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Sanitation: The First Line Of Defense In Pest Management

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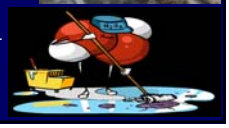
Overview Of Presentation

* Plant Protection

* Sanitation Practices And Guidelines

* Questions And Discussion



Plant Protection: Protecting Indoor And Outdoor-Grown Horticultural Crops From Harmful Organisms

Greenhouse Production Of Horticultural Crops

Cultural Practices And Sanitation

* Proper watering (irrigation)

* Proper fertility

* Proper plant spacing

* Remove all weeds (undesirable plants), and plant and growing medium debris


"Cleanliness Is Next To Godliness"






The First Line Of Defense Against Insect And Mite Pests, And Plant Diseases Involves Implementing Appropriate Sanitation Practices!

Fundamentals Of Greenhouse Sanitation

* Place all debris into refuse containers with tight-sealing lids or dispose of debris into dumpsters or 'compost piles.'
* Eliminate algae from benches and floors.
* Remove weeds, and plant and growing medium debris.
* Dispose of old stock plants or any left-over plant material.
* Clean plant containers thoroughly if they are to be re-used.

Implementing A Proper Sanitation Program Can Reduce Problems With Insect And Mite Pests, And Plant Pathogens (Fungi And Bacteria)

Top Five Sanitation Tips

1. Throw Away Dead Plants
2. Pick-Up All Plant And Leaf Litter
3. Clean Filters
4. Use Filtered Water
5. Clean Bench Surfaces, Tools, And Containers

Cleaning-Up Greenhouses After Each Cropping Cycle Will Mitigate Problems With Carryover Of Insect And Mite Pests

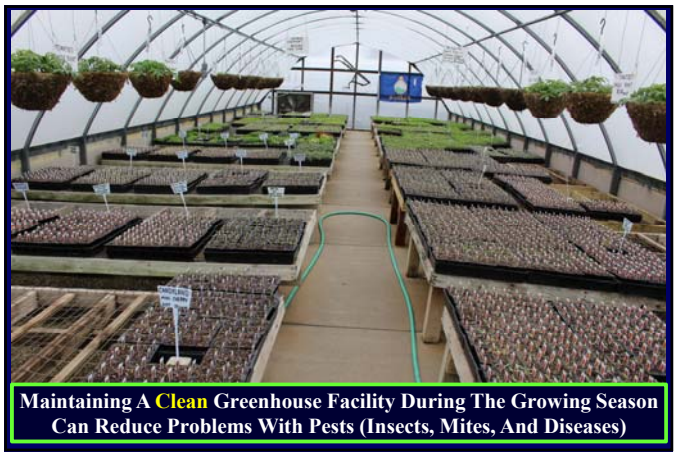
Make Sure That All Debris Is Picked-Up!

Use A Shop-Vac® To Vacuum Up Plant And Growing Medium Debris

Why Are These "Plants" Still In The Greenhouse?

Can You Really Sell This?

Preventative Action Such As Sanitation Will Reduce Problems With Insect And Mite Pests, And Plant Diseases



Maintaining A Clean Greenhouse Facility During The Growing Season Can Reduce Problems With Pests (Insects, Mites, And Diseases)

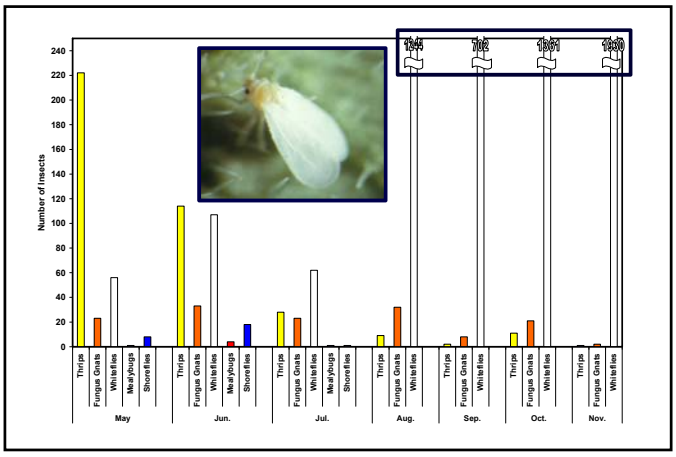
Sanitation: Place All Plant And Growing Medium Debris Into Refuse Containers With Tight-Sealing Lids

Ensure That Refuse Containers Are Covered With Tight-Sealing Lids

How Important Is Sanitation In Avoiding Problems With Insect Pests?

