3. RESULTS

Application of paraquat on the grassy weeds of about 232 g/m^2 in density on 27 October, 1993 at the longan (*Dimocarpus longan Lour*) plantation at Ban Sop Pao, Muang District, Lamphun Province, resulted in the application rate 1584 g/ha (farmer's practice) and 377 g/ha (recommended practice), respectively, as shown in Table 3.1.

The minimum and maximum temperature, sunshine duration and relative humidity during the study period were 14.0-21.4^{0}c, 28.2-33.4^{0}c, 4.1-10.5 hours and 95-98%, respectively. There were also 7.9 mm of rain on 29 October, 1993. All the microclimate data were shown in Table 3.2.

The three sets of calibration curves of "low", "medium" and "high" concentrations of paraquat are shown in Figure 3.1.

The study of the stability of 1 ug/ml paraquat in weed extracting water revealed that up to 8 days after preparation there was no significant change in concentration, as shown in Table 3.3.

Determination of paraquat by reduction with alkaline sodium dithionite prior to analysis by using a Shimadzu UV-VIS Spectrophotometer yielded the instrumental detection limit (S/N=2) and the lower limit of determination at 0.015 and 0.025 ug/ml, respectively. Beer's law was obeyed in the range 0.025-10 ug/ml, as shown in Figure 3.2.

Table 3.1 Data of application of paraquat by the farmer's practice (F) and by the recommended practice (R).

	Dilution ratio	Spray strength (%w/v)	Volume used (L)	Application rate (g/ha)	Cost* ($/ha)
F	1:100	0.2	9.5	1584	33
R	1:250	0.08	5.65	377	8

* One liter of Gramoxone 27.6% w/v SL costs about 100 Baht.

Table 3.2 Microclimate data.

Date	Temperature (^{0}C) Max.	Min.	Sunshine duration (hr)	% Relative humidity	Rain (mm)
26-10-93	31.8	20.2	9.8	98	-
27-10-93	31.9	21.2	5.7	97	-
28-10-93	32.2	21.4	7.8	98	-
29-10-93	33.4	21.3	9.5	98	7.9
30-10-93	29.0	20.4	4.1	98	-
31-10-93	28.9	20.1	5.3	88	-
01-11-93	28.2	16.8	7.9	94	-
02-11-93	29.7	15.4	10.5	98	-
03-11-93	30.0	14.5	10.3	97	-
04-11-93	30.4	14.0	10.3	96	-
Average	30.6	18.5	8.12	96.2	

Source: The Northern Region Weather Forecast Center which obtained the above microclimate data from its meteorological station, approximately 1.5 km from the study site.

