International Journal of Economic Plants

https://ojs.pphouse.org/index.php/IJEP

Crossref

IJEP July 2025, 12(4): 01-07

Article IJEP6183a

Full Research

Natural Resource Management

Doi: HTTPS://DOI.ORG/10.23910/2/2025.6183a

Effect of Ageing on Seed Quality Parameters in Brinjal Var. Anand Raj

K. M. Bera[1*], Kalyanrao[1], M. M. Pandya[2], D. A. Patel[3], M. J. Jadav[1] and J. S. Mahla[4]

[1]Dept. of Seed Science and Technology, [4]Dept. of Genetics and Plant Breeding, B. A. College of Agriculture, Anand Agricultural University, Anand, Gujarat (388 110), India

[2]Main Vegetable Research Station, Anand Agricultural University, Anand, Gujarat (388 110), India

[3]Dept. of Agricultural Biotechnology, Centre of Excellence in Biotechnology, Anand Agricultural University, Anand, Gujarat (388 110), India

Corresponding Author

K. M. Bera

e-mail: berakomal555@gmail.com

Article History

Received on 27th February, 2025

Received in revised form on 05th June, 2025

Accepted in final form on 14th June, 2025

Published on 26th June, 2025

Abstract

The experiment was conducted during April, 2022–23 and April, 2023–24 at Department of Seed Science and Technology, B. A. College of Agriculture, AAU, Anand, Gujarat, India to study on the effect of seed accelerated ageing treatments on seed quality parameters of brinjal var. Anand Raj using the CRD design at Department of Seed Science and Technology, B. A. College of Agriculture, AAU, Anand, Gujarat, India. The seeds were aged with temperature 45˚C and 95 to 100% RH for various duration T_1: 0 days, T_2: 1 days, T_3: 2 days, T_4: 3 days, T_5: 4 days during 2022-23, 2023-24. The data pertaining to seed quality attributes showed the non aged seeds (T_1) showed positive response for all quality parameters and recorded significantly highest as germination (96.33%), seedling root length (4.66 cm), seedling shoot length (5.24 cm), seedling length (9.90 cm), seedling fresh weight (0.49 g), seedling dry weight (0.0403 g), seedling vigour index I (1009.38) and seedling vigour index II (3.87). Seed quality influenced by seed accelerated ageing duration significantly higher germination (94.67%), seedling root length (4.23 cm), seedling shoot length (4.86 cm), seedling length (9.09 cm) seedling fresh weight (0.42 g), seedling dry weight (0.0382 g), seedling vigour index I (894.67) and seedling vigour index II (3.60) was showed by T_2: 1 days of ageing. Ageing is the irreversible damage to seed and more ageing duration and given temperature leads to damage and reduced seed quality and other quality parameter of brinjal seed.

Keywords: Brinjal, accelerated ageing, seed ageing duration, seed quality

1. Introduction

Brinjal, also known as eggplant, is a widely cultivated and consumed vegetable in the world, native to South Asia but introduced to tropical and subtropical regions (Rao et al., 2020). With a global acreage of 6.75 lakh hectares, it produces 178.76 lakh tonnes and has an average productivity of 26.43 tonnes per hectare. Major producing states include Odisha, Bihar, Karnataka, West Bengal, Andhra Pradesh, Maharashtra, and Uttar Pradesh. Brinjal is a key crop in countries like India, China, and Egypt, and is also grown extensively in the Far East (Sharma et al., 2022).

Brinjal is a rich source of vitamins, minerals, and bioactive compounds, including antioxidants, anti-inflammatory, and anticancer properties (Abd-Elsalam et al., 2022) (Cheng et al., 2022). Its fruit contains high amounts of carbohydrates, protein, fat, calcium, phosphorus, iron, and other minerals. It also contains β-carotene, riboflavin, thiamine, niacin, and ascorbic acid (Mishra et al., 2023) (Choudhary, 1976). Brinjal is a good brain booster and helps maintain good health by lowering cholesterol (Anonymous, 2022). Its composition per 100 g includes calories, sodium, moisture content, copper, potassium, sulphur, chlorine, fiber, Vitamin A, oxalic acid, folic acid, magnesium, vitamin C, zinc, and amino acids (Gopalan et al., 2007).

