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Colorado State University

College of Agricultural Sciences

Department of Bioagricultural Sciences and Pest Management

2012 Colorado Field Crop Insect Management Research and Demonstration Trials

2012 Colorado Field Crop Insect Management Research and Demonstration Trials[1]

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TABLE OF CONTENTS

CONTROL OF RUSSIAN WHEAT APHID BIOTYPE RWA2 IN WINTER WHEAT WITH HAND-APPLIED INSECTICIDES, ARDEC, FORT COLLINS, CO, 2012

Jeff Rudolph, Terri Randolph, Frank Peairs, Jack Mangles, Darren Cockrell, and Katrina Paule, Department of Bioagricultural Sciences and Pest Management, Colorado State University.

CONTROL OF RUSSIAN WHEAT APHID BIOTYPE RWA2 IN WINTER WHEAT WITH HAND-APPLIED INSECTICIDES, ARDEC, FORT COLLINS, CO, 2012: Treatments were applied on 13 April 2012 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 44-48°F with 3-5 mph wind from the North 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 late stem elongation (Zadoks 33). The crop had been infested with greenhouse-reared aphids on 13 Oct 2011 and 9 and 15 March 2012.

Treatments were evaluated for Russian wheat aphid control by collecting 20 symptomatic tillers along the middle four rows of each plot -1, 8, 15 and 22 days after treatment (DAT). Tiller samples were placed in Berlese funnels for 24 hours to extract aphids into alcohol for counting. Symptomatic tiller samples -1 DAT averaged 10.8 Russian wheat aphids per tiller.

A naturally occurring brown wheat mite infestation was evaluated by taking five five-second subsamples per plot 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 -1 DAT averaged 10.1 mites per sample.

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

Aphid pressure was greater than in 2011, with approximately 235 aphid days/tiller in the untreated control 22 DAT (Table 2) compared to 63 aphid days/tiller 26 DAT in 2011. Crop condition was excellent. All treatments had fewer aphid days than the untreated control. Lorsban Advanced, 16 fl oz, dimethoate 267, 16 fl oz, Endigo ZC, 4.5 fl oz + COC 1% v/v, and Stallion, 11.75 fl oz reduced total aphid days over three weeks by 90% or more, the level of performance observed by the more effective treatments in past experiments. Brown wheat mite abundance was much lower than in 2011, with ca. 7 mites/sample in the untreated control 5 DAT compared to ca. 454 in 2011. No treatment had fewer mites than the untreated control (Table 1). No phytotoxicity was observed with any treatment.

Field History

Pest:	Russian wheat aphid, *Diuraphis noxia* (Kurdjumov) Brown wheat mite, *Petrobia latens* (Müller)
Cultivar:	'Snowmass'
Planting Date:	22 September 2011
Irrigation:	Post planting, linear move sprinkler with drop nozzles
Crop History:	Fallow in 2011
Herbicide:	Huskie 15 fl oz/acre with 0.25% v/v NIS on 9 April 2012
Insecticide:	None prior to experiment
Fertilization:	None
Soil Type:	Sandy clay loam
Location:	ARDEC, 4616 North Frontage Road, Fort Collins, CO 80524 (Block 1030 NW) N40.65464, W104.99770

Table 1. Control of brown wheat mite in winter wheat with hand-applied insecticides, ARDEC, Fort Collins, CO. 2012.

PRODUCT, FL. OZ/ACRE	BROWN WHEAT MITES ± SE[1] 5 DAT
Cobalt Advanced, 11 fl oz	0.8 ± 0.2 A
Dimethoate 267, 16 fl oz	1.0 ± 0.4 A
Stallion, 11.75 fl oz	1.4 ± 0.4 A
Lorsban Advanced, 16 fl oz	1.6 ± 0.5 A
Warrior II, 1.28 fl oz	4.5 ± 0.7 A
Baythroid XL, 2.4 fl oz	5.2 ± 0.5 A
Endigo ZC, 4.5 fl oz + COC 1% v/v	5.4 ± 0.5 A
Warrior II, 0.96 fl oz	6.7 ± 0.4 A
Untreated Control	7.0 ± 1.3 A
Mustang Max, 4.0 fl oz	8.7 ± 0.8 A
F value	2.96
p>F	0.0076

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

Table 2. Control of Russian wheat aphid in winter wheat with hand-applied insecticides, ARDEC, Fort Collins, CO. 2012.

PRODUCT, FL. OZ/ACRE	APHIDS PER TILLER ± SE[1] 8 DAT	15 DAT	22 DAT	APHID DAYS PER TILLER[2] ± SE	% REDUCTION IN APHID DAYS
Lorsban Advanced, 16 fl oz	1.7 ± 1.0 C	0.7 ± 0.2 C	5.2 ± 2.5 B	79.1 ± 15.5 D	94
dimethoate 267, 16 fl oz	1.6 ± 0.3 C	4.0 ± 1.6 BC	5.7 ± 2.6 B	102.8 ± 15.8 CD	92
Endigo ZC, 4.5 fl oz + COC 1% v/v	0.9 ± 0.3 C	3.9 ± 1.3 BC	8.6 ± 5.4 B	107.3 ± 25.2 CD	92
Stallion, 11.75 fl oz	1.4 ± 0.3 C	3.2 ± 1.0 BC	15.9 ± 9.0 B	131.5 ± 35.1 BCD	90
Warrior II, 1.28 fl oz	2.0 ± 0.8 C	10.7 ± 6.7 BC	6.4 ± 2.7 B	155.1 ± 45.9 BCD	89
Cobalt Advanced, 11 fl oz	9.2 ± 7.4 B	3.2 ± 1.1 BC	10.6 ± 3.7 B	171.4 ± 54.9 BCD	88
Mustang Max, 4.0 fl oz	7.9 ± 2.0 B	8.1 ± 3.0 BC	29.3 ± 6.1 B	261.6 ± 31.9 B	81
Baythroid XL, 2.4 fl oz	7.0 ± 0.8 B	14.5 ± 6.7 B	25.9 ± 6.6 B	288.1 ± 65.2 B	79
Warrior II, 0.96 fl oz	4.2 ± 0.8 BC	3.2 ± 1.3 BC	59.6 ± 34.0 AB	305.2 ± 117.8 B	78
Untreated Control	42.7 ± 7.9 A	67.4 ± 10.5 A	155.3 ± 6.2 A	1378.6 ± 98.1 A	—
F value	19.17	9.70	7.73	18.33	—
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 are not statistically different, Tukey's HSD (∝=0.05).

[2]Total aphid days per tiller calculated by the Ruppel method.

CONTROL OF RUSSIAN WHEAT APHID BIOTYPE RWA2 IN SPRING BARLEY WITH HAND-APPLIED INSECTICIDES, ARDEC, FORT COLLINS, CO, 2012

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CONTROL OF RUSSIAN WHEAT APHID BIOTYPE RWA2 IN SPRING BARLEY WITH HAND-APPLIED INSECTICIDES, ARDEC, FORT COLLINS, CO, 2012: Treatments were applied on 16 May 2012 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 during treatment were 74°F, smoky, 0% cloud cover, and calm. Plots were 6 rows (5.0 ft) by 28.0 ft, arranged in six replicates of a randomized, complete block design. Crop stage at application was tillering (Zadoks 18). The crop had been infested with greenhouse-reared aphids on 18 April and 2 May 2012.

Treatments were evaluated for Russian wheat aphid control by collecting 20 symptomatic tillers along the middle four rows of each plot -1, 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 -1 DAT averaged 13.1 Russian wheat aphids per tiller.

Aphid counts were transformed by the log + 1 method to correct for nonadditivity, and transformed counts were used for analysis of variance and mean separation by Tukey's HSD test (α=0.05). Original means are presented in Table 3. Total aphid days per tiller for each treatment were calculated according the method of Ruppel (Journal of Economic Entomology 76: 375-7, 1983), transformed by the log + 1 method, and analyzed in the same manner, with original means presented in Table 3. Reductions in insect days were calculated by Abbott's (1925) formula: (percent reduction = ((untreated-treated)/untreated) X 100).

Aphid pressure was higher than in 2011, with approximately 172 aphids/tiller in the untreated control 21 DAT (Table 3) compared to more than 58 aphids per tiller 21 DAT in 2011. Crop condition was excellent. All treatments except Baythroid XL 1 EC, 2.4 fl oz and Quilt Xcel 2.2 SE, 12 fl oz (a fungicidal control) had fewer aphid days than the untreated control. The Endigo 2.06 ZC, 4 fl oz, Endigo ZCX 2.71 ZC, 4 fl oz, + Quilt Xcel 2.2 SE, 12 fl oz, and Warrior II 2.09 CS, 1.92 fl oz, + Quilt Xcel 2.2 SE, 12 fl oz treatments reduced total aphid days over three weeks by 90% or more, the level of performance observed by the more effective treatments in past experiments. No phytotoxicity was observed.

Field History

Pest:	Russian wheat aphid, *Diuraphis noxia* (Kurdjumov)
Cultivar:	'Otis'
Planting Date:	19 March 2012
Irrigation:	Post planting, linear move sprinkler with drop nozzles
Crop History:	Field corn in 2011
Herbicide:	Huskie, 12 fl oz + 1 lb ammonium sulfate/acre on 16 May 2012
Insecticide:	None prior to experiment
Soil Type:	Sandy clay loam
Location:	ARDEC, 4616 North Frontage Road, Fort Collins, CO 80524 (Block 1080 south) N40.65526, W104.99654

Table 3. Control of Russian wheat aphid in spring barley with hand-applied insecticides, ARDEC, Fort Collins, CO. 2012.

