INTEGRATED PEST MANAGEMENT & CORESTA IPM GROUP

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CEG Tobacco online meeting

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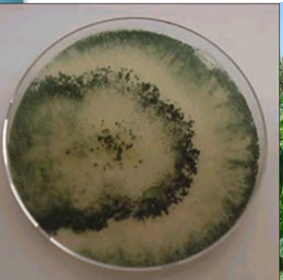
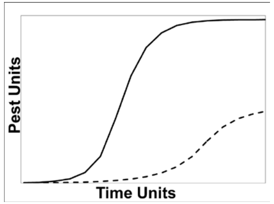





Outline

- What is IPM?
  - Some basic facts
- How IPM affects the mechanics of disease epidemics
  - How IPM fits into the theory of epidemics



- Some case studies
  - 4 case studies

- The CORESTA IPM subgroup
  - Brief description of the subgroup and its work

WHAT IS IPM?

What is IPM?

- Integrated Pest Management
- **Definition - American Phytopathology Society**
  - "A sustainable approach to managing pests by combining biological, cultural, physical and chemical tools in a way that minimizes economic, health and environmental risks".
    - IPM ≠ organic
    - Chemical control important component of IPM
      - Emphasis on responsible, sustainable and minimal use of CPAs
      - Integrated control program can reduce CPA use

"PEST" = pathogen, nematode, insect or weed

IPM is Not New

- **INTEGRATED management system**
  - **US grower guides 1940’s recommended**
    - Rotation & hygiene for black shank control
    - Hygiene for TMV control
  - **Zimbabwe, TRB handbook 1950’s recommended**
    - Rotation for nematode control
    - Hygiene for TMV control
    - Avoiding over-fertilization to mitigate bacterial foliar disease
- **More recent IPM strategies**
  - **Mostly built on well-established principles**

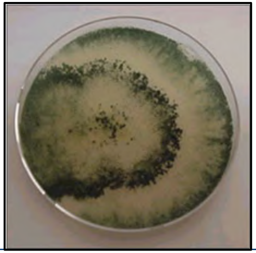
CPA Residues

- **MAJOR issue for tobacco industry**
  - IPM → lower CPA residues
    - CPAs may be replaced or partly replaced by other strategies
    - Lower rates and/or fewer applications
      - Scouting
      - Proper application
      - Lower disease/pest pressure

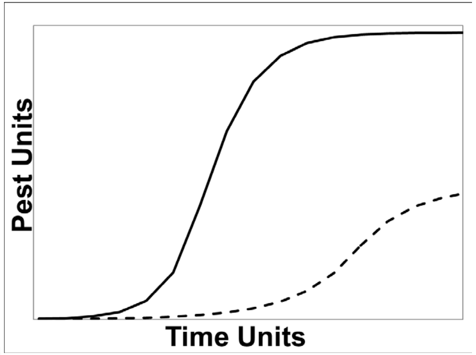
CPA Residues cont

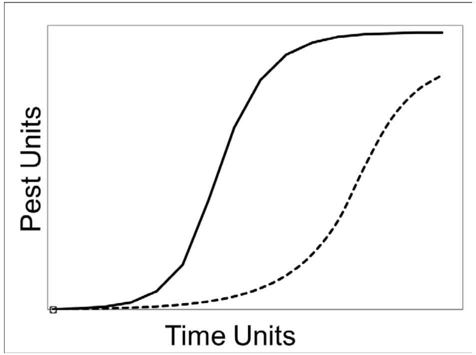
- **Lower disease/pest populations ⟶ easier control, less CPAs**
  - Rotations, good hygiene etc.
    - Prevent or slow build-up of diseases / pests
- **Biocontrols**
  - No residues






HOW IPM AFFECTS THE MECHANICS OF DISEASE EPIDEMICS





Crops vs Natural Vegetation

If crops can be totally destroyed by disease and insects …….

……. why does this not happen in natural undisturbed vegetation?

Crops vs Natural Vegetation cont

Success of:

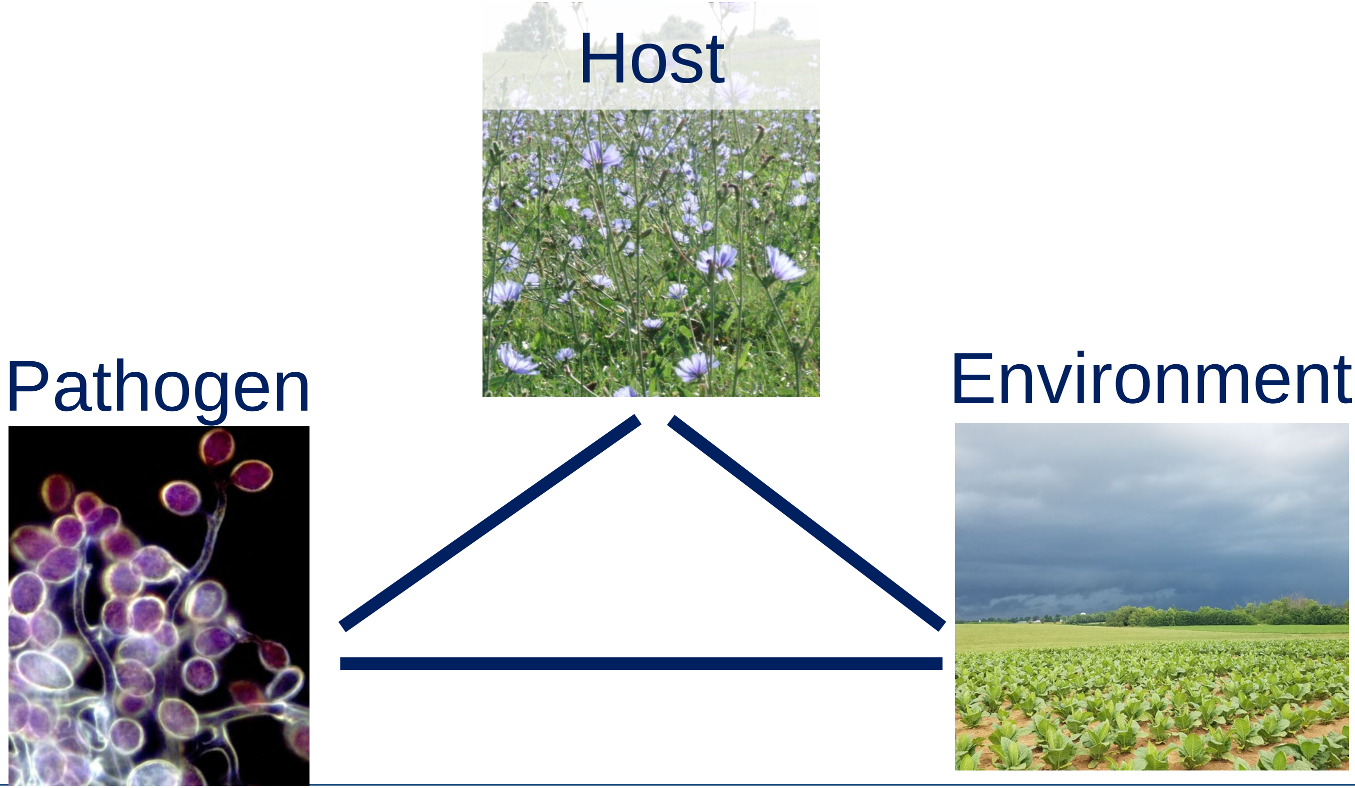
plant to produce crop ….

or …..

for disease to succeed

depends on …….

Disease Triangle



Reduce or eliminate infection

Resistance

Disease ∆ – Environment

Reduce or eliminate infection

Soil Type

pH

Alternate Hosts

Disease ∆ – Pest

Reduce or eliminate infection

Rotation	Sanitation	CPAs

Crops vs Natural Vegetation

In undisturbed natural vegetation ….

… plant host

and

pathogen

in equilibrium

with environment ….

…. most of time

Crops vs Natural Vegetation cont

In natural vegetation,

two factors favour success of host plant:

Spatial separation

between plants of same species
interspersed with non-host species

Genetic variability

wide variation, between orders, families
less variation between species

>> pest may not find another host

Crops vs Natural Vegetation cont

Commercial agriculture

large expanses

genetically identical plants

close proximity

⇨ constraints on success of pests no longer applicable

Pests/diseases multiply unimpeded

Containment of Pests

Protection of these man-made plant communities from pests requires man's intervention

- Containment methods used for centuries –
  - burning
  - rotation
  - site selection

With time, experience & science

Understanding of interaction between plant, pest, environment

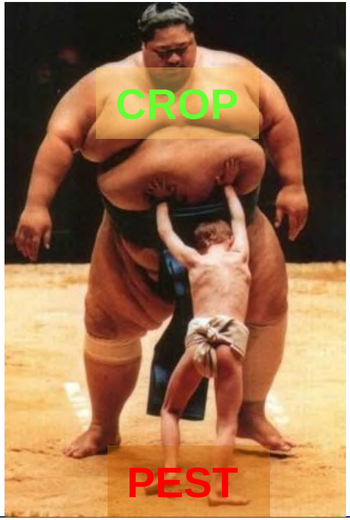
- Improved containment methods

Effect of IPM on Epidemics

IPM shifts balance of plant-pest-environment interaction ….

