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Seed priming for improving quality and performance of partially-deteriorated groundnut seeds

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Abstract

An investigation was undertaken in the Department of Seed Science and Technology, OUAT, Bhubaneswar to study the effect of a few priming treatments on enhancement of seed quality and improvement of subsequent performance of groundnut. *Rabi* 2016-17 harvested seeds of groundnut cv. ICGV 91114 with 92.0% germination were packed in HDPE containers and stored under ambient conditions for five months. At the end of the storage period the seeds had 69.0% germination. The partially-deteriorated seeds were subjected to priming treatments, viz. hydropriming of kernels for 2, 3, 4 and 5 hours and moist sand conditioning (MSC) of kernels for 24, 36, 48, 60 and 72 hours. An unprimed Control was maintained for comparison. After hydration, the seeds were dried back to original moisture content. Performance of the primed seeds was studied in a field trial during *Rabi* 2017-18. Priming of seeds significantly increased the germination percentage. MSC-24 hours gave highest germination (82.5%), followed by MSC-36 hours (79.50%), an increase of 20.0% and 15.6%, respectively, over the unprimed Control. Seeds without priming treatment gave the lowest germination of 68.75%. Priming treatments also resulted in higher SVI-I and lower EC of seed leachate. Highest field emergence of 75.60% was recorded in MSC-24 hours, followed by 74.4% in MSC-36 hours, as against 59.2% in unprimed seeds. The primed seeds also took less number of days to flowering initiation and maturity, with minimum number of days to flowering and maturity recorded in MSC-24 hours, followed by MSC-36 hours. The two treatments also recorded higher plant height, number of mature pods per plant, pod yield per plant and pod yield per hectare. MSC-24 hours produced highest pod yield of 1557.14 kg/ha followed by MSC-36 hours, hydropriming-3hours and MSC-48 hours. The crop raised from unprimed seed (T_1) recorded lowest pod yield of 1101.42 kg/ha. The yield advantage of moist sand conditioning of kernels for 24 hours was 41.4% compared to the unprimed Control. Priming treatments had no significant influence on the pod and seed characteristics of the produced seeds, viz., mean pod length, 100-pod weight, number of kernels per pod, shelling percentage, oil content and protein content. Similarly, no significant influence of the priming treatments was observed on germination of the produced seed and accelerated ageing test. However, lowest EC of seed leachate was recorded in seed produced from MSC-24 hours, while it was highest in unprimed Control. Therefore, moist sand conditioning of kernels for 24 to 36 hours (@ 1 part seed : 3 parts sand moistened with water 10% of its weight), followed by drying to the original moisture content, proved to be superior than other treatments and can be taken up as a low cost technique of improving the quality and performance of partially-deteriorated groundnut seeds.

Keywords: Groundnut, priming, hydro priming, moist sand conditioning

Introduction

Groundnut (*Arachis hypogaea* L.) is one of the most important oilseed crops of Odisha. In India, during the year 2016-17, the crop was grown in an area of 53.1 lakh hectares with annual production of 75.65 lakh tonnes. The overall productivity of this crop in India is quite low (1424 kg/ha). Among the states, during 2016-17, Gujarat occupied maximum area (17.53 lakh ha) under the crop with highest production of 37.37 lakh tonnes, while productivity was highest in Tamil Nadu (2612 kg/ha).

In the state of Odisha, groundnut occupied an area of 2.68 lakh hectares during 2013-14, with annual production of 4.78 lakh tonnes and productivity of 1784 (kg/ha). Groundnut is grown extensively in the state in *Rabi* season, while in *Kharif* the area is quite limited. Similarly, seed production in *Kharif* season is limited to a few pockets in the state and is not sufficient to meet the seed demand for the *Rabi* season. Poor storability of this ‘high oil - high protein’ containing seed under high humidity - high temperature conditions (monsoon season) means that harvest from the previous *Rabi* season is not fit enough to be used as seed in the ensuing *Rabi* season. The Government is compelled to procure seeds from other states like Andhra Pradesh and Karnataka. On many occasions, the seeds reach the end-users (farmers) quite late. Hence, due to low availability and/or delayed supply of CS or TLS by the Government or the public sector, in most of the years, farmers use their own saved seed. Farmers' saved seeds are of relatively inferior quality as compared to the quality seeds purchased from the market. Due to use of low quality seeds, the performance of the crop is even more affected when adverse weather conditions prevail during sowing and/or the crop growth season. All these factors, in combination, contribute largely towards low productivity of this crop in the state.

