CEREAL RUSTS BULLETIN

EDITED BY

G. E. RUSSELL

VOLUME 9 PART 1

PUBLISHED BY
THE EUROPEAN AND MEDITERRANEAN CEREAL RUSTS FOUNDATION

CONTENTS

EDITORIAL

Both parts of Volume 9, which are being published simultaneously, consist of research papers and several brief reports of the cereal rust situation in 1980 in different parts of the European and Mediterranean region. It is hoped that these reports will enable readers to keep in touch with the recent rust situation in other countries.

I would like to emphasise that the future of the Cereal Rusts Bulletin depends on a constant supply of suitable research papers and reports of general interest. Please send contributions as soon as possible to my successor, Dr. Norman Chamberlain at the address below:

Dr. Norman Chamberlain,
Editor, Cereal Rusts Bulletin,
Rothwell Plant Breeders Ltd.,
Rothwell,
Lincoln, LN7 6DT,
England.

Professor G.E. Russell
Department of Agricultural Biology
The University
Newcastle upon Tyne NE1 7RU
England

Gordon E. Russell
October 1981

SUBSCRIPTIONS

The Bulletin is published twice a year and is sent directly to subscribers on payment of an annual subscription. Alternatively, orders can be placed through booksellers at extra cost. Enquiries regarding subscriptions and orders should be sent to Dr. J.E. Parlevliet, Treasurer, European and Mediterranean Cereal Rusts Foundation, Institute of Plant Breeding, 166 Lawickse Allee, Wageningen, The Netherlands.

Cereal Rusts Bulletin Vol. 9, Part 1, 1981

PRESENCE IN MOROCCO OF BROWN RUST, PUCCINIA HORDEI, WITH A WIDE RANGE OF VIRULENCE TO BARLEY

BY J.E. PARLEVLIET[1], J.G. v.d. BEEK[2] AND R. PIETERS[2]

[1] Institute of Plant Breeding, Agricultural University, Wageningen, The Netherlands, and
[2] Direction de la Recherche Agronomique, Rabat, Morocco.

SUMMARY

Two cultures of brown rust, *Puccinia hordei*, collected from the barley cultivars Aim, carrying *Pa3*, and Cebada Capa, carrying *Pa7*, near Rabat, Morocco, were virulent on eight of the nine recognized *Pa* resistance genes. The virulence on cultivars carrying *Pa7* is especially remarkable as no virulence to this gene has previously been reported from brown rust on cultivated barley.

The latent period, one of the components of partial resistance, also showed small race-specific effects. On the cultivars Peruvian, Bolivia and Vada the standard race 1-2-1 gave a significantly longer latent period than on typical susceptible cultivars like Sultan and Gold. With the two Moroccan cultures this difference in latent period disappeared completely for Peruvian and Bolivia and was reduced somewhat for Vada.

INTRODUCTION

Resistance of barley to brown rust caused by *Puccinia hordei* can be classified into two types, the hypersensitive or low-infection type resistance and the partial resistance. The former is controlled by major genes (Parlevliet, 1976), the latter by polygenes (Parlevliet, 1978).

At present, nine major genes causing a low-infection type of resistance have been identified. They are designated as *Pa* genes (Parlevliet, 1976; Clifford, 1977; Tan, 1977b). Most brown rust populations, wherever tested, lack virulence against *Pa7*, although races virulent on *Pa7* have been obtained in Israel from the alternate host *Ornithogalum* (Golan *et al*., 1978); most populations also show a low to very low frequency of virulence to *Pa3* and *Pa9*, while the frequency of virulence against the other *Pa* genes varies from moderately high to very high (Clifford, 1974; Rintelen, 1975; Parlevliet, 1976;

Tan, 1977a, b; Ceoloni, 1979; Walther, 1979). *Pa9* has been used in commercial cultivars, but within four years the corresponding races of the pathogen appeared (Walther, 1979).

The European Barley Disease Nurseries (1981) were planted and evaluated in Rabat, Morocco, within the scope of a horizontal resistance breeding programme in barley. All barley cultivars carried brown rust, including those cultivars carrying *Pa3* and *Pa7*. Most barley plants showed barley yellow dwarf virus symptoms and it seemed that the virus infection may have made the barley plants more susceptible to brown rust.

In order to study the virulence spectrum of the brown rust on the assumed resistant cultivars, leaf samples carrying urediosori were collected from cultivars carrying *Pa3* and *Pa7*.

