1-2013

2013 Update Mtg: Fairy Ring on Cranberry: There have been many changes!

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Fairy Ring on Cranberry: There have been many changes!

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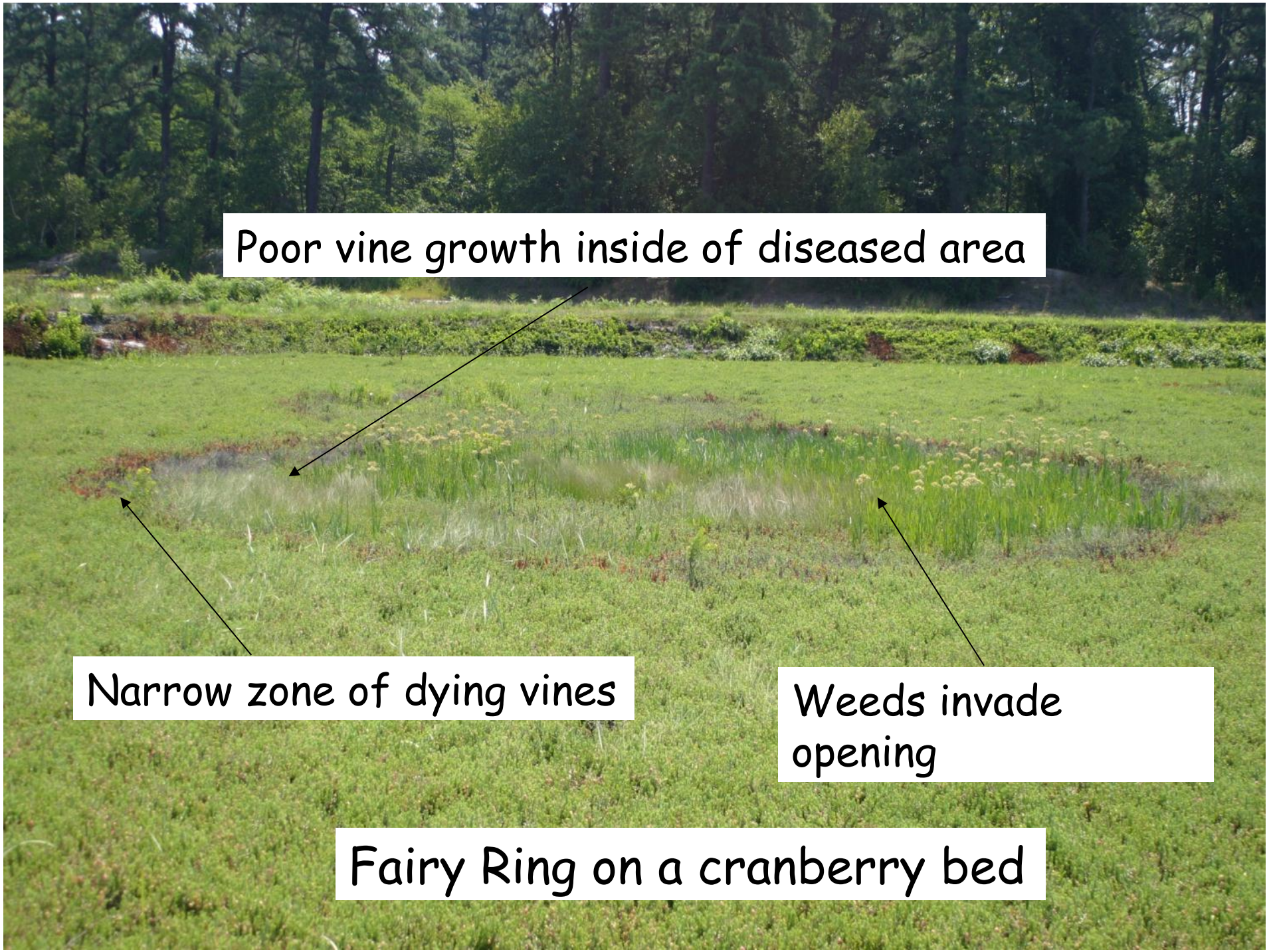
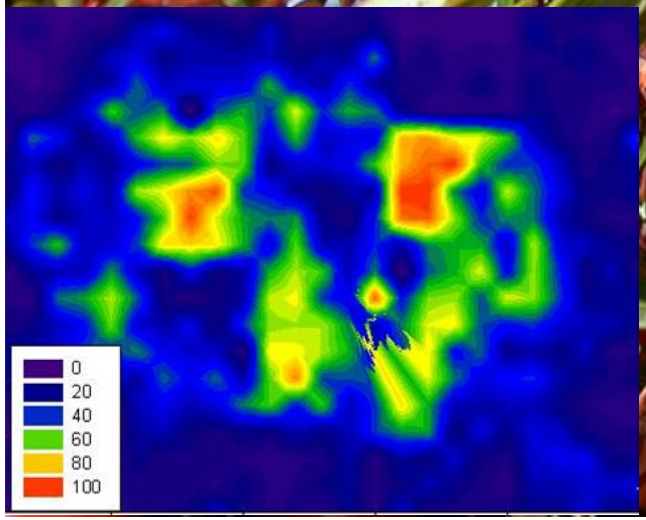
Funding from USDA-SCRI Block Grant,American Cranberry Growers Association and New Jersey Cranberry Research Council


Fairy Ring on a cranberry bed



Fairy Ring on a cranberry bed

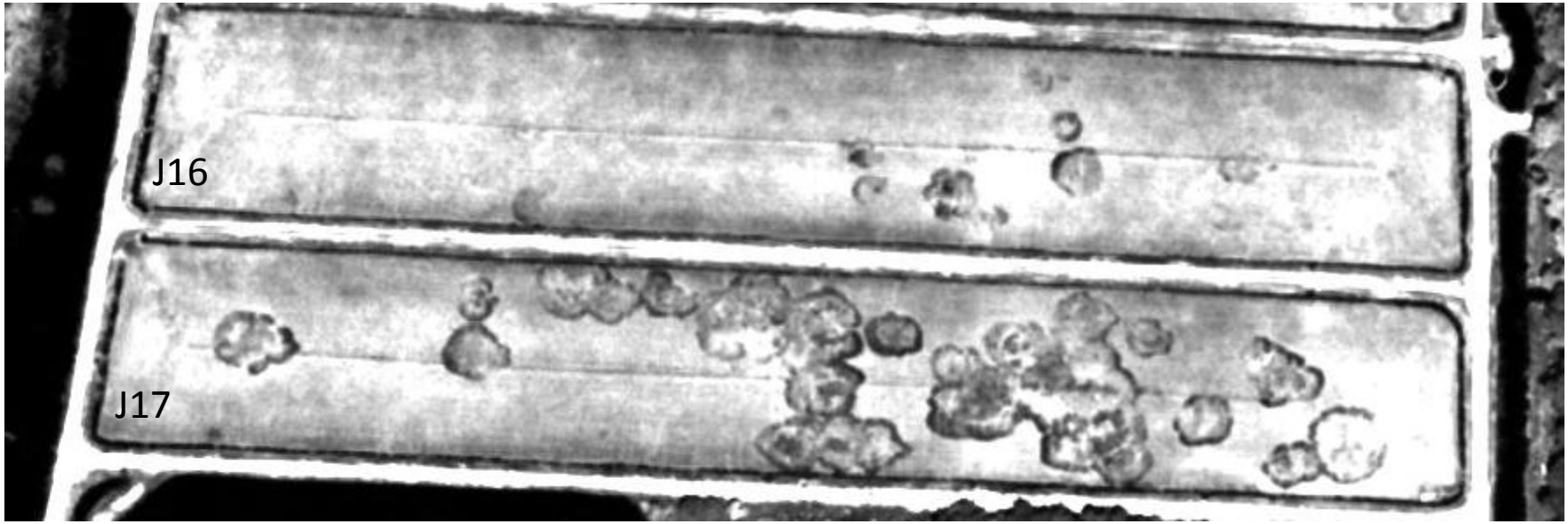
Fruit Rot



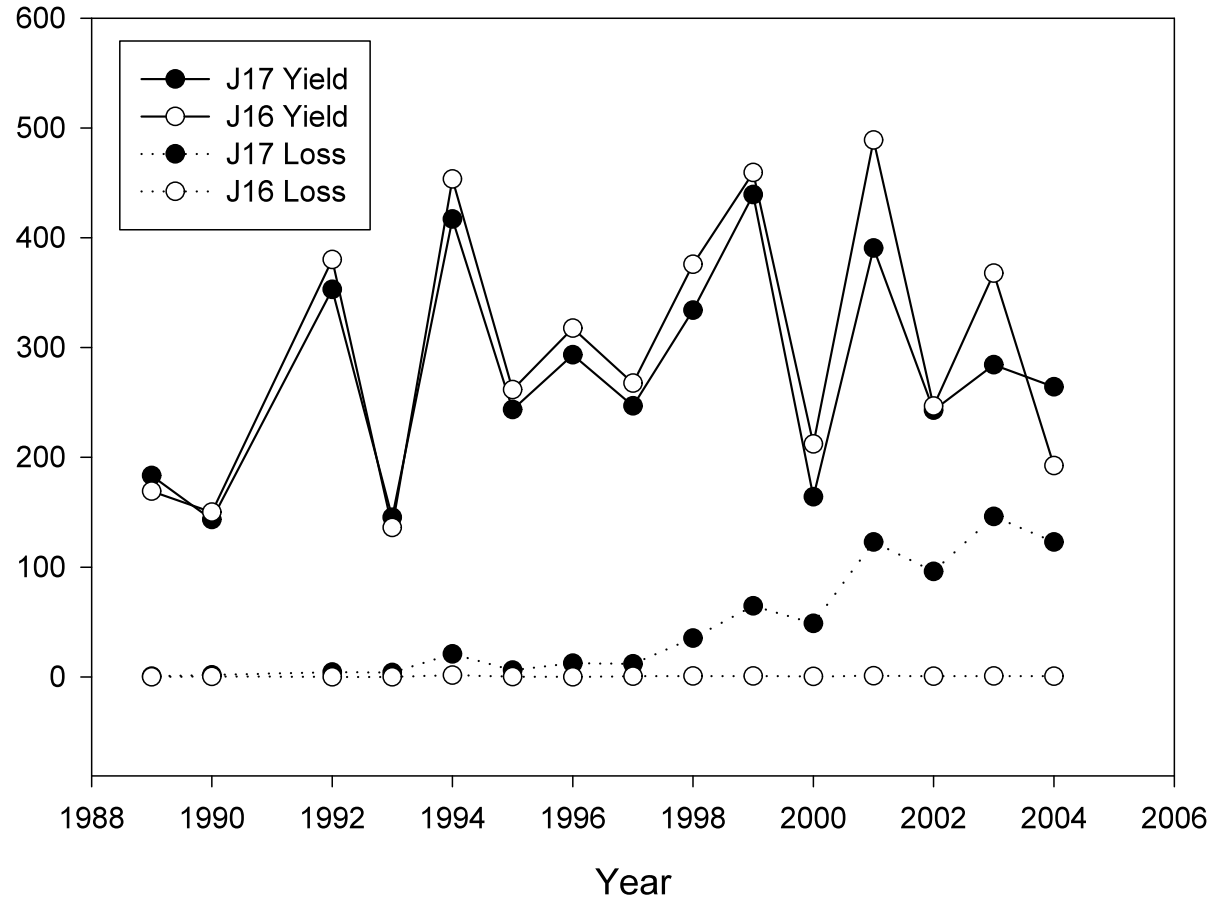
Yield Effects of Fairy Ring on Cranberry Yield

Condition	Yield 2002 (kg/ha)	Yield 2003 (kg/ha)	Yield 2004 (kg/ha)
Inside	8730	10500	13270
Outside	18420	25500	37140
	p<0.001	p<0.001	p<0.001

Understanding Yield Loss From Fairy Ring



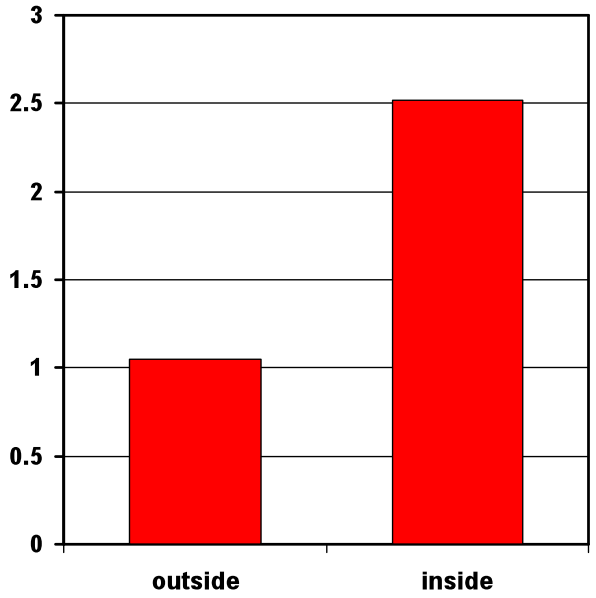
Understanding Yield Loss From Fairy Ring



J16

J17

Fairy Ring Patches are a source of Rogue Genotypes



Differences in the number of genotypes of vines inside and outside of well-established Fairy Rings

Control Methods

Vol. 52, No. 1--PLANT DISEASE REPORTER--January 1968

CONTROL OF FAIRY RING DISEASE OF THE CULTIVATED CRANBERRY

B. M. Zuckerman, K. J. Rochefort, and G. B. Rounsville[1]

Summary

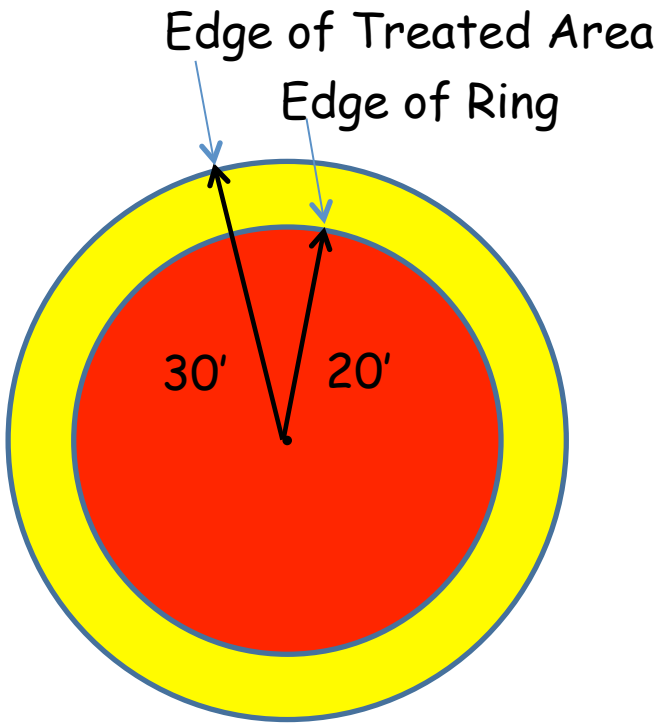
Fairy ring has hitherto been an exceedingly difficult disease to control. In the experiments reported in this paper, very good control of the fairy ring disease was obtained with ferbam, applied in the fall immediately after harvest, as a drench at the rate of 6.84 lb (actual)/100 gallons of water, one gallon per square foot, with treatments up to 3 feet outside and 2 feet within the ring.

Ferbam (carbamate) at a rate of 0.43kg/m^2 cost of approximately 16,000/treated acre.


