

Compatibility of Entomopathogenic Nematodes and Predatory Mites to Control the Western Flower Thrips, *Frankliniella occidentalis*

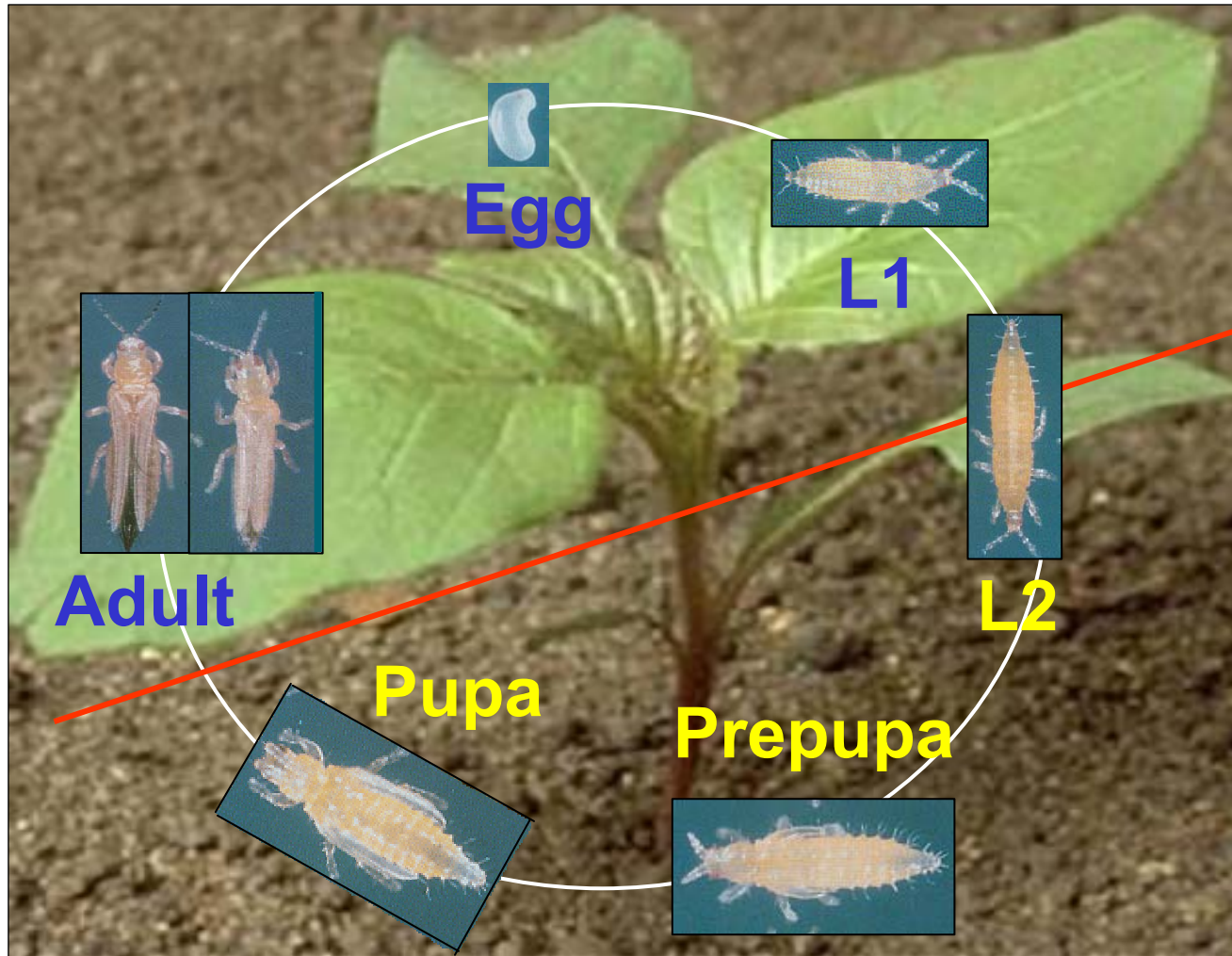


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Western Flower Thrips (WFT)



Western Flower Thrips (WFT): Damage



- Damage high value crops through direct feeding and oviposition
- Vectoring plant viruses, e.g., TSWV