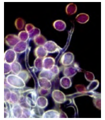
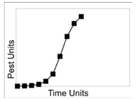
…. in favour of plant

to detriment of pest

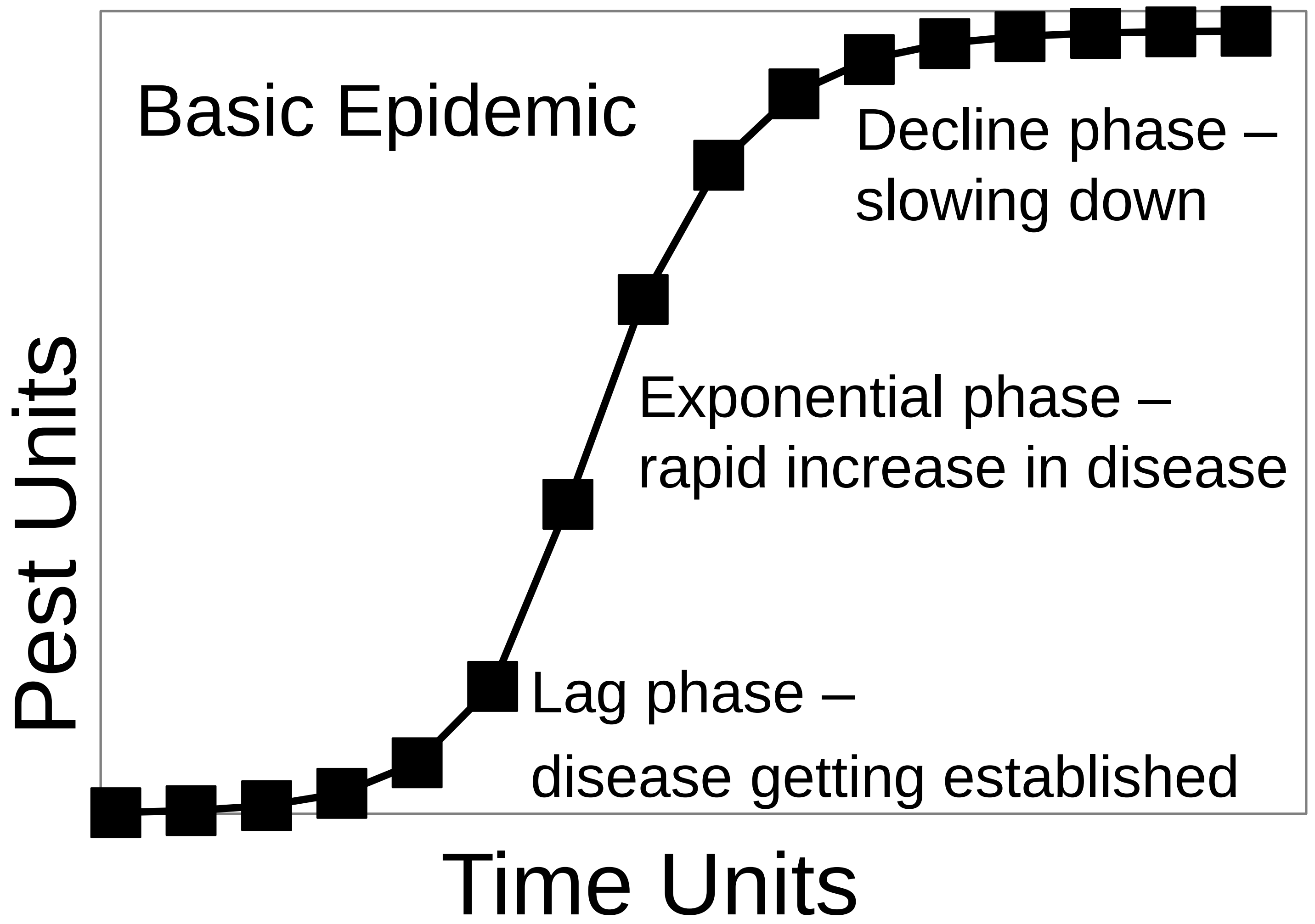


Epidemics

Epidemics modeled mathematically: $pR = pr_I e^{prI}$

- Three components, analogous to financial interest:
  - Initial inoculum = principal value  
  - Increase rate = interest 

  - Time  
    - fungal & bacterial leaf diseases – days 
    - insects – days/weeks 
    - soil-borne/root diseases – years 


Basic Epidemic
Decline phase –
slowing down
Exponential phase –
rapid increase in disease
Lag phase –
disease getting established
Pest Units
Time Units

Managing Epidemics

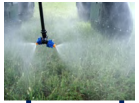
To reduce crop losses from disease epidemics ….

…. employ reverse strategy to that of retirement savings ……

and do whatever is necessary to reduce "financial" gain by …..

- reducing "principal investment" (initial inoculum)

- lowering "interest" rate (slowing increase of disease)



- reducing the time of the "investment" (timing of crop, dead period)

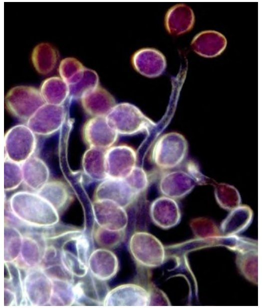
Achieved by

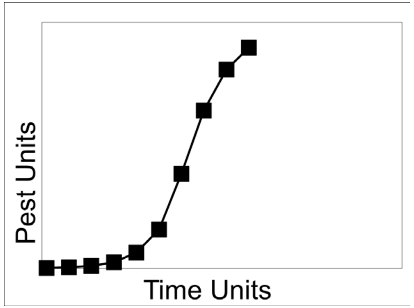
- Breaking / disrupting life cycle of pest
- Altering environment / host

