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Cultivar Response to Wheat Strawworm[1]

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ABSTRACT

A survey of six Ellis county Kansas wheat (*Triticum aestivum* L. em. Thell.) fields in 1979 indicated that 53% of culms were infested with larvae of the second generation wheat strawworm, *Harmolita grandis* (Riley) form *grandis*. Early maturing cultivars tended to escape infestation in cultivar yield trials at Hays, Kans. in 1979. However, 'Centurk', 'Centurk 78', 'Rocky', and 'Parker' cultivars had lower infestations than others of the same maturity class, indicating possible cultivar resistance. Yield losses of 6 to 10 % were recorded for 'Sage' wheat culms infested with form *grandis* in 1979 and 1980. These losses, combined with the more serious damage reported for the spring form *minuta*, indicate this pest should be monitored more accurately, since moderate wheat strawworm damage may go unnoticed or credited to other insects.

Additional index words: **Wheat strawworm, *Harmolita grandis*, Wheat, *Triticum aestivum*, Insect resistance, Yield loss.**

WHEAT strawworm (WSW), *Harmolita grandis* (Riley), was once regarded as a major pest of wheat (*Triticum aestivum* L.), causing losses estimated at 10 to 15 million bushels per year in Kansas (Phillips and Poos 1953). Thousands of acres of wheat were damaged in 1929, and again during 1945-1948 (Gates 1952). It has not been reported in Kansas since 1949. Most of the available information on WSW importance, distribution, biology, and control was reported by Phillips and Poos (1953).

The WSW produces two generations of different morphological forms each year. The spring form *minuta* is wingless and smaller than the winged summer form *grandis*. Larvae of form *minuta* kill young culms and are more damaging than *grandis* larvae, which feed in the culms near the nodes. However, Phillips and Poos (1953) reported poor quality grain, and yields reduced by 22 % from *grandis* infested culms.

Form *grandis* of the WSW was found in 1979 and 1980 at the Fort Hays Branch, Kansas Agricultural Experiment Station. Our objectives were: 1.) determine the incidence of WSW in Ellis county Kansas in 1979, 2.) determine if cultivars sustained different levels of WSW infestation, and 3.) determine the yield loss caused by the WSW.

MATERIALS AND METHODS

Nineteen wheat cultivars were planted 1 Sept. 1978, in 0.02 ha plots (6-row plots with 33-cm row spacing). A randomized complete block design with 4 replications was used. Soil moisture was favorable and comparable plant populations among cultivars were obtained. Heading date, grain yield, grain-test weight, and infestation of WSW were recorded. Fifty culms were randomly selected from each plot (200/cultivar) and the number and location of WSW pupae were recorded.

In addition, 25 'Sage' wheat plants (3 culms/plant) were pulled from the two outside rows of each of four replications in the cultivar trial. Only the center four rows were harvested for yield. Location, number of WSW, and grain weights were recorded for the primary culm, the two secondary culms, and total plant. Since few noninfested 3-culm plants were available in 1979, grain weights from the 3-culm plants having one WSW were combined with those from noninfested plants and compared to plants having two or more WSW.

In 1980 a test designed to determine grain yield loss to form *grandis* was conducted in a production field of Sage wheat. Four plots (6 m × 6 m) staked out 80 m apart were used. On 24, 26, and 28 June 1980, culms with spikes that had just emerged from the boot were tagged. Different colored tags were used to denote heading date, which eliminated the possibility of comparing infested and noninfested culms of different maturities. Tagged culms were harvested and the number and location of WSW

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were determined. Grain weight/culm, kernel number/culm, and kernel weight were determined. Comparisons were between equal numbers of infested and noninfested culms that headed the same day. Data reported are the average of all three heading dates.

WSW infestations were determined on mature third-instar larvae of form *grandis* by splitting the wheat culms with a scalpel. The nodes were numbered one (first node below spike) to three (third node below spike). Samples were taken when the crop was mature and ready for harvest. Plant samples with three culms were pulled with the crown intact. Samples from commercial fields and wheat cultivars were cut with a knife at ground level.

Analysis of variance was computed for all results and treatment means compared with Duncan's Multiple Range Test. Correlation coefficients were calculated for WSW infestations with plot means of agronomic data collected for wheat cultivars.

