

Rainfastness of pesticides



Mario Lanthier

CropHealth Advising & Research

Kelowna, B.C. www.crophealth.com

I just sprayed a pesticide.
Then it started to rain. Darn...



Let's review the topic.

Try your knowledge with these questions...

For what group of pesticides are we concerned about rain after the spray ?

- A. Insecticides
(products for insect control)
- B. Fungicides
(products for disease control)
- C. Herbicides
(products for weed control)
- D. Molluscicide
(products for slug control)

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(products for slug control)

For this question,
all answers
are good

Let's build proper “rules of thumb” for rainfall after a spray

- Insecticides
- Fungicides
- Herbicides
- Molluscicides

Japanese beetles are a serious problem in Ontario and Michigan



Research in Michigan for grapes



Pest *Management*

RAINFASTNESS of pesticides varies

Rainfastness depends on the amount of rain, the age of the residues, and the insecticides used.

by Richard Lehnert

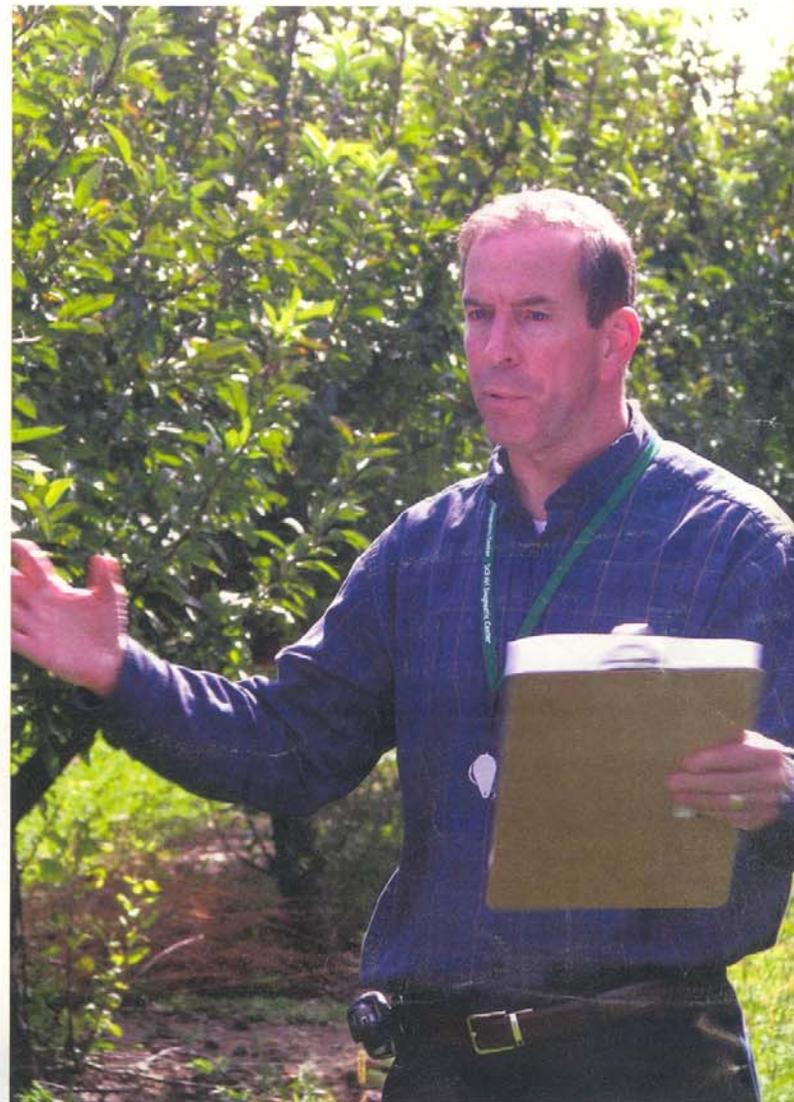
Folklore says that after a heavy rainfall, you might as well get your sprayer out and reapply your insecticides. For those old twentieth century wettable powders, the folklore may be largely reliable, says Michigan State University entomologist Dr. John Wise. But it's not necessarily true for twenty-first century materials. Many of the new reduced-risk insecticides have enhanced capacity to bind to plant surfaces or systemic activity within plant tissues, which can result in better rainfastness, and save a spray.

For grape growers in the eastern half of North America, the vine-munching Japanese beetle provides virtually constant pressure from midsummer on. Without an insecticide in place, they attack en masse and can strip a vine of foliage in a few days.

So, how much rainfall is too much? And which insecticides are most rainfast?

“The more inherently effective the compound is, the more forgiveness you'll have in relationship to weather conditions.”

—John Wise



John Wise carries out his rainfastness work on grapes and apples at Michigan State University's Trevor Nichols Research Complex, where he is coordinator of research.