➔ WFT is probably the number one pest for plant production in greenhouses

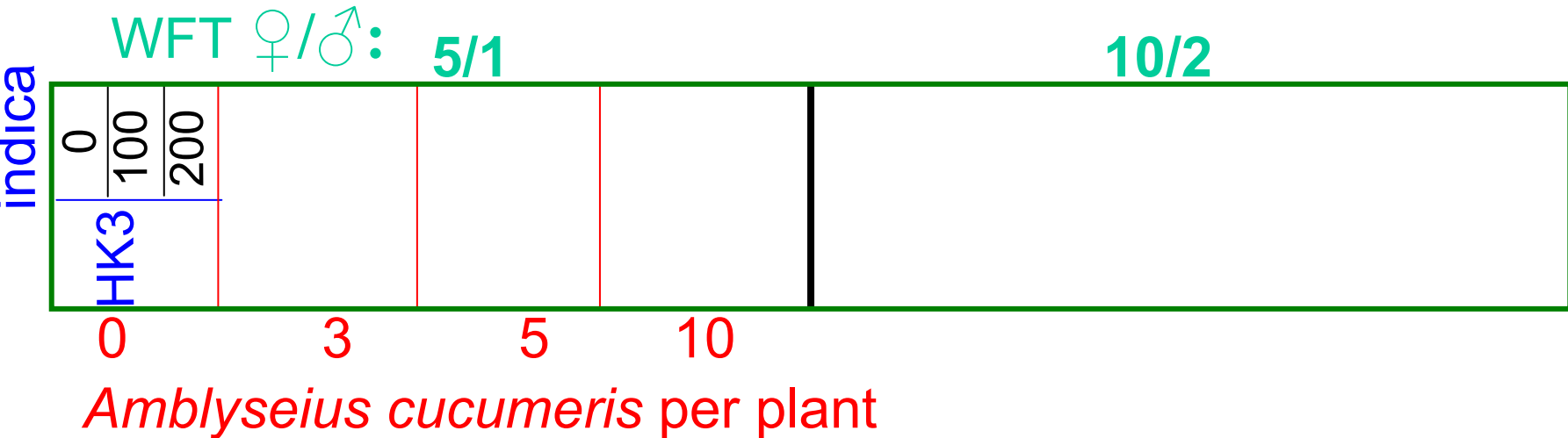
Objectives of the study

- The soil-dwelling developmental stages of WFT are susceptible to EPNs but high concentrations of the nematodes are required to achieve acceptable control levels
- Thus, in the present investigations, single and combined effects of EPNs and AC are studied in climate-controlled growth chamber and in greenhouse
 - ❖ plant-soil conditions = *Phaseolus vulgaris* grown on peat-rich substrate (Fruhstorfer Erde)

