



Sesame (*Sesamum indicum* L.) Invigoration Through Organic Priming with Oil Cake Extracts

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ABSTRACT

Background: An environmentally responsible and sustainable method of improving seed quality characteristics in crops like sesame is seed priming with organic oil cake extracts. This technique encourages ecologically friendly agricultural methods for better crop establishment and productivity, efficiently uses natural resources and lessens reliance on chemical treatments by increasing germination rate, seedling growth and vigor.

Methods: The study aimed to identify the best oil cake extract and the ideal concentration for sesame cultivar TMV 7 seed priming. Groundnut, sesame, coconut, cotton and neem extracts were among the organic oil cake extracts that were tested at varying quantities. In order to determine the most effective natural priming agent for sesame cultivation, these treatments were evaluated for their capacity to improve seed germination, seedling growth, vigor and overall quality.

Result: When compared to hydroprimed and nonprimed seeds, the seeds primed with oil cake extracts showed greater percentages of seed quality parameters, such as vigour index, maximum dry matter production, longest root and shoot length, speed of germination and higher germination percentage. It was found that the ideal seed priming agent for sesame was 5% cotton oil cake extract.

Key words: Germination, Oil cake extract, Seed priming, Sesame, Vigour.

INTRODUCTION

Sesame (*Sesamum indicum* L.) believed to have originated from Tropical Africa, one of the important oilseed crops, which is gaining popularity due to its inevitable nutrient composition of its oil. It is widely cultivated and utilized all over the world due to the use of its seed as well as oil in food and medicine. But sesame crop found to have serious issues with seed germination, vigour and storage which should be addressed to enhance the production potential of this neglected crop (Yadav *et al.*, 2022; Sharma *et al.*, 2025). There are numerous presowing seed invigorating treatments, all of which are said to have a stimulating effect on improving the emergence, germination, field stand, growth, development and productivity of numerous crops (Shrestha *et al.*, 2021). Based on their origin and composition, oil cakes a significant by-product of the oil extraction industry are generally divided into edible and non-edible categories. Derived from seeds like groundnut, sesame and coconut that contain edible oils, edible oil cakes are frequently utilized to partially satisfy the nutritional needs of animal feed or, occasionally, human consumption (Singh *et al.*, 2022). Contrarily, non-edible oil cakes are made from seeds that contain harmful or unwanted ingredients, such as castor and neem, which renders them unfit for human consumption. Because of their high nutrient content, they are mostly used in industrial settings or as organic fertilizers (Mitra and Misra, 1967).

Around the world, groundnut oil cake has been a significant source of vegetable protein for animal diets. Between 43 and 48 percent crude protein is present in the solvent that is extracted from groundnut oil cake (Vichare

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et al., 2024). Although it lacks lysine, cysteine and methionine, it is a great source of arginine. Sesame oil

cake contains 40 per cent protein and 8 per cent crude fibre. The protein rich in arginine, leucine and methionine but low in lysine (Himabindhu *et al.*, 2023). A beneficial by-product that is high in protein, fat, fiber, vitamins and minerals is coconut oil cake. It is particularly abundant in arginine but lacking in amino acids such as lysine, methionine, threonine and histidine. In addition to having about 20% protein, it is a great source of dietary fiber and minerals including potassium and salt (Weerakoon *et al.*, 2024). Cotton oil cake is deficient in lysine, methionine, threonine and tryptophan but has roughly 40% protein and 11%-13% fiber. Neem oil cake is well known for its dual use as a natural insecticide and organic fertilizer. Its protein level ranges from 20% to 32%, depending on the hull portion. It is a crucial component of environmentally friendly and sustainable farming methods since it improves soil fertility and effectively controls pests (Abedini *et al.*, 2022).

The use of organic macro or micronutrient for seed priming has lately gained attention, as noted (Devi *et al.*, 2025). Typically, plants receive nutrients through foliar, fertigation, or soil treatments (Niu *et al.*, 2021), another way to prevent the hazards stated above is to apply nutrients as a seed treatment by seed priming and seed coating. The current study aims to concentrate on the applicability of oil cake extracts for seed priming in sesame seeds because there aren't many studies that use oil cake extract as a priming agent in seed invigorative investigations.

