Strategies for Enhancing Brassicas' Multipurpose Attributes in Managing Nematode Parasitism Complexes

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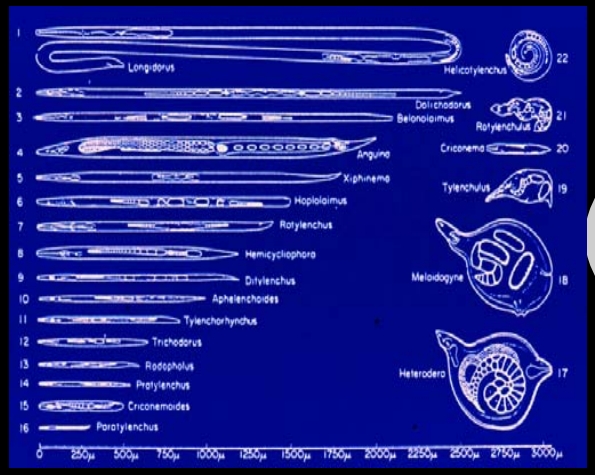
Talk Outline:

i) Brassicas' and nematode biology

ii) Possibilities for multiple uses

iii) Application of fertilizer use efficiency (FUE) model



Parasitism

Ecto

Migratory

Sedentary

Cell damage

Killed

Modified

Umbrella Project:

Physiological basis for an integrated approach towards sustainable nematode management

Central theme:

Organismal to ecosystem level of interactions

Theme strategic steps:

I: Host-nematode-nutrient interactions

II: Adaptation and parasitic variability

III: Efficiency of management strategies

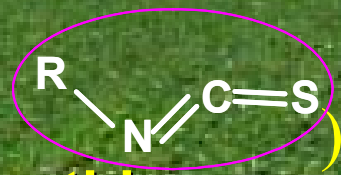
WHY DID WE DO THE WORK?

Brassicas (mustard) multi-purpose use:

Trap crop (do not allow full development)

Cover crop

Biofumigant (glucosinolate =>



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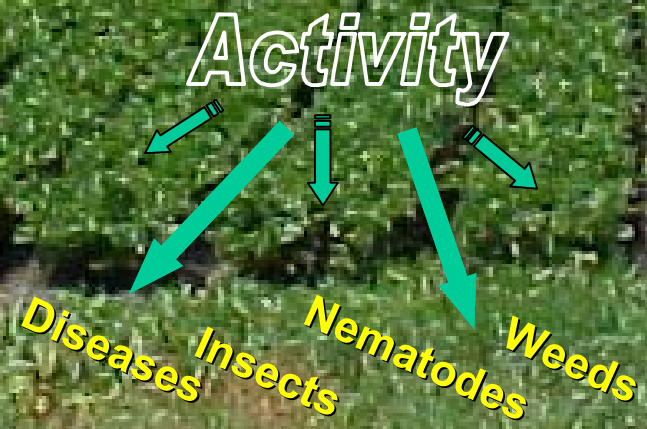
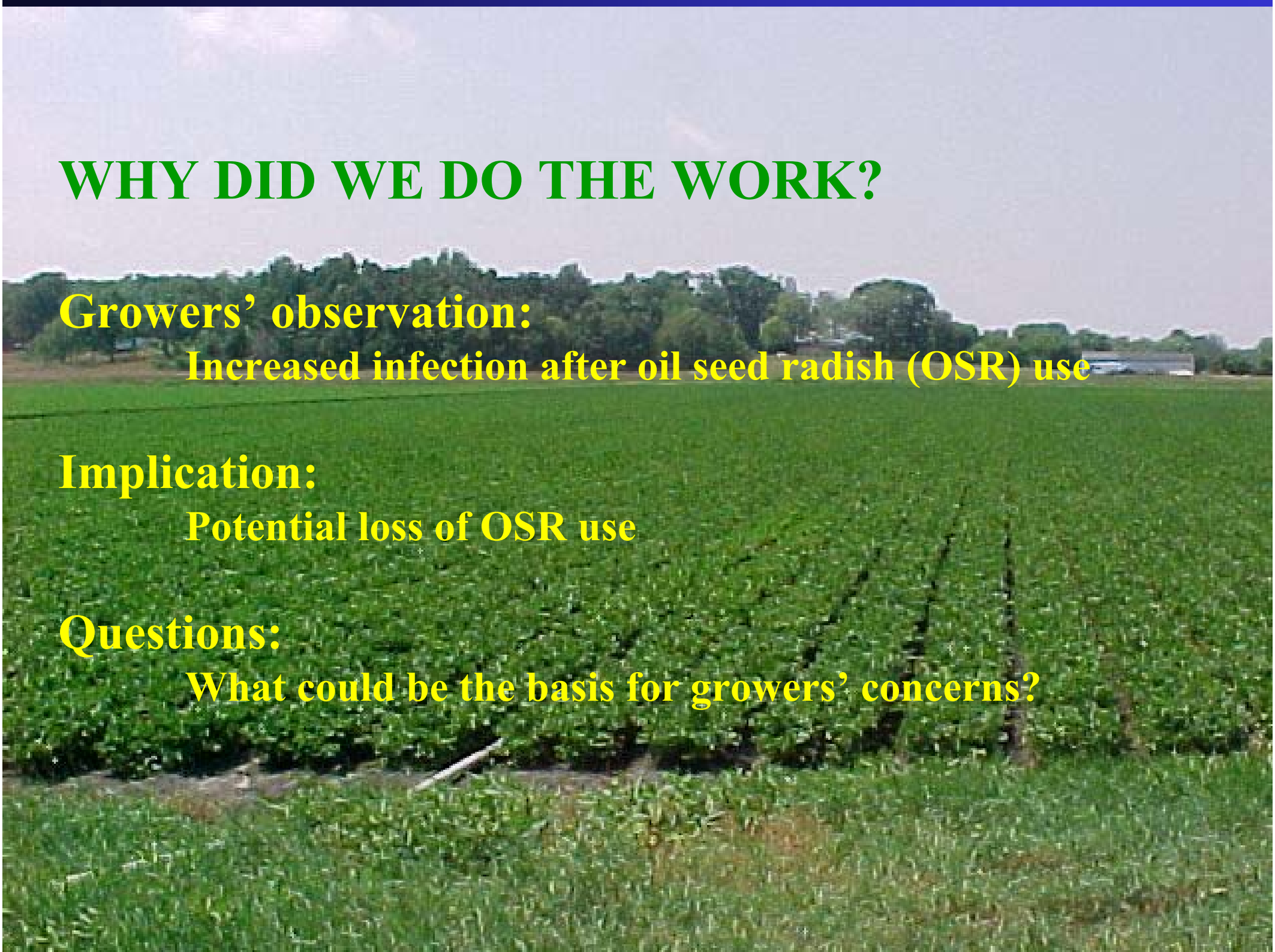
Isothiocyanate

Vegetable crop (some)

Combinations





WHY DID WE DO THE WORK?

