

Formulations, Modes of Action & Staining



Formulation: definition

The material/mixture in the container at the time of purchase





Formulations

ACTIVE INGREDIENTS:

Fipronil: 5-amino-1-(2,6-dichloro-4-(trifluoromethyl)phenyl)-4-((1,R,S)-(trifluoromethyl)sulfinyl)-1-H-pyrazole-3-carbonitrile 9.1%

INERT INGREDIENTS: 90.9%



Examples of Formulations

Emulsifiable Concentrate

Solution

Ready-to-use (RTU)

Ultra-low-volume (ULV)

Aerosol

Dusts

Suspended Concentrate

Granules

Baits

Pellets

Wettable Powder

Soluble Powder

Microencapsulated

Capsule Suspension

Water-Dispersible Granules

Fumigant

Formulations Used in Massey Services' Pest Prevention Program

Dust (D)

Dry formulation

Ready to use formulation (no mixing required)

Fine particles made from talc, chalk, clay, ash

Easily drift off target during application

Ineffective/will clump if product becomes damp

Residue is easily moved off target by air & can cause irritation to eyes, nose, throat and skin

CimeXa™
insecticide dust



BorActin™
insecticide powder



Wettable Powder (WP)

Dry, finely ground

Resembles dust but must be mixed with water to apply; water needed to activate active ingredient

Particles do not dissolve in water

- Settle
- Must be constantly agitated

Poses inhalation hazard

Abrasive to application equipment

Readily clog nozzles and screens

Residues are visible



Capsule Suspension (CS)/ Microencapsulated

Active ingredient is encased in a plastic coating

Must be mixed with water

Plastic coating breaks down and slowly releases the active ingredient which prolongs the effectiveness of the product

Volatilizes more slowly



Granular Residuals (G)

Dry formulation

Similar to dust except particles are larger and heavier

Course particles made from clay, corncobs, walnut shells, old tires, etc.

Active ingredient

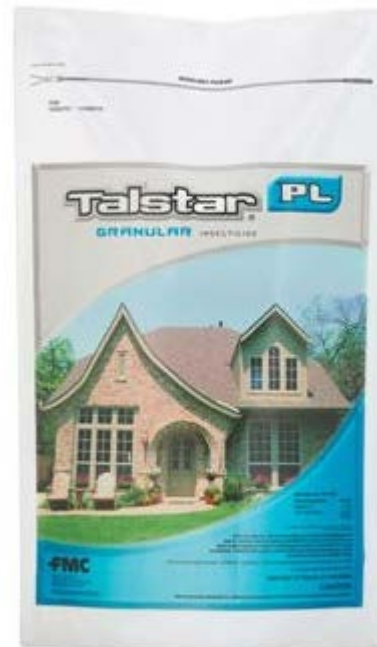
- Absorbed into the particle
- Coats the exterior

Reduces chance of drift

Low inhalation hazard

NOT mixed with water, but may need moisture to activate

Not ingested by insect; must come in contact with product



Suspended Concentrate

Considered wettable powders packaged in liquid formulation.

Consist of

- very small crystals of technical grade insecticide
- an extremely fine, inert dust
- small amount of water
- various other inert ingredients

Will settle out of suspension and require constant agitation.



Water Soluble Granulars (WSG)/ Water Dispersible Granulars

Similar to wettable powders but not dust-like; they are small, easily measured generally clumped up WP granules

Reduces the risk of inhalation

Dry/solid formulation that must be mixed with water to apply

Particles do not dissolve in water

- Settle
- Must be constantly agitated

Abrasive to application equipment

Readily clog nozzles and screens

Residues are visible





Baits

Combination of an active ingredient and a food attractant

Must be ingested to be effective

Granular Bait

- Advion Insect Granular
- Advion Fire Ant Bait
- Niban FG
- Intice Granular
- Maxforce Fly Spot Bait
- Invict X-Press
- Extinguish Plus
- Maxforce Complete

Liquid Bait

- Quantum Ant Bait
- Terro
- Intice Thiquid
- Liqua-Tox

Other

- Avert DF
- Rodenticide blocks

Gel Bait

- Advion Roach Gel Bait
- Advion Ant Gel Bait
- Optigard Ant Gel Bait
- InVict Gold
- Maxforce Magnum

Granular Baits vs Granular Residuals

Granular Baits:

Insect must
INGEST



Granular Residuals:

Insect must
CONTACT



Emulsifiable Concentrate (EC)

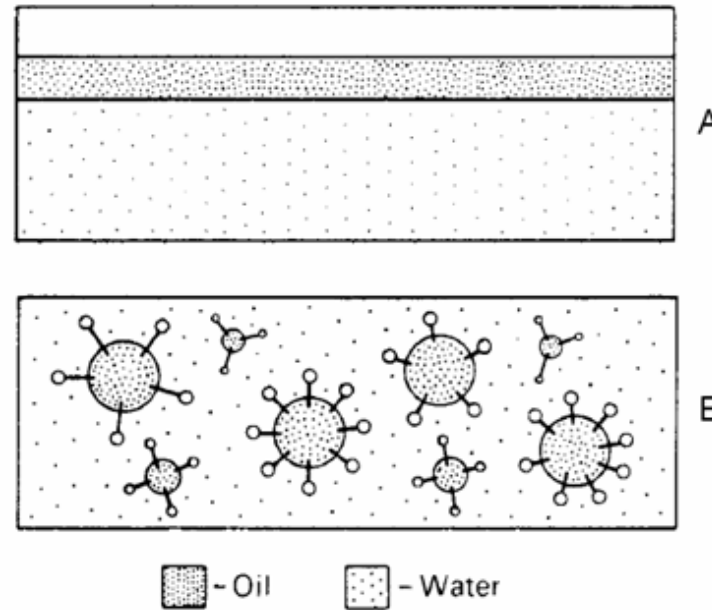
AI is dissolved in oil/petroleum-based solvent and emulsifier so the formulation can be mixed with water

Advantages

- Little agitation required; will not settle out
- Little visible residue on treated surfaces

Disadvantages

- Easily absorbed through skin
- Easy to overdose or underdose because of high concentration
- Can deteriorate rubber hoses, gaskets, etc



Choosing a Formulation

Before selecting formulations, it is helpful to understand the sites to be treated.

A complete inspection of the property will provide the information needed to select the best formulation(s) for the job.

Carefully consider these questions about formulation selection before making an application:

Can the formulation be applied safely in sensitive areas?





Is the formulation effective against the target pest?

- Identify Target Pest(s)
- Will the Material Reach the Pest(s)
- Must pests feed on or walk over material to die?



Will the formulation perform well on the surfaces to be treated?

Residuals perform differently on different surfaces

These surfaces can be described as porous, non-porous types and semi-porous

- **Porous surfaces** include: concrete, wooden mulches, unfinished wood, gypsum wallboard, paper and plastics
- **Nonporous surfaces** are glass, ceramic tile and stainless steel
- **Semi-porous surfaces** such as enamel- and latex-painted wood, vinyl tile and Formica

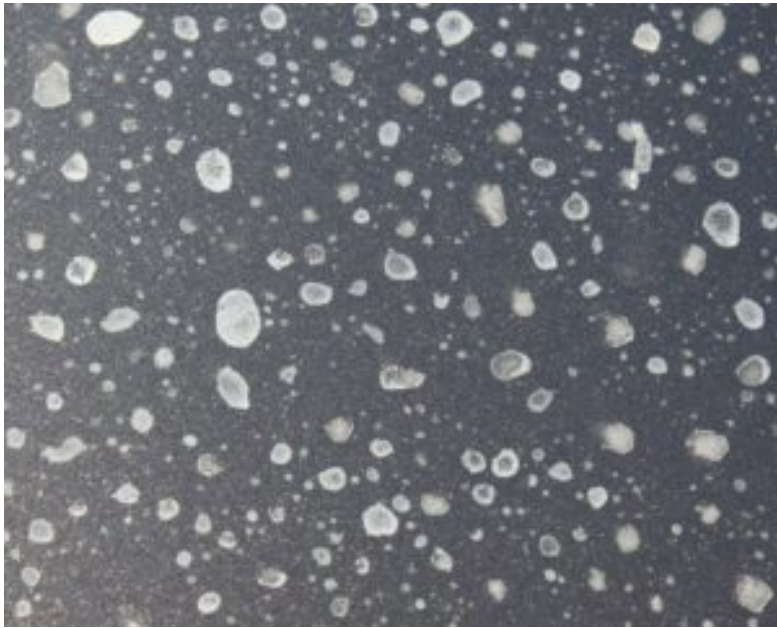
EC formulations are absorbed into porous or semi-porous surfaces

WP, SC, CS and D formulations are not easily absorbed by porous surfaces and are more readily “picked up” by crawling insect pests

Will the formulation run off or drift during or after the application?



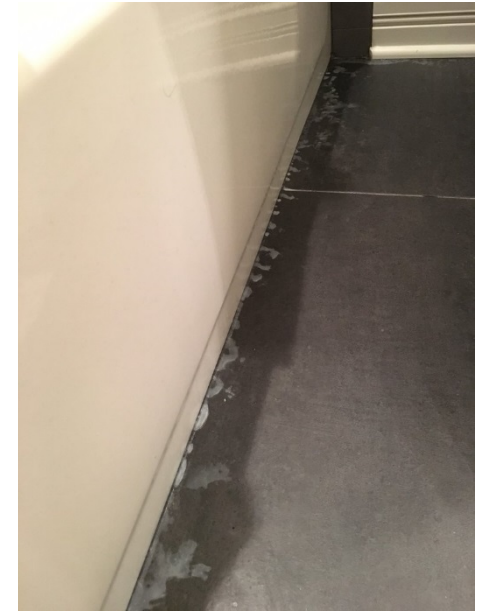
Will there be a problem with visible residues on treated surfaces?



Dried material on glass



Dried material on wallpaper



Wet material on carpet



Will there be a problem with visible residues on treated surfaces?

SOME RESIDUES WILL NEVER WASH OFF, CREATING A PERMANENT STAIN

Pass around:

- Stained Plastic
- Stained Asphalt Shingle
- Stained Wallpaper





How Do Insecticides Work?

A Few Terms to Know

Mode of Entry

- Way an insecticide enters the insect's body to reach its target site

Target Site

- Physical location within an insect where the insecticide acts

Mode of Action

- Action of an insecticide at its target site

Mode of Entry

Contact Poison

- Insect comes in contact with the chemical as it moves across a treated surface

Stomach Poison

- Insect directly feeds on bait
- Insect walks through product, picking it up on its feet or cuticle
- When grooming, ingests when feet cleaned with mouth
- Ingestion usually is more toxic to the insect than direct contact

Fumigant

- Gas/Vapor
- Enter insect through spiracles; the insect's breathing apparatus

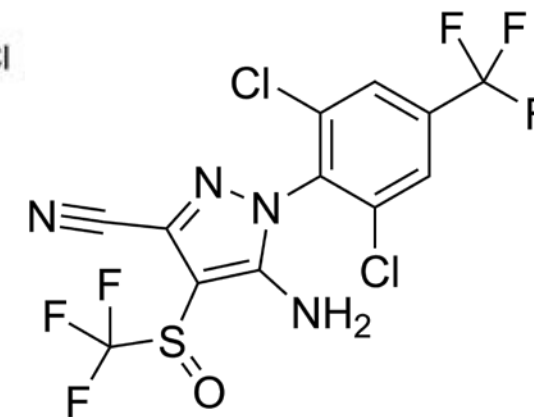
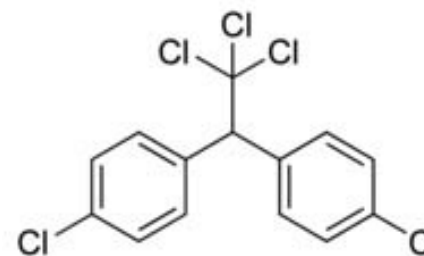
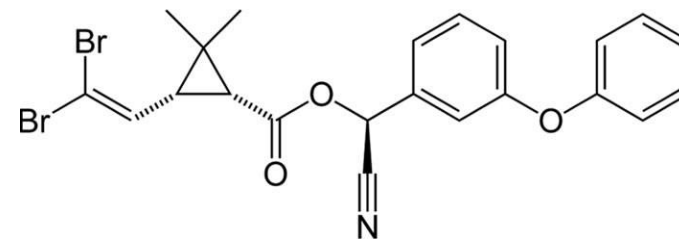
Insecticide Mode of Action

Insecticides have chemical structures that allow them to be classified based on the commonality of the active ingredient's chemistry.

Thus, all members of an insecticide class have similar characteristics.

