on susceptible varieties such as Proctor and Golden Promise than on varieties such as Julia.

Although both fungicides were generally effective in 1974 in terms of disease control and yield response, the occurrence of insensitivity necessitates the maintenance of a close watch on the pathogen population in 1975, together with full implementation of the recommendation not to use ethirimol on winter barley.

MILDEW OF WHEAT

BY M S WOLFE & SUSAN WRIGHT

Plant Breeding Institute, Cambridge

Of 97 isolates received, about half came from Plant Breeding Institute varieties which showed selection for virulence for Triticum timopheevi (CI 12633) derived resistance genes, particularly Pm2.

Source of tested isolates	Axmin Pm1	Chul Pm3b	Hope Pm5	14/44 M1r	Ulka Pm2	13471 Pm2+'x'	Weih M1 M1c	No of isolates received
Kleiber (Moulton)								3
Reso (Moulton)			x					4
M Huntsman (Rothamsted)					x			16
M Fundin (E Ross)					x			4
M Huntsman (E Drayton	x				x			
M Nimrod (E Ross)	x				x			14
M Dove (Moulton	x				x			6
TJB 158/891 (Cockle Pk)	x				x			3
M Templar (E Ross)					x	x		5
Kleiber (Moulton)					x	x		
M Huntsman (N England)	x				x	x		
	(5)	(0)	(1)	(0)	(9)	(3)	(0)	

Occasional isolates have shown susceptible reactions on Maris Huntsman and Maris Templar, but these have not been consistent.

MILDEW OF OATS

BY I T JONES & R B CLOTHIER

Welsh Plant Breeding Station, Aberystwyth

Of the sixty two samples received thirty eight were from Wales and the remainder from most areas in Britain excluding S.W. England and Eire. Only two of the samples failed to culture.

Half of the samples were from varieties claimed to have major gene resistance derived from either 9065 Cn or Cc4146. The identifications of samples are given in Table 1.

Race 2 which is avirulent on these resistance sources was only identified from eleven samples.

Race 4, virulent on Mostyn, was identified from more than half of the samples received and is now the most prevalent race.

Race 4 was isolated from samples from N.Ireland for the first time and this coincides with the first year of Mostyn being recommended in N. Ireland.

Nine samples were found to be race 5, virulent on 9065Cn and Cc4146, seven of these coming from Dyfed. For the first time the race has been identified from an area other than Dyfed, i.e. from the P.B.I., Cambridge and Loughborough, Leicestershire.

Race 3, which overcomes the resistance of Cc4146 but not 9065Cn, was not identified from any sample in 1974.

It was again found that Race 2 and Race 4 were able to colonise varieties such as Maris Tabard and Nelson to a limited extent.

Table 1. Race identification of oat mildew samples

Code	Sender	Collection Date	Location	Variety	Severity	Race
OMS-74-1	R Griffiths	17/4/74	Llanon, Dyfed	Century	5%	4
2	I.T. Jones	19/4/74	WPBS. Dyfed	S.172	5%	4
3	R. Davies	22/4/74	WPBS. "	Peniarth	20%	2
4	R.B. Clothier	28/5/74	WPBS, "	Peniarth	10%	4
5	R. Griffiths	29/5/74	Llanon, Dyfed	Astor	65%	4
6	"	"	" "	Manod	50%	4
7	"	"	" "	Maris Tabard	5%	4
8	R.B. Clothier	30/5/74	WPBS. Dyfed	Peniarth	15%	4
9	C.J. Whittles	2/6/74	Moulton, Northants	Astor	10%	4
10	"	"	" "	Condor	10%	4
11	"	"	" "	Mostyn	5%	4
12	"	"	" "	Selma	10%	4
13	R. Griffiths	5/6/74	Llanon, Dyfed	Mostyn	20%	4
14	R.B. Clothier	26/6/74	WPBS. Dyfed	Maris Tabard	10%	5
15	"	"	" "	Mostyn	10%	4
16	"	"	" "	Nelson	20%	5
17	R. Griffiths	26/6/74	PBI, Cambridge	Maris Tabard	20%	5
18	"	"	" "	Mostyn	20%	4
19	"	27/6/74	Llanon, Dyfed	Maris Tabard	2%	5
20	D.I. Breese	8/7/74	Castledillon,N.I.	Astor	5%	2
21	"	"	" "	Condor	5%	4
22	"	"	" "	Selma	5-10%	4

Table 1 Race identification of oat mildew samples (continued)

