Breeding Resistance to Yellow (Stripe) Rust in Wheat

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Preface

The information contained in this paper is a *précis* of the PhD thesis of Dr. H.P. Bimb. Since yellow (stripe) rust has recently reared its head in West and South Asia, the rapid publication of this Wheat Program Special Report is especially opportune. The report will be useful particularly for breeders and pathologists who need the most recent information on the yellow rust resistance genes present in certain CIMMYT-derived wheats.

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Introduction

More than 40 million hectares of wheat in developing countries and 10 million hectares in industrialized countries are planted with cultivars of spring habit, derived from the International Maize and Wheat Improvement Center (CIMMYT) wheat breeding programs, or with CIMMYT wheats in their pedigrees. More than 300 bread wheat cultivars, based in varying degrees on CIMMYT germplasm, have been released by national plant improvement agencies.

Yellow or stripe rust, caused by the fungal pathogen *Puccinia striiformis*, is an important disease wherever wheat is grown in cool maritime climates or at high altitudes. Many spring habit wheats are grown in such environments, and yellow rust frequently occurs, especially on genetically susceptible cultivars.

In CIMMYT wheat breeding programs, great emphasis has been placed on selection for disease resistance, with the recognition that inherited disease resistance is environmentally safe and requires no disease control input from growers. This is especially important in areas where farmers do not have adequate resources to purchase and apply chemical control methods. Among the diseases for which the greatest efforts to achieve resistance have been made are the three rust diseases, black or stem rust, brown or leaf rust and yellow rust. The pathogens that cause these diseases are highly variable and resistance that is introduced by breeders does not always remain effective. New strains of the pathogens appear, and cultivars may become susceptible.

Because of natural variation in the distribution of these diseases, CIMMYT breeders have made great advances in the introduction of resistance to stem and leaf rust. Breeding for resistance to yellow rust has been hampered by a lack of useful sites for selection for resistance to this disease in the main wheat breeding fields of CIMMYT breeders. This arises partly from the variation present in the fungus population at these sites. Whereas in Europe and some other areas, there is a plethora of different races, in Mexico, a very restricted range exists.

In recent years there have been epidemics of yellow rust on some cultivars derived from CIMMYT programs. For example, in Ethiopia the cultivar Dashen, of CIMMYT origin, became highly susceptible in 1988. Yellow rust has been observed on Annapurna 1 and Annapurna 3 in Nepal. There have been epidemics recently in Pakistan on Pak 81 and Pirsabak 85 and, notably, a severe epidemic in Iran on a cultivar Seri 82 (given the name Falat), particularly in 1995 (personal observation of R. Johnson).

Because of the limited ability to test for resistance to yellow rust within the CIMMYT wheat breeding programs, the project described here was proposed to permit the testing and genetic analysis of resistance to yellow rust using the wide array of races of the pathogen available at the John Innes Centre (JIC), including races imported from outside the UK to diversify the tests. The objectives were to diagnose the presence of known and unknown genes for resistance in a range of CIMMYT wheats, particularly those grown or under development for the areas of Nepal and Pakistan and more widely in mid Asian countries. A second objective was to investigate potential genetic vulnerability to yellow rust using tests on adult plants as well as on seedlings.

Methods and Materials

Wheat cultivars and lines

Altogether 280 wheats were included in the tests, of which 124 were derived from the CIMMYT 25th International Bread Wheat Screening Nursery (IBWSN). This nursery included wheats for multilocation testing for disease resistance and is widely distributed to national programs. Wheats selected from this nursery were those adapted to the conditions of the Indian sub-continent, particularly northern areas where yellow rust is common. Also, important additional sets of CIMMYT wheats were obtained from CIMMYT in Mexico and Nepal and from Pakistan. Of those tested, the following are among the recent important commercial cultivars in Nepal, Pakistan and Iran: 1) Nepal: Annapurna 1, Annapurna 3, Sonalika, UP262, Nepal 297, Vinayak; 2) Pakistan: Pak 81, Pirsabak 85, Faisalabad 85, Punjab 83, Chakwal 86, Kohinoor 83; 3) Iran: Falat (=Seri 82).

Twenty-one cultivars for differentiating the races were included in the tests, 17 from a standard set, and four additional cultivars with known resistance genes. It was necessary to use these four cultivars because the original 17 differential cultivars possess some unidentified resistance genes that obscure the classification of virulence in races from some parts of the world. The additional cultivars were Anza, Kalyansona, Sonalika and Federation 4/Kavkas. Thus, in all tests, the isolate of pathogen used was checked on this set of cultivars for its virulence. The full set of cultivars is listed in the Summary Table.

Rust isolates

A large collection of isolates of *Puccinia striiformis*, the pathogen that causes yellow rust of wheat, is maintained at the John Innes Centre in vapor-phase liquid nitrogen storage. This collection includes many isolates from the UK and several obtained from the IPO, Wageningen, The Netherlands, from R.W. Stubbs and G.K.H. Kema. Some of these were obtained during the course of the investigation. Race names, isolate numbers and virulence characters of these isolates are given in Table 1.

Seedling tests

It is possible to deduce the probable presence of identified genes in seedlings of cultivars by testing them with a range of isolates of known virulence characters, based upon a gene-for-gene interaction between host resistance genes and pathogen avirulence genes. The gene-for-gene interaction creates characteristic patterns of interactions and where these correspond to the interaction patterns of known genes, provides a diagnostic tool for identification of resistance genes.

Seedlings were grown in peat based compost, with nutrients in 7.5 cm diameter plastic plant pots, 6 to 8 seedlings per pot and covered with 0.5 cm of the peat mixture. The seedlings for these tests were raised in special glasshouses at the JIC with filtered air, to protect plants from contamination with pathogen spores, and partially controlled temperatures. When the first leaf was fully expanded and the second leaf half the length of the first, they were inoculated with spores of *P.*

striiformis dispersed in pure talc. The spores were taken from vapor-phase liquid nitrogen storage and treated at 37°C for 5 min in a sealed container to reverse cold-induced dormancy.

The seedlings were transferred to a special trolley with a tightly fitting door and trough of free water inside. The seedlings were sprayed with a fine mist of distilled water containing a drop of Tween 20 per liter as a wetting agent. The spore-talc mixture was distributed to the seedlings with a powder blower using a hand operated rubber air pump. The seedlings were then lightly sprayed again with the water. The trolley was then moved to an incubation room at 10°C for 24 h before being returned to the glasshouse bench.

Scoring for infection type (IT) was carried out approximately 2 wks later, depending on the speed of development of the infection on susceptible cultivars. In winter, additional lighting was provided in the glasshouse by a mixture of 400 watt halogen lamps and tungsten bulbs to correct the spectrum, arranged to provide 18 h light and supplement the light level during the day.

In total, 21 different races of the pathogen were used, so the total number of plants tested in this way was 8 (per pot approximately) x 280 (cultivars) x 21 (races) which was approximately 47,000 seedlings. The IT of each seedling was recorded on first and second leaves. ITs were recorded visually on a scale from fleck (;) indicating full resistance with small chlorotic flecks, 0 indicating sizable chlorotic patches without sporulation and from 1 to 4 indicating increasing sporulation and decreasing chlorosis with 4 representing the fully susceptible IT. Sometimes there was variation in IT within a pot of seedlings and where this was slight, the most frequent IT was recorded as the characteristic, but where there were marked differences, two or more ITs were recorded and indicated genetic heterogeneity for resistance of the line or cultivar.

The data were used for postulation of known resistance genes and the detection of reactions that could not be explained by known genes. In addition to these tests, cultivars and generations of seedlings from crosses between them were also tested with selected races for the genetic analysis of resistance.

Field tests and tests on adult plants in the glasshouse

Resistance to yellow rust can be effective at the seedling stage and throughout the life of the plant or can develop at later growth stages following susceptible reactions at the seedling stage. Resistance that develops after the seedling stage can be extremely important in determining the susceptibility of cultivars in the field. Therefore, it was important to determine the reaction of these cultivars in post-seedling stages.

