

Stability analysis over different environments for pod and its components traits in Sesame (*Sesamum indicum* L.)

ABSTRACT

Aims: To assess the stability over different environments for seed yield and its component traits in sesame (*Sesamum indicum* L.).

Study design: Eberhart and Russell model.

Place and Duration of Study: Conducted at three different experimental farms during kharif 2025, namely E1 (College of Agriculture, Latur), E2 (College of Agriculture, Ambajogai), and E3 (College of Agriculture, Parbhani).

Methodology: The investigation evaluated twenty-five genotypes for ten quantitative characters, including days to 50% flowering, days to maturity, plant height, number of branches per plant, number of capsules per plant, capsule length, number of seeds per capsule, 1000-seed weight, oil content, and seed yield per plant. Data were subjected to analysis of variance (ANOVA) and Eberhart and Russell stability parameters.

Results: Analysis of variance revealed highly significant differences among genotypes for all characters across all environments. Pooled analysis indicated that environmental variances were highly significant for all traits except the number of capsules per plant. Genotypes such as TBS-9, V-21-1, and TBS-12 recorded the highest seed yield per plant across environments. Based on stability parameters, genotypes TBS-5-1, TBS-7-3, and TLT-5 were stable for average environments, TBS-7-2 and TLT-10 for favorable environments, and TS-13 for poor environments.

Conclusion: The identified stable genotypes can be directly utilized across varying environmental conditions and incorporated into future breeding programs for stability enhancement.

Keywords: Sesame, Stability analysis, Genotype-environment interaction, Eberhart and Russell model, Correlation, Path coefficient analysis, Seed yield components.

1. INTRODUCTION

Sesame (*Sesamum indicum* L.), belonging to the family Pedaliaceae, is widely recognized as one of the oldest domesticated oilseed crops known to humanity. Cultivated extensively across tropical and subtropical regions of the world, sesame is highly valued for its premium-quality edible oil, high protein content, essential vitamins, and amino acids. The seeds typically contain an exceptional oil content ranging from 37% to 63%, characterized by natural antioxidants such as sesamin, sesamol, and sesamol, which impart remarkable oxidative stability and a long shelf life. Genetic and environmental factors influence the oil content and fatty acids profile in sesame.

In India, the cultivation is mainly concerned to M.P, Maharashtra, Rajasthan, U.P, A.P, Orissa, Gujarat, T.N and Karnataka. In India, area, production and productivity is 1620 thousand/ha, 760 thousand tones and 474 kg/ha, respectively. In Maharashtra, this crop covers on an area of 7000 ha, production of 2000 tones and productivity of 279.8 kg/ha.

Agronomically, sesame is adapted to diverse climatic conditions and is well-known for its strong drought tolerance, enabling it to thrive in marginal environments where other conventional crops often fail. Globally, it plays a vital role in agricultural economies and human nutrition. However, despite its widespread cultivation and economic significance, sesame productivity is frequently constrained by various biotic and abiotic stresses, as well as significant genotype-environment interactions across varying production locations and seasons.

Seed yield in sesame is a complex quantitative trait governed by numerous polygenes and highly influenced by environmental fluctuations. Genotype-environment ($G \times E$) interactions often confound selection programs, as genotypes that perform exceptionally at one location frequently falter under different agro-climatic conditions.

To bridge the gap between current yields and the crop's maximum genetic potential, understanding the stability and performance of different genotypes across diverse environments is essential. Evaluating yield components such as plant height, branching pattern, capsule traits, and seed weight—alongside stability parameters provides critical insights for plant breeders. Such evaluations facilitate the identification of robust, widely adaptable, or environment-specific cultivars, ultimately guiding effective selection strategies for future crop improvement programs.

2. MATERIAL AND METHODS

To evaluate the stability performance of twenty-five sesame genotypes concerning seed yield and its associated traits, a field experiment was executed in a randomized complete block design utilizing two replications. The study was performed across three distinct environments during kharif 2025: E1 at the College of Agriculture, Latur; E2 at the College of Agriculture, Ambajogai; and E3 at the College of Agriculture, Parbhani. Each entry was planted in two-row plots with 3 meters in length with a spacing of 30 cm between rows and 10 cm between plants.

