Section IV.
Cereal Crop Pests

EFFECTS OF TILLAGE AND CROPPING SYSTEM ON HESSIAN FLY DENSITIES IN SMALL GRAINS OF CENTRAL WASHINGTON

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In response to an EPA requirement to reduce PM-10 (particulate matter less than 10 microns) in the 7-15 inch rainfall zone of Central Washington, a multi-disciplinary research project examined the impact of shifting from traditional winter wheat/fallow cropping system to spring cropping systems under no-till cultivation. One objective was to monitor Hessian fly, *Mayetiola destructor* (Say), densities and determine if this cropping change would exacerbate problems with this pest. Earlier research has shown that spring wheat is more susceptible to infestation, because there can be two spring generations of Hessian fly (Pike and Antonelli 1981), conservation tillage allows greater survival of the flies, which over-winter in grass stubble (Pike et al. 1993), and cultivation prevents fly emergence by deeply burying the puparia (Rockwood and Reeher 1933).

Three years of data are presented from on-farm replicated (n=4) plots (10x500ft) consisting of four cropping systems: 1) soft white winter wheat/cultivated fallow, 2) soft white spring wheat/chemical fallow, 3) continuous hard red spring wheat (no-till), 4) hard red spring wheat/spring barley (no-till). Densities of Hessian fly (HF) eggs, larvae and puparia were recorded in winter wheat, spring wheat and spring barley over three years. At each sampling, 25 plants were removed per plot (5 plants from 5 locations) and examined. Winter wheat was sampled in the fall and spring. Spring grains were sampled when mean temperature reached 50°F (minimum for HF emergence). There were three spring sampling dates in 1998, five in 1999, and three in 2000. Plant samples harboring puparia were collected and sent to R. Ratcliffe for biotype determination.

Hessian fly was not found in wheat in the semi-arid region of Washington state in earlier reports (Rockwood and Reeher 1933, Pike and Antonelli 1981). However, HF attacked susceptible wheat in this study (Table 1). Continuous hard red spring wheat (HRSW), P5 and P6 plots, supported the highest infestations, with numbers doubling from 1998 to 1999 and from 1999 to 2000 (Figure 1.) Almost 47% and 43% of the tillers in P5 and P6 plots, respectively, were infested in 2000. The economic injury level is estimated to be 15-20% infested tillers (Pike et al. 1993). Hessian fly populations were very low in winter wheat in 1998 and 1999, but reached a level of 23.2% infested tillers in 2000. 'Baronesse', the barley cultivar in this study, is resistant to HF (R. Ratcliffe, unpublished data) and was resistant in this study.

Table 1. Hessian fly infestations, Ralston Project, 1998, 1999 and 2000.

Plot[1]	Cropping System		8 June 1998 (mean infestation)[2]		8 June 1999 (mean infestation)[2]		2 June 2000 (mean infestation)[2]	
	1999	1998/ 2000	% Infested Plants	% Infested Tillers	% Infested Plants	% Infested Tillers	% Infested Plants	% Infested Tillers
P1	Fallow	WW	2.0	0.2	-	-	70.0	23.2
P2	WW	Fallow	-	-	0.0	0.0	-	-
P3	Fallow	SWSW	34.5	7.9	-	-	47.0	14.85
P4	SWSW	Fallow	-	-	10.0	2.5	-	-
P5	HRSW	HRSW	30.5	10.4	63.0	24.6	96.0	46.76
P6	HRSW	HRSW	17.0	4.9	28.0	11.0	81.0	42.75
P7	SB	HRSW	31.0	10.3	0	0	68.0	25.45
P8	HRSW	SB	0	0	24.0	7.5	2.0	0.35

[1] Odd numbered plots located at the west site, even numbered plots at the east site.
[2] Winter wheat sampled on 4 May 1998, on 29 April 1999, and 24 April 2000.

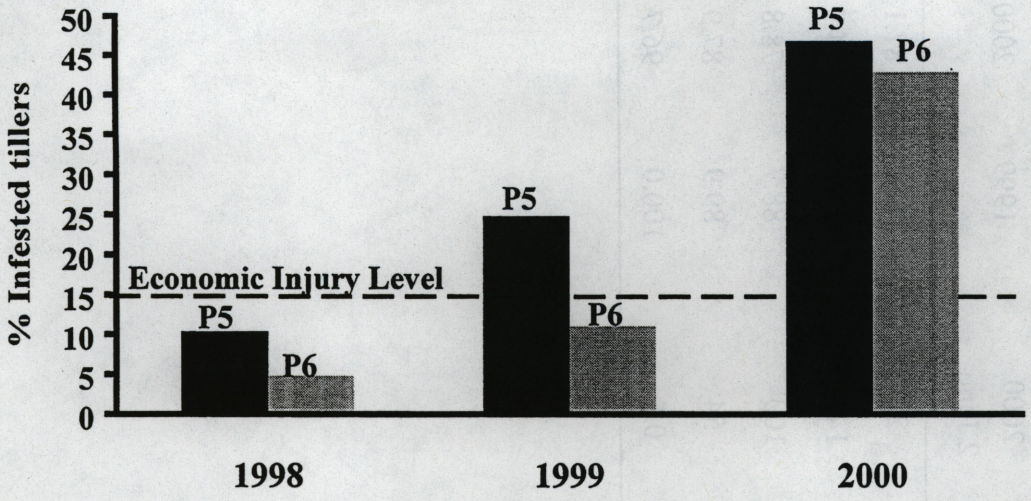

Figure 1. Hessian fly infestation in continuous hard red spring wheat.

Natural mortality of Hessian fly from the egg to puparium stage was very high, ranging from 88.7 to 100% in 1999 and from 78.8 to 96.7 in 2000 (Table 2). Even with high mortality, infestations exceeded the economic injury level in P5 plots during 1999 and in almost all wheat plots during 2000. Five HF biotypes are present at the research site (Table 3), the most prevalent being GP biotype, which has no virulence against resistant genes (Ratcliffe and Hatchett 1997). The remaining biotypes have virulence against one or two resistant genes. Ratcliffe et al. (2000) reported a similar biotype profile for other Pacific Northwest HF populations.

References

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Table 2. Mortality of Hessian fly between egg and larvae/puparia stages, Ralston plots, 1999 and 2000.

Plot	Crop	Mean no. eggs[1]		Mean no. larvae/puparia[1]		% mortality	
		1999 11 May	2000 1 May	1999 8 June	2000 2 June	1999	2000
P4/P3	SWSW	57	194	4	25	92.9	87.1
P5	HRSW	521	919	42	141	91.9	84.7
P6	HRSW	150	472	17	100	88.7	78.8
P8/P7	HRSW	115	445	12	54	89.9	87.9
P7/P8	SB	9	15	0	0.5	100.0	96.7

[1] n=25 plants, replicated 4 times

Table 3. Hessian fly biotypes and virulence against resistant genes.

Hessian fly biotype	% of population	Virulence against Resistant genes*
GP	58	None
E	17	H3
F	14	H6
G	10	H3, H6
N	1	H5, H6

* R. Ratcliffe, unpublished data