

## **APPENDIX**

ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่

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## Appendix A 1

Summarized data of the number of Chilli thrips in the UV opaque greenhouse

Table shows summarized results of the number of chilli thrips attracted by yellow stick traps on the sixteen square grid

Day	Trap location	Number of Aphids per 16 square grid																Total number of thrips per trap	Total number of thrips per day
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16		
24.3.15 (Day 1)	T1	2							1									3	
	T2																	0	
	T3					1		1		1							1	4	
	T4		1	1														2	
	T5													1				1	10
27.3.15 (Day 2)	T1	3												1				4	
	T2								1						1			2	
	T3	1																1	
	T4					1												1	

	T5		1				1					2		1	1		6	14
31.3.15 (Day 3)	T1			2													2	
	T2											1					1	
	T3		1				1	1									3	
	T4							1				1			1		3	
	T5			1								3					4	13
3.4.15 (Day 4)	T1							1	1	1							3	
	T2							1									1	
	T3				1				2								3	
	T4	1															1	
	T5	1		2	3			1	1		1			1			10	18
7.4.15 (Day 5)	T1			2	8			2	1	4	4	1	1	1			24	
	T2	1		1	1	2				1				1		1	8	
	T3	1	1		3		3		1	7	5	1	6		1		29	
	T4	1	1				1			2	2	2				1	10	
	T5	1			2	2	1			1	1		3	1	1	1	3	88
10.4.15 (Day 6)	T1	2	1							3	1	1	2		1		11	
	T2	3	1	1	1		1	1	2		1			2			13	
	T3		3	2	3			1		2				2			1	14
	T4	2	3	2	1	2	2			4		4	3	1	1		1	26
	T5	3	3	4	2		1		2	4	1	2	3	1		1	1	28
14.4.15 (Day 7)	T1	6	7	5	12	3	5	5	12	4	2	3	5	3	3	4	1	80

	T2	2	1	3	3	2	2	1	4	2	1	1	4	2	1		4	33	
	T3	1	0	2	7	1	1	2	7	8	2	1	1	1	2	1	1	38	
	T4	3	1	4	3	1	2	1	3	2	1	1	2		1	1	2	28	
	T5	1	3	3	1	1		1		1		2	2		1	1	2	19	198
<b>17.4.15 (Day 8)</b>	T1	7	6	5	11	2	5	4	11	4	2	2	6	2	4	3	1	75	
	T2	2	1	2	3	2	1	2	3	2		1	3	1	1		4	28	
	T3	2	1	1	8		1	2	6	8	2	2	1	1	2		2	39	
	T4	4	2	3	4		1	1	4	1		2	2		1	1	2	28	
	T5	1	4	3	1		1		1		1	1	2		1		2	18	188
<b>21.4.15 (Day 9)</b>	T1	2	2	4	1		1	1	2	3	2	3	5	4	6	1	4	41	
	T2	2	1	2	1	3	2	1	5	3	2	5	5	3	2	5	2	44	
	T3	6	6	8	6	4	5	1	7	7	4	6	8	8	4	2	4	86	
	T4	8	1	3	5	10	1	4	4	4	4	2	2	9	1	6	12	76	
	T5	1		1	3	2	1	1	1	2	1	3	1		1		3	21	268
<b>24.4.15 (Day 10)</b>	T1	6	10	13	10	2	4	2	14	6	6	8	11	4	5	8	1	110	
	T2	11	6	1	10	5	4	1	4	7	11	6	4	4		5	11	90	
	T3	6	9	4	6	2	6	4	4	9	5	3	3	5	1	3		70	
	T4	1	5	4	3	1	4	5	3	6			1	1	2	2	3	41	
	T5	3	4	4	5		3	5	5	8	4		3	5	3	1	3	56	367
<b>28.4.15 (Day 11)</b>	T1	24	8	11	14	8	9	4	11	18	3	4	7	9	11	6	15	162	
	T2	43	22	9	14	22	13	5	8	16	5	13	22	17	8	12	20	249	
	T3	27	20	11	20	10	5	1	13	11	3	4	11	13	8	7	12	176	
	T4	32	15	15	44	21	5	7	17	9	9	8	31	23	8	4	21	269	
	T5	23	6	7	12	10	9	3	7	11	5	5	8	6	3	8	11	134	990
<b>1.5.15 (Day 12)</b>	T1	12	4		7	7	3		1	3	3	3	6	7	7	6	17	86	
	T2	8	3	2	2		1	4	1	3	2		3	6	3	2	2	42	