Brinjal, a staple crop globally, is highly adaptable to various agro-climatic conditions, making it a significant agricultural resource (Kumar et al., 2020). Pest infestations such as brinjal fruit and shoot borer, which can seriously impair productivity and quality, are one of the major obstacles facing bhandaloom farming (Thakur et al., 2021). The growing demand for pesticide-free produce and sustainable farming practices has prompted research on integrated pest management strategies and the development of pest-resistant cultivars (Suryawanshi et al., 2023). The increasing demand for pesticide-free produce and sustainable farming practices has led to research on integrated pest management strategies and the development of pest-resistant cultivars (Sharma et al., 2023a). Genetic advancements are being used to improve yield, disease resistance, and nutritional content of brinjal, a biofortified crop, in response to global interest in sustainable agriculture and functional foods (Kumar et al., 2022a) (Das et al., 2022). Moreover, brinjal's role in soil health, particularly in crop rotation systems, is also being investigated for its ecological benefits in integrated farming systems (Nanda et al., 2021).

The quality parameters of brinjal, including color, firmness, taste, and the concentration of essential nutrients, can deteriorate rapidly after harvesting, which poses significant challenges in its storage, transport, and marketability (Nandhini et al., 2023). Aging in brinjal is influenced by both biotic and abiotic factors, including environmental conditions, harvest time, and handling practices. The degradation of key quality attributes such as color, texture, and nutritional composition has been a significant focus of recent research. Brinjal's high water content and delicate skin make it prone to shriveling, browning, and loss of flavor during storage (Pereira et al., 2022). Furthermore, ripening and senescence processes, which involve enzymatic activities and oxidative stress, result in the breakdown of cell walls, leading to softening and reduced shelf life (Singh et al., 2021). Brinjal's quality parameters, including color, firmness, taste, and essential nutrients, can deteriorate rapidly after harvesting, posing challenges in storage, transport, and marketability (Nandhini et al., 2023). Aging in brinjal is influenced by environmental conditions, harvest time, and handling practices (Pereira et al., 2022) (Singh et al., 2021). Recent research has focused on the molecular mechanisms underlying aging, including ethylene role in fruit ripening and environmental stressors (Ghosh et al., 2021). The browning of brinjal during aging affects its visual appeal and consumer acceptability (Kumar et al., 2022) (Sharma et al., 2023). Further research and standardization are needed to improve seed quality and support the vegetable seed sector effectively.

2. Materials and Methods

The experiment was conducted during April, 2022–23 and April, 2023–24 at Department of Seed Science and Technology, B. A. College of Agriculture, Anand Agricultural University, Anand, Gujarat, India. The seeds of Gujarat Round Brinjal 8 (Anand Raj) were obtained from Main Vegetable Research Station (MVRS), Anand Agricultural University, Anand. These seeds were placed in accelerated ageing test and after that these seeds were used for seed quality testing. An accelerated ageing test was conducted over a period of four days, using a Completely Randomized Block Design (Factorial) with three repeats.

2.1. Accelerated aging test

Accelerated aging was conducted in desiccator measuring $14\times12\times4.5$ cm^3. A fiber mesh screen was suspended inside the desiccator on which seeds were evenly distributed to form a thin layer. Approximately 2.0 g of seeds from each treatment in three replications were tied in a fine muslin cloth bag was used. The lower part of the desiccators were filled with water, 100 ml of water was added to each desiccator, so that there was not any direct contact between water and the seed. The desiccators were covered with the lid and sealed with paraffin wax to make it airtight. To create the desired humidity condition for the test, The desiccators were then placed in the hot air oven/ incubator maintaining set of seeds at 45°C for 0, 1, 2, 3 and 4 days after which seeds were submitted to the germination test as previously described. Evaluation was performed 7 and 14 days and the results expressed as mean percentage of normal seedlings for each treatments.

2.2. Seed quality parameters recorded

The observation on seed quality parameters in laboratory condition viz., Germination (%), Seedling root length (cm), Seedling shoot length (cm), Seedling length (cm), Seedling fresh weight (g), Seedling dry weight (g), Seedling vigour index I and II were measure following standard procedure.

2.3. Statistical methods

The data observed were statistically analyzed by appropriate statistical methods as worked out using, Completely Randomized Design concept (Panse and Sukhatme, 1978) for each character. The standard error of the mean (SEm±) and Critical difference (CD) at a 5% level of probability was worked out and presented in respective tables for interpretation of the results.

