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Effect of Orgo-nutri Priming on the Germination and Seedling Traits of Groundnut (*Arachis hypogaea* L.)

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ABSTRACT

Background: The goal of the current study was to ascertain how well oil cake extracts functioned as nutrient source and seed priming agent for groundnut seeds in order to improve their seed quality attributes. Experiments were conducted on cv. CO 7 variety of groundnut to determine the best oil cake extracts and concentrations for seed priming.

Methods: For the experiment, seed priming agents were groundnut, sesame, coconut, cotton and neem extracts from oil cakes. The various concentrations of each oil cake extract, namely 5, 10, 15 and 20%, were made and used to treat seeds with oil cake extracts at their ideal concentration.

Result: The seeds pre-treated with oil cake extracts had improved seed quality, including faster germination, higher germination rates, the longest root and shoot lengths, the highest levels of dry matter production and a higher vigour index. The most effective groundnut seed priming agent was found to be 20% groundnut oil cake extract. Hence, the groundnut oil cake produced as a farm byproduct can be successfully used to increase the vigour of the seedlings, simplifying the recycling of agricultural products.

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

INTRODUCTION

There are several presowing seed vigoring procedures and each one is said to have a vigour-enhancing impact for promoting crop germination, emergence, field stand, growth, development and productivity. Seed priming is a pre-sowing technique that boosts seedling establishment, germination rate and plant performance by regulating pre-germination metabolic activity before the radicle appears (Singh *et al*., 2015). Radicle emergence is not allowed, however priming makes it possible for seed hydration to begin at the early phases of germination, then the moisture content is restored to its original level (Waqas *et al*., 2019). Some research suggests that seed priming promotes early protein, RNA and DNA synthesis, enhances embryo growth, repairs damaged seed components and reduces metabolite leakage (Johnson and Puthur, 2021).

Oil cakes are major waste product in the edible oil industry after oil extraction. Oil cake production is anticipated to increase at an average annual rate of 2.3% throughout the ten years leading up to 2010. India is a significant producer of oilseeds worldwide (Ramachandran *et al*., 2007). These nutrient-rich oil cakes, which have mostly been fed to cattle, include proteins, carbs, antioxidants, vitamins and minerals (Sunil *et al*., 2015).

Rehman *et al*. (2012) claims that the use of macro or micronutrient-enriched seeds is the current focus of seed priming with organic nutrients. Normally, nutrients are sprayed onto plant leaves, fertigated into the soil, or applied to the soil (Elbagory, 2018). Using nutrients as a seed treatment through seed coating and seed priming is another option that reduces the risks mentioned above (Afzal *et al*., 2020). The use of seeds that have been treated with micronutrients has been recommended as a more efficient way to address micronutrient shortages (seed priming). When seeds are primed with micronutrients, they may swiftly absorb water, restart metabolism and start germination. improved stand establishment, enhanced resistance to pests and drought and eventually higher yield (Vanitha and Kathiravan, 2022). So, the oilseed's nutritional value.

The *Arachis hypogaea* L., sometimes known as ground nut or peanut, is a significant rainfed crop in Asia and Africa. To fulfil the rising demand for its seeds, which contain 40-50% oil, 20-30% proteins, vitamins and mineral sources, this crop's supply needs be expanded (Bhuva *et al*., 2017). The pod yields of this crop are largely determined by the initial seedling vigour, with the soil's nutritional state and crop stand playing a significant role.

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Groundnut seedling characteristics were found to be positively impacted by the priming with several agents, including bacteria (Subba and Mathur, 2022). The current study intended to concentrate on the applicability of oil cake extracts for seed priming in groundnuts because seed invigorative investigations employing oil cake extract as a priming agent were not conducted.

MATERIALS AND METHODS

The Department of Oilseeds at the Tamil Nadu Agricultural University in Coimbatore provided the genetically pure CO7 variety groundnut seeds used in the current experiment. The oil mill in Kalveerampalayam, Coimbatore, provided groundnut, sesame, coconut, cotton and neem oil cakes. The laboratory tests were carried out at Tamil Nadu Agricultural University, Coimbatore between 2020 and 2021 at the Department of Seed Science and Technology.

The cold-water extract of oil cakes, such as groundnut, sesame, coconut, cotton and neem, was made by putting 5, 10, 15 and 20 g of dried seed cake in 100 ml of distilled water. The mixture was then allowed to sediment for 4-6 hours while being shaken periodically every 30 minutes. The oil cake extracts were then filtered using muslin cloth or fine mesh (Terpinc *et al*., 2012). The present experiment was carried out using those oil cake extracts as priming agents. Water and different oil cake extracts, including groundnut, sesame, coconut, cotton and neem, were used as priming treatments. The treated seeds are soaked for 8 hours at room temperature with varied concentrations of oil cake extracts (Viji, 2018).