### Analysis of Variance Table for thrips

Source DF SS MS F P

rep 4 1165 291.4 0.39 0.8187

day 11 158671 14424.6 19.09 0.0000

tr 2 9182 4591.2 6.08 0.0029

day\*tr 22 166977 7589.9 10.04 0.0000

Error 140 105783 755.6

Total 179 441779

Grand Mean 40.739 CV 67.47

There is significantly difference among the dates of experiment ( $P < 0.05$ ). The UV intensity also response to number of thrips differently ( $P < 0.05$ ). There is interaction between days of UV exposure ( $P < 0.05$ ).

### Tukey HSD All-Pairwise Comparisons Test of thrips for tr tr Mean Homogeneous Groups

2 50.800 A

1 36.483 B

3 34.933 B

Alpha 0.05 Standard Error for Comparison 5.0186

Critical Q Value 3.314 Critical Value for Comparison 11.761

Error term used: rep\*day\*tr, 140 DF

There are 2 groups (A and B) in which the means

are not significantly different from one another.

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**Tukey HSD All-Pairwise Comparisons Test of thrips for day\*tr day tr Mean Homogeneous Groups**

11 2 198.00 A

12 2 160.40 A

12 1 131.80 AB

11 1 89.40 BC

10 2 73.40 BCD

10 1 54.60 CDE

9 2 53.60 CDE

4 3 52.80 CDE

2 3 52.20 CDE

3 3 50.80 CDE

9 1 45.40 CDE

5 3 43.20 CDE

6 3 42.60 CDE

7 2 39.60 CDE

8 3 39.20 CDE

7 3 38.80 CDE

8 2 37.60 CDE

7 1 28.60 CDE

6 1 28.20 CDE

8 1 27.40 CDE

11 3 23.40 CDE

10 3 21.60 DE

9 3 20.00 DE

1 3 20.00 DE

6 2 18.40 DE

5 2 17.60 DE

12 3 14.60 DE

5 1 10.40 DE

2 1 8.00 DE

3 1 7.00 DE



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1 1 3.60 E

4 2 3.60 E

4 1 3.40 E

2 2 2.80 E

3 2 2.60 E

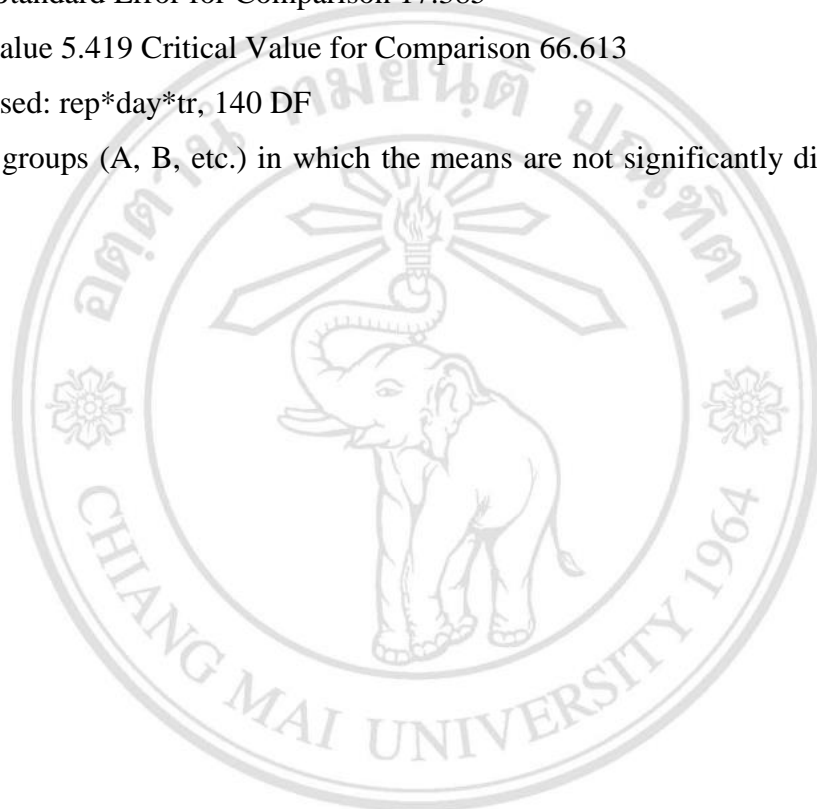
1 2 2.00 E

Alpha 0.05 Standard Error for Comparison 17.385

Critical Q Value 5.419 Critical Value for Comparison 66.613

Error term used: rep\*day\*tr, 140 DF

There are 5 groups (A, B, etc.) in which the means are not significantly different from one another.



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## Appendix B

Summarized data of the number of Chilli thrips in the experiment II

