

CHAPTER 3

MATERIALS AND METHODS

Before do experiment I had done a small experiment to fine out it field capacity. The soil that used in my experiment was San Sai Soil. First weigh 5kg of soil and put in the plastic pot with 1 liter of water and keep it about 24 to 48 hours. After I take a 200g to 300g of wet soil put in can (Weigh a wet soil and can about 5 samples) and keep it in oven machine 48 hours at 70°C. Weight a dry soil and can again and calculate it. Field capacity of this soil was 22%.

3.1 Experiment 1

This experiment aimed to establish the levels of water stress to be imposed in later studies. Four levels of water (100%, 67%, 50% and 33% of water content at field capacity, referred to as 100%FC, 67%FC, 50%FC, 33%FC through out the thesis) were applied to hybrid maize variety 888. The experiment was arranged in a randomized complete block (RCB) design with 4 replicates. This experiment was conducted in pots in the greenhouse at the Faculty of Agriculture, Chiang Mai University. The trial was commenced on 10 September 2007 and ended on 22 October 2007. The maize plants were grown in a pot (29 cm in diameter top, 21.5 cm bottom and 25.5 cm deep) at 3 plants per pot. Basal fertilizers consisted of 15-15-15 (referring to percentages of N-P₂O₅-K₂O) and urea were applied at the rates 76 kg N, 30 kg P₂O₅ and 30 kg K₂O/ha. The mixed fertilizer 15-15-15 was applied to all pots before planting and urea was split three times (one third each time at 2, 3 and 4 weeks after planting). There two separate sets of pots for each harvest at 3 and 6 weeks). Water contents of the pots and watering were determined by weighing.

Measurements recorded were the amount of water added to each pot every day. Data recorded at each harvest were plant height (cm), leaf area (cm^2/plant), root length (cm), shoot dry weight (g/plant), root dry weight (g/plant), total dry weight (g/plant) and N, P, K content (mg/plant).

3.2 Experiment 2

This experiment evaluated the performance of 11 maize varieties (Table 3.1) at 2 water levels 67%FC and 50%FC. The experimental design was a split plot with 4 replications. Water levels were assigned to the main plots with maize varieties in the subplots. The maize plants were grown in a pot (29 cm in diameter top, 21.5 cm bottom and 25.5 cm deep) at 3 plants per pot. Water contents of the pots and watering were determined by weighing. This experiment was conducted from 15 June 2008 to 27 July 2008 (6 weeks). The amount of water added to each pot every day were recorded. Each pot contained 3 plants. Basal fertilizers consisted of 15-15-15 (referring to percentages of N- P_2O_5 - K_2O) and urea were applied at the rates 76 kg N, 30 kg P_2O_5 and 30 kg K_2O /ha. The mixed fertilizer 15-15-15 was applied to all pots before planting and urea was split three times (one third each time at 2, 3 and 4 weeks after planting). Data recorded were the plant height (cm), leaf area (cm^2/plant), root length (cm), shoot dry weight (g/plant), root dry weight (g/plant) and total dry weight (g/plant).

Table 3.2.1 Eleven maize varieties used in experiment 2 (with selected varieties used in other experiments).

Maize variety	Seed source ¹	Grain color	Type
Pioneer A33	Pioneer	yellow	hybrid maize
NS72	NSFCRC ²	yellow	hybrid maize
CM	private company	yellow	hybrid maize
888	CP group	yellow	hybrid maize
Pumpui	Thai local variety	white	glutinous maize
Sainampeung	Thai local variety	yellow	glutinous maize
Super sweet	Thai local variety	yellow	sweet maize
Semi-sweet maize	Thai local variety	purple	sweet maize
Dragon 8 rows	Thai local variety	white	sweet maize
Loeung Mongkul	CARDI ³	yellow	open pollinated maize
Sor Chey	CARDI	white	open pollinated maize

