Agronomic Performance of F7 Large Seed Soybean Breeding Lines in Medium Plains

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Abstract

Hybridization between different genotypes aims to obtain descents (breeding lines) which inherits with the good characters of both parents. One of the soybean breeding program is directed to obtain new varieties with higher yield potential, wide adaptation, desirable agronomic traits and large seed. A total of 60 F7 soybean breeding lines (origin crosses of Tanggamus x Local Tegal , Sibayak x Local Tegal, and Sibayak x Argomulyo), selected in 2007, and four large seed standard varieties (Argomulyo, Burangrang, Anjasmoro, and Panderman) were evaluated in rice fields, Sukasono Village, Sukawening Subdistrict, Garut District, West Jawa, Indonesia (at 700 m above sea level) on the early dry season (February-May) 2008. A randomized block design with three replicates was used. Experimental plot size was 0.9 x 4.0 m, spacing of 45 x 10 cm, one plant per hill. Intensive techniques cultivation involves fertilizing with 75 kg urea, 200 kg SP36, and 150 kg KCl per ha, controlling of weeds, pests and diseases were carried out. Irrigation was applied when there was no rain. The results showed that there was variability of seed yield and agronomic traits among the breeding lines tested. Among the 60 F7 breeding lines, eight lines were significantly better yield than Anjasmoro (best standar variety), namely U-719-1-1, U-509-1-1, U-714-1-1, V-159-1-3, V-426-1-2, V-421-1-1, V-563-1-1, and V-570-1-2 with a yield capacity ranged from 2.5 to 2.7 t/ha, meanwhile Anjasmoro yielded at 2.3 t/ha. Breeding lines of U-719-1-1 and U-714-1-1 had a moderate seed size (12.0 to 12.5 g/100 seeds); V-159-1-3 and V-570-1-2 had a slightly large seed (13.6 g/100 seeds), and U-509-1-1, V-426-1-2, V-421-1-1 and V-563-1-1 had a large seed (14.6 to 15.6 g/100 seeds). Breeding line with the U and V code were derived from Tanggamus x Lokal Tegal and Sibayak x Local Tegal crosses, respectively. Plant height was suggested as a criterion of selection for high yield.

Keywords: soybean, high yield, large seed

Introduction

The availability of improved varieties of high yielding, early maturity or moderate, and good seed quality are needed for increasing the domestic soybean production. Today the preferences of users (farmers and craftsmen tempeh and tofu) were more likely to require large varieties of soybean seed. Craftsmen tempeh and tofu has long accustomed to using large seed soybean imports, so that preferences are now a lot towards the large seed. To meet user demand, then breeding programs to produce varieties of soybean large seed in major need of attention. A number of varieties of soybean large seed has been available as Argomulyo, Burangrang, Anjasmoro, and Grobogan (Hermanto *et al.,* 2009).

In an effort to produce new varieties of soybeans are superior to varieties already exist, a number of crossing (hybridization) between the genotypes having high yield potential, adaptation is quite broad, many pods and smaller seeds with the genotypes of the large seed, few pods, narrow adaptation and relatively low yield potential was created in 2004 (Arsyad *et al.* 2005). Arsyad and Asadi (2011) reported that amount of 4800 F4 lines originated from five single cross combination were planted in ricefield, Sukawening, Garut District, West Java on early dry season 2007. By using pedigree method of selection, 1311 F5 lines were selected and grown in similar site on late dry

season 2007. Amount of 540 F6 lines were selected and grown in similar site on early rainy season 2007/2008. Sixty-two F7 lines were selected and 42 lines among them had high yield and large seed size.

This study aims were to: (a) obtain F8 lines better than comparable variety of Anjasmoro, having the higher yield potential, good agronomic traits, and has a large seed size or slightly larger, and (b) investigate the behavior of the relationship between traits in soybean breeding lines.

