THE EFFECT OF WHEAT SOILBORNE MOSAIC VIRUS ON AGRONOMIC CHARACTERS OF WHEAT

by

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INTRODUCTION

The economic loss in crop plants due to plant diseases is often underestimated in many areas of the world today. This is due in part to a continued small endemic disease loss that occurs but does not receive the attention that losses do with epidemic proportions. However, there are several methods available for disease control that can be used to minimize such endemic crop losses. With wheat soilborne mosaic (WSBM), a virus disease of wheat (Triticum aestivum L. em Thell), the only effective control measure is through the use of resistant varieties. Resistant varieties, when grown in infested areas, have provided an adequate and inexpensive means of disease control.

As early as 1923 McKinney (8) began reporting the need for resistant varieties as a control measure for this disease.

In 1949, WSBM was reported in eleven places in Kansas by Fellows and King (4). Since this first reported occurrence in Kansas the virus now infests over 2,000,000 acres of wheat-land. The increased WSBM incidence contributed to an estimated yield loss of 5% to the 1977 Kansas wheat crop; accounting for the major yield loss for wheat diseases detected in Kansas that year.

Breeding resistant varieties by growing breeding material in WSBMV infested areas is our best protection in controlling this disease.

Several authors have investigated the effect of WSBM on grain yield and yield components. This study is an effort to provide additional information on losses due to WSBM.

LITERATURE REVIEW

Several researchers have conducted numerous experiments with different designs to study the effect of wheat soilborne mosaic virus (WSBMV) on the yield of winter wheat varieties (1, 3, 6, 7, 10, 14). Similar experiments also were used to evaluate the effect of WSBM on specific agronomic traits other than yield (3, 5, 12). The results of these experiments indicated that WSBM was causing significant losses when winter wheat is sown in infested soils and resistant varieties are not used.

An early investigation into the effect on yield of WSBM was conducted in Oklahoma in 1953 by Wadsworth and Young (14). Their results compared several varieties in the same field in infested and uninfested areas. These paired plot tests of diseased and healthy areas staked out in several fields showed losses approached 50%. A similar plot design in Virginia with Atlas 50, Roane _et al_. (11) produced an average yield of 49 and 13.5 bushels per acre, respectively, on uninfested and infested areas.

In 1953, Bever and Pendleton (1) compared the yields of several varieties when grown in areas heavily infested with the virus and in virus-free soil. Twenty-five varieties were grown in each area and percent yield loss ranged from 0 to 85%. Those wheat plants showing rosette symptoms had a mean crop loss of 80.7%, while those showing severe leaf mottle reflected a mean percent loss of 18.5%.

McKinney (8) reported a 40% yield loss due to green mosaic virus infection. Crop losses attributed to the yellow mosaic virus infection are of primary importance in Kansas as the green mosaic virus had not been observed in Kansas (12). Fellows, Sill and King (4) estimated losses between 8-13% of yield in the 1952 epiphytotic of yellow virus in Kansas.

A study on the damage caused by WSBM in Florida in 1970 showed losses in grain weight varied from 42% to 52.5% in diseased areas of commercial fields (7). "Yield was measured by harvesting the plants in rod-row plots within infected areas and within normal appearing areas of a commercial field" (7). Palmer and Brakke (10) conducted a 3-year disease survey (1972-74) on 13 fields. Their results revealed crop losses as high as 44%, and an average of 20% over the entire length of the study. Campbell et al. (3) used 13 varieties and their known response to WSBMV for their investigation. Their results showed a depression in grain yield up to 48%. Although WSBMV is not controlled with soil fumigation, crop loss estimates were minimal in fumigation as reported by Pacumba et al. (9).

Reductions in grain yield occurred as a result of fewer seeds per spike and lower test weight (Campbell et al., 1977). The primary factor listed by Kucharek and Walker (7) also was fewer seeds per spike. Research in Illinois showed plants to be severely stunted along with a reduction of stems and heads per unit area (6). Koehler et al. (6) also found a good correlation between rank in yield and the extent of mottling. Finney and Sill (5) reported that the WSBMV infested wheat had (a) milling properties that were inferior, (b) the protein quality and mixing properties that were unchanged, and (c) other baking properties were superior to those of the control. They further reported that although the quality of forage would be reduced, no reduction would be observed from a livestock nutritive standpoint (5).

The success achieved in using resistant varieties as a control measure has been demonstrated in several investigations. The selection of suitable varieties on infested areas, displaying good resistance has been a design of several breeding programs. In order to insure the success of these breeding efforts, studies of the type reported on in this paper are important in contributing information regarding losses due to WSBM.