The chemical structure of an insecticide generally defines its

- target site
- mode of action at that target site



Modes of Action of Insecticides

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graph TD; A[Modes of Action of Insecticides] --> B[Nervous System]; A --> C[Cuticle Production]; A --> D[Water Balance]; A --> E[Growth and Metamorphosis]; A --> F[Energy Production];
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Nervous System

Cuticle Production

Water Balance

Growth and
Metamorphosis

Energy Production

Target: Nervous System

Insects lose control: tremors, uncoordinated movement or become paralyzed

Chemical Classes

- Pyrethroids: Demand SC, Talstar, Tempo
- Pyrethrins: PI, BP-100, BP-300
- Oxadiazine: Advion products, Arilon
- Neonicotinoids: Premise, Maxforce Quantum
- Phenylpyrazoles: Termidor, Maxforce Magnum

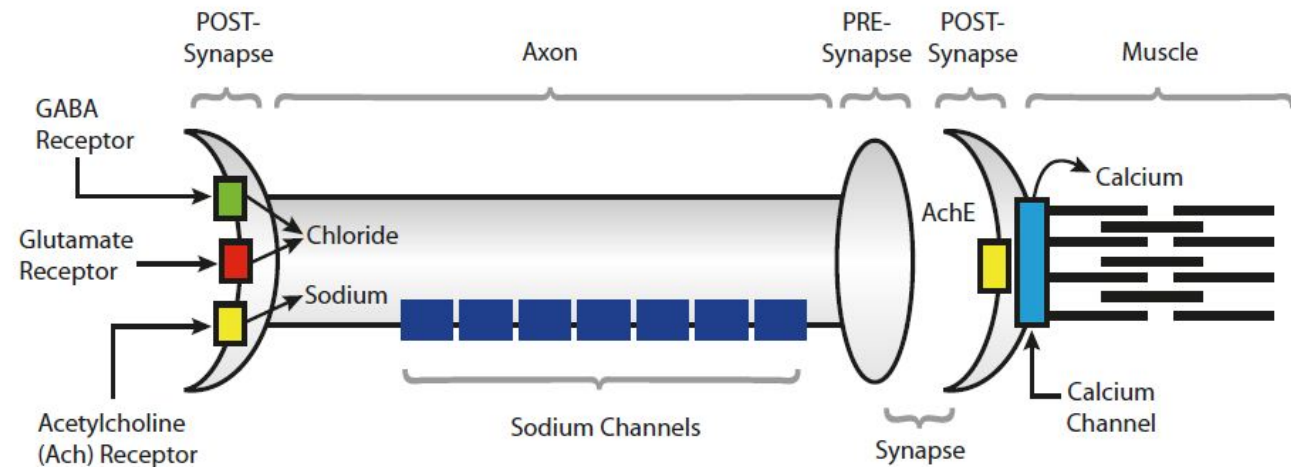
Target site: Sodium Channels

Pyrethrins and Pyrethroids keep Sodium Channels open longer

Excitatory to the nerve cell

Under normal conditions, when sodium channels are

- Open: it allows for movement of insect
- Closed: insect stops moving

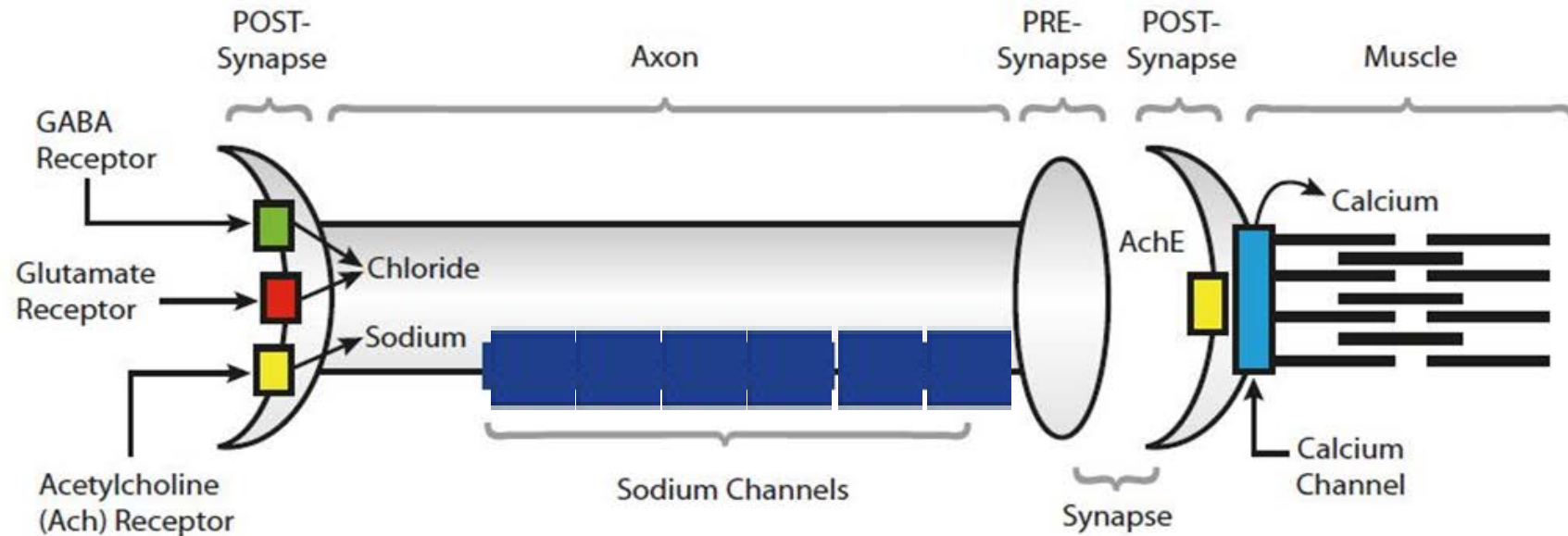


Target site: Sodium Channels

Pyrethrins and Pyrethroids keep Sodium Channels open longer

This results in uncontrolled, uninterrupted nerve firing.

Insect convulses; exhibits tremors and shaking and quickly dies.

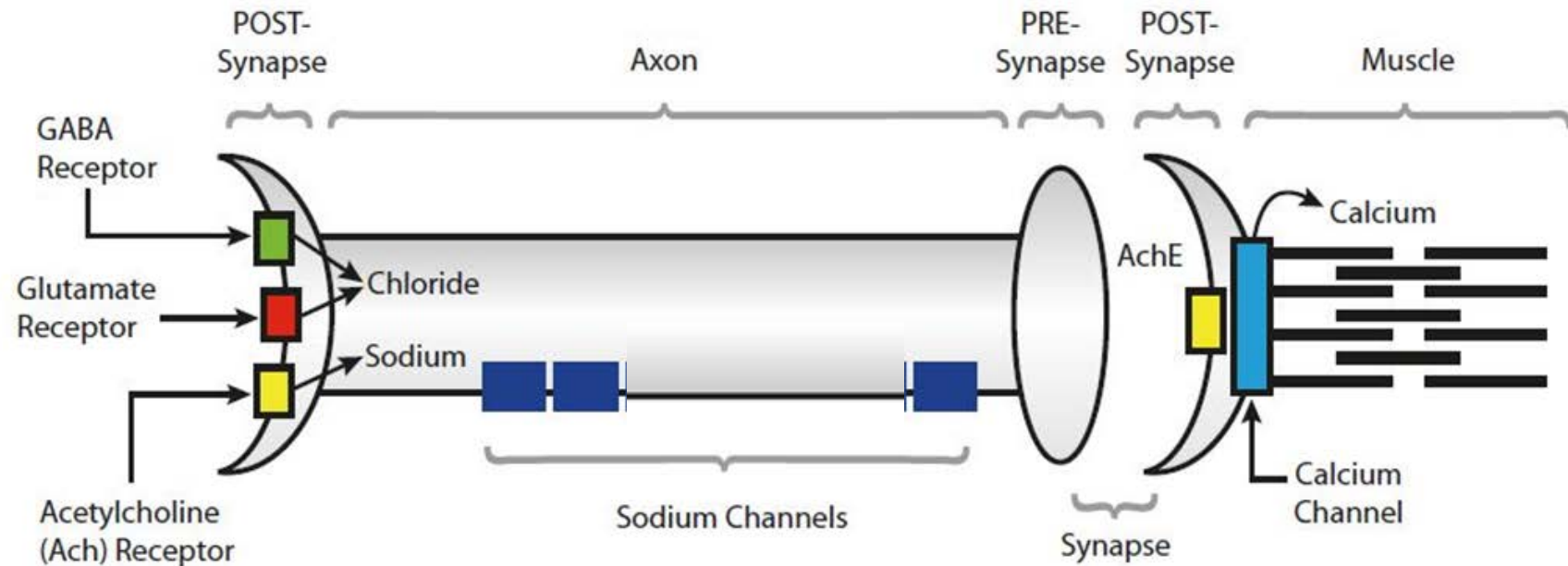


Target site: Sodium Channels

Oxadiazines: Advion & Arilon

Bind to the sodium channel and completely blocks the flow of sodium into the next nerve cell

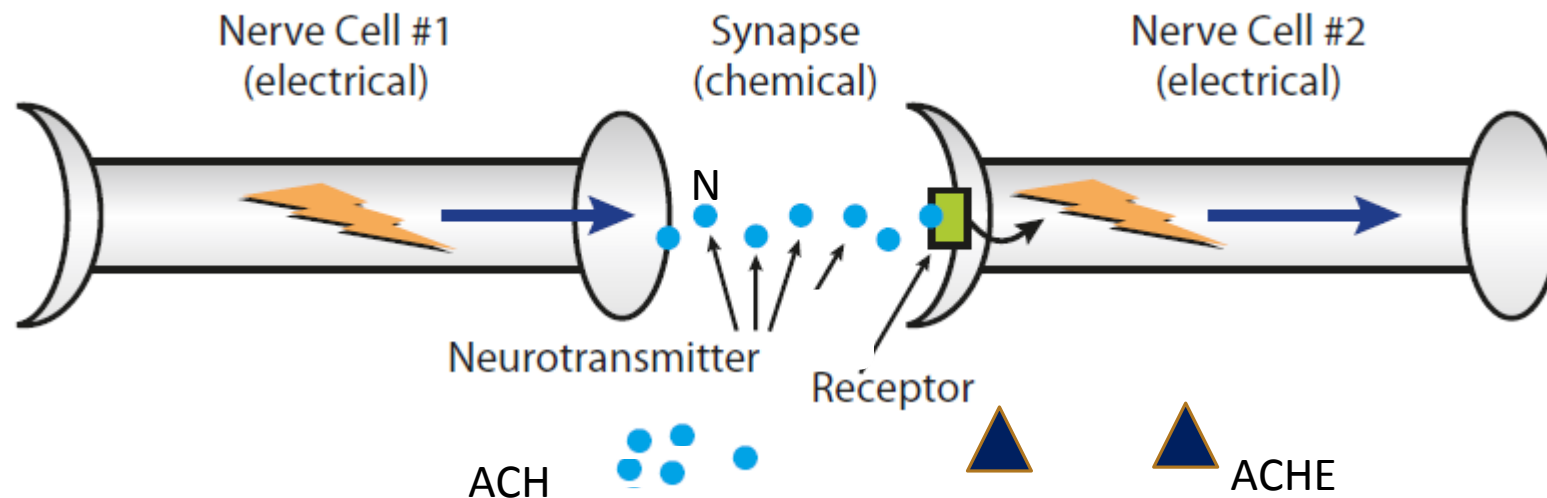
This results in insects that are incapable of movement. They are paralyzed and limp.



Target site: Acetylcholine (Ach) System

Neonicotinoids: Premise, OptiGard Ant Gel, Advance Roach Gel, Maxforce Fly Bait, Invict Gold

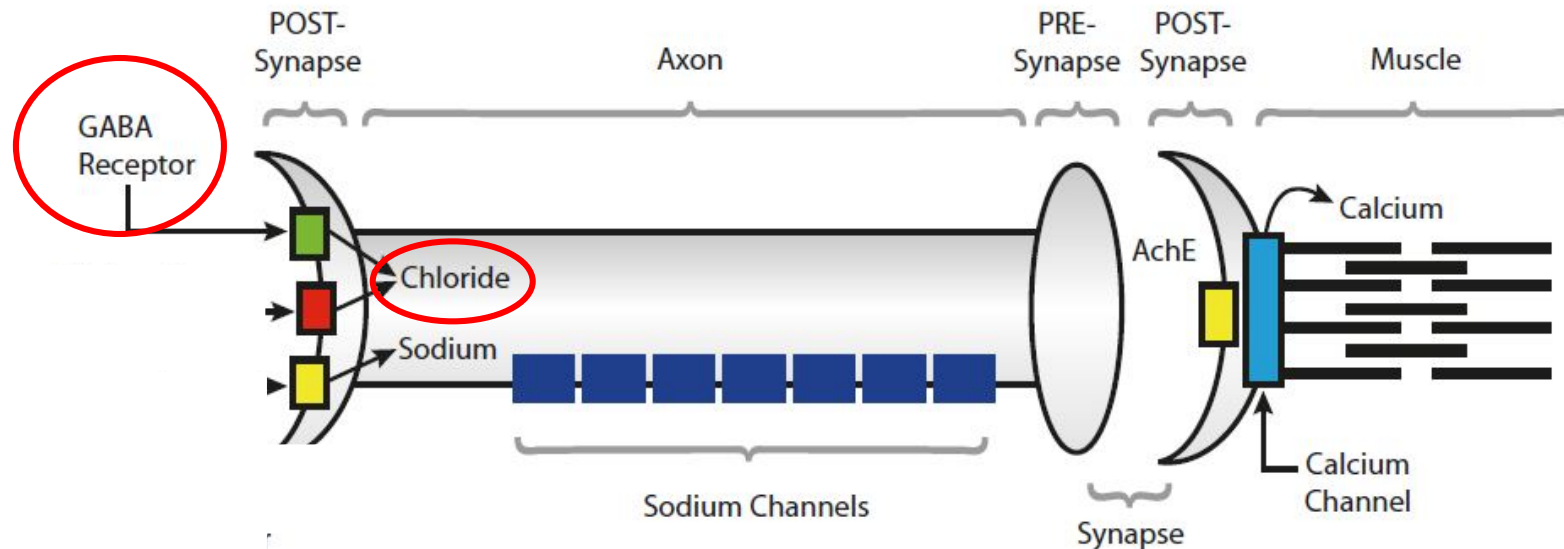
- Acetylcholinesterase (AchE) binds to Ach, making it ineffective
- AchE prevents overstimulation of the nervous system
- Without AchE, a nerve cell cannot return to its resting state, causing overstimulation, convulsions and death