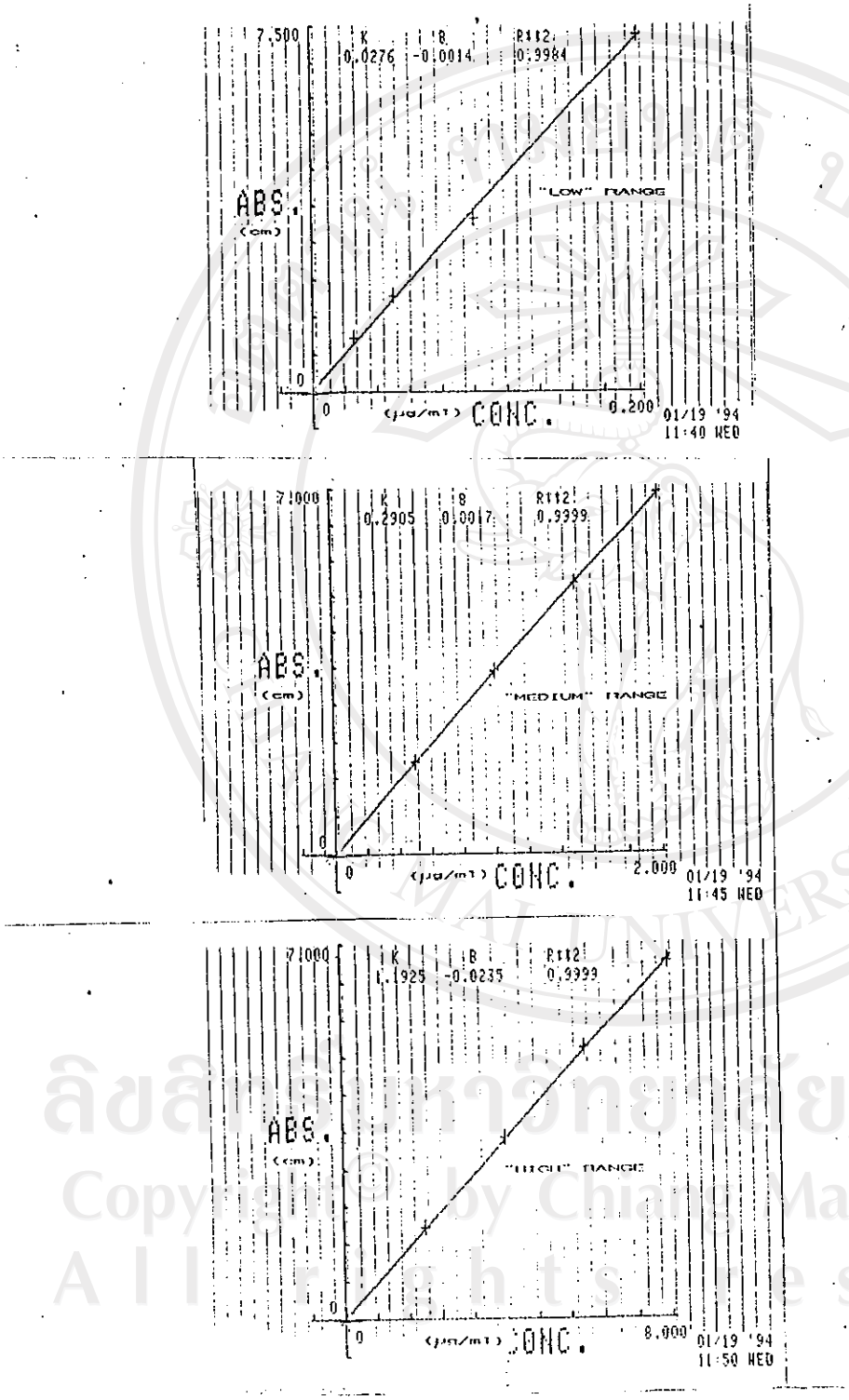


Figure 3.1 Standard paraquat calibration curves. (Absorbance is based on the peak height at 396 nm.)

Table 3.3 Stability of 1 ug/ml paraquat in weed extracting water.

Time	Concentration (ug/ml)
0 min.	1.06
30 mins.	1.06
60 mins	1.02
90 mins	1.06
2 days	1.02
3 days	1.02
4 days	1.02
6 days	1.06
8 days	1.02

Table 3.4 Recovery data of paraquat.

	$\bar{X}$	SD	%CV
Paraquat 2 ug (n=2)	94%	0.6	0.6
Paraquat 30 ug (n=2)	88%	1.5	1.7
Average	91%	1.05	1.2

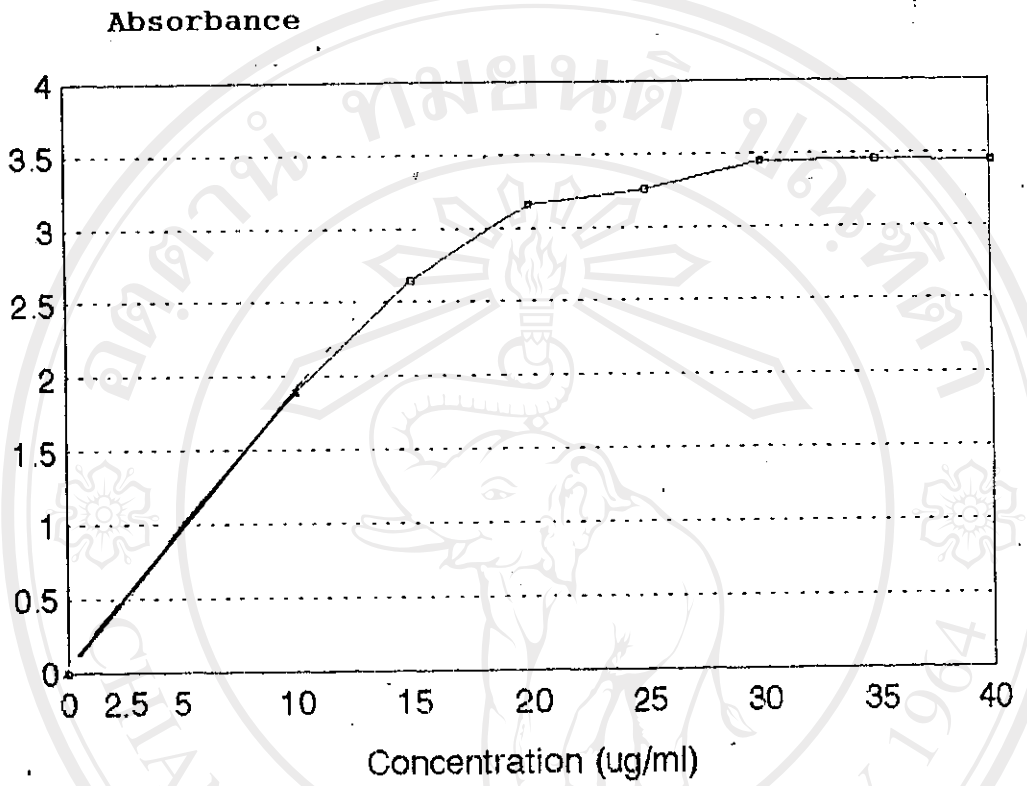


Figure 3.2 Linearity curve for the standard paraquat cation, obtained with the UV-VIS spectrophotometer.