Standard agronomical practices and plant protection measures were strictly adopted to ensure optimal crop growth. Observations were gathered from five randomly chosen plants within each entry and replication, utilizing their mean values for subsequent statistical analyses. Ten quantitative characters were investigated: days to 50% flowering, days to maturity, plant height (cm), branches per plant, capsules per plant, capsule length (cm), seeds per capsule, test weight (g), oil content (%), and seed yield per plant. Stability evaluation was carried out employing the linear regression model established by Eberhart and Russell (1966).

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Table 1: List of sesame genotypes selected for the study

Sr.	Parents	Sr.	Parents
01	R - 09	14	TBS - 5 - 2
02	V - 13	15	TBS - 5 - 3
03	V - 18	16	TBS - 6
04	V - 21	17	TBS - 7 - 2
05	V - 21 - 1	18	TBS - 7 - 3
06	V - 32 - 1	19	TBS - 9
07	TS - 11	20	TBS - 12
08	TS - 13	21	TBS - 12 - 2
09	TS - 14	22	TLT - 5
10	TBS - 5	23	TLT - 10
11	TBS - 2 - 1	24	TLT - 408
12	TBS - 2 - 2	25	AKT - 101
13	TBS - 5 - 1		

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79 3. RESULTS AND DISCUSSION

80 The stability analysis of variance conducted for all ten characters under three environments
81 presented in table 2 were highly significant for all characters in all three environments. The
82 result of pooled analysis of variances over environments is presented in Table 3 revealed
83 that the variances due to environment were highly significant for all the characters except
84 number of capsules per plant. The variances due to environment were highly significant for
85 all the characters. Mean squares due to $G \times E$ interaction presented in table 4 was
86 significant for all the characters, days to 50% flowering, days to maturity, plant height,
87 branches per plant, capsules per plant, capsule length, seeds per capsule, test weight and
88 oil content seed yield per plant and only while for, harvest index and protein content they
89 were non-significant. The mean square due to pooled deviation were found significant for
90 days to 50 % flowering, plant height (cm), number of branches per plant, number of capsules
91 per plant, capsule length (cm), number of seeds per capsule, 1000 seed weight (g) oil
92 content (%) and seed yield per plant (g) and found the days to maturity was non-significant
93 indicating that the genotypes varied considerably for stabilities and hence, prediction of their
94 performance across environment for this traits are not possible. These was also reported by
95 Kumarsan and Nadarajan (2005), Rani and Kumar (2011), Mirza *et al.* (2013), Mali *et al.*
96 (2015), Misganaw *et al.* (2015), Patel *et al.* (2022), Chaudhari, B. D. (2022) and Shaikh *et al.*
97 (2024).

98 Eberhart and Russell. (1966) emphasized the need of considering both linear regression
99 coefficient (b_i) and nonlinear, i.e. deviation from regression (S^2_{di}) components of $G \times E$
100 interactions in measuring the stability of genotypes. In the present investigation three
101 measures, viz. higher mean performance, regression coefficient ($b_i = 1$) and deviation from
102 regression ($S^2_{di} = 0$) were used to identify superior and stable genotypes. As the $G \times E$
103 interaction was significant for all the characters, their results pertaining to stability
104 performance have been discussed and presented in Table 5.

105 The genotypes are stable which are with high mean value regression coefficient near to unity
 106 ($bi \approx 1$) and non-significant deviation from regression coefficient (S^2di) which are stable are
 107 better environments in case of days to 50 percent are TLT-408. Whereas, the genotypes V-
 108 21-1, TBS-7-2, TBS-9 are stable for poor environmental conditions. And the genotypes
 109 which are with low mean value but with non-significant deviation from regression coefficient
 110 (S^2di) are V-21, TS-13, TBS-5-1, TBS-5-2, TBS-5-3, TBS-12-2 and TLT-408.

