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GERMINATION ENHANCEMENT IN GREEN GRAM (*Vigna radiata* L.) BY PRIMING WITH OIL CAKE EXTRACTS

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ABSTRACT

The present study was aimed to evaluate the efficacy of some oil cake extracts as seed priming agent and nutrient source to improve the seed quality attributes. Studies were conducted on green gram cv. 'CO 8' to identify the suitable oil cake extracts and optimize the concentration of oil cake extracts for seed priming. The extracts of oil cakes *viz.*, groundnut, sesame, coconut, cotton and neem were evaluated using variable concentrations i.e. 5, 10, 15 and 20%. The seeds primed with oil cake extracts increased seed quality attributes *viz.*, speed of germination, germination percentage, root and shoot length, dry matter production and vigour index as compared to the hydro- and non-primed seeds. The extract of coconut oil cake (15%) was identified as the best suitable seed priming agent for green gram.

Keywords: Germination; green gram; oil cake extracts; seed priming

INTRODUCTION

Green gram [*Vigna radiata* (L.) Wilczek] is one of the extensively grown pulse in India and the country contributes 70% of the world-wide green gram production (Indiastat, 2020). It is rich in nutrients, especially easily digestible proteins, so can substitute animal protein in a balanced diet. Pre-sowing seed priming reportedly have invigourative effect in enhancing seed germination, emergence, field stand, growth, development and productivity of many crops (Farooq *et al.*, 2009; Sharma *et al.*, 2020). Seed priming is a pre-sowing strategy to improve seed germination and seedling establishment by modulating pre-germination metabolic activity prior to the emergence of radicle (Ghassemi-Golezani *et al.*, 2008). Priming allows seed hydration, thereby initiates the early events of germination, but does not permit radicle emergence (Ashraf and Foolad, 2005). Seed priming permits early DNA replication, increases RNA and protein synthesis, enhances embryo growth, repairs deteriorated seed parts and reduces leakage of metabolites (Mcdonald, 2000).

Organic amendment with oil cakes to soil have successfully been employed to recycle valuable sources of macro- and micro-nutrients. Oil cakes are major byproducts of edible oil industries obtained after oil extraction. Annual average growth in oil cake production is projected to be 2.3% over a decade. India is one of the world's leading oilseed producers (Ramachandran *et al*., 2007). These oil cakes are mainly used as feed for cattle and are rich in nutrients like proteins, carbohydrates, antioxidants, vitamins and minerals (Pandey *et al*., 2000; Sunil *et al.*, 2015). The economic benefits might be improved by using oil cakes as seed treatments (Ramesh and Gowda, 2009).

Seed priming with organic nutrients is practiced by using macro- or micro-nutrient enrichment of seeds (Mirshekari *et al.*, 2012; Rehman *et al.*, 2012). Generally nutrients are delivered to the plants as

soil applications, fertigation or foliar spray (Johnson *et al.*, 2005; Roberts, 2008). Applying nutrients as seed treatment, through seed coating and seed priming avoids the risks of nutrient loss (Farooq *et al.*, 2012). The seed priming reportedly overcomes micronutrient deficiencies and helps the plant to rapidly imbibe water and revive metabolism and germination. This results in higher seed germination, improves stand establishment, increases drought and pest tolerance and ultimately leads to higher yields (Rowse, 1996; Harris *et al.*, 1999). The nutrients in oilseed cakes can be effectively utilized by plant as a nutrient source during critical stage of germination (Abdelhamid *et al*., 2014). In present study several oil cake-extracts have been evaluated as priming agent in green gram.

