Performances of Soybean Breeding Lines in Dryland Acid Soils

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ABSTRACT

In 1995, a field trial was conducted in North Lampung to evaluate soybean germplasm in an effort to develop soybean cultivars suitable for acid soils in Sumatera. Thirty soybean genotypes were selected from 350 germplasm accessions based on their agronomic performances. These genotypes were then reevaluated, and four genotypes were selected. Twelve single-cross combinations were made, and pedigree as well as bulk methods were used for inbreeding from F_2 to F_5 generations. A number of 80 F_6 breeding lines were evaluated and selected for tolerance to acid soils in North Lampung. Selected 10 F_7 lines along with check cultivars Wilis, Slamet, and Sindoro were reevaluated in Lampung and North Sumatera provinces. A breeding line K3911-66 was identified as the best line with good adaptability to both trial sites. Lines D3578-4 and D3623-22 well adapted to North Sumatera and Lampung conditions. Those breeding lines were considered as promising lines that need to be evaluated further in other locations and seasons.

Key words: Soybean breeding lines, tolerance to acid soils, Lampung and North Sumatera

INTRODUCTION

The demand for soybean in Indonesia continuously increases annually. However, the domestic soybean production has not met the national demand. An effort to increase production through expansion of soybean growing area needs to be done. The expansion to new areas has to go outside of Java, such as Sumatera, Kalimantan, and Sulawesi, this particularly because the land available for growing soybean in Java has been decreasing continuously.

The development of soybean production outside Java has to be done in line with the government's transmigration program. Unfortunately, most of the lands opened for the transmigrants are acid soils. This type of soils covered an area of about 51 million hectares and very commonly found in Sumatera, Kalimantan, Sulawesi, and Irian Jaya (Muljadi, 1977). Productivity of the acid soils for food crops productions is low. Actually conditions of the acid soils can be improved through liming and fertilizer applications, but these practices are costly and the materials are not always available in many areas. Development of cultivars tolerant to dryland acid soils is needed to support the production development of soybean in the areas.

MATERIALS AND METHODS

A number of 350 soybean genotypes consisting of local and introduced germplasm were evaluated for tolerance to acid soil in North Lampung. The soil pH in the trial site 4.7 with aluminum (Al) saturation 39.2%. Thirty genotypes were selected based on their agronomic characters and reevaluated for their tolerance to acid soil at the same site. Finally, four genotypes were selected and used as parent materials for crossing with national improved cultivars Wilis, Kerinci, and Dempo. Pedigree and bulk methods were used for inbreeding of the soybean populations. Eighty F_6 breeding lines were selected, and evaluated in a preliminary yield trial with two replications. Seeds of each lines were grown in a 0.8 m x 3.0 m plot with a plant spacing 40 cm x 15 cm, two plants per hill. Ten lines were selected based on their growth performances in the trial site. These lines along with the check cultivars, Wilis, Kerinci, Dempo, Slamet, and Sindoro, were evaluated in a replicated yield trial on farmers' fields in Lampung and North Sumatera provinces. Each entry was grown in a 3.2 m x 4.5 m with a plant spacing 40 cm x 15 cm, two plants per hill. A randomized block design with four replications was used in each location. Fertilizers were applied at the rate of 50 kg Urea, 75 kg SP36, and 75 kg KCl per ha at the planting time.

RESULTS

Yield performances of the F_6 soybean breeding lines varied, ranging 0.75 to 1.71 t/ha. Based on distribution frequency of the yields, 13 or 16% of the breeding lines yielded better than the check cultivars Wilis, Kerinci, Dempo, Slamet, and Sindoro (Table 1). The check cultivars produced comparable yield levels ranging from 1.0 to 1.1 t/ha. Most of the selected lines inherited the genetic background of cultivars Dempo, No. 3578, No. 3623, and Wilis (Table 2).

The yield performances of the F_7 breeding lines in North Sumatera varied with the genotypes in North Sumatera and Lampung (Trial 1) and in Lampung (Trial 2) (Table 3). Eight breeding lines produced higher yields than check cultivar Slamet in North Sumatera. Most of the lines had the genetic background of Dempo, No. 3578, and No. 3623. The most promising lines were D3578-4 and D3577-27, W3578-15 and K3911-66.