¹Seeds were obtained commercially except NS72 and Loeung Mongkul and Sor Chey

²NSFCRC = Nakhonsawan Field Crops Research Center

³CARDI = Cambodian Agricultural Research and Development Institute

3.3 Experiment 3

The experiment aimed to repeat an again and evaluate the effect of drought tolerance on a range of four maize genotypes at different water levels, and to include 100%FC as control. Four maize varieties identified for their different tolerance to drought in Experiment 2 (Dragon 8 row, most tolerant; 888 and Loeung Mongkul moderately tolerant and and CM least tolerant, see Table 3.1 for details of varieties) were evaluated at 3 water levels (100%FC, 67%FC and 50%FC). The experiment design was a split plot with 4 replications. Water levels were assigned to the main plots while maize varieties were in subplots. The experiment was conducted in the greenhouse at Chiang Mai University, Thailand. The trial was conducted from 30 December 2008 to 10 February 2009 (6 weeks). The maize plants were grown in a pot (29 cm in diameter top, 21.5 cm bottom and 25.5 cm deep) at 3 plants per pot. Basal fertilizers consisted of 15-15-15 (referring to percentages of N-P₂O₅-K₂O) and urea were applied at the rates 76 kg N, 30 kg P₂O₅ and 30 kg K₂O/ha. The mixed fertilizer 15-15-15 was applied to all pots before planting and urea was split three times (one third each time at 2, 3 and 4 weeks after planting). Data recorded were the plant height (cm), leaf area (cm²/plant), root length (cm), shoot dry weight (g/plant), root dry weight (g/plant), total dry weight (g/plant) and N, P, K content (mg/plant).

3.4 Experiment 4

The experiment aimed to examine root growth at different water levels. Four maize varieties identified for their different tolerance to drought in Experiment 2 (Dragon 8 row, most tolerant; 888 and Loeung Mongkul moderately tolerant and and CM least tolerant, see Table 3.1 for details of varieties). Water levels were assigned

to main plots while maize varieties were in subplots. The experiment design was a split plot with 4 replications. The maize plants were grown in PVC pipes that were 16.5 cm in diameter and 1 m deep, with 3 plants per pipe. The experiment was conducted in the greenhouse at Chiang Mai University, Thailand. The period for this experiment is 6 weeks after planting and it was conducted from 17 February 2009 to 01 April 2009. Basal fertilizers consisted of 15-15-15 (referring to percentages of N-P₂O₅-K₂O) and urea were applied at the rates 76 kg N, 30 kg P₂O₅ and 30 kg K₂O/ha. The mixed fertilizer 15-15-15 was applied to all pots before planting and urea was split three times (one third each time at 2, 3 and 4 weeks after planting). Data recorded were plant height (cm), leaf area (cm²/plant), root length (cm), shoot dry weight (g/plant), root dry weight (g/plant) and total dry weight (g/plant).

3.5 Experiment 5

The experiment aimed to examine root distribution at different water levels in two maize varieties with contrasting responses to drought. Two maize varieties (Dragon 8 row, most tolerant; Loeung Mongkul least tolerant, see Table 3.1 for details of varieties) had evaluated 3 water levels of field capacity (100%FC, 67%FC and 50%FC). The experimental design was a split plot with 4 replications, with water levels assigned to main plots while maize varieties were in subplots. The maize plants were grown in PVC pipes 16.5 cm in diameter and 1 m deep, with 3 plants per pipe. The trial was conducted in the greenhouse at Chiang Mai University, Thailand. The experiment was commenced in 27 May 2009 and ended in 26 June 2009 (4 weeks). Two types of fertilizer 15-15-15 and urea were applied at the rates 76 kg N, 30 kg P₂O₅ and 30 kg K₂O/ha. Basal fertilizers consisted of 15-15-15 (referring to

percentages of N-P₂O₅-K₂O) and urea were applied at the rates 76 kg N, 30 kg P₂O₅ and 30 kg K₂O/ha. The mixed fertilizer 15-15-15 was applied to all pots before planting and urea was split three times (one third each time at 2, 3 and 4 weeks after planting). Data recorded were the plant height (cm), leaf area (cm²/plant), root length (cm), shoot dry weight (g/plant), root dry weight (g/plant), total dry weight (g/plant), root dry weight every 25 cm deep (g/plant) and N, P, K content (mg/plant).