Net Weight
10 lbs
Carbamate WDG
Fungicide
For Agricultural or Commercial Use Only
EPA Est. 32557-BL-1
ACTIVE INGREDIENT:
INERT INGREDIENTS:
TOTAL

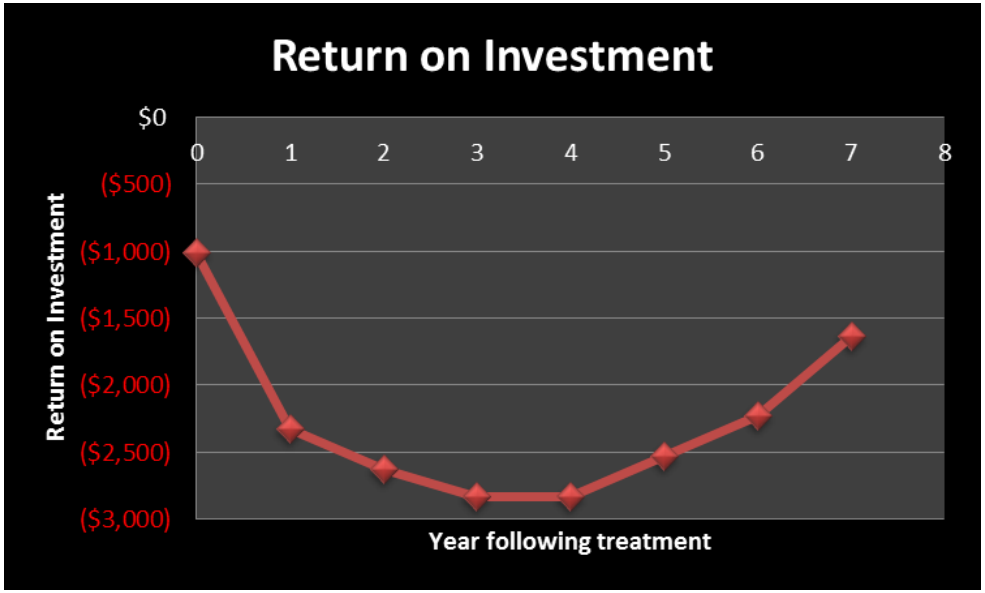

Greening effect due to Ferbam

Example

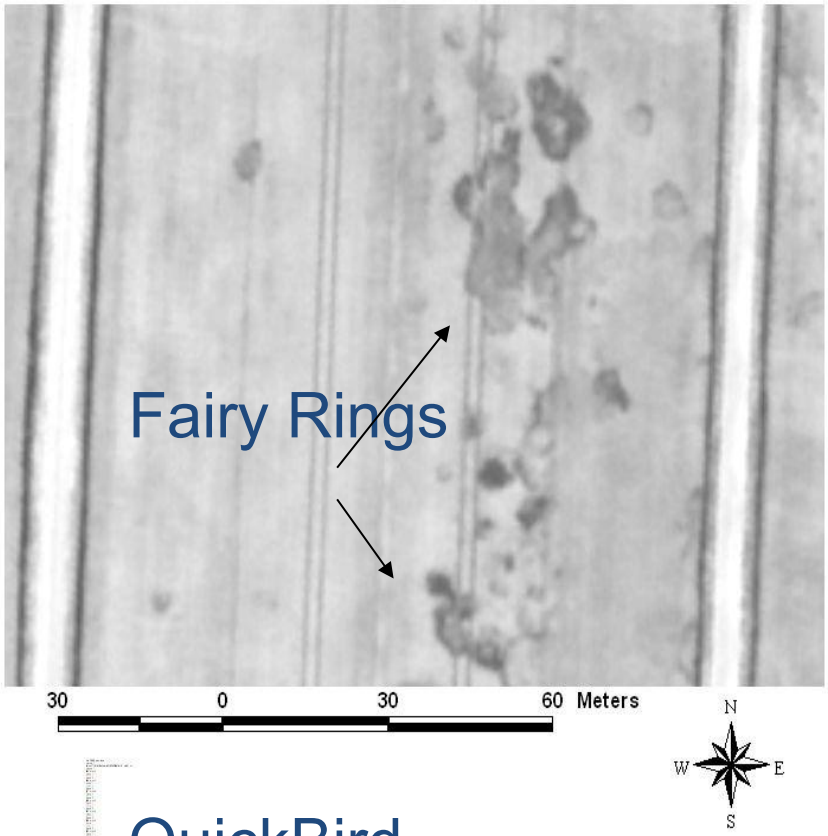


Treated Area = Πr^2
3.13 x 30 x 30 = 2826

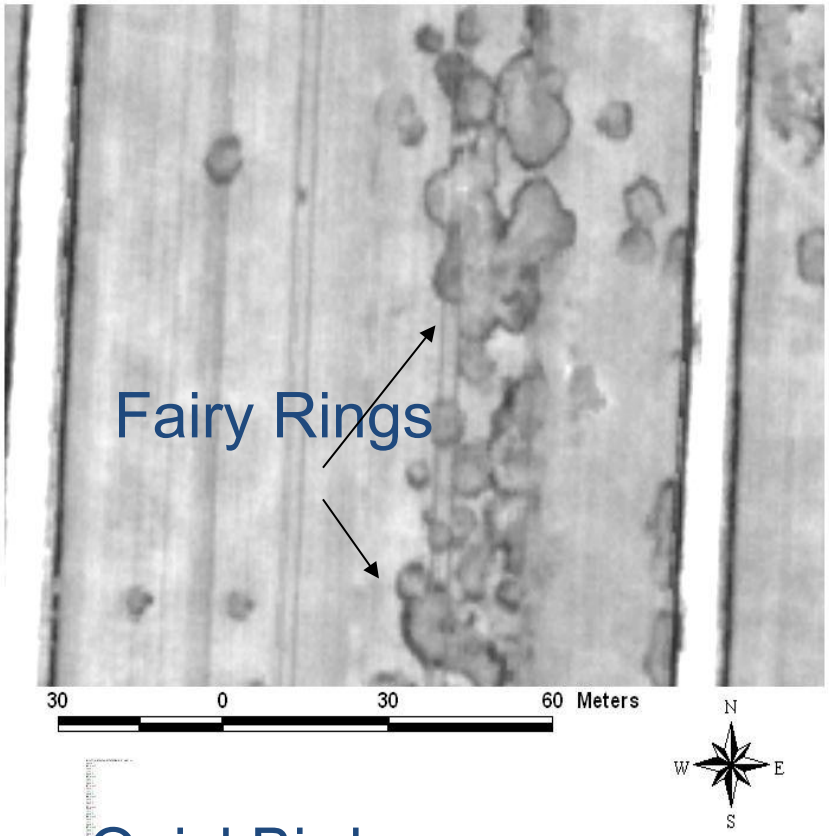
Area	Healthy Production	Diseased Production	Ferbam Use
	400 bbl/acre	160 bbl/acre	9 lb/100ft^2
2826 ft^2	25 bbl	10 bbl	254 lb
2826 ft^2	$1500	$600	$1016



Spread of Fairy Ring Disease
2006 - 2008

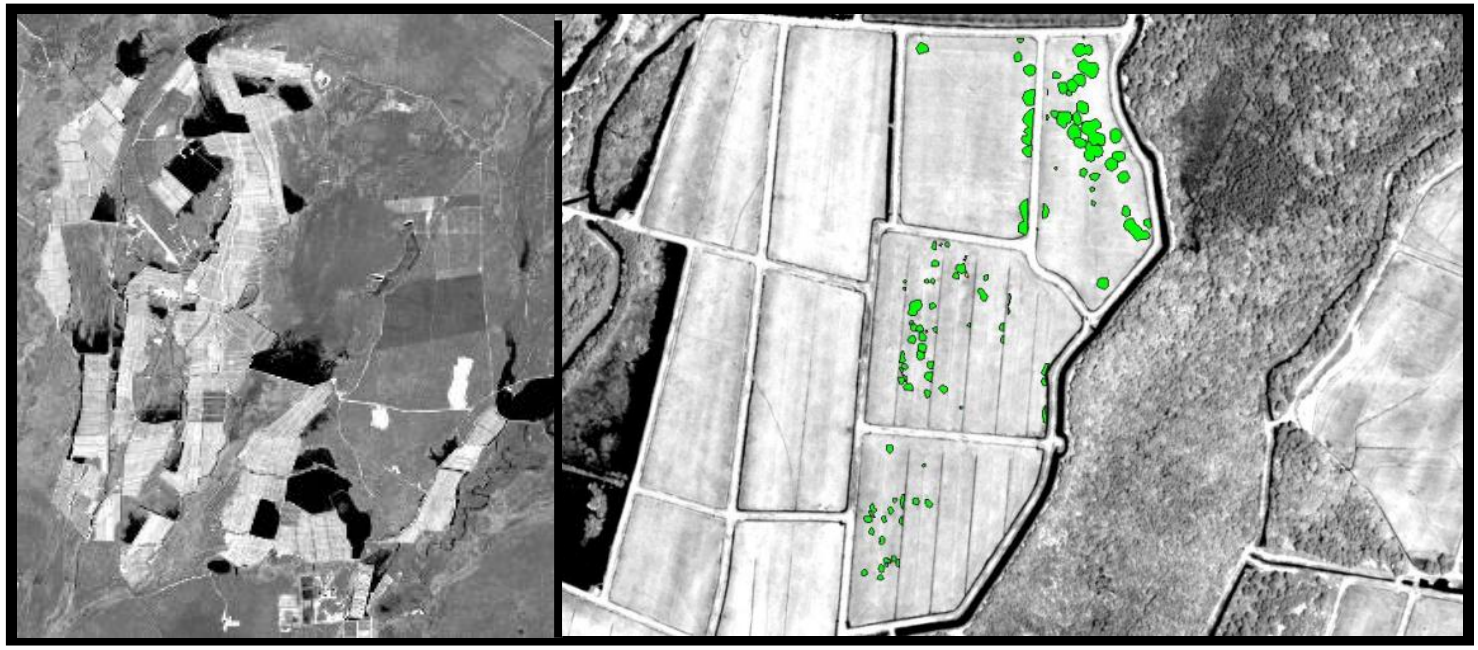


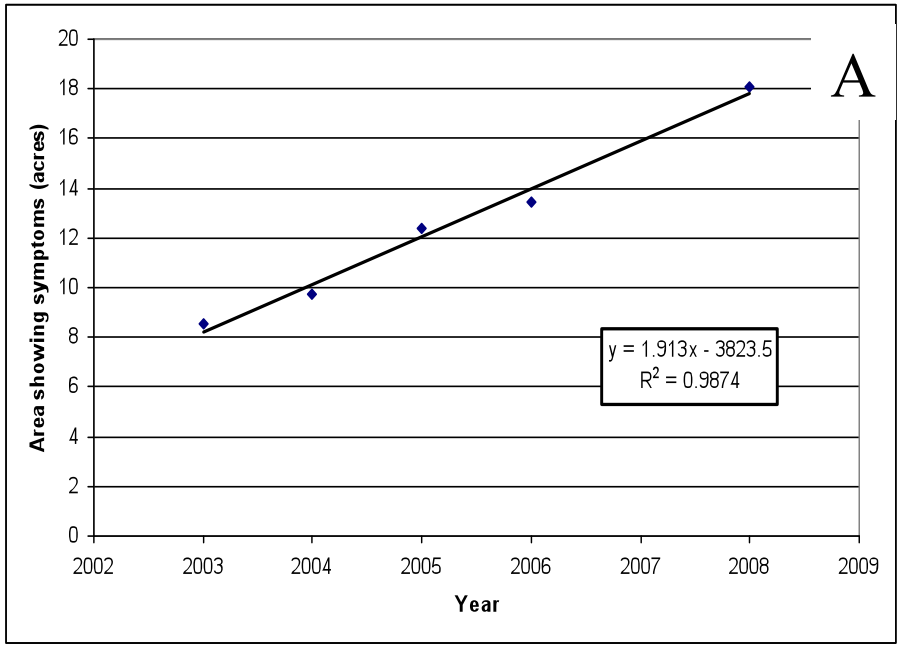
QuickBird Panchromatic image taken July 18, 2006

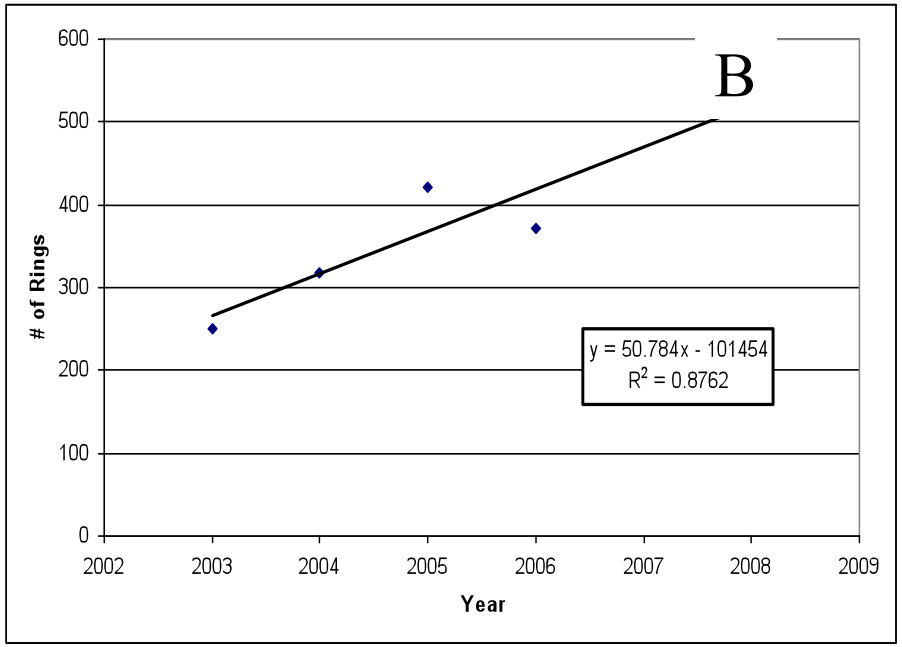


QuickBird Panchromatic image taken June 27, 2008

Incidence and severity of fairy ring disease on cranberry fields near Chatsworth, NJ in 2006				
Cultivar	Area Sampled (ha)	Number of rings	Area Infected (ha)	Fields infected (Total fields)
Ben Lear	49	163	2.33	15 (30)
Early Black	290	105	1.88	29 (165)
Stevens	126	63	0.48	12 (83)







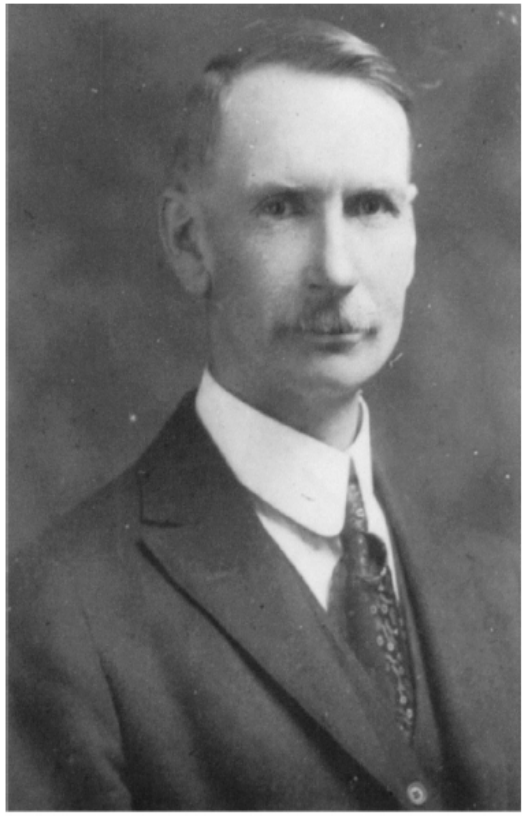
Change in fairy ring severity across a study area of ~1300 acres. A) Increase in acreage affected by the disease from 2003 – 2008. B. Shows the increase in the number of rings over the same time period. Data was collected from satellite imagery taken just following the bloom period each year.

- Stand opening diseases have the potential to increase genetic diversity and reduce longevity of productive beds
- Economical control measures are necessary
- Causal agent

Importance and Economic Impact

- Distribution limited to the northeast region
- Once considered minor now impacting high yielding cultivars such as Stevens and Ben Lear
- Reduces yield (50-60%)
- Increases fruit rot
- Opens canopy to weed invasion
- Increases genetic diversity of cranberry crop
- Increases need for replanting

Isolation and identification of the causal agent has proven difficult



Psilocybe agrariella
Shear et al., 1931. USDA Agric. Tech. Bull.