Using the Bakerbond cyano-spe for sample preparation to cleanup and concentrate the paraquat in the weed extracting water matrix gave the percentage recovery greater than 88%, as shown in Table 3.4

The repeatability of the absorption measurement of 2 ug/ml paraquat (n=10) resulted in only 0.56% coefficient of variation and the unstable reduced paraquat ion gave the maximum absorption at 396 nm at immediately after gently mixed, as shown in Figure 3.3.

The Bakerbond cyano-spe and the paraquat free weed extracting water absorption spectrum are shown in Figures 3.4 and 3.5, respectively.

The pre-application and post-application data of weed analysis are shown in Tables 3.5 and 3.6, respectively, and the average amounts of the deposited paraquat are shown in Table 3.7. The deposited amounts of paraquat at the interval of time 0, 1, 2, 3 and 8 days after application by the farmer's practice were detected in the range 0.8-13 mg/kg or 1.1-20 g/ha, whereas the amounts from the application by the recommended practice were found to be in the range 0.33-10 mg/kg or 0.54-16 g/ha, as shown in Tables 3.8 and 3.9 and Figures 3.6 and 3.7, respectively. The limit of determination of this analytical procedure was found to be 0.02 mg/kg or 0.06 g/ha.

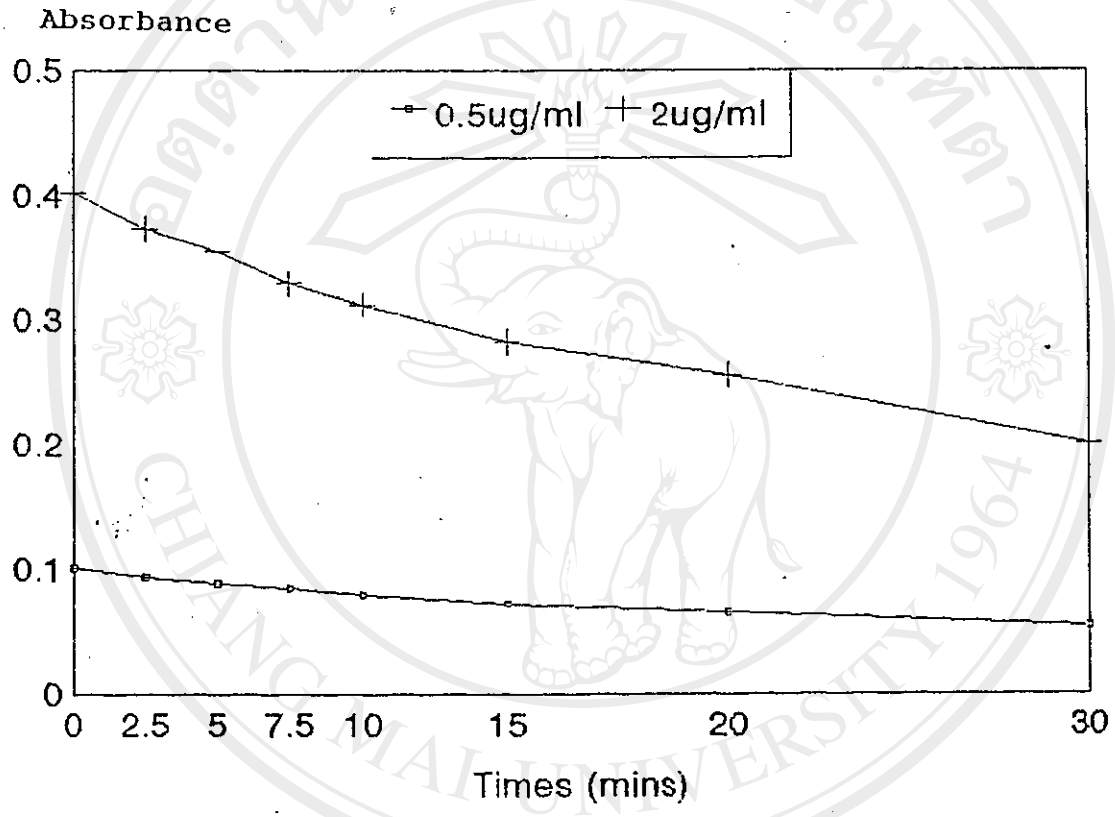


Figure 3.3 Stability of the paraquat radical cation.