Question #1

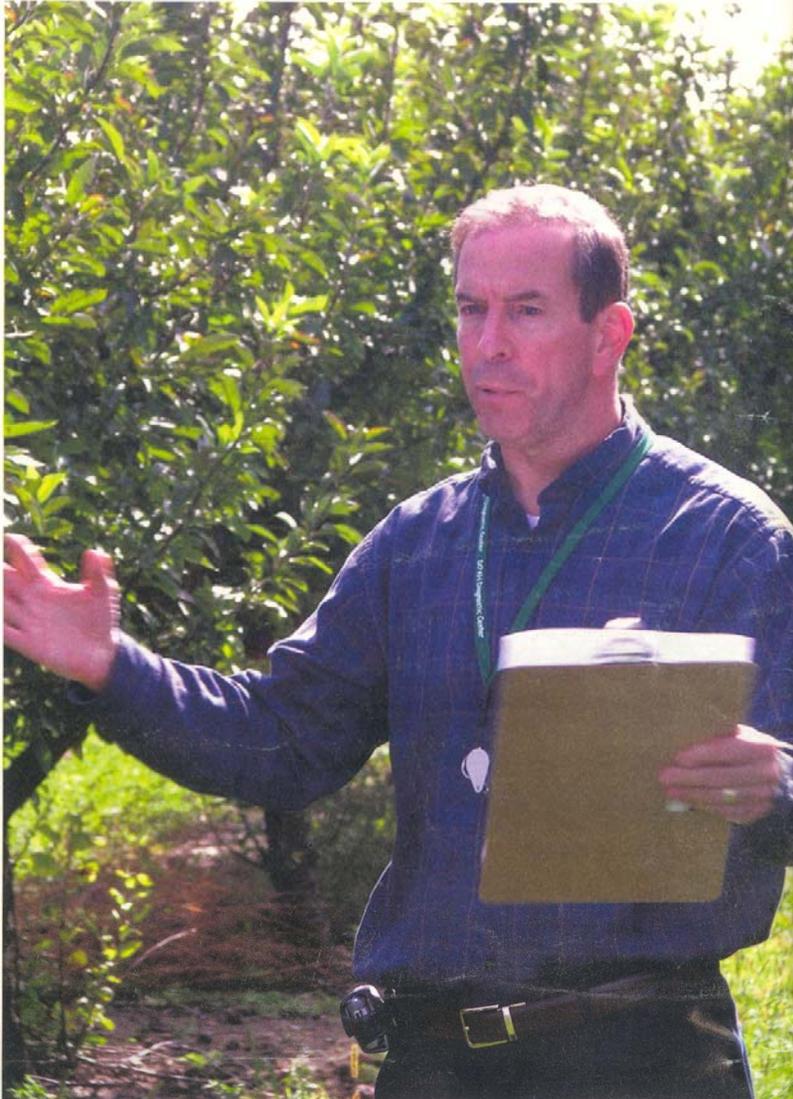
Rainfastness of insecticides

For insecticides, which conditions would result in the least removal from the plant ?

- A. Rainfall of $\frac{1}{2}$ inch
2 hours after spraying
- B. Rainfall of $\frac{1}{2}$ inch
24 hours after spraying
- C. Rainfall of 1 inch
7 days after spraying
- D. Rainfall of 2 inches
24 hours after spraying

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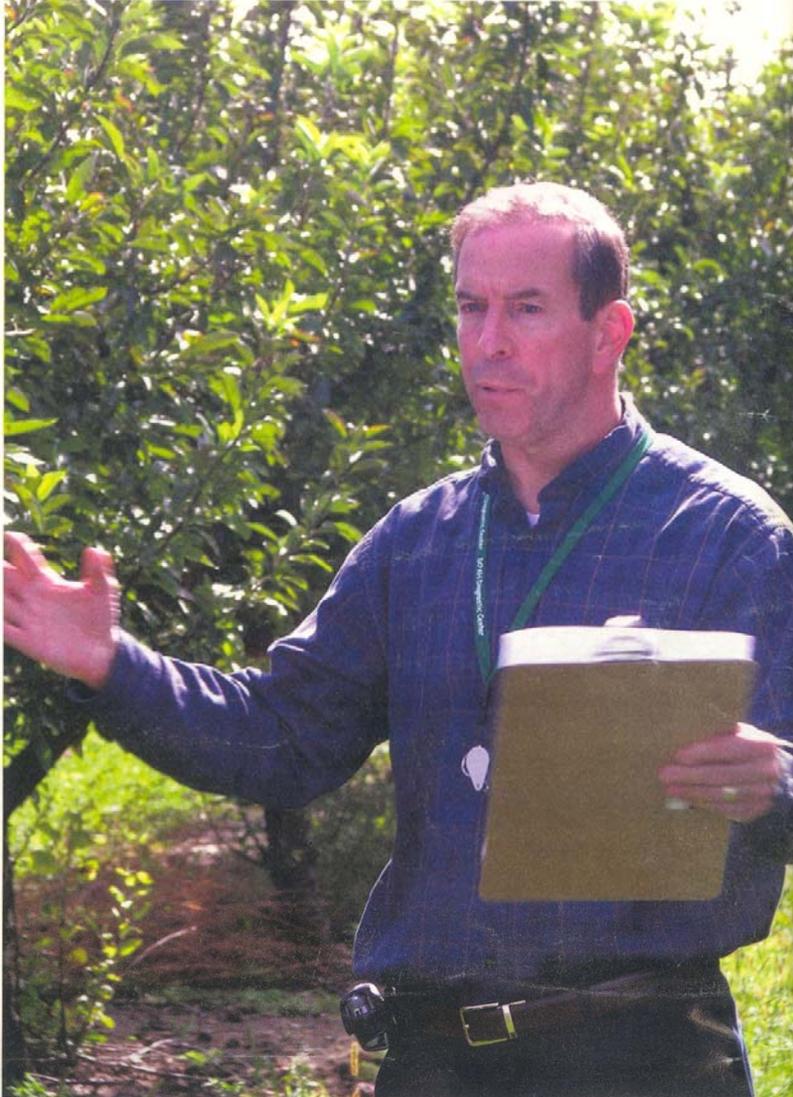


John Wise carries out his rainfastness work on grapes and apples at Michigan State University's Trevor Nichols Research Complex, where he is coordinator of research.

According to his studies, a two-inch rainfall will remove enough insecticide to make immediate reapplication necessary for all the insecticides he tested: Imidan (an organophosphate), Sevin (a carbamate), Capture/Brigade (the pyrethroid bifenthrin), Actara (a neonicotinoid), and Avaunt (an oxidiazine).

For a recently applied spray (day-old residues), all compounds but Imidan could withstand an inch of rain and would not need to be reapplied immediately. If residues have aged in the field for seven days before the rain, however, then reapplication would be needed for all.

Rainfall of half an inch would not require that any of these be reapplied immediately, but most would need reapplication if the rain occurred after seven days of aging. Sevin, which is particularly effective against Japanese beetles, was



“For most insecticides, a drying time of two to six hours is sufficient to ‘set’ the compound in or on the plant.

With neonicotinoids, for which plant penetration is important, up to 24 hours is needed for optimal plant penetration.”

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Contact insecticides are more rainfast than systemic insecticides



Newer insecticides are more rainfast than older insecticides



Question #2

The very safe to use insecticidal soap

For insecticidal soap, what is the expected residual activity after a spray ?

