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## GREEN BUG INJURY ON BARLEY VARIETIES AT WOODWARD, OKLAHOMA, IN 1943

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The green bug (*Toxoptera graminum* Rond.) is an aphid attacking small grain crops. *T. graminum* has been shown by Fenton (1942) to be of major economic importance to the farmers of Oklahoma. In the late winter and early spring the infestations develop in fall planted grain fields from more or less circular areas where the insects have overwintered. Later, fields may become infested by flights of winged aphids from these original centers of infestation.

Since no practical method of chemical control has been developed for the green bug, other means of checking this pest have been sought, including the development of resistant varieties of grain and the improvement of the resistance of the plants by cultural methods. Tests have shown considerable differences among barley varieties in resistance to green bug injury.<sup>1</sup> While data presented in this paper show differences in varietal resistance, they also indicate that resistance is influenced by the vigor of the plants as modified by environmental factors.

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<sup>1</sup> Special report of variety tests at Lawton, Oklahoma, by R. G. Dahms.

The green bug infestation at the United States Field Station at Woodward, Oklahoma, reached outbreak proportions during the latter part of March 1943. The peak of the population was reached during the first week in April, after which it gradually decreased. When injury data were obtained, April 23 to 27, the green bugs had largely disappeared from the small grain plots. Accordingly, no infestation counts were made. Heavy populations of ladybird beetles and *Lysiphlebus* (as shown by numerous "shells" of parasitized green bugs) were noted in all barley plots. No dead spots, characteristic of overwintering infestations, were observed in the small grain at the field station, indicating that the area was infested by flights of winged forms. This method of dissemination should result in a generally uniform distribution of the initial population. This assumption was substantiated by observations by the station agronomist<sup>2</sup> who regularly visited the small grain plots during the outbreak.

#### METHODS

The degree of injury was determined by making an examination of individual plants or of small clumps of plants. Samples were taken from near the ends and from the approximate center of the middle row of each plot. The exact location of each sample was determined by arbitrary measurements or was selected at random. From three to twelve 1-linear-yard samples were examined from each plot. Each variety was replicated three or more times. The classes of injury were:

- "Normal"—no noticeable injury;
- "Light"—up to 10 per cent of the leaves dead;
- "Medium"—10 to 40 per cent of the leaves dead;
- "Heavy"—40 to 75 per cent of the leaves dead;
- "Total"—75 to 100 per cent of the leaves dead.

It will be noted that plants were described as injured only when there was dead leaf tissue present. Dead leaves from winter killing were easily distinguished from green bug injury by their dark brown weathered appearance.

Plant vigor classifications were made of each plot using as criteria height, diameter, color, succulence, etc. The classes used were "Good", "Fair", and "Poor." In some cases where the vigor was intermediate between two classes, minus values were added to the classes to give "Good-", "Fair-", etc.

Yield ratings were determined from numbers of heads developed. These records were made from certain of the 1-linear-yard samples used in making injury classifications.

The counts were made during the period June 5 to 7. Later, at harvest time, weight yields were obtained. The weight yield records for the spring barley varieties were in general agreement with the earlier head counts. However, in the case of the Ward winter barley, planted on cropped land and fallow land, the two types of yield records differed widely. This difference was thought to be due to the severe drought during the late spring and summer months. Since the head counts were made before the drought had begun to affect the plants noticeably, it is thought that they would more accurately show the effects of green bug injury upon the yield. Accordingly, the yield ranking in this paper is based entirely on the earlier yield records of head counts.

#### RESULTS

It will be noted in Tables I, II, and III that there is a general correlation between degree of injury and plant vigor. In Table I there are only three varieties that deviate from this correlation and these only by

<sup>2</sup> Credit is due V. C. Hubbard, Assistant Agronomist, Division of Dry Land Agriculture, United States Department of Agriculture, for observations and suggestions relative to classifications of injury and vigor.

one to three places<sup>3</sup> from their theoretical positions. These varieties are Composite Cross 2457, Michigan Winter, and Ward. This correlation is further emphasized by averages of the classes of vigor. Seven plots with "Good" vigor had an injury ranking range of 1-10 and an average injury ranking of 4.7 as compared with 5-21 and 13.8, respectively, for the 13 plots having "Fair" vigor. Five plots with "Poor" vigor had a range of 20-25 and an average of 22.8.

Table II gives comparative records for rows of five spring barley varieties growing adjacent to rye and rows of the same five varieties not adjacent to rye but in the immediate vicinity of it. The rye by April had reached a height of 18 to 24 inches and had established a deep and extensive root system. As a result barley plants adjacent to it were subjected to severe competition for moisture and light and had a consistently low general vigor. These five rows with an average vigor of "Poor" had an average of 62 per cent of the plants totally injured as compared with "Fair" and 32 per cent, respectively, for five rows of the same varieties not adjacent to rye.

Table III gives data on Ward winter barley planted on cropped land and on fallow land. These two areas were contiguous and had the same type of soil. The only important difference between the areas was that the soil moisture content of the fallow land was higher than that of the cropped land during the fall, winter, and early spring. Again it is noted that the degree of injury is consistently correlated with plant vigor. Eight plots on cropped land with an average vigor of "Fair" had an average estimated green bug injury of 52 per cent as compared with the corresponding averages of "Good" and 32 per cent for eight plots grown on fallow land.

There is a moderate correlation between plant vigor and yield. A close correlation would not be expected since there are a number of factors which could affect the yield after vigor classifications were made. If specific varieties be considered (Table I), a number of variations from correlation are noted. Probably one of the causes of this variation is the difference between varieties in their ability to recover from injury. This may account for the fact that certain varieties such as Beecher, Vance-Smyrna, Danne Selection 113, and Flynn have considerably higher rankings in yield than in vigor and injury. That there is a general correlation, despite these variations, is shown by the averages given in the three tables. In Table I the average yield rankings for the three classes of vigor are: for "Good", 6.7; for "Fair", 13.0; and for "Poor", 19.0.

