

CHAPTER 4

RESULTS

4.1 Experiment 1

Effects of water stress on plant growth

In this experiment all growth indicators of plant height, leaf area, root length, shoot dry weight, root dry weight and total dry weight of the maize variety 888 at 67%FC, 50% and 33%FC showed effects of water stress compared to 100%FC. The effect was slight at 3 weeks but more strongly at 6 weeks. The effect was smallest at 67%FC and increased with increasing water stress to 50% and 33%.

Plant Height

At 3 weeks plant height was depressed with increasing water stress ($P < 0.01$) (Figure 4.1.1A). The effect was slight at 67%FC, more strongly at 50%FC, with most pronounced effect at 33%FC. The effects became stronger at 6 weeks ($P < 0.01$) (Figure 4.1.1B).

Leaf area

At 3 weeks leaf area was depressed with increasing water stress ($P < 0.01$). The effect was slight at 67%FC at 3 weeks, more strongly at 50%FC but at 50%FC was not significant different from 67%FC, with most pronounced effect at 33%FC (Figure 4.1.2A). The effects became stronger at 6 weeks ($P < 0.01$) (Figure 4.1.2B).

Root Length

At 3 weeks root length was depressed with increasing water stress ($P < 0.01$). The effect was slight at 67%FC, more strongly at 50%FC but at 50%FC was not significant different from 67%FC on root length, with most pronounced effect at 33%FC (Figure 4.1.3A). At 6 weeks root length of the maize variety 888 was

decreased with increasing water stress, with more pronounced effect at 33%FC (Figure 4.1.3B). Significant effects ($P<0.01$) was only observed between 100%FC and 33%FC. The effect of 67%FC and 50%FC were slight and were not significant from 100%FC.

Shoot dry weight (Shoot DW)

Shoot DW of the maize variety 888 at 3 weeks was depressed with increasing water stress ($P<0.01$). The effect was slight at 67%FC, more strongly at 50%FC, with most pronounced effect at 33%FC (Figure 4.1.4A). The effects became stronger at 6 weeks ($P<0.01$). The effect was slight at 67%FC at 6 weeks, more strongly at 50%FC but at 50%FC was not significant different from 67%FC, with most pronounced effect at 33%FC, but at 33%FC was not significant different from 50%FC (Figure 4.1.4B).

Root dry weight (Root DW)

Root DW of the maize variety 888 at 3 weeks was depressed with increasing water stress ($P<0.01$). The effect was slight at 67%FC at 3 weeks, more strongly at 50%FC but at 50%FC was not significant different from 67%FC, with most pronounced effect at 33%FC, but at 33%FC was not significant different from 50%FC (Figure 4.1.5A). The effects became stronger at 6 weeks ($P<0.01$) (Figure 4.1.5B).

Total dry weight (Total DW)

Total DW of the maize variety 888 at 3 weeks was depressed with increasing water stress ($P<0.01$). The effect was slight at 67%FC at 3 weeks, more strongly at 50%FC but at 50%FC was not significant different from 67%FC, with most pronounced effect at 33%FC (Figure 4.1.6A). The effects became stronger at 6 weeks ($P<0.01$). The effect was slight at 67%FC at 6 weeks, more strongly at 50%FC but at

50%FC was not significant different from 67%FC, with most pronounced effect at 33%FC, but at 33%FC was not significant different from 50%FC (Figure 4.1.6B).

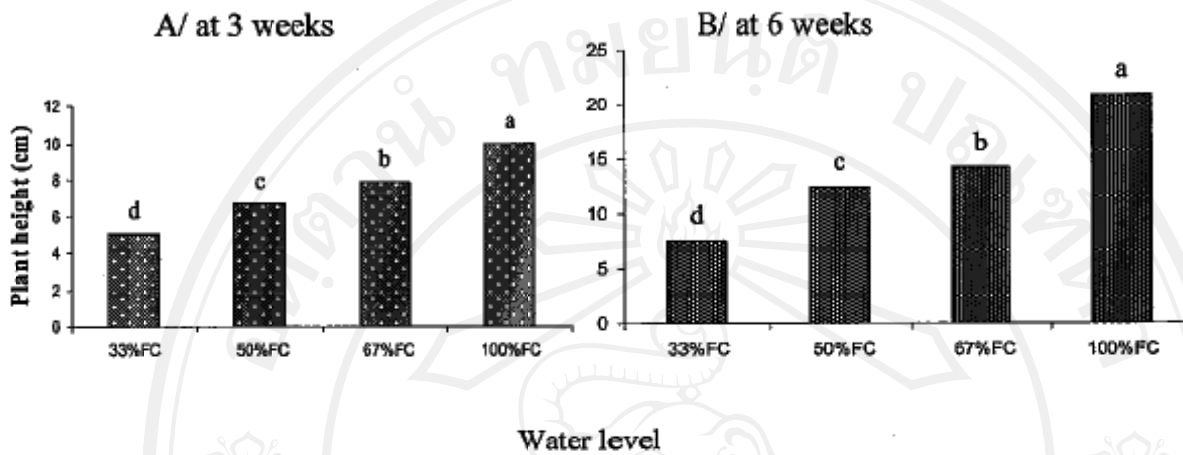


Figure 4.1.1 Effect of four water levels on plant height of the maize variety 888 at 3 weeks (A) and 6 weeks (B) after planting. Different letters above the bars indicate significant difference by LSD_{0.05}

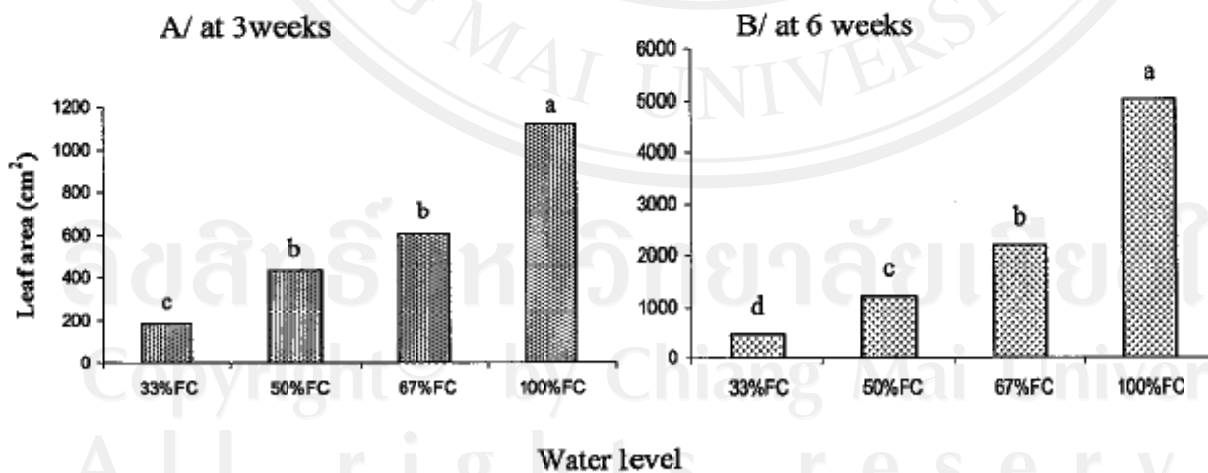


Figure 4.1.2 Effect of four water levels on leaf area of the maize variety 888 at 3 weeks (A) and 6 weeks (B) after planting. Different letters above the bars indicate significant difference by LSD_{0.05}

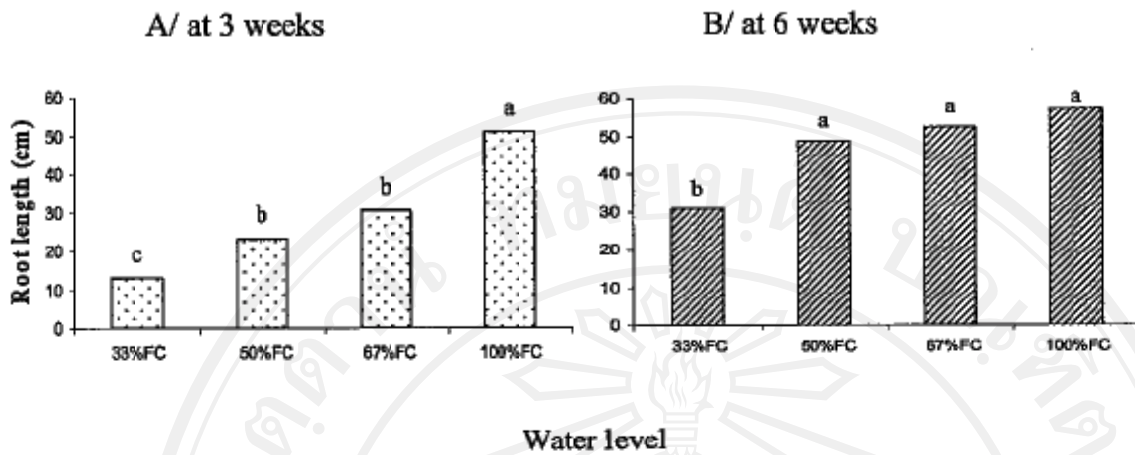


Figure 4.1.3 Effect of four water levels on root length of the maize variety 888 at 3 weeks (A) and 6 weeks (B) after planting. Different letters above the bars indicate significant difference by LSD_{0.05}

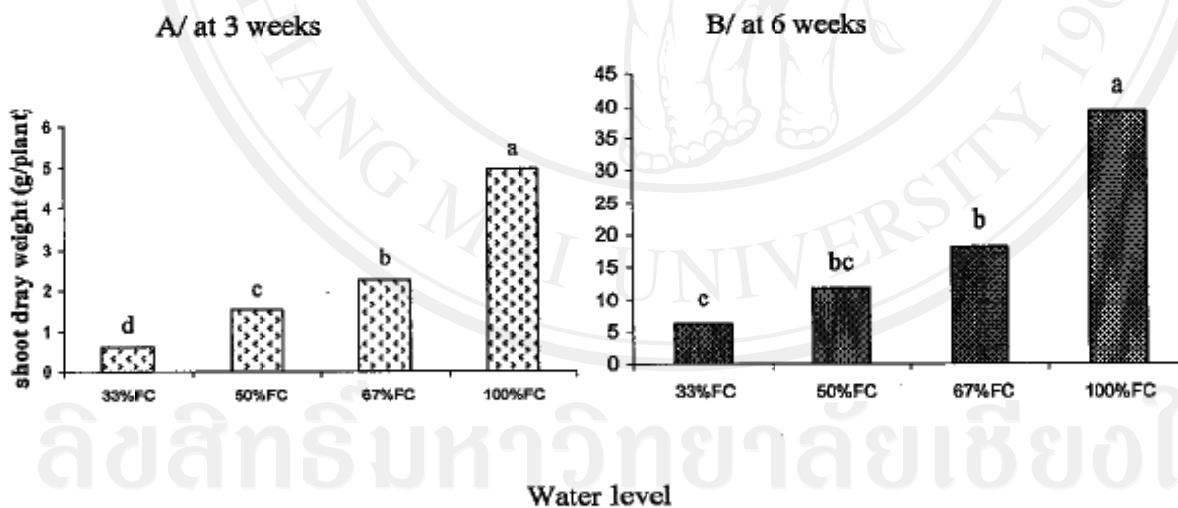


Figure 4.1.4 Effect of four water levels on shoot dry weight (Shoot DW) of the maize variety 888 at 3 weeks (A) and 6 weeks (B) after planting. Different letters above the bars indicate significant difference by LSD_{0.05}

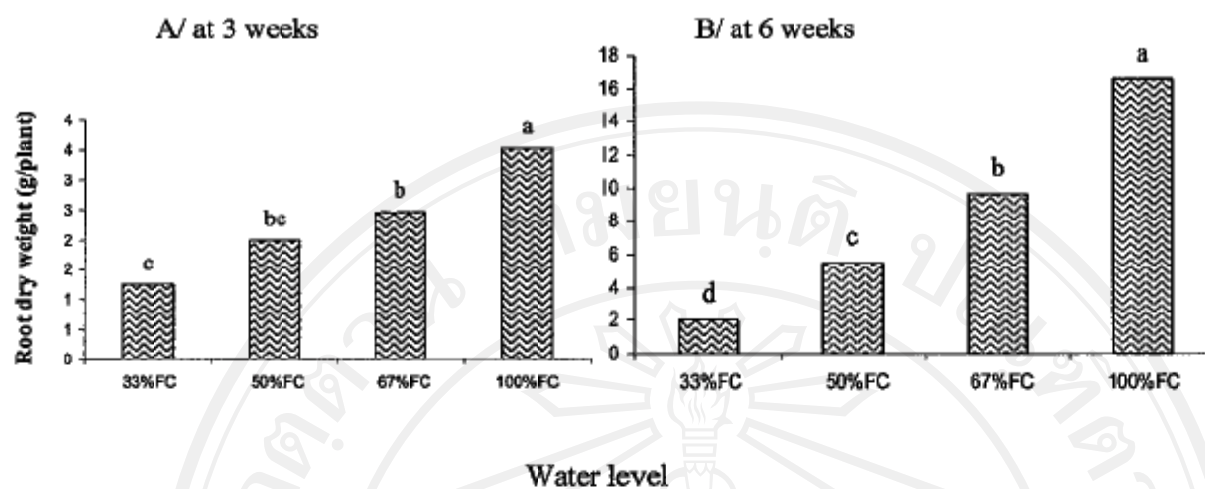


Figure 4.1.5 Effect of four water levels on root dry weight (Root DW) of the maize variety 888 at 3 weeks (A) and 6 weeks (B) after planting. Different letters above the bars indicate significant difference by LSD_{0.05}

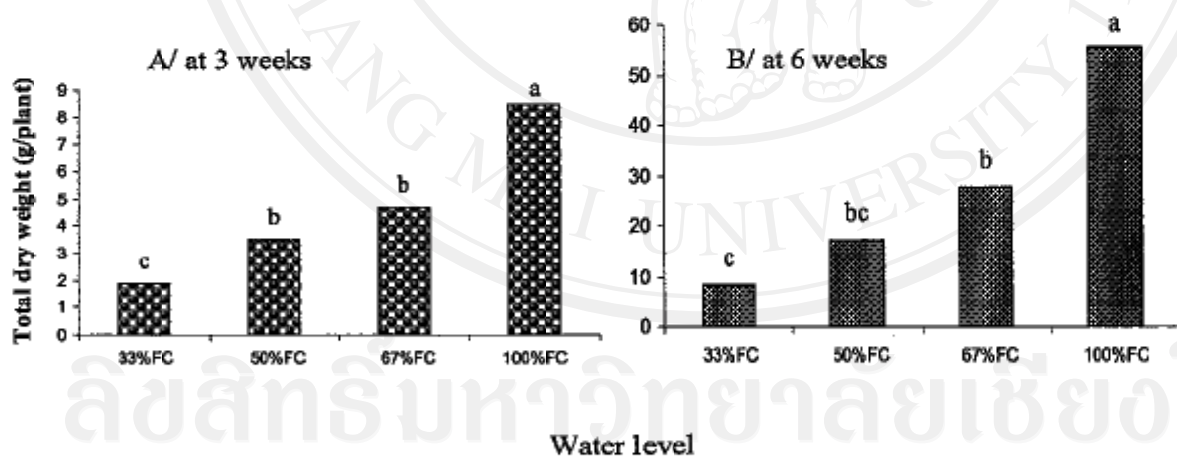


Figure 4.1.6 Effect of four water levels on total dry weight (Total DW) of the maize variety 888 at 3 weeks (A) and 6 weeks (B) after planting. Different letters above the bars indicate significant difference by LSD_{0.05}

Effects of water stress on NPK content

In this experiment all nutrient indicators of NPK content in shoot and root and total NPK content in shoot and of the maize variety 888 at 67%FC, 50% and 33%FC showed effects of water stress compared to 100%FC. The effect was slight 3 weeks but more strongly at 6 weeks. The effect was smallest at 67%FC and increased with increasing water stress to 50% and 33%.