Materials and Methods

A total of 60 F7 soybean breeding lines (origin crosses of Tanggamus x Local Tegal, Sibayak x Local Tegal, and Sibayak x Argomulyo) selected in 2007, and four large seed standard varieties (Argomulyo, Burangrang, Anjasmoro, and Panderman) were evaluated in rice fields, Sukasono Village, Sukawening Subdistrict, Garut District (700 m above sea level) on the early dry season (February-May) 2008. A randomized block design with three replicates was used. Experimental plot size was 0.9 x 4.0 m, spacing of 45 x 10 cm, one plant per hill. Intensive techniques cultivation involves fertilizing with 75 kg of urea, 200 kg of SP36, and 150 kg of KCl per ha, controlling of weeds, pests and diseases were carried out. Irrigation was applied, if there is no rain. Observations were made on days to maturity, plant height, number of branches, number of pods, seed yield, 100 seed weight. Analysis of variances was performed on the characters observed and followed by LSD (Gomez and Gomez 1984), and inter-character correlation and path analysis followed Singh dan Chaudhary (1979).

Result and Discussion

Analysis of variances showed that there were significant different among the breeding lines tested against agronomic performances such as yield, seed size (weight of 100 seeds), plant height and number of pods per plant (Table 1). The range of seed yield of the 60 lines tested ranged from 1.53 to 2.65 t/ha, whereas the yield of four check varieties ranged from 1.47 to 2.30 t/ha. Large seeds (based on 100 seed weight) of 60 lines tested ranged from 10.3 to 20.7 g, and four check varieties had 100 seeds weight from 14.7 to 19.4 g. The breeding lines selected were those with 100 seed weight over 14 g. Based on these criteria, 32 lines were selected. The best check variety (Anjasmoro) with the yield of 2.3 t/ha and 100 seed weight was 14.7 g, while three other check varieties gave lower yield (1.5 to 2.0 t/ha).

By using Anjasmoro as a comparison, the eight lines significantly better, namely U-719-1-1, U-509-1-1, U-714-1-1, V-159-1-3, V-426-1-2, V-421-1-1, V-563-1-1, and V-570-1-2. Two lines, namely U-719-1-1 and U-714-1-1 had a moderate seed size (12.0 to 12.5 g/100 seeds), two other lines of V-159-1-3 and V-570-1-2 had a slightly large seed size (13.6 g/100 seeds), and four other lines of the U-509-1-1, V-426-1-2, V 421-1-1 and V-563-1-1 had a large seed size (14.6 to 15.6 g/100 seeds). There were 27 other lines that have a large seed size (> 14 g/100 seeds), but the yield was lower or equal to Anjasmoro.

The results of the preliminary yield test of F7 lines showed that there were the best five lines derived from cross of Sibayak x Local Tegal and three lines derived from cross of Tanggamus x Tegal, while lines derived from cross of Sibayak x Argomulyo nothing was selected. All F7 lines tested in this study had a yellow seed color, and the seeds was classified as moderate, rather large and large. Genotypes (parents) who are used to form the lines tested in this study had a medium seed size (Sibayak), rather small (Tanggamus) and large (Local Tegal and Argomulyo).

Table 1. Seed yield, 100 seed weight, number of plant harvested, plant height, number of pods per plant, and days to maturity of F7 soybean breeding lines in Garut, early dry season 2008

