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Viraj Jadhav

Seed Technology Research Unit,
M. P. K. V., Rahuri,
Maharashtra, India

Dr. Avinash Karjule

Seed Technology Research Unit,
M. P. K. V., Rahuri,
Maharashtra, India

Dr. Kailas Gagare

Seed Technology Research Unit,
M. P. K. V., Rahuri,
Maharashtra, India

Vijay Shelar

Seed Technology Research Unit,
M. P. K. V., Rahuri,
Maharashtra, India

Corresponding Author:

Viraj Jadhav

Seed Technology Research Unit,
M. P. K. V., Rahuri,
Maharashtra, India

Screening for morphophysiological, seed yield and quality parameters in soybean genotypes (*Glycine max* (L.) Merrill)

Viraj Jadhav, Dr. Avinash Karjule, Dr. Kailas Gagare and Vijay Shelar

Abstract

Among the 30 genotypes, for yield contributing parameters, the genotype KDS 726 (3131.16 kg ha⁻¹) recorded the highest seed yield per ha followed by KDS 753 (2843.60 kg ha⁻¹). The increase in seed yield per hectare was due to the higher number of pods per plant in KDS 726 (42.33) followed by KDS 756 (40.66), higher number of branches per plant in KDS 726 (6) followed by KDS 753 (6). The hundred seed weight was highest in KDS 726 (14.13 g) followed by KDS 753 (13.94 g). While the highest plant height of 53.33 cm. was recorded by genotype EC 390977 and genotype JS 9305 recorded early flowering i.e. 35.66 days and early maturity i.e. 95.66 days. In case of seed quality attributing characters, the highest germination was recorded in the genotype KDS 726 (90.00%) followed by KDS 753 (89.33%). The highest vigour index I was recorded in genotype KDS 726 (2850) followed by KDS 753 (2709) and the highest vigour index II was recorded in KDS 726 (131.11) followed by KDS 753 (127.45). The highest moisture content was recorded in genotype KDS 1150 (10.87%) followed by MACS-NRC-1667 (8.60%).

Keywords: Flowering, seed yield, germination, moisture content, vigour index

Introduction

Soybean (*Glycine max* (L.) Merrill) is known as the "Golden Bean," has become a miracle crop of the 20th century. It is a triple-benefit crop, a one-of-a-kind food, a valuable feed and a high-potential industrial raw material. Soybean is a low-cost source of protein for food and feed. It contains 43.2 percent protein in addition to 19.5 percent oil (Halwankar *et al.*, 1992)^[11]. Soybean is rich in amino acids, vitamins A, B and D. The sprouted seed is high in vitamin C and also high in phosphorous and sulphur content. It lowers the risk of cardiovascular disease, osteoporosis, diabetes as well as the severity of menopausal symptoms (Chandrawat *et al.*, 2014)^[8]. Many phenolic compounds are found in soybean seeds including acids such as chlorogenic acid, caffeic acid, ferulic acid and p-coumaric acid. These have antioxidant properties that are beneficial to human health (Kim *et al.*, 2009)^[13]. In a very short period, soybean has become an important oilseed crop in India, with 113.98 lakh ha area under cultivation during *Kharif* 2019-20. Madhya Pradesh, Maharashtra, Rajasthan, Karnataka and Telangana are the major soybean-growing states. One of the most significant parameters of seed quality is seed vigour which has the potential to impact crop performance by means of seedling establishment particularly under adverse climatic conditions (Khaliliaqdam *et al.*, 2012)^[12]. But soybean production is experiencing problems due to its seed quality which is dependent on seed handling during harvesting, processing and storage.

High yielding soybean genotype had a greater leaf area index, greater dry mass production ability and higher absolute growth rate at all growth stages (Malek *et al.*, 2012)^[14]. There is significant positive correlation between seed yield contributing characters with that of yield attributing agronomic parameters. Seed and plant morphological characters are very useful and most important features for characterization of improved soybean cultivars. Days to flowering had a positive and significant phenotypic correlation with days to maturity in soybean. There is positive relationship between pod yield per hectare and pod yield per plant, leaf area index, pod weight, pod length, leaf area, ovule number per pod, plant height and number of seeds per pod at both the phenotypic and genotypic levels (Angadi *et al.*, 2012)^[3]. In view of this an experiment was carried out for screening of 30 soybean genotypes for seed yield and quality parameters.