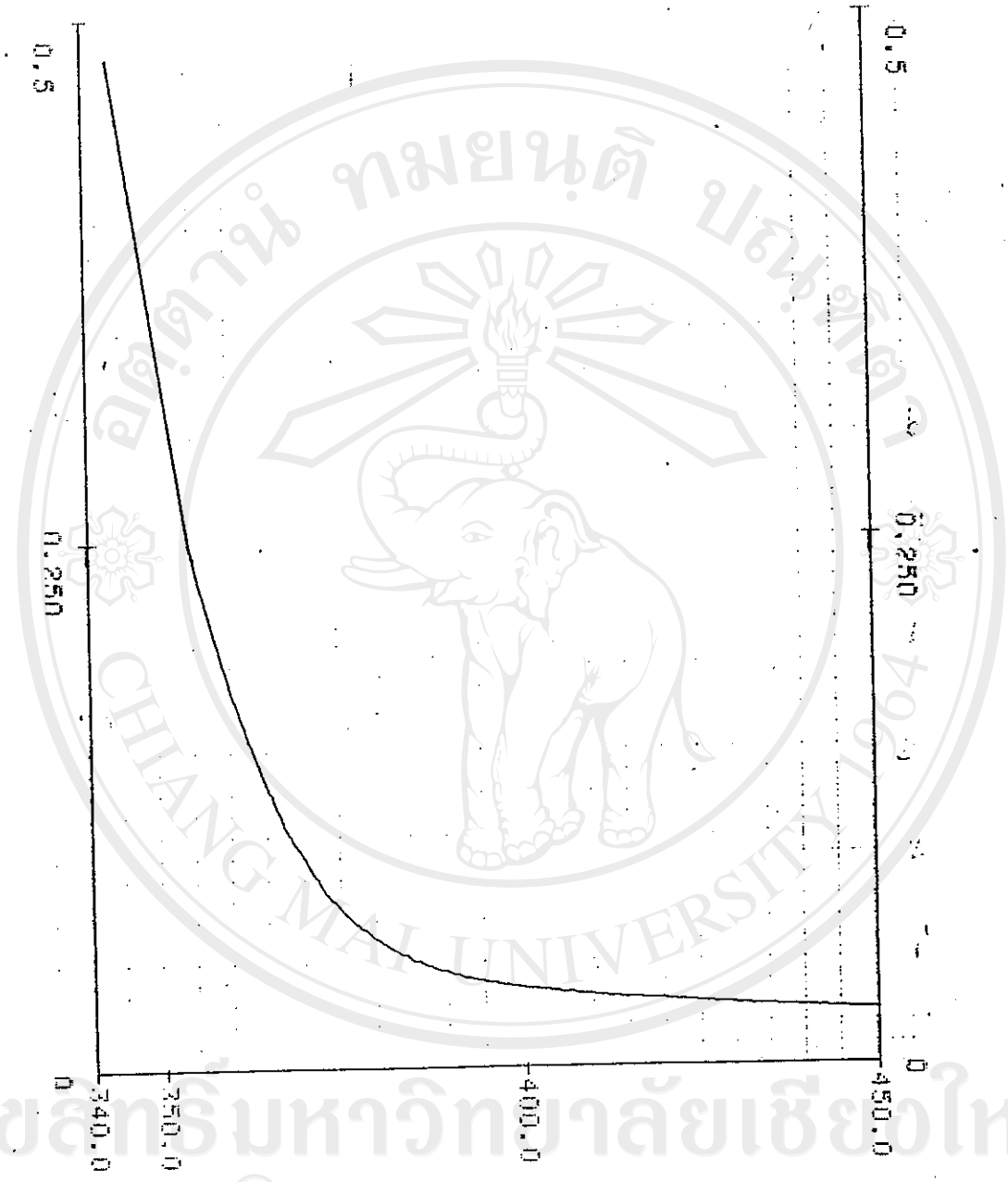


Figure 3.4 UV-VIS spectrum of distilled water passing through the Bakerbond cyano-spe.