No.	Breeding line	Seed yield (t/ha)	100 seed weight (g)	Number of plant harvested per 3.6 m^2	Plant height (cm)	Number of pods per plant	Days to maturity
1	U-788-1-1	1.91	12.5	42	66	43	84
2	U-121-1-1	1.76	12.9	45	59	53	84
3	U-719-1-1	2.46	12.0	50	67	55	85
4	U-562-2-2	1.53	12.4	39	52	56	84
5	U-534-3-1	2.10	15.1	38	66	49	85
6	U-511-1-1	1.93	12.7	47	74	51	85
7	U-79-2-2	1.84	13.6	42	62	46	88
8	U-79-2-3	2.02	14.2	47	55	46	89
9	U-509-1-1	2.49	15.6	48	65	58	89
10	U-508-3-1	2.00	15.0	48	69	45	90
11	U-601-1-1	1.70	13.6	47	68	41	90
12	U-622-1-1	2.24	13.3	48	73	49	87
13	U-622-1-2	2.21	13.7	46	56	46	89
14	U-464-1-1	2.34	12.5	54	64	59	88
15	U-76-2-1	2.07	12.3	52	58	47	91
16	U-221-1-1	2.22	12.3	45	58	42	92
17	U-142-1-1	2.25	13.2	53	66	49	85
18	U-505-1-1	2.27	14.2	44	67	52	90
19	U-805-1-1	2.37	14.2	46	69	50	90
20	U-714-1-1	2.50	12.5	55	63	56	86
21	U-553-1-1	2.20	12.6	47	63	46	86
22	U-512-1-1	2.11	14.5	43	54	44	92
23	U-675-1-1	2.25	13.3	51	63	46	90
24	U-542-1-1	2.12	14.9	43	58	38	83
25	U-568-1-1	1.69	13.5	40	52	40	89
26	U-788-1-1	2.09	10.8	39	61	63	93
27	V-4-1-2	2.32	14.9	48	66	48	91
28	V-92-1-2	2.16	16.0	40	70	44	92
29	V-129-1-1	1.80	14.3	38	75	40	92
30	V-129-1-2	2.07	16.9	47	77	30	91
31	V-129-1-3	2.05	14.6	46	70	39	87
32	V-158-2-1	2.09	13.7	49	68	45	86
33	V-159-1-3	2.52	13.6	51	78	49	86
34	V-160-1-1	2.04	13.6	39	68	58	86
35	V-180-1-2	2.30	15.1	56	81	46	91
36	V-180-1-3	1.94	15.0	48	69	39	91
37	V-273-2-3	1.75	15.2	39	76	45	89
38	V-284-2-2	2.33	14.5	52	81	37	89
39	V-284-2-3	2.36	14.4	48	77	53	89
40	V-296-1-1	1.94	15.2	45	67	45	93
41	V-296-1-3	1.94	15.2	38	74	53	93
42	V-215-1-1	2.01	13.5	47	73	40	89
43	V-342-1-1	2.25	13.8	48	94	51	89
44	V-426-1-2	2.50	14.6	51	82	52	89
45	V-421-1-1	2.65	15.2	46	86	47	88
46	V-421-1-2	2.39	14.5	53	71	44	93
47	V-424-1-3	1.87	15.1	43	65	47	91
48	V-468-1-2	2.04	14.3	47	66	48	91
49	V-503-1-1	1.59	14.6	38	55	45	93
50	V-563-1-1	2.63	15.3	46	72	40	89
51	V-570-1-2	2.61	13.6	49	71	47	92
52	V-579-1-1	2.13	13.0	44	71	51	91
53	V-933-2-1	1.80	14.6	41	77	44	88
54	V-933-2-2	1.99	20.7	39	69	36	86
55	V-1118-1-1	1.88	16.2	42	66	44	82
56	V-1118-1-3	1.95	16.8	47	72	39	94
57	W-104-2-1	1.79	12.6	44	62	56	92
58	W-38-1-1	2.06	14.6	53	83	46	93

59	W-38-1-2	2.04	12.7	51	74	42	95
60	W-106-1-3	2.37	10.3	58	79	58	89
61	Argomulyo	1.47	15.9	51	52	22	80
62	Burangrang	2.00	15.7	49	74	40	81
63	Anjasmoro	2.30	14.7	44	76	35	85
64	Panderman	1.60	19.4	38	59	38	95
	Breeding lines	**	**	**	**	**	-
	LSD .05	0.12	1.3	10	12	14	-
	CV (%)	13.1	6.8	13.9	10.9	19.2	-

Breeding lines of U code was from Tanggamus x Tegal cross; Breeding lines of V code was from Sibayak x Tegal cross; Breeding lines of W code was from Sibayak x Argomulyo cross

In the plant breeding needs to investigate the relationship (correlation) between characters. If the selection is done on a character, we need to observe how they affect other characters (Burton, 1983). Analysis of correlation between traits in this study showed that seed yield had the strongest positive correlation with the number of plants in both F7 populations (lines) (Table 2). The greater the number of plants the higher plants and the higher the seed yield. The pattern of relationships among characters in Tanggamus x Tegal population seemed to differ from the Sibayak x Tegal population.

