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Agricultural Experiment Station

Colorado State University

College of Agricultural Sciences

Department of Bioagricultural Sciences and Pest Management

2009 Colorado Field Crop Insect Management Research and Demonstration Trials

2009 Colorado Field Crop Insect Management Research and Demonstration Trials[1]

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Jeff Rudolph, Terri Randolph, Frank Peairs, Tyler Keck, Marie Stiles, and Dylan Walker, Department of Bioagricultural Sciences and Pest Management

CONTROL OF RUSSIAN WHEAT APHID BIOTYPE RWA2 AND BROWN WHEAT MITE IN WINTER WHEAT WITH HAND-APPLIED INSECTICIDES, ARDEC, FORT COLLINS, CO, 2009: Treatments were applied on 7 May 2009 with a 'rickshaw-type' CO_2 powered sprayer calibrated to apply 20 gal/acre at 3 mph and 32 psi through three 8002 (LF2) nozzles mounted on a 4.0 ft boom. Conditions were partly cloudy and calm with temperatures of 60°F during the time of treatment. Plots were 6 rows (5.0 ft) by 28.0 ft and were arranged in six replicates of a randomized, complete block design. Crop stage at application was early jointing (Zadoks 30). The crop had been infested with greenhouse-reared Biotype RWA2 aphids on 24 February 2009.

Treatments were evaluated for Russian wheat aphid control by collecting 20 symptomatic tillers along the middle four rows of each plot 7, 14 and 21 days after treatment (DAT). Tiller samples were placed in Berlese funnels for 24 hours to extract aphids into alcohol for counting. Symptomatic tiller samples taken the day before treatment averaged 3.8 Russian wheat aphids per tiller.

A naturally occurring brown wheat mite infestation was evaluated by taking five two-second samples with a Vortis suction sampler and placing the collected material in Berlese funnels for 48 h to extract mites into alcohol for counting. The brown wheat mite precounts taken the day before treatment averaged 279.2 mites per sample.

Aphid counts transformed by the square root + ½ method (7 and 21 DAT) or the log + 1 method (14 DAT and total aphid days) were used for analysis of variance and mean separation by Tukey's HSD test (α=0.05). Mite counts were transformed by the log + 1 method prior to similar analysis. Original means are presented in Tables 1 and 2. Total aphid or mite days for each treatment were calculated according the method of Ruppel (Journal of Economic Entomology 76: 375-7, 1983) and analyzed in the same manner, with original means presented in Table 1. Reductions in insect days were calculated by Abbott's (1925) formula: (percent reduction = ((untreated-treated)/untreated) X 100).

Aphid pressure was more severe than in the 2008 and similar to the 2007 experiments, with about 32 aphids/tiller in the untreated control 21 DAT (Table 1) compared to 27 and 20 in 2007 and 2008, respectively. The mite infestation was severe and unusual for this location. Crop condition was fair and in recovery from severe drought and the mite infestation. All treatments had fewer aphid days than the untreated control. The high rate of Lorsban Advanced and the Cobalt, 13 fl. oz., were the only treatments to reduce total aphid days over three weeks by 90% or more, the level of performance observed by the more effective treatments in past experiments. Only the Lorsban Advanced, 8 fl. oz., had fewer mite days than the untreated control. No phytotoxicity was observed with any treatment.

Field History

Pest:	Russian wheat aphid, *Diuraphis noxia* (Kurdjumov)
	Brown wheat mite, *Petrobia latens* (Müller)
Cultivar:	'Hatcher'
Planting Date:	11 Sept 2008
Irrigation:	Post planting, linear move sprinkler with drop nozzles
Crop History:	Fallow in 2008
Herbicide:	0.5 oz Harmony Extra and 16 oz MCPA per acre on 26 May 2009
Insecticide:	None prior to experiment
Fertilization:	None
Soil Type:	Sandy clay loam
Location:	ARDEC, 4616 North Frontage Road, Fort Collins, CO 80524 (Block 1030)

Table 1. Control of Russian wheat aphid with hand-applied insecticides, ARDEC, Fort Collins, CO. 2009.

PRODUCT, FLUID OUNCES/ACRE	APHIDS/TILLER ± SE[1] 7 DAT		14 DAT		21 DAT		APHID DAYS/TILLER ± SE[1]		% CONTROL[2]
Lorsban Advanced, 16 fl oz	0.5 ± 0.1	E	0.3 ± 0.1	F	1.7 ± 1.0	CD	37.7 ± 3.8	F	92
Cobalt, 13 fl oz	0.5 ± 0.2	E	1.4 ± 0.5	DEF	0.7 ± 0.5	D	42.4 ± 2.7	EF	91
Lorsban Advanced, 8 fl oz	0.8 ± 0.3	DE	2.2 ± 1.1	CDEF	1.2 ± 0.5	D	52.0 ± 7.3	EF	89
Ultor, 6 fl oz + Dyne-Amic + Baythroid XL 2.4 fl oz	2.2 ± 0.6	CDE	1.5 ± 0.6	DEF	2.9 ± 1.1	BCD	62.7 ± 8.9	DEF	87
Ultor, 8 fl oz + Dyne-Amic + Baythroid XL 2.4 fl oz	3.3 ± 0.4	BCD	0.9 ± 0.2	EF	2.2 ± 0.5	CD	63.3 ± 4.5	DEF	87
Dimethoate 4E, 12 fl oz	1.7 ± 0.3	CDE	3.4 ± 0.7	BCDE	4.0 ± 1.5	BCD	76.3 ± 8.6	CDE	85
Warrior II 2.09 CS, 1.92 fl oz	3.3 ± 1.4	BCD	2.6 ± 0.6	BCDE	3.3 ± 1.0	BCD	78.9 ± 11.3	CDE	84
Ultor, 4 fl oz + Dyne-Amic + Baythroid XL 2.4 fl oz	4.8 ± 0.6	BC	3.1 ± 0.8	BCDE	4.1 ± 1.1	BCD	96.3 ± 9.7	BCD	80
Baythroid XL, 2.4 fl oz	6.3 ± 1.0	B	6.2 ± 1.5	BC	6.7 ± 2.0	BCD	137.7 ± 19.1	BC	72
Mustang Max 0.8 E, 4 fl oz	7.0 ± 1.3	B	5.1 ± 1.6	BCD	8.8 ± 3.1	BC	141.6 ± 22.3	BC	71
Baythroid XL, 2.4 fl oz + Dyne-Amic	6.6 ± 1.7	B	8.5 ± 2.2	AB	11.9 ± 3.9	B	173.8 ± 39.1	B	65
Untreated control	26.7 ± 2.5	A	24.1 ± 4.2	A	31.6 ± 6.0	A	493.3 ± 50.8	A	—
F value	37.93		14.13		13.73		32.02		–
p>F	<0.0001		<0.0001		<0.0001		<0.0001		–

[1] SE, standard error of the mean. Means in the same column followed by the same letters(s) are not statistically different, Tukey's HSD (∝=0.05).

[2]% reduction in total aphid days per tiller, calculated by the Ruppel method.

Table 2. Control of brown wheat mite with hand-applied insecticides, ARDEC, Fort Collins, CO. 2009.

PRODUCT, FLUID OUNCES/ACRE	MITES/SAMPLETILLER ± SE[1] 8 DAT		21 DAT		MITE DAYS ± SE[1]		% CONTROL[2]
Lorsban Advanced, 8 fl oz	33.7 ± 4.8	B	4.3 ± 1.8	AB	1535.7 ± 61.7	B	70
Lorsban Advanced, 16 fl oz	68.7 ± 23.7	AB	4.5 ± 1.3	AB	1939.4 ± 266.9	AB	62
Warrior II 2.09 CS, 1.92 fl oz	88.3 ± 26.3	AB	1.2 ± 0.5	B	2140.6 ± 302.4	AB	59
Cobalt, 13 fl oz	99.8 ± 61.6	AB	1.7 ± 0.7	AB	2276.6 ± 711.0	AB	56
Dimethoate 4E, 12 fl oz	116.2 ± 64.7	AB	5.7 ± 1.7	AB	2494.4 ± 743.9	AB	52
Baythroid XL, 2.4 fl oz	160.7 ± 32.9	AB	12.2 ± 3.2	AB	3054.9 ± 384.3	AB	41
Mustang Max 0.8 E, 4 fl oz	195.5 ± 49.9	AB	6.8 ± 1.7	AB	3415.5 ± 569.2	AB	34
Ultor, 6 fl oz + Dyne-Amic + Baythroid XL 2.4 fl oz	223.2 ± 78.8	AB	8.5 ± 4.1	AB	3746.2 ± 919.0	AB	28
Baythroid XL, 2.4 fl oz + Dyne-Amic	278.0 ± 99.6	AB	9.7 ± 3.1	AB	4385.5 ± 1147.3	AB	15
Untreated control	335.3 ± 79.2	A	26.7 ± 12.2	A	5172.3 ± 986.8	A	–
Ultor, 8 fl oz + Dyne-Amic + Baythroid XL 2.4 fl oz	344.5 ± 87.1	A	16.0 ± 5.6	AB	5197.8 ± 995.7	A	–
Ultor, 4 fl oz + Dyne-Amic + Baythroid XL 2.4 fl oz	368.7 ± 142.6	A	15.2 ± 5.1	AB	5469.4 ± 1664.8	A	–
F value	3.42		2.81		3.72		
p>F	0.0011		0.0056		0.0005		

SE, standard error of the mean. Means in the same column followed by the same letters(s) are not statistically different, Tukey's HSD (∝=0.05).

[2]% reduction in total mite days, calculated by the Ruppel method.