This was accomplished in two ways, one of which was to grow plants singly in 10 cm diameter plant pots in the glasshouse and infect them when the flag leaf had just emerged. The other was to plant the seeds in field trials. Owing to the extreme earliness of most of the cultivars, field trials sown in the spring became only slightly infected, and grew extremely poorly. A successful field trial was conducted by sowing the cultivars in the autumn, inoculating them with rust in the spring, and using a high nitrogen dose and irrigation during dry weather to encourage spread of the disease. Because of the large number of cultivars, only a single race of the pathogen was used in the glasshouse, and a small selection of races in the field trials. Only the last, most successful field trial is reported here, in which a single race was used, the same as in the glasshouse test of adult plants. The choice of race is explained in the results.

Tests for resistance to powdery mildew

A common feature of CIMMYT wheat cultivars is the presence of a segment of chromosome from rye, replacing the short arm of chromosome 1B of wheat. This segment of rye chromosome carries resistance genes for stem rust, leaf rust and yellow rust (the gene for yellow rust resistance is called *Yr9*). It is also believed to carry a powdery mildew resistance gene *Pm8* but this has been somewhat controversial because some cultivars with the rye segment do not express resistance. In order to determine the expression of powdery mildew resistance in CIMMYT wheats that carry the rye segment, a detached leaf test was conducted. Susceptible control cultivars and lines with single identified genes for resistance to powdery mildew were included.

Seedlings of selected cultivars were produced in the glasshouse with filtered air. At 12 days old the primary leaf of each seedling was cut and transferred to the laboratory for inoculation. Segments of the detached leaves were placed in polystyrene boxes on 0.5% agar with 100 ppm of Benzimidazale to delay senescence of the detached leaf. Groups of seedlings were inoculated with five different races of *Erysiphe graminis*, the powdery mildew pathogen. The sets for each race were replicated three times and two leaf segments were used for each treatment. Inoculation was by tapping leaves infected with the appropriate races over the seedlings to be tested. The boxes with seedlings were kept in a controlled environment room at 15°C. ITs were recorded ten days after inoculation and classified as resistant, intermediate or susceptible.

Tests for seed storage proteins

The rye segment of chromosome 1B of the wheats carrying the 1B-1R translocation affects the protein content of the endosperm. The effects can be observed using Sodium Dodecyl Sulphate-Poly Acrylamide Gel Electrophoresis (SDS-PAGE) in which the characteristic proteins migrate to different positions on the gel during electrophoresis. This test was run in conjunction with the powdery mildew tests, to confirm the presence of the 1B-1R translocation by observing the absence of gliadin B1 and presence of Secalin 1, and comparing this with expression of the powdery mildew resistance.

Genetic analysis of resistance to yellow rust

Genetic analysis, observing the reactions of F1 and F2 plants, and F3 families to infection, is used as a more intensive method of identifying the genes for resistance than is possible by the interaction with races tests described above. The selected wheat cultivars were crossed with susceptible cultivars to determine the number of resistance genes present, and with each other or other test cultivars, to determine allelism of the genes and their identity. A total of 62 crosses was created and F1, F2 and F3 generations were produced. Ears of plants for seed production were bagged before anthesis to ensure self pollination and eliminate outcrossing. The seedlings in the different generations were tested for resistance to selected races of the pathogen. Tests were carried out using similar techniques of growing and scoring the seedlings described above.

Results

For reference purposes, the results for gene diagnosis and susceptibility in the field test are presented in the Summary Table. The most important conclusions are given below.

Results of race tests

The set of races used had, between them, a wide range of variation in virulence. However, even with the 21 isolates used, there was no race with virulence for all the possible combinations of known resistance genes. Of particular importance was the recognition that only one isolate, classified as race 6E16, possessed virulence for a cultivar Selkirk. The gene giving resistance in Selkirk is present in several wheats from CIMMYT sources. However, the race in which the virulence was identified did not possess virulence for genes *Yr9* and *YrA*, both of which are also known to be present in some CIMMYT wheats. British races with virulence for *Yr9* lack virulence for *YrA* and for the *YrSk* gene of Selkirk. The main race with combined virulence for *Yr2, Yr6, Yr7, Yr9* and *YrA*, all of which can be found in CIMMYT wheats, was classified as race 6E0. This race was therefore very important in the tests, particular for adult plant resistance. However, it lacked virulence for *YrSk.*

Using these races of *P. striiformis,* it was possible to diagnose the presence of certain known genes for resistance, present either singly or in combinations in the cultivars. A striking feature of the results was the presence in many of the wheats of the two genes *Yr7* and *Yr9*. The latter was sometimes present alone, but in 80 wheats, these two genes were found together. Many of these wheats are selected from the Veery and Bobwhite groups and included most of the cultivars on which epidemics were reported recently—Pak 81 (Veery #5), Pirsabak 85 (Veery #7) and Seri 82 (Falat in Iran). Other wheats in this large group had these susceptible cultivars in the pedigrees or Veery and Bobwhite parents. The *Yr9* gene entered CIMMYT programs through the use of a Russian wheat cultivar, Kavkas.

In addition to this clear diagnosis in many cultivars, other cultivars showed more complicated patterns, some of which were diagnostic for other known genes, particularly *Yr6* and *Yr2* and perhaps *Yr3* and *Yr4*. In some cultivars no known genes could be recognized—some of these were susceptible and some were resistant. The data indicated the probable presence of several unidentified race-specific genes present in CIMMYT wheats. Additional unidentified resistance in cultivars is marked by + in the Summary Table.

Several cultivars gave resistance to all the races. Reference to pedigrees of these races could help to indicate possible presence of known genes. Some of the possible genes in such cultivars are listed with ? and require further tests for confirmation. Resistance to all the available races could have resulted from a combination of several known genes with the *YrSk* gene of Selkirk, but this combination could not be diagnosed with confidence. Some cultivars with carriers of *YrSk* in their pedigrees evidently had not inherited the *YrSk* gene judging by their susceptibility to races unable to overcome this gene.

Results of glasshouse and field tests on older plants

An important aspect of the work was to try to identify possible examples of potentially susceptible wheats. Because of the limited range of variability in the set of races used, the main tests were conducted using race 6E0 (WYR 85/22). The most successful glasshouse test, using this race, gave results that corresponded quite well with the field data, although, not surprisingly, the amount of infection was generally less in the glasshouse than in the field. This probably arose from two influences: 1) only two doses of inoculum could be applied in the glasshouse, rather than the continuous inoculum that occurs in the field, and 2) the temperature in the glasshouse was higher than in the field and yellow rust is better adapted to cooler environments.

The results presented in the Summary Table show a wide range of levels of infection. On the basis of performance of some cultivars in field epidemics, such as Seri 82 in Iran, a risk of severe epidemics on a cultivar has been entered on the table. It is interesting to note that a considerable number of the more susceptible wheats have Seri in their pedigrees. All such cultivars should be treated with caution in the regions of the Indian and Middle East where yellow rust is currently causing problems. Where cultivars were more resistant in this test, they can only be diagnosed as not at risk from the race used in the tests. Thus, those rated as a moderate or low risks, or with ? require further investigation to assess their resistance to a wider range of races. One of the cultivars with resistance to race 6E0 is Lemhi (37) and this shows as resistant in the Summary Table. This cultivar is highly susceptible to many races of *P. striiformis* and serves as a warning against drawing conclusions about the safety of using cultivars on the basis of being resistant in this trial.

One of the interesting aspects of the adult tests was whether the gene *Yr18* for adult plant resistance could be identified. This gene is present in the cultivar Anza (275), reputed to possess durable resistance to yellow rust. The stock of Anza used in these experiments was not genetically uniform and appeared to be heterogeneous both for resistance at the seedling stage (due to the *YrA* gene) and in the field, possibly due to variation in presence of the *Yr18* gene. Some plants were rated as 70MSMR and others as 30MS—a very significant difference in field performance. It is possible from this observation that the presence of *Yr18* in a cultivar should limit the susceptibility to about 30MS in this trial.