Growers' observation:

Increased infection after oil seed radish (OSR) use

Implication:

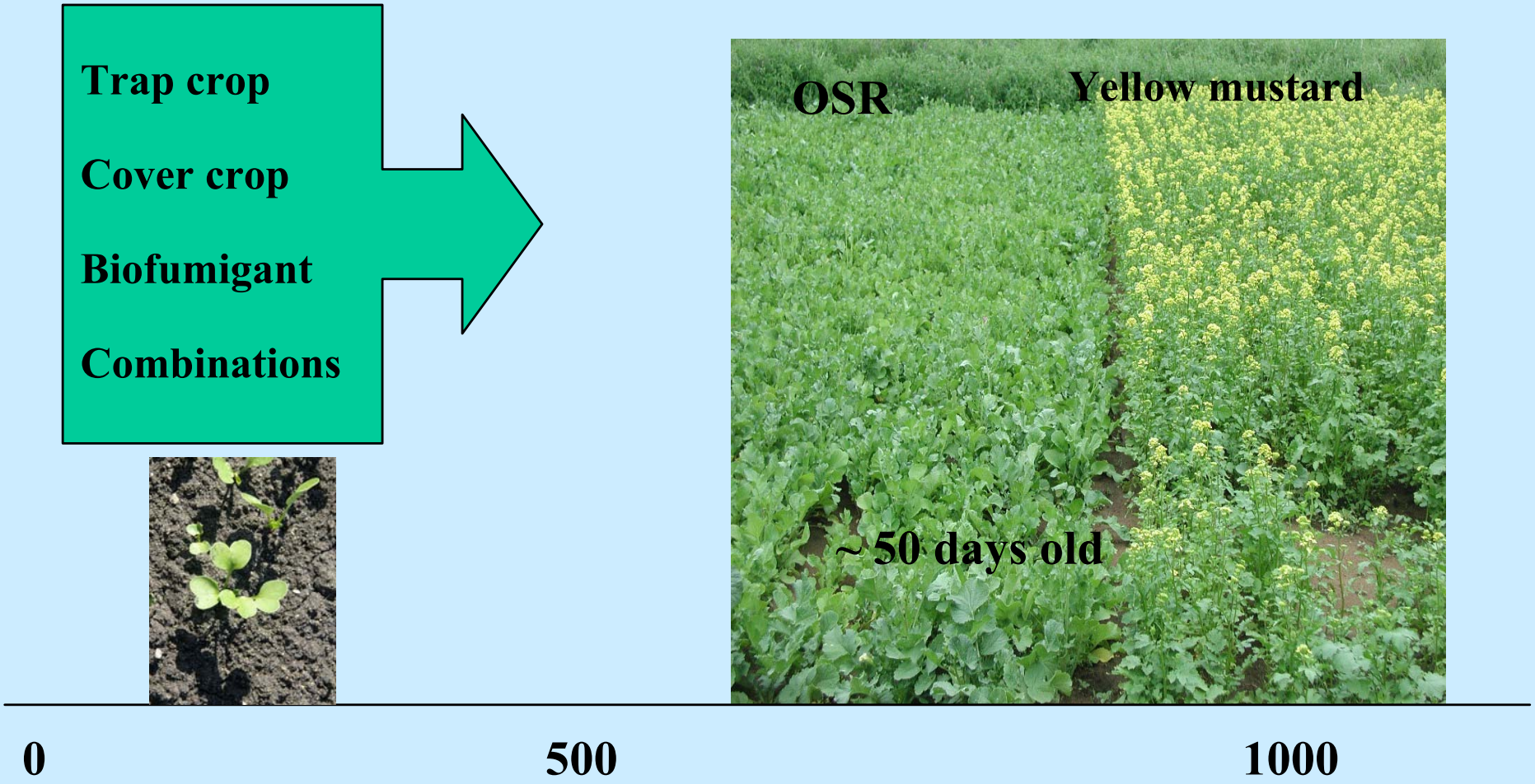
Potential loss of OSR use

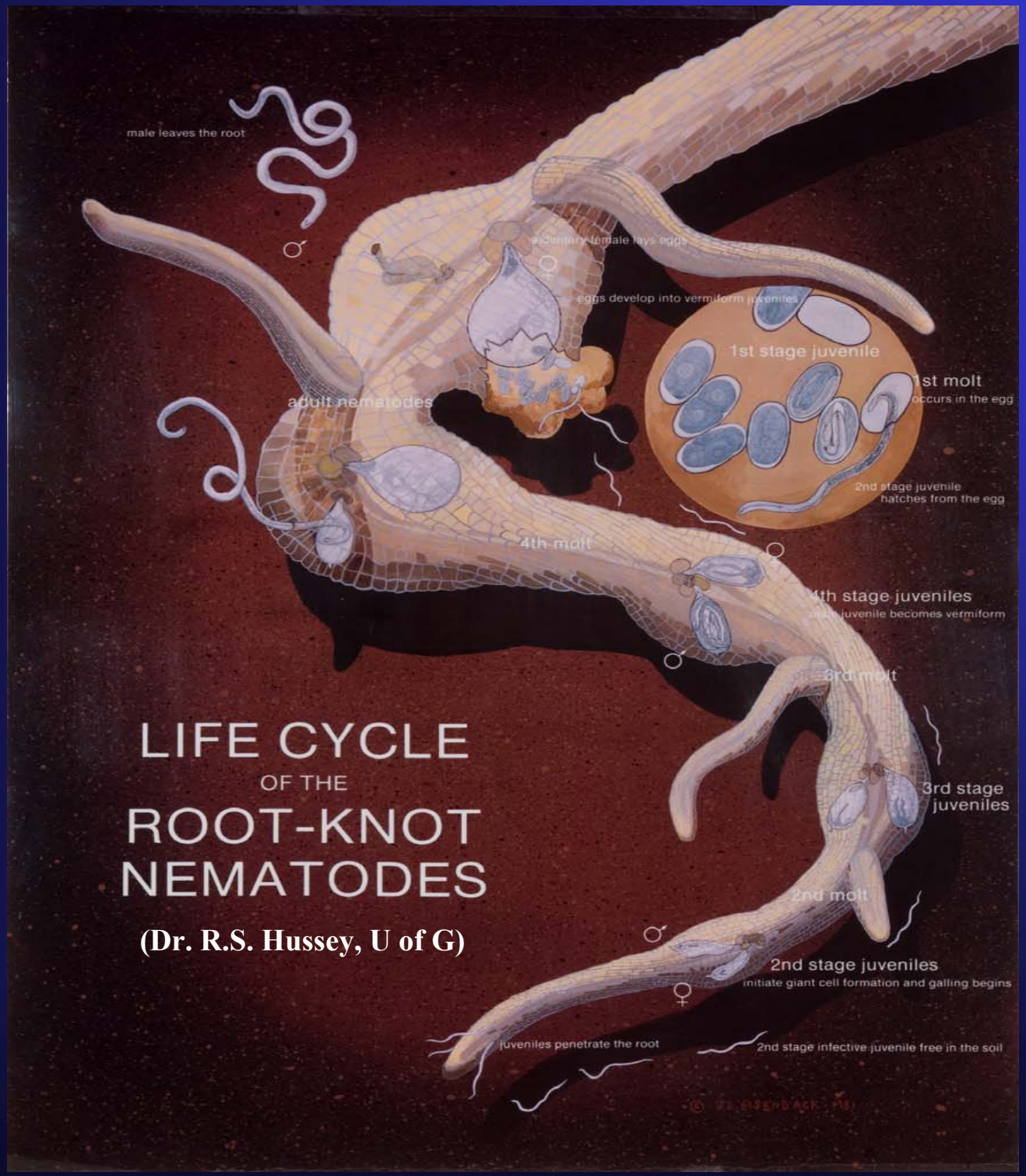
Questions:

