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EDITED BY

J. G. MANNERS

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FOUNDATION

NOMENCLATURE

The Board of the European and Mediterranean Cereal Rusts Foundation has decided that the following system should normally be adopted in all articles in the Bulletin.

A. Names of cereal rust species and formae speciales

Puccinia coronata Corda var. *avenae* Fraser & Led.

Common name: Crown rust.

Puccinia graminis Pers. f.sp. *avenae* Eriks. & Henn.
f.sp. *secalis* Eriks. & Henn.
f.sp. *tritici* Eriks. & Henn.

Preferred common name: Black rust
Alternative common name: Stem rust

Puccinia hordei Otth

Preferred common name: Brown rust (of barley)
Alternative common name: Leaf rust (of barley)

Puccinia polysora Underw.

Common name: Tropical maize rust

Puccinia recondita Rob. et Desm. f.sp. *tritici* Eriks. & Henn.
f.sp. *recondita* Rob. et Desm.

Preferred common name: Brown rust (of wheat/rye)
Alternative common name: Leaf rust (of wheat/rye)

Puccinia sorghi Schw.

Common name: Maize rust

Puccinia striiformis West.

Preferred common name: Yellow rust
Alternative common name: Stripe rust

In Bulletin articles, it will not, in general be necessary to quote the Authority for the above Latin names, unless the paper has taxonomic implications. When a rust is first mentioned, the Latin name and preferred or alternative common name should be quoted. Subsequently, either Latin or common name may be used.

B. Names of spore stages

The following system, based on that of Laundon (*Trans.Br.mycol.Soc.* 50, 189, 1967) should be used.

Urediospores, produced in uredia.
Teliospores, produced in telia.
Basidiospores, produced on basidia.
Pycniospores, produced in pycnia.
Aeciospores, produced in aecia.

SUBSCRIPTIONS

Owing to continued increases in costs, it has become necessary to increase the subscription charges for the Bulletin, and as from Vol.4, the subscription charges will be as follows:

Direct subscribers f. 30

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NEWS AND NOTES

Dr. M. Clive James, formerly of the crop loss section, Ottawa Research Station, Agriculture Canada, is now at F.A.O, Via delle Terme di Caracalla, 00100, Rome, where he has responsibilities to develop a system to assess the economic losses in crops due to pests and diseases, with particular reference to pesticide usage in the developing countries.

LIST OF CEREAL RUST WORKERS IN THE EUROPEAN AND MEDITERRANEAN AREA

The following correction should be made to the list published in Vol.4, Part 1 of the Bulletin:

Add:

USSR

PLOTNIKOVA, J., Dr.Miss. Plant Pathology Laboratory, Main Botanical Gardens, Botanitscheskaja 4, Moscow 127276 (7,c)

EUROPEAN AND MEDITERRANEAN CEREAL RUSTS FOUNDATION

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1976

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ROLE OF THE WESTERN HIMALAYAS IN THE ANNUAL RECURRENCE OF YELLOW RUST IN NORTHERN INDIA

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Yellow rust of wheat and barley caused by *Puccinia striiformis* West. is a serious problem in the northern plains of India. However, it is practically absent in peninsular India mainly due to higher temperatures prevailing there. It has been established long ago (Mehta, 1929, 1940, 1952) that due to extremely high temperature prevailing in the plains of India, wheat rusts cannot survive in the plains during the summer months. Till recently it has been accepted that for all the three wheat rusts, the Himalayas are the effective source of infection. However, extensive surveys carried out since 1967 and precise mapping of the directional movement of rusts carried out during the last few years have shown that chief source of black rust infection is the south Indian hills and that the north Indian hills are of little or no significance in the epidemiology of this rust in the plains of north India (Joshi *et al.*, 1971, 1972; Nagarajan, 1973). In view of this finding it was felt desirable to re-examine the role of the Himalayas in the perpetuation of the other two rusts also and the data collected for yellow rust are presented in this article.