PRODUCT, FL OZ/ACRE	APHIDS PER TILLER ± SE[2] 7 DAT	14 DAT	21 DAT	APHID DAYS PER TILLER ± SE[3]	% REDUCTION IN APHID DAYS
Endigo ZC, 4 fl oz[1]	2.2 ± 1.0 CD	4.9 ± 2.3 C	4.1 ± 0.9 E	112.6 ± 23.1 D	91
Endigo ZCX 2.71 ZC, 4 fl oz, + Quilt Xcel 2.2 SE, 12 fl oz[1]	5.6 ± 2.2 BCD	1.8 ± 0.9 C	8.8 ± 2.1 DE	130.7 ± 21.3 D	90
Warrior II 2.09 CS, 1.92 fl oz, + Quilt Xcel 2.2 SE, 12 fl oz	2.8 ± 1.1 CD	4.7 ± 1.6 C	9.9 ± 1.0 DE	135.5 ± 16.6 D	90
Cobalt Advanced, 11 fl oz	5.7 ± 2.6 BCD	5.0 ± 2.2 C	7.3 ± 1.2 DE	148.8 ± 28.2 D	89
Endigo ZCX 2.71 ZC, 4 fl oz[1]	1.7 ± 1.3 D	20.9 ± 19.0 ABC	5.2 ± 1.8 E	224.7 ± 136.6 D	83
Warrior II 2.09 CS, 1.92 fl oz[1]	2.4 ± 1.0 CD	13.7 ± 5.6 ABC	29.5 ± 17.2 CD	264.3 ± 100.1 CD	80
Baythroid XL 1 EC, 2.4 fl oz, + Headline 2.09 SC, 9 fl oz[1]	8.5 ± 2.2 ABC	35.4 ± 17.8 AB	44.9 ± 11.8 BC	512.5 ± 143.8 BC	61
Baythroid XL 1 EC, 2.4 fl oz[1]	13.6 ± 2.5 AB	75.7 ± 34.4 A	70.0 ± 16.4 AB	918.8 ± 292.7 AB	30
Quilt Xcel 2.2 SE, 12 fl oz[1]	17.1 ± 4.8 AB	57.3 ± 19.3 A	100.2 ± 17.3 AB	920.0 ± 177.8 AB	30
Untreated control	22.2 ± 5.1 A	72.0 ± 24.3 A	171.9 ± 40.3 A	1309.6 ± 300.0 A	—
F value	8.74	10.89	27.91	18.09	—
p>F	0.0000	0.0000	0.0000	0.0000	—

[1]plus crop oil concentrate
[1]SE, standard error of the mean. Means in the same column followed by the same letter are not statistically different, Tukey's HSD (∝=0.05).
[2]Total aphid days per tiller calculated by the Ruppel method.

CONTROL OF WHEAT STEM SAWFLY ADULTS IN WINTER WHEAT, NEW RAYMER, CO, 2012

Frank Peairs, Terri Randolph, Jeff Rudolph, Jim Mertens, Jack Mangels, Anthony Peairs, Darren Cockrell, Scot Sharp, and Katrina Paule, Department of Bioagricultural Sciencesand Pest Management, Colorado State University.

CONTROL OF WHEAT STEM SAWFLY ADULTS IN WINTER WHEAT, NEW RAYMER, CO, 2012: The small plot experiment was treated using an ATV-mounted sprayer calibrated to apply 12 gpa at 32 psi through six 8002 (XR T-Jet 2VS) nozzles mounted on a 10 ft boom at 5 mph. Plots were 10 ft by 30 ft and arranged in six replicates of a randomized complete block design. Plots were laid out end-to-end along the southern edge of the field. Treatments containing Palisade 2 EC were applied on 10 April 2012 at Zadoks growth stage 31. Conditions at the time of this treatment were clear, 60°F with 6 - 8 mph wind from the south. Treatments targeting the first female sawfly were applied on 14 May 2012. Conditions at the time of this treatment were clear, 58°F with 5 - 10 mph wind from the south. Retreatments were applied two weeks after the first female treatments on 29 May 2012. Conditions at the time of this treatment were clear, 72°F with 5 - 6 mph wind from the southeast. The large plot experiment was implemented on 14 May 2012 by treating alternating strips of an 80 acre field with 1.92 fl. oz. Warrior II per acre using a 1010 Apache self-propelled sprayer calibrated to apply 12 gpa at 50-60 psi through 11008 flat fan nozzles mounted on a 90 ft boom positioned four ft above ground level at 13 mph. Conditions at the time of treatment were were 80°F with 7 mph wind from the west. Treatments were not applied until the sprayer was ca. 200 ft from the eastern edge of the field, and this area was used as an untreated control without adjacent treated plots.

Small plot treatments were evaluated for infested stems on 1 June 2012 by collecting 100 tillers at random per plot. These were placed in coolers and returned to the laboratory for subsequent evaluation. Each tiller was dissected to determine the presence or absence of wheat stem sawfly larvae. On 27 June 2012 the total stems in 1 row-meter per plot were counted, as were the number of cut stems. Percentage infested and cut stems were analyzed by ANOVA and subsequent mean separation by Tukey's HSD test (α=0.05). Means are presented in Table 5. Large plots were evaluated on 10, 15 and 22 May and 1 June by taking 100 180°-sweeps per plot and returning the collected adults to the laboratory to be sexed and counted. Total adult days was calculated for each strip by the method of Ruppel (Journal of Economic Entomology 76: 375-7, 1983). Percentage infested and cut tillers were determined, as described above, on 7 and 27 June 2012, respectively. Total adult days, percentage infested tillers and percentage cut stems in the treated and untreated plots were compared using a paired t-test (α=0.05) (Table 4). Yield estimates were provided by the grower cooperator.

Treatment of large plots with Warrior II resulted in fewer wheat stem sawfly adult days, but not fewer infested stems or cut stems (Table 4). Wheat yields were 25 and 24 bu/ac in the treated and untreated strips, respectively. While not comparable statistically, the untreated border at the front of the experiment had more lodging (55%) than untreated strips flanked by treated strips (19.9%), suggesting that treating alternating strips may have potential for cost-effective adult control.
Percentage infested stems was not affected by treatment in the small plot study (Table 5). No treatment was different than the untreated control in terms of percentage cut stems. Treatments involving early treatment with Warrior II followed by retreatment at the first observation of adult females tended to have fewer cut stems, which may merit further investigation.

Field History

Pest:	Wheat stem sawfly, *Cephus cinctus* Norton
Cultivar:	'Hatcher'
Planting Date:	10 September 2011
Plant Population:	Not available
Irrigation:	Dryland
Crop History:	Fallow in 2011
Insecticide:	None prior to experiment
Soil Type:	Clay loam
Location:	Weld CR 123, ½ mile S of Co Hwy 14

Table 4. Control of wheat stem sawfly adults with a single Warrior II treatment at the first observation of adults, New Raymer, CO, 2012.

	Treated	Untreated	T-value	p-value
Mean adult days ± SE[1]	30.5 ± 7.2	56.0 ± 10.7	-1.74	0.1319
% Infested stems ± SE[1]	77.0 ± 3.5	77.3 ± 5.1	-0.05	0.9611
% Lodged stems ± SE[1]	23.9 ± 4.9	19.9 ± 4.1	0.86	0.4212

[1]SE, standard error of the mean.

Table 5. Control of wheat stem sawfly larval infestation and stem damage with foliar insecticide and plant growth regulator treatments, New Raymer, CO, 2012.

PRODUCT, FL OZ/ACRE	% INFESTED STEMS ± SE[1]	% CUT STEMS ± SE[1]
Warrior II 2.09CS 1.92 oz/acre + COC 1% v/v, Zadoks 31, repeated at first female	86.5 ± 7.7	15.7 ± 4.3 B
Palisade 2 EC, 7.0 oz/acre + Warrior II 2.09CS 1.92 oz/acre + COC1% v/v, 4.5 oz/acre, Zadoks 31, Warrior repeated at first female	77.0 ± 9.4	18.4 ± 5.9 B
Palisade 2 EC, 7.0 oz/acre, Zadoks 31	85.3 ± 4.6	18.8 ± 7.6 AB
Warrior II 2.09CS 1.92 oz/acre + COC 1% v/v, first female, repeat at 2 weeks	67.2 ± 9.5	23.0 ± 8.7 AB
Endigo ZCX 2.71ZC, 4.5 oz/acre + COC 1% v/v, Zadoks 31, repeat at first female	90.3 ± 2.7	25.2 ± 4.2 AB
Palisade 2 EC, 7.0 oz/acre + Endigo ZCX 2.71ZC + COC1% v/v, 4.5 oz/acre, Zadoks 31, Endigo repeat at first female	71.3 ± 13.7	25.3 ± 9.0 AB
Warrior II 2.09CS 1.92 oz/acre + COC 1% v/v, first female	82.7 ± 5.3	25.3 ± 6.2 AB
Untreated	84.8 ± 10.3	30.4 ± 13.1 AB
Endigo ZCX 2.71ZC, 4.5 oz/acre + COC 1% v/v, first female	87.0 ± 5.8	33.5 ± 9.5 AB
Endigo ZCX 2.71ZC, 4.5 oz/acre + COC 1% v/v, first female, repeat at 2 weeks	82.3 ± 9.8	56.2 ± 10.9 A
F value	1.01	2.11
p>F	0.4437	0.0488

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

CONTROL OF BROWN WHEAT MITE IN RIPPER WINTER WHEAT AT TWO GROWTH STAGES WITH DIMETHOATE 4E, LAMAR, CO, 2011.

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CONTROL OF BROWN WHEAT MITE IN RIPPER WINTER WHEAT AT TWO GROWTH STAGES WITH DIMETHOATE 4E, LAMAR, CO, 2011. Dimethoate 4E was applied to the winter wheat using a John Deere 4920 self-propelled sprayer with a 120-foot spray boom. Plots were 75 by 120 ft long and arranged in eight replicates of a randomized complete block design. The Feekes 3 (regrowth) treatment was applied 25 March 2011 using 8 oz/A dimethoate 4E plus 0.25% Induce applied in 5 gal/A water with TeeJet XF 20 nozzles at 30 psi. Conditions at the time of application were 43˚F with wind speeds of 1 mph. The Feekes 5-6 (pseudo stem elongation) treatment was applied 11 April 2011. Conditions at the time of application were 55.1˚F with wind speeds of 3-5 mph.

Brown wheat mite abundance was estimated -1, 7, 15, and 28 days after treatment (DAT) using a Vortis insect suction sampler for five seconds at each of five 0.2 m^2 sites within each plot. The composite sample from each plot was placed on a paper plate in a Berlese funnel for 72 hours to extract mites into alcohol for counting.