What could be the basis for growers' concerns?

Wise use of trap and cover crops

OSR's attributes and host phenology:




male leaves the root
sedentary female lays eggs
eggs develop into vermiform juveniles
1st stage juvenile
1st molt
occurs in the egg
adult nematodes
2nd stage juvenile
hatches from the egg
4th molt
4th stage juveniles
3rd molt
LIFE CYCLE
OF THE
ROOT-KNOT
NEMATODES
(Dr. R.S. Hussey, U of G)
3rd stage
juveniles
2nd molt
2nd stage juveniles
initiate giant cell formation and galling begins
juveniles penetrate the root
2nd stage infective juvenile free in the soil

Meloidogyne hapla in OSR (Diakon and Ro4S-PSOSR) at 504 degree days (base 10 C; 28 days)

Soil types	Nematodes/g fresh root (#) total	Dry shoot Weight (g)
Sandy	104 a	0.95 c
Loamy sand	31 b	1.16 a
Muck	10 c	1.53 a

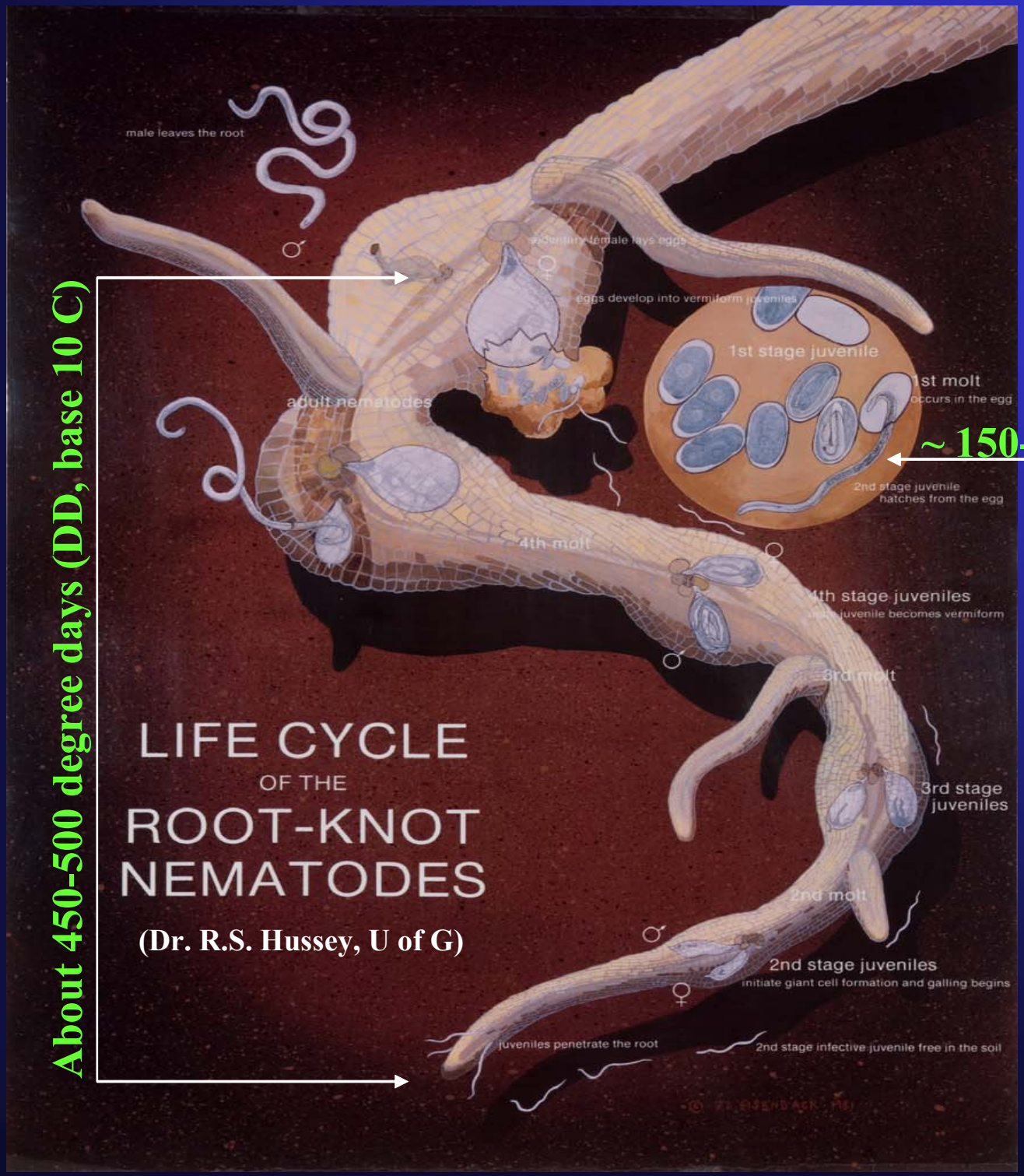
Meloidogyne hapla in OSR (Diakon and Ro4S-PSOSR) at 504 degree days (base 10 C; 28 days)