MATERIALS AND METHODS

Six near-isogenic populations and two commercial varieties showing resistance vs. susceptibility to WSBMV were selected and grown at four locations in 14 defined environments. An environment rated diseased or disease-free based on observations obtained in previous years when susceptible varieties were grown at that location. Eight locations were WSBMV-infested and 6 were uninfested soil sites in Kansas during 1972 to 1976. Table 1 lists the wheat populations studied and their WSBMV disease rating.

The wheat populations were derived originally from crosses made with resistant and susceptible parents. The near-isogenic populations were constituted by bulking resistant and susceptible lines as suggested by Burton (2), except that F_3-resistant and F_3-susceptible lines were used instead of seed from F_2 plants. Soil sites were classified as silt loam to silty clay loam mostly found in losses and were representative of the wheatlands at each location in Kansas. Seeding was done with the same nursery seeder at all locations using a 30 cm spacing in four-row plot 3.9 meters long. Seeding rates were 67 kg/ha at Hutchinson and Newton and 81 kg/ha at Manhattan and Powhattan. The plots were trimmed to 2.8 meters before harvest and the two center rows harvested at all the locations except at Newton (in 1975) and Manhattan (1976), when a combine was used to harvest all four rows. A split-plot

Table I. Populations studied in 1972-1976; their disease response, and number of F_2 families bulked in isogenic population.

No.	Population	Disease Response	Number of F_2 Families per Population
1	Concho/2* Triumph, Ks644	R	64
2	Triumph 64	MS	1
3	Concho/3* Triumph	MR-R	2
4	Concho/3* Triumph	MS-MR	2
5	Cohcho/Triumph//2*Kaw	R	16
6	Concho/Triumph//2*Kaw	MS	16
7	Concho/2* Triumph// Scout	R	9
8	Concho/2* Triumph// Scout	S	9
9	Scout*5/Agent//Shawnee	R	20
10	Scout*5/Agent//Shawnee	S	20
11 1/	Tascosa/Scout	R	21
12	Tascosa/Scout	S	21
13	Centurk	MR-MS	
14	Eagle	VS	

1/ All populations below this number added in 1975.

R = resistant; MR = moderately resistant; MS = moderately susceptible; S = susceptible; VS = very susceptible.

design with populations as main plots and disease reaction as sub-plots was used. Four replications were seeded at all test sites except Powhattan in 1975 which included only 3 replications. Entries and environments were assessed to be random effects. Yield was recorded as total grams of grain from the harvested area. Tiller number was determined by counting the spike bearing culms in a randomly selected 61-cm section of plot. Test weight of grain was determined by the standard method using a bulked sample from 4 replications. Kernel weights were obtained by the number of kernels in a 5-gram sample converted to grams per 1000 kernels. Plant height measurements were obtained by averaging three random readings per plot of the distance from soil line to tip of spike. Number of kernels per spike was obtained by the following equation:

$$\text{No. of kernels per spike} = \frac{Xn}{Y} \times 1000 \div Xt$$

Where Xn = weight in grams of grain from 2-foot section; Y = weight of 1000 kernels; Xt = number of tillers per 2-foot section, all figures derived from same plot.

Early spring forage yield was measured in the WSBMV invested environment at Newton (in 1972). The vegetation was harvested (30, March) and fresh weight recorded. Dry weight was obtained after drying the samples for 10 days at 120° F. Data from all 14 environments were combined for computation of means and analysis of variance. In cases where exact F-tests were not available, the method suggested by Snedecor and Cockran (13) defining approximate F-tests was substituted.

RESULTS

Observations made over the entire length of this study (1972-76), revealed good disease symptoms on susceptible wheat plants grown on all infested sites. There was considerable variation in the amount of stunting and mottling of the leaves, however. Considerable variation resulted in losses reflecting damage due to WSBMV.

Data collected from the five near-isogenic populations during the entire length of the study at all locations are presented in Table 2.

The analysis of variance (Table 3) indicated that environment, population, and environment x resistance interaction were significant for all traits investigated with the exception of number of kernels per spike. Yield was the only trait studied exhibiting significance over the environment x population x resistance interaction.

Table 2 represents and compares a list of isoline populations grown in different environments and compares four yield components: total grain yield, tiller number, kernel and test weight. Each comparison involves the bulk of resistant isoline populations compared to a bulk of the susceptible isoline populations.

In five of the seven comparisons conducted in infested environments, the resistant isoline populations yielded significantly higher than the susceptible populations. In

Table 2. Comparison of WSBMV resistant vs. susceptible isoline populations at different environments for yield, kernel weight, tiller number and test weight in Kansas, 1972-1976.

