CHAPTER 2

MATERIALS AND METHODS

Materials

1. Seeds of two soybean varieties, namely, CM 60 and SJ 5, were obtained from Chiang Mai Field Crops Research Center, and were multiplied at the Department of Plant Science, Faculty of Natural Resources, Prince of Songkla University, Hat Yai, Songkhla.
2. Plastic baskets size 19x26x6 cm
3. Plastic trays size 23x31x4 cm
4. Sandy loam, silt loam, and clay soils
5. Towel papers
6. Plastic and paper bags
7. Moisture cans
8. Polystyrofoam boxes
9. Fungicide (captan)
10. Other laboratory materials

Equipments

1. Analytical balance
2. Hot air oven
3. Germinator
4. Seed storage cold room ($10^{\circ}C$)

Methods

Seed storage

To obtain the seeds of various qualities with germination between of 99.50-14.25% to use in the experiments, the seeds were separately stored in a cold room (10^0C) and at room temperature by packing in paper or plastic bags and placing in plastic baskets and polystyrofoam boxes. The stored seeds were tested for their standard germination before doing the experiments.

All seed tests and experiments were done in four replications and soil tests were done in three replications.

Standard germination evaluation

One hundred seeds per replication were subjected to germinate in between paper (BP) at alternate temperature of 20-30^0C as described in the AOSA rules for seed testing (AOSA, 2001). Germination evaluation was done at 4, 6 and 8 days after germinating.

Field emergence

I. Soybean seed field characteristics under different field planting conditions

Various lots of high quality soybean seeds of CM 60 and SJ 5 varieties with germination of 86.50-99.50% were used. Fifty seeds per replication were planted at 2.5 cm depth in a row of 120 cm long. The normal seedlings were counted at 4, 6 and 8 days after planting. The soil around seeds at 3-5 cm depth of all watering patterns was collected daily at 3 p.m. to determine soil moisture content using a gravimetric method (Topp, 1993). Field emergence was calculated using the same procedure as described in AOSA (2001). Field emergence index was

calculated by dividing the field emergence by the standard germination of the seeds and multiplying by 100. The weather conditions were collected from Kho Hong Agri-Meteorological Station and are shown in Table 2A.

Daily watering planting was done in September 2001, March, April, and July 2002. The planted seeds were watered daily, except on days when it rained. The daily watering patterns are indicated as treatments 1-8 in Tables 2 and 3.

For water-limited field conditions or limited water supply treatments, the seeds were planted in September 2001, March, April, July, August 2002, and March 2003. Various water-limited watering patterns as shown in Table 2 (Treatments 9-32) and Table 3 (Treatments 9-30) were applied.

Rainy season planting was done in October 2001 and indicated as treatment 33 and 31 in Tables 2 and 3, respectively.

II. Field emergence of soybean seeds planted under different field conditions

Soybean seeds of various qualities with germination of 99.50-54.00% planted under 1) daily watering for 10 and 11 lots of CM 60 and SJ 5 varieties, respectively, 2) drought; water-limited condition, in which the high quality seeds had field emergence index in the range of 80-60% (17 and 14 lots for CM 60 and SJ 5 varieties, respectively), and 3) rainy season with 3 lots of each variety, were analyzed for their seed field performances.

The normal seedlings were counted at 4, 6 and 8 days after planting. Field emergence was calculated. Speed of emergence index was calculated using the same procedure as described in AOSA (2002),

$$\text{Speed of emergence index} = \frac{\text{number of normal seedlings}}{\text{days of first count}} + \ldots + \frac{\text{number of normal seedlings}}{\text{days of final count}}$$

At the final count, ten normal seedlings per replication were randomly measured for seedling height. The same seedlings were cut at soil level, their cotyledons were removed, and the seedling axes were dried at 80 ^{0}C for 24 hrs. The dried seedling shoots were weighed at the end of drying. The field emergence index was also calculated.