RESULTS AND DISCUSSION

Each of six Ellis county wheat fields sampled in 1979 were infested with 1 to 42 WSW/25 culms. The average percent of culms with zero, one, two, and three WSW/culm were 47, 27, 19, and 6 respectively. Knowlton (1931) described as moderately heavy an infestation in Utah with 33% of the examined culms infested. Our limited survey indicated that 53% of culms were infested in Ellis county, Kansas in 1979.

Numbers of WSW/50 culms varied from 8 for 'Triumph 64' to 54 for 'Eagle' (Table 1). Triumph 64 headed 8 days earlier than Eagle. Numbers of WSW and days to heading were positively correlated (+0.51, $P < 0.01$) for the 19 cultivars. Therefore the earlier maturing cultivars had fewer WSW. Oviposition by form *grandis* apparently depends on growth stage of plants when adults are active. In Kansas, early maturing cultivars tend to escape infestation, so the recommendation of Phillips and Poos (1953) to grow early cultivars to reduce WSW damage remains valid. Cultivar maturity probably would not reduce infestation by *minuta* because it attacks in early spring.

Our results indicate the 'Centurk', 'Centurk 78', 'Rocky', and 'Parker' may resist WSW as they had fewer WSW than other cultivars in their maturity class (Table 1). Triumph 64, 'Trison', 'Wings', and 'Vona' were equally low in WSW/50 culms, but these cultivars headed significantly earlier than Centurk, Centurk 78, Parker, and Rocky. The increased percent of WSW in the first node of the early cultivars (Table 1) indicates that the first node was probably the only receptive site for oviposition of WSW development when the adult was active. Therefore, early heading is probably responsible for the low number of WSW/50 culms in the early cultivars. Infestations in the first node were negatively correlated (−0.77, $p < 0.01$) with days to heading.

The four cultivars that appeared to have some resistance to WSW are genetically related. Parker is in the parentage of Centurk while Centurk 78 and Rocky are selections from Centurk. The WSW resistance in these cultivars is probably derived from the same source.

Resistance to WSW has not been reported in common wheats, but rye (*Secale cereale* L.) and some wheat × rye hybrids are resistant (Gates 1952). No WSW were found in 50 culms each of five triticale cultivars sampled at Hays, Kansas in 1979.

Table 1. Mean number of wheat strawworms (WSW), percent in first node, days to heading, grain test weight, and grain yield of 19 wheat cultivars in 1979.

	Characters				
Cultivar	WSW/50 culms	% WSW in 1st node	Days to heading from 1 Jan.	Grain test weight kg/hl	Grain yield kg/ha
Triumph 64	8 a*	91 de	147 a	78 fg	2070 bcd
Parker	10 ab	64 abc	150 bc	77 ef	2097 bcd
Centurk 78	14 abc	67 abcd	152 d	75 bc	2056 bcd
Centurk	16 abc	60 ab	153 de	75 bc	1714 a
Trison	16 abc	85 bcde	147 a	77 ef	2070 bcd
Rocky	16 abc	68 abcde	154 efg	74 abc	1982 abcd
Wings	22 bcd	92 e	148 a	78 fg	2231 d
Vona	23 bcd	91 de	148 a	76 cde	2117 bcd
Cheney	26 cde	65 abc	152 d	75 bc	1982 abcd
Scout	28 cdef	62 abc	154 efg	75 bc	1828 abc
Larned	34 defg	57 a	155 g	73 ab	1922 abcd
Lindon	35 defg	87 cde	149 b	79 g	2097 bcd
Newton	35 defg	59 a	153 de	73 ab	1814 ab
Payne	39 efgh	75 abcde	151 c	74 abc	2083 bcd
Sage	42 fgh	–	155 g	74 abc	1895 abcd
TAM 101	46 gh	61 ab	153 de	77 ef	2184 cd
Bennett	49 h	66 abc	154 efg	74 abc	1848 abc
Buckskin	50 h	52 a	155 g	73 ab	1868 abc
Eagle	54 h	51 a	155 g	75 bc	1895 abcd

* Means followed by the same letter do not differ significantly ($P < 0.05$) according to Duncan's Multiple Range Test.