Two characters are linked to this gene; one is a gene for leaf rust resistance *Lr34* and the other is leaf tip necrosis (Ltn). Scoring for Ltn showed, unfortunately, that its occurrence was not closely correlated with resistance to yellow rust in the field trial. Although few highly susceptible cultivars were diagnosed as having it, several diagnosed as having moderate Ltn were considered too susceptible for safe commercial use (diagnosed too susceptible SS). A number of cultivars with a high level of resistance showed Ltn—further work is needed to relate this to the possible presence of *Yr18/Lr34*. In the summary table, a number of cultivars are postulated to possess *Yr18* as indicated by Dr. R. P. Singh (CIMMYT, personal communication). Many of these wheats possessed adequate resistance in the field but accessions 29, 61, 68, 95 with postulated *Yr18* were classified as too susceptible. Further investigation of these lines is necessary.

Genetic studies
No details of the genetic tests are presented in this report. However, the tests permitted confirmation of the presence of hypothesized genes, including *Yr7* and *Yr9* in Pak 81 (Entry number 1), Veery "S" (26), Amsel (28), Annapurna 1 (10), Annapurna 3 (11), Gov/Az67//Mus (29), Seri 82 (30), Bow/Pvn (31), Peacock (32), Ning 8611 (33), Faisalabad 85 (169), Genaro 81 (42), Bacanora 88 (45) and Kauz (57). The data showed that *Yr9* was dominant in some crosses and recessive in others, apparently depending on the genetic background. The gene *Yr2* is known to be present in CIMMYT wheats. However, no race was available that could discriminate this gene in the presence of the two genes *Yr7* and *Yr9*. On the basis of segregation ratios in the genetic analysis, it was concluded that *Yr2* was not present in Pak 81, Annapurna 1, Annapurna 3, Gov/Az67//Mus, Seri 82, Peacock, Bow/Pvn, Ning 8611, Faisalabad 85 and Genaro 81. The possible presence of *Yr4* in Faisalabad 85 was supported by the genetic studies, although further confirmation would be desirable.

Powdery mildew tests
The presence of *Yr9* was detected by gel-electrophoresis and by resistance to yellow rust and it was confirmed that the gene *Pm8* which is linked to *Yr9* and thought to be carried on the same section of chromosome 1R, is not expressed in several wheat cultivars including twelve CIMMYT cultivars out of about 70 tested: Veery "S" (26), Annapurna 1, Pak 81, Bau (50), Pirsabak 85 (40), Seri 82, Gov/Az67//Mus, Attila (77), Carrizo (139), Mairaj 93 (173), WS 10 (185), and Pirsabak 91 (179). This is believed to be due to an inhibitor of the *Pm8* gene in these genetic backgrounds.

Discussion

The results obtained in this study extend the knowledge of resistance to yellow rust in CIMMYT wheats and provide genetic diagnosis of the presence of a number of identified genes in a wide range of cultivars. This lays a valuable foundation on which further genetic studies can be based.

Perhaps the most significant finding of immediate practical benefit, is the diagnosis of a substantial number of cultivars whose susceptibility to yellow rust is too high for reliable commercial use. This could provide early warning against the widespread use of some of the lines and cultivars in national programs, and the need for further breeding of the most promising lines for greater resistance to this disease. The exact level of disease at which high risk should be determined may still be subject to refinement. It has been suggested in the Summary Table that any cultivar showing a percentage leaf area infected at 35% or above is rated as high risk. At this starting point, it could be that the chance of an epidemic would depend on conduciveness of the environment. However, the relative performance of Seri 82 in this trial at 50MSS and the epidemic it sustained in Iran indicate that this level of infection is a clear indicator of high risk.

Unfortunately, even though more than 20 races of *P. striiformis* were used in these tests, there were still unsolved questions about the reliability of resistance in the case of cultivars that displayed adequate resistance in these tests. This uncertainty emphasizes the need for extending the system of testing CIMMYT wheats for resistance to yellow rust. The resistance of the cultivar Lemhi (37) in the field trial serves as a warning about drawing conclusions about the potential safety of resistant lines from this one trial. Lemhi is highly susceptible to many races of *P. striiformis*. Another problem is the possibility that some lines with complete resistance to the set of races used and in the field trial could depend on the presence of such race-specific genes *YrSk* with *Yr9* for which no race in these tests possessed corresponding virulence. However, past experience does not lead to the expectation that resistance depending on two race-specific genes would be durable.

The objective of CIMMYT breeders and the national programs is to produce wheat cultivars with durable resistance to yellow rust, as well as to the other rusts and other diseases. This would prevent repetition of the current problems where yellow rust is developing to epidemic levels in parts of the middle eastern and Indian sub-continent areas of wheat production. However, the challenge of identifying and reproducing such durable resistance is not easily solved.

As noted in the results, one opportunity for durable resistance to yellow rust is provided by the cultivar Anza of CIMMYT origin. In this cultivar the linked genes *Yr18/Lr34* are believed to be present and to be associated with durable resistance to both yellow and brown (leaf) rust. This combination may be present in many CIMMYT wheats and may be associated with the presence of leaf tip necrosis. An attempt was made to identify the possible presence of this gene combination on the basis of the linked leaf tip necrosis. However, some of the cultivars in which the character was identified were too susceptible in the field trial to be considered safe for commercial production. Further work is therefore required to relate the observed leaf tip necrosis with knowledge of the distribution of the gene combination *Yr18/Lr34* to establish whether the gene *Yr18* would give adequate resistance to yellow rust in conducive environments.

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Table 1. Races of *Puccinia striiformis*, isolate number, country of origin and virulence for known *Yr* genes.

	Race[1]	Isolate number	Origin	Virulence
1	108E141 (3)	WYR 81/12	UK	2,3,4,6,L[4]
2	169E136	WYR 83/8	UK	1,2,3,9,L
3	171E138	WYR 80/9	UK	1,2,3,7,9,L
4	232E137	WYR 75/20	UK	2,3,4,9,L
5	43E138	WYR 72/56	UK	1,2,3,7,L
6	6E0	WYR 85/22	Ecuador[2]	2,6,7,9,A[4]
7	66E0	WYR 87/11	Ecuador[2]	2,7,Su[4]
8	6E16	WYR 87/12	Lebanon[2]	2,6,7,8,L,Sk[4]
9	104E137A+	WYR 85/25	Australia	2,3,4,A,L
10	108E9 (2)	WYR 81/20	UK	3,4,6,L
11	41E136 (4)	WYR 79/4	UK	1,2,3,L
12	108E25	WYR 76/10	UK	3,4,6,8,L
13	37E132	WYR 78/7	UK	1,2,6,L
14	39E134	WYR 68/2	UK	1,2,6,7,L
15	106E139	WYR 81/24	UK	2,3,4,7,L
16	109E9	WYR 75/31	UK	1,3,4,6,L
17	38E150	IPO 86053	Rwanda[3]	2,6,7,8,9,A,L
18	234E139	IPO 78627	Netherlands[3]	2,3,4,7,9,L
19	236E141	IPO 82069	Chile[3]	2,3,4,6,9,A,L
20	109E9 (4)	WYR 88/55	UK	1,3,4,L
21	45E140 (1)	WYR 75/23	UK	1,2,3,6,L

[1] Race nomenclature refers to formulae as described by Johnson *et al.* (1972).

[2] Foreign races maintained at the John Innes Centre, Norwich, UK.

[3] Foreign races obtained from the Research Institute for Plant Protection (IPO), Wageningen, the Netherlands.

[4] L=Lemhi, A=*YrA* (Avocet), Sk=*YrSk* (Selkirk), Su=Suwon92XOmar (Su is also susceptible when virulence for 3 + 4 is present in UK races).

Interpreting the Summary Table

Seed source: Pak. = Pakistan, YR DIFF=Yellow rust differential, JI = John Innes Centre, 25IBWSN = 25th International bread wheat screening nursery, BV-93 = Mexican nursery 1993.

Yr genes: 1 - 18, A=Avocet, Sk=Selkirk, L=Lemhi, + = undiagnosed resistance, Sg=Segregating, OAR = Resistance to all races at seedling stage.

Field: Percentage leaf area infected and an infection type where R = resistant, S = susceptible, M = Moderate. Many plants had a range of infection types.

