

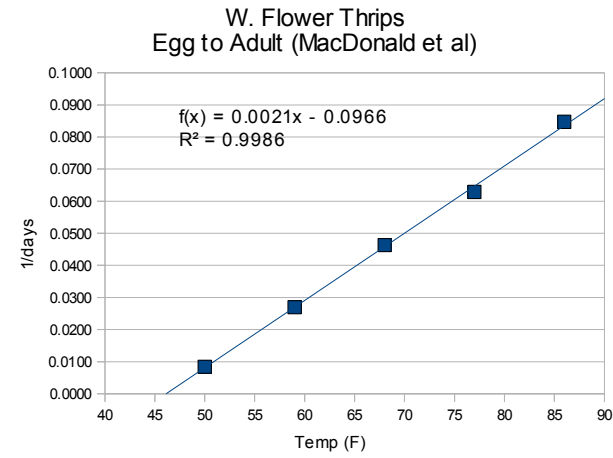
IPPC Synthesis Analysis – July 19, 2011 1st draft/preliminary analysis – Len Coop

Western Flower Thrips degree-day model *Frankliniella occidentalis* (Thysanoptera: Thripidae)

Goal: combine available studies with emphasis on higher quality food hosts (thus faster devel. Rates)
 assuming spinach is a higher quality food host more similar to green bean pods and peanut lease than for Chrysanthemum and cucumber leaves
 thus emphasize works by Stacey et al. 2002, Lowry et al. 1992, Lublinkhof and Foster 1977, and EPPO Data Sheet
 moreso than McDonald et al. 1998, Robb & Parrella, 1991, Gaum et al. 1994, and Wang and Shipp 2001

Model Summary:

Lower Threshold: 45 F; Begin Jan. 1	
OW Gen adults present	20
Gen 1, peak Egg Hatch	338
Gen 1, peak adults	675
Gen 2, peak Egg Hatch	1013
Gen 2, peak adults	1350
Gen 3, peak Egg Hatch	1688
Gen 3, peak adults	2025
Gen 4, peak Egg Hatch	2363
Gen 4, peak adults	2700
Gen 5, peak Egg Hatch	3038
Gen 5, peak adults	3375
Gen 6, peak Egg Hatch	3713
Gen 6, peak adults	4050
Gen 7, peak Egg Hatch	4388
Gen 7, peak adults	4725
Gen 8, peak Egg Hatch	5063
Gen 8, peak adults	5400
Gen 9, peak Egg Hatch	5738
Gen 9, peak adults	6075



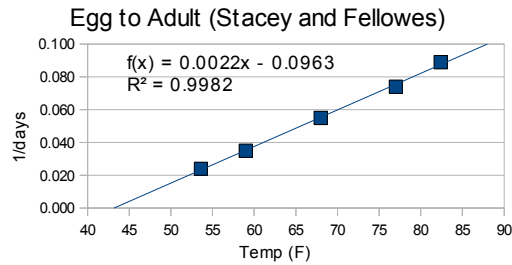
1. McDonald, Bale and Walters 1998. Effect of temperature on development of the western flower thrips, F. o. Eur. J. Entomol. 95:301-306

-studied in York, UK
 -lab development 6 temperatures on chrysanthemum

Temp C	Days Devel						Devel. Rate 1/days					
	Egg	Larvae	Propupa	Pupa	Total	Total Larvt/Temp F	Egg	LarvtoAdul	Temp F	EgctoAdult		
10	31.3	59	9.4	22.1	118.6	87.3	50.00	0.0319	0.0115	50	0.0084	
15	9.2	17	3.9	7.8	37.1	27.9	59.00	0.1087	0.0358	59	0.0270	
20	6.7	9.4	1.6	3.8	21.6	14.9	68.00	0.1493	0.0671	68	0.0463	
25	4.1	7.8	1.3	2.8	15.9	11.8	77.00	0.2439	0.0847	77	0.0629	
30	3.1	6.3	1.1	1.9	11.8	8.7	86.00	0.3226	0.1149	86	0.0847	
								0.00796	slope		0.00210	
								-0.37006	intercept		-0.09661	
								0.98753	R-sq		0.99860	
								46.5 Tlow =	-a/b	46.1	7.84	
								351.67	125.6 Dds devel	1/slope	477.3	265.16
notes: no diapause; overwinter in active state								Propor.	0.74		F	C