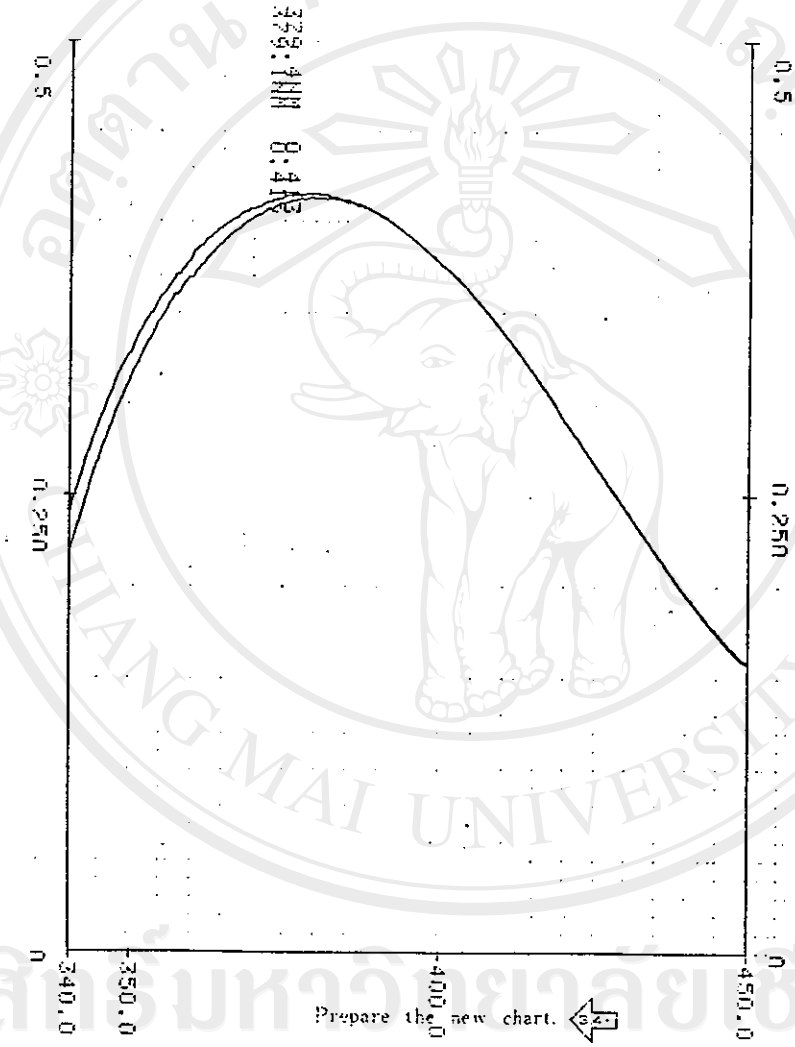


Figure 3.5 UV-VIS spectrum of the paraquat free weed extracting water.

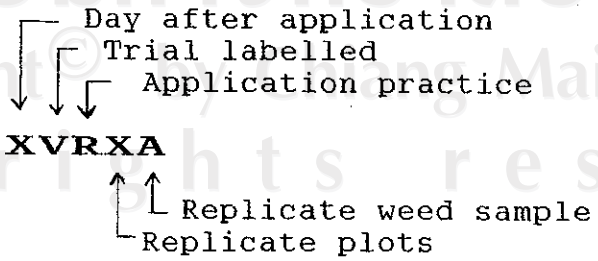
Table 3.5 Pre-application data on weed samples.

Sample code	Dry weight (g)		Extracting water (ml)		Paraquat (mg/kg)
	W	WT	V	VT	
VR1	10.66	148.52	200	460	ND
VR2	11.17	297.79	200	498	ND
VR3	19.91	273.35	200	460	ND
VF1	12.21	191.55	200	497	ND
VF2	11.53	96.15	200	485	ND
VF3	8.98	151.31	200	465	ND

Average weed dry weight= 257.4 g/m^2

Sample code	Dry weight (g)		Extracting water (ml)		Paraquat (mg/kg)
	W	WT	V	VT	
LR1	10.86	165.61	200	495	ND
LR2	11.95	103.91	200	475	ND
LR3	10.96	141.59	200	465	ND
LF1	10.15	146.51	200	495	ND
LF2	11.50	206.26	200	475	ND
LF3	12.69	167.41	200	475	ND

Average weed dry weight= 206.9 g/m^2



Sample Code Symbol

Table 3.6 Post-application data on the treated weed samples.

Sample code	Dry weight (g)		Water extracting volume (ml)		Paraquat eluted (ug)		Paraquat found	
	W	WT	V	VT	E1	E2	mg/kg	g/ha
0VR1A	12.94	108.52	100	545	23.2	0.57	10.01	14.48
B	13.16		100	540	23.2	0.85	9.54	13.81
0VR2A	14.0	113.97	100	530	18.2	1.3	7.38	11.22
B	14.16		100	500	20.8	0.41	7.49	11.38
0VR3A	12.29	121.5	100	485	38.4	0.94	15.52	25.15
B	14.5		100	535	36.4	0.62	13.66	22.13
0VF1A	11.1	122.18	50	485	15.6	0.23	13.83	22.53
B	7.72		50	500	13.4	0.7	18.26	29.75
0VF2A	11.64	119.1	100	485	39.4	1.8	17.17	27.26
B	11.77		100	515	22.0	0.56	9.85	15.65
0VF3A	13.81	117.63	50	510	14.0	0.27	10.54	16.53
B	12.13		50	480	11.6	0	9.18	14.4
0LR1A	13.14	119.66	200	500	44.4	1.7	8.77	13.99
B	14.17		200	510	60.8	1.3	11.17	17.83
0LR2A	14.68	148.16	200	495	34.8	0.97	6.03	11.91
B	14.65		200	510	40.8	0.85	7.25	14.32
0LR3A	14.05	117.52	200	505	55.2	1.6	10.21	15.99
B	14.47		200	540	54.0	1.6	10.37	16.26
0LF1A	12.87	139.27	50	540	18.6	0.56	16.10	29.9
B	13.55		50	485	24.0	0.29	17.39	32.29
0LF2A	11.73	115.78	50	495	4.8	0	4.05	6.25
B	11.67		50	500	11.6	0.22	10.13	15.63
0LF3A	12.99	91.11	50	500	13.4	0.27	10.52	12.78
B	12.99		50	460	19.8	0.34	14.26	17.33

Table 3.6 (continued)