Target site: Chloride Channels

Phenylpyrazole: Termidor (fipronil)

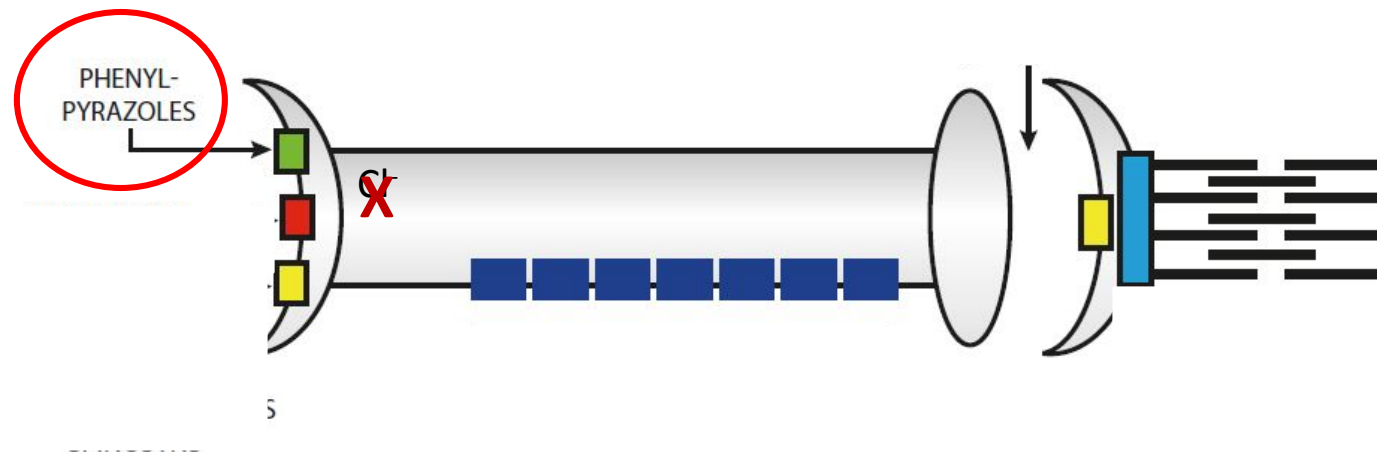
Associated with the neurotransmitter, gamma amino butyric acid (GABA) and the GABA receptor on post-synaptic nerve cell



Target site: Chloride Channels

Phenylpyrazole: Termidor (fipronil)

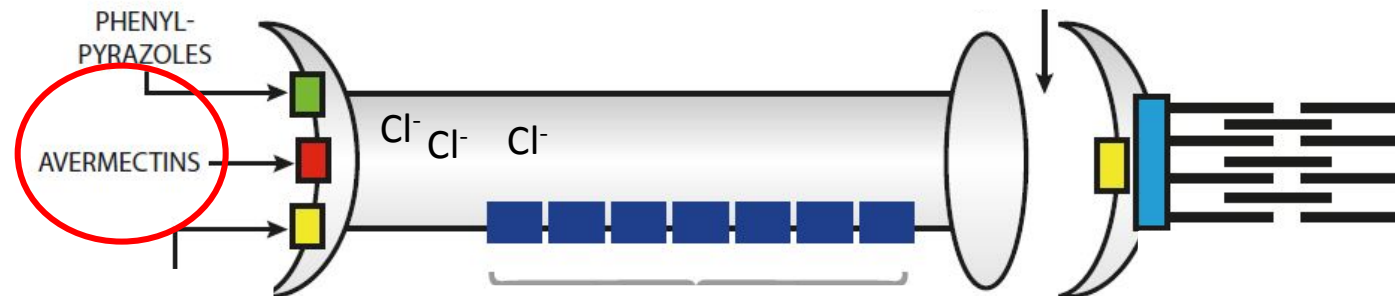
- Binds to and blocks the GABA receptor on the post-synaptic nerve cell
- Prevents GABA from binding to receptor site, which prevents chloride ions from entering the next nerve cell ➡ Rapid nerve firing & tremors



Target site: Chloride Channels

Avermectins: Avert products

- Bind to chlorine channels regulated by the neurotransmitter, glutamate
- Stimulate chlorine channels, resulting in constant flow of chlorine into nerve cell
- Results in insects that are incapable of movement. They are paralyzed and limp



Target: Growth, Reproductive and Development Systems

- Associated with disruption of normal insect growth, development and reproduction

Chemical Classes

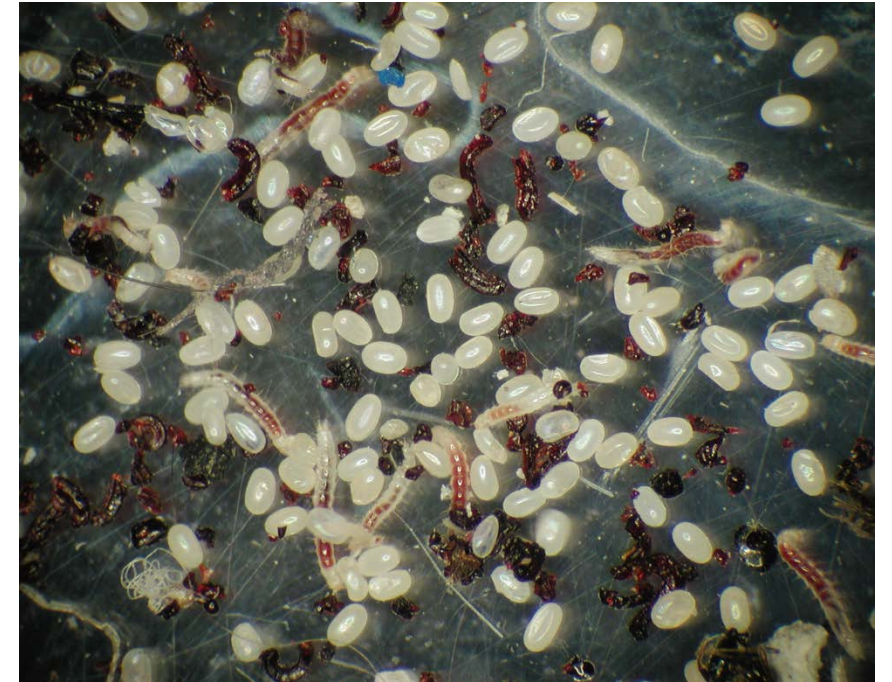
- Chitin Synthesis Inhibitors: Sentricon AA
- Juvenile Hormone Analogs: NyGuard, Gentrol, Altosid

Chitin Synthesis Inhibitors

Noviflumeron, Hexaflumeron, (SENTRICON), Lufenuron

Disrupt insect development by inhibiting an essential enzyme, chitin synthase, necessary for the production of chitin

The insect is unable to molt and dies



Juvenile Hormone (JH) Analogs

Hydroprene, Methoprene, Pyriproxifen, Fenoxycarb

JH occurs naturally in immature insects. As they mature, the level in the blood is reduced. With less JH present, insect proceeds naturally to adulthood

Application of JH Analogs, help to maintain high levels of JH in the insect.

This alteration of physiological development keeps insect in immature stage

Physical abnormalities, sterilization and ultimately death can occur



Target: Energy Production

Effect insects at a cellular level

Inhibit the production of energy in the mitochondria

Chemical Classes

- Pyrroles: Phantom
- Amidinohydrazone: Maxforce Complete, Amdro
- Metabolic Inhibitor/Cellular Toxicant: Borate based products

Target: Water Balance

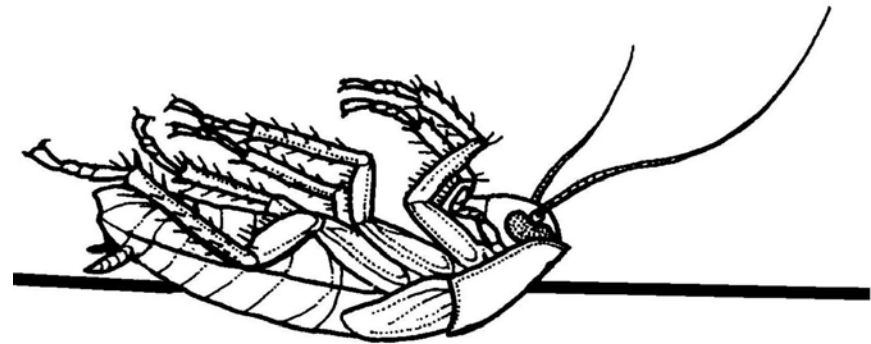
Product is absorbed by the waxy coating of the cuticle

Results in rapid water loss

Dries the insect out

Chemical Classes

- Desiccants: Borates, diatomaceous earth, CimeXa, Drione





WEEKLY TRAINING SESSION



Large Patch Fungus in Turf

Topic Category: Lawn

Recordable Verifiable Training Hours: 1

Objectives: This lesson is designed to teach the basics of Large Patch Fungus biology and management.

Length of lesson: Minimum of 60 minutes to Qualify for Department of Agriculture ID Cardholder Training.

Materials needed:

- Department of Agriculture ID Cardholder Training Form (one for each Team Member) This form can be found in the G: Drive Quality Assurance\GreenUp Reference Materials\Weekly Training Sessions\Current Months
- GreenUP Protocol Large Patch (Brown Patch) Fungus – on the G: Drive Quality Assurance\GreenUp Reference Materials\GreenUp Protocols\Individual Protocols\Lawn Damaging Diseases
- Collect samples of Large Patch from the field, if available.
- Florida Lawn Handbook (SECOND EDITION), page 212, plate 89. **or** Florida Lawn Handbook (Third Edition), page 138-139, plate 73,74 and 75
- Pre- and Post- tests.

Training Guidelines:

- Make copies of the tests and training materials for all Team Members attending.
- Set up the training area in an area of the office that will minimize disruptions.
- **Have each Team Member complete a Department of Ag ID Cardholder Training form**
- Begin the meeting by defining the training topic and handing out the Pre-test
 - Allow a few minutes for Team Members to complete the Pre-test.
 - Collect the pre-test and hand out the Verifiable Training Record Form (VTRF)
- Distribute and review the training materials on Large Patch.
 - Encourage active participation from all Team Members
 - Ask probing questions to develop key points
 - Encourage group reading
- After reading and reviewing all materials, ask questions to verify the lesson has been understood.
- Hand out the Post-tests. When complete, grade the tests and record the score on the VTRF.
- Collect tests and place with the verifiable materials in the Service Center Verifiable Training File.
- Make copies of the VTRF and place in each Team Member's training file.
- Complete all Weekly VTM's through Massey University
- Place each Team Member's Department of Agriculture ID Cardholder Training Form in their individual training file.



WEEKLY TRAINING SESSION



Large Patch Fungus in Turf

Pre and Post Test

1. Large Patch is caused by a
 - a. Bacteria
 - b. Fungus
 - c. Virus
 - d. Aphids
2. T or F Symptoms of Large Patch appear as ring of fire, yellow blades, base of affected blade is brown, water soaked and has a rotten smell.
3. Large Patch prefers
 - a. Over 90 degrees and dry weather
 - b. Below 80 degrees and humid weather
 - c. Over 90 degrees and humid weather
 - d. Below 80 degrees and dry weather
4. The best control measure is _____.
 - a. Proper cultural practices
 - b. Armada
 - c. Affirm
 - d. Both b and c
5. What grass type is likely to be infected?
 - a. St. Augustine
 - b. Centipede
 - c. Zoysia
 - d. Any of the above
6. T or F A severe Large Patch infection will typically kill the turf.
7. When Large Patch is active, _____ is applied for control.
 - a. Pillar and Armada
 - b. Affirm
 - c. Armada
 - d. Both b and c



WEEKLY TRAINING SESSION



Large Patch Fungus in Turf

8. _____ is used for the prevention of Large Patch.
 - a. Pillar or Armada
 - b. Affirm
 - c. Armada
 - d. Both b and c
9. T or F Turf that was infected last year will most likely be re-infected this year.
10. T or F The application rate (in a fluid ounce measuring cup) for Affirm WDG and Armada WDG is 1.6 and 2.5 ounces per 1000 sq. ft. respectively.
11. T or F The follow-up interval for a treatment with Affirm and Armada is 30 days.
12. T or F The application rate for Pillar G is 3 pounds per 1000 sq. ft.
13. T or F The follow-up interval for Pillar or Armada WDG is 2 weeks.