Yield (gms/plot)

Soil site:	DF[1]	D[2]	DF	D	DF	D	DF	D	DF	D	DF	D	D	
Environments	1	2	3	4	5	6	7	8	9	10	12	13	14	
Resistant	427	431	529	336	432	387	472	208	349	310	398	800	1024	
Susceptible	444	416	532	272	431	212	489	148	326	222	407	498	990	
% Loss		3.4		19.0*		45.2*		28.8*		28.4*		37.8*	3.3	LSD=56.3

Kernel Wt. (wt/1000 kernels)

	DF	D	DF	D	DF	D	DF	DF	D	DF	D	D	D	
Environments	1	2	3	4	5	6	7	9	10	12	13	14	11	
Resistant	29.51	28.15	28.47	33.20	38.46	35.35	31.71	26.82	28.86	30.41	30.89	33.55	30.22	
Susceptible	30.49	26.19	29.03	31.08	39.35	30.31	33.77	26.85	23.76	30.28	27.28	28.72	26.88	
% Loss		6.9*		6.4*		14.3*			17.7*		11.7*	14.4*	11.1*	LSD=1.18

Table 2. (Continued)

	Tiller No. (No. of tillers/61 cm section)									
	Environments									
	DF 1	D 2	DF 3	D 4	DF 5	D 6	DF 7	DF 9	D 10	
Resistant	94.9	103.8	108.4	85.2	105.4	77.8	122.5	88.3	89.4	
Suscep-tible	92.7	107.1	111.7	84.6	106	51.3	114.7	95.3	71.1	
% Loss		-3%		.7%		34.1*			20.5*	LSD=10.51

	Test Wt. (kg/hl)														
	Environments														
	DF 1	D 2	DF 3	D 4	DF 5	D 6	DF 7	D 8	DF 9	D 10	D 11	DF 12	D 13	D 14	
Resis-tant	79.46	77.14	79.59	76.76	83.46	78.95	79.72	75.08	77.14	76.37	79.21	80.50	78.95	74.69	
Suscep-tible	79.85	76.63	80.24	76.19	83.33	76.76	79.98	73.36	77.14	73.14	76.88	80.63	75.59	74.95	
% Loss		.6%		.74%		2.7*		2.2*		4.2*	2.9*		4.2*	-.34	LSD=.51

*Indicates significant at .05 level. DF = Disease Free; D = Diseased.

Table 3. Analysis of variance of resistant and susceptible populations 1-5 for yield, kernel weight, tiller number, number of kernels per spike, plant height and test weight.

Source of Variation	M.S.[2]		M.S.		M.S.	
	d.f.[1]	Yield	d.f.	Kernel Wt.	d.f.	Tiller No.
Environment	12	1,761,634**[3]	12	453**	9	11721**
Population	4	159,655**	4	322**	5	3923**
Res. vs Sus.	1	386,488	1	362	1	2143
Env. x Pop.	62	37,390**	81	16**	55	947*
Env. x Res.	12	84,953**	12	65**	8	1230**
Pop. x Res.	4	14,413	4	28**	4	182
Env. x Pop. x Res.	48	7,840*	48	344	32	266

Source of Variation	M.S.		M.S.		M.S.	
	d.f.	No. Ker./Spike	d.f.	Plant Ht.	d.f.	Test Wt.
Environment	8	253**	3	480**	13	39**
Population	5	42*	4	150**	4	18**
Resistance	2	36	1	36	1	14
Env. x Pop.	81	15	18	5	----	----
Env. x Res.	8	5	3	4*	13	3**
Pop. x Res.	4	8	4	2	4	1**
Env. x Pop. x Res.	32	8	12	1	----	----

[1] d.f. = degrees of freedom

[2] M.S. = mean square

[3] * and ** indicates differences are significant at 5% and 1% level, respectively.

the infested environments the reduction of yield was 3.4 to 45.2%. No significant differences occurred between the resistant and susceptible isoline populations in disease-free environments.

Kernel weight of the susceptible populations was significantly reduced in all seven diseased infested environments. The range in reduction of kernel weight was 6.9 to 17.7%. There was no difference in kernel weight in the disease-free environments between the resistant and susceptible isoline populations.

Significant differences in tiller number occurred in only two of the four diseased environments. The range of reduction was -3 to 34.1%. No significant differences were found in the disease-free environments.

