Western IPM Center

Project Report Form

How to submit: Please submit this completed form electronically, as an attached Microsoft Word file, to Frank Zalom at fgzalom@ucdavis.edu. **Content:** Complete each section below, and include responses to as many of the questions listed in Attachment A as are relevant to your project. *These are guidelines.* Provide your readers with enough detail that someone who is not familiar with your project can understand what you were trying to achieve, how you went about it, and what you accomplished, but please keep it concise.

A. Report Data

Date: October 13, 2009
Reporting Period: 2007-2008
Report Type (please check one):
☐ Progress Report ☒ Final Report

B. Grant Data

- Grant Agreement #: COLO-2007-04128 & COLO-2007-03625

Title: Cultivar Resistance to IYSV and Thrips in Bulb Onion in the Western United States

- Grant Type: R/E
- Lead investigator:
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- Team members (name, title, institution): Whitney S. Cranshaw , Professor Entomology & Extension Specialist, Colorado State University; Michael E. Bartolo, Senior Research Scientist,Arkansas Valley Research Center - CSU
- State(s) involved: Colorado

C. Nontechnical Summary. An overview of the project, briefly outlining the problem(s), how your project addresses them, and your results, *written to a lay audience.* (500 words)

Iris yellow spot virus (IYSV) and its onion thrips (Thrips tabaci) vector are immediate and serious threats to sustainable and profitable onion production in the western U.S. Onion growers in the western U.S. currently rely exclusively on high-risk insecticides for thrips management, the use of which has increased with a resultant widespread increase in insecticide resistance in thrips populations. The literature is devoid of IYSV management studies, and in the absence of sound management strategies growers have implemented more intensive thrips insecticide programs, with little effective reduction in IYSV incidence or severity. Identification of thrips damage tolerance levels has never been conducted among existent onion cultivars. However, optimizing onion cultivar tolerance to thrips feeding injury could be critical to long-term management of onion thrips; especially if combined with resistance to IYSV. It is suggested that a dedicated effort be made to exploit this tolerance mechanism by screening a collection of onion cultivars for relative tolerance to thrips feeding. With this information, existing onion cultivars can be categorized for relative risk of yield loss from onion thrips infestation.

D. Objectives and Progress. List your objectives and describe your progress for each objective.

The overall goal of this study was to accelerate the identification and establishment of host plant resistance in management of thrips and IYSV in onions. The specific objectives were to: I. Develop methods to identify onion cultivars that have resistance to thrips and to establish the nature of this resistance (e.g., tolerance, antixenosis); II. Develop methods to identify onion cultivars that have resistance to Iris yellow spot virus; and III. Disseminate this information to breeders who can then incorporate resistance to thrips and IYSV into breeding lines, and to growers for selection of less susceptible cultivars.

Progress for Objective:
I & II. Ranking of onion varietal responses to IYSV and Thrips pressure under field conditions with varying pest pressure in Colorado revealed that entries such as 'Colorado 6' and 'OLYSOS5N5' were less affected by thrips and disease than most of the other replicated entries at 2 locations during 2008 and 2007. The evaluation design verified that screening nurseries planted in fields with a history of problems from onion thrips and IYSV could provide moderate to severe pest and disease pressure to enable the identification of less susceptible onion entries (varieties or germplasm).
III. Varietal information on less susceptible materials has been shared with onion breeders and IPM personnel in regional committee meetings and reports associated with the multistate research project W1008 entitled, "Biology and Management of Iris yellow spot virus (IYSV) and Thrips in Onions" at annual meetings in Denver, CO (2007) and Savannah, GA (2008).

E. Outputs. List your project's outputs, which might include publications, information, data, meetings held, attendance at meetings held, etc.

Project outputs on varietal responses to thrips and IYSV have been shared with onion growers and processors at Colorado meetings (125 participants at summer field days in 2007 and 2008 and winter educational events n 2007, 2008 and 2009), as well at national meetings of more 100 onion colleagues (breeders and IPM) that attended the 2008 National Allium Research Conference in December of 2008 where poster and oral presentations were made by the PD and project PIs - http://www.alliumnet.com/Annualreports.htm. This information has also been shared at the following web site devoted to IYSV and Thrips: htttp://www.alliumnet.com/index.htm

F. Impacts and Potential Impacts. The "impacts" and "potential impacts" sections of your report will help the Western IPM Center highlight the value of IPM research and education by detailing the real-world impacts of Center-funded projects. We will use the information in news articles, reports,

and informational brochures to showcase the impacts of projects that our program supports. *See Attachment A at end of form for questions to assist you in describing the impacts of your project.*

1. Impacts. Describe any impacts of your work. ***Impacts*** are specific changes in condition for those affected by your work. Impacts include adoption of technology, creation of jobs, reduced cost to the consumer, less pesticide exposure to farmers, access to more nutritious food, and a cleaner environment and healthier communities.