MATERIALS AND METHODS

Genetically pure seeds of green gram cv. 'CO 8' were procured from the Department of Pulses, TNAU, Coimbatore (India). Oil cakes were obtained from an oil mill in Kalveerampalayam, Coimbatore (India). Laboratory studies were conducted in the Department of Seed Science and Technology, TNAU, Coimbatore. Water extract of oil cakes *viz*., groundnut, sesame, coconut, cotton and neem, each in 5, 10, 15 and 20% concentration, were prepared by dispensing 5, 10, 15 and 20 g dried seed cake in 100 mL distilled water and kept as such for 4-6 h with intermittent shaking after every 30 min. Oil cake extracts, filtered through fine mesh or muslin cloth, were used as priming agents. Control treatments, treated with water alone (hydro-priming) and without any treatment (non-primed) were also maintained. The crop seeds, as per treatment, were soaked in equal volume of oil cake extracts for 3 h under ambient conditions (Viji and Manonmani, 2018). After priming, the seeds were shade-dried at room temperature to bring it back to its original moisture content (Gupta, 1993). The experiment was carried out in a completely randomized block design with each treatment replicated four times. The primed and non-primed seeds were evaluated for various physiological parameters. The number of seeds germinated on each day was counted and the speed of germination calculated. Germination test was performed in a germination room maintained at 25 ± 2°C and 95 ± 3% RH on 400 seeds using roll towel medium (ISTA, 2012). The number of normal seedlings was counted after 8 days. The germination percentage was calculated as per the following formula:

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

For germination count, ten normal seedlings were randomly selected and their root and shoot length measured. The seedlings were dried under shade for 24 h and then kept in an oven maintained at 85°C for 24 h. After drying, the seedlings were cooled in a closed desiccator for 30 min and weighed in a top pan balance and the values expressed as mg 10 seedling^{-1}. Vigour index was calculated as per Abdul-Baki and Anderson (1973) and expressed as a whole number.

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

The data was analyzed statistically as per Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

The biopriming with the extracts of oil cakes *viz*., groundnut, sesame, coconut, cotton and neem significantly affected the speed of germination (Table 1-6). The seeds primed with 15% coconut oil cake extract exhibited maximum speed of germination (4.6) which was at par with neem oil cake extract 10% (4.5). The speed of germination of non-primed seeds was slow (3.6). Generally, seed germination entails three distinct phases i) imbibition, ii) lag phase and iii) radicle growth and emergence. The purpose of priming is to prolong the lag phase which allows some pre-germinative physiological and biochemical processes to take place but prevents germination (Bradford, 1986). Among the various priming treatments, the seeds primed with coconut oil cake extract @ 15 and 20%

recorded maximum germination (93%); however, it was at par with groundnut oil cake extract. The poor germination was noticed in non-primed seeds (88%). Coconut oil cake is rich in nutrients like proteins, fats, vitamins and minerals which might be the reason for increase in seed germination and seedling vigour observed in pulses and maize due to seed priming with coconut oil cake extract (Saittagaroon *et al.*, 1983; Viji and Manonmani, 2018). The seed priming with sesame oil cake extract also enhanced early germination, root and shoot length and vigour index. Similar results of higher germination and improvement in other seed quality parameters have been reported by Chavan *et al.* (2014) and Parmar *et al.* (2016) in soybean and custard apple, respectively.

Table 1: Effect of seed priming with groundnut oil cake extract on physiological traits of green gram

Priming treatments	Speed of germination	Germination (%)	Root length (cm)	Shoot length (cm)	Dry matter production (mg 10 seedling^{-1})	Vigour Index
Non-primed seed	3.6	88 (69.73)	18.23	16.5	181.8	3056
Hydro-priming	4.3	90 (71.57)	20.04	17.55	196.8	3383
Groundnut oil cake						
5%	3.8	92 (73.57)	22.41	17.88	175.4	3707
10%	4.2	90 (71.57)	21.59	17.73	184.6	3539
15%	4.0	92 (73.57)	22.00	18.29	207.6	3707
20%	4.3	93 (74.66)	21.49	18.88	224.4	3754
Mean	4.0	91 (72.54)	20.96	17.81	195.1	3524
SE+	0.037	1.166	0.404	0.267	2.689	24.364
$CD_{0.05}$	0.08	2.449	0.849	0.560	5.649	51.188

The figures in parenthesis indicate arcsine transformed values; ** Non-primed seed – without soaking in water (control seed). Hydro-priming – soaking in water

