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PHYSIOLOGIC RACES OF PUCCINIA RUBIGO-VERA F. SP. TRITICI IN MEXICO ¹

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SUMMARY

Physiologic race analysis of 153 collections of leaf rust of wheat made in Mexico during 7 of the 10 years, 1944-1953 inclusive, revealed that race 11 and similar races constituted the dominant race group in each year except 1949 and 1950. The group comprised 51.2 per cent of all isolates for the entire period. It also was the most abundant race in all the states, except Tamaulipas, from which

collections were received. Races 5, 15, 93, and 105 showed increased abundance beginning in 1949. Although race 11 has long been a dominant race on the Pacific Coast of the United States, it has shown only a slight increase in the large wheat-producing area of central United States during recent years.

Leaf rust (caused by *Puccinia rubigo-vera* (DC.) Wint. f. sp. *tritici* (Eriks.) Carleton) is one of the important diseases of wheat in Mexico, as it is in nearly all wheat-producing countries. One of the most important phases of research in connection with the control of the disease is the determination of the physiologic races of the organism. The increase, in recent years, of breeding for disease resistance in Mexican wheat varieties made it desirable to determine the distribution and prevalence of races of the leaf rust fungus in Mexico. Information on the interchange of races between Mexico and the United States also was desired.

MATERIALS AND METHODS.—Studies on the races of the fungus causing leaf rust of wheat in Mexico were made during 1944 to 1953, inclusive. No data were recorded for 1945, 1946, and 1952. Physiologic race analyses were made at Manhattan, Kansas. Collections made in 1945 and 1946 proved to be nonviable, and none were made in 1952. Cultures were obtained from some collections made during 7 years of the period, but many were nonviable, apparently because of unfavorable conditions in transit.

Cultures were obtained from 153 field collections. These represented collections made during 7 years and in 8 different Mexican states, although material was not received from each state each year. Various wheat-growing areas were represented with the greatest number of collections from the states of Coahuila, Sonora, Guanajuato, Queretaro, and Mexico (including the Federal District). Several single-pustule isolations were made from the culture arising from each collection. Some cultures were lost, but in general about the same number of isolates of each collection were studied. They averaged about 3 per collection.

EXPERIMENTAL RESULTS.—The 153 collections yielded

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TABLE 1.—Groups of physiologic races of *Puccinia rubigo-vera* f. sp. *tritici* from Mexican field collections, 1944-1953

Race group	Constituent races and percentages of total isolates
5	5(13.8), 52(2)
9	9(3.3), 10(2.2), 19(0.7), 20(0.7)
11	11(45.6), 14(3.7), 38(0.4), 131(1.5)
15	2(0.9), 15(5.5), 25(0.2)
37	37(1.5), 43(0.2), 50(2.0), 110(0.2)
58	3(0.2), 12(0.2), 44(0.4), 58(2.4)
68	68(0.2)
92	92(0.4)
93	93(4.6)
105	6(0.4), 103(0.2), 105(5.2), 126(1.5)
122	122(0.2)

457 isolates that revealed the presence in Mexico during the period of study of 29 physiologic races. These were identified by use of the latest available revision of the International Register of physiologic races.³ Eighteen of the 29 races, however, were considered of minor importance. They closely resembled other well-known and important races. The minor ones, therefore, were grouped with the important races that they most closely resembled, under the number of the major race, as had been done earlier.⁴ The groupings and constituent races are shown in Table 1. This arrangement gave 11 distinctly different race-groups. Only groups 68, 92, 93, and 122 were composed of a single race each. These were all minor races.

Race group 11 was by far the most abundant in Mexico, representing 51.2 per cent of all isolates. Table 2 shows that it was isolated from collections made in all states except Tamaulipas and represented from 27 to 67 per cent of the isolates from collections made in each of the remaining 7 states. It comprised more than 60 per cent of the isolates from collections

³ Johnston, C. O., and H. A. Rodenhiser. 1951. Fourth revision of the international register of physiologic races of the leaf rust of wheat (*Puccinia rubigo-vera tritici* (tritricina)). U. S. Dept. of Agr., Bur. Pl. Ind. Mimeographed Pub. 203cc.

⁴ Huffman, M. D., and C. O. Johnston. 1952. Prevalence and distribution of physiologic races of the leaf rust of wheat in Kansas. Kans. Acad. Sci. Trans. 55: 419-426.

made in Guanajuato, Queretaro, and Hidalgo, approximately 50 per cent of those from Mexico and Sonora, and 40 per cent of those from Coahuila. It also comprised from $\frac{1}{3}$ to nearly $\frac{3}{4}$ of the total number of isolates for all of the states during each of the 7 years. The data for Tamaulipas, Puebla, and Hidalgo may not be representative because of the small number of collections tested, but those for other states are considered significant.