Table 2. Effect of wheat strawworm (WSW) on grain yield of Sage wheat plants in 1979.

	Avg No. WSW/ culm or plant†	Avg grain†		Probability of significance (P)
		Weight g	Loss (%)	
Culms				
Primary	0	0.87	10	0.23
	1.3	0.78		
Secondary	0	0.50	8	0.19
	1.4	0.46		
3-culm plants	0.8‡	1.97	14	0.06
	3.1§	1.69		

† Based on 100 plants or 300 culms.
‡ Infested with 0 to 1 WSW/3-culm plant.
§ Infested with 2 or more WSW/3-culm plant.

The numbers of WSW in culms were not significantly correlated with grain yield or test weight. However, yield and test weight were significantly negatively correlated [−0.43 and −0.64 ($P < 0.01$), respectively] with days to heading. This indicates late maturing cultivars had more WSW and yielded less than early cultivars. The 1979 season favored early maturing cultivars because soil moisture was depleted before late maturing cultivars had completed grain filling. In 1979 yields probably were affected more by maturity than by WSW infestation.

Grain from infested primary and secondary culms of 3-culm Sage wheat plants weighed 8 to 10% less (nonsignificant) than grain from noninfested culms in 1979 (Table 2). Yield of 3-culm plants infested with two or more (avg 3.1) WSW/plant was 14% less than the yield of plants infested with zero to 1 (avg 0.8) WSW/plant ($P < 0.06$). Yields of infested culms were reduced 6% in 1980 (Table 3), similar to the loss we measured in 1979 for single infested culms (Table 2). The reduction of variability obtained by comparing infested and noninfested culms that headed on the

Table 3. Effects of wheat strawworm (WSW) on kernel weight/culm, kernels/culm, and weight/kernel in culms of Sage wheat with the same heading date in 1980.

	Kernel wt/culm†	Kernels/culm	Wt/kernel†
	g		mg
Infested	0.75	27	28
Uninfested	0.80	29	28
Loss	0.05*	2**	-
% Loss	6	8	--

*,** Loss due to WSW significant at 0.05 and 0.01 probability levels, respectively.

† Based on 50 each of infested and uninfested culms from each of four replications.

same day resulted in statistically significant losses measured in 1980. Fewer kernels/culm accounted for the yield loss, as kernel weight was not affected (Table 3).

Phillips and Poos (1953) reported yield reduction up to 22% by form *grandis*. Our data show smaller losses (5 to 10%) on each infested culm.

It is difficult to accurately determine effects of form *grandis* larvae on grain yield because plants within cultivars and culms of individual plants are not randomly infested. Since early cultivars tend to escape infestation, it seems likely that early plants or culms within plants may also be infested less than late ones. Therefore a late infested culm compared to an earlier noninfested culm of the same plant would result in a yield bias in favor of the noninfested culm since the earliest culms on an individual plant usually yield more than the later culms. Hopefully this bias was kept at a minimum in 1980 when comparisons were made between culms that headed on the same date. In addition, Doan (1926) reported that WSW form *grandis* often selects the strongest culms for oviposition, which may bias grain yields in favor of infested plants.

The losses shown here from form *grandis* coupled with the undetermined loss from form *minuta* may be significant. Our survey results, although limited, indicate that WSW infestations may be more widespread than generally recognized. More attention should be given to assessing the importance of WSW in wheat producing areas, particularly under minimal tillage, which should provide optimum winter survival conditions for WSW.

REFERENCES

1. Doan, R. W. 1926. The reappearance of *Harmolita grandis* and *Harmolita vaginicola* in Utah. J. Econ. Entomol. 19:730–73.
2. Gates, D. E. 1952. Sources of resistance to wheat strawworm, *Harmolita grandis* (Riley). M. S. thesis Kansas State Univ., Manhattan. 46p
3. Knowlton, G. F. 1931. The wheat strawworm, *Harmolita grandis* (Riley), in Utah — 1930. J. Econ. Entomol. 24:414–416.
4. Phillips, W. J., and F. W. Poos. 1953. The wheat strawworm and its control. USDA Farmer's Bull. no. 1323 6p.