111 For days to maturity none of the genotypes shown deviation from regression coefficient
 112 (S^2di), where few are with high mean as TLT-5 and AKT-101, where for low mean values are
 113 R-09, V-13, V-21, TS-11, TS-13, TBS-2-1, TBS-2-2, TBS-5-2, TBS-5-3, TLT-5, AKT-101.
 114 These genotypes are stable across the environments but change with lower and higher
 115 mean which refers yield. The similar results as high and low mean value but with non-
 116 significant deviation from regression deviation for Beniwal *et al.* (2018) and Patil *et al.*
 117 (2015). And the genotypes V-18, TBS-5 and TBS-12-2 were identified as early genotypes
 118 with low mean and regression coefficient less than unity ($bi < 1$) with non-significant deviation
 119 from regression coefficient (S^2di) exhibited it's specially adapted to poor environments.

120 In plant height the genotypes such as R-09, TBS-7-2, TS-14 are with high mean value and
 121 shown near to unity ($bi \approx 1$) and non-significant deviation from regression coefficient (S^2di),
 122 but the most genotypes with low value but are near to unity and are stable as V-18, V-21-1,
 123 V-32-2, TBS-2-1, TBS-2-2, TBS-5-1 and TBS-5-3 which are stable for average
 124 environments.

125 For number of branches per plant some of the genotypes had significant deviation from
 126 regression showed unstable nature. The genotypes with high mean and bi near to unity
 127 found stable over average environmental condition i.e. TS-13, TBS-7-2, and TLT-5. The
 128 genotype TBS-5-2 with low mean regression coefficient near to unity ($bi \approx 1$) with non-
 129 significant deviation from regression coefficient (S^2di) indicates stable but poor adaptability
 130 over all environment, while genotypes AKT-101 observed with high mean regression
 131 coefficient less than unity ($bi < 1$) and non-significant deviation from regression coefficient
 132 (S^2di) was specifically adapted to poor environment.

133 In number of capsules per plant genotype TLT-408 with high mean ($\bar{X}_i$) regression coefficient
 134 more than unity ($bi > 1$) non-significant deviation from regression coefficient (S^2di) specifically
 135 adapted to favorable environment, meanwhile the genotype AKT-101 with high mean value
 136 regression coefficient less than unity ($bi < 1$) non-significant deviation from regression
 137 coefficient (S^2di) could perform well under unfavorable environment. Also, there are few
 138 which are with low mean value and are more than unity ($bi > 1$) non-significant deviation from
 139 regression coefficient (S^2di) are R-09 and V-21-1.

140 Next with capsule length, V-21, TS-11 and TBS-2-2 had high mean value regression
 141 coefficient near to unity ($bi \approx 1$) and non-significant deviation from regression coefficient (S^2di)
 142 indicated wider adaptability over average environmental condition. And four genotypes V-13,
 143 V-21-1, TBS-7-3, TLT-10 had lower mean, value regression coefficient less than unity ($bi < 1$)
 144 non-significant deviation from regression coefficient (S^2di) specifically adapted to poor
 145 environment.

146 For number of seeds per capsules, the genotype AKT-101 were quite stable and well
 147 adapted over the environment having high mean value, regression coefficient near to unity
 148 ($bi \approx 1$) and non-significant deviation from regression coefficient (S^2di), while the TS-11, TBS-
 149 5, TBS-2-2, TBS-5-3, TBS-7-3, TBS-9, TLT-408 and TLT-408 were quite stable but poorly
 150 adapted over the environment.

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Table 2: Analysis of variance for ten characters over three environments in Sesame (*Sesamum indicum* L.)