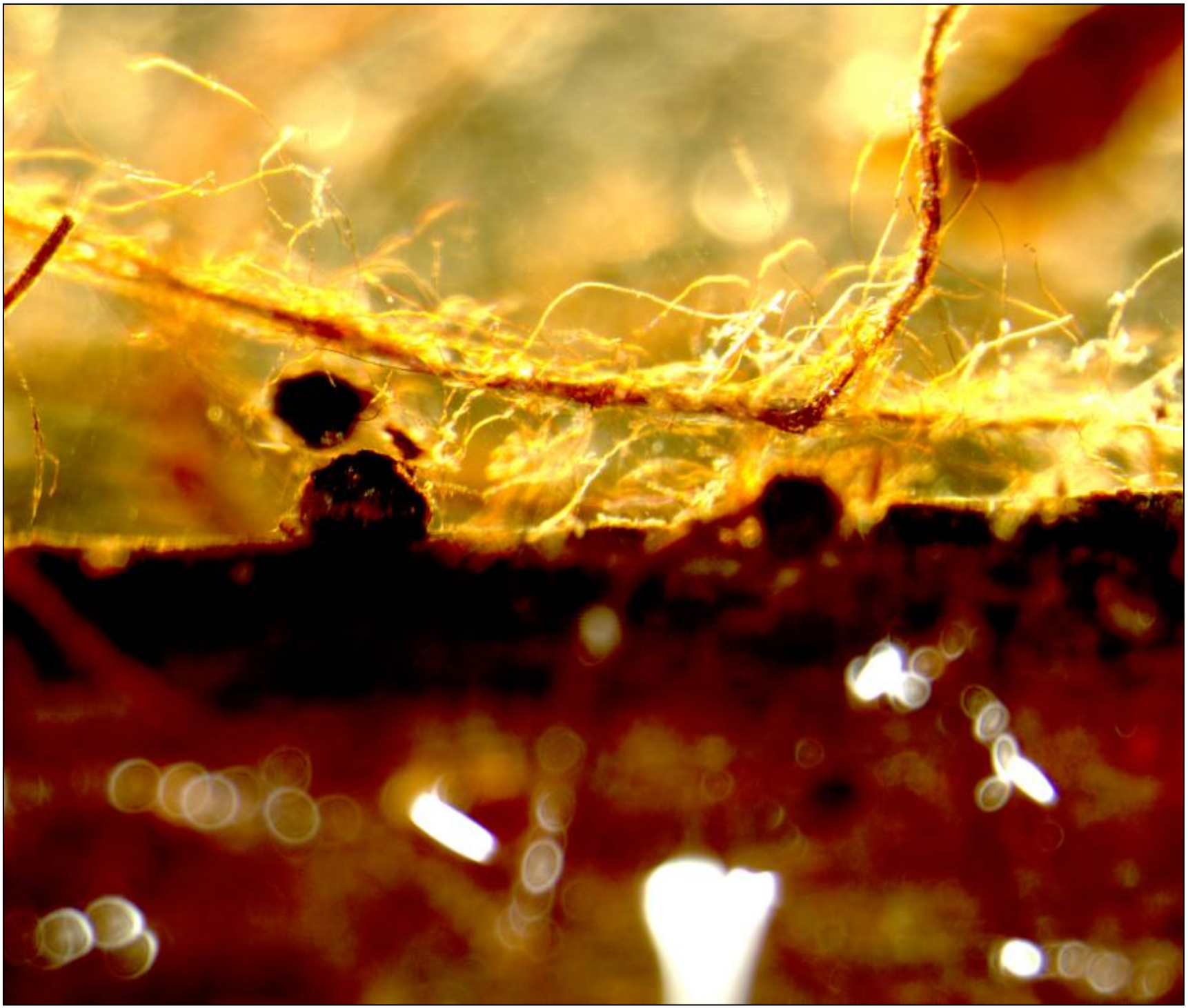
Phialophora sp.
Hlubik, 1988. Rutgers University M.S. thesis

***Rhizoctonia* sp.**
Chang, 1989. Rutgers University M.S. thesis

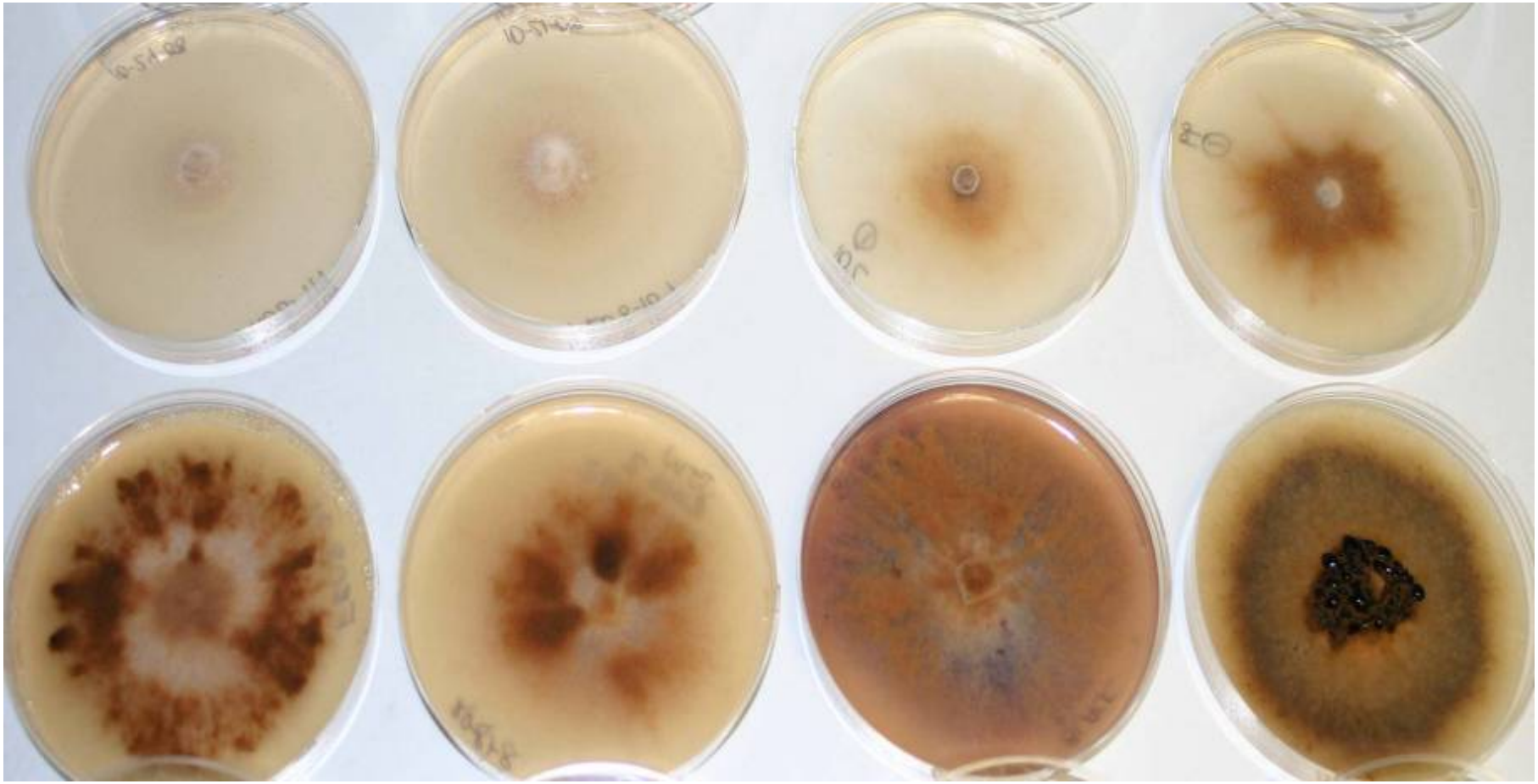
***Pezicula* sp.**
Oudemans, et al. 2003

Fairy Ring Causal Agent

- Koch's Postulates failed on two counts
  - Essential protocol to demonstrate pathogenicity has failed with all fungi isolated from fairy rings
    - Suspected pathogen not consistently isolated
    - Suspected pathogen not pathogenic
- We changed our approach
  - Observed dark structures on stolons
  - External mycelium evident



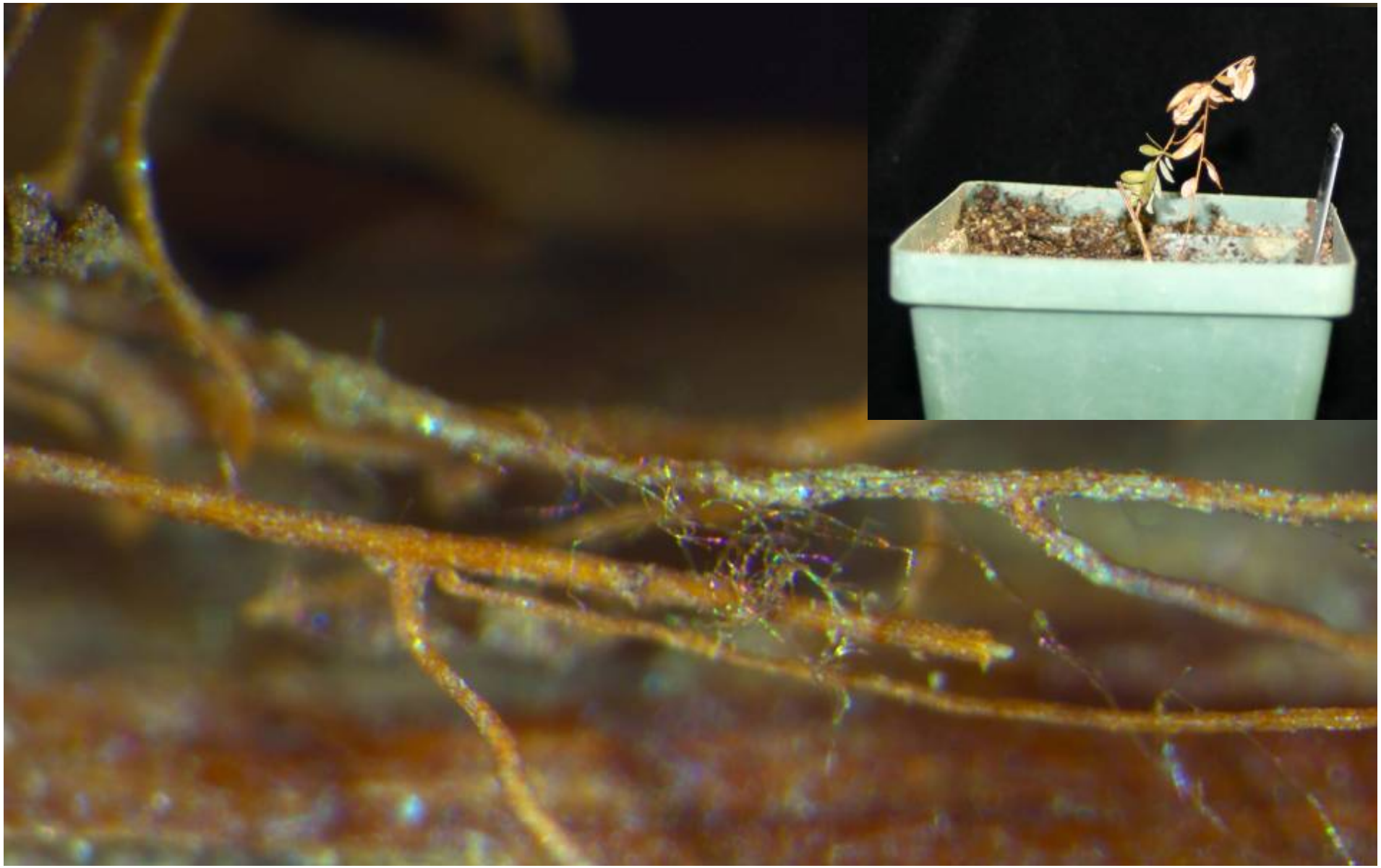
Isolated Cultures



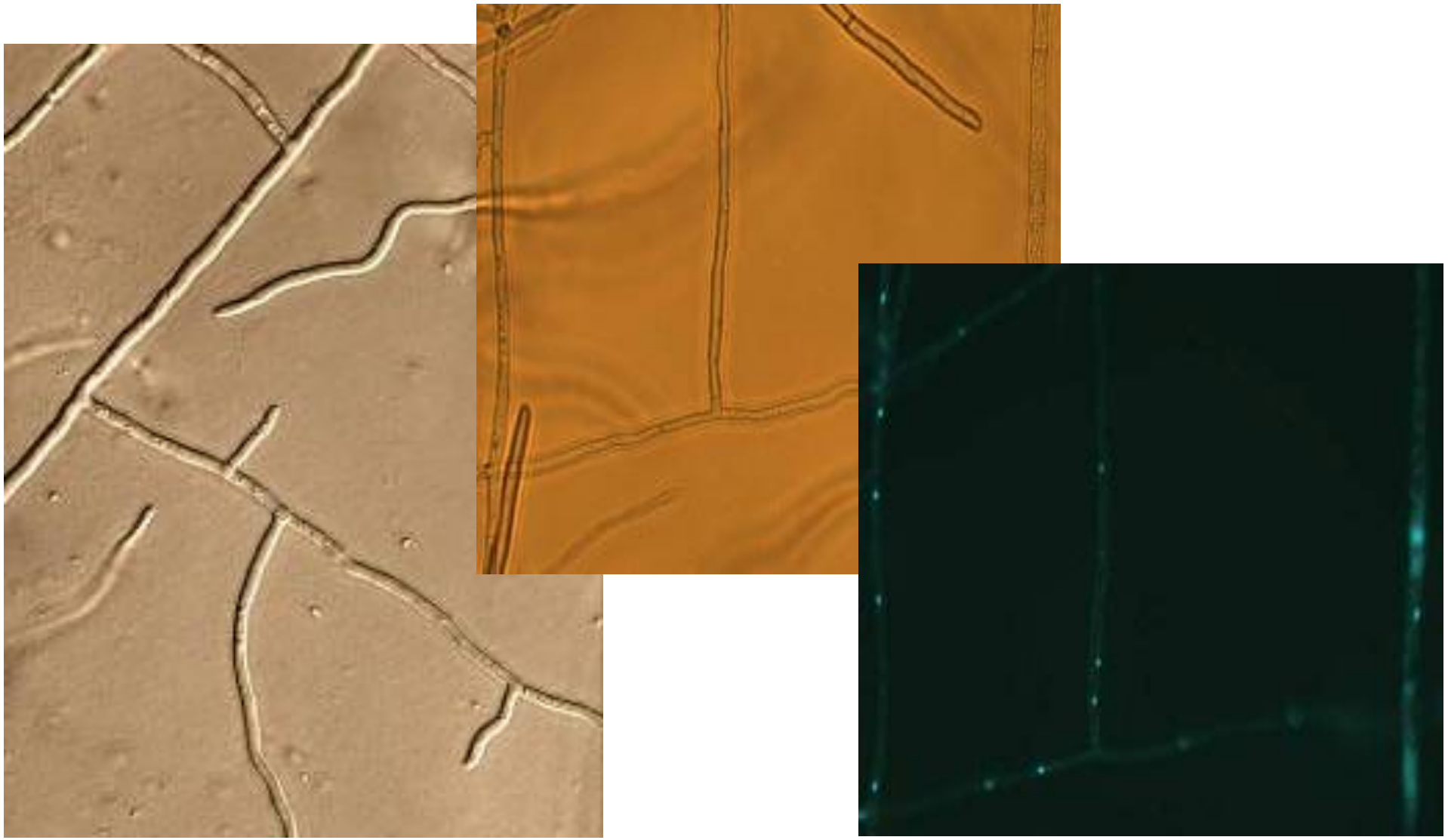
*No sporulation in culture

Inoculations

Infection and Plant Death



Fairy Ring Causal Agent



Sequence Analysis for Identification

AY292443.1	Helicobasidium longisporum I voucher M 5803 18S ribosomal RNA gene, partial sequence; internal transcribed spacer 1, 5.8S ribosomal RNA gene, and internal transcribed spacer 2, complete sequence; and 28S ribosomal RNA; amplified by primers ITS1 gene, partial sequence	652
AY292427.1	Helicobasidium longisporum I voucher GZU 74-99 18S ribosomal RNA gene, partial sequence; internal transcribed spacer 1, 5.8S ribosomal RNA gene, and internal transcribed spacer 2, complete sequence; and 28S ribosomal RNA; amplified by primers ITS1 gene, partial sequence	652
AY460155.1	Tuberculina persicina isolate ml73 18S ribosomal RNA gene, partial sequence; internal transcribed spacer 1, 5.8S ribosomal RNA gene, and internal transcribed spacer 2, complete sequence; and 28S ribosomal RNA gene, partial sequence	652
AY460153.1	Tuberculina persicina isolate ml324 18S ribosomal RNA gene, partial sequence; internal transcribed spacer 1, 5.8S ribosomal RNA gene, and internal transcribed spacer 2, complete sequence; and 28S ribosomal RNA gene, partial sequence	652
AB056725.1	Helicobasidium purpureum genes for nuclear small rRNA, ITS1, 5.8S rRNA, ITS2, nuclear large rRNA	652
AB044140.1	Rhizoctonia violacea gene for nuclear small rRNA, ITS1, 5.8S rRNA, ITS2, nuclear large rRNA, partial and complete sequence	652
AY292426.1	Helicobasidium longisporum II voucher CBS 296.50 18S ribosomal RNA gene, partial sequence; internal transcribed spacer 1, 5.8S ribosomal RNA gene, and internal transcribed spacer 2, complete sequence; and 28S ribosomal RNA; amplified by primers ITS1 gene, partial sequence	645