How Well Do You Know Your Garbage?

Garbage Is Dynamic



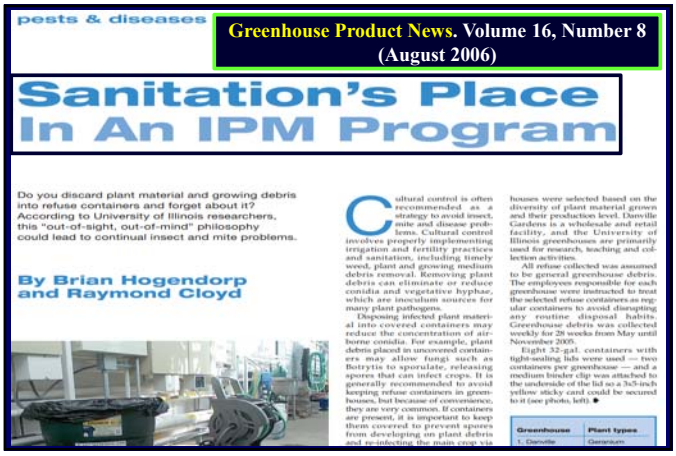
First Documented Study To Determine The Relationship Between Sanitation And Insect Pest Populations (HortTechnology; October-December 2006)

Insect Management in Floriculture: How Important Is Sanitation in Avoiding Insect Problems?

Brian K. Hogendorp and Raymond A. Cloyd

Additional index words. cultural control, refuse containers, debris, disposal, greenhouse

Summary. Sanitation, which includes removing plant and growing medium debris, is an important component of any greenhouse or nursery pest management program. However, there is minimal quantitative information on how sanitation practices can reduce pest problems. In this study, conducted from May through Nov. 2005, we evaluated plant and growing medium debris as a source of insect pests from four greenhouses located in central Illinois. Two 32-gal refuse containers were placed in each greenhouse with a 3 × 5-inch yellow sticky card attached to the underside of each refuse container lid. Each week, yellow sticky cards and plastic refuse bags were collected from the containers and insects captured on the yellow sticky cards were identified. Insects captured on the yellow sticky cards were consistent across the four greenhouses with western flower thrips (*Frankliniella occidentalis*), fungus gnats (*Bradysia* spp.), and whiteflies (*Bemisia* spp.) the primary insects present each week. Insect numbers, in order of prevalence on the yellow sticky cards, varied across the four locations, which may be related to the type of plant debris discarded. For example, extremely high numbers of adult whiteflies (range = 702 to 1930) were captured on yellow sticky cards in one greenhouse each month from August through November. This was due to the presence of yellow sage (*Lantana camara*), bee balm (*Monarda didyma*), garden verbena (*Verbena xhybrida*), common zinnia (*Zinnia elegans*), sage (*Salvia* spp.) and fuchsia (*Fuchsia* spp.) debris that was heavily-infested with the egg, nymph, pupa, and adult stages of whiteflies. High western flower thrips adult numbers in the greenhouses were generally associated with plant types such as marguerite daisy (*Dendranthema frutescens*) and pot marigold (*Calendula officinalis*) disposed while in bloom with opened yellow flowers, which contained adult western flower thrips. Based on the results of this study, it is important that greenhouse producers timely remove plant and growing medium debris from greenhouses or place debris into refuse containers with tight-sealing lids to prevent insect pests from escaping.



pests & diseases

Greenhouse Product News. Volume 16, Number 8 (August 2006)

Sanitation's Place In An IPM Program

Do you discard plant material and growing debris into refuse containers and forget about it? According to University of Illinois researchers, this "out-of-sight, out-of-mind" philosophy could lead to continual insect and mite problems.