Code	Sender	Collection Date	Location	Variety	Severity	Race
OMS-74-23	W. Jones	11/7/74	WPBS. Dyfed	Maris Tabard	20%	5
24	"	"	" "	Mostyn	30%	5
25	"	"	" "	Maris Tabard	10%	5
26	T. Fozzard	9/7/74	Brecon, Brecs.	Condor	10%	4
27	A.D. Rivett	16/7/74	Morpeth, Northumb.	Astor		4
28	"	"	" "	Condor		2
29	"	"	" "	Maris Quest		2
30	"	"	" "	Peniarth		4
31	"	"	" "	Selma		2
32	C.A. Leigh	16/7/74	Newport, Salop	Astor	65%	2
33	"	"	" "	Condor	40%	4
34	"	"	" "	Maris Oberon	0.1% (20%)	2
35	"	"	" "	Maris Tabard	0.1% (20%)	4
36	"	"	" "	Maris Titan	0.1%	4
37	"	"	" "	Mostyn	25%	4
38	"	"	" "	Nelson	2%	4
39	"	"	" "	Selma	70%	4
40	"	"	" "	02994Cn	0.1%	4
41	"	"	" "	04336Cn	1%	4
42	"	15/7/74	Loughborough,	Maris Tabard	25%	5
43	"	"	" Leics	Mostyn	25%	4
44	D.I. Breese	16/7/74	Castledillon, N.I.	Mostyn	1%	4
45	P.A. York	18/7/74	Marloes, Pembs	Mostyn	5%	4
46	E.G. Gray	22/7/74	Evanton, Ross & Cromarty	Condor	50%	FTC
47	T. Fozzard	22/7/74	Talgarth, Brecs.	Astor	60%	4
48	"	"	" "	Condor	60%	2
49	"	"	" "	Maris Oberon	1%	2
50	"	"	" "	Maris Tabard	1%	4
51	"	"	" "	Maris Titan	1%	2
52	"	"	" "	Mostyn	25%	4
53	"	"	" "	Nelson	3%	2
54	"	"	" "	Selma	60%	4
55	H.W. Roderick	25/7/74	WPBS. Dyfed	Maris Tabard	10%	FTC
56	"	"	" "	Nelson	20%	5
57	M. Phillips	8/8/74	Roslin, Midlothian	Astor	75%	4
58	"	"	" "	Condor	50-75%	4
59	"	"	" "	Maris Quest	10%	4
60	"	"	" "	Maris Tabard	25%	4
61	"	"	" "	Nelson	1%	4
62	"	"	" "	Selma	75%	4

RHYNCHOSPORIUM OF BARLEY

BY R B CLOTHIER

Welsh Plant Breeding Station, Aberystwyth

No. of samples 47

Results 4 samples of race U.K.2
39 samples of race U.K.1
4 samples failed to culture

Forty seven samples were received, seven from winter varieties, thirty-nine from spring varieties and one from rye. Four of these samples failed to produce an infection. The identification of samples are given in Table 1.

Four samples gave race U.K.2 reactions, all coming from winter varieties resistant to race U.K.1. The sample from rye gave a race U.K.1 reaction. The remaining 38 samples were race U.K.1.

The four race U.K.2 isolates came from Devon and Dyfed.

Five samples were received from N.Ireland, which were race U.K.1 and so far race U.K.2 has not been identified from Ireland.

Table 1 Race identification of Rhynchosporium of barley samples

Code	Sender	Collection Date	Location	Variety	Severity	Race
RS-74-1	M.C. Kemp	5/2/74	Morley, Norfolk	Proctor	Tr	1
2	H.M. Roberts	14/2/74	Kings Lynn,Norfolk	Tern	20%	1
3	R. Griffiths	20/2/74	Llanon, Dyfed	Sabarlis	5%	1
4	R. Griffiths	17/4/74	Llanon, Dyfed	Maris Otter		1
5	D.J. Hayes	23/4/74	WPBS, Dyfed	Rheidol	5%	1
6	J.D. Wafford	25/4/74	Preston, Lancs	Proctor	25%	1
7	B.C. Clifford	7/5/74	WPBS, Dyfed	-	1%	1
8	Mrs.M.Carter	29/5/74	Starcross, Devon	Maris Otter	5-10%	1
9	"	"	" "	Senta	Tr	2
10	R. Griffiths	31/5/74	Llanon, Dyfed	Maris Otter	10%	1
11	"	"	" "	F6 HJ/7/130/212	25%	2
12	Mrs.M. Carter	4/6/74	Kenn, Devon	Astrix	5%	2
13	"	"	" "	Senta	5%	2
14	B. Mahir	8/7/74	Bideford, Devon	Julia	5%	1
15	"	"	" "	Lofa Abed	5%	1
16	"	"	" "	Vada	5%	1
17	T. Fozzard	8/7/74	Bridgend, Glam	Lofa Abed		1
18	I.A. Cragg	9/7/74	Trefor, Anglesey	Clermont	10%	1
19	"	"	" "	Julia	25%	1
20	"	"	" "	Lofa Abed	5%	1
21	"	"	" "	Proctor	3%	1
22	M.J.Richardson	10/7/74	Midlothian	Maris Otter	20%	1
23	A. Young	11/7/74	Auldearn,Nairnshire	Golden Promise		1
24	D.J. Yarham	16/7/74	Buntingford,Herts	Abacus		1
25	"	"	" "	Aramir		1
26	"	"	" "	Julia		FTC
27	"	"	" "	Maris Mink		1
28	"	"	" "	Mazurka		1
29	"	"	" "	Tern		1
30	"	"	" "	Universe		1
31	"	"	" "	Varunda		FTC
32	"	"	" "	Zephyr		1
33	"	"	" "	SJ 678060		1

Table 1 (continued)

Code	Sender	Collection Date	Location	Variety	Severity	Race
RS-74-34	R.G. Davis	15/7/74	Newport, Salop	Arnelle		1
35	"	"	" "	Julia		1
36	"	"	" "	Lofa Abed		1
37	"	"	" "	Proctor		1
38	"	"	" "	Vada		1
39	"	"	" "	Zephyr		1
40	I.A. Cragg	23/7/74	Llandegfan, Anglesey	Julia	50%	1
41	D.I. Breese	29/7/74	Castle Dillon, N.I.	Arnelle	2%	1
42	"	"	" "	Clermont	5%	1
43	"	"	" "	Julia	5%	1
44	"	"	" "	Midas	10%	1
45	"	"	" "	Zephyr	2%	1
46	J.L. Jennett	31/7/74	St.Erth, Cornwall	Arnelle		FTC
47	"	"	" "	Clermont		FTC