Soil types	Nematodes/g fresh root (#)		Dry shoot Weight (g)
	total	% females	
Sandy	104 a	80 a	0.95 c
Loamy sand	31 b	68 b	1.16 a
Muck	10 c	82 a	1.53 a

***Nematology* 10: 373-379**

Wise use of cover crops-Conclusion

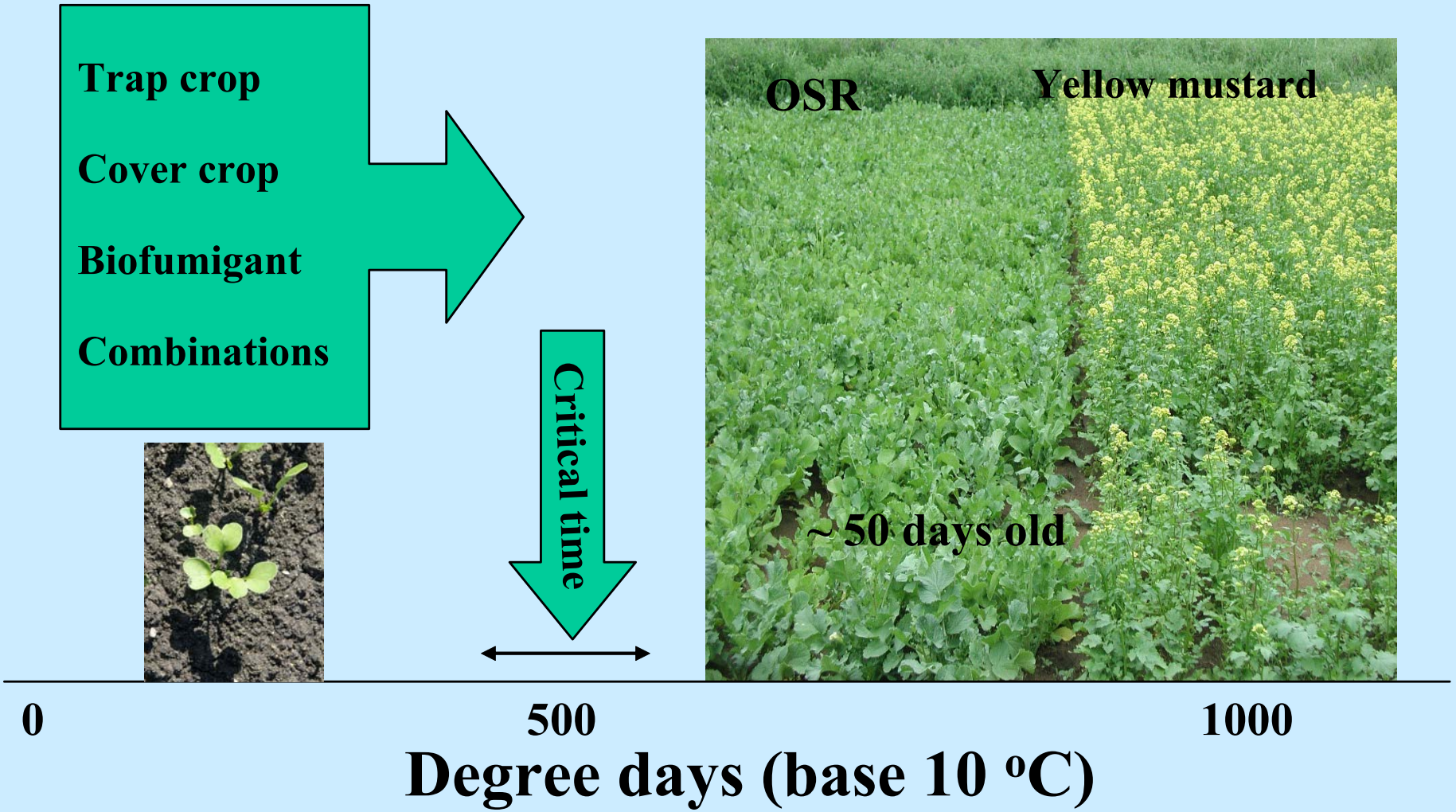
- Know when the target nematode completes a life cycle



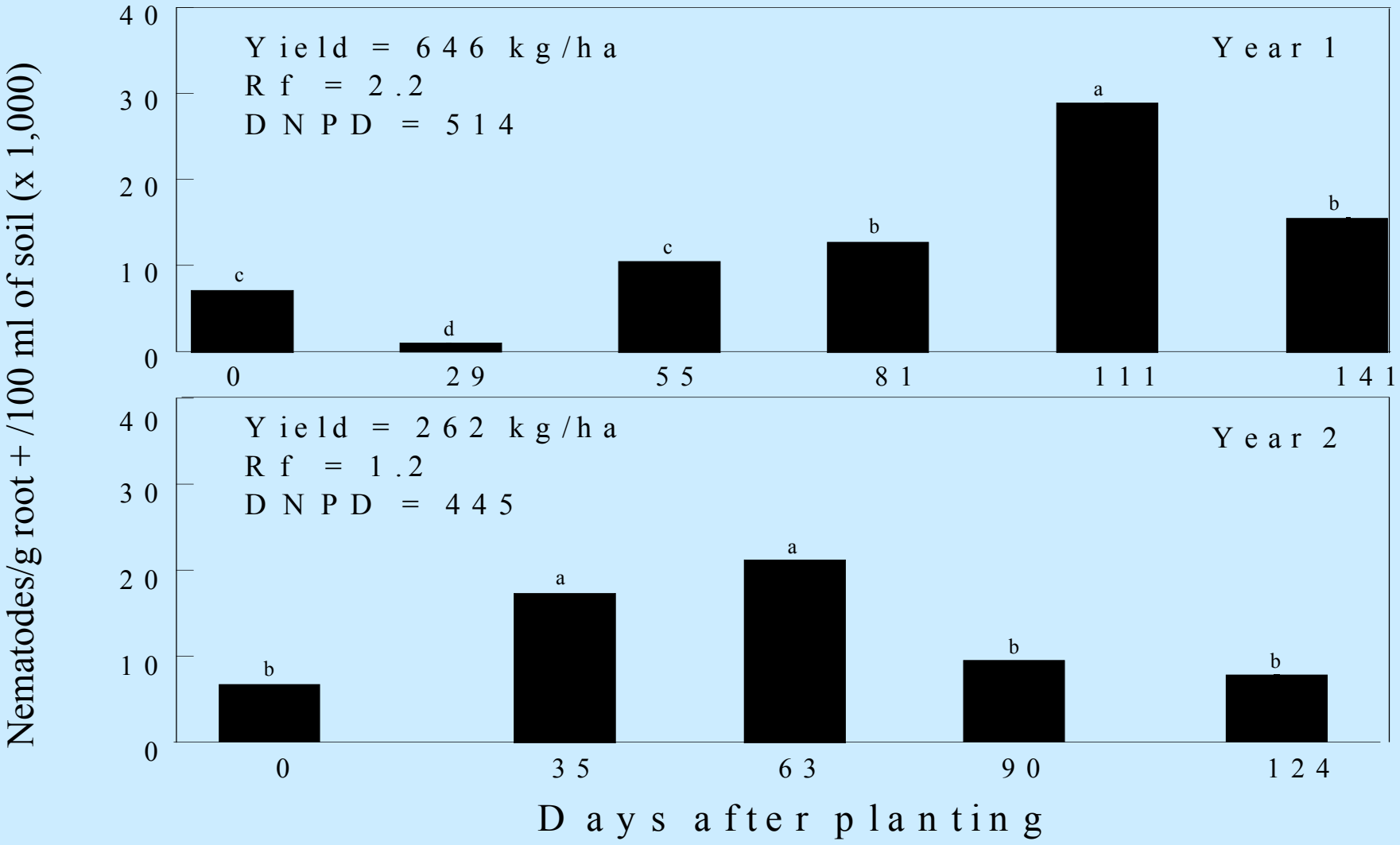
About 450-500 degree days (DD, base 10 C)

