INSECTICIDE ROTATIONS FOR CONTROL OF THRIPS IN ONIONS, 2011

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Introduction

Onion thrips and the virus that these thrips transmit are major production factors in the Treasure Valley. There are about 20,000 acres of onion produced within a 50-mile radius of Ontario, Oregon. The high concentration of onions makes for unique production challenges, especially thrips control and iris yellow spot virus transmission. Most of the thrips population is comprised of parthenogenic (asexually reproducing) females. Asexual reproduction along with a short generation time (3–4 weeks) can lead to rapid development of resistance to insecticides. Rotation of insecticides is a key to delay thrips development of resistance to insecticides. This trial seeks to determine the most effective strategies to maintain yield and quality while rotating insecticides with different modes of action.

In 2009 and 2010, starting applications with Mustang® (synthetic pyrethroid), Lannate®, or Cyazypyr™ resulted in earlier thrips population peaks and poor thrips control. The results suggest that two Movento® applications, followed by two Radiant® applications, followed by Lannate resulted in higher colossal yields and better thrips control in 2009, and better thrips control in 2010. A hypothesis is that by starting with higher selectivity insecticides, populations of natural enemies of thrips (beneficials) are allowed to increase, providing better control than with broad-spectrum insecticides.

Since Carzol® is unlikely to receive a registration, other products with a higher likelihood of getting labeled were included. These were Agri-Mek® (currently labeled in Washington, Colorado, and New York under a Section 18) and DuPont's new product Cyazypyr (not currently labeled). This project examined the timing and rotation sequence of labeled insecticides, plus insecticides that may be labeled in the next few years.

The treatments tested insecticide application sequences and compared their effectiveness to provide season-long control of thrips and onion bulb yield and grade. **Not all insecticides referred to in this report are registered for use on onions. Always obtain and read the insecticide label to ensure that the product is currently registered for the crop for which it is intended.**

Methods

In 2011, onions were grown on an Owyhee silt loam previously planted to wheat. In the fall of 2010, the wheat stubble was shredded and the field was irrigated and disked. The field was then moldboard-plowed, groundhogged, roller-harrowed, and bedded at 22 inches.

The wet and cold spring of 2011 delayed planting. Seed of onion variety 'Vaquero' (Nunhems, Parma, ID) was planted on April 7, 2011. The seed was planted in double rows spaced 3 inches apart at 9 seeds/ft of single row. Each double row was planted on beds spaced 22 inches apart. Planting was done with customized John Deere Flexi Planter units equipped with disc openers. Onions were grown under furrow irrigation due to instructions by the Malheur County Onion Growers, but a drip irrigation system was used to germinate the onions. Drip tape with emitters spaced 12 inches apart and emitter flow rate of 0.22 gal/min/100 ft (T-tape, T-systems International, San Diego, CA) was laid at 4-inch depth between 2 onion beds at the same time as planting. The distance between the tape and the center of each bed was 11 inches. The water application rate was 0.06 inch per hour. Immediately after planting, the onions received a narrow band of Lorsban 15G® at 3.7 oz/1,000 ft of row (0.82 lb ai/acre), and the soil surface was rolled.

Onion emergence started on April 26. On June 9, alleys 3 ft wide were cut between plots, leaving plots 27 ft long. The drip tape was removed on June 9. On June 10, the seedlings were hand thinned to a plant population of 2 plants/ft of single row (6-inch spacing between individual onion plants, or 95,000 plants/acre). After thinning, the furrows between onion rows were cultivated to allow for furrow irrigation.

The field was divided into plots 4 double rows wide by 27 ft long. The experimental design was a randomized complete block with four replicates. There were 12 treatments (Table 1) that were combinations of 8 insecticides (Table 2) applied at different rotation sequences. Both the untreated check treatment and the first intended insecticide applications (not presented in this report) were omitted on the instructions of a third party. The insecticides had different modes of action and selectivity to target pests. Each treatment was applied weekly on Tuesdays starting on June 14 and ending on July 26, totaling 7 applications. The treatments were applied using a CO_2-pressurized backpack sprayer delivering 35 gal/acre. Insecticide application rates and adjuvants are listed in Table 3.

Table 1. Insecticide rotation sequence treatments tested for efficacy against onion thrips. Malheur Experiment Station, Oregon State University, Ontario, OR, 2011.