Material and Methods

For the screening of different 30 genotypes of soybean the recommended agronomic package of practices were carried out at. The Thirty genotypes of soybean used for the present investigation were obtained from the Soybean Breeder, ARS Kasbe Digraj Dist. Satara (MS). The gross plot size was 0.60 x 3.30 m². Fertilizer dose applied to soybean crop as per recommended dose 50:75:45 NPK kg/ha. Observation of field trial conducted for screening of genotypes were recorded at Post Graduate Institute Farm, M.P.K.V., Rahuri. The observations on morpho physiological parameters viz., Days to 50% flowering, Plant height (cm) at maturity, Number of branches and pods per plant, Number of seeds per pod, Days to maturity, Seed yield per plant were recorded on five randomly selected plants from each genotypes in each replication and averages were worked out. The seed quality parameters viz., seed germination was worked out with four replications of 100 seeds from each genotype were kept for germination using between paper methods at 25±2°C in germinator for 8 days (Anonymous, 1999) [4]. The moisture content was determined by hot air oven method. 10 g of seeds were kept in hot air oven at 103±2 °C for 17±1 hour in hot air oven (Anonymous, 1999) [4]. Immediately after germination ten normal seedlings from each replication were selected for calculations of vigour index I and II (Abdul-baki and Anderson, 1973) [11] and 100 seed weight was worked out with fully matured and well developed cleaned 100 seeds in four replications of each genotype were taken from bulk seeds of five randomly selected plants and weighed with help of an electronic balance and expressed in gram. The data was analyzed through analysis of variance (ANOVA) technique for factorial controlled randomized design and presented at 5% level of significance (P = 0.05) by the procedure prescribed by Panse and Sukhatme (1967) [17].

Result and discussion

A. Performance of soybean genotypes for morphological and Yield contributing Parameters

The performance of different soybean genotypes for different plant morphological, yield and contributing parameters are presented in Table 1 and 2.

I. Days to 50% Flowering

The data on days to 50% flowering varied significantly among the 30 soybean genotypes. The genotypes were classified into three categories early (<36 days), medium (36 to 45 days) and late (>45 days). Among 30 genotypes 28 genotypes were medium while one was early (JS-9305) and one was late (Type 49). Significantly higher days to 50% flowering was observed in the genotype Type 49 (49) whereas it was minimum in JS-9305 (35.66 days).

II. Plant Height (cm)

The data pertaining to plant height of different soybean genotypes varied significantly. The genotypes were categorized as short (<40 cm), medium (40-50 cm) and tall (>50 cm). Among 30 genotypes 6 genotypes recorded short height (<40 cm), 20 genotypes recorded medium height (40-50 cm) and 4 genotypes recorded tall plant height (>50 cm). The genotype EC 390977(53.33 cm) recorded highest plant height while genotype MACS 1520 (36.33 cm) recorded lowest plant height. Wide variation in plant height was observed due to genetical characters of the genotypes and also might be influenced by agronomical and environmental factors. Similar results were reported by Manjaya and Bapat (2008) [15] and Tarasatyavathi *et al.* (2004) [24] in different soybean genotypes.

III. Number of Branches per Plant

The number of branches per plant as influenced by soybean genotypes differed significantly. The mean branches per plant for 30 genotypes was 4.24 and significantly highest branches were observed in KDS 726 and KDS 753 (6 branches) while lowest branches was observed in RCS-11-07 (3 branches). The number of branches per plant were found correlated with yield characteristics in soybean. Similar results were observed by Muhammad *et al.* (2006) [16] in soybean genotypes. The variation in branches is attributed mainly due to the genetic factors.

IV. Number of pods per plant

The significantly highest pods recorded in genotypes KDS 726 followed by KDS 992, KDS 753 with 42.33, 41.67 and 40.66 pods per plant respectively. While the significantly lowest pods were recorded in genotypes RCS-11-07 with 30 pods. The pods per plant was found positively correlated with yield parameters. Similar results were observed by Rasaily *et al.* (1986) [20], Antalikova *et al.* (2008) [5], Ramirez and Moreno (2012) [19] in different soybean genotypes. While the variation in pods may be due to pod bearing ability of the genotype itself and different response to environment and soil conditions up to some extent.

V. Number of seeds per pod

The data revealed that mean number of seeds per pod was 2.74 for 30 genotypes. From the data it is observed that the genotype KDS 992, KDS 1273, KDS 1274, MACS-NRC-1667, MACS 450, Birsa Soya 1, Type 49, KDS 726 and KDS 753 reported highest 3 seeds per pod each. While genotypes KDS 1097 and MAUS 71 recorded lowest 2.33 seeds per pod.

