## APPENDIX

1. Experiment: Effects of Fe toxicity on Laos rice variety (TDK 1).

4.0

## 1.1. Completely Randomized AOV for Plant Height

	Source	D	F SS	MS	F	Р
	Treat	2	550.042	275.021	7.93	0.0103
	Error	9	312.188	34.688	A	
	Total	11	862.229			
	Grand M	Mea	an 59.792	CV 9.85	~	
2						

Component of variance for between groups 60.0833

Effective cell size

Treat	Mean		
Control	66.000		
Fe1000	63.000		
Fe2000	50.375		

Observations per Mean4Standard Error of a Mean2.9448

Std Error (Diff of 2 Means) 4.1646

## 1.2. LSD All-Pairwise Comparisons Test of Plant Height

Treat Mean Homogeneous Groups ลัยเชียงใหม 66.000 Control 63.000 Fe1000 biang Mai University 50.375 Fe2000 4.1646 Standard Error for Comparison 0.05 Alpha Critical T Value 2.262 Critical Value for Comparison 9.4209 There are 2 groups (A and B) in which the means

are not significantly different from one another.

1.3. Completely Randomized AOV for Leaf Number					
Source DF SS MS F P					
Treat 2 364.292 182.146 5.50 0.0275					
Error 9 298.125 33.125					
Total 11 662.417					
Grand Mean 43.917 CV 13.11					
Component of variance for between groups 37.2552					
Effective cell size 4.0					
Treat Mean					
Control 47.750					
Fe1000 47.875					
Fe2000 36.125					
Observations per Mean 4					
Standard Error of a Mean 2.8777					
Std Error (Diff of 2 Means) 4.0697					
1.4. LSD All-Pairwise Comparisons Test of Leaf Number					

Treat	Mean Homogeneous Group					
	Fe1000	47.875	Α			
	Control	47.750	А			
. 2	Fe2000	36.125	В			

Alpha0.05Standard Error for Comparison 4.0697Critical T Value 2.262Critical Value for Comparison 9.2063There are 2 groups (A and B) in which the means<br/>are not significantly different from one another.

าเชียงใหม่

1.5. Completely Randomized AOV for Root Length

 Source
 DF
 SS
 MS
 F
 P

 Treat
 2
 684.667
 342.333
 13.2
 0.0021

Error 9 233.563 25.951

Total 11 918.229

Grand Mean 30.292 CV 16.82

Component of variance for between groups 79.0955

4.0

Effective cell size

TreatMeanControl36.125Fe100035.125Fe200019.625Observations per Mean4Standard Error of a Mean2.5471

Std Error (Diff of 2 Means) 3.6022

1.6. LSD All-Pairwise Comparisons Test of Root Length

TreatMean Homogeneous GroupsControl36.125AFe100035.125AFe200019.625B

# Fe200019.625BAlpha0.05Standard Error for Comparison 3.6022Critical T Value 2.262Critical Value for Comparison 8.1487There are 2 groups (A and B) in which the means<br/>are not significantly different from one another.

2/07/03/09

## 1.7. Completely Randomized AOV for Tiller number

2/0703/19 Source DF SS MS Ρ 5.01 0.0345 Treat 2 18.2917 9.14583 Error 9 16.4375 1.82639 Total 11 34.7292 Grand Mean 9.4583 CV 14.29 Component of variance for between groups 1.82986 Effective cell size 4.0Treat Mean 10.000 Control Fe1000 10.625 Fe2000 7.750 **Observations per Mean** 4 Standard Error of a Mean 0.6757 Std Error (Diff of 2 Means) 0.9556

## 1.8. LSD All-Pairwise Comparisons Test of Tiller Number

Treat Mean Homogeneous Groups Fe1000 10.625

Fe2000

Control 10.000 A

7.7500

# ชียงใหม 0.05 Standard Error for Comparison 0.9556 Alpha Critical T Value 2.262 Critical Value for Comparison 2.1617 There are 2 groups (A and B) in which the means

B

are not significantly different from one another.