N content in shoot

At 3 weeks N content in shoot was depressed with increasing water level ($P<0.01$) (Figure 4.1.7. A). The effect was slight at 67%FC, more strongly at 50%FC, with most pronounced effect at 33%FC. The effect became stronger at 6 weeks ($P<0.01$). The effect was slight at 67%FC, more strongly at 50%FC, with most pronounced effect at 33%FC, but at 33%FC was not significant different from 50%FC (Figure 4.1.7. B).

N content in root

At 3 weeks N content in root was decreased with increasing water stress, with more pronounced effect at 33%FC (Figure 4.1.8. A). The significant effect ($P<0.01$) was only observed between 100%FC and 33%FC. The effect of 67%FC at 3 weeks was slight and was not significant from 100%FC. And the effect of 50%FC was slight and not significant from 67%FC, but 50%FC was not significant from 33%FC. The effect became stronger at 6 weeks ($P<0.01$). The effect of 67%FC at 6 weeks was slight and was not significant from 100%FC, more strongly at 50%FC, with most pronounced effect at 33%FC (Figure 4.1.8. B).

Total N content in shoot and root

At 3 weeks total N content in shoot and root was depressed with increasing water level ($P < 0.01$). The effect was slight at 67%FC at 3 weeks, more strongly at 50%FC, but at 50%FC was not significant different from 67%FC, with most pronounced effect at 33%FC (Figure 4.1.9. A). The effect became stronger at 6 weeks ($P < 0.01$) (Figure 4.1.9. B).

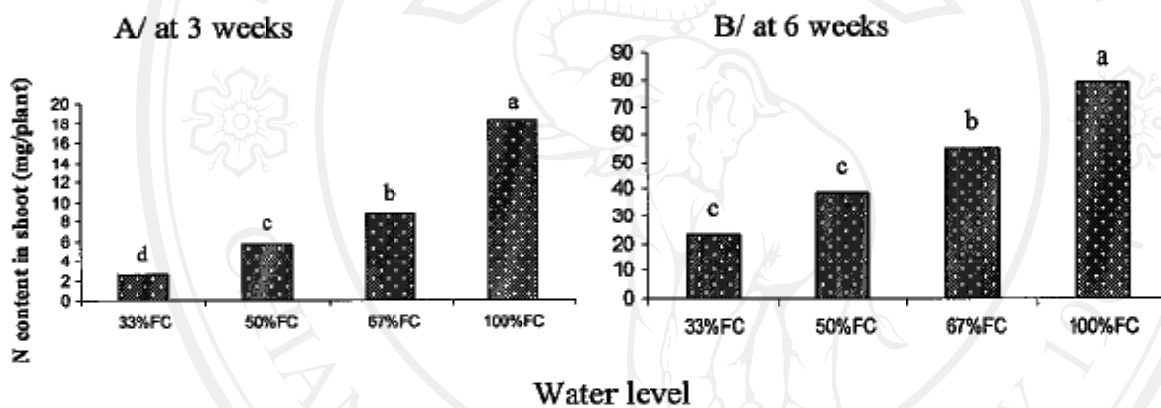


Figure 4.1.7 Effect of water levels on N content in shoot (mg/plant) of the maize variety 888 at 3 weeks (A) and 6 weeks (B) after planting. Different letters above the bars indicate significant difference by $LSD_{0.05}$

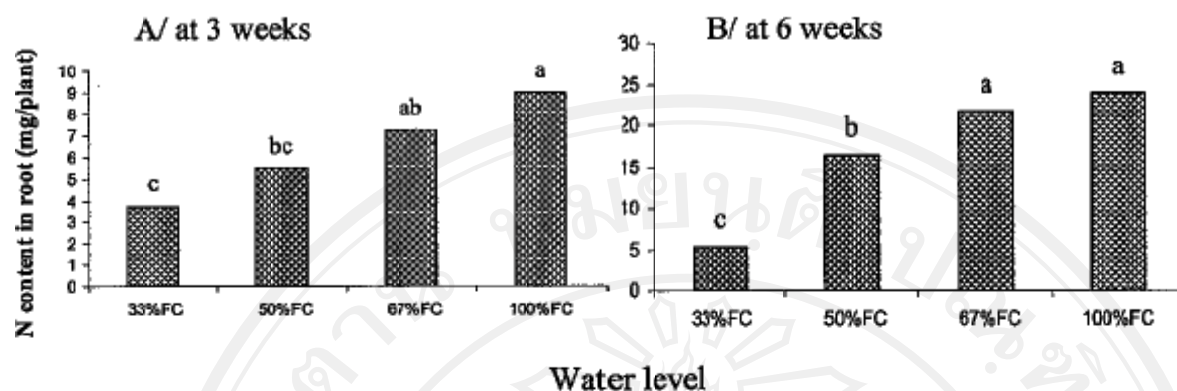


Figure 4.1.8 Effect of water levels on N content in root (mg/plant) of the maize variety 888 at 3 weeks (A) and 6 weeks (B) after planting. Different letters above the bars indicate significant difference by $LSD_{0.05}$

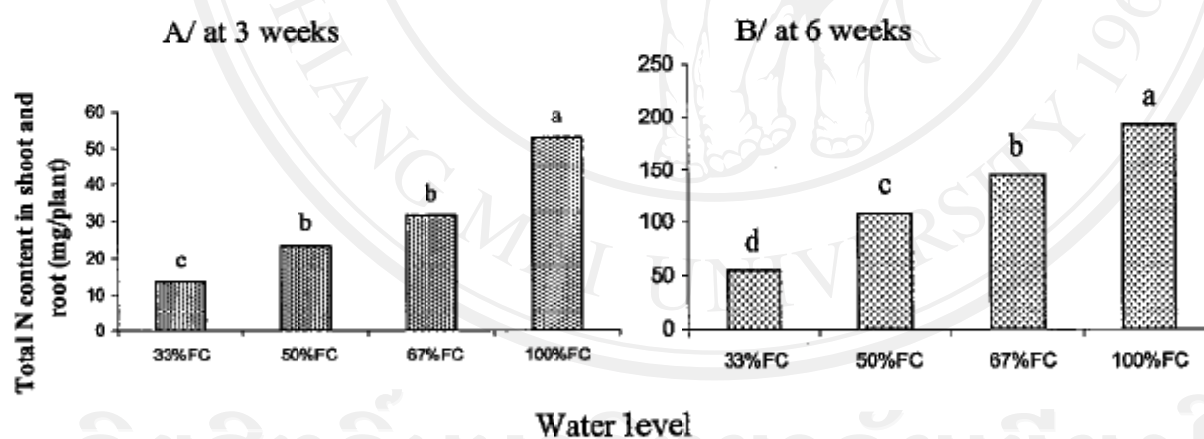


Figure 4.1.9 Effect of water levels on total N content in shoot and root (mg/plant) of the maize variety 888 at 3 weeks (A) and 6 weeks (B) after planting. Different letters above the bars indicate significant difference by $LSD_{0.05}$

P content in shoot

At 3 weeks P content in shoot was depressed with increasing water level ($P < 0.01$). The effect was slight at 67%FC at 3 weeks, more strongly at 50%FC but at 50%FC was not significant from 67%FC, with most pronounced effect at 33%FC, and at 33%FC was not significant from 50%FC (Figure 4.1.10). The effect became stronger at 6 weeks ($P < 0.01$). The effect was slight at 67%FC at 6 weeks, more strongly at 50%FC but at 50%FC was not significant from 67%FC, with most pronounced effect at 33%FC, and at 33%FC was not significant from 50%FC (Figure 4.1.10. B).

P content in root

At 3 weeks P content in root was depressed with increasing water level ($P < 0.01$). The effect was slight at 67%FC at 3 weeks, more strongly at 50%FC but at 50%FC was not significant from 67%FC, with most pronounced effect at 33%FC, and at 33%FC was not significant from 50%FC (Figure 4.1.11. A). The effect became stronger at 6 weeks ($P < 0.01$). The effect was slight at 67%FC, more strongly at 50%FC, with most pronounced effect at 33%FC (Figure 4.1.11. B).

Total P content in shoot and root

At 3 weeks total P content in shoot and root was depressed with increasing water level ($P < 0.01$). The effect of 67%FC, 50%FC and 33%FC at 3 weeks were slight and were not significant different from each other on total P content in shoot and root (Figure 4.1.12. A). The effect became stronger at 6 weeks ($P < 0.01$). The effect was slight at 67%FC, more strongly at 50%FC, with most pronounced effect at 33%FC (Figure 4.1.12. B).

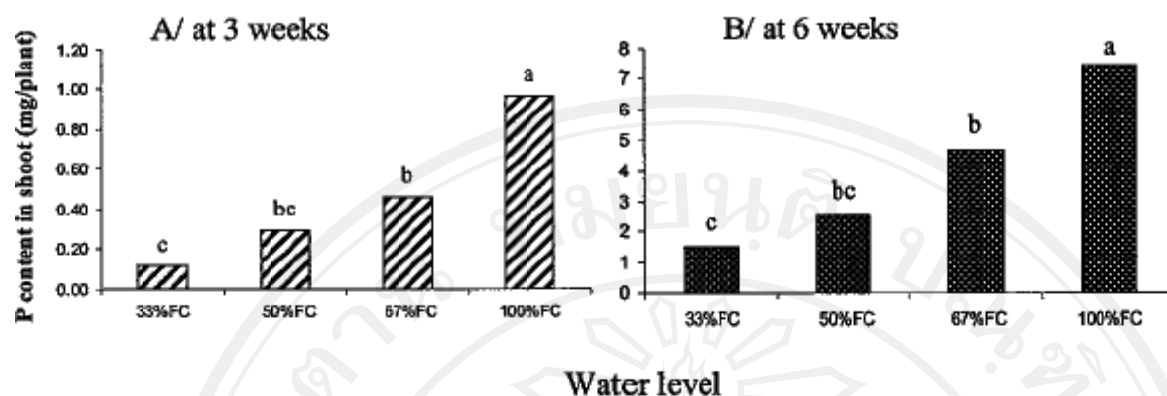


Figure 4.1.10 Effect of water levels on P content in shoot (mg/plant) of the maize variety 888 at 3 weeks (A) and 6 weeks (B) after planting. Different letters above the bars indicate significant difference by $LSD_{0.05}$

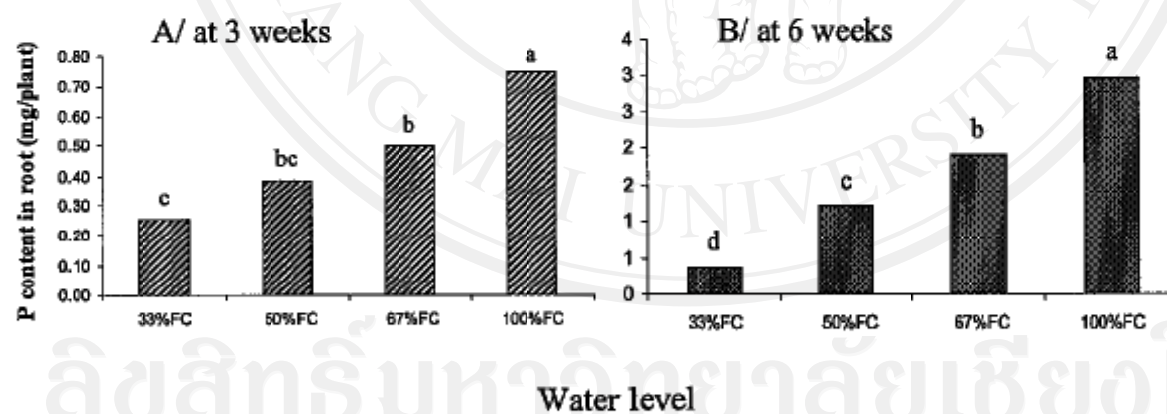


Figure 4.1.11 Effect of water levels on P content in root (mg/plant) of the maize variety 888 at 3 weeks (A) and 6 weeks (B) after planting. Different letters above the bars indicate significant difference by $LSD_{0.05}$

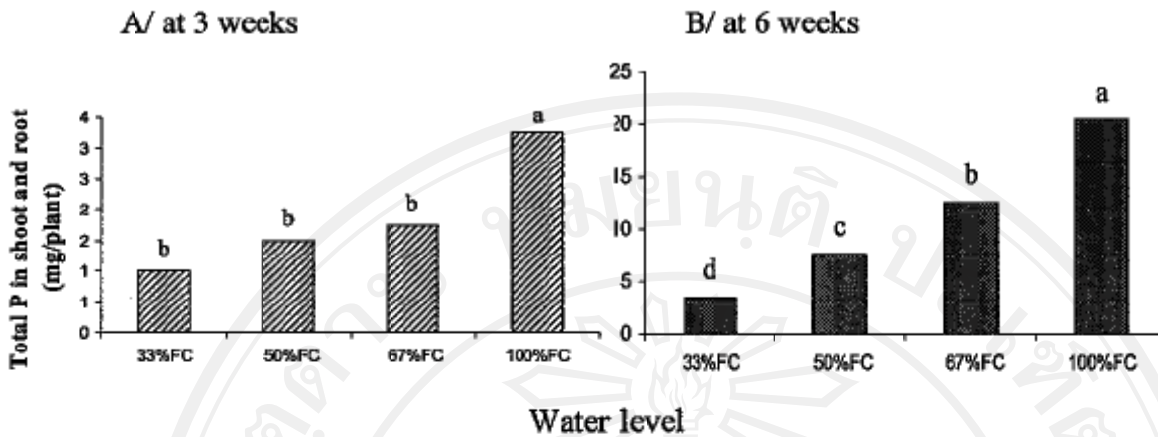


Figure 4.1.12 Effect of water levels on total P content in shoot and root (mg/plant) of the maize variety 888 at 3 weeks (A) and 6 weeks (B) after planting. Different letters above the bars indicate significant difference by $LSD_{0.05}$

K content in shoot

At 3 weeks K content in shoot was depressed with increasing water level ($P < 0.01$). The effect was slight at 67%FC, more strongly at 50%FC, with most pronounced effect at 33%FC (Figure 4.1.13. A). The effect became stronger at 6 weeks ($P < 0.01$). The effect was slight at 67%FC, more strongly at 50%FC, with pronounced effect at 33%FC but at 33%FC was not significant from 50%FC on K content in shoot (Figure 4.1.13. B).

K content in root

At 3 weeks K content in root was depressed with increasing water level ($P < 0.01$). The effect was slight at 67%FC at 3 weeks, more strongly at 50%FC and at 50%FC was not significant from 67%FC, with pronounced effect at 33%FC, but at 33%FC was not significant from 50%FC (Figure 4.1.14. A). The effect became

stronger at 6 weeks ($P < 0.01$). The effect of 67%FC at 6 weeks was slight and was not significant from 100%FC, more strongly at 50%FC but at 50%FC was not significant from 67%FC, with pronounced effect at 33%FC (Figure 4.1.14. B).

Total K content in shoot and root

At 3 weeks total K content in shoot and root was depressed with increasing water level ($P < 0.01$). The effect was slight at 67%FC, more strongly at 50%FC, with most pronounced effect at 33%FC (Figure 4.1.15. A). The effect became stronger at 6 weeks ($P < 0.01$) (Figure 4.1.15. B).