Table shows summarized results of the number of chilli thrips attracted by yellow stick traps on the sixteen square grid in the lab and in the outside

Date	Light	Number of Thrips																Total number of thrips per trap			
Lab																					
15.5.15	UV	15	16	10	29	7	7	12	35	6	6	9	14								166
	Warm	12	13	9	16	6	10	18	5												89
	Yellow	6	2	7	2	4	4	6	3	4	2	4	2	2	3	1	2	2	1		57
16.5.15	UV	1	1	4	3	1	1	3	3	3	3	2	5	6	10						46
	Warm	2	4	4	4	2	3	3	2	1	1	6	1	4	5						42
	Yellow	2	3	1	2	2	3	6	3	2	1	1	1	7							34
17.5.15	UV	3	2	2	1	2	2	4	5	3	2	2									28
	Warm	2	5	3	4	3	1	3	2	5	1	3	1	1							34
	Yellow	2	2	1	1	1	1	4	2	2	1	1	1								19



Outside																				
<b>18.5.15</b>	UV	6	5	1	1	1	1	1	1	1	1	1	1	2						23
	Warm	2	1	3	2	1	3	2												14
	Yellow	1																		1
<b>19.5.15</b>	UV	2	4	5	1	5	2	1	5	1	2	3								31
	Warm	3	2	1	10	5	4	2	4	3	4	4	5	5	6					58
	Yellow	2	1	1	1	2	2	3	2	1	1									16
<b>20.5.15</b>	UV	1	1	1	3	1	1	1	2	4	1	3	3	1	2	1				26
	Warm	2	2	10	4	3	1	3	2	3	1	5	1							37
	Yellow	1	2	1	1															5



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Table describes the total number of thrips in the lab and in the outside

Conditions	Replications	Treatments		
		UV light	Warm White	Yellow Light
Laboratory	R1	166	89	57
	R2	46	42	34
	R3	28	34	19
	Mean	80	55	36.67
	SD	75.02	29.72	19.14
Outside	R1	23	14	1
	R2	31	58	16
	R3	26	16	5
	Mean	26.67	29.33	7.33
	SD	4.04	24.85	7.77

#### Analysis of Variance Table for ThripsT

##### Source DF SS MS F P

rep 2 5 79.906 15.9812 11.49 0.0007

tr 2 24.555 12.2776 8.83 0.0062

Error 10 13.904 1.3904

Total 17 118.365

Grand Mean 5.8101 CV 20.29

#### Tukey's 1 Degree of Freedom Test for Nonadditivity

##### Source DF SS MS F P

Nonadditivity 1 0.1174 0.11735 0.08 0.7882

Remainder 9 13.7866 1.53184

#### LSD All-Pairwise Comparisons Test of ThripsT for condition

##### condition Mean Homogeneous Groups

1 7.1604 A

2 4.4599 B

Alpha 0.05 Standard Error for Comparison 1.0285

Critical T Value 2.228 Critical Value for Comparison 2.2917

Error term used: rep\*condition\*tr, 10 DF

All 2 means are significantly different from one another.

