Life after methyl bromide: Fumigant and non-fumigant options and ideas for raspberry production

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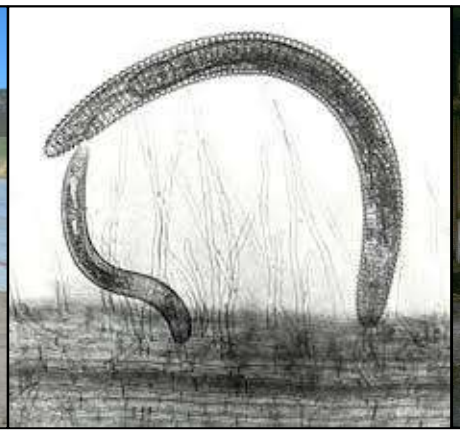
"When using management practices other than soil fumigation, growers will need a basic knowledge of pathogen biology (host range, life cycle, survival strategies) and access to resources such as diagnostic services"

Presentation outline

1. Target soilborne pathogens in raspberry
2. Decision-making for soilborne pathogen management
3. Soilborne pathogen management ideas
4. Conclusions


Target pathogens

Plant-parasitic nematodes

Phytophthora root rot
(*P. rubi*)

Agrobacterium

Others?

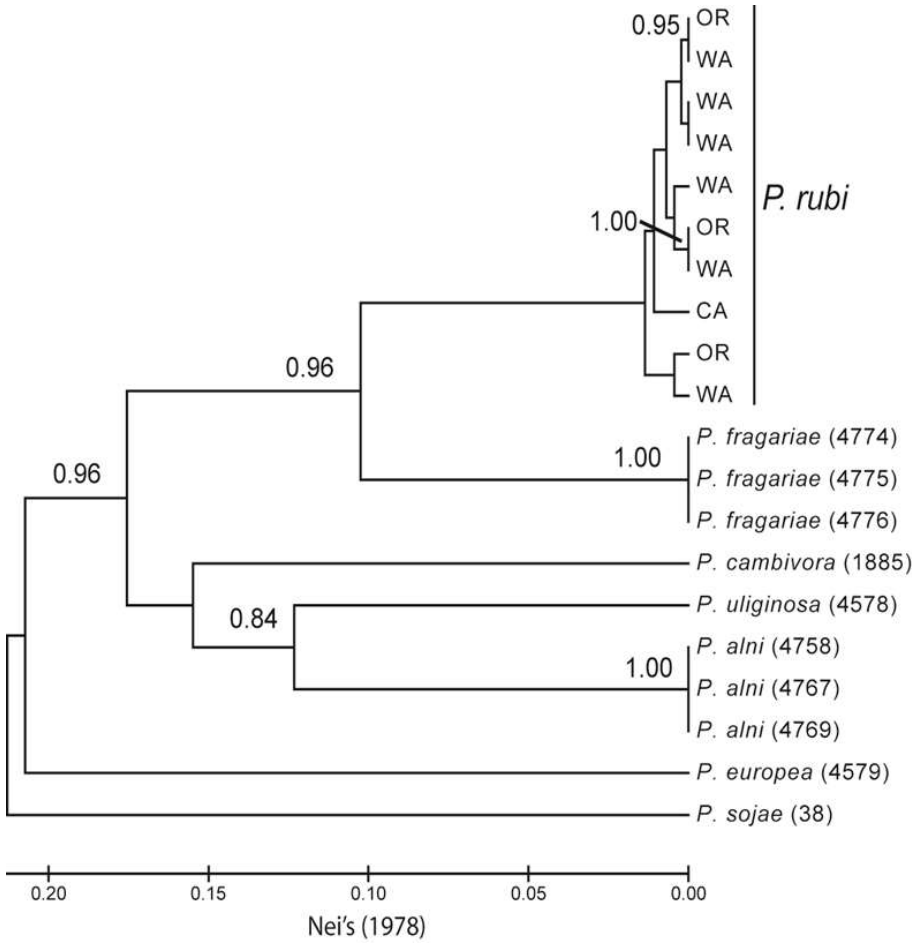
Verticillium

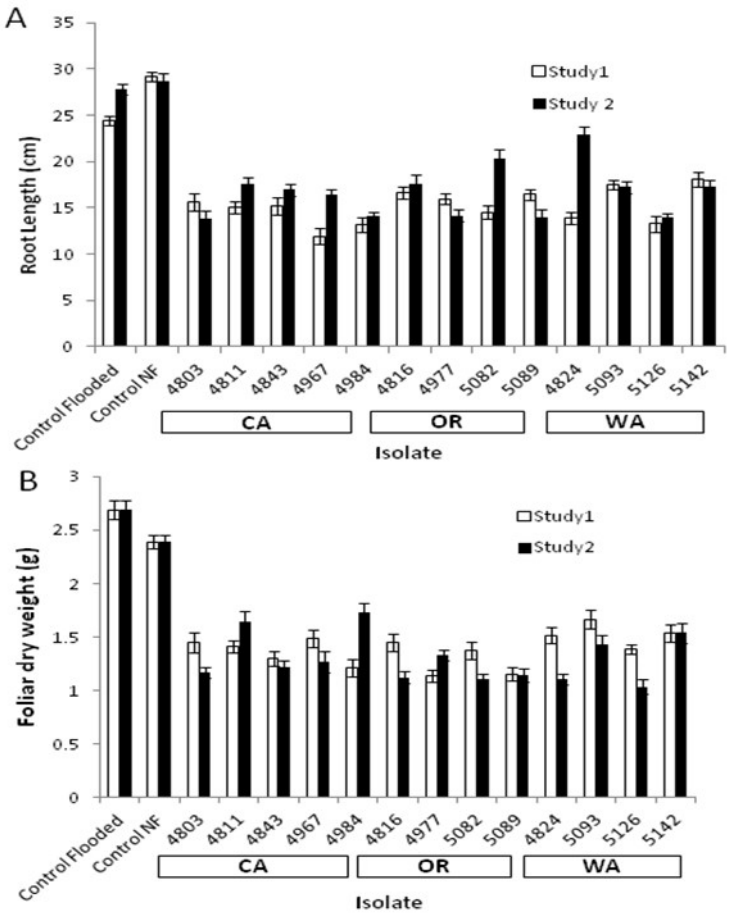
Alternaria

Rhizoctonia

Replant disorder

Phytophthora root rot





Pathogen is similar in CA, OR, and WA

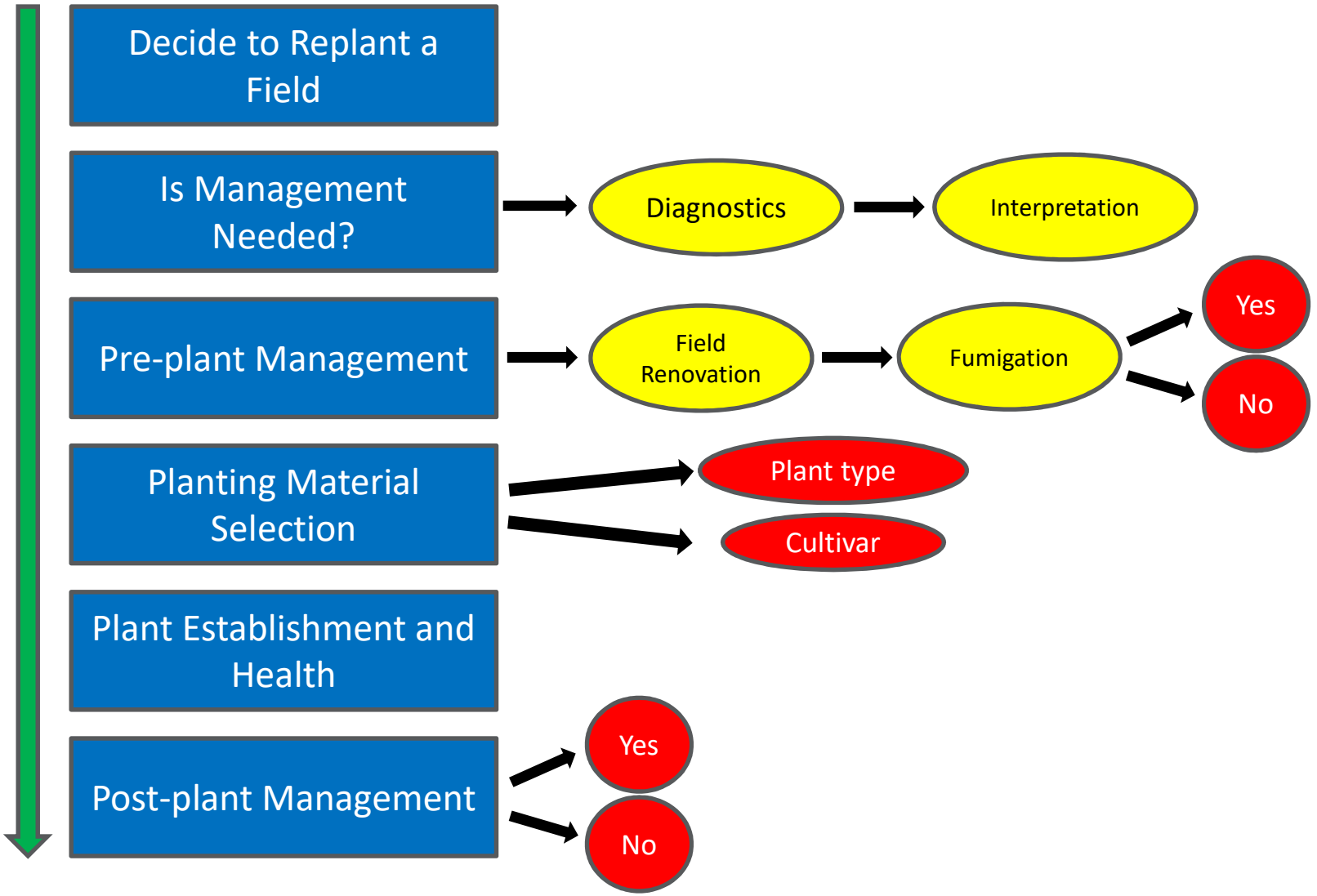
Root lesion nematode

Not commonly found in CA raspberry fields
Widespread in WA raspberry fields

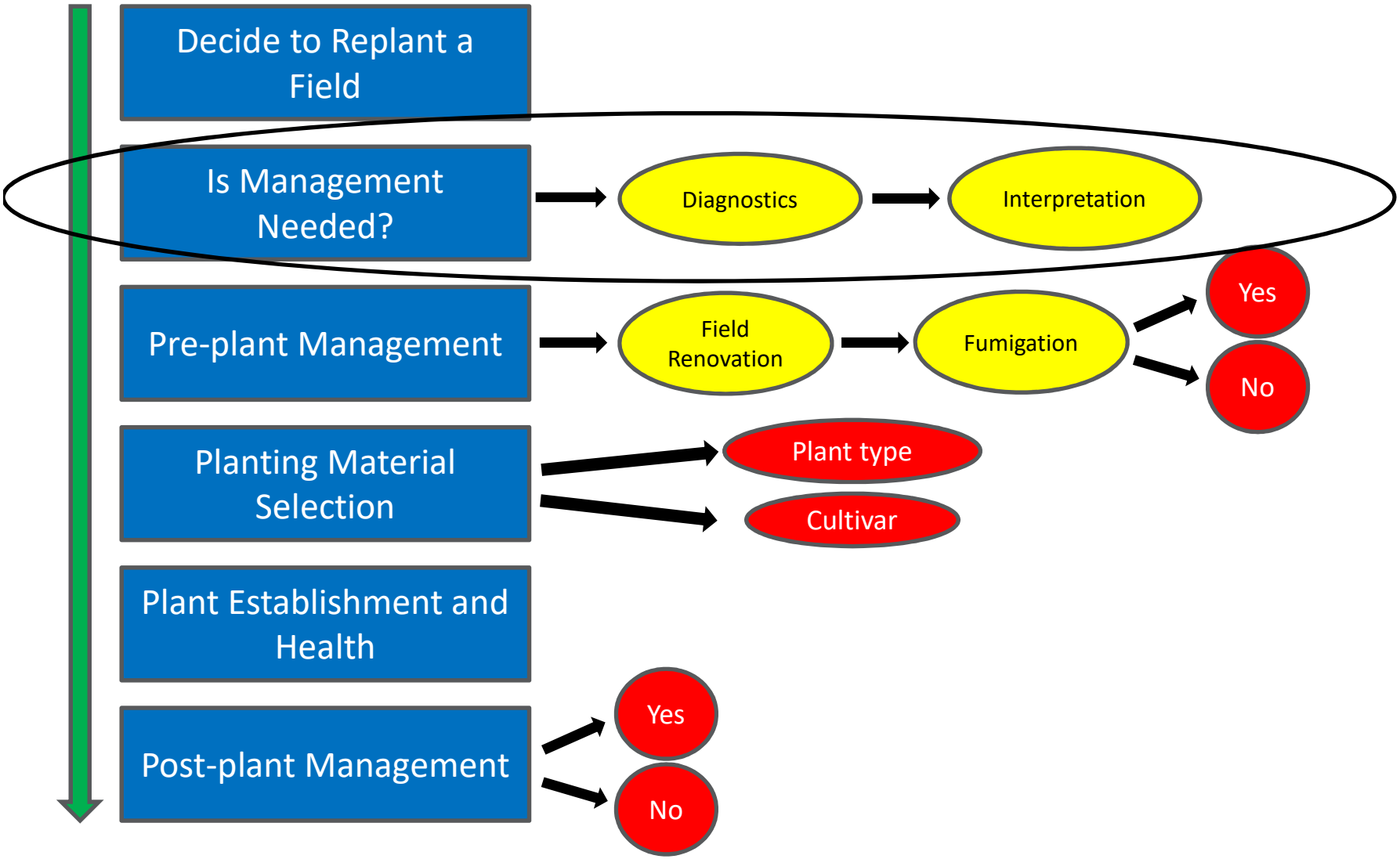
Fumigated

Nonfumigated