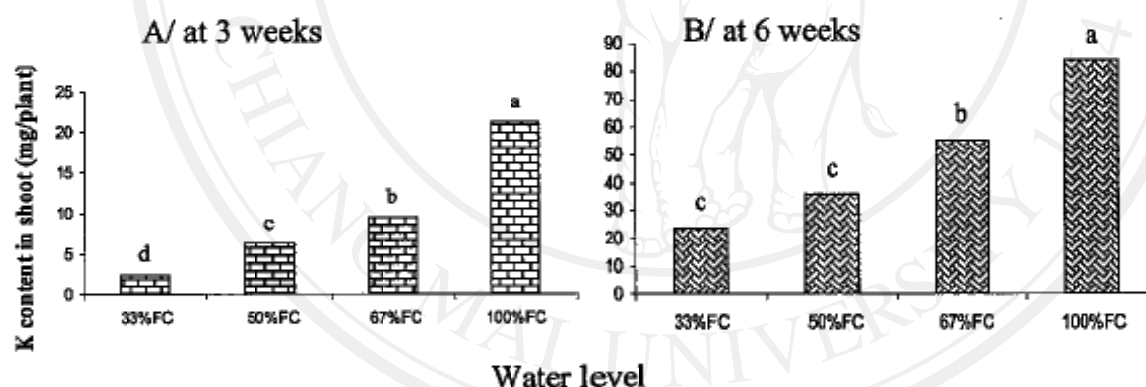


Figure 4.1.13 Effect of water levels on K content in shoot (mg/plant) of the maize variety 888 at 3 weeks (A) and 6 weeks (B) after planting. Different letters above the bars indicate significant difference by $LSD_{0.05}$

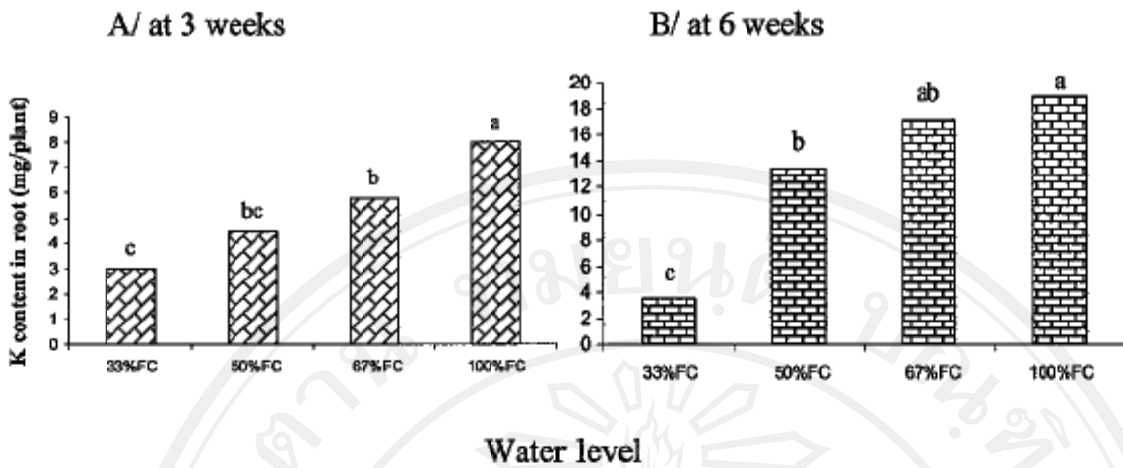


Figure 4.1.14 Effect of water levels on K content in root (mg/plant) of the maize variety 888 at 3 weeks (A) and 6 weeks (B) after planting. Different letters above the bars indicate significant difference by LSD_{0.05}

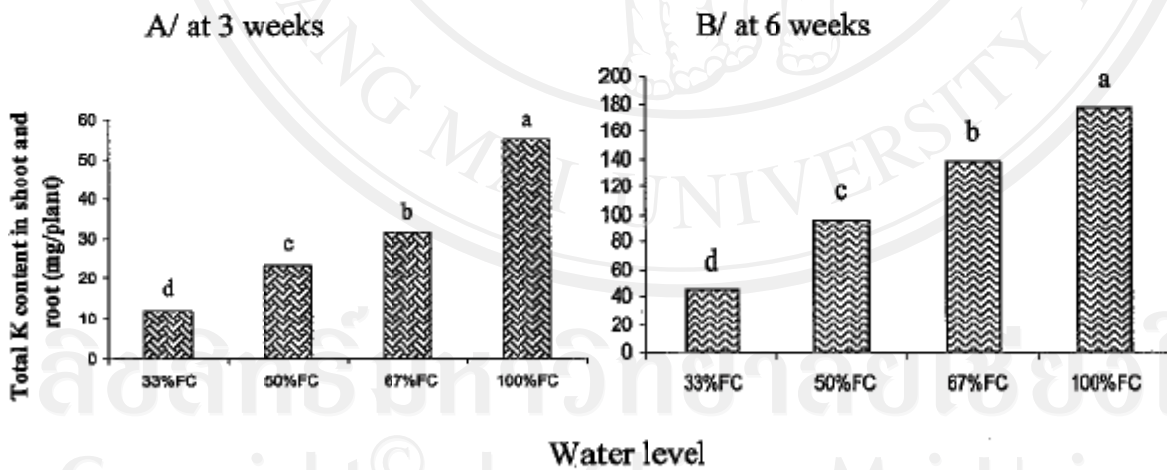


Figure 4.1.15 Effect of water levels on total K content in shoot and root (mg/plant) of the maize variety 888 at 3 weeks (A) and 6 weeks (B) after planting. Different letters above the bars indicate significant difference by LSD_{0.05}

Reduction (%) of all parameters of maize variety

The reduction (%) of plant height, leaf area, root length, shoot dry weight, root dry weight and total dry weight of each maize variety at 67%FC, 50%FC and 33%FC relative to those at 100%FC were shown in table 4.1.1. At 3 and 6 weeks, the reduction 888 was compared, slight at 67%FC, more reduction at 50%FC, with most reduction at 33%FC on all parameters in this case.

Table 4.1.1 Reduction (%) of studied parameters of 888 maize variety at 67%FC, 50%FC and 33%FC compared to 100%FC at 3 and 6 weeks after planting.

Parameters	Water level					
	At 3 weeks			At 6 weeks		
	67%FC	50%FC	33%FC	67%FC	50%FC	33%FC
	% reduction					
Plant height	21	33	49	32	41	64
Leaf area	45	62	83	56	76	91
Root length	38	54	72	8	15	47
Shoot dry weight	53	69	87	52	70	86
Root dry weight	29	43	64	42	67	88
Total dry weight	43	58	77	49	69	87

Reduction (%) of total NPK content in shoot and root of maize variety

The reduction (%) of total NPK content in shoot and root of each maize variety at 67%FC, 50%FC and 33%FC relative to those at 100%FC were shown in table 4.1.2. At 3 and 6 weeks, the reduction 888 maize variety was compared, slight at 67%FC, more reduction at 50%FC, with most reduction at 33%FC on total NPK content in shoot and root in this case.

Table 4.1.2 Reduction (%) of total NPK content in shoot and root of 888 maize variety at 67%FC, 50%FC and 33%FC compared to 100%FC at 3 and 6 weeks after planting.

Parameters	Water levels					
	At 3 weeks			At 6 weeks		
	67%FC	50%FC	33%FC	67%FC	50%FC	33%FC
	% reduction					
Total N content in SR	42	57	74	24	44	71
Total P content in SR	33	33	67	35	60	85
Total K content in SR	44	58	78	22	46	75

Effects of water stress on total NPK concentration (%)

In this case all total NPK concentration in shoot and root of the maize variety 888 at 67%FC, 50% and 33%FC showed effects of water stress compared to 100%FC. The effect was smallest at 67%FC and increased with increasing water stress to 50% and 33%.

Total NPK concentration in shoot and root at 3 weeks

Total N concentration in shoot and root was depressed with increasing water stress with more pronounced effect at 33%FC (Table 4.1.3). Significant effect ($P < 0.05$) was only observed between 100%FC and 33%FC. The effect of water level at 67%FC and 50%FC were slight and were not significant from 100%FC. The effect at 33%FC was slight and was not significant from 67%FC and 50%FC in this growth stage.

Total PK concentration in shoot and root were slight reduction with increasing water stress (Table 4.1.3). Significant effect was not significant between 100%FC to

33%FC. The effect of water level at 67%FC, 50%FC and 33%FC were slight and were not significant from 100%FC.

Total NPK concentration in shoot and root at 6 weeks

Total N concentration in shoot and root at 6 weeks was depressed with increasing water stress with more pronounced effect at 33%FC (Table 4.1.4). Significant effect ($P < 0.01$) were observed between 100%FC, 67%FC, 50%FC and 33%FC. The effect was slight at 67%FC, more strongly at 50%FC, with most pronounced effect at 33%FC.

Total P concentration in shoot and root were slight reduction with increasing water stress (Table 4.1.4). Significant effect was not observed between 100%FC, 67%FC, 50%FC and 33%FC.

Total K concentration in shoot and root was depressed with increasing water stress with more pronounced effect at 33%FC (Table 4.1.4). Significant effect ($P < 0.05$) was only observed between 100%FC and 33%FC. The effect of water level at 67%FC and 50%FC were slight and were not significant from 100%FC.

Table 4.1.3 Effect of water levels on total NPK concentration of 888 maize variety at 3 weeks after planting.

Water level	Total NPK concentration in shoot and root at 3 weeks		
	Total N %	Total P %	Total K %
100%FC	7.28 a	0.40 a	6.42 a
67%FC	6.67 ab	0.39 a	6.64 a
50%FC	6.68 ab	0.41 a	6.78 a
33%FC	6.19 b	0.41 a	6.47 a

Means follow by different letter differ significantly by $LSD_{0.05}$

Table 4.1.4 Effect of water levels on total NPK concentration of 888 maize variety at 6 weeks after planting.

Water level	Total NPK concentration in shoot and root at 6 weeks		
	Total N %	Total P %	Total K %
100%FC	7.00 a	0.41 a	5.58 a
67%FC	6.26 b	0.43 a	5.68 a
50%FC	5.36 c	0.46 a	5.16 a
33%FC	3.48 d	0.37 a	3.18 b

Means follow by different letter differ significantly by $LSD_{0.05}$

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4.2 Experiment 2

In the experiment 2 found the variation among 11 maize varieties in their response to water levels of 67%FC and 50%FC. The result showed that the plant height, leaf area, root length, shoot dry weight, root dry weight and total dry weight were significant affected by interaction between varieties and water levels.

Plant height

The effect of water stress on plant height at 6 weeks depressed with increasing water stress ($P < 0.01$). The effect was strong at 50%FC except 888 and Dragon 8 Rows. At 67%FC, Super sweet and Pumpui maize varieties had the highest, followed by Semi-sweet maize and 888 the shortest plant height. The plant height of 7 maize varieties, namely, Dragon 8 Rows, Loeung Mongkul, NS72, Sainampeung, Pioneer A33, Sor Chey and CM, was falling between. When increase water stress at 50%FC, Super sweet had the highest plant height, followed by Dragon 8 Rows while CM was lowest in this case. The plant height of the 8 maize varieties, namely, Pumpui, Semi-sweet maize, Loeug Mongkul, NS72, Sainampeung, Pioneer A33, Sor Chey and 888, was falling between (Table 4.2.1).

Leaf area

The effect of water stress on leaf area at 6 weeks depressed with increasing water stress ($P < 0.01$). The effect was strong at 50%FC. At 67%FC, Pumpui, Sor Chey, Semi-sweet maize, Dragon 8 Rows and Loeung Mongkul maize varieties had the highest and Pioneer A33 the lowest plant height. The leaf area of 5 maize varieties, namely, Super sweet, CM, NS72, 888 and Sainampeung, was falling between. When increase water stress at 50%FC, Dragon 8 Rows had the leaf area highest, followed by Pumpui while Pioneer A33 was lowest in this case. The leaf

area of the 8 maize varieties, namely, Super sweet, Semi-sweet maize, CM, Loeug Mongkul, Sor Chey, NS72, 888 and Sainampeung, was falling between (Table 4.2.2).

Root length

The effect of water stress on root length at 6 weeks depressed with increasing water stress ($P < 0.01$). The effect was strong at 50%FC (only Pioneer A33, NS72, 888 and Semi-sweet maize, but the other maize varieties were not significant effect on root length if compare to 67%FC. At 67%FC, Semi-sweet maize and Loeung Mongkul maize varieties had the longest, followed by NS72 and 888 and Dragon 8 Rows the shortest root length. The root length of 6 maize varieties, namely, Sor Chey, Pioneer A33, CM, Pumpui, Sainampeung and Super sweet, was falling between (Table 4.2.3). When increase water stress at 50%FC, Loeug Mongkul had the root length longest, followed by Sor Chey, while Pioneer A33 was shortest in this case. The root length of the 8 maize varieties, namely, CM, Dragon 8 Rows, Sainampeung, NS72, Semi-sweet maize, 888, Super sweet and Pumpui, was falling between (Table 4.2.3).

Shoot dry weight (Shoot DW)

The effect of water stress on shoot DW at 6 weeks depressed with increasing water stress ($P < 0.01$). The effect was strong at 50%FC. At 67%FC, Semi-sweet maize varieties had the highest, followed by Super sweet and Loeung Mongkul and Sainampeung the lowest shoot DW but Sainampeung, 888 and Pioneer A33 were not significant different from each other in this case. The shoot DW of 5 maize varieties, namely, Sor Chey, Pumpui, Dragon 8 Rows, NS72 and CM, was falling between (Table 4.2.4). When increase water stress at 50%FC, Pumpui and NS72 had the shoot DW highest while Pioneer A33 was lowest in this case. The shoot DW of the 8 maize

varieties, namely, Super sweet, Semi-sweet maize, Dragon 8 Rows, Loeug Mongkul, Sor Chey, CM, 888 and Sainampeung, was falling between (Table 4.2.4).

Root dry weight (Root DW)

The effect of water stress on root DW at 6 weeks depressed with increasing water stress ($P < 0.01$). The effect was strong at 50%FC. At 67%FC, Loeung Mongkul and CM maize varieties had the highest and Sainampeung the lowest root DW. The root DW of 8 maize varieties, namely, Sor Chey, Super sweet, NS72, Pumpui, 888, Pioneer A33, Dragon 8 Rows and Semi-sweet maize, was falling between (Table 4.2.5). When increase water stress at 50%FC, Loeug Mongkul had the root DW highest, followed by Sor Chey while Sainampeung was lowest in this case. The root DW of the 8 maize varieties, namely, NS72, CM, Pioneer A33, Pumpui, Super sweet, 888, Dragon 8 Rows and Semi-sweet maize, was falling between (Table 4.2.5).

Total dry weight (Total DW)

The effect of water stress on total DW at 6 weeks depressed with increasing water stress ($P < 0.01$). The effect was strong at 50%FC. At 67%FC, Loeung Mongkul maize variety had the highest, followed by Super sweet and Sainampeung, the lowest total DW. The total DW of 8 maize varieties, namely, Sor Chey, Semi-sweet maize, Pumpui, CM, NS72, Dragon 8 Rows, Pioneer A33 and 888, was falling between (Table 4.2.6). At 50%FC, NS72 and, Pumpui had the total DW highest while Sainampeung was lowest in this case. The total DW of the 8 maize varieties, namely, Loeug Mongkul, Super sweet, Dragon 8 Rows, Semi-sweet maize, Sor Chey, CM, 888 and Pioneer A33, was falling between (Table 4.2.6).

Table 4.2.1 Effect of water levels on plant height (cm) of 11 maize varieties at 6 weeks after planting.

Maize variety	Plant height	
	67%FC	50%FC
Pioneer A33	26.63 de	22.19 hi
NS72	28.58 bcd	24.19 gh
CM	26.40 defg	18.67 k
888	21.08 ij	19.43 jk
Pumpui	33.42 a	26.38 defg
Sainampeung	27.90 bcde	23.52 h
Super sweet	33.54 a	28.88 bc
Semi-sweet maize	29.59 b	26.21 efg
Dragon 8 rows	29.09 bc	26.92 cde
Loeug Mongkul	29.09 bc	24.35 fgh
Sor Chey	26.50 def	20.75 ijk

Means follow by different letter differ significantly by $LSD_{0.05}$

Table 4.2.2 Effect of water levels on leaf area (cm²) of 11 maize varieties at 6 weeks after planting.

Maize variety	Leaf area	
	67%FC	50%FC
Pioneer A33	1190 g	868 i
NS72	1519 c	1137 g
CM	1661 b	1177 g
888	1503 cd	1134 g
Pumpui	1838 a	1393 de
Sainampeung	1421 cde	999 h
Super sweet	1767 ab	1349 ef
Semi-sweet maize	1815 a	1245 fg
Dragon 8 rows	1795 a	1411 cde
Loeug Mongkul	1787 a	1169 g
Sor Chey	1817 a	1140 g

Means follow by different letter differ significantly by LSD_{0.05}

Table 4.2.3 Effect of water levels on root length (cm) of 11 maize varieties at 6 weeks after planting.