## 1.9. Completely Randomized AOV for Total Dry Weight

2670379 Source DF SS MS P Treat 2 47.5531 23.7765 14.5 0.0015 Error 9 14.7109 1.6345 Total 11 62.2639 Grand Mean 8.4008 CV 15.22 Component of variance for between groups 5.53550 Effective cell size 4.0 Treat Mean Control 10.407 Fe1000 9.107 Fe2000 5.688 Observations per Mean 4 Standard Error of a Mean 0.6392 Std Error (Diff of 2 Means) 0.9040

## 1.10. LSD All-Pairwise Comparisons Test of Total Dry Weight

Treat	Mean He	omogeneous Groups	Т
	Control	10.407	A
	Fe1000	9.1075	A
.2	Fe2000	5.6875	В

Alpha0.05Standard Error for Comparison 0.9040Critical T Value 2.262Critical Value for Comparison 2.0451There are 2 groups (A and B) in which the means<br/>are not significantly different from one another.

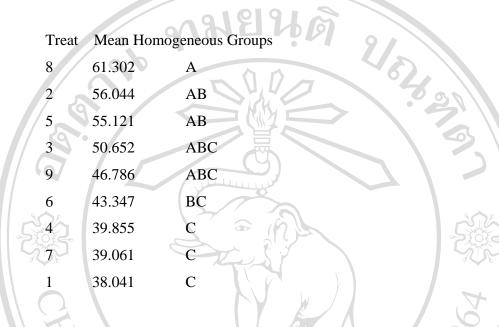
เชียงใหม

## 2. Experiment 2 Screening Fe toxicity tolerance in different rice varieties.

2.1. Randomized Complete Block AOV Table for Total dry weight

Source DF **SS** MS P F Rep 3 158.45 52.817 Treat 2270.31 283.788 2.82 0.0235 8 24 2418.01 100.750 Error Total 35 4846.77 Grand Mean 47.801 CV 21.00 Р Source DF SS MS Nonadditivity 1 211.25 211.253 2.20 0.1514 95.946 Remainder 23 2206.75 Means of DW for Treat Treat Mean 38.041 1 2 56.044 3 50.652 4 39.855 5 55.121 6 43.347 39.061 ายาลัยเชียงใหม่ 61.302 9 46.786 Chiang Mai University Observations per Mean 4 Standard Error of a Mean 5.0187 Std Error (Diff of 2 Means) 7.0975





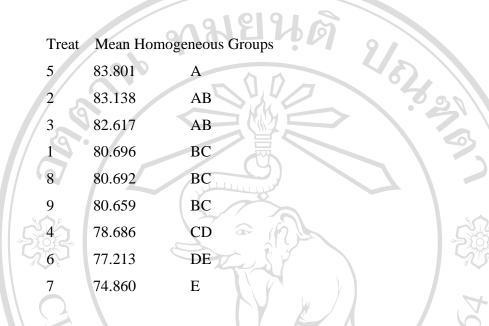
Alpha0.05Standard Error for Comparison 7.0975Critical T Value 2.064Critical Value for Comparison 14.649Error term used: Rep\*Treat, 24 DFThere are 3 groups (A, B, etc.) in which the meansare not significantly different from one another.

ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่ Copyright<sup>©</sup> by Chiang Mai University AII rights reserved

2.3. Randomized Complete Block AOV Table for Plant height

Source DF SS 2/0703/19 MS 3 508.678 169.559 Rep Treat 8 271.317 33.915 11.73 0.0000 Error 24 69.411 2.892 Total 35 849.405 Grand Mean 80.263 CV 2.12 Source DF SS MS Р F 1.0126 1.01260 0.34 0.5652 Nonadditivity 1 23 68.3982 2.97383 Remainder Means of High for Treat Treat Mean 1 80.696 2 83.138 3 82.617 78.686 4 5 83.801 77.213 6 7 74.860 8 80.692 80.659 **เยาลัยเชีย**งใหม**่** 9 Observations per Mean Standard Error of a Mean 0.8503 Std Error (Diff of 2 Means) 1.2025 hiang Mai University erv t s r l g **e** 





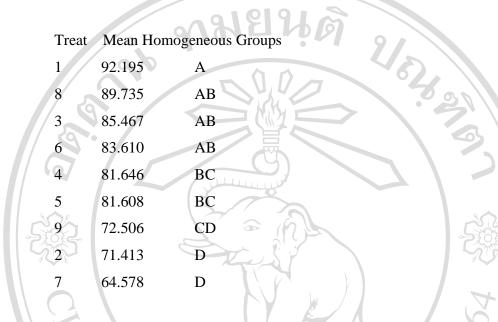
Alpha0.05Standard Error for Comparison 1.2025Critical T Value 2.064Critical Value for Comparison 2.4819Error term used: Rep\*Treat, 24 DFThere are 5 groups (A, B, etc.) in which the meansare not significantly different from one another.

ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่ Copyright<sup>©</sup> by Chiang Mai University AII rights reserved

2.5. Randomized Complete Block AOV Table for Root length

2/07/03/13 Source DF SS MS F 3 197.32 65.772 Rep Treat 8 2634.23 329.278 7.65 0.0000 Error 24 1032.45 43.019 Total 35 3863.99 Grand Mean 80.306 CV 8.17 Source DF SS Ρ MS F 7.70 7.7016 0.17 0.6814 Nonadditivity 1 23 1024.75 44.5543 Remainder Means of L for Treat Treat Mean 92.195 1 2 71.413 3 85.467 81.646 4 5 81.608 6 83.610 7 64.578 89.735 8 72.506 ายาลัยเชียงใหม่ 9 Observations per Mean Standard Error of a Mean 3.2794 Std Error (Diff of 2 Means) 4.6378 Alang Mai University erve t s r **e** l g r

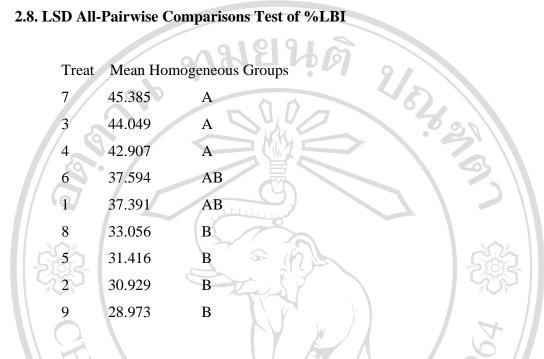
## 2.6. LSD All-Pairwise Comparisons Test of Root length



Alpha0.05Standard Error for Comparison 4.6378Critical T Value 2.064Critical Value for Comparison 9.5720Error term used: Rep\*Treat, 24 DFThere are 4 groups (A, B, etc.) in which the meansare not significantly different from one another.

ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่ Copyright<sup>©</sup> by Chiang Mai University AII rights reserved 2.7. Randomized Complete Block AOV Table for %LBI

Source DF 2/0703 SS MS F 3 497.61 165.870 Rep 8 1212.88 151.610 4.07 0.0035 Treat Error 24 893.43 37.226 Total 35 2603.92 Grand Mean 36.856 CV 16.55 Source DF SS MS Р F 168.868 5.36 0.0299 Nonadditivity 1 168.868 Remainder 23 724.560 31.503 💿 Means of LBI for Treat Treat Mean 37.391 1 30.929 2 3 44.049 42.907 4 5 31.416 37.594 6 7 45.385 8 33.056 28.973 ายาลัยเชียงใหม่ 9 Observations per Mean Standard Error of a Mean \_ 3.0507 Std Error (Diff of 2 Means) 4.3143 hiang Mai University erve t s r **e** g r



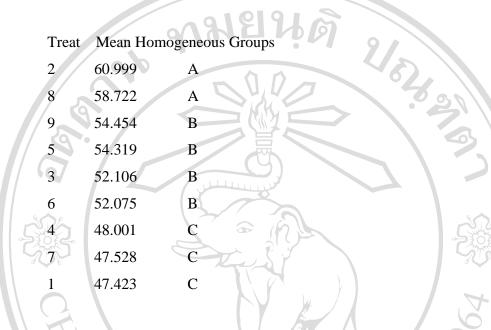
Alpha0.05Standard Error for Comparison 4.3143Critical T Value 2.064Critical Value for Comparison 8.9043Error term used: Rep\*Treat, 24 DFThere are 2 groups (A and B) in which the meansare not significantly different from one another.

ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่ Copyright<sup>©</sup> by Chiang Mai University All rights reserved

2.9. Randomized Complete Block AOV Table for Leaf number

Source DF SS 2/0703/19 MS F 3 9943.3 3314.45 Rep 8 752.2 Treat 94.03 12.48 0.0000 Error 24 180.8 7.53 Total 35 10876.4 Grand Mean 52.847 CV 5.19 Source DF SS Р MS F 9.041 9.04108 1.21 0.2826 Nonadditivity 1 23 171.793 7.46925 Remainder Means of Leaf for Treat Treat Mean 1 47.423 2 60.999 3 52.106 48.001 4 54.319 5 52.075 6 7 47.528 8 58.722 54.454 ายาลัยเชียงใหม่ 9 Observations per Mean Standard Error of a Mean 1.3725 Std Error (Diff of 2 Means) 1.9410 hiang Mai University serve t s ľ g **e** r

### 2.10. LSD All-Pairwise Comparisons Test of Leaf number

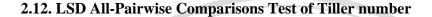


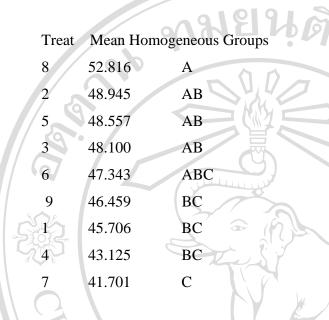
Alpha0.05Standard Error for Comparison 1.9410Critical T Value 2.064Critical Value for Comparison 4.0060Error term used: Rep\*Treat, 24 DFThere are 3 groups (A, B, etc.) in which the meansare not significantly different from one another.

ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่ Copyright<sup>©</sup> by Chiang Mai University AII rights reserved

2.11. Randomized Complete Block AOV Table for Tiller number

Source DF SS MS 2/07/03/19 F 3 13329.2 4443.08 Rep Treat 8 345.7 43.21 0.0483 2.38 Error 24 436.5 18.19 Total 35 14111.4 Grand Mean 46.972 CV 9.08 Source DF SS Р MS F 27.690 27.6898 1.56 0.2245 Nonadditivity 1 23 408.820 17.7748 Remainder Means of Tiller for Treat Treat Mean 1 45.706 2 48.945 3 48.100 43.125 4 5 48.557 47.343 6 7 41.701 8 52.816 46.459 ายาลัยเชียงใหม่ 9 Observations per Mean Standard Error of a Mean 2.1324 Std Error (Diff of 2 Means) 3.0156 hiang Mai University serve t s re g r





Alpha0.05Standard Error for Comparison 3.0156Critical T Value 2.064Critical Value for Comparison 6.2239Error term used: Rep\*Treat, 24 DFThere are 3 groups (A, B, etc.) in which the meansare not significantly different from one another.

## Remark



2/5283753

#### 9 (IR70617-B4-B-19-2-3-1-1)

3. Experiment 3 Growth and yield of rice varieties with different sensitivity to Fe toxicity in the field with Fe toxicity problem in Vientiane, Laos.

- Harvest1
- 3.1. Analysis of Variance Table for %LBI

				25			
Harvest1	`/				20		
.1. Analysis of Variance Table for %LBI							
Source	DF	SS	MS	F	Р		
Rep	3	141.67	47.222	2.12	0.1399		
Treat	1	37.50	37.500	1.69	0.2135		
Var	2	1014.58	507.292	22.83	0.0000		
Treat*Var	2	6.25	3.125	0.14	0.8699		
Total	23	1533.33			5		

Grand Mean 46.667 CV 10.10

3.2. LSD All-Pairwise Comparisons Test of %LBI for treatment

Treat	Mean	Homogeneous Groups
Dipped	47.917	А

Control รียอไหม 45.417 A Standard Error for Comparison 1.9245 Alpha 0.05 Critical Value for Comparison 4.1020 Critical T Value 2.131 Error term used: Rep\*Treat\*Var, 15 DF There are no significant pairwise differences among the means.

## 3.3. LSD All-Pairwise Comparisons Test of LBI for Var

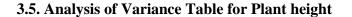
Variety	Mean 8	Homogeneous Groups
TDK7	51.875	A
TDK10	50.625	A
TDK5	37.500	B
Alpha 0.05	Standard Erro	r for Comparison 2.3570

