

Project Title: Evaluation of experimental lines containing the Sm1 gene for antibiosis against the Orange Wheat Blossom Midge (owbm)

Objectives: To verify the presence of the Sm1 gene and to evaluate the agronomic performance of experimental lines of spring wheat

Materials and Methods:

Experimental materials derived from crosses between a Sm1 line from North Dakota and several Montana spring wheat varieties and advanced lines were evaluated for resistance to the owbm as well as for agronomic performance. Several commercial varieties also were included for comparison.

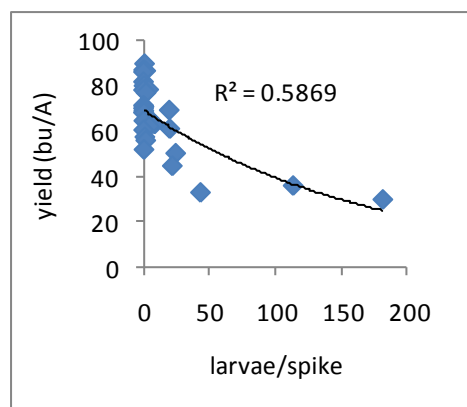
This study was established in a field which had been in spring wheat for the previous five years and had a history of moderate to high midge densities. The study was conducted using conventional tillage and was fertilized with 97-30-120-24 lb/A of N-P-K-S. Treatments were seeded at a rate of 75 lb/A in six inch wide rows, to a depth of two inches on May 7, 2010. Individual treatments consisted of seven, 15 foot long rows, with each treatment replicated three times in a randomized complete block design.

Heading was recorded when 50 percent of the plants in a plot had half the spike exposed. Plant height measurements and foliar disease ratings were taken the first week of August. The latter included stripe rust and septoria. Percent green leaf area was also recorded at this time. Three spikes were sampled from each plot on August 9. Each spike was dissected and the number of larvae and seeds counted. Stem samples also were taken to assess stem solidness on a scale of 5 (hollow) to 25 (solid). Plots were harvested on September 14 to determine grain yield, protein, test weight, and polyphenol oxidase (PPO).

Results:

Yields averaged 66 bu/A, and ranged from a high of 89 bu/A for CAP339-1 to a low of 30 bu/A for Hank (Table 1). Wheat yields were affected by midge densities, with yields declining exponentially as larvae numbers increased (Figure 1). The highest larvae densities, and the lowest grain yields, were observed

Figure 1. Effect of owbm density on yield.



with the commercial varieties Choteau, Vida and Hank. In contrast, incorporation of the Sm1 gene greatly reduced owbm densities, benefiting yields in the process. While the non-attractive spring wheat Reeder had larval numbers typical of this variety, the relative yield ranking was lower than normal. At a minimum this response demonstrates that several experimental lines not only have a much lower incidence of midge as compared to Reeder, but have superior yield potential as well.

Yields were also negatively affected by the foliar diseases, stripe rust and septoria. Septoria was wide spread throughout the nursery. Infection levels averaged 23 percent and ranged from a low of 10 to a high of 38 percent. Stripe rust was less of a problem and most entries expressed high levels of resistance. Infection levels averaged 13 percent and ranged from 0 to 65 percent. CAP82-3, CAP577-1, and Hank had the highest incidence of stripe rust. While foliar diseases were prevalent, the impact on yield was less relative to the owbm.

As yields increased, protein levels decreased, but test weights increased. Protein averaged 13.91 percent, ranging from a low of 11.87 for CAP 197-1 to a high of 16.20 for Vida. Protein content tended to increase as midge numbers increased. Test weights were lower than normal, and averaged 58.40 lb/bu. CAP523-3 had the lowest test weight at 54.63 lb/bu, while CAP289-2 had the highest test weight at 60.40 lb/bu. Polyphenol oxidase levels ranged from a low of 0.7041 to a high of 1.1485.

The average heading date for the nursery was 186 (July 5), with the earliest and latest dates being 184 and 189 respectively. Yields tended to decrease as heading was delayed, but the effect was minimal. Plant height averaged 38 inches and ranged from a low of 35.43 for CAP151-3 to a high of 40.94 for Vida. Stem solidness varied greatly among the entries ranging from a low of 7.27 for CAP281-2 to a high of 22.87 for CAP73-1. Plant height and stem solidness were marginally correlated to PPO levels. As plant height increased, so too did PPO levels. In contrast, stem solidness decreased as PPO levels increased.

Overall, these preliminary results demonstrate that there are several high yielding experimental lines that have resistance to the midge as well as stripe rust and septoria, while also possessing excellent quality attributes. In particular, CAP151-3 is a short, early heading, solid stem line that has excellent insect and disease resistance, high protein, and very good yield potential.