CONTROL OF RUSSIAN WHEAT APHID BIOTYPE RWA2 IN SPRING BARLEY WITH HAND-APPLIED INSECTICIDES, ARDEC, FORT COLLINS, CO, 2009

Jeff Rudolph, Terri Randolph, Frank Peairs, Tyler Keck, Marie Stiles, and Dylan Walker, Department of Bioagricultural Sciences and Pest Management

CONTROL OF RUSSIAN WHEAT APHID BIOTYPE RWA2 IN SPRING BARLEY WITH HAND-APPLIED INSECTICIDES, ARDEC, FORT COLLINS, CO, 2009: Treatments were applied on 28 May 2009 with a 'rickshaw-type' CO_2 powered sprayer calibrated to apply 20 gal/acre at 3 mph 32 psi through three 8004 (LF4) nozzles mounted on a 5.0 ft boom. Conditions were partly cloudy with N-NW wind at 3 mph and air temperature of 65°F (start) to 70°F (finish) at the time of treatment. Plots were 6 rows (5.0 ft) by (30 ft) and were arranged in six replicates of a randomized, complete block design. Crop stage at application was early boot (Zadoks 39). The crop had been infested with greenhouse-reared aphids on 29 April 2009.
Treatments were evaluated by collecting 20 symptomatic tillers along the middle four rows of each plot 7, 14, and 21 days after treatment (DAT). Tiller samples were placed in Berlese funnels for 24 hours to extract aphids into alcohol for counting. Symptomatic tiller samples taken the day before treatment averaged 9.4 Russian wheat aphids per tiller. Aphid counts were subjected to analysis of variance and mean separation by Tukey's HSD test ($\propto$=0.05). Aphid counts at 7, 14, and 21 DAT were transformed by the log + 0.01 method prior to analysis. Original means are presented in Table 3. Total insect days for each treatment were calculated according to the method of Ruppel (Journal of Economic Entomology 76: 375-7, 1983) and analyzed in the same manner, with original means presented in the table. Reductions in insect days were calculated by Abbott's (1925) formula: (percent reduction= ((untreated-treated)/untreated) x 100). Aphid pressure was less severe than in artificially-infested winter wheat experiments conducted this season, with about 7 aphids/tiller in the untreated control 21 DAT compared to 20 and 32 in the other trials. This was about a 50% reduction from 7 DAT and was likely due to the substantial precipitation experienced post treatment. All treatments had fewer aphids per tiller 21 DAT and fewer total aphid days than the untreated control. No treatment provided 90% reduction in aphid days, which is considered good control of Russian wheat aphid in winter wheat.

Field History

Pest:	Russian wheat aphid, *Diuraphis noxia* (Kurdjumov)
Cultivar:	'Otis'
Planting Date:	17 March 2009
Irrigation:	Post planting, linear move sprinkler with drop nozzles
Crop History:	Sweet corn in 2008
Herbicide:	16 oz MCPA per acre on 26 May 2009
Insecticide:	None prior to experiment
Fertilization:	None
Soil Type:	Sandy clay loam
Location:	ARDEC, 4616 North Frontage Road, Fort Collins, CO 80524 (Field 1060 southeast)

Table 3. Control of Russian wheat aphid in spring barley with hand-applied insecticides, ARDEC, Fort Collins, CO. 2009

	APHIDS PER TILLER ± SE[1]			TOTAL APHID DAYS	% REDUCTION
PRODUCT, FLUID OZ/ACRE	**7 DAT**	**14 DAT**	**21 DAT**	**PER TILLER ± SE**	**IN APHID DAYS**
Losban Advanced, 16 fl oz	0.3 ± 0.1 D	0.4 ± 0.2 BC	0.2 ± 0.1 B	38.4 ± 1.4 C	80
Endigo 2.06 ZC, 4.5 fl oz	0.9 ± 0.3 CD	0.1 ± 0.1 C	0.1 ± 0.0 B	40.1 ± 2.0 C	79
Endigo 2.06 ZC, 3.5 fl oz	0.8 ± 0.2 CD	0.2 ± 0.1 C	0.1 ± 0.0 B	40.2 ± 1.5 C	79
Warrior II 2.09 CS, 1.92 fl oz	1.1 ± 0.3 CD	0.1 ± 0.0 C	0.4 ± 0.2 B	43.0 ± 2.2 C	77
Warrior II 2.09 CS, 1.28 fl oz	0.9 ± 0.3 CD	0.2 ± 0.1 C	0.6 ± 0.2 B	43.1 ± 2.1 C	77
Actara 25 WG, 4.0 oz	1.6 ± 0.6 BC	0.5 ± 0.2 B	0.3 ± 0.1 B	48.5 ± 4.3 C	75
Actara 25 WG, 2.4 oz	3.3 ± 0.8 B	1.1 ± 0.2 B	1.0 ± 0.4 B	67.4 ± 6.5 B	65
Untreated control	15.0 ± 2.9 A	4.2 ± 0.9 A	6.8 ± 1.9 A	191.3 ± 24.1 A	–
F Value	38.50	24.43	22.27	20.23	–
p > F	<0.0001	<0.0001	<0.0001	<0.0001	–

[1]SE, standard error of the mean. Means in the same column followed by the same letter(s) are not statistically different, Tukey's HSD (α=0.05) .

[2]% reduction in total aphid days per tiller, calculated by the Ruppel method.

CONTROL OF BROWN WHEAT MITE AND RUSSIAN WHEAT APHID IN FIVE VARIETIES OF WINTER WHEAT, LAMAR, CO 2009

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CONTROL OF BROWN WHEAT MITE AND RUSSIAN WHEAT APHID IN FIVE VARIETIES OF WINTER WHEAT, LAMAR, CO 2009: 'Ripper', 'Hatcher', 'Hawken', 'Keota', and 'Bill Brown' winter wheat varieties were planted on 30 August 2008, as part of a Collaborative On-Farm Trial (COFT) with Stulp Farms. Single strip plots, ca. 42 ft. by 2640 ft, were planted on a 10" row spacing at a seeding rate of 45 lbs/acre. Dimethoate 4E, 0.25 lb (AI)/acre + Induce (nonionic wetter/spreader) 0.25% v/v, was applied on 7 March 2009 to seven 42 ft by 90 ft. plots per strip, using a John Deere 4720 sprayer equipped with TeeJet FX 20 nozzles mounted on a 90-foot boom at calibrated to apply five gal/acre at 30 psi. Temperature was 45°F with wind speeds of 9-10 mph. Plant growth stage was Zadoks growth stage (GS) 25 (regrowth). Plots were retreated in the same manner on 20 March 2009, however, the dimethoate rate was increased to 0.375 lb (AI)/acre due to the presence of Russian wheat aphid. Temperature was 55°F with wind speeds of 3-5 mph. Plant growth stage was Zadoks GS 30 (pseudo stem elongation).

Brown wheat mite densities were evaluated at 0, 5, 12, 18 and 26 days after treatment (DAT) using a Vortis insect suction sampler. Five 5-second samples were taken at random within each plot. Composite plot samples were placed on paper plates in Berlese funnels for 72 hours to extract mites into alcohol for counting. Mite counts and mite days (calculated by the method of Ruppel, J. Econ. Entomol. 76: 375-377) were transformed by the square root + 0.5 method prior to analysis of variance and mean separation by Tukey's HSD method ($\propto$ = 0.05). Reductions in mite days were calculated by Abbott's (1925) formula: (percent reduction = ((untreated-treated)/untreated) x 100) using the average total mite days of the untreated control. Original mite means are presented in the tables. Russian wheat aphid infestation was evaluated on 21 May 2009 by collecting 25 tillers at random from each plot, determing the percentage infested tillers, and placing the tillers in Berlese funnels for 24 hours to extract the aphids into alcohol for counting. Aphid counts were transformed by the log + 1 method prior to analysis of variance and means separation by Tukey's HSD method ($\propto$ = 0.05). Original means are presented in the tables.

Brown wheat mite densities were similar for all varieties prior to the Zadoks GS 25 treatment (Table 4). Varietal differences in brown wheat mite abundance were not observed except at 12 DAT, when fewer mites were collected in Hatcher plots than in Bill Brown plots. Dimethoate treatment reduced brown wheat mite abundance at 12, 18, and 26 DAT and total mite days. Overall reduction in total mite days was 94%.

Brown wheat mite abundance was similar for all varieties prior to the Zadoks GS 30 treatment (Table 5). Varietal differences in brown wheat mite densities were not observed except at 12 DAT, when more mites were collected in Hatcher plots than in Bill Brown plots. Dimethoate treatment reduced brown wheat mite abundance at 5, 12, 18, and 26 DAT and total mite days. Overall reduction in total mite days was 84%. A 12-inch snow event occurred 6-7 DAT, and reduction of mites in the untreated plots from 5 DAT to 12 DAT was 32%. However, abundance increased from 12 DAT to 18 DAT. Yields were not obtained due to a 11 June hailstorm, so it is unknown if the greater reduction in mite days from the Zadoks 25 treatment would have been reflected in yield.

Fewer Russian wheat aphids were found in the Russian wheat aphid biotype RWA1-resistant varieties, Bill Brown, Hatcher, and Ripper, than in the susceptible varieties, Keota and Hawken (Table 6). Insecticide treatment effects were not observed, perhaps due to timing, which was earlier than is considered optimal for this aphid.

Field History

Pest:	Russian wheat aphid, *Diuraphis noxia* (Kurdjumov)
	Brown wheat mite, *Petrobia latens* (Müller)
Cultivar:	See text
Planting Date:	31 August 2008

Field History (continued)

Irrigation:	Dryland
Crop History:	Wheat Fallow rotation, Fallow in 2008
Herbicide:	0.10 oz/acre Ally XP with fertilizer on 26 February 2009
Insecticide:	None prior to experiment
Fertilization:	30 lb 10-40-0-10-1 (N-P-K-S-Zn) at planting, 10 gal/acre 28-0-0-5 on 26 February 2009
Soil Type:	Wiley silt loam
Location:	South of Lamar, Colorado. West side of Hwy 287; S31, T23S, R46W

Table 4. Brown wheat mites in five winter wheat varieties treated with dimethoate 0.25 .b (AI)/acre at Zadoks GS 25, Lamar, CO. 2009

		Brown wheat mites per 25 seconds[1]						
Variety	**Treated**	**0 DAT**	**5 DAT**	**12 DAT**	**18 DAT**	**26 DAT**	**Mite Days [2]**	**Reduction [3]**
Bill Brown	No	67 A	113 AB	347 A	526 A	354 A	8201 A	
	Yes	64 A	15 B	7 B	20 C	6 C	462 BC	94
Hatcher	No	75 A	155 A	235 A	210 B	192 B	4887 A	
	Yes	21 A	5 B	5 B	11 C	6 C	213 BC	95
Hawken	No	31 A	99 A	368 A	446 AB	261 AB	7232 A	
	Yes	54 A	9 AB	7 B	24 C	6 C	419 B	94
Keota	No	45 A	162 A	320 A	385 AB	240 AB	6820 A	
	Yes	57 A	10 B	16 B	17 C	10 C	469 BC	93
Ripper	No	105 A	235 A	398 A	356 AB	262 AB	7803 A	
	Yes	69 A	7 B	12 B	17 C	8 C	446 BC	94
	Effect	F Value/p>F						
	wheat	1.10/0.3644	0.28/0.8872	0.64/0.6342	2.22/0.0779	1.67/0.1687	6.22/0.0003	
	treatment	0.15/0.6970	57.21/0.0000	131.12/0.0000	171.62/0.0000	423.23/0.0000	1227.8/0.0000	
	wheat x trt	0.96/0.4386	0.45/0.7746	0.30/0.8766	1.55/0.1990	1.47/0.2228	0.54/0.7097	

[1] Treatment means in the same column followed by the same letter are not statistically different, Tukey;s HSD (∞=0.05).