Cumulative mite days for each treatment were calculated according to the method described by Ruppel (J. Econ. Entomology 76: 375-377). Brown wheat mite counts and cumulative mite days were transformed by the log + 0.5 method prior to analysis of variance (PROC GLM) and mean separation by Tukey's HSD test (α=0.05) (SAS 9.3 for Windows, Cary, NC, SAS Institute Inc., 2011.). Original means are presented in Tables 6 and 7. Reductions in cumulative mite days were calculated by Abbott's formula (J. Econ. Entomology 18: 265-267) where (percent reduction = ((untreated-treated)/untreated) X 100). Original yield means were analyzed by PROC GLM (SAS), and means were separated by Tukey's HSD test (α=0.05) (Table 8).

Treatment at Feekes 3 reduced brown wheat mite abundance at 15 DAT. Total mite days were reduced 56.7% (Table 6). Treatment at Feekes 5-6 reduced mite abundance 15 and 28 DAT and total mite days were reduced 49.5% (Table 7). Mites in the untreated control had declined noticeably by 28 DAT so treating at Feekes 5-6 may be too late to get full treatment benefit. Yield was not affected by treatment (Table 8), however the yield ranking suggests that earlier treatment should be investigated.

Field History

Pest:	Brown wheat mite, *Petrobia latens* (Müeller)
Cultivar:	'Ripper'
Planting Date:	5 October 2010
Plant Population:	Seeded at 45 lbs/A
Irrigation:	Dryland
Crop History:	Fallow in 2010
Fertilizer:	30 lbs/A 12-40-0-10-1 (N-P-K-S-Zn) at planting
Insecticide:	None prior to experiment
Soil Type:	Clay loam
Location:	Stulp Farms, Lamar, Prowers County, CO

Table 6. Brown wheat mites collected from 1 m^2 in 5 sec with a Vortis suction sampler within untreated plots and plots treated at Feekes 3 with dimethoate 4E, 8 oz/A on 25 March 2011, Lamar, CO.

	Brown wheat mites per 1 m^2 in 5 sec[1]				Cumulative	% Reduction in
Treatment	-1 DAT	7 DAT	15 DAT	28 DAT	Mite Days[1]	Cumulative Mite Days
Untreated	84.1	74.25	364.8 A	335.1	6859 A	-
Dimethoate	-	75.75	117.1 B	135.3	2971 B	56.7
F Value	-	0.04	5.05	1.16	6.14	-
p>F	-	0.8437	0.0414	0.2988	0.0266	-

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

Table 7. Brown wheat mites collected from 1 m^2 in 5 sec with a Vortis suction sampler within untreated plots and plots treated at Feekes 5-6 with dimethoate 4E, 8 oz/A on 11 April 2011, Lamar, CO.

	Brown wheat mites per 1 m^2 in 5 sec[1]			Cumulative	% Reduction in
Treatment	-1 DAT	15 DAT	28 DAT	Mite Days[1]	Cumulative Mite Days
Untreated	418.5[A]	335.1 A	19.1 A	5789 A	-
Dimethoate	364.8[A]	19.3 B	3.2 B	2924 B	49.5
F Value	0.22	21.17	11.37	4.90	-
p>F	0.6433	0.0004	0.0046	0.0440	-

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

Table 8. Yield and test weight of Ripper winter wheat following brown wheat mite control at Feekes 3 or Feekes 5-6 with dimethoate 4E, 8 oz/A, Lamar, CO, 2011.

Treatment	**BU/A[1]**	**Test Weight (lb)[1]**
Untreated	39.0	58.9
Feekes 3	40.1	58.8
Feekes 5-6	30.6	58.9
F Value	2.41	0.05
p>F	0.1145	0.9523

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

CONTROL OF ALFALFA INSECTS WITH HAND-APPLIED INSECTICIDES, ARDEC, FORT COLLINS, CO, 2012

Jeff Rudolph, Terri Randolph, Frank Peairs, Jack Mangels, Darren Cockrell, Scot Sharp, Katrina Paule, Chrissy Ward, Ashley Longo-Peairs, Christa Pacheco, Department of Bioagricultural Sciencesand Pest Management, Colorado State University.

CONTROL OF ALFALFA INSECTS IN ALFALFA WITH HAND-APPLIED INSECTICIDES, ARDEC, FORT COLLINS, CO, 2012: Early treatments were applied on 13 April 2012 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 on 13 April 2013, 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 16 May 2012. Conditions for the early treatments were 48-50°F with 5-8 mph wind from the north, and 68-74°F with no wind during the later treatments. Plots were 10.0 ft by 25.0 ft and arranged in six replicates of a randomized, complete block design. The untreated control and Warrior II, 1.92 oz/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 six inches in height at the time of early treatments and 18 inches 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 four days prior to the later treatments by taking 100, 180° sweeps across the experimental area. This sample averaged 15.7 and 18.9 alfalfa weevil larvae and pea aphids per sweep, respectively. Insect counts were transformed by the log + 1 method to correct for nonadditivity and then subjected to analysis of variance and mean separation by Tukey's HSD procedure (α=0.05). Original means are presented in Tables 9-11. Total insect days for each treatment were calculated according to the method of Ruppel (Journal of Economic Entomology 76: 375-7, 1983), transformed by the log + 1 method, and analyzed in the same manner, with original means presented in the tables. Yields were measured on 6 June 2012 by hand harvesting two 0.1 m^2 areas per plot. Samples were weighed wet and dry and converted to lbs of dry hay per acre prior to comparing yields of treated plots to those of untreated plots using a paired t-test.

Pea aphid and alfalfa weevil larval densities were greater than those observed in 2011. Alfalfa weevil days averaged ca. 825 and 347 in 2012 and 2011, respectively. Pea aphid days averaged 2022 and 665 in 2012 and 2011, respectively. Adult alfalfa weevils were not abundant, and, while statistical differences were noted at 7 and 14 DAT, no clear pattern of control was observed (Table 10). All treatments, except for those containing Entrust, had fewer alfalfa weevil larvae than the untreated control at 7 DAT. At 14 DAT, all treatments except the two Entrust treatments, Lorsban Advanced, 32 fl oz, and F9114 0.8EC, 4 fl oz, and Mustang Max 0.8EC, 4 fl oz had fewer alfalfa weevil larvae per sweep than the untreated control. At 21 DAT, all treatments except the two Entrust treatments, Lorsban Advanced, 32 fl oz, Steward EC, 11.3 fl oz, Cobalt Advanced, 19 fl oz and Baythroid XL, 2.8 fl oz, early, had fewer alfalfa weevil larvae per sweep than the untreated control (Table 9). All treatments, except for those containing Entrust, had fewer alfalfa weevil days than the untreated control. No treatment had fewer pea aphid days than the untreated control. Mustang Max 0.8EC, 4 fl oz, early, and Baythroid XL, 2.8 fl oz, early, had more pea aphid days than the untreated control (Table 11). No phytotoxicity was observed with any treatment. Yields were reduced 23.9%, which was significant (DF=22, f=6.93, p>F=0.0153). Yield reduction measured since 1995 has averaged 6.9%, with a range of 0.0% to 23.9%.

Field History

Pests:	Alfalfa weevil, *Hypera postica* (Gyllenhal)
	Pea aphid, *Acyrthosiphon pisum* (Harris)
Cultivar:	Dekalb DKA41-18RR
Plant Stand:	Good
Irrigation:	Flood, not irrigated in 2010
Crop History:	Alfalfa since 2005
Herbicide:	None
Insecticide:	None prior to experiment
Fertilization:	None
Soil Type:	Sandy clay loam
Location:	ARDEC, 4616 North Frontage Road, Fort Collins, CO, 80524 (Weber triangle); N 40.57360, W 104.98635

Table 9. Control of alfalfa weevil larvae with hand-applied insecticides, ARDEC, Fort Collins, CO. 2012.

PRODUCT, FL. OZ/ACRE	ALFALFA WEEVIL LARVAE PER 180° SWEEP ± SE[1] 7 DAT	14 DAT	21 DAT	WEEVIL DAYS[2] ± SE	% REDUCTION IN WEEVIL DAYS
Warrior II, 1.92 fl oz, early	0.2 ± 0.1 F	0.5 ± 0.2 D	1.5 ± 1.1 CDE	75.5 ± 3.7 D	92
Mustang Max 0.8EC, 4 fl oz, early	0.7 ± 0.2 DEF	0.8 ± 0.2 D	0.9 ± 0.1 CDE	78.9 ± 1.0 D	92
Baythroid XL, 2.8 fl oz	1.0 ± 0.4 DEF	1.1 ± 0.3 CD	0.5 ± 0.2 DE	82.1 ± 3.4 D	92
Warrior II, 1.92 fl oz	0.4 ± 0.2 EF	2.2 ± 1.6 BCD	0.3 ± 0.1 E	84.5 ± 10.9 D	92
Stallion, 8 fl oz	1.8 ± 1.2 DEF	1.9 ± 0.6 BCD	1.0 ± 0.3 CDE	95.3 ± 9.6 CD	90
Cobalt Advanced, 19 fl oz, early	1.8 ± 0.5 DEF	2.2 ± 0.5 BCD	1.6 ± 0.4 CDE	98.9 ± 7.1 CD	90
Stallion, 11.75 fl oz	1.1 ± 0.5 DEF	3.9 ± 3.0 BCD	0.8 ± 0.3 CDE	103.3 ± 21.3 CD	90
Baythroid XL, 2.8 fl oz, early	0.5 ± 0.2 DEF	0.8 ± 0.2 D	10.0 ± 7.6 ABC	109.4 ± 27.9 CD	89
Cobalt Advanced, 19 fl oz	1.8 ± 0.7 DEF	2.2 ± 0.8 BCD	4.7 ± 3.6 ABCD	110.0 ± 21.5 CD	89
Mustang Max 0.8EC, 4 fl oz	1.7 ± 0.8 DEF	6.0 ± 4.7 ABCD	1.5 ± 0.6 CDE	124.4 ± 32.3 CD	88
Steward EC, 11.3 fl oz	7.2 ± 4.3 BCD	2.7 ± 0.9 BCD	4.3 ± 1.2 ABCD	149.0 ± 37.6 CD	85
F9114 0.8EC, 4 fl oz	1.2 ± 0.8 DEF	13.9 ± 13.0 ABCD	0.7 ± 0.1 CDE	173.3 ± 89.5 CD	83
Lorsban Advanced 32 fl oz	9.9 ± 8.2 BCD	13.0 ± 8.6 ABCD	8.2 ± 3.7 ABC	254.1 ± 129.9 BC	75
Entrust, 3.0 oz	11.7 ± 3.3 ABC	36.7 ± 11.6 ABC	29.3 ± 7.2 AB	506.5 ± 114.6 AB	50
Entrust, 1.5 oz	12.7 ± 2.4 AB	43.6 ± 11.9 AB	31.8 ± 8.5 AB	571.0 ± 82.9 A	43
Untreated control	34.6 ± 8.8 A	80.4 ±27.7 A	38.3 ± 9.7 A	1003.7 ± 204.5 A	—
F value	12.64	5.12	11.15	15.17	
p>F	0.0000	0.0000	0.0000	0.0000	

[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 (∝=0.05).

