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August 29, 2014

Robert Morrissey
National Watermelon Association
5129 South Lakeland Drive, Suite 1
Lakeland, Florida 33813

Project Title:

"Management of Fusarium wilt and foliar diseases of watermelon through application of fungicides through drip irrigation"

University of MD PI:

Kathryne L. Everts, Professor & Extension Specialist, Vegetable Plant Pathology
University of Maryland
Lower Eastern Shore Research & Education Center
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Dear Mr. Morrissey:

The University of Maryland is pleased to submit its proposal for the above referenced project on behalf of Dr. Kathryne L. Everts, Department of Plant Science and Landscape Architecture. This proposal has been reviewed and approved by an authorized official at the University of Maryland for submission to the National Watermelon Association. Support is requested in the amount of \$18,300 in order to complete all work as outlined in the proposal, from 01/31/15 through 12/31/15.

If this proposal is successful, the University of Maryland will ensure compliance with all pertinent regulations and policies. The agreement should be between your agency and the University of Maryland, and should be sent to the Office of Research Administration for review and execution. Questions regarding the technical aspects of this proposal should be directed to Dr. Everts at (410) 742-1178 x305 or keverts@umd.edu. Administrative questions should be directed to my attention at (301) 405-8280 or sswartz1@umd.edu.

Sincerely,

Stephanie Swartz
Sr. Contract Administrator

cc: Kathryn Everts, PSLA
Marie Bryer, PSLA
Chris Aubry, AGNR

National Watermelon Association Proposal – 2014

Title:

Management of Fusarium wilt and foliar diseases of watermelon through application of fungicides through drip irrigation.

Principal Investigator:

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Major Collaborator:

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Location where the work will be performed:

University of Maryland Lower Eastern Shore Research and Education Center, Salisbury
University of Delaware Research and Education Center, Georgetown

Priority areas:

Primary – Fusarium wilt
Secondary – gummy stem blight and anthracnose

Project Details:

Rationale: Watermelon Fusarium wilt is caused by *Fusarium oxysporum* f. sp. *niveum*. Fusarium wilt had been successfully managed for many years through the use of resistant cultivars and long rotations. However the shift to seedless production, loss of methyl bromide fumigant, and

limitations on rotational ground in some production regions has resulted in increases in wilt. Management of Fusarium wilt of watermelon requires an integrated approach and it would be highly beneficial to have an option that could be applied in-season when wilt first occurs. Until recently there have been few non-fumigant chemical options available, and when Fusarium wilt occurred in-season, little could be done to minimize the problem.

Following the recent increases in yield losses due to watermelon Fusarium wilt, the U.S. national program, interregional project 4 (IR-4) received several requests for the registration of fungicides for watermelon Fusarium wilt. However, without efficacy data agrichemical companies had little interest in registration of their products and thus depended on the U.S. government program, IR-4. The IR-4 program evaluated several fungicides in field production systems in the eastern, midwestern and southern United States. Researchers in Maryland, Indiana and Georgia demonstrated that two fungicides, Proline and Topsin M, applied through the drip irrigation system three times during watermelon transplant establishment, reduces Fusarium wilt, increases vine length and improves yield (Everts, et al., in press).

Recently Bayer CropScience LP, Research Triangle Park, NC, received a Supplemental Label for drip irrigation application of Proline (prothioconazole) on watermelon in some states within the U.S. However the label limits drip applications to one per season, although additional foliar applications are permitted.

Proline also has efficacy on foliar disease of watermelon, and could have the dual benefit of reducing gummy stem blight and anthracnose. Foliar application of Proline was evaluated in 2014 in Maryland. Preliminary data indicate that Proline reduced overall foliar disease (several diseases were present, including *Cercospora* leaf spot, gummy stem blight, and downy mildew). However phytotoxicity was observed where Proline was used weekly (Fig. 1), but not on a 14-day schedule alternated with chlorothalonil. The phytotoxicity symptoms were marginal necrosis following three foliar applications of the label rate of Proline. These symptoms occurred on all plants within a plot.