By Brian Hogendorp and Raymond Cloyd

Cultural control is often recommended as a strategy to avoid insect, mite and disease problems. Cultural control involves properly implementing irrigation and fertility practices and sanitation, including timely weed, plant and growing medium debris removal. Removing plant debris can eliminate or reduce conidia and vegetative hyphae, which are inoculum sources for many plant pathogens.

Disposing infected plant material into covered containers may reduce the concentration of airborne conidia. For example, plant debris placed in uncovered containers may allow fungi such as Botrytis to sporulate, releasing spores that can infect crops. It is generally recommended to avoid keeping refuse containers in greenhouses, but because of convenience, they are very common. If containers are present, it is important to keep them covered to prevent spores from developing on plant debris and re-infecting the main crop via

houses were selected based on the diversity of plant material grown and their production level. Danville Gardens is a wholesale and retail facility, and the University of Illinois greenhouses are primarily used for research, teaching and collection activities.

All refuse collected was assumed to be general greenhouse debris. The employees responsible for each greenhouse were instructed to treat the selected refuse containers as regular containers to avoid disrupting any routine disposal habits. Greenhouse debris was collected weekly for 28 weeks from May until November 2005.

Eight 32-gal. containers with tight-sealing lids were used — two containers per greenhouse — and a medium binder clip was attached to the underside of the lid so a 3x5-inch yellow sticky card could be secured to it (see photo, left). ▶

Greenhouse	Plant types
1. Danville	Geranium

Fungus Gnat Adults In Refuse Container: November 9 Through November 14, 2010

346 On One Yellow Sticky Card (185 + 161)

Refuse Containers Need To Be Emptied Each Day!

Ensure That All Refuse Containers Are Covered With Tight-Sealing Lids

Eliminate Algae From Floors And Underneath Benches In Greenhouses

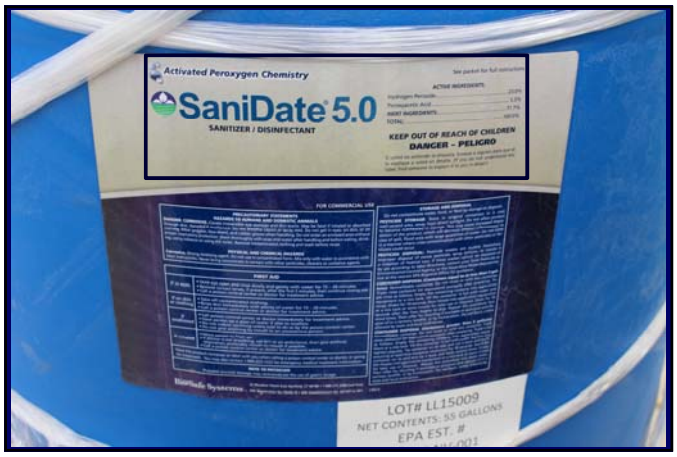
Algae Provides A Favorable Habitat For Fungus Gnats And Shore Flies

Algae Accumulating On Growing Medium Surface Provides A Favorable Habitat For Fungus Gnat And Shore Fly Populations

Cleaning (Sanitizing) Benches Regularly Will Alleviate Problems With Algae

Sanitizing Plant Containers For Re-Use In Production

It Is Important To Thoroughly Sanitize Containers That Are Going To Be Reused!



Weeds Growing Underneath Bench: Not Good Sanitation Practice!

Importance Of Weed Management

- Many broadleaf weeds may harbor populations of insect and mite pests, including: aphids, whiteflies, spider mites, and thrips.

- Many weeds may also harbor viruses that are vectored by aphids, whiteflies, and thrips.