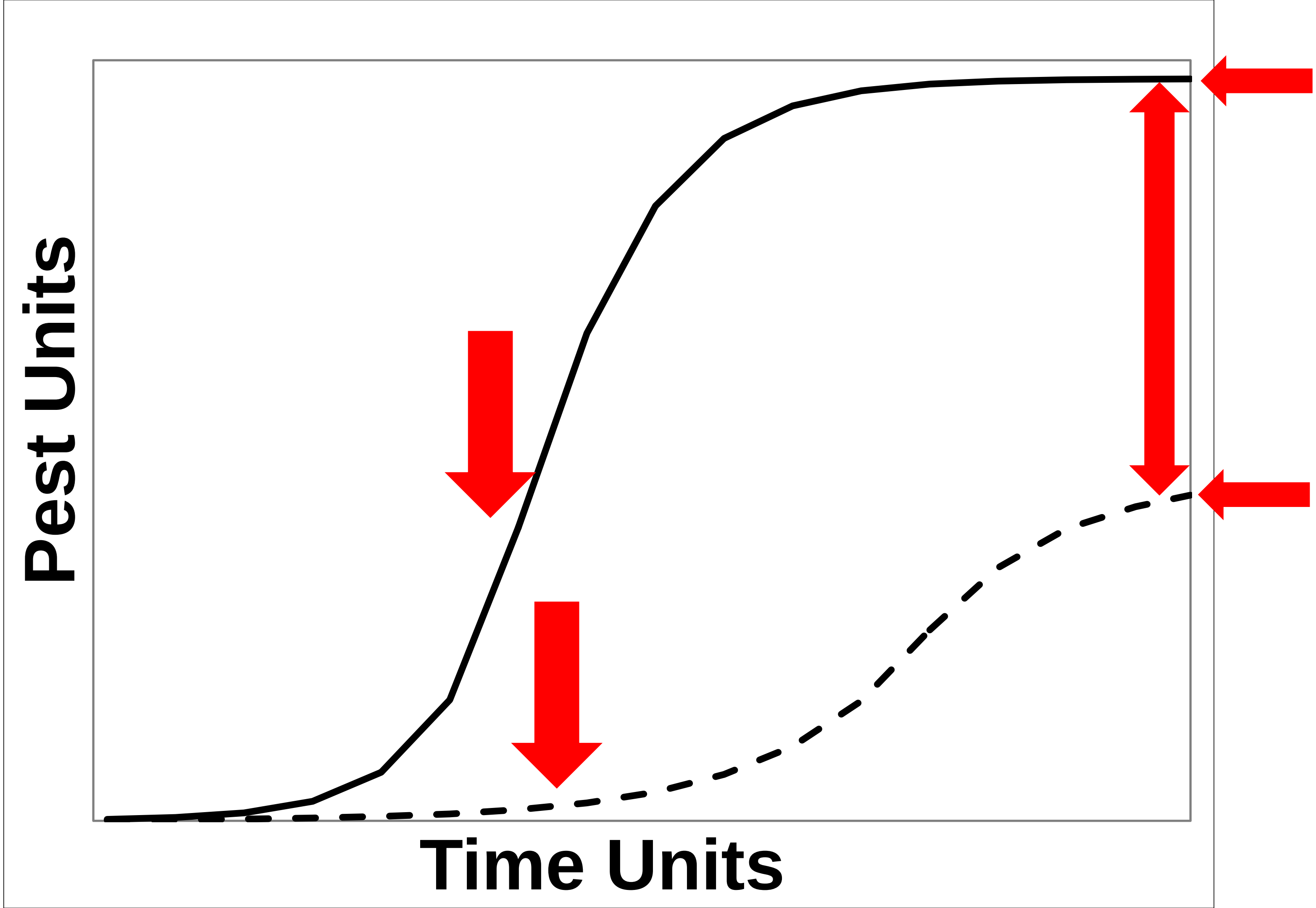
>> Timing of crop, dead period

>> Reducing numerical value of

- initial inoculum
- increase rate






Pest Units
Time Units

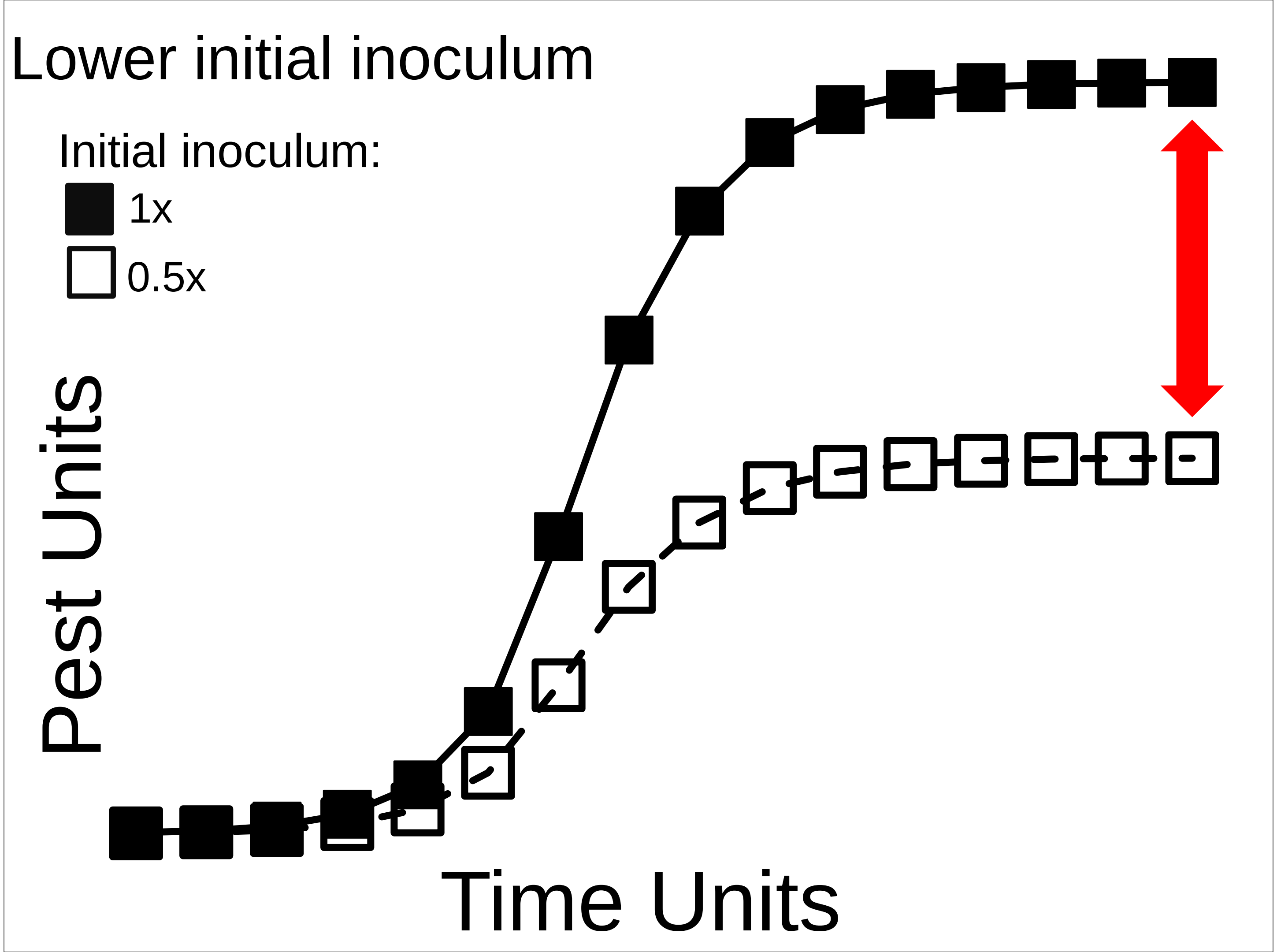
Initial Inoculum

Reduce initial inoculum

- Hygiene & sanitation (eg TMV)

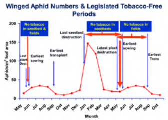
- Rotation
  - Well rotated field vs field with history of disease

- Amount can vary by 10,000s
  - Compare investing $1 vs. $10,000

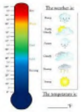


Lower initial inoculum
Initial inoculum:
1x
0.5x
Pest Units
Time Units

Reduce Initial Inoculum

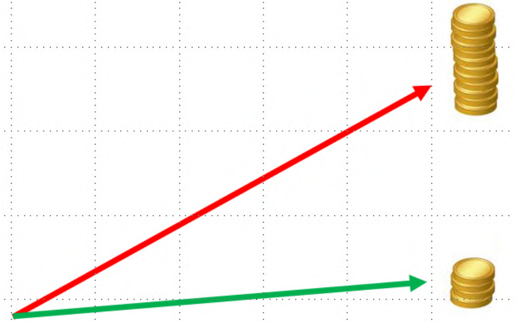
- Rotation 
- Stalk destruction 
- Crop residue breakdown  
- Disease-free seed, seedlings   
- Awareness of alternative hosts & adjacent crops  
- Hygiene, disinfectants 
- Tobacco-free period 

