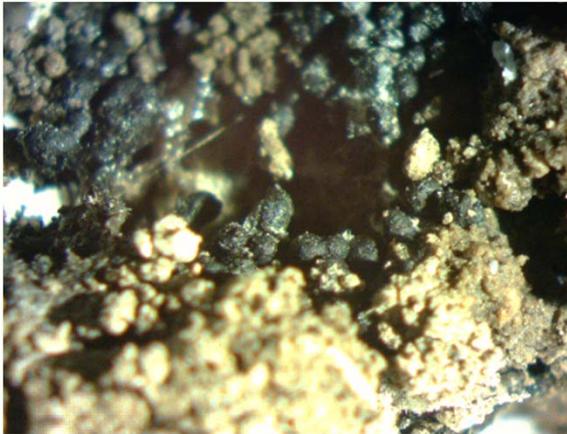




Evaluation of Sclerotia Germination Stimulants for White Rot Control

California Garlic and Onion Symposium, 2017

Jeremiah Dung | Oregon State University | Central Oregon Agricultural Research Center | Madras, Oregon



Acknowledgements

Collaborators:

- Robert Wilson – UC-ANR, IREC
- Tom Turini – UC-ANR, Fresno
- Michael Qian – OSU, Corvallis

Technical assistance:

- Jeness Scott
- Travis Klopp
- IREC and COARC Staff

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- CA Garlic and Onion Research Advisory Board
- CA Department of Pesticide Regulation
- The Garlic Company
- Olam Spices and Vegetables
- Isagro USA

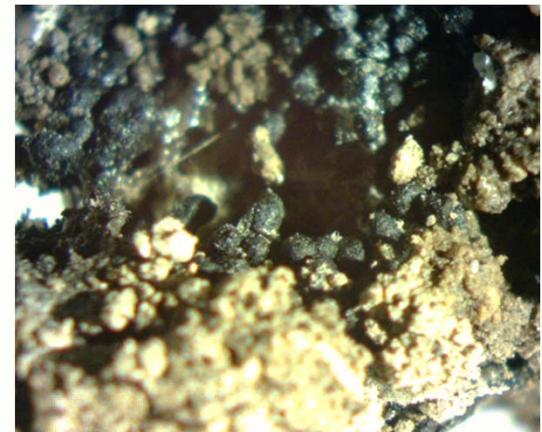
Collaborative White Rot Research

- **CAGORAB-funded projects:**
 - **Central OR microplot studies** (Dung and Qian)
 - Fresno field research (Turini and Dung)
 - Characterization of stimulants (Qian et al.)
- **CA Department of Pesticide Registration Grant** (Wilson, Turini, Dung)

- **Proposed projects:**
 - New fungicides for white rot (Wilson and Dung)
 - Specialty Crops Research Initiative – *proposal in preparation*

White Rot 101

- Caused by the fungus *Sclerotium cepivorum*
- Leaves decay at the base, turn yellow, wilt, and collapse
- Fluffy mycelium on rotted roots and bulbs
- Watery, decayed bulbs
- Outer scales dry, shrink and crack
- Small sclerotia (0.02 inch, about the size of a poppy seed) form in and on the surface of affected bulb parts





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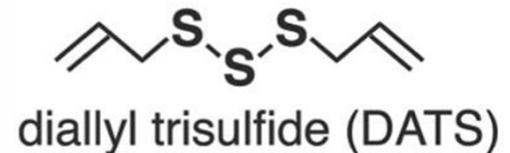
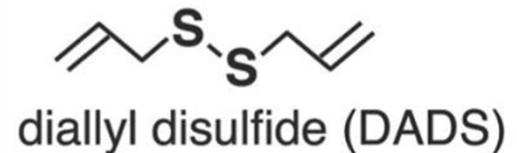
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White Rot Epidemiology