3. Results and Discussion

3.1. Seed quality parameters

3.1.1. Germination (%)

The seed germination percentage was the highest in the control (0 days) but it decreased linearly with an increase in the days of ageing during both years and on pooled basis and the results are presented in Table 1 and Plate 1 respectively. The observations on T_1 (0 days) treatment germination per cent were significantly highest germination (96.67%), (99.33%) and (98%) whereas, significantly lowest germination (74.67%), (82.00%) and (78.33%) was recorded by T_5 (4 days) days of ageing during April, 2022–23, April 2023–24 and on pooled basis respectively.

The percentage of aged brinjal seeds that germinated was lower than that of the control group, and it declined more as the aging period increased. A physiological stress test known as "accelerated aging" allows seeds to deteriorate under controlled conditions when they are exposed to high temperatures and high relative humidity (over 90%). Elevated temperature and humidity have an impact on seed metabolism, which in turn increases seed moisture and speeds up the rate of deterioration. The results support the current

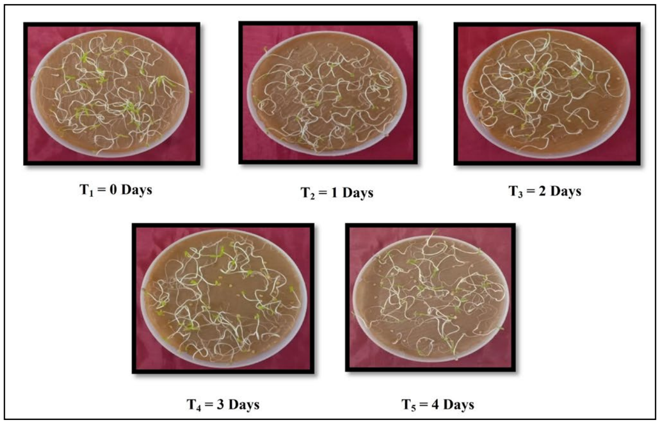

Plate 1: Effect of accelerated ageing diffrent treatment of germination (5)

finding of Amjad and Anjum (2002) in onion, Khan et al. (2004) in onion, Jain et al. (2006) in radish, Kavak et al. (2008) in chilli, Kaewnaree et al. (2011) in sweet pepper, Demirkaya (2013) in pepper, Ahamed et al. (2014) in chilli, Almeida et al. (2014) in tomato, Vijayalakshmi et al. (2014) in tomato, Keshavulu et al. (2012) in okra, Parmoona et al. (2018) in okra, Deuner et al. (2018) in brinjal, Nigam et al. (2019) in tomato, Nisha et al. (2023) in brinjal.

3.1.2. Seedling root length (cm)

The seedling root length were significantly influenced by different days of ageing during both year and on pooled basis and the results are presented in table 1 respectively. The treatment T_1 (0 days) recorded significantly highest root length (4.60 cm), (4.73 cm) and (4.66 cm) whereas, significantly lowest seedling root length (3.20 cm), (3.09 cm) and (3.15 cm) was recorded by the treatment T_5 (4 days) during april, 2022–23, april, 2023–24 and pooled basis respectively.

Accelerating the aging duration has a considerable impact on seedling root length. Following each stage of accelerated ageing, there was a considerable drop in root length. However, there was little difference in the rate of decrease between the seeds. The seeds lose viability day by day as a result of the accelerated aging process, and the germination rate and normal seedling development were significantly reduced. It measures seed vigor directly. The reduction in seed biochemical activity may be the cause of the drop in seedling root length. Enzymes required to transform embryonic reserve food into a form that may be used and, eventually, produce healthy seedlings are harmed by aging (Iqbal et al., 2002). The outcomes support the current findings of Khan et al. (2004) in onion, Jain et al. (2006) in radish, Kaewnaree et al. (2011) in chilli, Vijayalakshmi et al. (2014) in tomato, Nigam et al. (2019) in tomato.

3.1.3. Seedling shoot length (cm)

The data recorded on seedling shoot length were significantly influenced by different days of ageing during both years and on pooled basis and the results are presented in table 1 respectively. The treatment T_1 (0 days) recorded significantly highest shoot length (5.25 cm), (5.22 cm) and (5.24 cm) whereas, significantly lowest seedling shoot length (4.22 cm), (4.31 cm) and (4.27 cm) was recorded by the treatment T_5 (4 days) during april, 2022–23, april, 2023–24 and on pooled basis respectively.

