

Research
Paper

Evaluation of genotypes for seed qualitative parameters in *Kharif* and summer grown soybean [*Glycine max* (L.) Merrill]

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ABSTRACT

An experiment was conducted to evaluate ninety soybean genotypes in two seasons viz., *Kharif* and summer for seed qualitative characters. The *Kharif* season recorded significantly higher oil content (14.47%), seed germination (64.82%), shoot length (14.28 cm), root length (17.84 cm), seedling dry weight (1.04 g), seedling vigour index (1951), reducing sugar (1.33%) compared to summer season (13.59%, 58.54%, 12.61 cm, 16.26 cm, 0.78 g, 1943 and 1.00%, respectively). Irrespective of sowing seasons, significantly maximum, oil content (17.05%) in VL Soya21 (G₈₉), seed germination (89.00%) in Birsa Soy1 (G₄), seedling vigour index (3222) in Birsa Soy1 (G₄) were recorded over sowing seasons.

Dandagi, Mohan R., Lakkundi, Basavaraj S., Patted, Vinay S., Merwade, M.N. and Tattimani, Manjunath H. (2011). Evaluation of genotypes for seed qualitative parameters in *Kharif* and summer grown soybean [*Glycine max* (L.) Merrill]. *Adv. Res. J. Crop Improv.*, 2 (1) : 58-69.

Key words : Seed quality, *Kharif*, Summer, Genotypes, Soybean

INTRODUCTION

Soybean [*Glycine max* (L.) Merrill] tops in the world production of both oil seed and edible oil. World harvest of soybean is more than 50 per cent of the total world's oil seed production. USA, the world leader in soybean production produces about 40 per cent of world's output. Apart from USA, China and Brazil are the other leading soybean producers. India ranks fifth in the world soybean production. In India, soybean has witnessed a phenomenal growth both in area and production during last two decades, wherein, it is presently grown in about 9.67 million hectares area contributing to 9.73 million tonnes production annually (Anonymous, 2009). In Karnataka state, soybean is currently becoming more popular with the farmers as an oil seed crop. It is grown annually over an area of 1.78 lakh ha and 2.36 lakh tonnes production (Anonymous, 2009). Karnataka ranks fourth in area and production next to Madhya Pradesh, Maharashtra and Rajasthan States. Dharwad, Belgaum, Bidar, Bagalkot and Haveri are the major soybean growing districts in Karnataka State

The season of seed production is one of the important

factors which influences the seed yield and quality since the weather conditions such as temperature, relative humidity, photoperiod and wind velocity vary from season to season and region to region resulting in differential seed yield and quality (Heydecker, 1972). The environments under which seeds are developed play a decisive role on seed quality (Vanangamudi and Karivartharaju, 1989). Therefore, selection of optimum season for producing better quality seeds is the at most aspect of soybean seed production programme but, the information on seasonal effect on seed quality is rather scanty in soybean and it needs to be investigated.

MATERIALS AND METHODS

An experiment was conducted at College of Agriculture, Dharwad, Karnataka, India during 2009-2010 with three replications. The field experiment was laid out in the Completely Randomized Block Design with factorial concept and replicated thrice for record of various observations. 90 soybean genotypes were evaluated in two seasons viz., *Kharif* and summer. The observations

on the seed quantitative parameters *viz.*, oil content (%), reducing sugar (%), seed germination (%), shoot length (cm), root length (cm), seedling dry weight (g), seedling vigour index, and electrical conductivity (dSm-1) were recorded. The germination test was conducted as per ISTA procedure by adopting rolled towel method. Seedling dry weight was calculated based upon the ten normal seedlings which were selected at 750 for 24 hours. The vigour index was calculated by adopting the methods suggested by Abdul-Baki and Abderson (1973) and expressed in whole numbers for each treatment by using the following formula. Vigour index = Germination (%) x Seedling length (cm).

The analysis of oil content of seeds were made through the Nuclear Magnetic Resonance (NMR) Spectrophotometer installed at Main Agricultural Research Station, Raichur and was expressed as percentage of oil content for each treatments. Reducing sugar content in seed samples was estimated by Nelson-Somogyi's method (Nelson, 1944).

RESULTS AND DISCUSSION

The results obtained from the present investigation have been discussed in the following sub heads :

Effect of sowing seasons on seed qualitative parameters:

Irrespective of genotypes, sowing seasons exhibited significant variations on seed qualitative parameters in both *Kharif* and summer seasons (Table 1-8). Between the two seasons, *Kharif* season recorded significantly higher oil content (14.47%), seed germination (64.82%), shoot length (14.28 cm), root length (17.84 cm), seedling dry weight (1.04 g), seedling vigour index (1951), reducing sugar (1.00%) compared to summer season (13.59%, 58.54%, 12.61 cm, 16.26 cm, 0.78 g, 1935, 40.64% and 1.00%, respectively). In contrast to these results, electrical conductivity of seed leachates was significantly less in *Kharif* season (2.67 dSm-1) over summer season (3.05 dSm-1). The superior seed quality parameters with lower electrical conductivity noticed in *Kharif* seeds season may be attributed to better expression of growth and reproductive parameters which resulted in higher test weight, seed germination, shoot length, root length, seedling dry weight, seedling vigour index, and reducing sugar in the seeds of *Kharif* unlike those of summer season which yielded poor quality seeds with higher electrical conductivity due to inferior crop growth and reproductive performance in view of the prevalence of adverse weather conditions. Similar results on the effect of different sowing seasons on seed quality parameters were also obtained by Krishnamurthy *et al.*

(1992) and Chandrashekhar (2008) in french bean; Dixit *et al.* (1993), Kharag and Malhotra (1997), Singh *et al.* (1997) and Merwade (2000) in chickpea.

Effect of genotypes on seed qualitative parameters:

Irrespective of sowing seasons, all the test genotypes differed significantly and consistently for the various seed qualitative parameters studied (Table 1-8). On an average, oil content was significantly highest in VL Soya 27 (G_{89}) genotype followed by VL soya-2 (G_{88}) (16.77%), LS 525 (G_{82}) (16.55%) as against KB-79 (G_{33}) which recorded lowest oil content. Likewise, maximum seed germination was in Birsa soy-1 (G_4) (89.00%) followed by J71-05 (G_{22}) (85.00%) Kalitur (G_{32}) (84.67%) and minimum in DSb-1 (G_{12}) (39.00%). The significantly highest and lowest shoot length were seen in genotype SL96 (G_{80}) (17.35 cm) and CO-soya (G_7) (9.93 cm), respectively. Next higher shoot length was recorded in RAUS-5 (G_{76}) (16.41 cm) and JS76-205 (G_{24}) (16.10 cm) genotypes. Root length was significantly maximum in RAUS-5 (G_{76}) (22.47 cm) genotype followed Birsa soy -1 (G_4) (22.43 cm) and JS-71-05 (G_{22}) (21.93 cm) as against Alankar (G_2) (11.93 cm) genotype. Likewise, highest seedling dry weight was in CO Soya 2 (G_7) (1.49 g) genotype followed by NRC-12 (G_{53}) (1.34 g), VL-Soya 2 (G_{87}) (1.30 g) and lowest weight in Pusa-22 (G_{72}) (0.59 g). The significantly maximum and minimum seedling vigour index was seen in genotype Birsay soy 1 (G_4) (3222) and Alankar (G_2) (750), respectively. Next higher seedling vigour index was recorded by Gujarat soybean 1 (G_{15}) (3171) and Kaliter (G_{32}) (30.17). The significantly highest and lowest reducing sugar contents were recorded in JS76-205 (G_{24}) (2.09%) and Ankur (G_3) and PK471 (G_{60}) (0.64%). Next higher reducing sugar was recorded by JS 90-41 (G_{27}) (1.96%) and PS1042 (G_{65}) (1.86%). Similar results on seed quantitative parameters due to genotypic differences were also confirmed by Poma *et al.* (1990), Singh and Verma (1995), Aziz and Rehman (1996) and Merwade (2000) in chickpea.