ITS BLAST Results

Tuberculina – Thanatophytum/Rhizoctonia crocorum – Helicobasidium: a unique mycoparasitic–phytoparasitic life strategy†

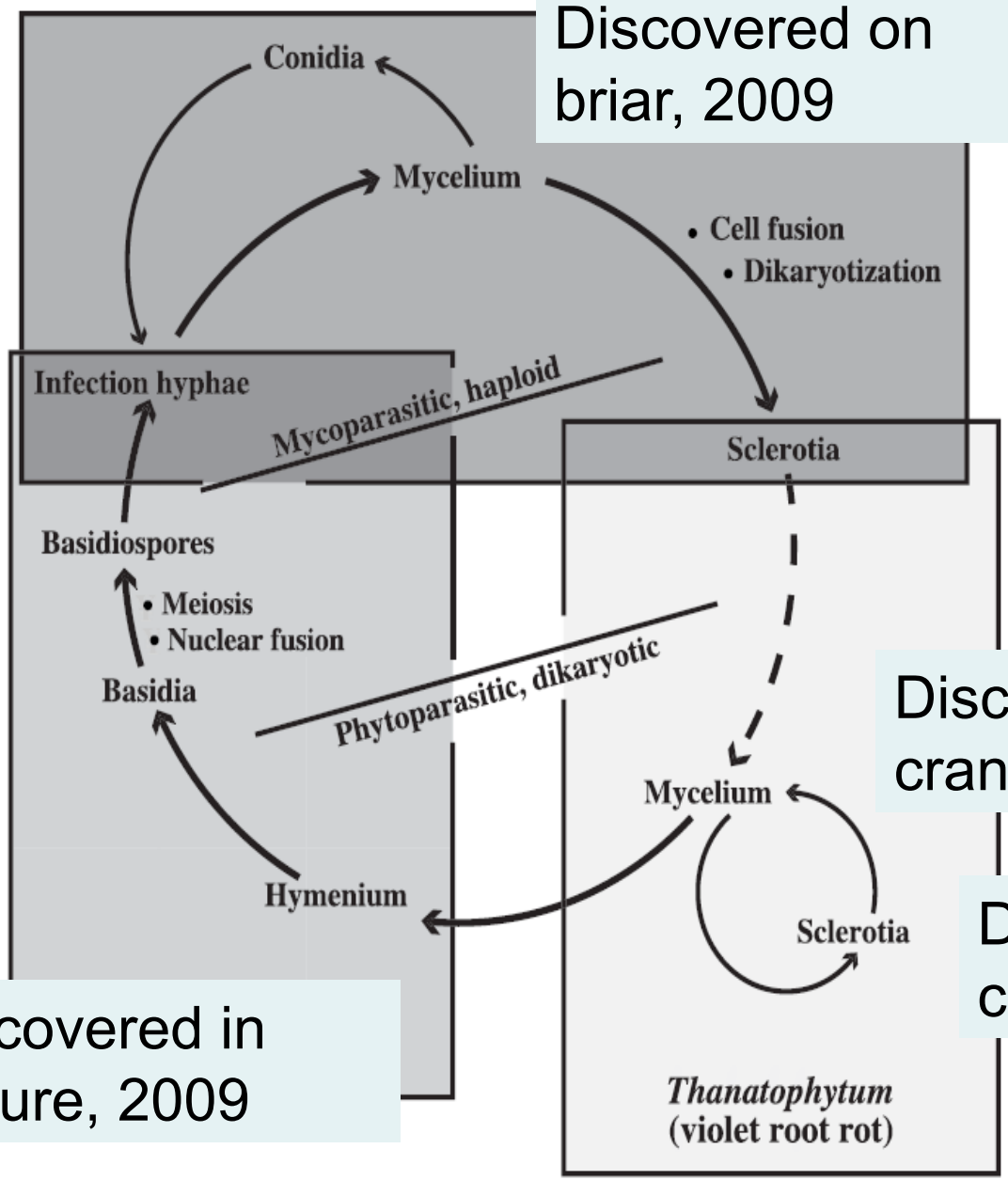
Matthias LUTZ*, Robert BAUER, Dominik BEGEROW and Franz OBERWINKLER

Mycol. Res. **108** (3): 227–238 (March 2004).

DOI: 10.1017/S0953756204009359 *Printed in the United Kingdom.*

Key Points: *Tuberculina* a rust hyperparasite is synonymous with *Thanatophytum*