- A. Insecticidal soap is effective starting about 7 days after application
- B. Insecticidal soap is effective immediately and for 24 hours after application
- C. Insecticidal soap is effective only at the time of application
- D. Insecticidal soap may be effective for others but it has never been for me

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Let's build proper “rules of thumb” for rainfall after a spray

- Insecticides

Allow 2 to 6 hours to set the product on the plant
Expect little efficacy after 2 inches of rain

- Fungicides

- Herbicides

- Molluscicides

Definitions for rainfastness

Source: University of Florida Extension

Rainfastness of Pesticides¹

Bonnie Wells and F.M. Fishel²

Introduction

Applicators of pesticides often question whether an application they have made will be effective if rainfall occurs too soon after the application. But what is too soon? Is it 10 minutes, an hour, 4 hours, 24 hours, etc.? Rainfall occurring after application can have a significant effect on the residual activity and efficacy of pesticides. A pesticide's rainfastness, or its ability to withstand rainfall, is an important factor affecting the efficacy of foliar-applied pesticides. Generally, it is best to avoid pesticide application when rainfall is likely; however, weather can be unpredictable, so it is best to choose a product with good rainfast characteristics.

Definition of Rainfastness

A pesticide is considered rainfast after application if it has adequately dried or has been absorbed by plant tissues so

Others may *recommend* that a product is not applied within a stated timeframe (Figure 4).

Rainfastness

Fusilade DX Herbicide is rainfast 1 hour after application.

Figure 1. Label wording example seen on a pesticide label.
Credits: CDMS Agrochemical Database, <http://www.cdms.net/LabelsMsds/LMDefault.aspx?t=>

Rainfastness: Heavy rainfall soon after application may wash this product off of the foliage and a repeat application may be required for adequate weed control.

Figure 2. Label wording example seen on a pesticide label.
Credits: CDMS Agrochemical Database, <http://www.cdms.net/LabelsMsds/LMDefault.aspx?t=>

USE PRECAUTIONS

- **DO NOT** apply this product through any type of irrigation system.
- **DO NOT** apply this product if rainfall is expected within 24 hours of application.
- **DO NOT** feed gin trash, treated foliage or immature crops to livestock.

Figure 3. Label wording example seen on a pesticide label.
Credits: CDMS Agrochemical Database, <http://www.cdms.net/>

Definitions for rainfastness

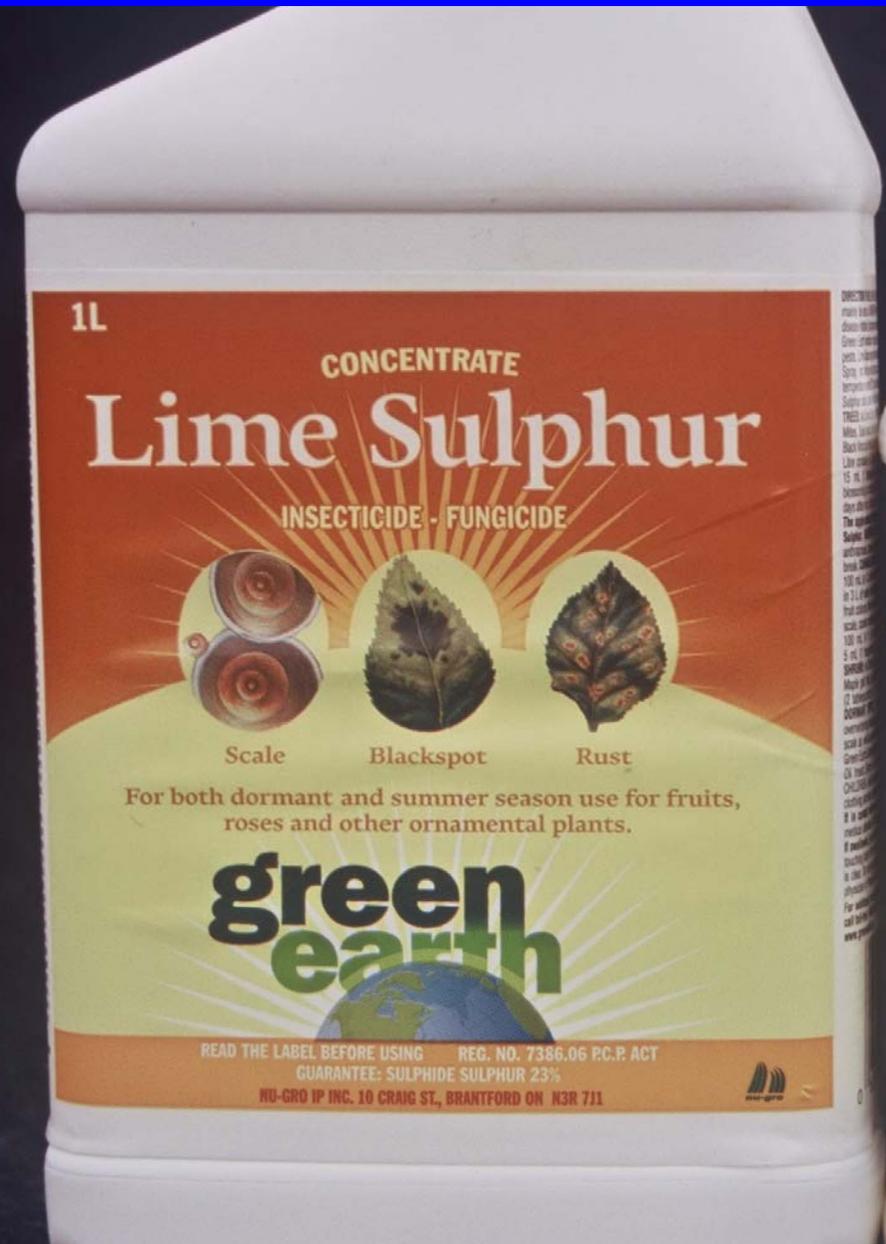
Source: University of Florida Extension

- A pesticide is considered rainfast if it has adequately dried or has been absorbed so it will still be effective
- Rainfall affects the pesticide application by washing away the pesticide or by diluting the product
- Removal of pesticides is greatest when rainfall occurs within 24 hours of spraying

Examples of contact fungicides



Example of an eradicant fungicide



Question #3

Rainfastness of fungicides

For fungicides, which products are most rainfast if applied shortly before rain ?