#### DISCUSSION

Since the green bugs had largely disappeared when the collection of these data was begun, no population counts were made. As a result, the degree of infestation of the different plots is unknown. However, the fact that the plots were presumably infested by flight of winged forms, and the presence of a heavy and widespread population of ladybird beetles and numerous parasitized green bugs, indicate that the population was generally uniform. Furthermore, replication of plots should tend to cancel the effect of population variations.

In consideration of limitations of the data, definite conclusions are not justified. However, there are certain indications that should be of value as supplementary to other data. These indications are: (1) the greater the vigor of the plant the smaller is the injury sustained; (2) the greater the vigor of the plant, the higher is the yield; and (3) varieties differ in their ability to recover from injury.

#### LITERATURE CITED

Fenton, F. A. 1942. An ecological study of *Toxoptera graminum* in Payne County. Proc. Okla. Acad. Sc. 33:14-17.

<sup>3</sup> Ranking on injury is from least to highest; ranking on yield is from highest to lowest.

TABLE I  
*Green bug injury on barley varieties, Woodward, 1943*

Variety	General vigor, April 23-27	Per. cent of plants totally injured	Rank <sup>a</sup> Injury	Yield
Composite Cross 6619	good	12	1	2
Composite Cross 6620	good	15	2	6
Composite Cross 6725	good-	19	3	4
Arivat 6573	good-	19	4	12
Composite Cross 2457	fair	21	5	16
Rex 6618	good-	22	6	9
Colby x Flynn 2034	good-	23	7	7
Vaughn 1367	fair	23	8	8
Beecher 6566	fair	27	9	1
Michigan Winter 2036	good-	27	10	20 <sup>b</sup>
Vance-Smyrna 4585	fair	30	11	3
Danne Selection 113 6140	fair	31	12	5
Compans 5438	fair	33	13	18
Perth W. Australia 6025	fair-	34	14	10
B. K. L. Selection 6009	fair-	35	15	11
Woodwin 7033	fair-	35	16	22
Woodward- Bulk 38B2	fair-	38	17	19
Oderbrucker 940	fair-	41	18	21
Flynn 5911	fair-	42	19	13
Tenkow 646	poor	44	20	23
Ward 6007	fair-	45	21	24
Atlas 4118	poor	48	22	15
Lico 6279	poor	48	23	17
Wiebe Bulk 4131	poor	50	24	14
Wintex 6127	poor-	54	25	25
Averages by classes of vigor:				
	Good	19.5	4.7	6.7
	Fair	33.4	13.8	13.0
	Poor	48.8	22.8	19.0

<sup>a</sup> Ranking on injury is from least to highest; ranking on yield is from highest to lowest.

<sup>b</sup> A winter variety; did not have time to mature.

TABLE II

Comparative green bug injury on rows of spring barley adjacent to rye and on rows of the same varieties not adjacent to rye, Woodward, 1943

Variety	Rows adjacent to rye			Rows not adjacent to rye		
	General vigor	Per cent of plants totally injured	Number of heads	General vigor	Per cent of plants totally injured	Number of heads
Composite Cross						
2457	poor-	50	3	fair	21	69
Vaughn 1367	poor	40	27	fair	23	117
Tenkow 646	poor-	70	0	poor	44	39
Compans 5438	poor-	70	0	fair	33	42
Oderbrucker 940	poor-	80	0	fair-	41	30
Average:	poor-	62	6	fair-	32	60

TABLE III

Green bug injury on Ward winter barley, seeded at four rates and on four different dates, Woodward, 1943

Date and rate per acre	CROP LAND			FALLOW LAND		
	General vigor, April	Estimated green bug injury in April, per cent <sup>a</sup>	No. of <sup>b</sup> heads, June	General vigor, April	Estimated green bug injury in April, per cent	No. of <sup>b</sup> heads, June
Sept. 15, 2 pks.	Poor	56	19	Fair	26	113
" " 4 pks.	"	63	32	"	37	41
" " 6 pks.	"	62	29	"	42	95
" " 8 pks.	"	67	23	"	40	101
Sept. 15 Average	Poor	62	26	Fair	36	88
Oct. 1 2 pks.	Fair	48	38	Good	35	152
" " 4 pks.	"	57	36	"	41	95
" " 6 pks.	"	57	25	"	43	112
" " 8 pks.	"	56	59	"	28	134
Oct. 1 Average	Fair	55	37	Good	37	123
Oct. 22 2 pks.	Fair	35	28	Good	18	110
" " 4 pks.	"	31	23	"	23	168
" " 6 pks.	"	36	55	"	22	153
" " 8 pks.	"	37	71	"	23	200
Oct. 22 Average	Fair	35	44	Good	22	158
Nov. 15 2 pks.	Fair	67	1	Good	50	34
" " 4 pks.	"	56	15	"	37	76
" " 6 pks.	"	48	65	"	23	132
" " 8 pks.	"	53	36	"	23	173
Nov. 15 Average	Fair	56	29	Good	33	104
Crop Average:	Fair-	52	34	Fallow Av. Good-	32	118

<sup>a</sup> The per cent injury given in this table was obtained by adding  $\frac{1}{2}$  of the light injury percentage,  $\frac{1}{4}$  of medium, and  $\frac{1}{2}$  of heavy to the percentage totally injured.

<sup>b</sup> The numbers of heads given were obtained by adding  $\frac{1}{2}$  of the number of medium heads to the number of good heads.