- Affects only *Allium* spp. (e.g. onion, garlic, leek, and shallot)
- Sclerotia from an initially high population may survive 20 to 30 years or more in soil without the presence of a host
- Easily spreads from plant to plant
- Fungus is favored by cool soils and is restricted above 75° F
- White rot can continue to decay infected bulbs in storage if humidity is not kept low
- Sclerotia germinate in to sulfur-containing root exudates from Alliums (C-C-C-S)

Sclerotia Germination Stimulants and Fungicides

- Garlic juice, garlic oil, garlic powder, onion oil, onion compost
- Diallyl disulfide (DADS) mimics natural garlic and onion sulfur compounds and can reduce sclerotia populations by 80-98% (Coley-Smith, McDonald, Davis, Crowe)
- Alli-Up™
- DADS, combined with tebuconazole with or without penthiopyrad and/or fludioxonil, improves control and marketable yields (Ferry and Davis)



Central OR Microplot Studies

Objectives:

- Test different rates of garlic powder to reduce white rot
- Evaluate dimethyl disulfide (DMDS) and allyl isothiocyanate (AITC) for white rot control

Dimethyl Disulfide (DMDS)

- DMDS kills several soil pathogens and nematodes
- DMDS is a sulfur compound found in garlic that has been suggested to have sclerotial germination stimulant properties
- Paladin is a soil fumigant containing DMDS
- Not currently registered for use in CA

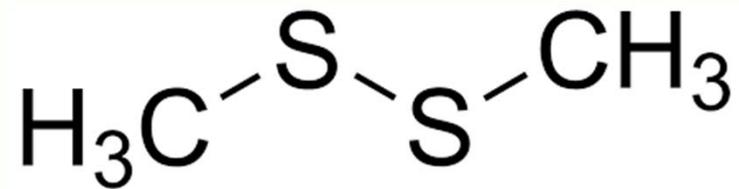


Soil Fumigant

For control or suppression of weeds, soil-borne plant pathogens and nematodes in soils to be planted with vegetables (tomatoes, peppers, eggplants), cucurbit crops (cucumber, squash and melons), strawberries, blueberries, field-grown ornamentals, and forest nursery stock where plastic tarp is used for fumigation. For application via raised bed shank injection and broadcast/flat fume methods only.

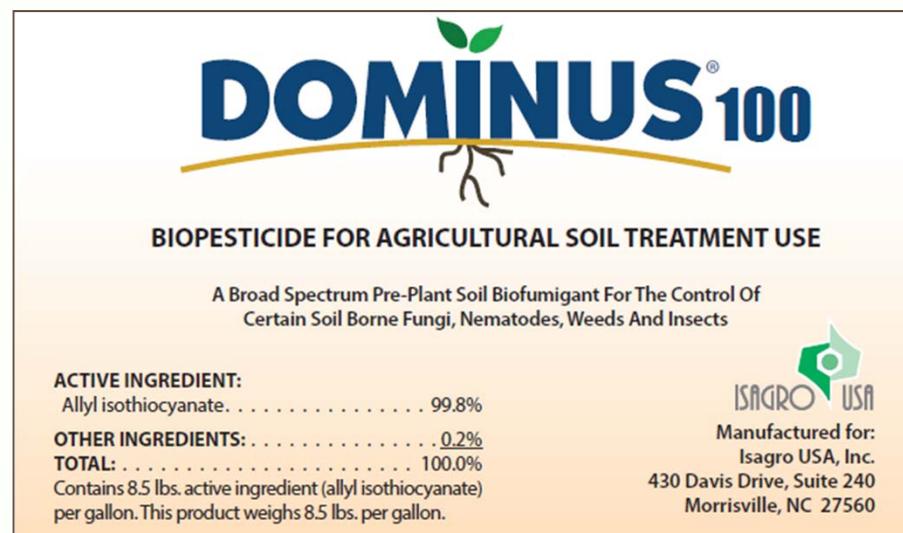
ACTIVE INGREDIENT:	
Dimethyl disulfide.....	98.8%
OTHER INGREDIENTS:	1.2%
TOTAL:	100.0%