The studies were undertaken to identify pockets where wheat rusts, particularly yellow rust, could survive almost all the year round in the Simla hills. Various places like Galu, Theog, Matiana, Shillaru and Narkanda in Himachal Pradesh from 7000 to 9000 ft (2200 to 2800 m) a.s.l. were surveyed from 1968 to 1970. The places appear in these hills where yellow rust can survive all the year round are at around 8000 ft (2500 m) a.s.l. At higher altitudes like Narkanda (9,200 ft (2,850 m) a.s.l.), as already pointed out by Mehta (1940) this rust could not be found throughout the year due to very low temperatures. It is reasonable to presume that there are probably very few foci which are capable of harbouring yellow rust all the year round but in general yellow rust can survive within a range between 6000-8000 ft (2200-2500 m) or above, shifting up and down from one place to another as the environment changes. These conclusions are supported by the data presented in Table 1. For example rust was not observed at Narkanda (9200 ft (2850 m) a.s.l.) in the colder months from January to April, 1968 but was present at a lower altitude (8200 ft, 2550 m) at Matiana during this period. On the other hand, during the summer months of May to September it was present at Narkanda but was absent for most of the time at Theog which is situated at a lower elevation (7000ft, 2200 m).

Table 1. Monthly yellow rust position in the higher hills of Himachal Pradesh during 1968-69.

Year/ month	Theog 7000 ft. a.s.l.	Galu 8000 ft. a.s.l.	Matiana 8200 ft. a.s.l.	Shillaru 8500 ft. a.s.l.	Narkanda 9200 ft. a.s.l.
1968					
July	x	Heavy infection	Traces	x	Heavy
August	x	"	Moderate	Traces	"
September	x	"	"	x	"
October	x	"	"	x	"
November	Traces	"	"	Heavy	"
December	x	"	"	Heavy	"
1969					
January	x	Fields covered with snow Traces	x	x	x
February	x	Traces	Traces	x	x
March	Traces	Heavy	Traces	Traces	x
April	Traces	"	Traces	Traces	x
May	Traces	"	Traces	Traces	Moderate
June	Traces	"	Moderate	Traces	"
July	x	"	Moderate	Traces	Heavy
August	x	"	Traces	Traces	"
September	x	"	Traces	Heavy	"
October	x	"	Moderate	Heavy	-

x = Rust not present

Galu (8000 ft, 2500 m), about 15 km from Simla in Himachal Pradesh appears to be the only place out of all the places surveyed which supports yellow rust all the year round. In the absence of a regular wheat crop during the months of July to middle of October, it flourished very well on ratoon tillers as well as on self sown plants near the threshing floors. Wheat is sown in this area in late September and it was observed that when the regular crop was only in the 2-3 leaf stage and merely 15 days old, it had become heavily infected with yellow rust. This observation was made in both 1968 and 1969.

Races 14, 20, 38, and 57 of yellow rust isolated from the self sown plants surviving the off-season, were also met with from the regular wheat crop during the season (Table 2), thus supporting the view that infection surviving the off-season may be responsible for the epidemic on the regular crop. The presence of these races on the regular crop in the hills as well as in the northern plains provide indirect evidence indicating that the infection both in the foot-hills and on adjoining plains comes from the higher hills.

Table 2. Physiologic races of yellow rust isolated from self sown plants and regular wheat crops at different altitudes in Himachal Pradesh during the 1967-68 and 1968-69 seasons.

Site No.	Localities in Simla hills	Altitude (ft. a.s.l.)	Races isolated from the regular wheat crop	Races isolated from self sown plants
1	Galu	8000	13, 31, 38	13, 38
2	Narkanda	9200	14, 38, 57	14, 31, 38, 57
3	Shillaru	8500	14, 57	57
4	Matiana	8200	20, 38	20, 38, 19
5	Darlaghat	4500	19	
6	Bilaspur	3000	14	
7	Mandi	2800	14, 38	
8	Dharamshala	4500	14	
9	Simla	7000	14, 38	
10	Mashobra	7500	19	
11	Soghi	6500	14	
12	Dhaula Kuan	2500	14, 19	
13	Solan	5000	20	

The presence of yellow rust on off-season plants from May to November and February to December, respectively, in the higher hills of Simla in Himachal Pradesh confirms the earlier observations made by Mehta (1940). The races identified from the off-season plants have been the same as those isolated from subsequent regular crops in the hills as well as in the plains. In the light of these studies it appears logical to conclude that yellow rust survives at about 8000 ft. (2500 m) a.s.l. in the Simla hills during the off-season and is responsible for its recurrence on regular crop in the hills as well as on the adjoining plains.