SV	DF	DF	DM	PH (cm)	NBPP	NCP	CL (cm)	NSP	TSW (g)	OC (%)	SYPP (g)
Mean sum of squares											
E1 = Latur											
Replication	1	0.001	0.46	1.008	0.006	5.48	0.0002	2.17	0.009	0.64	0.34
Genotype	24	5.84**	6.35**	8.1**	0.77**	36.63**	0.04**	6.38**	0.10**	15.34**	1.74**
Error	24	0.78	2.20	0.93	0.008	5.09	0.01	2.97	0.01	3.88	0.08
E2 = Ambajogai											
Replication	1	0.03	0.02	1.57	0.007	5.48	0.10	2.09	0.10	0.09	0.08
Genotype	24	6.83**	9.63**	11.22**	0.32**	50.54**	0.07*	236.12**	0.51**	18.68**	0.35**
Error	24	1.25	1.45	1.46	0.006	5.09	0.07	2.8	0.02	3.91	0.08
E3 = Parbhani											
Replication	1	1.19	0.04	2082	0.01	5.48	0.00	5.48	0.02	0.005	0.25
Genotype	24	7.56**	9.63**	19.54**	0.99**	40.42**	0.03**	15.20**	0.48**	25.64**	0.62**
Error	24	1.09	1.66	2.60	0.01	5.09	0.04	5.09	0.02	4.10	0.23

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Abbreviations: DFF = Days to 50% flowering; DM = Days to maturity; PH = Plant height; NBPP = Number of branches per plant; NCP = Number of capsules per plant, CL = Capsule Length, NSP = Number of seeds per Capsules, TSW = 1000 Seed Weight, OC = Oil Content, SYPP = Seed Yield per Plant.

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Table 3 Analysis of variance for Genotype × Environment interactions over three environments in Sesame (*Sesamum indicum* L.)

SV	DF	DF	DM	PH (cm)	NBPP	NCPP	CL (cm)	NSPC	TSW (g)	OC (%)	SYPP (g)
Mean sum of squares											
Genotype	24	6.16**	13.33**	12.84**	0.62**	42.18**	0.06**	89.92**	0.09**	41.45**	1.05**
E + (G×E)	50	7.23**	6.78**	24.70**	2.39**	87.52**	0.08**	83.32**	0.11*	9.79**	2.31**
Environment	2	11.80**	22.05**	305.01**	42.02**	1162.92	0.78**	69.54**	0.16**	26.20**	24.39**
G×E	48	7.04**	6.14**	13.01**	0.73**	42.71**	0.05**	83.89**	0.10**	9.10*	1.34**
Environment (lin.)	1	23.62**	44.11**	610.03**	84.04**	2325.85**	1.57**	139.10**	0.33**	52.42**	48.78**
G×E (lin)	24	8.17**	14.14**	41.52**	4.16**	141.75**	0.13**	99.04**	0.08**	11.55**	2.95**
Pooled deviation	25	5.67*	1.7	4.76**	0.39**	19.48**	0.02**	35.78**	0.07**	4.24**	0.87**
Pooled error	72	1.04	0.88	0.83	0.005	2.54	0.003	1.82	0.07	1.98	0.06
S.E. Mean		0.41	0.53	0.53	0.04	0.92	0.03	0.78	0.05	0.80	0.17
S.E. (bi)		1.47	1.39	0.37	0.08	0.33	0.45	1.14	1.53	1.91	0.43

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* Significant at $P \leq .05$; ** Significant at $P \leq .01$.

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Abbreviations: E + (G×E) = Environment + (Genotypes × Environment), G×E = Genotype × Environment, lin = linear.

Table 4: Estimates of stability parameters for ten characters over three environments in Sesame (*Sesamum indicum* L.)