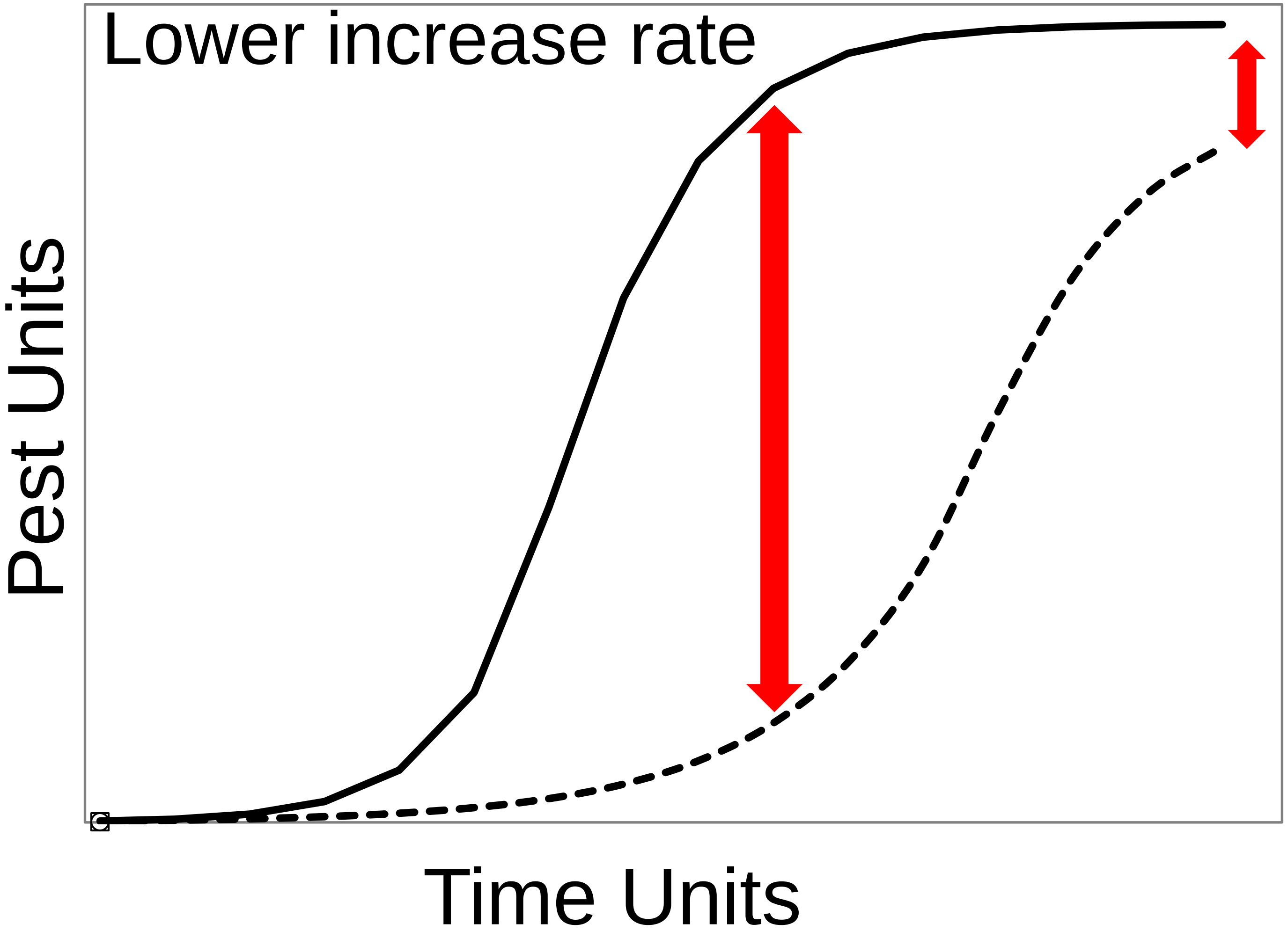
Lower Increase Rate

- Affected by how favourable environment is
  - temperature 
  - rainfall 
  - humidity 
  - soil type 
  - crop maturity  

Rate can vary by 1000x

Compare investing at 1% vs. 5%




Lower increase rate
Pest Units
Time Units

Increase Rate cont

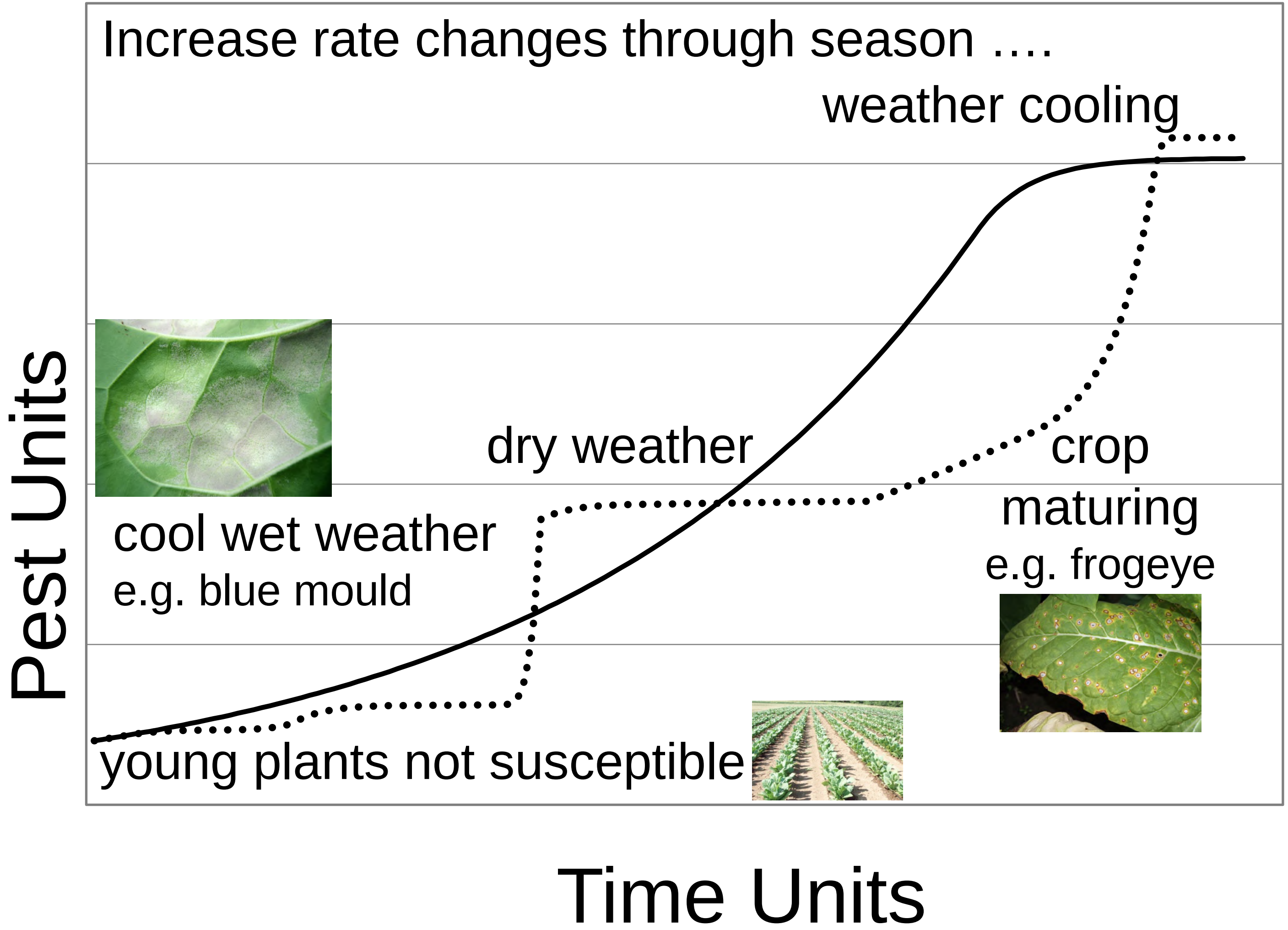
The increase rate ….

…. declines as environment deteriorates

competition for space

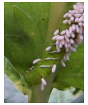
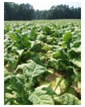
nutrient supply dwindles

unfavourable weather at end of season


Increase rate changes through season ….
weather cooling
dry weather
crop
maturing
e.g. frogeye
cool wet weather
e.g. blue mould
young plants not susceptible
Pest Units
Time Units

Lower Increase Rate by

- **balanced fertility** 

- **biological control** 
- **pesticides** 
- **resistance*** 
- **tolerance*** 

Resistance = prevention/reduction of infection

Not necessarily immunity

Tolerance = ability of plant to develop normally and produce acceptable yield and quality ….

…. despite infection

Some points about

Pest Groups

Insects

- **Caution: Threshold levels vary by region depending on**
    - cost of pesticide 
    - application cost 
    - crop value 
    - pest population vs. damage

- **To establish thresholds requires extensive monitoring of:**
    - pest levels vs. economic damage   
        - at multiple locations, for several years