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EVIDENCE OF LONG-DISTANCE DISPERSAL OF LIVE SPORES OF *PUCCINIA HORDEI* AND *P.RECONDITA* F.SP. *TRITICI*

BY

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Recently Hermansen, Torp and Prahm (1975) reported on the long-distance dispersal of live spores of *Erysiphe graminis*. A further project, along similar lines and using the same techniques is in progress (Hermansen, 1975). In 1975 notes were also taken on the appearance of rust infections and the results of these observations are given in this report.

MATERIALS AND METHODS

Seeds of Fong Tien or Edda barley and Michigan Amber wheat were sown in standard soil (Professor Fruhstorfer, type K: 60% peat, 40% clay) in 10 cm pots to give approximately ten seedlings per pot. After sowing the pots were covered with 0.03 mm polyethylene plastic bags to give an approximately 2 l air volume after attachment. The plastic bags were removed only during the period of exposure (Table 1). The bags were removed from the control pots and replaced immediately, thus the only difference between the treated plants and the control plants is the length of the exposure period. The number of control pots was between 15-20 per cent of the number of pots exposed for longer periods.

Plants were exposed at Blåvandshuk only when air mass movement from The British Isles was predicted and at a place east of Rødbyhavn only under southerly wind conditions (Fig.1). The selected exposure sites are situated in large non cereal growing areas. Following exposure, the plants were grown on in a greenhouse at air temperatures which usually lay between 15° and 25°C. Overheating of the plastic covered pots by direct sunlight was prevented by means of shading. Air trajectories were calculated at the 1000 mb-level (surface) and for long-distance sources in most cases also at the 850 mb-level (altitudes between 1000-1500 m). Prahm *et al.* (1974, 1976) have shown that particles and gases may be traced over long distances by this method.

