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EVALUATION OF BLACK SEEDED SOYBEAN GENOTYPES FOR YIELD AND YIELD RELATED TRAITS AT JIMMA, SOUTH WESTERN ETHIOPIA

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ABSTRACT

Soybean is versatile crop and becoming the most important oil crop in Ethiopia. Soybean can be classified into different group based on the color. Black soybean is the most preferred ones due to the nutritional and economical values. To date in Ethiopia a total of 26 yellow seeded soybean varieties are under production**.** Evaluating the performance of black soybean genotypes has paramount importance. The trial was conducted with 64 black seeded soybean genotypes in the year 2019 main cropping season at Jimma, South Western parts of Ethiopia. The experimental design used wastriple lattice. The data collected include; days to flowering, days to maturity, number of pods per plant, number of seeds per plant, hundred seed weight, rust ,common bacterial blight ,lodging score and grain yield. The statistical analysis showed significant differences at ($P<0.05$) among the varieties for all parameters. Mean grain yield ranged from 0.5 t/ha (T2-EL-LG-90-JM17-F4) to 2.59 (T2-EL-LG-90-JM17-B6) t/ha. Out of the total tested soybean genotypes 47 black seeded soybean genotypes produced a better grain yield than the most adapted check variety, Clark 63k. On the other hand, 17 genotypes produced better than the second check variety, Coker - 240. The research result indicates as there is a possibility of developing black seeded soybean varieties for production. Consequently, it is recommended to advance promising black seeded soybean genotypes for further test.

I. INTRODUCTION

Soybean (Glycine max L. Merr) has been the most widely used raw material for industry. Based on seed color soybean can be classified into black; yellow; red; green and brown. Black seeded soybean is native to tropical Asia. Black soybean is one of the largest sources of edible oil and account for roughly 50% of the total oilseed production of the world (Berk, 1992). Black soybean genotypes have many advantages, both in terms of health as well as economic. Black soybean occupies the top list with the highest antioxidant activity, compared to other types of soybean. Black color on the skin indicates that soy contains anthocyanin compounds, which is one source of anti –oxidants (Todd and Vodkin). Anthocyanins, a group of reddish or purple flavonoids, are reported to be the primary pigments in the black soybean genotypes (Choung et al. 2001; Kuroda and Wada 1933; Lee et al. 2009; Yoshikura and Hamaguchi 1969).

Anthocyanins are groups of reddish or purple flavonoids which have been reported to reduce the risk of coronary heart disease (Stocker and O'Halloran 2004; Waterhouse 1995). Anthocyanins are also known to have anti-cancer (Hyun and Chung 2004; Kamei et al. 1995; Zhao et al. 2004), hypoglycemic (Tsuda et al. 2003), and anti-inflammatory effects (Tsuda et al. 2002) and have been used in the treatment of various circulatory disorders (Bettini et al. 1985). Furthermore, these functions provide synergic effects with various nutrients in vivo, so their nutritional values are of great interest recently consumptions of black soybeans are rapidly growing due to their nutritional values and potentials to develop as healthy functional food ingredients in different countries especially in eastern. In recent times, beside the use as a raw material of food, black soybean also can use as a biofuel alternative (Chindy *et al*,2015). Soybean is believed introduced to Ethiopia in the 1950's and to date 26 soybean genotypes were released for production for different agro ecology but all of them are yellow seed color. Black seeded soybean genotypes were evaluated at observation nursery and promising black soybean genotypes were selected.

Objective(s): to evaluate the performance and to advance the selected black seeded soybean genotypes in to the next stage of evaluation.

2. MATERIALS AND METHODS

2.1 The Study Area

This study was conducted at Jimma Agricultural Research Centers in Ethiopia. Jimma agricultural research centers are located in the Oromia region, in South Western Ethiopia. Jimma agricultural research center is located at 12 km distance from Jimma town (1,754 m.a.s.l, 07o 30'N $36^0$47'E). The place has a mean maximum and minimum temperature of 26.3 and 11.6^0C respectively, with mean annual rainfall of 1,572mm.

2.2 Experimental Treatments and Design

A total of 62 black soybean genotypes and two yellow seeded check varieties were evaluated in the triple lattice design. The experiment was planted in 4 rows plot of 4 m length. The spacing used was 60 cm between rows and 5 cm between plants. The seed was drilled during planting and later thinned at 5 cm spacing. All agronomic practices were applied based on the recommendation.