Accelerated aging of the seeds is the primary cause of the variation in seedling shoot length. Lower respiration and fewer

Table 1: Effect of accelerated ageing on germination (%), seedling root length (cm) seedling shoot length (cm) and seedling length (cm)

treatments		Germination %			Seedling root length (cm)			Seedling shoot length (cm)			Seedling length (cm)		
		2022–23	2023–24	pooled	2022–23	2023–24	pooled	2022–23	2023–24	pooled	2022–23	2023–24	pooled
T_1: 0 days		94.67	98.00	96.33	4.60	4.73	4.66	5.25	5.22	5.24	9.82	9.98	9.90
T_2: 1 days		93.33	96.00	94.67	4.27	4.20	4.23	4.62	5.10	4.86	8.89	9.29	9.09
T_3: 2 days		92.00	95.33	93.67	4.10	3.87	3.98	4.24	4.88	4.56	8.33	8.75	8.54
T_4: 3 days		90.00	88.00	89.00	3.91	3.31	3.60	4.52	4.62	4.57	8.43	7.93	8.17
T_5: 4 days		74.67	82.00	78.33	3.20	3.09	3.15	4.22	4.31	4.27	7.42	7.40	7.41
SEm±	y	-	-	0.55	-	-	0.08	-	-	0.02	-	-	0.11
	t	1.27	1.19	1.66	0.05	0.05	0.13	0.06	0.04	0.14	0.10	0.06	0.18
	y×t	-	-	1.23	-	-	0.05	-	-	0.05	-	-	0.08
	y	-	-	NS	-	-	NS	-	-	NS	-	-	NS
	t	3.99	3.76	6.52	0.17	0.16	0.53	0.20	0.13	0.54	0.315	0.196	0.73
	y×t	-	-	3.63	-	-	0.15	-	-	0.16	-	-	0.24
c.v. %		2.46	2.25	2.36	2.44	2.33	2.39	2.36	1.46	1.94	2.0–2	1.25	1.67

Table 2: Effect of accelerated ageing on seedling fresh weight (g), seedling dry weight (g) and seedling vigour index - I & II

treat-ments		Seedling fresh weight (g)			Seedling dry weight (g)			Seedling vigour index - I			Seedling vigour index - II		
		2022–23	2023–24	pooled	2022–23	2023–24	pooled	2022–23	2023–24	pooled	2022–23	2023–24	pooled
T_1: 0 days		0.487	0.500	0.493	0.0454	0.0352	0.0403	929.65	1089.11	1009.38	4.30	3.45	3.87
T_2: 1 days		0.417	0.420	0.418	0.0426	0.0338	0.0382	916.35	872.99	894.67	3.97	3.25	3.60
T_3: 2 days		0.450	0.390	0.420	0.0316	0.0316	0.0316	858.73	833.73	846.23	2.91	3.01	2.95
T_4: 3 days		0.443	0.360	0.401	0.0310	0.0313	0.0311	848.41	697.87	773.14	2.79	2.75	2.77
T_5: 4 days		0.330	0.320	0.325	0.0277	0.0294	0.0285	618.43	601.68	610.05	2.06	2.41	2.23
SEm±	y	-	-	0.013	-	-	0.0018	-	-	4.98	-	-	0.16
	t	0.009	0.007	0.021	0.001	0.001	0.0028	10.97	11.29	55.74	0.052	0.061	0.26
	y×t	-	-	0.008	-	-	0.0006	-	-	11.13	-	-	0.05
	y	-	-	NS	-	-	NS	-	-	NS	-	-	NS
	t	0.028	0.023	0.083	0.002	0.002	0.0110	34.55	35.59	218.83	0.163	0.193	1.03
	y×t	-	-	0.024	-	-	0.0017	-	-	32.83	-	-	0.16
c.v. %		3.64	3.18	3.44	3.04	2.98	3.02	2.28	2.39	2.33	2.80	3.57	3.18

mitochondria in cells are the primary causes of diminished seedling growth brought on by accelerated aging (McDonald, 1999). A higher stress level may be the cause of the decline in seedling shoot length. Metabolic activities that promote cell development and division activity will also likely be reduced, and a decrease in cell division under aging stress conditions may be the cause of the reduction in shoot growth. The results of this investigation are in line with the findings of Jain et al. (2006) in radish, Vijayalakshmi et al. (2014) in tomato, Nigam et al. (2019) in tomato.