The described stages are linked in a relatively complex life-cycle



Discovered on briar, 2009

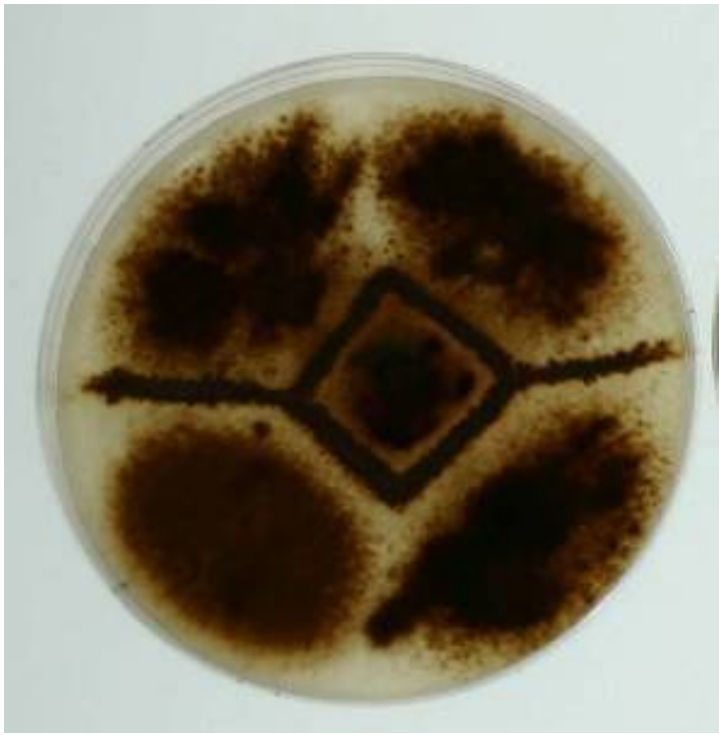
Discovered on cranberry, 2008

Discovered on cranberry, 2008

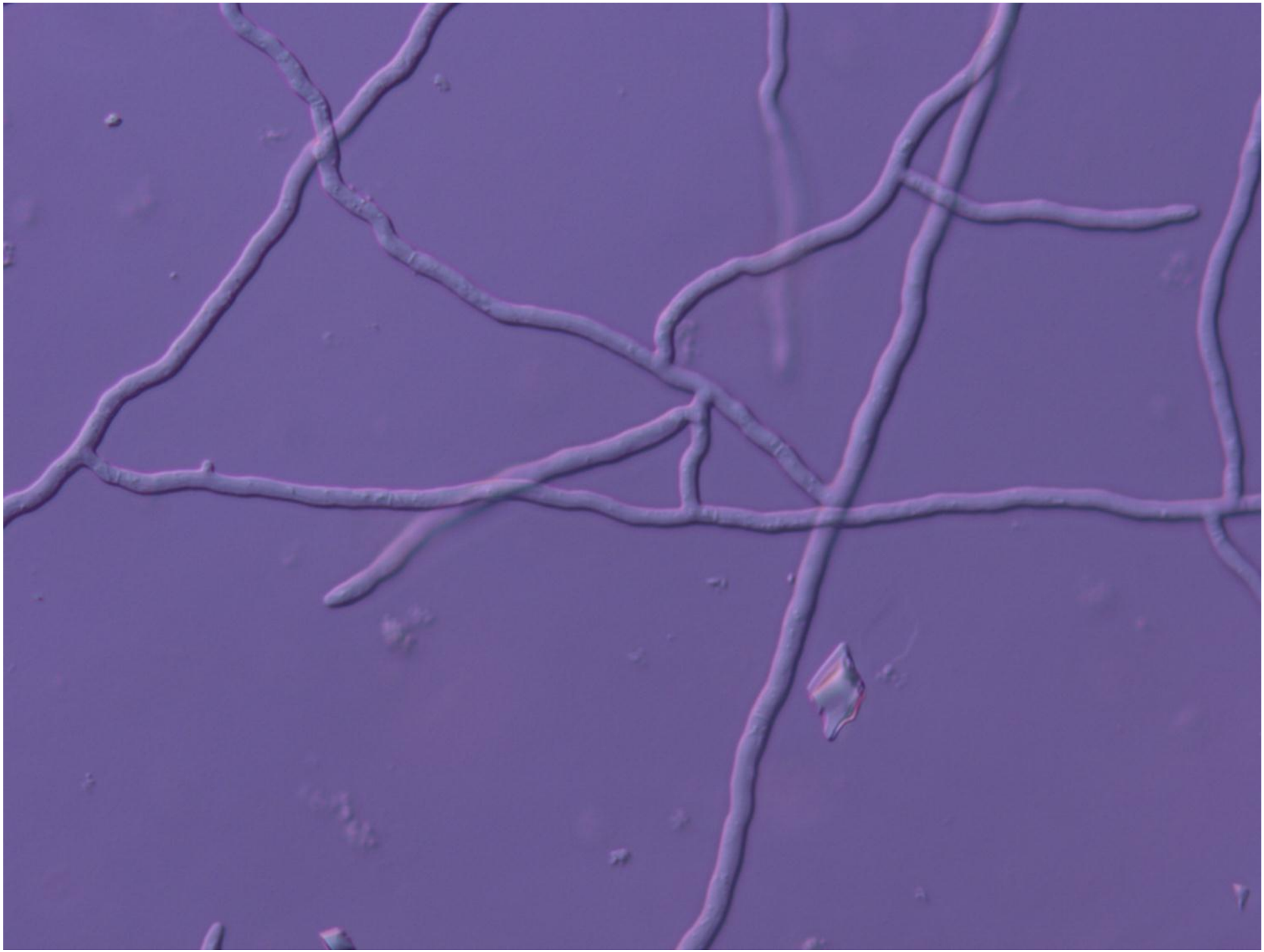
Discovered in culture, 2009

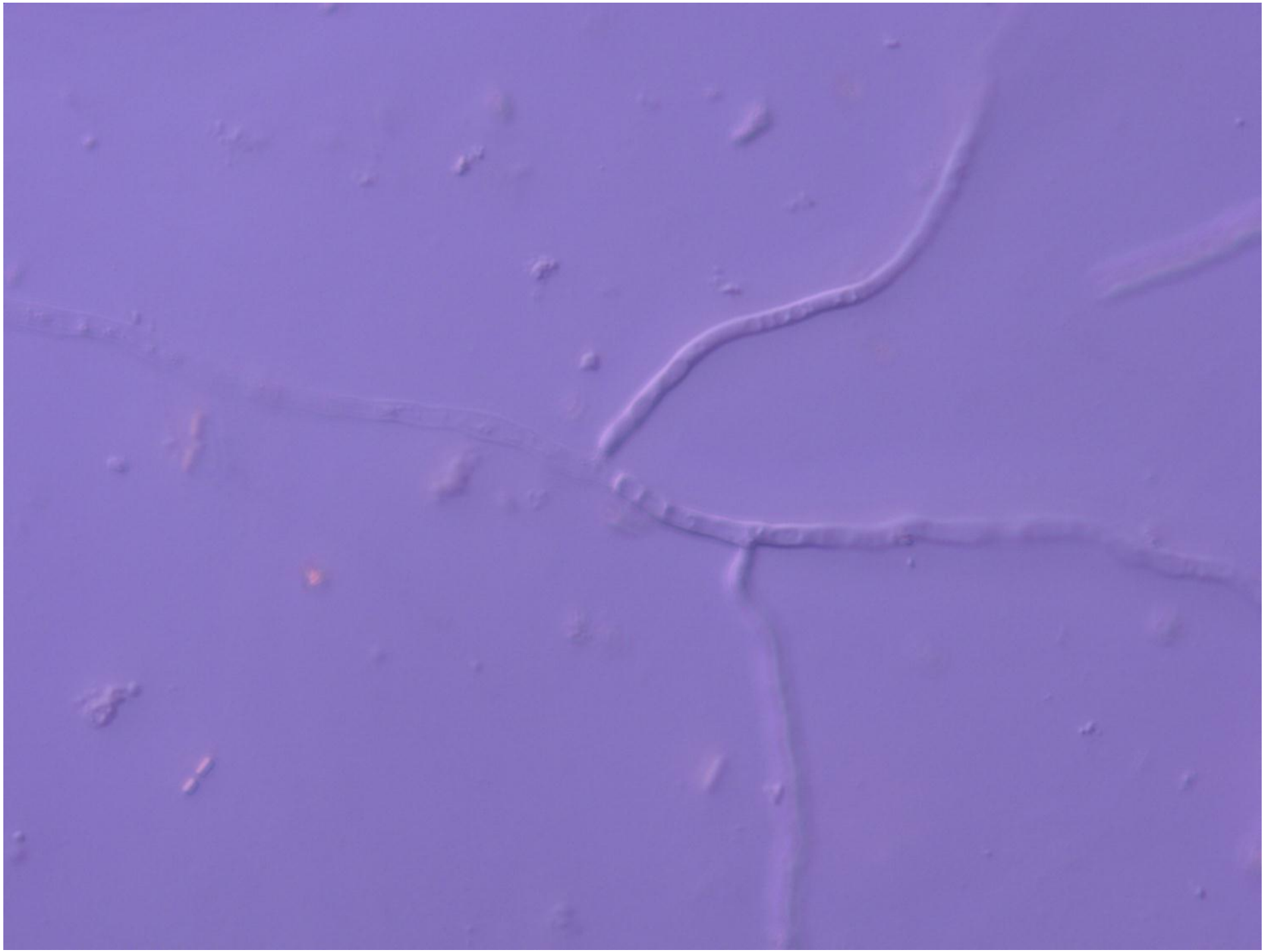
Vegetative Incompatibility

	R1a	R1b	R2a	R2b
R1a	+			
R1b	+	+		
R2a	-	-	+	
R2b	-	-	+	+

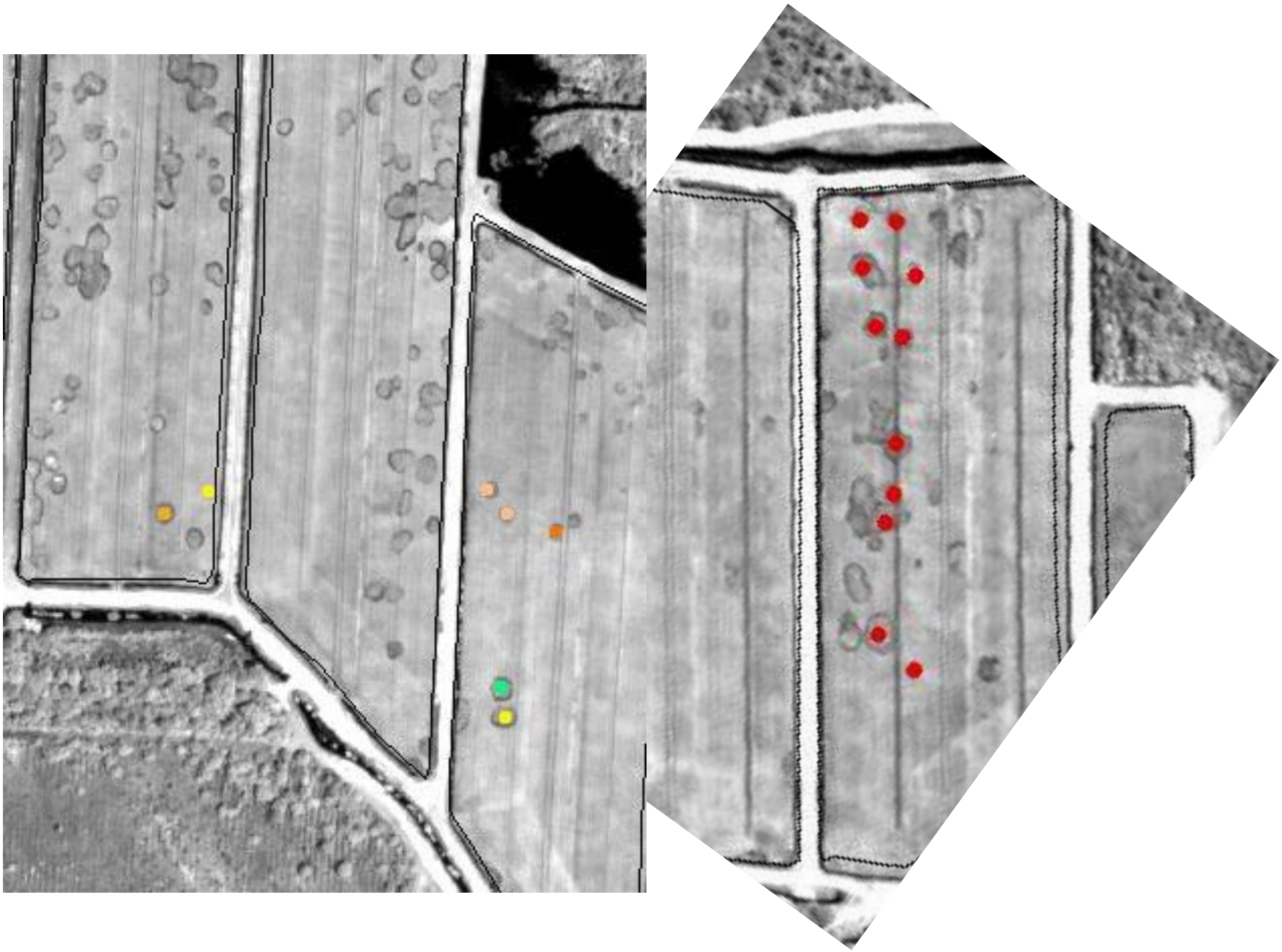


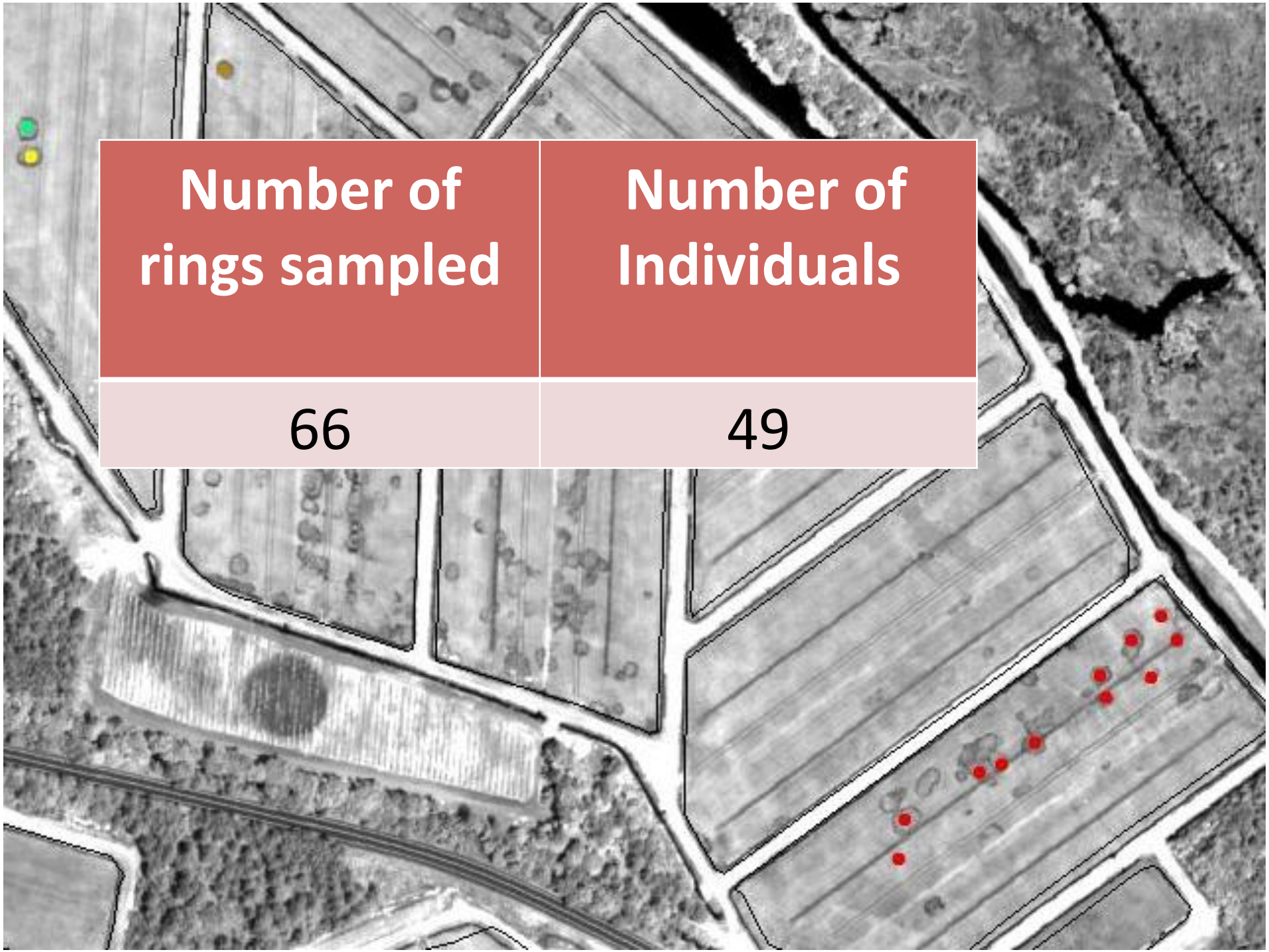
- Same ring = same VC
- Different rings = different VC





Distribution of VCGS

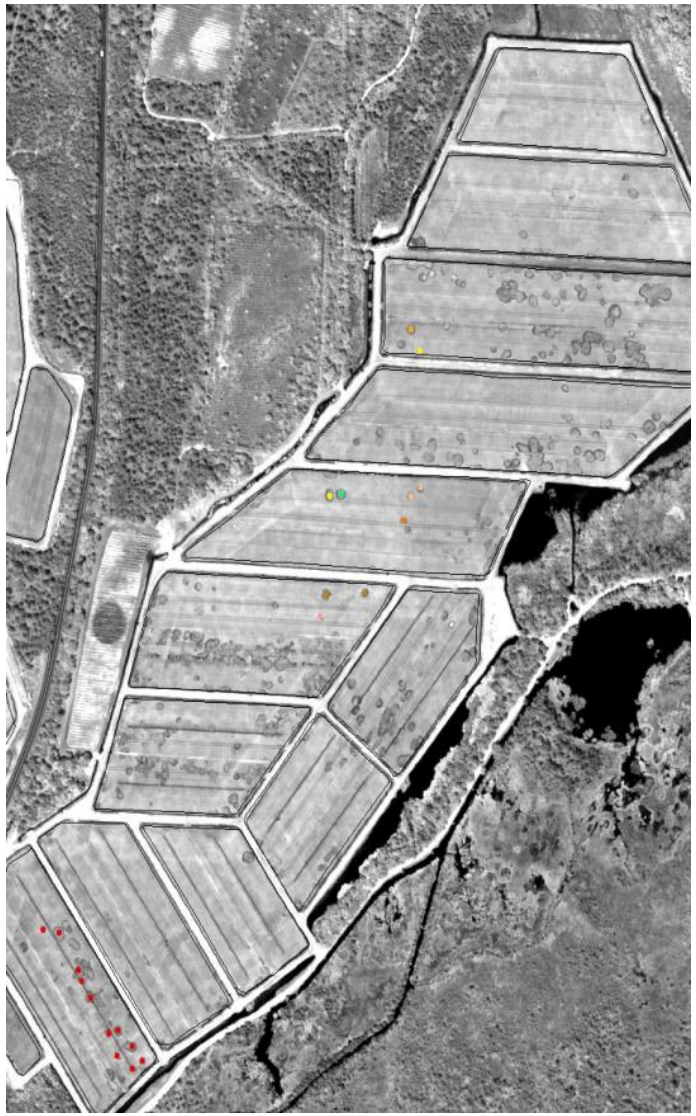




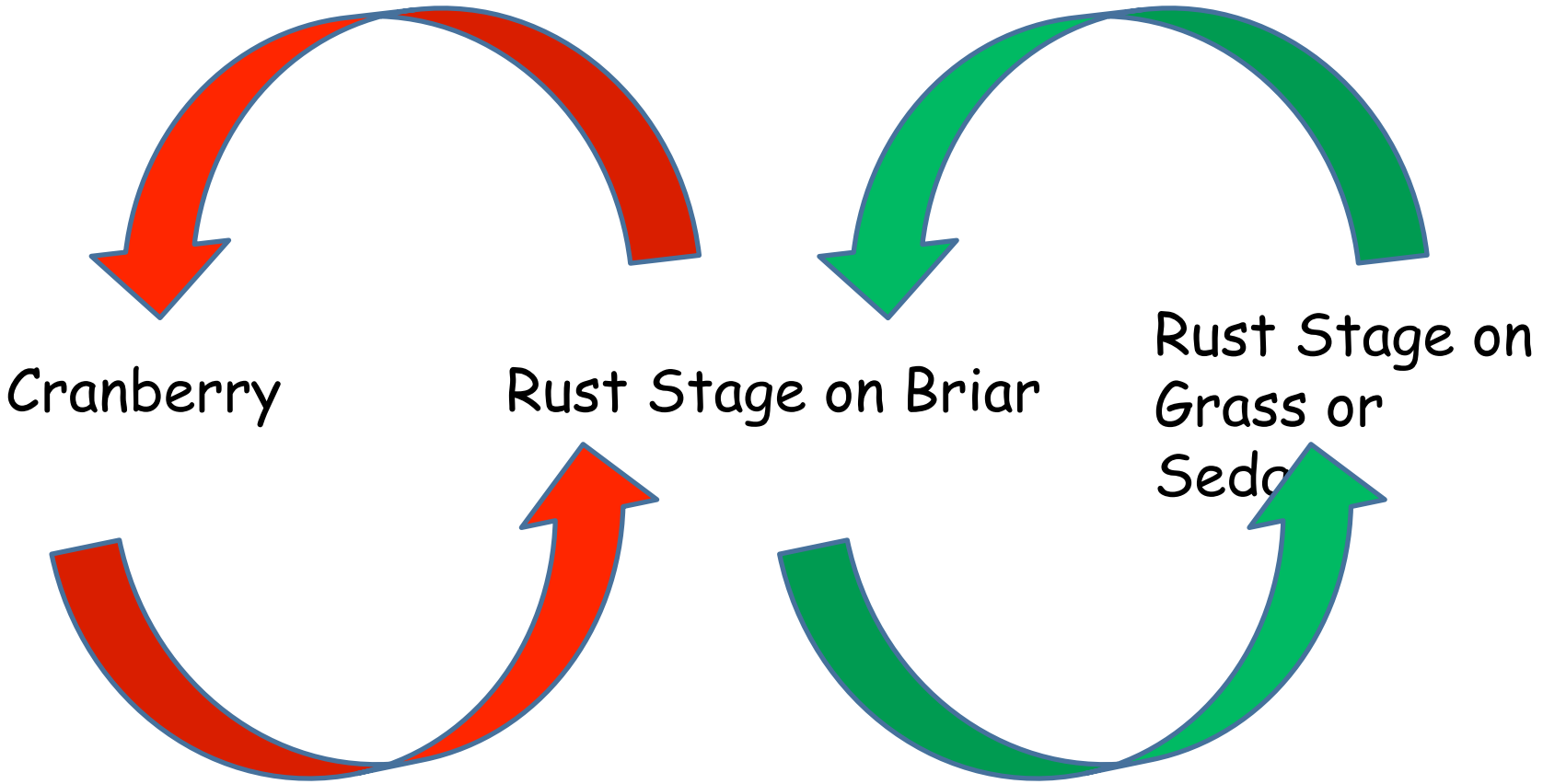
Number of rings sampled	Number of Individuals
66	49

Vegetative Incompatibility

- Isolates have been obtained from 66 rings
- From those we have found 49 VCGs
- Duplicate VCGs are always found in the same bed
- Five rings with five isolates each confirm a single VCG per ring