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

Table 10. Control of alfalfa weevil adults with hand-applied insecticides, ARDEC, Fort Collins, CO. 2012.

	ALFALFA WEEVIL ADULTS PER 180° SWEEP ± SE[1]		
PRODUCT, FL. OZ/ACRE	**7 DAT**	**14 DAT**	**21 DAT**
Warrior II, 1.92 fl oz, early	0.2 ± 0.1 AB	0.3 ± 0.1 AB	0.1 ± 0.0
Warrior II, 1.92 fl oz	0.0 ± 0.0 B	0.1 ± 0.0 AB	0.1 ± 0.0
Mustang Max 0.8EC, 4 fl oz, early	0.2 ± 0.1 AB	0.4 ± 0.1 AB	0.2 ± 0.0
Stallion, 11.75 fl oz	0.0 ± 0.0 B	0.2 ± 0.1 AB	0.4 ± 0.0
Baythroid XL, 2.8 fl oz, early	0.2 ± 0.1 AB	0.5 ± 0.2 AB	0.4 ± 0.0
Cobalt Advanced, 19 fl oz, early	0.4 ± 0.1 A	0.6 ± 0.1 A	0.4 ± 0.0
Entrust, 1.5 oz	0.2 ± 0.0 AB	0.3 ± 0.2 AB	0.4 ± 0.0
Steward EC, 11.3 fl oz	0.0 ± 0.0 B	0.1 ± 0.0 AB	0.4 ± 0.0
Lorsban Advanced 32 fl oz	0.2 ± 0.1 AB	0.2 ± 0.1 AB	0.4 ± 0.0
Baythroid XL, 2.8 fl oz	0.0 ± 0.0 B	0.0 ± 0.0 B	0.4 ± 0.0
Stallion, 8 fl oz	0.0 ± 0.0 B	0.3 ± 0.1 AB	0.5 ± 0.0
Untreated control	0.0 ± 0.0 B	0.3 ± 0.1 AB	0.5 ± 0.0
Entrust, 3.0 oz	0.1 ± 0.0 B	0.3 ± 0.1 AB	0.5 ± 0.0
F9114 0.8EC, 4 fl oz	0.0 ± 0.0 B	0.2 ± 0.1 AB	0.6 ± 0.1
Mustang Max 0.8EC, 4 fl oz	0.0 ± 0.0 B	0.2 ± 0.1 AB	0.7 ± 0.1
Cobalt Advanced, 19 fl oz	0.1 ± 0.0 AB	0.3 ± 0.1 AB	0.7 ± 0.1
F value	5.46	1.88	1.22
p>F	0.0000	0.039	0.2791

[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 (∝=0.05).

Table 11. Control of pea aphids in alfalfa with hand-applied insecticides, ARDEC, Fort Collins, CO. 2012.

	PEA APHIDS PER 180° SWEEP ± SE[1]							
PRODUCT, FL. OZ/ACRE	**7 DAT**		**14 DAT**		**21 DAT**		**APHID DAYS[2] ± SE**	
Lorsban Advanced 32 fl oz	5.7 ± 1.6	C	36.1 ± 5.8	B	115.4 ± 30.0	A	752.0 ± 93.1	E
Cobalt Advanced, 19 fl oz	5.8 ± 1.5	C	38.3 ± 4.5	B	127.4 ± 15.1	A	810.1 ± 56.5	DE
Untreated control	16.4 ± 5.8	ABC	68.1 ± 9.4	AB	110.8 ± 33.8	A	1035.3 ± 148.6	CDE
Warrior II, 1.92 fl oz	6.2 ± 1.3	C	61.3 ± 9.3	AB	155.4 ± 33.7	A	1072.1 ± 174.7	BCDE
Stallion, 11.75 fl oz	4.5 ± 1.0	C	61.0 ± 10.7	AB	160.1 ± 26.5	A	1075.0 ± 136.7	BCDE
Stallion, 8 fl oz	6.4 ± 2.1	C	63.8 ± 9.7	AB	159.5 ± 25.5	A	1104.8 ± 152.5	ABCDE
Mustang Max 0.8EC, 4 fl oz	19.3 ± 6.9	ABC	77.4 ± 21.5	AB	196.6 ± 56.1	A	1420.6 ± 237.1	ABCDE
Entrust, 3.0 oz	23.6 ± 5.2	AB	90.6 ± 13.1	AB	179.6 ± 19.1	A	1483.1 ± 117.8	ABCD
Entrust, 1.5 oz	30.9 ± 10.5	AB	105.5 ± 19.5	AB	176.5 ± 51.0	A	1628.0 ± 267.7	ABCD
F9114 0.8EC, 4 fl oz	14.5 ± 5.4	ABC	117.9 ± 29.0	AB	207.0 ± 34.0	A	1707.2 ± 177.9	ABC
Steward EC, 11.3 fl oz	19.3 ± 6.3	ABC	157.2 ± 39.7	A	136.2 ± 12.1	A	1768.3 ± 263.8	ABC
Cobalt Advanced, 19 fl oz, early	24.2 ± 4.1	AB	131.2 ± 51.1	AB	202.0 ± 43.9	A	1850.2 ± 407.9	ABC
Baythroid XL, 2.8 fl oz	26.5 ± 8.7	AB	137.8 ± 54.8	AB	226.1 ± 48.4	A	1997.4 ± 433.4	ABC
Warrior II, 1.92 fl oz, early	41.9 ± 15.0	A	139.2 ± 28.2	AB	206.8 ± 42.7	A	2046.5 ± 313.3	ABC
Baythroid XL, 2.8 fl oz, early	29.6 ± 7.9	AB	172.7 ± 37.4	A	202.2 ± 31.2	A	2179.2 ± 375.1	AB
Mustang Max 0.8EC, 4 fl oz, early	37.7 ± 12.4	A	160.4 ± 57.5	A	243.6 ± 50.6	A	2295.1 ± 528.7	A
F value	8.29		3.55		1.92		6.02	
p>F	0.0000		0.0001		0.0345		0.0000	

[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 (∝=0.05).
[2]% reduction in total weevil days, calculated by the Ruppel method.

CONTROL OF WESTERN CORN ROOTWORM IN FIELD CORN WITH PLANTING-TIME SOIL INSECTICIDES, SEED TREATMENTS, AND PLANT-INCORPORATED PROTECTANTS, ARDEC, FORT COLLINS, CO, 2012
Jeff Rudolph, Terri Randolph, Frank Peairs, Jack Mangles, Darren Cockrell, Katrina Paule, and Chrissy Ward, Department of Bioagricultural Sciencesand Pest Management, Colorado State University.

CONTROL OF WESTERN CORN ROOTWORM IN FIELD CORN WITH PLANTING-TIME SOIL INSECTICIDES, SEED TREATMENTS, AND PLANT-INCORPORATED PROTECTANTS, ARDEC, FORT COLLINS, CO, 2012: All treatments were planted on 17 May 2012. 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. Plots were one 25-ft row arranged in six replicates of a randomized complete block design. Seed for the "washed" treatment was rinsed with tap water to remove the Cruiser 0.25. The Cruiser 1.25 treatment was developed by adding 1.0 mg a.i./kernel Cruiser 5FS to the seed used in the 2K591 (Cruiser 0.25) treatment.

Treatments were evaluated by digging three plants per plot on 13 July 2012. 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). Plot means were used for analysis of variance and mean separation by Tukey's HSD method ($\alpha=0.05$). Treatment efficiency was determined as the percentage of total plants per treatment (18) having a root rating of 0.25 or lower.

Western corn rootworm pressure was much lower than observed in 2011 (Table 12). This likely was due to dry soil conditions during the early part of the growing season. Damage rating in the untreated control (washed Cruiser 0.25) averaged 1.70 and 0.11 in 2011 and 2012, respectively. All treatments, except the 2K591 (Cruiser 1.25) treatment, were less damaged than the untreated control (washed Cruiser) treatment. No phytotoxicity was observed with any treatment.

Field History

Pest:	Western corn rootworm, *Diabrotica virgifera virgifera* LeConte
Cultivar:	2K591 (RR), unless otherwise indicated
Planting Date:	17 May 2012
Plant Population:	29,000
Irrigation:	Furrow
Crop History:	Corn in 2011
Insecticide:	None prior to experiment
Soil Type:	Clay loam
Location:	ARDEC, 4616 North Frontage Road, Fort Collins, CO 80524 (northern part of Block 3100). N40.66606, W104.99657

Table 12. Commercial and experimental treatments for control of western corn rootworm, ARDEC, Fort Collins, CO. 2012.

TREATMENT	ROOT RATING[1]	EFFICIENCY[2]
2K591 (Cruiser 0.25)	0.00 B	100
2K592 (HxTRA RR, 2011 seed)	0.00 B	100
2K594 (SmartStax)	0.00 B	100
Lorsban 15G, 8 oz/1000 ft	0.01 B	100
Aztec 2.1G, 6.7 oz/1000 ft	0.02 B	100
Counter 15G, 8 oz/1000 ft	0.02 B	100
H6467 3000GT	0.02 B	100
Force 3G, 4 oz/1000 ft	0.02 B	100
2K591 (Cruiser 1.25)	0.03 AB	100
2K591 (washed to remove Cruiser)	0.11 A	89
F value	2.92	—
p>F	0.0082	—

[1]Means in the same column followed by the same letter are not statistically different, Tukey's HSD (α=0.05).
[2]% total plants (18) per treatment having a root rating of 0.25 or lower.

