Journal of Biology and Nature

Volume 16, Issue 2, Page 58-62, 2024; Article no.JOBAN.12484
ISSN: 2395-5376 (P), ISSN: 2395-5384 (O), (NLM ID: 101679666)

Evaluation of Sesame Genotypes under *In vitro*-salt Stress Conditions Based on Seed-related Traits

Ibrahim J [a], Kaaviyan RS [a], Keerthika, X [a], Lokeshwaran S [a], Nabeesath Beema NS [a], Chitra. S [a*] and Gunasekaran, M. [a]

[a] Department of Plant Breeding and Genetics, Agricultural College and Research Institute, Madurai, 625 104, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.56557/joban/2024/v16i28961

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://prh.ikprress.org/review-history/12484

Original Research Article

Received: 16/09/2024
Accepted: 19/11/2024
Published: 27/11/2024

ABSTRACT

Sesame has adaptability to a wide range of climates and soil concludes and its cultivation may be an alternative option in areas with salinity problems. However, the performance of this plant in salinity stress environment and the evaluation of germplasm from different places with morphological and physiological diseases have not been studied well. With this background, the present investigation was carried out at Agricultural College and Research Institute, Madurai, to evaluate the salt tolerance potential of twenty sesame genotypes under salinity stress. Based on overall observations, the sesame genotype VS-20-042 is identified as more saline tolerant, followed by the genotypes Kattikulam local, TMV 3, VS-20-078, and VS-20-008. The sesame variety VRI 4 is moderately sensitive to salinity followed by the genotype VS-20-054 and VS-21-060. The sesame

**Corresponding author: E-mail: chitras@tnau.ac.in;*

Cite as: *J, Ibrahim, Kaaviyan RS, Keerthika, X, Lokeshwaran S, Nabeesath Beema NS, Chitra. S, and Gunasekaran, M. 2024. "Evaluation of Sesame Genotypes under In Vitro-Salt Stress Conditions Based on Seed-Related Traits". Journal of Biology and Nature 16 (2):58-62. https://doi.org/10.56557/joban/2024/v16i28961.*

genotypes, SVPR 1, Swetha, VRI 2 and VS-20 -005 are selected as highly salt sensitive. From this study it is concluded that the identified salt tolerant sesame genotypes *viz.,* VS-20-042, Kattikulam local, TMV3, VS-20-078 and VS-20-008 may be used as salt tolerant donor in salt stress tolerance breeding programme.

Keywords: Sesame; salinity; In vitro.

1. INTRODUCTION

Food security is becoming significantly important become of growing population and climate change. Drought and salinity are becoming increasingly common, particularly in arid and semi- arid regions. Therefore, crop irrigation scheduling and farm water management must be optimized to promote food securely and farmers, better livelihood (Fuji maki et al*.,* 2020). Salinization is recognized to be among the most severe soil degradation factor in arid and semi-arid region has drastically decreased in recent years, imposing additional obstacles to agricultural production. Crop densification through the cultivation of salt and drought-tolerant unconventional crops could be an option to sustain the productivity of salt-affected dry lands. This can be achieved by integrating new genetically improved lines with high-yield and quality-promoting traits into a saline agricultural production system.

Sesame (Sesamum *indicum* L.) is the fifth important oilseed crop in India after groundnut, Soyabean, Sunflower and rapeseed- mustard. Sesame seeds are contained manganese, iron, zinc and fibres. Sesame oil is considered to be the best edible oil in India, which is having antioxidants such as sesamin, sesamol, sesamolin *etc.* and upto 80% of the total fatty acid is unsaturated fatty acids [1]. The oil contains sesaminol and sesamin lignans that play an important role in the activity of tocopherols and other antioxidants [2]. The oil extracted from its seeds can be used in the manufacturing of pies, margarine, perfumes, lubricants, medicines and soap.

Besides the nutritional importance, Sesame stands out in terms of good production stability relative to the water factor (low water requirement) compared to other cultivated species Sesame is more adaptable to a broad range of soil types [3]. This quality raised sesame as an attractive crop specially designed for challenging climate changes [4] although salt stress is a serious factor affecting productivity [5,6]. With this point of view, the present study was carried out to identify salt tolerant sesame genotypes under *invitro* condition.

2. MATERIALS AND METHODS

The present study was conducted at a Research laboratory in the Department of Plant Breeding and Genetics, Agricultural College and Research Institute, Madurai, during the year 2024. About twenty sesame genotypes *viz.,* VRI-1, VRI-2, VRI-3, VRI-4, VRI-5, TMV-3, TMV-6, Swetha, GT-10, SVPR-1, Kattikulam local, Aritapatti local, VS-19-054, VS-20-054, VS-20-078, VS-21-042, VS-21-060, VS-20-008, VS-20-040 and VS-20-005 and mature and healthy seeds were placed under *invitro* condition using roll towel method. Four treatments were formulated along with control (control, 50mM, 100mM, 150mM) and for each treatment, fifteen seeds were used with two replications and observations were recorded for six biometric traits *viz.,* germination percentage, shoot length(cm), root length (cm), seedling height (cm), root to shoot ratio and vigour index (Table 1).