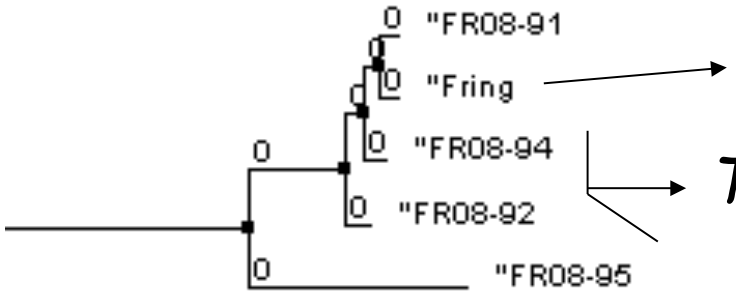


Fairy Ring – Controlling the Spread



THE ALTERNATE HOST: RUST

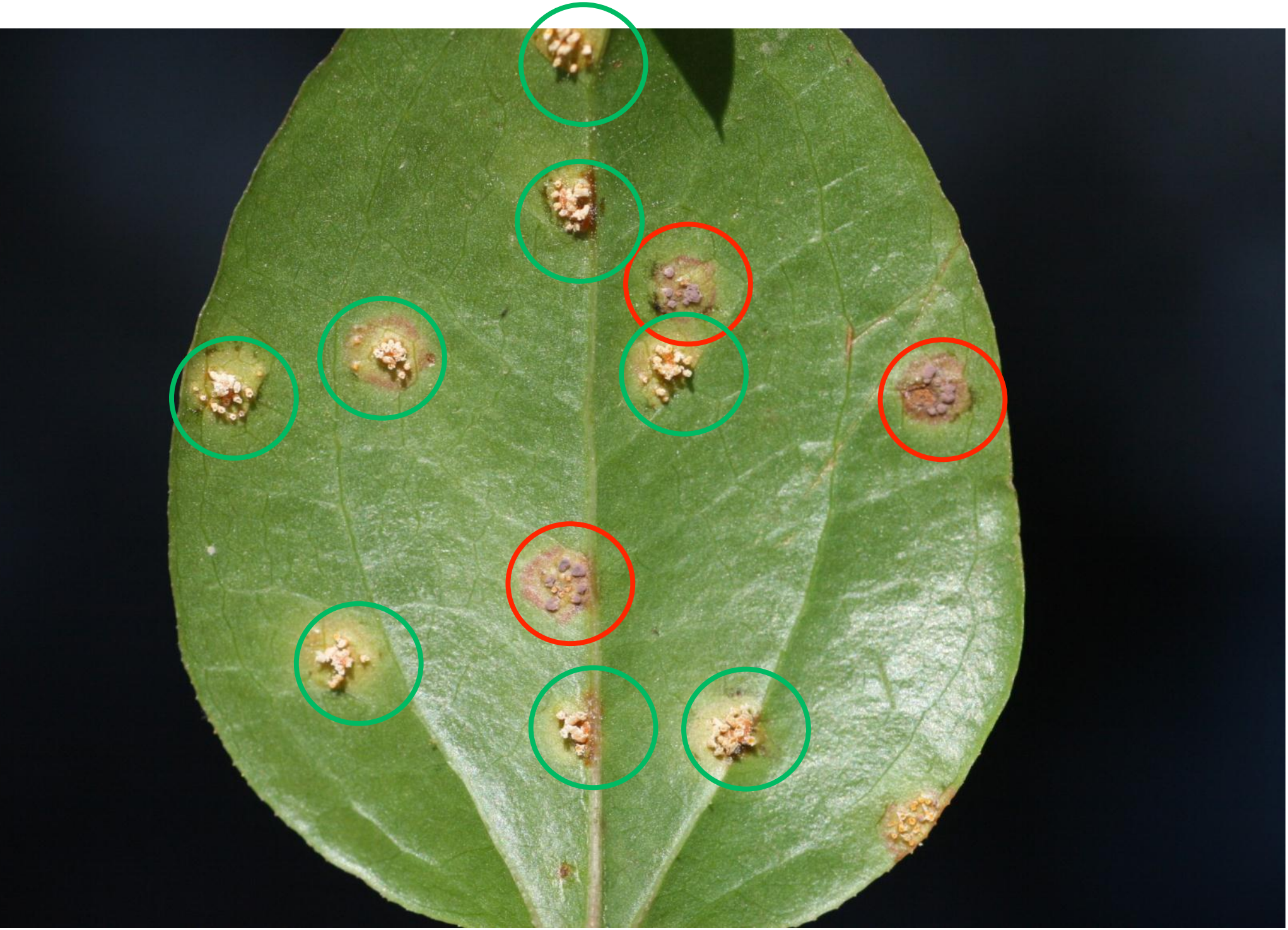
Comparison of Pine Barrens isolates with GenBank data sing ITS and 5.8s ribosomal gene



Tuberculina Briar Rust

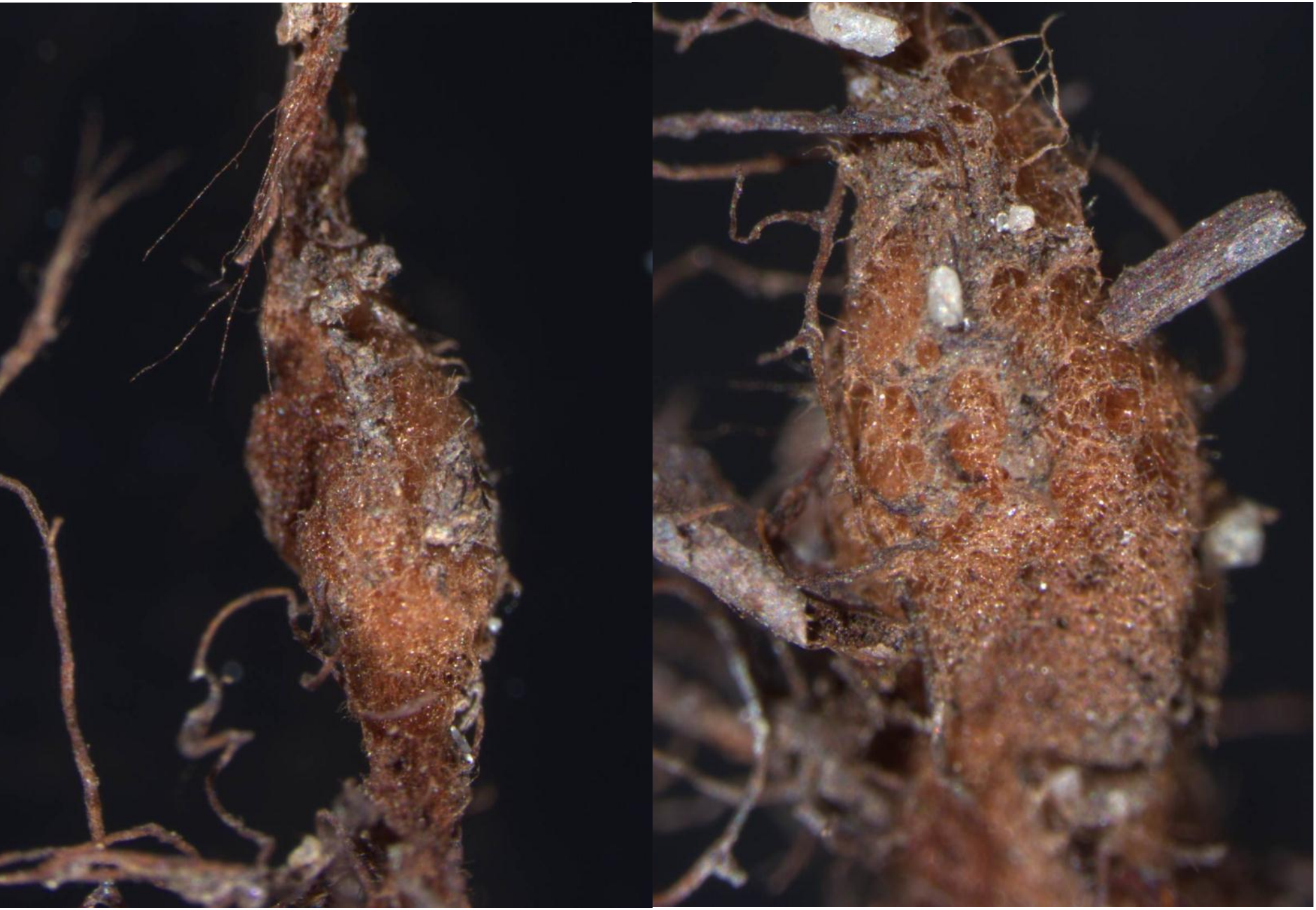
Thanatophytum cranberry

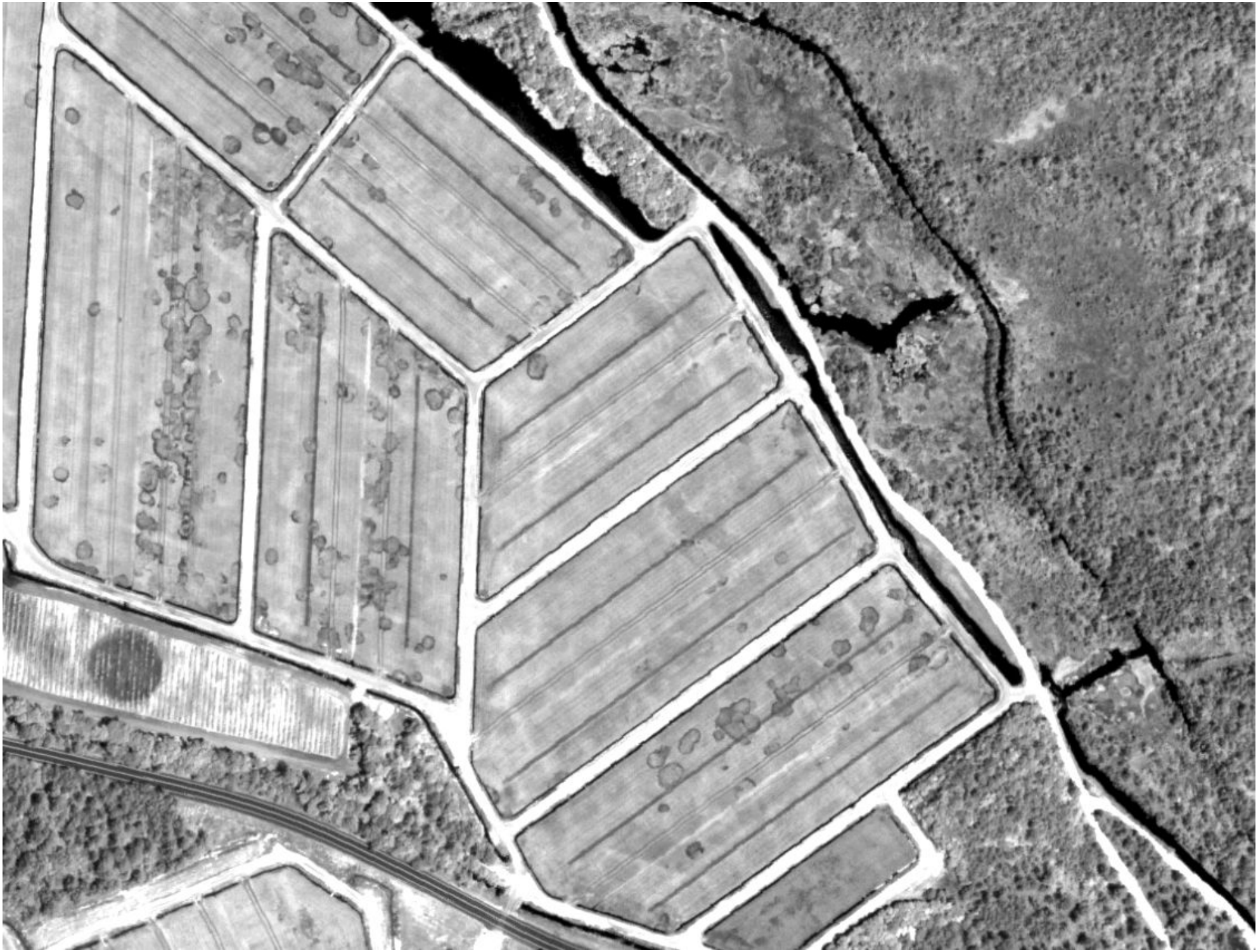
Rust Lifecycle



FAIRY RING


2
3
4
5
6
7
8
9
Compliments of the
Vegetable Growers Association
PHONE/FAX PHIL TRAINO
609-985-4382
PHONE/FAX ROCKY DIGEROLAMO

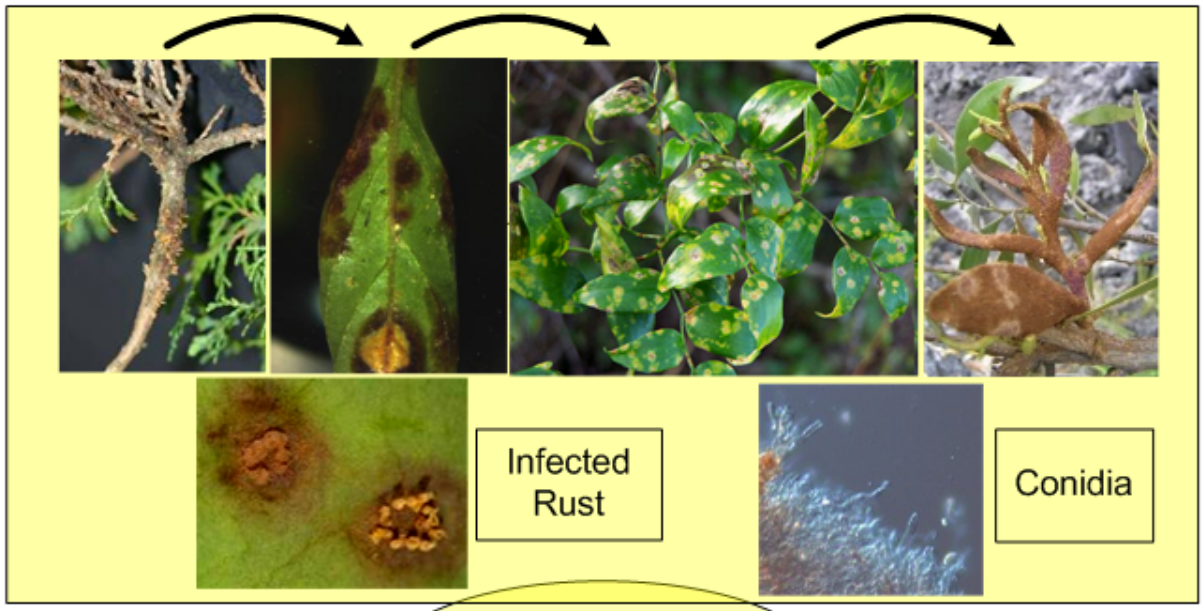




A second plant species that may harbour the Fairy Ring fungus
Swamp Loosestrife (*Decodon verticillatus)*

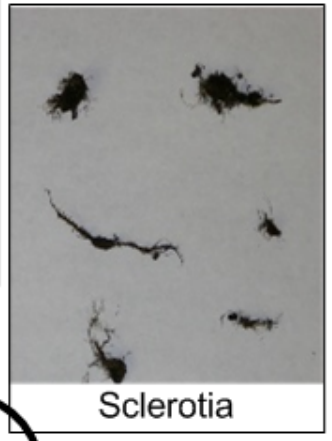
The Life Cycle of Fairy Ring Disease on Cranberry

Basidiospores



Infected Rust

Conidia



Sclerotia

Tuberculina

Basidiospores

Sclerotia

Meiosis

Helicobasidium

Thanatophytum

Conclusions

- Causal agent of fairy ring is a species of *Thanatophytum/Helicobasidium/Tuberculina*
- Spread of this pathogen likely involves the hyperparasitic phase on at least one rust species
- Control options may now target one or more alternate hosts
- The pathogen genetic structure suggests a large population size and one that is supported by multiple host species

How Has Fairy Ring Control Changed???