Evaluating Resistance in the Field

Severe epidemics were reported on Seri 82 (Falat) in Iran and on Pak 81 (Veery#5) in Pakistan. In the field trial reported here, they sustained 50MSS and 50MS, respectively. It is therefore assumed that cultivars with 40MS or more have inadequate resistance—marked SS.

Where cultivars had 35MS, they may be rather susceptible under conducive environments and are marked S?.

Where cultivars had 30MS or less disease, they are rated as having adequate resistance to the race used. Where it is suspected that high levels of resistance depend on a known race-specific gene and they are therefore not considered safe, despite adequate resistance in this trial, they are marked *.

? is used to indicate uncertainty.

Summary Table: ACC = Entry number, VAR/CROSS = Name or cross of wheat variety, PEDIGREE = Selection pathway, SOURCE = Origin of line, Yr = Postulated identified and unidentified (+) Yr genes for resistance to yellow rust in seedlings, SR6E0 = Seedling reaction to race 6E0 r or s, FIELD = Field susceptibility (percentage leaf area infected and infection type on 20 June 1995, mean of two replicates) to race 6E0 - virulence: (V2 V6 V7 V9 VA), SS = Inadequate resistance in the field, Ltn = Leaf tip necrosis ++ moderate or +++ strong +++ very strong.

ACC	VAR/CROSS	PEDIGREE	SOURCE	Yr	SR6E0	FIELD		Ltn
1	PAK 81=VEERY#5	CM 33027-F-15M-500Y-0M-76B-0Y	NEPAL	7,9	s	50MS	SS	
2	VEE "S"	CM 33027-F-15M-500Y-0M-66B-0Y	,,	7,9	s	75MS	SS	
3	,,	CM 33027-F15M-500Y-0M-75B-0Y	,,	7,9	s	85MS	SS	
4	,,	CM 33027-F-15M-500Y-0M-90B-0Y	,,	7,9	s	55MS	SS	
5	,,	CM 33027-F-15M-500Y-0M-107B-0Y	,,	7,9	s	50MS	SS	
6	,,	CM 33027-F-15M-500Y-0M-3B-0Y	,,	7,9	s	45MS	SS	
7	,,	CM 33027-F-15M-500Y-0M-76B-0Y	,,	7,9	s	60MS	SS	
8	SERI	CM 33027-F-15M-500Y-0M-87B-0Y	,,	7,9	s	40MS	SS	
9	VEE "S"	CM 33027-F-15M-500Y-0M-89B-0Y	,,	7,9	s	60MS	SS	
10	NL 459	CM 33027-F-15M-500Y-0M-98B-0Y	,,	7,9	s	65MS	SS	
11	NL 460	CM 33027-F-15M-500Y-0M-110B-0Y	,,	7,9	s	35MS	S?	
12	,,	CM 33027-F-15M-500Y-0M-126B-0Y	,,	7,9	s	45MS	SS	
13	,,	CM 33027-F-15M-500Y-0M-115B-0Y	,,	7,9	s	65MSS	SS	
14	,,	CM 33027-F-15M-500Y-0M-98B-0Y	,,	7,9	s	55MS	SS	
15	,,	CM 33027-F-15M-500Y-0M-75B-0Y-0PTZ-0Y	,,	7,9	s	50MS	SS	
16	,,	CM 33027-F-15M-500Y-0M-126B-0Y-1PTZ-0Y	,,	7,9	s	70MSS	SS	
17	,,	CM 33027-F-15M-500Y-0M-7B-0Y	,,	7,9	s	35MS	SS	
18	,,	CM 33027-F-15M-500Y-0M-68B-0Y-0PTZ	,,	7,9	s	50MSS	SS	
19	,,	CM 33027-F-15M-500Y-0M	,,	7,9	s	50MSS	SS	
20	,,	CM 33027-F-15M-500Y-0M-75B-0Y-0PTZ-0Y	,,	7,9	s	80MS	SS	
21	,,	CM 33027-F-15M-500Y-0M-81B-0Y-0PTZ	,,	7,9	s	35MS	S?	
22	,,	CM 33027-F-15M-500Y-0M-126B-0Y-1PTZ-0Y	,,	7,9	s	50MS	SS	
23	,,	CM 33027-F-15M-500Y-0M-7B-0Y	,,	7,9	s	55MSS	SS	
24	,,	CM 33027-F-15M-500Y-0M-11B-0Y-0PTZ	,,	7,9	s	30MSMR		
25	,,	CM 33027-F-15M-500Y-1M-0Y-0PTZ-0Y	,,	7,9	s	50MSS	SS	
26	,,	CM 33027-F-9M-1Y-4M-500Y-500M-502Y-0M	NEPAL	7,9,+	r	0	?	
27	,,	CM 33027-F-15M-500Y-0M-62B-0Y-PURAT	,,	7,9	s	80MSS	SS	
28	AMSEL=MRNG/BUC//BLO/PSN	CM 69191-A-5Y-1M-3Y1M-0Y-0-1B	,,	7,9,+,18	s	0	?	++
29	GOV/AZ67//MUS	CM 41257-I-8M-2Y-1M-3Y-0M	CIMMYT	7,9,+,18	s	50MSS	SS	++
30	SERI 82	CM 33027...	,,	7,9	s	50MSS	SS	++
31	BOW/PVN	CM 61830-3M-1Y-1M-2Y-2M-0Y	,,	9	s	5MR		
32	PEACOCK (VEE"S"/CKR"s")	CM 74539-1M-3Y-2M-1Y-3M-0Y	,,	9,+	s	20MS		++
33	NING 8611	-	,,	9,+	s	10MR		
34	SALZMUNDE 14/44	-	JI	9,+	r	10MS		
35	RIEBESEL 47/51	-	,,	9,+	r	0		
36	SELKIRK=MCMURACHY/EXCHANGE// 3*REDMAN (ACC.6)	-	,,	Sk	r	0	*	
37	LEMHI (CHECK)	-	,,	L	r	5MS	*	
38	CHAKWAL 86	-	PAK.	?	s	no plant		
39	FAISALABAD 85=MAYA/ MON"S"//KVZ/TRM	CM 44083-N-3Y-1M-1Y-1M-1Y-0B	,,	4,7,9,18	r	no plant		
40	PIRSABAK 85=VEERY#7	CM 33027-F-15M-4Y-4M-3Y-2M-1Y-0M	,,	7,9	s	85MSS	SS	
41	AMBASSADOR	-	JI	9,+	r	no plant		
42	GENARO 81 = VEERY#3	CM 33027...	25IBWSN	7,9	s	60MSS	SS	
43	OPATA 85=CHEEL	CM 40038...	,,	Sk,18	rs	0	*	
44	SIETE CERROS	-	,,	2	s	60MSS	SS	
45	BACANORA 88=BJY/ JUP//URES	CM 67458-4Y-1M-3Y-1M-5Y-0B	,,	7,9,18	s	30MRMS		++
46	KA"S"/NAC	3B-4Y-1M-0Y-27M-0Y	,,	?,18	r	0	?	
47	MAYA/NAC	CM 39424-1M-1M-4Y-1M-2Y-1M-0Y	,,	3,+,18	r	0	?	
48	FCT "S"	CM 43598-II-8Y-1M-3Y-1M-3Y-0B	,,	?	s	30MSMR		
49	TEPOCA=BUC/4/TZPP//IRN46/ CNO67/3/PRT	CM 56744-7Y-2Y-1M-1Y-0M	,,	6,+	r/s sg	0	?	++
50	BAU CM 59123-3M-1Y-2M-1Y-3M-0Y		,,	7,9	r/s sg	40MSMR	SS	+++