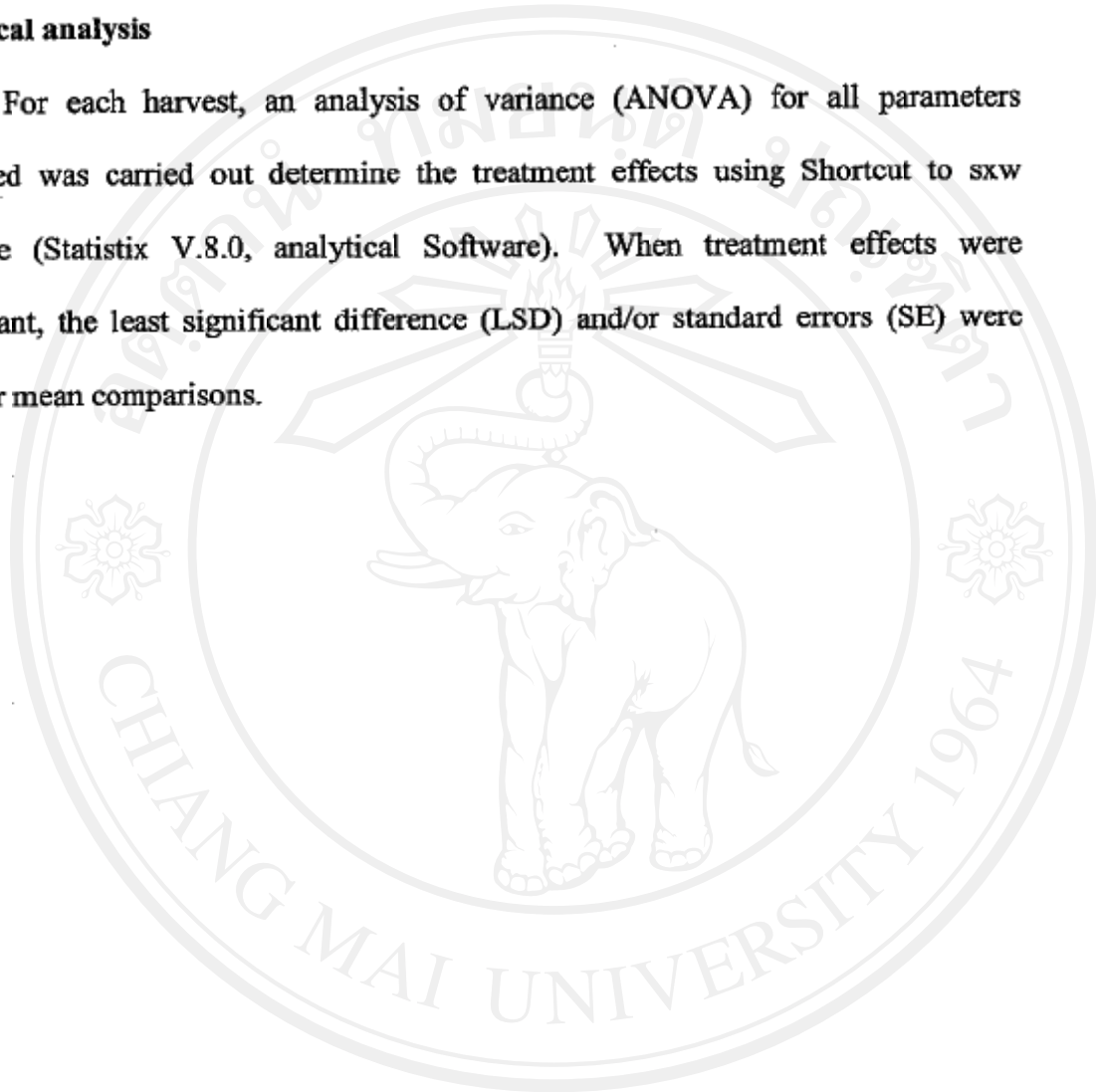
3.6 Experiment 6

This experiment aimed to examine grain yield responses to drought of the maize varieties in the field. Four maize varieties as in experiment 4 (Dragon 8 row, most tolerant; 888 and Loeng Mongkul moderately tolerant and CM least tolerant, see Table 3.1 for details of varieties) were grown in the field with two levels of irrigation (water applied every 15 days and every 30 days). The experiment design was a split plot with 4 replications, with water levels in main plots and maize varieties in subplots. This experiment was in the field at Agronomy Department, Chiang Mai University, Thailand. Each plot was 2 m x 3 m, in a total experiment area of 16 m x 31 m. Each plot consisted of 4 2-m rows 0.75 m apart and 0.25 m between hills in a row. The experiment was conducted from 14 January 2009 to 15 May 2009, plants were harvested at grain maturity. Basal fertilizers consisted of 15-15-15 (referring to percentages of N-P₂O₅-K₂O) and urea were applied at the rates 76 kg N, 30 kg P₂O₅ and 30 kg K₂O/ha. The mixed fertilizer 15-15-15 was applied to all pots before planting and urea was split three times (one third each time at 2, 3 and 4 weeks after planting). Data recorded were gravimetric soil water content at 0-20cm and 20-40 cm deep before each rewatering. At grain maturity plants were sampled for plant height

(cm), biomass dry weight (kg/m^2), grain yield potential (kg/m^2).

Statistical analysis

For each harvest, an analysis of variance (ANOVA) for all parameters measured was carried out to determine the treatment effects using Shortcut to sxw software (Statistix V.8.0, analytical Software). When treatment effects were significant, the least significant difference (LSD) and/or standard errors (SE) were used for mean comparisons.



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