Maize variety	Root length	
	67%FC	50%FC
Pioneer A33	61.25 <u>bcdef</u>	52.75 <u>h</u>
NS72	67.50 <u>ab</u>	57.25 <u>efgh</u>
CM	60.25 <u>cdefg</u>	59.00 <u>defgh</u>
888	66.75 <u>ab</u>	55.00 <u>fgh</u>
Pumpui	59.75 <u>cdefgh</u>	54.00 <u>gh</u>
Sainampeung	59.75 <u>cdefgh</u>	58.00 <u>defgh</u>
Super sweet	59.25 <u>cdefgh</u>	54.50 <u>fgh</u>
Semi-sweet maize	69.75 <u>a</u>	55.75 <u>fgh</u>
Dragon 8 rows	56.25 <u>fgh</u>	58.50 <u>defgh</u>
Loeug Mongkul	69.50 <u>a</u>	66.25 <u>abc</u>
Sor Chey	64.50 <u>abcd</u>	63.50 <u>abcde</u>

Means follow by different letter differ significantly by $LSD_{0.05}$

Table 4.2.4 Effect of water levels on shoot dry weight (g/plant) of 11 maize varieties at 6 weeks after planting.

Maize variety	Shoot dry weight	
	67%FC	50%FC
Pioneer A33	5.35 d	3.33 f
NS72	6.71 c	5.16 d
CM	6.64 c	3.64 f
888	5.23 d	3.48 f
Pumpui	7.14 abc	5.22 d
Sainampeung	5.22 d	3.48 f
Super sweet	7.60 ab	4.85 de
Semi-sweet maize	7.80 a	4.84 de
Dragon 8 rows	6.81 bc	4.81 de
Loeug Mongkul	7.57 ab	4.77 de
Sor Chey	7.36 abc	4.08 ef

Means follow by different letter differ significantly by $LSD_{0.05}$

Table 4.2.5 Effect of water levels on root dry weight (g/plant) of 11 maize varieties at 6 weeks after planting.

Maize variety	Root dry weight	
	67%FC	50%FC
Pioneer A33	1.86 ef	1.56 hijkl
NS72	2.14 bc	1.64 ghij
CM	2.33 a	1.59 hijk
888	1.94 de	1.42 lm
Pumpui	2.05 cd	1.54 ijkl
Sainampeung	1.52 jkl	1.18 n
Super sweet	2.22 ab	1.47 kl
Semi-sweet maize	1.60 hijk	1.26 n
Dragon 8 rows	1.71 fgh	1.28 mn
Loeug Mongkul	2.34 a	1.78 efg
Sor Chey	2.28 ab	1.68 ghi

Means follow by different letter differ significantly by $LSD_{0.05}$

Table 4.2.6 Effect of water levels on total dry weight (g/plant) of 11 maize varieties at 6 weeks after planting.

Maize variety	Total dry weight	
	67%FC	50%FC
Pioneer A33	7.20 e	4.89 ij
NS72	8.85 cd	6.80 ef
CM	8.98 bcd	5.22 hij
888	7.17 e	4.90 ij
Pumpui	9.19 abcd	6.76 ef
Sainampeung	6.73 ef	4.67 j
Super sweet	9.82 ab	6.32 efg
Semi-sweet maize	9.39 abcd	6.09 fgh
Dragon 8 rows	8.51 d	6.09 fgh
Loeug Mongkul	9.90 a	6.55 efg
Sor Chey	9.63 abcd	5.76 ghi

Means follow by different letter differ significantly by $LSD_{0.05}$

Ranking mean of reduction of studied parameters of maize varieties

The ranking mean of reduction (%) of plant height, leaf area, root length, shoot dry weight, root dry weight and total dry weight of each maize variety at 50%FC relative to those at 67%FC were shown in table 4.2.7. The Dragon 8 Rows was compared, smallest ranking mean of reduction on all parameters , followed by

NS72 while Sor Chey and CM maize varieties were biggest ranking mean of reduction. The mean of ranking of all parameters of 8 maize varieties, namely, Sainampeung , Pumpui, 888, Pioneer A33, Super sweet, Loeung Mongkul and Semi-sweet maize, was falling between.

Table 4.2.7 Ranking mean of reduction (%) of studied parameters of maize varieties at 50%FC compared to 67%FC.

Maize variety	PH	LA	RL	SDW	RDW	TDW	Mean \pm SD
Pioneer A33	8	6	8	8	1	5	6 \pm 2.52
NS72	5	4	9	1	4	1	4 \pm 2.71
CM	11	7	2	11	10	11	9 \pm 3.30
888	2	4	10	4	9	5	6 \pm 2.87
Pumpui	9	2	7	2	6	2	5 \pm 2.81
Sainampeung	6	8	4	4	2	4	5 \pm 1.89
Super sweet	4	2	6	6	11	9	6 \pm 2.98
Semi-sweet maize	3	9	11	8	2	8	7 \pm 3.24
Dragon 8 rows	1	1	1	3	6	3	3 \pm 1.80
Loeug Mongkul	6	10	5	7	5	7	7 \pm 1.70
Sor Chey	10	11	2	10	8	10	9 \pm 3.04

Note : PH= plant height, LA= leaf area, RL= root length, SDW= shoot dry weight

RDW= root dry weight and TDW= total dry weight.

4.3 Experiment 3

This experiment found that, the plant height, leaf area, root length, shoot dry weight, root dry weight, total dry weight and total NPK content in shoot and root were significant affected by interaction between varieties and water levels.

Plant Height

The effect of water levels on plant height at 6 weeks after planting was depressed with increasing water stress ($P < 0.01$). The effect was slight at 67%FC except Loeung Mongkul, and most pronounced at 50%FC (Figure 4.3.1). At 100%FC, Dragon 8 Rows maize variety has highest plant height and 888 the shortest but 888 was not significant difference from CM on plant height. The plant height of two maize varieties, namely, Loeung Mongkul, was falling between. At 67%FC, Loeung Mongkul had highest and 888 the shortest plant height. The plant height of two maize varieties, namely, Dragon 8 Rows and CM, was falling between, but CM and 888 maize varieties were not significant difference from each other in this case. At 50%FC, Dragon 8 Rows variety had highest plant height and 888 the shortest in this case. The plant height of two maize varieties, namely, Loeung Mongkul and CM, was falling between.

Leaf area

The effect of water levels on leaf area at 6 weeks after planting was depressed with increasing water stress ($P < 0.01$). The effect was slight at 67%FC and most pronounced at 50%FC (Figure 4.3.2). At 100%FC, Loeung Mongkul maize variety has highest leaf area and 888 the lowest. The leaf area of two maize varieties, namely, CM and Dragon 8 Rows, was falling between, and there were not significant difference from each other. At 67%FC, Loeung Mongkul also had highest and 888

the lowest leaf area. The leaf area of two maize varieties, namely, CM and Dragon 8 Rows, was falling between. At 50%FC, Dragon 8 Rows maize variety had highest leaf area and 888 the lowest in this case. The leaf area of two maize varieties, namely, Loeung Mongkul and CM, was falling between.

Root Length

The effect of water levels on root length at 6 weeks after planting was depressed with increasing water stress ($P < 0.01$). The effect was slight at 67%FC and most pronounced at 50%FC except 888 maize variety (Figure 4.3.3). At 100%FC, CM maize variety has slight longer root length than CM, Loeung Mongkul and 888 maize varieties but there were not significant difference from each other on root length, and Dragon 8 Rows the shortest. At 67%FC, CM had longest and Dragon 8 Rows the shortest root length. But Dragon 8 Rows and 888 were slight reduce and was not significant from each other. The root length of maize variety, namely, Loeung Mongkul, was falling between. At 50%FC, CM had longest root length and Dragon 8 Rows the shortest in this case. The root length of two maize varieties, namely, 888 and Loeung Mongkul, was falling between.

Shoot dry weight (Shoot DW)

The effect of water levels on shoot DW at 6 weeks after planting was depressed with increasing water stress ($P < 0.01$). The effect was slight at 67%FC and most pronounced at 50%FC (Figure 4.3.4). At 100%FC, Loeung Mongkul maize variety has highest shoot DW and 888 the lowest. The shoot DW of two maize varieties, namely, CM and Dragon 8 Rows, was falling between, but there were not significant difference from each other in this case. At 67%FC, Loeung Mongkul had highest and 888 the lowest shoot DW. The shoot DW of two maize varieties, namely,

CM and Dragon 8 Rows, was falling between, and there were not significant difference from each other. At 50%FC, Dragon 8 Rows maize variety had highest shoot DW and 888 the lowest in this case. But Dragon 8 Rows and Loeung Mongkul were not significant difference from each other on shoot DW. The shoot DW of maize variety, namely, CM, was falling between.

Root dry weight (Root DW)

The effect of water levels on root DW at 6 weeks after planting was depressed with increasing water stress ($P < 0.01$). The effect was slight at 67%FC only Dragon 8 Rows and other maize varieties had not effect on root DW, and most pronounced at 50%FC (Figure 4.3.5). At 100%FC, CM maize variety has highest root DW and 888 the lowest. But CM and Loeung Mongkul maize varieties were not significant difference from each other on root DW. The root DW of maize variety, namely, Dragon 8 Rows, was falling between. At 67%FC, CM maize variety still has highest root DW and Dragon 8 Rows the lowest. But CM and Loeung Mongkul maize varieties were slight increased and has not significant from each other. The root DW of maize varieties, namely, 888, was falling between but 888 and Dragon 8 Rows were not significant difference from each other in this case. At 50%FC, CM maize variety has highest root DW and 888 the lowest. But CM and Loeung Mongkul maize varieties were not significant from each other. The root DW of maize variety, namely, Dragon 8 Rows, was falling between.

Total dry weight (Total DW)

The effect of water levels on total DW at 6 weeks after planting was depressed with increasing water stress ($P < 0.01$). The effect was not at 67%FC but most pronounced at 50%FC (Figure 4.3.6). At 100%FC, Loeung Mongkul maize variety

has highest total DW and 888 the lowest. The total DW of two maize varieties, namely, CM and Dragon 8 Rows, was falling between. At 67%FC, Loeung Mongkul still had highest and 888 the lowest total DW. The total DW of two maize varieties, namely, CM and Dragon 8 Rows, was falling between. At 50%FC, Loeung Mongkul variety had highest total DW and 888 the lowest in this case. But Loeung Mongkul and Dragon 8 Rows varieties were not significant from each other in this growth stage. The total DW of maize variety, namely, CM, was falling between.

Reduction (%) of all parameters of maize varieties

The reduction (%) of plant height, leaf area, root length, shoot dry weight, root dry weight and total dry weight of each maize variety at 50%FC relative to those at 100%FC were shown in table 4.3.1. The general, Dragon 8 Rows was compared, smallest reduction on all parameters, followed by Loeung Mongkul while 888 maize variety was biggest reduction. All parameters of maize variety, namely, CM, was falling between.

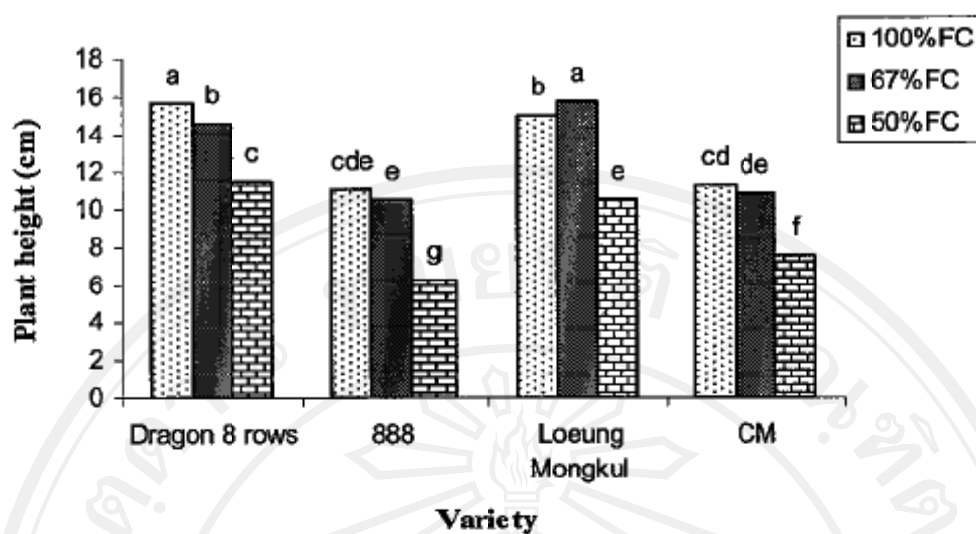


Figure 4.3.1 Effect of water levels on plant height (cm) of four maize varieties at 6 weeks after planting. Different letters above the bars indicate significant difference by LSD_{0.05}

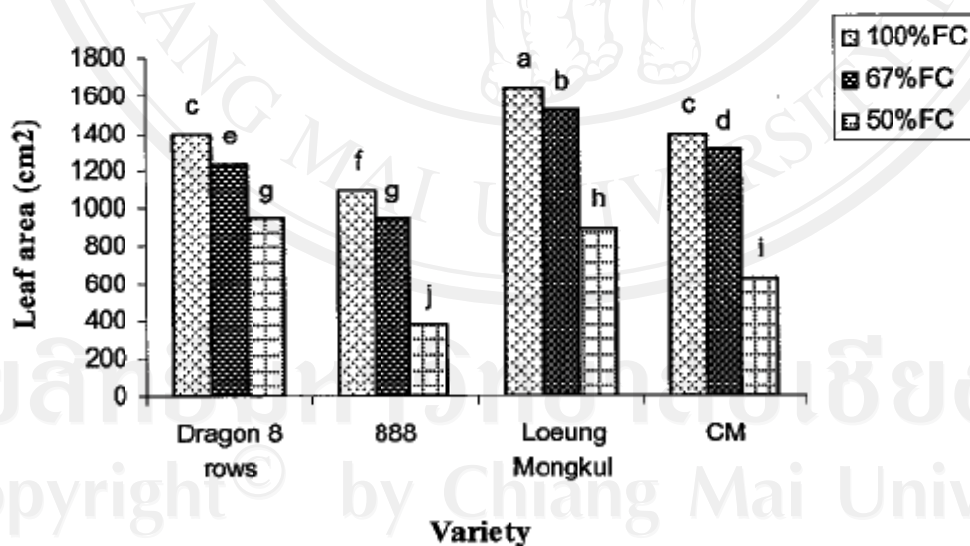


Figure 4.3.2 Effect of water levels on leaf area (cm²/plant) of four maize varieties at 6 weeks after planting. Different letters above the bars indicate significant difference by LSD_{0.05}

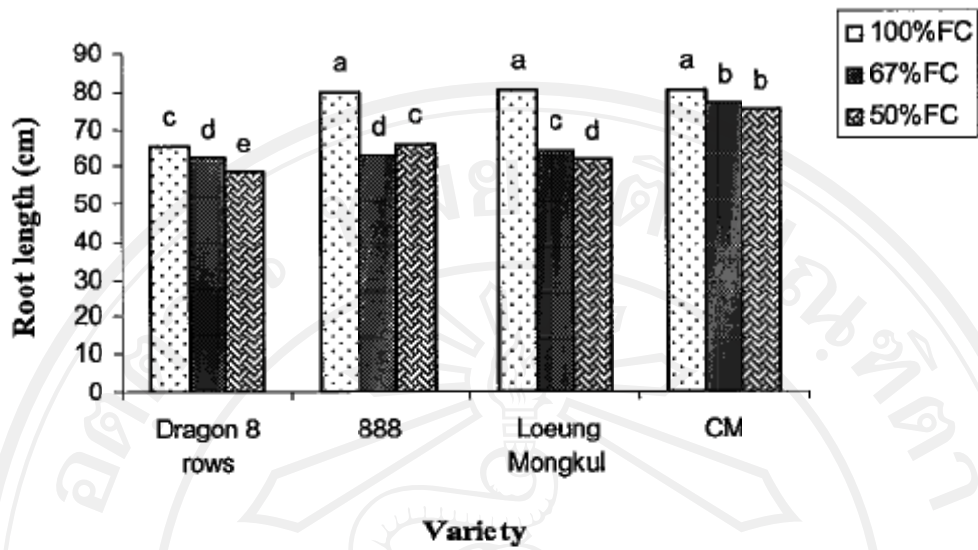


Figure 4.3.3 Effect of water levels on root length (cm) of four maize varieties at 6 weeks after planting. Different letters above the bars indicate significant difference by $LSD_{0.05}$