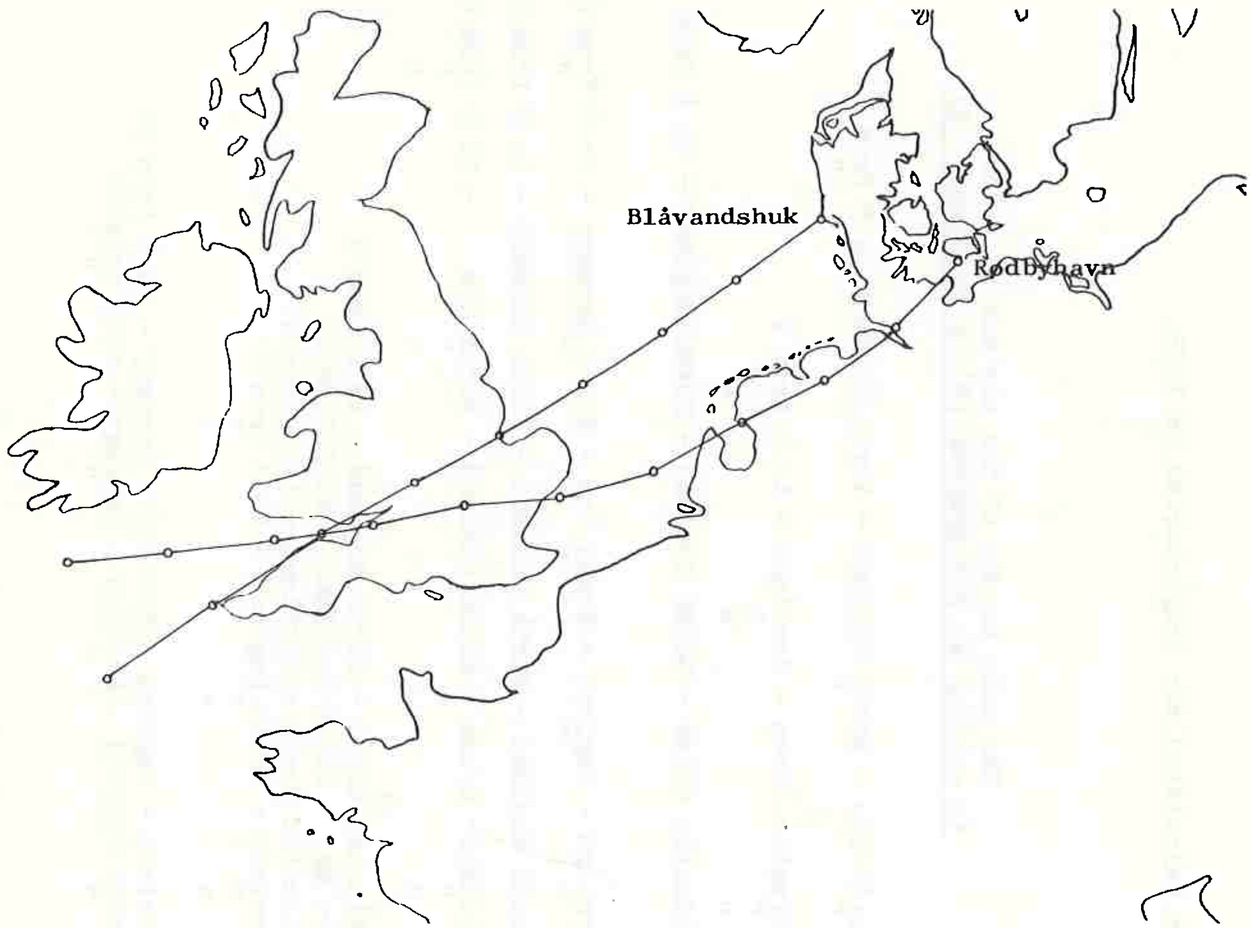
RESULTS AND CONCLUSIONS

Table 1 shows the numbers of leaf rust infections obtained on wheat and barley. No infection was obtained following exposure on 6 or 14 June, whereas exposure on 13 July and thereafter results in infection. The number of infections never exceeded 15 per 100 pots per hour. No infections occurred on the control plants. The number of *Puccinia hordei* infections was much smaller than the number of infections of *P. recondita* f.sp. *tritici* at Blåvandshuk, whereas the difference was less marked at Rødbyhavn (Table 1, fig. 1).

Table 1. Number of infections of *Puccinia hordei* and *P. recondita* f.sp. *tritici* obtained as a result of exposing susceptible barley and wheat plants at Blåvandshuk (B) and near Rødbyhavn (R) in 1975. Each pot contained approximately 20 plants.

Date and place of exposure		Hour of exposure	Length of exposure period (hours)	Number of pots exposed	Number of infections	Calculated number of infections per 100 pots per hour
June						
6	R	11.30	5	40 barley	0	0
14	B	23.30	9½	30 barley	0	0
14	B	"	"	10 wheat	0	0
July						
13	R	8.00	7	30 barley	11	4
13	R	"	"	1 wheat	0	0
15	B	7.30	7½	30 barley	0	0
15	B	"	"	16 wheat	13	11
21	B	19.00	13	40 barley	2	0.4
21	B	"	"	28 wheat	12	3
22	R	18.00	13	40 barley	46	9
22	R	"	"	3 wheat	6	15

Fig. 1. Trajectories of air masses arriving at Blåvandshuk July 15, 11.00 hours and at Rødbyhavn July 22, 01.00 hours respectively (local time). Starting at Blåvandshuk or Rødbyhavn each point covers the preceding three hours. Other trajectories, calculated for other air masses arriving a few hours earlier and later than those in the figure were similar (see Table 2).



All exposures (except that of 6 June) were subsequent to showers or periods of light rain at the supposed source areas (Table 2). Had dry weather prevailed at the source areas, greater numbers of infections might have appeared on the exposed plants. No yellow rust infections appeared. This might have been because day temperatures in the greenhouse where the exposed plants were placed often exceeded 20°C.

Table 2. Tabulated information from calculated air trajectories in 1975.

Arrival time of traced air masses: date	local time	Level in mb	The main tracks of the air masses prior to arrival at Blåvandshuk (B) or Rødbyhavn (R)	Approx. time (h) taken by air mass to cross the sea (from coast of source area)
June				
6	13	1000	North Sea - North Holland - North Germany to R from S	3
6	16	1000	" " " "	3
14	23	1000	Atlantic Ocean - Scotland - to B from W	18
14	23	850	" " "	14
15	19	1000	" " "	22
15	19	850	Atlantic Ocean - North Ireland - North England - to B from W	20
July				
13	10	1000	Ireland - England - North Sea - North Germany - to R from SW	3
13	13	1000	" " " " "	3
13	16	1000	South England - North Holland - North Germany - to R from SW	3
15	7	1000	Atlantic Ocean - South England - North Sea - to B from SW	13
15	11	1000	" " " "	12
15	15	1000	" " " "	9
21	19	1000	Atlantic Ocean - North England - to B from W	39
21	19	850	Ireland - South Scotland - to B from W	24
22	1	1000	Atlantic Ocean - Scotland - to B from W	21
22	1	850	Ireland - North England - to B from W	16
22	7	1000	" " "	16
22	7	850	" " "	16
22	19	1000	Ireland - England - Holland - Germany - to R from SW	1
23	1	1000	South England - Holland - Germany - to R from SW	1
23	7	1000	" " " "	1

