# **Arizona Vegetable IPM Program Evaluation**

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"We are conducting an evaluation of the UA Vegetable IPM Program to explore activities that significantly impact the agricultural community to improve effectiveness"

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### Abstract

Analyzing, planning and evaluating the performance of programs is a key element for Extension professionals for prioritizing the characteristics of issues and the resources that should receive the most attention. Through "Program Evaluations" or "Importance Performance Analysis" high priority elements are identified (Fitzpatrick, 2011). An evaluation of the University of Arizona Vegetable Integrated Pest Management (IPM) Program was conducted to explore its activities that significantly impact the agricultural community. Two online questionnaires were developed based on the program's logic model and a links were provided to the program's distribution list for participation. The respondents kept their anonymity and responded through "Qualtrics" software developed by a US company based in Provo, Utah. Findings are presented and show the program's short, medium and long term impacts and economic relevance in the state of Arizona.

### **Background Information**

#### The Arizona Pest Management Center

As part of the UA College of Agriculture and Life Sciences (CALS), the Arizona Pest Management Center (APMC) is an organization that strives to promote the implementation of Integrated Pest Management (IPM) strategies in Arizona. The Arizona Pest Management Center (APMC) aims to provide support to UA faculty members in delivering outstanding IPM programs for people in Arizona, which includes agricultural, urban communities and natural areas.

The Arizona Pest Management Center's main Logic Model contains models for each of the following areas: Agronomic Crops IPM, IPM Training and Implementation in Schools, IPM

Education for Pesticide Applicators, IPM Assessment, and Vegetable (Specialty) Crops IPM, which is the subject of this evaluation plan.

The APMC partners with the following organizations:

- The Western IPM Center (WIPMC)
  - This is one of four Regional IPM Centers in a national network.
- The Arid Southwest IPM Network
  - o Funded by the Western IPM Center through an Information Network grant
- The Arizona Plant Diagnostics Network (AZPDN)
  - Includes researchers, diagnosticians, and regulatory personnel from the University of Arizona, Arizona Department of Agriculture, and USDA/APHIS. The AZPDN is part of the Western Plant Diagnostic Network and the National Plant Diagnostic Network.
- The University of Arizona Insect Collection.
  - Provides entomological research and diagnostics in Arizona and maintains approximately 2.0 million insect specimens.

## **Vegetable IPM Program Justification**

There is a need for effective IPM in high value, high input vegetable cropping systems with many insect, weed, and disease pests in Arizona. Additionally, science and research based information on pest biology, management, and IPM solutions specific to a unique low desert cropping systems are required. It is essential to provide education and outreach to facilitate PCA and Arizona Vegetable farmer adoption of reduced-risk pesticides, resistance management practices & IPM strategies management. Selective insecticides, fungicides and herbicides are emerging that need to be screened and fully researched for their efficacy in controlling our pest complex. Educational meetings, email newsletters, on-farm demonstrations, field days and pest crop losses workshops are needed for the development of new IPM tactics. Additionally, the Yuma Vegetable IPM Team is working to increase stakeholder engagement in the IPM process. The Arizona Vegetable IPM Program Logic model contains information that will be used for the conduction of the present evaluation.

### Mission of the Arizona Vegetable IPM Program

The mission of the Arizona Vegetable IPM program is to provide timely, reliable and practical information for those involved in the desert vegetables industries. The UA Yuma IPM team promotes the integration and implementation of multidisciplinary methods for developing pest management strategies for AZ growers.