MATERIALS AND METHODS

Genetically pure sesame cultivar TMV 7 seeds, obtained from the Department of Oilseeds at Tamil Nadu Agricultural University (TNAU), Coimbatore, were used in this investigation. A local oil mill at Kalveerampalayam, Coimbatore, provided a variety of oil cakes, including cotton, neem, coconut, groundnut and sesame. The potential of these oil cakes as organic seed priming agents led to their selection. At the Department of Seed Science and Technology, TNAU, Coimbatore, characterisation of the collected oil cakes and sesame seeds was done in order to evaluate their chemical and physical characteristics. Their acceptability and effectiveness in seed priming treatments intended to improve the germination, vigour and general seed quality features of sesame under controlled laboratory conditions were determined based on this preliminary study.

In this experiment, the prepared oil cake extracts served as seed priming agents. Priming treatments included distilled water and the various oil cake extracts. Sesame seeds were soaked in an equal volume of the respective solutions for eight hours at room temperature, using oil cake extracts of different concentrations, before being evaluated for their effects on seed quality attributes. The oil cake extracts of sesame, groundnut, neem, coconut and cotton at concentrations of 5, 10, 15 and 20% were prepared using cold water by mixing the required quantity in 100 ml of distilled water and shaking intermittently every 30 minutes

for four to six hours. Following priming, the seeds were taken out of the solutions and allowed to air dry at room temperature until their moisture content returned to normal. To guarantee precise and trustworthy experimental results, four replications of a completely randomized block design (CRD) were used to assess the physiological characteristics of primed and non-primed seeds.

The rate of germination was determined by counting the number of seeds that sprouted each day. Using roll towel medium and four hundred seeds, the germination test was carried out in accordance with ISTA (2022)'s guidelines in a germination room that was kept at $25\pm2^{\circ}\text{C}$ and $95\pm3\%$ relative humidity. After six days, or the conclusion of the last count days for green grams, the seedlings were assessed. The following formula was used to determine the germination % based on normal seedlings and the mean was then reported as a percentage.

$$\text{Germination (\%)} = \frac{\text{Number of normal seedlings}}{\text{Total number of seeds sown}} \times 100$$

Ten normal seedlings were randomly chosen to measure the length of the seedlings' roots and shoots at the time of germination count. The chosen seedlings were stored in an oven set at 85°C for 24 hours and dried in the shade for another 24 hours. Following a 30-minute cooling time in a closed desiccator, the seedlings were weighed using a top pan balance and the mean was reported as milligrams of seedlings⁻¹⁰ (Gupta, 1993). Using the formula proposed by Abdula-Baki and Anderson (1973), the Vigour Index (VI) was computed and represented as a whole number.

$$\text{Vigour index} = \text{Germination (\%)} \times [\text{Root length (cm)} + \text{Shoot length (cm)}]$$

RESULTS AND DISCUSSION

A statistically significant difference in germination speed was observed between the priming treatments. The fastest germination rate (15.4) was obtained by seeds primed with 5% cotton oil cake extract, surpassing all other treatments. Seeds primed with 15% coconut oil cake extract and 20% groundnut oil cake extract came next, both of which accomplished a germination speed of 14.8% and followed by neem oil cake extract 10 %. On the other hand, non-primed seeds showed a significantly slower rate of germination (10.8), suggesting that some oil cake extracts had a beneficial effect on speeding up germination in sesame seeds (Table 1, 2, 4, 5 and 6).

The percentage of germination was significantly impacted by seed priming treatments. The highest germination rate of 84% was observed by seeds primed with 5% cotton oil cake extract, followed closely by seeds primed with 15% coconut oil cake extract, which produced an 83% germination rate and 82% was observed by seeds primed with neem oil cake extract 10%. In comparison to the control, other priming treatments also showed enhanced germination. Although non-primed seeds had the lowest germination rate (78%), it is evident that some

oil cake extracts, especially cotton oil cake at the right dosage, can significantly improve sesame seed germination over untreated seeds (Table 2, 4, 5 and 6).

The Root length of seedlings with priming treatments caused a statistically significant variation. The longest root length measured by seeds primed with 5% cotton oil cake extract was 12.28 cm, which was comparable to sesame oil cake extract 5% (11.34 cm) followed by neem oil cake

extract 10%. The nonprimed seeds had the shortest root length, measuring 7.24 cm (Table 3, 4, 5 and 6).

In sesame seedlings, priming treatments had a major impact on shoot length. Shoots from non-primed seeds were the shortest, growing to a length of 3.79 cm. On the other hand, seeds primed with 5% cotton oil cake extract outperformed all other treatments by recording the maximum shoot length of 5.16 cm. This was closely

Table 1: Standardization of priming with groundnut oil cake extract to improve sesame physiology parameters.