Test weight was significantly (P=.05) reduced in 5 of the 7 diseased environments. The range of reductions were -.34 to 4.2%. Plant height was measured in one diseased environment and 3 disease-free environments. There was a significant (P=.05) difference between the resistant and susceptible isoline populations in the diseased environment. The reduction in plant height was 4.7%. There was no significant difference in the disease-free environments.

Early forage growth data were collected in one diseased environment (data not shown) and resistant populations produced more forage than the susceptible populations (P=.01).

Table 4 gives the results of combined data for the five paired isoline populations in all environments and are

Table 4. Resistant vs. susceptible isoline populations in soil infested with WSBMV and uninfested environments for average grams/plot, kernel weight, test weight and plant height in Kansas (1972-1976).

Environment	Resistant Populations	Susceptible Populations	(actual difference)	LSD 5% level	% Loss or gain[1]	Significance
	grams per plot					
Infested	369	288	(-81)	22.5	22.0	*
Uninfested	434	440	(+6)	-	0.1	ns
	1000 - kernel weight in grams					
Infested	31.5	27.7	(-1.8)	1.2	11.8	*
Uninfested	30.9	31.6	(+.7)	-	0.2	ns
	average tiller number per 2-foot row					
Infested	80.1	78.5	(-1.6)	10.5	11.8	*
Uninfested	104	104	0	-	0	ns
	test weight, kilograms per hectoliter					
Infested	76.98	78.31	(-1.3)	0.5	2.3	*
Uninfested	79.81	80.07	(+.2)	-	.002	ns
	average plant height in cm					
Infested	35.2	33.5	(-1.7)	0.8	4.7	*
Uninfested	38.4	37.7	(-.7)	-	0.2	ns

[1]Resistant populations = 100%.

illustrated in Fig. 1 to Fig. 4. Comparisons are made for yield, kernel weight, tiller number, test weight and plant height. The percent loss column in Table 4 represents the average reduction obtained when data for the entire study were combined. Yield was reduced an average of 22%, kernel weight and tiller number each had an 11.8% reduction and test weight exhibited the least loss of only 3.4%. Observations made on total performance of all WSBMV infested soils compared to uninfested soils can be found in Table 4 also. All traits observed exhibited a superior performance when measured in uninfested environments for both resistant and susceptible isoline populations. A breakdown of comparisons between environments is found in Fig. 1 to Fig. 3. The ranking of environments indicated that performance was superior in most cases in uninfested environments. Any variation from this trend may reflect significant environment and genotype interaction.

The near-isogenic populations from the cross Tascosa/ Scout showed the same trends established by the five near-isogenic populations in the three years (4 locations) they were grown (data not shown).

Comparisons made between Eagle, a very susceptible cultivar, and Centurk, a moderately resistant cultivar, that exhibits recovery after infestation are presented in Figure 5. Extensive tests in Kansas as reported by Ted Walter (15) indicated that yield of Eagle and Centurk was similar under WSBMV free conditions. Test weights are similar but Centurk

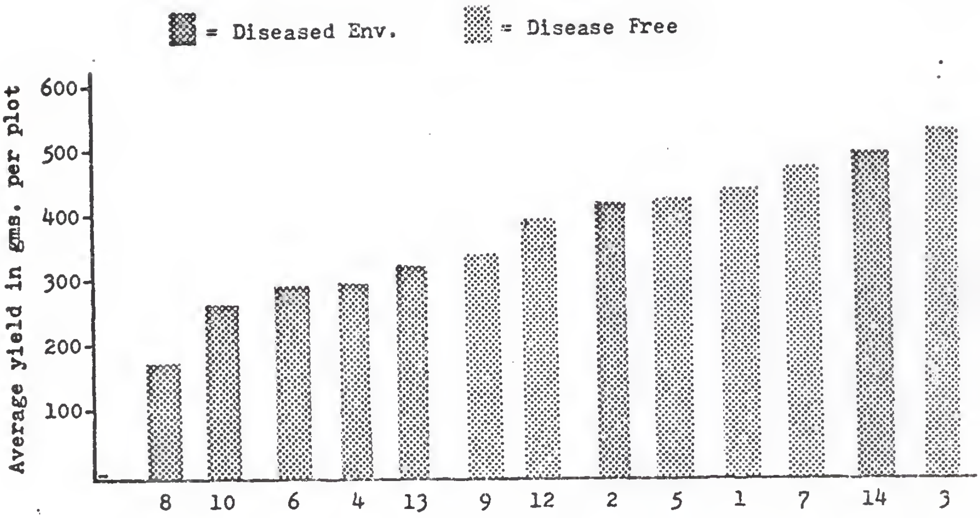


Figure 1. Rank of average yield performance of each environment with resistant and susceptible isoline populations bulked.