Sr. No.	Genotype	Days to 50% flowering			Days to maturity			Plant height (cm)		
		Xi	bi	S ² di	Xi	bi	S ² di	Xi	bi	S ² di
1	R-09	43.30	-1.28	2.61*	91.54	-0.56	-0.88	92.76	1.71	0.09
2	V-13	44.43	-2.94	2.99*	92.16	-1.47	-0.88	93.05	1.18	6.49**
3	V-18	43.87	1.66	10.84**	95.3	-2.60	-0.88	91.60	1.78	-0.76
4	V-21	43.18	-0.28	0.50	92.43	0.42	-0.88	92.66	1.42	2.61*
5	V-21-1	43.7	5.53	0.38	95.23	5.12	-0.88	90.55	0.16	-0.71
6	V-32-2	43.96	2.80	0.76	94.6	4.25	-0.88	92.19	0.72	0.46
7	TS-11	41.93	0.14	2.31*	92.6	-1.30	-0.88	92.94	0.93	3.46*
8	TS-13	42.66	1.60	0.26	93.56	-0.95	-0.88	92.93	2.62	5.18**
9	TS-14	43.13	7.62	2.34*	96.57	1.92	-0.88	93.41	1.04	0.23
10	TBS-5	41.83	3.05	-0.11	95.03	-0.60	-0.88	90.58	1.88	23.34**
11	TBS-2-1	42.03	1.57	11.93**	93.53	0.17	-0.88	89.83	-0.24	-0.78
12	TBS-2-2	42.26	0.82	8.84**	93.53	0.43	-0.88	90.93	0.15	1.44
13	TBS-5-1	42.27	3.79	0.24	94	3.12	-0.88	91.71	0.30	1.97

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Sr. No.	Genotype	Days to 50% flowering			Days to maturity			Plant height (cm)		
		Xi	bi	S ² di	Xi	bi	S ² di	Xi	bi	S ² di
14	TBS-5-2	43.2	3.46	-0.52	92.5	1.56	-0.88	92.6	0.84	15.78**
15	TBS-5-3	42.9	4.68	0.04	93.5	0.52	-0.88	91.58	0.63	-0.71
16	TBS-6	43.01	-2.80	1.49	93.56	-1.21	-0.88	92.33	-0.24	-0.12
17	TBS-7-2	45.33	-1.68	-0.22	96.43	7.99	-0.88	93.87	0.88	0.55
18	TBS-7-3	42.80	-2.77	6.02**	92.27	2.42	-0.88	91.99	0.42	0.18
19	TBS-9	45.7	2.89	-0.25	95.3	5.21	-0.88	96.82	1.74	26.97**
20	TBS-12	44.09	-2.18	2.14*	93.76	-1.21	-0.88	91.83	2.87	1.34
21	TBS-12-2	43.13	-1.76	-0.41	92.36	-2.52	-0.88	91.02	1.28	-0.60
22	TLT-5	43.77	-1.78	3.12*	93.87	0.87	-0.88	94.28	0.61	4.06*
23	TLT-10	43.11	-2.26	1.87*	91.7	-1.04	-0.88	91.38	0.53	1.83
24	TLT-408	41.65	1.24	-0.47	93.5	2.86	-0.88	94.17	1.51	2.36
25	AKT-101	43.86	3.85	1.13	96.60	1.57	-0.88	92.26	0.16	3.63*
	Mean	43.24			93.81			92.37		

160 * and ** significant at 5% and 1% level respectively

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Sr. No.	Genotype	Number of branches per plant			Number of capsules per plant			Capsule length (cm)		
		Xi	bi	S ² di	Xi	bi	S ² di	Xi	bi	S ² di
1	R-09	3.3	1.51	0.03	33.98	2.70	5.97	2.30	1.62	-0.001
2	V-13	3.6	1.47	0.001	34.16	1.38	8.87*	2.51	-0.80	-0.002
3	V-18	3.13	1.01	1.08**	33.5	1.21	17.54**	2.38	2.32	0.04**
4	V-21	3.33	1.11	0.018	31.9	1.51	7.22	2.54	0.86	0.002
5	V-21-1	2.3	0.71	0.34	32.86	1.39	4.66	2.44	0.54	-0.001
6	V-32-2	2.95	1.23	-0.04	33.93	1.02	-2.40	2.33	1.56	-0.003
7	TS-11	2.66	0.41	2.91**	33.7	-0.61	57.63**	2.41	1.29	0.005
8	TS-13	3.26	1.03	0.005	36.5	1.06	39.43**	2.52	1.38	0.004
9	TS-14	3.5	1.75	-0.004	37.9	0.92	12.97*	2.45	1.74	-0.003
10	TBS-5	3.3	0.94	2.15**	37.86	0.28	78.15**	2.61	2.42	0.005
11	TBS-2-1	3.13	0.16	0.45	36.26	0.35	54.39**	2.30	2.05	0.014*
12	TBS-2-2	3.03	0.81	0.018	35.63	1.18	7.20	2.53	1.04	-0.001
13	TBS-5-1	3.1	0.34	0.16	35.3	0.69	-2.54	2.47	1.37	-0.001