One gallon weighs 8.85 lbs. at 68° F



Allyl Isothiocyanate (AITC)

- Broad spectrum soil biofumigant produced by mustards
- Dominus is a biofumigant containing DADS
- Touted as safer and more environmental friendly fumigant than Telone and Vapam.
- Possible labeling for organic systems



DOMINUS[®] 100

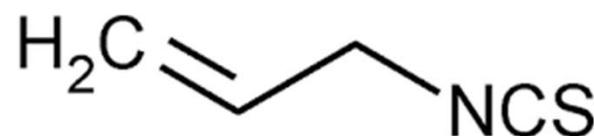
BIOPESTICIDE FOR AGRICULTURAL SOIL TREATMENT USE

A Broad Spectrum Pre-Plant Soil Biofumigant For The Control Of
Certain Soil Borne Fungi, Nematodes, Weeds And Insects

ACTIVE INGREDIENT:	
Allyl isothiocyanate.	99.8%
OTHER INGREDIENTS:	0.2%
TOTAL:	100.0%

Contains 8.5 lbs. active ingredient (allyl isothiocyanate) per gallon. This product weighs 8.5 lbs. per gallon.

ISAGRO USA
Manufactured for:
Isagro USA, Inc.
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Morrisville, NC 27560



Materials and Methods - Central OR Microplot Studies

- Microplots were established in an infested field located at COARC
- Round (24" diameter x 18" tall), bottomless nursery pots
- 6 replicates
- Treatments applied on 4-21-16



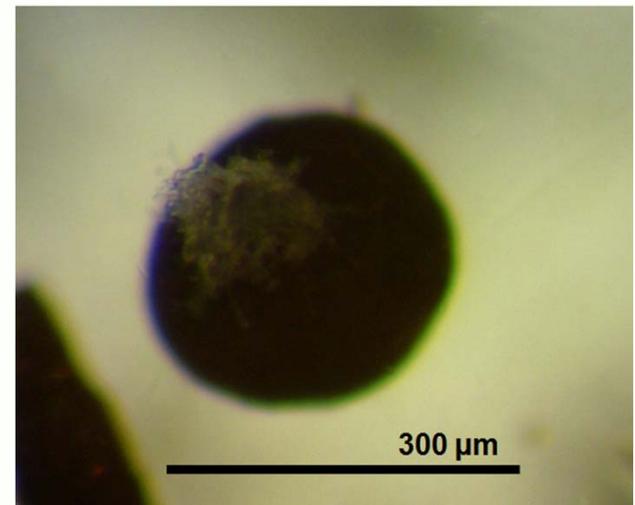
Materials and Methods - Central OR Microplot Studies

- Treatments applied at a depth of six inches
- Garlic powder treatments were sprinkled and incorporated by hand
- DADS, DMDS, and AITC treatments were applied using a CO₂ backpack sprayer
- Irrigated (0.5") after treatments
- Tarped treatments (DMDS and AITC) were covered with white, 6-mil poly film and removed 18 days later



Materials and Methods - Central OR Microplot Studies

- Soil cores sampled prior to treatment (April 20) and 3 months after treatment (July 21)
- Sclerotia recovered via wet-sieving and sucrose flotation
- Sclerotia counted and tested for viability by plating



Results - Central OR Microplot Studies

		Sclerotia/quart soil		Reduction
		Pre-treatment	Post-treatment	
Germination stimulant	Rate			
Non-treated control	NA	53.3	51.3	0.3%
DADS	1 gal/A	56.0	6.0	91.8% *
Garlic powder	100 lb/A	50.7	7.3	83.7% *
Garlic powder	75 lb/A	45.3	20.0	54.0% *
Garlic powder	60 lb/A	39.3	19.3	45.8% *
Dimethyl disulfide	51.3 gal/A	52.0	51.3	2.0%
Dimethyl disulfide (tarped)	51.3 gal/A	40.0	38.7	1.7%
Allyl isothiocyanate (tarped)	40 gal/A	30.7	29.3	3.2%