Priming treatments	Speed of germination	Germination (%)	Root length (cm)	Shoot length (cm)	Dry matter production (mg seedlings ⁻¹⁰)	Vigour index
Nonprimed seed	10.8	78 (62.03)	7.24	3.79	19.20	860
Hydropriming	13.2	80 (63.47)	9.24	4.33	22.60	1086
5%	13.3	76 (60.67)	10.78	4.95	26.10	1195
10%	13.0	78 (62.03)	10.77	4.82	25.60	1216
15%	13.9	80 (63.47)	10.35	4.7	26.30	1204
20%	14.8	81 (64.16)	11.24	5.06	27.80	1320
Mean	13.0	79 (62.73)	9.94	4.61	25.00	1147
SEd	0.150	0.876	0.096	0.046	0.348	16.450
CD (P =0.05)	0.315	1.840	0.202	0.097	0.732	34.561

Figures in parenthesis indicate arcsine transformed values.

Table 2: Standardization of priming for coconut oil cake extract to improve sesame physiology attributes.

Priming treatments	Speed of germination	Germination (%)	Root length (cm)	Shoot length (cm)	Dry matter production (mg seedlings ⁻¹⁰)	Vigour index
Nonprimed seed	10.8	78 (62.03)	7.24	3.79	19.20	860
Hydropriming	13.2	80 (63.47)	9.24	4.33	22.60	1086
5%	14.2	82 (64.90)	9.3	4.66	23.30	1145
10%	13.7	81 (64.16)	8.15	4.28	22.50	1007
15%	14.8	83 (65.65)	10.64	4.92	23.70	1291
20%	14.2	82 (64.90)	9.14	4.00	22.60	1077
Mean	13.5	81 (64.16)	8.95	4.33	22.32	1078
SEd	0.172	0.923	0.137	0.041	0.324	15.841
CD (P =0.05)	0.362	1.939	0.287	0.086	0.682	33.281

Figures in parenthesis indicate arcsine transformed values.

Table 3: Sesame oil cake extracts standardization and priming to improve sesame physiology characteristics.

Priming treatments	Speed of germination	Germination (%)	Root length (cm)	Shoot length (cm)	Dry matter production (mg seedlings ⁻¹⁰)	Vigour index
Nonprimed seed	10.8	78 (62.03)	7.24	3.79	19.2	860
Hydropriming	13.2	80 (63.47)	9.24	4.33	22.60	1086
5%	13.7	80 (63.47)	11.34	4.98	27.8	1306
10%	13.0	78 (62.03)	10.38	3.79	24.8	1105
15%	13.4	79 (62.73)	10.8	4.5	25.3	1209
20%	12.6	78 (62.03)	11.04	4.76	26.70	1232
Mean	12.8	79 (62.73)	10.01	4.36	24.40	1133
SEd	0.184	0.482	0.142	0.047	0.304	15.886
CD (P =0.05)	0.387	1.012	0.298	0.098	0.639	33.375

Figures in parenthesis indicate arcsine transformed values.

followed by seeds primed with 20% groundnut oil cake extract, which produced a shoot length of 5.06 cm. Seeds treated with 10% neem oil cake extract also showed a comparable response, recording a shoot length of 4.75 cm. In comparison to untreated seeds, the results demonstrate the beneficial effects of some oil cake extracts, especially

those from cotton and groundnut, in fostering superior shoot growth (Table 1, 4, 5 and 6).

The dry matter produced by the ten seedlings varied statistically significantly depending on the priming treatments. The seeds primed with 5% cotton oil cake extract produced the highest dry matter yield (28.20 mg

Table 4: Standardization of priming with cotton oil cake extract to improve sesame physiology traits.

Priming treatments	Speed of germination	Germination (%)	Root length (cm)	Shoot length (cm)	Dry matter production (mg seedlings ⁻¹⁰)	Vigour index
Nonprimed seed	10.8	78 (62.03)	7.24	3.79	19.20	860
Hydropriming	13.2	80 (63.47)	9.24	4.33	22.60	1086
5%	15.4	84 (66.42)	12.28	5.16	28.20	1465
10%	14.2	82 (64.90)	11.36	4.91	24.7.0	1334
15%	14.8	83 (65.65)	10.99	4.99	25.00	1326
20%	14.5	82 (64.90)	11.45	4.93	25.90	1343
Mean	13.8	82 (64.90)	10.43	4.69	24.27	1236
SEd	0.271	0.789	0.129	0.065	0.388	18.459
CD (P =0.05)	0.569	1.659	0.271	0.136	0.814	38.781

Figures in parenthesis indicate arcsine transformed values.