~ 150-200 DD

Balancing OSR's use and nematode life cycle:



Measure Seasonal Fluctuation, not P_f/P_i only!



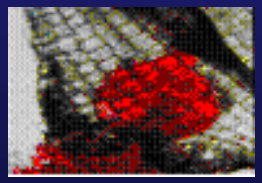
Precision Agriculture 2008, in press.

Talk Outline:

i) **Brassicas' and nematode biology**

ii) **Possibilities for multiple uses (Arugula)**

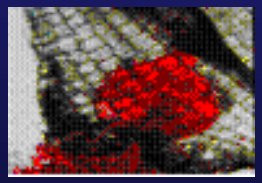
Promising multi-purpose crops: Arugula (*Eruca sativa* L.)



Traps root-knot

Nematology 8:793-799

Promising multi-purpose crops: Arugula (*Eruca sativa* L.)



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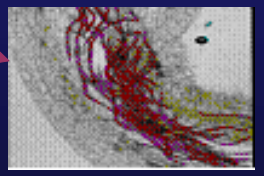

Traps root-knot

Nematology 8:793-799

Host to root-lesion

Experimental conditions at time zero.

Components	Soil types		
Texture (%)	Sandy[1]	Sandy loam[2]	Muck[3]
Sand	94.1[4]	72.2	59.8
Silt	5.5	20.4	19.8
Clay	0.4	8.4	20.4
pH	6.6	7.3	6.4
NO_3	1.07	8.6	35.6
N (added)	**34.5**	**27.0**	**0**

M. hapla eggs/ 300 ml of soil
0
4000
8000

Collected from [1] tomato field in Southwest Michigan, [2]MSU campus corn field and [3] celery farm in Western Michigan. [4] Data are means of three replications.

Melakeberhan *et al*. unpublished

Means across two experiments at 24 days (430 degree-days, base 10 ^{o}C) after *Meloidogyne hapla* inoculation.

Soil types	Nems/g root[1]	Shoot nutrient contents (%)[2]				
		N	P	K	Ca	Mg
Sandy	13.9 b	3.75 a	0.34 a	3.71 a	2.63 a	0.60 a
Sandy loam	44.7 a	3.86 a	0.42 b	4.33 b	2.31 b	0.55 b
Muck	25.4 ab	4.97 b	0.56 c	4.81 c	2.96 c	0.46 c

Data are means of [1]16 and [2]24 replications.

Melakeberhan *et al*. unpublished

What does it mean?

Possibilities	Efficiency for		Application		Likely use as a		
	Host growth	Nematode trapping	Site-specific	Broad	Trap	Biofumigant	Vegetable
1	Efficient	Efficient	✓	✓	✓	✓	✓
10	Inefficient	Inefficient	-	-	-	-	-

✓ = Yes; - = Unlikely.

Potential for entrepreneurship?

Melakeberhan *et al*. unpublished

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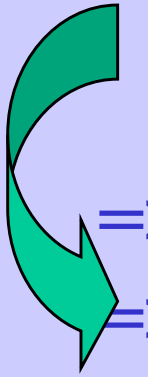
Why biological management of soil health?