The Disease Cycle Exhibits Two Stages

Rust Stage

- Air-borne – maximum dispersal rate
- Spores can be carried large distances
- Foliar disease can be controlled with foliar fungicides
- Scouting to identify areas where rust host(s) is present

Cranberry Stage

- Soil-borne – limited dispersal
- Sclerotia can be moved in soil by equipment
- Control requires drenching using volumes of water with fungicides
- Progress can be monitored using aerial/ satellite imagery

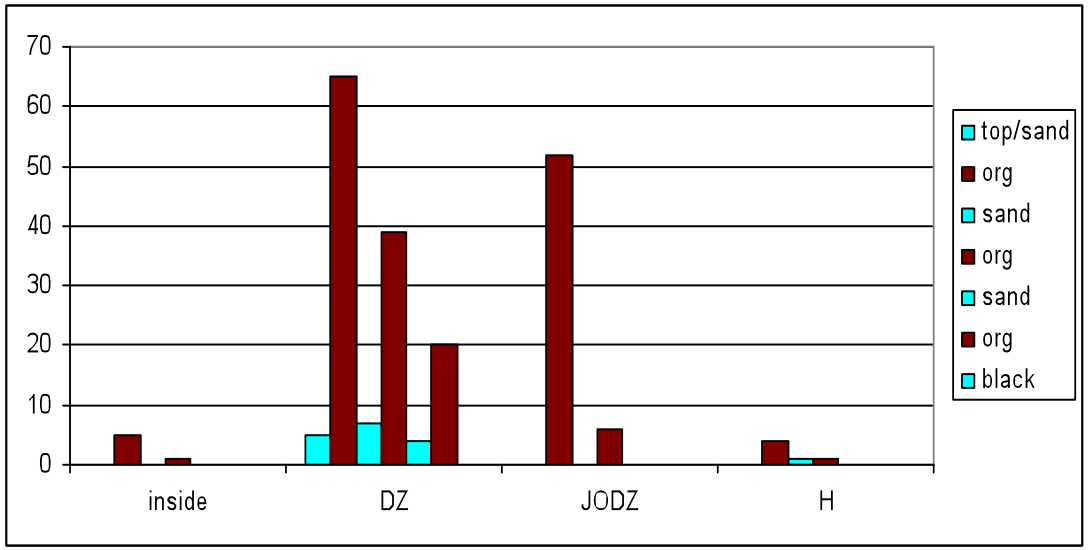
RUST STAGE

- The rust is very sensitive to Indar as well as other fungicides in the FRAC group 3
- Therefore, timing fruit rot applications to coincide with rust infectivity will serve a double purpose
- Obviously, Briar control is the best approach

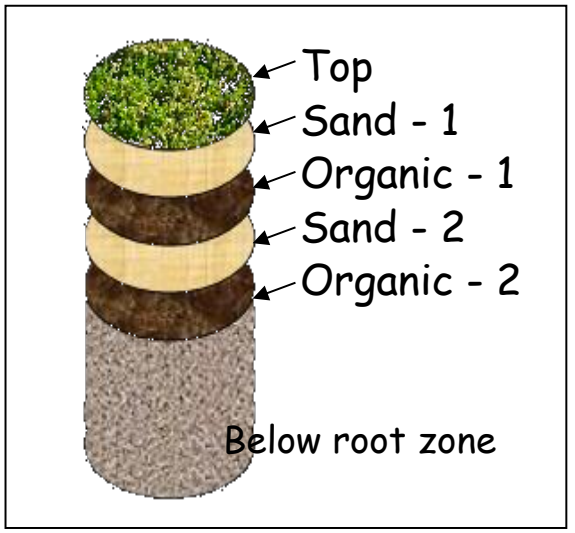
Cranberry Stage

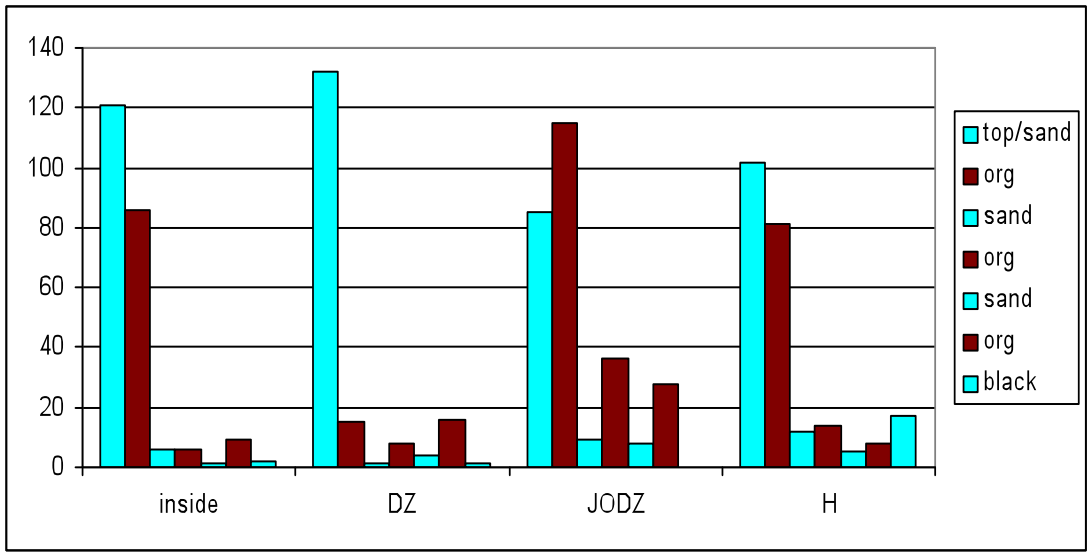
1. Soils cores are evaluated to determine the depth and location of fairy ring distribution.
2. Samples are collected along a transect to determine the distribution of fairy ring, in particular the distance beyond the advancing edge
3. Imagery will be analyzed (when available) to determine the rate of disease spread under various control scenarios