Successful management of Fusarium wilt of watermelon must involve multiple tactics such as use of host resistance, cover crops that improve soil organic matter, use of nitrate nitrogen and avoidance of use of diseased transplants. The ability to use a fungicide that can be applied through the drip irrigation system, in combination with the use of cultural practices and host resistance, will enable growers to improve management for watermelon Fusarium wilt.



Figure 1. Marginal necrosis following weekly Proline applications.

In order for watermelon producers to optimally and fully implement this new tactic for management of Fusarium wilt, additional research is needed.

Objectives:

The use of Proline, and Topsin M as in-season applications to reduce Fusarium wilt and to improve foliar disease control would be highly beneficial to growers in all regions of the U.S.. However, before in-season fungicide application through drip irrigation can be fully utilized, more information on is needed in three areas.

- 1) Efficacy on management of Fusarium wilt when only one application is through the drip, but additional foliar applications are used.
- 2) Determine under what programs phytotoxicity to watermelon plants occur – especially when applications through the drip are followed by foliar applications.
- 3) Evaluate foliar disease management under field conditions on the major watermelon diseases gummy stem blight and anthracnose.

Experimental Plan:

Two experiments will be conducted, one at the University of Maryland Lower Eastern Shore Research and Education Center and one at the University of Delaware Research and Education Center in Georgetown. The fields at these locations have a high (Salisbury) and moderate (Georgetown) level of *Fusarium oxysporum* f. sp. *niveum* inoculum that includes races 0, 1, and 2. One experiment will evaluate several programs with differing timing of Proline and Topsin M applications for management of Fusarium wilt.

Plots will be 30 to 40 ft long with 5 ft of nontreated border between plots within the row. Fertilizer will be applied to the field preplant according to commercial practice. The cultivar ‘Fascination’, along with pollinizers will be seeded in the UM greenhouse and transplanted to the field in May. Weeds and insects will be managed according to commercial practices, as needed. Fungicides will be applied through the drip irrigation system and with a tractor-mounted sprayer that delivers 45 gal/A at 43 psi through six D4-45 hollow cone nozzles mounted in a directed pattern.

Several fungicide schedules will be evaluated and will include a minimum of the following treatments:

- 1) Proline applied through the drip irrigation at transplant, two and four weeks later (positive control).
- 2) Topsin M applied through the drip irrigation at transplant, two and four weeks later (positive control).
- 3) Proline or Topsin M applied through the drip irrigation once at transplant. Foliar applications at 2 and four weeks after transplant

- 4) Proline or Topsin M applied through the drip irrigation once at transplant and applied at weekly intervals for four weeks.
- 5) Non-treated plots.

A second experiment will evaluate the efficacy of similar treatments for watermelon foliar disease management and phytotoxicity. This experiment will be established in a field that does not have high levels of *F. oxysporum* f. sp. *niveum* so the impact of foliar disease management on yield can be evaluated. Treatments will be established to evaluate the efficacy of Proline and Topsin M in various spray schedules. The field procedures will be similar to those described previously.

Assessment of treatments: Plots will be evaluated weekly for Fusarium wilt incidence and wilt severity beginning at transplant and continuing for 6 weeks. Whole plot wilt evaluation will continue weekly to harvest. Foliar disease also will be evaluated weekly following disease onset. Individual foliar diseases will be assessed until symptoms coalesce and cannot be distinguished. Whole plot foliar disease assessments will be made until harvest.

Results from his study will inform watermelon growers on how to best deploy Proline and/or Topsin M for in-season Fusarium wilt management. Additionally watermelon growers will gain information on how to minimize phytotoxicity. Information will be developed to determine the contribution, if any, of these programs to foliar disease management and how to maximize foliar disease management of both drip irrigation and foliar application treatments.

NWA Report Submissions: Reports will be submitted to the National Watermelon Association in May and August. Final reports with complete statistical analysis will be submitted in December 2015.

References:

Everts, K. L., Egel, D. S., Langston, D., and Zhou, X. G. 2014. Chemical Management of Fusarium Wilt of Watermelon. *Crop Protection in press*.

Himmelstein, J.C., Maul, J.E., and Everts, K.L. 2014. Impact of five cover crop green manures and Actinovate on Fusarium wilt of watermelon. *Plant Dis.* 98:965-972.