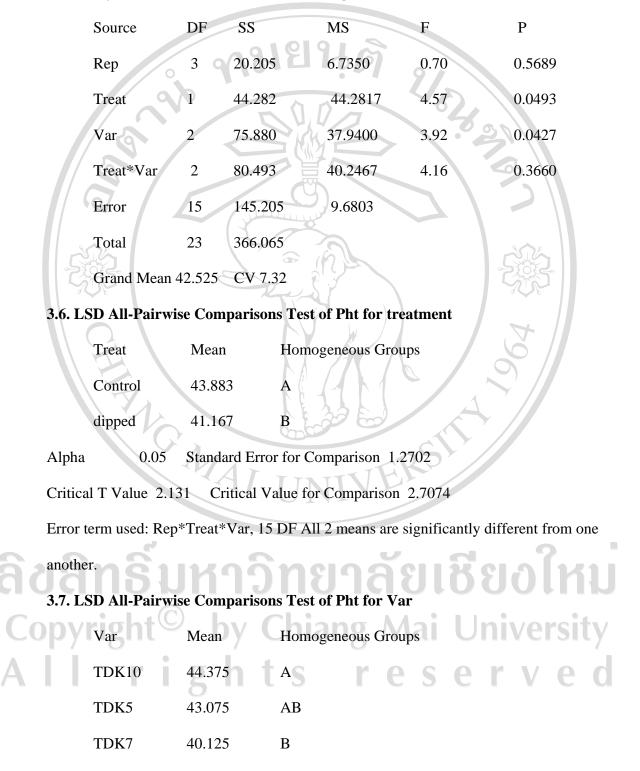
Critical T Value 2.131 Critical Value for Comparison 5.0239 Error term used: Rep\*Treat\*Var, 15 DF There are 2 groups (A and B) in which the means

are not significantly different from one another.

# 3.4. LSD All-Pairwise Comparisons Test of LBI for Treat\*Var

	Treat	Var	Mean Homogeneous Groups			
	Dipped	TDK10	52.50A			
	Dipped	TDK7	52.50A			
	Control	TDK7	51.25A			
	Control	TDK10	48.75A			
ລິນສີ	Dipped	TDK5	<sup>38.75B</sup>			
CIOCI	Control	TDK5	36.25B			
COAlpha	igh <sub>0.05</sub>	Standard Erro	r for Comparison 3.3333 University			
Critical T Value 2.131 Critical Value for Comparison 7.1048						
Error term used: Rep*Treat*Var, 15 DF There are 2 groups (A and B) in which the means						
are not	are not significantly different from one another.					





## Alpha 0.05 Standard Error for Comparison 1.5557

Critical T Value 2.131 Critical Value for Comparison 3.3158

Error term used: Rep\*Treat\*Var, 15 DF There are 2 groups (A and B) in which the means are not significantly different from one another.

# 3.8. LSD All-Pairwise Comparisons Test of Pht for Treat\*Var

Treat	Var	Mean	Homogeneous Groups
dipped	TDK10	44.600	A
Control	TDK10	44.150	A
Control	TDK7	44.050	A
Control	TDK5	43.450	A
dipped	TDK5	42.700	A
dipped	TDK7	36.200	В
		1845	

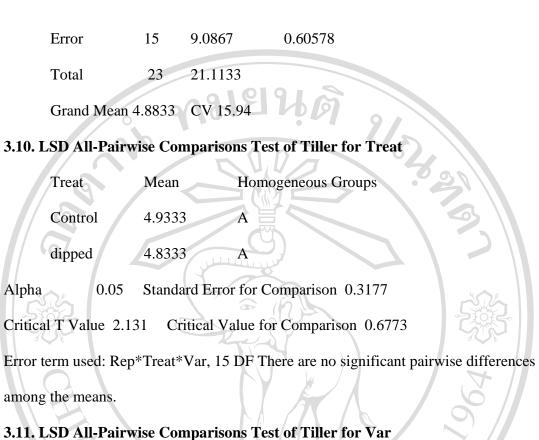
Alpha 0.05 Standard Error for Comparison 2.2000

Critical T Value 2.131 Critical Value for Comparison 4.6893

Error term used: Rep\*Treat\*Var, 15 DF There are 2 groups (A and B) in which the means are not significantly different from one another.

3.9. Analysis of Variance Table for Tiller

10 <b>G</b>	Source	DF	SS	MS	F	Paoini	
Copy	Rep	3 0	9.8333	3.27778	5.41	0.0100 versity	
	Treat	g	0.0600	0.06000	0.10	0.7573 V e d	
	Var	2	1.8533	0.92667	1.53	0.2485	
	Treat*Var	2	0.2800	0.14000	0.23	0.7964	