[2] Total mite days calculated by the Ruppel method (J. Econ. Entomol. 76: 375-377).

[3] % reduction in total mite days calculated by Abbott's method, percent reduction = ((untreated-treated)/untreated) x 100.

Table 5. Brown wheat mites in five winter wheat varieties treated with dimethoate 0.375 lb (AI)/acre at Zadoks GS 30, Lamar, CO. 2009

		Brown wheat mites per 25 seconds[1]												
Variety	**Treated**	**0 DAT**		**5 DAT**		**12 DAT**		**18 DAT**		**26 DAT**		**Mite Days [2]**		**Reduction [3]**
Bill Brown	No	347	A	526	A	354	A	219	A	146	B	8440	A	
	Yes	332	A	33	CD	13	B	16	B	18	C	1295	B	84
Hatcher	No	235	A	210	BC	192	A	327	A	218	AB	6254	A	
	Yes	336	A	34	CD	8	B	11	B	15	C	1236	B	80
Hawken	No	368	A	446	AB	261	A	346	A	222	AB	8610	A	
	Yes	386	A	24	D	7	B	18	B	14	C	1341	B	84
Keota	No	320	A	385	AB	240	A	260	A	177	AB	7196	A	
	Yes	207	A	38	CD	28	B	19	B	15	C	1122	B	84
Ripper	No	398	A	356	AB	262	A	319	A	388	A	8608	A	
	Yes	279	A	24	D	8	B	19	B	13	C	1081	B	87

Effect	F Value/p>F					
wheat	0.36/0.8372	1.68/0.1662	1.66/0.1722	0.51/0.7287	1.43/0.2346	0.51/0.7268
treatment	0.18/0.6749	137.54/0.000	337.78/0.0000	193.54/0.0000	137.29/0.0000	350.27/0.0000
wheat x trt	0.55/0.7009	1.89/0.1231	1.35/0.2626	0.66/0.6245	1.90/0.1218	0.73/0.5767

[1] Treatment means in the same column followed by the same letter are not statistically different, Tukey;s HSD (∞=0.05).

[2] Total mite days calculated by the Ruppel method (J. Econ. Entomol. 76: 375-377).

[3] % reduction in total mite days calculated by Abbott's method, percent reduction = ((untreated-treated)/untreated) x 100.

Table 6. Russian wheat aphids in five winter wheat varieties treated with dimethoate 0.25 lb (AI)/acre at Zadoks GS 25 or dimethoate 0.375 lb (AI)/acre at Zadoks GS 30, Lamar, CO. 2009

Variety	Treated	% Infested Tillers		Aphids per Tiller	
Bill Brown	No	8.0	ABC	21.5	ABCD
	Yes (Zadoks GS 25)	12.0	ABC	8.8	ABC
	Yes (Zadoks GS 30)	2.4	C	0.0	BCD
Hatcher	No	3.0	BC	2.8	CD
	Yes (Zadoks GS 25)	7.0	ABC	19.0	ABC
	Yes (Zadoks GS 30)	3.0	BC	1.3	CD
Hawken	No	15.0	ABC	32.0	ABC
	Yes (Zadoks GS 25)	14.0	ABC	26.3	ABC
	Yes (Zadoks GS 30)	14.0	ABC	31.8	ABC
Keota	No	22.0	AB	38.0	AB
	Yes (Zadoks GS 25)	24.0	A	107.3	A
	Yes (Zadoks GS 30)	15.0	ABC	50.3	AB
Ripper	No	0.0	C	0.0	D
	Yes (Zadoks GS 25)	1.0	C	0.3	D
	Yes (Zadoks GS 30)	3.9	ABC	8.8	CD
	Effect	**F Value/p>F**			
	wheat	11.02/0.0000		21.33/0.0000	
	treatment	1.23/0.3023		3.06/0.0575	
	wheat x trt	0.55/0.8108		1.35/0.2457	

[1] Treatment means in the same column followed by the same letter are not statistically different, Tukey;s HSD (∞=0.05).
[2] Total mite days calculated by the Ruppel method (J. Econ. Entomol. 76: 375-377).
[3] % reduction in total mite days calculated by Abbott's method, percent reduction = ((untreated-treated)/untreated) x 100

EFFECT OF IRRIGATION, FERTILIZATION AND INSECTICIDE TREATMENT ON BROWN WHEAT MITE IN SPRINKLER-IRRIGATED WINTER WHEAT. HOLLY, CO, 2009.

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EFFECT OF IRRIGATION, FERTILIZATION AND INSECTICIDE TREATMENT ON BROWN WHEAT MITE IN SPRINKLER-IRRIGATED WINTER WHEAT. HOLLY, CO, 2009: A 110 acre field of 'Hatcher' winter wheat was fertilized with 20 gallons of 28-0-0 on 27 February 2009. The crop was then irrigated with 2acre inches of water, starting on 27 February and ending on 6 March 2009. Water was appied via i-Wob emitters, and the application amount was verified using five rain gauges placed along a transect starting from the pivot. On 24 March 2009, the east half of the field was treated with dimethoate, 0.375 lb. (AI)/acre + LI700 0.25% v/v, and the west half was treated with chlorpyrifos, 0.5 lb. (AI)/acre + LI700 0.25% v/v. Treatment was applied with a Weatherly 620 A aircraft equipped with 24 CP nozzles mounted on a 40 ft boom calibrated to apply 2 gal/acre at 110 mph over a 54 ft swath.

Treatments were sampled at five points along each of four transects from the pivot, which ran north, east, west and northwest from that point. Treatments were sampled on 4 March 2009, which was partway through the irrigation, resulting in two transects having been fertilized and two transects having been fertilized and irrigated. A second sample was taken on 9 March 2009 after the irrigation had been completed. Insecticide treatments were evaluated with samples taken on 24 March and 1 April 2009. Brown wheat mite abundance was determined using a Vortis insect suction sampler. Each of the five points along each transect was sampled by taking five two-second subsamples around each sample point. The composite samples were placed on paper plates and held in Berlese funnels for 72 hours to extract the mites into alcohol for counting. Total brown wheat mites were counted on the 25 February and 4 March sample dates, while larvae (first stage after hatch) were counted separately on the 9 March, 24 March and 1 April dates. This was done to determine the effect of treatment on the egg stage. Russian wheat aphid, *Diuraphis noxia* (Kurdjumov) and Banks grass mite, *Oligonychus pratensis* (Banks), were also collected by the Vortis and were extracted and counted in the same manner. Additionally, on 1 April 50 tillers were collected at each sample point. Russian wheat aphids were extracted and counted from this sample, as well. Insect and mite counts were compared using paired t-tests. Finally, two composite samples of tillers showing virus symptoms were collected. One was sent to the Colorado State University Plant Disease Diagnostic Lab, and the other was sent to sent to the Schutter Diagnostic Disease Lab at Montana State University to be tested for Barley Yellow Streak Mosaic Virus (BaYSMV) , a disease transmitted by brown wheat mite.

Fertilization reduced brown wheat mite abundance, as did irrigation (Table 7). Mite mortality may have been related to the fertilizer causing mites to stick to the leaves. The effects of fertilization and irrigation were short-lived, and not of the magnitude caused by insecticide treatment. The reduction in brown wheat mite density was similar for the two insecticides ($t=1.47$, $df=9$, $P=0.1757$). Fewer adult mites were observed after insecticide treatments, with reductions greater than 99%. Larval counts seemed less affected by treatment, with reductions ranging from 63 - 96%, suggesting that, as expected, these insecticides have little ovicidal activity (Table 8).

Banks grass mite was present at low densities (Table 9). Fertilization and irrigated reduced mite abundance in three of four transects. The two insecticides were similar in their effect on this mite ($t=0.60$, $df=9$, $P=0.5636$).

Russian wheat aphid also was present in densities too low to determine treatment effects (Table 10). No aphids were found in a 50 tillers sample collected from each of the two insecticide treated areas on 1 April 2009. Tissue samples collected at this time tested positive for Wheat Streak Mosaic Virus (WSMV) and negative for Cereal Yellow Dwarf Virus (formerly Barley Yellow Dwarf Virus-rpv), Barley Yellow Dwarf-pav, Barley Yellow Streak Mosaic Virus, High Plains Virus, and Triticum Mosaic Virus at Colorado State University and negative for Barley Yellow Streak Mosaic Virus at Montana State University. Crop yield was 61 bu/acre, based on a yield map provided by the grower-cooperator.

Field History

Pest:	Brown wheat mite, *Petrobia latens* (Müller)
	Russian wheat aphid, *Diuraphis noxia* (Kurdjumov)
	Banks grass mite, *Olygonychus pratensis* (Banks)
Cultivar:	'Hatcher'
Planting Date:	15 Sept 2008
Irrigation:	Two inches applied 25 Feb - 6 March 2009, center pivot sprinkler with i-Wob nozzles
Crop History:	Wheat in 2008
Herbicide:	1 pt MCPA per acre
Insecticide:	None prior to experiment
Fertilization:	20 gallons 28-0-0/acre applied 25 Feb 2009
Soil Type:	Tivoli sand
Location:	S of Holly, CO. S34,T23S, R42W, Prowers County

Table 7. Brown wheat mite abundance (total mites per transect) after fertilization, irrigation and insecticide treatment, Holly, CO, 2009.