CONTROL OF WESTERN BEAN CUTWORM IN FIELD CORN HYBRIDS WITH COMMERCIAL Bt EVENTS, ARDEC, FORT COLLINS, CO, 2012

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CONTROL OF WESTERN BEAN CUTWORM IN FIELD CORN HYBRIDS WITH COMMERCIAL Bt EVENTS, ARDEC, FORT COLLINS, CO, 2012: The experiment was planted on 17 May 2012. Plants were infested prior to and during the green silk stage by using a Davis insect inoculator (Davis, F. M. and T. G. Oswalt. 1979. Hand inoculator for dispensing lepidopterous insects. Agricultural Research [Southern Region], Science and Education Administration, USDA, New Orleans, LA. Southern Series 9) to place neonate western bean cutworm larvae mixed with corn cob grits on the silks. Larvae were hatched from field-collected egg masses purchased from Appel Crop Consulting, Grant, NE. Plants were infested on 26 July and 3 August with ca. 25 and 8 larvae per primary ear, respectively. Approximately one week later, infested ears were covered with tassel bags to exclude birds and rootworm adults. Plots consisted of three 20-ft rows, and 10 plants in the middle of each treatment row were infested. The experiment was replicated six times.

Treatments were evaluated on 11 September 2012 by opening the husks of the primary ear of each of the infested plants and counting damaged ears, western bean cutworm larvae and naturally occurring corn earworm larvae. The damaged area per damaged ear then was determined by estimating the cm^2 of ear fed upon, using a transparent grid held over the affected area. Western bean cutworm and corn earworm larval counts and area damaged by western bean cutworm are presented in Table 13.

Infestation levels were very low and variable. The crop was not mature enough when larvae were available, which likely affected larval success. Only the Viptera trait had no evidence of western bean cutworm or corn earworm feeding.

Field History

Pest:	Western bean cutworm, *Striacosta albicosta* (Smith) Corn earworm, *Helicoverpa zea* (Boddie)
Cultivar:	Experimentals
Planting Date:	17 May 2012
Plant Population:	29,000
Irrigation:	Furrow
Crop History:	Silage corn in 2011
Insecticide:	None prior to experiment
Soil Type:	Clay loam
Location:	ARDEC, 4616 North Frontage Road, Fort Collins, CO 80524 (northern part of Block 3100)**.** N40.66606, W104.99657

Table 13. Western bean cutworm (WBC) and corn earworm (CEW) on corn with commercial Bt events, ARDEC, Fort Collins, CO. 2012.

TRAIT	CM^2 WBC FEEDING DAMAGE[1]	WBC/EAR[1]	CEW/EAR[1]
Viptera	0.00 B	0.00 B	0.00 A
SmartStax	0.16 B	0.02 AB	0.00 A
HxTRA	0.43 AB	0.02 AB	0.08 A
No trait	3.63 A	0.13 A	0.07 A
F value	4.56	4.46	4.03
p>F	0.0184	0.0199	0.0275

[1]Means in the same column followed by the same letter are not statistically different, Tukey's HSD (∝=0.05).

CONTROL OF SPIDER MITES IN CORN WITH HAND-APPLIED INSECTICIDES AND MITICIDES, ARDEC, FORT COLLINS, CO, 2012

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CONTROL OF SPIDER MITES IN CORN WITH HAND-APPLIED INSECTICIDES AND MITICIDES, ARDEC, FORT COLLINS, CO, 2012: Early treatments were applied on 19 July 2012 using a 2 row boom sprayer mounted on a backpack calibrated to deliver 17.8 gal/acre at 32 psi with three XR8002VS nozzles. All other treatments were applied in the same manner on 2 August 2012. Conditions were calm, clear, 68 - 74°F temperature at the time of early treatments. Conditions were mostly cloudy, calm, 68 - 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. Because of the number of treatments, two experiments, containing several treatments in common, were planted. Plots were separated from neighboring plots by a single buffer row. Plots were infested on 28 June 2012 by laying mite infested corn leaves, collected earlier that day in Boulder County, CO, across the corn plants on which mites were to be counted. On 29 June 2012, the experimental area was treated with permethrin 3.2E, 0.2 lb (AI)/acre to control beneficial insects 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 1-2 days prior to and 7, 14, 21 and 28 days after the later treatments (DAT). Corn leaves were placed in Berlese funnels for 48 hours to extract mites into alcohol for counting. Extracted mites were identified as Banks grass mite or twospotted spider mite and counted. Most were Banks grass mite (99.5%) so only total mites counts were analyzed. Grain yields were estimated for the Oberon 4SC, 5 fl oz + 32 fl oz COC (early), Onager 1E, 10 fl oz + Kinetic 0.25% v/v (early), dimethoate 400, 16 fl oz + Kinetic 0.25% v/v (late) and the untreated control treatments in experiment 2 by harvesting the ears from 0.001 acre per plot, drying and shelling the ears, weighing the dried grain, and converting yields to bu/acre at 15.5% moisture. Mite counts were transformed by the log + 1 method to address nonadditivity issues. Total mite days were calculated by the method of Ruppel (J. Econ. Entomology 76: 375-377). Counts and total mite days were subjected 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 accumulated mite days of the untreated control. Grain yields were compared with ANOVA. Original means for total mites at 0, 7, 14, 21 and 28 DAT are presented in Tables 14 and 15.

Mite densities were very low in experiment 1 and few difference among treatments were observed (Table 14). It is unclear as to why the infestation did not develop in this field, although unusually high temperatures are a possibility. Mite abundance in experiment 2 was roughly 10X greater than in experiment 1 but still substantially lower than years of high mite abundance at this location. No treatment in experiment 2 had fewer mite days than the untreated control. The untreated control (104 bu/acre) yielded more than the dimethoate (94 bu/acre) and the Onager treatment (94 bu/acre), while the Oberon treatment yield (99 bu/acre) was statistically similar to the other three (df=3, 15; F=4.95, p>F=0.0139).

Field History:

Pest:	Banks grass mite, *Oligonychus pratensis* (Banks) Twospotted spider mite, *Tetranychus urticae* Koch
Cultivar:	Golden Harvest H7149GT
Planting Date:	17 May 2012
Plant Population:	28,000
Irrigation:	Linear move sprinkler
Crop History:	Corn in 2011 (Part 1) and spring barley in 2011 (Part 2)
Herbicide:	Glystar Gold 40 fl oz + Kicker Pro 64 fl oz/acre on 12 June 2012
Fertilization:	120 N, 80 P
Soil Type:	Clay loam
Location:	ARDEC, 4616 North Frontage Road, Fort Collins, CO 80524 (Part 1, Block 1030, east N40.65464, W104.99770; Part 2, Block 1080, north N40.65578, W104.99648)

Table 14. Control of spider mites in field corn with hand-applied miticides (Part 1), ARDEC, Fort Collins, CO, 2012.

	Mites per Leaf ± SE[4]					
TREATMENT, PRODUCT/ACRE	0 DAT	7 DAT	14 DAT	21 DAT	28 DAT	Total Mite Days ± SE[5]
Experimental A1	0.2 ± 0.1	0.3 ± 0.1	0.2 ± 0.1 B	0.1 ± 0.0	0.0 ± 0.0	4.0 ± 1.1
Brigade 2EC, 6.4 fl oz + dimethoate 400, 16 fl oz[1,2]	0.6 ± 0.2	0.1 ± 0.1	0.2 ± 0.1 B	0.0 ± 0.0	0.1 ± 0.0	4.9 ± 1.2
Onager 1E, 10 fl oz	0.4 ± 0.2	0.1 ± 0.1	0.1 ± 0.1 B	0.2 ± 0.1	0.4 ± 0.2	5.3 ± 1.2
Oberon 4SC, 4 fl oz[3]	0.1 ± 0.1	0.4 ± 0.1	0.1 ± 0.0 B	0.3 ± 0.2	0.1 ± 0.1	5.4 ± 1.1
Oberon 4SC, 4 fl oz[1,3]	0.3 ± 0.2	0.3 ± 0.1	0.2 ± 0.1 B	0.1 ± 0.0	0.2 ± 0.0	5.4 ± 0.9
Oberon 4SC, 5 fl oz[3]	0.2 ± 0.1	0.3 ± 0.1	0.1 ± 0.0 B	0.3 ± 0.2	0.1 ± 0.1	5.4 ± 2.0
Oberon 4SC 4 fl oz + Induce 0.25% v/v	0.6 ± 0.3	0.3 ± 0.1	0.1 ± 0.1 B	0.1 ± 0.1	0.2 ± 0.1	5.8 ± 0.9
Experimental B1	0.6 ± 0.2	0.2 ± 0.1	0.1 ± 0.1 B	0.3 ± 0.2	0.2 ± 0.1	6.3 ± 1.7
Experimental A5	0.8 ± 0.5	0.2 ± 0.1	0.1 ± 0.1 B	0.2 ± 0.1	0.1 ± 0.1	6.7 ± 1.7
Experimental B2	0.8 ± 0.3	0.3 ± 0.1	0.1 ± 0.1 B	0.2 ± 0.1	0.0 ± 0.0	6.9 ± 1.6
Experimental B4	1.1 ± 0.9	0.0 ± 0.0	0.2 ± 0.2 B	0.2 ± 0.1	0.1 ± 0.1	7.0 ± 2.9
Experimental A3	0.9 ± 0.4	0.1 ± 0.1	0.3 ± 0.1 AB	0.2 ± 0.1	0.1 ± 0.1	7.1 ± 1.4
Experimental A4	0.6 ± 0.2	0.3 ± 0.1	0.2 ± 0.2 B	0.3 ± 0.1	0.0 ± 0.0	7.9 ± 1.5
Experimental B3	0.1 ± 0.1	0.4 ± 0.3	0.4 ± 0.1 AB	0.2 ± 0.1	0.1 ± 0.0	8.1 ± 2.3
Oberon 4SC, 5 fl oz[1,3]	1.1 ± 0.8	0.2 ± 0.1	0.2 ± 0.1 B	0.1 ± 0.0	0.2 ± 0.1	8.1 ± 3.9
Experimental B5	0.4 ± 0.2	0.4 ± 0.2	0.4 ± 0.2 AB	0.2 ± 0.1	0.2 ± 0.1	9.3 ± 2.8
UNTREATED	0.9 ± 0.7	0.5 ± 0.2	0.3 ± 0.2 AB	0.1 ± 0.1	0.0 ± 0.0	9.6 ± 4.3
Onager 1E, 10 fl oz[1]	1.2 ± 0.6	0.4 ± 0.3	0.3 ± 0.1 AB	0.1 ± 0.1	0.1 ± 0.1	10.7 ± 4.4
Experimental A2	0.9 ± 0.5	0.4 ± 0.2	0.4 ± 0.1 AB	0.4 ± 0.3	0.1 ± 0.1	11.9 ± 4.3
Brigade 2EC, 6.4 fl oz[1,2]	1.2 ± 0.6	3.0 ± 2.1	2.8 ± 1.6 A	7.4 ± 5.6	0.2 ± 0.1	96.6 ± 58.4
F value	0.93	1.52	2.46	1.28	1.46	1.48
p>F	0.5530	0.0968	0.0023	0.1237	0.1186	0.1113

[1]Late treatment
[2]+ Kinetic 0.25% v/v
[3]+ 16 fl oz crop oil concentrate/acre
[4]SE, standard error of the mean, DAT, days after treatment. Means in the same column followed by the same letter(s) are not statistically different, Tukey's HSD (∝=0.05).
[5]Total mite days, calculated by the Ruppel method.