III. Response of soybean seed quality to the field planting conditions

Most lots of the high, medium and low quality soybean seeds planted under daily watering, drought, and rainy season were evaluated for their average field emergence. The normal seedlings were counted at 4, 6 and 8 days after planting and the field emergence was then calculated.

Water-limited germination test

The tests were done by planting the seeds in soil in plastic baskets. Three statistically different quality seeds of CM 60 and SJ 5 soybean were used. The soil was collected from the same field as in the emergence test. The soil field capacity, permanent wilting point, and plant available water (PAW) were determined using the methods in Cassel and Nielsen (1986). Fifty seeds per replication were subjected to germinate in 1,000 g soil at room temperature. They were watered at 40 and 50% of PAW daily and every 2 and 3 days. First and final counts were done at three and five days, respectively. Germination percentage and speed of emergence index were calculated. At the final count, seedling height and seedling shoot dry weight were determined using the same procedure as in the field emergence.

Flooded germination test

The same planting method as for the water-limited germination test was used. Only high quality seeds were used and the seeds were treated with captan before germinating. The planting baskets were placed in plastic trays and were flooded at 1 cm above soil level for 0, 4, 6, 12, 24 and 48 hours. After the end of flooding duration, the water was drained and the seeds were placed for further germinating. The germination was evaluated at 5 days after planting.

Effect of soil series on water-limited germination test in soybean seeds

The sources of soil used were three different locations in Songkhla province. They were 1) the experimental field of Department of Plant Science, Prince of Songkla University, Hat Yai, 2) a rice field at Ko Yai sub-district, Krasasin, and 3) a rice field at Chalae sub-district, Singha Nakorn. According to the Department of Land Development (1973), the soils used in this study belong to Ranong/Phato association (Rg/Pto), Ko Yai (Koy), and Tha Khwang (Tq) series and are classified as Typic Paleudults, Typic Tropaquepts, and Sulfic Tropaquepts, respectively. The soil from each location was collected from the surface at 0-15 cm depth. It was sampled, air dried, and sieved through a 2-mm size screen. The soil properties determined were soil texture (Gee and Bauder, 1986), field capacity, permanent wilting point, plant available water, hydraulic conductivity (Youngs, 1991), pH (Tanavud *et al.*, 2001), bulk and particle densities (Blake and Hartge, 1986a, b), porosity (Danielson and Sutherland, 1986), and electrical conductivity (Tanavud *et al.*, 2001). The soil properties of the three different series are shown in Table 1.

The water-limited germination tests were done on three different quality seeds of CM 60 and SJ 5 varieties. Fifty seeds per replication were subjected to germinate in 1,000 g of each soil in plastic baskets at room temperature. They were watered at 50% of PAW every 2 days. Germination was evaluated at 5 days after planting.

Table 1 Properties of soil from three different series.

Soil property	Soil series		
	Rg/Pto	Koy	Tq
1. Soil texture			
- clay particle (%)	14.98	26.28	64.52
- silt particle (%)	25.19	67.60	34.50
- sand particle (%)	59.83	6.12	0.98
Texture	sandy loam	silt loam	clay
2. Field capacity (% by weight)	20.47	38.98	44.12
3. Permanent wilting point (% by weight)	4.60	26.65	25.35
4. Plant available water (% by weight)	15.87	12.33	18.77
5. Hydraulic conductivity (cm hr^{-1})	10.319	0.003	0.004
6. pH	6.40	4.79	4.61
7. Bulk density (g cm^{-3})	1.83	1.48	1.52
8. Particle density (g cm^{-3})	2.64	2.56	2.63
9. Porosity (%)	30.52	42.13	42.39
10. Electrical conductivity (dS m^{-1})	0.11	0.33	0.10

Rg/Pto = Ranong/Phato association

Koy = Ko Yai

Tq = Tha Khwang

Data and statistical analyses

The data were subjected to analyse in a completely randomized design. Their means were tested to separate using Duncan's multiple range test (DMRT).