One of the approaches for improving the performance of partially-deteriorated seeds is through priming. Seed priming is a controlled hydration technique in which seeds are soaked in water or low osmotic potential solution to a point where germination related metabolic activities begin in the seeds but radicle emergence does not occur. Priming allows some of the metabolic processes necessary for germination to occur without germination actually taking place. Seed priming is an effective technology to enhance rapid and uniform emergence and to achieve high vigour, leading to better stand establishment and yield [1, 2, 3]. It is a simple and low cost hydration technique, which can easily be adopted by farmers for improving the performance of their seeds. Various studies have shown better seedling performance, crop establishment, and ultimately, increased yield due to seed priming in several crops, including groundnut. Harris [4] reported that seed priming led to better establishment and growth, earlier flowering, increased tolerance of the seed to adverse environment and greater yield in maize. Rehman [3] reported that seed priming is a cost effective technology that can enhance early crop growth leading to earlier and more uniform stand with yield associated benefits in many field crops, including oilseeds. Priming treatments have been reported to show better seedling performance and crop establishment in groundnut [5]. The present investigation was undertaken to study the effect of a few priming treatments on enhancement of seed quality and improvement of subsequent performance of groundnut.

Materials and Methods

The experiment was initiated in Department of Seed Science and Technology, OUAT, Bhubaneswar in the month of May 2017, with the collection of freshly harvested seeds of groundnut cv. ICGV 91114, i.e. from *Rabi* 2016-17 produce. The initial germination and moisture content of the seeds were 92.0% and 7.10%, respectively. The seeds were stored in HDPE bags under ambient conditions for a period of five months. The physiological quality parameters of the seed prior to priming treatments, i.e., in October 2017, were studied (Table 1). The groundnut kernels were then subjected to the following priming treatments.

T_1: Control (No priming)
T_2: Hydro priming for 2 hours
T_3: Hydro priming for 3 hours
T_4: Hydro priming for 4 hours
T_5: Hydro priming for 5 hours
T_6: Moist sand conditioning for 24 hours
T_7: Moist sand conditioning for 36 hours
T_8: Moist sand conditioning for 48 hours
T_9: Moist sand conditioning for 60 hours
T_{10}: Moist sand conditioning for 72 hours

After priming, seeds were shade dried for 2 days and then sun dried to lower the moisture content to the original level. Thereafter, the physiological quality status of primed seeds parameters was studied. The performance of the primed seeds was evaluated by raising the crop in a field trial in the Central Farm, OUAT, Bhubaneswar during *Rabi* 2017-18. The experiment was laid out in Randomised Block Design with three replications. Various growth and yield attributing characters, seed yield and quality parameters were recorded and analysis of the data was done using appropriate statistical techniques.

Results and Discussion

After storage of the groundnut seeds in HDPE bags under ambient condition for five months, it was observed that there had been substantial deterioration in the quality of seeds and seed germination had reduced to 69.0%, i.e., below the Minimum Seed Certification Standards (70%) for the crop (Table 1). Under field conditions, farmers usually face such problems of sowing seeds with low germination potential. The normal practice is to try and compensate the low germination by raising the seed rates. However, higher seed rate not only increases the cost of cultivation but also is seldom effective in improving the performance of the crop. After five months storage, moisture content of the seeds had risen to 8.30% as the storage period coincided with high humidity period of the monsoon season.

Table 1: Seed quality parameters of groundnut cv. ICGV 91114 prior to priming treatments

Seed quality parameter	Status
Seed germination	69.0%
Seedling length	14.47 cm
SVI-I	998.43
Seedling dry weight	231.24 mg
SVI-II	15.95
Moisture content	8.30%
EC of seed leachate	0.65 dS/m

The seed quality parameters after priming treatments have been presented in Table 2. Moisture content of seeds after priming was recorded. After hydration of seeds in each treatment, dehydration was done to ensure that the seed moisture content was reduced to almost the same level in all the treatments, so as to negate the effect of moisture content on seed quality and its subsequent performance. The mean seed moisture contents of various treatments ranged from 8.32 to 8.39%.

