Onion Research at Fruita CO, 2002

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Summary

Several research projects regarding the biology and management of onion thrips were conducted at the Western Colorado Research Center at Fruita during 2002. Thirty onion varieties were evaluated to determine their relative tolerance to thrips feeding. The results were variable, but in general supported 2001 results in which the greatest tolerance was found in the most vigorous growing full Spanish varieties. Surveys of flowering plants in the vicinity of Fruita showed that only whitetop supported onion thrips populations early in the season. Thrips populations appeared in onions in early June, and peaked at about 600 per plant in mid July before collapsing to less than ten per plant in early August. Predators such as minute pirate bugs and lady beetles were responsible in part for the population collapse. Western flower thrips constituted about 10% of adult thrips in the onions until nearby alfalfa was cut, at which time the proportion increased to 33%. Spray schedules in insecticide trials consisted of two sprays, five days apart, followed by furrow irrigation. Lannate LV and Vydate L, either alone or in combination with other insecticides reduced onion thrips numbers in both trials conducted. Differences in performance were noted when comparing Colorado Front Range and West Slope insecticide trial results.

Introduction and Objectives

Onion thrips (OT), *Thrips tabaci* Lindeman, is a major pest of onion production in western Colorado. Resistance to pyrethroid insecticides developed during the late 1990's, and control has been a challenge to producers since that time. Growers need non-chemical techniques to add to an integrated management program. This report describes research conducted at the Western Colorado Research Center at Fruita during 2002 to address several aspects of thrips management in onions. The objectives of this work were:

1) Identify early season non-crop host plants of onion thrips.
2) Monitor population trends of thrips in onions.
3) Evaluate insecticides and timing schedules for effectiveness against onion thrips.
4) Evaluate onion varieties for tolerance to thrips feeding.

Early Season Non-Crop Host Plants of Onion Thrips

Flowering weeds in the vicinity of Fruita were collected in April and May 2002, and insects extracted in Berlese funnels. Specimens of adult thrips were mounted on microscope slides and identified under a compound microscope. Identification was based on taxonomic keys in either Mound & Kibby (1998), or Stannard (1968).

Plant species sampled during 2002 are listed in Table 1. Western flower thrips (WFT), *Frankliniella occidentalis* (Pergande), were found on all plants sampled. Thrips other than OT and WFT were not identified, but were present on several plant species. Onion thrips were found in all collections of whitetop, but not in any other plant collection.

Table 1. Plant species sampled for thrips during 2002.

Common Name	Plant Family	Botanical Name
Russian knapweed	Asteraceae	*Centaurea repens* L.
Hairy golden aster	Asteraceae	*Heterotheca villosa* Pursh.
Dandelion	Asteraceae	*Taraxacum officinale* Weber
Whitetop	Brassicaceae	*Cardaria draba* (L.) Desv.
Field bindweed	Convolvulaceae	*Convolvulus arvensis* L
Alfalfa	Fabaceae	*Medicago sativa* L.
Utah sweet vetch	Fabaceae	*Hedysarum boreale* Nutt.
Yellow sweet clover	Fabaceae	*Metilotus officinalis* (L.) Lam.
Iris	Iridaceae	*Iris* sp.
Four o'clock	Nyctaginaceae	*Mirabalis multiflora* (Torr.)
Peony	Ranunculaceae	*Paeonia* sp.
Apricot	Rosaceae	*Prunus*
Peach	Rosaceae	*Prunus* L.

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Population Trend of Thrips in Onions

Twenty onion plants (cv 'Gladstone') were collected from unsprayed plots at Fruita on a weekly basis beginning mid May and continuing though early September. Thrips were sorted into mature and immature classifications, and the mature thrips were further separated by species (OT or WFT). The results from that sampling are presented in Figure 1.