Table 1. Distribution frequency of soybean yield of 85 F_6 soybean breeding lines in North Lampung, late rainy season of 1997/98

Yield (t/ha)	Frequency	Genotype
<0.75	5	
0.75–1.00	35	
1.01–1.25	32	Wilis, Kerinci, Dempo, Slamet, Sindoro
1.26–1.50	11	
1.51–1.75	2	
	85	

Table 2. Yield and agronomic performances of 18 F_6 soybean breeding lines in acid soils of North Lampung, late rainy season of 1997/98

Breeding line	Yield (t/ha)	Maturity (days)	Plant height (cm)	Average no. of branches per plant	Number of pods per plant
D3578-4	1.71	92	51	3.0	56
D3623-27	1.53	94	60	3.0	63
D3578-3	1.50	92	53	2.3	61
D3577-27	1.50	92	54	2.8	39
W3578-17	1.48	92	43	2.1	38
W3578-16	1.38	92	50	2.8	50
D3623-5	1.38	94	63	4.1	59
W3578-15	1.33	92	57	2.5	52
D3623-22	1.30	94	50	2.5	53
D3578-2	1.29	92	53	3.0	52
W3911-29	1.27	94	49	2.7	56
K3911-66	1.25	94	45	3.0	64
D3623-2	1.24	94	55	3.2	47
W3577-5	1.24	92	51	2.3	48
D3623-1	1.23	94	50	2.8	39
W3623-5	1.21	92	50	3.5	68
D3578-6	1.20	92	42	3.0	63
D3578-8	1.20	92	55	3.1	65
Wilis	1.12	88	55	2.7	46
Kerinci	1.09	90	54	3.0	55
Dempo	1.08	94	58	3.6	66
Slamet	1.01	90	58	2.6	46
Sindoro	1.04	90	53	2.3	47
Mean (18 lines)	1.35	93	52	2.9	54
Mean (5 cultivars)	1.07	90	56	2.9	53

Four breeding lines, K3911-66, D3623-22, W3578-16, and D3578-4 performed better than check cultivar (Slamet) in Lampung (Trial 1). Line W3578-16 was also better in Lampung than the check cultivar (Trial 2).

It was indicated that the environmental condition of the trial site in Lampung (Trial 1) was better than that in North Sumatera. In Trial 2, however, the environmental condition in Lampung (Trial 2) showed the low productivity (Table 3). Based on soybean yield on both trial sites, four lines, W3578-16, K3911-66, D3577-27, and D3623-22, were identified promising.

CONCLUSION

Soybean breeding lines D3578-4 and D3623-22 showed good adaptability to acid soil in North Sumatera and Lampung. Breeding line K3911-66 was the best line with good adaptability to both trial sites. Those breeding lines were considered as promising lines and need to be evaluated further in other locations and seasons.

Table 3. Yield of 10 F_7 soybean breeding lines in dryland acid soil of three trials sites in the 1998/99 rainy season

Line	Yield (t/ha)			Mean
	NS	LP (1)	LP (2)	
W3578-15	1.47*	1.30	0.45	1.08
W3578-16	1.25*	1.53*	0.99*	1.26
W3578-17	1.24*	1.48	0.85	1.19
K3911-66	1.43*	1.81*	0.44	1.23
D3577-27	1.61*	1.50	0.64	1.25
D3578-4	1.61*	1.52*	0.43	1.19
D3623-5	1.02	1.45	0.51	1.00
D3623-22	1.36*	1.60*	0.68	1.22
D3623-27	1.21*	1.20	0.58	1.00
TGX 1448	0.95	1.42	0.52	0.97
3465/4126-21-1	0.92	1.40	0.63	0.99
Wilis	1.37	1.36	0.69	1.14
Slamet	0.98	1.21	0.54	0.91
Sindoro	1.16	1.31	0.61	1.03
Local	1.18	1.16	0.72	1.02
Mean	1.25	1.42	0.62	1.10
LSD 0.5	0.11	0.29	0.33	
CV (%)	9.20	14.90	28.90	

Notes: NS = North Sumatera, LP (1) = Lampung (Trial 1), LP (2) = Lampung (Trial 2)

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