WEEKLY TRAINING SESSION



Large Patch Fungus in Turf

Pre and Post Test Answers

1. Large Patch is caused by a
 - a. Bacteria
 - ☒ b. Fungus
 - c. Virus
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WEEKLY TRAINING SESSION



Large Patch Fungus in Turf

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12. ☒ T or F The application rate for Pillar G is 3 pounds per 1000 sq. ft.
13. T or ☒ F The follow-up interval for Pillar or Armada WDG is 2 weeks.



GreenUP Service Protocols

Large Patch Fungus in Turf

Large Patch fungus (formerly referred to as Brown Patch fungus) is a common disease of all warm season turf grasses. It is very common in St. Augustine, Centipede, Bermuda and Zoysiagrass. Shade tolerant varieties of St. Augustine such as Seville are often the most severely affected.

Pathogen

Large patch is caused by the fungus *Rhizoctonia solani*. This fungus affects the base of the leaf sheath where the blade attaches to the stolon. It rots off the blade, causing the leaf to decline. It does not, however, damage the stolon or the roots of the plant.

Symptoms

The affected blades will yellow at the onset of infection. The disease will then begin to spread to neighboring turf. As the infection progresses, the blades begin to brown and the pattern can take on a ring shape. The outer edge of the ring begins to yellow, followed by a band of orange-brown turf. The grass blades inside these bands can be water-soaked and gray, with possible green tissue in the very center of the circle. Since this fungus does not affect the stolon of the plant, new leaf tissue will begin to grow after the fungus has moved on. This will give the appearance of a yellow and brown ring with healthy turf in the center (Figure 1). The pattern can grow large enough that the ring becomes large arcs across the turf. As a result, this disease is often called the “ring of fire”.



Figure 1



Figure 2

The easiest way to distinguish Large Patch from other causes of turf decline is to pull on the leaf blade. Leaf blades affected by Brown Patch will detach very easily from the stolon and slide out of the sheath. Inspection of the base of the blade will show dark water soaked tissue with a rotten smell (Figure 2). This can be confused with damage from phenoxy herbicides (i.e.- 2,4-D, MCP, MCPA, Dicamba); the base of phenoxy damaged turf is a brighter red color and the stolon nodes are brittle.

Conducive Conditions

Large Patch fungus develops most rapidly when the air temperatures are below 80° and free moisture is present on the leaf. Infection is triggered by rainfall, excessive irrigation or extended periods of high humidity resulting in the leaf canopy being continually wet for 48 hours or more. These conditions occur most often and for longer duration in the fall and in the late winter/early spring. High levels of readily available nitrogen will also increase the severity of the disease. Fungal activity generally stops when air temperatures reach 90°; therefore, it is normally not active during the summer. If symptoms are active during the summer, the cause may be another form of Large Patch known as sheath blight or *Rhizoctonia zereae*.



Large Patch Fungus in Turf

Control

Once the disease has infected the plant, control is required. To control this disease, we refer to the Disease Triangle (Figure 3). In order for a disease to fester and spread, it needs three things:

- The Pathogen
- The Host
- The Conducive Condition

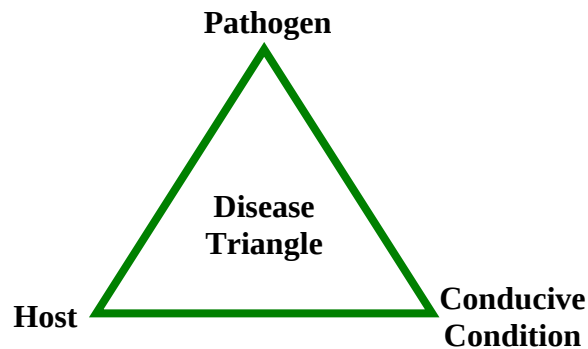


Figure 3. Disease Triangle

The removal of any one of these three will result in the control of the disease. The Disease Triangle for Large Patch is represented by Figure 4. Control can be achieved by:

- Replacing turf with landscaping
- Changes in the environment
- Application of a fungicide

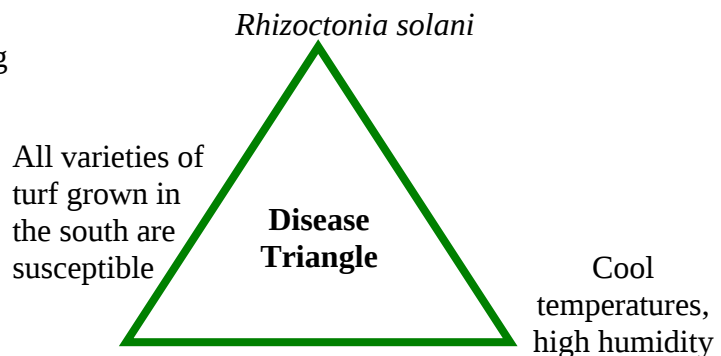


Figure 4. Disease Triangle for Large Patch

Cultural control is the best method and should always be attempted. Cultural control for Large Patch would include the removal of the conducive conditions. This would mean:

- Eliminating excess moisture through proper irrigation practices such as watering only when the turf wilts and only during the early AM hours.
- Reducing or eliminating free nitrogen applications. We apply slow release nitrogen during this time period to reduce the chances for this disease to take hold.

A more severe cultural control method would be the removal of the host plant and replacing it with a landscaping plant (i.e. tree or shrub) or other ground cover. This is rarely an option but remember it is an option!



GreenUP Service Protocols

Large Patch Fungus in Turf

Certain times of the year, typically fall and spring, the climate or weather provides the conducive conditions. It is then that chemical control needs to be applied. Customers who have had problems with Large Patch in the past should be identified for treatment when the soil temperatures go down to about 70 degrees. Assuming the disease symptoms are not present, Armada WDG would be applied at this time for prevention. Another application would be performed 3 to 4 weeks afterwards using Armada again or you can switch to Pillar G.

When a problem with Large Patch arises and symptoms of damage is identified, an application of Affirm WDG with Armada WDG is performed. Affirm will provide very good control of an existing Large Patch problem, but the residual effects do not last as long as Armada WDG. When Affirm and Armada are applied for an existing problem, Pillar G must be applied 30 days later. 3 to 4 weeks after this treatment, Armada WDG is reapplied.

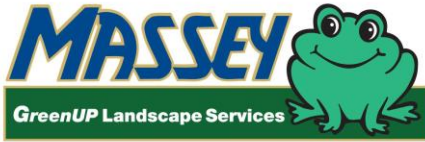
Affirm WDG and Armada WDG are liquid applied systemic fungicides, but with different active ingredients. Armada WDG is a combination of two highly effective active ingredients. Both products (as well as Pillar G) travel upward in the water flow system (xylem) of the plant. These fungicides need to be applied with a sufficient amount of water to put the material where the fungus is active; at least 2 gallons of water per 1000 sq. ft. is recommended. They will work particularly well when applied out of a droptank at 5 gallons of water per 1000 sq. ft. If there is need to apply these fungicides from a backpack sprayer, an 8010E spray tip must be used and the treatment must be watered in ASAP with a light application of water. The required PPE for Armada WDG and Affirm is long sleeved shirt, long pants, waterproof gloves, and shoes with socks.

Pillar G is used at 3 pounds per 1000 sq. ft. (spreader setting 10 with the Lesco calibration tool) for prevention and control. Proactive retreatments are performed at 14 to 21 day intervals. Eye protection is required PPE in addition to those listed above for Affirm and Armada.

When the disease has been controlled or suppressed, the damage will stop spreading. The affected portions of turf will begin recover (although slowly due to the cooler weather). Since the disease organism is not completely removed from the area after treatment, infection can occur (or re-occur) as long as the environmental conditions favoring the development of the disease persist. If the symptoms of re-infestation occur and the Large Patch becomes active again, start the same procedure again with the Affirm and Armada and then 3 to 4 weeks later retreat with Pillar G.

Since the disease can occur in the same general locations, year after year when favorable environmental conditions are present, set the proper expectation with the customer.

The application rate for Affirm is 0.9 ounces (by weight) per 1000 sq. ft. 0.9 ounces of Affirm looks like 1.6 ounces in a fluid ounce measuring cup. The application rate for Armada is 1.5 ounces (by weight) per 1000 sq. ft. 1.5 ounces of Armada looks like 2.5 ounces in a fluid ounce measuring cup. When applications are made from a droptank, mix only the amount that you would expect to use in one day. Measure the water accurately using the measuring stick. The pump and hose lines will hold about 5 gallons of water. If the fungicide was not used immediately prior to the application, an additional 1000 sq. ft. worth of product would be added to the tank. For example, if you were mixing 25 gallons in the droptank, 5000 sq. ft. would be covered. But if the pump and hose lines do not already have the fungicide product in them, 6000 sq. ft.

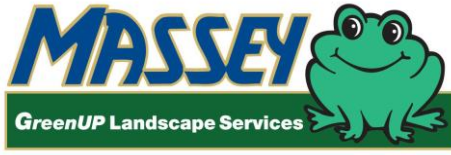


GreenUP Service Protocols

Large Patch Fungus in Turf

worth of product would be added to the tank. Then the application wand would be put into the tank to agitate the mixture and to ensure fungicide has made its way through the pump and hose.

When making spot applications make sure to treat a few feet beyond the affected area to prevent the advancement of the disease. Avoid walking through Large Patch affected areas when possible. Large Patch can be spread by walking through infected turf onto unaffected turf. This does not mean we avoid making our regular application to the affected area. It is free nitrogen, that can cause the disease to take hold, the nitrogen in our regular service applications are slow release for this reason. Do not apply any additional supplemental nitrogen to affected areas.



WEEKLY TRAINING SESSION



Branch Canker and Dieback of Various Cypress Species

Topic Category: Lawn

Recordable Verifiable Training Hours: 0.5

Objectives: This lesson is designed to teach the various causes of branch dieback of various cypress species.

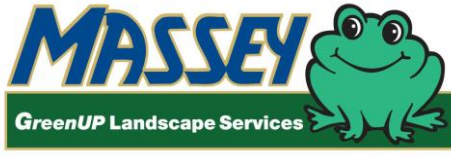
Length of lesson: Approx 30 minutes.

Materials needed:

- Training Guideline
- GreenUP Protocol Branch Canker and Dieback of Various Cypress Species Training Document
- Collect samples of Seiridium Canker from the field, if available.
- Pre- and Post- tests.

Training Guidelines:

- Make copies of the tests and training materials for all Team Members attending.
- Set up the training area in an area of the office that will minimize disruptions.
- Begin the meeting by defining the training topic and handing out the Pre-test
 - Allow a few minutes for Team Members to complete the Pre-test.
 - Collect the pre-test and hand out the Verifiable Training Record Form (VTRF)
- Distribute and review the training materials on Branch Canker and Dieback of Various Cypress Species
- Use the Training outline as a guide for key points.
 - Encourage active participation from all Team Members
 - Ask probing questions to develop key points
 - Encourage group reading
- After reading and reviewing all materials, ask questions to verify the lesson has been understood.
- Hand out the Post-tests. When complete, grade the tests and record the score on the VTRF.
- Collect tests and place with the verifiable materials in the Service Center Verifiable Training File.
- Make copies of the VTRF and place in each Team Member's training file.
- Complete all Weekly Training VTM's through Massey University.



WEEKLY TRAINING SESSION

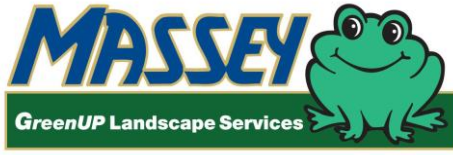


Branch Canker and Dieback of Various Cypress Species

Name _____ Date _____

PRE & POST TEST

1. T or F Brown branches on Leyland Cypress or junipers are only caused by fungal branch cankers.
2. The common causal organisms of fungal branch cankers in shrubs and trees in the cypress or juniper family are typically...
 - a. Sphaeropsis
 - b. Seiridium
 - c. Botryosphaeria
 - d. Either b or c
3. T or F Small black spore masses from fungal diseases are called pycnidia.
4. T or F Symptoms of these fungal cankers appear as oval shaped sunken or depressed areas of wood in a branch or multiple branches. Small black spore masses (pycnidia) and sap ooze may be present as well.
5. The spores of the fungal organism typically enter the plant from wounds caused by.
 - a. Insects or hail
 - b. mechanical injury
 - c. wood damage from drought
 - d. any of the above
6. T or F Spores are most active during dry weather.
7. T or F Dieback symptoms are typically expressed during dry weather.
8. T or F Southern Red Cedar and Atlantic White Cedar are equally susceptible to these fungal cankers as Leyland Cypress.
9. T or F Branch cankers need to be removed by cutting off the branch a few inches below the area of infection.
10. T or F Armada has been proven effective against these branch fungal cankers.



WEEKLY TRAINING SESSION



Branch Canker and Dieback of Various Cypress Species

PRE & POST TEST ANSWER KEY

1. T or ☒ F Brown branches on Leyland Cypress or junipers are only caused by fungal branch cankers.
2. The common causal organisms of fungal branch cankers in shrubs and trees in the cypress or juniper family are typically...
 - a. Sphaeropsis
 - b. Seiridium
 - c. Botryosphaeria
 - ☒ d. Either b or c
3. ☒ T or F Small black spore masses from fungal diseases are called pycnidia.
4. ☒ T or F Symptoms of these fungal cankers appear as oval shaped sunken or depressed areas of wood in a branch or multiple branches. Small black spore masses (pycnidia) and sap ooze may be present as well.
5. The spores of the fungal organism typically enter the plant from wounds caused by.
 - a. Insects or hail
 - b. mechanical injury
 - c. wood damage from drought
 - ☒ d. any of the above
6. T or ☒ F Spores are most active during dry weather.
7. ☒ T or F Dieback symptoms are typically expressed during dry weather.
8. T or ☒ F Southern Red Cedar and Atlantic White Cedar are equally susceptible to these fungal cankers as Leyland Cypress.
9. ☒ T or F Branch cankers need to be removed by cutting off the branch a few inches below the area of infection.
10. ☒ T or F Armada has been proven effective against these branch fungal cankers.