Onion thrips appeared in the field in late May, well before bulbing was initiated. Populations increased rapidly, until there were almost 600 thrips per plant in mid July, at early bulb growth stage. Thrips populations then fell to near zero in the next three weeks. The population reduction was largely due to predation by several insects. Minute pirate bugs, lady beetles, lacewings, predatory mites, and other beneficial insects were present in the field. Predation in the research plots was very great due to the small field size (~1 acre) and the presence of unsprayed alfalfa or sweet corn on either side of the field. Predators built up on aphids and mites in the adjacent crops, and moved as the alfalfa was cut and the sweet corn matured. The data shows that predators can effectively reduce thrips populations in some circumstances.

Early season sampling showed that 90% of adult thrips in the field were OT, with the remainder being WFT. The second cutting of adjacent alfalfa, which was heavily infested with WFT was taken on July 2, and the percentage of WFT increased to 33.4% in a sample taken one week later. It is unknown if WFT reproduce in onion fields. Immature thrips are extremely difficult to identify, so no attempt made to do so in this project. The alfalfa cutting was taken within one week of the

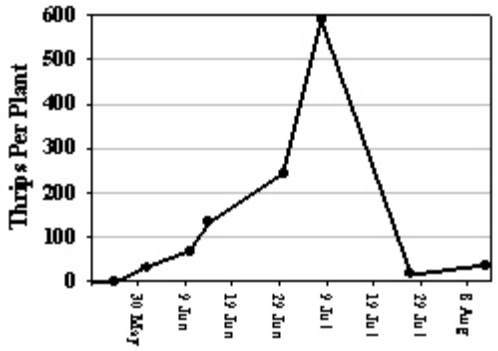

Figure 1. Onion thrips population during the 2002 growing season in unsprayed plots at Fruita CO. Data points are average number of thrips per plant, in 20 plant sample.

thrips population peak, so it is apparent that the influx of adult thrips from alfalfa played no more than a minor role in the overall thrips population trend.

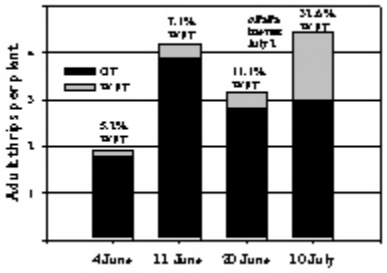

Figure 2. Species composition of adult thrips in onions on four sample dates at Fruita. The percentage of WFT increased after alfalfa harvest.

Chemical Control

Two insecticide trials were conducted in 'Teton' onions at Fruita in 2002. Sprays in both trials were applied with a hand held CO_2 pressured sprayer calibrated to apply 18 gal/acre of material. Plots were 7.5 ft (three 30" beds, with two seed rows per bed) by 25 ft, arranged in a randomized complete block design with four replications. All data was subjected to analysis of variance and means separated with LSD (P=0.05).

Trial # 1

This experiment was designed to evaluate onion thrips control using currently labeled insecticides and combinations. Non-ionic surfactant (Activator 90, Loveland Industries) was added to all materials at a concentration of 1% by volume. Insecticides were applied four times (June 19 and 24, July 9 and 12). The field was furrow irrigated immediately after the second and fourth sprays. Plots were sampled twice, after the field had dried following the two irrigations. Three plants were randomly chosen from the center of each plot, and thrips extracted in Berlese funnels for 24 hours. Thrips were separated by growth stage (adult and immature) in the counting process.

Trial # 2

This trial evaluated both labeled insecticide combinations and unlabeled materials. Methods were the same as used in trial #1, with the exception of the first sample. Insecticides were applied on July 8 and again on July 12. Crop oil (Clean Crop 83% A.I. Paraffin Base Petroleum Oil) was added to Lannate, Vydate, and Penncap-M treatments and combinations The plots were sampled on July 15 (3 DAT) by counting the thrips in the field on three plants from the center of each plot. A second sample was taken on July 18, using the same methods as in trial # 1. Count data from the July 18 sample was $(X + 0.5)^{1/2}$ transformed before statistical analysis.

Results

Lannate LV and Vydate L reduced thrips numbers in both trials, either alone or in combination with other insecticides. Both of these are carbamate insecticides. The two pyrethroid insecticides tested, Warrior ZT and Bathroid 2, were not effective in reducing thrips numbers. The addition of sulfur did not increase the efficacy of any insecticide.