VI. Days to maturity

The genotypes were classified into three categories early (<90 days), medium (90 to 105 days) and late (>105 days). Among 30 genotypes 28 genotypes recorded medium days to maturity while two recorded late days to maturity (MACS 450 and Type 49). The genotype Type 49 recorded significantly higher days for maturity of 109.33 days. While it was lowest in genotype JS 9305 (95.66 days). Similar results were observed by Diazcarrasco *et al.* (1986) [10], Tarasatyvathi *et al.* (2004) [24] and Manjaya and Bapat (2008) [15] in soybean.

VII. Seed yield per plant (g)

Significantly higher seed yield per plant was recorded in genotypes KDS 726 (16.96 g) followed by KDS 753 (15.63 g) and KDS 992 (15.00 g). While the lowest seed yield per plant was recorded in genotype RCS-11-07 (7.87 g) followed by Type 49 (8.00 g). seed yield had direct correlation with number of pods per plant and number of branches per plant. Similar results were observed by Rasaily *et al.* (1986) [20], Ramirez *et al.* (2012) [19] and Baig *et al.* (2017) [7] in different soybean genotypes.

VIII. Seed yield per plot (kg)

The data revealed that significantly higher seed yield per plot was recorded in genotype KDS 726 (0.62 kg) followed by KDS 753 (0.56 kg) and KDS 992 (0.52 kg). While the lowest seed yield per plot was recorded in genotype Type 49 (0.32 kg) and RCS-11-07 (0.33 kg).

IX. Seed yield per hectare (kg)

The data on seed yield per hectare varied significantly among the 30 soybean genotypes. The data revealed that significantly higher yield per ha was recorded in KDS 726 that is 3131.16

kg/ha followed by KDS 753 (2843.60 kg). Whereas, the lowest seed yield per ha was recorded in genotype Type 49 (1616.16 kg) followed by RCS-11-07 (1666.66 kg). Seed yield per ha was found positively correlated with seed yield per plant and seed yield per plot, number of pods and branches per plant and 100 seed weight. Similar results were observed by Rasaily *et al.* (1986)^[20] and Antalikova *et al.* (2008)^[5] in different soybean genotypes.

X. 100 Seed weight (g)

The data on 100 seed weight varied significantly among the 30 soybean genotypes. The genotypes were classified as small (< 10.0 g), medium (10.1 to 13.0 g) and large (>13.0 g) for 100 seed weight. Among the 30 genotypes 23 were medium while 7 genotypes reported large size. The genotype KDS 726 recorded significantly higher 100 seed weight (14.13 g) followed by KDS 753 (13.94 g) and was lowest in the genotype RCS-11-07 (10.15 g) followed by Type 49 (10.51). Similar type of results were observed by Babrenfus and Fehr (1984)^[6] in different soybean genotypes.

B. Performance of soybean genotypes for seed quality parameters

The performance of different soybean genotypes for different plant morphological, yield and contributing parameters are presented in the table 3.

I. Seed germination (%)

The significantly higher germination percentage was recorded by genotype KDS 726 (90%) followed by KDS 753 (89.33%). Whereas lowest germination percentage was recorded in

genotype Type 49 (75%) followed by KDS 1150 (76%). Similar results were observed by Ravikumar (1999)^[21] and Sharma *et al.* (2009)^[22] in different soybean genotypes.

II. Moisture content (%)

The highest moisture content was recorded in genotype KDS 1150 (8.80 %) compared to the rest of the genotypes followed by MACS-NRC-1667(8.60%). Whereas genotype KDS 1274 (7.43%) exhibited lowest moisture content. The variation in moisture content might be due to genetic makeup of seed. Similar results were observed by Raja Reddy *et al.* (2018)^[18] in different soybean genotypes.

III. Vigour Index I

Among the 30 genotypes KDS 726 recorded highest vigour index I of 2850 followed by KDS 753 (2709). While genotype Type 49 recorded lowest vigour index I of 2049 followed by KDS 1150 (2077). The seed vigour index I was found to be dependent on root shoot length and germination percentage. Similar results were observed by Ali *et al.* (2018)^[2] in soybean and Dhaiya *et al.* (1997)^[9] chickpea genotypes.

IV. Vigour Index II

The genotype KDS 726 recorded highest vigour index II of 131.11 whereas, it was found lowest 104.11 in the genotype KDS 1150 followed by Type 49 (104.49). The seed vigour index II was found dependent on germination as well as seedling weight. Similar results were observed by Sooganna *et al.* (2015)^[23] and Ali *et al.* (2018)^[2] in different soybean genotypes.