Branch Canker and Dieback of Various Cypress Species

Localized branch dieback on various species of evergreen shrubs and trees, such as Leyland Cypress, Italian Cypress and junipers is fairly common. There are numerous potential causes of a branch or a few branches dying on an evergreen shrub or tree.

When diagnosing these types of problems, begin your inspection at the tip of the branch and inspect your way toward the trunk. Look at the bark area for any type of damage. The branch could be broken or cracked; the bark (phloem) could be girdled or cut; or you could have a canker or gall type fungal disease.

Shrubs and trees in the cypress and juniper family are often affected by branch fungal cankers caused by *Seiridium* or *Botryosphaeria*. These branch fungal cankers appear as oval shaped sunken or depressed areas of wood under the bark in a branch or multiple branches. Small black spore masses (pycnidia) may be present as well. Sap ooze at or near the area of infection is very common with either of these diseases.

These fungal cankers may effect single or multiple branches. The ends of the branches would first turn a faded green or grayish green and then to golden brown and finally reddish brown. Ultimately, more branches would be effected and then result in death of the entire tree.



Figure 1 – Branch canker with pycnidia

Branch Canker and Dieback of Various Cypress Species



Figure 2 – Branch dieback



Figure 3 – Dieback on multiple branches

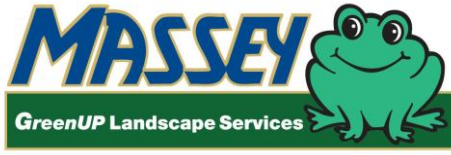


Branch Canker and Dieback of Various Cypress Species

Spores from either of these diseases enter the tree through any type of wound or crack in the bark tissue. These wounds could be caused by insects, hail, mechanical injury or wood damage from drought. The spores are most active and infection occurs most often during wet weather, but the die-back symptoms are typically noticed in hot dry weather.

Cultural management of the disease includes selecting evergreens that are less susceptible to these diseases such as Southern Red Cedar or Atlantic White Cedar. Proper installation and initial care of susceptible evergreens as well as controlling insect pests will greatly reduce the potential for infection.

Armada has been proven effective at suppressing these diseases. Treatments for susceptible plants would be performed with a liquid application to the branches and trunk as well as a drench to the root system. Areas of damage must be pruned out at least 4 inches below the point of infection. The cutting tool must be sterilized after each cut using either Lysol, alcohol or 10% Clorox to water solution. If fungal cankers are present on the trunk, particularly the lower portion of the trunk, it is likely that the tree will need to be removed.



WEEKLY TRAINING SESSION



Invasive Whitefly Protocol

Topic Category: Lawn

Recordable Verifiable Training Hours: 0.5 to 1

Objectives: This lesson is designed to teach how to identify two new invasive whitefly pests, the control methods and treatment pricing.

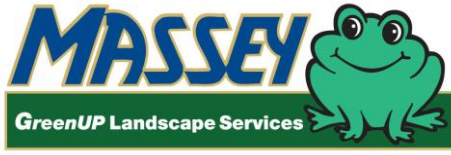
Length of lesson: Approximately 30 to 60 minutes.

Materials needed:

- Training Guideline
- Invasive Whitefly Protocol Training Document
- Collect samples of the Ficus fig and Rugose whitefly from the field, if available.
- Pre- and Post- tests.

Training Guidelines:

- Make copies of the tests and training materials for all Team Members attending.
- Set up the training area in an area of the office that will minimize disruptions.
- Begin the meeting by defining the training topic and handing out the Pre-test
 - Allow a few minutes for Team Members to complete the Pre-test.
 - Collect the pre-test and hand out the Verifiable Training Record Form (VTRF)
- Distribute and review the Invasive Whitefly Protocol.
 - Encourage active participation from all Team Members
 - Ask probing questions to develop key points
 - Encourage group reading
- After reading and reviewing all materials, ask questions to verify the lesson has been understood.
- Hand out the Post-tests. When complete, grade the tests and record the score on the VTRF.
- Collect tests and place with the verifiable materials in the Service Center Verifiable Training File.
- Make copies of the VTRF and place in each Team Member's training file.
- Complete all Weekly VTM's through Massey University.



WEEKLY TRAINING SESSION

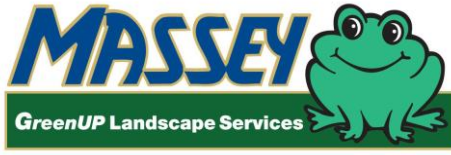


Invasive Whitefly Protocol

Name _____ Date _____

PRE & POST TEST

1. T or F Two new invasive whitefly species are the Ficus Fig whitefly and the Rugose whitefly.
2. T or F The Ficus Fig whitefly is a very damaging pest of many whitefly species.
3. T or F The body of the Ficus Fig whitefly is brown in color. The wings are white with a faint grey band across the wings.
4. T or F The Rugose whitefly will produce an abundance of white waxy material, egg masses laid in spiral patterns, and honeydew with the resulting sooty mold.
5. T or F Whitefly eggs are laid underneath their wax covering.
6. T or F Both the male and female adult stages are tiny white flies.
7. T or F Adult whiteflies feed on the plant.
8. T or F Control of these two invasive whiteflies in shrubbery is performed using Imidacloprid as a root drench and Forbid as a foliar spray.
9. T or F A Ficus hedge that is 8 feet high, **6 feet wide** and **75 feet long** will require **36 gallons** of Imidacloprid drench.
10. T or F The charge to treat the same Ficus hedge would be \$300.
11. T or F Larger palms or trees are treated with Ima-jet and the Arborjet injection system.



WEEKLY TRAINING SESSION



Invasive Whitefly Protocol

PRE & POST TEST ANSWER KEY

1. ☒ T or ☐ F Two new invasive whitefly species are the Ficus Fig whitefly and the Rugose whitefly.
2. ☒ T or ☐ F The Ficus Fig whitefly is a very damaging pest of many whitefly species.
3. ☐ T or ☒ F The body of the Ficus Fig whitefly is brown in color. The wings are white with a faint grey band across the wings.
4. ☒ T or ☐ F The Rugose whitefly will produce an abundance of white waxy material, egg masses laid in spiral patterns, and honeydew with the resulting sooty mold.
5. ☐ T or ☒ F Whitefly eggs are laid underneath their wax covering.
6. ☒ T or ☐ F Both the male and female adult stages are tiny white flies.
7. ☐ T or ☒ F Adult whiteflies feed on the plant.
8. ☒ T or ☐ F Control of these two invasive whiteflies in shrubbery is performed using Imidacloprid as a root drench and Forbid as a foliar spray.
9. ☒ T or ☐ F A Ficus hedge that is 8 feet high, 6 feet wide and 75 feet long will require 36 gallons of Imidacloprid drench.
10. ☐ T or ☒ F The charge to treat the same Ficus hedge would be \$300.
11. ☒ T or ☐ F Larger palms or trees are treated with Ima-jet and the Arborjet injection system.

Invasive Whitefly Protocol

There are currently two invasive whitefly species attacking South Florida in great numbers. One is the Ficus Fig Whitefly (*Singhiella simplex*) the other is the Rugose Whitefly (*Aleurodicus rugioperculatus*). As of November 2012, the Rugose Whitefly has made its way northward to Brevard County on the east coast and Pinellas County on the west coast.

The Ficus Fig Whitefly is a very damaging pest to many of the Ficus species; primarily *Ficus benjamina*. Severe infestations of Ficus Fig Whitefly will cause massive leaf drop and defoliation. If the foliage is disturbed, there will be clouds of tiny white, gnat-like adult whiteflies flying from the foliage. The body of the adult whitefly is yellow in color and the wings are white with a faint grey band towards the middle of the wing. Immature stages (eggs, nymphs and pupae) can be found on the underside of the leaves. The pupae are small tan to light green discs with red eyes measuring about 1.3 mm long and 1 mm wide.



The Rugose Whitefly will infest a very wide range of plant material. It is not typically as damaging to the plant as the Ficus Fig Whitefly, but produces an abundance of white, waxy material (Figure 1), egg masses laid in spiral patterns (Figure 2), honeydew and the resulting sooty mold.



Figure 1-Rugose Whitefly Waxy Byproduct



Figure 2-Rugose Whitefly Egg Masses

All whiteflies have a similar lifecycle. Eggs are laid under leaf surfaces. Crawlers hatch from the eggs and crawl across the leaf until they find a spot to feed. Once inserting their piercing sucking mouthparts, they will remain in the same spot until reaching the adult stage. The nymphs pass through 2 additional feeding stages before going into the pupal stage. They pupate underneath their wax covering and both the male and female adult stages emerge



Invasive Whitefly Protocol

through a "T" shaped slit as the tiny white flies. The entire lifecycle takes approximately 16 days. It is important to know that the adult stage does not feed on the plant.

Both of types of whitefly are controlled on shrubbery in the same manner; a drench of the root system is performed using Imidacloprid (Criterion or Zenith 2F) and a liquid application to the foliage is performed using Forbid.

The Forbid foliage application will provide good control of the egg, nymph and even the pupa stages within about 10 days. The Imidacloprid drench will take a number of weeks before the product reaches all areas of the plant, but will provide longer residual for further control and to protect against future infestations.

Imidacloprid Drench:

The amount of mix needed will depend on the square footage of the area being treated and the height of the shrub (Cubic Feet). The rate is 1 gallon of drench for every 100 cubic feet of shrub bed. To calculate the total amount of mix needed, multiply the length times the width of the shrub bed and then multiply this number times the height of the shrub and divide by 100.

Example 1: If a Ficus hedge was 50 feet long with a bed area of 4 feet wide and a height of 5 feet, $50 \times 4 \times 5 = 1000$ cu. ft. 1000 divided by $100 = 10$. 10 gallons of drench will be needed.

Example 2: If a Ficus hedge was 50 feet long with a bed area of 8 feet wide and a height of 12 feet, $50 \times 8 \times 12 = 4800$ cu. ft. 4800 divided by $100 = 48$. 48 gallons of drench will be needed.

Mix 0.2 ounces of Criterion or Zenith 2F for every 10 gallons of water needed.

Forbid Foliage Application:

Use the Forbid Spot Treatment Slurry at 2 ounces per 10 gallons of water. This slurry can be found in the G: Drive\Quality Assurance\GreenUp Reference Materials\Van Label Sets\Slurry Labels\Current Slurries\Back Pack Slurries\Shrub. These treatments should be performed on a quarterly basis to maintain control. When control has been achieved, the Forbid application is no longer necessary. The Imidacloprid Drench will act as the preventative.

Our charge for this treatment is a minimum of \$50 or \$2.50 per 100 cu. ft. of bed area. (Length x Width x Height divided by 100 x \$2.5)

Example 1: If a Ficus hedge was 50 feet long with a bed area of 4 feet wide and a height of 6 feet, $50 \times 4 \times 6 = 1200$ cu. ft. 1200 divided by $100 = 12$ $12 \times \$2.5 = \30 , so the minimum charge of \$50 would apply.

Example 2: If a Ficus hedge was 50 feet long with a bed area of 8 feet wide and a height of 12 feet, $50 \times 8 \times 12 = 4800$ cu. ft. 4800 divided by $100 = 48$ $48 \times \$2.5 = \120 .

Larger palms or trees are treated twice a year with Ima-jet using the Arborjet injection system. See the GreenUP Protocol Palm and Tree Injection for Insect Control



WEEKLY TRAINING SESSION



Large Patch Fungus in Turf

Topic Category: Lawn

Recordable Verifiable Training Hours: 1

Objectives: This lesson is designed to teach the basics of Large Patch Fungus biology and management.

Length of lesson: About of 60 minutes

Materials needed:

- GreenUP Protocol Large Patch Fungus – on the G: Drive Shared\GreenUp Reference Materials\GreenUp Protocols\Individual Protocols\Lawn Damaging Diseases
- Collect samples of Large Patch from the field, if available.
- Ornamental and Turfgrass Pest Management – Plate 1a, Pages 65 and 66.
- Pre- and Post- tests.