MATERIALS AND METHODS

Urediospores of dried leaf samples collected at Rabat were transferred to seedlings of the universally susceptible cultivar L98 and incubated at 100% RH during one night. This resulted in two cultures, one from Cebada Capa, a *Pa7* carrier (Mor-1), and the other from Aim, a *Pa3* carrier (Mor-2). Spores of the two cultures were transferred for further multiplication to seedlings of Cebada Capa and cultivar Ribari carrying *Pa7* and *Pa3* respectively. This was done to prevent any contamination from other brown rust cultures at Wageningen, which are all avirulent on cultivars carrying *Pa3* or *Pa7*.

Seedlings of the differential set of cultivars (Clifford, 1977) to which cv. Vada was added, were inoculated with urediospores of three cultures, race 1-2-1 and the two Moroccan cultures Mor-1 and Mor-2. This was done twice. The Moroccan cultures were derived from several spores present on the dried leaves of Cebada Capa and Aim. The spores of culture Mor-1 used in the second series of seedlings were derived from a single urediosorus. The inoculated seedlings were kept at 100% RH for approximately 16 hours.

The infection types (IT) were scored using the 0-9 scale of McNeal *et al.* (1971), where 0-3 designate a resistant, 4-7 a moderately resistant and 8-9 a susceptible IT. On seven cultivars the latent period, as described by Parlevliet (1975), was measured.

RESULTS AND DISCUSSION

Race 1-2-1 is the standard race used in our barley-brown rust research in Wageningen and is very common in Western Europe. From Table 1 it can be seen that it is avirulent on *Pa3*, *Pa7* and *Pa9*. *Pa3* and *Pa7* react with small necrotic flecks, *Pa9* with very small urediosori surrounded by chlorotic tissue. The cultivars Peruvian and Bolivia have a susceptible IT although the urediosori appear later and more irregularly, expressed as a longer latent period (LP) as shown in Table 1. This longer LP cannot be due to *Pa2* because Quinn does not show this increased LP.

The two Moroccan cultures resembled one another very strongly. They were virulent on all *Pa* genes except *Pa9* (Table 1). The longer LP of Peruvian and Bolivia completely disappeared with both cultures (Table 2). On Vada the LP was still significantly longer than on the other cultivars, although somewhat reduced compared with the LP of 1-2-1 on Vada. The mono-pustule culture derived from culture Mor-1, and used in the second series, differed in one respect from the original culture; it had a reduced IT on Gold. The brown rust samples collected, although very similar in their behaviour, were genetically not completely uniform.

Table 1 Infection types of seedlings of 11 barley cultivars inoculated with urediospores of three cultures of *Puccinia hordei*.

Cultivar	*Pa*-resistance gene	Culture 1-2-1	Culture Mor-1	Culture Mor-2
Sudan	*Pa*	8-9	9	9
Peruvian	*Pa2*	9	9	8-9
Ribari	*Pa3*	1	9	9
Gold	*Pa4*	9	8-9/4-7[a]	9
Quinn	*Pa2* + *Pa5*	8	9	9
Bolivia	*Pa2* + *Pa6*	8-9	9	9
Cebada Capa	*Pa7*	2	9	9
Egypt IV	*Pa8*	8-9	8-9	8-9
CI 1243	*Pa9*	4-7	5-8	6-8
Sultan	-	9	9	9
Vada	-	9	9	9

[a]8-9 in first, 4-7 in second series.

The Moroccan brown rust cultures showed two highly interesting features. First, their virulence spectrum on *Pa* genes is unusually wide, although no such resistance genes have been used in North Africa. The virulence against Pa7 is particularly important, as this gene is being introduced by several breeders into commercial cultivars. These breeders started to use this gene as it was reported to be effective everywhere except in Israel, where races with a virulence spectrum similar to the Moroccan cultures were found from the alternate host (Golan *et al.*, 1978). Although the virulence spectrum appears to be the same, the Moroccan cultures seem better adapted to cultivated barley than the cultures from Israel. The latter caused, on all cultivars tested, a significantly longer LP than 1-2-1 and on Cebada Capa the IT was only a 7 to 8. The Moroccan cultures gave a LP similar to or even shorter than that of 1-2-1. The slightly longer LP of Mor-2, compared with those of Mor-1 and 1-2-1, was almost certainly due to a much lower density of urediosori. This lower density was a result of the small amount of inoculum of Mor-2 available. Pustule density is known to influence LP considerably (Parlevliet, 1975).