Due to priming of seeds, germination percentage was significantly increased. Among seed priming treatments, moist sand conditioning (MSC) of kernels for 24 hours (T_6) gave significantly higher percentage of germination (82.5%), followed by MSC-36 hours (T_7 - 79.50%), an increase of 20.0% and 15.6%, respectively, over the unprimed Control. Seeds without priming treatment (Control - T_1) gave the lowest germination of 68.75%. Priming treatments resulted in slight increase in mean seedling length, mean seedling dry weight and SVI-II, though the difference among treatments in these parameters was statistically non-significant. Among the priming treatments, highest Seed Vigour Index-I value of 1091.76 was recorded in MSC-24 hours (T_6), followed by MSC-36 hours (T_7 - 981.59). The increase in Seed Vigour Index-I was due to increase in seed germination and seedling length. Among the treatments, lowest EC of seed leachate (0.42 dS/m) was recorded in MSC-24 hours (T_6), which might be due to beneficial effect of MSC treatment in strengthening the cell membrane integrity of the groundnut seeds. Seeds subjected to accelerated ageing treatment after MSC-24 hours recorded highest germination, followed by MSC-36 hours (T_7). Massawe *et al.* [6] observed that hydration for different duration in three cultivars of Bambara groundnut significantly increased the germination from 49% to 74%. Moreover, the seedling emergence is rapid and uniform, since priming is useful in initiation of germination related metabolic activities as well as repair mechanisms to operate within the seed. Once sown, primed seeds spend a relatively less time for radicle protrusion and seedling establishment. Chiu and Sung [7] reported that seed priming has many advantages including rapid and uniform emergence, improved seedling growth and better stand establishment under any environmental and soil conditions. In many instances, a major cause of poor stand establishment and low crop yield is unfavourable environmental conditions for seed germination and seedling emergence. However, rapidly germinating seedlings could emerge and produce deep roots before the upper layers of the soil are dried out and crusted, which may result in good crop establishment and higher crop yield. Results from various studies indicate that hydropriming is a useful method for improving the quality of aged seeds, if seed deterioration has not gone too far [8, 9, 10, 11]. Many investigations have suggested that priming is a practical treatment for increasing germination parameters [12, 13, 14].

Table 2: Seed quality parameters of groundnut cv. ICGV 91114 subjected to various priming treatments

Treatment	Moisture content (%)	Germination (%)	Seedling length (cm)	Seed vigour index-I	Seedling dry weight (mg)	Seed vigour index-II	EC of seed leachate (dS/m)	Germination (%) after AA
T_1	8.33	68.75 (56.01)	14.28	799.93	229.22	12.84	0.66	55.75
T_2	8.36	76.25 (60.83)	15.14	921.04	241.93	14.72	0.61	58.25
T_3	8.39	76.75 (61.17)	15.38	940.67	245.62	15.02	0.57	58.50
T_4	8.36	76.50 (61.00)	15.14	923.68	241.93	14.76	0.61	58.25
T_5	8.38	73.50 (59.02)	14.66	865.49	237.78	14.03	0.63	57.75
T_6	8.32	82.50 (65.29)	16.72	1091.76	251.38	16.40	0.42	60.50
T_7	8.33	79.50 (63.08)	15.56	981.59	249.51	15.74	0.48	59.75
T_8	8.36	77.00 (61.34)	15.38	943.78	245.62	15.07	0.57	58.50
T_9	8.39	76.25 (60.84)	15.14	921.75	241.93	14.73	0.61	58.25
T_{10}	8.32	73.75 (59.18)	14.66	867.39	237.78	14.08	0.63	57.75
S.E.m.(±)	0.071	0.375	0.438	29.287	10.049	0.628	0.014	0.478
$C.D._{0.05}$	NS	1.115	NS	87.015	NS	NS	0.041	1.421
C.V. (%)	1.67	1.07	4.99	5.48	7.18	7.38	4.13	1.42

The field performance of primed seeds has been presented in Table 3. Among the priming treatments, MSC-24 hours (T_6) gave highest field emergence of 75.60%, followed by MSC-36 hours (T_7 - 74.4%). Lowest field emergence of 59.2% was recorded in case of unprimed Control (T_1). Stand establishment is of primary importance for optimizing field production of any crop plant. At suboptimal conditions of environment, poor seed germination and subsequently poor field establishment is a common phenomenon. It has been reported that one of the major obstacles to high yield and production of crop plants is the lack of synchronized crop establishment due to poor weather and soil conditions [15]. Seeds are occasionally sown in seedbeds having unfavourable moisture because of the lack of rainfall at sowing time which results in poor and unsynchronized seedling emergence [16]. Rapid germination and emergence are essential for successful crop establishment, for which seed priming could play an important role.