	Sample date (DAT[a], treatment)			
Transect	25 Feb (Precount)	4 Mar (0 DAT, fertilization)	9 Mar (3 DAT, irrigation)	24 Mar (9 DAT, insecticide)
1[b]	1358	796	878	89
2[b]	628	532	731	107
3[c]	435	70	324	79
4[c]	2094	659	1622	44

[a]DAT, days after treatment

[b]Not irrigated on the 4 March sample, treated with dimethoate, 0.375 lb (AI)/acre.

[c]Irrigated on the 4 March sample, treated with chlorpyrifos, 0.5 lb (AI)/acre.

Table 8. Brown wheat mite abundance (total larvae and other stages per transect) after fertilization, irrigation and insecticide treatment, Holly, CO, 2009.

	Sample date (DAT[a] , treatment)			
Transect	9 Mar (3 DAT fertilization)	24 Mar (9 DAT, insecticide)	9 Mar (3 DAT, fertilization)	24 Mar (9 DAT, insecticide)
	Stages Other Than Larvae		Larvae	
1[b]	342	1.2	536	88
2[b]	240	1.2	491	106
3[c]	111	0.8	213	79
4[c]	550	0.6	1072	44

[a]DAT, days after treatment

[b]Treated with dimethoate, 0.375 lb (AI)/acre.

[c]Treated with chlorpyrifos, 0.5 lb (AI)/acre.

Table 9. Banks grass mite abundance (total mites per transect) after fertilization, irrigation and insecticide treatment, Holly, CO, 2009.

	Sample date (DAT[a], treatment)			
	25 Feb	4 Mar	9 Mar	24 Mar
Transect	(Precount)	(0 DAT, fertilization)	(3 DAT, irrigation)	(9 DAT, insecticide)
1[b]	22	70	36	10
2[b]	74	23	23	5
3[c]	30	3	5	6
4[c]	83	18	21	4

[a]DAT, days after treatment

[b]Not irrigated on the 4 March sample, treated with dimethoate, 0.375 lb (AI)/acre.

[c]Irrigated on the 4 March sample, treated with chlorpyrifos, 0.5 lb (AI)/acre.

Table 10. Russian wheat aphid abundance (total aphids per transect) after fertilization, irrigation and insecticide treatment, Holly, CO, 2009.

	Sample date (DAT[a], treatment)			
	25 Feb	4 Mar	9 Mar	24 Mar
Transect	(Precount)	(0 DAT, fertilization)	(3 DAT, irrigation)	(9 DAT, insecticide)
1[b]	0	0	0	10 + (2)[d]
2[b]	0	12	0	5
3[c]	0	1	0	6 + (1)[d]
4[c]	0	0	0	4

[a]DAT, days after treatment

[b]Not irrigated on the 4 March sample, treated with dimethoate, 0.375 lb (AI)/acre.

[c]Irrigated on the 4 March sample, treated with chlorpyrifos, 0.5 lb (AI)/acre.

[d]Number of winged aphids in sample.

CONTROL OF BROWN WHEAT MITE IN IRRIGATED WINTER WHEAT, HILLROSE, CO, 2009.

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CONTROL OF BROWN WHEAT MITE IN IRRIGATED WINTER WHEAT, HILLROSE, CO, 2009. A field of winter wheat heavily infested with brown wheat mite was treated with 0.25 lb (AI)/acre dimethoate 4E on 20 March 2009. Treatment was applied with a (sprayer details -boom width, # nozzles, psi, volume). Conditions at the time of treatment were warm and calm. An approximately 3 acre strip along the NW edge of the field was used as an untreated control. The crop was drought stressed and in Feekes GS 4.0 - 4.5.

Brown wheat mite abundance was evaluated by taking five 5-second samples with a Vortis Insect Suction Sampler at each sample site. Samples were placed on paper plates and placed in Berlese funnels for 3 days to extract the mites and recently hatched larvae into 70% alcohol for subsequent counting. Newly hatched larvae were counted separately. Three pretreatment samples were taken on 19 March 2009 at random sites throughout the field. On 3 April 2009, 14 days after treatment (DAT), the field was sampled along a transect, with eight samples in the untreated part of the field and eight samples in the treated area. Samples sites were spaced at approximately 30-foot intervals along the transect. The field was resampled in the same manner 35 DAT. On 9 July 2009 yields were measured from adjacent strips of 0.445 and 0.658 acres of the untreated and treated areas, respectively, using a weigh wagon.

Mite abundance was reduced approximately 88% by treatment 11 DAT (Table 11). Reduction 32 DAT was 51%. Mite increase from 14 to 35 DAT was much greater in the treated area (581%) than in the untreated area (35%). Yield was 14 bushels (19%) lower in the untreated area than in the treated area (Table 12). Test weights were not affected by treatment. However, this field had become infested with Russian wheat aphid and the entire field was treated with chlorpyrifos 0.5 lb (AI)/acre on ?? May 2009.

Field History

Pest:	Brown wheat mite, *Petrobia latens* (Müller)
Cultivar:	Not available
Planting Date:	2008
Irrigation:	Not available
Crop History:	Not available
Herbicide:	Not available
Insecticide:	None prior to experiment
Fertilization:	Not available
Soil Type:	Not available
Location:	Hillrose, Morgan County, CO

Table 11. Brown wheat mites plus larval mites per 25 seconds of suction sampling , Hillrose, Morgan County, CO, 2009.

	Brown Wheat Mites (Larvae) per 25 Sec. Suction Sample		
Treatment	**Pretreatment**	**14 DAT**	**35 DAT**
Untreated	597 (137)	413 (50)	453 (172)
Dimethoate 4E, 0.25 lb (AI)/acre	-	44 (9)	228 (80)

Table 12. Effect of brown wheat mite treatment on yield and test weight, Hillrose, Morgan County, CO, 2009.

Treatment	Bushels/acre	Test Weight
Untreated	58.9	60.5
Dimethoate 4E, 0.25 lb (AI)/acre	72.9	60.5

CONTROL OF ALFALFA INSECTS IN ALFALFA WITH HAND-APPLIED INSECTICIDES, ARDEC, FORT COLLINS, CO, 2009

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CONTROL OF ALFALFA INSECTS IN ALFALFA WITH HAND-APPLIED INSECTICIDES, ARDEC, FORT COLLINS, CO, 2009: Early treatments were applied on 22 April 2009 with a ‘rickshaw-type’ CO_2 powered sprayer calibrated to apply 20 gal/acre at 3 mph and 30 psi through six XR8002VS nozzles mounted on a 10.0 ft boom. Early treatments were made approximately when army cutworm treatments are applied in the region. This was done to determine the effect of army cutworm treatment in alfalfa on subsequent alfalfa weevil larval densities. All other treatments were applied in the same manner on 28 May 2009. Conditions were partly cloudy and calm, with temperatures of 65°F at the time of early treatments. Conditions were partly cloudy with N-NW winds at 3 - 8 mph and temperatures of 65 - 70°F at the time of the later treatments. Plots were 10.0 ft by 25.0 ft and arranged in six replicates of a randomized, complete block design. Untreated control and Warrior II, 0.03 lb (AI)/acre, plots were replicated 12 times for a more accurate comparison of treatment effects on yield (insect counts from six reps of each treatment were included in the analyses described below). The crop was 4 inches in height at the time of early treatments. The crop was in the prebud stage at the time of the later treatments.

Treatments were evaluated by taking ten 180° sweeps per plot with a standard 15 inch diameter insect net 7, 14 and 21 days after the later treatments (DAT). Alfalfa weevil larvae, alfalfa weevil adults and pea aphids were counted. A pretreatment sample was taken one day prior to the later treatments by taking 100, 180° sweeps across the experimental area. This sample averaged 8.1 and 17.6 alfalfa weevil larvae and pea aphids per sweep, respectively. Insect counts transformed by the square root + 0.5 method were used for analysis of variance and mean separation by Tukey’s HSD procedure (α=0.05). Original means are presented in the tables. Yields were measured on 19 June 2009 by harvesting 125 sq. ft. per plot with a Carter forage harvester. Yields were converted to lbs of dry hay per acre, using a subsample to determine moisture content. Yields of treated plots were compared to the untreated control using a paired t-test.

Pea aphid and alfalfa weevil larval densities were similar to those observed in 2008. All treatments had fewer alfalfa weevil larvae than the untreated control at 7 and 14 DAT (Table 13). Larval counts were close to zero in the untreated control at 21 DAT, so no treatment differences were observed. All treatments had fewer alfalfa weevil adults than the untreated control at 21 DAT (Table 14). Only the Warrior treatments had fewer pea aphids that the untreated control on all three sample dates. No phytotoxicity was observed with any treatment. The plots treated with Warrior II, 1.92 fl. oz./acre, yielded 4.6% more than the untreated control. The difference was not significant (df=1,22; F=1.67; p>F=0.2094). Yield reduction measured since 1995 has averaged 6.9%, with a range of 0.0% to 20.9%.

Field History

Pests:	Alfalfa weevil, *Hypera postica* (Gyllenhal)
	Pea aphid, *Acyrthosiphon pisum* (Harris)
Cultivar:	Unknown
Plant Stand:	Thin, dry conditions
Irrigation:	Linear move sprinkler with drop nozzles
Crop History:	Alfalfa since 2002
Herbicide:	None
Insecticide:	None prior to experiment
Fertilization:	None
Soil Type:	Sandy clay loam
Location:	ARDEC, 4616 North Frontage Road, Fort Collins, CO, 80524 (Block 1050 NE)

Table 13. Control of alfalfa weevil larvae, ARDEC, Fort Collins, CO, 2009.

