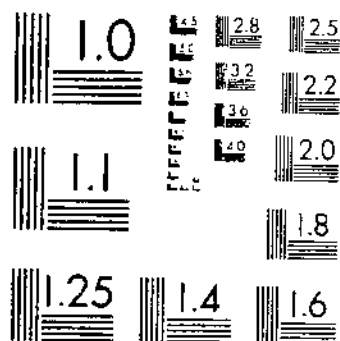
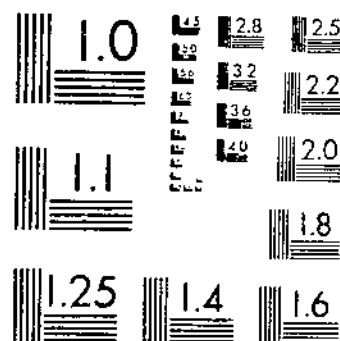


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WHEAT VARIETIES RESISTANT TO THE HESSIAN FLY, AND THEIR REACTIONS TO STEIN  
CARTRIGHT, M. B. SHANDS, R. C. GILBERT, AND J. W. WILSON  
1962-63

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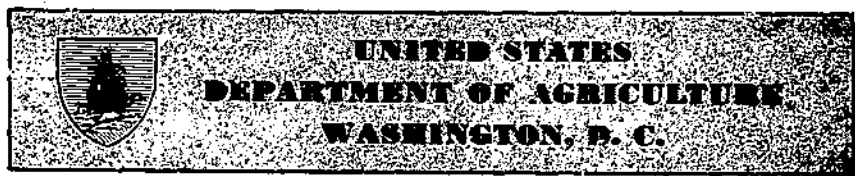
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# Wheat Varieties Resistant to the Hessian Fly and Their Reactions to Stem and Leaf Rusts<sup>1</sup>

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## SUMMARY

In the period 1939 to 1943, inclusive, a series of infestation tests were made in the greenhouse and in the field at La Fayette, Ind., of about 3,000 domestic and foreign varieties and strains of wheat, to find those that might possess sufficient resistance to the hessian fly to be of value for commercial use or as parent material in the breeding of fly-resistant varieties. About 6 percent of the varieties tested were found to be sufficiently resistant to warrant inclusion in a list for publication, together with infestation figures showing their reactions to the fly and the reactions of standard-check resistant and susceptible varieties, which were included in the tests for comparison.

Most of the varieties listed were also tested for resistance to stem rust and leaf rust at Madison, Wis., in 1941 and 1942, and the results of these tests are given. A number of the varieties tested showed a high degree of resistance to leaf rust or stem rust, or to both, as well as to the fly.

## INTRODUCTION

It is the purpose of this paper to report the reaction to the hessian fly, stem rust, and leaf rust of certain varieties of wheat found to be resistant to the hessian fly in tests at La Fayette, Ind. The reactions to stem rust and leaf rust were determined at Madison, Wis. It is

<sup>1</sup> Submitted for publication June 22, 1944.

<sup>2</sup> The authors wish to thank Philip Luginbill, in charge of the La Fayette, Ind., laboratory of the Bureau of Entomology and Plant Quarantine, for his supervision and assistance in obtaining the facilities for the experimental work on the hessian fly reported herein.

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believed that these records will be of great value to wheat breeders and others interested in wheat improvement. The wheat varieties reported here are those found to be fly-resistant in a series of tests of approximately 3,000 varieties and strains of American and foreign origin<sup>3</sup> received during the period 1938-43 from the classification and foreign-introduction files of the Bureau of Plant Industry, Soils, and Agricultural Engineering, through the cooperation of B. B. Bayles, of the Division of Cereal Crops and Diseases.

### HESSIAN FLY TESTS

The initial tests for reaction to the hessian fly included approximately 2,600 common, 250 durum, and 50 poulard wheats, and 100 varieties of Polish, club, Persian, and timopheevi wheats, emmer, and others of the *Triticum* group taken together. Most of these were tested in the greenhouse, although it was recognized that a few classified as susceptible under greenhouse environments would show moderate or variable resistance in the field. The method of testing in the greenhouse was the one used in classifying the hybrid wheats in the breeding program at the La Fayette, Ind., laboratory.<sup>4</sup>

This method consisted of seeding a series of the wheats in rows in standard flats and subjecting the young seedlings to a heavy infestation of eggs from flies reared in the greenhouse and confined in cloth cages over the flats for a day or two. The cages were then removed. Three weeks later the plants were examined and the varieties and strains were rated for resistance to the hessian fly. If the infestation in a variety was significantly less than that in the susceptible checks or approached that of the resistant check in the same flat it was rated as resistant. If 90 to 100 percent of the plants of a variety, taken consecutively in a series of 20 or more plants, contained 1 or more mature hessian fly larvae or puparia and showed the other plant responses of susceptibility, the variety was rated as susceptible. Likewise, the percentage of plant infestation was the criterion for separating resistant and susceptible varieties in the field tests. Six different tests in 4 different years, including 4 tests in the greenhouse and 2 in the field, were conducted, although not all varieties were included in all tests. As indicated by the 100-percent infestation in the susceptible Thatcher checks in 4 of the tests and very high infestation in the other 2, the strains were subjected to very severe trials.