3. RESULTS AND DISCUSSION

3.1 Effect of Salinity on Germination Percentage

The salinity treatments negatively influenced the germination percentage. When salinity increased, the germination percentage decreased in all the sesame genotypes. All the genotypes showed different germination percentages in different levels of salinity [7,8]. At higher salt concentration of 150mM level, the highest germination percentage (76%) was recorded by the genotype Kattikulam local, followed by VRI 5 (71%) sesame variety, whereas the lowest of 53 % germination percentage was recorded by the genotypes VS-20 -054 and VS-20 -054 followed by the genotypes VRI 3 (54%) and VS -20- 078 (54%). Hence, the sesame genotypes, Kattikulam local, TMV 6, Swetha, GT 10, and SVPR 1, are identified as more salt-tolerant types. The sesame genotypes VRI 4, VS-20-008, VS-21-060, VRI 2, TMV 3, VS-21-042, and VS-20-040 are moderately sensitive to salinity, whereas the

sesame genotypes VS-20-054, VS-20-078, VS -19-054, VRI 3, Aritapatti local and VS-20-005 are more sensitive to salinity.

3.2 Effect of Salinity on Shoot Length

The shoot length was reduced with increasing NaCl concentration in all the sesame genotypes studied in this experiment. The similar reports were reported in Sesame [9,10]. In higher NaCl concentration (150mM), the maximum shoot length (7.5cm) registered by the three sesame entries (VRI 1, Kattikulam local and VS-20-078) followed by the two genotypes (VS-20-054 and VS-21-042) expressed shoot length of 7.0 cm. By considering overall reduction of shoot length at higher NaCl concentration level, the sesame genotypes, VS-20-078, VS-21-042, VS-20-008 and Kattikulam local and more salt tolerant genotypes than others. The six sesame genotypes *viz.,* VRI 4, GT 10, SVPR 1, VS-20-005, Aritapatti local, and VRI 2 are highly sensitive to salinity.

3.3 Effect of Salinity on Root Length

The sesame genotypes showed a decrease in root length and an increase in salinity treatment. Bahrami et al*.* [11] and Basrafshan and Ehsanzadeh [12]. reported a significant reduction in the seedling root length in sesame.

In 150 mM NaCl concentration treatment the highest root length of 4.0cm was registered by the four genotypes viz., TMV3, VS-20-054, VS-21-042 and VS-20-040 whereas the lowest root length (2.0cm) recorded by the two local and sesame genotype (Kattikulam local and Aritapatti local) followed by the root length of 2.5cm expressed by six sesame genotypes *viz.,* VRI 1, TMV 6 , Swetha , GT 10 , SVPR 1 and VS-20-078. When taken in account of overall all reduction in root length the sesame genotypes VS-20-040, VS-21-042, TMV 3, VRI 3, VS-20-054 and VS-20-078 are more salt tolerant types, the sesame genotypes VRI 3, VRI 4, TMV 6, Kattikulam local, VS-20-005, VRI 2, SVPR 1 are highly sensitive to salinity.

Table 1. Effect of higher salt concentration on sesame genotypes

S.No	GENOTYPE	I	II	III	IV	V	VI
1.	VRI-1	56.0	7.5	2.5	10.0	0.33	560.0
2.	VRI-2	63.0	5.5	3.0	8.5	0.54	535.5
3.	VRI-3	54.0	6.0	3.5	9.5	0.58	513.0
4.	VRI-4	67.0	6.5	3.5	10.0	0.53	670.0
5.	VRI-5	71.0	6.0	3.0	9.0	0.50	639.0
6.	TMV-3	58.0	6.0	4.0	10.0	0.66	580.0
7.	TMV-6	65.0	6.5	2.5	9.0	0.38	585.0
8.	SWETA	67.0	5.5	2.5	8.0	0.45	536.0
9.	GT-10	65.0	6.5	2.5	8.0	0.38	520.0
10.	SVPR-1	66.0	6.5	2.5	8.0	0.38	528.0
11.	Kattikulam local	76.0	7.5	2.0	9.5	0.26	722.0
12.	Aritapatti local	62.0	6.0	2.0	8.0	0.30	496.0
13.	VS-19-054	56.0	5.0	3.0	8.0	0.60	448.0
14.	VS-20-054	53.0	7.0	4.0	11.0	0.57	583.0
15.	VS-20-078	54.0	7.5	2.5	9.5	0.36	513.0
16.	VS-21-042	66.0	7.0	4.0	11.0	0.57	726.0
17.	VS-21-060	64.0	6.5	3.5	10.0	0.53	640.0
18.	VS-20-008	67.0	6.5	3.0	9.5	0.46	636.5
19.	VS-20-040	62.0	6.0	4.0	10.0	0.66	620.0
20.	VS-20-005	61.0	5.5	3.0	8.5	0.54	518.5
	Mean	**62.7**	**6.4**	**3.0**	**9.3**	**0.5**	**578.5**
	SEd	**17.58**	**0.64**	**0.98**	**1.15**	**0.11**	**13.64**
	CD(5%)	**51.97**	**1.89**	**2.89**	**3.41**	**0.33**	**40.31**
	CV %	**41.54**	**29.53**	**14.83**	**23.51**	**2.65**	**2.98**