Training Guidelines:

- Make copies of the tests and training materials (GreenUP Protocol Large Patch Fungus) for all Team Members attending.
- Set up the training area in an area of the office that will minimize disruptions.
- Begin the meeting by defining the training topic and handing out the Pre-test
 - Allow a few minutes for Team Members to complete the Pre-test.
 - Collect the pre-test and hand out the Verifiable Training Record Form (VTRF)
- Distribute and review the training materials on Large Patch.
 - Encourage active participation from all Team Members
 - Ask probing questions to develop key points
 - Encourage group reading
- After reading and reviewing all materials, ask questions to verify the lesson has been understood.
- Hand out the Post-tests. When complete, grade the tests and record the score on the VTRF.
- Collect tests and place with the verifiable materials in the Service Center Verifiable Training File.
- Make copies of the VTRF and place in each Team Member's training file.
- Complete all Weekly VTM's through Massey University



WEEKLY TRAINING SESSION



Large Patch Fungus in Turf

Pre and Post Test

1. Large Patch is caused by a
 - a. Bacteria
 - b. Fungus
 - c. Virus
2. Symptoms of Large Patch Fungus appear as...
 - a. Large circular areas of damaged grass with a yellow outer ring of damage
 - b. Fist size areas of damaged grass with leaf spot lesions on the grass blades
 - c. Small oblong gray lesions on the grass blades
3. Large Patch prefers
 - a. Over 90 degrees and dry weather
 - b. Below 80 degrees and humid weather
 - c. Over 90 degrees and humid weather
 - d. Below 80 degrees and dry weather
4. T or F The best control measure is to eliminate the conducive conditions.
5. What grass type is likely to be infected?
 - a. Bermuda
 - b. Tall Fescue
 - c. Zoysia
 - d. Any of the above
6. T or F A severe Large Patch infection will typically kill the turf.
7. T or F The retreatment interval for Pillar G when treating this disease is 7 to 10 days.
8. How much area of turf should be covered with one pound Pillar G?
 - a. 1000 sq. ft.
 - b. 333 sq. ft.
 - c. 500 sq. ft.
9. T or F Turf that was infected last year will most likely be re-infected this year.
10. T or F When treating Large Patch, the application rate per 1000 sq. ft. for Pillar G is 3 pounds.
11. What is the spreader setting using the Lesco Calibration tool for Pillar G?
 - a. #3
 - b. #7
 - c. #10



WEEKLY TRAINING SESSION



Large Patch Fungus in Turf

Pre and Post Test Answers

1. Large Patch is caused by a
 - a. Bacteria
 - ☒ b. Fungus
 - c. Virus
2. Symptoms of Large Patch Fungus appear as...
 - ☒ a. Large circular areas of damaged grass with a yellow outer ring of damage
 - b. Fist size areas of damaged grass with leaf spot lesions on the grass blades
 - c. Small oblong gray lesions on the grass blades
3. Large Patch prefers
 - a. Over 90 degrees and dry weather
 - ☒ b. Below 80 degrees and humid weather
 - c. Over 90 degrees and humid weather
 - d. Below 80 degrees and dry weather
4. ☒ T or F The best control measure is to eliminate the conducive conditions.
5. What grass type is likely to be infected?
 - a. Bermuda
 - b. Tall Fescue
 - c. Zoysia
 - ☒ d. Any of the above
6. ☒ T or F A severe Large Patch infection will typically kill the turf.
7. ☒ T or F The retreatment interval for Pillar G when treating this disease is 7 to 10 days.
8. How much area of turf should be covered with one pound Pillar G?
 - a. 1000 sq. ft.
 - ☒ b. 333 sq. ft.
 - c. 500 sq. ft.
9. ☒ T or F Turf that was infected last year will most likely be re-infected this year.
10. ☒ T or F When treating Large Patch, the application rate per 1000 sq. ft. for Pillar G is 3 pounds.
11. What is the spreader setting using the Lesco Calibration tool for Pillar G?
 - a. #3
 - b. #7
 - ☒ c. #10

Large Patch Fungus in Turf

Large Patch fungus (formerly referred to as Brown Patch fungus) is a common disease of all warm season turf grasses. It is very common in St. Augustine, Centipede, Bermuda and Zoysiagrass. Shade tolerant varieties of St. Augustine such as Seville are often the most severely affected.

Pathogen

Large patch is caused by the fungus *Rhizoctonia solani*. This fungus affects the base of the leaf sheath where the blade attaches to the stolon. It rots off the blade, causing the leaf to decline. It does not, however, damage the stolon or the roots of the plant.

Symptoms

The affected blades will yellow at the onset of infection. The disease will then begin to spread to neighboring turf. As the infection progresses, the blades begin to brown and the pattern can take on a ring shape. The outer edge of the ring begins to yellow, followed by a band of orange-brown turf. The grass blades inside these bands can be water-soaked and gray, with possible green tissue in the very center of the circle. Since this fungus does not affect the stolon of the plant, new leaf tissue will begin to grow after the fungus has moved on. This will give the appearance of a yellow and brown ring with healthy turf in the center (Figure 1). The pattern can grow large enough that the ring becomes large arcs across the turf. As a result, this disease is often called the “ring of fire”.



Figure 1



Figure 2

The easiest way to distinguish Large Patch from other causes of turf decline is to pull on the leaf blade. Leaf blades affected by Brown Patch will detach very easily from the stolon and slide out of the sheath. Inspection of the base of the blade will show dark water soaked tissue with a rotten smell (Figure 2). This can be confused with damage from phenoxy herbicides (i.e.- 2,4-D, MCP, MCPA, Dicamba); the base of phenoxy damaged turf is a brighter red color and the stolon nodes are brittle.

Conducive Conditions

Large Patch fungus develops most rapidly when the air temperatures are below 80° and free moisture is present on the leaf. Infection is triggered by rainfall, excessive irrigation or extended periods of high humidity resulting in the leaf canopy being continually wet for 48 hours or more. These conditions occur most often and for longer duration in the fall and in the late winter/early spring. High levels of readily available nitrogen will also increase the severity of the disease. Fungal activity generally stops when air temperatures reach 90°; therefore, it is normally not active during the summer. If symptoms are active during the summer, the cause may be another form of Large Patch known as sheath blight or *Rhizoctonia zereae*.

Large Patch Fungus in Turf

Control

Once the disease has infected the plant, control is required. To control this disease, we refer to the Disease Triangle (Figure 3). In order for a disease to fester and spread, it needs three things:

- The Pathogen
- The Host
- The Conducive Condition

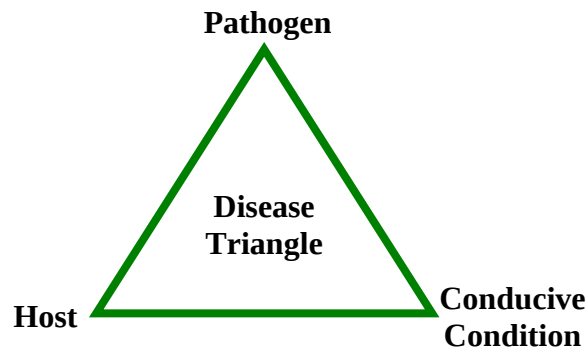


Figure 3. Disease Triangle

The removal of any one of these three will result in the control of the disease. The Disease Triangle for Large Patch is represented by Figure 4. Control can be achieved by:

- Replacing turf with landscaping
- Changes in the environment
- Application of a fungicide

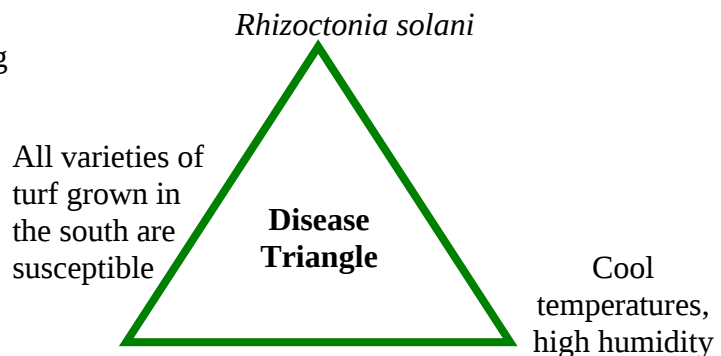


Figure 4. Disease Triangle for Large Patch

Cultural control is the best method and should always be attempted. Cultural control for Large Patch would include the removal of the conducive conditions. This would mean:

- Eliminating excess moisture through proper irrigation practices such as watering only when the turf wilts and only during the early AM hours.
- Reducing or eliminating free nitrogen applications. We apply slow release nitrogen during this time period to reduce the chances for this disease to take hold.

A more severe cultural control method would be the removal of the host plant and replacing it with a landscaping plant (i.e. tree or shrub) or other ground cover. This is rarely an option but remember it is an option!



GreenUP Service Protocols

Large Patch Fungus in Turf

Certain times of the year, typically fall and spring, the climate or weather provides the conducive conditions. It is then that chemical control needs to be applied. Customers who have had problems with Large Patch in the past should be identified for treatment when the soil temperatures go down to about 70 degrees. Assuming the disease symptoms are not present, Armada WDG would be applied at this time for prevention. Another application would be performed 3 to 4 weeks afterwards using Armada again or you can switch to Pillar G.

When a problem with Large Patch arises and symptoms of damage is identified, an application of Affirm WDG with Armada WDG is performed. Affirm will provide very good control of an existing Large Patch problem, but the residual effects do not last as long as Armada WDG. When Affirm and Armada are applied for an existing problem, Pillar G must be applied 30 days later. 3 to 4 weeks after this treatment, Armada WDG is reapplied.

Affirm WDG and Armada WDG are liquid applied systemic fungicides, but with different active ingredients. Armada WDG is a combination of two highly effective active ingredients. Both products (as well as Pillar G) travel upward in the water flow system (xylem) of the plant. These fungicides need to be applied with a sufficient amount of water to put the material where the fungus is active; at least 2 gallons of water per 1000 sq. ft. is recommended. They will work particularly well when applied out of a droptank at 5 gallons of water per 1000 sq. ft. If there is need to apply these fungicides from a backpack sprayer, an 8010E spray tip must be used and the treatment must be watered in ASAP with a light application of water. The required PPE for Armada WDG and Affirm is long sleeved shirt, long pants, waterproof gloves, and shoes with socks.

Pillar G is used at 3 pounds per 1000 sq. ft. (spreader setting 10 with the Lesco calibration tool) for prevention and control. Proactive retreatments are performed at 14 to 21 day intervals. Eye protection is required PPE in addition to those listed above for Affirm and Armada.

When the disease has been controlled or suppressed, the damage will stop spreading. The affected portions of turf will begin recover (although slowly due to the cooler weather). Since the disease organism is not completely removed from the area after treatment, infection can occur (or re-occur) as long as the environmental conditions favoring the development of the disease persist. If the symptoms of re-infestation occur and the Large Patch becomes active again, start the same procedure again with the Affirm and Armada and then 3 to 4 weeks later retreat with Pillar G.

Since the disease can occur in the same general locations, year after year when favorable environmental conditions are present, set the proper expectation with the customer.

The application rate for Affirm is 0.9 ounces (by weight) per 1000 sq. ft. 0.9 ounces of Affirm looks like 1.6 ounces in a fluid ounce measuring cup. The application rate for Armada is 1.5 ounces (by weight) per 1000 sq. ft. 1.5 ounces of Armada looks like 2.5 ounces in a fluid ounce measuring cup. When applications are made from a droptank, mix only the amount that you would expect to use in one day. Measure the water accurately using the measuring stick. The pump and hose lines will hold about 5 gallons of water. If the fungicide was not used immediately prior to the application, an additional 1000 sq. ft. worth of product would be added to the tank. For example, if you were mixing 25 gallons in the droptank, 5000 sq. ft. would be covered. But if the pump and hose lines do not already have the fungicide product in them, 6000 sq. ft.

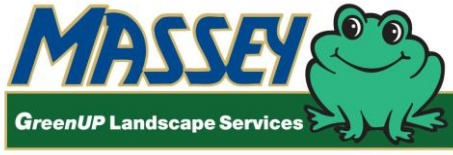


GreenUP Service Protocols

Large Patch Fungus in Turf

worth of product would be added to the tank. Then the application wand would be put into the tank to agitate the mixture and to ensure fungicide has made its way through the pump and hose.

When making spot applications make sure to treat a few feet beyond the affected area to prevent the advancement of the disease. Avoid walking through Large Patch affected areas when possible. Large Patch can be spread by walking through infected turf onto unaffected turf. This does not mean we avoid making our regular application to the affected area. It is free nitrogen, that can cause the disease to take hold, the nitrogen in our regular service applications are slow release for this reason. Do not apply any additional supplemental nitrogen to affected areas.



WEEKLY TRAINING SESSION



Branch Canker and Dieback of Various Cypress Species

Topic Category: Lawn

Recordable Verifiable Training Hours: 0.5

Objectives: This lesson is designed to teach the various causes of branch dieback of various cypress species.

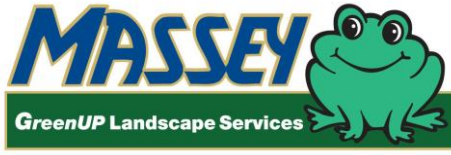
Length of lesson: Approx 30 minutes.

Materials needed:

- Training Guideline
- GreenUP Protocol Branch Canker and Dieback of Various Cypress Species Training Document
- Collect samples of Seiridium Canker from the field, if available.
- Pre- and Post- tests.