To retain the original moisture content of primed seeds they are removed from the extract solutions and shade dried at room temperature. The physiological characteristics of the unprimed and primed seeds were compared. The four replications of the experiment were carried out using a completely randomized block design.

The number of seeds germinated on each consecutive day and the germination rate is determined for calculations (Maguire, 1962). Based on the ISTA (2012), a germination test is conducted with 400 seeds as 4 × 100 seeds per roll towel medium maintained at 25±2°C and 95±5% RH. On the final count day, the number of seedlings is assessed. The germination % was estimated using the following formula based on normal seedlings and the mean was expressed as a percentage.

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

To measure the root and shoot lengths, ten healthy seedlings were randomly selected among the seedlings present at the time of the germination count. These selected seedlings were then dried in the shade for 24 hours and then maintained in an oven set at 85°C for 24 hours. After the drying process, the seedlings were weighed in a top pan balance and chilled in a closed desiccator for 30 minutes (Gupta, 1993), G seedlings-10 was used to represent the mean value. The vigor index (VI), which was then expressed as a whole number, was calculated using the Abdul-Baki and Anderson (1973) method.

Vigour index =
Germination (%) × [Root length (cm) + Shoot length (cm)]

RESULTS AND DISCUSSION

The priming treatments had a considerable impact on the rate of germination. The quickest rate of germination observed in seeds primed was recorded with groundnut oil cake extract 20% (6.5), followed by seeds primed with coconut oil cake extract 15% (6.4), whereas unprimed seeds took longer to germinate (5.8) (Table 1, 3 and 6). Seeds primed with sesame oil cake extracts recorded the lowest germination percentage and vigour index when compared to seeds primed with water (hydropriming) (Table 2).

The variations in root length were significantly influenced by the priming treatments. The largest root length was 14.41 cm in seeds primed with 20% groundnut oil cake extract, followed by 15% coconut oil cake extract (13.75 cm) The non-primed seeds performed the worst, as evidenced by their shortest root length (10.09 cm) (Table 1, 3 and 6).

Table 1: Standardization of seed priming with groundnut oil cake extract on physiological traits in groundnut.

Priming treatments	Speed of germination	Germination (%)	Root length (cm)	Shoot length (cm)	Dry matter production (g seedlings^{-10})	Vigour index
Nonprimed seed	5.8	69 (56.17)	10.09	10.35	1.969	1410
Hydropriming	6.0	72 (58.05)	12.22	12.48	2.319	1778
5%	6.1	72 (58.05)	11.9	12.07	2.382	1726
10%	6.2	72 (58.05)	10.85	13.22	2.398	1733
15%	6.0	70 (56.79)	12.35	13.37	2.404	1800
20%	6.5	74 (59.34)	14.41	15.76	2.758	2233
Mean	6.1	72 (58.05)	11.97	12.88	2.372	1780
SEd	0.098	0.639	0.153	0.190	0.017	28.490
CD (P=0.05)	0.205	1.343	0.322	0.398	0.035	59.856

Groundnut oil cake extract- 5, 10, 15 and 20%.

(Figures in parenthesis indicate arcsine transformed values).

Significant differences in root length between priming treatments were noticed. Seeds primed with groundnut oil cake extract 20% recorded the largest shoot length of 15.76 cm, followed by seeds primed with coconut oil cake extract 15%. Non-primed seeds performed poorly, recording the least shoot length of 10.35 cm (14.52 cm) (Table 1, 3 and 6).

The priming treatment resulted in significant dry matter production, which was observed in 10 seedlings. Among the treatments, priming with groundnut oil cake extract recorded the highest dry matter production of 2.758 g seedlings^{-10} followed by seeds primed with coconut oil cake extract 15% and neem oil cake extract 10% (2.633 g seedlings^{-10}).

Table 2: Standardization of seed priming with sesame oil cake extract on physiological traits in groundnut.

Priming treatments	Speed of germination	Germination (%)	Root length (cm)	Shoot length (cm)	Dry matter production (g seedlings^{-10})	Vigour index
Nonprimed seed	5.8	69 (56.17)	10.09	10.35	1.969	1410
Hydropriming	6.0	72 (58.05)	12.22	12.48	2.319	1778
5%	6.3	70 (56.79)	11.35	13.95	2.585	1771
10%	6.1	71 (57.42)	10.81	12.05	2.437	1623
15%	6.0	69 (56.17)	10.28	12.41	2.261	1566
20%	6.2	68 (55.55)	10.14	12.12	2.563	1514
Mean	6.1	70 (56.79)	10.815	12.23	2.356	1610
SEd	0.069	0.593	0.122	0.164	0.020	14.568
CD (P =0.05)	0.144	1.245	0.256	0.345	0.041	30.608

Sesame oil cake extract- 5, 10, 15 and 20%.