Sowing seasons and genotypes (SxG) interaction on seed qualitative parameters:

The interaction between sowing seasons and genotypes (SxG) revealed marked variations on seed qualitative parameters (Table 1-8). On an average, the significantly highest value was seen for oil content in the treatment combinations of VL Soya 21 genotypes sown in *Kharif* season (G_{89}) (17.57%) and summer season and SL-52 (G_{82}) (16.53%); for seed germination, in the interactions of *Kharif* season and MAUS-47 (G_{45}) (96.00%) and summer season and CO₃ (S2G8) (90.00%);

Table 1: Effect of sowing seasons on oil content (%) in soybean genotypes

Genotypes (G)		Sowing seasons (S)			Genotypes (G)		Sowing seasons (S)		
		S ₁	S ₂	Mean			S ₁	S ₂	Mean
G ₁	ADT-1	13.30	12.50	12.90	G ₄₆	MAUS-61	13.30	12.80	13.05
G ₂	Alankar	13.63	13.13	13.38	G ₄₇	MAUS-61-2	14.47	14.93	14.70
G ₃	Ankur	12.13	11.50	11.82	G ₄₈	MAUS-71	14.50	13.73	14.12
G ₄	Birsa Soy 1	11.40	10.53	10.97	G ₄₉	MAUS-81	14.70	13.93	14.32
G ₅	Bragg	14.93	12.37	13.65	G ₅₀	Monetta	14.43	13.53	13.98
G ₆	CO ₁	13.17	11.50	12.33	G ₅₁	NRC-2	16.00	15.33	15.67
G ₇	CO Soya 2	14.53	13.57	14.05	G ₅₂	NRC-7	17.33	16.43	16.88
G ₈	CO ₃	13.50	12.47	12.98	G ₅₃	NRC-12	15.90	15.20	15.55
G ₉	Durga	13.07	12.50	12.78	G ₅₄	NRC-37	16.47	16.33	16.40
G ₁₀	DS-9712	13.40	13.03	13.22	G ₅₅	Palam Soya	16.37	15.40	15.88
G ₁₁	DS-228	11.50	10.90	11.20	G ₅₆	PK 262	16.17	15.23	15.70
G ₁₂	DSb-1	14.93	14.27	14.60	G ₅₇	PK 308	15.40	14.23	14.82
G ₁₃	DSb-8	13.83	12.43	13.13	G ₅₈	PK 327	16.77	16.23	16.50
G ₁₄	Gurav	13.80	13.37	13.58	G ₅₉	PK 416	16.37	15.33	15.85
G ₁₅	Gujarat Soybean 1	10.93	10.67	10.80	G ₆₀	PK 471	15.43	14.33	14.88
G ₁₆	Gujarat Soybean 2	11.80	11.43	11.62	G ₆₁	PK 472	14.33	13.03	13.68
G ₁₇	Hardee	13.83	12.43	13.13	G ₆₂	PS 564	15.70	14.37	15.03
G ₁₈	Hara soya	14.57	14.53	14.55	G ₆₃	PS 1024	16.27	15.20	15.73
G ₁₉	Indira soy 9	14.43	13.47	13.95	G ₆₄	PS 1029	16.90	15.60	16.25
G ₂₀	Improved pelican	13.53	11.90	12.72	G ₆₅	PS 1042	15.07	14.53	14.80
G ₂₁	JS 2	13.47	12.50	12.98	G ₆₆	PS 1092	16.37	14.77	15.57
G ₂₂	JS 71-05	15.47	14.17	14.82	G ₆₇	PS 1241	16.33	15.27	15.80
G ₂₃	JS 75-46	12.63	12.57	12.60	G ₆₈	PS 1347	15.03	13.77	14.40
G ₂₄	JS 76-205	14.20	12.50	13.35	G ₆₉	Punjab-1	15.07	14.50	14.78
G ₂₅	JS 79-81	11.57	12.40	11.98	G ₇₀	Pusa-16	16.43	15.40	15.92
G ₂₆	JS 80-21	13.33	12.07	12.70	G ₇₁	Pusa-20	16.97	16.33	16.65
G ₂₇	JS 90-41	12.43	11.13	11.78	G ₇₂	Pusa-22	16.53	15.23	15.88
G ₂₈	JS 93-05	12.57	11.67	12.12	G ₇₃	Pusa-24	14.33	13.47	13.90
G ₂₉	JS 335	14.40	12.37	13.38	G ₇₄	Pusa-37	16.53	15.43	15.98
G ₃₀	JS 95-60	12.63	11.60	12.12	G ₇₅	Pusa-40	16.17	15.43	15.80
G ₃₁	JS 97-52	12.57	11.43	12.00	G ₇₆	RAUS-5	16.80	15.33	16.07
G ₃₂	Kalitur	12.50	10.73	11.62	G ₇₇	Samrat	12.73	13.47	13.10
G ₃₃	KB-79	10.80	9.83	10.32	G ₇₈	Shilajeet	15.37	14.37	14.87
G ₃₄	KHSb-2	12.70	11.17	11.93	G ₇₉	Shivalik	16.63	15.30	15.97
G ₃₅	Lee	13.27	12.50	12.88	G ₈₀	SL 96	15.23	14.27	14.75
G ₃₆	Lsb-1	12.27	11.53	11.90	G ₈₁	SL 295	16.80	15.03	15.92
G ₃₇	MACS-13	12.07	10.47	11.27	G ₈₂	SL 525	16.57	16.53	16.55
G ₃₈	MACS-57	12.03	10.20	11.12	G ₈₃	SL 688	14.77	14.60	14.68
G ₃₉	MACS-58	14.03	13.57	13.80	G ₈₄	TAMS-38	13.30	13.57	13.43
G ₄₀	MACS-124	15.13	14.47	14.80	G ₈₅	TAMS-9821	14.17	12.90	13.53
G ₄₁	MACS-450	14.83	13.87	14.35	G ₈₆	Type-49	16.43	14.53	15.48
G ₄₂	MAUS-1	15.63	16.33	15.98	G ₈₇	VL Soya1	13.80	13.53	13.67
G ₄₃	MAUS-2	14.47	14.37	14.42	G ₈₈	VL Soya2	17.50	16.03	16.77
G ₄₄	MAUS-32	14.27	14.33	14.30	G ₈₉	VL Soya21	17.57	16.53	17.05
G ₄₅	MAUS-47	13.63	13.67	13.65	G ₉₀	VL Soya47	13.40	12.03	12.72
					Mean		14.47	13.59	15.18
For comparing the means of		S.E. ±			C.D. (P=0.01)				
S		0.03			0.09				
G		0.17			0.63				
SxG		0.24			0.88				