ECOLOGY OF INTERACTIONS BETWEEN WEEDS AND ARTHROPODS

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Key Words IPM, trophic interactions, integrated pest management, alternative hosts, diversity, habitat management

■ **Abstract** Weeds and arthropods interact in agricultural systems. Weeds can directly serve as food sources or provide other ecosystem resources for herbivorous arthropods, and indirectly serve carnivorous (beneficial) arthropods by providing food and shelter to their prey. Weeds can serve as alternative hosts for pest and beneficial arthropods when their preferred crop host is absent. Herbivory on crops by pest arthropods reduces the competitive ability of crop plants, leading to increased weed growth. Interactions between weeds and arthropods have several implications to integrated pest management (IPM). Pest and beneficial arthropod populations can be maintained in the absence of crop hosts. This statement also applies to all other pests that use weeds as a food source, including pathogens, nematodes, mollusks, and vertebrates. Weeds outside crop fields that maintain overwintering populations of arthropod pests are the major reason for the development of area-wide IPM programs for certain mobile arthropod pests. Weeds can serve as a source of increased diversity in agroecosystems. Increased diversity has been the rationale for enhancing biological control of arthropod pests through habitat management. The consequences of such approaches are difficult to predict on a multispecies IPM basis.

ROLE OF WEEDS IN THE INCIDENCE OF VIRUS DISEASES

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INTRODUCTION

From the standpoint of control of virus diseases, there is perhaps no phase of virology more important than epidemiology. The role of weeds in the occurrence and spread of plant virus diseases is an integral part of the ecological aspect of virus transmission.

Summer Weeds as Hosts for *Frankliniella occidentalis* and *Frankliniella fusca* (Thysanoptera: Thripidae) and as Reservoirs for Tomato Spotted Wilt Tospovirus in North Carolina

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J. Econ. Entomol. 98(6): 1810–1815 (2005)

ABSTRACT In North Carolina, Tomato spotted wilt tospovirus (family *Bunyaviridae*, genus *Tospovirus*, TSWV) is vectored primarily by the tobacco thrips, *Frankliniella fusca* (Hinds), and the western flower thrips, *Frankliniella occidentalis* (Pergande) (Thysanoptera: Thripidae). TSWV overwinters in winter annual weeds from which it is spread to susceptible crops in spring. Because most susceptible crops are destroyed after harvest before winter weeds emerge in the fall, infected summer weeds are thought to be the principal source for spread of TSWV to winter annual weeds in fall. A survey of summer weeds associated with TSWV-susceptible crops in the coastal plain of North Carolina conducted between May and October revealed that relatively few species were commonly infected with TSWV and supported populations of *F. fusca* or *F. occidentalis*. *F. occidentalis* made up >75% of vector species collected from 15 summer weed species during 2002. The number of *F. occidentalis* and *F. fusca* immatures collected from plant samples varied significantly among plant species. *Ipomoea purpurea* (L.) Roth, *Mollugo verticillata* L., *Cassia obtusifolia* L., and *Amaranthus palmeri* S. Wats supported the largest numbers of immature *F. occidentalis*. *Richardia scabra* L., *M. verticillata*, and *Ipomoea hederacea* (L.) supported the largest numbers of *F. fusca* immatures. TSWV was present at 16 of 17 locations, and naturally occurring infections were found in 14 of 29 weed species tested. Five of the TSWV-infected species have not previously been reported as hosts of TSWV (*A. palmeri*, *Solidago altissima* L., *Ipomoea lacunosa* L., *I. purpurea*, and *Phytolacca americana* L.). Estimated rates of infection were highest in *I. purpurea* (6.8%), *M. verticillata* (5.3%), and *I. hederacea* (1.9%). When both the incidence of infection by TSWV and the populations of *F. occidentalis* and *F. fusca* associated with each weed species are considered, the following summer weed species have the potential to act as significant sources for spread of TSWV to winter annual weeds in fall: *I. purpurea*, *I. hederacea*, *M. verticillata*, *A. palmeri*, *C. obtusifolia*, *R. scabra*, *Ambrosia artemisiifolia* L., *Polygonum pensylvanicum* L., and *Chenopodium album* L.