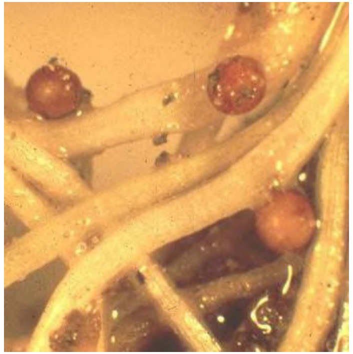
 

- **Threshold much lower for insects that are disease vectors**

Nematodes & Weeds

Nematodes

Soil sample analysis

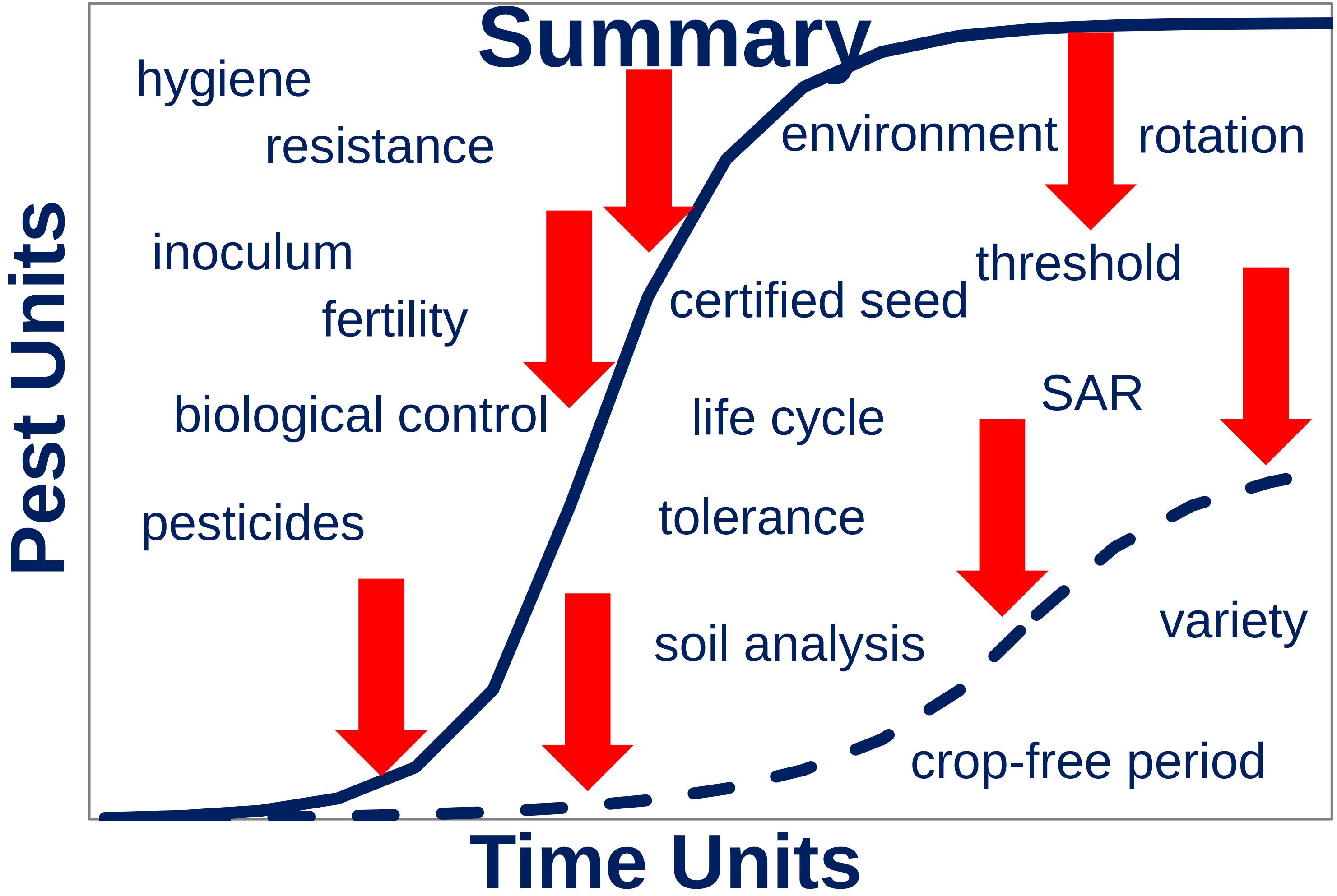


Weeds

Late season weed control effect

- reduce "initial inoculum" seed

Summary


hygiene
resistance
inoculum
fertility
biological control
pesticides
environment
rotation
threshold
certified seed
SAR
life cycle
tolerance
variety
soil analysis
crop-free period
Pest Units
Time Units

Epidemics Conclusion

With some careful planning,

crop protection could be upgraded …

... from where we are now …

… to a whole new level

SOME CASE STUDIES

Tobacco Free "Dead" Period

- **Tobacco Bushy Top Virus**
  - Devastating virus disease

    - Can cause 100% loss
- Occurs mainly in southern & central Africa
- Aphid borne

    - Mainly affects late-planted crops, only affects new growth
    - Like all virus diseases, no chemical control
    - Only control of vector

Dead Period Legislation

- **Legislation**
  - Seedbeds
    - Earliest sowing date
    - Latest seedbed destruction date
  - Fields
    - Earliest transplanting date
    - Latest stalk/residue destruction date
- 6 weeks with no tobacco growing – fields or seedbeds

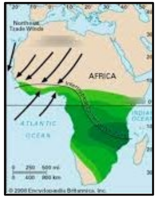




Reason for Dead Period

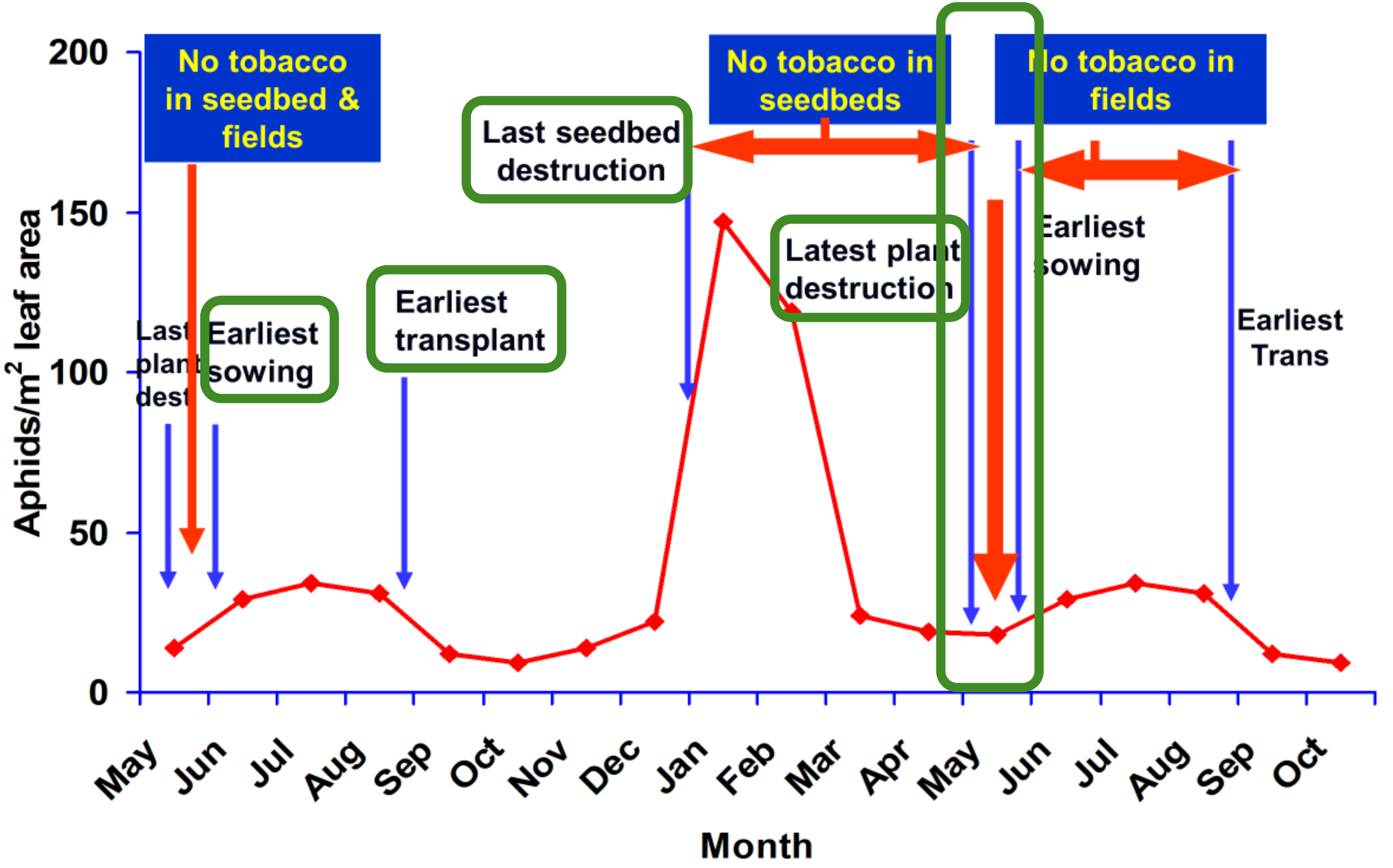
- **Based on knowledge of aphid populations**
  - Small aphid populations overwinter

    - Winters cold & dry, very little green vegetation (~4 months w/o rain)
  - Most aphids come with rains, on ITCZ in November
    - Then multiply rapidly