Sowing seasons (S) : S₁ – Kharif S₂ – Summer

Table 2: Effect of sowing seasons on seed germination (%) in soybean genotypes

Genotypes (G)		Sowing seasons (S)			Genotypes (G)		Sowing seasons (S)		
		S ₁	S ₂	Mean			S ₁	S ₂	Mean
G ₁	ADT-1	58.67 (49.97)	47.33 (43.45)*	53.00 (46.70)	G ₄₆	MAUS-61	67.50 (55.15)	75.33 (60.22)	71.41 (57.65)
G ₂	Alankar	58.25 (48.67)	36.00 (36.81)	46.12 (42.76)	G ₄₇	MAUS-61-2	70.67 (57.32)	70.00 (56.78)	70.33 (57.05)
G ₃	Ankur	62.00 (51.94)	80.00 (63.67)	71.00 (57.81)	G ₄₈	MAUS-71	87.33 (69.31)	50.67 (42.38)	69.00 (56.14)
G ₄	Birsa Soy 1	92.67 (77.17)	85.33 (67.47)	89.00 (72.32)	G ₄₉	MAUS-81	86.00 (68.11)	40.67 (39.60)	63.33 (53.86)
G ₅	Bragg	81.33 (64.47)	60.00 (50.77)	70.67 (57.62)	G ₅₀	Monetta	92.00 (75.05)	58.67 (50.01)	75.33 (62.53)
G ₆	CO ₁	78.00 (62.00)	66.67 (54.73)	72.33 (58.37)	G ₅₁	NRC-2	90.67 (72.44)	27.33 (31.38)	59.00 (51.91)
G ₇	CO Soya 2	33.33 (35.25)	52.67 (46.53)	43.00 (40.89)	G ₅₂	NRC-7	37.33 (37.55)	43.33 (41.11)	40.33 (39.33)
G ₈	CO ₃	61.33 (51.53)	90.67 (72.79)	76.00 (60.64)	G ₅₃	NRC-12	84.67 (67.18)	65.33 (53.94)	75.00 (60.56)
G ₉	Durga	64.00 (53.10)	68.67 (55.95)	66.17 (54.39)	G ₅₄	NRC-37	90.00 (71.59)	67.00 (56.12)	78.83 (62.58)
G ₁₀	DS-9712	60.00 (50.76)	52.00 (46.13)	56.00 (48.45)	G ₅₅	Palam Soya	78.67 (63.02)	39.33 (38.73)	59.00 (50.88)
G ₁₁	DS-228	52.67 (46.51)	63.33 (52.76)	58.00 (49.64)	G ₅₆	PK 262	65.33 (53.96)	46.00 (42.68)	55.67 (48.32)
G ₁₂	DSb-1	25.33 (29.69)	52.67 (46.55)	39.00 (38.12)	G ₅₇	PK 308	89.33 (71.40)	68.67 (55.97)	79.00 (63.69)
G ₁₃	DSb-8	68.25 (55.68)	84.00 (66.50)	76.12 (60.72)	G ₅₈	PK 327	68.67 (55.97)	58.00 (49.67)	63.33 (52.71)
G ₁₄	Gurav	57.85 (49.50)	65.33 (53.94)	61.59 (51.68)	G ₅₉	PK 416	74.00 (59.69)	71.33 (57.92)	72.67 (58.81)
G ₁₅	Gujarat Soybean 1	92.67 (74.50)	83.33 (65.89)	88.00 (70.20)	G ₆₀	PK 471	89.33 (70.93)	64.67 (53.57)	77.00 (62.25)
G ₁₆	Gujarat Soybean 2	53.33 (46.90)	70.00 (56.84)	61.67 (51.87)	G ₆₁	PK 472	63.33 (52.82)	54.00 (47.50)	58.66 (49.97)
G ₁₇	Hardee	71.33 (57.69)	62.67 (53.22)	67.00 (55.46)	G ₆₂	PS 564	69.33 (58.66)	46.00 (42.68)	57.67 (50.67)
G ₁₈	Hara soya	65.33 (54.05)	45.33 (42.30)	55.33 (48.17)	G ₆₃	PS 1024	90.00 (71.59)	67.33 (56.57)	78.66 (62.46)
G ₁₉	Indira soy 9	58.33 (49.78)	94.67 (77.06)	76.50 (60.98)	G ₆₄	PS 1029	56.67 (48.83)	40.67 (39.53)	48.67 (44.18)
G ₂₀	Improved pelican	37.33 (37.49)	68.00 (55.56)	52.67 (46.53)	G ₆₅	PS 1042	52.67 (46.52)	52.00 (46.13)	52.33 (46.33)
G ₂₁	JS 2	88.67 (70.36)	64.67 (53.57)	76.67 (61.96)	G ₆₆	PS 1092	27.33 (31.49)	57.33 (49.21)	42.33 (40.35)
G ₂₂	JS 71-05	95.33 (77.55)	74.67 (59.80)	85.00 (68.68)	G ₆₇	PS 1241	68.67 (55.97)	46.00 (42.68)	57.33 (49.20)
G ₂₃	JS 75-46	71.33 (57.60)	76.67 (61.15)	70.00 (59.32)	G ₆₈	PS 1347	44.00 (41.53)	44.00 (41.53)	44.00 (41.53)
G ₂₄	JS 76-205	82.00 (65.81)	66.67 (55.07)	74.33 (60.44)	G ₆₉	Punjab-1	42.67 (40.74)	46.00 (42.68)	44.33 (41.71)
G ₂₅	JS 79-81	72.15 (58.12)	35.33 (36.41)	53.74 (47.15)	G ₇₀	Pusa-16	83.33 (66.50)	75.33 (60.20)	79.33 (62.93)
G ₂₆	JS 80-21	64.67 (53.31)	88.67 (70.31)	76.67 (61.09)	G ₇₁	Pusa-20	76.33 (46.12)	66.67 (54.77)	71.50 (57.60)

Table 2 contd...

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G ₂₇	JS 90-41	76.67 (46.12)	73.33 (58.91)	75.00 (52.52)	G ₇₂	Pusa-22	88.00 (69.83)	71.00 (57.44)	79.50 (63.05)	
G ₂₈	JS 93-05	87.33 (69.18)	62.00 (51.94)	74.67 (60.56)	G ₇₃	Pusa-24	86.67 (68.65)	56.00 (48.46)	71.33 (58.55)	
G ₂₉	JS 335	88.67 (70.41)	42.67 (40.76)	65.67 (55.59)	G ₇₄	Pusa-37	92.67 (74.29)	65.67 (54.96)	79.17 (62.82)	
G ₃₀	JS 95-60	58.00 (49.52)	71.33 (57.62)	64.66 (53.50)	G ₇₅	Pusa-40	58.00 (49.52)	47.33 (44.00)	52.66 (46.51)	
G ₃₁	JS 97-52	63.33 (53.07)	46.67 (43.07)	55.00 (48.07)	G ₇₆	RAUS-5	92.67 (74.97)	59.33 (50.45)	76.00 (62.71)	
G ₃₂	Kalitur	82.67 (65.52)	86.67 (68.88)	84.67 (67.20)	G ₇₇	Samrat	91.33 (73.22)	53.33 (46.13)	72.33 (58.24)	
G ₃₃	KB-79	75.33 (60.21)	68.00 (55.62)	71.67 (57.92)	G ₇₈	Shilajeet	85.33 (67.65)	74.00 (59.36)	79.67 (63.51)	
G ₃₄	KHSb-2	59.33 (50.39)	66.00 (54.60)	62.67 (52.50)	G ₇₉	Shivalik	92.00 (74.46)	53.00 (46.13)	72.66 (58.45)	
G ₃₅	Lee	64.00 (53.26)	50.00 (44.99)	57.00 (49.12)	G ₈₀	SL 96	83.33 (65.89)	70.00 (56.84)	76.67 (61.37)	
G ₃₆	Lsb-1	72.00 (58.14)	40.00 (39.21)	56.00 (48.68)	G ₈₁	SL 295	64.67 (53.51)	53.00 (46.13)	58.83 (50.07)	
G ₃₇	MACS-13	64.00 (53.13)	89.33 (71.16)	76.67 (62.15)	G ₈₂	SL 525	66.00 (54.32)	72.00 (56.29)	69.00 (55.30)	
G ₃₈	MACS-57	89.33 (71.51)	45.33 (42.30)	67.33 (56.90)	G ₈₃	SL 688	84.00 (66.50)	54.67 (47.67)	69.33 (57.09)	
G ₃₉	MACS-58	58.25 (49.73)	78.00 (62.14)	68.42 (55.79)	G ₈₄	TAMS-38	93.33 (77.92)	62.67 (52.33)	78.00 (65.12)	
G ₄₀	MACS-124	62.67 (52.36)	57.33 (49.26)	60.00 (50.81)	G ₈₅	TAMS-9821	68.67 (55.50)	62.00 (51.94)	65.33 (53.91)	
G ₄₁	MACS-450	47.33 (43.43)	45.33 (42.30)	46.33 (42.87)	G ₈₆	Type-49	69.33 (56.54)	58.67 (49.50)	64.00 (53.51)	
G ₄₂	MAUS-1	60.00 (50.83)	48.67 (44.22)	54.33 (47.52)	G ₈₇	VL Soya1	71.33 (57.69)	56.67 (48.86)	64.00 (53.28)	
G ₄₃	MAUS-2	59.51 (50.48)	56.67 (48.91)	58.09 (49.64)	G ₈₈	VL Soya2	51.33 (45.74)	56.00 (48.47)	53.67 (47.09)	
G ₄₄	MAUS-32	56.25 (48.54)	72.67 (58.52)	56.67 (49.05)	G ₈₉	VL Soya21	64.00 (52.76)	73.33 (58.90)	68.67 (55.83)	
G ₄₅	MAUS-47	96.00 (79.07)	63.25 (52.66)	79.62 (63.14)	G ₉₀	VL Soya47	85.33 (67.65)	72.00 (58.10)	78.67 (62.88)	
							Mean	64.82 (54.70)	58.54 (50.19)	61.68 (52.45)
For comparing the means of										
				S.E. ±	C.D. (P=0.05)					
S				0.31	1.14					
G				2.09	7.65					
SxG				2.96	10.82					

