Spatial and Temporal Dynamics of Sweetpotato Weevil Cylas formicarius (Fab) catches in Female Sex Pheromone Traps

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The History

- The sweetpotato weevil, *Cylas formicarius* (Fab) is endemic insect pest worldwide.
- Causes 65-100% yield losses.

Weevil damaged stems

Weevil grubs inside stem

Importance of Spatial Distribution

- Distribution of insect pests in a habitat is a unique characteristic of the species.
- Important structure of the population
- The distribution of natural enemies namely parasitoids and predators is governed by their hosts/preys, intra-interspecific competitions, host-insect-parasitoid/predators.

Dispersion Indices Used

1. Variance Mean Ratio (VMR) (Square of SD)
   - *1 Poisson Distribution/Random*
   - *<1 Regular or Positive Bionomial*
   - *>1 Negative Binomial/Contagious*

2. David & Moore Index (VMR-1)
   - *0 Poisson Distribution*
   - *+ve value Negative Binomial*
   - *-Ve value Positive Binomial*

Dispersion Indices used

3. Exponent of Negative Binomial 'k'
   - 0 Random Distribution
   - >0 Negative Binomial
   - <0 Logarthmic Distributions

4. Taylor's Power law $S^2 = a\mu^b$

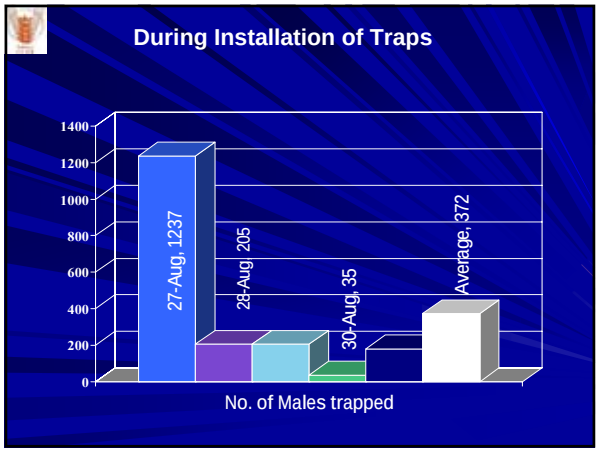
   $\text{Log } S^2 = \text{Log } a + b \text{ Log } \mu$

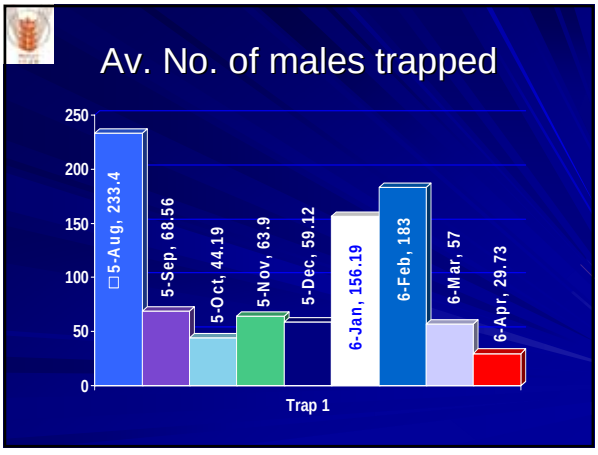
   High values of b>1 = Strong Contagion

   b<1 Poisson

Dispersion Indices Used

- Mean Crowding and Lloyd Index of Patchiness
  - <1 Under Dispersion
  - ≥ Random or Clumped Distribution
- Iwao's Patchiness Regression-Index
  - $\alpha \geq 0$ & $\beta > 1$ Negative Binomial
  - $\alpha = 0$ & $\beta = 1$ Random Distribution (Poisson)
  - $\alpha < 0$ & $\beta < 1$ Regular Binomial





Sept 2005 n=30

	Trap1	Trap 2	Trap 3	Trap 4	Trap 5	Trap 6
Mean	68.56	75.73	63.16	89.96	112.16	88.85
Variance	1432	3240	1887	1855	14466	2941
VMR	20.89	42.78	29.87	20.96	128.97	33.10
k	3.44	1.81	2.18	4.50	0.876	2.767
IDM	19.88	41.78	28.87	19.96	127.97	32.10
Mean crowding	88.44	117.5	92.03	109.9	240.1	120.9
Index of patchiness	1.28	1.55	1.45	1.22	0.87	1.36
Taylor's Power Law (Log Variance on Log Mean) Y= 1.22 + 0.19 X R^2= 0.616				Iwoa's Patchiness Regression α=47.13 β= 0.28 R^2=0.78		

October 2005 n=30

	Trap1	Trap 2	Trap 3	Trap 4	Trap 5	Trap 6
Mean	44.19	56.64	81.87	70.32	97.80	32.80
Variance	617	1458	2042	916	1692	239
VMR	13.97	24.46	24.9	13.03	17.30	7.29
k	3.40	0.39	0.29	0.17	0.16	0.19
IDM	12.97	23.46	23.94	12.03	16.30	6.29
Mean crowding	57.16	83.1	105.8	82.35	114.1	39.09
Index of patchiness	1.29	1.39	1.29	1.17	0.06	1.19
Taylor's Power Law (Log Variance on Log Mean) Y= -0.236 + 1.801 X R^2= 0.835				Iwoa's Patchiness Regression α=5.60 β= 1.158 R^2=0.95		