2.3 Data Collection

Days to flowering, days to maturity and hundred seed weight, disease severity and yield were collected on plot base. Five plants from the central rows were randomly selected for data collection on plant basis and the averages of the five plants in each experimental plot were used for statistical analysis for traits such as plant height, number of pods/plant and number of seeds/plant.

2.4 Data Analysis

The collected data were subjected to Analysis of variance using SAS Software after testing the ANOVA assumptions and treatment means were separated with the Least Significant Difference (LSD) at 5% probability level.

3. RESULTS AND DISCUSSION

Table1. Analysis of variance summary for yield and related traits at Jimma in 2019

Trait	Source of variation	
	Mean square	Error
DF	25.16**	5.51
DM	49.03**	23.75
PH	29.28**	10.54
NP	45.63**	20.19
NS	127.32*	70
NB	0.74**	0.22
HSW	5.99**	2.08
Yield	438076.92**	71238.08

Remarks;- Where DF = days to 50% flowering, DM = days to maturity, PH = plant height, NP = number of pods per plant, NS= seed per plant, NB= number of branch es per plant; HW =hundred seed weight,* = significant at (P≤0.05), and **= significant at (P≤ 0.01) .

The analysis of variance indicates significant to highly significant (P≤0.01) differences for all of the studied traits. Days to 50% flowering of the genotype was the earliest T2-EL-LG-90-JM17-H16 (37.5 days); while genotype T2-EL-LG-90-JM17-14 showed the latest for flowering (69.3days), days to maturity ranged from 119 for the variety T2-EL-LG-90-JM17-B9 - 147.5 days for the variety T2-EL-LG-90-JM17-F11 with mean value of 128.2 days to maturity. Similar trends of variability in phonology were also reported in soybean i.e., 30 to 57 days to 50% flowering, and a range of 79 to 101 days to maturity (Singh *et al*., 1996). Similarly, differences in days to maturity in different genotypes were reported (Adiyata *et al.* 2011). In the present study out of the total tested soybean genotypes the tallest plant height was recorded from T2-EL-LG-90-JM17-E5 (69 cm) and the shortest from T2-EL-LG-90-JM17-F17 (51.2) with a mean value of 61.2cm.

The maximum number of pod per plant was observed on the genotypes T2-EL-LG-90-JM17-H24 (38.8) and the minimum from the genotypes T2-EL-LG-90-JM17-B1 (13.7). The result is comparable to the one reported by Shankar (2014), who reported that pod per plant ranged from 19.20 to 53.93 with a general mean of 28.82 pods per plant. EL-LG-90-JM17-H24 showed the largest number of seed per plant (71.9), while genotypes T2-EL-LG-90-JM17-B1showed the lowest number of seed per plant (25.4).

The maximum hundred seed weight was recorded from the variety T2-EL-LG-90-JM17-B19 (20.7 g), while the minimum from the genotypes T2-EL-LG-90-JM17-F25 (9.9 g). Out of the total tested soybean genotypes 47 genotypes produced grain yield better than Clark 63k(check1) ; while 17 genotypes produced better than Coker – 240 (Check2). Genotypes T2-EL-LG-90-JM17-B6 was the top yielder with grain yield of 2.59 t/ha. And, the lowest yielding genotypes were T2-EL-LG-90-JM17-F4 (0.5 t/ha).

Table 1.Mean grain yield (t/ha) and other parameters of black seeded soybean genotypes evaluated at Jimma in the year 2019.