ACC	VAR/CROSS	PEDIGREE	SOURCE	Yr	SR6E0	FIELD		Ltn
51	SIREN=R37/GHL121//KAL/BB/3/ KLTCM 64609-6Y-	3M-1Y-05M-0Y	25IBWSN	7,+,18	r	0	?	++
52	PRL/VEE#6	CM 64624-2Y-1M-4Y-0M-5Y-0M	,,	7,9,+,18	r	0	?	++
53	FASAN=JKAM/EMU//CHRC/4/IAS20// WTE*3/NAR/KVK	CM 66246-C-1M-1Y-1M-2Y-0M	,,	7,9,+,18	r/s sg	20MRMS		
54	VEE/KOEL	CM 67395-2H-2E-1E-2E-0B	,,	3,+	r	0	?	++
55	BOW/NKT	CM 67428-6M-1Y-05M-3Y-1Y-0Y	,,	7?	r/s sg	30MSMR		
56	PEEP/CKR	CM 67437-2Y-1M-2Y-1M-0Y	,,	7,9	s	55MSS	SS	++
57	KAUZ=JUP/BJY"S"// URES	CM 67458-4Y-1M-3Y-1M-0Y	,,	6,7,9	r/s sg	0	?	++
58	TUI CM 74849-2M-2Y-3M-2Y-0B-4M-0Y		,,	9	r/s sg	75MS	SS	
59	CULIACAN=TUE	CM 74849-	..	9	s	60MSS	SS	
60	FCT/3/GOV/AZ//MUS	CM 76290-32Y-04M-06Y-2B-0Y	,,	9,18	s	30MS		
61	MNV/VEE 5	CM 77091-14Y-04M-06Y-3B-1Y-0B	,,	7,9,18	r/s sg	65MS	SS	
62	CNO 79//PF 70354/ MUS	CM 77793-14Y-01M-0Y-4M-0Y	,,	3,4,6,Sk?	r	0	?	++
63	URES/BOW	CM 78108-1M-02Y-02M-10Y-2B-0Y	,,	7,9,+	s	30MS		+++
64	PARANA 2//JUP/BJY"S"/3/ VEE 5"S"/JUN"S"	CM 79694-B-1M-05Y-01M-4Y-0B	,,	9,+	r/s sg	20MSMR		+++
65	URES/TRT"S"	CM 79818-10Y-025H-0Y-6M-0Y	,,	9,+	r	0	?	
66	IAS20/H567.71// VEE 10	CM 80844-21Y-025H-0Y-3M-1Y-0M	,,	7,9,+	r[1]	80MS	SS	
67	URES//BOW"S"/ TAN"S"	CM 82312-14Y-06M-0Y-3M-1Y-0M	,,	7,9,+	s	70MS	SS	
68	CNO 79/PRL	CM 83271-5Y-4B-1Y-10B-0Y	,,	2,+,18	s	45MS	SS	+++
69	OPATA/BOW	CM 83398-2M-0Y-0M-5Y-0M	,,	?	r/s sg	0	?	
70	ANB/BUC	CM 84758-10Y-0M-0Y-4M-0Y	,,	7,+	s	25MSMR		
71	PFAU"S"/BOW"S"//VEE 9	CM 85294-043TOPY-1M-0Y-0M-7Y-0M	,,	7,+	r	0	?	
72	PFAU/SERI//BOW	CM 85295-0101TOPY-2M-0Y-0M-1Y-0M	,,	2,+	s	0	?	++
73	KEA//ALD/MN 72130	CM 85577-8Y-0M-0Y-3M-0Y	,,	9,+	s	65SMS	SS	
74	JUN/GEN	CM 85663-6Y-0H-0Y-2M-0Y	,,	7,+	s	30MSMR		
75	PFAU/VEE 5	CM 85795-17Y-0M-0Y-6M-0Y	,,	7,9,+	s	55SMS	SS	++
76	PGO/SERI	CM 85817-22Y-0M-0Y-5M-0Y	,,	7,+	r	0	?	
77	ATTILA=ND/VG9144// KAL/BB/3/YACO/4/ 5	CM 85836-4Y-0M-0Y-14M-0Y	,,	9	s	65SMS	SS	
78	KEA/BUC//FCT	CM 85839-8M-0Y-0M-9Y-0M	,,	?	s	40SMS	SS	++
79	CMT/YR//MON/3/THB	CM 86092-7Y-0M-0Y-1M-0Y	,,	9,+	s	80S	SS	
80	CAR853/COC//VEE"S"/3/SARA	CM 86108-30Y-0M-0Y-2M-0Y	,,	9	s	10MS		
81	F6.74/BUN//SIS//VEE 7	CM 86141-22M-0Y-0BH-2Y-0B	,,	7,9	s	75SMS	SS	
82	F6.74/BUN"S"/ SIS"S"/3/THB"S"	CM 86731-9Y-0M-0Y-7M-0Y	,,	9?	r	20MSMR		++
83	SERI/CEP 80120	CM 88072-56M-0Y-0M-8Y-0M	,,	9	s	60MS	SS	++
84	TRAP 1/BOW	CM 88127-45M-0Y-0M-5Y-0M	,,	9,+,18	s	30MS		++
85	LIRA/TAN	CM 88144-13Y-0M-0Y-4M-0Y	,,	6,7,9,18	r/s sg	35SMS	S?	
86	TAN/PEW//SARA	CM 88386-23M-0SY-0H-7Y-0M	,,	7,9,+	r/s sg	70SMS	SS	++
87	FCT//YR/PAM	CM 88510-6Y-0M-0Y-1M-0Y	,,	?	s	40MSS	SS	
88	SHA 7/VEE 5	CM 88893-6Y-0M-0Y-3M-5Y-0B	,,	7,9	s	50MSS	SS	
89	FFN/VEE 5	CM 88930-12Y-0M-0Y-5M-0Y-3B	,,	9	r/s sg	70MSS	SS	
90	FLN/ACC//ANA/3/SERI	CM 89078-5M-0Y-0M-3Y-0M	,,	?	s	25MS		
91	MAI/PJ//EMU/3/MRL/BUC	CM 89092-4M-0Y-0M-3Y-0M	,,	6,+	r	20MRMS		
92	CNO 79*2/PRL	CM 90312-C-7B-16Y-3B-0Y	,,	?,18	r/s sg	20MS		++
93	CNO 79*2/HE 1	CM 90313-E-2B-9Y-0B-30M-0Y	,,	6,7,Sk?,+?	r/s sg	0	?	
94	URES*2/PRL	CM 90315-C-1B-3Y-2B-0Y	,,	?,18	s	25MSMR		++
95	HAHN"S"*2/PRL"S"	CM 90320-A-1B-5Y-0B-6M-0Y	,,	9,18	s	40MSMR	SS	
96	KEA/TOW//LIRA	CM 90450-1Y-0M-0Y-3M-0Y	,,	?	s	15MSMR		
97	ND/VG9144//KAL/ BB/3/YACO/4/CHIL	CM 90461-5Y-0M-0Y-5M-0Y	,,	3,4,9,+	r	0	?	+++
98	MYNA/VUL//BUC/FLK	CM 90482-3Y-0M-0Y-3M-0Y	,,	7,Sk?,+?	r	0	?	
99	BOW//BUC/BUL	CM 90526-2M-0Y-0M-3Y-0B	,,	9,+	r/s sg	0	?	
100	GJO/TRM//BDA/HUAC/3/VEE 6	CM 90563-8Y-0H-0Y-6Y-0B	,,	OAR	r	0	?	++++