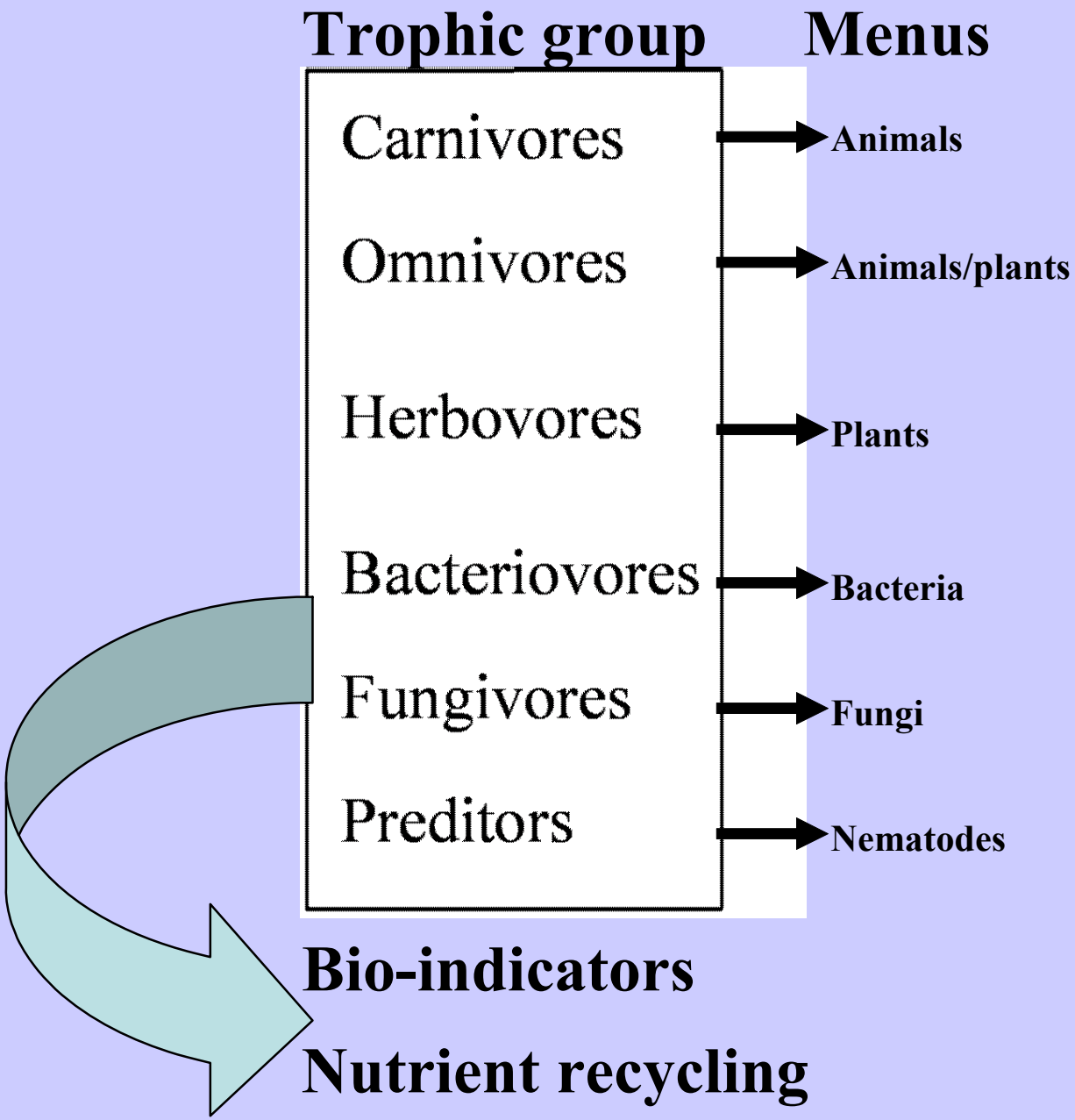
Agronomic, ecological, economic, pest management & Social



=> Identify soil conditions

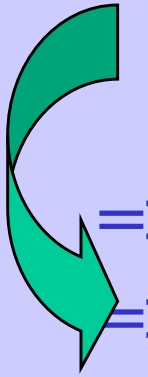
=> Change soil conditions

The World of Nematodes



Why biological management of soil health?