## Appendix C 1

Table: Chiang Mai Monthly Weather Data from Weather Meteorological

Day	Rainfall (mm)			RH (%)			Max Tem (°C)			Min Tem (°C)		
	Marc h	Apri l	Ma y	Marc h	Apri l	Ma y	Marc h	Apri l	Ma y	Marc h	Apri l	Ma y
1		-	-	53	47	53	36.4	-	37.6	17.8	-	24.2
2	-	-	-	54	39	54	36.5	36.5	38.1	19.1	22.7	25.3
3	-	-	-	53	49	52	37	37	38	18.5	22.8	26.1
4	-	-	-	48	50	54	38	38.4	39.5	21	23.2	27.6
5	-	-	-	50	50	60	37	38.5	38	21.5	23.8	26.3
6	-	-	0.7	49	54	62	37.5	38.5	38.3	20.3	24.5	25.7
7	-	2	-	48	49	62	37.5	39.1	38.6	19.8	25.5	24.6
8	-	0.1	-	48	64	56	37.4	36.7	39.5	18.5	25	25.6
9	-	17.4	2.4	51	73	62	37.2	36.5	36.8	19.3	23.3	24.8
10	-	-	-	54	67	63	37.3	36.6	37.6	20.6	22.5	24.5
11	-	-	-	54	57	58	37.1	35.5	38.7	22	24.9	25.6
12	-	0.2	-	54	67	53	36.7	33.5	39.5	22	23.9	26.3
13	-	-	-	46	62	50	37.8	33.6	39.5	21	23.8	25.9
14	-	-	-	44	54	54	37.6	35	39.5	20.5	22.7	27.1
15	-	-	-	51	45	62	35.5	36.3	37.7	19.6	22	26
16	-	-	1.3	54	52	65	36.3	37.5	38.4	20.4	24	26.6
17	-	-	-	57	58	65	37	37.5	36.5	20.4	24.7	26.4
18	-	-	0.5	53	50	68	38.5	38.8	37	20.9	23.2	25.8
19	-	-	-	52	52	65	39.5	38	35.5	21.1	25	26.2
20	-	-	14.9	51	49	74	38.6	39	34.2	20.7	25.4	25.8
21	-	-	14.9	52	46	83	39.3	39.6	33	21	26.3	25.2
22	-	1.8	11.5	55	56	89	37.5	36.5	29.8	23.5	27.8	24.6
23	3.8	29.6	20.3	60	67	87	37.5	35	30.3	24.7	22.3	24.4
24	22.4	-	-	70	74	74	34.4	32.8	35.5	23.2	21.8	23.6
25	0.3	T	-	75	66	64	30	34.2	36	20.8	23.6	25.2
26	1	2.6	-	67	73	64	30.5	30.7	36.7	21.6	23.9	26
27	-	0.1	-	66	69	63	32.3	35.4	36.7	21.7	21.8	25.8
28	-	-	-	64	64	63	34.6	35.1	36.5	20.7	23.3	26.2
29	-	-	-	68	62	64	33.8	36	37.7	21.2	24	25.8
30	-	-	-	65	57	67	35.9	37	37.5	20.8	24.3	26.7
31	-	-	10	51	-	70	37.1	-	35.8	21.6	-	26.3

Department, (<http://www.tmd.go.th/en/>)

## Appendix C2

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10	Day 11	Day 12
<b>UV Open</b>	18	40	35	17	52	141	143	137	227	273	447	659
<b>UV Opaque</b>	10	14	13	18	88	92	198	188	268	367	990	802
<b>Outside</b>	100	261	254	264	216	213	194	196	100	108	117	73
<b>Mean Tem °C</b>	28.15	26.65	28.9	29.9	32.3	29.55	28.85	31.1	32.95	27.3	29.2	30.9
<b>Rainfall YTD (mm)</b>				106.4	108.4	125.9	126.1	126.1	126.1	157.5	160.2	160.2
<b>Wind (km/hr)</b>				18.53	16.68	20.39	18.53	14.83	22.24	18.53	29.65	16.68

Table: The weather data for the duration of the 12 day experiment (mean temperature, rainfall and wind)