Table 2 Latent period, in days, of seedlings of seven barley cultivars inoculated with urediospores of three cultures of *Puccinia hordei*.

Cultivar	Pa-resistance gene	Culture 1-2-1	Culture Mor-1	Culture Mor-2
Sultan	-	6.6	6.8	7.1
Gold	Pa4	6.7	6.8	7.0
Ribari	Pa3	-	6.8	7.0
Cebada Capa	Pa7	-	6.9	7.1
Vada	-	8.2	7.6	7.8
Peruvian	Pa2	8.1	6.9	7.0
Bolivia	Pa2 + Pa6	8.5	6.8	7.3

For the breeders planning to use, or already using, major genes such as Pa7 in their breeding programmes, these Moroccan cultures provide a warning. Apparently none of the present Pa genes form a serious barrier to the pathogen.

The second interesting feature is the effect of the Moroccan cultures on the LP of the cultivars Bolivia, Peruvian and Vada. These cultivars have with race 1-2-1 a relatively long LP, whereas with the Moroccan cultivars the LP is either somewhat shorter (Vada) or fully reduced to those of Sultan and Gold. This represents a race-specific effect. Partial resistance of barley to brown rust resembles in many aspects the horizontal resistance (HR) described by Van der Plank (1968). True HR, however, does not allow for such race-specifi effects. In the barley-brown rust relationship such small race-specific effects have been reported before (Clifford & Clothier, 1974; Parlevliet, 1977; Aslam & Schwarzbach, 1980). How far the presence of such small race-specific effects affects the assumed durability of partial resistance has been discussed elsewhere (Parlevliet, 1981).

REFERENCES

ASLAM, M. & SCHWARZBACH, E. (1980). Specificity of quantitative interactions between brown rust isolates and barley varieties. Proc. Fifth Eur. and Mediterranean Cereal Rusts Conf., Bari and Rome, pp. 123-127.

CEOLONI, C. (1979). Puccinia hordei in Italy: A preliminary survey on the virulence characteristics of the fungus in our country. Cereal Rusts Bull. 6: 11-16.

CLIFFORD, B.C. (1974). The choice of barley genotypes to differentiate races of Puccinia hordei Otth. Cereal Rusts Bull. 2: 5-6.

CLIFFORD, B.C. (1977). Monitoring virulence in Puccinia hordei; a proposal for the choice of host genotypes and survey procedures. Cereal Rusts Bull. 5: 34-38.

CLIFFORD, B.C. & CLOTHIER, R.B. (1974). Physiologic specialization of Puccinia hordei on barley hosts with non-hypersensitive resistance. Trans. Brit. Myc. Soc. 63: 421-430.

GOLAN, T., ANIKSTER, Y., MOSEMAN, J.G. & WAHL, I. (1978). A new virulent strain of Puccinia hordei. Euphytica 27: 185-189.

McNEAL, F.H., KONZAK, C.F., SMITH, E.P., TATE, W.S. & RUSSELL, T.S. (1971). A uniform system for recording and processing cereal research data. U.S.D.A. Agr. Res. Serv. Wash. DC. ARS. 34-121, 42 p.

PARLEVLIET, J.E. (1975). Partial resistance of barley to leaf rust, Puccinia hordei. I. Effect of cultivar and development stage on latent period. Euphytica 24: 21-27.

PARLEVLIET, J.E. (1976). The genetics of seedling resistance to leaf rust, Puccinia hordei Otth., in some spring barley cultivars. Euphytica 25: 249-254.

PARLEVLIET, J.E. (1977). Evidence of differential interaction in the polygenic Hordeum vulgare - Puccinia hordei relation during epidemic development. Phytopathology 67: 776-778.

PARLEVLIET, J.E. (1978). Further evidence of polygenic inheritance of partial resistance in barley to leaf rust, Puccinia hordei. Euphytica 27: 369-379.

PARLEVLIET, J.E. (1981). Race-non-specific disease resistance. In Strategies for the Control of Cereal Disease, (ed. Jenkyn, J.F. and Plumb, R.T.). Blackwell Scient. Publ. Oxford, pp. 47-54.

RINTELEN, J. (1975). Physiologic specialization of Puccinia hordei Otth. and reactions of barley varieties and cultivars to physiologic races. In Barley Genetics III.(ed. Gaul, H.).Karl Thiemig, Münich, pp. 464-467.