Keinath, A.P., and Hassell, R.L. 2014. Control of Fusarium wilt of watermelon by grafting on bottlegourd or interspecific hybrid squash rootstocks despite colonization of the rootstocks by *Fusarium oxysporum*. *Plant Dis.* 98:255-266.

Martyn, Ray D. "Fusarium Wilt of Watermelon: 120 Years of Research." *Horticultural Reviews: Volume 42* (2014): 349-442.

Zhou, X.G. and Everts, K.L. 2007. Characterization of a regional population of F.O.N. by race, cross pathogenicity and vegetative compatibility. *Phytopathology.* 97:461-469.

Timeline: 01/01/2015 – 12/31/2015

Objective	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Prepare field and establish both experiments			XXX	XXX	XXX							
Evaluate Fusarium wilt incidence and severity					XXX	XXX	XXX					
Evaluate foliar disease severity					XXX	XXX	XXX	XXX				
Evaluate yield							XXX	XXX	X			
Submit project reports to NWA					X			X				X

Funding Requested and Justification:

A. Salaries and Wages: Funds requested are for the salary for a research technician – Plant Pathology, who will be assisting with all aspects of the project. He will work under the supervision of Dr. Everts and will conduct efficacy trials for fungicide programs, on watermelon at the University of Maryland Lower Eastern Shore Research and Education Center and at the University of Delaware Research and Education Center.	\$11,000.00
B: \$3,300. Fringe benefits are 30% of salary;	<u>3,300.00</u>
C. Total Salaries, Wages and Benefits	\$14,300.00
D. Equipment	-0-
E. Materials and supplies: Artificial potting medium, plastic trays, labels, fertilizer, greenhouse sanitation solutions, petri plates, media, glassware, chemicals and fertilizer, drip tape, plastic, etc.	\$ 3,000.00
F. Travel	\$1,000.00
Total direct costs	\$18,300.00
Indirect costs (not allowed by sponsor)	<u>-0-</u>
Total direct and indirect costs	\$18,300.00

Addendum to proposal:

This proposal aims to increase Fusarium wilt management options in watermelon production. Losses due to Fusarium wilt have been increasing in the past decade as changes in production, such as the loss of methyl bromide and the dominance of triploid (seedless) varieties, occurred. Particularly, we seek to increase options and provide an in-season management practice that is effective by providing information on efficacy of drip irrigation applications of Proline and Topsin M. Our second objective is to evaluate how these treatments, which are targeted for Fusarium wilt, impact foliar diseases. The expected impacts of this research on U.S. watermelon industry are listed below.

- 1) Watermelon Fusarium wilt is caused by *Fusarium oxysporum* f. sp. *niveum*. Fusarium wilt had been successfully managed for many years through the use of resistant cultivars and long rotations. However the shift to seedless production, loss of methyl bromide fumigant, and limitations on rotational ground in some production regions has resulted in increases in Fusarium wilt.
- 2) Recent field research in Maryland, Delaware, Indiana and Georgia demonstrated that some fungicides, applied three times through the drip irrigation system, reduced Fusarium wilt and improved watermelon yield. However, when the most efficacious of these fungicides was registered, the label restricted drip irrigation applications to one, but allowed additional foliar applications.
- 3) The data collected in our project will determine if one application through the drip irrigation combined with additional foliar applications of these fungicides, also reduces Fusarium wilt, and improves yield. These fungicide schedules are compatible with current production methods and would be easy to implement by watermelon producers that use drip irrigation. The potential increase in yield would vary depending on the level of infestation. However, yield increases in highly infested fields should range from 5 to 30%.
- 4) In addition to evaluation of the impact of these drip irrigation and foliar applications on Fusarium wilt, we will develop information on the efficacy for foliar disease management and on phytotoxicity to the plant. Currently management practices for Fusarium wilt, such as use of moderately resistant cultivars, do not impact foliar disease. The prospect of a management program that could minimize both Fusarium wilt and foliar diseases is an attractive one. This project will provide information on dual effects of these fungicide programs.
- 5) The information generated by this research will provide critical data for the watermelon industry to improve management of Fusarium wilt, reduce foliar diseases, and improve yields. The results will fit well in existing production practices and provide information to benefit watermelon producers today.