November, 2005 n=30

	Trap1	Trap 2	Trap 3	Trap 4	Trap 5	Trap 6
Mean	63.96	83.86	55.96	87.56	93.8	28.7
Variance	1394	1591	1555	2545	4612	570
VMR	21.79	18.97	27.79	29.06	49.17	19.87
k	0.32	0.21	4.49	0.32	0.51	0.65
IDM	20.79	17.97	26.79	28.06	48.17	18.87
Mean crowding	84.75	101.83	82.75	115.8	141.97	47.6
Index of patchiness	1.32	1.214	1.478	1.32	0.127	1.656
Taylor's Power Law (Log Variance on Log Mean) Y= -0.236 + 1.801 X R^2= 0.835				Iwoa's Patchiness Regression α=5.60 β= 1.158 R^2=0.95		

December, 2005

	Trap1	Trap 2	Trap 3	Trap 4	Trap 5	Trap 6
Mean	59.12	52.35	37.77	65.83	50.90	17.77
Variance	450	252	90	233	372	50
VMR	7.61	4.8	2.4	3.55	7.3	2.8
k	0.11	0.07	0.037	0.038	0.124	0.103
IDM	6.61	3.81	1.40	2.55	6.3	1.83
Mean crowding	65	56	39	68	57	19
Index of patchiness	1.11	1.072	1.03	1.03	1.124	1.103
Taylor's Power Law (Log Variance on Log Mean) Y= 0.533 + 1.069 X R^2= 0.77				Iwoa's Patchiness Regression α=3.10 β= 1.022 R^2=0.99		

January, 2006

	Trap1	Trap 2	Trap 3	Trap 4	Trap 5	Trap 6
Mean						
Variance						
VMR	117.5	151	167	38	125	37
k	0.74	1.33	1.71	0.45	0.85	1.10
IDM						
Mean crowding	272	262	263	119	269	68
Index of patchiness	1.74	2.33	2.71	1.45	1.85	2.10

Taylor's Power Law
(Log Variance on Log Mean)
Y= -0.004 + 1.988 X R^2= 0. 97

Iwoa's Patchiness Regression
α=4.48 β= 1.933 R^2=0.904

February, 2006

	Trap1	Trap 2	Trap 3	Trap 4	Trap 5	Trap 6
Mean						
Variance						
VMR						
k						
IDM						
Mean crowding						
Index of patchiness	1.67	1.83	1.35	1.18	2.04	1.63

Taylor's Power Law
(Log Variance on Log Mean)
Y= -1.57 + 2.59 X R^2= 0. 92

Iwoa's Patchiness Regression
α= -46.7 β= 1.933 R^2=0.94

March 2006

	Trap1	Trap 2	Trap 3	Trap 4	Trap 5	Trap 6
Mean						
Variance						
VMR						
k						
IDM						
Mean crowding						
Index of patchiness	1.40	1.23	1.40	1.24	2.04	1.60

Taylor's Power Law
(Log Variance on Log Mean)
Y= 0.34 + 1.71 X R^2= 0. 48

Iwoa's Patchiness Regression
α= 59.05 β= 1.103 R^2=0.354

April 2006

	Trap1	Trap 2	Trap 3	Trap 4	Trap 5	Trap 6
Mean						
Variance						
VMR						
k						
IDM						
Mean crowding						
Index of patchiness	1.87	1.11	1.16	1.44	1.27	1.32

Taylor's Power Law
(Log Variance on Log Mean)
Y= -0.41 + 2.0 X R^2= 0. 69

Iwoa's Patchiness Regression
α= -0.56 β= 1.452 R^2=0.354

	Taylor's Power law $S^2 = a\mu^b$			Iwoa's Patchiness Regression $M^* = \alpha \pm \beta\,\mu$		
	a	b	R^2	α	β	R^2
Sept 05	1.22	0.19	0.61	47.13	0.28	0.78
Oct 05	-0.23	1.80	0.83	5.6	1.15	0.96
Nov 05	0.67	9.06	0.81	9.06	1.25	0.92
Dec 05	0.53	1.06	0.77	3.10	1.02	0.99
Jan 06	0.00	1.98	0.97	4.48	1.93	0.90
Feb 06	-1.57	2.59	0.92	-46.73	1.98	0.94
Mar 06	0.34	1.71	0.48	59.05	1.10	0.35
Apr 06	-0.41	2.00	0.69	-0.56	1.45	NA
Overall	0.98	1.56	0.81	43.98	1.91	0.83

Overall Regressions

Taylor's Power Law (Log Variance on Log Mean)	Iwoa's Patchiness Regression
$Y = 0.984 + 1.561\ X$	$\alpha = 43.98$ $\beta = 1.91$
$R^2 = 0.809$	$R^2 = 0.835$
NEGATIVE BINOMIAL DISTRIBUTION	NEGATIVE BINOMIAL DISTRIBUTION