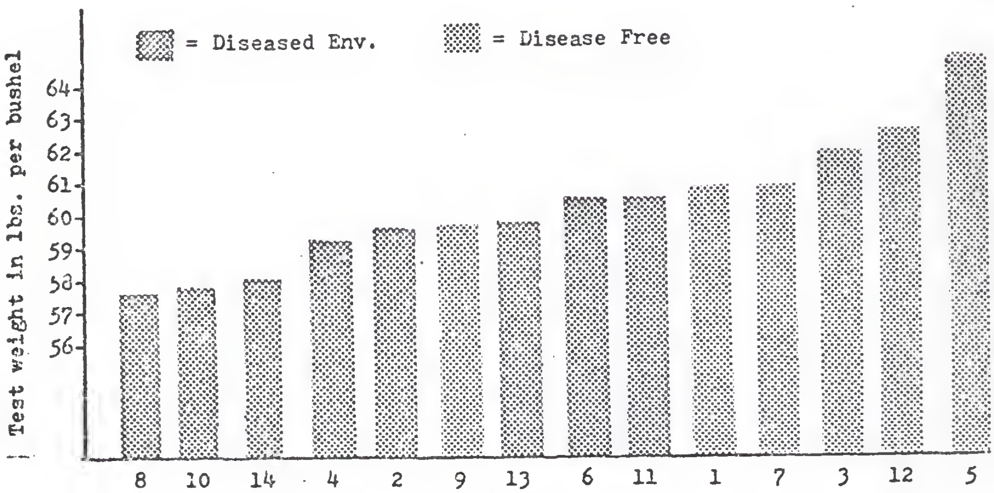


Figure 2. Rank of test weight performance of each environment with resistant and susceptible isoline populations bulked.

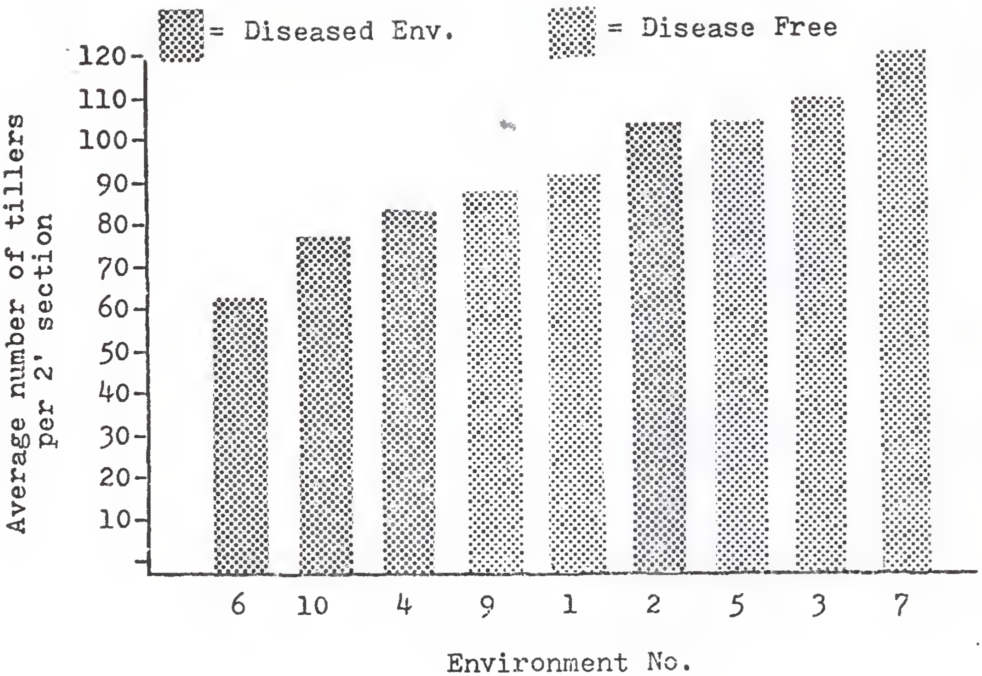


Figure 3. Rank of average tiller number performance of each environment with resistant and susceptible isoline populations bulked.