Sowing seasons (S) : S₁ – Kharif S₂ – Summer * Figures in the parenthesis are arcsine transformed values

Table 3: Effect of sowing seasons on shoot length (cm) in soybean genotypes

Genotypes (G)		Sowing seasons (S)			Genotypes (G)		Sowing seasons (S)		
		S ₁	S ₂	Mean			S ₁	S ₂	Mean
G ₁	ADT-1	13.40	12.70	13.05	G ₄₆	MAUS-61	13.57	11.90	12.73
G ₂	Alankar	12.10	9.20	10.65	G ₄₇	MAUS-61-2	13.97	14.50	14.23
G ₃	Ankur	13.73	12.67	13.20	G ₄₈	MAUS-71	11.33	13.83	12.58
G ₄	Birsa Soy 1	14.60	13.03	13.82	G ₄₉	MAUS-81	13.23	13.87	13.55
G ₅	Bragg	15.27	11.57	13.42	G ₅₀	Monetta	12.07	13.00	12.53
G ₆	CO1	14.77	10.83	12.80	G ₅₁	NRC-2	11.70	12.43	12.07
G ₇	CO Soya 2	11.27	8.60	9.93	G ₅₂	NRC-7	13.10	8.87	10.98
G ₈	CO3	15.73	11.73	13.73	G ₅₃	NRC-12	13.60	11.30	12.45
G ₉	Durga	14.80	10.50	12.65	G ₅₄	NRC-37	11.13	13.07	12.10
G ₁₀	DS-9712	13.13	11.97	12.55	G ₅₅	Palam Soya	12.77	11.93	12.35
G ₁₁	DS-228	13.47	10.83	12.15	G ₅₆	PK 262	11.60	13.93	12.77
G ₁₂	DSb-1	14.53	10.37	12.45	G ₅₇	PK 308	15.43	14.77	15.10
G ₁₃	DSb-8	14.60	9.50	12.05	G ₅₈	PK 327	13.07	13.87	13.47
G ₁₄	Gurav	15.40	13.87	14.63	G ₅₉	PK 416	13.73	10.40	12.07
G ₁₅	Gujarat Soybean 1	16.90	14.17	15.53	G ₆₀	PK 471	16.43	12.30	14.37
G ₁₆	Gujarat Soybean 2	14.90	10.93	12.92	G ₆₁	PK 472	14.90	13.13	14.02
G ₁₇	Hardee	12.00	14.67	13.33	G ₆₂	PS 564	12.63	14.50	13.57
G ₁₈	Hara soya	11.63	11.34	11.49	G ₆₃	PS 1024	15.47	9.40	12.43
G ₁₉	Indira soy 9	17.23	11.20	14.22	G ₆₄	PS 1029	12.30	12.47	12.38
G ₂₀	Improved pelican	14.93	10.88	12.91	G ₆₅	PS 1042	13.13	12.47	12.80
G ₂₁	JS 2	16.87	13.50	15.18	G ₆₆	PS 1092	12.03	9.13	10.58
G ₂₂	JS 71-05	16.30	14.73	15.52	G ₆₇	PS 1241	12.20	12.78	12.49
G ₂₃	JS 75-46	16.17	14.93	15.55	G ₆₈	PS 1347	12.97	12.05	12.51
G ₂₄	JS 76-205	16.87	15.33	16.10	G ₆₉	Punjab-1	12.37	11.93	12.15
G ₂₅	JS 79-81	12.37	13.30	12.83	G ₇₀	Pusa-16	15.70	13.15	14.43
G ₂₆	JS 80-21	15.53	13.60	14.57	G ₇₁	Pusa-20	16.10	13.39	14.75
G ₂₇	JS 90-41	14.70	12.10	13.40	G ₇₂	Pusa-22	14.47	13.95	14.21
G ₂₈	JS 93-05	14.50	13.43	13.97	G ₇₃	Pusa-24	14.40	14.31	14.36
G ₂₉	JS 335	12.30	12.43	12.37	G ₇₄	Pusa-37	15.87	13.47	14.67
G ₃₀	JS 95-60	14.53	11.57	13.05	G ₇₅	Pusa-40	15.53	12.83	14.18
G ₃₁	JS 97-52	13.70	14.70	14.20	G ₇₆	RAUS-5	17.50	15.32	16.41
G ₃₂	Kalitur	14.30	15.67	14.98	G ₇₇	Samrat	16.57	13.27	14.92
G ₃₃	KB-79	13.27	15.20	14.23	G ₇₈	Shilajeet	18.80	11.60	15.20
G ₃₄	KHSb-2	13.60	15.87	14.73	G ₇₉	Shivalik	14.60	11.90	13.25
G ₃₅	Lee	11.77	15.73	13.75	G ₈₀	SL 96	19.77	14.93	17.35
G ₃₆	Lsb-1	10.33	11.90	11.12	G ₈₁	SL 295	15.07	10.00	12.53
G ₃₇	MACS-13	13.63	13.27	13.45	G ₈₂	SL 525	12.97	12.00	12.48
G ₃₈	MACS-57	12.87	14.37	13.62	G ₈₃	SL 688	13.47	12.97	13.22
G ₃₉	MACS-58	15.17	12.13	13.65	G ₈₄	TAMS-38	13.50	14.07	13.78
G ₄₀	MACS-124	15.37	12.00	13.68	G ₈₅	TAMS-9821	18.70	12.53	15.62
G ₄₁	MACS-450	11.80	12.13	11.96	G ₈₆	Type-49	15.87	15.30	15.58
G ₄₂	MAUS-1	13.50	12.07	12.78	G ₈₇	VL Soya1	16.10	9.85	12.98
G ₄₃	MAUS-2	13.53	12.17	12.85	G ₈₈	VL Soya2	14.27	9.10	11.68
G ₄₄	MAUS-32	15.83	11.57	13.70	G ₈₉	VL Soya21	17.30	11.50	14.40
G ₄₅	MAUS-47				G ₉₀	VL Soya47	17.80	14.00	15.90
					Mean		14.28	12.61	13.44
For comparing the means of		S.E.±			C.D. (P=0.01)				
S		0.06			0.24				
G		0.43			1.58				
SxG		0.61			2.24				