# Arizona Vegetable IPM Program Logic Model

SITUATION	INDUMO	Output		OUTCOMES-IMPACTS		
SITUATION	INPUTS	ACTIVITIES	PARTICIPATION	SHORT TERM	MEDIUM TERM	LONG TERM
There is a need for	1) Our time and					
effective IPM in high value,	expertise: Assistant in	1) Stakeholder engagement	1) Arizona and	1) Increased awareness	1) Increase the use	1) Reduced grower reliance on
high input vegetable	Extension; Vegetable	to identify priorities,	California	and knowledge of IPM	and adoption of	broadly toxic pesticides without
cropping systems with	IPM Leadership Team	support on farm research	vegetable	including new	reduced-risk IPM	sacrificing yields.
many insect, weed, and	(Entomologist, Plant	demonstrations and IPM	growers	technology in vegetable,	management options	2) Reduced risk to health and
disease pests in Arizona.	Pathologist, Weed	assessment activities		melon & other specialty	in vegetable	safety of pesticide applicators
Additionally science and	Scientist, IPM	2) Production of new IPM	2) Arizona and	crop production.	production.	and the public.
research based information	Assessment Specialist,	technical publications and	California Pest	2) Improve	2) Reduced usage of	3) Synergize the economic
on pest biology,	Vegetable production	videos, including bi	Control Advisors	understanding of how	broad-spectrum,	impact of the University of
management, and IPM	& food safety	weekly "Veg IPM Updates"	and applicators.	the new reduced risk	high-risk pesticides	Arizona outreach efforts in in the
solutions specific	2) IBM Assessment	delivered via email, smart	2) Ag Industry	chemistries replace the	of increased (or	Vegetable Integrated Pest
cronning system is needed	Loadorshin Toom	phone and online, in	oj Ag Illuusu y	nosticidos	leading to if there is	5) Improved yield and economic
It is assential to provide	nesticide use	response to timely pest	Tepresentatives	3) Improved	no current level of	sj improved yield and economic
education and outreach to	database and cron	auestions (e.g. hagrada	4) Arizona and	understanding of	nractice	returns for growers
facilitate PCA and farmer	pest losses surveys to	hug)	California	resistance	identification and	
adoption of reduced-risk	support evaluation.	3) Translational science	stakeholders	management.	avoidance by PCAs	
pesticides, resistance mgt.	3) Organization	and on- farm	organizations	4) Improved	growers and	
practices & IPM strategies	expenses for	demonstrations (new	with leadership in	understanding of	applicators of	
management.	workshops,	technology/efficacy for	the area	advanced concepts in	practices that	
Available emerging	conferences and field	insects, weeds		"risk" and risk	increase the risk of	
selective insecticides,	days.	& diseases)	5) Academic and	management.	resistance	
fungicides and herbicides	4) Equipment and	4) Educational meetings	Extension		generation and	
need to be screened for	software for	and events (Extension	scientists		other risks.	
their efficacy in controlling	developing videos	meetings, industry/PCA	(through			
our pest complex.	5) Travel expenses.	educational meetings, field	collaborations			
Educational meetings,	6) Resources for	days)	and research			
email newsletters, on-farm	conducting lab,	5) IPM education for	presented at			
demonstrations, neid days,	greennouse, and field	pesticide applicators with	scientific			
pest crop losses workshops	demonstrations at	support of assistants in	meetings).			
development of new IPM	commercial fields	extension for pesticide				
tactics There is also a need	7) Stakeholder innut	6) Dest Crop Losses				
to increase stakeholder	on IPM priorities and	Workshops for IPM				
engagement in the IPM	emerging issues to	assessments				
process.	support IPM program	7) Field site visits in				
P. C.	planning and focus of	response to pest issues.				
	resources	guidance on new and				
	8) Assistant in	existing problems.				
	Extension for	8) Participate				
	pesticide education.					

<b>EVALUATION QUESTIONS INPUTS (#2 and 3)</b>					
Q#1 was participation/demographic					
1.How would		2.How adequate	3. Do you		
you describe		was the	believe		
yourself?		expertise	additional		
•		provided by the	personnel		
		UA Vegetable	should be		
		<b>IPM Specialists</b>	added to the		
			Vegetable IPM		
			team?		
	INDICAT	ORS INPUTS (#2	and 3)		
Q#1 was participa	tion/demographic				
Percent (%) of		Percent (%) of	Percent (%) of		
Respondents		Respondents	Respondents		
who likely make		who highly	who thinks		
decisions in the		approve the	additional		
field		expertise	personnel		
		provided	should be		
		<b>F</b>	added to IPM		
			team		
CRITERIA INPUTS (#2 and 3)					
Q#1 was participa	tion/demographic	× ×	,		
50% of		70% of	70% of		
respondents are		respondents	respondents		
growers, PCAs		consider	either agree or		
or work in the		expertise	strongly agree		
industry		provided is	that additional		
		either adequate	personnel		
		or very	should be		
		adequate	added to IPM		
		-	team		

EVALUATION QUESTIONS OUTPUTS/ACTIVITIES					
4. How many meetings offered by the UA Vegetable IPM team have you attended the past year?	5A. Was the advice provided by the IPM Team appropriate in a) Entomology	5B. Was the advice provided by the IPM Team appropriate in b) Plant Pathology	5C. Was the advice provided by the IPM Team appropriate in c) Weed Science	6. Did the publications, videos and newsletters provided a timely response to pest issues?	7. How helpful were the vegetable IPM publications, newsletters, and videos in increasing your knowledge in vegetable production?
INDICATORS OUTPUTS/ACTIVITIES					
# of meetings attended	% of respondents who report entomologist advice was appropriate	% of respondents who report plant pathologist advice was appropriate	% of respondents who report weed science advice was appropriate	% of respondents who report information was provided in time	% of respondents who report publications are helpful or very helpful
CRITERIA OUTPUTS/ACTIVITIES					
70% of respondents attended at least one meeting	70% of respondents either agrees entomologist advice was most of the time or always appropriate	70% of respondents either agrees plan pathology advice was always or most of the time appropriate	70% of respondents either agrees weed science advice was most of the time or always appropriate	70% of respondents either agrees material provided always or almost always timely	70% of respondents agree that publications are either helpful or very helpful