Sample code	Dry weight (g)		Water extracting volume (ml)		Paraquat eluted (ug)		Paraquat found	
	W	WT	V	VT	E1	E2	mg/kg	g/ha
1VR1A	12.27	101.99	150	530	14.0	ND	4.03	5.48
B	12.85		150	490	15.6	0.77	4.16	5.66
VR2A	11.15	174.97	200	470	18.2	1.0	4.05	9.44
B	11.29		150	465	11.0	3.15	3.88	9.06
1VR3A	10.13	163.21	150	500	18.2	0.69	6.21	13.53
B	10.39		150	480	24.0	0.57	7.57	16.47
1VF1A	14.75	104.47	150	525	24.0	0.55	5.82	8.11
B	11.09		150	520	30.0	1.0	9.7	13.5
1VF2A	11.8	120.04	200	520	27.6	1.75	6.47	10.35
B	12.71		150	505	20.4	0.55	5.55	8.88
1VF2A	11.35	63.77	150	505	54.0	1.3	16.40	13.95
B	9.37		150	520	45.6	0.55	17.07	14.52
1LR1A	12.83	112.97	150	480	8.4	5.0	3.34	5.03
B	11.41		150	500	9.2	0.25	2.76	4.16
1LR2A	12.57	96.18	150	460	5.4	ND	1.32	1.69
B	12.16		150	490	6.2	ND	1.66	2.13
1LR3A	8.88	110.9	150	485	5.4	0.18	2.03	3.00
B	10.49		150	495	8.4	0.25	2.72	4.02
1LF1A	9.45	93.25	150	520	40.0	0.85	14.98	18.63
B	12.55		150	550	22.2	0.73	6.70	8.33
1LF2A	12.69	125.95	150	490	37.0	0.55	9.67	16.23
B	20.97		150	495	48.0	1.75	7.93	13.15
1LF3A	14.09	103.91	150	495	30.0	1.3	7.33	10.16
B	13.36		150	520	34.6	1.15	9.28	12.85

ND = Not Detected

Table 3.6 (continued)

Sample code	Dry weight (g)		Water extracting volume (ml)		Paraquat eluted (ug)		Paraquat found	
	W	WT	V	VT	E1	E2	mg/kg	g/ha
2VR1A	14.45	178.25	150	490	2.5	ND	0.56	1.34
B	13.89		150	525	9.05	0.31	2.36	5.60
2VR2A	14.68	152.22	150	500	3.2	ND	0.73	1.47
B	14.39		150	505	1.3	ND	0.30	0.62
2VR3A	15.25	174.56	150	530	10.3	0.51	2.52	5.85
B	15.36		150	5305	5.4	ND	1.24	2.89
2VF1A	15.09	145.35	150	570	4.55	ND	1.14	2.22
B	12.43		150	555	1	ND	0.30	0.58
2VF2A	12.58	99.88	150	555	9.6	0.19	2.88	3.83
B	16.71		150	520	11.4	0.2	2.41	3.20
2VF2A	18.59	141.88	150	540	36.0	1.3	7.22	13.66
B	18.36		150	550	41.0	ND	8.19	15.49
2LR1A	18.57	119.89	150	510	5.7	0.02	1.05	1.67
B	18.85		150	525	5.4	0.03	1.01	1.61
2LR2A	15.8	136.11	150	520	6.4	0.29	1.47	2.66
B	15.66		150	540	5.55	0.21	1.32	2.40
2LR3A	13.68	81.23	150	540	4.5	0.19	1.23	1.34
B	13.77		150	525	5.4	0.22	1.43	1.55
2LF1A	15.1	116.63	150	530	4.65	0.17	1.13	1.75
B	15.57		150	480	7.25	0.33	1.56	2.42
2LF2A	19.91	169.52	150	530	3.95	ND	0.70	1.58
B	16.95		150	510	8.15	0.29	1.7	3.83
2LF3A	18.93	89.68	150	520	16.3	0.75	3.12	3.73
B	18.67		150	495	16.0	0.49	2.91	3.48

ND = Not Detected

Table 3.6 (continued)

Sample code	Dry weight (g)		Water extracting volume (ml)		Paraquat eluted (ug)		Paraquat found	
	W	WT	V	VT	E1	E2	mg/kg	g/ha
3VR1A	11.6	130.04	150	520	1.9	ND	0.57	0.98
B	14.05		150	540	1.75	ND	0.44	0.78
3VR2A	13.13	117.85	150	525	1.15	ND	0.31	0.48
B	15.39		150	525	1.45	ND	0.33	0.52
3VR3A	12.07	121.35	150	480	1.45	ND	0.38	0.62
B	11.27		150	525	1.6	ND	0.50	0.80
3VF1A	13.65	106.66	150	570	7.6	0.19	2.17	3.08
B	11.89		150	530	3.65	ND	1.08	1.54
3VF2A	13.36	117.12	150	535	15.2	0.53	4.20	6.56
B	14.41		150	500	8.75	0.33	2.10	3.28
3VF2A	12.29	100.34	150	515	5.85	ND	1.63	2.19
B	12.05		150	500	5.1	ND	1.41	1.89
3LR1A	13.59	132.16	150	550	1.3	ND	0.35	0.62
B	12.36		150	510	1	ND	0.27	0.48
3LR2A	14.16	131.11	150	500	1.75	ND	0.41	0.72
B	12.5		150	490	2.0	ND	0.52	0.91
3LR3A	15.15	109.24	150	530	2.0	ND	0.47	0.68
B	14.95		150	495	1.6	ND	0.35	0.51
3LF1A	13.51	106.05	150	505	4.1	0.19	1.07	1.51
B	12.97		150	525	2.75	ND	0.74	1.05
3LF2A	14.55	129.44	150	520	4.35	ND	1.04	1.19
B	12.84		150	500	7.0	0.18	1.86	3.22
3LF3A	15.8	117.44	150	510	6.0	0.18	1.33	2.08
B	14.25		150	540	5.35	0.18	1.40	2.19