ACC	VAR/CROSS	PEDIGREE	SOURCE	Yr	SR6E0	FIELD		Ltn
101	TUC/MON//VEE/3/LIRA	CM 90570-7Y-0M-0Y-5M-0Y	25IBWSN	6,9,+	0	?		+++
102	MON/IMU//BAU	CM 90704-16Y-0M-0Y-4M-0Y	,,	7,+	0	?		++
103	SIREN/SERI	CM 90719-25Y-0H-0KCM-0B-0Y	,,	?	r/s sg	95S	SS	
104	PRL/VEE 6//MYNA/ VUL CM 90722-22Y-0M-0Y-3M-0Y	,,	3,9,18		r	15MRMS		++
105	KITE/GLEN	CM 90735-3Y-0H-0Y-1M-0Y	,,	6,7	s	40MSMR	SS	
106	KITE/PGO	CM 90738-6Y-0M-0Y-2M-0Y	,,	7,+	s	0	?	++
107	CHUM 18/BAU	CM 91045-6Y-0M-0Y-2M-4Y-0B	,,	7,9,+	s	50MS	SS	
108	NANJING 8319/LIRA	CM 91200-9Y-0M-0Y-2M-0Y	,,	9	s	20MRMS		
109	VEE//DOVE/BUC	CM 91436-1Y-0M-0Y-1M-0Y	25IBWSN	9,+	r/s sg	40MSS	SS	
110	BUC/FLK//MYNA/VUL	CM 91575-2Y-0M-0Y-1M-0Y	,,	3,4,+	r	5R		
111	D6301/HN7//ERA/3/ BUC /4/LIRA/5/SPB	CM 91708-Y-0Y-0M-0Y-2M-0Y	,,	9	s	75MS	SS	
112	PGO/SERI//BAU	CM 91927-0-0Y-0M-0Y-3M-0Y	,,	3,9,+	r	0	?	
113	BOW/NAC//VEE/3/BJY/COC	CM 92066-J-0Y-0M-0Y-1M-0Y	,,	?	s	75MS	SS	++
114	GAA//PRL/VEE 6	CM 92277-30M-0Y-0M-5Y-0B	,,	9,+,18	r	2MR		
115	CNO 79/PRL//CHIL	CM 92313-3M-0Y-0M-2Y-0B	,,	3,4,+	r	0	?	
116	CNO 79*2/PRL//CHILL	CM 92354-33M-0Y-0M-1Y-0B	,,	?	s	55MSMR	SS	
117	BOW/PRL//BUC	CM 92377-11M-0Y-0M-1Y-0B	,,	7,9	s	75MSS	SS	
118	GAA/BOW	CM 92478-32M-0Y-0M-4Y-0B	,,	9	s	30MSMR		
119	PSN/BOW//SERI	CM 92909-5M-0Y-0M-1M-0B	,,	7,9	s	90S	SS	
120	BAU/SERI	CM 92991-27M-0Y-OM-3Y-0B	,,	7,9	s	25MRMS		
121	MRL/BUC//SERI	CM 93046-8M-0Y-0M-6Y-0B	,,	6,7,+	r/s sg	5MR		++
122	CAR 422/ANA//URES	CM 93553-14M-0Y-0M-1Y-0B	,,	3,+	r/s sg	20MRMS		
123	CHIL/BUC	CM 93687-55M-0Y-0M-3Y-0B	,,	7,+	r	5MR		
124	JUP/ZP//COC/3/PVN/4/GEN	CM 93697-11M-0Y-OM-5Y-0B	,,	7,9	r/s sg	45MSS	SS	++
125	UHU/PVN	CM 93725-22Y-0M-0Y-3M-0RES	,,	6,7,+	r	0	?	
126	GIM/BUC	CM 93754-8M-0Y-0M-5Y-0B	,,	7,9,+	r	0	?	
127	MN 75136/PGO	CM 93759-1Y-0M-0Y-1M-0RES	,,	?	r/s sg	0	?	
128	GZ 156/NAC//PSN/ URES /3/OPATA	CM 93786-5M-0Y-OM-6Y-0	,,	OAR	r	0	?	
129	PFAU/VEE 9//URES	CM 94295-F-0M-0Y-0M-5Y-0B	,,	7,9	s	50MS	SS	
130	ULC/PVN//TAN/3/BUC	CM 96119-43Y-0M-0Y-2M-0RES	,,	?	r	0	?	
131	OPATA/KILL	CM 97029-10Y-0B-0Y	,,	?,18	r/s sg	0	?	
132	OPATA/AUK	CM 97037-0Y-0B-0Y	,,	?,18	r/s sg	0	?	+++
133	OPATA*3/WULP	CM 100657-R-0B-0Y	,,	?,18	s	35MRMS	S?	++
134	OPATA*2/WULP	CM 100684-A-0B-0Y	,,	?,18	s	5MR		+++
135	OPATA*2/KILL	CM 100685-A-0B-0Y	,,	?,18	r/s	5MR		++
136	OPATA/KILL//PRL/VEE 6	CM 100707-G-0B-0Y	,,	?,18	r/s sg	0	?	
137	STAR "S"	SWM 7215-2Y-2Y-0Y-2Y-0Y-41M-0Y	,,	7,+,18?	r	0	?	
138	CNO 67/2*SX//IMU	CMH 80.600-4Y-1B-6Y-1B-2Y-1B-0Y	,,	OAR,7?,+?	r/s sg	0	?	
139	CARRIZO=VEE/H499.71A//48JUP	-	,,	9	s	35MS	S?	
140	CMH73A.497/2* CNO 79	CMH 81A.75-6B-1Y-1B-3Y-0B	,,	6,+?	r/s sg	100S	SS	
141	AGA/4*TI//GEN	CMH 81A.466-7B-1Y-1B-1Y-1B-2Y-1B-0Y	,,	6,7,+	s	80S	SS	
142	CMH 81A.564	CMH 81A.564-5B-6Y-2B-0Y-1B-0Y	,,	?	r/s sg	0	?	
143	HE 1/3*CNO 79	CMH 82A.361-C-2B-3Y-2B-1Y-1B-0Y	,,	7,Sk?,+?	r	0	?	+++
144	CMH 80.541/2* CNO 79	CMH 82A.515-B-2B-3Y-1B-0Y	,,	Sk?	r/s sg	0	?	
145	CMH 75A.66/SERI	CMH 83.2001-2B-2Y-2B-3Y-0B-3Y-0B	,,	7,9	s	50MSS	SS	
146	AGA/5*TI//2*GEN	CMH 83.2537-B-4B-1Y-2B-3Y-0Y	,,	7,9,+	s	90SMS	SS	
147	RL 6043/4*NAC	CMH 83.2551-A-1B-1Y-3B-0Y	,,	7,+,18	r	0	?	++
148	SPRW/2*7C//SERI	CMH 84.279-1Y-4B-3Y-0B	,,	9	s	65MSS	SS	
149	CMH 73A.497/3* CNO 79	CMH 84.3053-4B-1Y-2B-3Y-0B	,,	6,Sk?,+?	r	0	?	
150	INIA/A.DIST//INIA/3/GEN	CIGM 81.62-20B-4Y-4B-2Y-2B-1Y-6B-0Y	,,	7,+	s	15MS		
151	INIA/A.DIST//INIA/3/2*CNO79	CIGM 83.7-1B-1Y-2B-0Y	,,	7,+	s	75MSS	SS	
152	GEN*3/PRL	CRG 58-C-1Y-4B-0Y	,,	7,9	s	45MS	SS	
153	SERI*3/BUC	CRG 68-C-10Y-3B-0Y	,,	7,9	s	50MSS	SS	
154	SERI*3//BUC/BJY	CRG 70-G-9Y-5B-0Y	,,	7,9,18	s	25MRMS		
155	SERI*3//AGA/G*YR	CRG 72-J-6Y-3B-0Y	,,	2,+	s	80MSS	SS	