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Sr. No.	Genotype	Number of branches per plant			Number of capsules per plant			Capsule length (cm)		
		Xi	bi	S ² di	Xi	bi	S ² di	Xi	bi	S ² di
14	TBS-5-2	2.83	0.63	0.12	32.63	0.70	-1.10	2.35	2.01	0.02**
15	TBS-5-3	2.96	1.23	0.13	36	1.76	6.69	2.30	1.62	0.001
16	TBS-6	2.73	0.25	0.85*	36.77	0.72	9.34*	2.50	0.37	0.01*
17	TBS-7-2	3.61	1.33	0.001	41.40	1.29	16.59**	2.58	1.92	0.009
18	TBS-7-3	3.03	0.76	0.34	37.46	0.72	27.91**	2.45	0.25	-0.001
19	TBS-9	3.71	1.61	-0.004	39.85	1.79	20.39**	2.49	0.52	0.01*
20	TBS-12	3.08	1.80	0.11	39.15	1.77	8.96*	2.36	0.09	0.15**
21	TBS-12-2	2.97	1.04	0.01	36.06	1.21	7.89*	2.39	-0.51	0.02**
22	TLT-5	3.23	0.98	-0.002	38.13	0.98	10.24*	2.34	1.75	0.11**
23	TLT-10	2.96	0.83	0.02	36.73	0.28	30.19**	2.22	-0.25	-0.002
24	TLT-408	3.46	1.00	0.06	37.63	0.88	-2.34	2.42	0.72	-0.002
25	AKT-101	2.96	0.94	0.59*	42.1	-0.28	-0.58	2.29	-0.97	0.02**
Mean		3.12			36.29			2.41		

163 * and ** significant at 5% and 1% level respectively

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Sr. No.	Genotype	Number of seeds per capsule			1000 Seed weight (g)		
		Xi	bi	S ² di	Xi	bi	S ² di
1	R-09	56.66	0.48	-1.72	3.28	-1.35	0.07*
2	V-13	56.1	2.18	21.08**	3.37	6.08	0.00
3	V-18	56.8	-0.88	-1.77	3.28	0.48	0.01
4	V-21	57.86	1.03	-1.82	3.22	3.69	-0.003
5	V-21-1	55.7	0.62	14.51**	3.32	-1.41	-0.004
6	V-32-2	55.93	-0.36	-0.89	3.23	0.90	-0.007
7	TS-11	58.13	-1.25	1.93	3.43	-0.005	0.02*
8	TS-13	58.1	-0.01	15.11**	3.30	1.10	-0.002
9	TS-14	62.43	4.39	5.29	3.49	-0.57	0.079
10	TBS-5	59.56	0.19	1.29	3.46	2.04	0.05
11	TBS-2-1	56.83	-1.79	2.55	3.41	-0.44	0.006
12	TBS-2-2	57.86	0.25	-1.26	3.26	-1.18	0.006
13	TBS-5-1	56.86	-0.30	-0.44	3.37	-1.51	-0.004

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Sr. No.	Genotype	Number of seeds per capsule			1000 Seed weight (g)		
		Xi	bi	S ² di	Xi	bi	S ² di
14	TBS-5-2	57	-0.34	12.95**	3.50	1.25	0.23**
15	TBS-5-3	58.13	0.59	0.35	3.45	1.50	0.08**
16	TBS-6	57.14	-1.45	0.04	3.67	6.81	0.00
17	TBS-7-2	59.35	0.56	18.43**	3.61	3.10	0.04*
18	TBS-7-3	58.57	0.13	0.96	3.36	1.44	0.06**
19	TBS-9	58.36	0.29	0.83	3.34	-2.23	-0.006
20	TBS-12	39.96	19.63	730.18**	3.55	1.60	0.42**
21	TBS-12-2	56.63	1.40	-1.80	3.37	1.45	0.36**
22	TLT-5	58.95	0.42	7.45*	3.33	-0.56	0.002
23	TLT-10	58.91	-1.69	24.70**	3.42	-0.09	0.18**
24	TLT-408	59.61	-0.43	2.76	3.46	2.77	0.001
25	AKT-101	57.71	1.33	-1.82	3.13	0.12	-0.005
Mean		57.16			3.38		