3.1.4. Seedling length (cm)

The seedling length were significantly influenced by different days of ageing during both years and on pooled basis and the results are presented in table 1 and plate 2 respectively. The treatment T_1 (0 days) recorded significantly highest seedling length (9.82 cm), (9.98 cm) and (9.90 cm) whereas, significantly lowest seedling length (7.42 cm), (7.40 cm) and (7.41 cm) was recorded by the treatment T_5 (4 days) during april, 2022–23, april, 2023–24 and pooled basis respectively.

Significant impacts of ageing were also observed on seedling length. Un-aged seeds were found to have the longest lengths, and as seeds aged, their length decreased. The primary cause of the variation in seedling length is the accelerated aging process. Accelerated ageing test of seeds, which has a positive correlation with the vigor of the seedlings. The length of the seedlings decreased gradually with increasing age and temperature, and at the end of the experiment, it was found to be significantly shorter than that of the control. This could be caused by ageing-related declines in the weight of the mobilized seed reserve, reductions in the activities of antioxidant enzymes such as glutathione reductase, ascorbate peroxidase, peroxidase, catalase, and superoxide dismutase,

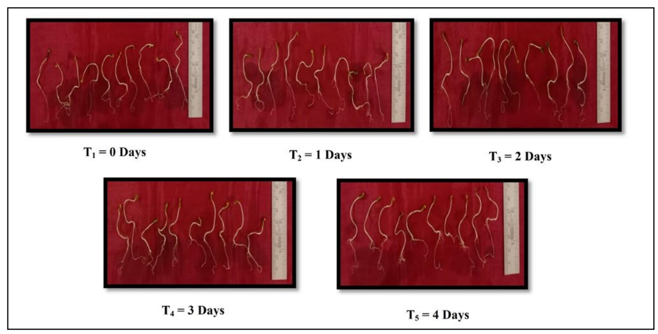

Plate 2: Effect of accelerated ageing different treatment on seedling length (cm)

as well as an increase in the content of malondialdehyde and total free fatty acids. Decreased amount of protein. Current outcomes match the reports provided by Jain et al. (2006) in raddish, Ahamed et al. (2014) in chilli, Nigam et al. (2019) in tomato, Nisha et al. (2023) in brinjal.

3.1.5. Seedling fresh weight (g)

Significant results on seedling fresh weight were observed by different days of ageing during 2022–23, 2023–24 and on pooled basis and the results are presented in table 2 respectively. The significantly highest seedling fresh weight was recorded by treatment T_1 (0 days) (0.49 g), (0.50 g) and (0.49 g) whereas, significantly lowest seedling fresh weight was recorded by the treatment T_5 (4 days) (0.33 g), (0.32 g) and (0.33 g) during april, 2022–23, april, 2023–24 and on pooled basis respectively.

Accelerated aging tests artificially stress seeds, resulting in poor germination and aberrant, sickly seedlings with low fresh weight. The reduction in the fresh weight of seedlings can be ascribed to various biochemical processes, such as impaired synthesis of enzymes necessary for the initial stages of germination, reduced ATP generation, a decline in soluble protein and sugar, a decrease in necessary enzymatic activities such as glutathione reductase, ascorbate peroxidase, peroxidase, and superoxide dismutase, an increase in the activity of α and β-amylase, and the production of free fatty acids. The decline in the activity of the enzymes responsible for the depletion of seed reserves was another factor. Present findings match the reports by Jain et al. (2006) in raddish, Nigam et al. (2019) in tomato.

3.1.6. Seedling dry weight (g)

The seedling dry weight showed significant results with different days of ageing during april, 2022–23, april, 2023–24 and on pooled basis and the results are presented in table 2 respectively. The significantly highest seedling dry weight (0.0454 g), (0.0352 g) and (0.0403 g) was recorded similarly by treatment T_1 (0 days) in both years. The significantly lowest seedling dry weight was recorded by the treatment T_5 (4 days) (0.0277 g), (0.0294 g) and (0.0285 g) during both years and pooled basis respectively.

The primary cause of the variations in seedling dry weight amongst the seeds is the accelerated ageing period. Test for Accelerated Aging has a good correlation with the vigor of seedlings. The result of plant physiological and biological activities is the dry weight of the seedlings. Poor seedling development following the accelerated ageing test is the primary reason of the reduction in dry matter output caused by the accelerated aging test (Mosavi et al., 2011). Several scientists have also reported similar results Jain et al. (2006) in raddish, Ahamed et al. (2014) in chilli, Vijayalakshmi et al. (2014) in tomato, Nigam et al. (2019) in tomato, Nisha et al. (2023) in brinjal.