Table 1, which presents the pertinent data obtained in these experiments, lists only those varieties or plant lines that appeared to be at least moderately resistant to the hessian fly, and the varieties Thatcher and Illinois No. 1 W38 as checks. These included 3 club wheats, 1 emmer, 1 poulard wheat, 21 durum, and 92 common wheats. A relatively large number of the durum wheats showed variable reactions and only those having consistently high resistance in the tests of plant lines are included in the table. It is probable that some of the durum wheats showing high but not total susceptibility in the greenhouse and not reported here may have been mixtures of resistant and susceptible types, because many foreign introductions are not pure.

<sup>3</sup> The countries represented included Abyssinia, Afghanistan, Alaska, Australia, Brazil, Bulgaria, Canada, Chile, China, Colombia, Czechoslovakia, Denmark, Egypt, England, Finland, France, Germany, Greece, Guatemala, Honduras, Hungary, India, Iran, Iraq, Ireland, Italy, Japan, Manchuria, Mexico, Morocco, Netherlands, New Zealand, Peru, Philippines, Poland, Portugal, Rumania, United States, Union of Soviet Socialist Republics, Spain, Sweden, Tibet, Transvaal, Turkistan, Turkey, Uruguay, Venezuela, and Yugoslavia.

<sup>4</sup> CARTWRIGHT, W. B., and LA FAYETTE, D. W. TESTING WHEATS IN THE GREENHOUSE FOR HESSIAN FLY RESISTANCE. *Jour. Econ. Ent.* 37: 385-387, illus. 1914.

TABLE I.—The relative resistance of varieties and selected lines of wheat to hessian fly at La Fayette, Ind., in 1939-43, and to leaf and stem rusts at Madison, Wis., in 1941 and 1942

Variety or strain	P. I. No.1	C. I. No.2	Place of origin	Plants infested by the hessian fly at La Fayette, Ind.						Rust infection in field tests at Madison, Wis.	
				Greenhouse tests				Field tests		Leaf	Stem
				1939	1940	1941	1942	1942	1943		
1 Common wheat:											
Thatcher (average of checks).....		10003	U. S. A	Percent 100	Percent 100	Percent 100	Percent 95	Percent 100	Percent 88	Percent 05	Percent 2
Illinois No. 1 W33 (average of checks).....		12191	do.	29	30	43	0	7	0	40	60
Alberta Early Sel.....		10025-2	do.	40	9	71	18			60	60
Do.....		10025-3	do.		16	82	42			30	60
Amareillo de barba preta X Ribeiro Sel.....	50219-0	7027	Portugal	24	39	04	12		8	20	80
Do.....	50219-10	7027	do.		31	80	4		0	15	80
Barbella X Santa Martha Sel.....	50222-8	7030	do.		24	53	20			30	70
Do.....	50222-6	7030	do.		20	85	7		0	20	70
Do.....	50222-13	7030	do.	59	29	100	13			15	70
Barbilla.....	13657		Spain			40	37	4	12	0	95
Barletta.....		3300	Argentina				7		0	70	70
Do.....		8355	U. do.			44	18		12	20	50
Beirao Sel.....	50202-1	7010	Portugal	33	3	0	14		0	15	40
Do.....	50202-2	7010	do.		33	33	31			30	60
Do.....	50202-5	7010	do.	0	0	0	3	58	12	30	60
Do.....	50202-14	7010	do.	0	0	0	7		0	30	70
Caledon Baard.....		4180	Africa				33		0	0	90
Centenario, Ks. 38 F. N. 4002.....			Uruguay			79	48	16	4	4	40
Dixon.....		6040	U. S. A	59		69	23	8	0	50	50
Greek 10.....	110227		Australia	15			42		0	70	10
Illinois No. 1.....		11933	U. S. A			57	0		4	4	
IVel, Ks. 36 R. N. 3570.....			U. S. A		91	61	58	31	4	10	70
IVy, Ks. 36 R. N. 3580.....			Uruguay	42	74	44	33	27	0	15	50
Java.....		10051	U. S. A	39	74	58	11		0	05	50
Kearney.....		6585	do.			61	18	8	0	0	90
Lobeiro X Barbilla Sel.....	50225-1	7033	Portugal	22	15	100	0	12	0	20	60
Do.....	50225-10	7033	do.		2	10	3			15	60
Do.....	50225-11	7033	do.		4	45	0		0	10	60
Lobeiro X Ribeiro Sel.....	50227-1	7035	do.		14	50	0		0	50	60
Marquillo.....		6857	U. S. A	97	75	53	18	77	0	5	2
Marvol.....		8870	do.			65	0		0	20	50
Portugal 90.....	116231		Australia	90			76	0	4	5	1
Portugez Sel.....	50204-1	7012	Portugal		27	16	20				3 50
Do.....	50204-7	7012	do.		25	13	24	4	0		3 50
Rafaela 5 Sel.....	104136-1		Argentina		50	77	56				T
Do.....	104136-2		do.		32	46	46				T
Renacimiento, Ks. 38 F. N. 88.....			Uruguay		63	84	46	16	4		50
Ribeiro Sel.....	50206-8	7014	Portugal	14	11	19	15	0	0		3 50