Conclusions - Central OR Microplot Studies

- A significant effect of DADS and garlic powder was observed
- Higher rates (≥ 100 lb/acre) or repeated applications of (this) garlic powder would be required to reduce sclerotia to acceptable levels
- DMDS and AITC were not effective; however, efficacy may depend on application methods (e.g. shank injection may be more effective)
- Garlic (15 cloves/microplot) was planted on Oct. 3, 2016
- White rot and yield will be evaluated in 2017

Pesticide Management Research Grant White Rot Project

- R. Wilson, T. Turini, J. Dung received a PMRG grant from the CA Department of Pesticide Regulation
- Compare highest possible rate of garlic juice, garlic oil and other products against DADS and Vapam
- IREC and Fresno test sites
- Field trials began in 2016

Treatment	Rate/A
Untreated Control	n/a
DADS	1 gal/A
Garlic Company Garlic Juice	max.appl.rate
Synthetic Garlic Oil Blend	2 gal/A
AITC (Dominus) test at IREC only	10-40 gal/acre
Vapam test at IREC only	50 gal/A

Materials and Methods – CA DPR

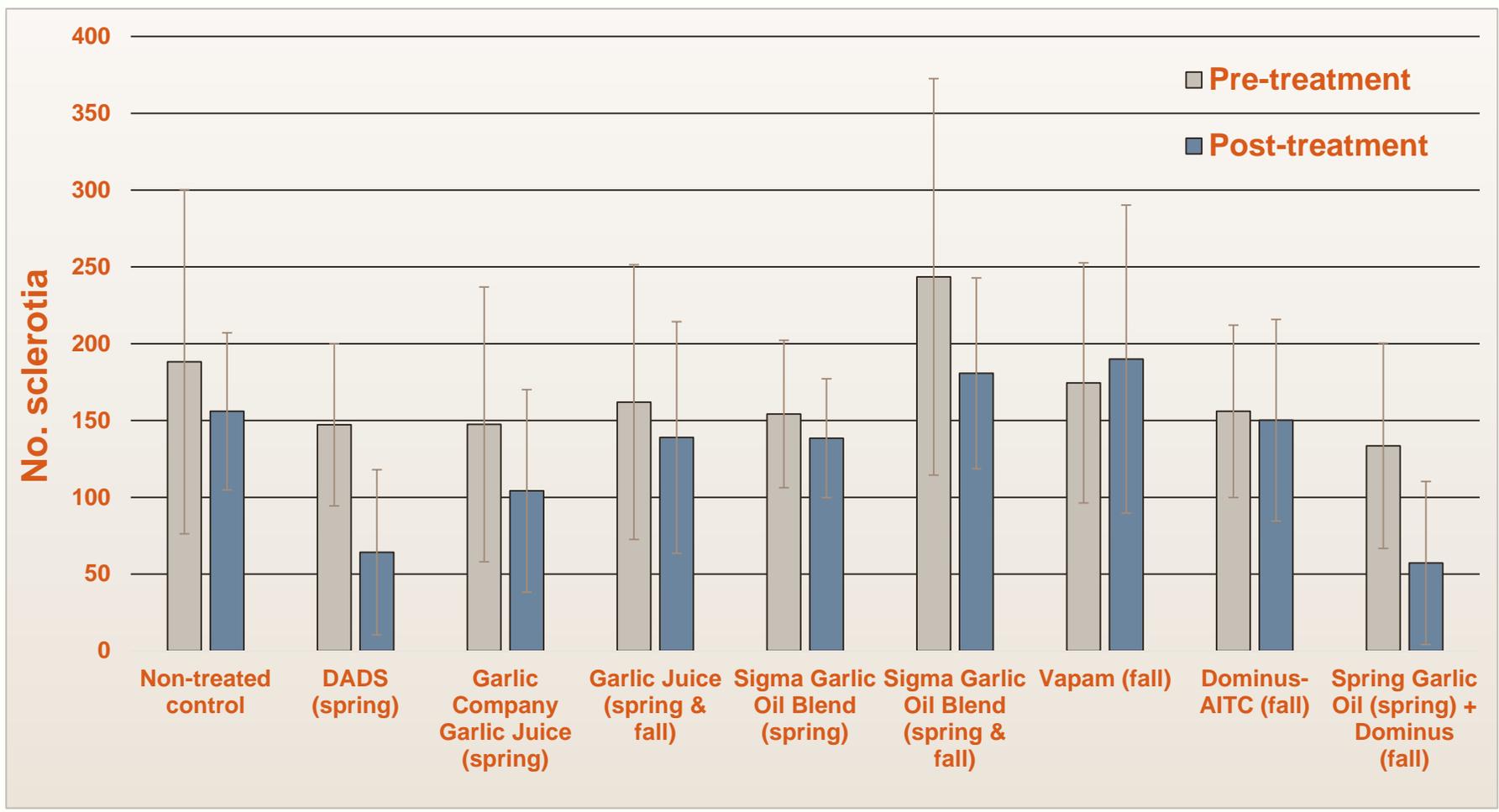
Treatment	Rate	Timing
Untreated Control	N/A	N/A
Vapam	75 gal/A	Fall
DADS	1 gal/A	Spring
Garlic Juice (100% v/v)	100 gal/A	Spring
Garlic Juice (100% v/v)	100 gal/A	Spring & Fall
Sigma Garlic Oil	2 gal/A	Spring
Sigma Garlic Oil	2 gal/A	Spring & Fall
Dominus	10 gal/A	Fall
Sigma Garlic Oil & Dominus	2 gal/A & 10 gal/A	Spring & Fall