Decision-making for soilborne pathogen management

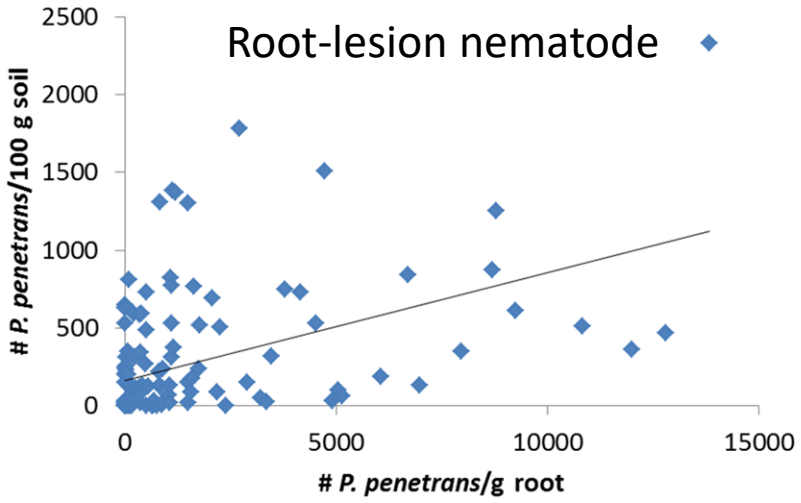


Decision-making for soilborne pathogen management

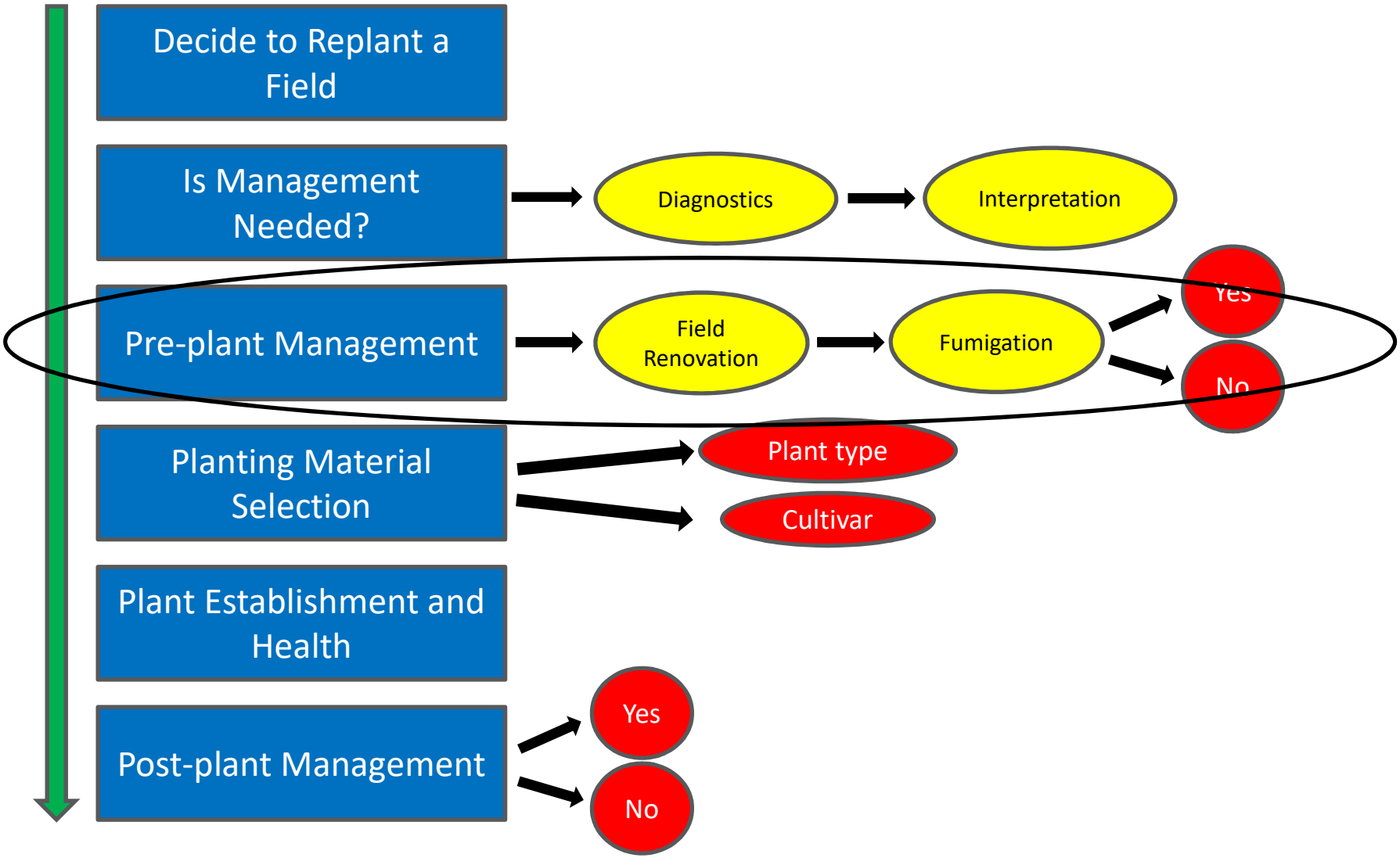


Diagnosing a problem

- Field history
- In-field symptoms
- Sampling and lab results



Decision-making for soilborne pathogen management



Pre-plant soil fumigation

- Soil fumigants
  - 1,3-Dicholoropropone
    - 1,3-D is the 6th most abundantly used pesticide in the U.S.
  - Chloropicrin
  - Metam sodium
  - Metam potassium
  - Dimethyl disulfide
  - Allyl isothiocyanate