ND = Not Detected

Table 3.6 (continued)

Sample code	Dry weight (g)		Water extracting volume (ml)		Paraquat eluted (ug)		Paraquat found	
	W	WT	V	VT	E1	E2	mg/kg	g/ha
8VR1A	14.71	130.59	150	450	0.7	ND	0.14	0.25
B	13.29		150	490	1.15	ND	0.28	0.49
8VR2A	15.29	136.66	150	515	1.3	ND	0.29	0.53
B	14.66		150	500	1.45	ND	0.33	0.60
8VR3A	14.85	135.68	150	495	2.6	ND	0.58	1.04
B	13.25		150	490	2.45	ND	0.60	1.09
8VF1A	14.95	87.96	150	460	1.0	ND	0.20	0.24
B	15.13		150	480	1.9	ND	0.40	0.47
8VF2A	18.07	112.05	150	495	6.4	ND	1.17	1.75
B	17.01		150	480	6.85	ND	1.29	1.92
8VF3A	17.85	94.07	150	475	4.1	ND	0.73	0.91
B	16.29		150	505	4.65	ND	0.96	1.20
8LR1A	17.3	89.79	150	470	1.6	ND	0.29	0.35
B	16.49		150	485	2.0	ND	0.39	0.47
8LR2A	16.37	122.08	150	475	1.3	ND	0.25	0.41
B	15.71		150	450	1.75	ND	0.33	0.54
8LR3A	15.04	99.32	150	495	0.7	ND	0.15	0.20
B	15.77		150	500	1.6	ND	0.34	0.45
8LF1A	16.35	114.96	150	495	5.37	ND	1.08	1.66
B	16.37		150	485	4.1	ND	0.79	1.21
8LF2A	18.51	121.67	150	490	4.1	ND	0.72	1.17
B	19.83		150	485	5.55	ND	0.90	1.47
8LF3A	21.09	78.14	150	530	4.35	ND	0.73	0.76
B	17.83		150	465	3.85	ND	0.67	0.70

ND = Not Detected

Table 3.7 Amounts of paraquat in different trials.

DAA	PQ in VR		PQ in VF		PQ in LR		PQ in LF	
	mg/kg	g/ha	mg/kg	g/ha	mg/kg	g/ha	mg/kg	g/ha
0	10.6	16.4	13.1	21.0	9.0	15.0	12.1	19.0
1	5.0	9.9	10.2	11.5	2.3	3.3	9.3	13.2
2	1.3	3	3.7	6.5	1.2	1.9	1.8	2.8
3	0.4	0.7	2.1	3.1	0.4	0.6	1.2	2.0
8	0.4	0.7	0.8	1.1	0.3	0.4	0.8	1.2

DAA = days after application
PQ = Paraquat
V,L = Trial labelled
F,R = Farmer's practice and recommended practice

Table 3.8 Amounts of deposited paraquat in mg/kg on the treated weed samples

	Days After Application				
	0	1	2	3	8
F (mg/kg)	13	10	2.8	1.7	0.8
R (mg/kg)	10	3.6	1.3	0.41	0.33

Limit of determination = 0.02 mg/kg

Table 3.9 Amounts of deposited paraquat in g/ha on the treated weed samples

	Days After Application				
	0	1	2	3	8
F (g/ha)	20	12	4.6	2.5	1.1
R (g/ha)	16	7	2.4	0.8	0.54