Many Weeds Serve As Hosts For Insect And Mite Pests

Population Of Aphids On A Weed

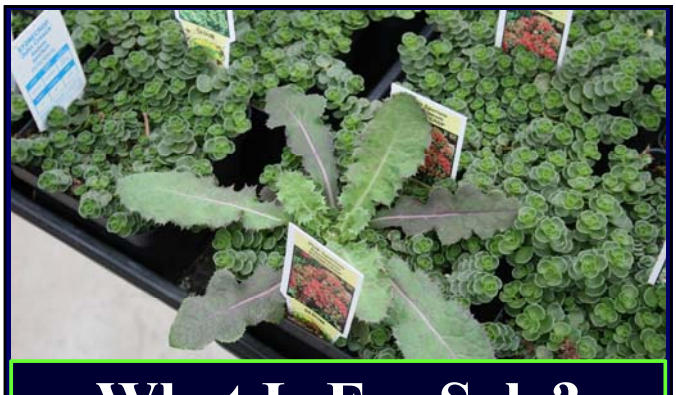
Spider Mite Feeding Damage On Weed

Weeds Are A Source Of Contamination

Common Groundsel

Creeping Woodsorrel

Does Anyone Know What These Are?



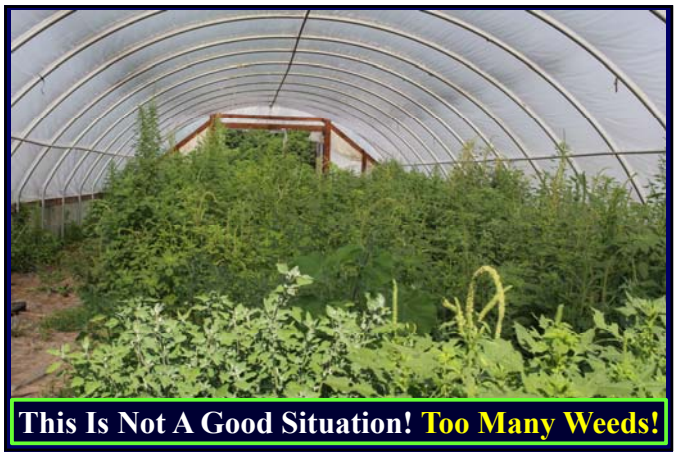
What Is For Sale?

Innocent Looking Weed?

Whiteflies On Leaf Undersides

Pigweed In Greenhouse Harboring Western Flower Thrips Population

Many Different Weed Types (Species) May Be Present In Greenhouses—Especially When Moist Conditions Persist



This Is Not A Good Situation! Too Many Weeds!

Weeds Growing Outside Of Greenhouse Openings

Gravel Placed Around The Greenhouse Perimeter Will Discourage Weed Establishment

Geotextile Fabric Barrier Can Reduce Problems With Weeds And Algae When Installed Over Floors

Installing Geotextile Fabric Barrier Over Flooring Can Substantially Reduce Problems With Weeds And Algae

Concrete Flooring Can Alleviate Problems With Algae And Weeds

Keeping Areas Of The Greenhouse Weed Free Avoids Potential Problems With Insect And Mite Pests

Even If You Have Gravel Flooring Underneath Benches—It is Important To Eliminate All Weeds—If Possible!

Removing All Weeds From Underneath Greenhouse Benches Eliminates Hosts For Insect And Mite Pests

Keep All Plant And Growing Medium Debris Away From Greenhouse Facilities!

Compost Pile Outside Of Facility: Not A Good Sanitation Practice!

Keep All Refuse Receptacles Away From Greenhouses And Ensure That Lids Are Closed!

This Situation Is OK As Long As The Dumpster Is Away From The Main Greenhouse Facility!

Do Not Leave Any Plant Or Growing Medium Debris In The Greenhouse!

Do Not Leave Water Wands On The Ground. This May Lead To A Plant Disease Problem Later On In Production!