See footnotes at end of table.

TABLE 1.—The relative resistance of varieties and selected lines of wheat to hessian fly at La Fayette, Ind., in 1939-43, and to leaf and stem rusts at Madison, Wis., in 1941 and 1942—Continued

Variety or strain	P. I. No. <sup>1</sup>	C. I. No. <sup>2</sup>	Place of origin	Plants infested by the hessian fly at La Fayette, Ind.						Rust infection in field tests at Madison, Wis.	
				Greenhouse tests				Field tests		Leaf	Stem
				1939	1940	1941	1942	1942	1943		
1. Common wheat—Continued.				Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Ribeiro Sel.	56206-11	7014	Portugal	50	14	57	37				
S 633		12162	do				8		0		
San Martin Sel.	104137-1		Argentina		30	76	29			20	50
Do	104137-2		do		23	73	17			15	50
Do	104137-3		do		49	83	44			15	50
Santa Martha X Fuscense Sel.	56229-5	7037	Portugal		33	79	15		0	50	50
Temperao de Coruche Sel.	56208-1	7016	do	38	36	94	15		12	30	80
Do	56208-3	7016	do	46	13	90	0		3	30	80
Trijo roji Sel.	93337-2		Spain		31	36	4		0	75	50
Do	93337-13		do	28	22	45	3		4	70	40
Triunfo Sel.	104138-2		Argentina	11	3	100	12			50	40
Do	104138-3		do	9	0	80	14			30	50
Do	104138-7		do		10	73	6			50	40
Wolhuter		6073	Africa				25		0		80
Unnamed		2796	Mexico				11		8		60
Do		4181	Africa				17		0		80
Do		5104	Argentina				23		0		90
Do		5493	Uruguay				21		0		90
Do		5498	do				19		0		90
Do		5490	do				20		12		95
Do		5503	do				24		0		95
Do		5508	do				20		0		95
Do		5515	do				32		4		70
Do		5516	do				35		0		95
Do		5518	do				26		0		95
Do		6002	U. S. A				27		8		95
Unnamed Sel.	94379-3		Armenia	8	9	8	0		4	20	30
Do	94379-6		do	10	24	26	7	16	0	10	20
Do	94547-1		Asia Minor	21	19	63	38	13	4	60	30
Do	94549-5		Portugal	80		0	65	20	4	20	50
Do	94549-6		do		23	0	22		0	15	50
Do	94570-8		Greece	32	13	55	13	15	0	15	70
Do	94570-11		do	22	12	56	22			25	70
Do	94571-14		do	83	13	0	48		0	15	30
Do	94571-15		do	71	13	0	50			15	30
Do	94571-16		do	54	23	0	43		0	15	30
Do	94585-7		Portugal		27	48	6		0	40	60
Do	94585-11		do	29	7	50	58	15	4	40	30