### Appendix C3

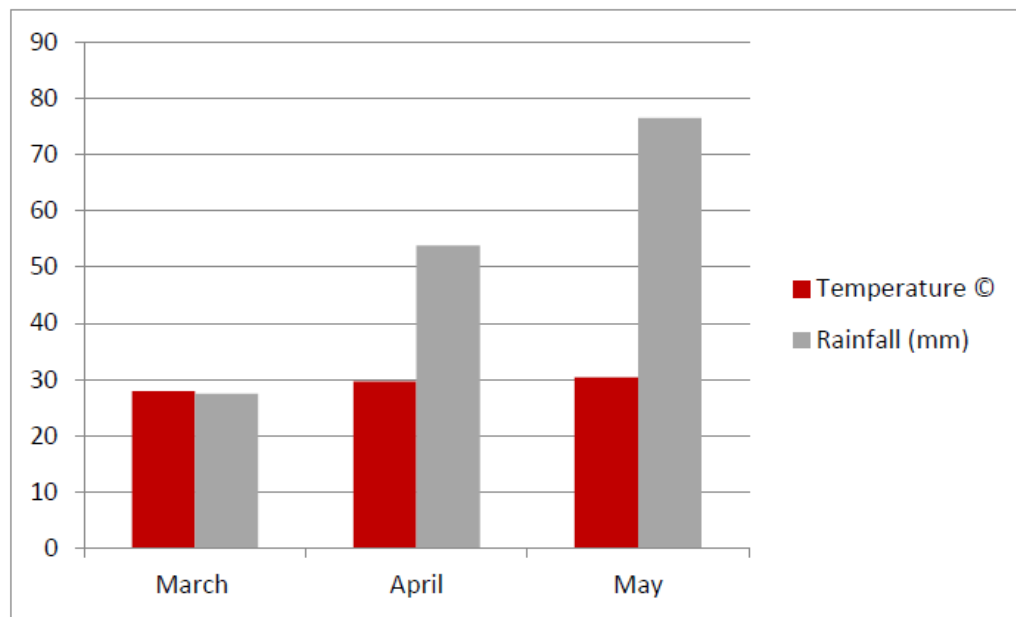


Figure 1: Chiang Mai monthly temperature and rainfall