TAN, B.H. (1977a). Evaluating host differentials of Puccinia hordei. Cereal Rusts Bull. 5: 17-23.

TAN, B.H. (1977b). A new gene for resistance to Puccinia hordei in certain Ethiopian barleys. Cereal Rusts Bull. 5: 39-43.

VAN DER PLANK, J.E. (1968). Disease Resistance in Plants. Academic Press, New York and London. 206 p.

WALTHER, U. (1979). Die Virulenz- und Resistenzgensituation bei Puccinia hordei West. Archiv für Züchtungsforschung 9: 49-54.

Cereal Rusts Bulletin Vol. 9, Part 1, 1981

DIFFER: A PROCEDURE TO FIND NEW DIFFERENTIAL VARIETIES IN LARGE CULTIVAR-ISOLATE REACTION MATRICES

BY P. KAMPMEIJER

Research Institute for Plant Protection, Wageningen, The Netherlands

INTRODUCTION

Each year the Research Institute for Plant Protection (IPO) receives a large number of wheat leaf samples with yellow rust (*Puccinia striiformis*). Isolates from these samples are tested on a range of differential varieties. By means of the reactions on the differential varieties the virulence genotype of an isolate is determined (Johnson *et al*., 1972). The resistance of varieties to yellow rust is regularly broken by a new race of the disease. Often it is not possible, with the existing set of differential varieties, to differentiate the new race from former races. In such cases an additional differential variety is needed.

Rust samples from Asia and Africa showing differences in the field cannot be distinguished with the differential varieties as selected by Johnson *et al*. They are currently tested on a relatively large number of varieties grown or selected in both continents. However, to keep up with the stream of incoming samples the number of differential varieties should be as small as possible.

A procedure to define new differential varieties will be described here. The procedure is implemented as a computer program. The program can assign a completely new set of differential varieties or it can begin with a predefined set of differential varieties. Then the program tests whether this set suffices for the current data and, if not, assigns additional differential varieties. The program is written in FORTRAN and can be supplied by the author.

METHOD

Greenhouse data for yellow rust reactions are scored on a 0-9 scale. The scores 0-3 refer to the resistant reactions, 4-6 to moderate resistant to moderate susceptible reactions, and 7-9 to susceptible reactions (McNeal et al., 1972). For simplicity, this scale is reduced to two values: resistant (0-6) and susceptible (7-9), as is usual in yellow rust identification (Johnson et al., 1972). The borderline between resistant and susceptible can be changed if necessary. As a consequence of the reduction to only two reaction classes, resistant and susceptible, reaction patterns that were different, may appear to be identical. Of the identical varieties and identical isolates all but one are left out of the procedure.

In the data matrix thus remaining, the program searches for the variety with equal numbers of resistant and susceptible reactions, or the closest approximation to this. Addition of a second variety will result in the reaction patterns R-R, R-S, S-R and S-S. The variety that produces equal groups is the next best choice. In each subsequent iteration loop the isolates are subdivided in such a way that resistant/susceptible combinations are cut into groups that are as equal in size as possible. This process goes on until all isolates are uniquely defined. Finally, a determination key for the isolates is printed. In Fig. 1 a sample output of the program is given.

DISCUSSION

If all combinations of resistance genes are present in the varieties tested, the procedure leads to one minimum in which the differential varieties have monogenic resistance. If not all combinations of resistance genes are present (the usual situation), the procedure does not in all cases lead to the minimum number of differential varieties. Sometimes several retries with different starting points are needed to find this smallest number. As each run of the program takes only a few seconds, the number of retries is not a limiting factor.

The problem to find the minimum number of differential varieties from a matrix of variety-isolate reactions has some interesting mathematical implications. It is a practical application of the Minimum Test Set Problem as defined by Garey & Johnson (1979). They proved that the Minimum Test Set Problem is NP-complete. This means that an algorithm to find the minimum test set within a reasonable time has not yet been found. The only way to find a minimum solution is to try all possible combinations. The proof, that a certain solution is a minimum solution, is obtained only by evaluation of all the possible combinations, thus solving the whole problem again. The number of iteration steps needed to find the minimum solution is in the worst case 2**n, where n is the number of varieties. The number of isolates is of less

Fig. 1a   Complete table of "reduced values" as produced by DIFFER

The rows are the varieties, the columns the isolates.
Rows and columns contain a sequence number as label.