Do.....	11245-5		Turkey		6	65	0		8	60	20
Do.....	11245-10		do	3	0	27	21	12	0	70	30
Unnamed	119305		do	82			24	7	0		
Unnamed Sel.	119334-5		do		8		6				
Do.....	119334-11		do	9	7		23				
Do.....	119335-5		do		14		41	0			
Do.....	119338-4		do		5		23	10			
Do.....	119341-3		do		16		30	10			
Do.....	119344-2		do		13		29	9			
Do.....	119344-7		do	12	7		17	9			
Do.....	119355-7		do		13		12	10			
Do.....	119355-8		do		7		14				
Do.....	125390-7		Afghanistan	11	12	52				95	80
Do.....	125390-8		do		11	39	6	2	0	80	70
Unnamed	134864		Portugal			80	0	8	4		90
Do.....	134867		do			84	81	16	8		90
2. Club wheat:											
Termok		3720	U. S. S. R.				25		0		80
Unnamed Sel.	101567-1		France		17	51	17		0	95	95
Do.....	101567-9		do	30	14	47	43		0	95	95
3. Emmer: Yaroslav		1562	U. S. S. R.	5	0	0	5		0		
4. Durum wheat:											
Aza de Corvo Sel.	56244-1	7053	Portugal		0	0	0				5 T
Da Terra Sel.	56238-5	7046	do		0	0	6			0	5 20
Do.....	56238-8	7046	do	3	0	0	0			0	5 20
Monjil No. 22 Sel.	56248-2	7057	do	0	0	0	0			0	5 15
Do.....	56248-3	7057	do	0	0	6	0			0	5 25
Tremez molle Sel.	56258-1	7067	do	0	0	0	0			0	T
Do.....	56258-2	7067	do	0	0	0	0			0	T
Do.....	56258-4	7067	do	0	0	0	0			0	T
Tremez preto Sel.	56256-3	7065	do	0	0	0	7			0	T
Do.....	56256-4	7065	do	0	0	0	0			0	T
Do.....	56256-5	7065	do	0	0	0	0			0	3 T
Tremez rijo Sel.	56257-1	7066	do	0	0	0	0			0	T
Do.....	56257-2	7066	do	0	0	0	0			0	T
Do.....	56257-3	7066	do	0	0	0	7			0	5
Unnamed	94587		do	2	0	0	0		0		T
Unnamed Sel.	111244-3		Turkey		0	0	0				25
Do.....	111244-4		do		0	0	7				30
Do.....	111244-5		do		0	0	0				20
Unnamed	134905		Portugal		0	0	0		0		T
Do.....	134908		do		0	0	0		0		10
Do.....	134943		do		0	0	0		0		50
5. Poulard wheat: Unnamed	134962		do		0	0	5		0		95

<sup>1</sup> Accession number, Division of Plant Exploration and Introduction, Bureau of Plant Industry, Soils, and Agricultural Engineering.

<sup>2</sup> Accession number, Division Cereal Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering.

<sup>3</sup> Brown necrosis, a nonparasitic dark-brown discoloration of glumes.

<sup>4</sup> T=Trace.

<sup>5</sup> Light-green color of leaves and leaf sheaths.

All the wheats found to be resistant appeared to be spring wheats except P. I. Nos. 119334 to 119358, inclusive, which had a winter habit of growth.

As shown in table 1, most of the wheats were less infested in the field than in the greenhouse. In 1943 this was presumably because of exposure to fewer flies in the field tests; however, it was not true of the tests in 1942, and in that year the differences in resistance between the wheats tested in the greenhouse and those tested in the field were much less.

The durumms on the whole were more resistant to the hessian fly than were the other varieties. Some selections of the common wheats showed a resistance approaching that of the more resistant durumms in the field, but none have retained such high resistance under the higher temperatures and unfavorable light conditions encountered in the greenhouse.

Resistant spring wheats were especially common among those introduced from Portugal, Argentina, and Uruguay. Several varieties of winter wheat moderately resistant to the hessian fly were obtained from Turkey.

### RESISTANCE TO STEM RUST AND LEAF RUST

Most of the wheats listed in table 1 were sown at the normal spring seeding date in single rows 10 feet long at Madison, Wis., where they were observed for heading date and reactions to leaf and stem rusts. These wheats did not include winter strains from Turkey. Part of them were grown in 1941 and part in 1942. In both years they were subjected to natural epidemics of leaf rust. Spreader rows of susceptible wheat varieties were artificially inoculated with race 56 of stem rust in 1941 and with races 19 and 56 in 1942. Other races may have occurred naturally each year. Fairly severe epidemics of stem rust were obtained each year. The severity of the epidemics of both leaf rust and stem rust were approximately the same each year; therefore the varietal reactions given in table 1 are roughly comparable, although some of the varieties were grown in one year and some in another.

In these tests most of the varieties of common wheat were more or less susceptible to both stem rust and leaf rust. Five varieties from Portugal, Uruguay, and Argentina showed only traces of leaf rust; 15 other varieties showed only from 5 to 20 percent. Marquillo and Portugal 90 appeared to be the most resistant to stem rust. The few representatives of club wheat in these tests were susceptible to both rusts. Although Yaroslav enumer was not included, it has been found to be resistant to leaf and stem rusts in other tests. All the durum wheats were highly resistant to leaf rust. Of the durum varieties selected, 6 showed only traces of stem rust infection, while several other selections had low percentages. Some of the durumms appeared to offer good resistance to the hessian fly and to both leaf rust and stem rust; therefore they may be especially useful in breeding programs. The lone variety of poulard was susceptible to stem rust.



**END**