EVALUATION QUESTIONS					
SHORT TERM OUTCOMES		MEDIUM TERM OUTCOMES		LONG TERM OUTCOMES	
8. How much did you learn from the Veg IPM Team specific to reduced risk chemistries?	9. How much did you learn from the Veg IPM Team specific to resistance management?	10. Your pest management practices changed due to information provided by the Vegetable IPM Team.	11. What is your level of satisfaction on insect, weed and disease ID service provided by the Vegetable IPM Team?	12. The industry has adopted reduced risk practices due to Vegetable IPM Team's activities	
INDICATORS					
SHORT TERM	OUTCOMES	MEDIUM TERM OUTCOMES		LONG TERM OUTCOMES	
% respondents who report they learned a great deal or a moderate amount of reduced risk chemistries.	% of respondents who report they learned a great deal or a moderate amount of resistance management	% of Respondents who report change in management practices due to information provided by IPM Team.	% of Respondents who report satisfied and very satisfied levels from insect, weed and disease ID service provided by the Vegetable IPM Team	% Respondents who think industry has adopted reduced risk practices due to Vegetable IPM Team's activities	
CRITERIA					
SHORT TERM OUTCOMES		MEDIUM TERM OUTCOMES		LONG TERM OUTCOMES	
70% of respondents report that they learned about reduced risk chemistries from IPM Team	70% of respondents report they learn of resistance management from IPM Team	70% of respondents report they changed practices due to information provided by the IPM Team	70% of respondents either report satisfied or very satisfied from services provided by the IPM Team	70% of respondents either agrees or strongly agrees industry has adopted reduced risk practices due to Vegetable IPM Team's activities	

EVALUATION QUESTIONS (2)					
PARTICIPATION	LONG TERM OUTCOMES				
1. How would you describe yourself?	2. If a PCA or Grower how many acres does your operation include?	3. What is the approximate value of your operation?	4. What percent of the value of your operation was positively affected by the Arizona Vegetable IPM Team?	5. What percent of the value of your operation was maintained due to reduced risks achieved through the IPM team recommendations?	
INDICATORS					
SHORT TERM OUTCOMES		LONG TER	M OUTCOMES		
Percent (%) of respondents who likely make decisions in the field	% of respondents who report the size of their operation in acres	% of respondents who report the value of their operation.	% of respondents who report the percent of the operation positively affected	% Respondents who report value of the operation maintained due to reduced risk promoted by IPM team	
CRITERIA					
SHORT TERM OUTCOMES	LONG TERM OUTCOMES				
50% of respondents are growers, PCAs or work in the industry	70% of respondents report they work in operations ranging from 1000-8000 acres	50% of respondents report they work in operations ranging from \$3,000,000- 25,000,000	70% of respondents report operations were affected positively	70% of respondents reported value of the operation was maintained due to reduced risk promoted by IPM team	

EVALUATION QUESTIONS LONG TERM OUTCOMES (2)					
6. How much have your economic returns per acre improved due to better insect IPM practices promoted by specialist?	7. How much have your economic returns per acre improved due to disease IPM practices promoted by our specialists?	8. How much have your economic returns per acre improved due to better weed IPM practices promoted by our specialists?	9. How much yield and economic loss was prevented by recommendations of our Entomology IPM specialist?	10. How much yield and economic loss was prevented by recommendations of our Plant Pathology IPM specialist?	11. How much yield and economic loss was prevented by the recommendations of our Weed Science IPM specialist?
		INDICATOR	S LONG TERM OU	TCOMES	
% of respondents reporting improvement to their economic returns/ac due to better insect IPM practices in USD	% of respondents reporting improvement to their economic returns/ac due to disease IPM practices promoted by our specialists in USD	% of respondents reporting improvement to their economic returns/ac due to weed IPM practices promoted by our specialists in USD	% of respondents reporting yield and economic loss was prevented by recommendations of our Entomology IPM specialist in USD	% of respondents reporting yield and economic loss was prevented by recommendations of our plant pathology IPM specialist in USD	% of respondents reporting yield and economic loss was prevented by recommendations of our weed IPM specialist in USD
CRITERIA LONG TERM OUTCOMES					
70% of respondents reported economic returns improved due to better insect IPM practices promoted by the specialist	70% of respondents reported economic returns improved due to better disease IPM practices promoted by the specialist	70% of respondents reported economic returns improved due to better weed IPM practices promoted by the specialist	70% of respondents reported economic loss was prevented by recommendations of our Entomology IPM specialist	70% of respondents reported economic loss was prevented by recommendations of our plan pathology IPM specialist	70% of respondents reported economic loss prevented by recommendations of our weed IPM specialist

#### **Description of Stakeholders**

A group of stakeholders internal to the Arizona Vegetable IPM program are the UA specialists who provide instruction on new IPM technologies instruction to the individuals in the agricultural industry such as Pest Control Advisors (PCAs) and AZ growers, some of which are also PCAs.