Treatment number	Application sequence						
	14-Jun	21-Jun	28-Jun	5-Jul	12-Jul	19-Jul	26-Jul
1	Lannate + Cyazypyr	Movento	Movento	Radiant	Radiant	Lannate	Lannate
2	Movento	Lannate	Lannate	Radiant	Radiant	Lannate	Lannate
3	Lannate	Cyazypyr	Cyazypyr	Movento	Movento	Lannate	Lannate
4	Movento	Movento	Radiant	Radiant	Lannate	Lannate	Lannate
5	M-Pede	M-Pede	Movento	Movento	Radiant	Radiant	Carzol
6	Aza-direct + M-Pede	Aza-direct + M-Pede	Movento	Movento	Radiant	Radiant	Carzol
7	Movento + M-Pede	Movento + M-Pede	Radiant	Radiant	Carzol	Lannate	Lannate
8	Radiant + M-Pede	Radiant + M-Pede	Movento	Radiant	Radiant	Lannate	Lannate
9	Agri-Mek	Movento	Movento	Radiant	Radiant	Lannate	Lannate
10	Movento	Movento	Agri-Mek	Agri-Mek	Radiant	Radiant	Lannate
11	Radiant	Movento	Movento	Lannate	Lannate	Carzol	Lannate
12	Movento	Radiant	Radiant	Lannate	Lannate	Carzol	Lannate

Table 2. Characteristics of insecticides tested in 12 treatments for efficacy against onion thrips. Malheur Experiment Station, Oregon State University, Ontario, OR, 2011.

Trade name	Common name	Mode of action**
Agri-Mek	abamectin	6
Aza-Direct*	azadirachtin	unknown
Carzol	formetanate	1A
Cyazypyr	cyantraniliprole	28
Lannate	methomyl	1A
M-Pede*	potassium salts of fatty acids	unknown
Movento	spirotetramat	23
Radiant	spinetoram	5

*OMRI listed

**Insecticide Resistance Action Committee (www.irac-online.org)

Table 3. Insecticide application rates and adjuvants. Malheur Experiment Station, Oregon State University, Ontario, OR, 2011.

	Rate		
Trade name	product/acre	lb ai/acre	Adjuvants
Agri-Mek	10 fl oz	0.01	Ballast 1.5 fl oz/100 gal, Preference 0.25% v/v
Aza-Direct	12 fl oz	0.01	
Carzol	1.25 lb	1.15	Ballast 1.5 - 2 fl oz/100 gal
Cyazypyr	13.5 fl oz	0.09	Ballast 1.5 - 2 fl oz/100 gal, MSO Destiny 2.8 pt/acre
Lannate	3 pt	0.90	Preference 0.25% v/v
M-Pede	5.6 pt	2.94	
Movento	5 fl oz	0.08	Ballast 1.5 - 2 fl oz/100 gal, MSO Destiny 2.8 pt/acre
Radiant	8 fl oz	0.06	Dyne-Amic 0.7 pt/acre

Thrips counts were taken weekly on Mondays starting May 24 and ending August 15. Thrips counts were made by counting the total number of thrips in 15 consecutive plants in 1of the middle 2 rows in each plot.

The onions were managed to minimize yield reductions from weeds, pests, diseases, water stress, and nutrient deficiencies. On May 13, Prowl H_2O ® at 0.95 lb ai/acre was applied for weed control. On May 31, Goal® at 0.16 lb ai/acre, Buctril® at 0.19 lb ai/acre, and Volunteer® at 0.25 lb ai/acre were applied for weed control. Root tissue samples were taken on June 21, July 8, and July 22. Based on the tissue analysis, nitrogen (N) was applied as water-run urea on June 3 at 50 lb N/acre, June 10 at 50 lb N/acre, July 1 at 30 lb N/acre, July 19 at 40 lb N/acre, and August 2 at 20 lb N/acre. On July 19, 5 lb magnesium/acre and 0.2 lb boron/acre were also water-run.

The trial was furrow irrigated when the soil water tension at 8-inch depth reached 25 cb (1 cb = 1 kPa). Starting in mid-June, soil water tension was monitored by six granular matrix sensors (GMS, Watermark Soil Moisture Sensors Model 200SS, Irrometer Co. Inc., Riverside, CA) centered at 8-inch depth below the onion row. The sensors were automatically read three times a day with an AM-400 meter (Mike Hansen Co., East Wenatchee, WA). The last irrigation was on August 29.

The onions were lifted on September 13 to field cure. Onions from the middle two rows in each plot of the full-season trial were topped by hand and bagged on September 14. The bags were put in storage on September 24. The storage shed was ventilated and the temperature was slowly decreased to maintain air temperature as close to 34°F as possible. Onions were graded out of storage on October 6 and 7.