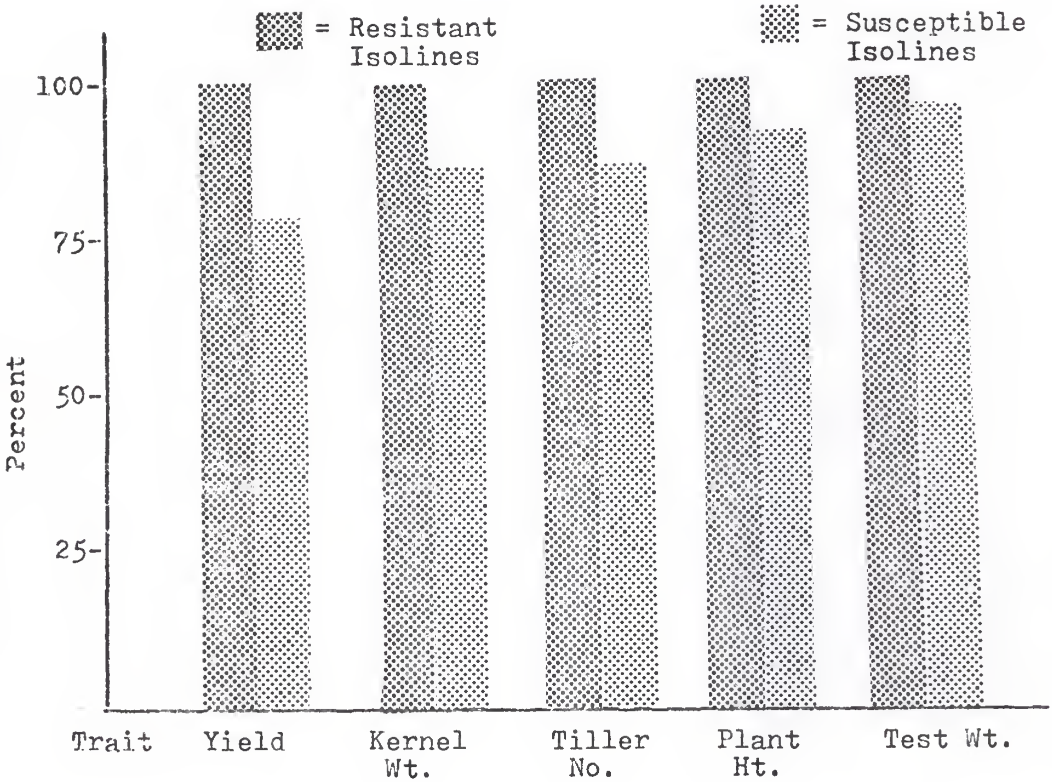
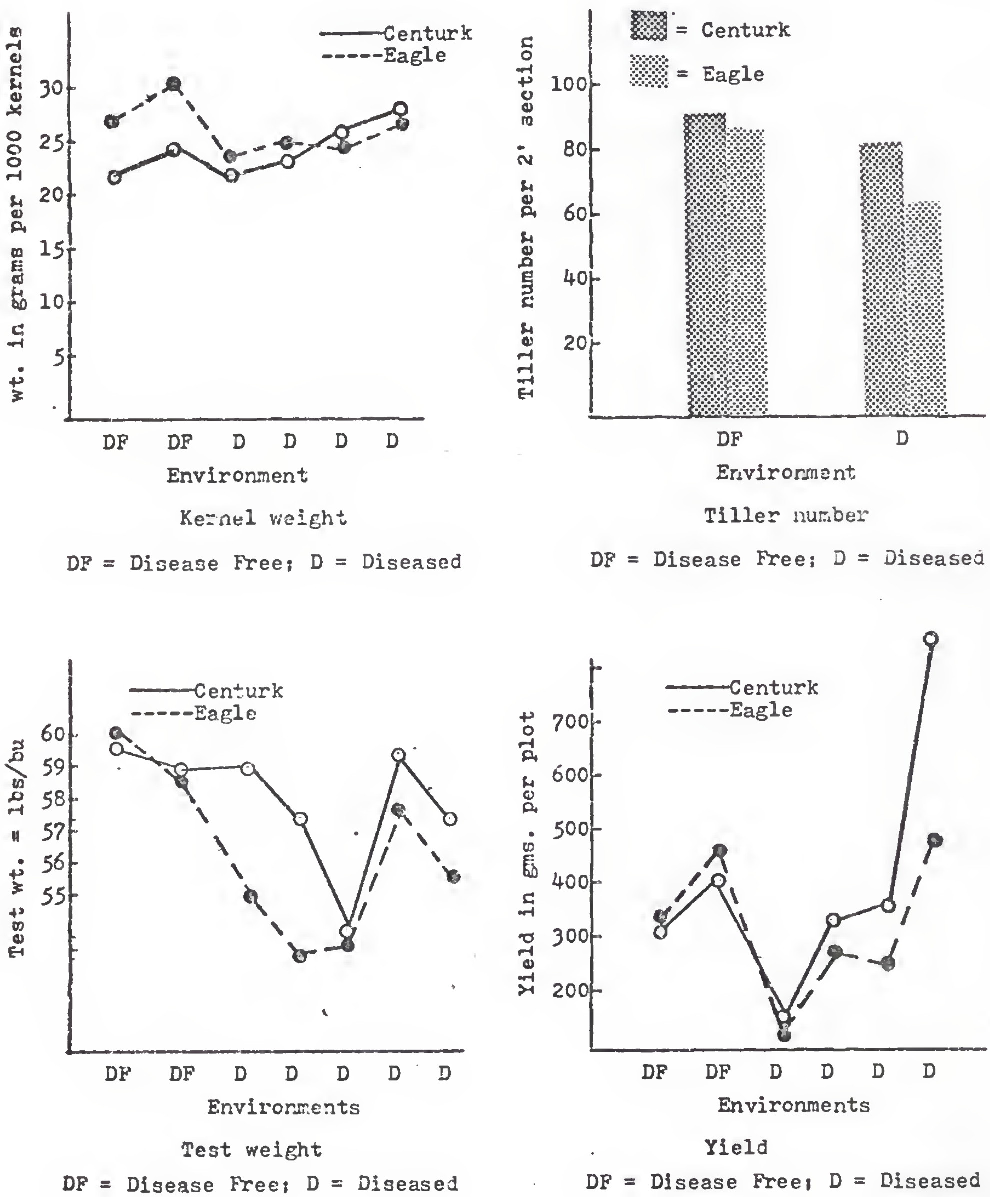