An external group of stakeholders to the IPM is the growers and PCAs themselves who can provide qualitative data on the program effectiveness and level of satisfaction. This group benefits from the quality of the program by taking advantage of the outputs in the form of new technologies and advice provided from the specialists.

### Constraints

The UA provides a portion of the resources needed by the Researchers that deliver the Arizona Vegetable IPM program. A considerable amount of the funding is obtained by conducting grant-funded research and extension projects in the areas of insect management, weed and disease control from the specialists. One of the constraints for them includes resources for transportation when field visits are needed. All of these services are provided free of cost to the AZ vegetable growers and PCAs. Field sampling is required for diagnostics of symptomatic plants. The laboratories have the equipment provided at the Yuma Agricultural Center for the analytical work, however reactants and standards for the procedures are required and highly expensive. The resources for this purpose are gathered by conducting research projects funded by the Iceberg Research Lettuce council or Arizona Department of Agriculture and Specialty Crop Block Grants.

#### **Questions and Criteria for First Survey**

The questionnaire was prepared with the participation of the internal stakeholders. Some questions were focused on the inputs but the main emphasis was placed on the outputs and expected outcomes illustrated in the logic model. The survey was administered online and distributed via email using the University Arizona Yuma Vegetable IPM Team distribution email list on May 13, 2016. The survey was sent to 865 subscribers and the number of respondents was 77 individuals. The criteria in many of the evaluation questions were the recognition of the resources offered by the program to the agricultural vegetable industry as useful or appropriate and mainly using both a qualitative and quantitative approach.

Our introduction to the survey included a purpose statement expressing that an evaluation was being conducted using a survey as an instrument.

The original purpose statement as stated in the cover page was: "We are conducting an evaluation of the Yuma Vegetable IPM Program to explore activities that significantly impact the agricultural community to improve effectiveness"

The email containing the anonymous link for the survey was: "We have developed a questionnaire to survey the services provided by the Arizona Vegetable IPM TEAM to the agricultural community and specifically to the vegetable industry in Arizona. John, Palumbo, Mike Matheron, Barry Tickes and the Evaluation Team would <u>really</u> like to know your opinion of all activities performed.

Please respond to all survey items to help the team make improvements.

We know you are busy! It will take only 2 minutes to finish this questionnaire.

Thank you for providing us with your input. Just click **SURVEY**"

Survey started as follows:

"Dear Arizona Vegetable IPM Subscriber,

This survey has been developed to evaluate the services provided by the Arizona Vegetable IPM (Integrated Pest Management) team to the agricultural community and specifically to the vegetable industry in Arizona.

Dr. John Palumbo from the UA Department of Entomology, Michael Matheron Extension Plant Pathologists, Barry Tickes our Weed Science Specialist, and our evaluation team would like to know your opinion of all activities performed. As you know, these activities include planning and producing meetings, publications, videos, newsletters, field visits, insect, disease and weed identification services as well as pesticide diagnostic laboratory provided free of cost. Please respond to all survey items, to help the team make improvements. It will take you approximately two minutes to finish this questionnaire. Thanks again for providing us with your input. The Vegetable IPM Evaluation Team."

### **Results Part A**

The following questions will include charts in the report for better visualization:

1. How would you describe yourself?

The objective of this demographic question was to determine if the target population has been reached. In this case, the objective was to reach individuals making major decisions in the vegetable production industry of Arizona.

The categories included were: Grower, Pest Control Advisor (PCA), Ag Career Student, Ag service/product provider, and Other: Please describe.



**Respondents Demographics** 

Interestingly 43% of our respondents were PCA's, 21% growers (segment we wanted to survey), 20 % service or product providers and 15% others.

2. How adequate was the expertise provided by the UA Vegetable IPM Specialists? The answers were stated in the Likert scale: Very adequate, adequate, neither adequate or inadequate, inadequate, and very inadequate. This question used a qualitative approach in which the criteria are the recognition by the respondents of the adequacy or non-adequacy of the expertise provided by the team.



Adequacy of Expertise Provided

Likert scale: Very adequate, adequate, neither adequate or inadequate, inadequate, and very inadequate The response for the "very adequate" category was 84% and 16% for "adequate", which reflects that inputs as shown in the Logic Model were considered to be at least adequate by 100% of the questionnaire respondents.

3. I believe additional personnel should be added to the Vegetable IPM team.

Again, the responses were evaluated in a Likert scale as follows: Strongly Agree, Agree, Neither Agree or Disagree, Disagree, Strongly Disagree. This question was designed to assess the level of satisfaction with the inputs of the program, in this case the size of the team.