ACC	VAR/CROSS	PEDIGREE	SOURCE	Yr	SR6E0	FIELD		Ltn
156	SERI*3//RL 6010/4*YR	CRG 73-V-7Y-4B-0Y	25IBWSN	9,+	s	95SMS	SS	
157	K134(60)/4/TOB/ BMAN//BB/3/CAL	PBT 9-23A-4A-0A	,,	6,+	s	20MSMR		
158	TR 801504	TR 801504-1R-1R-2R-0R	,,	3,4,+,18	r	0	?	
159	PRL"S"/PVN	TE 82.0009-5Y-025H-0Y06M-0Y	,,	2,+,18	r/s sg	30MSS		
160	PRL II/CM 65531	TE 82.0021-6Y-05M-0Y-7M-0Y	,,	2,+	s	5MR		
161	IAS58/4/KAL/BB//CJ"S"/3/ ALD"S"/5/YAV"S"	CD 58620-12M-4Y-1M-1Y-2B-0Y	,,	3,4,+	r	0	?	
162	INIA/A.DIST//INIA/3/VEE"S"	-	,,	7,9	s	35MSMR	S?	
163	DESCONOCIDO/CELAYA	-	,,	?	r/s sg	0	?	
164	PF 87828	-	,,	?	r/s sg	2R	?	
165	PF 87829	-	,,	?	r	0	?	
166	BARANI 83	-	PAK.	7,+	r	55MS	SS	
167	CHAKWAL 86=FLN/ACC//ANA	SWM 4578-56M-3Y-3M-0Y	,,	?	rs	30MRMS		
168	FAISALABAD 83	-	,,	7,+	r	0	?	
169	FAISALABAD 85	-	,,	3,4,7,9,18	r	0	?	
170	KAGHAN 93=BAGULA	CM 591233M-1Y-2M-1Y-2M-2Y-0M	,,	7,9,+	r/s sg	20MRMS		
171	KHYBER 87=KVZ/ TRM//PTM/ANA	CM 43903-H-4Y-1M-1Y-3M-2Y-0B	,,	9,+	r/s sg	10MR		
172	KOHINOOR 83	-	,,	9	s	60MSS	SS	
173	MAIRAJ 93=POTHWAR 93=URES/BOW"S"	CM 78108-1M-02Y-02M-18Y-0B	,,	7,9,+	s	20MRMS		
174	NR 29=JUP/BJY"S"//URES	CM 76243-224-04M-02Y-2B-1Y-0B	,,	OAR,7,9?,sg	r	0	?	
175	PAK 81	-	,,	7,9	s	45MSMR	SS	
176	PARWAZ 93=V-5648/ "S"	Pb. 20089-7a-4a-0a	,,	A,+,18?	s	30MSMR		
177	PASBAN=INIA66/A.DISTT.//INIA66/ 3/GEN81.W.5898-1	FW-0a-0a-7K-0a	,,	9,+	s	30MSMR		
178	PIRSABAK 85	-	,,	7,9	s	75S	SS	
179	PIRSABAK 91=KVZ//CNO/CHR/3/ON/ 4/KAL/BB	FR 2208-7F-1F-0F	,,	7,9	s	30MSMR		
180	PUNJAB 85	-	,,	9,+	r/s sg	30MSS		
181	ROHTAS 90=INIA66/A.DISTT.// INIA66/3/GEN81	FW 8461-W3-W0-W0-18K-0A	,,	7,9	s	30MSMR		++
182	S 19=SAIRAB-92=JUNCO"S"	CM 33483-C-7M-1Y-0M	,,	7,+	s	40MSMR	SS	
183	SUTLEJ 86=CMT/YR//MON"S"	CM 43405-A-2Y-1M-5Y-5M-1Y-0B	,,	3,9,18	r/s sg	5R		
184	V 8829=SA42/V1299	-	,,	9,+	r	0	?	+++
185	WS 10=URES/BOW"S"	CM 78108-1M-02Y-02M-16Y-2B-0Y	,,	7,9,+	s	40MSS	SS	++
186	WS 56=KAUZ"S"	CM 67458-4Y-1M-3Y-1M-5Y-0B	,,	7,9,18	r/s sg	0	?	+++
187	ZAMINDAR 80	-	,,	A,+	s	40MSS	SS	
188	ZAR GHOON 79	-	,,	6,+	s	20MR		
189	89 A 044=F.3.71/TRM//Pb81	Pb.21362-13a-0a	,,	6,9	s	70SMS	SS	
190	DOVE/BUC	CM 58808-6M-5Y-1M-1Y-1M-0Y	CIMMYT	9	s	25MRMS		
191	PRL/VEE 6	CM 64624-2Y-1M-4Y-0M-5Y-0M-0ECU-0Y	BV-93	3,9,+,18	r	0?	?	++
192	,,	CM 64624-2Y-1M-4Y-0M-34Y-0M-0ECU-0Y	,,	7,9,+,18	r	0	?	++
193	KAUZ=JUP/BJY"S"//URES	CM 67458-4Y-1M-3Y-1M-2Y-0B-0ECU-0Y	,,	OR,6,7,9,18	r	0	?	++
194	,,	CM 67458-4Y-1M-3Y-1M-4Y-0B-0ECU-0Y	,,	9,+(6,7)	r	0	?	
195	,,	CM 67458-4Y-1M-3Y-1M-5Y-0B-0ECU-0Y	,,	9,+(6,7),18	r	0	?	
196	SITE=SITELLA=BOW/BUC	CM 74005-8M-1Y-03M-5Y-2B-0Y-0ECU-0Y	,,	?	s	0	?	
197	,,	CM 74005-8M-1Y-03M-5Y-2B-0Y-1B-0Y-0ECU-0Y	,,	9	s	0	?	
198	MILAN=VS73.600/MRL/3/ BOW//YR/TRF	CM 75113-B-5M-1Y-05M-3Y-2B-0Y-0ECU-0Y	,,	6,+,18	r	0	?	
199	THB/CEP 7780	CM 76635-8Y-0Z-0Y-1M-0Y-2PZ-0Y-0ECU-0Y	,,	9,+ (1)	r	0	?	
200	,,	CM 76635-8Y-0Z-0Y-2M-0Y-4PZ-0Y-0ECU-0Y	,,	9,+ (1)	r	0	?	
201	GOV/AZ//MUS/3/DODO/4/BOW	CM 79515-044Y-1M-02Y-07M-3Y-3B-0Y-0ECU-0Y	,,	9,+ (1)	r	0	?	
202	,,	CM 79515-044Y-1M-02Y-07M-3Y-3B-0Y- 0PZ-2PZ-0Y-0ECU-0Y	,,	9,+ (1)	r	0	?	
203	F3.71/TRM//BUC/3/LIRA	CM 79630-F-1M-010Y-04M-5Y-0B-0ECU-0Y	,,	9,+ (1)	r	0	?	
204	MON/IMU//ALD/PVN	CM 85835-1Y-0H-05Y-3M-0Y-1PZ-0Y-0ECU-0Y	,,	6,7,9,+	r	0	?	++++
205	ATTILA	CM 85836-4Y-0M-0Y-6M-0Y-3PZ-0Y-0ECU-0Y	,,	OAR,9?,+?	r	0	?	