	ALFALFA WEEVIL LARVAE PER 180° SWEEP ± SEM[1]		
PRODUCT, FLUID OUNCES/ACRE	**7 DAT**	**14 DAT**	**21 DAT**
Cobalt, 38 fl oz product	0.3 ± 0.1 E	0.0 ± 0.0 C	0.3 ± 0.0 A
Steward EC, 11.3 fl oz	0.9 ± 0.1 BCDE	0.2 ± 0.0 BC	0.4 ± 0.0 A
Warrior II, 1.92 fl oz	0.4 ± 0.1 DE	0.3 ± 0.0 BC	0.5 ± 0.1 A
Mustang Max 0.8EC, 4 fl oz	0.3 ± 0.1 DE	0.4 ± 0.0 BC	0.6 ± 0.1 A
Warrior 1E, 1.92 fl oz, early	0.4 ± 0.3 E	0.6 ± 0.1 BC	0.1 ± 0.0 A
Baythroid XL, 2.8 fl oz	0.4 ± 0.1 DE	0.6 ± 0.1 BC	0.2 ± 0.0 A
Cobalt, 19 fl oz product	1.6 ± 0.7 BCDE	0.8 ± 0.1 BC	0.3 ± 0.0 A
Baythroid XL, 2.8 fl oz, early	0.8 ± 0.1 CDE	1.2 ± 0.1 BC	0.4 ± 0.0 A
Cobalt, 38 fl oz product, early	2.2 ± 0.3 BC	1.2 ± 0.1 BC	0.5 ± 0.1 A
Mustang Max 0.8EC, 4 fl oz, early	2.6 ± 0.6 B	1.8 ± 0.2 B	0.6 ± 0.1 A
Lorsban Advance 4F, 24 fl oz	1.6 ± 0.4 BCD	2.5 ± 0.3 B	0.1 ± 0.0 A
Untreated control	38.1 ± 2.5 A	21.2 ± 2.1 A	0.2 ± 0.0 A
F value	134.72	38.76	1.89
p>F	<0.0001	<0.0001	0.0608

[1] SEM, standard error of the mean. Means in the same column followed by the same letter(s) are not statistically different, Tukey's HSD (α=0.05).

Table 14. Control of alfalfa weevil adults, ARDEC, Fort Collins, CO, 2009.

	ALFALFA WEEVIL ADULTS PER 180° SWEEP ± SEM[1]		
PRODUCT, FLUID OUNCES/ACRE	7 DAT	14 DAT	21 DAT
Baythroid XL, 2.8 fl oz	0.0 ± 0.0 B	0.0 ± 0.0 A	0.1 ± 0.0 E
Mustang Max 0.8EC, 4 fl oz	0.0 ± 0.0 B	0.1 ± 0.0 A	0.1 ± 0.0 E
Cobalt, 38 fl oz product	0.0 ± 0.0 B	0.0 ± 0.0 A	0.1 ± 0.0 E
Warrior II, 1.92 fl oz	0.0 ± 0.0 B	0.0 ± 0.0 A	0.1 ± 0.0 E
Warrior 1E, 1.92 fl oz, early	0.0 ± 0.0 AB	0.0 ± 0.0 A	0.2 ± 0.0 DE
Cobalt, 19 fl oz product	0.0 ± 0.0 AB	0.0 ± 0.0 A	0.2 ± 0.0 CDE
Steward EC, 11.3 fl oz	0.0 ± 0.0 B	0.0 ± 0.0 A	0.4 ± 0.0 BCDE
Baythroid XL, 2.8 fl oz, early	0.1 ± 0.0 AB	0.0 ± 0.0 A	0.7 ± 0.1 BCD
Lorsban Advance 4F, 24 fl oz	0.0 ± 0.0 AB	0.1 ± 0.1 A	0.8 ± 0.1 BC
Cobalt, 38 fl oz product, early	0.1 ± 0.0 AB	0.1 ± 0.0 A	1.0 ± 0.1 B
Mustang Max 0.8EC, 4 fl oz, early	0.1 ± 0.0 A	0.0 ± 0.0 A	1.1 ± 0.1 B
Untreated control	0.1 ± 0.0 AB	0.0 ± 0.0 A	8.7 ± 1.8 A
F value	3.43	1.97	58.33
P>F	0.0011	0.0499	0.00

[1] SEM, standard error of the mean. Means in the same column followed by the same letter(s) are not statistically different, Tukey's HSD (α=0.05).

Table 15. Control of pea aphids, ARDEC, Fort Collins, CO, 2009.

PRODUCT, FLUID OUNCES/ACRE	PEA APHIDS PER 180° SWEEP ± SEM[1] 7 DAT		14 DAT		21 DAT	
Warrior 1E, 1.92 fl oz, early	13.3 ± 6.9	C	7.9 ± 2.2	BC	14.0 ± 1.8	D
Warrior II, 1.92 fl oz	5.4 ± 0.8	C	5.7 ± 1.0	C	14.0 ± 1.1	CD
Mustang Max 0.8EC, 4 fl oz, early	61.5 ± 8.6	AB	43.0 ± 2.7	A	20.2 ± 3.2	BCD
Baythroid XL, 2.8 fl oz, early	76.9 ± 16.8	A	37.8 ± 6.7	A	21.8 ± 4.0	BCD
Cobalt, 38 fl oz product	2.2 ± 0.4	C	5.9 ± 1.0	C	24.8 ± 4.4	ABCD
Baythroid XL, 2.8 fl oz	9.0 ± 0.7	C	9.0 ± 2.7	BC	25.0 ± 2.8	ABC
Untreated control	43.3 ± 10.1	AB	35.5 ± 5.9	A	25.4 ± 3.3	AB
Mustang Max 0.8EC, 4 fl oz	10.0 ± 2.4	C	11.5 ± 1.3	BC	26.0 ± 3.6	AB
Cobalt, 19 fl oz product	4.1 ± 1.2	C	10.6 ± 1.9	BC	31.2 ± 3.3	AB
Steward EC, 11.3 fl oz	57.6 ± 10.8	AB	41.8 ± 4.6	A	32.3 ± 3.4	AB
Lorsban Advance 4F, 24 fl oz	4.3 ± 0.8	C	15.7 ± 3.4	B	34.5 ± 4.1	A
Cobalt, 38 fl oz product, early	36.8 ± 5.1	B	34.9 ± 5.4	A	36.2 ± 4.1	A
F value	28.57		36.52		8.29	
P>F	<0.0001		<0.0001		<0.0001	

[1] SEM, standard error of the mean. Means in the same column followed by the same letter(s) are not statistically different, Tukey's HSD (α=0.05).

CONTROL OF WESTERN CORN ROOTWORM IN FIELD CORN WITH PLANTING-TIME SOIL INSECTICIDES, SEED TREATMENTS, AND PLANT-INCORPORATED PROTECTANTS, ARDEC, FORT COLLINS, CO, 2009

Jeff Rudolph, Terri Randolph, Frank Peairs, Tyler Keck, Marie Stiles, and Dylan Walker, Department of Bioagricultural Sciences and Pest Management

CONTROL OF WESTERN CORN ROOTWORM IN FIELD CORN WITH PLANTING-TIME SOIL INSECTICIDES, SEED TREATMENTS, AND PLANT-INCORPORATED PROTECTANTS, ARDEC, FORT COLLINS, CO, 2009: All treatments were planted on 20 May 2009. Granular insecticides were applied with modified Wintersteiger meters mounted on a two-row John Deere Maxi-Merge planter. T-band granular applications were applied with a 4-inch John Deere spreader located between the disk openers and the press wheel. Liquids were applied in a t-band using a CO_2-powered sprayer calibrated to apply 2.8 gal/acre through one 8001VS nozzle directed between the disk openers and the presswheel. Plots in the first experiment were one 25-ft row arranged in six replicates of a randomized complete block design, while plots in the other three experiments were four 25-ft rows arranged in four replicates of a randomized complete block design.

Treatments in the first experiment were evaluated by digging three plants per plot on 10 July 2008. The roots were washed and the damage rated on the 0-3 node injury scale (http://www.ent.iastate.edu/pest/rootworm/nodeinjury/nodeinjury.html). Treatments in the second experiment were evaluated in the same manner, except three plants were taken from both the first and fourth row of the plot. Plot means were used for analysis of variance and mean separation by Tukey's HSD method (α=0.05). Treatment efficiency was determined as the percentage of total plants per treatment having a root rating of 0.25 or lower.

Yield was evaluated in the other three experiment by hand-harvesting the center two rows of the plot on 21-22 October 2009. Plot weights were converted to bushels per acre at 15.5% moisture and analyzed as described above.

Western corn rootworm pressure was somewhat lower than in 2008 (0.94 and 1.18 untreated control ratings in two 2008 experiments), with the untreated controls averaging 0.18 in four 2009 experiements. In the first and second experiments, but not the third and fourth, all treatments were less damaged than the untreated control (Table 16 - 19). No treatment effects on yield were observed. No phytotoxicity was observed with any treatment.

Field History

Pest:	Western corn rootworm, *Diabrotica virgifera virgifera* LeConte
Cultivar:	N40T, unless otherwise indicated
Planting Date:	20 May 2009
Plant Population:	Not available
Irrigation:	Furrow
Crop History:	Corn in 2008
Insecticide:	None prior to experiment
Soil Type:	Clay loam
Location:	ARDEC, 4616 North Frontage Road, Fort Collins, CO 80524 (northern Block 3100)

Table 16. Commercial and experimental treatments for control of western corn rootworm, ARDEC, Fort Collins, CO. 2009.

TREATMENT	ROOT RATING[1]	EFFICIENCY[2]
Counter 15G, 8 oz/1000 ft	0.00 B	100
Force 3G, 4 oz/1000 ft	0.00 B	100
Force 3G, 5 oz/1000 ft	0.00 B	100
Cruiser, 0.25 mg/seed	0.00 B	100
YieldGard® Rootworm	0.00 B	100
Herculex® RW	0.01 B	100
Agrisure® RW	0.03 B	100
Aztec 2.1G 6.7 oz/1000 ft	0.03 B	100
Lorsban 15G, 8 oz/1000 ft	0.04 B	94
Force CS, 0.57 fl oz/1000 row ft	0.06 B	94
Cruiser, 1.25 mg/seed	0.06 B	94
Force CS, 0.46 fl oz/1000 row ft	0.08 B	94
Untreated	0.53 A	50
F value	6.66	—
p>F	0.00	—

[1]0-3 node damage scale. Means followed by the same letter(s) are not statistically different, Tukey's HSD (α=0.05).
[2]Percentage of 18 plants (total in 6 replicates of a treatment) with a rating of 0.25 or less.

Table 17. Agrisure® events (hybrid background A) combined with Force CS for control of western corn rootworm, ARDEC, Fort Collins, CO. 2009.