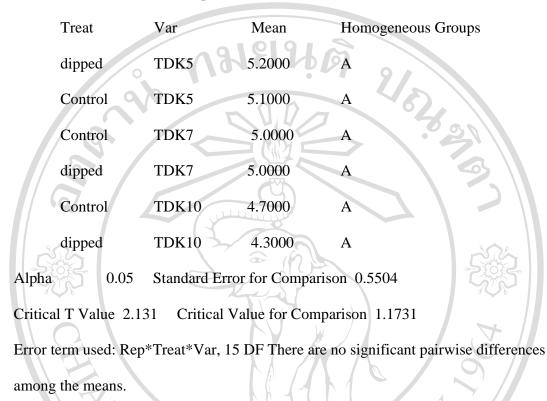
Var	Mean	Homogeneous Groups
TDK5	5.1500	A
TDK7	5.0000	ANIVEL
TDK10	4.5000	Α
Alpha 0.05	Standard Erro	r for Comparison 0.3892
Critical T Value 2.13	31 Critical V	alue for Comparison 0.8295

Error term used: Rep\*Treat\*Var, 15 DF There are no significant pairwise differences

ts r

Α

among the means.



3.12. LSD All-Pairwise Comparisons Test of Tiller for Treat\*Var

• Harvest2

3.13. Analysis of Variance Table for Pht

	Source	DF	SS	MS	F	Р
ລິນສີ	Rep	3	27.04	9.01	0.17	0.9158
CIUCI	Treat	2	1549.96	774.98	14.58	0.0001
Сору	Var ht	2 b	2253.70	1126.85	2 <sub>21.20</sub> ni	0.0000
	Treat*Var	4	353.78	88.45	1.66	0.1911
	Error	24	1275.62	53.15		
	Total	35	5460.10			

Grand Mean 74.122 CV 9.84

## 3.14. LSD All-Pairwise Comparisons Test of Pht for Treat

	Treat	Mean 8	Homogeneous Groups
	Control	82.817	A
	spray	72.583	B
	dipped	66.967	B
ha	0.05	Standard Erro	or for Comparison 2 9763

Alpha 0.05 Standard Error for Comparison 2.9763

Critical T Value 2.064 Critical Value for Comparison 6.1428

Error term used: Rep\*Treat\*Var, 24 DF There are 2 groups (A and B) in which the means are not significantly different from one another.

## 3.15. LSD All-Pairwise Comparisons Test of Pht for Var

Var	Mean	Homogeneous Groups
TDK5	85.150	A Sol Sol
TDK10	70.250	B
TDK7	66.967	BNIVE
· 0.0	5 Stondard France	on for Companian 2 0762

Alpha 0.05 Standard Error for Comparison 2.9763

Critical T Value 2.064 Critical Value for Comparison 6.1428

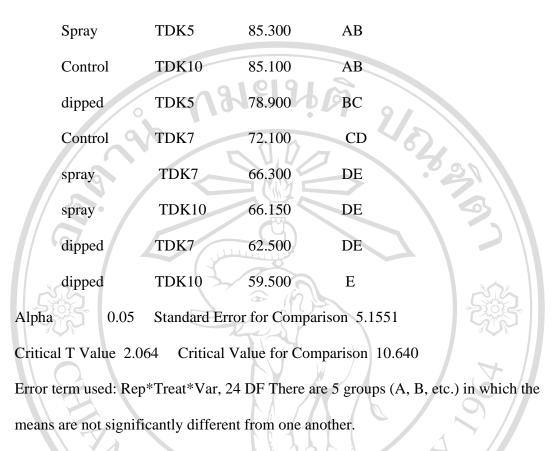
Error term used: Rep\*Treat\*Var, 24 DF There are 2 groups (A and B) in which the means

versi

are not significantly different from one another.