During grading, bulbs were separated according to quality: bulbs without blemishes (No. 1s), split bulbs (No. 2s), neck rot (bulbs infected with the fungus *Botrytis allii* in the neck or side), plate rot (bulbs infected with the fungus *Fusarium oxysporum*), and black mold (bulbs infected with the fungus *Aspergillus niger*). The No. 1 bulbs were graded according to diameter: small (<2¼ inches), medium (2¼ - 3 inches), jumbo (3 - 4 inches), colossal (4 - 4¼ inches), and super colossal (>4¼ inches). Bulb counts per 50 lb of super colossal onions were determined for each plot of every variety by weighing and counting all super colossal bulbs during grading. Marketable yield consists of No.1 bulbs larger than 2¼ inches.

Treatment differences were compared using analysis of variance. Means separation was determined using a protected Fisher's least significant difference test at the 5 percent probability level, LSD (0.05). The least significant difference LSD (0.05) values in each table should be considered when comparisons are made between treatments for significant differences in performance characteristics. Differences between treatments equal to or greater than the LSD value for a characteristic should exist before any treatment is considered different from any other treatment in that characteristic.

Results

Insecticide applications were begun June 14, after thrips populations exceeded 1 per plant on June 13. Growers should monitor thrips populations and should expect to need to start thrips control earlier than mid-June; 2011 was a cool, late year. Averaged over treatments, the thrips population reached a peak at the July 5 count (Table 4). Treatments 2, 6, and 8 were among the treatments with the lowest average number of thrips per plant at the July 5 count and for the season average (Fig. 1). Treatment 11 had the highest average number of thrips per plant at the July 5 count and for the season average.

There was no significant difference between treatments in total yield and marketable yield (Table 5). Treatments 2, 3, and 6 were among the treatments with the highest super colossal yield (Table 5). Treatments 2, 5, and 6 were among the treatments with the highest colossal plus super colossal yield.

Among treatments, total yield and super colossal yield decreased with increasing average number of thrips per plant (Figs. 2 and 3), demonstrating the importance of thrips control for onion bulb production. For each additional average seasonal thrips count, total yields decreased by1,010 lb/acre and super colossal yield decreased by 265 lb/acre.

Table 4. Average number of thrips per onion plant by sampling date in response to 12 insecticide treatments. Malheur Experiment Station, Oregon State University, Ontario, OR, 2011.

Treatment	24-May	31-May	3-Jun	6-Jun	13-Jun	20-Jun	27-Jun	5-Jul	11-Jul	18-Jul	25-Jul	1-Aug	8-Aug	15-Aug	Avg.
1	0.0	0.7	0.5	0.6	3.8	3.8	13.6	45.7	33.6	8.3	7.4	2.6	5.6	8.1	9.6
2	0.0	0.5	0.6	0.7	4.4	5.1	10.9	8.0	6.1	1.9	3.8	2.2	5.4	8.3	4.1
3	0.0	0.4	0.3	0.5	4.1	5.5	6.8	14.1	26.4	11.4	11.4	11.0	11.8	8.2	8.0
4	0.1	0.4	0.4	0.6	3.3	3.6	11.2	31.4	8.5	11.0	15.0	6.5	11.2	8.7	8.0
5	0.0	0.5	0.4	0.7	3.1	6.6	20.4	40.0	15.4	8.6	5.1	2.1	7.8	11.3	8.7
6	0.1	0.6	0.3	0.8	4.1	5.4	7.0	5.7	4.0	3.6	5.4	3.1	11.7	12.7	4.6
7	0.0	0.4	0.4	0.7	3.7	4.6	13.6	17.2	10.3	12.9	8.0	5.0	12.0	8.4	7.0
8	0.0	0.5	0.5	0.7	4.0	3.6	7.0	6.2	4.9	5.8	5.9	2.7	7.7	5.4	3.9
9	0.0	0.4	0.4	0.6	2.9	6.4	10.6	27.9	24.0	15.0	19.5	7.4	10.1	8.8	9.6
10	0.0	0.6	0.5	0.7	3.4	5.0	20.2	41.7	26.0	6.5	4.8	2.0	5.8	9.1	9.0
11	0.1	0.6	0.3	0.5	3.5	3.5	15.7	55.9	37.2	11.2	8.8	6.1	9.4	13.9	11.9
12	0.1	0.6	0.5	0.6	2.9	5.3	17.2	19.0	11.7	19.8	9.5	8.1	11.0	10.1	8.3
Average	0.0	0.5	0.4	0.6	3.6	4.9	12.8	26.1	17.3	9.7	8.7	4.9	9.1	9.4	7.7
LSD (0.05)	NS	NS	NS	NS	NS	1.5	3.6	7.7	8.4	6.5	3.9	3.6	3.8	NS	1.4

Table 5. Onion yield in response to 12 insecticide rotation treatments. Malheur Experiment Station, Oregon State University, Ontario, OR, 2011.