TREATMENT	ROOT RATING[1]	EFFICIENCY[2]	BUSHELS PER ACRE @15.5%
Agrisure® 3000 GT + Force CS, 0.35 fl oz/1000 row ft	0.00 B	100	129.6
Agrisure® 3000 GT + Force CS, 0.46 fl oz/1000 row ft	0.01 B	100	123.5
Agrisure® GT/CB/LL + Force CS, 0.46 fl oz/1000 row ft	0.02 AB	100	120.7
Agrisure® 3000 GT	0.03 AB	100	129.2
Agrisure® GT/CB/LL + Force CS, 0.35 fl oz/1000 row ft	0.03 AB	100	135.1
Agrisure® GT/CB/LL	0.10 A	83	126.4
F value	3.26	—	1.13
p>F	0.0343	—	0.3876

[1]0-3 node damage scale. Means followed by the same letter(s) are not statistically different, Tukey's HSD (α=0.05).
[2]Percentage of 24 plants (total in 4 replicates of a treatment) with a rating of 0.25 or less.

Table 18. Agrisure® events (hybrid background B) combined with Force CS for control of western corn rootworm, ARDEC, Fort Collins, CO. 2009.

TREATMENT	ROOT RATING[1]	EFFICIENCY[2]	BUSHELS PER ACRE @15.5%
Agrisure® RW/CB/LL + Force CS, 0.46 fl oz/1000 row ft	0.00 B	100	162.4
Agrisure® GT/CB/LL + Force CS, 0.35 fl oz/1000 row ft	0.01 AB	100	157.8
Agrisure® RW/CB/LL	0.01 AB	100	153.2
Agrisure® RW/CB/LL + Force CS, 0.35 fl oz/1000 row ft	0.01 AB	100	164.9
Agrisure® GT/CB/LL + Force CS, 0.46 fl oz/1000 row ft	0.02 AB	100	146.2
Agrisure® GT/CB/LL	0.03 A	100	150.9
F value	2.64	—	1.48
p>F	0.0663	—	2.548

[1]0-3 node damage scale. Means followed by the same letter(s) are not statistically different, Tukey's HSD (α=0.05).
[2]Percentage of 24 plants (total in 4 replicates of a treatment) with a rating of 0.25 or less.

Table 19. Agrisure® events (hybrid background C) combined with Force CS for control of western corn rootworm, ARDEC, Fort Collins, CO. 2009.

TREATMENT	ROOT RATING[1]	EFFICIENCY[2]	BUSHELS PER ACRE @15.5%
Agrisure® 3000 GT + Force CS, 0.35 fl oz/1000 row ft	0.00 A	100	147.9
Agrisure® 3000 GT	0.01 A	100	130.6
Agrisure® GT/CB/LL + Force CS, 0.35 fl oz/1000 row ft	0.02 A	100	136.4
Agrisure® 3000 GT + Force CS, 0.46 fl oz/1000 row ft	0.03 A	100	142.6
Agrisure® GT/CB/LL + Force CS, 0.46 fl oz/1000 row ft	0.05 A	92	127.4
Agrisure® GT/CB/LL	0.09 A	88	125.8
F value	2.07	—	2.96
p>F	0.1263	—	0.0469

[1]0-3 node damage scale. Means followed by the same letter(s) are not statistically different, Tukey's HSD (α=0.05).
[2]Percentage of 24 plants (total in 4 replicates of a treatment) with a rating of 0.25 or less.

CONTROL OF SPIDER MITES IN CORN WITH HAND-APPLIED INSECTICIDES AND MITICIDES, ARDEC, FORT COLLINS, CO, 2009

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CONTROL OF SPIDER MITES IN CORN WITH HAND-APPLIED INSECTICIDES AND MITICIDES, ARDEC, FORT COLLINS, CO, 2008: Early treatments were applied on 29 July 2009 using a 2 row boom sprayer mounted on a backpack and calibrated to deliver 17.8 gal/acre at 32 psi with five XR8002VS nozzles. All other treatments were applied in the same manner on 13 August 2009. Conditions were cloudy, N wind 3-6 mph, and 68 - 80°F temperature at the time of early treatments. Precipitation within 24 h of treatment totaled 0.46 inches. Conditions were cloudy, calm and 72°F temperature at the time of late treatments. Early treatments were applied at tassel emergence and late treatments were applied at brown silk. Plots were 25 ft by two rows (30 inch centers) and were arranged in six replicates of a randomized complete block design. Plots were separated from neighboring plots by a single buffer row. Plots were infested on 8 July 2009 by laying mite infested corn leaves, collected earlier that day at Grand Junction, CO, across the corn plants on which mites were to be counted. On 10 July 2009, the experimental area was treated with permethrin 3.2E, 0.2 lb (AI)/acre to control mite predators and promote spider mite abundance.

Treatments were evaluated by collecting three leaves (ear leaf, 2nd leaf above the ear, 2nd leaf below the ear) from two plants per plot -2, 7, 14, 21, and 28 days after the later treatments (DAT). Corn leaves were placed in Berlese funnels for 24 hours to extract mites into alcohol for counting. Extracted mites were identified as Banks grass mite or twospotted spider mite and counted, however, only three twospotted spider mites were found. Mite counts were transformed by the square root + 0.5 method prior to analysis. Counts were subjected to analysis of variance and mean separation by Tukey's HSD method ($\propto$=0.05), where appropriate. Untransformed mite counts are presented in Table 20.

Mite densities were extremely low (Table 20). July was the fifth wettest on record, and temperatures were below average. Results are generally inconclusive, given the low mite abundance. There was no phytotoxicity observed for any treatment.

Field History:

Pest:	Banks grass mite, *Oligonychus pratensis* (Banks)
Cultivar:	N40T
Planting Date:	May 2008
Plant Population:	28,000
Irrigation:	Linear move sprinkler
Crop History:	Field corn in 2008
Herbicide:	Roundup UltraMax, 23 fl.oz./acre + 32 oz Harness + 1% ammonium sulphate on 29 June 2009
Fertilization:	120 N, 80 P
Soil Type:	Clay loam
Location:	ARDEC, 4616 North Frontage Road, Fort Collins, CO 80524 (Block 1030, east end)

Table 20. Control of Banks grass mite in field corn with hand-applied miticides, ARDEC, Fort Collins, CO, 2009.

	BANKS GRASS MITES PER LEAF ± SEM[1]				
PRODUCT, FLUID OUNCES/ACRE	**-2 DAT[2]**	**14 DAT**	**21 DAT**	**28 DAT**	**TOTAL MITE DAYS[3]**
Zeal, 1.5 oz (early)	0.19 ± 0.07	0.11 ± 0.07	0.17 ± 0.04	0.89 ± 0.20	23.77 ± 0.77
Oberon 4SC, 4 oz + 16 oz COC (early)	0.14 ± 0.11	0.14 ± 0.14	0.03 ± 0.03	1.67 ± 0.59	23.91 ± 1.24
Oberon 4SC, 6 oz + 16 oz COC (early)	0.08 ± 0.06	0.17 ± 0.11	0.28 ± 0.06	1.03 ± 0.28	23.98 ± 0.65
Zeal, 3.0 oz (early)	0.19 ± 0.16	0.06 ± 0.04	0.25 ± 0.10	0.92 ± 0.26	24.05 ± 0.75
Comite II, 36 oz, + dimethoate 4E, 16 oz (early)	0.08 ± 0.08	0.00 ± 0.00	0.19 ± 0.10	2.28 ± 1.21	24.09 ± 1.19
Oberon 4SC, 6 oz + 16 oz COC + 32 oz UAN 28% (early)	0.00 ± 0.00	0.06 ± 0.04	0.14 ± 0.08	3.06 ± 1.26	24.33 ± 1.18
GWN-1708, 15 oz (early)	0.19 ± 0.12	0.03 ± 0.03	0.19 ± 0.11	2.00 ± 1.12	24.45 ± 1.23
Zeal, 2.0 oz (early)	0.08 ± 0.06	0.14 ± 0.09	0.19 ± 0.08	1.58 ± 0.57	24.62 ± 0.74
GWN-9815, 3.3 oz + COC @ 1% v/v (early)	0.06 ± 0.04	0.17 ± 0.07	0.22 ± 0.10	1.67 ± 0.74	24.63 ± 0.94
Oberon 4SC, 6 oz + dimethoate 4E, 16 oz (early)	0.08 ± 0.06	0.08 ± 0.04	0.17 ± 0.07	1.44 ± 0.42	24.76 ± 1.09
Hero, 10.3 oz + 16 oz COC	0.11 ± 0.04	0.08 ± 0.04	0.36 ± 0.23	1.94 ± 1.06	24.81 ± 0.95
Zeal, 1.0 oz (early)	0.08 ± 0.06	0.06 ± 0.06	0.14 ± 0.07	2.69 ± 0.69	24.88 ± 1.03
Onager 1E, 10 oz (early)	0.03 ± 0.03	0.03 ± 0.03	0.31 ± 0.15	2.69 ± 1.28	25.00 ± 1.44
Zeal, 2.5 oz (early)	0.25 ± 0.08	0.06 ± 0.04	0.14 ± 0.05	2.56 ± 1.31	25.17 ± 0.75
GWN-9814, 5 oz + COC @ 1% v/v (early)	0.14 ± 0.09	0.08 ± 0.04	0.11 ± 0.06	2.39 ± 1.25	25.24 ± 1.66
Hero, 5.15 oz + dimethoate 4E, 16 oz + 16 oz COC, early, repeat at 10 days	0.14 ± 0.07	0.06 ± 0.04	0.31 ± 0.12	1.97 ± 0.59	25.27 ± 1.37
GWN-2106, 2.2 oz + COC @ 1% v/v (early)	0.33 ± 0.11	0.08 ± 0.04	0.14 ± 0.09	2.69 ± 1.38	25.74 ± 1.19
GWN-1708, 22 oz (early)	0.33 ± 0.25	0.06 ± 0.04	0.19 ± 0.10	2.53 ± 1.48	26.28 ± 2.06
Hero, 10.3 oz + 2.85 oz Oberon 4SC + 16 oz COC	0.36 ± 0.19	0.11 ± 0.06	0.25 ± 0.11	1.81 ± 0.55	27.49 ± 1.72
UNTREATED	0.50 ± 0.34	0.56 ± 0.49	1.78 ± 1.58	1.69 ± 0.53	30.91 ± 6.17
F value	1.21	0.73	0.9	0.52	0.75
p>F	0.2701	0.779	0.5863	0.9478	0.7534

[1]SEM, standard error of the mean.
[2]DAT, days after treatment.
[3]calculated according the method of Ruppel (Journal of Economic Entomology 76: 375-7, 1983)

Table 21. 2008 pheromone trap catches at ARDEC and Briggsdale.