(Figures in parenthesis indicate arcsine transformed values).

Table 3: Standardization of seed priming with coconut oil cake extract on physiological traits in groundnut.

Priming treatments	Speed of germination	Germination (%)	Root length (cm)	Shoot length (cm)	Dry matter production (g seedlings^{-10})	Vigour index
Nonprimed seed	5.8	69 (56.17)	10.09	10.35	1.969	1410
Hydropriming	6.0	72 (58.05)	12.22	12.48	2.319	1778
5%	6.1	72 (58.05)	12.49	12.08	2.431	1769
10%	6.2	70 (56.79)	12.61	13.23	2.272	1809
15%	6.4	73 (58.70)	13.75	14.52	2.633	2064
20%	6.3	72 (58.05)	12.06	11.9	2.514	1725
Mean	6.1	71 (57.42)	12.20	12.43	2.356	1759
SEd	0.082	0.297	0.188	0.184	0.035	25.282
CD (P =0.05)	0.172	0.623	0.395	0.387	0.073	53.117

Coconut oil cake extract- 5, 10, 15 and 20%.

(Figures in parenthesis indicate arcsine transformed values).

Table 4: Standardization of seed priming with cotton oil cake extract on physiological traits in groundnut.

Priming treatments	Speed of germination	Germination (%)	Root length (cm)	Shoot length (cm)	Dry matter production (g seedlings^{-10})	Vigour index
Nonprimed seed	5.8	69 (56.17)	10.09	10.35	1.969	1410
Hydropriming	6.0	72 (58.05)	12.22	12.48	2.319	1778
5%	6.2	72 (58.05)	12.93	13.45	2.504	1899
10%	5.9	70 (56.79)	11.9	12.07	2.398	1678
15%	5.8	70 (56.79)	10.85	11.22	2.458	1545
20%	6.1	71 (57.41)	10.22	12.48	2.382	1612
Mean	6.0	71 (57.41)	11.37	12.01	2.338	1654
SEd	0.077	0.515	0.157	0.174	0.038	27.684
CD (P =0.05)	0.161	1.083	0.330	0.366	0.080	58.163

Cotton oil cake extract- 5, 10, 15 and 20%.

(Figures in parenthesis indicate arcsine transformed values).

Non-primedimed seeds recorded the lowest dry matter production of 1.969 g seedlings^{-10} (Table 1, 3, 5 and 6).

The variation for the vigour index was found to be significant for priming treatments. Among the priming treatments, seeds primed with 20% groundnut oil cake extract had the highest vigour index (2233), followed by seeds primed with 15% coconut oil cake extract (2064). Nonprimed seeds had the lowest vigour index of 1410 (Table 1, 3, 4 and 6).

The current study aims to evaluate the effectiveness of oil cake extracts as a seed priming agent and nutrient for treating various agricultural seeds in order to improve their seed quality traits. The following oil cakes are used in this study: groundnut, sesame, coconut, cotton and neem. In general, oil cakes contain amino acids, as well as crude protein and crude fibre (Sunil *et al*., 2015). Siva Sankari *et al.* (2022) reported that macro and micronutrients are present in various edible and non-edible oil cakes.

Despite the fact that the nutrient content of oil cake extracts and their effect on plant growth and productivity via soil application as manure is well established, the invigorating effect of oil cake extracts on seed germination and vigour potential as seed priming agent is the first attempt in seed science research. As a result, efforts are being made to investigate the effect of oil cake extracts as seed invigorating nutrients for improving seed quality attributes such as germination and vigour, which ultimately lead to the growth and yield of various crops such as brinjal (Som *et al*., 1992) and pearl millet (Patel, 1993). Plant growth and productivity are also improved by priming with nutrient solutions. Poovarasan *et al.* (2019) reported similar findings.

The current study found that groundnut oil cake extract 20% outperformed other treatments in terms of emergence speed, root and shoot length and dry matter production over non primed seeds (12.1, 39.6, 40.0 and 31.0%, respectively).

Groundnut oil cake extracts 20% outperformed other treatments in terms of germination and vigor index over non primed seeds (7.2 and 58.3%, respectively) (Fig 1). Groundnut oil cake is a significant source of vegetable protein in animal diets worldwide. The crude protein content of the solvent extracted from groundnut oil cake ranges between 43 and 48%. It is a good source of arginine but lacking in lysine, cysteine and methionine (Asghar *et al*., 2014).

Table 5: Standardization of seed priming with neem oil cake extract on physiological traits in groundnut.