Table 1: Performance of soybean genotypes for morphological and yield contributing parameters

Sr. No.	Genotype	Days to 50% flowering (Days)	Plant height (cm)	No. of branches per plant	No. of pods per plant	Days to maturity
1	KDS 980	40.00	41.67	4.67	38.67	97.00
2	KDS 992	42.33	40.67	5.00	41.67	100.00
3	KDS 1096	38.67	43.33	4.33	39.33	97.33
4	KDS 1097	42.33	45.00	3.67	37.33	100.33
5	KDS 1114	37.67	40.00	4.67	36.00	98.33
6	KDS 1142	37.33	42.33	3.66	34.33	99.00
7	KDS 1144	36.66	44.00	4.00	35.33	97.33
8	KDS 1149	38.33	39.33	4.33	37.66	97.66
9	KDS 1150	37.66	42.00	4.00	35.66	99.33
10	KDS 1272	42.66	43.33	3.66	32.00	102.00
11	KDS 1273	39.33	42.66	4.00	30.33	98.66
12	KDS 1274	42.00	44.66	5.00	32.66	99.33
13	MAUS 71	40.00	39.00	4.33	34.00	100.33
14	MAUS 612	38.66	38.33	3.66	32.33	96.00
15	NRC 147	43.33	50.33	3.33	34.66	100.33
16	MACS-NRC-1667	37.33	45.66	3.33	33.33	100.00
17	MACS 450	42.66	41.66	3.66	31.00	105.33
18	MACS 1460	39.66	42.00	4.00	31.00	96.33
19	MACS 1520	41.33	36.33	3.66	32.00	98.33
20	RCS-11-07	41.00	44.00	3.00	30.00	103.33
21	EC 390976	39.33	47.33	4.66	31.00	100.00
22	EC 390977	37.33	53.33	3.66	31.66	97.33
23	Birsa Soya 1	37.66	40.00	4.66	31.33	100.66
24	Type 49	49.00	37.00	3.66	30.33	109.33
25	DSb 21	42.66	46.00	4.66	33.00	103.33
26	KDS 726	42.33	52.66	6.00	42.33	100.66
27	KDS 753	42.00	51.66	6.00	40.66	101.33
28	DS 228	39.00	41.00	5.33	35.66	102.33
29	JS 9305	35.66	37.00	4.66	37.66	95.66
30	JS 335	36.33	40.00	4.33	36.66	99.33
	Mean	40.01	43.08	4.24	34.66	99.88
	SE (±)	0.611	1.180	0.541	0.783	0.601
	CD at 5%	1.730	3.342	1.533	2.218	1.704

Table 2: Performance of soybean genotypes for yield contributing parameters

Sr. No.	Genotype	No of seeds per pod	Seed Yield per Plant(g)	Seed Yield per Plot (kg)	Seed Yield per ha (kg)	100 Seed weight (g)
1	KDS 980	2.67	12.160	0.470	2373.67	12.73
2	KDS 992	3.00	15.000	0.520	2626.00	13.60
3	KDS 1096	2.67	11.720	0.430	2171.80	11.69
4	KDS 1097	2.33	10.480	0.390	1969.77	12.33
5	KDS 1114	2.67	11.000	0.380	1919.40	12.11
6	KDS 1142	2.66	11.183	0.443	2236.66	12.63
7	KDS 1144	2.66	11.143	0.427	2156.33	13.46
8	KDS 1149	2.66	11.487	0.460	2323.36	12.05
9	KDS 1150	2.66	10.563	0.400	2020.40	11.75
10	KDS 1272	2.66	9.060	0.367	1853.43	10.84
11	KDS 1273	3.00	9.257	0.377	1904.43	10.66
12	KDS 1274	3.00	12.000	0.480	2424.26	12.92
13	MAUS 71	2.33	8.810	0.377	1904.33	10.80
14	MAUS 612	2.66	8.590	0.350	1766.66	10.93
15	NRC 147	2.66	10.200	0.410	2070.60	11.94
16	MACS-NRC-1667	3.00	10.903	0.413	2085.70	11.29
17	MACS 450	3.00	8.137	0.347	1752.73	10.87
18	MACS 1460	2.66	8.397	0.350	1767.66	11.36
19	MACS 1520	2.66	8.727	0.340	1717.33	11.49
20	RCS-11-07	2.66	7.870	0.330	1666.66	10.15
21	EC 390976	2.66	8.667	0.360	1818.33	11.44
22	EC 390977	2.66	9.207	0.380	1919.43	11.58
23	Birsa Soya 1	3.00	9.360	0.410	2070.66	11.09
24	Type 49	3.00	8.003	0.320	1616.16	10.51
25	DSb 21	2.66	12.157	0.453	2287.76	13.75
26	KDS 726	3.00	16.967	0.620	3131.16	14.13
27	KDS 753	3.00	15.633	0.563	2843.60	13.94
28	DS 228	2.66	11.327	0.467	2358.30	12.98
29	JS 9305	2.66	12.247	0.500	2525.40	13.17
30	JS 335	2.66	12.460	0.517	2611.13	13.34
	Mean	2.74	10.760	0.420	2129.77	12.05
	SE (\pm)	0.280	0.414	0.009	0.803	0.328
	CD at 5%	NS	1.173	0.025	2.273	0.929