- A. Contact fungicides
are most rainfast when applied before rainfall
- B. Systemic fungicides
are most rainfast when applied before rainfall
- C. Eradicant fungicides
are most rainfast when applied before rainfall
- D. All fungicides are rainfast
when applied shortly before rainfall

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Research in Michigan for grape production

RUTGERS
New Jersey Agricultural
Experiment Station

FRUIT EDITION
JUNE 22, 2010

PLANT & PEST ADVISORY

A RUTGERS COOPERATIVE EXTENSION PUBLICATION



INSIDE

Fungicide Properties and Weather Conditions

Annemiek Schilder, Plant Pathology, Michigan State University Extension

Reprinted from Fruit Crop Advisory Team Alert, Michigan State University Extension, June 15, 2010

Fungicides can be divided into two groups: **protectant** and **systemic** fungicides. Protectant fungicides are contact materials that remain on the outside of the plant surface and kill fungal spores and hyphae upon contact, thereby preventing infection from occurring. Systemic fungicides are absorbed by the plant cuticle and underlying tissues and can act by killing spores and hyphae as well as incipient infections where the fungus has penetrated the plant surface. When they stop infections and prevent symptoms from developing they are called "curative." However, symptoms that are already present will not be "cured" by the fungicide in question. After symptoms appear, some fungicides can reduce or inhibit fungal sporulation: these are called "anti-sporulants." The term "eradicant" is often used for products

Research in Michigan for grape production

Most systemic fungicides are rainfast after a few hours, but a longer period (up to 24 hours) may be needed for some fungicides to get fully absorbed by the leaf or fruit surface.

During rainy periods, it is better to use systemic than protectant fungicides or a mixture of the two since systemic fungicides are less sensitive to wash-off by rain. Applying a mixture of systemic and protectant fungicides may be the best compromise. In addition, spreader-stickers can enhance adherence of protectant fungicides, while penetrants may speed up penetration of systemic fungicides. Technological advances ensure that many newer fungicides and fungicide formulations have excellent adhesion or absorption properties.

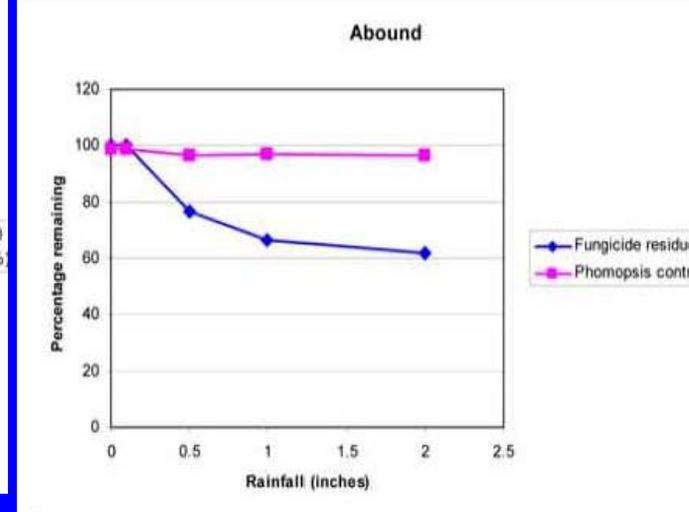
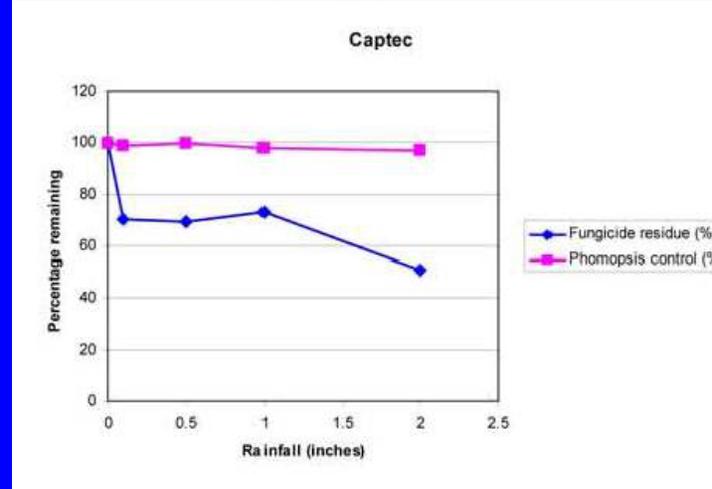
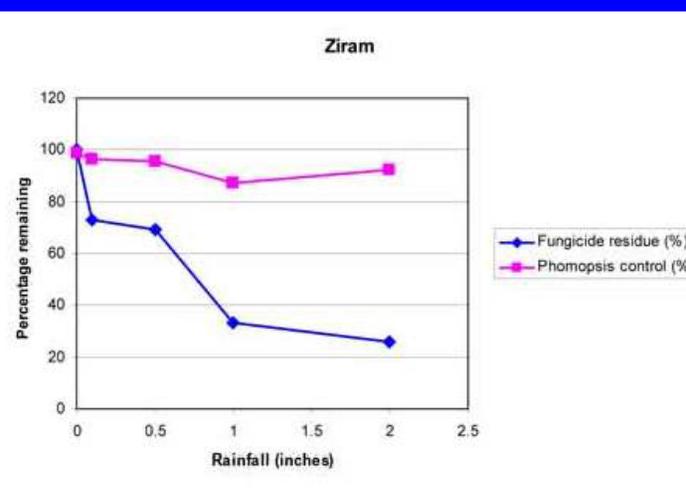
Systemic fungicides are generally rainfast as they penetrate the cuticle in 20 to 40 minutes



Research in Michigan for grape production

Results and Conclusions

The results show that fungicide residues were removed by rainfall but not substantially until about 1 to 2 inches of rainfall had occurred. Surprisingly, rainfall affected the systemic products Abound and Pristine more severely than Captan or Procure, particularly at 1 to 2 inches of rainfall. A general decline in disease control efficacy occurred with increasing rainfall but it was more gradual than the reduction in fungicide residues.



Research in Maryland for turf (dollar spot of creeping bentgrass)

FACTORS AFFECTING FUNGICIDE PERFORMANCE WHEN TARGETING
DOLLAR SPOT DISEASE IN CREEPING BENTGRASS

By

Raymond Leonard Pigati

Thesis submitted to the Faculty of the Graduate School of the
University of Maryland, College Park, in partial fulfillment
of the requirements for the degree of
Master of Science
2009

Research in Maryland for turf

Chapter I: Simulated Rainfall and Mowing Impact on Fungicide Performance When Targeting Dollar Spot in Creeping Bentgrass

Synopsis

The performance of fungicides as influenced by rainfall and mowing timing has not been studied for any turfgrass disease. In this two year field study, four chemically diverse fungicides (i.e., chlorothalonil, boscalid, iprodione, propiconazole and a tank-mix of chlorothalonil and propiconazole in 2008 only) were evaluated for their ability to control dollar spot (*Sclerotinia homoeocarpa* F.T. Bennett) in creeping bentgrass (*Agrostis stolonifera* L.) as influenced by simulated rain and mowing timing. The simulated rain parameter involved applying 2.54 to 3.18 cm rain using an overhead irrigation system about 30 minutes after fungicides were applied and was compared to rain-free plots. One set of plots was mowed in the AM with dew present prior to fungicide application and was compared to plots that only were mowed when the canopy was dry in the PM. Disease was assessed by counting the number of *S.*

Question #4

Fungicides for turf

In the 2009 study with dollar spot,
which of the following was the most rainfast ?