No	Genotype	DF	DM	PH	NPDP	NSP	NB	Rust	HSW (gm)	Yield (T/ha)
1.	T2-EL-LG-90-JM17-B21	57.5	119.5	57.5	26.4	52.4	3.6	5.0	13.0	2.04
2.	T2-EL-LG-90-JM17-B7	58.5	120.0	59.1	31.4	56.8	4.2	5.0	12.9	2.49
3.	T2-EL-LG-90-JM17-B9	55.5	119.5	60.2	25.6	49.9	3.6	5.0	14.4	1.73
4.	T2-EL-LG-90-JM17-C2	57.5	125.5	61.9	35.7	57.5	3.3	7.0	13.2	2.49
5.	T2-EL-LG-90-JM17-C17	57.0	132.0	62.8	27.1	37.1	3.7	6.0	13.2	1.69
6.	T2-EL-LG-90-JM17-C25	61.5	132.5	56.9	26.5	43.0	4.2	4.0	14.2	0.83
7.	T2-EL-LG-90-JM17-D3	57.0	133.0	67.4	27.4	43.1	4.8	5.0	12.7	1.61
8.	T2-EL-LG-90-JM17-D5	58.5	134.0	64.8	29.8	49.8	5.2	5.0	14.5	1.40
9.	T2-EL-LG-90-JM17-D7	58.5	130.0	54.8	23.4	35.0	3.5	6.0	13.2	1.01
10.	T2-EL-LG-90-JM17-D8	57.0	132.0	61.8	28.0	54.1	3.9	4.0	16.3	0.91
11.	T2-EL-LG-90-JM17-D11	56.0	124.0	64.1	25.4	44.0	3.3	6.0	11.8	1.81
12.	T2-EL-LG-90-JM17-D15	56.5	126.5	57.8	27.5	43.5	3.8	5.0	12.8	1.24
13.	T2-EL-LG-90-JM17-D17	57.0	131.0	66.2	32.7	56.8	5.2	5.0	12.1	1.63
14.	T2-EL-LG-90-JM17-D18	57.5	140.0	60.6	26.1	41.6	3.8	5.0	11.8	0.50
15.	T2-EL-LG-90-JM17-D24	55.5	124.5	54.2	24.3	40.8	3.4	5.0	12.6	2.08
16.	T2-EL-LG-90-JM17-D27	56.5	125.0	64.3	27.8	52.5	3.6	7.0	12.3	1.95
17.	T2-EL-LG-90-JM17-D32	56.5	129.5	57.3	32.0	51.9	3.3	7.0	14.4	2.34
18.	T2-EL-LG-90-JM17-E2	56.5	125.0	60.1	37.7	65.1	3.6	7.0	11.7	1.72
19.	T2-EL-LG-90-JM17-E4	58.5	124.5	62.6	25.4	44.5	3.7	7.0	13.1	1.83
20.	T2-EL-LG-90-JM17-E5	56.0	132.5	69.0	27.4	44.2	4.3	6.0	14.5	1.73
21.	T2-EL-LG-90-JM17-E7	58.0	131.5	58.1	27.2	44.4	3.7	7.0	15.9	0.98
22.	T2-EL-LG-90-JM17-E9	56.0	122.0	59.8	30.1	53.8	3.2	7.0	11.8	2.01
23.	T2-EL-LG-90-JM17-E10	56.0	133.0	58.5	23.5	34.5	3.8	5.0	16.2	0.89
24.	T2-EL-LG-90-JM17-F3	55.5	128.0	67.5	36.8	53.3	3.8	6.0	11.6	1.98
25.	T2-EL-LG-90-JM17-F4	57.0	129.0	66.9	30.1	49.3	4.2	6.0	13.8	1.55
26.	T2-EL-LG-90-JM17-F5	56.5	129.0	60.1	29.3	55.8	3.8	7.0	12.7	1.75
27.	T2-EL-LG-90-JM17-F7	56.5	144.5	53.1	33.9	55.9	4.2	4.0	15.0	1.33
28.	T2-EL-LG-90-JM17-F8	55.0	123.5	61.8	32.8	56.2	4.0	6.0	12.3	2.05
29.	T2-EL-LG-90-JM17-F9	57.5	126.0	65.7	37.6	64.4	4.2	6.0	13.7	1.90
30.	T2-EL-LG-90-JM17-F11	56.0	147.5	51.2	28.2	47.8	3.3	3.0	14.7	0.70
31.	T2-EL-LG-90-JM17-F15	56.5	131.5	60.7	32.1	50.5	4.2	6.0	13.6	1.78
32.	T2-EL-LG-90-JM17-F16	56.5	127.0	63.9	31.5	57.4	3.9	7.0	11.5	1.81
33.	T2-EL-LG-90-JM17-F20	55.5	123.5	58.6	27.4	43.1	2.9	7.0	11.5	1.70
34.	T2-EL-LG-90-JM17-F22	57.5	127.5	61.3	36.1	51.6	3.8	6.0	14.3	1.90
35.	T2-EL-LG-90-JM17-F23	56.5	135.5	54.8	33.5	52.5	3.3	4.0	15.3	0.92
36.	T2-EL-LG-90-JM17-F25	56.5	120.0	64.1	34.1	54.0	4.0	7.0	9.9	1.95
37.	T2-EL-LG-90-JM17-F27	55.5	125.5	62.7	34.2	58.5	3.8	7.0	12.0	2.03
38.	T2-EL-LG-90-JM17-F29	56.0	128.0	66.2	35.7	57.4	4.2	6.0	11.8	1.53
39.	T2-EL-LG-90-JM17-G1	57.0	135.0	59.6	23.9	38.6	4.2	5.0	12.3	0.61
40.	T2-EL-LG-90-JM17-G3	57.0	125.5	62.4	32.5	50.9	4.1	7.0	12.3	1.96
41.	T2-EL-LG-90-JM17-G4	59.5	126.5	65.6	38.1	71.9	3.8	7.0	11.9	2.30