Training Guidelines:

- Make copies of the tests and training materials for all Team Members attending.
- Set up the training area in an area of the office that will minimize disruptions.
- Begin the meeting by defining the training topic and handing out the Pre-test
 - Allow a few minutes for Team Members to complete the Pre-test.
 - Collect the pre-test and hand out the Verifiable Training Record Form (VTRF)
- Distribute and review the training materials on Branch Canker and Dieback of Various Cypress Species
- Use the Training outline as a guide for key points.
 - Encourage active participation from all Team Members
 - Ask probing questions to develop key points
 - Encourage group reading
- After reading and reviewing all materials, ask questions to verify the lesson has been understood.
- Hand out the Post-tests. When complete, grade the tests and record the score on the VTRF.
- Collect tests and place with the verifiable materials in the Service Center Verifiable Training File.
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WEEKLY TRAINING SESSION

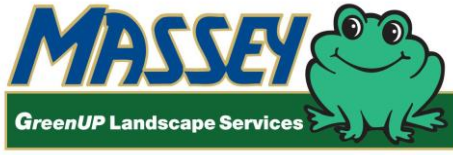


Branch Canker and Dieback of Various Cypress Species

Name _____ Date _____

PRE & POST TEST

1. T or F Brown branches on Leyland Cypress or junipers are only caused by fungal branch cankers.
2. The common causal organisms of fungal branch cankers in shrubs and trees in the cypress or juniper family are typically...
 - a. Sphaeropsis
 - b. Seiridium
 - c. Botryosphaeria
 - d. Either b or c
3. T or F Small black spore masses from fungal diseases are called pycnidia.
4. T or F Symptoms of these fungal cankers appear as oval shaped sunken or depressed areas of wood in a branch or multiple branches. Small black spore masses (pycnidia) and sap ooze may be present as well.
5. The spores of the fungal organism typically enter the plant from wounds caused by.
 - a. Insects or hail
 - b. mechanical injury
 - c. wood damage from drought
 - d. any of the above
6. T or F Spores are most active during dry weather.
7. T or F Dieback symptoms are typically expressed during dry weather.
8. T or F Southern Red Cedar and Atlantic White Cedar are equally susceptible to these fungal cankers as Leyland Cypress.
9. T or F Branch cankers need to be removed by cutting off the branch a few inches below the area of infection.
10. T or F Armada has been proven effective against these branch fungal cankers.



WEEKLY TRAINING SESSION



Branch Canker and Dieback of Various Cypress Species

PRE & POST TEST ANSWER KEY

1. T of ☒ F Brown branches on Leyland Cypress or junipers are only caused by fungal branch cankers.
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Branch Canker and Dieback of Various Cypress Species

Localized branch dieback on various species of evergreen shrubs and trees, such as Leyland Cypress, Italian Cypress and junipers is fairly common. There are numerous potential causes of a branch or a few branches dying on an evergreen shrub or tree.

When diagnosing these types of problems, begin your inspection at the tip of the branch and inspect your way toward the trunk. Look at the bark area for any type of damage. The branch could be broken or cracked; the bark (phloem) could be girdled or cut; or you could have a canker or gall type fungal disease.

Shrubs and trees in the cypress and juniper family are often affected by branch fungal cankers caused by *Seiridium* or *Botryosphaeria*. These branch fungal cankers appear as oval shaped sunken or depressed areas of wood under the bark in a branch or multiple branches. Small black spore masses (pycnidia) may be present as well. Sap ooze at or near the area of infection is very common with either of these diseases.

These fungal cankers may effect single or multiple branches. The ends of the branches would first turn a faded green or grayish green and then to golden brown and finally reddish brown. Ultimately, more branches would be effected and then result in death of the entire tree.



Figure 1 – Branch canker with pycnidia

Branch Canker and Dieback of Various Cypress Species

Figure 2 – Branch dieback



Figure 3 – Dieback on multiple branches



Branch Canker and Dieback of Various Cypress Species

Spores from either of these diseases enter the tree through any type of wound or crack in the bark tissue. These wounds could be caused by insects, hail, mechanical injury or wood damage from drought. The spores are most active and infection occurs most often during wet weather, but the die-back symptoms are typically noticed in hot dry weather.

Cultural management of the disease includes selecting evergreens that are less susceptible to these diseases such as Southern Red Cedar or Atlantic White Cedar. Proper installation and initial care of susceptible evergreens as well as controlling insect pests will greatly reduce the potential for infection.

Armada has been proven effective at suppressing these diseases. Treatments for susceptible plants would be performed with a liquid application to the branches and trunk as well as a drench to the root system. Areas of damage must be pruned out at least 4 inches below the point of infection. The cutting tool must be sterilized after each cut using either Lysol, alcohol or 10% Clorox to water solution. If fungal cankers are present on the trunk, particularly the lower portion of the trunk, it is likely that the tree will need to be removed.



WEEKLY TRAINING SESSION



Large Patch Fungus in Turf

Topic Category: Lawn

Recordable Verifiable Training Hours: 1

Objectives: This lesson is designed to teach the basics of Large Patch Fungus biology and management.

Length of lesson: About of 60 minutes

Materials needed:

- GreenUP Protocol Large Patch Fungus – on the G: Drive Shared\GreenUp Reference Materials\GreenUp Protocols\Individual Protocols\Lawn Damaging Diseases
- Collect samples of Large Patch from the field, if available.
- Ornamental and Turfgrass Pest Management – Plate 1a, Pages 65 and 66.
- Pre- and Post- tests.

Training Guidelines:

- Make copies of the tests and training materials (GreenUP Protocol Large Patch Fungus) for all Team Members attending.
- Set up the training area in an area of the office that will minimize disruptions.
- Begin the meeting by defining the training topic and handing out the Pre-test
 - Allow a few minutes for Team Members to complete the Pre-test.
 - Collect the pre-test and hand out the Verifiable Training Record Form (VTRF)
- Distribute and review the training materials on Large Patch.
 - Encourage active participation from all Team Members
 - Ask probing questions to develop key points
 - Encourage group reading
- After reading and reviewing all materials, ask questions to verify the lesson has been understood.
- Hand out the Post-tests. When complete, grade the tests and record the score on the VTRF.
- Collect tests and place with the verifiable materials in the Service Center Verifiable Training File.
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- Complete all Weekly VTM's through Massey University



WEEKLY TRAINING SESSION



Large Patch Fungus in Turf

Pre and Post Test

1. Large Patch is caused by a
 - a. Bacteria
 - b. Fungus
 - c. Virus
2. Symptoms of Large Patch Fungus appear as...
 - a. Large circular areas of damaged grass with a yellow outer ring of damage
 - b. Fist size areas of damaged grass with leaf spot lesions on the grass blades
 - c. Small oblong gray lesions on the grass blades
3. Large Patch prefers
 - a. Over 90 degrees and dry weather
 - b. Below 80 degrees and humid weather
 - c. Over 90 degrees and humid weather
 - d. Below 80 degrees and dry weather
4. T or F The best control measure is to eliminate the conducive conditions.
5. What grass type is likely to be infected?
 - a. Bermuda
 - b. Tall Fescue
 - c. Zoysia
 - d. Any of the above
6. T or F A severe Large Patch infection will typically kill the turf.
7. T or F The retreatment interval for Pillar G when treating this disease is 7 to 10 days.
8. How much area of turf should be covered with one pound Pillar G?
 - a. 1000 sq. ft.
 - b. 333 sq. ft.
 - c. 500 sq. ft.
9. T or F Turf that was infected last year will most likely be re-infected this year.
10. T or F When treating Large Patch, the application rate per 1000 sq. ft. for Pillar G is 3 pounds.
11. What is the spreader setting using the Lesco Calibration tool for Pillar G?
 - a. #3
 - b. #7
 - c. #10



WEEKLY TRAINING SESSION



Large Patch Fungus in Turf

Pre and Post Test Answers

1. Large Patch is caused by a
 - a. Bacteria
 - ☒ b. Fungus
 - c. Virus
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11. What is the spreader setting using the Lesco Calibration tool for Pillar G?
 - a. #3
 - b. #7
 - ☒ c. #10

Large Patch Fungus in Turf

Large Patch fungus (formerly referred to as Brown Patch fungus) is a common disease of all warm season turf grasses. It is very common in St. Augustine, Centipede, Bermuda and Zoysiagrass. Shade tolerant varieties of St. Augustine such as Seville are often the most severely affected.

Pathogen

Large patch is caused by the fungus *Rhizoctonia solani*. This fungus affects the base of the leaf sheath where the blade attaches to the stolon. It rots off the blade, causing the leaf to decline. It does not, however, damage the stolon or the roots of the plant.

Symptoms

The affected blades will yellow at the onset of infection. The disease will then begin to spread to neighboring turf. As the infection progresses, the blades begin to brown and the pattern can take on a ring shape. The outer edge of the ring begins to yellow, followed by a band of orange-brown turf. The grass blades inside these bands can be water-soaked and gray, with possible green tissue in the very center of the circle. Since this fungus does not affect the stolon of the plant, new leaf tissue will begin to grow after the fungus has moved on. This will give the appearance of a yellow and brown ring with healthy turf in the center (Figure 1). The pattern can grow large enough that the ring becomes large arcs across the turf. As a result, this disease is often called the “ring of fire”.



Figure 1



Figure 2

The easiest way to distinguish Large Patch from other causes of turf decline is to pull on the leaf blade. Leaf blades affected by Brown Patch will detach very easily from the stolon and slide out of the sheath. Inspection of the base of the blade will show dark water soaked tissue with a rotten smell (Figure 2). This can be confused with damage from phenoxy herbicides (i.e.- 2,4-D, MCP, MCPA, Dicamba); the base of phenoxy damaged turf is a brighter red color and the stolon nodes are brittle.

Conducive Conditions

Large Patch fungus develops most rapidly when the air temperatures are below 80° and free moisture is present on the leaf. Infection is triggered by rainfall, excessive irrigation or extended periods of high humidity resulting in the leaf canopy being continually wet for 48 hours or more. These conditions occur most often and for longer duration in the fall and in the late winter/early spring. High levels of readily available nitrogen will also increase the severity of the disease. Fungal activity generally stops when air temperatures reach 90°; therefore, it is normally not active during the summer. If symptoms are active during the summer, the cause may be another form of Large Patch known as sheath blight or *Rhizoctonia zereae*.



GreenUP Service Protocols

Large Patch Fungus in Turf

Control

Once the disease has infected the plant, control is required. To control this disease, we refer to the Disease Triangle (Figure 3). In order for a disease to fester and spread, it needs three things:

- The Pathogen
- The Host
- The Conducive Condition

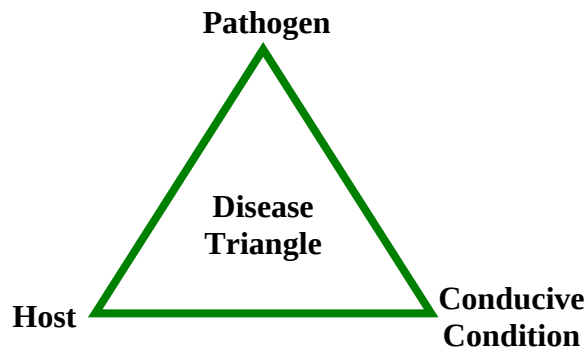


Figure 3. Disease Triangle

The removal of any one of these three will result in the control of the disease. The Disease Triangle for Large Patch is represented by Figure 4. Control can be achieved by:

- Replacing turf with landscaping
- Changes in the environment
- Application of a fungicide

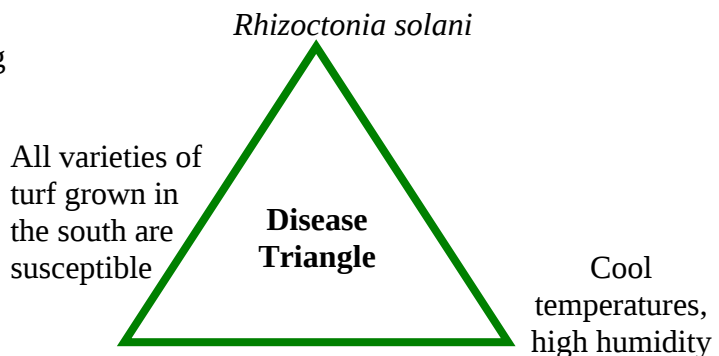


Figure 4. Disease Triangle for Large Patch

Cultural control is the best method and should always be attempted. Cultural control for Large Patch would include the removal of the conducive conditions. This would mean:

- Eliminating excess moisture through proper irrigation practices such as watering only when the turf wilts and only during the early AM hours.
- Reducing or eliminating free nitrogen applications. We apply slow release nitrogen during this time period to reduce the chances for this disease to take hold.

A more severe cultural control method would be the removal of the host plant and replacing it with a landscaping plant (i.e. tree or shrub) or other ground cover. This is rarely an option but remember it is an option!



GreenUP Service Protocols

Large Patch Fungus in Turf

Certain times of the year, typically fall and spring, the climate or weather provides the conducive conditions. It is then that chemical control needs to be applied. Customers who have had problems with Large Patch in the past should be identified for treatment when the soil temperatures go down to about 70 degrees. Assuming the disease symptoms are not present, Armada WDG would be applied at this time for prevention. Another application would be performed 3 to 4 weeks afterwards using Armada again or you can switch to Pillar G.

When a problem with Large Patch arises and symptoms of damage is identified, an application of Affirm WDG with Armada WDG is performed. Affirm will provide very good control of an existing Large Patch problem, but the residual effects do not last as long as Armada WDG. When Affirm and Armada are applied for an existing problem, Pillar G must be applied 30 days later. 3 to 4 weeks after this treatment, Armada WDG is reapplied.