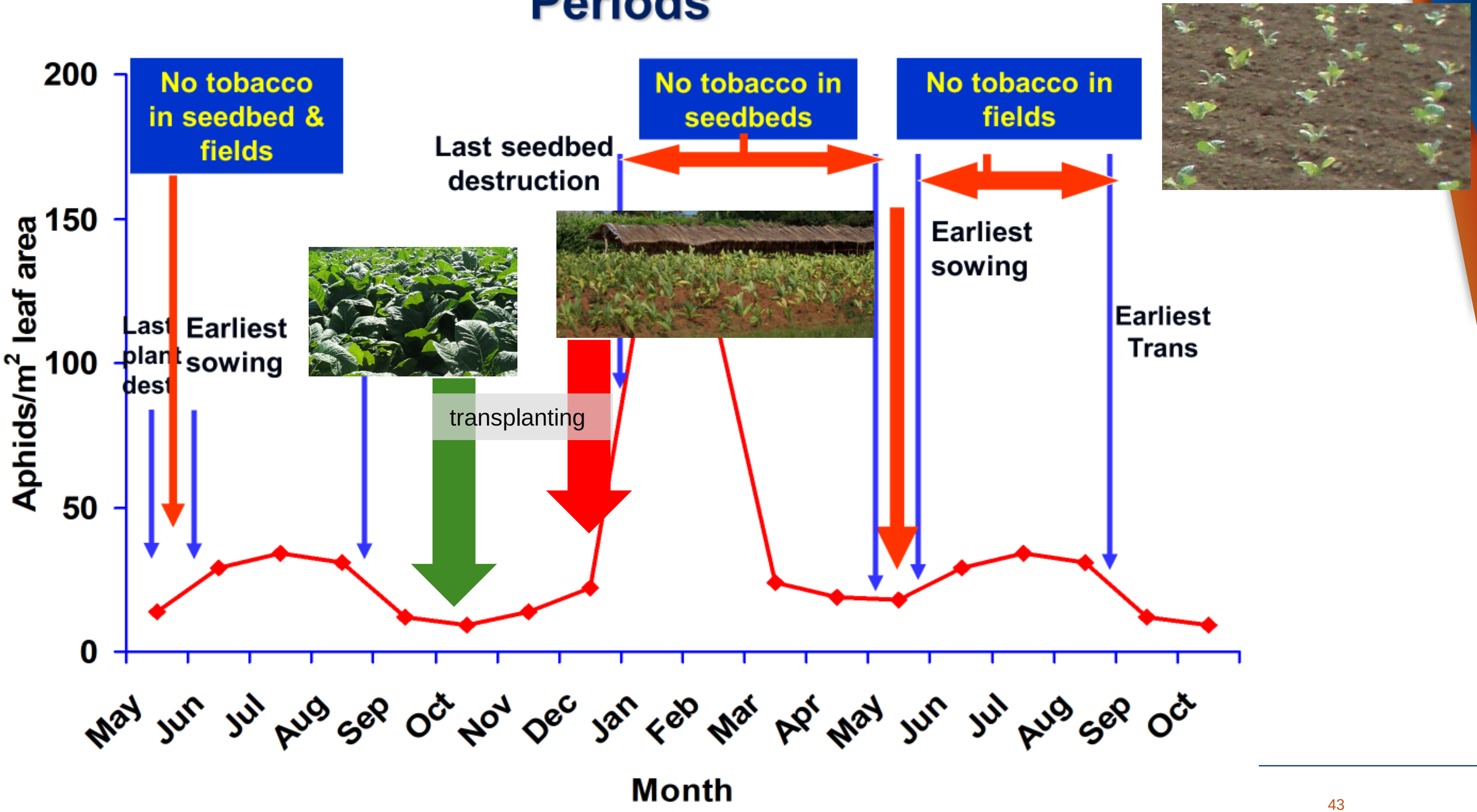


  - Dead period in winter
    - Tobacco would be the only green vegetation
    - Aphids would multiply early → high numbers at start of season

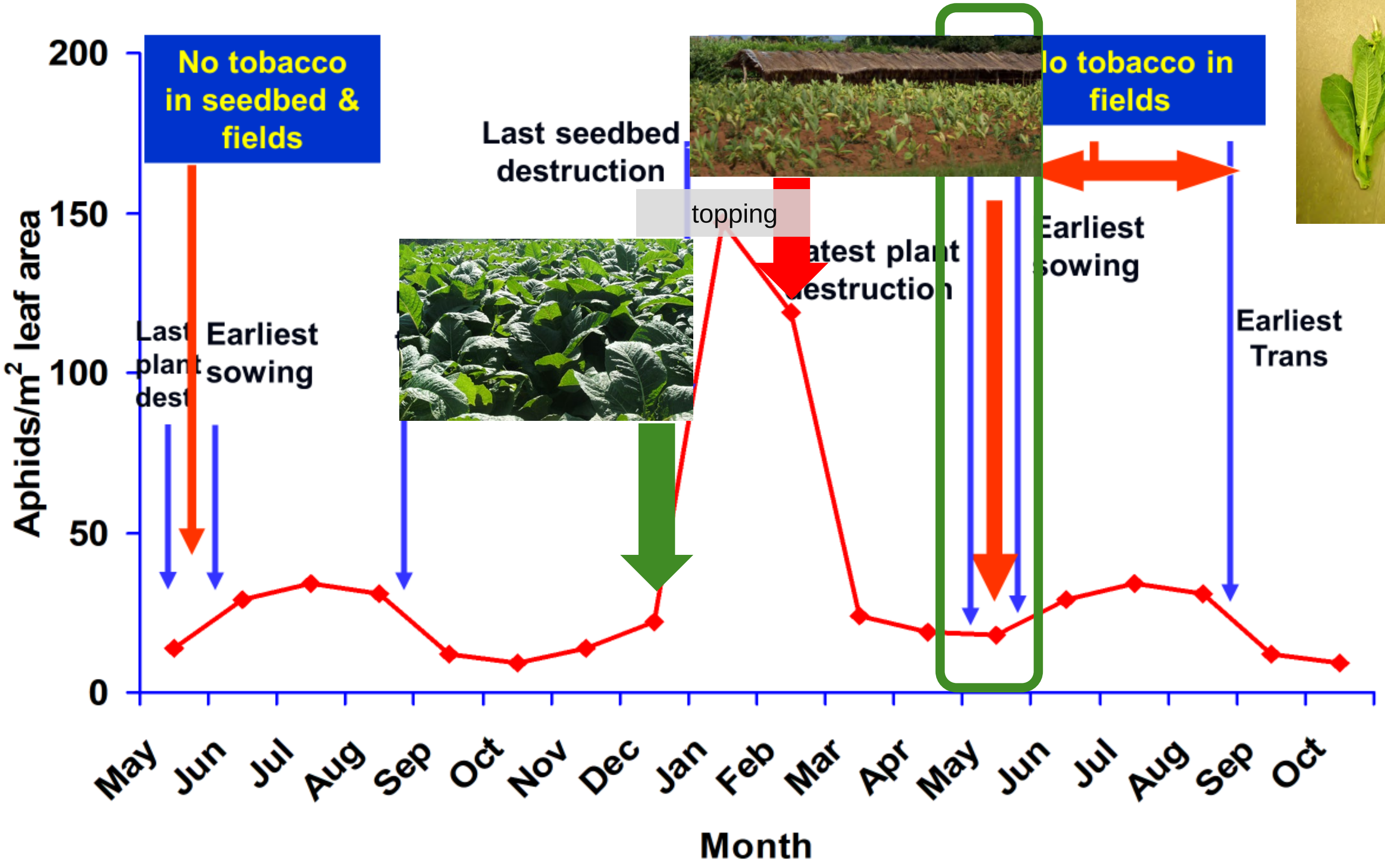
Winged Aphid Numbers & Legislated Tobacco-Free Periods



Winged Aphid Numbers & Legislated Tobacco-Free Periods



Winged Aphid Numbers & Legislated Tobacco-Free Periods



Success of Dead Period

- **Zimbabwe – very successful to end of 1990s**
  - Strictly enforced
  - Growers were mainly large commercial growers

- **Currently ineffective**
  - Not enforced
  - Growers now mainly smallholders
    - They have many challenges

Smallholder Challenges

- **Commercial growers**
  - Prepare fields early, mechanical tillage
  - Water-plant mid October
    - Early start, crop well-established when aphid populations peak
    - Crop topped while aphid numbers still low
- **Smallholders**
  - Wait for rain to prepare fields, ox-drawn tillage
  - Rain-plant in December
    - Crop in early stages when aphid populations peak
    - Crop only topped after aphid populations peak

Dead Period Then & Now

- **For about 50 years**
  - Success story in Zimbabwe
    - Bushy top rarely seen, occasionally on very late crops

- **Now bushytop rampant**
  - Double impact for smallholders
    - No dead period → high aphid populations
    - Plant late → crop infected early
      - → high losses – sometimes total losses