3.16. LSD All-Pairwise Comparisons Test of Pht for Treat\*Var

Treat	Var	Mean	Homogeneous Groups
Control	TDK5	91.250	А

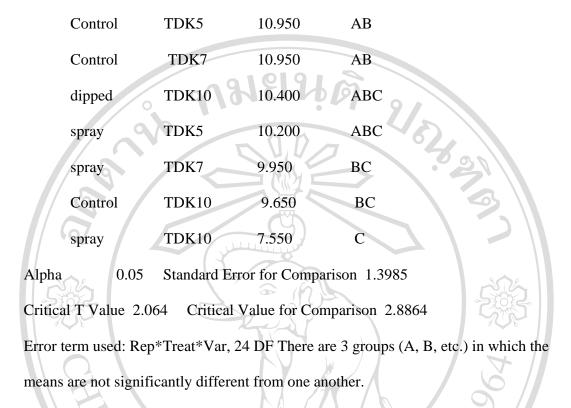


3.17. Analysis of Variance Table for Tiller

	Source	DF	SS	MS	F	Р
ຄີບສີ	Rep	3	13.310	4.4367	1.13	0.3552
	Treat	2	30.149	15.0744	3.85	0.0354
	Var	2	29.536	14.7678	3.78	0.0375
	Treat*Var	4	6.924	1.7311	0.44	0.7766
Сору	Error	24 0	93.880	3.9117	ail	University
	Total	35	173.799	re	S	erved
	Grand Mean 1	0.406	CV 19.01			

# 3.18. LSD All-Pairwise Comparisons Test of Tiller for Treat

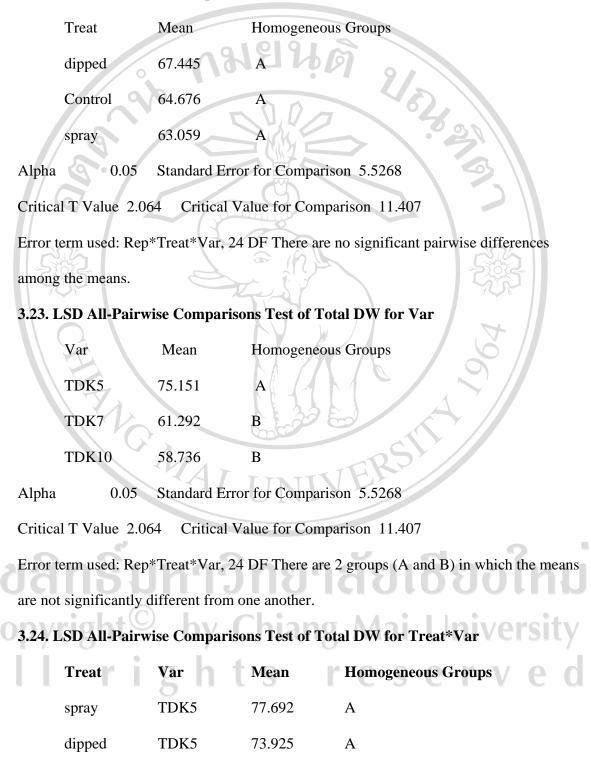
Treat	Mean	Homogeneous Groups
dipped	11.467	HALL AND
Control	10.517	AB B rror for Comparison 0.8074
spray	9.233	B
Alpha 0.05	5 Standard E	rror for Comparison 0.8074
Critical T Value 2	.064 Critical	Value for Comparison 1.6665
Error term used: R	ep*Treat*Var,	24 DF There are 2 groups (A and B) in which the means
are not significantl	y different from	n one another.
3.19. LSD All-Pai	rwise Compar	risons Test of Tiller for Var
Var	Mean	Homogeneous Groups
TDK5	11.383	
TDK7	10.633	AB
TDK10	9.200	B
Alpha 0.05	5 Standard E	rror for Comparison 0.8074
Critical T Value 2	.064 Critical	Value for Comparison 1.6665
Error term used: R	ep*Treat*Var,	24 DF There are 2 groups (A and B) in which the means
are not significantl	y different from	n one another.
3.20. LSD All-Pai	rwise Compar	risons Test of Tiller for Treat*Var
A Treat	Var	Mean Homogeneous Groups C
dipped	TDK5	13.000 A
dipped	TDK7	11.000 AB

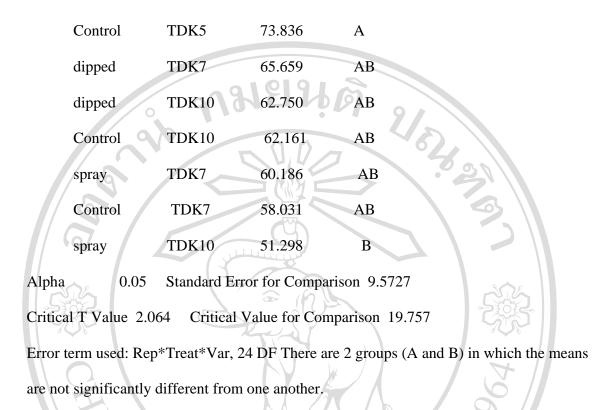


## 3.21. Analysis of Variance Table for Total DW

	Source	DF	SS	MS	F	Р
	Rep	3	946.07	315.355	1.72	0.1895
	Treat	2	118.07	59.035	0.32	0.7277
	Var	2	1872.15	936.076	5.11	0.0142
<b>R</b> k	Treat*Var	4	377.05	94.262	0.51	0.7258
	Error	24	4398.56 1	83.273		
Copy	Total	35 0	7711.89	ang M	ai	University
Grand	Mean 65.060	CV 20	).81 <b>t</b> S	re	S	erved