during the experiment

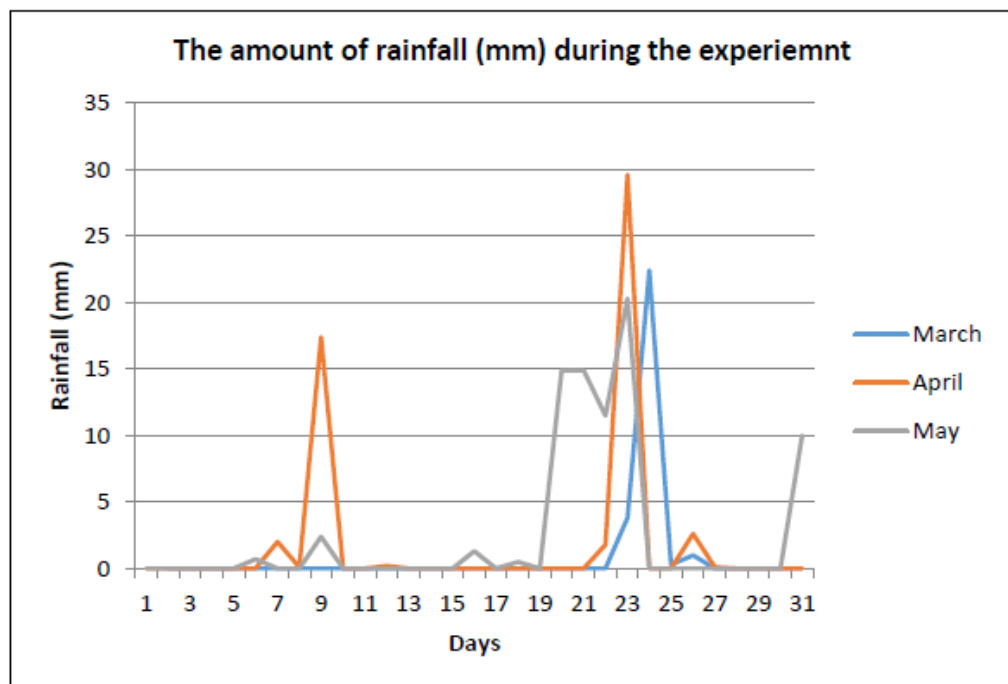
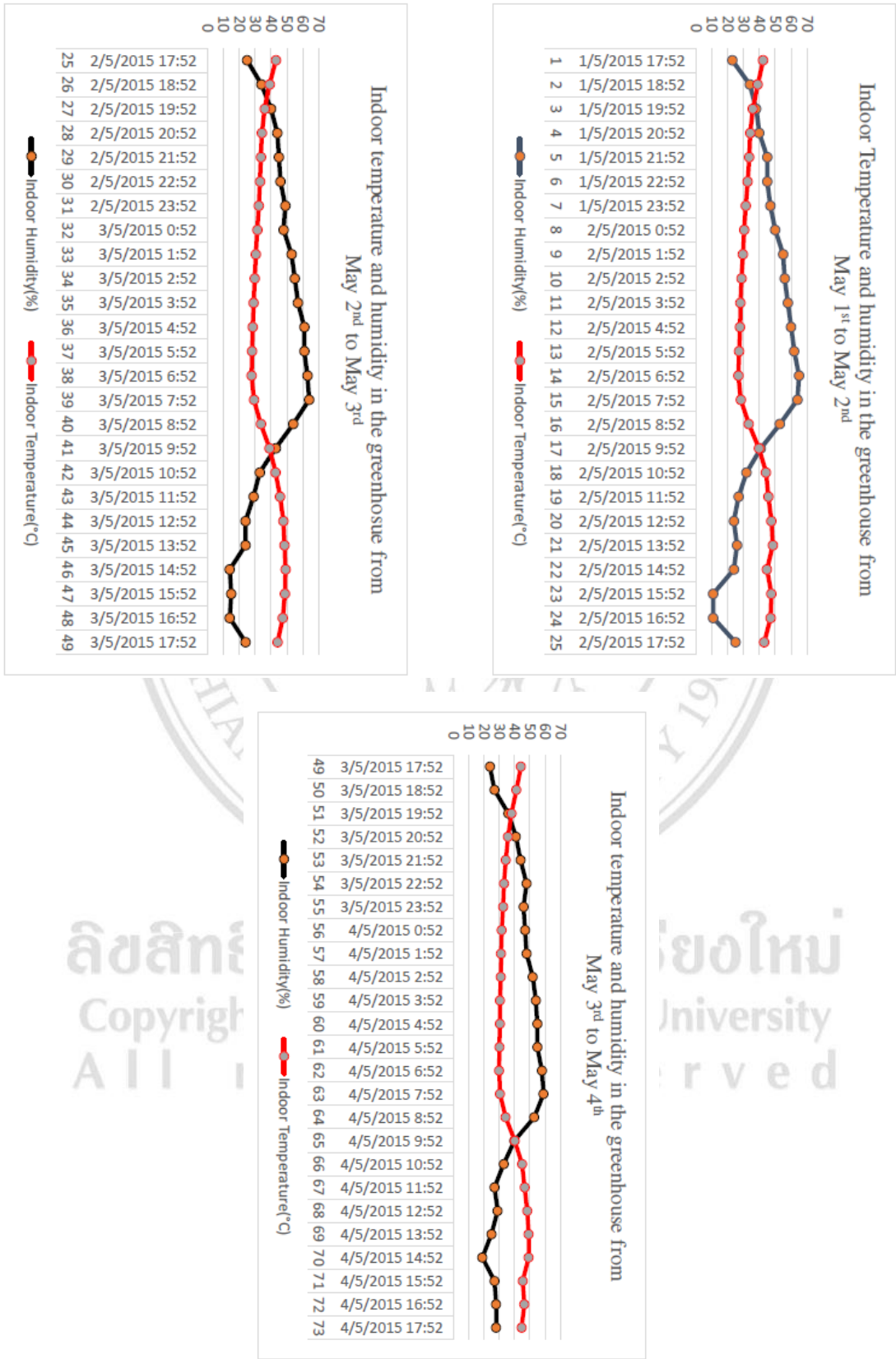