* = susceptible;   ? = missing value

```
             22334   122344 1122344111355112333341122344424
        345681779312770282798938656056201346014591245301498

 12                                       *       * **    *
 22                             * *  *     * *      **     *
  1                                     ***   ***  *****   **
  9                                   *  ** ****  * *** ****
 16                             **     * * *      ***** *****
 23                                   * ** * ******  * ** * *
 33                            **  *    *    ** ****  ***  **
 29             *        *  *      ** *    *     * *** ******
 30                             ***   **   ** **   **** ** **
 13                           * **   **    ** **   *********
 18                           *     *     *  **** **** **** ***
 20                             *  *   ***   ******  ****  ** *
 31       * *   * **       * * *         **   **    ** ****
  3                               *    * ***    *********** ***
  4                  *      *   *  * * *    ** * **********
 14                                     * * *** ** ************
 24                    *       **   * *  ***  ****** *****?
  2                                    * ***** ******* ***** **
  7                                  * *  ***  ************** *
  8                                   *  ****  ****************
 28     ** *****  ** ** ** *           * *      ***     **
 10                **   ** *   * * ** * *** ** *  * *  ****
 11                   * ?*   ** *   ****** * ** ** * *  * ****
 15                       *    *      *********** ** * *******
 35                    *     *     * ***  *****  *************
 21                             * ***  ******** *** ****** ****
  5                  *  *         ***** * ********** *********
 17                              *********  *************** **
 36                    ** *   ** ***** ** ?*?********?***** **
 19                       *    ***********  ******************
 32                     *      * **** ************************
 25                    *     ** ************************ *****
  6      *   *      ***  * * * ****************************
 27        ?    ***   **   **** ***************************
 34     **         **   ********************** ************
 37      *     * *****  ****** ********** ** ***** ********
 26        ****?**** **** * **** **************************
```

Fig. 1b   Computed results produced by DIFFER

```
File       : EXAMPL
Varieties  : 37
Isolates   : 51
```

RESULT:

Differential varieties:

```
   6  15  28  29  31  33  10  37  20  34
  35  27
```

Remaining duplicate isolates: 0

Determination key of the isolates:

```
        241145433441213321351 1 4 122424312 3212   33  43 24
        943290853105542060116192471054649876287218873679533

  6     ************************************
 15     *********************               **
 28     ******               *******          ********
 29     ****  ******         *      ***     * *       *
 31     ***   ****  **        *        ***     ***     **
 33     *   * *** * * ***    *      *  **                *
 10     ****  ** * ***** ***  **    *    **    *  *
 37     **  *********** **********  ******** * ** **  *   *
 20      ***  *  * *** **** **       * * *   *
 34     *************************   *** **** * *  * * *  *
 35     **************  ** * *       ***  **          *
 27     ***********************   * *****  ***  *    ? * **
```

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importance for the worst case, but it does influence the fraction of 2**n that will be needed. Consequently for larger matrices ($n > 40$) (as is mostly the case here) it is often impossible to prove that the solution found is a minimum solution. Lageweg (pers. comm.) constructed a "branch and bound' algorithm fitted to the Minimum Test Set Problem to give a proof for medium-sized matrices ($n < 40$).

When a proof of minimum is not needed and only an approximation of the minimum is already an improvement over the current situation, then the procedure outlined here is a good alternative.

REFERENCES

GAREY, M.R. & JOHNSON, D.S., (1979). Computers and intractability. A guide to the theory of NP-completeness. Freeman Co., San Francisco, pp 337.

JOHNSON, R., STUBBS, R.W., FUCHS, E. & CHAMBERLAIN, N.H. (1972). Nomenclature for physiologic races of *Puccinia striiformis* infecting wheat. Trans. Br. Mycol. Soc. 58 (3): 475-480.

McNEAL, F.H., KONZAK, C.S., SMITH, E.P., TATE, W.S. & RUSSEL, T.S. (1971). A uniform system for recording and processing cereal research data. Agric. Res. Service USDA, ARS 34-121, 42 pp.

COLOUR MUTATION IN RACE 10 OF *PUCCINIA RECONDITA* ROB. EX DESM.

BY S.K. NAYAR, M. SRIVASTAVA, L.B. GOEL, S.K. SHARMA,
P. BAHADUR AND K.L. MEENA

Indian Agricultural Research Institute, Regional Station,
Flowerdale, Simla-171002, India.