The main tracks of the air masses arriving at Blåvandshuk and Rødbyhavn in the periods of the exposure are outline in Table 2. The results strongly indicate that the obtained infections were caused by spores crossing either the North Sea or the Fehmern Belt. This means that spores of pathogenic races of important rust fungi such as *P. hordei* and *P. recondita* may be quickly carried by wind to distant areas where they may cause infection and multiply if a suitable host is present. The results support the hypothesis forwarded by Hermansen and Wiberg (1972) that late attacks of barley leaf rust on the Faeröes are due to spores of exophytoic origin from either the British Isles or northern-continental Europe.

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RECOVERY AND IDENTIFICATION OF PHYSIOLOGIC RACES OF *PUCCINIA HORDEI* FROM WINTER BARLEY

BY B.H. TAN

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It is now believed that the barley leaf rust organism, *Puccinia hordei* Otth overwinters in winter barley and that its putative alternate host, *Ornithogalum* spp., appears unimportant in its perennation in temperate Europe. Indirect evidence for this comes from observation of occasional uredia on winter barley plants during the winter months as well as from experiments involving artificial infection and subsequent urediospore recovery from winter barleys (Gassner and Pieschel, 1934; Simkin and Wheeler, 1974; Parlevliet and Ommeran, 1976).

This communication reports on the identification of naturally occurring strains of *P. hordei* recovered directly from a crop of winter barley during the winter months.

MATERIALS AND METHODS

Each week between 24 November 1975 and 29 March 1976, a random sample of about 20 seemingly healthy leaf tissues were harvested from the same crop of cv. Vogelsanger Frueh winter barley, sown adjacent to the Institute in late September 1975. When sampling commenced seedlings were in the 2-3 leaf stage, and leaf rust pustules were conspicuous on the first leaves. The disease presumably had resulted from infections spread from rusted stubble of the previous spring barley crop in the vicinity. However, by mid-December '75 the first and second leaves had been replaced and leaf rust (but not mildew) was no longer evident. The second and third seedling leaves were sampled at the beginning of the experiment but towards the conclusion, the third and fourth leaves of tillers. Isolated pustules were observed on the older leaves in March 1976.

Initially each leaf tissue was divided into two 2 cm segments, one of which was prepared for histological examination, but this was subsequently discontinued on account of interference from mildew infections. The second leaf segment was floated on a 40 p.p.m. benzimidazole solution in a sterile Petri dish and incubated at 20°C with continuous light. Mycelia of leaf rust (and mildew), if present, sporulate after 5-8 days under such conditions. The number of uredia so recovered ranged from nil (for week 1 and 3) to over 30 per 20 2 cm leaf segments per week. Single isolated pustules were selected and increased on susceptible barley seedlings. Of about 70 pustules recovered 36 were increased for tests and cryogenic storage. A conglomeration of smaller pustules around a single larger one was occasionally encountered (cf. Parlevliet and Ommeran, 1976), but subsequent tests gave no evidence to suggest heterogeneity when such a conglomeration of pustules were bulked, which justified scoring these as a single pustule.

The barley varieties chosen to differentiate the isolates included those proposed by Clifford (1974) as well as several others used previously by other workers.

RESULTS

None of the 36 isolates could attack Estate C.I.3410 (Pa3) or Cebada Capa C.I.6193 (Pa5), but all were virulent on Sudan C.I.6489 (Pa1), Speciale C.I.7536 (Pa1), Oderbrucker C.I.940 (Pa1), Reka 1 C.I.5051 (Pa2), Weider C.I. 1021 (Pa2), Ariana C.I.2524 (Pa2), Gold C.I.1145 (Pa4), Lechtaler C.I.6488 (Pa4), Franger C.I.881 (Pa4), Akermann's Bavaria H.276 (Pa4 ?), Heil's Franken H.49 (Pa4 ?) and Egypt 4 C.I.641 (Pa ?). For this reason their reactions are not shown in the table below. The chief variation revolves around the responses of Bolivia C.I.1257 (Pa2 + Pa6) and Quinn C.I.1024 (Pa2 + Pa ?) (Table 1).