42.	T2-EL-LG-90-JM17-G6	56.0	128.5	63.9	33.5	56.8	4.1	7.0	10.3	2.21
43.	T2-EL-LG-90-JM17-G10	57.5	127.5	60.1	35.5	60.6	4.1	7.0	13.0	1.85
44.	T2-EL-LG-90-JM17-G13	56.5	128.0	63.9	32.4	47.7	4.2	6.0	14.9	2.09
45.	T2-EL-LG-90-JM17-G15	57.0	132.0	60.5	26.9	40.4	3.3	7.0	13.5	0.74
46.	T2-EL-LG-90-JM17-G29	55.0	125.5	60.9	35.1	58.4	4.5	7.0	13.8	1.80
47.	T2-EL-LG-90-JM17-G31	56.5	124.5	62.1	33.6	47.0	4.1	6.0	11.8	1.86
48.	T2-EL-LG-90-JM17-H8	57.0	128.5	60.5	25.5	36.6	3.5	5.0	14.5	0.61
49.	T2-EL-LG-90-JM17-H16	37.5	124.5	67.3	36.2	55.9	4.0	7.0	12.0	2.26
50.	T2-EL-LG-90-JM17-H18	58.0	126.5	58.7	27.0	49.8	4.0	6.0	12.5	1.62
51.	T2-EL-LG-90-JM17-H20	58.0	123.0	62.0	24.6	37.1	3.1	7.0	12.9	1.62
52.	T2-EL-LG-90-JM17-H22	53.5	129.0	65.7	23.9	43.9	3.6	5.0	13.2	1.53
53.	T2-EL-LG-90-JM17-H24	56.0	142.5	63.0	38.8	71.4	4.1	6.0	12.0	1.86
54.	T2-EL-LG-90-JM17-I3	47.5	128.0	56.0	38.2	53.8	3.3	7.0	12.2	2.01
55.	T2-EL-LG-90-JM17-I4	69.3	125.0	65.0	28.9	43.0	3.2	7.0	12.3	1.65
56.	T2-EL-LG-90-JM17-I9	68.0	124.5	58.1	27.9	49.3	3.8	6.0	12.5	1.90
57.	T2-EL-LG-90-JM17-B1	57.5	130.5	54.6	13.7	25.4	1.5	3.0	19.8	0.95
58.	T2-EL-LG-90-JM17-B2	56.0	122.0	55.8	22.7	36.1	3.8	5.0	13.6	1.61
59.	T2-EL-LG-90-JM17-B6	56.5	121.5	62.6	28.1	52.4	3.2	5.0	15.7	2.59
60.	T2-EL-LG-90-JM17-B11	57.0	120.0	54.5	24.7	45.1	3.1	5.0	13.5	1.86
61.	T2-EL-LG-90-JM17-B13	56.0	128.5	63.0	37.3	58.4	4.1	6.0	11.6	2.02
62.	T2-EL-LG-90-JM17-B19	57.0	126.5	61.5	18.4	29.4	1.6	5.0	20.7	0.64
63.	Clarck 63-K(C_1)	56.5	129.0	64.7	35.6	48.5	4.9	5.0	11.7	1.49
64.	Coker 240(C_2)	55.5	130.5	67.7	26.9	48.8	5.0	5.0	18.3	1.95
	Min	37.5	119.5	51.2	13.7	25.4	1.5	3	9.9	0.50
	Max	69.3	147.5	69	38.8	71.9	5.2	7	20.7	2.59
	Mean	59.2	128.21	61.2	29.9	49.4	3.8	5.82	13.34	1.65
	CV	4.0	4.0	5.3	15.0	17.0	12.6	12.46	11.8	17.10
	LSD	4.8	9.8	6.8	9.6	16.8	1.0	1.44	2.90	0. 53

4. CONCLUSION

Soybean can be classified into different class based on seed color. Diversity in seed color has its own nutritional value. Black seeded soybean color has premium price and better nutritional value as compared to the yellow seeded color. The result of this study indicates significant variation among the genotypes. The yield ranges (2.59 t/ha), to 0.5 t/ha) and most of the genotype produce more than the two yellow seeded check varieties widely produced at Jimma. About 17 genotypes which produced better yielder than the checks. It is recommended to evaluate best performing black seeded soybean genotypes across location and year to release black seeded soybean varieties for production. In addition to agronomic traits it is highly recommended to include quality related traits.

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