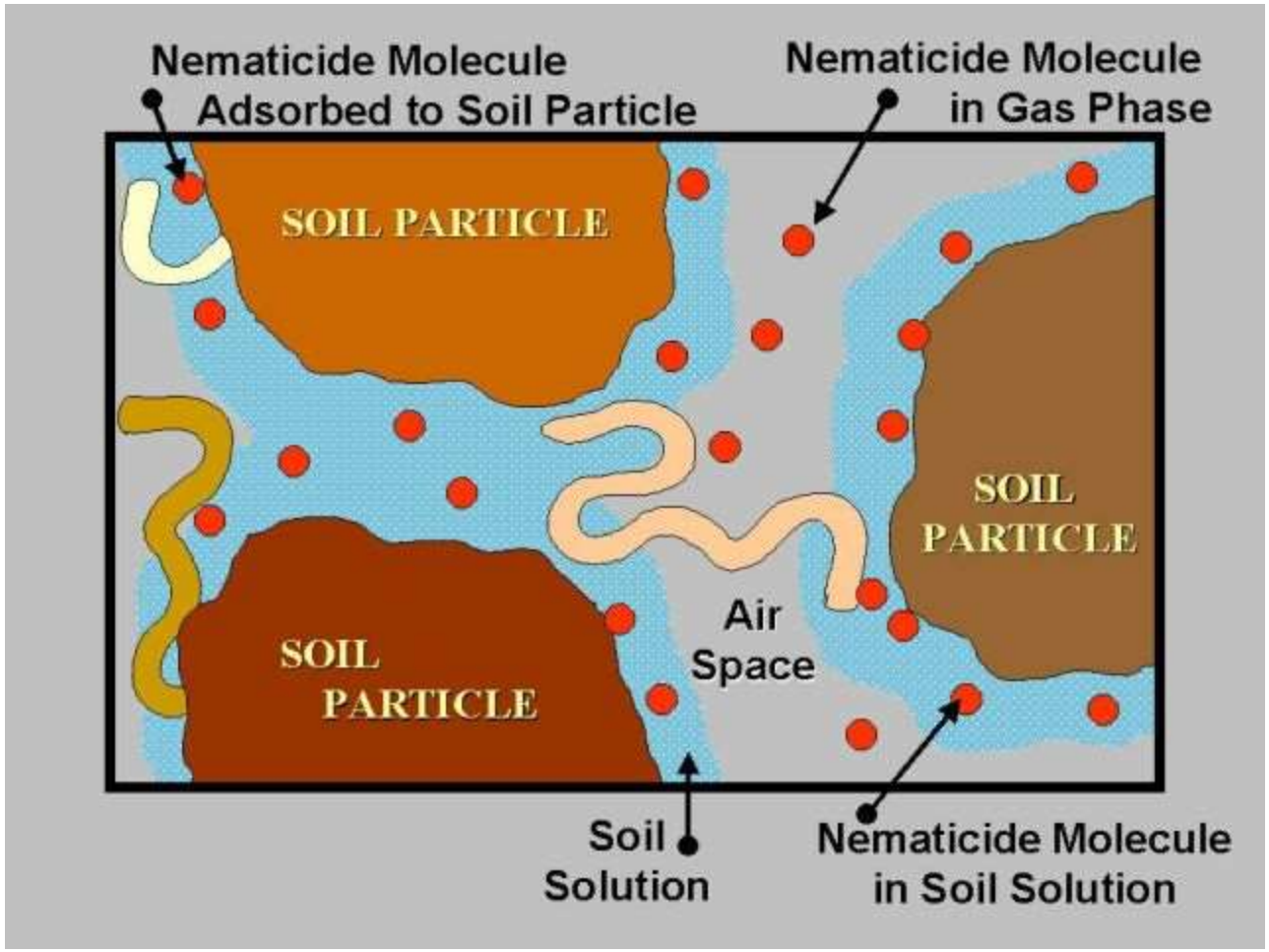
"This fact is still made quite clear from a review of recent field research trials conducted in Florida that shows that no single, equivalent replacement (chemical or nonchemical) currently exists that exactly matches the broad spectrum efficacy of methyl bromide." – J. Noling

Fumigant properties

Fumigant	Molecular weight	Density at 20 °C	Boiling point	Vapor pressure at 20 °C	Solubility in water at 20 °C
	g mol^{-1}	g ml^{-1}	°C	mm Hg	% w/w
Methyl bromide	95	3.97	4	1420	1.34
Chloropicrin	164	1.66	112	18	0.20
1,3-D	111	1.21	104	34	0.22
Metam sodium	73	1.21	119	21	0.76
Allyl isothiocyanate	99	1.01	148	4	0.1