- A. Daconil
(an older protectant fungicide)
- B. Lance
(a newer protectant fungicide)
- C. Rovral
(an older systemic fungicide)
- D. Banner
(an older systemic fungicide)

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C. Rovral

(an older systemic fungicide)

D. Banner

(an older systemic fungicide)

Research in Maryland for turf

the canopy was dry in the PM. Disease was assessed by counting the number of *S. homoeocarpa* infection centers (IC) in each plot. Simulated rain generally reduced the effectiveness of all fungicides. The percent reduction in dollar spot control associated with simulated rain versus rain-free treatments in 2007 and 2008 was as follows: chlorothalonil 68 to 96%; propiconazole 43 to 82%; boscalid 38 to 45%; and iprodione 28 to 87%. Hence, the activity of chlorothalonil was most consistently diminished by simulated rain. Iprodione and propiconazole exhibited an intermediate level of rain-safeness; whereas, boscalid was consistently the most rain-safe fungicide evaluated. The time of day that plots were mowed also impacted fungicide performance significantly. Mowing in the AM reduced dollar spot severity compared

Flowable and Suspension concentrate are more rainfast



Wettable powder and Granules are less rainfast

Kumulus (sulphur) – A protectant fungicide



Protectants must be applied more often than systemics.

Why not use only systemic fungicides ?



Question #5

Protectant and Systemic fungicides

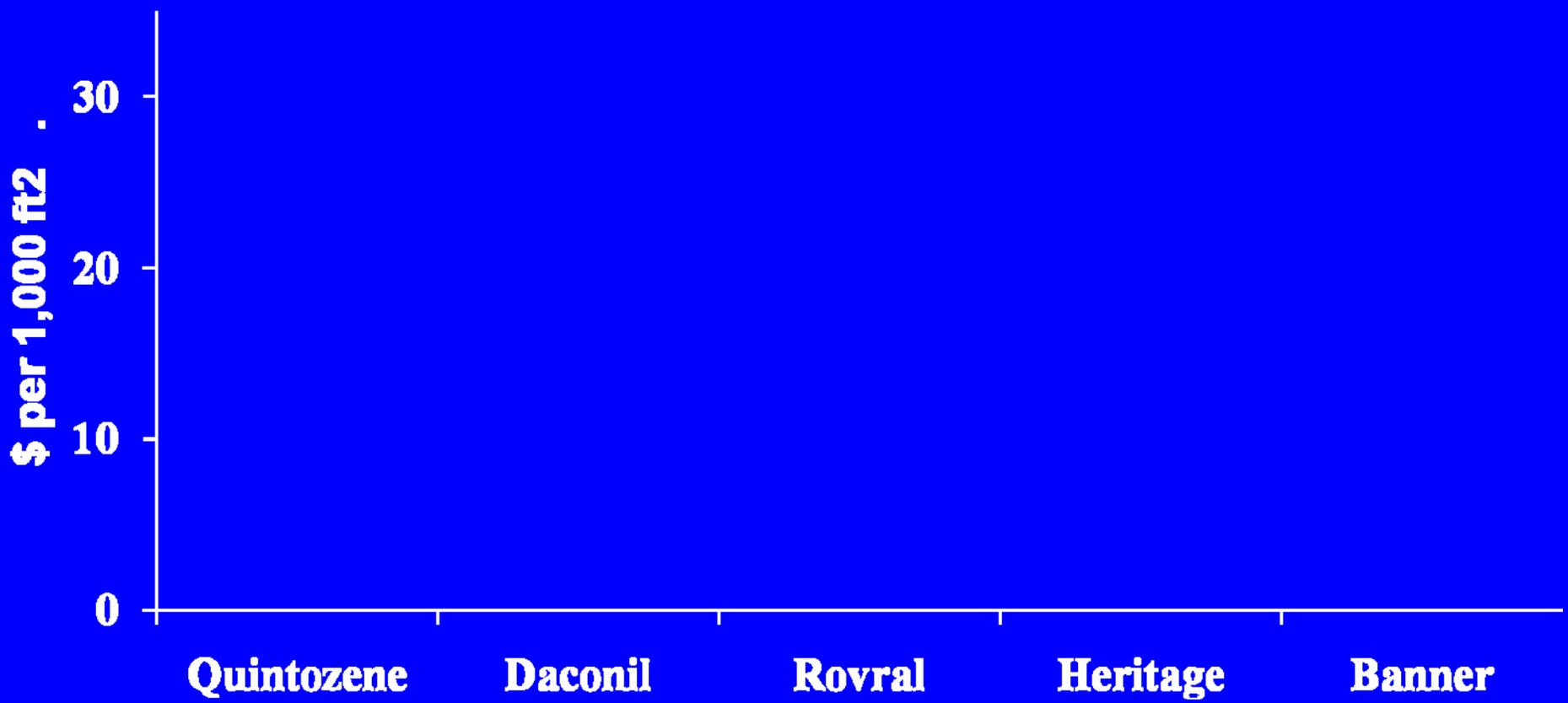
Why not use only systemic fungicides? They require fewer applications than protectants.