The study also found that seed yield did not correlate with weight (large) seed, but Susanto *et al.* (2001) reported that seed yield was positively correlated with large seeds. This suggested that there were opportunities to obtain lines of high yielding and large seeds. The results also found that the bigger the seed the less number of pods. This indicates that it would be difficult to obtain large seed lines by the high number of pods. To get maximum yield for the lines of large seed, let the optimum environmental conditions, so that seed filling goes well.

Dynamic relationship between the characters can be decomposed into two components, namely direct and indirect effects (Singh and Chaudhary 1979). The pattern of direct effect between the two populations seem to differ (Tables 3 and 4). In the cross of Tanggamus x Tegal, a strong direct effect was shown by the number of pods and number of plants, while in the cross of Sibayak x Tegal indicated by plant height and number of pods. Direct effect of pod number and plant number in the cross of Tanggamus x Tegal poorly supported by the results of the other components (Table 3). Direct effect of plant height in crosses Sibayak x Tegal also poorly supported by the results of the other components, but direct effect of pod number somewhat weakened by 100 seed weight (Table 4).

Characters that can be used as selection criteria for yield is the yield component that has a positive correlation with the yield and have a large direct effect on yield, and yield components which have a large positive direct effect (although less correlated with the outcome) (Board *et al.* 1997). Based on this, it appears that plant height and pod number are considered as selection criteria in soybean. In the field work selection, the use of pod number and plant height were also more practical compared with other characters.

Table 2. Correlation between characters of F7 soybean breeding lines in Garut, early dry season 2008

Character	Seed yield	100 seed weight	Number of plants	Plant height	Number of pods	Days to maturity
Seed yield		0,090	0,574**	0,348	0,327	0,146
100 seed weight	-0,197		-0,125	0,066	-0,365	0,012
Number of plants	0,662**	-0,272		0,325	0,174	0,016
Plant height	0,484**	-0,119	0,387**		0,190	-0,148
Number of pods	0,192	-0,526**	-0,050	0,084		-0,021
Days to maturity	-0,095	-0,074	0,040	-0,133	-0,062	

Value above and below diagonal represented for Tanggamus x Tegal (N=26) and Sibayak x Tegal (N=30), respectively
** significant at P. 0.01

Table 3. Direct effect (in diagonal) and indirect effect of yield component on yield of 26 F7 soybean breeding lines of Tanggamus x Local Tegal in Garut, early dry season 2008

Character	Number of plants	Plant height	Number of pods	100 seed weight	Days to maturity	Total effect
Number of plants	**0.544**	-0.133	0.159	0.008	-0,003	0,575
Plant height	0.177	**-0,408**	0,173	-0.004	-0,026	-0,088
Number of pods	0.095	-0.078	**0,911**	0,022	-0,004	0,946
100 seed weight	-0.068	-0.027	-0.333	**-0,060**	-0,002	-0,490
Days to maturity	0,042	-0,299	0,094	**-**0,004	**-0,036**	-0,203

Tabel 4. Direct effect (in diagonal) and indirect effect of yield component on yield of 30 F7 soybean breeding lines of Sibayak x Local Tegal in Garut, early dry season 2008

Character	Number of plants	Plant height	Number of pods	100 seed weight	Days to maturity	Total effect
Number of plants	**-0,022**	0.724	0.012	-0.029	0,002	0,687
Plant height	-0,009	**1,870**	0,020	-0.013	-0,006	1,862
Number of pods	0.001	0.157	**0,238**	-0,057	-0,003	0,336
100 seed weight	0.060	-0.223	-0.125	**0,108**	-0,003	-0,183
Days to maturity	-0,001	-0,249	-0,015	**-**0,008	**0,045**	-0,228

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