Priming treatments	Speed of germination	Germination (%)	Root length (cm)	Shoot length (cm)	Dry matter production (g seedlings^{-10})	Vigour index
Nonprimed seed	5.8	69 (56.17)	10.09	10.35	1.969	1410
Hydropriming	6.0	72 (58.05)	12.22	12.48	2.319	1778
5%	5.9	70 (56.79)	10.61	12.23	2.272	1599
10%	6.1	71 (57.42)	12.68	13.08	2.633	1829
15%	6.0	70 (56.79)	11.12	11.52	2.431	1585
20%	5.7	68 (55.55)	11.01	11.9	2.614	1558
Mean	5.9	70 (56.79)	11.29	11.93	2.373	1627
SEd	0.070	0.631	0.127	0.183	0.046	21.408
CD (P = 0.05)	0.148	1.327	0.266	0.383	0.096	44.977

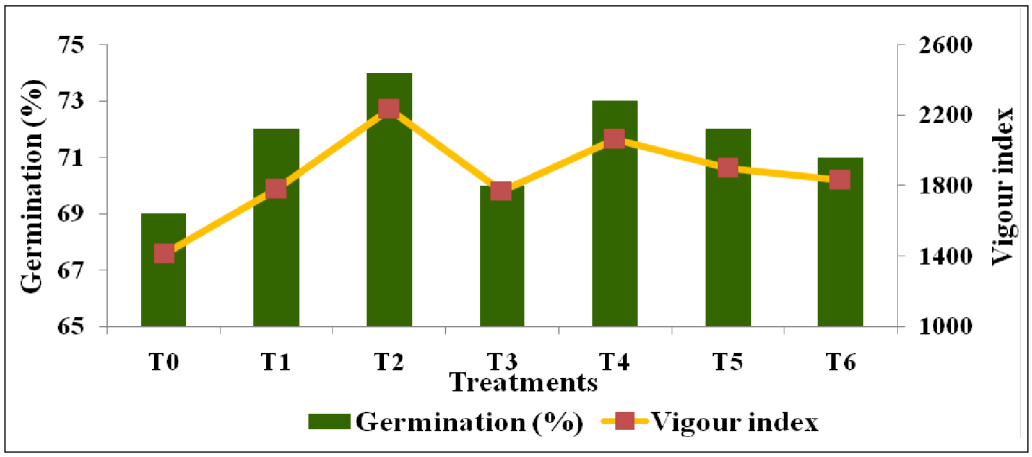
Neem oil cake extract- 5, 10, 15 and 20%.

(Figures in parenthesis indicate arcsine transformed values).

Table 6: Influence of seed priming with different oil cake extracts in groundnut.

Priming treatments		Speed of germination	Root length (cm)	Shoot length (cm)	Dry matter production (g seedlings^{-10})
Nonprimed seed		5.8	10.09	10.35	1.969
Hydropriming		6.0	12.22	12.48	2.319
Oil cake extract					
Groundnut	20%	6.5	14.41	15.76	2.758
Sesame	5%	6.3	11.35	13.95	2.585
Coconut	15%	6.4	13.75	14.52	2.633
Cotton	5%	6.2	12.93	13.45	2.504
Neem	10%	6.1	12.68	13.08	2.633
Mean		6.2	12.49	13.37	2.486
SEd		0.112	0.143	0.109	0.034
CD (P = 0.05)		0.232	0.298	0.227	0.070

(Figures in parenthesis indicate arcsine transformed values).



T_0 - Control; T_1- Hydro priming; T_2- Groundnut oil cake extract 20%; T_3- Sesame oil cake extract 5%; T_4- Coconut oil cake extract 15%; T_5- Cotton oil cake extract 5%; T_6- Neem oil cake extract 10%;

Fig 1: Seed priming influence on germination (%) and vigour index of groundnut.

Priming the seeds with various oil cake extracts allows them to quickly absorb water and reactivate metabolism and germination (N, P, K, protein, carbohydrates, antioxidants, vitamins and minerals), which may be the reason for the improvement of seed quality attributes of seed germination and crop vigour potential.

The improved germination caused by priming may be due to increased repair of the membrane, which is damaged during maturation drying. Because electrolyte leakage is caused in part by damaged cell membranes, the reduced leakage of electrolytes from primed seeds provides indirect support for this theory. However, electrolytes may leak out during priming, resulting in primed seeds with lower electrolyte levels than control seeds (Gour *et al*., 2019).

CONCLUSION

The findings of this study indicated that priming groundnut seeds with various oil seed cakes could significantly improve seed quality measures. Groundnut oil cake at 20% had the highest rates of emergence, germination, seedling length, dry matter production and vigour index when compared to other treatments and unprimed seeds. This could be due to the presence of additional nutrients, which can boost metabolic processes during germination. It was also demonstrated that groundnut oil cake 20% can be used effectively as a seed priming treatment for groundnut seeds. It can also be a good way to recycle farm products and use the groundnut oil seed cake to improve the nutrient status of the seed in the next crop.

Conflict of interest: None.

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