This preliminary information was successfully used to (a) educate growers and the onion industry on the potential for less susceptible onion varieties and germplasm to be identified by controlled research projects such as ours; (b) adopt standardized evaluation protocols to evaluate variable onion cultivars and germplasm for reactions to these prioritiy pests; and (c) pursue continuing and expanded grant opportunities from the Specialty Crop Research Initiative in the fall of 2008. This 4-year project entitled "Ensuring U.S. Onion Sustainability: Breeding and Genomics to Control Thrips and IYSV" is being coordinated by USDA-ARS scientists and those from various public and private organizations to expand the applied and basic evaluation (genomics) of elite cultivars and diverse germplasm of onions. An additional grant was obtained from the Root and Bulb Vegetable Crop Germplasm Committee to evaluate selected germplasm of Allium for their reaction to thrips and IYSV in Colorado and New Mexico trials during 2009 and 2010.

2. Potential impacts. Describe your project's potential impacts. ***Potential impacts*** are the ways that your project's outputs could directly lead to changes in condition that will unfold in the future.

Future changes will include the successful identification and release of onion cultivars and germplasm that are less susceptible to thrips and IYSV, provide reliable criteria for onion breeders to select less susceptible parents and improved breeding lines for future crosses and more successful varietal releases. Less susceptible varieties should require fewer pesticide applications, thereby reducing pesticide exposure and potential health threats to applicators, growers and consumers. Fewer pesticide applications will reduce economic costs for growers, and contribute to the long-term sustainability of onion production in the western United States. Fewer pesticide applications will reduce potential negative impacts on environmental resources including water, soil and wildlife. This information has been shared freely with other onion producing states and personnel in the western region and elsewhere, and should provide the basis for incorporating resistance to thrips and IYSV in development of future onion cultivars. In addition, IPM personnel will be able to incorporate less susceptible breeding lines and cultivars within other IPM strategies that are being developed to further reduce losses from thrips and IYSV; e.g., crop rotation and sanitation, weed management, reduction of other stresses (soil compaction, fertility and moisture extremes), and timely application schedules of more effective and environmentally-safe pesticides and their rotations.

G. Appendices

1. With your report, please attach ***at least two (2) photographs*** that illustrate your project. Please describe the photo and indicate the name and institution of the person who took the photo. (If you submit more than two photographs, please include those additional descriptions and photo credits under "H. Additional Information," below.)

Photo #1 description:

Symptoms of Iris yellow spot virus on infected onion plant.

Photo #1 credit (photographer's name and institution):

Howard F. Schwartz, Colorado State University

Photo #2 description:

Evaluation of onion plants for number of onion thrips present and reaction to Iris yellow spot virus.

Photo #2 credit (photographer's name and institution):

Howard F. Schwartz, Colorado State University

2. Also attach any printed fact sheets or other publications resulting from your work that will enhance our understanding of your project and its impacts. Please provide a description of each attached publication below.

Document #1 description:

Summary of 2008 Evaluations for Onion Thrips and Iris yellow spot virus at 2 locations in Colorado

Document #2 description:

Document #3 description:

H. Additional Information

Web site for Onion Thrips and Iris yellow spot virus: http://www.alliumnet.com/index.htm

Credit: *Some of the language about impacts and potential impacts was adapted from a PowerPoint presentation by H. Michael Harrington, Executive Director, Western Association of Agricultural Experiment Station Directors, Colorado State University.*

Attachment A

Questions to Help in Reporting Impacts and Potential Impacts

Below are some questions that will guide you in assessing and then describing the impacts and potential impacts of your project. The relevance of each question may vary depending on whether yours is a research or extension project. Please answer as many as you can to the best of your ability, and feel free to describe any additional types of impacts not mentioned below. Remember to identify any potential impacts.