**Additional Personnel Needs** 

### Likert scale: Strongly Agree, Agree, Neither Agree or Disagree, Disagree, Strongly Disagree

About 45% of the participants agreed that additional personnel should be added to the Arizona Vegetable IPM Team and the other 55% either disagree or neither agree or disagree.

4. How many meetings offered by the UA Vegetable IPM team have you attended during the past year?

The scale for this item included 0, 1-3, 4-6, 7-9, 10 or more. These criteria were to measure the effectiveness of the team in terms of event attendance.



**Meetings Attended** 

The chart shows that 83% of the respondents have attended at least 1-3 meetings promoted by the AZ Vegetable IPM Team. Additionally, we found that about 14% of respondents attended zero meetings.

5. Was the advice provided by the IPM team appropriate in the areas below?

The areas were Insects, Diseases and Weed Science and the Likert scale was composed of the following possible responses: Always, Most of the Time, About Half the Time, Sometimes and Never.



**Appropriateness of Advice Provided** 

#### Likert scale: Always, Most of the Time, About Half the Time, Sometimes and Never

A high percent of our respondents (85%) considered that the advice provided by the entomology specialist was always appropriate and 15 % appropriate most of the time. In the diseases (plant pathology area) 66% thought the advice was always appropriate and 28% appropriate most of the time. In the area of weed science, we had similar data with 66% of participants stating that advice was always appropriate and 29% declaring appropriate most of the time. In this area only one respondent stated that the advice was never appropriate.

6. Did the publications, videos and newsletters delivered via email provide a timely response to pest issues?

The scale utilized was: Always, Almost Always, Sometimes, Almost Never, and Never. The results were:



**Timely Response of Veg IPM Publications** 

Likert scale: Always, Almost Always, Sometimes, Almost Never, and Never

65% of respondents indicated the program always provided a timely response to pest issues and 30% considered almost always. This is very positive because it means that 95% of respondents think the IPM program always or almost always provides a timely response to pest issues.

7. How helpful were the Vegetable IPM publications, newsletters, and videos in increasing your knowledge of new technologies in vegetable production?

With Likert scale: Very helpful, Helpful, No Opinion, Unhelpful, and Very Unhelpful. The results were:



How Helpful Were IPM Publications

Likert scale: Very helpful, Helpful, No Opinion, Unhelpful, and Very Unhelpful

The responses reveal that 95% of people think the Vegetable IPM publications, newsletters, and videos were helpful in increasing your knowledge of new technologies in vegetable production Also, more than 65% think are very helpful.

8. How much did you learn from the Vegetable IPM Team specific to reduced risk chemistries?

The following are the Likert scale options for this question: A Great Deal, A Moderate Amount, A Modest Amount, Very Little and None.



**Reduced Risk Learning from Veg IPM Team** 

Likert scale: A Great Deal, A Moderate Amount, A Modest Amount, Very Little and None

Respondents answered: a great deal 54%, a moderate amount 37%, a modest amount 9%, very little 0% and none 0%. Revealing that 100% of participants learned at least a modest amount about reduced risk chemistries from the Vegetable IPM Team.

9. How much did you learn from the Vegetable IPM Team specific to resistance management?

The response options for this question were: A Great Deal, A Moderate Amount, A Modest Amount, Very Little and None.



**Resistant Management Learning** 

Likert scale: A Great Deal, A Moderate Amount, A Modest Amount, Very Little and None

In the graph above one can see that 93% of respondents indicated learned from the IPM program a moderate or greater amount of information specific to resistance management.

10. Your pest management practices changed due to information provided by the Vegetable

IPM Team.

The Likert Scale consisted of the following categories: Strongly Agree, Agree, Neither Agree or Disagree, Disagree, and Strongly Disagree.



**Change in IPM Practices** 

## Likert scale: Strongly Agree, Agree, Neither Agree or Disagree, Disagree, and Strongly Disagree

The chart shows that 80 % of the individuals making decisions in the field (PCAs and growers) believe that their pest management practices changed due to information provided by the Yuma Vegetable IPM Team. This is one of the long-term impacts and outcomes specified in the logic model.

11. What is your level of satisfaction on insect, weed and disease ID service provided by the Vegetable IPM Team?

The Likert scale used for this question was: Very Satisfied, Satisfied, Neither Satisfied or Dissatisfied, Dissatisfied, Very Dissatisfied.



Level of Satisfaction

Likert scale: Very Satisfied, Satisfied, Neither Satisfied or Dissatisfied, Dissatisfied, Very Dissatisfied The results show clearly that 97% of respondents are satisfied with the ID service provided by the AZ Vegetable IPM Team in Yuma.