3.1.7. Seedling vigour index I

The data recorded on seedling vigour index I were significantly influenced by different days of ageing during both years and on pooled basis and the results are presented in table 2 respectively. The treatment T_1 (0 days) recorded significantly highest seedling vigour index I (929.65), (1089.11) and (1009.38) whereas, significantly lowest seedling vigour index I (618.43), (601.68) and (610.05) was recorded by the treatment T_5 (4 days) during april, 2022–23, april, 2023–24 and on pooled basis respectively.

A fast test known as "accelerated ageing" is based on a higher rate of seed breakdown in hot, humid storage conditions. When compared to fresh seeds, the viability and vigor of the seeds were impacted by age. The seeds lose viability day by day as a result of the accelerated aging process, and the germination rate and normal seedling development were significantly reduced. At the end of the 14-day germination test, unaged seeds showed a high germination speed that produced long, healthy seedlings. However, as the seeds aged, this speed dropped, producing short, unhealthy seedlings. It measures seed vigor directly. In addition to the fall in the germination speed index and germination percentage, an accelerated aging pattern was also seen in the seedling vigour index. Among the physiological and biochemical changes that occur during seed aging may be linked to a drop in germination % and other indicators. The aging process shortens the lifespan of the plasma membrane, modifies the nucleic acid's molecular structure, reduces the activity of enzymes during seed senescence, lengthens the time required for quick germination, and weakens the vigor of the seed. Numerous scientists likewise reported similar outcomes Khan et al. (2004) in onion, Jain et al. (2006) raddish, Keshavulu et al. (2012) in okra, Ahamed et al. (2014) in chilli, Nigam et al. (2019) in tomato, Nisha et al. (2023) in brinjal.

3.1.8. Seedling vigour index II

Significant results on seedling vigour index II were observed by different days of ageing during 2022–23, 2023–24 and on pooled basis and the results are presented in table 2 respectively. The treatment T_1 (0 days) recorded significantly highest seedling vigour index II (4.30), (3.45) and (3.87) whereas, significantly lowest seedling vigour index II (2.06), (2.41) and (2.23) was recorded by the treatment T_5 (4 days) during april, 2022–23, april, 2023–24 and on pooled basis respectively.

The process of seed aging brings about a variety of biochemical changes that are essential for germination. As a result, the vigor and development of the seedlings decreased. Additionally, as seeds age, they lose their vigor and germination pattern due to RNA and DNA degradation, protein damage, and other factors. When compared to control seeds, this resulted in a reduced germination pattern and vigor level. It has an impact on the permeability of membranes, which eventually causes denaturation and improper development of the enzymes responsible for protein synthesis and the metabolism of carbohydrates. However, aged seeds eventually gave rise to aberrant and sickly seedlings, whose lower dry weight contributes to a decline in the vigor index pattern. Furthermore, a potential cause of decreased vigor could be the decline in metabolic activity in seeds. Ageing has harm effect on enzymes that are necessary to convert reserve food in the embryo to usable form and ultimately production of normal seedling (Iqbal et al., 2002). Similar outcomes were noted with Khan et al. (2004) in onion, Jain et al. (2006) in raddish, Keshavulu et al. (2012) in okra, Ahamed et al. (2014) in chilli, Nigam et al. (2019) in tomato, Nisha et al. (2023) in brinjal.

4. Conclusion

On the basis of experiments, it can be concluded that the third date of sowing (1st week of October), fruits harvested at 81–90 days after fruit formation and seed extracted by manual method was performed well in accelerated ageing treatment for seed quality parameter in brinjal variety Anand Raj under Anand condition.

5. Acknowledgement

The authors would like to thank University of Anand Agricultural University and also acknowledges the support of financial assistance from the Department of Education Government of Gujarat, culminating in the successful completion of their research.

6. References

Abd-Elsalam, K.A., El-Beltagi, H. S., El-Shereen, A.H., Al-Mahdy, D.A., Elsayed, A.M., 2022. Health-promoting bioactive compounds in brinjal (*Solanum melongena* L.): Current status and future prospects. Food Research International 143, 110267.

Ahamed, M.N., Channakeshava, B.C., Radha, B.N., Nagaraj, H., Umesha, 2014. Response of chilli genotypes to accelerated ageing test. International Journal of Applied Agricultural Research 9(1), 1–8.