1. ***Innovations in IPM:***
   Are there new IPM practices that have been (impacts) or could be (potential impacts) adopted as a direct result of your project? What is the total number of acres (or homes, schools, greenhouses, nurseries) on which these practices could realistically be implemented?
2. ***Safeguarding human health and the environment:***
   a. Has the project reduced risk (or could it potentially do so) by changing the use of pesticides on farms, in homes, in schools, etc.? For example, could it result in fewer sprays per season or a switch to lower-risk pesticides? If possible, quantify the changes in condition. (Since there is no unanimous definition of *high* and *low risk,* investigators selecting this indicator are asked to categorize the pesticides they are reporting on as *high* or *low risk* according to the particular situation [e.g., lower risk to natural enemies]).
   b. Are there any other impacts or potential impacts on human health or the environment as a result of your project?
3. ***Economic benefits:***
   a. What is (or could be) the economic benefit (e.g., dollars saved) for clientele who adopt IPM strategies and systems you studied? Do you envision potential commercialization or mass production of these systems?
   b. How many clients are satisfied with IPM results (such as improved yield, improved quality of yield, reduced pest populations, more effective pest control, greater preservation of nonpest species)?
   c. Are there other financial benefits that might be realized (potential impact) as a result of your project?
4. ***Implementation of IPM:***
   a. How many IPM strategies and systems have been validated through this project (e.g., through on-farm trials, large plot tests, or other methods used to confirm efficacy)?
   b. How many educational materials were delivered? To whom? And what are the impacts or potential impacts?
   c. What is the number of growers/personnel trained? And what are the impacts or potential impacts?
   d. For a Web site, what volume of traffic and type of use has the site experienced? (For example, number of visitors per day or month; number of page views; number of unique user sessions; change in volume during growing season; average viewing time.) And what are the impacts or potential impacts?
   e. How many more people adopted IPM practices as a direct result of your project, or how many people adopted new IPM practices?
   f. Are there other ways in which your work will result in improved use or increased implementation of IPM strategies in your region or across the West?
5. Has your project or study increased collaboration among stakeholders interested in the development and implementation of improved IPM strategies and systems?

Evaluation of Onion Cultivars for IYSV & Thrips Resistance - Arkansas Valley Research Center, 2008: Trials were conducted at the Arkansas Valley Research Center in Rocky Ford, CO. Individual plots consisted of 50-row ft of seeded onions in 4-row beds at 5-ft centers. Each cultivar was replicated four times in a randomized complete block design. Subplots were established within each plot, so that one half of the area was treated to control thrips, the other half remaining untreated. Thrips treatments consisted of a mixture of fipronil (Regent) and spirometrastat (Movento), which had been identified as the most effective treatments at that site in previous season. Applications were made 12 June, repeated 3 July. Excellent control (>5 thrips/plant) was maintained on these treated plots through the end of July when last observations were made (July 24).

IYSV disease incidence was monitored throughout the season, and only a trace incidence was observed in the field on August 19, 2008; disease pressure was too low for evaluation at that time and did not progress during the remainder of the season.

Two counts of thrips were made, each by counting the number of thrips on 10 plants in the center of untreated areas. Varieties with blue or blue-green leaves (higher wax coating) generally had higher thrips populations than varieties with green leaves (glossy coating).

Table 1: Thrips populations on 10 plants of different untreated onion varieties.

Variety	*Leaf Color*	*Thrips Population on 19 June**	*Thrips Population on 10 July**
1. Cometa	B	133.5 ab	243.5 abc
2. White Wing	B	132.0 ab	202.3 abcd
3. Salsa	B	136.5 a	339.25 ab
4. Red Bull	B	120.0 ab	303.5 abc
5. Red Wing	B	138.0 a	316.75 ab
6. Talon	B/G	104.0 abc	353.75 a
7. Tioga	B/G	91.0 abc	206.75 abcd
8. Gunnison	B	100.0 abc	259.0 abcd
9. Arcero	G	99.5 abc	153.0 abcde
10. Ranchero	G	105.0 abc	166.50 abcd
11. Calibra	B/G	127.0 ab	126.25 abce
12. X-202 (Mequite)	G	103.5 abc	103.75 bcde
13. Sedona	G	135.3 a	234.75 abc
14. OLYSOS5N5	G	100.3 abc	64.25 de
15. Colorado 6	G	114.3 ab	51.25 e
16. T-433	G	64.5 bc	78.25 de
17. Tamara	G	63.0 c	91.00 cde
18. Granero	G	129.3 ab	155.25 abcde
19. Oro Blanco	B/G	140.5 a	47.25 e
20. Vaquero	G	106.0 abc	101.0 bcde

B=blue, B/G= blue-green, G= green

Numbers within a column not follow by the same letter are significantly different (P>0.05) by SNK. * Original data. Thrips Data were log transformed for analysis

Table 2: Effect of thrips control on yield of different onion varieties.