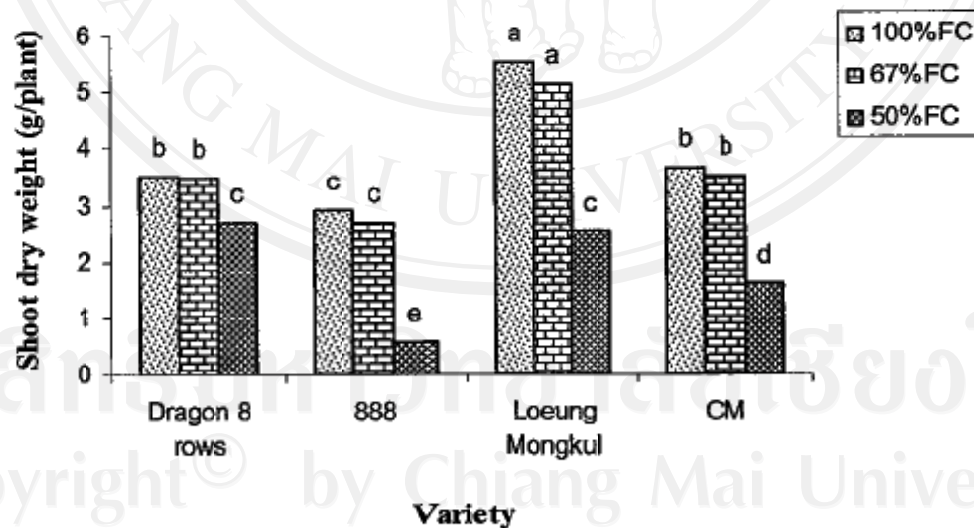


Figure 4.3.4 Effect of water levels on shoot dry weight (g/plant) of four maize varieties at 6 weeks after planting. Different letters above the bars indicate significant difference by $LSD_{0.05}$

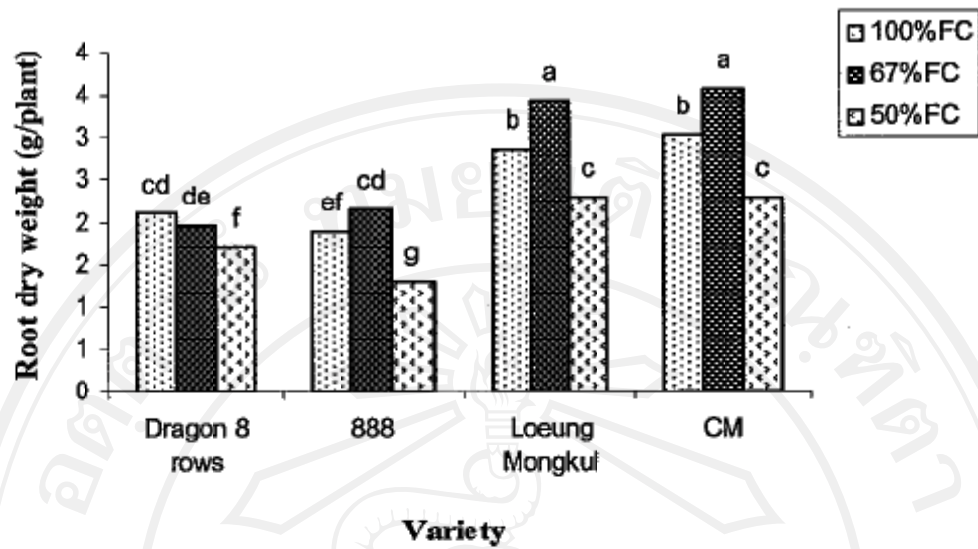


Figure 4.3.5 Effect of water levels on root dry weight (g/plant) of four maize varieties at 6 weeks after planting. Different letters above the bars indicate significant difference by $LSD_{0.05}$

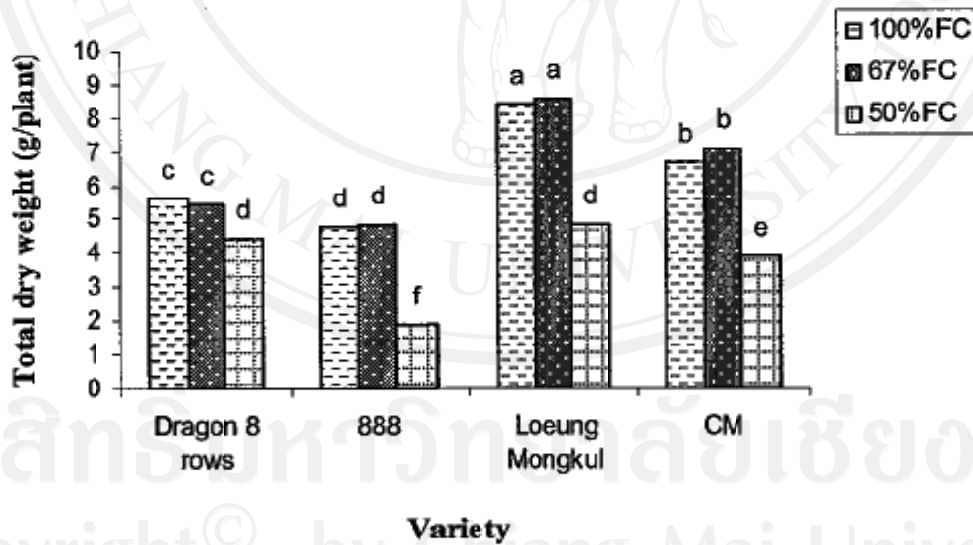


Figure 4.3.6 Effect of water levels on total dry weight (g/plant) of four maize varieties at 6 weeks after planting. Different letters above the bars indicate significant difference by $LSD_{0.05}$

Table 4.3.1 Reduction (%) of studied parameters of maize varieties at 50%FC compared to 100%FC.

Parameters	Variety			
	Dragon 8 Rows	888	Locung Mongkul	CM
	% reduction at 50%FC			
Plant height	26	44	30	33
Leaf area	32	65	45	56
Root length	11	18	23	7
Shoot dry weight	23	80	54	57
Root dry weight	19	31	20	24
Total dry weight	21	61	42	42

Total N content in shoot and root (Total N content in SR)

The effect of water levels on total N content in SR at 6 weeks after planting was depressed with increasing water stress ($P < 0.01$). The effect was not at 67%FC and most pronounced at 50%FC (Figure 4.3.7). At 100%FC, Loeung Mongkul maize variety has highest total N content in SR and 888 the lowest. The total N content in SR of two maize varieties, namely, Dragon 8 Rows and CM, was falling between, but there were not significant difference from each other. At 67%FC, Loeung Mongkul still had highest and 888 the lowest total N content in SR. The total N content in SR of two maize varieties, namely, CM and Dragon 8 Rows, was falling between, but there were not significant difference from each other. At 50%FC, Dragon 8 Rows variety had highest total N content in SR but Dragon 8 Rows and Loeung

Mongkul were not significant difference from each other while 888 the lowest in this case. The total N content in SR of maize variety, namely, and CM, was falling between.

Total P content in shoot and root

The effect of water levels on total P content in SR at 6 weeks after planting was depressed with increasing water stress ($P < 0.01$). The effect was slight at 67%FC except Loeung Mongkul, and most pronounced at 50%FC (Figure 4.3.8). At 100%FC, Loeung Mongkul maize variety has highest total P content in SR and 888 the lowest. The total P content in SR of two maize varieties, namely, CM and Dragon 8 Rows, was falling between. At 67%FC, Loeung Mongkul still had highest and 888 the lowest total P content in SR. The total P content in SR of two maize varieties, namely, CM and Dragon 8 Rows, was falling between. At 50%FC, Dragon 8 Rows variety had highest total P content in SR and 888 the lowest in this case. But Dragon 8 Rows and Loeung Mongkul were not significant from each other. The total P content in SR of maize variety, namely, CM, was falling between.

Total K content in shoot and root

The effect of water levels on total K content in SR at 6 weeks after planting was depressed with increasing water stress ($P < 0.01$). The effect was not at 67%FC and most pronounced at 50%FC (Figure 4.3.9). At 100%FC, Loeung Mongkul maize variety has highest total K content in SR but Loeung Mongkul and CM were not significant difference from each other while 888 the lowest. The Dragon 8 Rows was not significant difference from CM on total K content in SR. At 67%FC, Loeung Mongkul still had highest and 888 the lowest total K content in SR. But 888 and Dragon 8 Rows were not significant difference from each other. The total K content

in SR of maize variety, namely, CM, was falling between. At 50%FC, Dragon 8 Rows variety had highest total K content in SR and 888 the lowest in this case. But Dragon 8 Rows, Loeung Mongkul and CM were slight reduce and has not significant from each other.

Reduction (%) of total NPK content

The reduction (%) of total NPK content in shoot and root of each maize variety at 50%FC relative to those at 100%FC were shown in table 4.3.2. The maize variety Dragon 8 Rows was compared, smallest reduction on all parameters, followed by Loeung Mongkul while 888 maize variety was biggest reduction. All parameters of maize variety, namely, CM, was falling between.

Table 4.3.2 Reduction (%) of studied parameters (Total NPK content) of maize varieties at 50%FC compared to 100%FC.

Parameters	Variety			
	Dragon 8 Rows	888	Loeung Mongkul	CM
	% reduction at 50%FC			
Total N content	13	63	37	44
Total P content	35	73	50	56
Total K content	41	67	48	52

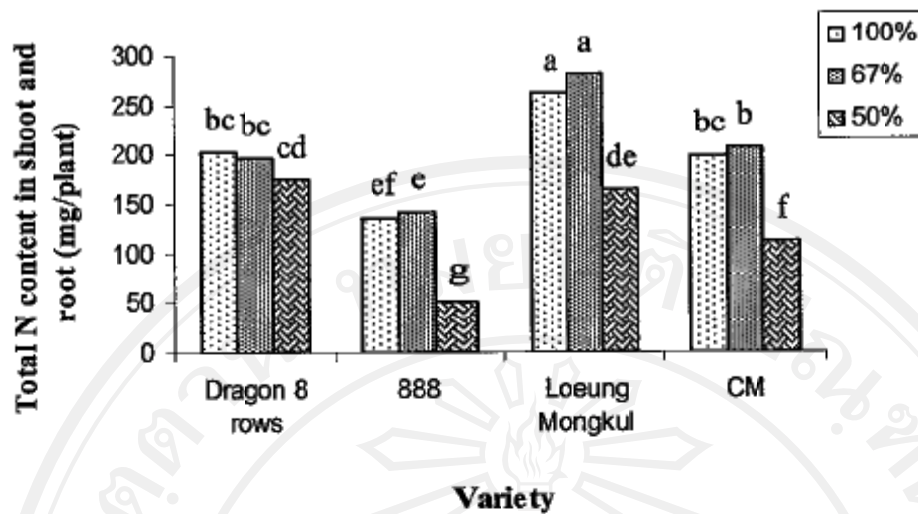


Figure 4.3.7 Effect of water levels on total N content in shoot and root (mg/plant) of four maize varieties at 6 weeks after planting. Different letters above the bars indicate significant difference by $LSD_{0.05}$

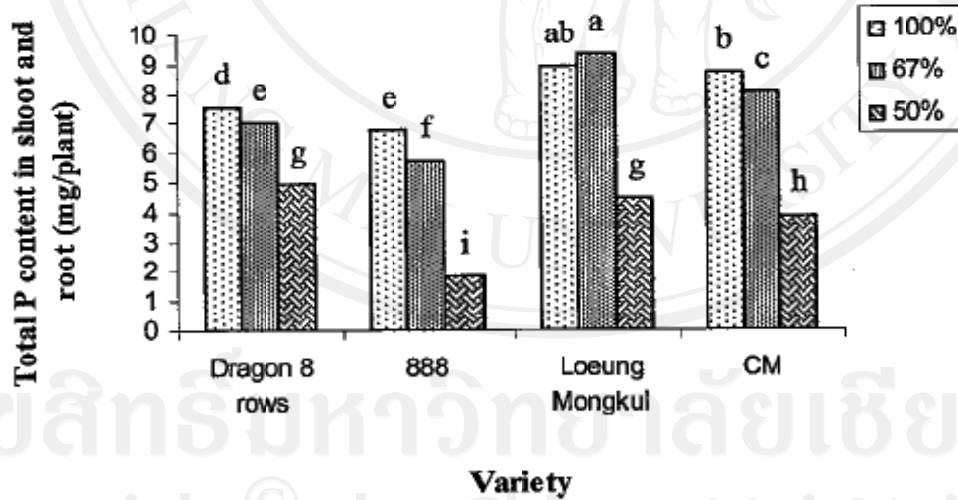


Figure 4.3.8 Effect of water levels on total P content in shoot and root (mg/plant) of four maize varieties at 6 weeks after planting. Different letters above the bars indicate significant difference by $LSD_{0.05}$

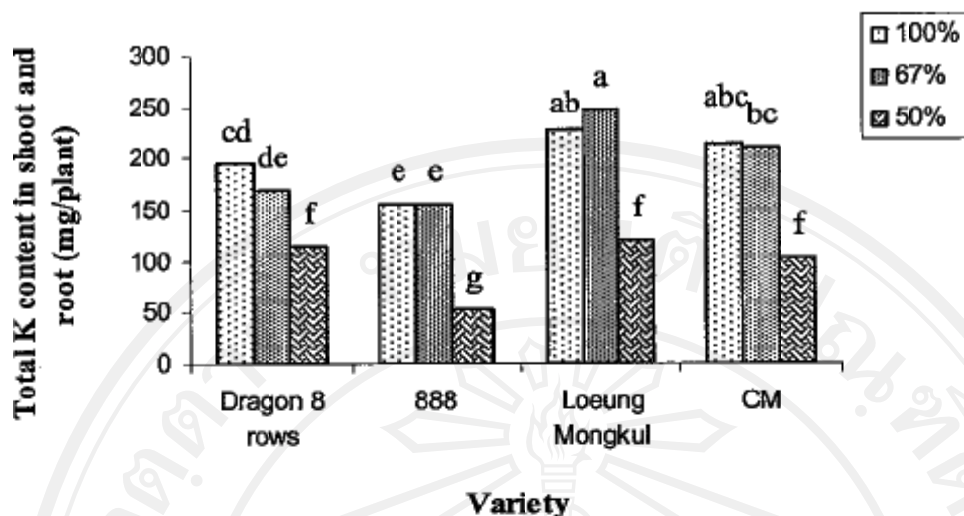


Figure 4.3.9 Effect of water levels on total K content in shoot and root (mg/plant) of four maize varieties at 6 weeks after planting. Different letters above the bars indicate significant difference by $LSD_{0.05}$

Effects of water stress on total NPK concentration (%)

In this experiment showed that, all total N, P and K concentration in shoot and root of four maize varieties were not significant affected by interaction between varieties and water levels.

Differences of maize varieties on total NPK concentration in shoot and root

Among the studied four maize varieties, they were significant different on total N, P and K concentration in shoot and root. Dragon 8 Rows maize variety had more total N concentration in shoot and root than Loeung Mongkul, CM and 888 ($P < 0.01$) while 888 maize variety was poorest, but 888 and CM were not significant difference from each other on total N concentration in shoot and root in this case (Table 4.3.3).

Dragon 8 Rows was the best for total P concentration in shoot and root but not differenced significantly from 888 maize variety while Loeung Mongkul was poorest compare to Dragon 8 Rows ($P < 0.01$) (Table 4.3.3).

Dragon 8 Rows was the best for total K concentration in shoot and root but not differenced significantly from 888 and CM maize varieties while Loeung Mongkul was poorest compare to Dragon 8 Rows ($P < 0.01$) (Table 4.3.3).