Limit of determination = 0.06 g/ha

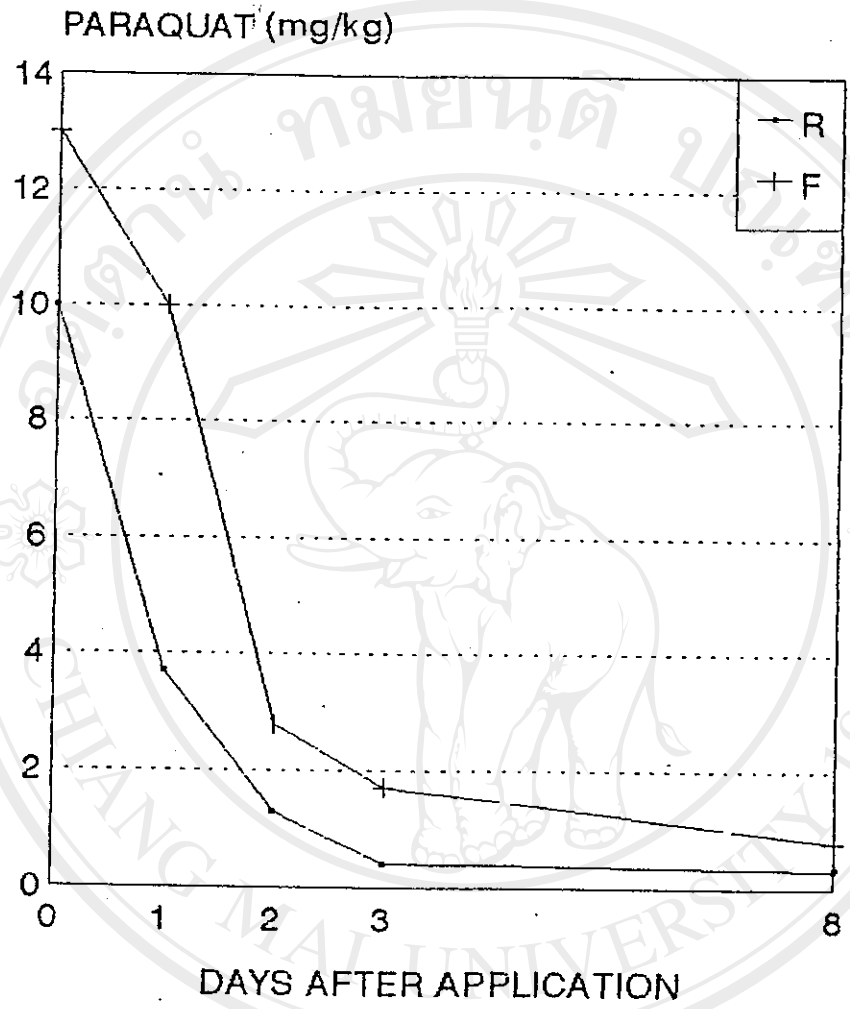


Figure 3.6 The amounts of paraquat in mg/kg found at different time interval.

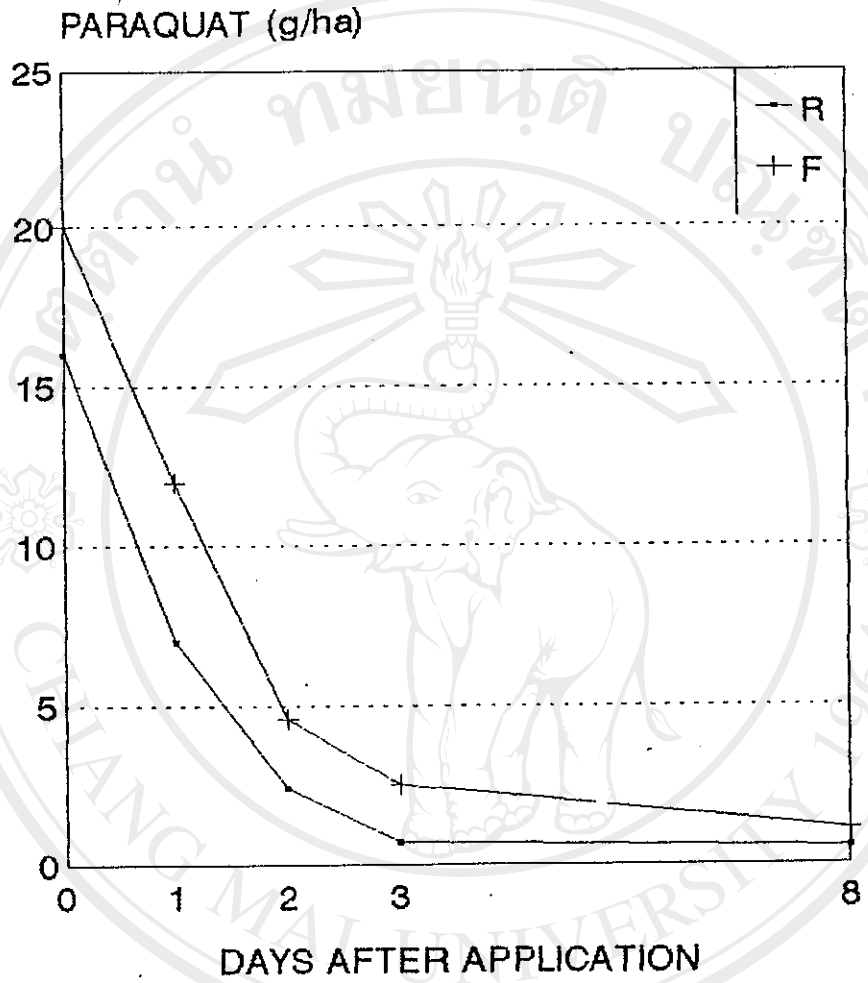


Figure 3.7 The amounts of paraquat in g/ha found at different time interval.