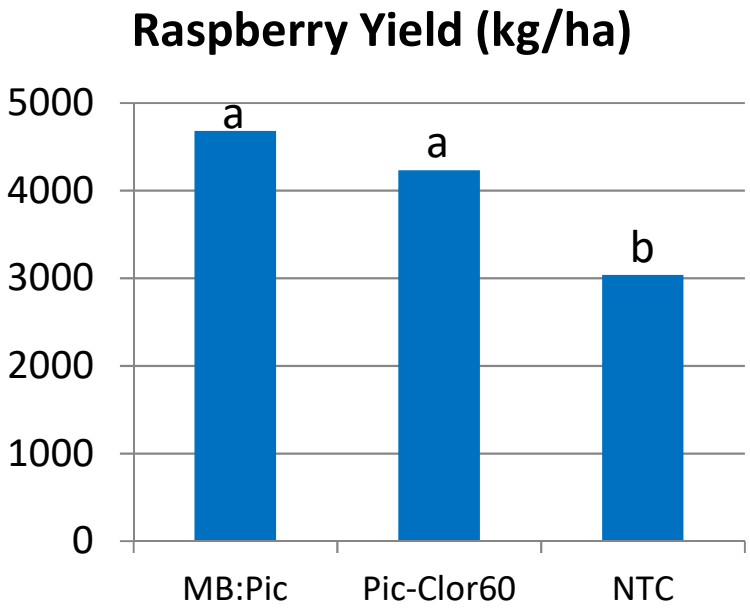
Courtesy Husein Ajwa

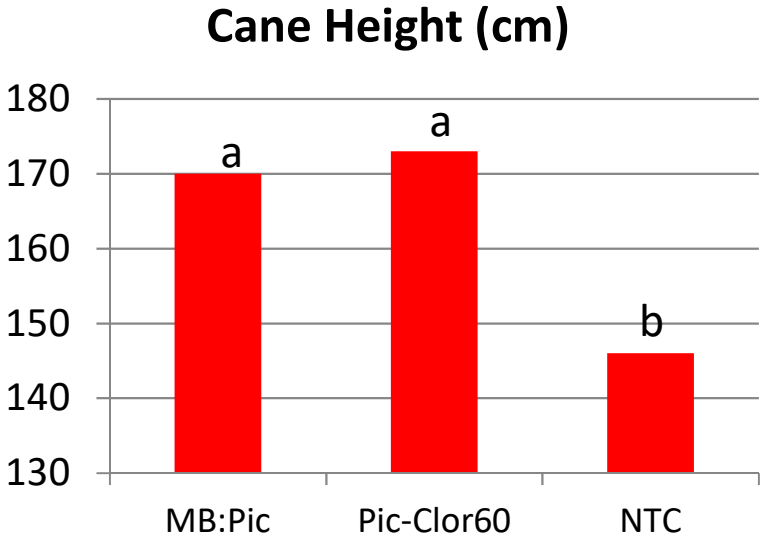
Fumigant properties



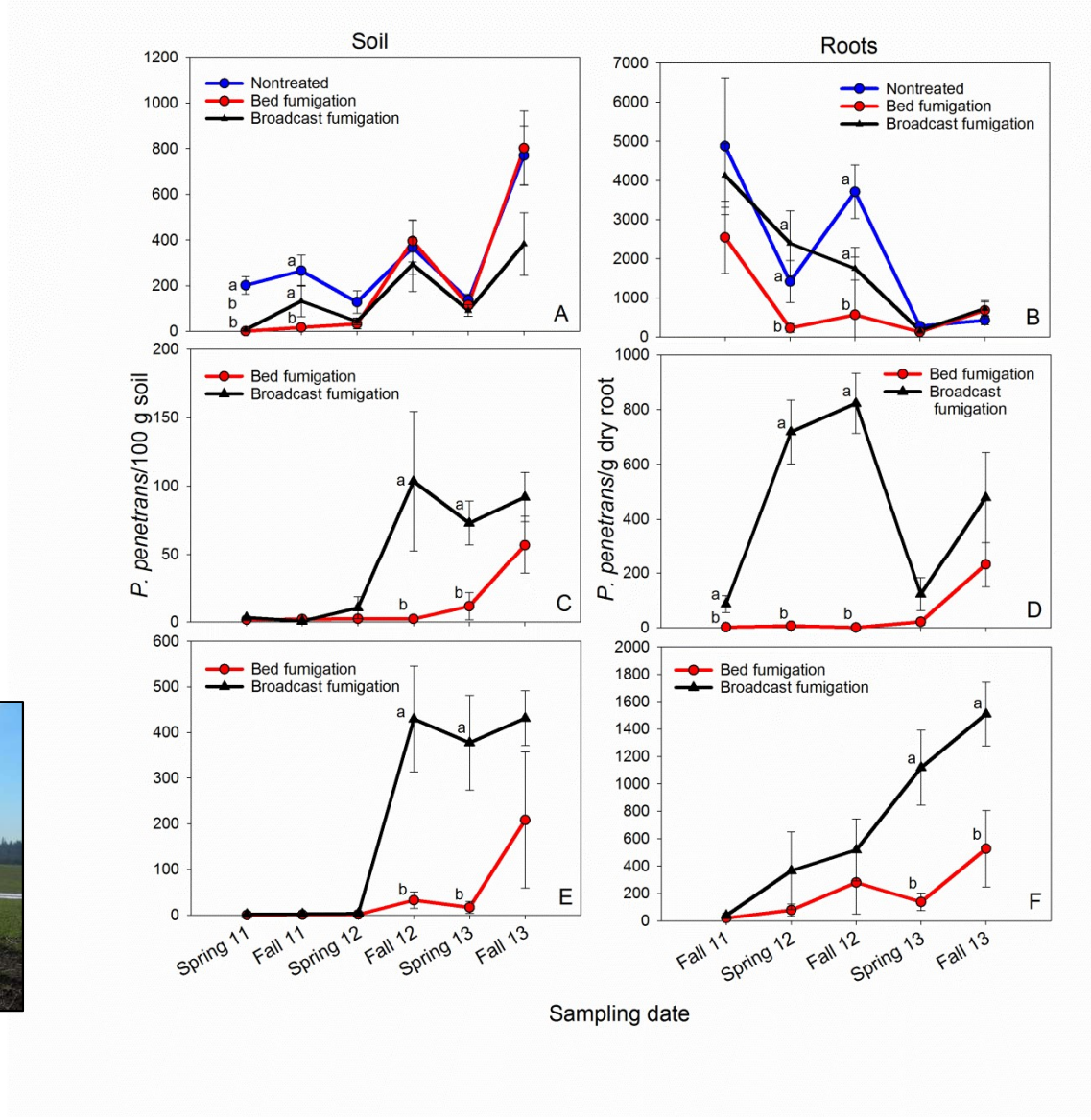
Courtesy Joe Noling

Fumigant efficacy in CA raspberry

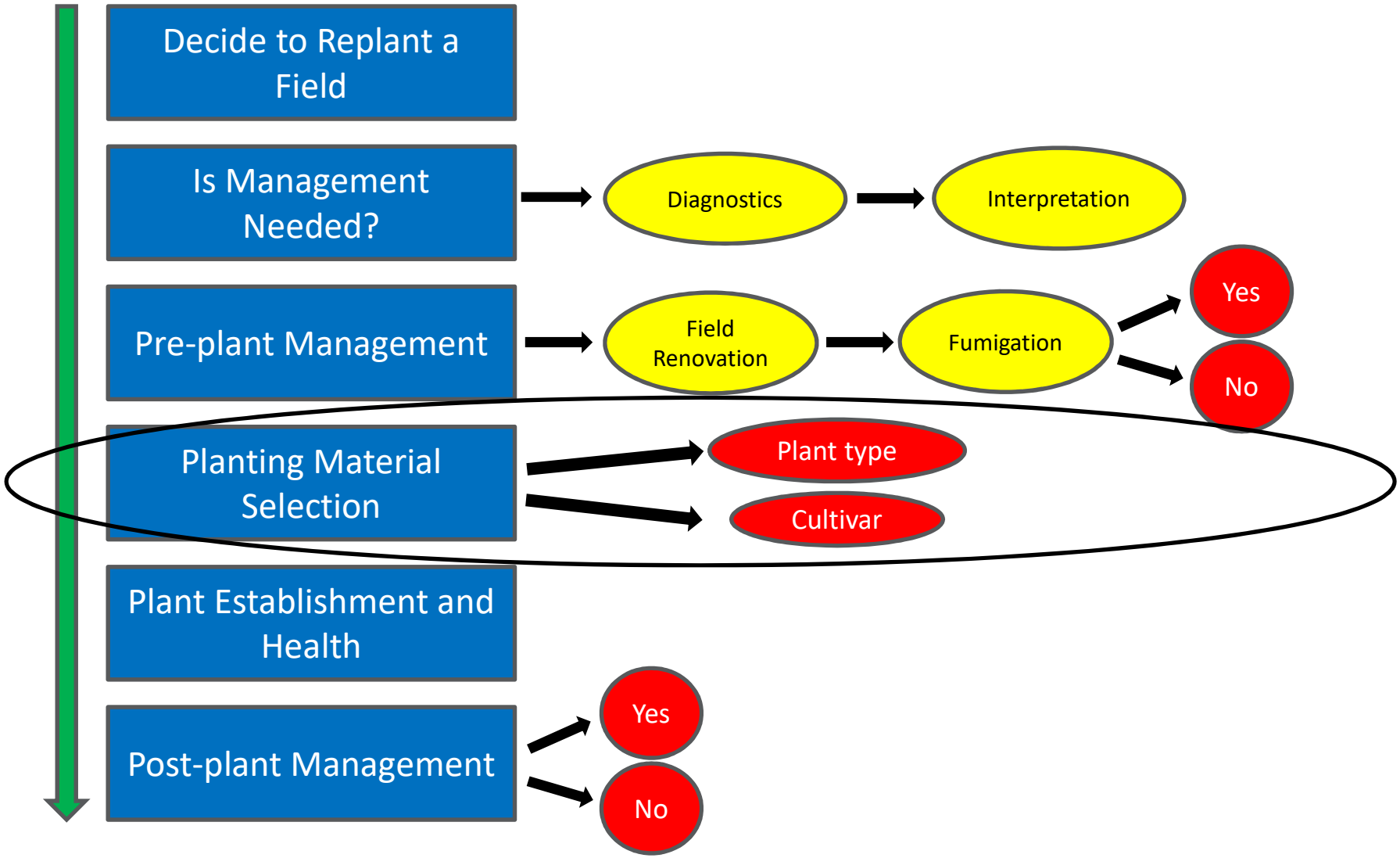




Fumigant efficacy in WA raspberry



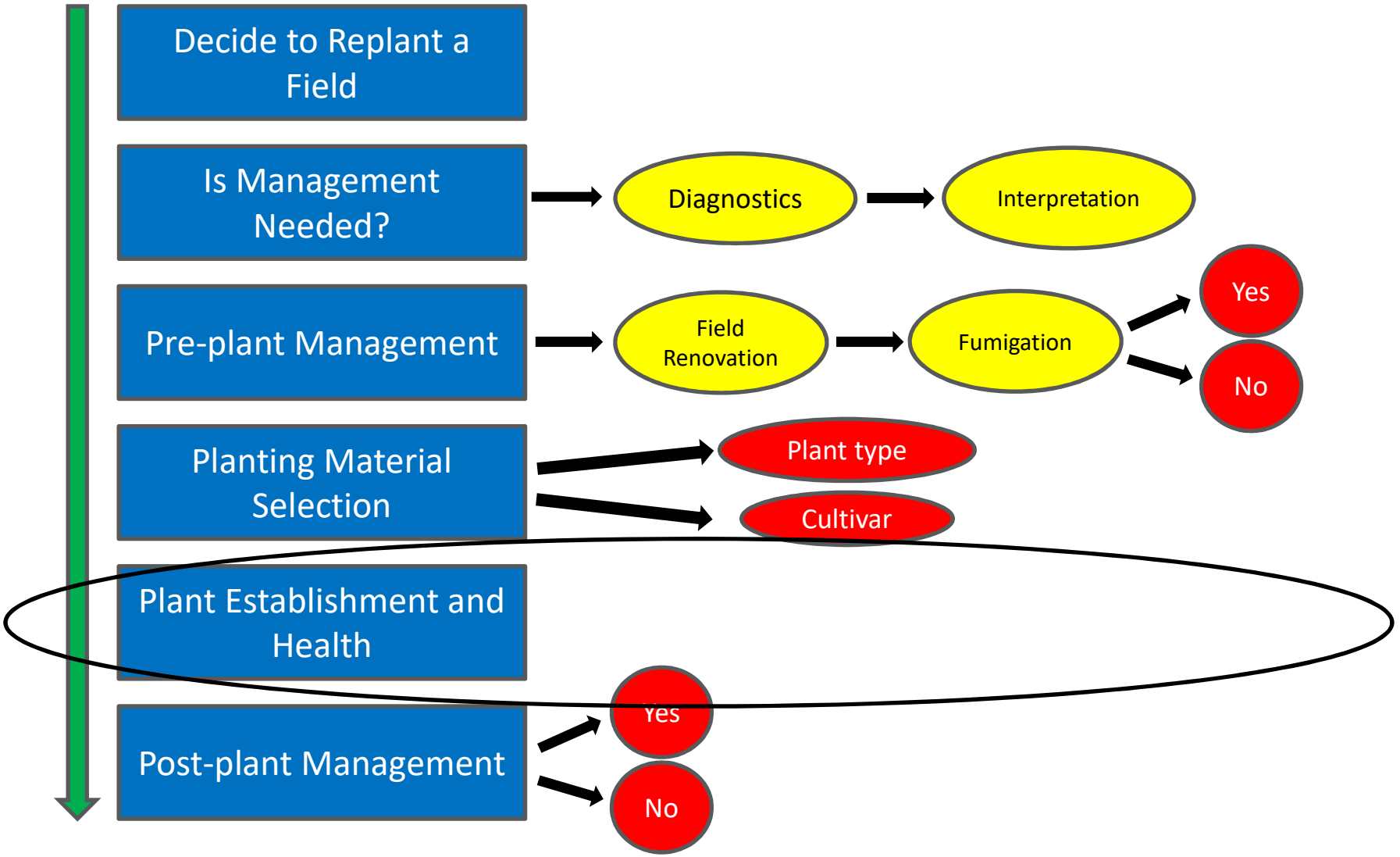
Decision-making for soilborne pathogen management



Planting material

- Only certified material free of pathogens should be planted
- Selection of planting material should be based upon knowledge of pathogens present at the site (pre-plant nematode sampling)
- Is there resistance available in raspberry?