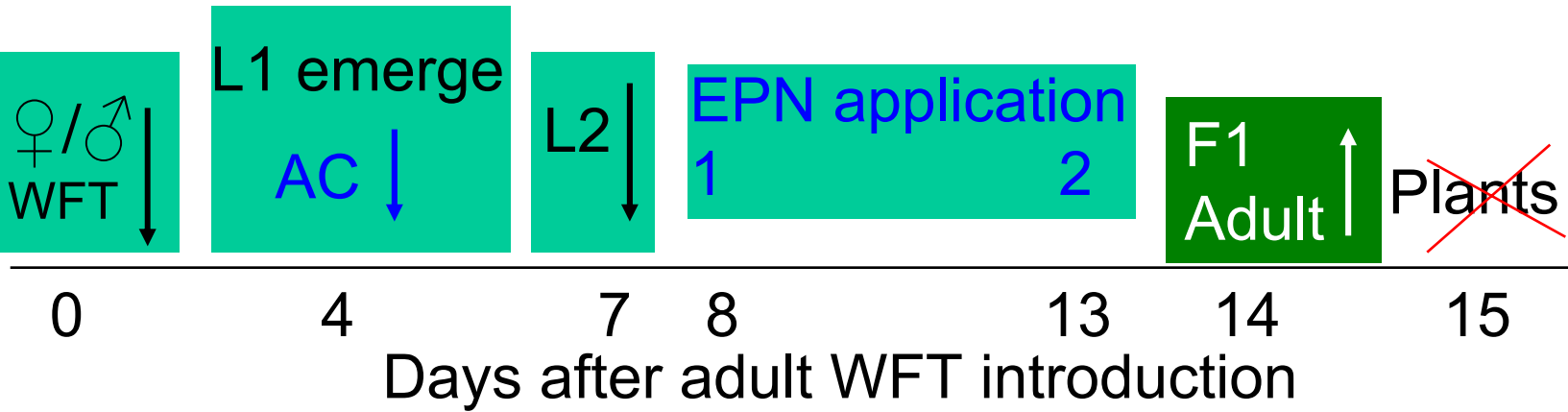
Climate-controlled growth chamber

Treatments

- Factor 1: Initial WFT density (**Adult0**) (♀/♂ per plant)
- Factor 2: *A. cucumeris* (**AC**) density per plant
- Factor 3: **EPN** species (*H. bacteriophora* HK3, *H. indica*)
- Factor 4: EPN concentration (**Conc**) (IJs cm⁻²; repeated twice)
- Replications: 5
- Design: split-split-plot



Experimental set-up



A. WFT population on the plant

Immature stages on the plant

No F2 larvae on the plant. Thus, no significant effects of EPN at any concentration:

concentration: $df = 2, 37$; $F = 1.24$; $P = 0.2939$



A. WFT population on the plant

Numbers of **adult** WFT per plant

Effect	df	<i>F</i>	<i>P</i>
Adult0	1, 4.94	9.61	0.0272
AC	3, 124	7.47	0.0001
Conc	2, 123	3.68	0.0279
Adult0*Conc	2, 123	3.08	0.0496
All others			> 0.05



A. WFT population on the plant

Numbers of **adult** WFT per plant

IJs cm ⁻²	Initial WFT density (♀:♂)	
	5:1	10:2
0	12.2 ± 2.52 a	18.2 ± 2.50 a
100	12.5 ± 2.51 a	13.0 ± 2.50 b
200	10.2 ± 2.50 a	12.9 ± 2.50 b

Means **within a column** followed by the different letters differ significantly



B. Effects of AC on WFT pupation behaviour

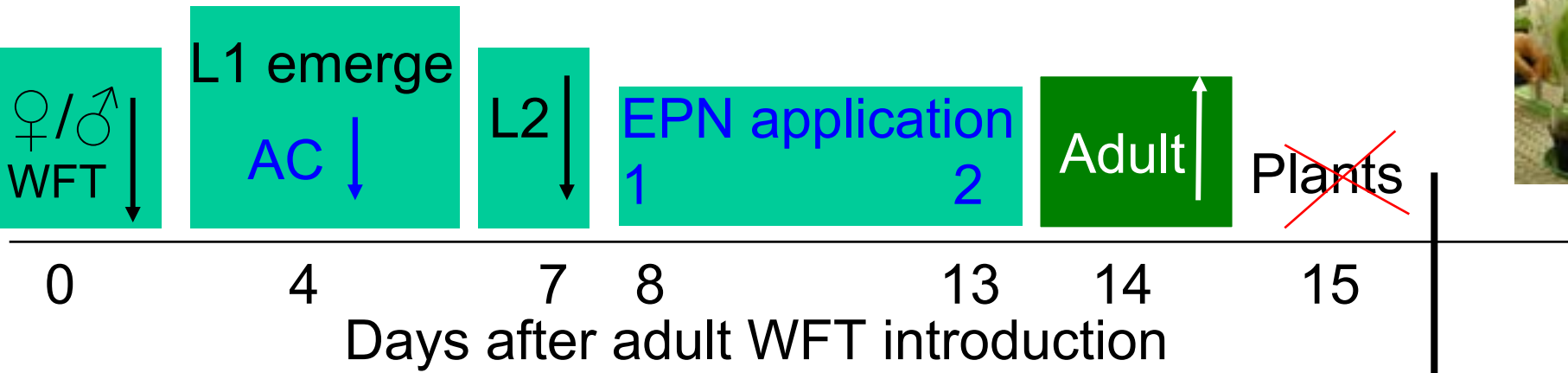
1. AC present - fewer L2 pupate on the plant

In the no nematode treatments:

Pupation on the plant (%)