Mutation in fungi is known to occur fairly often and the pathogenic fungi are no exception. Most of the mutations are to the disadvantage of the pathogen but some of them confer greater pathogenicity. One of the most common mutations reported in various rust races is for colour. During a regular seedling resistance test with race 10 of leaf rust (*Puccinia recondita tritici*), one pustule was spotted in January 1979 that distinctly differed from others in colour. This isolate occurred on variety Inia "S"-Soty x Czho, and was purified and maintained on cv. Agra Local which is known for its universal susceptibility.

The parent type race 10, detected first in 1931, has so far completed about 650 uredial passages in our single-spore culture maintenance. However, this is the first time that a mutation has been noticed. When this isolate was tested on international differentials it gave the same reaction as its parent race 10, with no noticeable difference in its pathogenicity on the differentials.

The colour mutation was carroty red and the spores were sticky, tending to clump. As the race was weak, it never ruptured the epidermis and hence spore release did not occur. In all our experiments, needle scrapings were used to get the spore out of the pustule for further inoculation.

In the preliminary tests with both the parent and the mutant it was found that the colour mutant has a low germination percentage and takes more time to germinate. It had an incubation period of 9 days while the normal race 10 needed just 6-7 days. Such a loss in germination and incubation period, together with the poor spore-releasing capacity, is probably related to the loci of the colour mutant.

The colour mutant was tested on a large number of cultivars and most of them showed resistance, including Kalyansona, Sonalika, Shailja, HD 2009, HD 2119, HD 2135, HD 2189, HD 2242, HS 84, WL 711, VL 421, UP 319 and UP 368. Such a source of resistance is of academic interest only, because the mutant does not rupture the epidermis and hence, it is not polycyclic. This clearly indicates that the colour mutant that we are maintaining has no epidemiological consequences. However, it is of academic utility as it can be used in population dynamics studies and in other genetic investigations.

REFERENCES

JOSHI, L.M. & KAK, D. (1955). Indian Phytopath. 8: 202-204.

KORNERUP, A. & WANSCHER, J.H. (1967). Methuen Handbook of Colours. Methuen & Co. Ltd.

MEHTA, K.C. (1940). Further studies in cereal rusts in India. Scientific Monography No. 14: 73.

MISRA, D.P. & LELE, V.C. (1955). Indian Phytopath. 8: 79-81.

NEWTON, M. & JOHNSON, T. (1927). Phytopathology 17: 711-25.

SHARMA, S.K. (1967). Indian Phytopath. 20: 248-49.

SHARMA, S.K. & MISRA, D.P. (1965). Indian Phytopath. 18: 363-66.

SINGH, SHEODHAN, SINHA, V.C., BAHADUR, P. & GOEL, L.B. (1973). Indian Phytopath 26: 352-54.

STAKMAN, E.C., LEVINE, M.N. & COTTER, R.U. (1930). Sci. Agric. 10: 707-20.

THE RUST SITUATION ON WHEAT IN CZECHOSLOVAKIA IN 1980

BY P. BARTOS

Research Institute for Crop Production, Praha, Ruzyne, Czechoslovakia

Wheat rusts did not cause any considerable loss of yield in 1980. Leaf rust was observed in all parts of the country; stem and yellow rust occurred locally in Moravia and Slovakia, yellow rust being particularly prevalent on cultivars of Yugoslav origin. The incidence of rusts has been reduced by growing resistant cultivars. Of the 13 winter wheat cultivars registered in Czechoslovakia all show a satisfactory (medium) field resistance to yellow rust and nine possess resistance to at least some races of stem rust.

A stem rust virulence survey showed that the following genes had effective resistance to all isolates: *Sr* 11, *Sr* 24, *Sr* 25, *Sr* 26, *Sr* 27, *Sr* 31, *Sr* Tt_2. The gene *Sr* 5 was effective to only a few of the isolates. Of the winter wheats registered in Czechoslovakia, the cultivars possessing *Sr* 31 (Amika, Istra, Solaris) were highly resistant to stem rust. The cultivars Vala and Hela, with stem rust resistance derived from the cultivar Moisson (*Sr* 23, *Sr* 29 ?), were moderately resistant. A similar resistance was observed in the cultivar Slavia.

The genes *Lr* 9 and *Lr* 19 were effective against all leaf rust isolates collected during a virulence survey in 1980. Of the registered cultivars, Amika, Istra and Solaris were resistant to the most common race UN 3-61 and only Istra to the race UN 13-77 SaBa that prevailed in earlier years.