Effects of water levels on total NPK concentration in shoot and root

Increasing of water stress resulted in significant reduction of total PK concentration in shoot and root of maize varieties except total N concentration in shoot and root as show in table 4.3.2. In the case of total P concentration in shoot and root of each level of water stress could reduce significantly total P concentration in shoot and root ($P < 0.01$). Significant reduction of total K concentration in shoot and root could observed only at 50%FC level compared to that at 100%FC and 67%FC ($P < 0.01$)

Table 4.3.3 Effect of water levels on total NPK concentration of 888 maize variety at 3 weeks after planting.

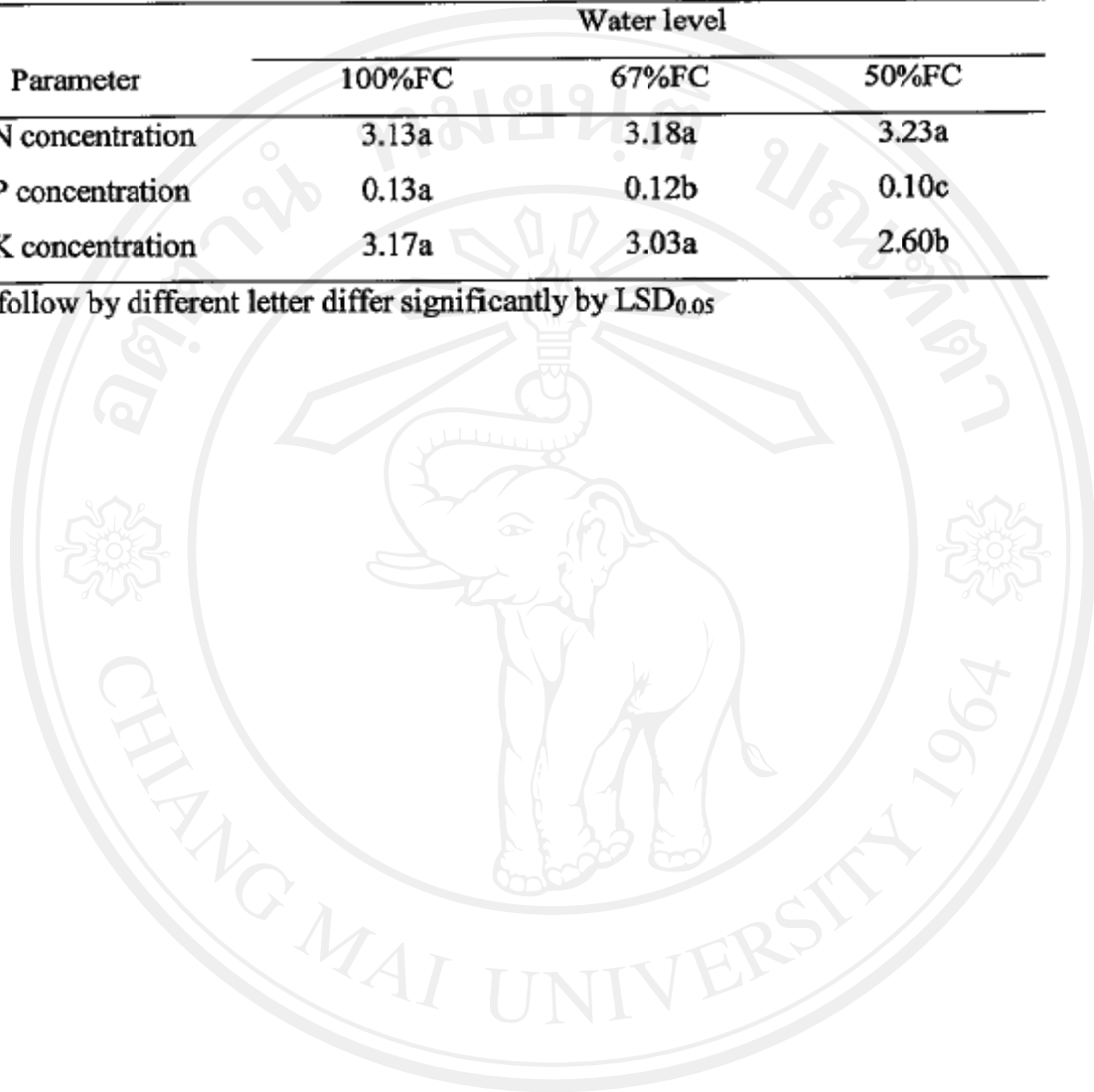
Parameter	Maize variety			
	Dragon 8 Rows	888	Loeung Mongkul	CM
Total N concentration	3.73 a	2.81 c	3.27 b	2.90 c
Total P concentration	0.12 a	0.12 ab	0.10 c	0.11 b
Total K concentration	3.09 a	3.05 a	2.66 b	2.94 a

Means follow by different letter differ significantly by $LSD_{0.05}$

Table 4.3.4 Effect of water levels on total NPK concentration of 888 maize variety at 3 weeks after planting.

Parameter	Water level		
	100%FC	67%FC	50%FC
Total N concentration	3.13a	3.18a	3.23a
Total P concentration	0.13a	0.12b	0.10c
Total K concentration	3.17a	3.03a	2.60b

Means follow by different letter differ significantly by $LSD_{0.05}$



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4.4 Experiment 4

In this experiment showed that, there were significant effects of water levels on all studied parameters while varieties affected ($P < 0.01$) only plant height and root length and leaf area, shoot dry weight, root dry weight and total dry weight were significant affected by interaction between varieties and water levels.

Differences of maize varieties on plant height and root length

Among the studied four maize varieties, they were significant different on plant height and root length only but not in the other parameters. Dragon 8 Rows and Locung Mongkul maize varieties had more plant height than 888 and CM ($P < 0.01$). CM maize variety was the best for root length but not differenced significantly from 888 maize variety while Dragon 8 Rows and Locung Mongkul were poorest compare to CM ($P < 0.01$). However there were no significant differences of root length among Dragon 8 Rows, 888 and Locung Mongkul maize varieties (Table 4.4.1).

Effects of water levels on plant height and root length

Increasing of water stress resulted in significant reduction of plant height and root length of maize varieties as show in table 4.4.2. Significant reduction of plant height could observed only at 50%FC level compared to that at 100%FC and 67%FC ($P < 0.05$). In the case of root length increasing of each level of water stress could reduce significantly root length ($P < 0.01$).

Leaf area

The effect of water levels on leaf area at 6 weeks after planting was depressed with increasing water stress ($P < 0.01$). The effect was slight at 67%FC and most pronounced at 50%FC (Table 4.4.3). At 100%FC, Locung Mongkul had the largest leaf area and 888 the lowest. But 888, CM and Dragon 8 Rows were not significant

difference from each other on leaf area. At 67%FC Dragon 8 Rows had slight larger than 888, CM and Loeung Mongkul but there were not significant difference from each other in this case. At 50%FC Dragon 8 Rows still had slight larger than Loeung Mongkul, 888 and CM but there were not significant difference from each other in this growth stage (Table 4.4.3).

Shoot dry weight (Shoot DW)

The effect of water levels on shoot DW at 6 weeks after planting was depressed with increasing water stress ($P < 0.01$). The effect was slight at 67%FC and most pronounced at 50%FC (Table 4.4.4). At 100%FC, Loeung Mongkul had the highest shoot DW and 888 the lowest. But 888, CM and Dragon 8 Rows were not significant difference from each other on shoot DW. At 67%FC Loeung Mongkul still had slight higher than 888, but there were not significant difference from each other. And also 888 was not significant difference from Dragon 8 Rows on shoot DW in this case. However CM the lowest but CM and Dragon 8 Rows and 888 were not significant difference from each other. At 50%FC Dragon 8 Rows had slight higher shoot DW than 888 and Loeung Mongkul but there were not significant difference from each other in this growth stage. CM maize variety the lowest but CM, Loeung Mongkul and 888 were not significant difference from each other on shoot DW. (Table 4.4.4).

Root dry weight (Root DW)

The effect of water levels on shoot DW at 6 weeks after planting was depressed with increasing water stress ($P < 0.01$). The effect was slight at 67%FC and most pronounced at 50%FC (Table 4.4.5). At 100%FC, CM variety had highest root DW at 6 weeks after planting while the lowest was Dragon 8 Rows. The root DW of

two maize varieties, namely, 888 and Loeung Mongkul, was falling between but there were not different from each other for root DW. When the water level decreased to 67%FC, Loeung Mongkul had slight higher root DW than Dragon 8 Rows but there were not significant difference from each other. While 888 maize variety was lowest but 888 and CM were not significant difference from each other. At 50%FC 888 had highest and Dragon 8 Rows the lowest. But 888 and CM were not significant difference from each other in this case on root DW. For Loeung Mongkul maize variety had slight higher root DW than Dragon 8 Rows but were not significant different from each other.

Total dry weight (Total DW)

The effect of water levels on shoot DW at 6 weeks after planting was depressed with increasing water stress ($P < 0.01$). The effect was slight at 67%FC and most pronounced at 50%FC (Table 4.4.6). At 100%FC, Loeung Mongkul was the best variety for total DW and Dragon 8 Rows the lowest. The total DW of maize variety, namely, CM, was falling between. For 888 maize variety had slight higher total DW than Dragon 8 Rows and not significant difference from each other. At 67%FC Loeung Mongkul had highest but Loeung Mongkul and Dragon 8 Rows were not significant difference from each other. While CM was lowest but CM, 888 and Dragon 8 Rows were not significant difference from each other in this growth stage. At 50%FC 888 had slight higher than Dragon 8 Rows, Loeung Mongkul and CM but there were not significant difference from each other on total DW in this case.

Reduction (%) of all parameters of maize varieties

Reduction (%) of plant height, leaf area, root length, shoot DW, root DW and total DW of each maize variety at 50%FC relative to those at 100%FC were shown in

table 4.4.7. The 888 was compared, small reduction of all studied parameters except leaf area and total DW were less than the other varieties while the most reduction on root DW and total DW were shown by Loeung Mongkul. Where Dragon 8 Rows and 888 were compared, small reduction on plant height, root length, shoot DW and root DW of 888 than Dragon 8 Rows was observed.

Dry weight of root : shoot ratio

When water stress increased particularly at 50%FC dry weight of root: shoot ratio of 888 was highest, followed by CM and Loeung Mongkul while Dragon 8 Rows the lowest (Table 4.4.8).

Table 4.4.1 Differences of plant height and root length at 6 weeks after planting of four maize varieties.

Parameter	Maize variety			
	Dragon 8 Rows	888	Loeung Mongkul	CM
Plant height (cm)	25 a	17 b	24 a	18 b
Root length (cm)	104 b	107 ab	105 b	111 a

Means in the same line follow by different letter differ significantly by $LSD_{0.05}$

Table 4.4.2 Effects of water levels on the averages of plant height and root length of all maize varieties at 6 weeks after planting.

Parameter	Water level		
	100%FC	67%FC	50%FC
Plant height (cm)	23 a	23 a	17 b
Root length (cm)	120 a	111 b	89 c

Means in the same line follow by different letter differ significantly by LSD_{0.05}

Table 4.4.3 Effect of water levels on leaf area (cm²) of four maize varieties at 6 weeks after planting.

Maize variety	Water level		
	100%FC	67%FC	50%FC
Dragon 8 Rows	3760.10 b	3363.80 bc	2086.70 d
888	3560.10 bc	3499.60 bc	1756.20 d
Loeung Mongkul	4241.60 a	3279.00 c	1755.8 d
CM	3749.30 b	3300.30 bc	1810.70 d

Means follow by different letter differ significantly by LSD_{0.05}

Table 4.4.4 Effect of water levels on shoot dry weigh (g/plant) of four maize varieties at 6 weeks after planting.

Maize variety	Water level		
	100%FC	67%FC	50%FC
Dragon 8 Rows	28.43 <u>bc</u>	26.45 <u>cd</u>	22.88 <u>e</u>
888	27.00 <u>bcd</u>	27.47 <u>bcd</u>	21.62 <u>ef</u>
Loeung Mongkul	32.81 <u>a</u>	28.47 <u>b</u>	22.30 <u>ef</u>
CM	27.76 <u>bcd</u>	25.79 <u>d</u>	21.01 <u>f</u>

Means follow by different letter differ significantly by LSD_{0.05}

Table 4.4.5 Effect of water levels on root dry weigh (g/plant) of four maize varieties at 6 weeks after planting.

Maize variety	Water level		
	100%FC	67%FC	50%FC
Dragon 8 Rows	5.46 <u>ef</u>	6.76 <u>cd</u>	3.25 <u>g</u>
888	8.27 <u>b</u>	5.33 <u>ef</u>	5.25 <u>ef</u>
Loeung Mongkul	7.90 <u>bc</u>	6.74 <u>cd</u>	3.32 <u>g</u>
CM	10.33 <u>a</u>	6.42 <u>de</u>	4.60 <u>f</u>

Means follow by different letter differ significantly by LSD_{0.05}

Table 4.4.6 Effect of water levels on total dry weight (g/plant) of four maize varieties at 6 weeks after planting.

Maize variety	Water level		
	100%FC	67%FC	50%FC
Dragon 8 Rows	33.88 cd	33.21 cd	26.12 e
888	35.26 c	32.80 d	26.87 e
Loeung Mongkul	40.71 a	35.21 c	25.61 e
CM	38.09 b	32.21 d	25.64 e

Means follow by different letter differ significantly by LSD_{0.05}

Table 4.4.7 Reduction (%) of studied parameters of maize varieties at 50%FC compared to 100%FC.

Parameters	Maize variety			
	Dragon 8 Rows	888	Loeung Mongkul	CM
	% reduction at 50%FC			
Plant height	26	21	32	30
Leaf area	45	51	39	52
Root length	29	21	28	26
Shoot dry weight	20	16	17	19
Root dry weight	41	36	57	55
Total dry weight	23	24	37	32

Table 4.4.8 Root and shoot ratio at 6 weeks after planting of different maize varieties at different water levels.

Maize variety	Water level		
	100%FC	67%FC	50%FC
Dragon 8 Rows	0.19	0.24	0.12
888	0.31	0.20	0.24
Loeung Mongkul	0.24	0.24	0.15
CM	0.37	0.25	0.22

4.5 Experiment 5

This experiment found that, the plant height, leaf area, root length, shoot dry weight, root dry weight, total dry weight and total NPK content in shoot and root were significant affected by interaction between varieties and water levels. Root dry weight at 0 to 25cm and 50 to 75cm deep soil layers were significant affected by interaction between maize varieties and water level. But at 25 to 50cm and 75 to 100cm deep soil layers were not significant affected by interaction between maize varieties and water level.

Plant height

The effect of water levels on plant height at 4 weeks after planting was depressed with increasing water stress ($P < 0.01$). The effect was slight at 67%FC and most pronounced at 50%FC (Figure 4.5.1). At 100%FC, the plant height of Loeung Mongkul maize variety has slight higher than Dragon 8 Rows, and there were not significant difference from each other on plant height in this case. At 67%FC, the plant height of Loeung Mongkul still had higher than Dragon 8 Rows, but there were not significant difference from each other. When increase water stress at 50%FC, Dragon 8 Rows variety had highest plant height and Loeung Mongkul the shortest in this case.

Leaf area

The effect of water levels on leaf area at 4 weeks after planting was depressed with increasing water stress ($P < 0.01$). The effect was slight at 67%FC and most pronounced at 50%FC (Figure 4.5.2). At 100%FC, Loeung Mongkul maize variety has largest leaf area and Dragon 8 Rows the lowest. At 67%FC, Dragon 8 Rows had slight larger leaf area than Loeung Mongkul, but there were not significant difference

from each other. When increase water stress at 50%FC, Dragon 8 Rows maize variety had largest leaf area and Loeung Mongkul the lowest in this case.