 Sowing seasons (S) : S₁ – Kharif S₂ – Summer

Table 4: Effect of sowing seasons on root length (cm) in soybean genotypes

Genotypes (G)	Sowing seasons (S)			Genotypes (G)	Sowing seasons (S)		
	S ₁	S ₂	Mean		S ₁	S ₂	Mean
G ₁ ADT-1	14.63	11.40	13.02	G ₄₆ MAUS-61	19.47	10.10	14.78
G ₂ Alankar	12.07	11.80	11.93	G ₄₇ MAUS-61-2	18.80	17.67	18.23
G ₃ Ankur	21.03	17.50	19.27	G ₄₈ MAUS-71	15.40	17.57	16.48
G ₄ Birsa Soy 1	23.40	21.47	22.43	G ₄₉ MAUS-81	17.63	19.90	18.77
G ₅ Bragg	19.80	17.87	18.83	G ₅₀ Monetta	18.53	20.47	19.50
G ₆ CO1	20.67	18.27	19.47	G ₅₁ NRC-2	13.87	21.70	17.78
G ₇ CO Soya 2	15.50	14.00	14.75	G ₅₂ NRC-7	14.20	13.20	13.70
G ₈ CO3	21.87	12.20	17.03	G ₅₃ NRC-12	13.30	17.97	15.63
G ₉ Durga	19.17	12.60	15.88	G ₅₄ NRC-37	13.10	18.87	15.98
G ₁₀ DS-9712	18.30	11.97	15.13	G ₅₅ Palam Soya	15.13	16.70	15.92
G ₁₁ DS-228	20.87	11.23	16.05	G ₅₆ PK 262	12.80	14.50	13.65
G ₁₂ DSb-1	19.77	11.27	15.52	G ₅₇ PK 308	18.33	19.70	19.02
G ₁₃ DSb-8	24.07	12.23	18.15	G ₅₈ PK 327	14.53	18.40	16.47
G ₁₄ Gurav	20.67	14.40	17.53	G ₅₉ PK 416	17.33	20.49	18.91
G ₁₅ Gujarat Soybean 1	22.93	18.40	20.67	G ₆₀ PK 471	18.13	21.07	19.60
G ₁₆ Gujarat Soybean 2	22.37	11.53	16.95	G ₆₁ PK 472	15.67	15.73	15.70
G ₁₇ Hardee	20.53	16.77	18.65	G ₆₂ PS 564	14.10	19.33	16.72
G ₁₈ Hara soya	13.97	18.27	16.12	G ₆₃ PS 1024	15.80	20.93	18.36
G ₁₉ Indira soy 9	23.40	11.47	17.43	G ₆₄ PS 1029	17.00	14.97	15.98
G ₂₀ Improved pelican	21.90	12.97	17.43	G ₆₅ PS 1042	13.40	13.47	13.43
G ₂₁ JS 2	21.37	21.43	21.40	G ₆₆ PS 1092	14.21	13.04	13.62
G ₂₂ JS 71-05	23.03	20.83	21.93	G ₆₇ PS 1241	13.73	12.40	13.07
G ₂₃ JS 75-46	20.90	13.60	17.25	G ₆₈ PS 1347	12.73	15.57	14.15
G ₂₄ JS 76-205	23.30	19.27	21.28	G ₆₉ Punjab-1	12.83	11.43	12.13
G ₂₅ JS 79-81	15.79	14.20	14.99	G ₇₀ Pusa-16	19.93	12.77	16.35
G ₂₆ JS 80-21	23.40	13.73	18.57	G ₇₁ Pusa-20	18.67	15.46	17.06
G ₂₇ JS 90-41	23.37	11.23	17.30	G ₇₂ Pusa-22	17.07	18.58	17.82
G ₂₈ JS 93-05	14.90	20.53	17.72	G ₇₃ Pusa-24	17.69	19.26	18.47
G ₂₉ JS 335	17.10	17.30	17.20	G ₇₄ Pusa-37	17.33	24.42	20.88
G ₃₀ JS 95-60	21.67	16.03	18.85	G ₇₅ Pusa-40	14.73	12.25	13.49
G ₃₁ JS 97-52	16.53	16.93	16.73	G ₇₆ RAUS-5	20.53	24.41	22.47
G ₃₂ Kalitur	21.39	19.90	20.65	G ₇₇ Samrat	16.27	20.25	18.26
G ₃₃ KB-79	20.97	20.23	20.60	G ₇₈ Shilajeet	22.73	14.97	18.85
G ₃₄ KHSb-2	18.20	15.50	16.85	G ₇₉ Shivalik	14.27	16.43	15.35
G ₃₅ Lee	11.77	18.10	14.93	G ₈₀ SL 96	19.47	18.25	18.86
G ₃₆ Lsb-1	13.63	19.77	16.70	G ₈₁ SL 295	16.73	11.80	14.27
G ₃₇ MACS-13	22.13	15.07	18.60	G ₈₂ SL 525	13.57	17.53	15.55
G ₃₈ MACS-57	16.50	21.53	19.02	G ₈₃ SL 688	13.57	19.73	16.65
G ₃₉ MACS-58	20.50	12.43	16.47	G ₈₄ TAMS-38	13.57	16.17	14.87
G ₄₀ MACS-124	21.07	12.20	16.63	G ₈₅ TAMS-9821	19.47	12.10	15.78
G ₄₁ MACS-450	17.17	10.90	14.03	G ₈₆ Type-49	14.93	14.33	14.63
G ₄₂ MAUS-1	16.93	16.07	16.50	G ₈₇ VL Soya1	20.60	16.19	18.39
G ₄₃ MAUS-2	17.07	17.17	17.12	G ₈₈ VL Soya2	15.23	12.87	14.05
G ₄₄ MAUS-32	17.90	16.40	17.15	G ₈₉ VL Soya21	22.20	13.27	17.73
G ₄₅ MAUS-47	15.10	20.13	17.62	G ₉₀ VL Soya47	18.30	19.10	18.70
				Mean	17.84	16.26	17.04
For comparing the means of		S.E.±		C.D. (P=0.01)			
S		0.09		0.32			
G		0.58		2.14			
SxG		0.83		3.03			

Sowing seasons (S) : S₁ – Kharif S₂ – Summer

Table 5: Effect of sowing seasons on seedling dry weight (g) in soybean genotypes