Tests with yellow rust isolates are not yet complete.

CEREAL RUSTS IN PORTUGAL IN 1980

BY A.P. DO CARMO E FREITAS

Estaçao Agronómica Nacional, 2780 Oeiras, Portugal.

Weather conditions in Portugal are very variable from year to year and rust development appears to be strongly dependent upon such factors as humidity and temperature during the spring.

Unusually hot weather without rain in April, followed by two weeks of low temperature with some rainfall at the beginning of May, were the main environmental conditions for the establishment and development of cereal rust in 1980.

In this country, the introduction of wheat varieties which reach maturity early in the spring has been responsible for stem rust escape. This has become the normal situation and, this year, only a few small pustules of stem rust were seen in a very small number of plants, and none on Triticales.

Leaf rust has been frequently observed in the wheat fields. However, this year the incidence was exceptionally low (0 - 20%), the national average being around 5%.

Wheat varieties cultivated in Portugal do not possess specific resistance to prevalent Portuguese *Puccinia recondita* races. However, some of them can avoid severe damage in the adult-plant stage. A few very susceptible varieties in experimental nurseries showed 70 - 80% damage, mainly on those growing in valleys in the north of the country where the temperature was lower, the environmental humidity higher and plants mature later, in July. The same was observed with rye and Triticales.

Stripe rust on wheat was found almost exclusively in the Province of Alentejo with a severity ranging from 0% to 40%, according to the local conditions and the behaviour of the varieties. However, a very few varieties showed from 60 - 70% damage in wheat nurseries. In the country as a whole the average severity was less than 10%. On rye and Triticales, stripe rust was almost absent.

Leaf rust of oats, which normally is very common, became rare this year and showed an exceptionally low severity.

Rust distribution and timing of development was very unusual in Portugal this year, particularly where leaf rust was concerned. However, because the spring weather in this country is so variable, these results represent only part of the overall picture seen when results from other years are examined.

THE RUST SITUATION IN DENMARK 1980

BY OLE BAGGER

National Research Centre for Plant Protection, Lyngby, Denmark

Since 1973-74 there have been no signs of rust epidemics in Danish cereal fields. Previously, however, there were heavy outbreaks of yellow rust (*Puccinia striiformis*) on winter wheat fields due to susceptible varieties such as Kranich (Cf. *Cereal Rusts Bulletin*, 2 (2), July 1974).

Since 1974, yellow rust has seldom attacked winter wheat because Danish farmers started to grow resistant varieties such as Starke and Solid. Cv. Solid, which is very seldom attacked by yellow rust, has been grown widely of late, and has been one of the predominant varieties, as shown in Table 1.

Table 1 Areas of winter wheat varieties in Denmark, 1976-1980 (as percentage of total winter wheat area).

Variety	1976	1977	1978	1979	1980
Solid	81	90	95	92	73
Vuka	-	-	-	3	18
Other	19	10	5	5	9
Area with winter wheat (1000 ha)	106	102	112	106	131

Vuka appeared during the late 1970s and by 1980 this variety covered 18% of the Danish wheat area. In 1980 outbreaks of yellow rust were observed on Vuka only, and were fairly severe in some places. If Vuka is grown in Denmark to a greater extent in future, the possibility of greater damage from yellow rust in wheat is increased.

In 1980 no outbreaks of barley yellow rust (*Puccinia striiformis*) were observed on spring barley, but in eastern Denmark mild outbreaks of barley brown rust (*Puccinia hordei*) have been observed during July.

Mild outbreaks of wheat leaf rust (*Puccinia recondita*) have been observed in few spring wheat fields.

In August a fairly mild outbreak of crown rust (Puccinia coronata) was observed on oats.

The conclusion must be that outbreaks of rust in Denmark in 1980 were mild (on most varieties) and of little economic importance, but of course we are keenly following up sporadic outbreaks.

THE RUST SITUATION ON WHEAT IN SWITZERLAND IN 1980

BY P.M. FRIED

Swiss Federal Research Station for Agronomy, Reckenholz, Zurich

Although in 1980 the weather conditions were very favourable for the development of yellow rust (24 days of rain in June), very few fields with disease severity above 1% could be found during the growing season. Such fields were limited to two local areas in the cantons of Berne and Zurich. No yellow rust could be found in the French-speaking area of Switzerland. This is probably because of the good field resistance of the variety Zenith, which covers more than 80% of the winter wheat area in the country, and the absence of a large amount of inoculum. The Research Institute for Plant Protection, Wageningen, The Netherlands (Ir. Stubbs, personal communication) identified the occurrence of the following races during the last 4 years: 32E64, 40E8, 40E0, 41E136, 169E136, 106E139, 105E137. Of particular note is the presence of virulence on Clement in race 169E136.