The results of these trials are different than those of eastern Colorado trials at Fort Collins and Rocky Ford in which different formulations of Warrior are still effective against onion thrips, and Lannate LV is relatively ineffective. Figure 2 shows the average control from insecticide trials on the Front Range (7 Warrior, 2 Lannate trials) and West Slope (5 trials each insecticide). The differences in efficacy are the result of resistance acquired by thrips from past exposure to insecticides.

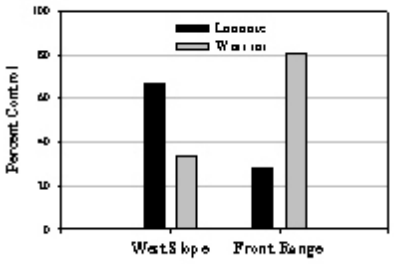

Figure 3. Onion thrips control comparison of eastern and western Colorado insecticide trials. The data is the average of multiple trials in each location.

Efficacy of insecticides in the 2002 Fruita trials may have been increased by the 2 spray schedule. Thrips hatch from

eggs and then spend two larval stages feeding actively on leaves before spending two quiescent stages in the soil. At summertime temperatures, the active and quiescent stages can last five days to a week. By applying two sprays, five days apart, most immature thrips will be exposed to insecticide residue.

Table 2. Results from insecticide trial #1.

Treatment	Rate	Thrips per plant					
		July 2			July 17		
	lb a.i./A	Adult	Immature	Total	Adult	Immature	Total
Lannate LV	0.6	10.4	23.2a	33.6a	16.8a	22.3ab	39.0ab
Lannate LV + Sulfur	0.6 + 1.5	6.3	28.4ab	3.48a	13.5a	35.3ab	48.8ab
Vydate L	1.0	6.8	29.1ab	35.8a	10.0a	24.3ab	34.3a
Vydate L	0.5	5.2	34.9ab	40.1a	12.3a	22.3ab	34.5a
Vydate L + Sulfur	0.5 + 1.5	4.3	39.8abcd	44.1a	20.8ab	52.3abc	73.0abc
Warrior ZT + Lannate LV	0.03 +0.6	5.8	43.2abcd	49.0 ab	10.8a	18.3a	29.0a
Warrior ZT	0.03	4.4	54.0bcd	58.4ab	28.0abc	193.5d	221.5d
Sulfur	1.5	4.1	55.6cd	59.7ab	24.3ab	147.5cd	171.8cd
Warrior ZT + Sulfur	0.03 + 1.5	7.8	67.2cde	74.9bc	28.8abc	167.5d	196.3d
Actara	0.0625	5.3	68.7de	74.0bc	39.3bc	97.0abcd	136.3abcd
Warrior ZT + Actara	0.03 + 0.0625	8.1	85.9e	94.0c	47.8c	148.8cd	196.5d
Untreated		4.2	54.8bcd	59.0ab	26.5ab	12.08bcd	147.3bcd

Means within a column followed by the same letter are not significantly different (P=0.05).

Table 3. Results from insecticide trial # 3.

Treatment	Rate	Thrips per plant			
	lb a.i./A	15 July	18 July		
		Total	Adult	Immature	Total
Lannate LV	0.9	14.2 a	17.8	60.3 ab	78.0 a
Lannate LV + Penncap-M	0.6 + 0.5	14.6 a	25.8	45.3 a	71.0 a
Vydate L + Penncap-M	0.5 + 0.5	21.2 a	24.5	80.3 abc	104.8 ab
Penncap-M	0.5	76.7 b	31.8	217.0 bcd	248.8 bc
Provado 1.6 P	0.11	94.6 b	28.3	168.5 abcd	196.8 abc
Bathroid 2	0.04	124.2 cd	24.3	239.8 cd	264.0 c
Leverage 2.7 SE	0.063	137.1 d	32.3	274.0 d	306.3 c
Untreated		101.7 bc	28.3	266.0 d	294.3 c

Means within a column followed by the same letter are not significantly different (P=0.05).