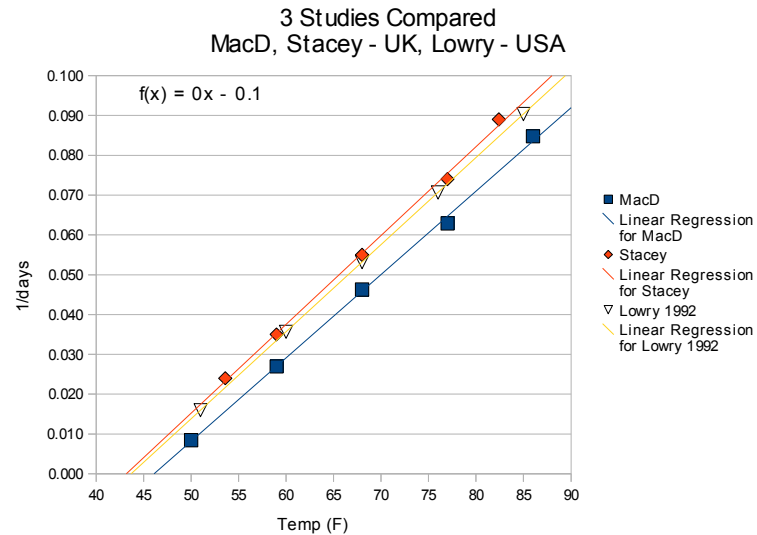
2. Stacey and Fellowes. 2002. Temperature and the development rates of thrips: Evidence for a constraint on local adaptation? Eur. J. Entomol. 99:399-404
 -pops from two locations in England (Yorkshire and Berkshire, 51-53 degrees latitude)

- review 9 other studies for F. occ.
- found that location/host did not influence devel. rate
- thrips reared at warmer temps were generally smaller
- reared on green bean pods



Temp C	Temp F	Temp F	EggtAdult
12		53.6	0.024
15		59	0.035
20		68	0.055
25		77	0.074
28		82.4	0.089
		slope	0.00223
		intercept	-0.09635
		R-sq	0.99821
Tlow = -a/b		43.2	6.21
Dds devel 1/slope		448.1	248.95

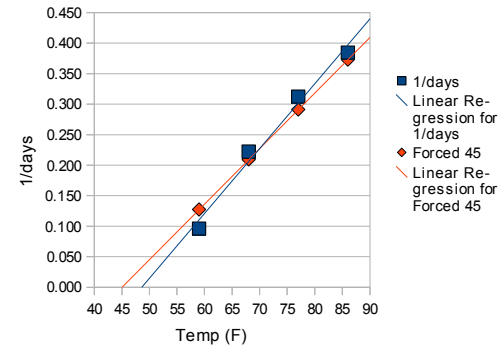
	F	1/days	days	Temp F	UK MacD	UK Stacey	estim from USA Lowry 1992
MacD:	50	0.008	118.6	50	0.008		
	59	0.027	37.1	59	0.027		
	68	0.046	21.6	68	0.046		
	77	0.063	15.9	77	0.063		
	86	0.085	11.8	86	0.085		
Stacey:	53.6	0.024	41.67	53.6		0.024	
	59	0.035	28.57	59		0.035	
	68	0.055	18.18	68		0.055	
	77	0.074	13.51	77		0.074	
	82.4	0.089	11.24	82.4		0.089	
Lowry:				51			0.016
				60			0.036
				68			0.053
				76			0.071
				85			0.090
		slope	0.00215		0.0022	0.0039	
		intercept	-0.09570		-0.0956		
		R-sq	0.96343				
Tlow = -a/b		44.5	6.93		43.7	6.5	
Dds devel 1/slope		464.7	258.17		457.02	253.9	
	F	C		F	C		



4. EPPO Data Sheets on Quarantine Pests, http://www.eppo.org/QUARANTINE/insects/Frankliniella_occidentalis/Franoc_ds.pdf
 Based on: Bryan, D.E.; Smith, R.F. 1956. The Frankliniella occidentalis complex in California. University of California, Publications in Entomology 10, 359-410.
 also based on: Lublinkhof, J. and D. E. Foster. 1977. Development and reproductive capacity of Frankliniella occidentalis reared at three temperatures. Journal of the Kansas Entomological Society 50, 313-316.
- pre-ov 10.4 days at 15C and 2-4 days at both 20 and 30C
 - egg dev. 4 days at 27C and 13 days at 15C
 - data suggest mating/pre-OV threshold at ca. 18C; force to DD standard (45F Tlow)