## 3.25. Analysis of Variance Table for Yield

Source	DF	SS	MS	F	Р
Rep	5	6515.7	1303.13	1.64	0.1719
Treat	2	11823.8	5911.89	7.44	0.0018
Var	2	5356.2	2678.08	3.37	0.0444
Treat*Var	4	1902.2	475.56	0.60	0.6660
Error	40	31795.4	794.89		
COPYITotal	53 0	57393.	ang M	ai l	Jniversity
Grand Mean 258.51	<b>CV</b> 10	).91 <b>t</b> S	re	S E	erved

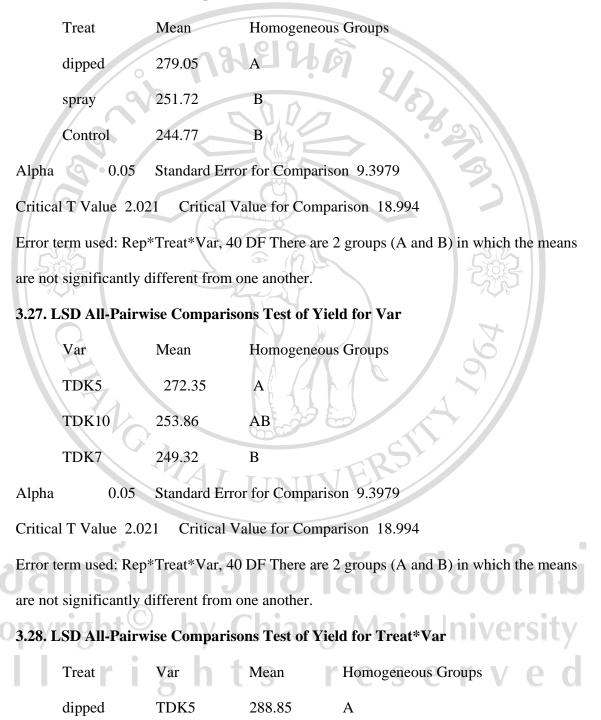
## 3.26. LSD All-Pairwise Comparisons Test of Yield for Treat

dipped

TDK10

282.93

AB



Contr	rol	TDK5	266.82	ABC			
dippe	ed	TDK7	265.37	ABC			
spray	0	TDK5	261.39	ABCD			
spray		TDK7	250.96	BCD			
spray		TDK10	242.80	CD			
Contr	rol	TDK10	235.85	CD			
Contr	rol	TDK7	231.64	D			
Alpha	0.05	Standard Error	for Compariso	on 16.278			
Critical T Value 2.021 Critical Value for Comparison 32.898							

ALG MAI

Error term used: Rep\*Treat\*Var, 40 DF There are 4 groups (A, B, etc.) in which the means are not significantly different from one another.

**ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่** Copyright<sup>©</sup> by Chiang Mai University All rights reserved

## **CURRICULUM VITAE**

Mr. Singty Voradeth

Date of Birth

July 13, 1978

**Educational background** 

1998-2001

Name

2007-2009

Scholarship **Work Experience** 2002-2007

Publication

Diploma. Agriculture National Higher (Agronomy) University of Laos. Faculty of Agriculture, Nabong Campus, Vientiane, Laos

2/02/03

M.Sc. Agriculture (Agronomy Chiang Mai University, Chiang Mai, Thailand

**Mcknight Foundation** 

Assistant Rice Breeder, Rice and Commercial Crop Research Center (RCCRC), National Agriculture and Forestry Research Institute (NAFRI), Ministry of Agriculture and Forestry (MAF), Laos

Voradeth, Sansanee Jamjod and Singty Benjavan Rerkasem. 2009. Evaluating rice varieties for Fe toxicity tolerance. A paper presented at Agriculture Research Meeting, March 12-13, 2009. Faculty of Agriculture,

Chiang Mai University, Thailand.