Hygiene & Sanitation

- **TMV tobacco mosaic virus**
  - Spread mechanically (hands, tools)
    - VERY easily spread
  - Affects new growth
    - Early infection VERY serious
    - Particular care with seedlings & transplants
  - Virus dissociated by soap
    - Washing facilities, footbaths at seedbed sites
    - Disinfect tools
    - No smoking

Success of Sanitation

- **Highly successful**
  - If done effectively, prevents TMV occurring on farm
  - Once present, very difficult to eradicate
    - Survives long periods in debris

    - Alternate hosts
      - Wide host range

  - One of the oldest IPM strategies
    - Employed long before resistant varieties available

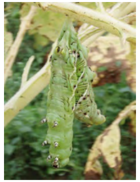
Biological Control – Bt

- ***Bacillus thuringiensis*** **– budworm/hornworm**
  - Soil bacterium, many products, kills most caterpillars


  - Safe

  - Cheap

  - Eco-friendly
    - Naturally occurring
    - Affects very specific insects




    - Safe for humans, animals, beneficial insects


Success of Bt

- **Successful for 100 years**
  - No residue issues
  - Effective
    - Must be applied early
  - Used globally
    - Europe since 1920s
    - US since 1950s
    - GAP, ESG

Rotation

- **Rootknot nematode *Meloidogyne javanica***
  - Major pest in southern & central Africa
  - Can cause heavy losses
    - Especially for smallholders

  - Susceptible tobacco variety
    - Fumigation + rotation
  - Resistant tobacco variety
    - Fumigation or rotation

Grass Rotation

- **Katambora Rhodes grass**
  - Non-host
  - 4 years grass rotation
    - Nematode populations drop drastically
  - Most tobacco growers use the grazing for cattle

- **No other rotation as effective**
  - Cash crops slow nematode increase
    - But do not decrease population

Success of Grass Rotation

- **Up to 1990s, very successful for commercial growers**
  - Large farms, enough land to rotate
- **Last 20 years, government has taken farms**
  - Smaller farms, limited rotation – much less effective
- **Smallholders**
  - Have never had enough land to rotate

Overall Success of IPM

- **Most IPM strategies**
  - Need a certain level of resources & sophistication
  - Dead period
    - Ability to plant early – tillage equipment, access to water

  - Sanitation
    - Good management, water

  - Bt
    - Good management, timeliness

  - Rotation
    - Enough land

CORESTA IPM SUBGROUP

FIELD GUIDE TO INTEGRATED PEST MANAGEMENT

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A.2. Bacterial Diseases

15. Wildfire, Angular Leaf Spot

Pseudomonas syringae pv. tabaci tox+, tox-
(formerly known as *P. tabaci*, *P. angulata*; also *P. syringae* pv. *tabaci*, *P. syringae* pv. *angulata*)
Anne Fisher, University of Kentucky, USA

General

Wildfire and angular leaf spot can affect tobacco in both the seedbeds / float trays and the field, although wildfire tends to be more of a problem in the seedbed and angular leaf spot in the field. Wildfire and angular leaf spot are not major problems in many tobacco producing areas, such as the USA, Brazil, and Europe. In Africa, they are diseases of major importance which can cause devastating losses, especially in wet seasons. The bacteria that cause wildfire and angular leaf spot are identical in all respects except that the wildfire bacteria produce a toxin and the angular bacteria do not. Wildfire is therefore caused by the "tox+" strain and angular leaf spot by the "tox-" strain.

Symptoms

The symptoms of the tox+ (toxin producing) and tox- (non-toxin producing) forms of this disease are quite different.

Wildfire (tox+) is characterized by a small brown or black watersoaked lesion, surrounded by a broad chlorotic halo (Figs. 15.1A, 15.2). The lesions increase in diameter and may coalesce until the diseased tissue eventually falls out leaving ragged holes. Wildfire can be systemic in seedlings, causing distortion (Fig. 15.4) of the apical bud, veins and leaves.

The angular (tox-) lesion is brown, dark brown or black, much larger than the wildfire lesion, has little or no chlorotic halo, and has angular margins because the lesion is confined by the lateral veins (Figs.15.1B, 15.3, 15.5). In Africa, both diseases tend to be more severe at the top of the plant (Figs. 15.2, 15.3).

Source and Transmission

The bacteria are spread in wind-driven water droplets, from leaf to leaf and plant to plant within the field, from field to field and from infected weed hosts or tobacco regrowth. Driving rains and sand blasting winds exacerbate the problem considerably. These diseases can also be seed transmitted. Tobacco regrowth and debris from infected plants should always be destroyed at the end of the season, as they are sources of inoculum to infect overwintering weed hosts. In the semi-tropical areas where these diseases are a problem, winters are seldom cold enough to kill overwintering weeds and tobacco regrowth. Wildfire and angular leaf spot are favoured by cloudy wet weather.

Rotation and Site Selection

Disease spread is reduced by planting earlier fields downwind of later planted fields; the earlier planted fields often serve as an inoculum source. These diseases are generally worse in intensively used fields, and can be minimised by suitable rotations (Ch. 77).

Alternate Hosts

Many solanaceous weeds are hosts of this pathogen (Ch. 61). Examples are Apple of Peru (*Nicandra physaloides*) and Jimson weed / stinkblaar (*Datura stramonium*), shown in Fig.15.6. Such weeds should be removed from the proximity of the fields and especially seedbeds / greenhouses. This is particularly important in areas which do not have killing winter frosts, where weeds overwinter.

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Chapter 15 Wildfire, Angular Leaf Spot

A.2. Bacterial Diseases

Tobacco Research Board of Zimbabwe. Handbook of recommendations.

Shew, H. D. and G.B. Lucas. Eds. 1991. Wildfire and Angular Leaf Spot. Pages 30-32 in: Compendium of Tobacco Diseases. APS Press. ISBN: 0-89054-117-5.

A Susan Dimbi, TRB, Zimbabwe B Anton Scholtz, LARSS, South Africa

Fig. 15.1: Wildfire and angular lesions. A: Wildfire; with chlorotic halo surrounding lesion B: Angular; with no chlorotic halo and angular margins

Michelle du Toit, Zimbabwe Chrissie Mainjeni, ARET, Malawi

Fig. 15.2: Wildfire; *Pseudomonas syringae* pv. *tabaci* (tox +)

Michelle du Toit, Zimbabwe Susan Dimbi, TRB, Zimbabwe

Fig. 15.3: Angular; *Pseudomonas syringae* pv. *tabaci* (tox -)

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Chapter 15 Wildfire, Angular Leaf Spot

Objectives

- **Objectives**
  - To summarize available IPM strategies for each pest & disease
    - Must be proven on field scale
  - Then produce a document for agronomists & farmers
    - Structured by disease or pest
    - With a common outline framework based on relevant IPM methods
    - NB – not a pathology textbook

Subgroup Structure

- **80 chapters over 5 groups**
  - diseases
  - nematodes
  - insects
  - weeds
  - IPM strategies
- **Each with a group leader**
  - organizes group
  - collects chapters
  - arranges reviews & editing





Subgroup Approach

Same approach for 3 groups

Diseases

fungal
bacterial
viral
seedling
post-harv

Nematodes

Insects

Groups divided into sections
Chapter for each disease or pest

Subgroup Approach cont

Weeds group

Field Weeds

Parasitic Weeds

Different approach

Principles of weed control

Specific weed problems

Subgroup Approach cont

IPM Strategies

Biological Control

Rotation

Correct CPA Usage

Sections deal with general IPM principles

Document

FIELD GUIDE TO INTEGRATED PEST MANAGEMENT

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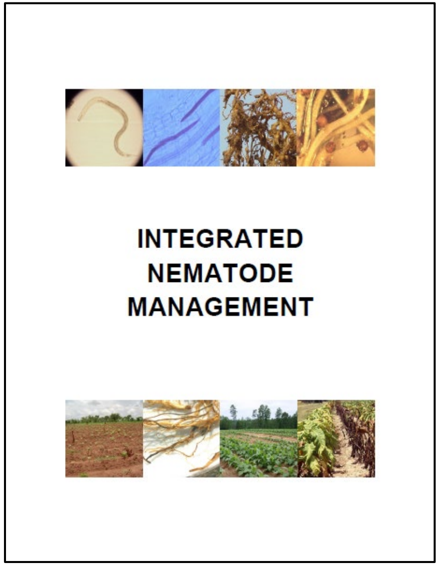
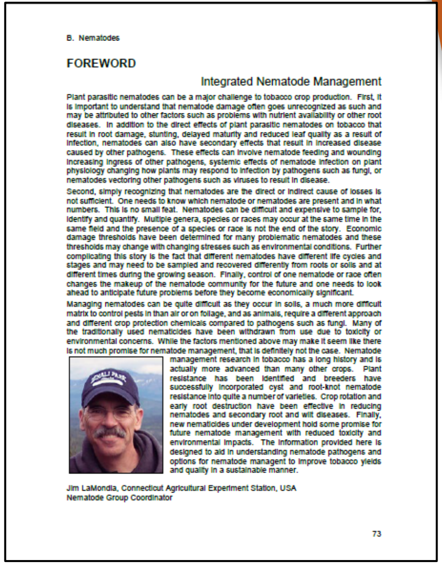


INTEGRATED NEMATODE MANAGEMENT



B. Nematodes

FOREWORD

Integrated Nematode Management

Plant parasitic nematodes can be a major challenge to tobacco crop production. First, it is important to understand that nematode damage often goes unrecognized as such and may be attributed to other factors such as problems with nutrient availability or other root diseases. In addition to the direct effects of plant parasitic nematodes on tobacco that result in root damage, stunting, delayed maturity and reduced leaf quality as a result of infection, nematodes can also have secondary effects that result in increased disease caused by other pathogens. These effects can involve nematode feeding and wounding increasing ingress of other pathogens, systemic effects of nematode infection on plant physiology changing how plants may respond to infection by pathogens such as fungi, or nematodes vectoring other pathogens such as viruses to result in disease.