Figure 2: Monthly rainfall during the experiment

Appendix D- Indoor temperature and humidity in the greenhouse





## Appendix E Additional elaborations



**Figure 1, 2: Infested chilli plants were collected at local field around Chiang Mai Municipality**



Figure 3, 4, and 5: Materials used for experiment (3) Red devil variety seed, German potting soil for the seedling (4) and the seedling chilli plants (5)





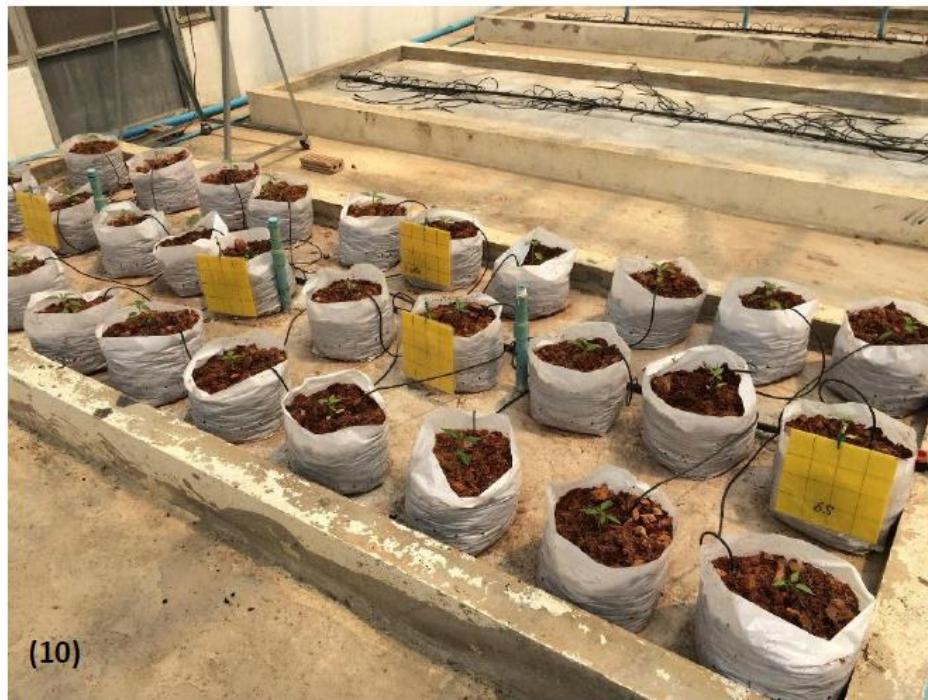
**Figure 6, 7: Greenhouse preparation**

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Figure 8, 9: Experiment preparation of medium using coconut fiber





**Figure 10, 11: Introduction of the yellow sticky traps to attract the chilli thrips in the greenhouse and outside**





(12)