Table 2: Effect of seed priming with sesame oil cake extract on physiological traits in green gram

Priming treatments	Speed of germination	Germination (%)	Root length (cm)	Shoot length (cm)	Dry matter production (mg 10 seedling^{-1})	Vigour Index
Non-primed seed	3.6	88 (69.73)	18.23	16.5	181.8	3056
Hydro-priming	4.3	90 (71.57)	20.04	17.55	196.8	3383
Sesame oil cake extract						
5%	4.4	92 (73.57)	21.84	18.93	202.9	3751
10%	4.2	91 (72.54)	20.24	17.48	195.4	3433
15%	4.3	91 (72.54)	21.1	17.21	196.8	3486
20%	4.0	90 (71.57)	19.29	18.03	181.3	3359
Mean	4.1	90 (71.57)	20.12	17.62	192.5	3411
SE+	0.070	1.037	0.336	0.206	1.977	38.072
$CD_{0.05}$	0.148	2.179	0.705	0.433	4.153	79.986

The figures in parenthesis indicate arcsine transformed values

Table 3: Effect of seed priming with coconut oil cake extract on physiological traits in green gram

Priming treatments	Speed of germination	Germination (%)	Root length (cm)	Shoot length (cm)	Dry matter production (mg 10 seedling $^{-1}$)	Vigour index
Non-primed seed	3.6	88 (69.73)	18.23	16.50	181.8	3056
Hydro-priming	4.3	90 (71.57)	20.04	17.55	196.8	3383
Coconut oil cake extract						
5%	4.5	90 (71.57)	21.63	18.03	204.6	3569
10%	4.1	92 (73.57)	21.70	17.55	208.7	3611
15%	4.6	93 (74.66)	22.27	19.90	242.5	3922
20%	4.4	91 (72.54)	20.53	17.37	220.8	3449
Mean	4.3	91 (72.54)	20.73	17.82	209.2	3498
SE+	0.059	0.601	0.287	0.261	3.395	44.367
$CD_{0.05}$	0.124	1.262	0.603	0.549	7.134	93.212

The figures in parenthesis indicate arcsine transformed values

Priming treatments significantly influenced both root and shoot length. The seeds primed with coconut oil cake extract @ 15% registered longest root length of 22.27 cm which was at par with sesame oil cake extract 5% (21.84 cm), whereas the non-primed seeds had shorter roots of 18.23 cm length (Table 1-6). The seeds primed with cotton oil cake extract @ 5% had longest shoot length of 19.98 cm which was at par with coconut oil cake extract @ 15% (19.9 cm); whereas non-primed seeds recorded shortest shoot length of 16.5 cm (Table 6). The improvement in germination and seedling length by priming might be due to enhanced repair of membrane which is disrupted during

Table 4: Effect of seed priming with cotton oil cake extract on physiological traits in green gram

Priming treatments	Speed of germination	Germination (%)	Root length (cm)	Shoot length (cm)	Dry matter production (mg 10 seedling^{-1})	Vigour index
Non-primed seed	3.6	88 (69.73)	18.23	16.5	181.8	3056
Hydro-priming	4.3	90 (71.57)	20.04	17.55	196.8	3383
Cotton oil cake extract						
5%	4.4	91 (72.54)	18.71	19.98	224.4	3521
10%	4.0	90 (71.57)	18.68	18.45	200.8	3342
15%	4.2	89 (70.63)	19.31	19.45	218.9	3450
20%	4.3	89 (70.63)	19.03	19.23	214.5	3405
Mean	4.1	90 (71.57)	19.00	18.53	206.2	3359
SE+	0.071	0.859	0.252	0.262	3.015	59.234
$CD_{0.05}$	0.150	1.806	0.528	0.550	6.335	124.447

The figures in parenthesis indicate arcsine transformed values

Table 5: Effect of seed priming with neem oil cake extract on some physiological traits in green gram

