MEXICAN VARIETIES OF WHEAT RESISTANT TO RACE 15B OF STEM RUST

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Race 15B of stem rust (Puccinia graminis var. tritici) of wheat became widely distributed for the first time in North America during the summer of 1950 when it was found throughout most of the central part of the United States and Canada[4]. This race[5] was found in Mexico for the first time during April 1951 in three widely separated geographic areas, namely, the States of Sonora (Northwest), Nuevo León (Northern), and Hidalgo and Mexico (South Central). There was no commercial damage, however, on the winter crop in these areas since the inoculum did not build up until the crop was approaching maturity. Temperatures and precipitation during the winter of 1950-51 were below normal in northern Mexico and probably accounted for the fact that stem rust did not become generally prevalent in the fall-seeded crop until it was nearly ripe. The summer crop, which is planted over a wide geographic area in May and June, was found generally infected. Severe losses occurred in some areas. Race 15B was the most prevalent race in the States of Jalisco, Guanajuato, Michoacán, Querétaro, Hidalgo, Mexico, Puebla, and the Federal District. This was the first time that stem-rust damage occurred on the varieties Supremo and Chapingo, which are resistant to the other races of stem rust prevalent in Mexico. Race 15B was found on commercial plantings of barley and also was widespread on volunteer wheat and barley plants in bean and corn fields in many parts of the central region.

Reaction of Mexican Commercial Varieties to Race 15B

The very severe epidemic in the summer of 1951 gave an excellent opportunity to study the field reaction of commercial varieties to this new race of rust. Two new varieties of wheat, developed by the Oficina de Estudios Especiales of the Secretaria de Agricultura y Ganaderia in collaboration with the Rockefeller Foundation, have been found to posses excellent resistance to 15B and to all other races of stem rust prevalent in Mexico. The varieties Kentana 48 (a cross of Kenya x Mentana) and Lerma 50 (a second backcross of Kentana to Mentana) were entirely free from rust when grown adjacent to fields of Supremo and Chapingo, which were killed. The resistance of Kentana and Lerma was uniform over the entire area wherever they were being grown in commercial plantings. Two other commercial varieties, Kenya Rojo RF-324 and Kenya Blanco RF-321, distributed by the Ministry of Agriculture of Mexico in 1946, were also found to be highly resistant. Kenya Rojo is the parent which has contributed the resistance to 15B to both Kentana and Lerma. Mentana, the other parent of both Kentana and Lerma, has a degree of seedling resistance to race 15B. The two Kenya varieties are still being grown commercially in some areas in Mexico but will be replaced rapidly by Kentana and Lerma because of their higher yields and earliness.

Sufficient seed of Kentana was harvested during October and November 1951, to plant approximately 40,000 acres to this variety during the current winter season. Consequently, by the time the 1951-52 winter crop is harvested, there will be adequate seed available to plant a large percentage of the Mexican wheat acreage to this variety. Lerma 50 is a newer variety which is being grown for the first time by Mexican farmers. Approximately 1,500 bushels of seed were harvested and all of this was planted during December. Kentana yields considerably better from December plantings than from June plantings, whereas Lerma is equally well adapted for winter or summer plantings. Both varieties are of spring habit, and both are susceptible to leaf rust. Kentana is red-grained, whereas the grain of Lerma is white.

The commercial varieties Yaqui, Mayo, Chapingo, and Nazas, carrying Newthatch type of stem rust resistance, were highly susceptible during the past summer. The variety Supremo, which has Surpresa and Hope as its stem-rust resistant parents and is the most extensively cultivated variety in Mexico at the present time, is highly susceptible. All of these varieties have

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[4]Stakman, E.C. and Loegering, W.Q. Physiologic races of Puccinia graminis in the United States in 1950. U.S. Dept. Agr., Bur. Entom. and Plant Quar., and Bur. Plant Indus., Soils, and Agr. Engin., and Minn. Agr. Expt. Sta. 16 pp. (Processed.) July 1951.
[5]Collections were identified as race 15B by E.C. Stakman and W.Q. Loegering of the Division of Plant Pathology and Botany, University of Minnesota, and Bureau of Entomology and Plant Quarantine, U.S. Dept. of Agr., St. Paul, Minn.

been resistant in the field to all of the races of stem rust found in Mexico with the exception of race 15B.