- A. Systemic fungicides are much more expensive than protectant fungicides
- B. Systemic fungicides are much less effective than protectant fungicides
- C. Systemic fungicides are much less rainfast than protectant fungicides
- D. Systemic fungicides are much more preferred by my manager

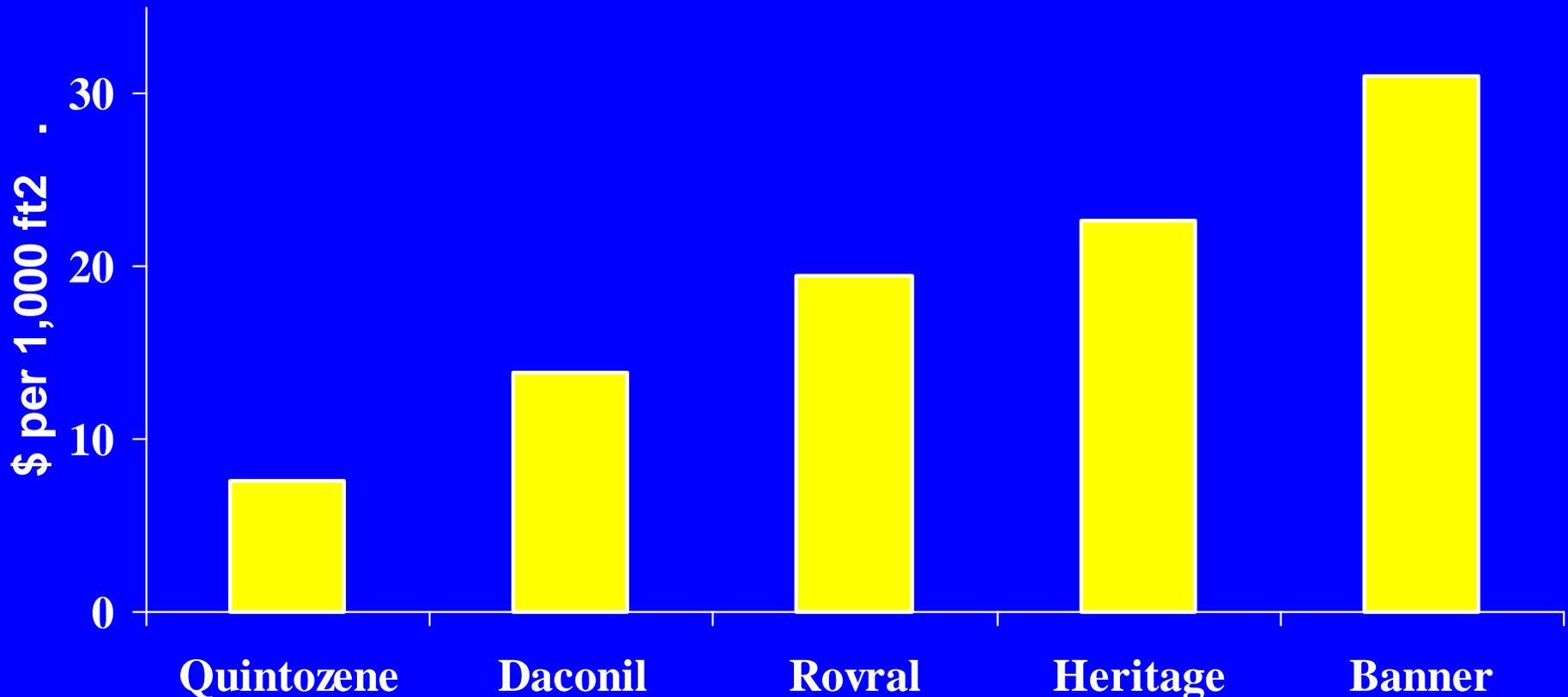
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Comparing pesticide costs: fungicides recommended for pink snow mold



Comparing pesticide costs: fungicides recommended for pink snow mold



Let's build proper "rules of thumb" for rainfall after a spray

- Insecticides

Allow 2 to 6 hours to set the product on the plant
Expect little efficacy after 2 inches of rain

- Fungicides

Apply protectant during dry sunny weather
Use systemic during rainy weather
Expect little efficacy after 2 inches of rain

- Herbicides

- Molluscicides

Herbicides are applied for weed control

- Foliage applied herbicides

 - Contact herbicides (acetic acid, chelated iron)

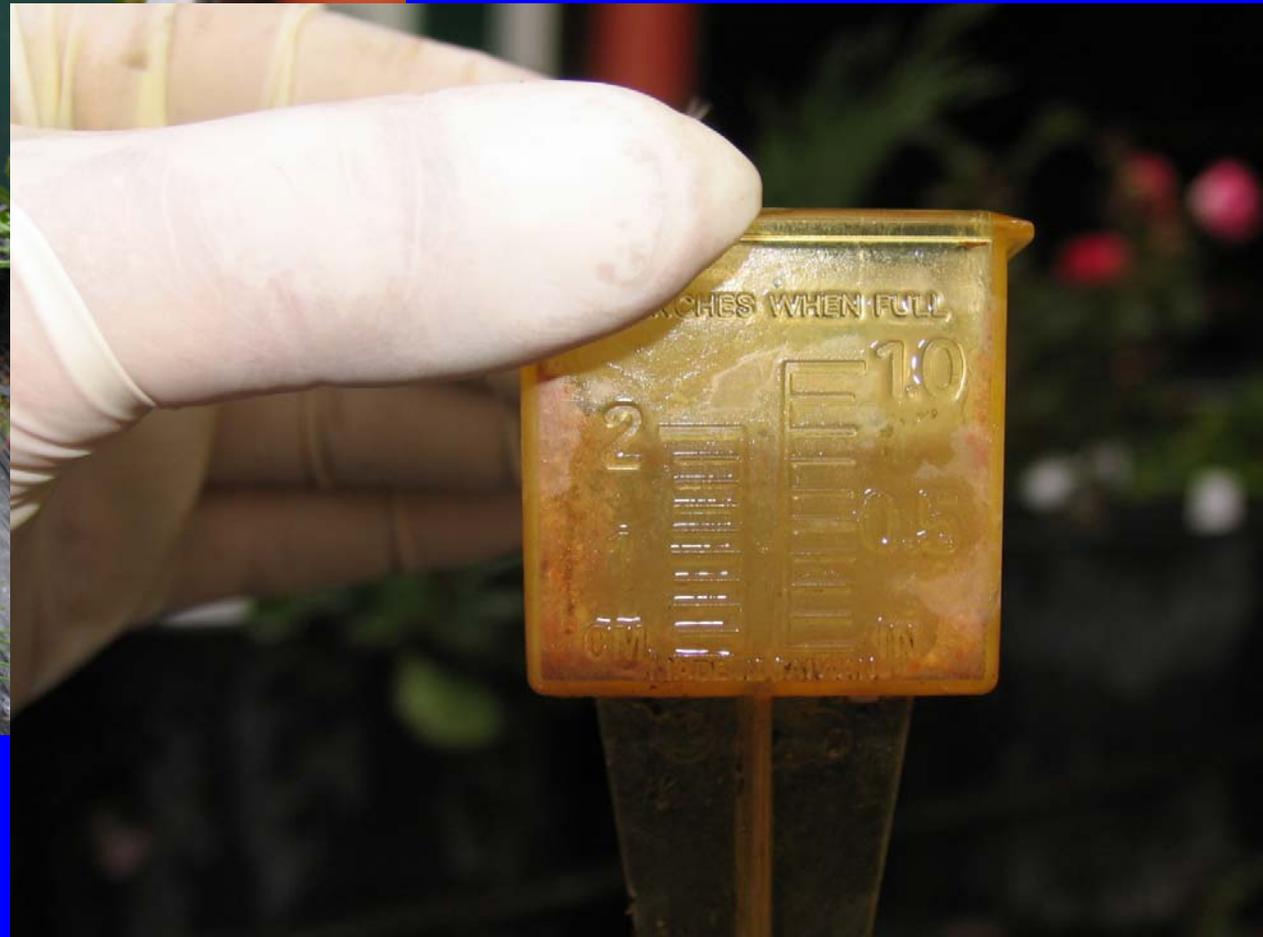
 - Systemic herbicides (Par III, Round-up)