Table 1. Reactions of barley differentials to field isolates of *P. hordei* at 20°C and 16-hour day.

Unified Race	UN 23							UN 30		UN 21			UN 14		
variant	1	2	3	4	5	6	7	1	2	1	2	3	1	2	3
Bolivia C.I.1257	S	S	S	S	S	S	S	S	S	R	R	R	R	r	R
Quinn C.I.1024	S	S	S	S	S	S	S	R	R	S	S	S	r	r	R
Peruvian C.I.935	S	r	S	S	S	S	S	S	S	s	r	R	S	S	s
Akermann's H.278 Isaria	S	S	S	S	S	S	R	S	S	S	r	S	S	S	S
Chilean D C.I.1433	S	S	S	S	S	S	S	s	R	s	S	R	S	S	s
Kinver C.I.2367	S	S	S	S	S	r	S	S	S	S	S	S	S	s	r
Batna C.I.3391	S	S	S	S	S	S	S	S	r	r	S	S	S	S	r
Taurus H.499	S	S	S	S	r	r	r	R	r	r	r	r	s	r	R
Cavolina H.3067	S	S	S	R	S	R	r	R	R	R	R	r	r	r	R
Ricardo C.I.6306	S	r	r	r	r	r	r	r	r	r	r	-	r	r	r
HOR 500-Sel.	R	S	R	R	R	R	R	S	R	R	R	R	S	R	R

C.I., U.S.D.A. Introduction
H., M.P.I.'s *Hordeum* accession
HOR , Gatersleben's *Hordeum* accession

R, resistant
S, susceptible
r, moderately resistant
s, " susceptible
-, not tested

Within each of the four possible resistant:susceptible combinations involving these two varieties, further discrimination between some of the isolates was possible with additional varieties so that, effectively, a total of 15 variants could be distinguished from four Unified Numeration races - designated UN 14, UN 21, UN 23 and UN 30, according to the key of Levine and Cherewick (1952). The additional differential varieties were not chosen at random; their resolving powers had in fact previously been evaluated by the author from tests involving over 20 cultures originating from Europe, U.S.A., Argentina and Australia. Other varieties examined but which gave susceptible responses to each of the 36 isolates included Australische 2-zeilige H.777, Berg C.I.6486, Cruzat H.2815, Featherstone C.I.1120, Juliaca C.I.1114, and Samaria C.I.6493. Two of the three supplemental differentials adopted by Nover and Lehmann (1974), viz. HOR 679-Sel. and HOR 1132-Sel., were, on the other hand, resistant "across the board".

DISCUSSION

The direct recovery of *P. hordei*, without prior artificial infection, from leaf tissues of winter barley supports the view that this fungus survives winter, supposedly in the form of dormant uredio-mycelia, in this primary host. What remains unanswered is the process or mechanism by which the organism infects emerging young leaf tissues in the cold months. Pustules could be recovered from these tissues in January and February; these tissues had not yet developed when aerial inocula were present in September and October the previous year. Moreover, the weekly deployment of mobile nurseries near the sampling site failed to detect wind-borne urediospores between mid-November 1975 and mid-March 1976. Could new infections during the cold period involve some unknown "internal" mechanism or process? The 1975-76 winter in Cologne was somewhat colder than normal with several snow precipitations, including a cover which persisted for two weeks. It is doubtful if pustulation could occur under these conditions and, if it did, that urediospores would remain infective for any reasonable period of time.

The recognition of at least 15 variants in a rather limited sample clearly reflects the considerable genetic variability inherent in the local population of *P. hordei*. The fact that only varieties with resistance genes Pa3 or Pa5 showed resistance demonstrates their high degree of virulence as well. Implicitly this situation is congenial for screening barley introductions and breeding materials for race-specific types of resistance to this pathogen. The disease moreover reaches epiphytotic levels almost yearly. In our 1975 spring barley planting, all entries were severely rusted with the exception of those purportedly carrying Pa3 (e.g., Estate, Aim, Rika x (Baladi 16 x Rika), Barley 16, Aegyptische Braugerste) or Pa5 (e.g., Cebada Capa, Dabat, France 7, France 21, H2212), and several others of unknown genotypes (e.g., Gondar, La Estanzuela, Abyssinian Schwarz, Forrajera, Addis Allem, Uadera, Ab 14, etc.). The predominant strains identified in last year's epiphytotic were UN 21 and UN 23, and this is consistent with their occurrence in winter barley in the ensuing winter.