Table 3: Performance of soybean genotypes for seed quality contributing parameters

Sr. No.	Genotype	Germination (%)	Moisture (%)	Vigour index I	Vigour index II
1	KDS 980	83.00(65.65)	7.93 (16.35)	2351	111.21
2	KDS 992	87.66(69.44)	7.50 (15.89)	2659	126.24
3	KDS 1096	82.66(65.40)	7.76 (16.18)	2287	109.64
4	KDS 1097	83.66(66.16)	8.06 (16.50)	2370	110.43
5	KDS 1114	78.33(62.26)	8.30 (16.74)	2115	107.57
6	KDS 1142	80.00(63.43)	8.10 (16.53)	2106	108.00
7	KDS 1144	77.33(61.57)	8.46 (16.91)	2140	106.21
8	KDS 1149	80.66(63.92)	7.70 (16.11)	2124	106.72
9	KDS 1150	76.00(60.66)	8.80 (17.25)	2077	104.11
10	KDS 1272	80.00(63.43)	7.83 (16.25)	2160	110.39
11	KDS 1273	81.66(64.66)	7.93 (16.35)	2178	108.60
12	KDS 1274	86.66(68.58)	7.43 (15.82)	2629	123.93
13	MAUS 71	85.00(67.22)	7.76 (16.18)	2323	115.59
14	MAUS 612	82.00(64.90)	8.30 (16.74)	2186	110.14
15	NRC 147	81.66(64.66)	7.90 (16.32)	2177	108.36
16	MACS-NRC-1667	76.33(60.89)	8.60 (17.05)	2112	104.83
17	MACS 450	86.00(68.03)	7.70 (16.11)	2637	123.84
18	MACS 1460	83.00(65.65)	7.83 (16.25)	2269	111.50
19	MACS 1520	79.66(63.20)	8.50 (16.95)	2177	109.16
20	RCS-11-07	85.00(67.22)	8.10 (16.53)	2323	114.74
21	EC 390976	80.00(63.43)	8.06 (16.50)	2186	106.94
22	EC 390977	82.00(64.90)	7.90 (16.32)	2295	110.70
23	Birsa Soya 1	83.33(65.90)	8.23 (16.67)	2139	113.61
24	Type 49	75.00(60.00)	8.50 (16.95)	2049	104.49
25	DSb 21	82.33(65.14)	7.70 (16.11)	2250	109.77
26	KDS 726	90.00(71.57)	8.10 (16.53)	2850	131.11
27	KDS 753	89.33(70.94)	8.00 (16.42)	2709	127.45
28	DS 228	84.00(66.42)	7.86 (16.28)	2380	115.08
29	JS 9305	84.66(66.96)	7.93 (16.35)	2314	116.16
30	JS 335	86.00(68.03)	7.90 (16.32)	2465	119.83

	Mean	82.43(65.34)	7.98(16.45)	2301	112.88
	SE (\pm)	0.468	0.076	37.888	1.253
	CD at 5%	1.324	0.215	107.182	3.547

*Figures in parenthesis indicate arcsine transformed value

Conclusion

Variability was observed in all the 30 genotypes for seed quality and yield contributing parameters. The genotype KDS 726 performed well for seed quality as it recorded highest yield contributing characters like pods per plant (42.33), branches per plant (6) seed yield per plant, plot and hectare with higher 100 seed weight (14.13 g). The seed quality viz., germination percentage, vigour index and vigour indices I were also found highest in the genotype KDS 726. Such genotypes having higher yield attributing parameters as well as better seed quality could be utilized for varietal improvement programme.

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