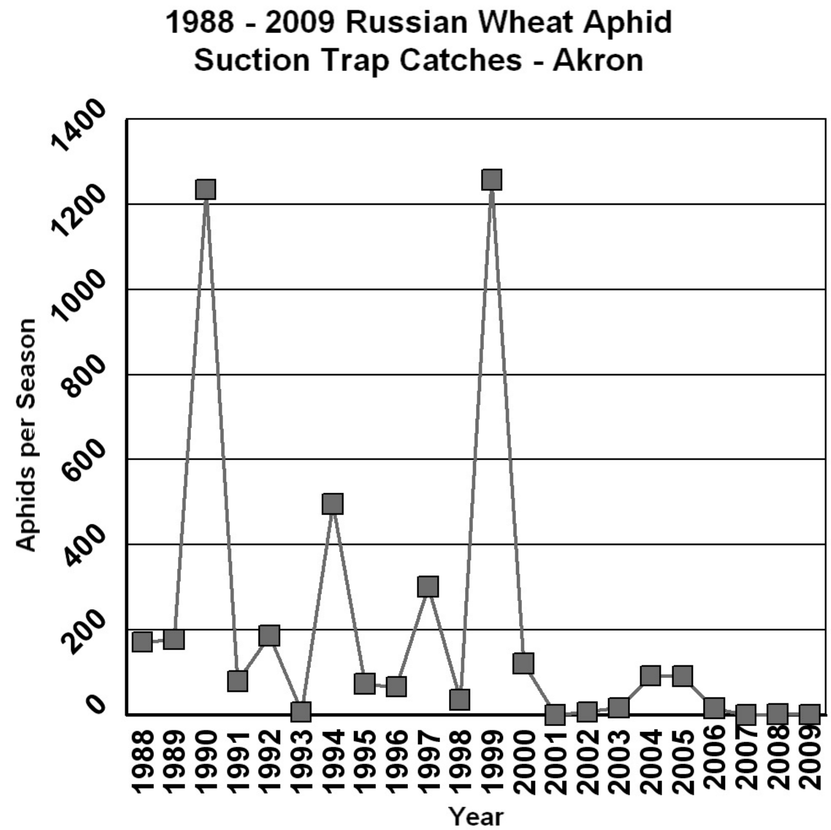
	ARDEC – 1070		Briggsdale[3]	
Species	**Total Caught[2]**	**Trapping Period**	**Total Caught[2]**	**Trapping Period[2]**
Army cutworm	21 (23)	8/27 - 10/14	95((18)	8/28 - 10/16
Banded sunflower moth	73 (0)	6/25 - 10/14	–	–
Corn earworm	1 (1)	7/2 - 9/3	–	–
European corn borer (IA)[1]	19 (54)	5/27 - 9/24	–	–
Fall armyworm	359(80)	6/25 - 10/14	–	–
Pale western cutworm	99 (94)	8/27 - 10/14	207 (144)	8/28 - 10/16
Southwestern corn borer	(0)	5/26 - 8/17	–	–
Sunflower moth	15 (1)	6/25 - 9/11	–	–
Western bean cutworm	10 (3)	6/25 - 9/24	–	–

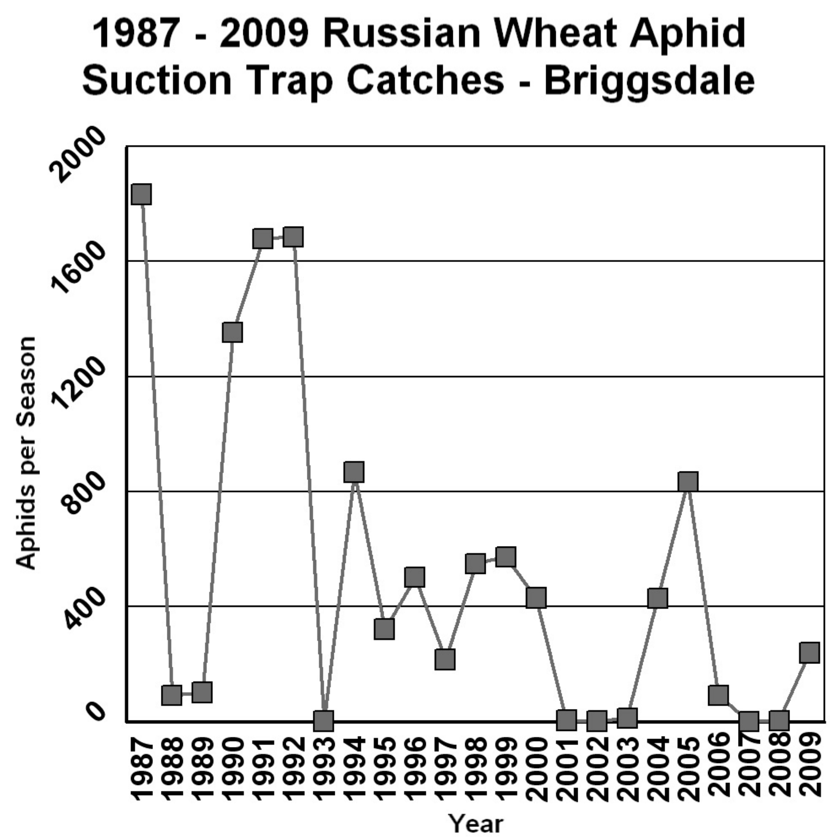
[1] IA, Iowa strain
[2]–, not trapped. Number in () is 2008 total catch for comparison
[3]Briggsdale counts are the average of two traps

Table 22. Wheathead armyworm pheromone trap catches, 2009.

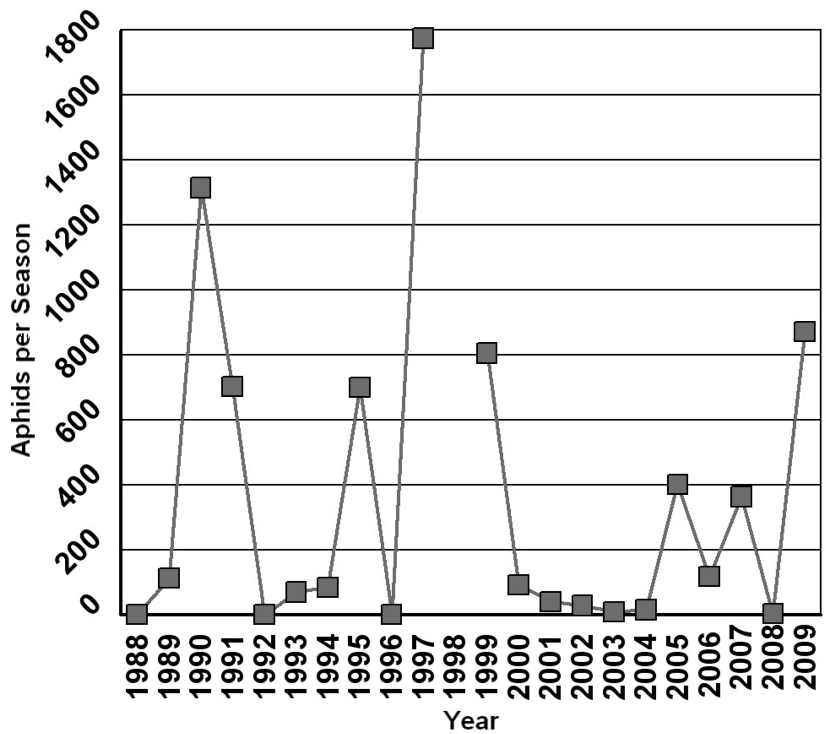
Week[1]	ARDEC	Briggsdale	Merino	Holly	Lamar
1	–	–	–	0	0
2	–	–	–	0	0
3	–	–	–	96	0
4	0	40	–	72	464
5	8	213	–	54	98
6	11	109	–	70	72
7	23	28	129	28	24
8	11	45	75	71	22
9	14	14	28	46	15
10	12	24	8	5	12
11	0	2	5	3	2
12	4	2	3	0	0
13	2	3	9	–	–
14	1	12	3	–	–
15	10	14	–	–	–
16	13	61	–	–	–
17	15	55	–	–	–
18	5	17	–	–	–
19	0	3	–	–	–
20	9	69	16	–	–
21	1	6	–	–	–
22	1	4	–	0	0
23	0	6	–	0	0
24	0	1	–	0	0
25	0	2	–	2	0
26	0	0	–	2	0
27	0	0	–	0	0
28	0	0	–	0	0
29	–	–	–	0	0
30	–	–	–	0	0

[1]Starting 6 April 2009; –, trap not in use

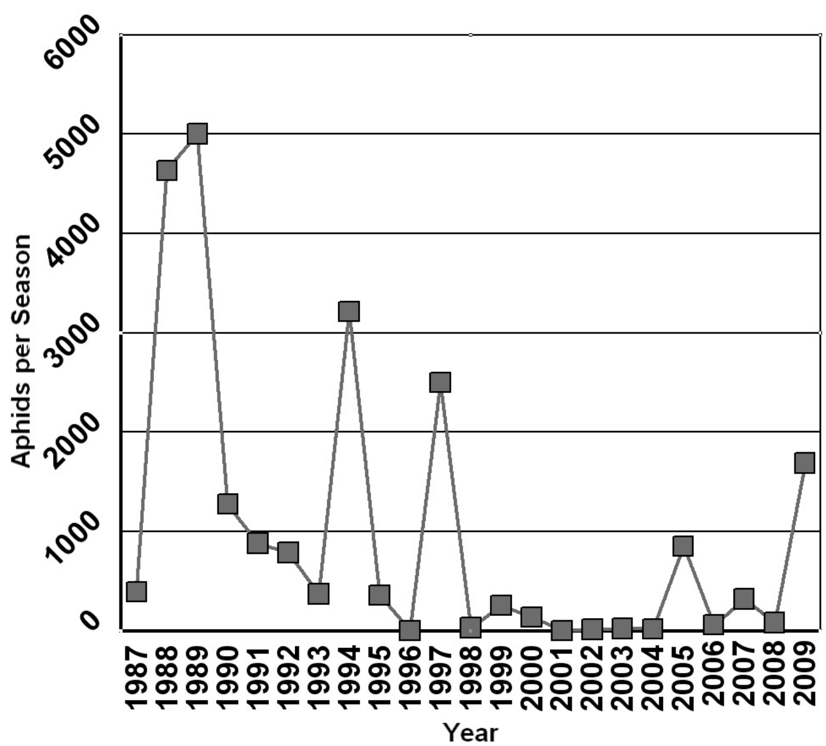

1988 - 2009 Russian Wheat Aphid
Suction Trap Catches - Akron
Aphids per Season
0
200
400
600
800
1000
1200
1400
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Year


1987 - 2009 Russian Wheat Aphid
Suction Trap Catches - Briggsdale
Aphids per Season
0
400
800
1200
1600
2000
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Year

1988 - 2009 Russian Wheat Aphid Suction Trap Catches - Lamar



1987 - 2008 Russian Wheat Aphid Suction Trap Catches - Walsh



INSECTICIDE PERFORMANCE SUMMARIES

Insecticide performance in a single experiment can be quite misleading. To aid in the interpretation of the tests included in this report, long term performance summaries are presented below for insecticides that are registered for use in Colorado and that have been tested at least three times. These summaries are complete through 2009.