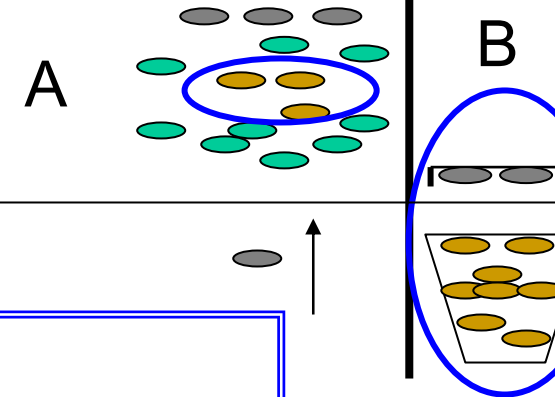


B. Effects of AC on WFT pupation behaviour



Days after adult WFT introduction

WFT: $\frac{\text{On the plant}}{\text{In the pot}}$



$$\text{Pupation on the plant (\%)} = \frac{A}{A + B} * 100$$

B. Effects of AC on WFT pupation behaviour

Pupation on the plant (%):

Effect	df	<i>F</i>	<i>P</i>
AC density	3, 46	5.8	0.0018
WFT density	1, 46	0.30	0.5858
AC*WFT	3, 46	0.69	0.6077



B. Effects of AC on WFT pupation behaviour

Pupation on the plant (%):

AC densities	Pupation on the plant (% \pm SE)
0	25.5 \pm 3.45 a
3	14.1 \pm 4.68 b
5	10.8 \pm 3.39 b
10	14.4 \pm 4.56 b

Means followed by different letters differ significantly



B. Effects of AC on WFT pupation behaviour

2. Does AC or density of WFT force early pupation?

In the no EPN treatments,
proportion (%) of adult WFT in the last 4 days

$$\frac{\text{\# of adult in the last 4 days}}{\text{Total \# of adults in the pot}} * 100$$



Effect	df	<i>F</i>	<i>P</i>
AC density	3, 46	1.22	0.3133
WFT density	1, 46	0.93	0.3407

23.4 ± 2.7 % the adults emerged in the last 4 days

C. Efficacy of *Amblyseius cucumeris* and/or EPNs

Data on the numbers of emerged adult WFT were used

In the no natural enemy control :

5:1 → 37.8 ± 9.7 ,

10:2 → 67.0 ± 12.8 adult WFT emerged

WFT in Control >* in AC and/or EPN treatments



C. Efficacy of *Amblyseius cucumeris* and/or EPNs

Using numbers of emerged adult WFT, **corrected mortality**

Source	df	<i>F</i>	<i>P</i>
Adult0	1	1.65	0.2019
AC	3	15.07	< 0.0001
EPN	1	1.18	0.2796
Conc	2	82.68	< 0.0001
Adult0*Conc	2	2.36	0.0994
AC*Conc	6	4.96	0.0002
All others			> 0.05
Error	101	-	-



C. Efficacy of *Amblyseius cucumeris* and/or EPNs

WFT mortality (%) by single or combined applications of EPNs and AC



		Numbers of <i>Amblyseius cucumeris</i> per plant			
EPN	IJs cm ⁻²	C*	3	5	10
C*	0	-	15.5 d	24.6 d	47.1 c
Hb	100	55.8 bc	47.2 c	62.3 bc	68.0 ab
	200	64.6 bc	60.2 bc	68.2 ab	82.9 a
Hi	100	60.1 bc	67.9 bc	57.4 bc	73.2 ab
	200	64.7 bc	64.1 abc	67.9 ab	83.1 a

*C = Control (no EPNs and/or no mites); Hb = *H. bacteriophora*; Hi = *H. indica*; means **within any cell** followed by different letters differ significantly

Greenhouse experiment

Growth conditions



Parameters	Growth chamber		Greenhouse (Mar-Sep)	
	Day	Night	Day	Night
Temp (°C)	23.9 a B	23.9 a A	29.2 a A	19.3 b B
RH (%)	67.7 a A	68.7 a A	38.0 b B	63.9 a A
VPD (kPa)	0.55 a B	0.53 a A	1.56 a A	0.49 b A