Figure 4. Average % loss of susceptible isolines for yield, kernel weight, tiller number, plant height, and test weight when compared to resistant isolines (100%).

Fig. 5. Comparison of Eagle (S) vs. Centurk (MR) in infested and disease free environments for kernel weight, tiller number, test weight and yield.



possesses a smaller kernel and a greater number of tillers. The results indicate that Centurk was superior to Eagle in terms of higher yield and tiller number and better test weight when grown in infested soil. In only two infested areas were the kernel weight of Centurk less than Eagle.

DISCUSSION AND CONCLUSIONS

The use of near-isogenic populations provides a more accurate measure of crop losses due to a plant disease than most other conventional methods. The resistant and susceptible isogenic populations were similar when grown in uninfested environments indicating the materials selected for the study were well suited.

Based on this relationship, the interpretation of the data using resistant and susceptible near-isogenic populations in virus infested soils as the potential of that environment gave a method to test the effect of this disease on several agronomic traits.

Results obtained during this study (1972-76) allow for several conclusions to be drawn. In the environments and locations tested it was found that the virus could cause a severe reduction of yield, tiller number, test weight, kernel weight and plant height. Number of kernels per spike and early forage yield also were depressed. The large variation in yield reductions (-3 to 45.8%) is attributable to several factors. Good symptoms of the virus were present in all diseased environments. Because of the fact that good symptom expression was evident in all infested soils and yield was not reduced uniformly indicated that degree of leaf mottling and extent of losses are not correlated well. The variation in yield losses was comparable to the other traits investigated in that they also exhibited no correlation between amount of symptom expression and amount of yield depression. Several factors may contribute to this apparent lack of correlation. For example, in some seasons the symptoms were present only a short time (10 days to two weeks) and at other times they persisted to the blooming stage. Another factor for consideration in failure to obtain good correlation between extent of mottling and yield reduction is the variation that exists among genotypes in recovery rates after infestation and also their simple yield potential regardless of WSBMV infestation. This evidence allows some flexibility in conclusions that can be drawn but it is certain that the environmental conditions favoring high depression of yield may not correspond to presence of disease symptoms. When the environments were ranked on the total performance (Fig. 1), diseased environment 14 was second in total yield performance even though it displayed good disease symptoms. This fact adds evidence to the assumption that other environmental conditions other than typical disease symptoms exist which cause losses due to WSBM.

The variation in genotype was observable in the same environment by the comparison of crop losses among susceptible isolines to that of reductions by the cultivar Eagle. The susceptible isolines exhibited a nonsignificant reduction of 3.3%. In contract, Eagle was severely depressed in yield even though environment 14 did not appear to cause losses that great. This variation on production was attributable to differences in genotypes as the near-isogenic susceptible populations generally were classified MS or S while Eagle was classified VS.

This range of variation in damage due to the disease makes it necessary that any conclusions drawn must pertain to the situation at each environment, the genotypes, and the interactions.