Table 15. Control of spider mites in field corn with hand-applied miticides (Part 2), ARDEC, Fort Collins, CO, 2012.

TREATMENT, PRODUCT/ACRE	Mites per Leaf ± SE[4] 0 DAT	7 DAT	14 DAT	21 DAT	28 DAT	Total Mite Days ± SE[5] (% Reduction)
Onager 1E, 12 fl oz[2]	1.1 ± 0.5 AB	0.1 ± 0.1 C	0.2 ± 0.1 CD	0.3 ± 0.1 B	0.1 ± 0.1 C	8.4 ± 2.9 C (95)
Onager 1E, 10 fl oz[2]	0.6 ± 0.3 B	0.2 ± 0.1 BC	0.3 ± 0.2 D	0.8 ± 0.3 B	0.1 ± 0.1 C	9.8 ± 3.3 C (94)
Onager 1E, 24 fl oz[2]	1.7 ± 0.7 AB	0.4 ± 0.2 ABC	0.5 ± 0.2 ABCD	0.2 ± 0.1 B	0.1 ± 0.1 C	15.2 ± 4.8 C (91)
Zeal 72WS, 2.0 oz[2]	1.9 ± 1.1 AB	0.9 ± 0.6 ABC	0.7 ± 0.3 A	1.6 ± 0.9 AB	0.1 ± 0.1 C	26.4 ± 9.4 BC (84)
Oberon 4SC, 5 fl oz[3]	0.5 ± 0.2 B	1.6 ± 0.7 ABC	1.2 ± 0.3 D	0.8 ± 0.2 B	0.4 ± 0.2 BC	29.8 ± 9.4 ABC (82)
dimethoate 400, 16 fl oz[1,2]	4.6 ± 2.4 AB	0.1 ± 0.1 C	0.8 ± 0.4 ABCD	1.0 ± 0.4 AB	0.3 ± 0.1 BC	30.0 ± 9.9 ABC (82)
GWN-1708, 20 fl oz[1,2]	2.6 ± 1.1 AB	1.6 ± 0.5 ABC	1.4 ± 0.7 BCD	0.5 ± 0.1 B	0.3 ± 0.1 BC	37.7 ± 9.1 ABC (78)
Brigade 2EC, 6.4 fl oz + dimethoate 400, 16 fl oz[1,2]	4.9 ± 2.4 AB	0.9 ± 0.7 ABC	0.9 ± 0.3 BCD	1.0 ± 0.3 AB	0.6 ± 0.3 BC	39.1 ± 15.8 ABC (77)
GWN-1708, 24 fl oz[2]	2.3 ± 1.1 AB	2.5 ± 2.2 ABC	1.1 ± 0.4 BCD	1.6 ± 0.8 AB	0.1 ± 0.1 C	42.7 ± 19.7 ABC (75)
Agri-Flex 1.55 SC, 8.5 fl oz[1,2]	3.8 ± 1.9 AB	3.8 ± 2.0 ABC	2.2 ± 1.1 ABCD	1.6 ± 1.0 AB	0.2 ± 0.1 BC	68.7 ± 25.9 ABC (59)
Apollo SC, 6 fl oz[2]	2.1 ± 1.6 AB	4.9 ± 4.6 ABC	4.7 ± 4.1 ABCD	2.7 ± 2.0 AB	0.4 ± 0.2 BC	102.2 ± 81.6 ABC (39)
GWN-1708, 20 fl oz[2]	2.4 ± 1.2 AB	1.6 ± 0.7 ABC	8.0 ± 7.1 BCD	0.7 ± 0.4 B	0.3 ± 0.1 BC	107.6 ± 84.4 ABC (36)
Apollo SC, 8 fl oz[2]	1.9 ± 0.8 AB	2.0 ± 1.3 ABC	2.6 ± 1.6 ABCD	12.4 ± 11.6 AB	6.1 ± 6.0 BC	112.7 ± 75.2 ABC (33)
Agri-Mek 0.70 SC, 2.5 fl oz[1,2]	9.0 ± 5.0 AB	1.9 ± 0.5 ABC	4.8 ± 1.6 ABCD	4.7 ± 3.3 AB	1.7 ± 1.0 BC	117.6 ± 39.3 ABC (30)
GWN-1708, 24 fl oz[1,2]	30.4 ± 25.5 A	1.9 ± 1.0 ABC	1.1 ± 0.6 ABCD	0.8 ± 0.2 B	0.3 ± 0.2 BC	135.2 ± 98.0 ABC (19)
Agri-Mek 0.70 SC, 2 fl oz[1,2]	2.4 ± 0.9 AB	7.6 ± 6.7 ABC	5.8 ± 5.1 ABCD	4.4 ± 3.9 AB	1.5 ± 1.4 BC	143.9 ± 120.7 ABC (14)
Untreated	2.7 ± 1.6 AB	6.4 ± 2.2 A	6.9 ± 5.1 BCD	11.7 ± 7.0 AB	0.2 ± 0.1 BC	167.6 ± 93.5 ABC (0)
Apollo SC, 6 fl oz + Brigade 2EC, 6.4 fl oz[2]	1.4 ± 0.9 AB	1.7 ± 0.5 ABC	13.0 ± 5.3 ABC	21.1 ± 8.4 A	8.1 ± 5.1 AB	255.3 ± 88.3 AB —
Apollo SC, 6 fl oz + Brigade 2EC, 3.2 fl oz[2]	5.9 ± 3.7 AB	4.9 ± 1.5 ABC	27.6 ± 15.0 AB	10.8 ± 6.9 AB	4.7 ± 3.2 ABC	398.6 ± 195.1 AB —
Brigade 2EC, 6.4 fl oz[1,2]	6.3 ± 3.7 AB	6.1 ± 2.7 ABC	57.1 ± 40.3 BCD	26.8 ± 14.7 A	16.3 ± 6.8 A	814.5 ± 489.3 A —
F value	2.01	2.69	3.4	3.33	3.94	3.9
P>F	0.0148	0.0008	0.0000	0.0001	0.0000	0.0000

[1]Late treatment

[2]+ Kinetic 0.25% v/v

[3]+ 16 fl oz crop oil concentrate/acre

[4]SE, standard error of the mean, DAT, days after treatment. Means in the same column followed by the same letter(s) are not statistically different, Tukey's HSD (∝=0.05).

[5]% reduction in total mite days, calculated by the Ruppel method. Means in the same column followed by the same letter(s) are not statistically different, Tukey's HSD (∝=0.05)

Table 16. 2012 pheromone trap catches at ARDEC, Fort Collins, CO.

	ARDEC – 1070	
Species	**Total Caught[2]**	**Trapping Period**
Banded sunflower moth	33 (22)	6/6 - 10/19
European corn borer (IA)[1]	5 (18)	5/18 - 10/19
Fall armyworm	142 (158)	5/20 - 10/29
Sunflower moth	24 (5)	5/25 - 9/21
Western bean cutworm	42 (0)	5/18 - 10/5
Wheat head armyworm	22 (13)	4/6 - 10/19

[1] IA, Iowa strain
[2]–, not trapped. Number in () is 2011 total catch for comparison

2012 wheat stem sawfly survey. Jack Mangels, Darren Cockrell, and Terri Randolph, Department of Bioagricultural Sciencesand Pest Management, Colorado State University.

Ninety-nine samples were collected, with sites per county based on the average planted wheat acreage for that county. In addition, sites were separated by a minimum of 10 miles. Each site consisted of a wheat field that shared a field edge with wheat stubble, with no intervening barriers or roads.

GPS coordinates were recorded at each location using a Garmin model GPSmap76S. A hand drawn map was then made for ease of returning to sites. Previous crop, presence of alternate host grasses, tillage type, stubble/residue percent cover, irrigation, county and wheat growth stage were recorded in a spreadsheet on an Acer Tablature tablet computer.

During the first visit to a field, 100 180-degree sweeps with a standard 15 inch sweep net were taken along the field edge closest to the wheat fallow area. Contents of the net were then emptied into ziplock plastic baggies and transported in coolers. The samples were then stored in the freezer for later sawfly adult counts. Sites where sawfly adults were collected were revisited after anthesis to collect 100 tillers for determining percentage larval infestation. One hundred tillers along the wheat/stubble border were cut, as close to the ground as possible. Tillers were placed into ziplock baggies and transported to the lab in coolers and later dissected.

Results

A map of wheat stem sawfly infested and non-infested sites was constructed using ESRI Arcmap 10.0 (Figure 1). This map also indicates the level of infestation when sawfly were present. A total of 32.6 % of the 99 sites sampled were infested with wheat stem sawfly. Sites with the highest infestation levels were located in Weld and Morgan counties. Mild to moderate infestation levels were found as south as Cheyenne county. This survey will be repeated in 2013 and 2014 to track the wheat stem sawfly spread.