Onion Variety Tolerance to Thrips Feeding

Twenty onion varieties were evaluated in 2001, and 30 in 2002, for tolerance to onion thrips feeding. Varieties were seeded in late March at Fruita. Plots were arranged in a randomized complete block, split plot design with four replications. Varieties were arranged as main plot and insecticide treatment as subplots. Insecticide (Vydate L, 4 pt/A, three applications) was applied to one subplot and the other was left untreated. The plant stand varied considerable with variety, and the percent stand was estimated for each plot before they were undercut. Onions were undercut on September 15 of each year and left to cure for one week before plot weights recorded. The onions in each plot were sorted into five size classes and the number of bulbs in each counted before weighing. Plot weight was adjusted for stand using stand estimates before analysis of variance.

Variety descriptions, yield, and bulb size distribution is displayed in Table 4. In general the long season full Spanish varieties had the greatest yield and percentage of jumbo and colossal onions. The hard globe and export types had the lowest yield and smallest bulb size. Yield of unsprayed plots was 6.5% lower than that of sprayed plots in 2002. The difference was 10% in 2001.

Economic yield was calculated using market prices (Medium - $8.25/CWT; Jumbo - $10.00/CWT; Colossal - $12.00/CWT). The economic return for each variety in treated and untreated plots is displayed in Figure 4. The difference (treated – untreated) in economic return between treatments is displayed in the lower graphs. Those varieties with positive economic return from insecticide treatments can be considered susceptible to onion thrips feeding. Those with negative or near zero economic return are possibly tolerant to thrips feeding, and are candidates for further testing. The response of varieties varied between years, but in general, full Spanish varieties showed the greatest tolerance to thrips feeding. These varieties had the most vigorous growth of any of the market types. Further testing of onion varieties is needed before thrips resistance characteristics can be fully understood.

Conclusions and Recommendations

- Early season flowering weeds, especially whitetop, may provide a source of onion thrips for infesting of fields. Controlling these weeds may delay initial infestation.

- The harvest or senescence of surrounding crops, especially alfalfa, can contribute significant numbers of western flower thrips to onion fields. The role of western flower thrips in damaging onions is unknown.

- Natural enemies can be very effective in reducing thrips numbers in onions. Control by natural enemies may not occur until thrips have reached damaging levels.

- There is considerably geographic variation in the response of onion thrips to insecticides. Growers should be aware of which insecticides are effective in their region. Thrips management should not rely exclusively on chemical methods.

- In general, onion varieties with vigorous growth characteristics can produce acceptable yield even with thrips feeding damage. Full Spanish type onions show the greatest tolerance to thrips feeding, although there is quite a bit of variation in their response to insecticide treatments.

Table 4. Varietal description, yield and bulb size distribution from Fruita variety tolerance study, 2002.