Genotypes (G)		Sowing seasons (S)			Genotypes (G)		Sowing seasons (S)		
		S ₁	S ₂	Mean			S ₁	S ₂	Mean
G ₁	ADT-1	0.72	0.63	0.68	G ₄₆	MAUS-61	0.75	0.60	0.67
G ₂	Alankar	1.34	1.05	1.20	G ₄₇	MAUS-61-2	1.50	0.62	1.06
G ₃	Ankur	1.17	1.03	1.10	G ₄₈	MAUS-71	1.22	0.59	0.91
G ₄	Birsa Soy 1	0.98	1.04	1.01	G ₄₉	MAUS-81	1.07	0.70	0.88
G ₅	Bragg	1.10	0.78	0.94	G ₅₀	Monetta	1.33	0.63	0.98
G ₆	CO1	1.05	0.81	0.93	G ₅₁	NRC-2	0.96	0.61	0.78
G ₇	CO Soya 2	1.53	1.45	1.49	G ₅₂	NRC-7	1.43	0.88	1.15
G ₈	CO3	0.85	0.66	0.76	G ₅₃	NRC-12	1.64	1.03	1.34
G ₉	Durga	0.91	0.91	0.91	G ₅₄	NRC-37	0.92	0.87	0.90
G ₁₀	DS-9712	0.93	1.03	0.98	G ₅₅	Palam Soya	1.23	0.80	1.01
G ₁₁	DS-228	0.92	1.03	0.97	G ₅₆	PK 262	0.82	0.77	0.79
G ₁₂	DSb-1	0.76	0.72	0.74	G ₅₇	PK 308	0.94	0.56	0.75
G ₁₃	DSb-8	1.14	0.93	1.03	G ₅₈	PK 327	1.08	0.64	0.86
G ₁₄	Gurav	0.73	0.74	0.74	G ₅₉	PK 416	1.08	0.61	0.85
G ₁₅	Gujarat Soybean 1	0.73	0.72	0.72	G ₆₀	PK 471	1.08	0.72	0.90
G ₁₆	Gujarat Soybean 2	0.98	0.85	0.92	G ₆₁	PK 472	0.91	0.69	0.80
G ₁₇	Hardee	1.01	0.91	0.96	G ₆₂	PS 564	0.98	0.75	0.87
G ₁₈	Hara soya	1.30	0.90	1.10	G ₆₃	PS 1024	1.09	0.64	0.86
G ₁₉	Indira soy 9	0.89	0.70	0.80	G ₆₄	PS 1029	0.85	0.86	0.86
G ₂₀	Improved pelican	0.99	0.70	0.85	G ₆₅	PS 1042	0.89	0.75	0.82
G ₂₁	JS 2	0.99	0.63	0.81	G ₆₆	PS 1092	1.10	0.81	0.96
G ₂₂	JS 71-05	1.21	0.72	0.97	G ₆₇	PS 1241	0.92	1.05	0.98
G ₂₃	JS 75-46	1.31	0.83	1.07	G ₆₈	PS 1347	1.18	0.67	0.93
G ₂₄	JS 76-205	0.98	0.88	0.93	G ₆₉	Punjab-1	0.76	0.74	0.75
G ₂₅	JS 79-81	0.84	0.88	0.86	G ₇₀	Pusa-16	0.86	0.55	0.71
G ₂₆	JS 80-21	1.47	0.65	1.06	G ₇₁	Pusa-20	0.92	0.57	0.74
G ₂₇	JS 90-41	0.78	0.71	0.75	G ₇₂	Pusa-22	0.71	0.47	0.59
G ₂₈	JS 93-05	1.22	1.00	1.11	G ₇₃	Pusa-24	0.80	0.75	0.77
G ₂₉	JS 335	1.00	1.33	1.17	G ₇₄	Pusa-37	0.92	0.64	0.78
G ₃₀	JS 95-60	1.15	1.12	1.14	G ₇₅	Pusa-40	0.90	0.59	0.74
G ₃₁	JS 97-52	0.66	0.54	0.60	G ₇₆	RAUS-5	0.92	0.67	0.79
G ₃₂	Kalitur	0.83	0.86	0.84	G ₇₇	Samrat	1.00	0.65	0.82
G ₃₃	KB-79	1.16	0.85	1.01	G ₇₈	Shilajeet	1.24	0.72	0.98
G ₃₄	KHSb-2	0.92	0.66	0.79	G ₇₉	Shivalik	0.94	0.66	0.80
G ₃₅	Lee	1.24	1.18	1.21	G ₈₀	SL 96	0.85	0.53	0.69
G ₃₆	Lsb-1	1.44	0.81	1.13	G ₈₁	SL 295	1.21	0.96	1.08
G ₃₇	MACS-13	1.09	0.70	0.90	G ₈₂	SL 525	1.05	0.87	0.96
G ₃₈	MACS-57	0.98	0.59	0.79	G ₈₃	SL 688	1.21	0.76	0.98
G ₃₉	MACS-58	1.11	0.72	0.92	G ₈₄	TAMS-38	0.86	0.83	0.84
G ₄₀	MACS-124	0.72	0.62	0.67	G ₈₅	TAMS-9821	0.71	0.59	0.65
G ₄₁	MACS-450	0.82	0.65	0.74	G ₈₆	Type-49	0.56	0.69	0.63
G ₄₂	MAUS-1	1.46	0.99	1.23	G ₈₇	VL Soya1	1.67	0.92	1.30
G ₄₃	MAUS-2	1.10	0.82	0.96	G ₈₈	VL Soya2	1.43	0.76	1.10
G ₄₄	MAUS-32	1.19	0.69	0.94	G ₈₉	VL Soya21	1.07	0.97	1.02
G ₄₅	MAUS-47	1.04	0.64	0.84	G ₉₀	VL Soya47	1.17	0.69	0.93
For comparing the means of					Mean	1.04	0.78	0.91	
					S.E. ±	C.D. (P=0.01)			
S					0.005	0.016			
G					0.030	0.106			
SxG					0.042	0.150			

Sowing seasons (S) : S₁ – Kharif S₂ – Summer

Table 6: Effect of sowing seasons on seedling vigour index in soybean genotypes

Genotypes (G)	Sowing seasons (S)			Genotypes (G)	Sowing seasons (S)		
	S ₁	S ₂	Mean		S ₁	S ₂	Mean
G ₁ ADT-1	932	1322	1127	G ₄₆ MAUS-61	734	2487	1610
G ₂ Alankar	631	869	750	G ₄₇ MAUS-61-2	2281	2293	2287
G ₃ Ankur	1871	2777	2324	G ₄₈ MAUS-71	2743	605	1674
G ₄ Birsa Soy 1	3200	3244	3222	G ₄₉ MAUS-81	2910	1258	2084
G ₅ Bragg	2394	2118	2256	G ₅₀ Monetta	3090	1796	2443
G ₆ CO1	2270	2361	2315	G ₅₁ NRC-2	3098	697	1898
G ₇ CO Soya 2	757	1411	1084	G ₅₂ NRC-7	824	1181	1003
G ₈ CO3	988	3410	2199	G ₅₃ NRC-12	2482	1757	2119
G ₉ Durga	1016	1652	1334	G ₅₄ NRC-37	2875	1157	2016
G ₁₀ DS-9712	1435	1629	1532	G ₅₅ Palam Soya	2253	1095	1674
G ₁₁ DS-228	1163	2177	1670	G ₅₆ PK 262	1858	1123	1490
G ₁₂ DSb-1	548	1805	1176	G ₅₇ PK 308	3079	2319	2699
G ₁₃ DSb-8	518	3252	1885	G ₅₈ PK 327	2214	1051	1632
G ₁₄ Gurav	999	2357	1678	G ₅₉ PK 416	2293	2218	2255
G ₁₅ Gujarat Soybean 1	3022	3320	3171	G ₆₀ PK 471	2981	2236	2608
G ₁₆ Gujarat Soybean 2	1198	2602	1900	G ₆₁ PK 472	1834	1588	1711
G ₁₇ Hardee	2240	2038	2139	G ₆₂ PS 564	2346	1228	1787
G ₁₈ Hara soya	1936	1162	1549	G ₆₃ PS 1024	2727	1168	1948
G ₁₉ Indira soy 9	530	3847	2188	G ₆₄ PS 1029	1554	1193	1374
G ₂₀ Improved pelican	890	2500	1695	G ₆₅ PS 1042	1367	1381	1374
G ₂₁ JS 2	3096	2473	2784	G ₆₆ PS 1092	605	1504	1055
G ₂₂ JS 71-05	3392	2932	3162	G ₆₇ PS 1241	1276	1189	1233
G ₂₃ JS 75-46	1467	2840	2153	G ₆₈ PS 1347	1216	1135	1176
G ₂₄ JS 76-205	2838	2676	2757	G ₆₉ Punjab-1	1000	1159	1080
G ₂₅ JS 79-81	1081	995	1038	G ₇₀ Pusa-16	1643	2686	2165
G ₂₆ JS 80-21	1216	3451	2334	G ₇₁ Pusa-20	1780	2312	2046
G ₂₇ JS 90-41	1789	2791	2290	G ₇₂ Pusa-22	2858	1766	2312
G ₂₈ JS 93-05	2966	1825	2395	G ₇₃ Pusa-24	2910	1790	2350
G ₂₉ JS 335	2637	1252	1945	G ₇₄ Pusa-37	3509	1813	2661
G ₃₀ JS 95-60	1325	2584	1954	G ₇₅ Pusa-40	953	1139	1046
G ₃₁ JS 97-52	2003	1412	1708	G ₇₆ RAUS-5	3680	2256	2968
G ₃₂ Kalitur	2941	3094	3017	G ₇₇ Samrat	3061	1423	2242
G ₃₃ KB-79	2672	2325	2498	G ₇₈ Shilajeet	2268	3068	2668
G ₃₄ KHSb-2	1862	2099	1980	G ₇₉ Shivalik	2607	1424	2016
G ₃₅ Lee	2164	1181	1673	G ₈₀ SL 96	2764	2746	2755
G ₃₆ Lsb-1	2277	963	1620	G ₈₁ SL 295	974	1687	1331
G ₃₇ MACS-13	1816	3198	2507	G ₈₂ SL 525	1949	1911	1930
G ₃₈ MACS-57	3209	1338	2274	G ₈₃ SL 688	2747	1478	2112
G ₃₉ MACS-58	787	2780	1784	G ₈₄ TAMS-38	2821	1694	2257
G ₄₀ MACS-124	1518	2090	1804	G ₈₅ TAMS-9821	458	2367	1412
G ₄₁ MACS-450	1089	1312	1200	G ₈₆ Type-49	2055	1192	1624
G ₄₂ MAUS-1	1688	1478	1583	G ₈₇ VL Soya1	1857	2079	1968
G ₄₃ MAUS-2	1290	1733	1511	G ₈₈ VL Soya2	686	1061	873
G ₄₄ MAUS-32	1139	2452	1796	G ₈₉ VL Soya21	1583	2897	2240
G ₄₅ MAUS-47	3175	833	2004	G ₉₀ VL Soya47	2821	2605	2713
				Mean	1951	1943	1935
For comparing the means of		S.E. ±		C.D. (P=0.01)			
S		9.8		36.0			
G		66.0		241.7			
SxG		93.3		341.9			