Table 5: Standardization of priming for neem oil cake extract to enhance sesame physiology characteristics.

Priming treatments	Speed of emergence	Germination (%)	Root length (cm)	Shoot length (cm)	Dry matter production (g seedlings ⁻¹⁰)	Vigour index
Nonprimed seed	10.8	78 (62.03)	7.24	3.79	19.20	860
Hydro Priming	13.2	80 (63.47)	9.24	4.33	22.60	1086
5%	11.6	78 (62.03)	8.38	4.59	23.10	1012
10%	12.5	82 (64.90)	9.02	4.75	23.70	1129
15%	12.4	82 (64.90)	8.17	4.38	22.10	1029
20%	12.0	80 (63.47)	8.93	4.65	22.00	1086
Mean	12.1	80 (63.47)	8.50	4.42	22.12	1034
SEd	0.169	1.098	0.134	0.064	0.306	12.215
CD (P = 0.05)	0.355	2.307	0.282	0.135	0.642	25.663

Figures in parenthesis indicate arcsine transformed values.

Table 6: Impact of seed priming in sesame using various oil cake extracts.

Priming treatments	Speed of emergence	Germination (%)	Root length (cm)	Shoot length (cm)	Dry matter production (g seedlings ⁻¹⁰)	Vigour index
Nonprimed seed	10.8	78 (62.03)	7.24	3.79	19.20	860
Hydropriming	13.2	80 (63.47)	9.24	4.33	22.60	1086
Oil cake extract	14.8	81 (64.16)	11.24	5.06	27.80	1320
Groundnut 20 %						
Sesame 5 %	13.7	80 (63.47)	11.34	4.98	27.8	1306
Coconut 15 %	14.8	83 (65.65)	10.64	4.92	23.7	1291
Cotton 5 %	15.4	84 (66.43)	12.28	5.16	28.2	1465
Neem 10 %	12.5	82 (64.90)	9.02	4.75	23.7	1129
Mean	13.6	81 (64.16)	10.14	4.71	24.71	1208
SEd	0.216	0.728	0.123	0.056	0.388	12.875
CD (P = 0.05)	0.450	1.513	0.256	0.116	0.807	26.775

Figures in parenthesis indicate arcsine transformed values.

seedlings⁻¹⁰). Their 20% groundnut oil cake extract and 5% sesame oil cake extract treatments produced 27.80 mg seedlings⁻¹⁰, respectively followed by neem oil cake extract 10 %. On the other hand, non-primed seeds produced the least amount of dry matter (19.20 mg seedlings⁻¹⁰), demonstrating the advantageous effect of particular oil cake extracts on the accumulation of biomass in seedlings (Table 1, 3, 4, 5 and 6).

There was a notable difference in the vigor index between the various priming regimens. The best seedling performance was shown by seeds primed with 5% cotton oil cake extract, which had the greatest vigour index of 1465. Seeds treated with 20% groundnut oil cake extract came next and they had a vigor index of 1320. The lowest vigour index, 860, was displayed by non-primed seeds, on the other hand, demonstrating the definite benefit of particular oil cake extract treatments in raising seedling vigour and overall establishing capability in sesame (Table 1, 4 and 6).

The current studies have examined the potential of these oil cake extracts as seed invigorates. In order to have a better understanding of how oil cake extracts can be used as a nutri-priming agent to improve seed characteristics like germination and vigor, the current research has been carried out. Evaluation of oil cake extracts' effectiveness as a nutrient and seed priming agent for various agricultural seeds in order to improve their seed quality qualities was the goal of the current study. In general, the proximate composition of oil cakes includes amino acids, macro and micro nutrients along with crude protein and fibre (Kaur *et al.*, 2021). The presence of plant essential primary/major and micro nutrient in different edible and non-edible oil cakes were conformed by Siva Sankari *et al.* (2022).

Oil cake extracts are known to have a high nutrient content and to improve plant growth and productivity when applied to soil as manure (Ngone *et al.*, 2023; Singh *et al.*,

2015). However, their use as seed priming agents to improve seed germination and vigor is a new area of study in seed science. Since germination and vigor are important aspects of seed quality that ultimately leads to increased crop development and production (Basu and Groot, 2023). This study investigates the potential of oil cake extracts as seed-invigorating nutrients (Manonmani *et al.*, 2023). Plant growth and productivity have also been demonstrated to be enhanced by nutrient-based priming were reported by (Dadlani, 2025; Vanitha and Kathiravan, 2022).