166 * and ** significant at 5% and 1% level respectively

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Sr. No.	Genotype	Oil content (%)			Seed yield/plant (g)		
		Xi	bi	S ² di	Xi	bi	S ² di
1	R-09	3.50	1.25	0.12	7.05	1.65	2.08**
2	V-13	3.45	1.50	-1.55	7.48	0.81	0.25*
3	V-18	3.67	6.81	-1.78	7.36	0.84	0.83**
4	V-21	3.61	3.10	11.01*	7.79	0.56	0.30
5	V-21-1	3.36	1.44	16.22**	7.21	2.51	2.56**
6	V-32-2	3.34	-2.23	-1.90	7.55	0.77	0.29*
7	TS-11	3.55	1.60	-0.84	7.66	-0.01	0.85**
8	TS-13	3.37	1.45	-0.35	7.21	1.26	0.15
9	TS-14	3.33	-0.56	-1.86	8.17	0.37	-0.01
10	TBS-5	3.42	-0.09	-1.74	7.88	-0.73	2.49**
11	TBS-2-1	3.46	2.77	0.009	7.86	0.88	2.76**
12	TBS-2-2	3.13	0.12	0.30	7.58	1.37	0.16
13	TBS-5-1	3.50	1.25	2.72	7.98	1.13	-0.04

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Sr. No.	Genotype	Oil content (%)			Seed yield/plant (g)		
		Xi	bi	S ² di	Xi	bi	S ² di
14	TBS-5-2	40.71	0.48	1.98	6.72	0.85	2.20**
15	TBS-5-3	41.74	0.64	-1.31	7.06	1.95	0.07
16	TBS-6	42.22	0.27	5.46	6.89	1.59	1.80**
17	TBS-7-2	47.65	3.44	-1.31	7.94	1.44	-0.08
18	TBS-7-3	47.29	2.00	-1.97	7.90	0.93	0.12
19	TBS-9	49.20	1.50	28.91**	8.21	1.71	0.32*
20	TBS-12	43.02	0.65	-1.63	8.09	1.19	0.34*
21	TBS-12-2	42.06	-0.47	4.87	7.28	1.23	0.42*
22	TLT-5	44.05	-0.38	-1.63	7.8	0.75	0.37*
23	TLT-10	43.36	0.87	-1.98	7.44	0.86	1.92**
24	TLT-408	44.19	2.77	-1.25	7.66	1.17	0.04
25	AKT-101	46.9	2.47	6.10*	8.15	-0.18	-0.07
Mean		23.08			7.59		

169 * and ** significant at 5% and 1% level respectively

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Table 5: Stable genotypes based on different stability parameters in Sesame (*Sesamum indicum* L.)

Sr. No.	Character	Stable for average environmental condition	Stable for favorable/better environmental condition	Stable for unfavorable/poor environmental condition
1	Days to 50% flowering	TLT-408	V-32-2, AKT- 101	V-21-1, TBS-7-2, TBS-9
2	Days to maturity	TLT-5	V-21-1, V-32-2, TS-14, TBS-5-1, TBS-7-2, TBS-9, AKT-101	V-18, TBS-5,
3	Plant height (cm)	R-09, TS-14, TBS-7,2	TLT-408	-
4	No. of branches per plant	TS-13, TBS-7-2, TLT-5	R-09, V-13, TS-14, TBS-9	V-21
5	No. of capsules per plant	TLT-408	AKT-101	-
6	Capsule length (cm)	V-21, TBS-2-2, TBS-2-2	TS-13, TS-14, TBS-5-1, TBS-7-2	V-21-1, TBS-7-3, TLT-408
7	No. of seeds per capsule	AKT-101	V-21, TS-14,	TS-11, TBS-5, TBS-2-2, TBS-5-3, TBS-7-3, TBS-9, TLT-408
8	1000 seed weight (gm)	-	TBS-6, TLT-408	TBS-2-1
9	Oil content (%)	-	R-09, V-32-2, TS-13, TBS-7-2, TBS-7-3	V-13, TS-11,
10	Seed yield per plant (gm)	TBS-5-1, TBS-7-3, TLT-408	TBS-7-2	V-21, TS-14, TLT-5, AKT-101