12. The industry has adopted reduced risk practices due to Vegetable IPM Team's activities. The scale utilized was: Strongly Agree, Agree, Neither Agree or Disagree, Disagree, Strongly Disagree.



**Risk Management Changes** 

## Likert scale: Strongly Agree, Agree, Neither Agree or Disagree, Disagree, Strongly Disagree

In this case 80% of the people surveyed agree the industry has adopted reduced risk practices due to the knowledge gained through activities of the Vegetable IPM Team.

13. How much have your yields and economic returns improved due to better Vegetable IPM practices?

The Likert scale utilized: Much Improved, Somewhat Improved, About the same, Somewhat Worse and Much Worse.



Yield and Returns Improvement

Likert scale: Much Improved, Somewhat Improved, About the same, Somewhat Worse and Much Worse

The chart shows that 83% of the PCAs and growers surveyed consider their yields have improved due to better IPM practices, which are based on the knowledge gained through the Program's activities.

 The reliance on broadly toxic pesticides has been reduced due to increased Vegetable IPM knowledge.

The scale utilized to assess this long-term output was: Strongly Agree, Agree, Neither Agree or Disagree, Disagree, and Strongly Disagree. The results are as follows:



**Broadly Toxic Pesticides Reduction** 

Likert scale: Strongly Agree, Agree, Neither Agree or Disagree, Disagree, and Strongly Disagree

The above graph portraits that 80% of the participants perceive a reduction of broadly toxic pesticides due to Vegetable IPM knowledge in AZ.

As stated earlier, the indicators for many of the evaluation questions were percentages of individuals changing practices, the amount of knowledge acquired through the Arizona Vegetable IPM program, and meeting attendance rates. Results reveal that 100% of respondents showed that expertise provided by the IPM team were "adequate", 95% indicated that advice provided was appropriate in all areas, which included Entomology, Plant Pathology and Weed Science. Similarly, 95% of respondents say IPM program almost always provides a timely response to pest issues and 100% of participants learned at least a modest amount about reduced risk chemistries from the Vegetable IPM Team.

The % of respondents that gained a moderate amount of information specific to resistance management from the program was 93%.

Also 80 % of the individuals making decisions in the field (PCAs and growers) believe that their pest management practices changed due to information provided by the Yuma Vegetable IPM Team. Additionally, 97% of respondents are satisfied with the ID service provided by the AZ Vegetable IPM Team in Yuma. The criteria established, which was set at 70% general performance suggests that the of the level of performance for the program was surpassed in all cases as stated in the logic model pages.

Based on the results on the portion of the evaluation that focused on the outputs and outcomes of the Vegetable IPM Program great impact on the industry. The items composing the questionnaire used to evaluate the program were designed to capture patterns and trends reflective of knowledge acquisition and behavior change on the part of Arizona's vegetable growers. This evaluation also aimed to capture the impact of the adoption of better practices by growers in terms of farm profitability and economic returns of growers. This was an internal evaluation done with stakeholder guidance from the Vegetable IPM Team Specialists from the University of Arizona Yuma Agricultural Center, as well as a sample of Pest Control Advisors in Yuma, AZ.

### **Questions and Criteria for Follow Up Questions**

This follow up questionnaire sent on December 29, 2016 included monetary figures to estimate the potential savings and losses prevented by the team of specialists belonging to the Arizona Vegetable IPM Team and focused predominantly on the medium and long term outcomes described in the theory of change or logic model description. The Survey introduction was the following: Dear Arizona Vegetable IPM Subscriber,

This follow up questionnaire has been developed to help estimate the economic effects of the Yuma Vegetable IPM TEAM in the state of Arizona.

In a previous questionnaire 80 % of the PCAs and growers that make critical field decisions stated the service provided by the Arizona Vegetable IPM Team have positively affected their operations in the following ways:

1. Pest management practices changed positively,

2. Yields and economic returns have improved due to better IPM practices, and

3. Perceived reductions in broadly toxic pesticides due to knowledge gained from the Vegetable IPM program in Arizona.

Our activities include planning and facilitating meetings, creating and disseminating publications, videos, newsletters, conducting field visits, providing insect, disease and weed identification services, and providing a pesticide diagnostic laboratory free of cost. Please respond to all survey items, which will take you approximately two minutes. Your response will help us understand the potential economic impact we have in Yuma and Imperial Counties and the State of Arizona.

Thank you for providing us with your input.

### Sincerely

The Vegetable IPM Evaluation team

## **Results Part B**

The follow-up questionnaire started with the same question, which had the objective of determining the respondent's demographics. Similarly, charts will be included in the report for better visualization:

1. How would you describe yourself?

The objective was to establish that we are reaching individuals making major decisions in the vegetable production industry of AZ.



**Respondents Demographics** 

The categories included were: Grower, Pest Control Advisor (PCA), Ag Career Student, Ag service/product provider, and Other: Please describe.