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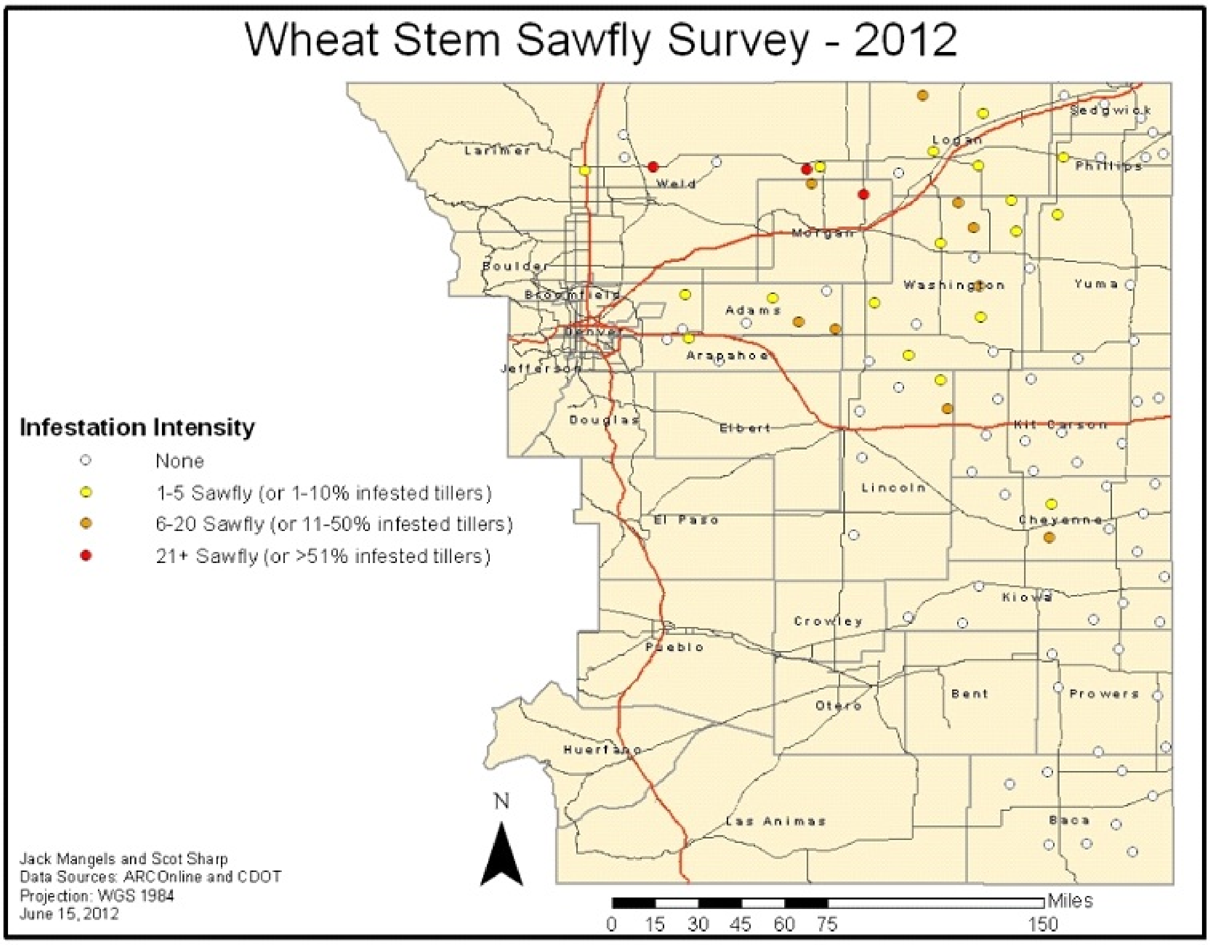
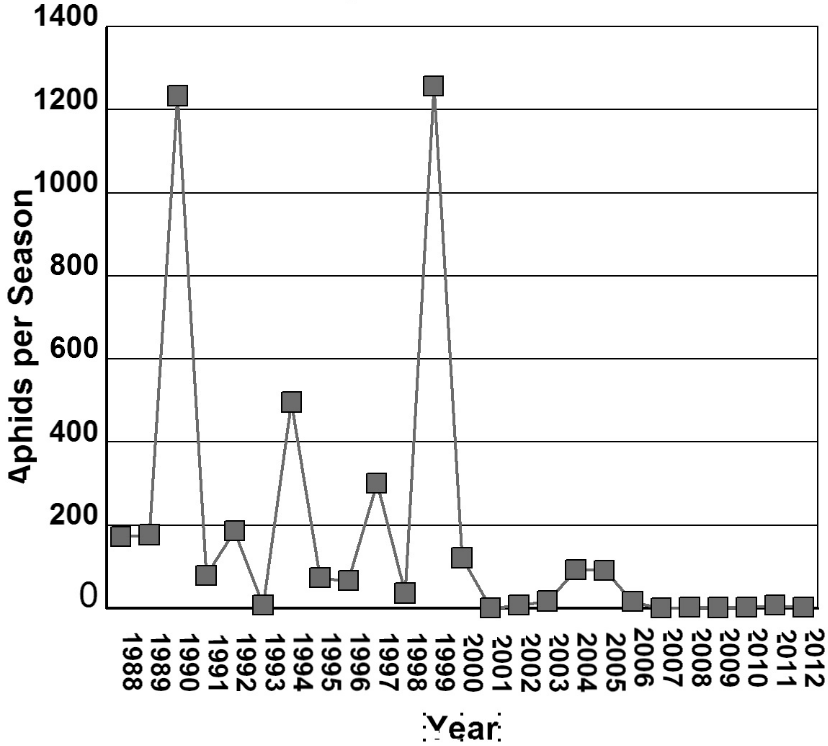
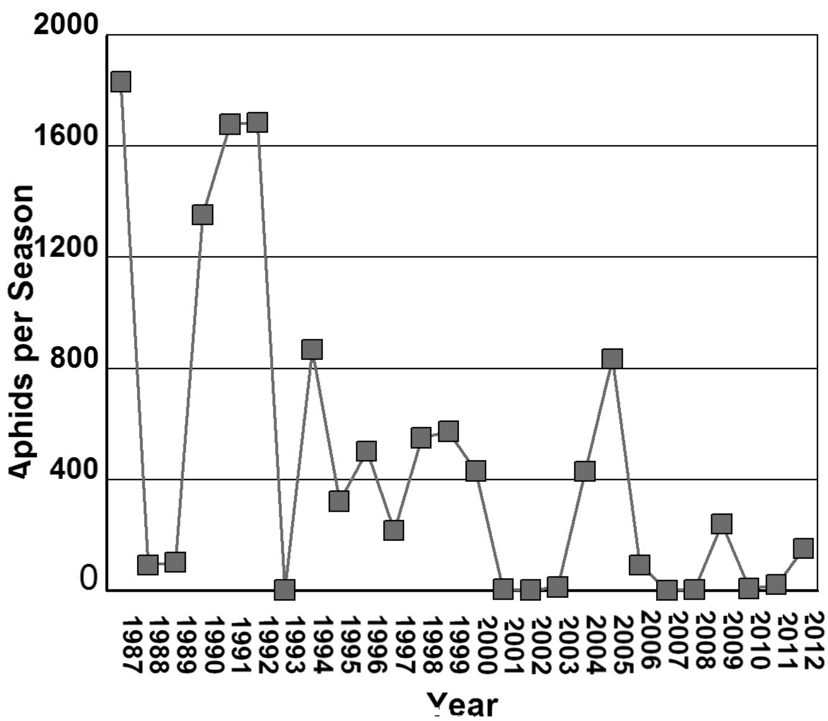


Figure 1. 2012 occurrence of wheat stem sawfly in eastern Colorado winter wheat.

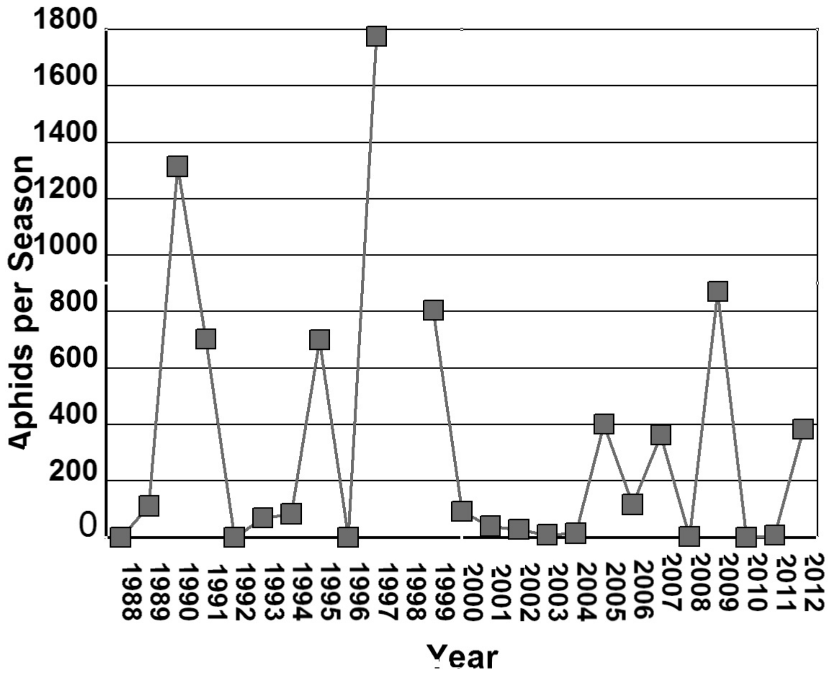
1988 - 2012 Russian Wheat Aphid Suction Trap Catches - Akron



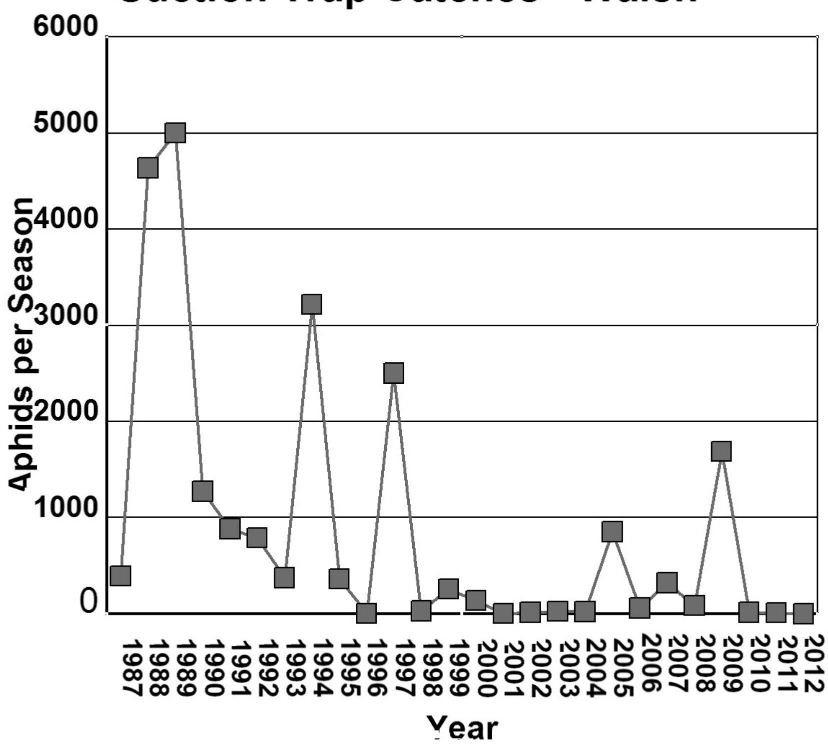
1987 - 2012 Russian Wheat Aphid Suction Trap Catches - Fort Collins



1988 - 2012 Russian Wheat Aphid Suction Trap Catches - Lamar



1987 - 2012 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 2011.