Priming treatments	Speed of emergence	Germination (%)	Root length (cm)	Shoot length (cm)	Dry matter production (mg 10 seedling $^{-1}$)	Vigour index
Non-primed seed	3.6	88 (69.73)	18.23	16.5	181.8	3056
Hydro-priming	4.3	90 (71.57)	20.04	17.55	196.8	3383
Neem oil cake extract						
5%	4.1	88 (69.73)	19.89	16.18	187.8	3174
10%	4.5	91(72.54)	20.75	17.87	210.1	3514
15%	4.2	89 (70.63)	19.67	17.48	201.8	3306
20%	4.0	88 (69.73)	18.48	16.44	202.5	3073
Mean	4.1	89 (70.63)	19.51	17.00	196.8	3251
SE+	0.042	1.032	0.267	0.307	2.170	45.463
$CD_{0.05}$	0.089	2.168	0.560	0.646	4.559	95.515

The figures in parenthesis indicate arcsine transformed values

Table 6: Effect of seed priming with various oil cake extracts on physiological traits in green gram

Priming treatments	Speed of emergence	Germination (%)	Root length (cm)	Shoot length (cm)	Dry matter production (mg 10 seedling $^{-1}$)	Vigour index
Non-primed seed	3.6	88 (69.73)	18.23	16.5	181.8	3056
Hydro-priming	4.3	90 (71.57)	20.04	17.55	196.8	3383
Oil cake extracts						
Groundnut 20%	4.3	93 (74.66)	21.49	18.88	224.4	3754
Sesame 5%	4.4	92 (73.57)	21.84	18.93	202.9	3751
Coconut 15%	4.6	93 (74.66)	22.27	19.90	242.5	3922
Cotton 5%	4.4	91 (72.54)	18.71	19.98	224.4	3521
Neem 10%	4.5	91 (72.54)	20.75	17.87	210.1	3514
Mean	4.3	91 (72.54)	20.47	18.52	211.8	3557
SE+	0.066	0.615	0.281	0.172	3.632	45.68
$CD_{0.05}$	0.136	1.279	0.585	0.357	7.554	95.00

The figures in parenthesis indicate arcsine transformed values

maturation drying. This is indirectly supported by the reduced leakage of electrolytes from primed seeds, since electrolyte leakage is in part the result of damage to cell membranes. However, electrolytes may be leak out during priming, resulting in lower levels of electrolytes in primed seeds than in control (Chiu *et al.*, 2002).

Highly significant variations were observed in seedling dry matter production due to priming treatments. The seeds primed with coconut oil cake extract @ 15% yielded higher dry matter (242.5 mg 10 seedling^{-1}), followed by the seeds primed with cotton oil cake extract @ 5% and groundnut oil cake extract @ 20% (224.4 mg 10 seedling^{-1}). The non-primed seeds had lowest dry matter of 181.8 mg 10 seedling^{-1} (Table 1-6). Generally, oil cakes in addition to crude protein and crude fibre contain macro- and micro-nutrients (Sunil *et al.*, 2015) which perhaps improve germination and vigour potential in seeds which ultimately leads to better crop growth and yield (Patel, 1993). Priming with nutrient solutions also improves plant growth and productivity (Johnson *et al.*, 2005; Harris *et al.*, 2007). The variation for vigour index was highly significant in priming treatments with coconut oil cake extract @ 15% primed seed showing greater vigour index (3922), followed by the seeds primed with sesame oil cake extract @ 5% (3751). The non-primed seeds registered lowest vigour index of 3056 (Table 1-6). Biopriming of seeds with oil cake extracts enables them to rapidly imbibe water and revive metabolism and germination due to the presence of nutrients (N, P, K, proteins, carbohydrates, antioxidants, vitamins and minerals).

Conclusion: The present study revealed that biopriming of green gram seeds with oil seed cake considerably improves seed quality parameters. Coconut oil cake extract @ 15% gave maximum speed of emergence, germination, seedling length, dry matter and vigour index as compared to hydro-primed and non-primed seeds. The oil cake priming supplements additional nutrients to the seed which enhances various metabolic processes during germination. The coconut oil cake extract @ 15% can be effectively used as seed priming treatment in green gram seeds.

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