Very similar to the earlier survey data 46% of our respondents were PCA's, 23% growers, 28% service or product providers and 19% others. This data shows that respondents were individuals holding critical positions and make impactful decisions in their particular operations.

2. If a PCA or Grower how many acres does your operation include?

The scale utilized ranges were: Less than 500 acres, 501 to 1000 acres, 1001 to 2000 acres, 2001 to 3000 acres, 3001 to 4000 acres, 4001 to 5000 acres, 5001 to 6000 acres, 6001 to 7000 acres, 7001 to 8000 acres and greater than 8000 acres.



#### Size of the Operation

The largest group of respondents, which was 44% of the total respondents, pertain to agricultural operations larger than 8,000 acres. If we sum up participants that work in operations ranging from 1001 to 7000 acres they comprise 33% of total participants. Another large group with 22% of the total respondents was participants in small operations with less than 500 acres.

## 3. What is the approximate value of your operation?

The choices given to respondents to this question were: less than \$99, 999, from \$100, 000 to \$999,999 next from \$1,000, 000 to \$2, 999,999, then \$3,000,000 to \$5, 999,999, then \$6,000,000

to \$7,000,000 to \$7,999,999, then \$8,000,000 to \$9,999,999, then \$10,000,000 to \$14,999,999, then from \$15,000,000 to \$19,999,999, then from \$20,000,000 to \$24,999,999 and finally more than \$25,000,000.



### Approximate Value of the Operation

Our largest group of respondents 30% make critical decisions in operations larger than \$25,000,000. Then our second group with 27% is in the range of \$100.000-\$999,999 operations. In the range of \$3,000,000-\$5,999,999 operations we had 15% of respondents. Additionally, 12% of respondents are grouped together in operations ranging from \$6,000,000 to \$14,999,999 dollars. The data collected testifies of the economic impact of the decision-making process in the agricultural industry.

4. What percent of the value of your operation was positively affected by adopting insect, weed and disease management practices that were recommended by the Arizona Vegetable IPM Team?

The choices for this question were 0%, 1 to 5.9%, 6 to 9.9%, 10 to 19.9%, 20 to 29.9%, 30 to 39.9%, 40 to 49.9%, 50 to 59.9%, 60 to 69.9%, 70 to 79.9%, 80 to 89.9% and 90 to 100%.



**Operation % Affected Positively** 

The results to this particular question showed 38% of respondents indicating that 90 to 100% of their operation was positively affected by adopting insect, weed and disease management practices that were recommended by the AZ Vegetable IPM Team.

Additionally, if added together 40% of respondents perceived that 50 to 89.9% of their operation was positively impacted.

5. What percent of the value of your operation was maintained due to reduced risks to

health and safety achieved through the implementation of IPM team recommendations? This question was related to one of the long-term goals stated in the program logic model and the options given were 0%, 1-5.9%, 6-9.9%, 10-19.9%, 20-29.9%, 30-39.9%, 42-49.9%, 50-59.9%, 60-69.9%, 70-79.9%, 80-89.9% and 90-100%.



**Operation % Maintained Due to Reduced Risk Practices** 

The responses show 29% of participants believe 90-100% of their operation was maintained due to reduced risks to health and safety achieved through the implementation of IPM team recommendations. All respondents considered the IPM evaluations of value except for one respondent.

6. How much have your economic returns per acre improved due to better insect IPM practices promoted by our specialist?

This question was formulated to determine the impact of our Entomology specialist in a per acre basis in the respondents' operation. The scale given was as follows: \$0, \$1- \$19.99, \$20 - \$39.99, \$40 - \$59.99, 60 - 79.99, 80 - 99.99, 100 - 119.99, 120 - 149.99, 150 - 169.99, \$170 - \$189.99, \$190 - 249.99 and more than \$250.00 per acre.



**Economic Returns Due to Better Insect Management** 

Our respondents were distributed across the ranges. Adding categories, the evaluation team observed that 63% of respondents perceive the Vegetable IPM Entomology specialist has improved their economic returns between \$60 to \$189 dollars per acre. To extrapolate this value to one of the 8,000-acre operation, which was the case for 44% of the individuals surveyed, the increase in returns would range from 480,000 - 1,512,000 USD economic returns improved for just one particular operation.

7. How much have your economic returns per acre improved due to disease IPM practices promoted by our specialists?

Similarly, to the previous this question was formulated to determine the impact of our Plant Pathologist specialist in a per acre basis in the respondents' operation. The scale given was as follows: \$0, \$1- \$19.99, \$20 - \$39.99, \$40 - \$59.99, 60 - 79.99, 80 - 99.99, 100 - 119.99, 120 - 149.99, 150 - 169.99, \$170 - \$189.99, \$190 - 249.99 and more than \$250.00 per acre.