Table 1. Evaluation of experimental spring wheat lines for resistance to the orange wheat blossom midge. Kalispell, 2010.

entry ID	Yield Bu/A	Protein %	Test		PPO	OWBM no/spike	Stripe	Green		Heading Julian	Height inches	Stem solidness 5 to 25
			weight lb/bu	rust %			Septoria %	leaf area %				
22	CAP339-1	89.60	14.33	59.10	1.0549	0.78	15.00	20.00	78.33	184.33	39.89	11.67
13	CAP201-2	86.86	13.20	59.33	1.0406	0.11	13.33	31.67	66.67	185.00	39.76	16.93
15	CAP219-2	86.49	12.40	59.23	1.0227	1.67	11.67	21.67	65.00	185.33	38.32	16.73
11	CAP197-3	85.99	12.07	59.17	0.9287	0.00	3.33	18.33	76.67	188.33	39.24	14.87
8	CAP151-3	81.67	14.77	59.30	0.8756	0.00	0.00	10.00	86.67	185.00	35.43	19.53
5	CAP84-1	79.92	13.93	58.97	1.0082	0.33	21.67	26.67	60.00	184.67	40.55	16.73
14	CAP219-1	78.36	12.70	59.23	1.0066	1.56	15.00	23.33	66.67	185.33	39.63	13.53
10	CAP197-1	78.25	11.87	59.83	1.0699	3.89	5.00	18.33	70.00	187.67	39.63	14.20
1	CAP34-1	78.08	12.93	59.13	0.7896	0.00	0.00	18.33	78.33	186.33	36.48	22.47
16	CAP219-3	76.85	12.57	59.33	0.8563	1.89	8.33	23.33	61.67	186.33	37.80	13.00
18	CAP281-2	71.32	13.30	59.00	1.1032	0.00	13.33	21.67	53.33	185.00	37.80	7.27
21	CAP311-2	70.75	14.97	58.20	0.8834	0.33	6.67	30.00	61.67	185.67	38.71	16.20
17	CAP277-1	70.02	14.20	59.50	1.0812	0.00	1.67	23.33	65.00	187.33	40.16	13.07
24	CAP401-2	69.25	13.70	59.47	0.8379	19.44	0.00	20.00	61.67	184.67	35.70	8.65
7	CAP108-3	68.97	13.43	58.43	0.7768	0.22	0.00	33.33	58.33	186.67	38.06	22.33
12	CAP201-1	68.21	12.20	59.47	1.1485	0.00	16.67	38.33	51.67	185.67	40.68	16.87
6	CAP84-2	68.17	12.90	59.37	0.8515	0.22	10.00	18.33	53.33	185.00	38.58	17.73
23	CAP400-1	65.56	14.33	57.83	0.9075	4.22	0.00	23.33	60.00	189.00	38.06	8.13
25	CAP523-3	64.59	16.00	54.63	0.8320	0.22	0.00	21.67	60.00	187.67	36.75	20.47
20	CAP289-2	63.13	14.90	60.40	1.0615	8.34	26.67	26.67	66.67	185.00	40.03	12.13
27	CAP577-1	62.14	13.57	55.63	0.9542	4.33	63.33	21.67	33.33	185.67	37.14	13.80
28	REEDER	61.10	14.87	59.70	0.9414	19.89	3.33	13.33	86.67	186.67	40.16	8.40
9	CAP172-2	60.53	13.20	58.40	0.9840	0.11	0.00	35.00	58.33	185.67	37.80	20.47
2	CAP73-1	57.48	13.83	59.23	0.7041	1.00	0.00	23.33	78.33	186.00	38.58	22.87
26	CAP548-2	55.96	13.17	57.20	0.8032	1.67	46.67	33.33	30.00	188.33	38.85	9.07
3	CAP82-3	51.95	13.47	59.00	0.7356	0.33	65.00	25.00	23.33	186.33	37.80	21.53
4	CAP83-3	50.32	15.40	56.07	0.8481	24.33	3.33	15.00	71.67	185.67	38.45	20.40
19	CAP284-1	44.80	16.13	56.60	1.1254	21.78	13.33	20.00	71.67	186.00	38.32	9.53

Table 1. Continued.

entry ID	Yield Bu/A	Protein %	Test	PPO	OWBM no/spike	Stripe	Septoria %	Green	Heading Julian	Height inches	Stem	
			weight lb/bu			rust %		leaf area %			solidness 5 to 25	
29	CHOTEAU	36.15	16.10	56.20	0.8713	113.22	0.00	21.67	68.33	186.00	38.45	21.80
31	VIDA	33.14	16.20	57.53	1.0955	43.11	3.33	11.67	91.67	188.33	40.94	12.13
30	HANK	30.06	14.53	55.77	1.0520	181.11	50.00	31.67	23.33	187.00	35.56	10.33
	MIN	30.06	11.87	54.63	0.7041	0.00	0.00	10.00	23.33	184.33	35.43	7.27
	MAX	89.60	16.20	60.40	1.1485	181.11	65.00	38.33	91.67	189.00	40.94	22.87
	MEAN	65.99	13.91	58.40	0.9436	14.65	13.44	23.23	62.53	186.18	38.49	15.25
	LSD (P=0.5)	14.50	1.20	0.58	0.2500	41.48	9.95	12.91	21.74	1.27	2.04	2.24
	CV	13.45	5.29	0.61	16.15	173.40	45.36	34.05	21.29	0.42	3.20	9.01
	TRT (P>F)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0040	0.0001	0.0001	0.0001	0.0001