- Soil applied herbicides

 - Short residual activity (Devrinol, Prowl)

 - Long residual activity (SureGuard, Casoron)

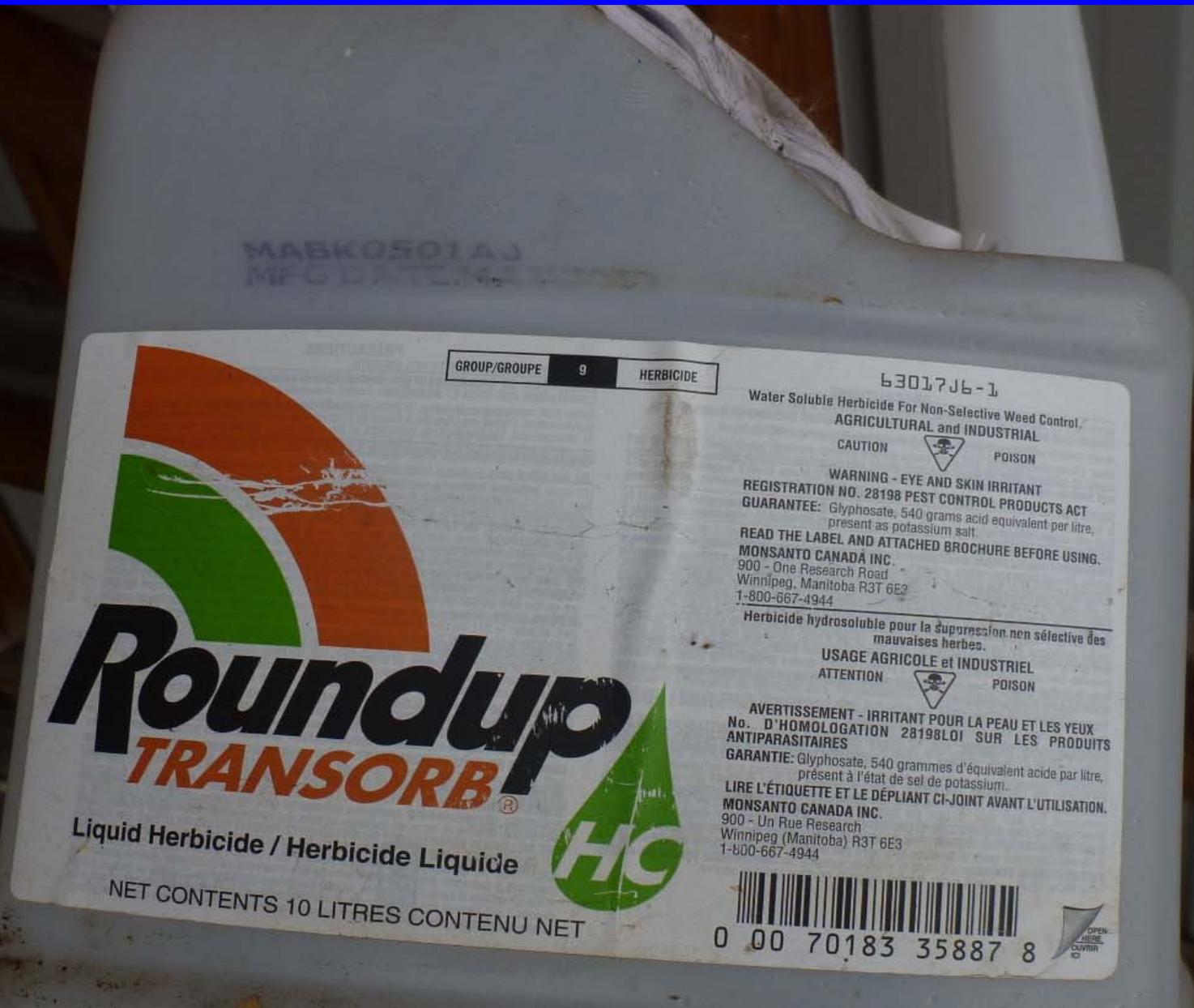
Soil-applied herbicides
must be followed by rainfall or irrigation



Roundup Original and Roundup Transorb



Let's examine Roundup Transorb



MABK0501AJ
MFG DATE: _____

GROUP/GROUPE 9 HERBICIDE


Roundup
TRANSORB[®]
Liquid Herbicide / Herbicide Liquide


NET CONTENTS 10 LITRES CONTENU NET

63017J6-1

Water Soluble Herbicide For Non-Selective Weed Control,
AGRICULTURAL and INDUSTRIAL

CAUTION  POISON

WARNING - EYE AND SKIN IRRITANT
REGISTRATION NO. 28198 PEST CONTROL PRODUCTS ACT
GUARANTEE: Glyphosate, 540 grams acid equivalent per litre,
present as potassium salt.

READ THE LABEL AND ATTACHED BROCHURE BEFORE USING.
MONSANTO CANADA INC.
900 - One Research Road
Winnipeg, Manitoba R3T 6E3
1-800-667-4944

Herbicide hydrosoluble pour la suppression non sélective des
mauvaises herbes.