Ensure That Water Wands Or Nozzles Are Off The Floor At All Times!

Foot Bath: Are These Effective In Preventing/Warding-Off Plant Problems?

Sanitation Duties	Name/Employee	Date
Empty refuse containers in facility	Steve Job	September 5, 2021
Dispose of plant debris in all growing areas	Jill Harbor	September 6, 2021
Remove weeds from around facility	Nick Jay	September 7, 2021
Clean/wash-out refuse containers	Amy Dunn	September 8, 2021
Power-wash concrete flooring	Tom Good	September 9, 2021

What Is Going On Here?

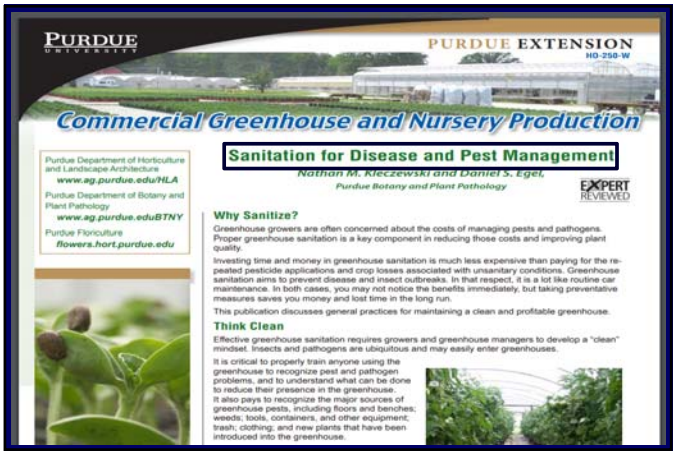
What Is Going On Here?

What Is Going On Here?

What The Heck Is Going On Here? Is This Good Sanitation?

Summary

* Always correctly identify all insect and mite pests.
* Implement proper sanitation practices.
* Develop checklist to help employees regularly perform sanitation practices.
* Place all plant and growing medium debris into refuse containers with tight-sealing lids.
* Do not allow weeds or algae to establish in greenhouses.
* Routinely train employees on the importance of maintaining sanitation practices throughout the growing season and maintain a checklist to record the completion of all sanitation duties.



Extension Publication **Sanitation Insect Pest Management In Greenhouse Production Systems (MF3592 September 2021)**

http://bookstore.ksre.ksu.edu/pubs/MF3592.pdf

The Case for Sanitation as an Insect Pest Management Strategy in Greenhouse Production Systems[1]

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Abstract Protection of greenhouse-grown horticultural crops, including ornamentals and vegetables, from damage caused by insect pests involves implementing strategies such as insecticidal and/or biological control. However, cultural control may also mitigate plant damage caused by insect pests, as well as plant diseases including fungi and bacteria. An important cultural control is sanitation. Herein, we review the use and potential impact of sanitation practices as a part of an integrated pest management program for greenhouse production. These include removing weeds from inside and around the greenhouse perimeter, disposing of plant and growing medium debris from inside the greenhouse, and managing algae within the greenhouse. Weeds serve as alternate hosts for insects, such as aphids (Aphididae), whiteflies (Aleyrodidae), and thrips (Thripidae), that can spread plant viruses among greenhouse-grown horticultural crops. Sanitation practices that may reduce problems with weeds include installing geotextile fabric barriers underneath benches and on walkways, hand removal, mowing around greenhouse perimeters, and/or applying herbicides. Plant and growing medium debris serve as sources of insect pests, such as whiteflies, thrips, and fungus gnats (Sciaridae). Therefore, removal of plant and growing medium debris from within greenhouses and/or placement into refuse containers with tight-sealing lids before disposal may reduce problems with insect pests. Algae provides a habitat for fungus gnats and shore flies (Ephydridae) to breed. Overwatering and overfertilizing plants contributes to algae growth. Applying disinfectants or algaecides may mitigate problems with algae accumulating in greenhouses. In addition to reducing insect pest problems, sanitation practices may help reduce inputs from insecticide applications.