Reaction of Breeding Materials to 15B Under Mexican Conditions

Four large wheat-breeding nurseries were grown during the summer of 1951 by the Oficina de Estudios Especiales in Mexico. These nurseries were seeded in June in four widely separated areas namely, Chapingo, Mexico; Mexe, Hidalgo; Irapuato, Guanajuato; and Guadalajara, Jalisco. In addition to the breeding material from the Oficina de Estudios Especiales which consisted of approximately 60,000 lines and varieties, a large number of lines, varieties, and collections were evaluated through a cooperative arrangement with the Divisions of Cereal Crops and Diseases and Plant Exploration and Introduction of the U. S. Department of Agriculture. This material included:

1. 1,007 of the most promising lines and standard varieties from the United States and Canadian breeding programs.
2. 4,702 foreign introductions -- (U. S. D. A. World Wheat Collections).
3. 200 miscellaneous introductions and lines from various South American countries.

Severe stem-rust epidemics, due principally to race 15B, developed at all four locations. The epidemics were especially severe at Mexe, Hidalgo, and Chapingo, Mexico, where the susceptible lines were generally killed. The nursery at Mexe, Hidalgo, was in a valley where Supremo was the predominant variety. The build-up of stem rust was so severe that many fields of this variety with a potential yield of 40 bushels were so badly damaged that they were not harvested. The inoculum in the Mexe nursery may, therefore, be assumed to have been largely race 15B. In the nursery at Chapingo, Mexico, inoculum of stem rust races 15B, 17, 19, 38, 56, and 59 was put into the nursery to supplement natural inoculum. The diversity of material planted in these nurseries, where severe epidemics developed with 15B one of the dominant races, made it possible to obtain a large amount of valuable information concerning the reaction of commercial varieties and the effectiveness of different types of resistance which currently is being used in the breeding programs. These field data can be summarized as follows:

1. All of the commercial varieties of spring wheats (bread and durums), currently grown in North America with the exception of Kentana 48, Lerma 50, Kenya Rojo, and Kenya Blanco, were severely rusted. Cadet, although susceptible, was somewhat less so than the other northern hard red spring wheat varieties.
2. Parental varieties or lines that are being used in bread wheat breeding programs in North America and which were found to be resistant or highly resistant included:
   (a) Kenya 58, Kenya 117-A, Kenya 338-AC.2.E.2, Kenya 291-J.I.I.I, Kenya 294B.2.A.3, Kenya 338-AA.1.A.2, Kenya RF-324, Kenya 130.B.6.B RF-321.
   (b) Red Egyptian.
   (c) McMurachy.
   (d) Egypt Na-95.
   (e) No. 43 (South Africa) P. I. 159106.
   (f) McMurachy-Exchange, RL-2265 (Canadian)
3. Parental varieties or lines that are commonly being used in breeding programs and which were found to be susceptible included:
   (a) Hope.
   (b) Egypt Na-101, Kenya Standard, and Kenya Governor[6].
   (c) Fronteira, Surpresa, Bage, Frontana, Rio Negro, Supremo, Redman, Newthatch, and Lee.
4. Bread-wheat introductions from World Wheat Collection (tested for the first time) which were highly resistant:
   (a) Transvaal Africa -- P. I.-170915, P. I.-170916, P. I.-170917, P. I.-170918, P. I.-170919, P. I.-170922.
   (b) Argentina -- H-797-49-4812, P. I.-189812.
   (c) Spain -- E.M.V. #1 P. I.-191426.
   (d) Portugal -- 117-AFS-1456, P. I.-192097.
   (e) Kenya 501 Tipo 231, P. I.-192154.

[6]These varieties probably were killed by a race other than 15B.