Variety	Source	Days	Type	MKT yield CWT/A		% Pre Pack		% Medium		% Jumbo		% Colossal	
Mesquite	Palmer	120	Full Spanish	679.2	A	2.2	IJ	23.6	LM	66.0	A	1.6	CDE
Xph01N03	Crookham	122	Full Spanish	654.4	A	3.5	GHIJ	23.2	LM	64.7	A	0.0	E
Tequilla	Palmer	113	Full Spanish	648.1	A	1.0	J	21.9	M	67.7	A	0.4	DE
Super Chief	Seminis	115	Full Spanish	576.0	AB	2.8	HIJ	27.6	KLM	65.4	A	0.0	E
Sweet Perfection	Crookham	125	Full Spanish	518.3	BC	2.0	J	27.4	KLM	69.3	A	0.0	E
Tioga	Seminis	115	Spanish Storage	514.9	BC	2.0	J	28.9	KLM	68.8	A	0.0	E
Raptor	Seedworks	118	Full Spanish	508.0	BC	3.6	GHIJ	31.0	JKLM	64.8	A	0.0	E
DPSX1171	Palmer	116	Full Spanish	495.9	BCD	4.6	GHIJ	32.2	JKLM	58.5	AB	1.3	CDE
Xph95345	Crookham	115	Spanish Storage	472.5	BCD	2.6	HIJ	31.9	JKLM	64.5	A	0.0	E
DPSX1172	Palmer	116	Full Spanish	454.5	CDE	10.0	EFGHI	40.0	HIJK	48.6	BCD	1.5	CDE
Kingfisher	Seminis	117	Spanish Storage	446.2	CDE	3.1	HIJ	36.1	IJKL	59.2	AB	0.0	E
T-439	American Takii	107	Full Spanish	427.9	CDE	4.7	GHIJ	46.0	GHI	48.7	BCD	4.3	BCD
Eagle	American Takii	117	Spanish Storage	387.4	DEF	8.2	FGHIJ	53.3	DEFGH	36.9	DEF	8.2	AB
Varsity	Seedworks	105	Spanish Storage	349.4	EFG	8.0	FGHIJ	56.1	DEFG	35.9	DEF	0.0	E
Delgado	Bejo	125	Spanish Storage	347.6	EFG	10.3	EFGH	56.9	CDEFG	32.8	EFGH	0.0	E
Kodiak	Palmer	112	Spanish storage x hard globe	345.1	EFG	7.0	FGHIJ	34.9	IJKLM	58.0	AB	1.0	CDE
Expression	Bejo	98	Intermediate	302.4	FGH	10.3	EFGH	52.3	DEFGH	37.4	DEF	0.0	E
DPS1169	Palmer	92	Hard Globe	294.6	FGHI	7.5	FGHIJ	48.2	FGHI	44.3	CDE	0.6	CDE
Daytona	Bejo	120	Spanish Storage	293.8	FGHI	5.1	GHIJ	43.9	GHIJ	51.0	BC	0.0	E
Legend	Bejo	125	Spanish Storage	282.1	FGHI	17.1	DE	60.8	BCDEF	22.1	GHIJ	0.0	E
Prince	Bejo	105	Export	274.2	GHI	11.1	EFG	81.9	A	6.9	LM	0.0	E
Seahawk	Seminis	115	Spanish Storage	272.8	GHI	13.3	DEF	51.4	EFGH	34.7	EFG	0.6	CDE
Tamara	Bejo	115	Export	251.6	GHIJ	13.6	DEF	65.3	BCD	21.1	HIJK	0.0	E
T-441	American Takii	107	Hard Globe	221.2	HIJK	17.2	DE	72.7	AB	10.0	JKLM	8.6	A
Husky	Palmer	90	Hard Globe	188.5	IJKL	20.3	CD	63.9	BCDE	15.7	IJKL	0.3	DE
BGS-142	Bejo	105	Export	187.8	IJKL	8.2	FGHIJ	63.3	BCDE	28.5	FGHI	0.0	E
DPSX 1170	Palmer	112	Spanish storage x hard globe	155.1	JKL	30.5	AB	60.9	BCDEF	8.5	KLM	4.7	ABC
Gallatin	Bejo	95	Intermediate	140.2	KL	27.1	BC	65.2	BCD	7.7	LM	0.0	E
T-418	American Takii	97	Export	131.0	KL	29.5	AB	69.5	ABC	0.9	M	1.3	CDE
Frontier	American Takii	97	Export	105.1	L	37.1	A	62.9	BCDE	0.0	M	8.6	A
			P-value	<0.0001		<0.0001		<0.0001		<0.0001		<0.0001	
			LSD (*P*=0.05)	110.7		7.9		13.3		13.3		4.2	

Means within a column followed by the same letter are not significantly different (LSD; *P*=0.05).