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172 In 1000 seed weight, the TBS-6, and TLT-408 had high mean regression coefficient more
173 than unity ($b_i > 1$) and non-significant deviation from regression coefficient (S^2_{di}) specifically
174 adapted to better environment. Also, few genotypes are unstable such as, R-09, TS-11,
175 TBS-5-2, TBS-5-3, TBS-7-2, TBS-7-3, TBS-12, TBS-12-2 and TLT-10 for this character.

176 For oil content, the genotypes R-09, V-32-2, TS-13, TBS-7-2 and TBS-7-3 had high mean
177 and regression coefficient more than unity ($b_i > 1$) exhibited wider adaptability to better
178 environment. The genotypes V-13 and TS-11 observed quite stable but poorly adapted to all
179 environments. The genotypes like TS-14, TBS-5, TBS-2-1, TBS-2-2, TBS-5-1, TBS-5-2,
180 TBS-5-3 and TBS-6 are low in mean value regression coefficient near to unity ($b_i \approx 1$) and
181 non-significant deviation from regression coefficient (S^2_{di}) which are stable are poor
182 environments.

183 Next for the most important character, seed yield per plant. The stability parameters shown
184 that, the genotypes TBS-5-1, TBS-7-3 and TLT-408 have high mean value regression
185 coefficient near to unity ($b_i \approx 1$) and non-significant deviation from regression coefficient (S^2_{di})
186 which are stable are average environments. The genotypes TS-13 and TS-14 with low mean
187 value regression coefficient near to unity ($b_i \approx 1$) and non-significant deviation from regression
188 coefficient (S^2_{di}) which are stable are poor environments. and genotype TBS-7-2 with high
189 mean value regression coefficient near to unity ($b_i \approx 1$) and non-significant deviation from
190 regression coefficient (S^2_{di}) which are stable are better environments.

191 The genotypes that shown low mean and deviation from regression coefficient (S^2_{di}) which
192 are unstable are R-09, V-13, V-18, V-21-1, TS-11, TS-13, TBS-2-1, TBS-5-2 TBS-6 TBS-9,
193 TBS-12, TBS-12-2 and TLT-10.

194 **4. CONCLUSION**

195 The investigation evaluated twenty-five sesame genotypes across three environments to
196 assess stability for seed yield and its component traits using the Eberhart and Russell
197 model. Analysis of variance revealed highly significant differences among genotypes,
198 indicating substantial genetic variability across all studied characters. Pooled analysis
199 demonstrated that environmental variances and genotype-environment interactions were
200 significant for most quantitative traits. Genotypes such as TBS-9, V-21-1, and TBS-12
201 recorded the highest seed yield per plant across environments. Based on stability
202 parameters, genotypes TBS-5-1, TBS-7-3, and TLT-5 were stable for average environments,
203 TBS-7-2 and TLT-10 for favorable environments, and TS-13 for poor environments. The
204 identified stable genotypes can be directly utilized across varying environmental conditions
205 and incorporated into future breeding programs for stability enhancement.

217 **COMPETING INTERESTS**

218 Authors have declared that no competing interests exist.

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228 **ETHICAL APPROVAL (WHERE EVER APPLICABLE)**

229 NOT APPLICABLE. THIS STUDY DID NOT INVOLVE HUMAN OR ANIMAL SUBJECTS.

230

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Declaration of AI Use

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