(f) Kenya, P. I.-192173.
(g) Kenya, P. I.-192182.
(h) Portugal -- V x 9 Maria 9 D_2 P. I.-192465.
(i) Portugal -- Roci Egipties 472 P. I.-192468.
(j) Portugal -- T. vulgare x Aegilops ovata 39, P. I.-192480.

5. Durums or Pouiard wheat (one T. persicum) introductions from World Wheat Collection which were highly resistant:
(a) Canada -- Golden Ball-Iumillo-Mindum, RL-1714.
(b) Portugal -- Tremez Preto, P. I.-56256-3.
(c) Portugal -- Tremez Rijo, P. I.-56257.
(d) Portugal -- Tremez Rijo, P. I.--56257-1.
(e) Portugal -- Tremez Molle, P. I.-56258-1.
(f) Arabia -- P. I.-145720.
(g) Spain -- Almendral P. I.-190990.
(h) Spain -- Amapole P. I.-190993.
(i) Spain -- Caravaca #1 P. I.-191054.
(j) Spain -- Claro de Bazalote P. I.-191076.
(k) Spain -- Recio de Toledo P. I.-191192.
(l) Spain -- Rojal de Alicante P. I.-191193.
(m) Spain -- Rojal de Almeria P. I.-191194.
(n) Spain -- Recio Dan Clemente P. I.-191251.
(o) Italy -- St-464, Ethiopia P. I.-191365.
(p) Portugal -- Anafiel Claro 3291 v86 P. I.-191743.
(q) Portugal -- Carnadi Abdu tipo 103 P. I.-192168.
(r) Portugal -- Amarai blanco tipo 142 P. I.-192179.
(s) Portugal -- Egypto 2100 P. I.-192502.
(t) Italy -- T. persicum fuliginosum P. I.-191395.

6. Crosses and the number of advanced generation lines from different breeding programs in America which showed high degree of resistance.

Cross	Number of lines	Country
Kenya R.F. 324 x Mentana	Several hundred	Mexico
Kenya R.F. 324 x Mentana^2	60	"
Kenya R.F. 324 x Mentana^3	Several hundred	"
Maria Escobar^2 x Newthatch	85	"
(Kenya-Marroqui^2) Maria Escobar	15	"
Egypt Na-101 x Timstein	65	"
(Aguilera-Kenya)x(Marroqui-Supremo)	10	"
Kenya R.F. 324 x Candeal	35	"
Kentana x Yaqui	170	"
Frondoso x Kenya C-9906	9	Texas, U.S.A.
Renacimiento x Kenya C-10862	27	"
Surpresa x Kenya-Gular C-4913	5	"
RL-2265 x Redman	2	Canada
RL-2265 x Redman^2	3	"
RL-2265 x Redman^3	2	"
Thatcher x (RL-2265-Redman^2)	6	"
(Mida-Cadet)x(RL-2265-Redman^2)	1	"
Frontana x (RL-2265-Redman^2)	1	"
Timstein x Kenya 58	1	Minnesota, U.S.A.
Kenya-Gular-Pilot x Kenya 58-Newthatch	2	"
Frontana x Thatcher	15	"
Red Egyptian x Frontana	3	"
Frontana x Kenya 58	5	Brazil, S.A.
Red Egyptian x Rio Negro	2	"
Red Egyptian x Rio Negro^2	5	"
Castelar 49-4131, line G 1-3-3-1	1	Argentina, S.A.

Development and Spread of Race 15B in Mexico

There is considerable circumstantial evidence that the spores which gave rise to the 1951 summer 15B epidemic in Mexico were blown into Mexico from the United States and Canada during the fall and winter of 1950-51. There was relatively little survival of these spores in northern Mexico during the winter season of 1950-51, probably because of the extensive drought and cold weather in that area. The rust overwintered, however, in many areas on the Pacific Coast and in south central Mexico. In the latter area it increased to epidemic proportions during the summer of 1951 and caused severe damage to commercial plantings.

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