Temp C	Egg to Egg Development time				Pre-OV Dev. Only			Forced 45		Days 1/days		Estimated Est. Egg to Ad. Egg to Adult	
	F	1/days	Forced 45days	Devel F	1/days	Forced 45	days	PreO'days	Days	1/days	Estimated Est.	Egg to Ad.	Egg to Adult
15	59	0.023	0.024	44.1	59	0.096	0.127	10.4	7.85	36.25	0.0276		
20	68	0.045	0.040	22.4	68	0.222	0.209	4.5	4.78	17.62	0.0567		
25	77	0.055	0.055	18.2	77	0.313	0.291	3.2	3.43	14.77	0.0677		
30	86	0.067	0.071	15	86	0.385	0.373	2.6	2.68	12.32	0.0812		
		slope	0.00158	0.00172		slope	0.01062	0.00910					
		intercept	-0.06738	-0.07740		intercept	-0.51597	-0.40950					
		R-sq	0.96676			R-sq	0.98398						
Tlow =	-a/b	42.6	45	Tlow =	-a/b	48.6	45						
Dds devel 1/slope	F	632.6	581.4	Dds devel =1/slope	F	94.2	109.89						

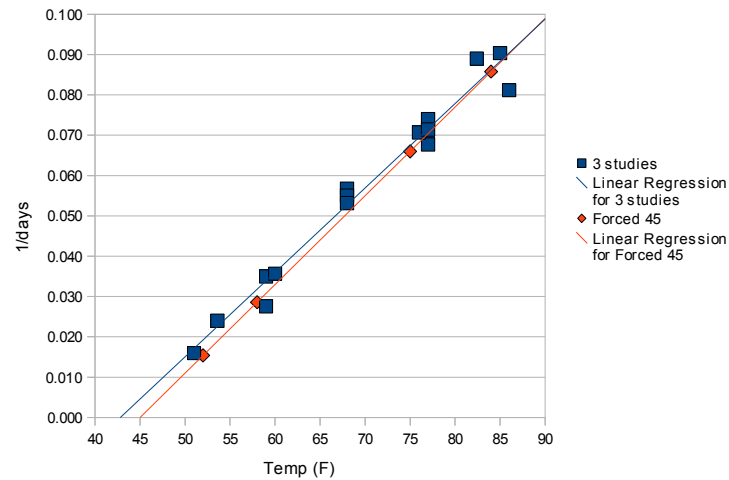
Pre-OV Development w/45 forcing



5. Use common threshold of 45 F and Lowry 1992 + Stacey 2002 + Lublinkhof and Foster 1977 to detn. DD reqs. Egg to Adult

	Temp F	3 studies	Forced 45	Days	Dds	Avg Dds
Lublinkhof:	59	0.028		36.25	507.51	
	68	0.057		17.62	405.31	
	77	0.068		14.77	472.51	
	86	0.081		12.32	505.11	
Lowry:	53.6	0.024		41.67	358.33	
	59	0.035		28.57	400	
	68	0.055		18.18	418.18	
	77	0.074		13.51	432.43	
Stacey:	82.4	0.089		11.24	420.22	
	51	0.016		62.61	375.63	
	60	0.036		28.04	420.57	
	68	0.053		18.81	432.57	
Est w/45 forcing:	76	0.071		14.15	438.63	
	85	0.090		11.07	442.63	430.69
	52		0.015	64.94	454.55	
	58		0.029	34.97	454.55	
Nielsen data->	75		0.066	15.15	454.55	
	84		0.086	11.66	454.55	
	77	0.071		14	448	
		slope	0.00209	0.00220		
	intercept	-0.08969	-0.09900			
	R-sq	0.97267				
Tlow =	-a/b	42.8	45	7.22		
Dds devel 1/slope	F	477.4	454.55	252.53		

Egg to Adult 3 Studies + 45 Tlow Forcing



6. Estimate time to peak oviposition - single Temperature study (Nielsen et al 2010) – Favor multi-temp work by Lublinkhof

M.-C. NIELSEN, D.A.J. TEULON, R. B. CHAPMAN, R. C. BUTLER, G. M. DRAYTON, AND H. PHILIPSE. 2010.

Comparison of Life History Parameters of Two *Frankliniella occidentalis* (Thysanoptera: Thripidae) Strains in New Zealand

Environ. Entomol. 39(2): 303-311

-require water and approp. substrate to oviposit; therefore estimates are liberal (gen time will be longer under field conditions depending on irrigation, rainfall, dew, etc.)

mean egg-to-adult time ca. 14.0 days at 25C =~ no diff. From Stacey or Lowry studies

Oviposition schedule (from Fig. 1):

day	cum egg/feegg/day	
2	4	2
3	5.5	1.5
4	9	3.5
5	15	6
6	20	5
7	23.5	3.5
8	25	1.5

6 ← approx peak egg laying at 25C; select to represent max OV for gen time = 5 days x (77-45=22) = 110 DD

7. Overall DD requirements and basis for model based on 4, 5, 6 above

Tlow = 45 F	
	DD
Egg	118
Larvae-adult	337
Egg to adult	455
PreOV	110
Population factor (use ca. Max. C)	110
Gen Time	675

DD model – assume overwinter as unmated adults; model begins Jan 1

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Gen 1, peak Egg Hatch	338
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