Variety	*Thrips Control*	*Yield (tons/acre)*	*Relative yield difference between treated and untreated*
1. Cometa	Yes	22.8 bcdefgh	+19.8%
	No	19.0 defgh	
2. White Wing	Yes	18.8 defgh	**-15.3%**
	No	22.3 bcdefg	
3. Salsa	Yes	19.2 defgh	+0.7%
	No	19.0 defgh	
4. Red Bull	Yes	17.6 efgh	+36.1%
	No	13.0 h	
5. Red Wing	Yes	17.0 efgh	+25.5%
	No	13.6 gh	
6. Talon	Yes	17.3 efgh	+9.5%
	No	15.8 efgh	
7. Tioga	Yes	26.3 abcde	+27.8
	No	20.6 cdefgh	
8. Gunnison	Yes	19.7 defgh	+40.0%
	No	14.1 fgh	
9. Arcero	Yes	23.8 abcdefgh	**-0.4%**
	No	23.9 abcdefgh	
10. Ranchero	Yes	33.0 ab	+11.7%
	No	29.6 abcd	
11. Calibra	Yes	23.6 abcdefgh	+7.8%
	No	21.9 bcdefgh	
12. X-202 (Mesquite)	Yes	31.0 abc	**-2.3%**
	No	31.7 ab	
13. Sedona	Yes	23.1 abcdefgh	+4.7%
	No	24.2 abcdefgh	
14. OLYSOS5N5	Yes	34.1 a	+9.7%
	No	31.1 abc	
15. Colorado 6	Yes	29.2 abcd	**-2.6%**
	No	30.0 abcd	
16. T-433	Yes	26.5 abcde	+6.4%
	No	24.9 abcdef	
17. Tamara	Yes	13.1 h	**-7.1%**
	No	14.1 fgh	
18. Granero	Yes	32.1 ab	+38.1%
	No	23.2 abcdefgh	
19. Oro Blanco	Yes	29.5 abcd	+33.9%
	No	22.1 bcdefg	
20. Vaquero	Yes	32.7 ab	+33.4%
	No	24.5 abcdefg	

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Onion Varietal Trial - ARDEC: Experimental design was a completely randomized 10 x 10 lattice with five replications; plots size was 4 beds wide with 2 lines seed/bed x 25 ft long and a 5 ft alley way between blocks. The plot was furrow irrigated and received herbicides as needed in accordance with standard grower practices.

Thrips counts were determined on 14 July & 14 August by counting all thrips on 10 plants/plot. A severe hail storm occurred late afternoon of 14 August, and plants sustained 50 – 75% defoliation; recovery was slow and plant growth was acceptable by mid September, but too late to promote resumed pressure from thrips or allow for adequate development (100% incidence as observed in 2007) of IYSV.

IYSV Ratings were determined on 7 October by examining 10 or more infected plants in the center 2 beds of each plot for the average severity of IYSV infection as: 1 = 1-2 small, 2 = 3 – 10 medium, 3 = 11-25 medium to large, and 4 = more than 25 medium to large lesions/leaf.

Table 3.

	Thrips/10 plants[a]		IYSV Rating
Cultivar	14 July*	14 August	7 October
1. Cometal	66.8 ab	153.0 abcd	2.0
2. White Wing	Poor Stand	Poor Stand	2.0
3. Salsa	27.0 c	115.0 abcd	2.2
4. Red Bull	64.2 abc	106.8 bcd	3.0
5. Red Wing	27.8 c	139.2 abcd	2.8
6. Talon	34.8 bc	154.2 abcd	2.0
7. Tioga	40.8 bc	85.2 cd	2.0
8. Gunnison	60.8 abc	207.2 a	2.4
9. Arcero	50.4 abc	55.8 d	2.0
10. Ranchero	45.4 abc	64.8 d	2.0
11. Calibra	49.5 abc	71.8 cd	2.0
12. X-202	41.2 abc	62.8 d	2.0
13. Sedona	41.8 abc	173.2 abc	2.0
14. OLYSO5N5	34.6 bc	51.0 d	2.0
15. Colorado 6	34.8 bc	76.2 cd	2.0
16. Vantage	54.6 ab	79.2 cd	2.0
17. Damascus	48.8 abc	194.8 ab	2.0
18. Granero	41.4 abc	83.8 cd	2.0
19. Oro Blanco	56.6 ab	72.0 cd	2.0
20. Vaquero	42.8 abc	65.2 d	2.0

a Numbers within a column not follow by the same letter are significantly different (P>0.05) by SNK. * Original data. Thrips Data were log transformed for analysis.

- Research Supported in part by Western Region IPM Center Grant, CSU – Agr. Exp. Station projects, and the Colorado Onion Association
- Project Coordinated by H. F. Schwartz, M. Bartolo and W. Cranshaw – Colo. State Univ.