ACC	VAR/CROSS	PEDIGREE	SOURCE	Yr	SR6E0	FIELD		Ltn
206	,,	CM 85836-4Y-0M-0Y-14M-0Y-0PZ-1PZ-0Y-0ECU-0Y	BV-93	OAR,9?,+?	r	0	?	++
207	,,	CM 85836-4Y-0M-0Y-14M-0Y-0PZ-5P-0Y-0ECU-0Y	,,	OAR,9?,+?	r	0	?	++
208	,,	CM 85836-4Y-0M-0Y-14M-0Y-5M-0Y-0ECU-0Y	,,	OAR,9?,+?	r	0	?	++
209	,,	CM 85836-4Y-0M-0Y-14M-0Y-4PZ-0Y-0ECU-0Y	,,	OAR,	r	0	?	++
210	,,	CM 85836-4Y-0M-0Y-17M-0Y-2M-5M-O-0ECU-0Y	,,	9?,+?	r[1]	40MSS	SS	++
211	ND/VG 9144//KAL/BB/3/ YACO/4/CHIL	CM 90461-5Y-0M-0Y-5M-0Y-0ECU-0Y	,,	9,+ (1)	r	0	?	+++
212	,,	CM 90461-6Y-0M-0Y-2M-0Y-0ECU-0Y	,,	9, (3)	r	0	?	
213	,,	CM 90461-38Y-0M-0Y-1M-0Y-1M-0-0ECU-0Y	,,	3,4,9	r	0	?	
214	,,	CM 90461-38Y-0M-0Y-1M-0Y-2PZ-0Y-0ECU-0Y	,,	9,+	r/s sg	20MRMS		
215	PRL/VEE 6//MYNA/VUL	CM 90722-22Y-0M-0Y-3M-0Y	,,	3,9,+,18	r	0	?	
216	,,	CM 90722-22Y-0M-0Y-3M-0Y-4M-1M-0Y-0ECU-0Y	,,	3,9,+,18	r	5R		++
217	Attila	CM 90722-22Y-0M-0Y-5M-0Y-0ECU-0Y	,,	3,9,+	r	0	?	
218	,,	CM 90722-22Y-0M-0Y-5M-0Y-0JMJ-0ECU-0Y	,,	3,9,+	r	0	?	++
219	,,	CM 90722-23Y-0M-2E-4Y-1Y-1M-0Y-0ECU-0Y	,,	OAR,9?,+?	r	0	?	++
220	KITE/GLEN	CM 90734-20Y-0M-0Y-2M-0Y	,,	9,+	r	5R		
221	PAT 24/ALD//DOVE/BUC	CM 90956-29Y-0M-0Y-3M-0Y	,,	9,+ (1,3)	r	5R		
222	,,	CM 90956-29Y-0M-0Y-4M-0Y-0ECU-0Y	,,	9,+	r	0	?	
223	,,	CM 90956-29Y-0M-0Y-5M-0Y-1M-1Y-0ECU-0Y	,,	OAR	r	5MS		
224	CHUM 18//JUP/BJY	CM 91046-7Y-0M-0Y-4M-1Y-0B-4M-2M-0Y-0ECU-0Y	,,	3,4,9,18	r	0	?	
225	TURACO/CHIL	CM 92354-62Y-0H-05Y-1M-0RES-0ECU-0Y	,,	3,9,18	r	5R		++
226	CHIL//ALD/PVN	CM 92801-65Y-0M-0Y-4M-0RES-0ECU-0Y	,,	OAR,3?,4?,9	r	5R		
227	CHIL/PVN	CM 93622-2Y-0M-0E-1E-3Y-0M-0ECU-0Y	,,	OAR	r/s sg	0	?	++
228	BUC/BJY//2* LJ 2484	CM 94175-500@-0YA-6J-0N-1N-0YA-0N-4Y-0Y	,,	OAR	r	0	?	+++
229	GAA/PRL	CM 94720-10Y-0M-0E-2E-2Y-0M-0ECU-0Y	,,	6,7,9,+,18	r	0	?	++
230	,,	CM 94720-10Y-0M-0E-2E-5Y-0M-0ECU-0Y	,,	6,7,9,+	r	0	?	
231	KAUZ//PRL/VEE#6	CM 94747-12Y-0H-0SY-5M-0RES-5M-2M-0Y-0ECU-0Y	,,	9,+ (3)	r	0	?	
232	,,	CM 94747-27Y-0H-0SY-4M-0RES-0ECU-0Y	,,	9,+	r	0	?	
233	GIM/KAUZ	CM 95848-10Y-0H-0SY-1M-0RES-5PZ-0Y-0ECU-0Y	,,	6,7,9,+	r	5MS	?	
234	URES//BUC/PVN/3/KAUZ	CM 96441-K-0Y-0M-0Y-2M-0RES-0ECU-OY	,,	6,7,9,+	r	5R	?	
235	BOW//BUC/BUL/3/KAUZ	CM 96492-AA-0Y-0M-0Y-5M-0RES-0SY-0ECU-0Y	,,	6,7,9,+	r	0	?	
236	V 81623//BUC/PVN	CM 99372-0M-7Y-030M-3Y-3Y-0M-0ECU-0Y	,,	OAR	r	0	?	
237	HE 1/3*CNO 79	CMH 82A.361-C-2B-4Y-2B-0Y-0ECU-0Y	,,	9,+	r	5R	?	
238	CMH76A.977/SERI//CMH76A.977/ CMH79A.307	CMH 83.262-3Y-3B-2Y-1B-0Y-0JMJ-OECU-OY	,,	9,+	r	5R	?	
239	KAUZ*2/YACO//KAUZ	CRG 873-2Y-010M-0Y-0ECU-0Y	,,	OAR,18	r	0	?	++
240	,,	CRG 880-5Y-010M-0Y-0ECU-0Y	,,	OAR,18	r	0	?	+++
241	KAUZ*2/4/CAR//KAL/BB/ 3/NAC/5/KAUZ	CRG 992-1Y-010M-0Y-0ECU-0Y	,,	OAR,9?,+,18	r	0	?	+++
242	F6 FECY 90-91.68	-2Y-0M-0ECU-0Y	,,	6,9,+	s	10MR		
243	RIVADENEIRA 4	-010Y-0M	,,	9,+ (3)	r	0	?	
244	RIVADENEIRA 5	-010Y-0M	,,	3,4,7,9,18	r	0	?	
245	RIVADENEIRA 7	-010Y-0M	,,	3,9,+	r	0	?	
246	DAGUA/TOTA/BB/WT/3/CAQUETA/ AURAUCA/4/YURIYA 79	1161668-4N-@M-1T-010Y	,,	9,+ (3,4)	r	0	?	
247	BUC/BJY/3/CNDR/ANA// CNDR/MUS	CM 8815951M-0Y-08H-1Y-0B	,,	OAR,9?,+?	r	0	?	
248	PRL/VEE#6//MYNA/VUL	CM 90722-36Y-0M-0Y-2M-0Y	,,	3,7,9,18	r	0	?	++
249	TNMU	CM 81812-12Y-06PZ-4Y-17M-0Y-2AL-0Y	,,	9	r/s sg	0	?	
250	H546.71*2/H567.71//AUFN/4/EMU/3/ TOB/ERA//TOB/CNO67	CM 61636-A-5Y-1M-1Y-1M-2Y-3M-0Y-0NJ	,,	6,+	r	5R	?	++
251	PRL/VEE#6//MYNA/ VULCM 90722-22Y-0M-0Y-5M-0Y	,,		3,9,+,18	r	0	?	+++
252	PGO/SERI//BAU	CM 91927-O-0Y-0M-0Y-3M-0Y	,,	OAR	r	5R	?	
253	PRL/VEE#6//MYNA/VUL	CM 90722-22Y-0M-0Y-5M-0Y	,,	3,9,18	r	0	?	
254	ALUCAN=IAS58/IAS55//ALD/3/MRNG/ 4/ALD/IAS58.103A//ALD/5/CNR	CM 78526-032PZ-2Y-0PZ-5Y-0M	,,	9,+	r/s sg	5R	?	
255	AMSEL	CM 69191-9-5Y-1M-1Y-2M-2Y-2M-0Y	,,	9,+(1,3),18	r	0	?	

ACC	VAR/CROSS	PEDIGREE	SOURCE	Yr	SR6E0	FIELD		Ltn
256	KAUZ//PRL/VEE#6	CM 94747-1E-1E-1E	BV-93	3,7,9,18	r	0	?	
257	PAT 24/ALD//DOVE/BUC	CM 90956-29Y-0M-0Y-3M-0Y	,,	9,+	r/s sg	0	?	
258	T.SPELTA ALBUM	YR DIFF	JI	5	r	0		
259	CLEMENT	,,	,,	2,9,+	r	0		
260	SUWON 92xOMAR	,,	,,	4?,+	r	30MSS[2]		
261	STRUBES DICKKOPF	,,	,,	Sd	r	0		
262	MORO	,,	,,	10	r	0		
263	VILMORIN 23	,,	,,	3,+	r	0		
264	HEINES KOLBEN	,,	,,	2,6	s	75S		
265	LEE ,,	,,		7,+	s	80S		
266	CHINESE 166	,,	,,	1	r	0		
267	HEINES VII	,,	,,	2,11,+	r	10MR		
268	SPALDING PROLIFIC	,,	,,	Sp	r	0		
269	CARSTENS V	,,	,,	Cv	r	0		
270	COMPAIR	,,	,,	8	r	0		
271	NORD DESPREZ	,,	,,	3,+	r	0		
272	HEINES PEKO	,,	,,	2,6,+	r	5R		
273	REICHERSBERG 42	,,	,,	7,+	r	0		
274	HYBRID 46	,,	,,	3,4	r	0		
275	ANZA G86 (AJT 743)	,,		A,18,+	s	70MS/30MS	sg	
276	KALYANSONA		,,	2	s	70MSS		
277	SONALIKA H.S. (AJT 987)	,,		2,A	s	60MSS		
278	FED/4/KVZ		,,	9	s	60MSS		
279	KRL 1-4		,,	-	s	50S		
280	KHARCHIA LOCAL		,,	-	s	80S		

1 Further investigation required to understand why susceptible when it was resistant to this race at the seedling stage.

2 Infection might be due to natural infection.

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(as of March 1997)

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