I- Germination percentage
II- Shoot length (cm)
III- Root length (cm)
IV- Seedling height (cm)
V- Root to shoot ratio
VI- Vigour Index

3.4 Effect of Salinity on Seedling Height

The decrease in seedling height was observed in all the sesame genotypes when increasing the salt treatment concentration. The same observation was reported by Anter and Sl-Sayed [9] and Dias et al*.,* 2017. In the highest concentration of salt treatment, the maximum seedling height of 8.0cm was exhibited by the five genotypes viz., Swetha, GT-10, SVPR-1, Aritapatti local, and VS-19-054 followed by the two genotypes (VRI 2 and VS-20-005) expressed the seedling height of 8.5cm. The maximum seedling height of 11.0cm registered by the two genotypes VS-20-054 and VS-21-042 followed by seedling height of 10.0cm registered by the four sesame genotypes (VRI 1, VRI 4, TMV 3 and VS-21-060). By considering overall reduction percentage of seedling the sesame genotypes V-21-042, TMV 3, VS-20-054, VS-20-040, VS-20-078, Kattikulam level, VRI 3, VS-21-060 and VS-20-008 are salt tolerant types. The sesame genotypes, VRI 1, VRI 4, TMV 6, Arititapatti local and VS-19-054 are moderately sensitive and VRI 2, VRI 5, Swetha, GT 10 and SVPR 1 are more sensitive to salinity.

3.5 Effect of Salinity on Root to Shoot Ratio

In this experiment increase in root to shoot ratio were observed with increase in salinity level. Similar results were observed in sesame by Anter and Sl-Sayed [9] and Suassuna et al*.* [10]. In 150mM NaCl salt treatment, the maximum root to shoot ratio (0.66) exhibited by the two sesame genotypes *viz.,* TMV 3 and VRI 5, VS-20-040 followed by the sesame genotype VS-19-054 recorded to shoot ratio of 0.60. The maximum root to shoot ratio (0.26) recorded by the local sesame genotypes (Kattikulam local) followed by Aritapatti local (0.30), VRI 1 (0.33) and VS-20-078 (0.38). When taken into account of overall reduction of root to shoot ratio of the sesame genotypes VS-20-040, TMV 3, VRI 3, VRI 2, VS-21-042 and VS-20-054 are more salt tolerant types when compared to other sesame genotypes. The sesame genotypes VRI 4, TMV 6, VS-21-060 and VS-20-005 are moderately sensitive to salinity whereas the sesame genotypes VRI 1, GT 10, VS-20-00, SVPR 1, Kattiulam local and Swetha are highly sensitive to salinity.

3.6 Effect of Salinity on Vigour Index

In the high salt treatment level (150mM), the maximum vigour index 725 exhibited by the sesame genotype VS-21-042 followed by the vigour index of 722 registered by the sesame local genotype kattikulam local. Whereas the minimum vigour index of 448 expressed by the Sesame genotype VS-19-054 followed by the local sesame genotype Aritapatti local registered vigour index of 496. By considering overall reduction percentage of vigorous index, the sesame genotypes TMV3, Kattikulam local, VS-21-042, VS-20-008, VS-21-060, VRI 3 and TMV 6 are more salt tolerant types the sesame genotypes VS-21-042, VS-20-054, GT 10, SVPR 1 are moderately sensitive to salinity whereas the sesame genotypes VRI 1, VRI 2, VRI 5, VS-19-054 and VS-20-005 are more sensitive to salinity. The same findings were registered by Bekele et al*.* [13] Bazrafshan and Ehsanzadeh [14,15,16].