Materials and Methods – CA DPR

- Main plots 12' x 60'
- Subplots: Tebuconazole (20.5 oz/A)
- Stimulant treatments applied 5-9-16
- Soil sampled before and 3 months after stimulant treatments



Results – CA DPR



Conclusions and Next Steps...

- DADS significantly reduced sclerotia numbers by 60%
- Spring application of garlic oil significantly reduced sclerotia counts by 59% in one treatment
- Additional sclerotia germination stimulants, Vapam, and Dominus were applied in September 2016.
- Onions will be planted in spring 2017.
- Fungicide treatments will be applied in-furrow in a split-block design
- Plots will be evaluated for sclerotia populations, disease severity, and yield at harvest.

Proposed Fungicide Evaluations (PI: Rob Wilson)

- In 2016, Bayer released Velum (fluopyram) products labeled for disease and nematode control
- Similar chemistries, such as Luna and Fontelis, have activity on white rot
- We would like to revisit testing fluopyram at a much higher use rate compared to the Luna products that were tested in the past
- Syngenta and DuPont also have new SDHI fungicides slated for registration that we would also like to test for white rot control
- **Objective:** Evaluate the efficacy of new SDHI fungicides for suppression of white rot including fluopyram (formulated as Velum Prime), solatenol, and unregistered compounds

SCRI Grant Proposal: Managing Stakeholder-Prioritized Pest and Diseases Threatening the US Allium Industry

- Very high ratings from the stakeholder review panel
- Invited to submit a full proposal in March
- Thank you for the letters of support!

NIFA-SCRI-SREP

Managing Stakeholder-Prioritized Pest and Diseases Threatening the US Allium Industry

Letters from Stakeholders and Industry Organizations

National Onion Association
California Garlic and Onion Research Advisory Board
Idaho-Eastern Oregon Onion Committee
Idaho Onion Growers' Association
Jefferson County (OR) Seed Growers Association
Malheur County (OR) Onion Growers Association
New Mexico Dry Onion Commission
New York State Vegetable Growers Association
Pacific Northwest Vegetable Association

Crookham Company
McCain's Foods USA Inc.
Nunhems/Bayer
Seminis/Monsanto

Individual Grower Letters

Garlic Seed Harvest in Culver, OR (2016)



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