#### **Economic Returns Due to Better Disease Management**

The largest group of respondents 20% perceives the Vegetable IPM program Plant Pathologist has improved economic returns of 20-40 USD per acre. Additionally, 10% of our survey responses consider the program specialist has improved economic returns more than \$250.00 dlls per acre. Similarly, if this was applied to an 8,000 ac farm the economic returns generated by the program would be over 1.9 million USD.

8. How much have your economic returns per acre improved due to better weed IPM practices promoted by our specialists?

The scale given for this question was: \$0, \$1- \$19.99, \$20 - \$39.99, \$40 - \$59.99, 60 - 79.99, 80 - 99.99, 100 - 119.99, 120 - 149.99, 150 - 169.99, \$170 - \$189.99, \$190 - 249.99 and more than \$250.00 per acre.



**Economic Returns Due to Better Weed Management** 

The majority (90%) of respondents to this question agreed that the AZ vegetable IPM program weed science recommendations are having an important economic impact. The data testifies of the success of the evaluated program.

9. How much yield and economic loss was prevented by the recommendations of our Entomology IPM specialist?

This question again is related to one of the long-term outputs mentioned in the program's logic model. Particularly insect losses prevention is addressed in this case. The ranges given were similar: \$0, \$1- \$19.99, \$20 - \$39.99, \$40 - \$59.99, 60 - 79.99, 80 - 99.99, 100 - 119.99, 120 - 149.99, 150 - 169.99, \$170 - \$189.99, \$190 - 249.99 and more than \$250.00 per acre.



**Economic Loss Prevented by Recommendations of Entomologist** 

Responses for this question indicate that 19% of respondents think the Entomology Specialist has prevented more than \$250.00 dollars per acre in their operation, followed by 13% saying the amount of prevented losses was \$100 to \$119.00 dollars per acre.

10. How much yield and economic loss was prevented by the recommendations of our Plant Pathology IPM specialist?

Similarly, the issue in this question was loss prevention in this case from the Plan Pathology Specialist. Similar scale: \$0, \$1- \$19.99, \$20 - \$39.99, \$40 - \$59.99, 60 - 79.99, 80 - 99.99, 100 -119.99, 120 - 149.99, 150 - 169.99, \$170 - \$189.99, \$190 – 249.99 and more than \$250.00 per acre.



**Economic Loss Prevented by Recommendations of Plant Pathologist** 

The results obtained show responses varied in different ranges. About 16% of respondents did not think that damage from disease was prevented by recommendations of the team. However, 42% of respondents considered there was loss prevention starting at \$60 to more than \$250 per acre if the four categories are added together.

11. How much yield and economic loss was prevented by the recommendations of our Weed Science IPM specialist? Similarly, the issue in this question was loss prevention in this case from the Arizona Vegetable IPM Weed Science Specialist. Similar scale: \$0, \$1- \$19.99, \$20 - \$39.99, \$40 - \$59.99, 60 - 79.99, 80 - 99.99, 100 - 119.99, 120 - 149.99, 150 - 169.99, \$170 - \$189.99, \$190 - 249.99 and more than \$250.00 per acre.



**Economic Loss Prevented by Recommendations of Weed Scientist** 

The results from our respondents show that our largest group considered that the weed science specialist contributed to avoid losses to the amount of \$60 - 79.99 dollars per acre. Additionally, 13% of responses report loss prevention greater than \$250.00 dollars per acre. In general, our criteria of 70% of responses reporting avoidance of losses was surpassed in this discipline as well as entomology and plant pathology. According to the Yuma Chamber of Commerce (2017) agriculture is the number one industry for Yuma County. In 2013, the University of Arizona published a study showing that agriculture contributes an estimated \$2.5 billion a year to the Yuma economy.

The Arizona Vegetable IPM Program located in Yuma has the objective of contributing to the State's economy by continue to explore and design the latest IPM (Integrated Pest Management) technologies and strategies when problems arise. The team is working on many projects addressing problems such as the outbreaks of insect pests, weeds and diseases as well as sharing the new strategies generated in conferences and publications. Another tool used by the team for seven years is the Arizona Vegetable IPM Updates Newsletter with 865 subscribers that is used by Pest Control Advisors for their field decision-making. Some product providers use the Updates to keep a good inventory for the growers needs. The contributors, Entomologist John Palumbo, Plant Pathologist Michael Matheron and Weed Scientist Barry Tickes are committed to continue serving servicing Arizona agricultural stakeholders, which makes this program a success.

#### References

Fitzpatrick J. L., Sanders J. R., & Worthen B.R. (2011). Program evaluation: alternative approaches and practical guidelines (4<sup>th</sup>. Ed), (PP, 3-37). Yuma County Chamber of Commerce (2017). http://www.yumachamber.org/agriculture.html