Root length

The effect of water levels on root length at 4 weeks after planting was depressed with increasing water stress ($P<0.05$). The effect was not at 67%FC and most pronounced at 50%FC (Figure 4.5.3). At 100%FC, Loeung Mongkul maize variety has slight longer root length than Dragon 8 Rows, but there were not significant difference from each. At 67%FC, Loeung Mongkul and Dragon 8 Rows had the same root length in this case. When increase water stress at 50%FC, Dragon 8 Rows maize variety had longest root length and Loeung Mongkul the lowest.

Shoot dry weight (Shoot DW)

The effect of water levels on shoot DW at 4 weeks after planting was depressed with increasing water stress ($P<0.01$). The effect was slight at 67%FC and most pronounced at 50%FC (Figure 4.5.4). At 100%FC, Loeung Mongkul maize variety has highest shoot DW and Dragon 8 Rows the lowest. At 67%FC, Dragon 8 Rows had highest shoot DW and Loeung Mongkul the lowest. When increase water stress at 50%FC, Dragon 8 Rows maize variety still had highest shoot DW and Loeung Mongkul the lowest in this case.

Root dry weight (Root DW)

The effect of water levels on root DW at 4 weeks after planting was depressed with increasing water stress ($P<0.01$). The effect was slight at 67%FC and most pronounced at 50%FC (Figure 4.5.5). At 100%FC, Loeung Mongkul maize variety has highest root DW and Dragon 8 Rows the lowest. At 67%FC, Loeung Mongkul had slight higher root DW than Dragon 8 Rows, but there were not significant

difference from each. When increase water stress at 50%FC, Dragon 8 Rows maize variety had highest root DW and Loeung Mongkul the lowest in this case.

Total dry weight (Total DW)

The effect of water levels on total DW at 4 weeks after planting was depressed with increasing water stress ($P < 0.01$). The effect was slight at 67%FC and most pronounced at 50%FC (Figure 4.5.6). At 100%FC, Loeung Mongkul maize variety has highest total DW and Dragon 8 Rows the lowest. At 67%FC, Dragon 8 Rows had highest total DW and Loeung Mongkul the lowest. When increase water stress at 50%FC, Dragon 8 Rows maize variety had highest total DW and Loeung Mongkul the lowest in this case.

Reduction (%) of all parameters of maize varieties

The reduction (%) of plant height, leaf area, root length, shoot dry weight, root dry weight and total dry weight of each maize variety at 50%FC relative to those at 100%FC were shown in table 4.5.1. Dragon 8 Rows was compared, smallest reduction on all parameters while Loeung Mongkul maize variety was biggest reduction.

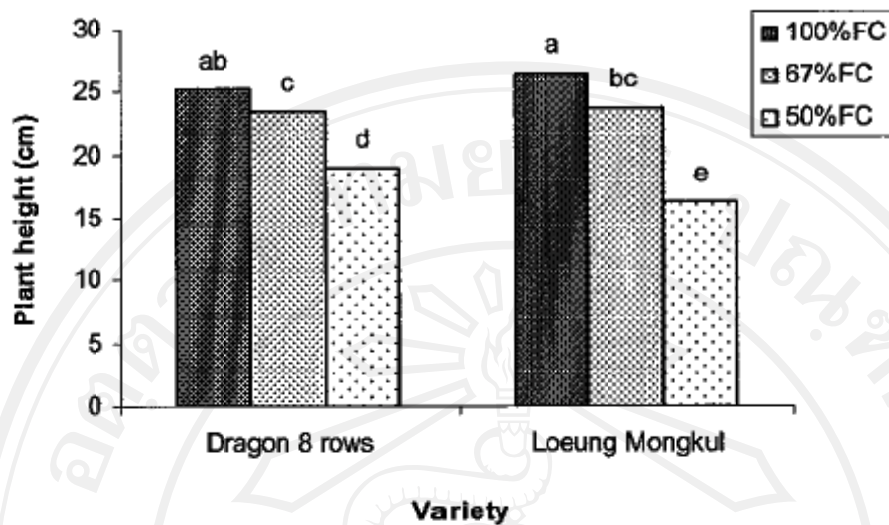


Figure 4.5.1 Effect of water levels on plant height (cm) of four maize varieties at 4 weeks after planting. Different letters above the bars indicate significant difference by $LSD_{0.05}$

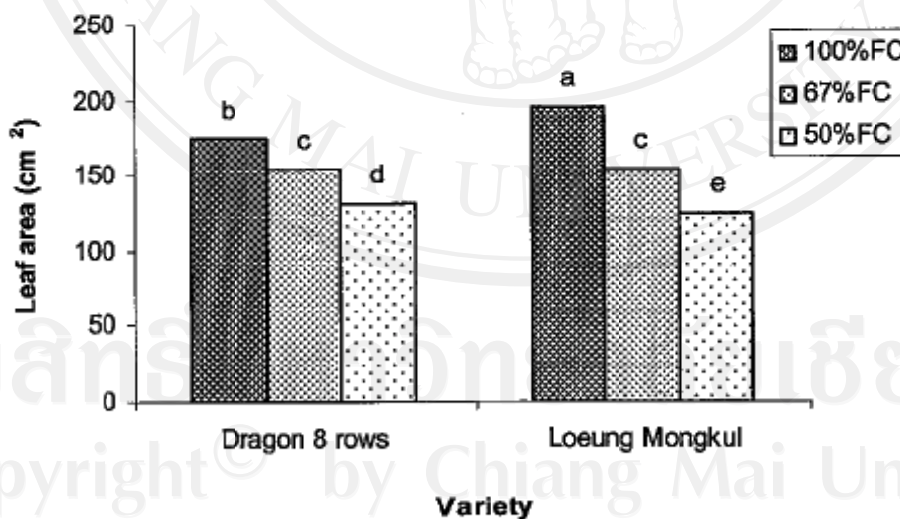


Figure 4.5.2 Effect of water levels on Leaf area (cm^2/plant) of four maize varieties at 4 weeks after planting. Different letters above the bars indicate significant difference by $LSD_{0.05}$

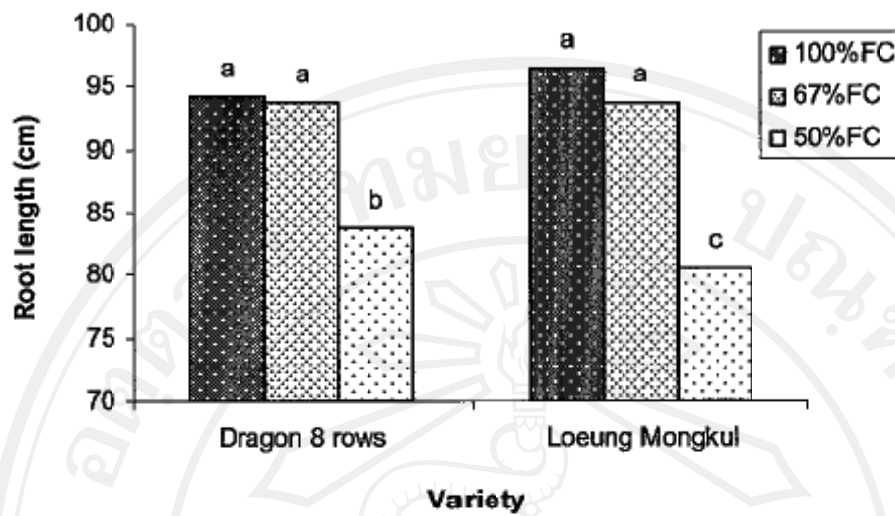


Figure 4.5.3 Effect of water levels on root length (cm) of four maize varieties at 4 weeks after planting. Different letters above the bars indicate significant difference by $LSD_{0.05}$

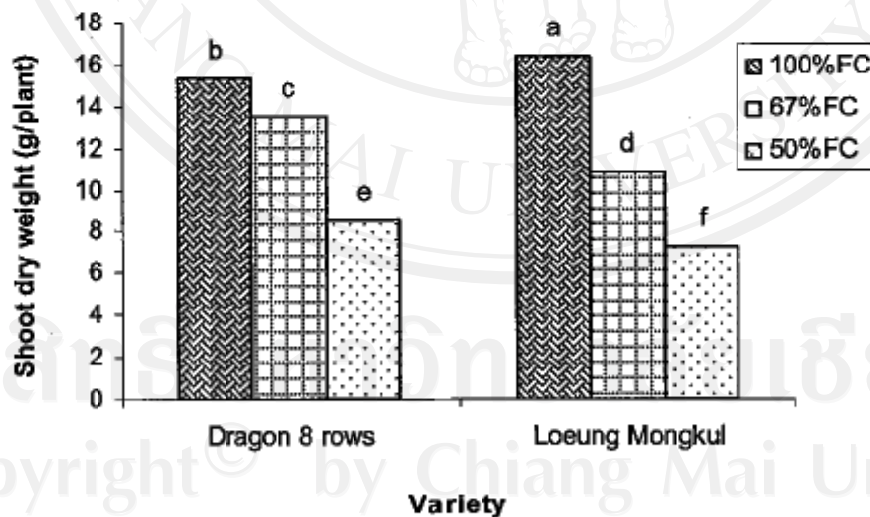


Figure 4.5.4 Effect of water levels on shoot dry weight (g/plant) of four maize varieties at 4 weeks after planting. Different letters above the bars indicate significant difference by $LSD_{0.05}$

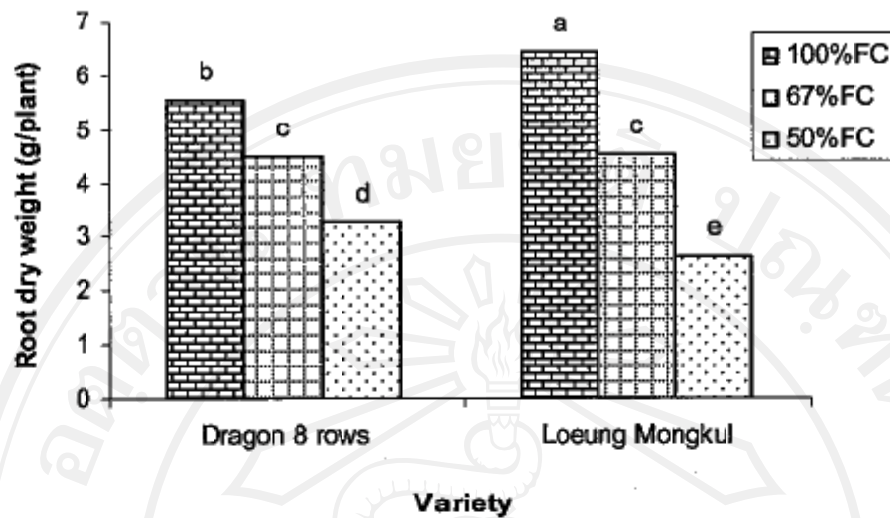


Figure 4.5.5 Effect of water levels on root dry weight (g/plant) of four maize varieties at 4 weeks after planting. Different letters above the bars indicate significant difference by $LSD_{0.05}$

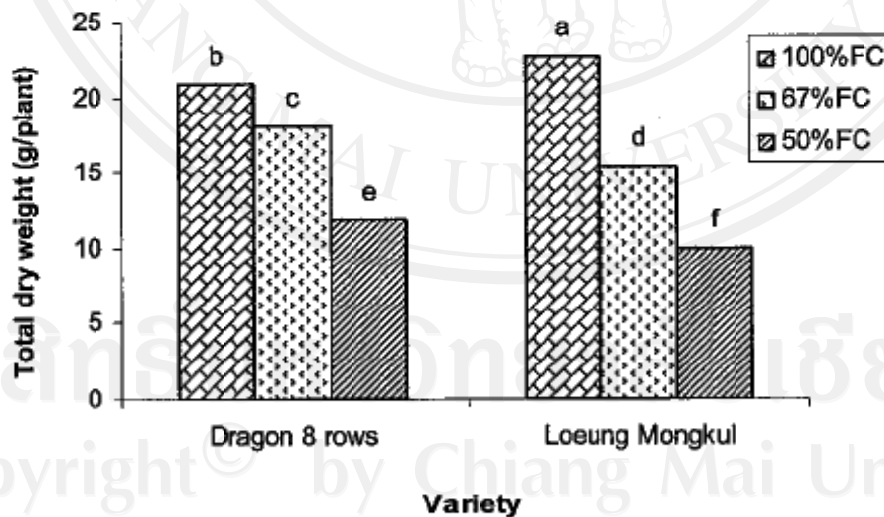


Figure 4.5.6 Effect of water levels on total dry weight (g/plant) of four maize varieties and water levels at 4 weeks after planting. Different letters above the bars indicate significant difference by $LSD_{0.05}$

Table 4.5.1 Reduction (%) of studied parameters of maize varieties at 50%FC compared to 100%FC.

Parameters	Maize variety	
	Dragon 8 Rows	Loeung Mongkul
	% reduction at 50%FC	
Plant height	25	39
Leaf area	25	36
Root length	11	17
Shoot dry weight	44	55
Root dry weight	40	59
Total dry weight	43	56

Root distribution

The result showed that, they were significant effect of water levels on all deep soil layers while varieties affected only root dry weight at 25cm to 50cm and 75cm to 100cm deep soil layers and root dry weight at 0cm to 25cm and 50cm to 75cm deep soil layers were significant affected by interaction between varieties and water levels.

Generally, at 0 to 25 cm deep soil layers of Dragon 8 rows and Loeung Mongkul maize varieties had more root dry weight than 25 to 50 cm, 50 to 75 cm and 75 to 100 cm deeps soil layers.

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Differences of maize varieties on root dry weight at 25cm to 50cm and 75 to 100cm deep soil layer.

Among the studied two maize varieties, they were significant difference on root dry weight at 25cm to 50cm and 75 to 100cm deep soil layer only but not in the other parameters. At 25cm to 50cm deep soil layer, Dragon 8 Rows had more root dry weight than Loeung Mongkul ($P < 0.01$). At 75 to 100cm deep soil layer Dragon 8 Rows had slight higher root dry weight than Loeung Mongkul but there were not significant difference from each other in this case (Table 4.5.2)

Effects of water levels on root dry weight at 25cm to 50cm and 75cm to 100cm deep soil layer.

Increasing of water stress resulted in significant reduction of root dry weight at 25cm to 50cm and 75cm to 100cm deep soil layer of maize varieties as show in table 4.5.3. Significant reduction of root dry weight at 25cm to 50cm deep soil layer could observed at 67%FC and 50%FC levels compared to that at 100%FC ($P < 0.01$). At 75cm to 100cm deep soil layer, increasing of each level of water stress could slight reduce and not significantly root dry weight at 75cm to 100cm deep soil layer.

Root dry weight at 0 cm to 25 cm deep soil layer (Root DW 0-25 cm)

The effect of water levels on root DW 0-25 cm at 4 weeks after planting was depressed with increasing water stress ($P < 0.05$). The effect was slight at 67%FC and most pronounced at 50%FC (Figure 4.5.7). At 100%FC, Loeung Mongkul maize variety has slight higher root DW 0-25 cm than Dragon 8 Rows, but there were not significant difference from each other. At 67%FC, Loeung Mongkul still had slight higher root DW 0-25 cm than Dragon 8 Rows, but there were not significant

difference from each other. At 50%FC, Dragon 8 Rows variety had highest root DW 0-25 cm and Loeng Mongkul the lowest in this case.

Root dry weight at 50 cm to 75 cm deep soil layer (Root DW 50-75 cm)

The effect of water levels on root DW 50-75 cm at 4 weeks after planting was increased (Dragon 8 Rows) and depressed (Loeng Mongkul) with increasing water stress ($P < 0.01$). Dragon 8 Rows was significant increase on root DW 50-75 cm could observed at 67%FC and 50%FC levels compared to that at 100%FC (Figure 4.5.7). At 100%FC, Loeng Mongkul maize variety has slight higher root DW 50-75 cm than Dragon 8 Rows, but there were not significant difference from each other. At 67%FC, Dragon 8 Rows had highest root DW 50-75 cm and Loeng Mongkul the lowest. When increase water stress at 50%FC, Dragon 8 Rows variety still had highest root DW 50-75 cm and Loeng Mongkul the lowest.