Treatment	Total yield	Marketable yield by grade						Small	Bulb counts >4¼ in
		Total	>4 in	>4¼ in	4-4¼ in	3-4 in	2¼-3 in		
	----------------------------- cwt/acre -----------------------------								#/50 lb
1	1032.9	1024.8	314.7	18.9	295.8	693.3	16.8	8.1	33.1
2	1046.4	1040.3	395.7	40.9	354.8	629.2	15.4	6.1	39.6
3	984.3	979.6	386.0	38.7	347.3	580.1	13.5	4.8	33.6
4	1002.7	997.5	275.9	17.5	258.4	700.5	21.2	5.1	31.8
5	1034.9	1028.6	411.9	38.1	374.5	604.5	11.5	6.3	33.6
6	1139.1	1134.0	484.6	53.2	431.4	640.6	8.8	5.0	36.0
7	1011.6	1005.4	370.6	36.4	334.2	616.8	18.1	6.2	34.4
8	1064.2	1057.9	337.0	31.4	305.6	705.7	15.2	6.4	34.6
9	1045.1	1037.2	257.4	17.1	240.3	758.6	21.2	7.9	36.1
10	1005.3	1001.0	378.7	32.2	346.5	609.9	12.4	4.8	31.7
11	997.6	994.3	301.8	26.0	275.8	677.3	15.1	3.3	33.5
12	1043.8	1040.3	351.8	32.1	319.7	677.2	11.3	3.4	36.0
LSD (0.10)	NS	NS	113.4	18.4	NS	NS	NS	NS	NS