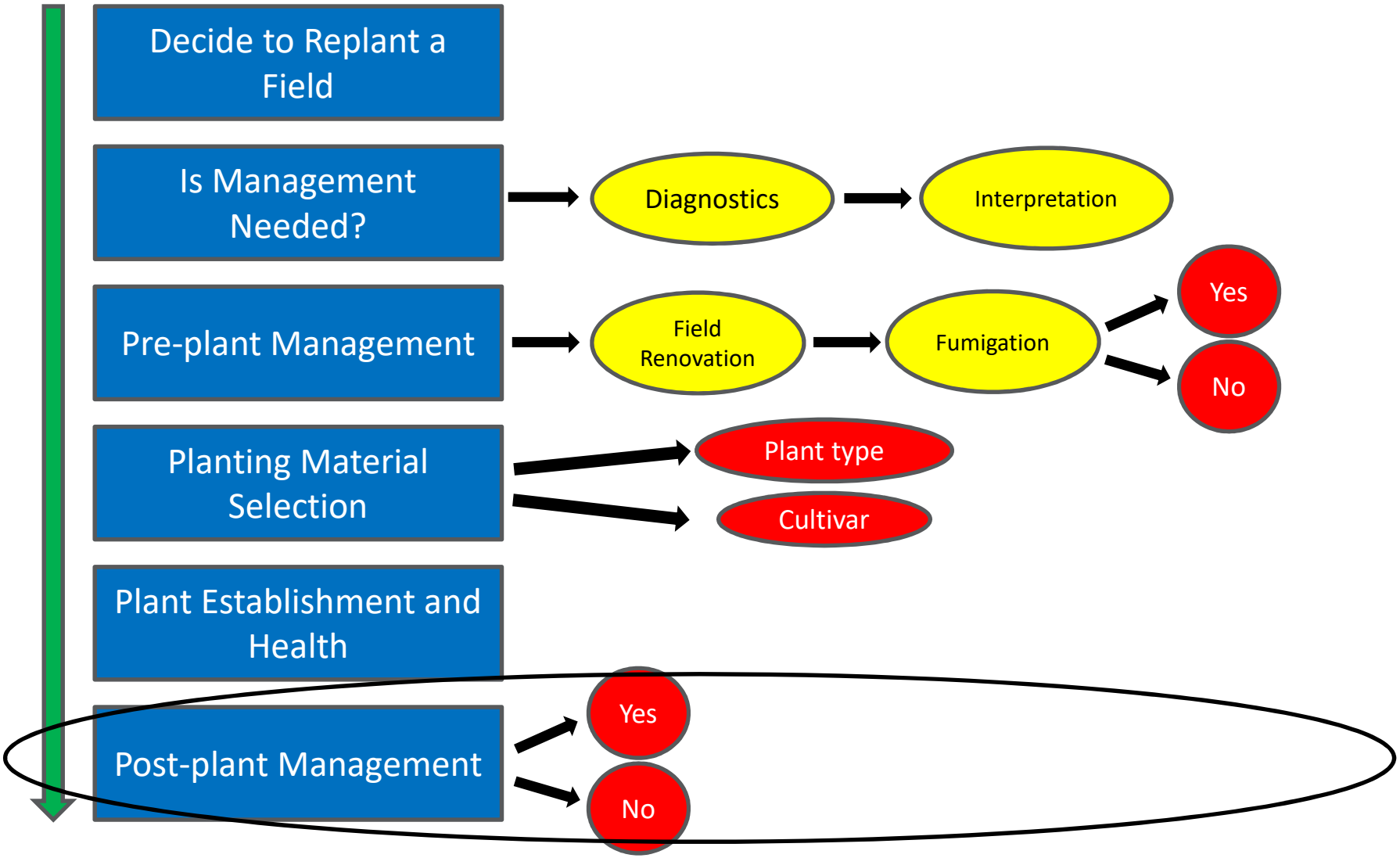
Decision-making for soilborne pathogen management



Plant health

- Water and nutrient management
- Minimize soilborne pathogen population buildup
- Enhance crop resilience
- Soil health

Decision-making for soilborne pathogen management

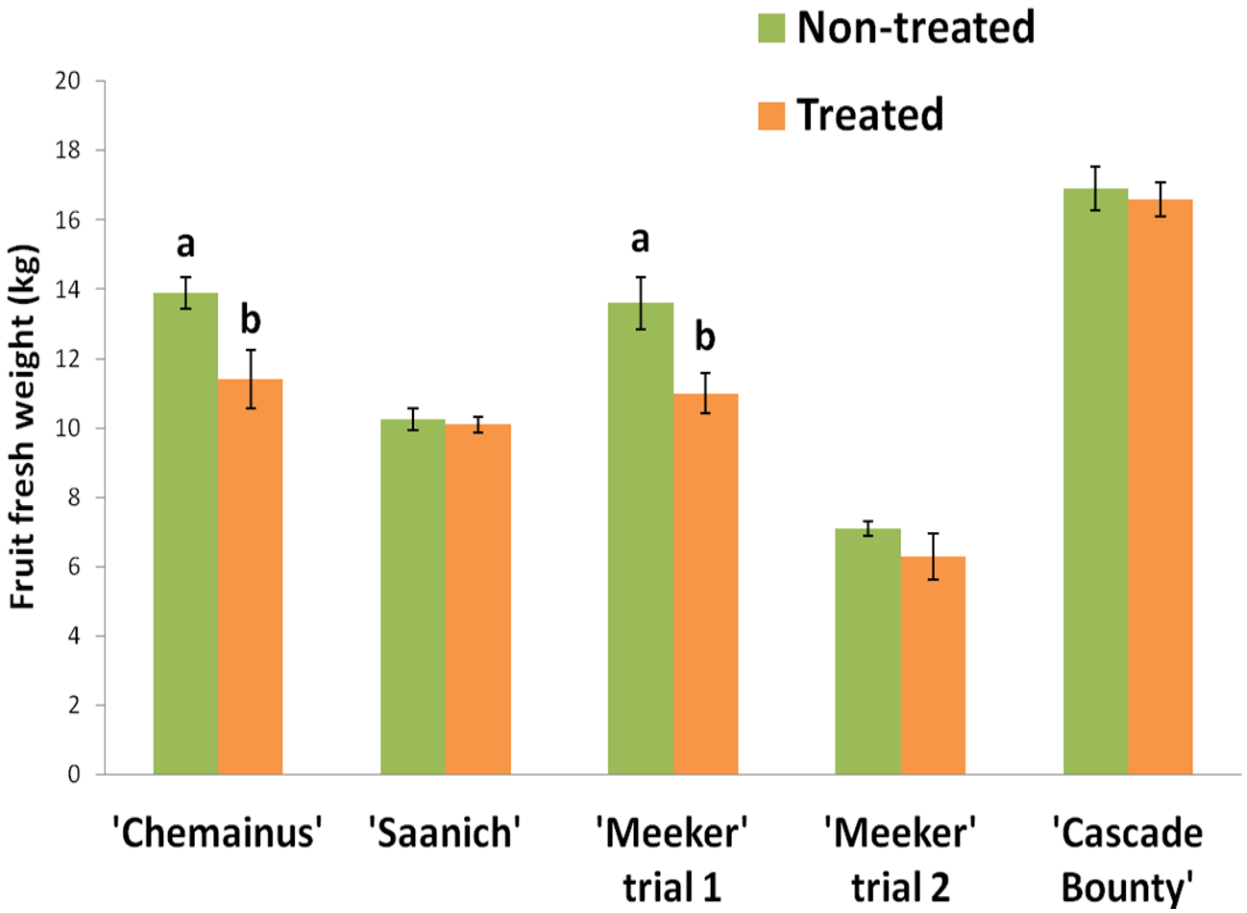


Registered post-plant nematicides in WA

Name	Ingredient	Type of nematicide
Admire Pro, Alias, Nuprid	Imidacloprid	Chemical
Azaguard, Azamax, Azasol, Azatin, Azatrol, Biosafe, Debug, Ecozin, Azatrol, Mot-X, Neemix	Azadirachtin	Botanical
Melocon	*Paecilomyces lilacinus*	Biological
Debug, Neem Pro, Neemix, Plasma Neem	Neem oil	Botanical
Monterey	*Quillaja saponins*	Botanical
Vydate	Oxamyl	Chemical
Ditera	*Myrothecium verrucaria*	Biological