The extracts of the previously stated oil cakes were used in seed priming tests at concentrations of 5%, 10%, 15% and 20%. Among these, the crop seeds assessed in this study showed the highest germination percentages and seedling vigor. These included groundnut oil cake extract at 20%, sesame at 5%, coconut at 15%, cotton at 5% and neem at 10%. Seed priming causes a number of metabolic and repair processes, including alterations in tissue morphology, to occur during the lag phase of seed germination, which occurs prior to the start of active growth (Corbineau *et al.*, 2023). Repair systems that deal with damage to proteins, RNA, DNA, or cellular membranes may be activated during these processes. In particular, DNA repair has been demonstrated to start minutes after dry seeds or embryos absorb water. It can also happen when there is a shortage of water (Musson *et al.*, 2022). The nutrients found in oilseed cake extracts in this study most likely aided in these repair processes, increasing the sesame seeds vigor.

The improvement in quality aspects (seeds) viz., emergence of speed, root and shoot length, germination, vigour index and dry matter production was observed in seeds primed with cotton oil cake 5% for sesame (42.6, 7.7, 69.6, 36.1, 46.8 and 70.3 %, respectively) (Table 6 and Fig 1). The ability of seeds to quickly absorb water, reactivate metabolic processes and start germination is improved by

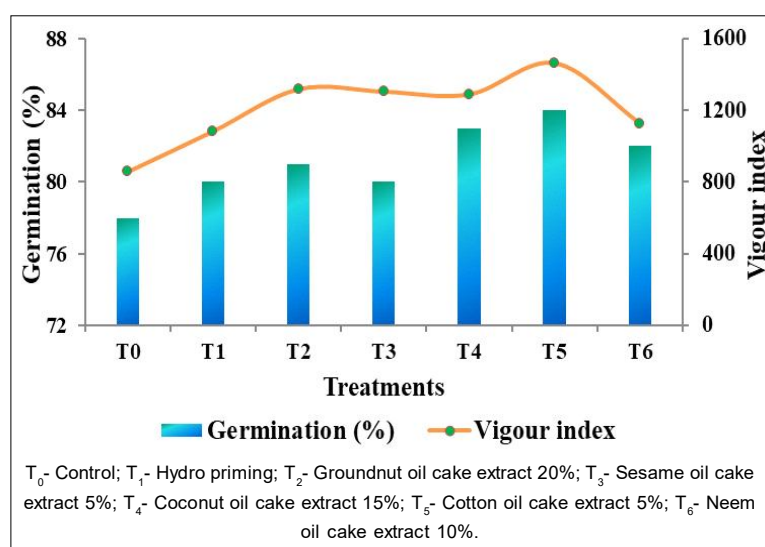


Fig 1: Seed priming's impact on sesame vigour index and germination rate (%).

priming them with different oil cake extracts (Corbineau *et al.*, 2023). This improvement can be ascribed to the abundance of nutrients found in the extracts, including proteins, carbohydrates, phosphorus, potassium, nitrogen, antioxidants, vitamins and minerals (Reddy *et al.*, 2025). These nutrients also probably help to improve seed quality traits like germination and crop vigor potential.

CONCLUSION

From the current study, priming sesame seeds with different oilseed cake extracts greatly improves the metrics related to seed quality. Outperforming the other treatments and non-primed seeds, the cotton oil cake extract at 5% concentration produced the highest values for emergence speed, germination percentage, seedling length, dry matter accumulation and vigor index among the treatments. The presence of extra nutrients that promote metabolic activity during germination is probably the cause of this enhancement. The results unequivocally show that 5% cotton oil cake extract works well as a green gram seed priming agent.

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Disclaimers

The views and conclusions expressed in this article are solely those of the authors and do not necessarily represent the views of their affiliated institutions. The authors are responsible for the accuracy and completeness of the information provided, but do not accept any liability for any direct or indirect losses resulting from the use of this content.

Informed consent

All animal procedures for experiments were approved by the Committee of Experimental Animal care and handling techniques were approved by the University of Animal Care Committee.

Conflict of interest

The authors declare that there are no conflicts of interest regarding the publication of this article. No funding or sponsorship influenced the design of the study, data collection, analysis, decision to publish, or preparation of the manuscript.

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