Although the present work suggests that certain barley varieties were efficacious in resolving hidden differences between isolates of the same UN group. Their adoption as standard or supplemental differentials is not proposed at this stage for any candidate variety should possess a major resistance genes demonstratably different from any of those already established by Roane and Starling (1967). The study nonetheless underscores the inadequacy of North American differentials in the European context (Clifford, pers. comm.).

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SOME OBSERVATIONS ON THE OCCURRENCE OF YELLOW RUST OF WHEAT, *PUCCINIA STRIIFORMIS*, IN CAMBRIDGE IN THE EARLY 1930's

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These previously unpublished observations on the incidence of yellow rust of wheat, *Puccinia striiformis* West. (formerly known as *P.glumarum* (Schm.) Erikss. & Henn.) were made at the Botany School Field Station, Cambridge, in 1932, 1933 and 1934 on wheats from the (then) Plant Breeding Station.

OBSERVATIONS

Three species wheats and twenty-nine cultivars were grown in rows in a bird-proof cage, and weekly observations made of the dates when yellow rust pustules appeared for the first time on the leaves and the final degree of severity of the infection. The maximum day temperatures were also recorded. Table 1 sets out these results in order of increasing severity of the infections in the first year of the observations. The degree of severity was recorded on a scale based on that of Hungerford & Owens (1923).

RESULTS

SPECIES

T.monococcum was not infected, *T.sphaerococcum* and *T.dicoccum* had a trace of infection, but only in 1932, and *T.dicoccum* was severely infected in 1933.

CULTIVARS

The dates on which pustules were first noted were not the same in each year, neither were the susceptible varieties infected to the same extent. In 1932 twenty-seven cultivars showed some degree of infection and many were severely infected. Pustules were first observed in mid May on only one cultivar, White Drotting. All the other susceptible cultivars showed pustules some time during June.

All those cultivars which were susceptible in 1932 were again susceptible in 1933, but not always to the same extent. The earliest infection was found in March on Cambridge Rivet,White Drotting and Wilhelmina. Infections on the other cultivars were found in April, May and June.

Some cultivars such as Yeoman were infected on the same date in both 1932 and 1933, and to the same degree of severity. In others, such as April Bearded, the date of the first appearance of pustules differed by the degree of infection was the same, whereas Squareheads Master showed pustules on different dates and the final degree of severity of infection was also different.

Table 1. The incidence and severity of yellow rust on wheat species and cultivars at the Botany School Field Station, Cambridge.