Leaf rust (Puccinia recondita f.sp. tritici) was absent from most wheat-growing areas, but apparently it could become more important in some fields in the north-eastern part of the country. As in the previous years, leaf rust was observed only late in the season in this area. Stem rust (Puccinia graminis f.sp. tritici) has been restricted for years to some alpine valleys in which there are large numbers of the alternate host. We did not observe it in farmers' crop fields.

Cereal Rusts Bulletin Vol. 9, Part 1, 1981

THE RUST SITUATION IN NORWAY, 1980

BY HÅKON A. MAGNUS

Norwegian Plant Protection Institute

After early and heavy attacks of yellow rust on the new winter wheat cultivar Skjaldar in 1979 in southern Norway, practically no rust was found the following year.

For a long period cereal rusts have appeared so late in the season that yield has not been affected.

The experience of the yellow rust epidemic in 1979 has called for a renewed interest in this disease.

CEREAL RUSTS : SITUATION IN FRANCE IN 1980

BY J.P. PIQUEMAL

Service de la Protection des Végétaux, BP. 95 84140 Montfavet

During the year 1978-1979 there was a very low intensity of cereal rusts because the weather during the previous winter did not encourage the development of epidemics.

In 1980, wet and cool weather in autumn and early in spring was favourable to the development of an epidemic of stripe rust in many areas of the country, mainly on the winter wheat varieties Talent and Lutin.

WHEAT
STRIPE RUST IN 1980

The first outbreaks of the disease were found in Normandy (Calvados) and in the south of Paris Centre (Eure) from the end of February. In both areas the epidemic increased until the early summer. Forty-seven diseased sites were verified in the south of Paris (Centre) on May 27th.

In other areas of the country the first diseased areas were found later and the epidemic was less widespread.

The table below lists the main areas where the outbreak was severe, the date of the occurrence of the disease, and the diseased varieties.

Areas in which stripe rust was observed in 1980	First occurrence	Varieties attacked by stripe rust
Aquitaine (Bas-Medoc, Marman-Dais, Riberacois, Gironde, Tussan)	20/4/80 1/5 to 15/5	Joss, Courtot, Top, Ducat, Florent, Talent
Auvergne (Allier)	27/5	Talent, Courtot
Bourgogne (Senonais) (Jovinien-Puisaye) Auxerrois, Tonnerois, Plaine Dijonnaise, Bourgogne Niver-naise, Chalons sous Saone	10 - 15/4 10 - 15/5 20/5	Lutin, Hardi, Scarcely, Joss, Darius, Gastan, Clément, Cocagne Caton

Areas in which stripe rust was observed in 1980	First occurrence	Varieties attacked by stripe rust
Bretagne (Region - Sud de Rennes	10/4	Corin, Talent, Clement, Castan, Lutin
Champagne - Zone de craie, Nogentais, Pays d'Othe, Marne, Bordure de l'Argonne	28/4	Corin, Talent
Region Parisienne	28 - 29/4	Lutin, Talent
Normandie - Calvados	End of February	Corin, Talent, Top
Nord - Pas-de-Calais Picardie	20/4	Talent, Lutin, Corin, Clement
Pays de Loire	20/4	Corin, Lutin, Talent
Poitou	10/5	Hardi, Talent

In May and June the disease incubation period was about 12 - 15 days (Poitou - Nord - Picardie). However, the dry periods which occurred in April and May reduced the spread of the disease, which seemed to be particularly virulent in some areas.

LEAF RUST (PUCCINIA RECONDITA)

Leaf rust appeared early in the season (in December in Poitou and Charente; in February in Aquitaine, Champagne, Nord-Picardie). The leaf rust blisters vanished during stem elongation. Only a few crops were slightly diseased later in summer, without damage.

BARLEY

DWARF LEAF RUST (PUCCINIA HORDEI)

Dwarf leaf rust was seen in a few crops in Auvergne and Bourgogne, where P. hordei was noted early in spring and then vanished, and in Bretagne mainly on crops without scald or powdery mildew.