Sowing seasons (S) : S₁ – Kharif S₂ – Summer

Table 7: Effect of sowing seasons on electrical conductivity (dSm⁻¹) in soybean genotypes

Genotypes (G)		Sowing seasons (S)			Genotypes (G)		Sowing seasons (S)		
		S ₁	S ₂	Mean			S ₁	S ₂	Mean
G ₁	ADT-1	3.21	3.04	3.12	G ₄₆	MAUS-61	3.80	3.44	3.62
G ₂	Alankar	3.19	3.02	3.10	G ₄₇	MAUS-61-2	2.41	3.02	2.72
G ₃	Ankur	2.07	2.44	2.26	G ₄₈	MAUS-71	1.75	3.23	2.49
G ₄	Birsa Soy 1	1.62	1.57	1.60	G ₄₉	MAUS-81	1.44	3.30	2.37
G ₅	Bragg	1.55	2.94	2.25	G ₅₀	Monetta	2.22	3.13	2.68
G ₆	CO1	2.07	2.42	2.25	G ₅₁	NRC-2	2.12	3.08	2.60
G ₇	CO Soya 2	2.81	2.91	2.86	G ₅₂	NRC-7	3.27	4.48	3.88
G ₈	CO3	3.00	1.94	2.47	G ₅₃	NRC-12	1.94	4.21	3.07
G ₉	Durga	3.63	3.30	3.47	G ₅₄	NRC-37	2.02	3.82	2.92
G ₁₀	DS-9712	2.73	3.50	3.12	G ₅₅	Palam Soya	2.31	3.39	2.85
G ₁₁	DS-228	2.88	1.73	2.30	G ₅₆	PK 262	3.08	4.86	3.97
G ₁₂	DSb-1	2.97	2.90	2.94	G ₅₇	PK 308	2.31	3.09	2.70
G ₁₃	DSb-8	3.03	3.25	3.14	G ₅₈	PK 327	3.23	3.73	3.48
G ₁₄	Gurav	3.03	3.20	3.12	G ₅₉	PK 416	3.02	2.70	2.86
G ₁₅	Gujarat Soybean 1	1.69	2.79	2.24	G ₆₀	PK 471	1.51	2.82	2.16
G ₁₆	Gujarat Soybean 2	2.67	2.80	2.74	G ₆₁	PK 472	2.92	2.83	2.88
G ₁₇	Hardee	2.25	3.31	2.78	G ₆₂	PS 564	2.65	3.21	2.93
G ₁₈	Hara soya	2.62	3.21	2.91	G ₆₃	PS 1024	2.53	2.04	2.28
G ₁₉	Indira soy 9	2.71	2.73	2.72	G ₆₄	PS 1029	3.63	3.40	3.52
G ₂₀	Improved pelican	2.99	3.49	3.24	G ₆₅	PS 1042	3.45	3.66	3.56
G ₂₁	JS 2	2.24	3.80	3.02	G ₆₆	PS 1092	3.02	3.13	3.07
G ₂₂	JS 71-05	1.83	2.65	2.24	G ₆₇	PS 1241	3.44	3.33	3.39
G ₂₃	JS 75-46	2.67	2.74	2.70	G ₆₈	PS 1347	3.26	3.17	3.22
G ₂₄	JS 76-205	1.16	1.05	1.11	G ₆₉	Punjab-1	3.02	3.84	3.43
G ₂₅	JS 79-81	3.63	3.76	3.69	G ₇₀	Pusa-16	2.94	2.44	2.69
G ₂₆	JS 80-21	2.70	2.15	2.43	G ₇₁	Pusa-20	3.43	3.31	3.37
G ₂₇	JS 90-41	2.90	2.74	2.82	G ₇₂	Pusa-22	1.94	2.22	2.08
G ₂₈	JS 93-05	2.31	3.69	3.00	G ₇₃	Pusa-24	1.76	3.00	2.38
G ₂₉	JS 335	1.65	3.46	2.56	G ₇₄	Pusa-37	1.62	2.86	2.24
G ₃₀	JS 95-60	2.90	3.07	2.99	G ₇₅	Pusa-40	3.31	3.44	3.37
G ₃₁	JS 97-52	3.60	3.61	3.60	G ₇₆	RAUS-5	1.70	3.14	2.42
G ₃₂	Kalitur	1.80	1.43	1.62	G ₇₇	Samrat	1.69	3.05	2.37
G ₃₃	KB-79	2.51	2.65	2.58	G ₇₈	Shilajeet	1.91	1.83	1.87
G ₃₄	KHSb-2	2.83	3.25	3.04	G ₇₉	Shivalik	2.75	3.69	3.22
G ₃₅	Lee	3.60	3.02	3.31	G ₈₀	SL 96	3.25	2.24	2.75
G ₃₆	Lsb-1	3.16	3.92	3.54	G ₈₁	SL 295	3.15	2.90	3.03
G ₃₇	MACS-13	3.41	2.34	2.88	G ₈₂	SL 525	2.90	3.63	3.27
G ₃₈	MACS-57	2.02	3.43	2.72	G ₈₃	SL 688	2.15	3.33	2.74
G ₃₉	MACS-58	3.92	2.73	3.33	G ₈₄	TAMS-38	1.41	3.43	2.42
G ₄₀	MACS-124	2.95	3.72	3.34	G ₈₅	TAMS-9821	3.44	3.07	3.26
G ₄₁	MACS-450	3.91	3.30	3.61	G ₈₆	Type-49	2.53	3.43	2.98
G ₄₂	MAUS-1	3.51	3.73	3.62	G ₈₇	VL Soya1	2.12	1.36	1.74
G ₄₃	MAUS-2	3.66	2.74	3.20	G ₈₈	VL Soya2	3.31	4.12	3.72
G ₄₄	MAUS-32	3.91	3.23	3.57	G ₈₉	VL Soya21	3.16	2.19	2.68
G ₄₅	MAUS-47	1.83	3.55	2.69	G ₉₀	VL Soya47	1.73	2.44	2.09
For comparing the means of		S.E. ±			Mean		C.D. (P=0.01)		
S		0.01					0.02		
G		0.04					0.15		
SxG		0.06					0.21		