Race 11 long has been the dominant physiologic race of the pathogen causing leaf rust of wheat on the Pacific Coast of the United States. It never has been a dominant race in the central and eastern wheat-growing areas. In recent years, however, isolates of race 11 have been encountered with increasing frequency in collections from central and south-eastern states. This may indicate some movement of the leaf rust pathogen from Mexico into the United States east of the Rocky Mountains. To date, however, the increase of race 11 in grain fields of the United States has been slight.

Race 93 was frequently isolated from Mexican collections but seldom has been encountered in the United States except in the southeastern states. Although it comprised only 4.6 per cent of the total isolates from Mexican collections during the period of this study, it was fairly abundant in 1948 and 1950. During those and other recent years it also was isolated from collections made in southeastern United States.

Race 92, although isolated only twice, is the only one from Mexican collections that has not been isolated at least once from collections made in the United States. It is a very unusual race because Mediterranean wheat is the only one of the 8 differential varieties-susceptible to it.

All the other groups of races that were isolated from Mexican collections have been isolated frequently from collections made in the United States. The most important of these was race 5, which was second in abundance in Mexico, comprising 15.8 per cent of all isolates. This race has been the most important one in the United States since 1917. Race 5 suddenly increased in abundance in Mexico in 1949, only 2 years after it became the most abundant race in the United States. This may indicate that race 5 moved from

TABLE 2.—Prevalence and distribution of race-groups of *Puccinia rubigo-vera* f. sp. *tritici* in Mexico, 1944-1953

State	Number of collections	Number of isolates of race-group											Total Percentage	
		5	9	11	15	37	58	68	92	93	105	122	isolates	race 11
Coahuila	32	15	12	34	6	8	3		3	6			87	39.1
Guanajuato	26	8	5	58	5	2			9	8			95	61.1
Queretaro	18	2	2	24	1	2	3		1	5			40	60.0
Tamaulipas	1	2											2	0.0
Hidalgo	6	3		12	1		1			1			18	66.7
Puebla	2		4	3	2		1			1			11	27.3
Mexico and Fed. Dist.	38	25	3	50	6	4				6	2		96	52.1
Sonora	30	17	5	53	9	2	7	1		2	11	1	108	49.1
Total	153	72	31	234	30	18	15	1	2	21	32	1	457	
Percentage of total isolates		15.8	6.8	51.2	6.6	3.9	3.3	0.2	0.4	4.6	7.0	0.2		

TABLE 3.—Prevalence by years of physiologic race-groups of *Puccinia rubigo-vera* f. sp. tritici isolated from collections made in Mexico, 1944-1953

Year	Number of collections	Number of isolations of physiologic race-group											Total isolates	Percentage race 11
		5	9	11	15	37	58	68	92	93	105	122		
1944	14	1	4	32	2	6	1					2	48	66.7
1947	16	4	9	33	3	6	6		1			4	66	50.0
1948	28	1	6	67	2	4	5	1	1		6	1	94	71.3
1949	44	16	2	35	3	1	2			2	18		79	44.3
1950	45	43	10	43	13	1				13	7		130	33.1
1951	3	4		9	2								15	60.0
1953	3	3		15	5		1						25	60.0
Total	153	72	31	234	30	18	15	1	2	21	32	1	457	
Percentage of total isolates		15.8	6.8	51.2	6.6	3.9	3.3	0.2	0.4	4.6	7.0	0.2		

the United States into Mexico during that period. It was isolated from collections made in all the Mexican states except Puebla and was particularly abundant in the Federal District, Coahuila, Sonora, and Guanajuato.

Race-groups 9, 15, and 105 each comprised approximately 7 per cent of the total isolates. They also are important races in the United States. Race 9 was isolated most frequently from collections in Coahuila, whereas races 15 and 105 were isolated more frequently from collections made in Sonora, although they also were important in Coahuila.

DISCUSSION.—It seems clear that race 11 was by far the most abundant race of the leaf rust fungus in Mexico during the period of study, although a total of 29 races comprising 11 race-groups were isolated. There is only meager evidence that race 11 moved from Mexico into central United States during the period of these studies. Its spread may have been restricted to some extent by the large acreage in central United States of such varieties as Pawnee, Ponca, and Quannah, which are resistant to race 11.

Race 11 was the most abundant physiologic race in Mexico in 6 of the 7 years of the study (Table 3). In 1950, race 5 and race 11 were equal in abundance, each represented by 43 isolates or 33.1 per cent of all isolates. Race 11 ranged from 33.1 per cent of all isolates in 1950 to 71.3 per cent in 1948. It is clear that there was a sharp increase in the abundance of race 5 in 1949. Before that year, race 5 ranged from 1.0 to 6.0 per cent of all isolates each year. From 1949 onward, it ranged from 12.0 to 33.1 per cent of the total isolates each year. Race 105 showed a large increase in 1949, and races 9, 15, and 93 increased markedly in 1950. Despite these increases, race 11 maintained its dominant position in Mexico in all years except 1949 and 1950.

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