USAGE AGRICOLE et INDUSTRIEL
ATTENTION  POISON

AVERTISSEMENT - IRRITANT POUR LA PEAU ET LES YEUX
No. D'HOMOLOGATION 28198LOI SUR LES PRODUITS
ANTIPARASITAIRES

GARANTIE: Glyphosate, 540 grammes d'équivalent acide par litre,
présent à l'état de sel de potassium.

LIRE L'ÉTIQUETTE ET LE DÉPLIANT CI-JOINT AVANT L'UTILISATION.
MONSANTO CANADA INC.
900 - Un Rue Research
Winnipeg (Manitoba) R3T 6E3
1-800-667-4944


0 00 70183 35887 8

 OPEN
HERE
CUTTER
SI

“Rainfall occurring within 60 minutes of treatment may result in reduced weed control.”



Do not treat weeds under poor growing conditions such as drought stress, disease or insect damage, as reduced weed control may result. Reduced results may also occur when treating weeds heavily covered with dust.

This product does not provide residual weed control. For subsequent residual weed control follow a label approved herbicide program. Read and carefully observe the cautionary statements and all other information appearing on the labels of all herbicides used.

Rainfall occurring within 60 minutes of treatment may result in reduced weed control. Heavy rainfall immediately after application may wash the chemical off the foliage and a repeat treatment may be required. Do not apply if rainfall is forecast for the time of application.

Do not mix with any surfactant, pesticide, herbicide oils or any other material other than water unless specified in this booklet. For best results, spray coverage should be uniform and complete. Do not spray weed foliage to the point of run-off.

RESISTANCE-MANAGEMENT RECOMMENDATIONS

For resistance management, Roundup Transorb HC Liquid Herbicide is a

Question #6

Rainfall after a Roundup application

Roundup Original was rainfast in 6 to 12 hours.
Why is Transorb rainfast in only 1 hour ?

- A. Round-up Transorb
stays better suspended in water
- B. Round-up Transorb
has a better molecule of glyphosate
- C. Round-up Transorb
has an adjuvant to penetrate into the plant
- D. Round-up Transorb
is the same as Original but with better marketing

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A pesticide is formulated with the active ingredient and an adjuvant

Pesticide = Ingredient 1 + Ingredient 2

= active ingredient + formulants
(carrier, adjuvant)

Roundup = glyphosate + trade secret

Commercial formulations of the “preferred” herbicide acetic acid



Question #7

The preferred herbicides of acetic acid

For herbicides of acetic acid, what are the ideal weather conditions for application ?

- A. Ideal weather is cool and sunny day
- B. Ideal weather is warm and cloudy day
- C. Ideal weather is warm and sunny day
- D. Ideal weather is warm and rainy day

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✓ C. Ideal weather is warm and sunny day

D. Ideal weather is warm and rainy day

The label of Munger Horticultural Vinegar

DIRECTIONS FOR USE

Best results are achieved from spring and early summer applications to actively growing young weeds. Degree of control depends on several factors, including size and stage at application.

Apply on a mostly sunny day with temperatures at or above 21° C (70° F). Small annual weeds may be completely controlled with a single application. Control of larger, more established weeds, not completely desiccated with one application may be short-term and require retreatment.

Weeds that are dormant or hardened due to moisture stress tend to be



Herbicides: rainfastness after a spray

- The short story
 - Follow the label instructions
- Common recommendations
 - Round-up Original is 6 to 12 hours
 - Round-up Weathermax (and Transorb) are 1 hour
 - 2,-4 Amine is 6 to 8 hours
 - 2,4-D Ester is 1 to 3 hours
 - Tordon is 2 hours

Let's build proper “rules of thumb” for rainfall after a spray

- Insecticides

 - Allow 2 to 6 hours to set the product on the plant
 - Expect little efficacy after 2 inches of rain

- Fungicides

 - Apply protectant during dry sunny weather
 - Use systemic during rainy weather
 - Expect little efficacy after 2 inches of rain

- Herbicides

 - Follow the label instructions if available
 - For many products, 6 hours are sufficient

- Molluscicides

The preferred molluscicide Ferric phosphate

D40910A

EP#0069208-MO-001

Safer's®

Will Not Harm Pets, Birds or Wildlife



EASY TO USE

For use around vegetables, fruit trees, berries, ornamentals (shrubs, flowers, trees) and lawns against slugs and snails in greenhouses and outdoors.

GUARANTEE: Ferric Sodium EDTA 6%
REG.No. 28775 P.C.P. ACT
READ THE LABEL BEFORE USING
KEEP OUT OF REACH OF CHILDREN

Warning, contains the allergen wheat

Woodstream Canada Corporation, 4 Lowry Drive, Brampton, ON L7A 1C4 (800) 800-1819



READY TO USE
Slug & Snail
KILLER

CONTROLS SLUGS
AND SNAILS

DOMESTIC
NET CONTENTS
500 g

The publication to write the certificate exam



MOLLUSCICIDE

Ferric Phosphate

A naturally occurring mineral, ferric phosphate (or iron phosphate) has been recently registered in Canada to control slugs and snails. It is as effective as metaldehyde slug baits, but much less toxic to non-target animals and should be used instead.



Mode of Action: Slugs stop feeding immediately after eating ferric phosphate baits, then start to dry out. They may not die for several days, but damage from their feeding stops as soon as they take the bait.

Formulation: The ferric phosphate is incorporated into a granular pasta bait which is spread around plants where slugs are causing damage.

Use: Ferric phosphate controls slugs and snails. Unlike metaldehyde slug baits, ferric phosphate is not toxic to dogs and other animals and they are not attracted to it. It is non-toxic to birds, fish and other wildlife and does not harm ground beetles, earthworms and other beneficial organisms.

Question #8 (and last)

Molluscicide ferric phosphate

With ferric phosphate,
what is the impact of rain after an application ?

- A. The slugs are happy
and they dance in the rain
- B. The slugs get moving
and they look for a welcoming garden
- C. The slugs check their phone
for the weather forecast
- D. The slugs rehydrate
and survive the poison

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“Rules of thumb” for rainfall after a spray

- Insecticides

- Allow 2 to 6 hours to set the product on the plant
 - Newer products have better rainfastness
 - Expect little efficacy after 2 inches of rain

- Fungicides

- Apply protectant during dry sunny weather
 - Use systemic ahead of rainy weather
 - Expect little efficacy after 2 inches of rain

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Thank you for your interest !



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