Affirm WDG and Armada WDG are liquid applied systemic fungicides, but with different active ingredients. Armada WDG is a combination of two highly effective active ingredients. Both products (as well as Pillar G) travel upward in the water flow system (xylem) of the plant. These fungicides need to be applied with a sufficient amount of water to put the material where the fungus is active; at least 2 gallons of water per 1000 sq. ft. is recommended. They will work particularly well when applied out of a droptank at 5 gallons of water per 1000 sq. ft. If there is need to apply these fungicides from a backpack sprayer, an 8010E spray tip must be used and the treatment must be watered in ASAP with a light application of water. The required PPE for Armada WDG and Affirm is long sleeved shirt, long pants, waterproof gloves, and shoes with socks.

Pillar G is used at 3 pounds per 1000 sq. ft. (spreader setting 10 with the Lesco calibration tool) for prevention and control. Proactive retreatments are performed at 14 to 21 day intervals. Eye protection is required PPE in addition to those listed above for Affirm and Armada.

When the disease has been controlled or suppressed, the damage will stop spreading. The affected portions of turf will begin recover (although slowly due to the cooler weather). Since the disease organism is not completely removed from the area after treatment, infection can occur (or re-occur) as long as the environmental conditions favoring the development of the disease persist. If the symptoms of re-infestation occur and the Large Patch becomes active again, start the same procedure again with the Affirm and Armada and then 3 to 4 weeks later retreat with Pillar G.

Since the disease can occur in the same general locations, year after year when favorable environmental conditions are present, set the proper expectation with the customer.

The application rate for Affirm is 0.9 ounces (by weight) per 1000 sq. ft. 0.9 ounces of Affirm looks like 1.6 ounces in a fluid ounce measuring cup. The application rate for Armada is 1.5 ounces (by weight) per 1000 sq. ft. 1.5 ounces of Armada looks like 2.5 ounces in a fluid ounce measuring cup. When applications are made from a droptank, mix only the amount that you would expect to use in one day. Measure the water accurately using the measuring stick. The pump and hose lines will hold about 5 gallons of water. If the fungicide was not used immediately prior to the application, an additional 1000 sq. ft. worth of product would be added to the tank. For example, if you were mixing 25 gallons in the droptank, 5000 sq. ft. would be covered. But if the pump and hose lines do not already have the fungicide product in them, 6000 sq. ft.

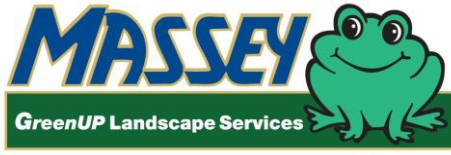


GreenUP Service Protocols

Large Patch Fungus in Turf

worth of product would be added to the tank. Then the application wand would be put into the tank to agitate the mixture and to ensure fungicide has made its way through the pump and hose.

When making spot applications make sure to treat a few feet beyond the affected area to prevent the advancement of the disease. Avoid walking through Large Patch affected areas when possible. Large Patch can be spread by walking through infected turf onto unaffected turf. This does not mean we avoid making our regular application to the affected area. It is free nitrogen, that can cause the disease to take hold, the nitrogen in our regular service applications are slow release for this reason. Do not apply any additional supplemental nitrogen to affected areas.



WEEKLY TRAINING SESSION



Branch Canker and Dieback of Various Cypress Species

Topic Category: Lawn

Recordable Verifiable Training Hours: 0.5

Objectives: This lesson is designed to teach the various causes of branch dieback of various cypress species.

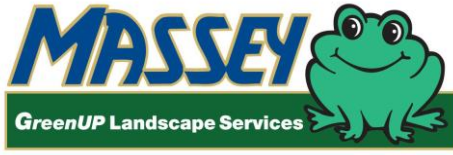
Length of lesson: Approx 30 minutes.

Materials needed:

- Training Guideline
- GreenUP Protocol Branch Canker and Dieback of Various Cypress Species Training Document
- Collect samples of Seiridium Canker from the field, if available.
- Pre- and Post- tests.

Training Guidelines:

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WEEKLY TRAINING SESSION

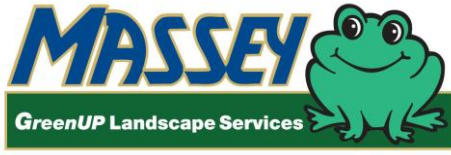


Branch Canker and Dieback of Various Cypress Species

Name _____ Date _____

PRE & POST TEST

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2. The common causal organisms of fungal branch cankers in shrubs and trees in the cypress or juniper family are typically...
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8. T or F Southern Red Cedar and Atlantic White Cedar are equally susceptible to these fungal cankers as Leyland Cypress.
9. T or F Branch cankers need to be removed by cutting off the branch a few inches below the area of infection.
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WEEKLY TRAINING SESSION



Branch Canker and Dieback of Various Cypress Species

PRE & POST TEST ANSWER KEY

1. T of ☒ F Brown branches on Leyland Cypress or junipers are only caused by fungal branch cankers.
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Branch Canker and Dieback of Various Cypress Species

Localized branch dieback on various species of evergreen shrubs and trees, such as Leyland Cypress, Italian Cypress and junipers is fairly common. There are numerous potential causes of a branch or a few branches dying on an evergreen shrub or tree.

When diagnosing these types of problems, begin your inspection at the tip of the branch and inspect your way toward the trunk. Look at the bark area for any type of damage. The branch could be broken or cracked; the bark (phloem) could be girdled or cut; or you could have a canker or gall type fungal disease.

Shrubs and trees in the cypress and juniper family are often affected by branch fungal cankers caused by *Seiridium* or *Botryosphaeria*. These branch fungal cankers appear as oval shaped sunken or depressed areas of wood under the bark in a branch or multiple branches. Small black spore masses (pycnidia) may be present as well. Sap ooze at or near the area of infection is very common with either of these diseases.

These fungal cankers may effect single or multiple branches. The ends of the branches would first turn a faded green or grayish green and then to golden brown and finally reddish brown. Ultimately, more branches would be effected and then result in death of the entire tree.



Figure 1 – Branch canker with pycnidia

Branch Canker and Dieback of Various Cypress Species



Figure 2 – Branch dieback



Figure 3 – Dieback on multiple branches



Branch Canker and Dieback of Various Cypress Species

Spores from either of these diseases enter the tree through any type of wound or crack in the bark tissue. These wounds could be caused by insects, hail, mechanical injury or wood damage from drought. The spores are most active and infection occurs most often during wet weather, but the die-back symptoms are typically noticed in hot dry weather.

Cultural management of the disease includes selecting evergreens that are less susceptible to these diseases such as Southern Red Cedar or Atlantic White Cedar. Proper installation and initial care of susceptible evergreens as well as controlling insect pests will greatly reduce the potential for infection.

Armada has been proven effective at suppressing these diseases. Treatments for susceptible plants would be performed with a liquid application to the branches and trunk as well as a drench to the root system. Areas of damage must be pruned out at least 4 inches below the point of infection. The cutting tool must be sterilized after each cut using either Lysol, alcohol or 10% Clorox to water solution. If fungal cankers are present on the trunk, particularly the lower portion of the trunk, it is likely that the tree will need to be removed.



Pipe Fittings of a residential irrigation system

PVC Pipe and fittings



- CLASS PIPE
 - CLASS 315, CLASS 200, CLASS 160 FOR IRRIGATION
 - ALL PIPE SIZES HAVE THE SAME PRESSURE RATING
 - AS THE PIPE OD GETS LARGER, THE WALL THICKNESS GETS LARGER (TO MAINTAIN THE PRESSURE RATING)
- SCHEDULE PIPE
 - SCH 40 AND SCH 80 FOR
 - IRRIGATION
 - ALL PIPE SIZES HAVE THE
 - SAME WALL THICKNESS
 - AS THE PIPE OD GETS LARGER,
 - THE PRESSURE RATINGS GET LOWER
 - SCH 80 PIPE IS USUALLY DARK GREY

Pipe Fittings of a residential irrigation system

PVC Fittings

- FITTINGS CONNECT PIPE TO PIPE AND PIPE TO OTHER COMPONENTS
- PVC SOLVENT WELD
- PVC THREADED FITTINGS
- PVC INSERT FITTINGS
 - FOR PE PIPE



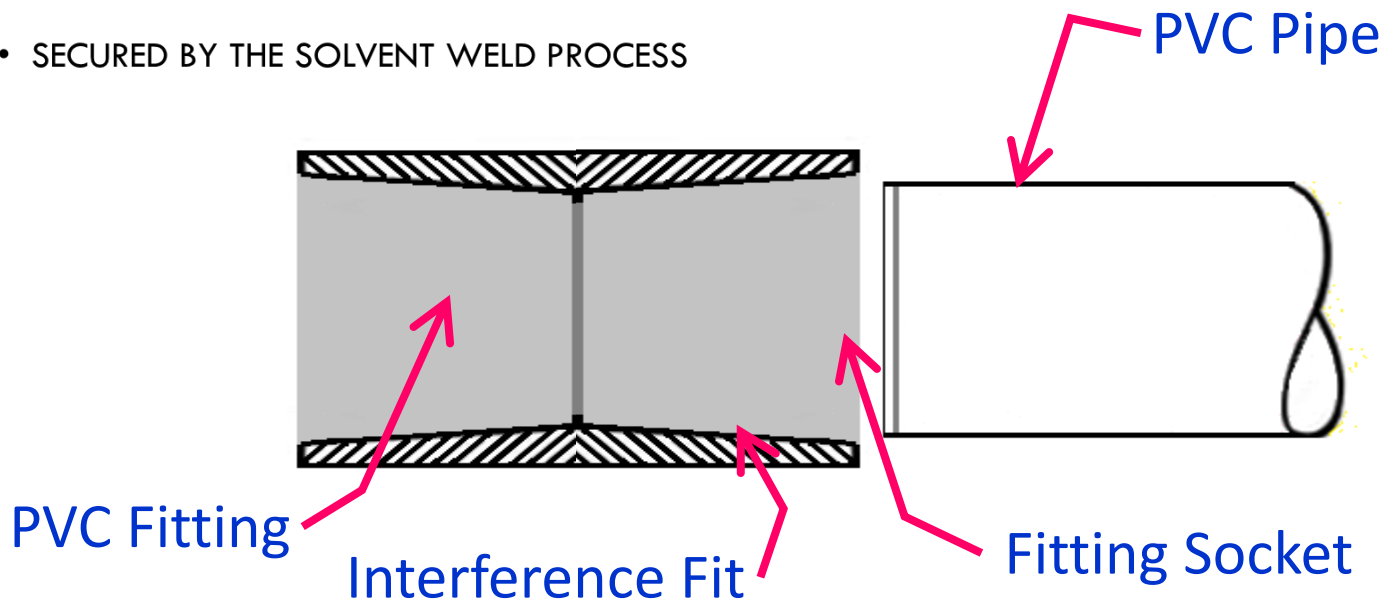
Flex Pipe

Polyethylene pipe (flex) is used for the connection between the lateral line piping to the sprinkler head. The fittings used for this connection is the same fittings as the class 200 and schedule 40 pipe uses. Standard PVC irrigation fittings is schedule 40 PVC.

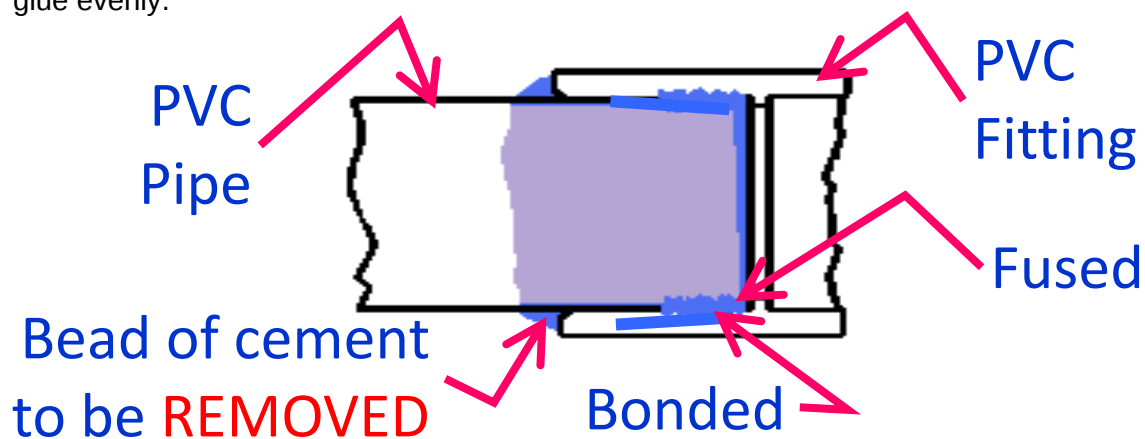
Pipe Fittings of a residential irrigation system

Solvent weld fitting connection

- MOST COMMON FITTING TYPE FOR IRRIGATION
- PIPE FITS INTO TAPERED FITTING SOCKET
- SECURED BY THE SOLVENT WELD PROCESS



Cement is applied to both pipe and fitting, then the pipe is pushed in the fitting with a ¼ turn to spread the glue evenly.



PVC Primer and (quick set) Blue Glue

Pipe Fittings of a residential irrigation system



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