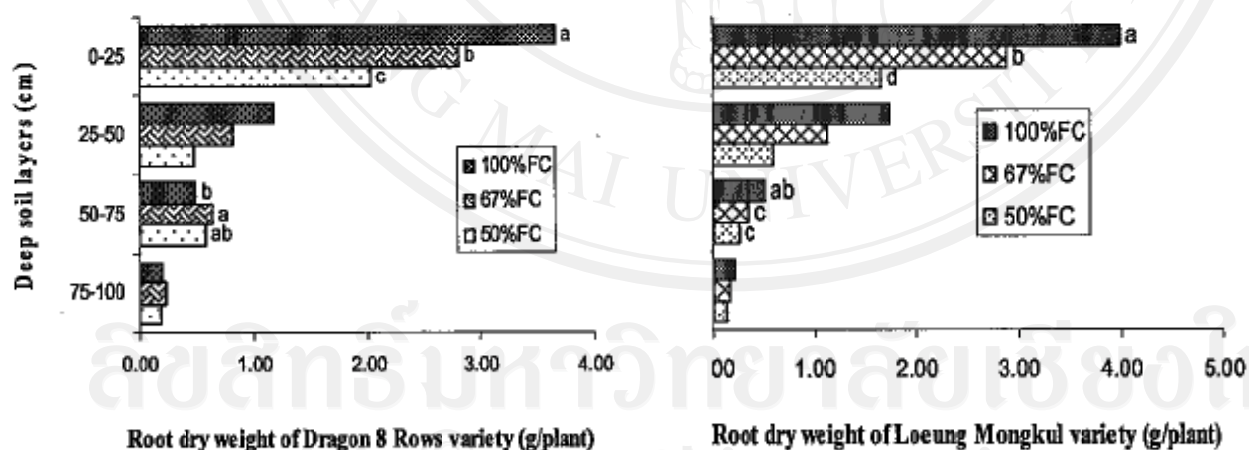


Figure 4.5.7 Effect of water levels on root dry weight every 25 cm deep soil layers (g/plant) of two maize varieties at 4 weeks after planting. Different letters above the bars indicate significant difference by LSD_{0.05}

Table 4.5.2 Differences of root dry weight at 25cm to 50cm and 75cm to 100cm deep soil layer.

Deep soil layer	Maize variety	
	Dragon 8 Rows	Loeung Mongkul
25cm to 50cm	1.16 a	0.83 b
75cm to 100cm	0.21 a	0.17 a

Means in the same line follow by letter differ significantly by $LSD_{0.05}$

Table 4.5.3 Effects of water levels on the average of root dry weight at 25cm to 50cm and 75cm to 100cm deep soil layer of two maize varieties.

Deep soil layer	Water level		
	100%FC	67%FC	50%FC
25cm to 50cm	1.46 a	0.98 b	0.54 c
75cm to 100cm	0.20 a	0.19 a	0.16 a

Means in the same line follow by letter differ significantly by $LSD_{0.05}$

Total N content in shoot and root (Total N content in SR)

The effect of water levels on total N content in SR at 4 weeks after planting was depressed with increasing water stress ($P < 0.01$). The effect was slight at 67%FC and most pronounced at 50%FC (Table 4.5.4). At 100%FC, Loeung Mongkul maize variety has highest total N content in SR and Dragon 8 Rows the lowest. At 67%FC, Loeung Mongkul still had highest total N content in SR and Dragon 8 Rows the lowest. At 50%FC, Dragon 8 Rows maize variety had highest total N content in SR and Loeung Mongkul the lowest in this case.

Total P content in shoot and root (Total P content in SR)

The effect of water levels on total P content in SR at 4 weeks after planting was depressed with increasing water stress ($P < 0.01$). The effect was slight at 67%FC and most pronounced at 50%FC (Table 4.5.5). At 100%FC, Loeung Mongkul maize variety has highest total P content in SR and Dragon 8 Rows the lowest. At 67%FC, Dragon 8 Rows had slight higher total P content in SR than Loeung Mongkul, but there were not significant difference from each other. At 50%FC, Loeung Mongkul variety had slight higher total P content in SR than Dragon 8 Rows, but there were not significant difference from each other.

Total K content in shoot and root (Total K content in SR)

The effect of water levels on total K content in SR at 4 weeks after planting was depressed with increasing water stress ($P < 0.05$). The effect was slight at 67%FC and most pronounced at 50%FC (Table 4.5.6). At 100%FC, Dragon 8 Rows maize variety has highest total K content in SR and Loeung Mongkul the lowest. At 67%FC, Dragon 8 Rows still had slight higher total K content in SR than Loeung Mongkul but there were not significant difference from each other. At 50%FC, Dragon 8 Rows variety had highest total K content in SR and Loeung Mongkul the lowest in this case.

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Table 4.5.4 Effect of water levels on total N content in shoot and root (mg/plant) of four maize varieties at 4 weeks after planting.

Maize variety	Water level		
	Total N content in shoot and root		
	100%FC	67%FC	50%FC
Dragon 8 rows	949 b	768 d	601 e
Loeung Mongkul	1008 a	880 c	552 f

Means in the same line follow by different letter differ significantly by LSD_{0.05}

Table 4.5.5 Effect of water levels on total P content in shoot and root (mg/plant) of four maize varieties at 4 weeks after planting.

Maize variety	Water level		
	Total P content in shoot and root		
	100%FC	67%FC	50%FC
Dragon 8 rows	68 b	53 c	30 d
Loeung Mongkul	72 a	51 c	32 d

Means follow by different letter differ significantly by LSD_{0.05}

Table 4.5.6 Effect of water levels on total K content in shoot and root (mg/plant) of four maize varieties at 4 weeks after planting.

Maize variety	Water level		
	Total K content in shoot and root		
	100%FC	67%FC	50%FC
Dragon 8 rows	988 a	750 c	538 e
Loeung Mongkul	940 b	630 c	488 f

Means follow by different letter differ significantly by LSD_{0.05}

Table 4.5.7 Reduction (%) of studied parameters (Total NPK) of maize varieties at 50%FC compared to 100%FC.

Parameters	Maize variety	
	Dragon 8 Rows	Loeung Mongkul
	% reduction at 50%FC	
Total N content in shoot and root	37	45
Total P content in shoot and root	56	56
Total K content in shoot and root	46	48

Reduction (%) of all total NPK content in shoot and root of maize varieties

The reduction (%) of total NPK content in shoot and root of each maize variety at 50%FC relative to those at 100%FC were shown in table 4.5.7. Dragon 8 Rows was compared, smallest reduction on all parameters while Loeung Mongkul maize variety was biggest reduction.

4.6 Experiment 6

The result in this experiment showed that, there were significant effects of water levels on all studied parameters while varieties affected ($P < 0.01$) only day to flowering and plant height, biomass dry weight and grain yield of the four maize varieties were significant affected by interaction between maize varieties and water levels.

Differences of maize varieties on day to flowering

Among the studied four maize varieties, they were significant different on day to flowering but not in the other parameters. CM and 888 maize varieties had longer day to flowering than Loeung Mongkul and Dragon 8 Rows ($P < 0.01$) while the Dragon 8 Rows was shortest day to flowering than each other (Table 4.6.1).

Effects of water levels on day to flowering

Increasing of water stress at watering every 30 days resulted in significant increase of day to flowering of maize varieties as show in table 4.6.1. Significant increasing of day to flowering could observe at watering every 30 days compared to that at watering every 15 days ($P < 0.05$).

Table 4.6.1 Effect of water levels on days to flowering of four maize varieties.

Maize variety	Days to flowering (day)		Mean
	Period of time irrigation		
	Every 15 days	Every 30 days	
Dragon 8 Rows	62	63	63 c
888	69	71	70 a
Loeung Mongkul	67	70	68 b
CM	70	71	71 a
Mean	67 b	69 a	

Means in the same line follow by different letter differ significantly by $LSD_{0.05}$

Plant height

Plant height was decreased when water stress increased. Plant height of all maize varieties were significant different between watering every 15 and 30 days (Figure 4.6.1). Plant height was significantly decreased when watering dropped to watering every 30 days ($P < 0.01$). At watering every 15 days, CM maize variety had the highest plant height and Dragon 8 Rows the shortest. The plant height of two maize varieties, namely, 888 and Loeung Mongkul, was falling between. At watering every 30 days, CM still had the highest plant height and Dragon 8 Rows maize varieties the shortest. The plant height of two maize varieties, namely, 888 and Loeung Mongkul, was falling between.

Biomass dry weight (Biomass DW)

Biomass DW was decreased when water stress increased. Biomass DW of all maize varieties were significant different between watering every 15 and 30 days (Figure 4.6.2). Biomass DW was significantly decreased when watering dropped to watering every 30 days ($P < 0.01$). At watering every 15 days, the CM and 888 maize varieties had most heavy biomass DW and Dragon 8 Rows was lowest biomass DW. The biomass DW of maize variety, namely, Loeung Mongkul, was falling between. At watering every 30 days, CM had most heavy biomass DW than each other and Dragon 8 Rows was lowest on biomass DW in this case. The biomass DW of two maize varieties, namely, 888 and Loeung Mongkul, was falling between but there were not significant different from each other for biomass DW at this growth stage.

Gain yield

Grain yield was decreased when water stress increased. Grain yield of all maize varieties were significant different between watering every 15 and 30 days (Figure 4.6.3). Grain yield was significantly decreased when watering dropped to every 30 days ($P < 0.01$). At watering every 15 days, the grain yield of CM and 888 maize varieties had the highest and the grain yield of Dragon 8 Rows was lowest. The grain yield of maize variety, namely, Loeung Mongkul, was falling between. At watering 30 days, CM was highest grain yield than each other while Dragon 8 Rows and Loeung Mongkul were lowest grain yield but 888, Loeung Mongkul and Dragon 8 Rows were not significant different from each other for grain yield in this case.

Reduction (%)

Reduction (%) of plant height, biomass DW and grain yield of each maize variety at watering every 30 days relative to those at watering every 15 days were shown in table 4.6.2. The Dragon 8 Rows was compared, small reduction on all parameters than 888, CM and Loeung Mongkul maize varieties while the most reduction on all parameters were shown by Loeung Mongkul. Where CM and 888 were compared, small reduction on plant height, biomass DW and grain yield of CM than 888 was observed.

Harvest Index

When water stress increased particularly at watering every 30 days, harvest index of Dragon 8 Rows was highest, followed by 888 and CM while Loeung Mongkul was lowest in this case (Table 4.6.3).

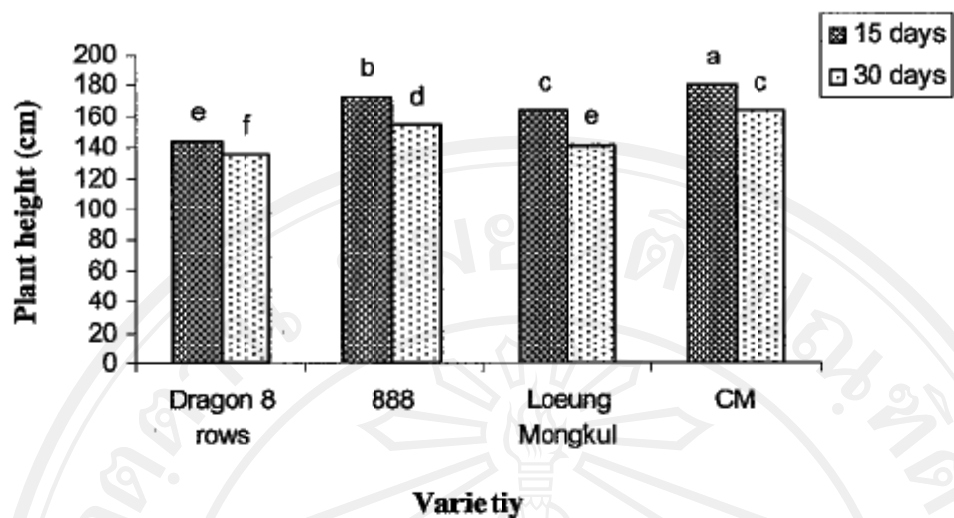


Figure 4.6.1 Effect of water levels on plant height (cm) of four maize varieties at maturity. Different letters above the bars indicate significant difference by $LSD_{0.05}$

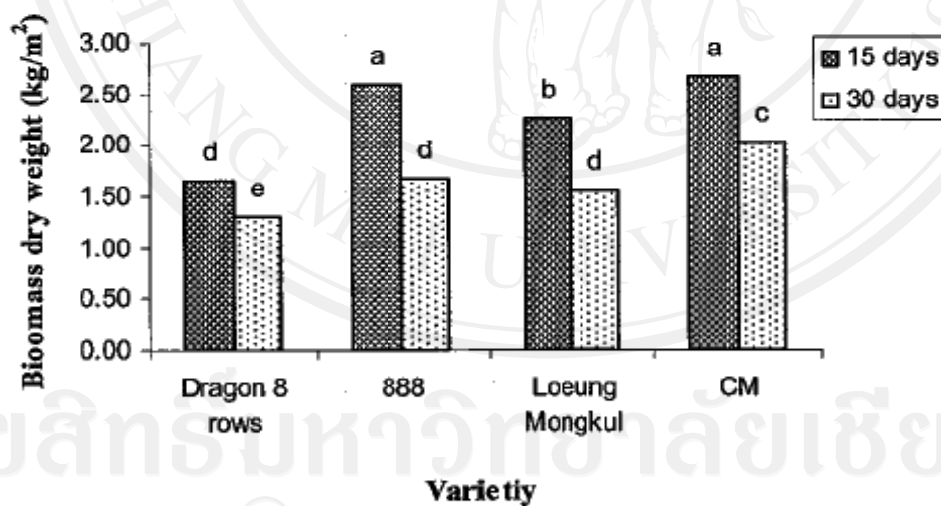


Figure 4.6.2 Effect of water levels on biomass dry weight (kg/m^2) of four maize varieties at maturity. Different letters above the bars indicate significant difference by

$LSD_{0.05}$

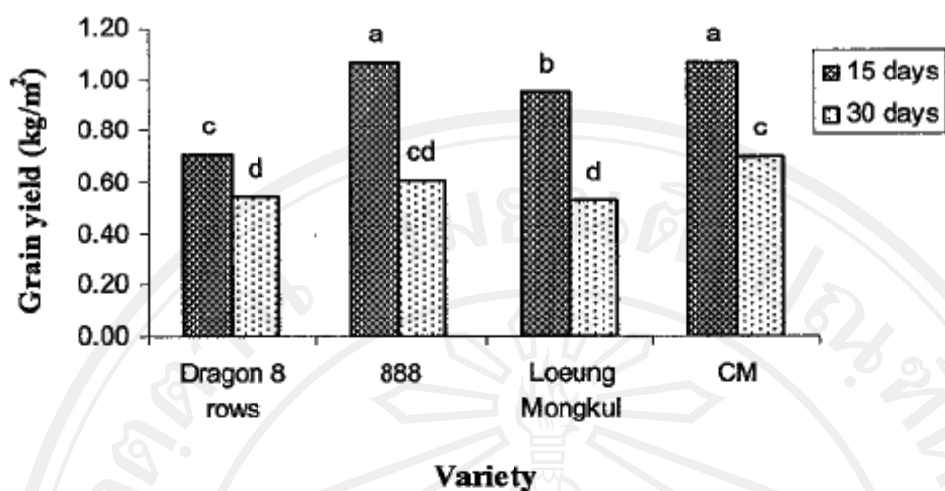


Figure 4.6.3 Effect of water levels on grain yield (kg/m²) of four maize varieties at maturity. Different letters above the bars indicate significant difference by LSD_{0.05}

Table 4.6.2 Reduction (%) of studied parameters of maize varieties at W30 days compared to W15 days.

Parameters	Variety			
	Dragon 8 Rows	888	Loeung Mongkul	CM
	% reduction at W30 days			
Plant height	7	10	13	9
Biomass dry weight	21	35	31	24
Grain yield	22	43	44	33

Table 4.6.3 Harvest index at maturity of different maize varieties at different water levels.

Maize variety	Harvest index	
	15 days	30 days
Dragon 8 rows	0.43	0.42
888	0.41	0.36
Loeung Mongkul	0.42	0.34
CM	0.40	0.35

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