4. CONCLUSION

Based on overall performance of sesame genotypes, the line VS-20-042 is the more saline tolerant one followed by the genotypes Kattikulam local, TMV3, VS-20-078 and VS-20-008. The sesame variety VRI 4 is moderately sensitive to salinity followed by the genotype VS-20-054 and VS-21-060. The sesame genotypes, SVPR 1, Swetha, VRI 2 and VS-20 -005 are highly salt sensitive. From this study it is concluded that the identified salt tolerant sesame genotypes viz., VS-20-042, Kattikulam local, TMV3, VS-20-078 and VS-20-008 may be used as salt tolerant donor in salt stress tolerance breeding programme.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Nupur M, Bhat KV, Srinivastava PS. Variation in fatty acid composition in Indian germplasm of sesame. Journal of the American Oil Chemists Society. 2010;8 (11):1263-1269.
2. Lee J, Lee Y, Chloe E. Effects of sesamol, sesamin, and sesamolin extracted from

roasted sesame oil on the thermal oxidation of methyl linoleate. LWT-Food science and Technology. 2008;41(10): 1871-1875.
3. Islam F, Gill RA, Ali B, Farooq MA, Xu L, Najeeb U, Zhou W. Sesame. In: Breeding oilseed crops for sustainable production: Opportunities and constraints; Gupta S.K., Ed; Academic press: Cambridge, MA, USA. 2016;135-147.
4. Li D, Dossa K, Zhang Y, Wei X, Wand L, Zhang Y, Liu A, Zhou R, Zhang X. GWAS uncovers the differential genetic bases for drought and salt tolerances in sesame at the germination stage. Genes. 2018;9(2):1-19.
5. Bahrami H, Jafari AO, Razmjoo J. Effect of salinity levels (NaCl) on yield, yield components and quality content of sesame (*Sesamum indicum* L.) cultivars. Envir. Manag. and Susta. Devel. 2016;5(2):104-117.
6. Zhang Y, Li D, Zhou R, Liu A, Wang L, Zhang Y, Zhang Y, Gong H, Zhang X, You J. A collection of transcriptomic and proteomic datasets from sesame in response to salt stress. Data in Brief. 2020; 32:106096.
7. El Harfi M, Hainie H, Rizki H, Latrache H, Nabloussi A. Effect of drought and salt stresses on germination and early seedling growth of different colour seeds of Sesame (*Sesamum indicum*). International Journal of Agriculture and Biology. 2016;18(6): 1088-1094.
8. Bahrami H, Razmjoo J. Effect of salinity stress(NaCl) on germination and early seedling growth of ten sesame cultivars (*Sesamum indicum* L.). I. J. AgriSci. 2012;2:529-537.
9. Anter AS, Sl-Sayed AB. Screening new sesame (*Sesamum indicum* L.) lines at two levels of NaCl incorporated with algae for salt tolerance. Plant Arch. 2020;20(2): 2271-2276.
10. Suassuna JF, Fernandes PD, Brito MEB, Arriel NHC, deMelo AS, Fernandes JD. Tolerance to salinity of sesame genotypes in different phenological stages. Am. J. Plant Sci. 2017;8:1904-1920.
11. Bahrami H, Jafari AO, Razmjoo J. Effect of salinity levels(NaCl) on yield, and yield components and quality content of sesame (*Sesamum indicum* L.) cultivars. Environmental Management and Sustainable Development. 2016;5(2):104-117.
12. Basrafshan AH, Ehsanzadeh P. Growth, photosynthesis and ion balance of sesame (*Sesamum indicum* L.) genotypes in response to NaCl concentrationin hydroponic solutions. Photosynthetica. 2014;52(1):134-147.
13. Bekele A, Besufekad Y, Adugna S, Yinur D. Screening of selected accessions of Ethiopinan sesame (*Sesamum indicum* L.) for salt tolerance. Biocatalysis and Agricultural Biotechnology. 2017;9:82-94.
14. Bazrafshan AH, Ehsanzadeh P. Evidence for differential lipid peroxidation and antioxidant enzyme activities of sesame (Sesamum indicum L.) genotypes under NaCl salinity. Journal of Agricultural Science and Technology. 2016;18:207-222
15. Boureima S, Eyletters M, Diouf M, Diop TA, Van Damme P. Sensitivity of seed germination and seedling radicle growth to drought stress in sesame sesamum indicum L. Research journal of environmental sciences. 2011;5(6):557-564,
16. Dias AS, Lima GSD, Gheyi HR, Nobre RG, Sanios JBD. Emergence, growth and production of sesame accessions using SSR markers and morpho-agronomic traits. Australian Journal of Crop Science. 2017;13(1):45-54.

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of the publisher and/or the editor(s). This publisher and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.

© Copyright (2024): Author(s). The licensee is the journal publisher. This is an Open Access article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:
The peer review history for this paper can be accessed here:
https://prh.ikprress.org/review-history/12484