WSU PICOL accessed November 18, 2016

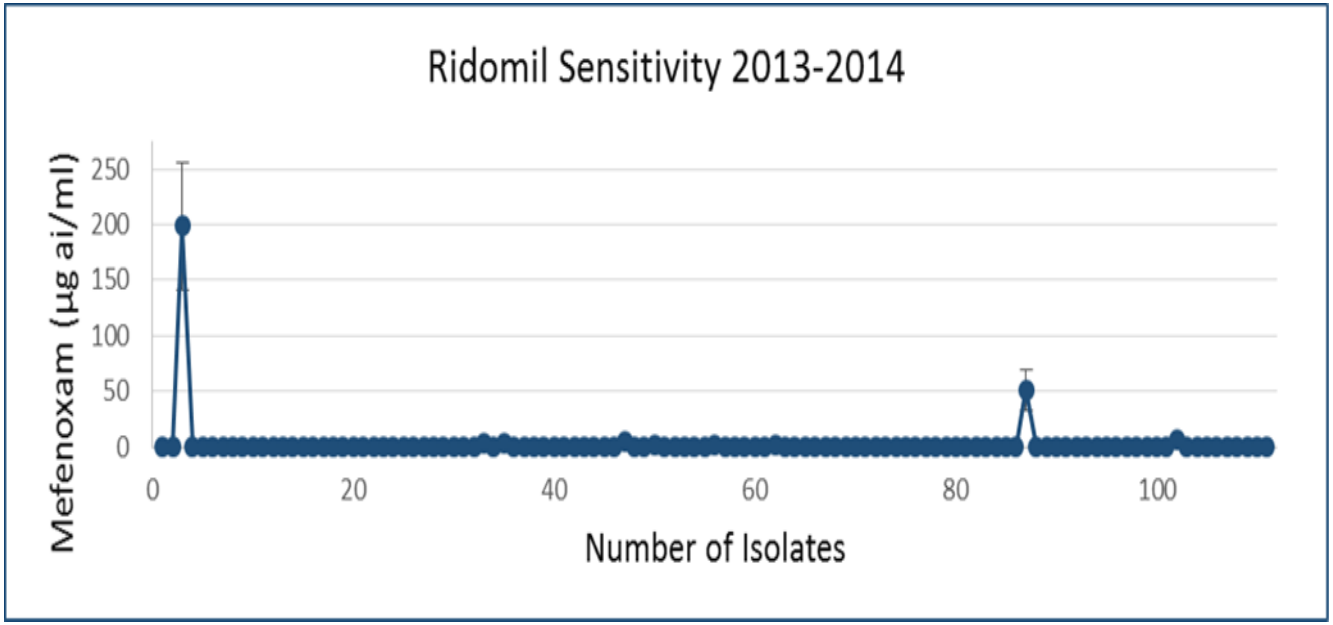
Raspberry plantings can't be "rescued"



15 months after treatment

Fungicides for Phytophthora root rot management

Mefenoxam (Ridomil)
Phosphorous acid (Aliette/Agri-Fos/Rampart)



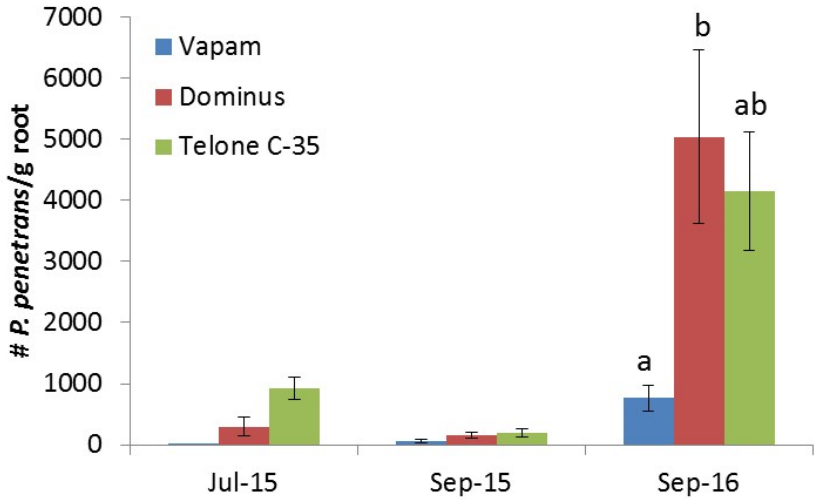
- 153 *P. rubi* isolates tested against Ridomil (0-100 ug/ml)
- Majority of isolates were sensitive to this compound

Avoid resistance by alternating use of compounds

Management ideas??

Problem: 1,3-D will be in short supply.

Solution: Other fumigants, fumigant combinations, and techniques will need to be implemented.



Dominus (allyl ITC) – efficacy and cost?

Paladin (DMDS) – smell?

Vapam (metam sodium) – movement in soil?

Management ideas??

Problem: Difficult to break the pathogen “cycle”.

Solution: Remove roots containing pathogen inoculum prior to implementing management practices.

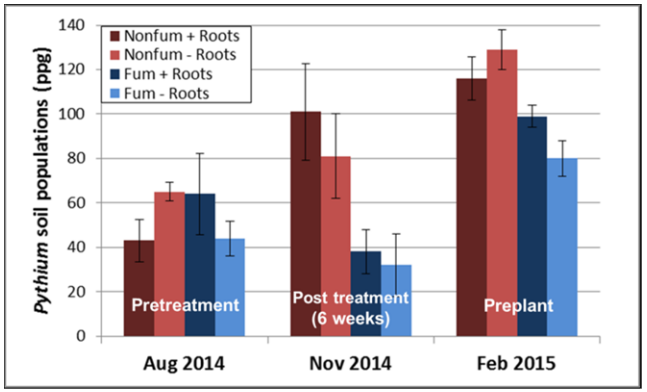
Device	Speed (km/h)	% material removed
Plant lifter	0.4	98
Beach cleaner	0.6	91
Potato harvester	1.6	96

Management ideas??

Problem: Difficult to break the pathogen “cycle”.

Solution: Remove roots containing pathogen inoculum prior to implementing management practices.

Treatment	Primocane #	Primocane ht (cm)	Raspberry yield (kg/plot)
Fum – removal	17	123 a	1.03 a
Fum + removal	17	124 a	1.02 a
Nonfum - removal	16	115 b	0.89 b
Nonfum + removal	15	114 b	0.91 b



Pythium populations over time

Management ideas??

Problem: Difficult to grow raspberry organically due in part to soilborne pathogens.

Solution: Implement bio-cultural practices.

OPTIONS	LIMITATIONS	BENEFITS
Cover crops	Cost	Ecosystem
Amendments	Efficacy	diversity
Biofumigation	Time	Plant nutrition
Non-host rotations	Expertise	Reduced pesticide use
Soil solarization	Lack of data	Long-term suppression
Biological control		
Anaerobic Soil Disinfestation		

Conclusions

- A diverse array of soilborne organisms wreak havoc on raspberry – replant issue.
- Changes in availability of fumigants and regulations regarding the use of fumigants will impact U.S. raspberry producers.
- There is a need for resistance to a range of soilborne organisms in commercially-acceptable varieties
- Future management will require a greater understanding of soilborne pathogen biology for targeted and integrated management strategies.
- **What are your ideas?**