Agronomic, ecological, economic, pest management & Social



=> Identify soil conditions

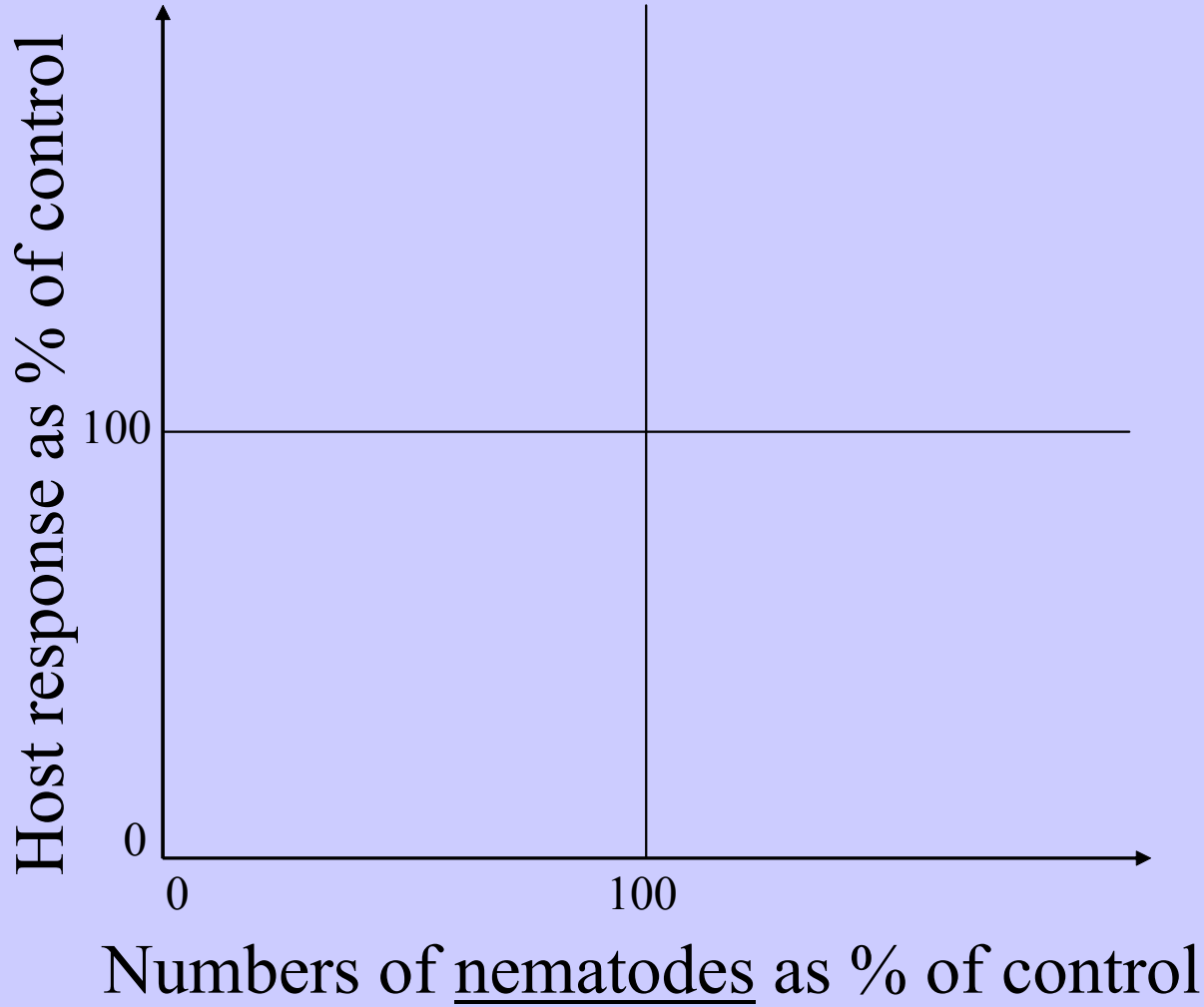
=> Change soil conditions

=> <u>Multi-dimensional integration</u>

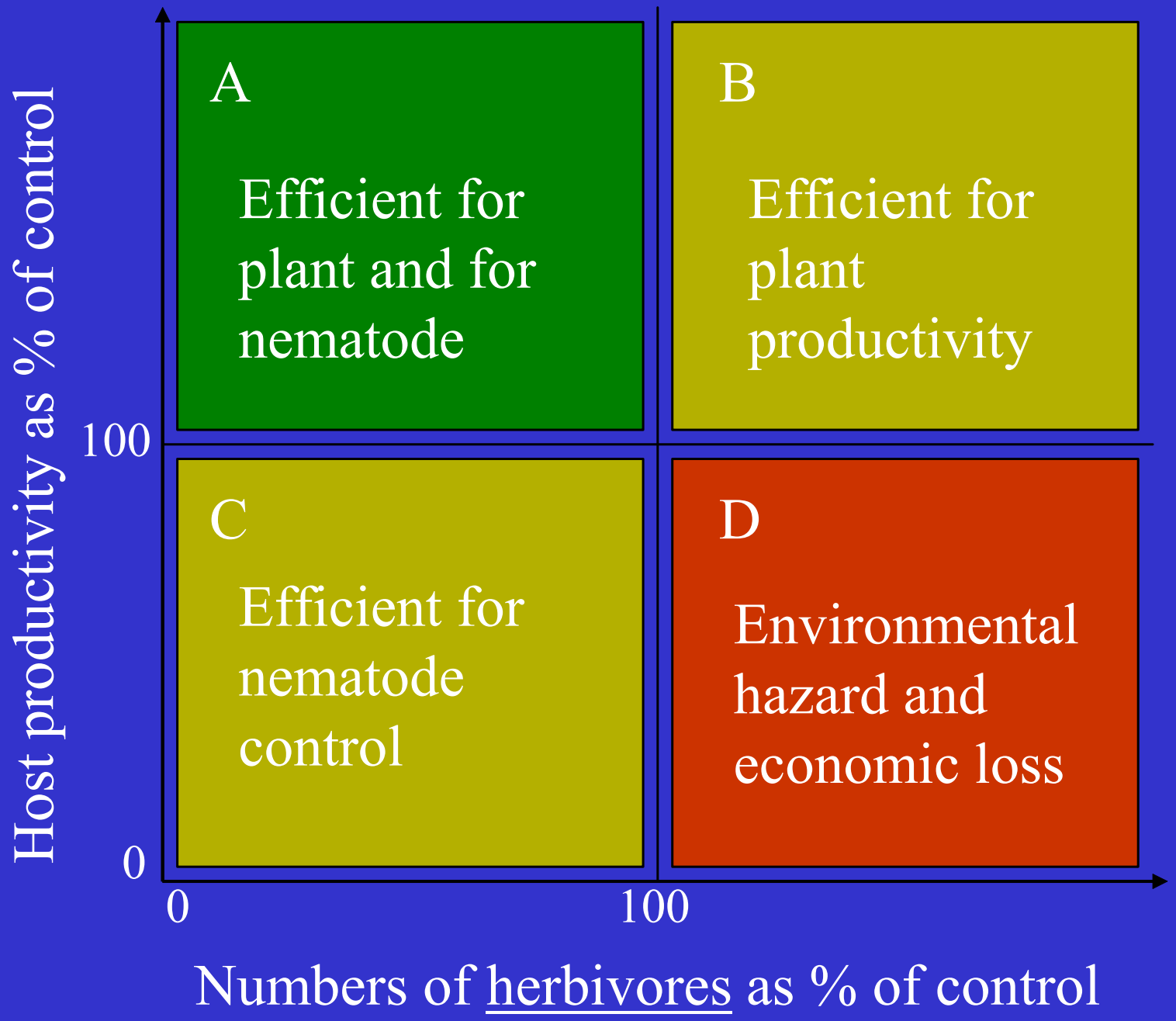
Fertilizer use efficiency (FUE) model:

- ►Responses are variable
- ►Integrated analysis identifies management options

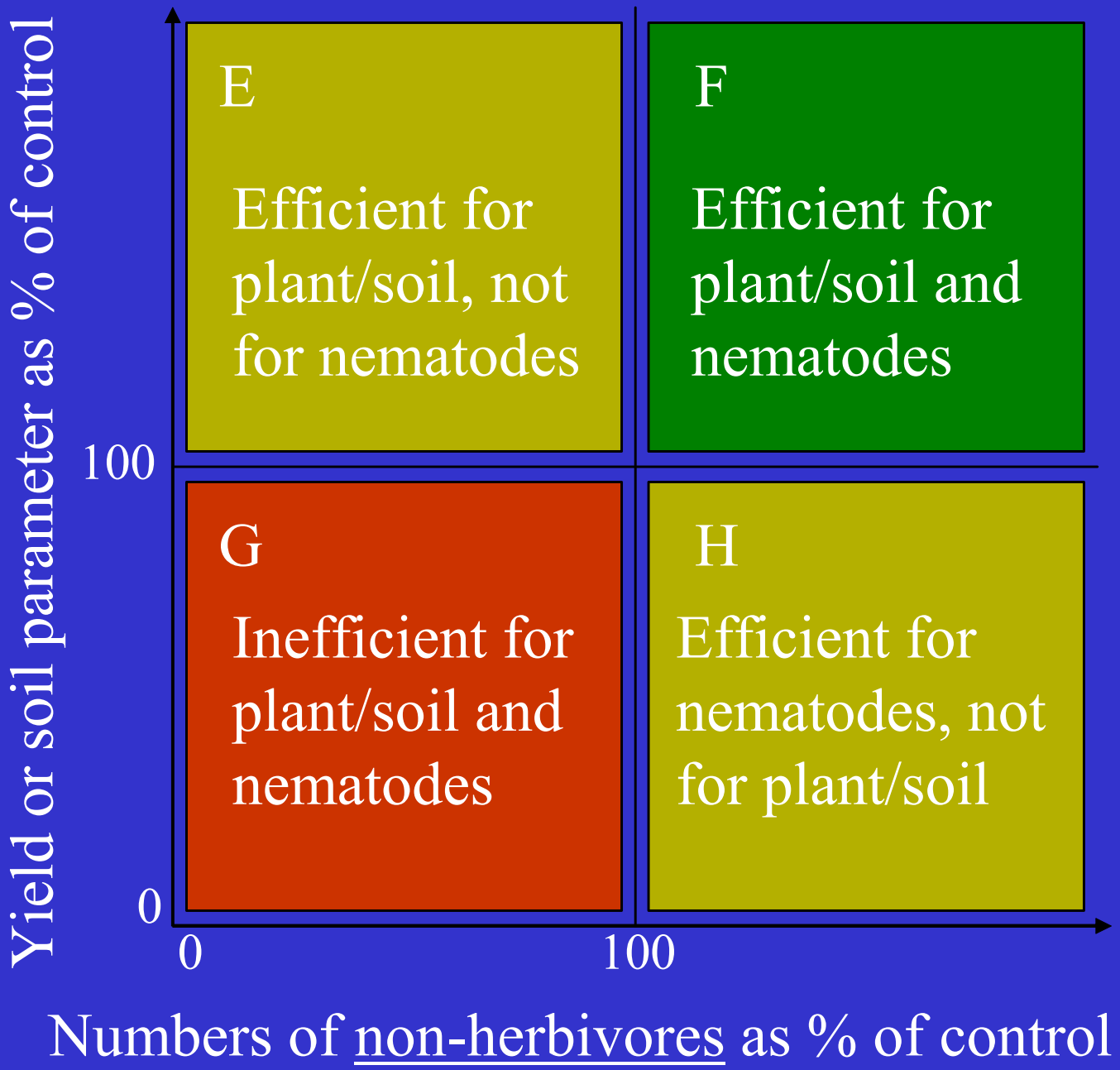
Nematology, 8: 129-137



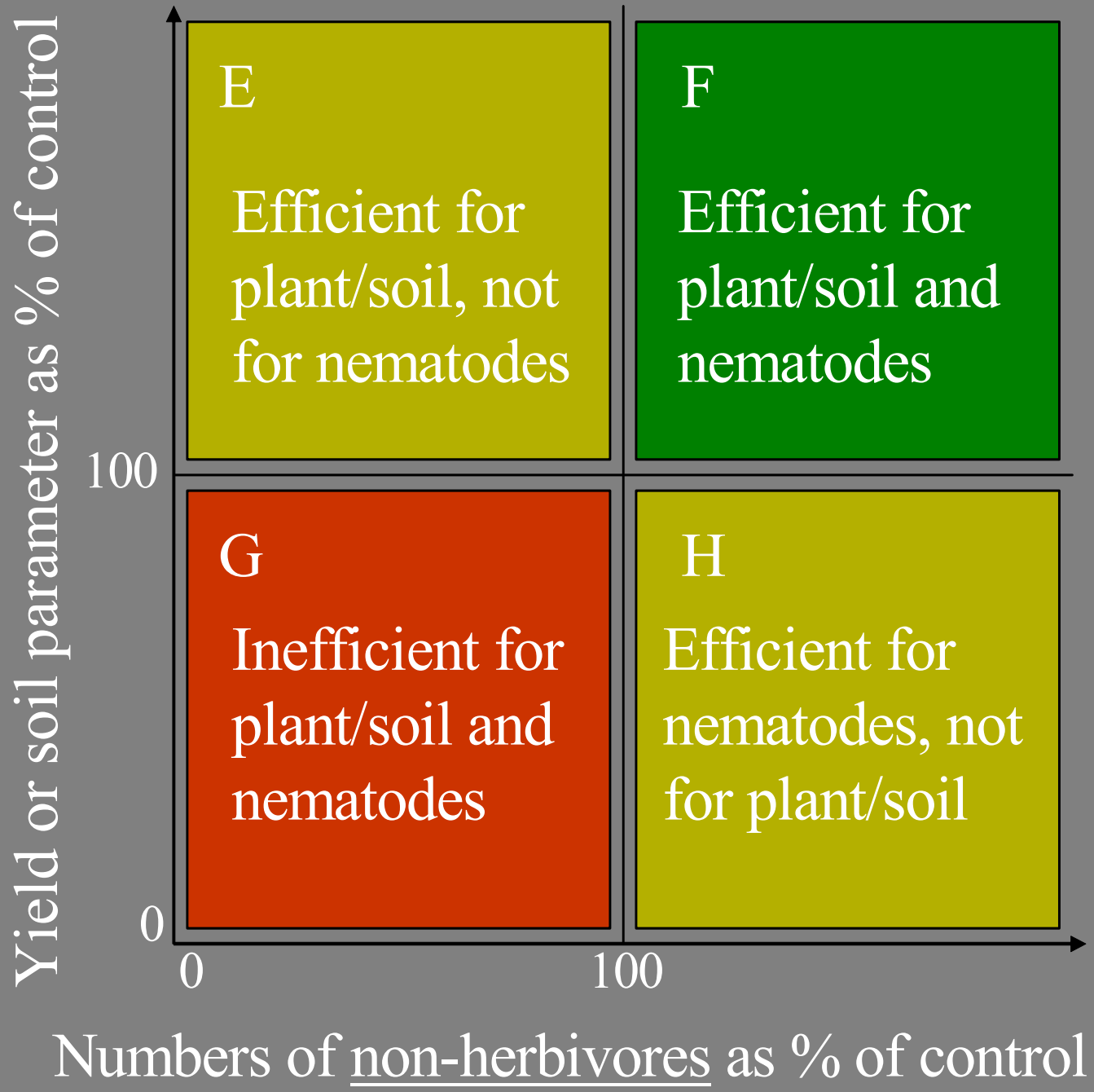
FUE model- Assessing herbivores



Assessing non-herbivores



Multi- and cross-disciplinary applications



Participants:

Agronomists

Breeders

Crop Consultants

Ecologists

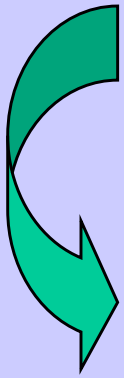
Economists

Environmentalists

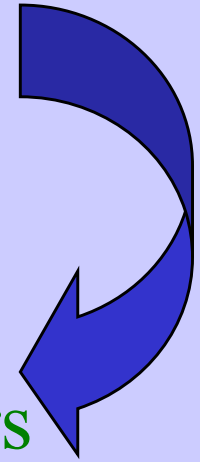
Soil Scientists

Why biological management of soil health?

Agronomic, ecological, economic, pest management & Social



=> Identify soil conditions
=> Change soil conditions
=> Multi-dimensional integration



Integrated Soil Biological Adjustment Barometers (ISBAB)?

ACKNOWLEDGEMETS

Contributors:

M. Ngouajio and S. Kravchenko

Funding:

Celery Research Inc., Michigan Potato Industry Commission, Michigan Department of Agriculture, Michigan Agricultural Experiment Station, Dean, College of Agriculture and Natural Resources, Dean, International Studies and Programs

Techinical assistance:

T. Kerchkof, C. Cuevas, and J. Getchel