Almeida, A.D.S., Deuner, C., Borges, C.T., Meneghello, G.E., Tunes, L.M., Villela, F.A., 2014. Accelerated aging in tomato seeds. American Journal of Plant Science 5, 1651–1656.

Amjad, M., Anjum, M.A., 2002. Effect of relative humidity and ageing period on the quality of onion seed. International Journal of Agriculture & Biology 4(2), 291–96.

Anonymous, 2022. Brinjal Cultivation Guide. https:// discuss.farmnest.com/t/brinjal-cultivation-guide/22199.

Cheng, F., Wang, Y., Liu, X., Zhang, Z., Li, Q., Chen, Y., Huang, J., 2022. Antioxidant and anti-inflammatory potential of brinjal (*Solanum melongena*) bioactive compounds. Antioxidants 11(3), 578.

Choudhary, B., 1976. Vegetables (4th Edn.), National Book Trust, New Delhi, pp. 50-8.

Das, S., Gupta, P., Roy, S., Mukherjee, A., Banerjee, S., Chatterjee, S., Sengupta, A., 2022. Biofortification of brinjal for improved antioxidant activity and nutritional value. Plant Foods for Human Nutrition 77(5), 312-323.

Demirkaya, M., 2013. Relationships between antioxidant enzymes and physiological variations occur during ageing of pepper seeds. Horticulture Environment and Biotechnology 54(2), 97–102.

Deuner, Rodrigues, D.B., Tunes, L.V.M., Almeida, A.S., Suñe, A.S., Martins, A.B.N., Zimmer, G., Chagas, H., Gewehr, E., Konzen, L.H., Reis, B.B., 2018. Accelerated aging for the evaluation of the physiological potential of eggplant Seeds. Journal of Agricultural Science 10(8), 477–82.

Ghosh, M., Banerjee, A., Roy, D., Gupta, S., Chatterjee, P., Das, K., Sengupta, S., 2021. The role of ethylene in ripening and senescence of brinjal (*Solanum melongena*). Journal of Plant Growth Regulation 40(3), 1083–1097.

Gopalan, C., Rama Sastri, B.V., Balasubramanian, S., 2007. Nutritive Value of Indian Foods. National Institute of Nutrition(NIN), ICMR.

Iqbal, N., Basra, S.H.M.A., Rehman, K., 2002. Evaluation of vigour and oil quality in cottonseed during accelerated aging. International Journal of Agriculture & Biology 4, 318–22.

Jain, N., Koopar, R., Saxena, S., 2006. Effect of accelerated ageing on seeds of radish (*Raphanus sativas* L.). Asian Journal of Plant Sciences 5(3), 461–64.

Kaewnaree, P., Vichitphan, S., Klanrit, P., Siri, B., Vichitphan, K., 2011. Effect of accelerated aging process on seed quality and biochemical changes in sweet pepper (*Capsicum annuum* Linn.) seeds. Biotechnology 10(2), 175–182.

Kavak, S., Ilbi, H., Eser, B, 2008.Controlled deterioration test determines vigour and predicts field emergence in pepper seed lots. Seed Science and Technology 36, 456–61.

Keshavulu, K., Reddy, N.M., Rajeswari, B., Kumar, M.A., Ankaiah, R., 2012. Effect of seed vigour on field performance and seed yield of okra (*Abelmoschus esculentus* L.). International Journal of Bio-resource and Stress Management 3(1), 26–30.

Khan, M.M., Iqbal, M., Abbas, M., Raza, H., Waseem, R., Ali, A., 2004. Loss of vigour and viability in aged onion (*Allium cepa* L.) seeds. International Journal of Agriculture & Biology 6(4), 708–11.

Kumar, A., Singh, R., Sharma, P., Gupta, V., Yadav, S., Meena, M., Chauhan, R., 2022. Polyphenol oxidase activity and its relationship with browning in brinjal during post-harvest storage. Food Chemistry 374, 131775.

Kumar, R., Singh, V., Sharma, P., Meena, R., Gupta, A., Choudhary, S., Patel, D., 2020. Brinjal cultivation in tropical and subtropical regions: Challenges and strategies. Agriculture and Food Security 9(1), 1–10.

Kumar, S., Verma, R., Singh, M., Chauhan, N., Yadav, P., Sharma, R., Pandey, A. 2022a. Molecular markers and breeding techniques for improving brinjal yield and disease resistance. Journal of Plant Breeding and Genetics 25(2), 123–135.