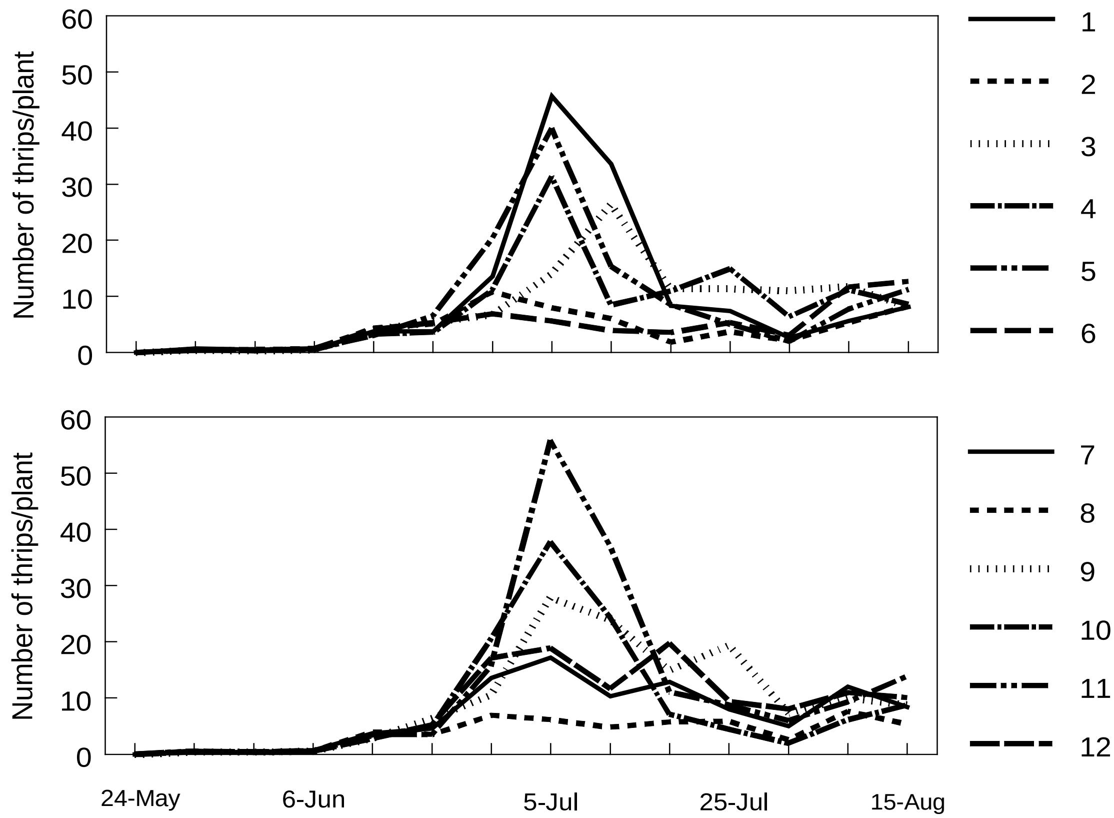

Figure 1. Average number of thrips per onion plant over time for 12 insecticide rotation treatments (Table 1). Malheur Experiment Station, Oregon State University, Ontario, OR. The weekly control treatments started on June 14, 2011.

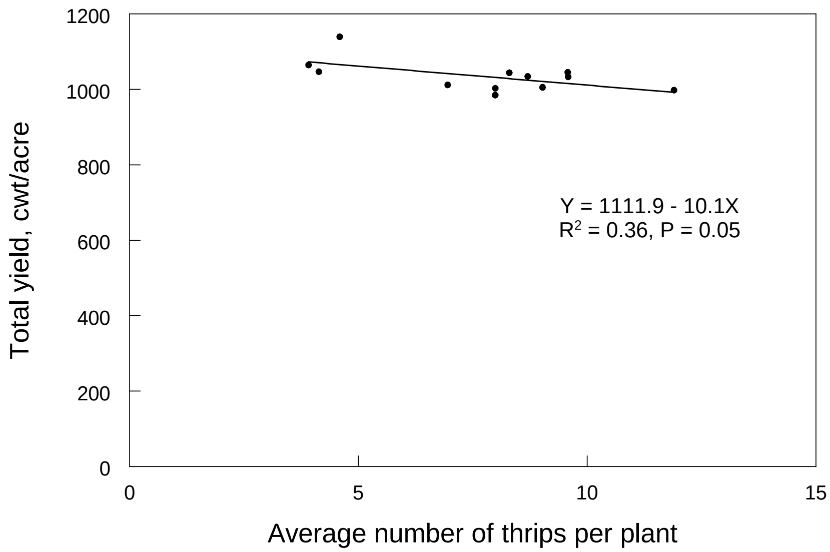

Figure 2. Relationship between average number of thrips per onion plant (x) and total yield (y in cwt/acre) for 12 insecticide rotation treatments. Malheur Experiment Station, Oregon State University, Ontario, OR.

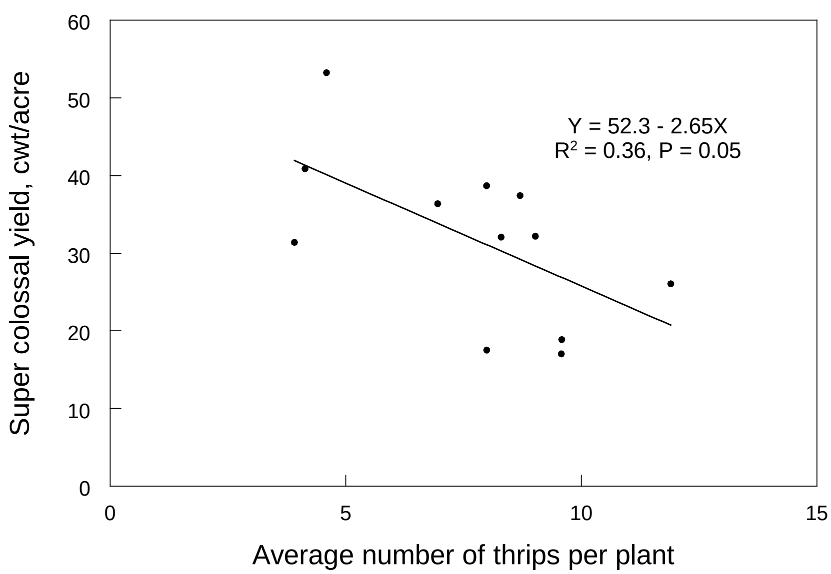

Figure 3. Relationship between average number of thrips per onion plant (x) and super colossal yield (y in cwt/acre) for 12 insecticide rotation treatments. Malheur Experiment Station, Oregon State University, Ontario, OR.