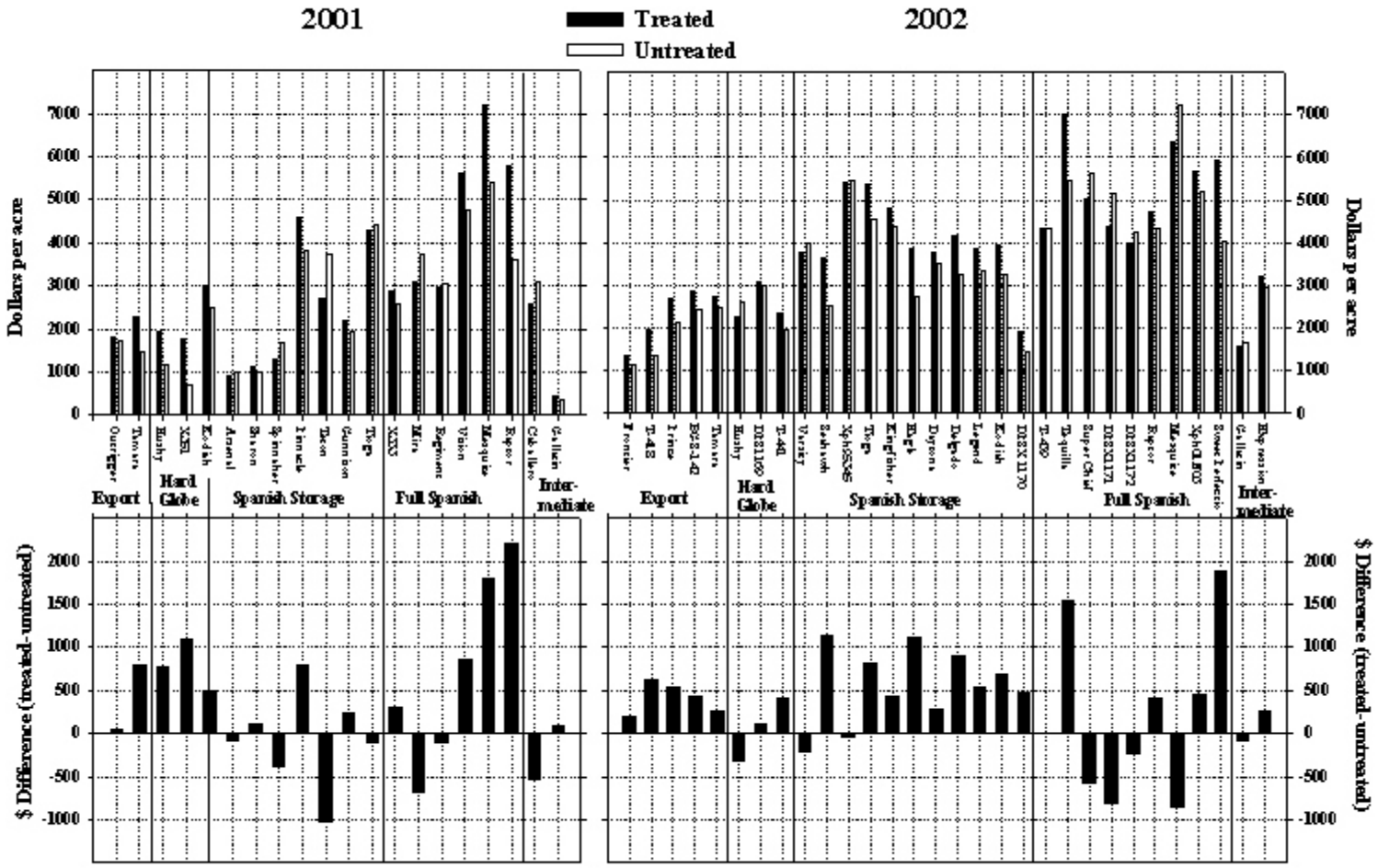

Figure 4. Economic yield of insecticide treated and untreated variety plots in 2001 and 2002 (upper graphs). Response to insecticides for those varieties is displayed in lower graphs. Varieties with zero or negative response in lower graphs are potentially tolerant to thrips feeding. Economics were calculated using $8.25/CWT for medium, $10.00/CWT for jumbo and $12.00/CWT for colossal.

References Cited

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