When agronomic traits were ranked on the performance at each environment, the infested sites generally showed the most reduction. The yield at the diseased sites were lowest except for the two environments. A similar pattern existed for tiller number and test weight and suggested that severe reduction in yield was due primarily to fewer number of tillers and a lower test weight. Plant height and early forage yield also was associated with yield depression. Number of kernels per spike did not respond the same as other traits studied. It was observed that recovery of susceptible genotypes after virus infection resulted in reasonable spike development even though reduced yield per unit area occurred. The surviving plants (or escapes) produced good but fewer spikes with average or above average kernels per spike.

During the course of this study it can be concluded that WSBM caused significant reductions in all traits examined. The preference of any population after infection by WSBMV is dependent primarily on the environmental conditions and the genotype of their population. The use of resistant varieties in controlling the disease is necessary under Kansas conditions.

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LITERATURE CITED

1. Bever, Wayne M. and J.W. Pendleton. 1954. The Effect of Soil-Borne Wheat Mosaic on Yield of Winter Wheat. Plant Disease Reporter 38:266-267.

2. Burton, G.W. 1966. Plant breeding - Prospects for the future. Intro. Plant Breeding, K.J. Frey, ed., pp. 391-402. Iowa State Univ. Press.

3. Campbell, L.G., E.G. Heyne, D.M. Gronau, and C. Niblett. 1977. Effect of Soil Borne Wheat Mosaic Virus on Wheat Yields. Plant Disease Reporter 59:472-476.

4. Fellows, H., W.H. Sill, Jr. and C.L. King. 1953. The 1952 epiphytotic of a soil-borne wheat mosaic in Kansas. Plant Disease Reporter 37:287-289.

5. Finney, K.F. and W.H. Sill, Jr. 1963. Effects of two virus diseases on milling and baking properties of wheat grain and flour and on probable nutritive value of forage wheat. Agron. Jour. 55:476-478.

6. Koehler, Benjamin, W.M. Bever, and O.T. Bonnett. 1952. Soil-Borne wheat mosaic. University of Illinois Agricultural Experiment Station, Bull. 556:567-599.

7. Kucharek, T.A. and J.H. Walker. 1974. The presence of and damage caused by soil-borne wheat mosaic virus in Florida. Plant Dis. Reportr. 58:763-765.

8. McKinney, H.H. 1923. Investigations of the russett disease and its control. J. Agric. Res. 23:771-800.

9. Pacumba, R.P., E.A. Addison, W.M. Sill, Jr. and O.J. Dickerson. 1968. Effect of soil fungigation on incidence of soilborne wheat mosaic and what yield. Plant Dis. Reptr. 52:559-562.

10. Palmer, L.T. and M.K. Brakke. 1975. Yield reduction in winter wheat infected with soilborne wheat mosaic virus. Plant Disease Reporter 59:469-471.

11. Roane, C.W., T.M. Starling and H.H. McKinney. 1954. Observations on wheat mosaic in Virginia. Plant Disease Reporter 38:14-18.

12. Sill, W.H., Jr. 1958. A comparison of some characteristics of soilborne wheat mosaic virus in the Great Plains and elsewhere. Plant Dis. Reptr. 42:912-924.

13. Snedecor, George W. and William G. Cochran. 1967. Statistical Methods. Iowa State Univ. Press, Ames, Iowa.

14. Wadsworth, D.F. and H.C. Young, Jr. 1953. A soil borne wheat mosaic virus in Oklahoma. Plant Dis. Reprt. 37: 27-29.

15. Walter, Ted. 1977. Kansas Performance Test with Fall-Planted Small Grains. Report of Progress 311, August, 1977.

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ABSTRACT

Wheat soilborne mosaic (WSBM) is a damaging disease of wheat in Kansas that causes extensive losses. Losses in 1977 were estimated to exceed 20 million bushels. There are about two million acres of wheatland infested with WSBMV in Kansas and the 1977 losses were the highest for all wheat diseases. Resistant varieties are the best and most economical control of the disease. This study indicated that losses due to WSBM varied considerably from season to season and by location. Five near-isogenic populations showing resistance or susceptibility to the disease were established to estimate damage. Two cultivars of winter wheat were also studied to determine losses due to the disease. Yield was reduced an average of 22% ranging from 3.3 to 45.2%. Kernel weight was reduced 11.8% ranging from 6.4 to 17.7% and tiller number was reduced 11.8% ranging from 3 to 34.1%. Test weight was reduced 3.4% and plant height 4.7%. Incidence of infestation in these studies was not a good guide to the amount of loss that occurred in any one location or season.