Mishra, S., Patel, R., Singh, T., Gupta, N., Yadav, M., Sharma, V., Khan, A., 2023. Brinjal in the management of metabolic diseases: Current perspectives and future directions. Nutritional Research Reviews 36(1), 44–59.

Mosavi, N.S., Tilebeni, H.G., Sadeghi, M., Sedighi, E., 2011. Free fatty acid and electrical conductivity changes in cotton seed (*Gossypium hirsutum*) under seed deteriorating conditions. International Journal of AgriScience 1(2), 62–66.

Nanda, S., Rao, P., Mehta, K., Singh, R., Kumar, A., Sharma, D., Patel, V., 2021. Brinjal as a sustainable crop in integrated farming systems for enhancing soil health. Field Crops Research 255, 107860.

Nandhini, S., Ramesh, K., Gupta, P., Singh, V., Mehta, S., Sharma, A., Rao, P., 2023. Impact of storage conditions on post-harvest quality parameters and shelf life of brinjal. Agricultural and Food Chemistry 71(5), 1237–1245.

Nigam, M., Mishra, A.P., Salehi, B., Kumar, M., Sahrifi-Rad, M., Coviello, E., Sharifi-Rad, J., 2019. Accelerated ageing induces physiological and biochemical changes in tomato seeds involving MAPK pathways. Scientia Horticulturae 248, 20–28.

Nisha, Bhuker, A., Singh, N., Singh, G., Akash, Sourabh, Kumar, M., Kumar, A., 2023. Impact of different storage containers on seed quality parameters of eggplant (*Solanum melongena* L.) during storage. Indian Journal of Agricultural Sciences 93(9), 1032–36.

Panse, V.G., Sukhatme, P.V., 1978. Statistical methods for agricultural workers. ICAR Publication (III Ed.), New Delhi.

Parmoona, G., Moosavi, S.A., Siadat, S.A., 2018. Performance of Iranian okra ecotypes under various accelerated aging conditions. Horticultural Plant Journal 5(1), 17–23.

Pereira, M., Costa, R., Fernandes, L., Oliveira, P., Gomes, A., Santos, D., Almeida, J., 2022. The role of antioxidant compounds in the post-harvest quality of brinjal. Food Research International 146, 110530.

Rao, K. S., Singh, P., Yadav, R., Sharma, S., Kumar, M., Gupta, R., Verma, A., 2020. Brinjal farming systems: Sustainable approaches and challenges. Indian Journal of Agricultural Sciences 90(4), 764-771.

Sharma, P., Gupta, R., Singh, V., Yadav, N., Mehta, S., Chauhan, A., Kumar, R., 2022. Nutritional and culinary significance of brinjal: A comprehensive review. Journal of Food Science and Nutrition 73(2), 325–336. https://doi.org/10.1002/jsfa.11720.

Sharma, P., Verma, S., Gupta, R., Meena, A., Yadav, N., Singh, T., Patel, K., 2023. Impact of storage temperature on antioxidant loss and aging of brinjal. Food Chemistry 380, 132320.

Sharma, S., Gupta, R., Singh, V., Yadav, K., Meena, P., Chauhan, A., & Kumar, R., 2023a. Abiotic stress tolerance in brinjal: Genetic improvements and breeding perspectives. Environmental and Experimental Botany 186, 104424.

Singh, S., Kumar, R., Yadav, P., Sharma, V., Gupta, M., Chauhan, S., Mehta, A., 2021. Brinjal ripening and its impact on shelf life: Mechanisms and post-harvest interventions. International Journal of Food Science & Technology 56(4), 1703–1712.

Suryawanshi, A., Patil, R., Deshmukh, S., Kulkarni, P., Shinde, M., Pawar, V., Jadhav, N., 2023. Integrated pest management in brinjal: Innovative solutions for sustainable agriculture. Pest Management Science 79(7), 2754–2762.

Thakur, P., Singh, R., Gupta, M., Verma, A., Choudhary, S., Yadav, R., Kumar, P., 2021. Management of brinjal fruit and shoot borer: A critical review of recent advances. International Journal of Pest Management 67(2), 137–145.

Vijayalakshmi, V., Poonguzhali, S., Ramamoorthy, K., Natarajan, N., 2014. Physiology and biochemical changes in accelerated aged tomato (*Solanum lycopersicum* Mill.) seeds. Journal of Applied Horticulture 16(3), 241–244.