Table 17. Performance of planting-time insecticides against western corn rootworm, 1987-2012, in northern Colorado.

INSECTICIDE	IOWA 1-6 ROOT RATING[1]
AZTEC 2.1G	2.6 (33)
COUNTER 15G	2.6 (35)
CRUISER, 1.25 mg (AI)/seed	2.6 (10)
FORCE 1.5G (8 OZ) or 3G (4 OZ)	2.6 (32)
FORCE 3G (5 OZ)	2.4 (10)
FORTRESS 5G	2.8 (14)
LORSBAN 15G	3.0 (29)
PONCHO 600, 1.25 mg (AI)/seed	2.4 (8)
THIMET 20G	3.4 (15)
UNTREATED CONTROL	4.1 (38)

[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 18. 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 19. 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 20. 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 21. 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 + OIL	I	72 (14)
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 22. Performance of hand-applied insecticides against alfalfa weevil larvae, 1984-2012, in northern Colorado.

PRODUCT	LB (AI)/ACRE	% CONTROL AT 2 WK[1]
BAYTHROID XL	0.022	97 (18)
BAYTHROID XL	0.022 (early)[3]	95 (9)
COBALT OR COBALT ADVANCED	19 fl oz	89 (6)
LORSBAN 4E	0.75	93 (23)
LORSBAN 4E	1.00	89 (9)
LORSBAN 4E	0.50	83 (10)
MUSTANG MAX	0.025	92 (8)
MUSTANG MAX	0.025 (early)[3]	90 (10)
PERMETHRIN [2]	0.10	67 (7)
PERMETHRIN [2]	0.20	80 (4)
STALLION	8 FL OZ	93 (2)
STALLION	11.75 FL OZ	94 (2)
STEWARD EC	0.065	80 (7)
STEWARD EC	0.110	85 (8)
WARRIOR 1E or T or II	0.02	92 (18)
WARRIOR II	0.03 (early)[3]	95 (4)
WARRIOR 1E or T or II	0.03	94 (11)

[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 23. Control of Russian wheat aphid with hand-applied insecticides in winter wheat, 1986-2012[1].

PRODUCT	LB (AI)/ACRE	TESTS WITH > 90% CONTROL 21 DAT	TOTAL TESTS	% TESTS
LORSBAN 4E	0.50	29	49	59
COBALT	13 FL OZ	3	5	60
BAYTHROID XL	0.019	0	6	0
DIMETHOATE 4E	0.375	9	41	22
ENDIGO	4.5 FL OZ	2	3	67
MUSTANG MAX	0.025	2	9	22
LORSBAN 4E	0.25	10	27	37
LORSBAN 4E	0.38	5	6	83
WARRIOR 1E	0.03	4	18	22

[1]Includes data from several states.

Table 24. Control of spider mites in artificially-infested corn with hand-applied insecticides, ARDEC, 1993-2012.

PRODUCT	LB (AI)/ACRE	% REDUCTION IN TOTAL MITE DAYS[1]
CAPTURE 2E	0.08	47 (18)
CAPTURE 2E + DIMETHOATE 4E	0.08 + 0.50	65 (18)
COMITE II	1.64	17 (17)
COMITE II	2.53	37 (9)
COMITE II + DIMETHOATE 4E	1.64 + 0.50	55 (13)
DIMETHOATE 4E	0.50	42 (16)
OBERON 4SC	0.135	50 (7)
ONAGER 1E	0.094	76 (7)

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

Table 25. 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[2]	0.75	CULTIVATION	61 (3)
FURADAN 4F[2]	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.
[2]No longer registered

ACKNOWLEDGMENTS

2012 COOPERATORS

PROJECT	LOCATION	COOPERATORS
Alfalfa insecticides	ARDEC, Fort Collins	Chris Fryrear, Mark Collins
Barley insecticides	ARDEC, Fort Collins	Chris Fryrear, Mark Collins
Corn rootworm control	ARDEC, Fort Collins	Chris Fryrear, Mark Collins
Western bean cutworm control	ARDEC, Fort Collins	Chris Fryrear, Mark Collins, Larry Appel
Corn spider mite control	ARDEC, Fort Collins	Chris Fryrear, Mark Collins, Thia Walker
Russian wheat aphid control	ARDEC, Fort Collins	Chris Fryrear, Mark Collins
Wheat stem sawfly control	New Raymer	Jim and Cole Mertens
Brown wheat mite control	ARDEC, Lamar	Chris Fryrear, Mark Collins, Jeremy Stulp, Thia Walker
Pheromone traps	ARDEC, Fort Collins	Chris Fryrear, Mark Collins
Suction trap	ARDEC, Fort Collins	Chris Fryrear, Mark Collins
Suction trap	Akron (Central Great Plains Research Station)	Dave Poss, Merle Vigil
Suction trap	Lamar	Jeremy Stulp, Wilma Trujillo, Thia Walker
Suction trap	Walsh (Plainsman Research Center)	Deb Harn, Kevin Larson,

PRODUCT INDEX

Endigo ZCX 2.71 ZC
Manufacturer: Syngenta
EPA Registration Number: experimental
Active ingredient(s) (common name): lambda cyhalothrin + thiamethoxam. 5, 8

Entrust
Manufacturer: Dow Agrosciences
EPA Registration Number: 62719-282
Active ingredient(s) (common name): spinosad. 11, 13-15

F9114 0.8EC
Manufacturer: FMC
EPA Registration Number: Experimental
Active ingredient(s) (common name): Experimental.. . . . . 11, 13-15

Force 3G
Manufacturer: Syngenta
EPA Registration Number: 100-1075
Active ingredient(s) (common name): tefluthrin.. . . . . 17, 28

Furadan 4F
Manufacturer: FMC
EPA Registration Number: 279-2876
Active ingredient(s) (common name): carbofuran. 31

GWN-1708
Manufacturer: Gowan
EPA Registration Number: experimental
Active ingredient(s) (common name): experimental.. 23

Headline
Manufacturer: BASF
EPA Registration Number: 7969-186
Active ingredient(s) (common name): pyraclostrobin 5

HxTRA
Manufacturer: Dow Agrosciences
Genetic insertion event DAS 59122-7 and TC1507
Active ingredient(s) (common name): Cry34/35Ab1 + Cry 1F. 17, 19

Lorsban 15G
Manufacturer: Dow Agrosciences
EPA Registration Number: 62719-34
Active ingredient(s) (common name): chlorpyrifos.. . . . . 17, 28, 29

Lorsban 4E
Manufacturer: Dow Agrosciences
EPA Registration Number: 62719-220
Active ingredient(s) (common name): chlorpyrifos. 29-31

Lorsban Advanced
Manufacturer: Dow Agrosciences
EPA Registration Number: 62719-591
Active ingredient(s) (common name): chlorpyrifos. 2, 3, 11, 13-15

Mustang Max
Manufacturer: FMC
EPA Registration Number: 279-3249
Active ingredient(s) (common name): zeta cypermethrin. 2-3, 11, 13-15, 30, 31

Oberon 4SC
Manufacturer: Bayer
EPA Registration Number: 264-850
Active ingredient(s) (common name): spiromesifen. 20, 22, 23, 31

Onager 1E
Manufacturer: Gowan
EPA Registration Number: 10163-277
Active ingredient(s) (common name): hexythiazox. 20, 22, 23, 31

Palisade 2EC
Manufacturer: Syngenta
EPA Registration Number: 95266-40-3
Active ingredient(s) (common name): trinexapac-ethyl. 8

Poncho 600
Manufacturer: Bayer
EPA Registration Number: 264-789
Active ingredient(s) (common name) : clothianidin. 28

Pounce 1.5G
Manufacturer: FMC
EPA Registration Number: 279-3059
Active ingredient(s) (common name) : permethrin. 29

Pounce 3.2E
Manufacturer: FMC
EPA Registration Number: 279-3014
Active ingredient(s) (common name) : permethrin. 29, 30

Quilt Xcel
Manufacturer: Syngenta
EPA Registration Number: 100-1324
Active ingredient(s) (common name) : azoxystrobin + propiconazole. 4, 5

Smartstax
Manufacturer: Dow Agrosciences
Genetic insertion events: MON 89034 x TC1507 x MON 88017 x DAS-59122-
Active ingredient(s) (common name): Cry 1A.l05 + Cry2Ab2 + Cry34/35Ab1 + Cry 1F. 17, 19

Stallion
Manufacturer: FMC
EPA Registration Number: 279-9545
Active ingredient(s) (common name): zeta cypermethrin + chlorpyrifos. 1-3, 13-15, 30

Steward EC
Manufacturer: DuPont
EPA Registration Number: 352-598
Active ingredient(s) (common name): indoxacarb 11, 13-15, 30

Thimet 20G
Manufacturer: Amvac and Micro-Flo
EPA Registration Number: 5481-530 and 241-257-51036
Active ingredient(s) (common name): phorate. 28, 29

Viptera
Manufacturer: Syngenta
Genetic insertion events: MIR162
Active ingredient(s) (common name): Vip3Aa20.. . . . . 18, 19

Warrior with Zeon Technology
Manufacturer: Syngenta
EPA Registration Number: 100-1112
Active ingredient(s) (common name): lambda-cyhalothrin. 29-31

Warrior II with Zeon Technology
Manufacturer: Syngenta
EPA Registration Number: 100-1295
Active ingredient(s) (common name): lambda-cyhalothrin. 1-8, 11, 13-15,