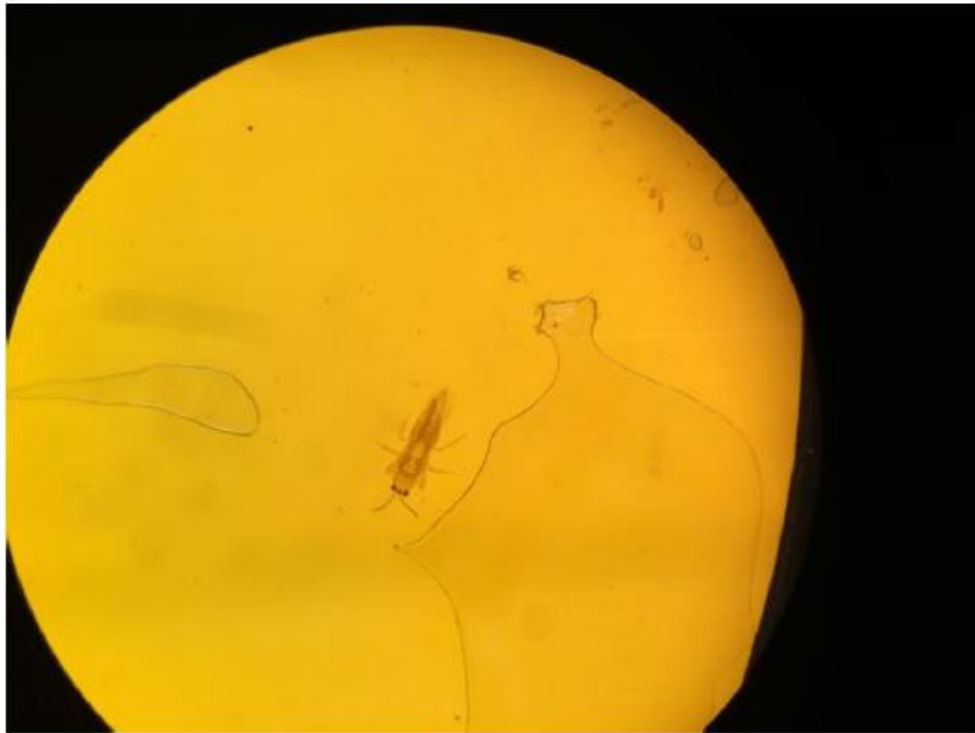


(18)

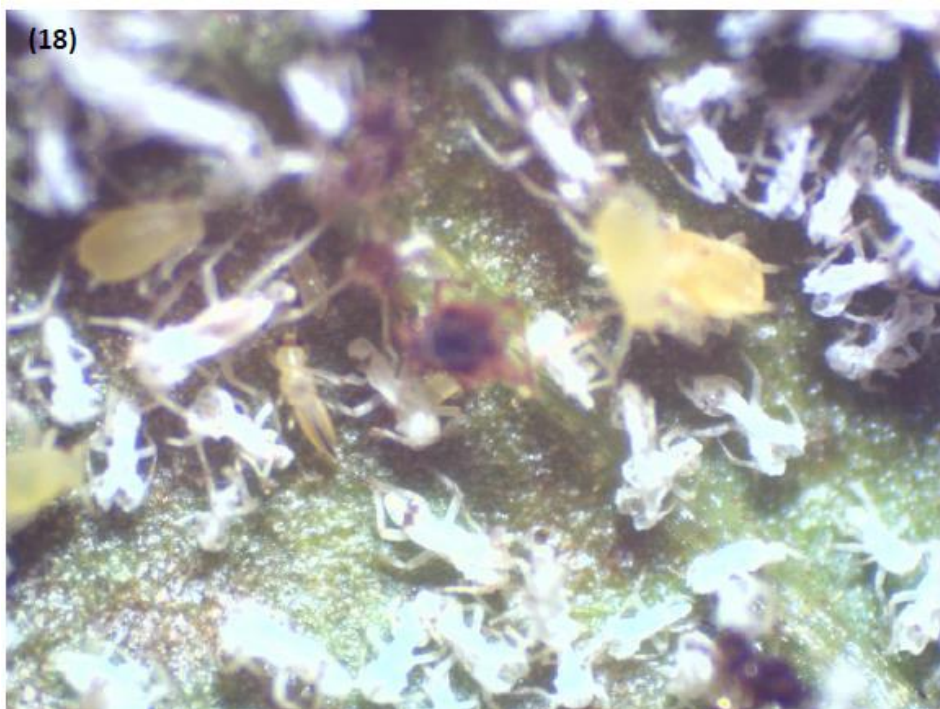




**Figure 12, 13, 14: Comparing the development of the chilli plants under varying conditions (UV opaque greenhouse, UV block and outside)**



**Figure 15, 16: The yellow sticky traps were collected and counted the number of thrips under the microscope from the experiment**



**Figure 17, 18: Chilli thrips and aphids under the microscope**





(19)



(20)

**Figure 19, 20: Three different kind of light bulbs (UV light, warm white and yellow light)**





**Figure 19, 20: Multiple choice experiment with three different lightings at outside**

## CURRICULUM VITAE

**Author's Name** Mr. Min Zaw Oo

**Date of Birth** 25 May 1986

### **Educational Background**

- 2004-2008 Bachelor of Agricultural Science (Plant Pest Protection), Yezin Agricultural University, Yezin, Myanmar
- 2009-2010 Post graduate diploma in agricultural science, Arava International Center for Agricultural Training Center, Israel
- 2013-2015 Master of science academic studies in Sustainable Agriculture and Integrated Watershed Management), Chiang Mai University (Thailand and University of Hohenheim (Germany)



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