Distribution of stolons in soil profiles



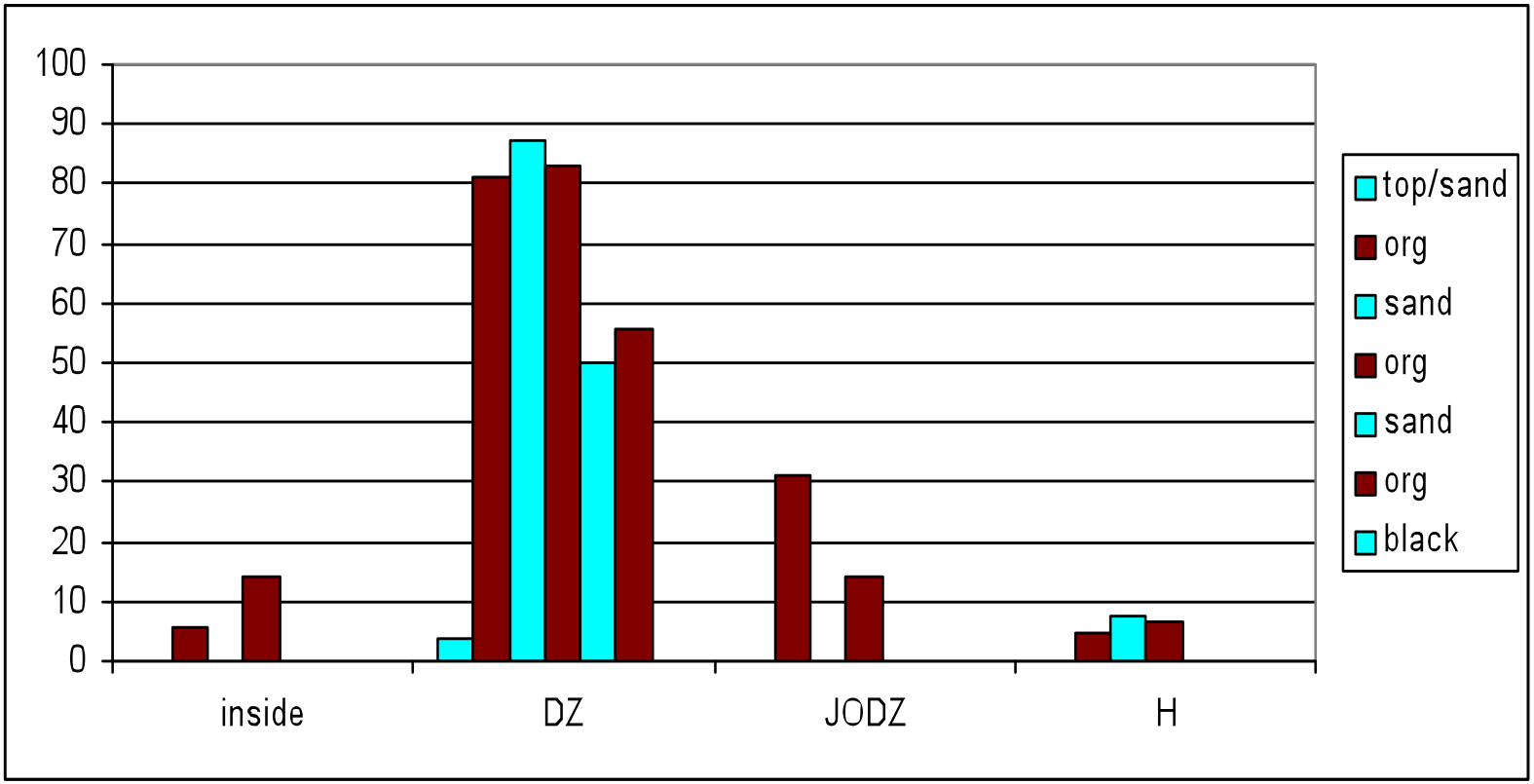
Stolons with infection pads





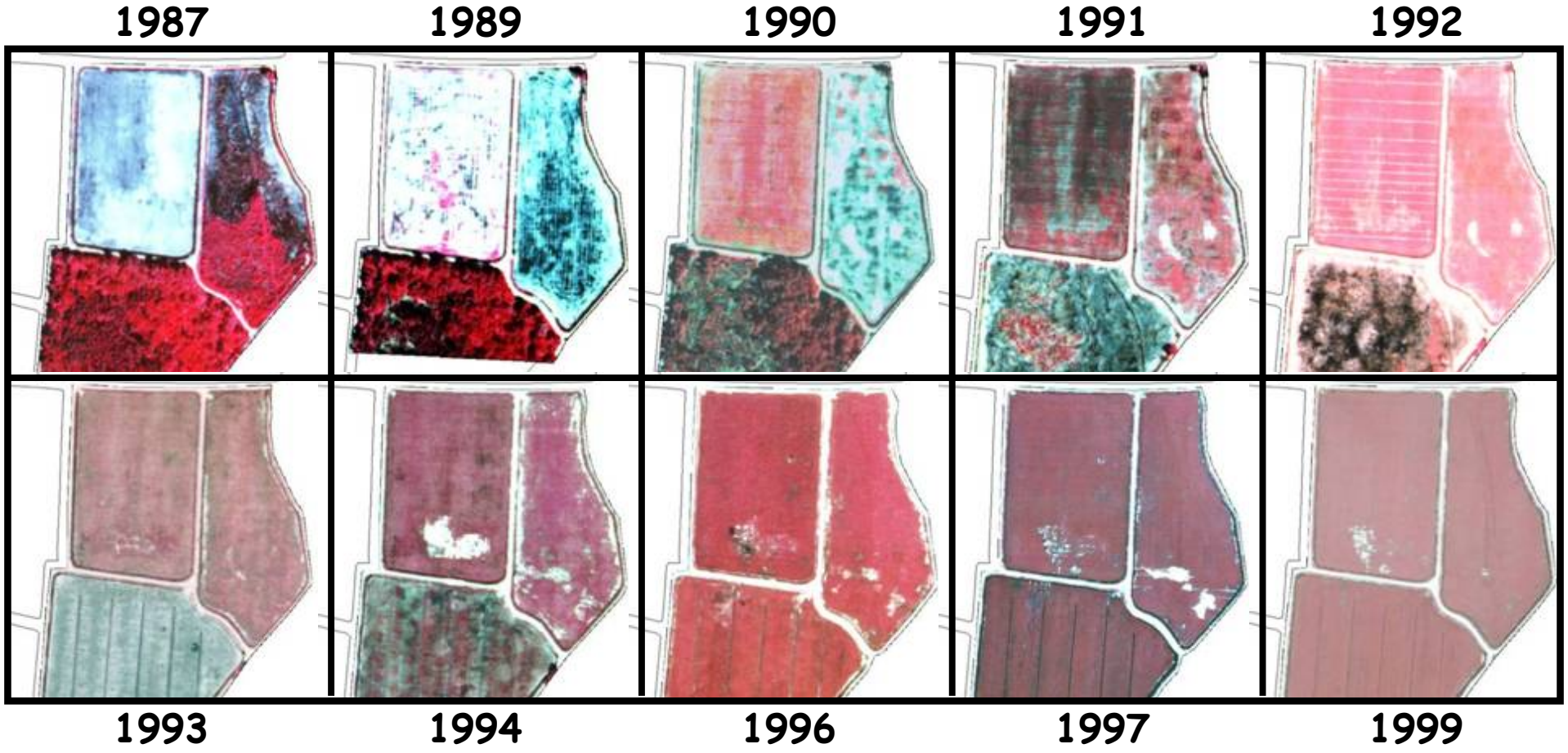
Stolons without infection pads

Distribution of stolons in soil profiles

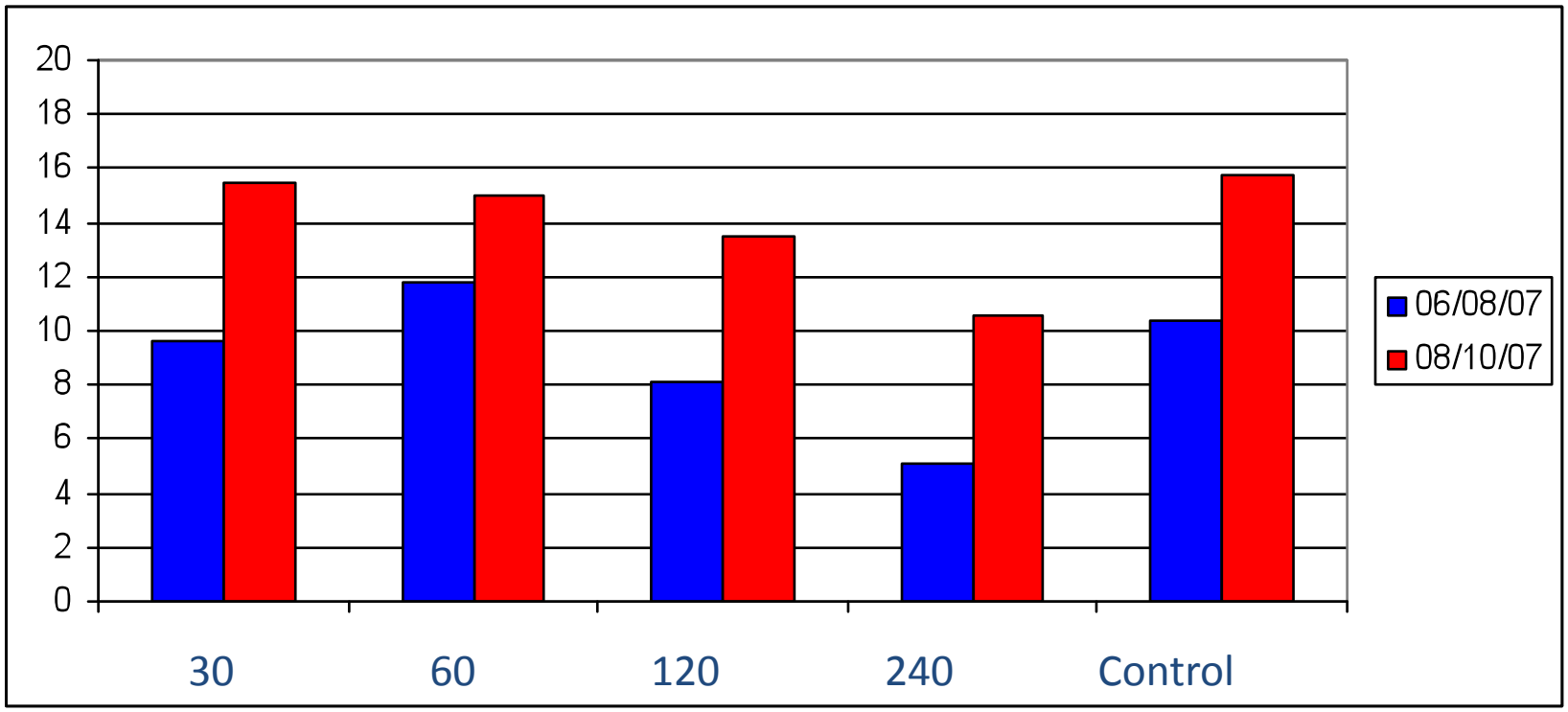


Percent stolons with infection pads

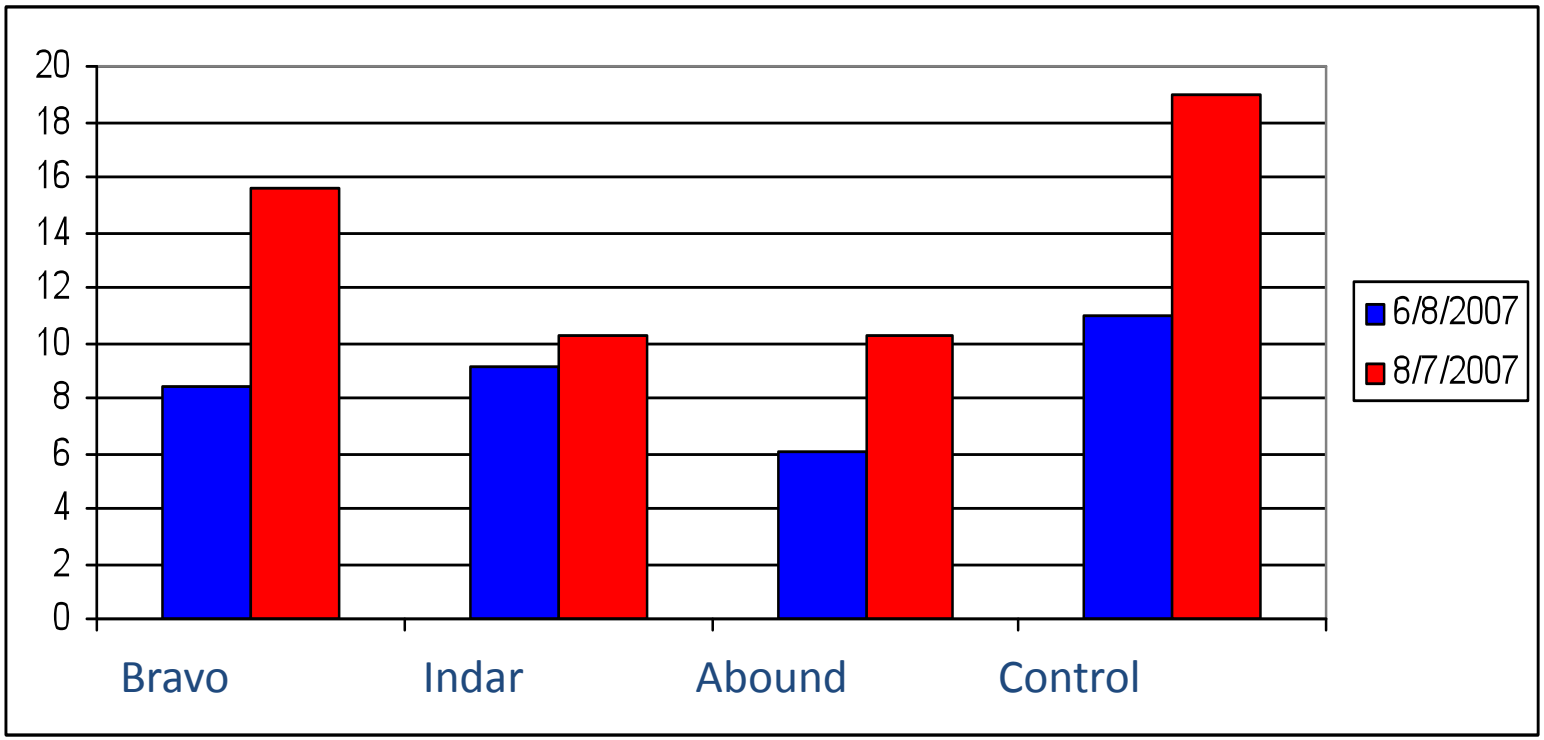
Scanned and georeferenced historical aerial imagery for AOI



Testing the optimum water volume with Indar 75WSP 4oz/ acre at 30, 60, 120, 240 gpa)

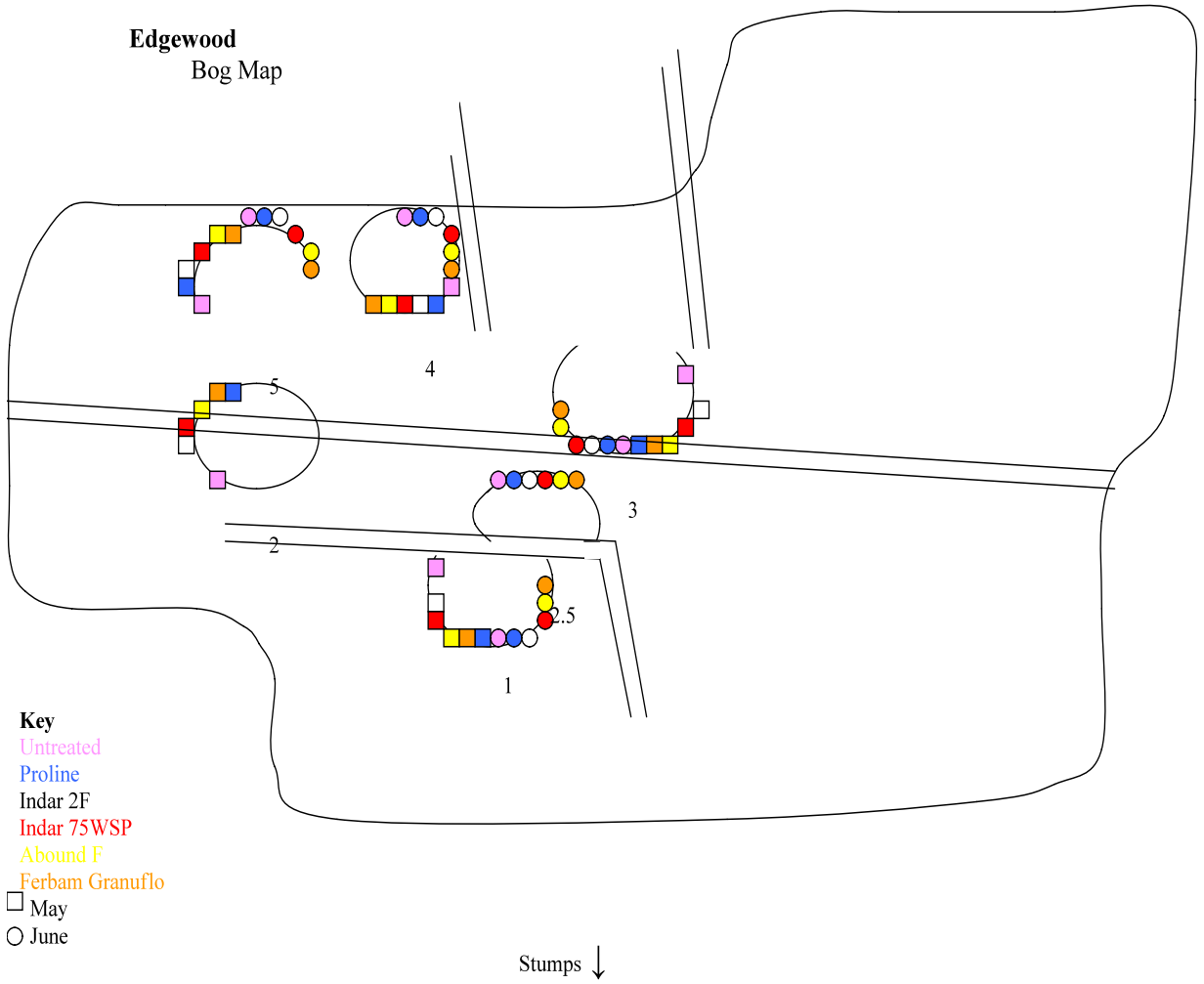


Materials
Bravo 5.5 pts/acre
Indar 4 oz/acre
Abound 15.2 oz/acre
Control



Fairy Ring Trials – Massachusetts

Courtesy of Dr. F. Caruso



Fairy Ring Trials – Massachusetts

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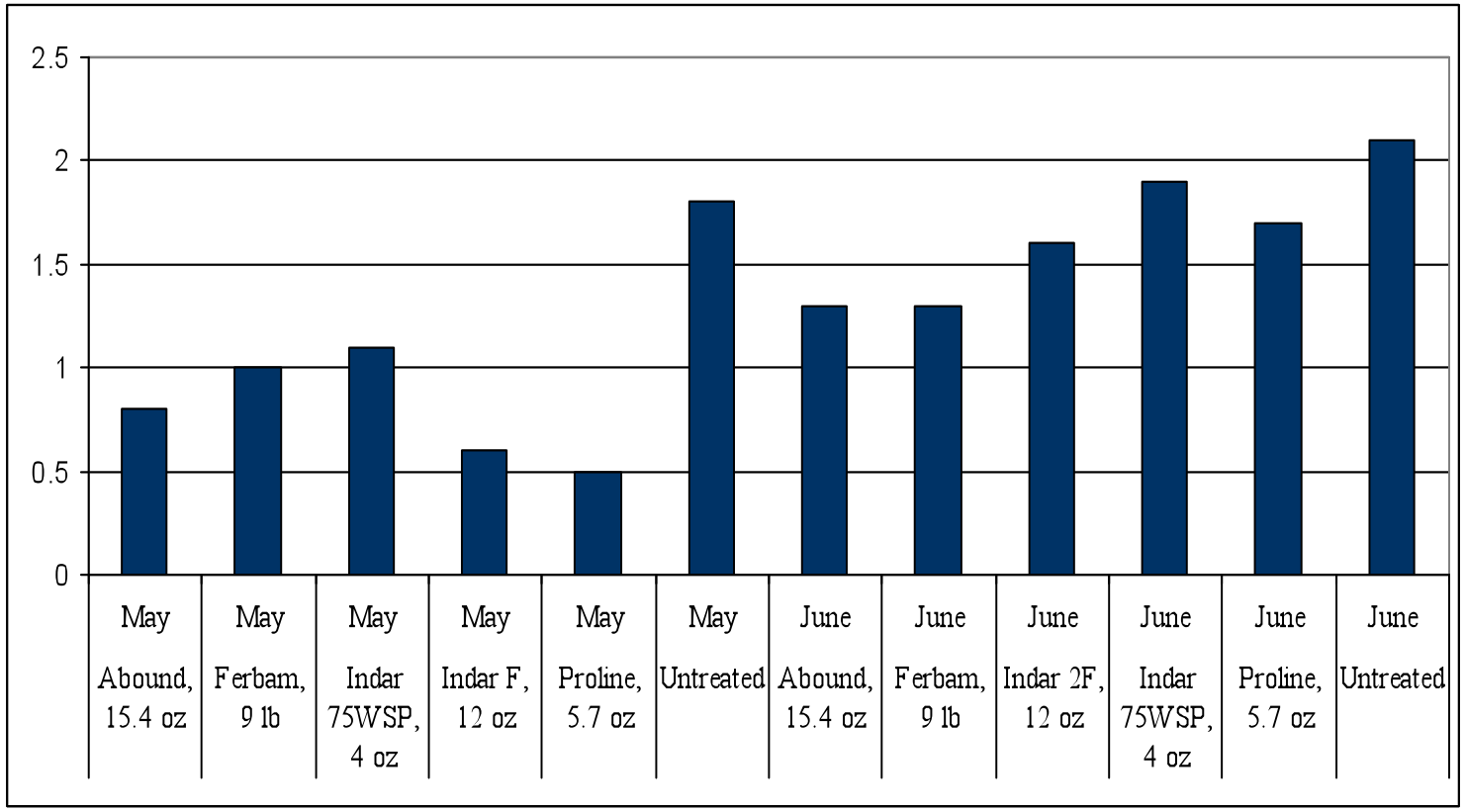

What about Concentration??

- Maximum labeled rate for Indar is 12 oz/ acre.
- On 1 acre bed you can treat up to 8600 ft^2 with 0.0014fl.oz./ft^2
- We have found that 0.2 gallons/ft^2 will carry the fungicide at least 6 inches into the soil


TRUCK EQUIPMENT
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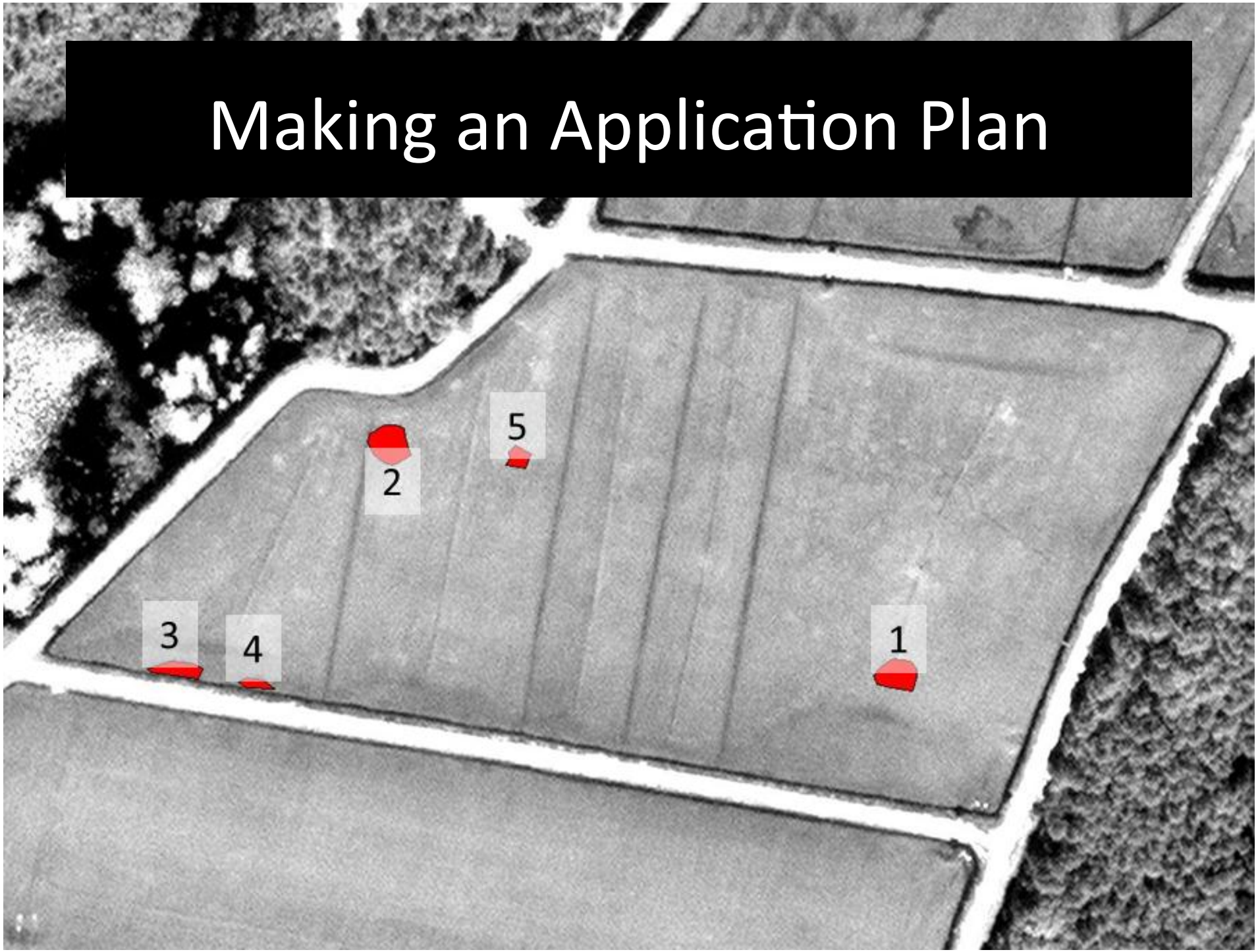
FV·63P
FARM USE

Making an Application Plan



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ID	Exhibit A	Area (ft2)	Gallons
1	F18	877	175
2	F18	1033	207
3	F18	497	99
4	F18	206	41
5	F18	313	63

Conclusions

- Fairy remains a very challenging disease to control
- Indar or Abound are our most effective materials
- Applications should be made no later than mid-May
- Higher volumes will provide greater penetration into soil (8700 gpa = 0.2 gallons/ sq ft)