Table 23. Performance of planting-time insecticides against western corn rootworm, 1987-2009, in northern Colorado

INSECTICIDE	IOWA 1-6 ROOT RATING[1]
AZTEC 2.1G	2.6 (31)
COUNTER 15G	2.6 (33)
CRUISER, 1.25 mg (AI)/seed	2.5 (8)
FORCE 1.5G (8 OZ) or 3G (4 OZ)	2.6 (30)
FORCE 3G (5 OZ)	2.4 (10)
FORTRESS 5G	2.8 (14)
LORSBAN 15G	3.0 (28)
PONCHO, 1.25 mg (AI)/seed	2.4 (8)
THIMET 20G	3.4 (15)
UNTREATED CONTROL	4.1 (37)

[1] Rated on a scale of 1-6, where 1 is least damaged, and 6 is most heavily damaged. Number in parenthesis is number of times tested for average. Planting time treatments averaged over application methods.

Table 24. Performance of cultivation insecticide treatments against western corn rootworm, 1987-2005, in northern Colorado.

INSECTICIDE	IOWA 1-6 ROOT RATING[1]
COUNTER 15G	2.8 (21)
FORCE 3G	3.3 (8)
LORSBAN 15G	3.1 (17)
THIMET 20G	2.9 (19)
UNTREATED CONTROL	4.2 (24)

[1] Rated on a scale of 1-6, where 1 is least damaged, and 6 is most heavily damaged. Number in () is number of times tested for average. Planting time treatments averaged over application methods.

Table 25. Insecticide performance against first generation European corn borer, 1982-2002, in northeast Colorado.

MATERIAL	LB/ACRE	METHOD[1]	% CONTROL[2]
DIPEL ES	1 QT + OIL	I	91 (4)
LORSBAN 15G	1.00 (AI)	A	77 (5)
LORSBAN 15G	1.00 (AI)	C	80 (6)
LORSBAN 4E	1.0 (AI)	I	87 (9)
POUNCE 3.2E	0.15 (AI)	I	88 (11)
POUNCE 1.5G	0.15 (AI)	C	87 (4)
POUNCE 1.5G	0.15 (AI)	A	73 (7)
THIMET 20G	1.00 (AI)	C	77 (4)
THIMET 20G	1.00 (AI)	A	73 (3)
WARRIOR 1E	0.03 (AI	I	85 (4)

[1] A = Aerial, C = Cultivator, I = Center Pivot Injection. CSU does not recommend the use of aerially-applied liquids for control of first generation European corn borer.
[2] Numbers in () indicate that percent control is the average of that many trials.

Table 26. Insecticide performance against western bean cutworm, 1982-2002, in northeast Colorado.

MATERIAL	LB (AI)/ACRE	METHOD[1]	% CONTROL[2]
CAPTURE 2E	0.08	A	98 (5)
CAPTURE 2E	0.08	I	98 (5)
LORSBAN 4E	0.75	A	88 (4)
LORSBAN 4E	0.75	I	94 (4)
POUNCE 3.2E	0.05	A	97 (7)
POUNCE 3.2E	0.05	I	99 (5)
WARRIOR 1E (T)	0.02	I	96 (2)

[1] A = Aerial, I = Center Pivot Injection
[2] Numbers in () indicated that percent control is average of that many trials.

Table 27. Insecticide performance against second generation European corn borer, 1982-2002, in northeast Colorado.

MATERIAL	LB (AI)/ACRE	METHOD[1]	% CONTROL[2]
DIPEL ES	1 QT PRODUCT	I	56 (16)
CAPTURE 2E	0.08	A	85 (8)
CAPTURE 2E	0.08	I	86 (14)
LORSBAN 4E	1.00	A	41 (6)
LORSBAN 4E	1.00 + OIL	I	72 (14)
PENNCAP M	1.00	A	74 (7)
PENNCAP M	1.00	I	74 (8)
POUNCE 3.2E	0.15	I	74 (11)
WARRIOR 1E	0.03	A	81 (4)
WARRIOR 1E	0.03	I	78 (4)

[1]A = Aerial, I = Center Pivot Injection
[2]Numbers in () indicate how many trials are averaged.

Table 28. Performance of hand-applied insecticides against alfalfa weevil larvae, 1984-2009, in northern Colorado.

PRODUCT	LB (AI)/ACRE	% CONTROL AT 2 WK[1]
BAYTHROID XL	0.022	97 (15)
BAYTHROID XL	0.022 (early)[3]	96 (6)
LORSBAN 4E	0.75	93 (23)
LORSBAN 4E	1.00	96 (6)
LORSBAN 4E	0.50	83 (10)
MUSTANG MAX	0.025	93 (5)
MUSTANG MAX	0.025 (early)[3]	89 (7)
PENNCAP M	0.75	84 (11)
PERMETHRIN [2]	0.10	67 (7)
PERMETHRIN [2]	0.20	80 (4)
STEWARD	0.065	80 (7)
STEWARD	0.110	86 (5)
WARRIOR 1E or T	0.02	92 (18)
WARRIOR 1E or T	0.02 (early)[3]	68 (5)
WARRIOR 1E or T	0.03	94 (8)

[1]Number in () indicates number of years included in average.
[2]Includes both Ambush 2E and Pounce 3.2E.
[3]Early treatment timed for control of army cutworm

Table 29. Control of Russian wheat aphid with hand-applied insecticides in winter wheat, 1986-2009[1].

PRODUCT	LB (AI)/ACRE	TESTS WITH > 90% CONTROL 21 DAT	TOTAL TESTS	% TESTS
LORSBAN 4E	0.50	28	45	62
COBALT	13 FL OZ	2	3	67
DIMETHOATE 4E	0.375	8	39	21
MUSTANG MAX	0.025	2	7	29
PENNCAP M	0.75	3	18	17
LORSBAN 4E	0.25	10	27	37
LORSBAN 4E	0.38	5	6	83
WARRIOR 1E	0.03	4	17	24

[1]Includes data from several states.

Table 30. Control of spider mites in artificially-infested corn with hand-applied insecticides, ARDEC, 1993-2008.

PRODUCT	LB (AI)/ACRE	% REDUCTION IN TOTAL MITE DAYS[1]
CAPTURE 2E	0.08	52 (14)
CAPTURE 2E + DIMETHOATE 4E	0.08 + 0.50	65 (14)
COMITE II	1.64	14 (14)
COMITE II	2.53	49 (6)
COMITE II + DIMETHOATE 4E	1.64 + 0.50	53 (10)
DIMETHOATE 4E	0.50	42 (14)
OBERON 4SC	0.135	55 (3)
ONAGER 1E	0.094	86 (3)

[1]Number in () indicates number of tests represented in average. 2009 data not included.

Table 31. Control of sunflower stem weevil with planting and cultivation treatments, USDA Central Great Plains Research Station, 1998-2002.

PRODUCT	LB (AI)/ACRE	TIMING	% CONTROL[1]
BAYTHROID 2E	0.02	CULTIVATION	57 (3)
BAYTHROID 2E	0.03	CULTIVATION	52 (3)
FURADAN 4F	0.75	CULTIVATION	61 (3)
FURADAN 4F	1.0	PLANTING	91 (3)
FURADAN 4F	1.0	CULTIVATION	83 (3)
WARRIOR 1E	0.02	CULTIVATION	63 (3)
WARRIOR 1E	0.03	CULTIVATION	61 (3)

[1]Number in () indicates number of tests represented in average.

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2009 COOPERATORS

PROJECT	LOCATION	COOPERATORS
Alfalfa insecticides	ARDEC, Fort Collins	Reg Koll, Chris Fryrear, Mark Collins
Barley insecticides	ARDEC, Fort Collins	Reg Koll, Chris Fryrear, Mark Collins
Corn rootworm control	ARDEC, Fort Collins	Reg Koll, Chris Fryrear, Mark Collins
Western bean cutworm control	ARDEC, Fort Collins	Reg Koll, Chris Fryrear, Mark Collins, Larry Appel, Randy Haarburg
Corn spider mite control	ARDEC, Fort Collins	Reg Koll, Chris Fryrear, Mark Collins, Kent Davis
Russian wheat aphid control	ARDEC, Fort Collins	Reg Koll, Chris Fryrear, Mark Collins
Brown wheat mite control	Lamar	Bruce Bosley, Pete Krone, Brian Pabst, Jeremy Stulp, Thia Walker
Pheromone traps	ARDEC, Fort Collins	Reg Koll, Chris Fryrear, Mark Collins
Pheromone traps	Briggsdale	Stan Cass
Suction trap	Briggsdale	Stan Cass
Suction trap	Akron (Central Great Plains Research Station)	Mike Koch, Merle Vigil
Suction trap	Lamar	Jeremy Stulp, Thia Walker
Suction trap	Walsh (Plainsman Research Center)	Deb Harn, Kevin Larson

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