Second, simply recognizing that nematodes are the direct or indirect cause of losses is not sufficient. One needs to know which nematode or nematodes are present and in what numbers. This is no small feat. Nematodes can be difficult and expensive to sample for, identify and quantify. Multiple genera, species or races may occur at the same time in the same field and the presence of a species or race is not the end of the story. Economic damage thresholds have been determined for many problematic nematodes and these thresholds may change with changing stresses such as environmental conditions. Further complicating this story is the fact that different nematodes have different life cycles and stages and may need to be sampled and recovered differently from roots or soils and at different times during the growing season. Finally, control of one nematode or race often changes the makeup of the nematode community for the future and one needs to look ahead to anticipate future problems before they become economically significant.

Managing nematodes can be quite difficult as they occur in soils, a much more difficult matrix to control pests in than air or on foliage, and as animals, require a different approach and different crop protection chemicals compared to pathogens such as fungi. Many of the traditionally used nematicides have been withdrawn from use due to toxicity or environmental concerns. While the factors mentioned above may make it seem like there is not much promise for nematode management, that is definitely not the case. Nematode management research in tobacco has a long history and is actually more advanced than many other crops. Plant resistance has been identified and breeders have successfully incorporated cyst and root-knot nematode resistance into quite a number of varieties. Crop rotation and early root destruction have been effective in reducing nematodes and secondary root and wilt diseases. Finally, new nematicides under development hold some promise for future nematode management with reduced toxicity and environmental impacts. The information provided here is designed to aid in understanding nematode pathogens and options for nematode managent to improve tobacco yields and quality in a sustainable manner.

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Document – Chapter

15. Wildfire, Angular Leaf Spot

Pseudomonas syringae pv. tabaci tox+, tox-

(formerly known as *P. tabaci*, *P. angulata*; also *P. syringae* pv. *tabaci*, *P. syringae* pv. *angulata*)

Anne Fisher, University of Kentucky, USA

General

Wildfire and angular leaf spot can affect tobacco in both the seedbeds / float trays and the field, although wildfire tends to be more of a problem in the seedbed and angular leaf spot in the field. Wildfire and angular leaf spot are not major problems in many tobacco producing areas, such as the USA, Brazil, and Europe. In Africa, they are diseases of major importance which can cause devastating losses, especially in wet seasons. The bacteria that cause wildfire and angular leaf spot are identical in all respects except that the wildfire bacteria produce a toxin and the angular bacteria do not. Wildfire is therefore caused by the "tox+" strain and angular leaf spot by the "tox-" strain.

Symptoms

The symptoms of the tox+ (toxin producing) and tox- (non-toxin producing) forms of this disease are quite different.

Wildfire (tox+) is characterized by a small brown or black watersoaked lesion, surrounded by a broad chlorotic halo (Figs. 15.1A, 15.2). The lesions increase in diameter and may coalesce until the diseased tissue eventually falls out leaving ragged holes. Wildfire can be systemic in seedlings, causing distortion (Fig. 15.4) of the apical bud, veins and leaves.

The angular (tox-) lesion is brown, dark brown or black, much larger than the wildfire lesion, has little or no chlorotic halo, and has angular margins because the lesion is confined by the lateral veins (Figs.15.1B, 15.3, 15.5). In Africa, both diseases tend to be more severe at the top of the plant (Figs. 15.2, 15.3).

Source and Transmission

The bacteria are spread in wind-driven water droplets, from leaf to leaf and plant to plant within the field, from field to field and from infected weed hosts or tobacco regrowth. Driving rains and sand blasting winds exacerbate the problem considerably. These diseases can also be seed transmitted. Tobacco regrowth and debris from infected plants should always be destroyed at the end of the season, as they are sources of inoculum to infect overwintering weed hosts. In the semi-tropical areas where these diseases are a problem, winters are seldom cold enough to kill overwintering weeds and tobacco regrowth. Wildfire and angular leaf spot are favoured by cloudy wet weather.

Rotation and Site Selection

Disease spread is reduced by planting earlier fields downwind of later planted fields; the earlier planted fields often serve as an inoculum source. These diseases are generally worse in intensively used fields, and can be minimised by suitable rotations (Ch. 77).

Alternate Hosts

Many solanaceous weeds are hosts of this pathogen (Ch. 61). Examples are Apple of Peru (*Nicandra physaloides*) and Jimson weed / stinkblaar (*Datura stramonium*), shown in Fig.15.6. Such weeds should be removed from the proximity of the fields and especially seedbeds / greenhouses. This is particularly important in areas which do not have killing winter frosts, where weeds overwinter.

Tobacco Research Board of Zimbabwe. Handbook of recommendations.

Shew, H. D. and G.B. Lucas. Eds. 1991. Wildfire and Angular Leaf Spot. Pages 30-32 in: Compendium of Tobacco Diseases. APS Press. ISBN: 0-89054-117-5.

A Susan Dimbi, TRB, Zimbabwe B Anton Scholtz, LARSS, South Africa

Fig. 15.1: Wildfire and angular lesions. A: Wildfire; with chlorotic halo surrounding lesion B: Angular; with no chlorotic halo and angular margins

Michelle du Toit, Zimbabwe Chrissie Mainjeni, ARET, Malawi

Fig. 15.2: Wildfire; *Pseudomonas syringae* pv. *tabaci* (tox +)

Michelle du Toit, Zimbabwe Susan Dimbi, TRB, Zimbabwe

Fig. 15.3: Angular; *Pseudomonas syringae* pv. *tabaci* (tox -)

Links

Alternate Hosts

Many solanaceous weeds are hosts of this pathogen (Ch. 61). Examples are A
Peru (*Nicandra physaloides*) and Jimson weed / stinkblaar (*Datura stramonium*),
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winter frosts, where weeds overwinter.

61. Weeds as Alternate Hosts to Other Pests

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General

Weeds can act as major hosts for diseases, nematodes and insects. Many weeds that commonly occur around tobacco fields can harbor other pests and result in increased infection on tobacco crops. Generally, weed species that have the closest botanical relationship to tobacco, (i.e. solanaceous weed species) are most likely to harbor pests that can infest tobacco. However, many plant species with little botanical relationship to tobacco can also serve as hosts.

Reference materials used to construct Tables 61.1 – 61.5 include Daub et al. (991), Groves et al. (2002), Wisler and Norris (2005) and Lucas (1975).

Diseases

Tables 61.1 – 61.3 list weed species that commonly act as alternate hosts for tobacco diseases. Many diseases have an extremely wide host range, and so only the number of species, families, genera, or most common host species are listed.

Table 61.1: Common weeds that serve as alternate hosts for fungal tobacco diseases

Disease	Causal Agent	Host Species	Plant Families	Common Weedy Hosts
Fusarium Wilt	*Fusarium oxysporum* f.sp. *nicotianae*	Many		
Verticillium Wilt	*Verticillium alboatrum*	250	Dicots	
Olpidium Seedling Blight	*Olpidium brassicae*	Many	Most common: Cruciferae Graminae Brassicacae	Shepherds-purse (*Capsella bursa-pastoris*) Common lambsquarters (*Chenopodium album*) White poplar (*Populus alba*)
Black Root Rot	*Thielaviopsis basicola*	137	33 Most common: Fabacae Solanaceae Cucurbitaceae	
Charcoal Rot	*Macrophomina phaseoli*	>300		

Thank You

QUESTIONS?