 Sowing seasons (S) : S₁ – Kharif S₂ – Summer

Table 8: Effect of sowing seasons on reducing sugar (%) in soybean genotypes

Genotypes (G)	Sowing seasons (S)			Genotypes (G)	Sowing seasons (S)		
	S ₁	S ₂	Mean		S ₁	S ₂	Mean
G ₁ ADT-1	1.33	0.89	1.11	G ₄₆ MAUS-61	1.33	0.59	0.96
G ₂ Alankar	1.01	0.80	0.91	G ₄₇ MAUS-61-2	0.87	0.43	0.65
G ₃ Ankur	0.82	0.45	0.64	G ₄₈ MAUS-71	1.04	0.90	0.97
G ₄ Birsa Soy 1	1.93	1.08	1.51	G ₄₉ MAUS-81	0.98	0.79	0.89
G ₅ Bragg	1.27	1.21	1.24	G ₅₀ Monetta	0.87	0.96	0.92
G ₆ CO1	1.97	0.97	1.47	G ₅₁ NRC-2	1.42	0.70	1.06
G ₇ CO Soya 2	1.70	1.26	1.48	G ₅₂ NRC-7	1.09	1.08	1.09
G ₈ CO3	2.25	0.72	1.49	G ₅₃ NRC-12	1.18	0.66	0.92
G ₉ Durga	1.14	0.79	0.97	G ₅₄ NRC-37	1.21	0.59	0.90
G ₁₀ DS-9712	1.80	0.32	1.06	G ₅₅ Palam Soya	1.17	1.23	1.20
G ₁₁ DS-228	1.37	0.74	1.06	G ₅₆ PK 262	1.04	0.65	0.85
G ₁₂ DSb-1	1.18	1.08	1.13	G ₅₇ PK 308	1.17	0.49	0.83
G ₁₃ DSb-8	2.75	0.86	1.81	G ₅₈ PK 327	1.33	0.26	0.80
G ₁₄ Gurav	2.35	0.92	1.64	G ₅₉ PK 416	1.17	0.64	0.91
G ₁₅ Gujarat Soybean 1	2.35	1.12	1.74	G ₆₀ PK 471	1.04	0.23	0.64
G ₁₆ Gujarat Soybean 2	1.16	0.59	0.88	G ₆₁ PK 472	1.03	1.80	1.42
G ₁₇ Hardee	2.18	0.96	1.57	G ₆₂ PS 564	1.04	1.34	1.19
G ₁₈ Hara soya	1.73	0.79	1.26	G ₆₃ PS 1024	1.03	1.33	1.18
G ₁₉ Indira soy 9	2.25	0.55	1.40	G ₆₄ PS 1029	0.57	1.37	0.97
G ₂₀ Improved pelican	2.51	0.85	1.68	G ₆₅ PS 1042	1.73	1.99	1.86
G ₂₁ JS 2	2.00	1.02	1.51	G ₆₆ PS 1092	0.41	2.07	1.24
G ₂₂ JS 71-05	1.76	0.55	1.16	G ₆₇ PS 1241	0.65	1.66	1.16
G ₂₃ JS 75-46	2.63	0.78	1.71	G ₆₈ PS 1347	0.63	1.53	1.08
G ₂₄ JS 76-205	2.92	1.26	2.09	G ₆₉ Punjab-1	0.70	1.45	1.08
G ₂₅ JS 79-81	2.18	0.88	1.53	G ₇₀ Pusa-16	1.97	0.97	1.47
G ₂₆ JS 80-21	2.79	0.80	1.80	G ₇₁ Pusa-20	0.87	1.45	1.16
G ₂₇ JS 90-41	2.67	1.25	1.96	G ₇₂ Pusa-22	0.55	1.30	0.93
G ₂₈ JS 93-05	1.94	0.64	1.29	G ₇₃ Pusa-24	0.49	0.98	0.74
G ₂₉ JS 335	2.30	0.33	1.32	G ₇₄ Pusa-37	1.09	0.95	1.02
G ₃₀ JS 95-60	1.14	0.68	0.91	G ₇₅ Pusa-40	1.08	1.34	1.21
G ₃₁ JS 97-52	1.12	1.35	1.24	G ₇₆ RAUS-5	0.49	1.31	0.90
G ₃₂ Kalitur	1.86	0.57	1.22	G ₇₇ Samrat	0.25	1.20	0.73
G ₃₃ KB-79	1.27	0.70	0.99	G ₇₈ Shilajeet	0.84	1.09	0.97
G ₃₄ KHSb-2	1.70	1.11	1.41	G ₇₉ Shivalik	0.80	2.36	1.58
G ₃₅ Lee	1.33	0.59	0.96	G ₈₀ SL 96	0.78	1.73	1.26
G ₃₆ Lsb-1	0.96	1.03	1.00	G ₈₁ SL 295	0.79	1.74	1.27
G ₃₇ MACS-13	1.48	0.54	1.01	G ₈₂ SL 525	0.84	1.63	1.24
G ₃₈ MACS-57	1.36	1.38	1.37	G ₈₃ SL 688	0.88	1.75	1.32
G ₃₉ MACS-58	1.21	1.21	1.21	G ₈₄ TAMS-38	0.72	1.70	1.21
G ₄₀ MACS-124	1.56	1.14	1.35	G ₈₅ TAMS-9821	0.81	0.73	0.77
G ₄₁ MACS-450	1.24	0.80	1.02	G ₈₆ Type-49	0.57	1.58	1.08
G ₄₂ MAUS-1	0.98	0.67	0.83	G ₈₇ VL Soya1	0.70	0.87	0.79
G ₄₃ MAUS-2	0.98	1.06	1.02	G ₈₈ VL Soya2	1.12	0.54	0.83
G ₄₄ MAUS-32	1.33	0.32	0.83	G ₈₉ VL Soya21	1.29	0.63	0.96
G ₄₅ MAUS-47	1.24	0.82	1.03	G ₉₀ VL Soya47	1.04	0.65	0.85
				Mean	1.33	1.00	1.17
For comparing the means of			S.E. ±	C.D. (P=0.05)			
S			0.01	0.03			
G			0.06	0.21			
SxG			0.08	0.29			

Sowing seasons (S) : S₁ – Kharif S₂ – Summer

for shoot length, summer season and KHSB-2 (S_2G_{34}) (15.87 cm), *Kharif* season and SL96 *Kharif* (S_1G_{80}) (19.77 cm); for root length, *Kharif* season and JS 80-21 (G_{26}) (23.4 cm) and summer season and Birsa soy 1 S_2G_4 (21.47 cm); for seedling dry weight *Kharif* season and VL Soya -2 (S_1G_{87}) (1.67 g) and summer season and Co Soya 2 (G_7) (1.45 g); for seedling vigour index, *Kharif* season and RAUS-5 (S_1G_{76}) (3680) and summer season and Indira Soya 9 (G_{19}) (3847); for electrical conductivity, *Kharif* season and MACS-58 (S_1G_{39}) (3.92 dSm^{-1}) and summer season and LSb-1 (S_2G_{36}) (3.92 dSm^{-1}); for reducing sugar, *Kharif* season and JS76-205 (S_1G_{24}) (2.92%) and summer season Shivalik genotype (S_2G_{79}). Whereas, least values for oil content were obtained in Gujarat soybean (10.93%) sown in *Kharif* season and KB-79 (G_{23}) sown in summer season (S_2) (9.83%); for seed germination, *Kharif* season and Indira Soya (S_1G_{19}) (23.33%) and summer season and MAUS-47 (S_2G_{45}) (30.00%); for shoot length, *Kharif* season and NRC-37 (S_1G_{54}) (11.13 cm) and summer season and CO-soya 2 (S_2G_7) (8.60 cm); for root length *Kharif* season and Lee (S_1G_{35}) (11.77 cm) and summer season and MAUS-61 (S_2G_{46}) (10.10 cm); for seedling dry weight, *Kharif* season and JS-97-52 (S_1G_{31}) (0.66 g), summer season and SL96 (S_2G_{80}) (0.50 g); for seedling vigour index, *Kharif* season and TAMS -9821 (S_1G_{85}) (458) and summer season and NRC-2 (S_2G_{51}) (697); for electrical conductivity, *Kharif* season and TAMS-38 (S_1G_{84}) (1.41 dSm^{-1}) and summer season and JS76 -205 (S_2G_{24}) (1.05 dSm^{-1}); for reducing sugar, *Kharif* season and summer (S_1G_{77}) (0.25%) and summer season and PK471 (S_2G_{60}) (0.23%). These results revealed significant variations on seed quality parameters among the genotypes sown in *Kharif* and summer seasons. These findings were also reported by Dixit *et al.* (1993); Aziz and Rehman (1996) and Merwade (2000) in chickpea and Chandrashekhar (2008) in frenchbean.

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