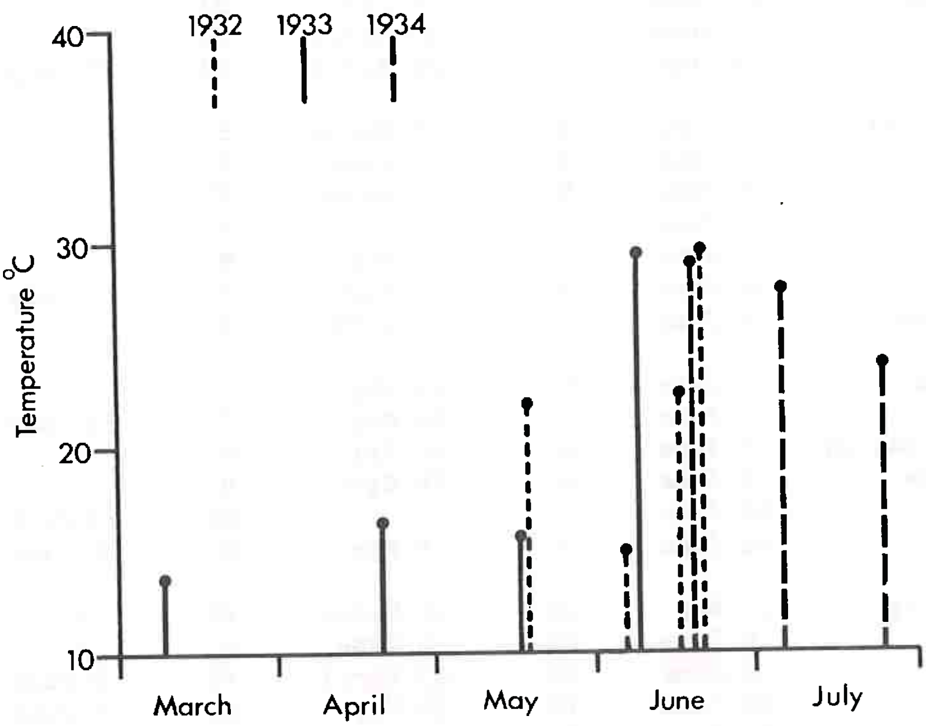
Cultivar	Date	Severity	Date	Severity	Date	Severity
American Club	-	N	6 June	T	-	N
Iumillo	-	N	-	N	-	N
White Spelt	-	N	-	N	-	N
T. monococcum	-	N	-	N	-	N
T. dicoccum	22 June	T	?	S	-	N
T. sphaerococcum	22 June	T	-	N	-	N
Iron	6 June	Sl	26 April	Sl	-	N
Joss 4	6 June	Sl	26 April	Sl	-	N
Kubanka	6 June	Sl	26 April	Sl	-	N
April Bearded	16 June	Sl	26 April	Sl	-	N
Brevit	16 June	Sl	26 April	Sl	-	N
Polish	16 June	Sl	26 April	Sl	23 July	T
Cambridge Rivet	6 June	M	10 March	S	-	N
F11.W76.10B	6 June	M	6 June	T	-	N
Wilhelmina	6 June	M	10 March	M	-	N
Yeoman	6 June	M	6 June	M		
Democrat	16 June	M	14 May	M	-	N
Hussar	16 June	M	26 April	M	23 July	T
Mediterranean	16 June	M	26 April	M	-	N
J.P.Turgidum	6 June	S	14 May	S	-	N
Malakoff	6 June	S	14 May	S	23 July	T
Squareheads Master	6 June	S	26 April	M	-	N
Chinese White	6 June	S	26 April	M	-	N
Loros	16 June	S	?	Sl	23 July	M
Norka	16 June	S	16 May	S	18 June	M
White Drotting	17 May	VS	10 March	VS	-	N
Grey Spelt	6 June	VS	6 June	S	-	N
Rivet 23	6 June	VS	23 April	VS	6 July	T
Corina	16 June	VS	14 May	VS	6 July	S
Webster	16 June	VS	14 May	M		

Scale of infection used to record degree of severity:

N, none; T, trace (a few very small pustules sometimes accompanied by very small chlorotic areas); Sl, slight (more pustules, widely scattered); M, moderate (larger pustules, leaf obviously infected); S, severe (large pustules, abundant, growing well, free sporing); VS, very severe (leaf surface covered with pustules, free sporing).

In contrast, there was very little yellow rust in 1934. Seven cultivars showed some pustules, but only Corina was severely infected. The first infection was not seen until mid June and some cultivars were not infected until July. Fig.1. shows the maximum day temperature on the first day of infection. Again there were differences between the three years. The infections in the early months of 1933 occurred at lower temperatures than the later infections in the same year and all the infections in 1934, and the temperatures on the dates of first infections in 1932 did not bear any close relation to those of the two other years.

Fig. 1. Maximum temperatures at Cambridge on days when yellow rust was first recorded on any wheat species or cultivar in 1932, 1933 and 1934.



DISCUSSION

The differences over the three years in the date of first infection, the maximum day temperature at the time and the degree of severity of infection suggested that more than one form of yellow rust was present in Cambridge in 1932, 1933 and 1934. Some attempt, using wheat cultivars available in Cambridge, was made to begin to identify forms, but no real progress was made until after the publication in 1932 by Gassner and Straib of their work on physiologic specialisation in *P.striiformis*. They kindly sent seed of their cultivars to Professor Brooks and when their cultivars were used as differentials hosts, ten 'physiologic forms' (now known as physiologic races) were isolated from samples of yellow rust collected from wheats in Cambridge and elsewhere in England and Wales. An account of this investigation will be published later.

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