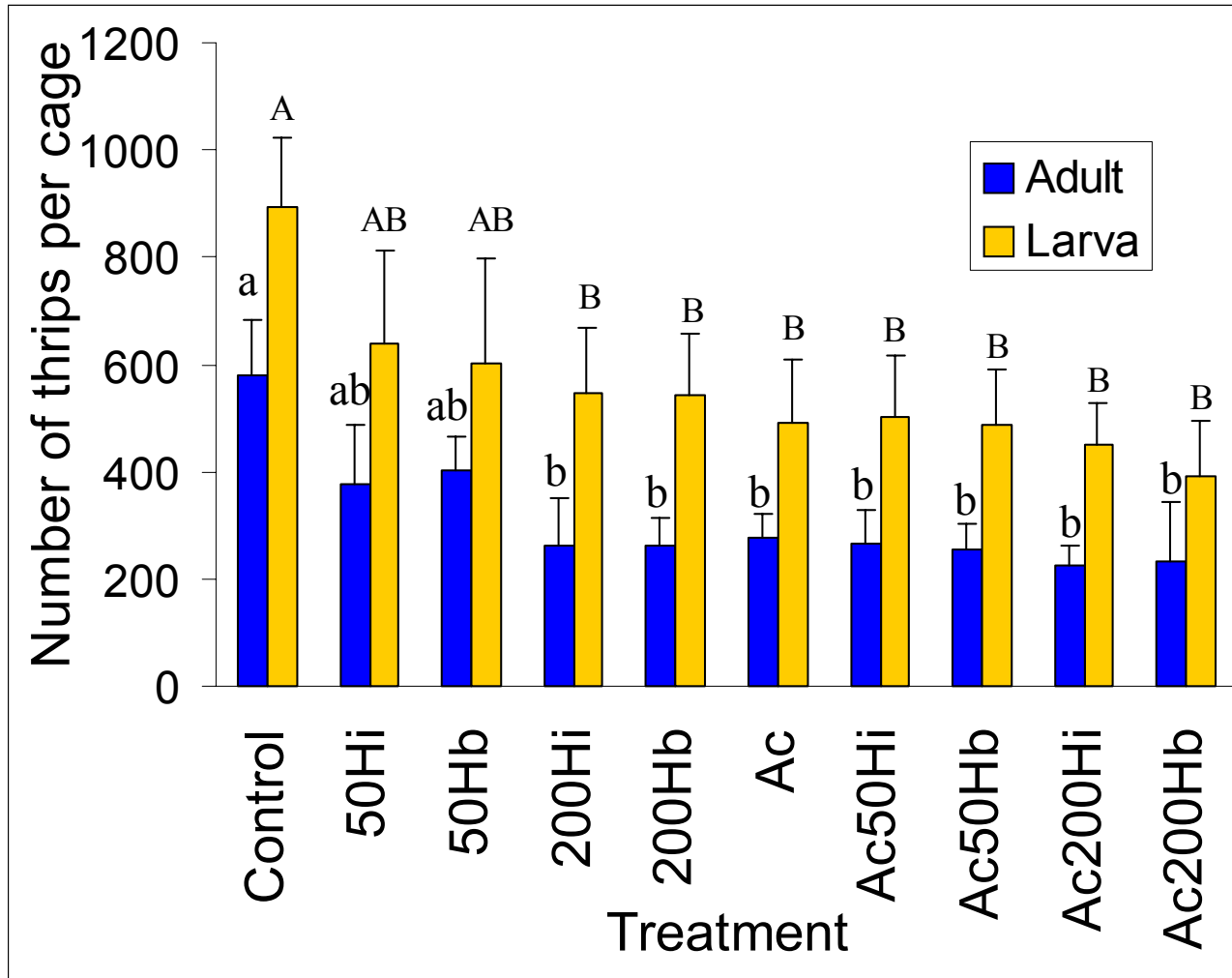
Means in a row for a given experimental place (lower case) and a given time (upper case) followed by different letters differ significantly

Treatments



- 15:3 WFT (♀:♂) per cage
- 0 or 9 **AC** per cage **weekly**,
- *H. indica* or *H. bacteriophora* at **0, 50, or 200 IJs cm⁻² weekly**
 - ➔ single or combined applications of AC and EPNs

Numbers of WFT (+ SE) in different treatments



Means of a given developmental stages of WFT followed by different letters differ significantly

Summary and conclusions

- EPN significantly reduced the numbers of F1 adult WFT which are from early pupation, **but only at a higher initial thrips density**
- Proportion of thrips pupated on the plant in no AC > AC treatment
 - Thus, with presence of AC on the plant more numbers thrips can be available for EPN in the ground
 - However, there is no forced early pupation of WFT by the presence of AC or higher thrips density on the plant
- Under controlled growth conditions, combined applications of EPNs and AC caused **greater thrips control than individual applications** of the two biocontrol agents. However, this effect was not achieved under variable growth conditions.



*Thank you very much
for your attention!*