Days to flowering initiation in 50% plants differed significantly due to seed priming treatments. Among the treatments, MSC-24 hours (T_6) took significantly less number of days for flowering initiation in 50% plants (25.3 days), followed by hydropriming of kernels for 3 hours (T_3 - 26.0 days) and MSC-36 hours (T_7 - 26.7 days), which were at par with each other. Maximum number of days required to flower initiation in 50% plants (30.0 days) was observed in the unprimed Control (T_1). Similarly, the minimum number of days taken to maturity was recorded in MSC-24 hours (T_6 – 90.3 days), followed by MSC-36 hours (T_7 – 91.8 days), while the highest days to maturity (94.3 days) were recorded in Control (T_1). Rehman *et al.* [17] found that seed priming of linseed reduced crop branching and flowering and maturity time and had the maximum plant height, number of branches, tillers, pods and seeds per pod. Harris *et al.* [18] drew inference that early emergence and maturity in seed priming treatment could be due to advancement in metabolic state. Musa *et al.* [19] also concluded that priming improves plant stand and provides benefits in term of maturity.

Among the priming treatments, significantly high plant height (100.06 cm) was recorded in MSC-24 hours (T_6), followed by MSC-36 hours (T_7 - 98.26 cm) while the lowest plant height (87.63 cm) was noticed in hydropriming-5 hours (T_5) and MSC-72 hrs (T_{10}). Several authors have reported the positive effect of seed priming on plant growth leading to higher plant height. Plant height and shoot dry weight of maize were increased by priming (without drying) [20]. Singh *et al.* [21] found that osmo-priming with KNO_3 for different durations were superior to unprimed treatment in terms of plant height and dry matter accumulation in cowpea. Shehzad *et al.* [22] reported that in sorghum seed priming increases cell division and seedling roots which cause an increase in plant height. Number of mature pods per plant is an important yield attributing parameter. Among the treatments, MSC-24 hours (T_6) recorded highest number of mature pods per plant (22.00) followed by MSC-36 hours (T_7 - 20.78) and the difference was statistically significant. The crop raised from unprimed seed (T_1) gave lowest number of mature pods per plant (14.69). Priming treatments did not have any significant effect on the number of immature pods per plant or aerial pegs per plant.

Among the treatments, MSC-24 hours (T_6) produced highest pod yield per plant (22.47 g). The treatment T_7 (MSC-36 hours) was at par with treatment T_3 (hydropriming of kernels) and T_8 (MSC-48 hours) with regards to the pod yield per plant. The crop raised from unprimed seed (T_1) produced lowest pod yield per plant (14.94 g). Among the priming treatments, T_6 (MSC-24 hours) produced highest pod yield per hectare (1557.14 kg). The treatment T_7 (MSC-36 hours) was at par with treatment T_3 (hydropriming-3hours) and T_8 (MSC-48 hours). The crop raised from unprimed seed (T_1) recorded lowest pod yield per hectare (1101.42 kg). The treatment T_6 gave higher yield of 41.4% over the unprimed Control. Naphade *et al.* [23] reported significantly higher yield (18.23 q/ha) over Control (15.61 q/ha) due to priming of groundnut seeds.

Table 3: Performance of groundnut seeds cv. ICGV 91114 subjected to various priming treatments

Treatment	Field emergence (%)	Days to flowering initiation in 50% plants	Days to maturity	Plant height (cm) at maturity	Mature pods per plant	Immature pods per plant	Aerial pegs per plant	Pod yield per plant (g)	Pod yield per ha (kg)
T_1	59.2 (50.33)	30.0	94.3	91.98	14.69	8.26	5.67	14.94	1101.42
T_2	67.7 (55.36)	27.7	92.7	92.02	18.89	8.46	5.66	18.06	1320.04
T_3	73.4 (58.95)	26.0	93.0	94.75	19.91	8.81	5.82	19.86	1467.33
T_4	67.9 (55.52)	27.7	92.7	92.02	18.89	8.46	5.66	18.06	1320.04
T_5	64.9 (53.65)	28.7	92.4	87.63	16.68	8.41	5.68	16.71	1224.21
T_6	75.6 (60.40)	25.3	90.3	100.06	22.00	9.05	5.98	22.47	1557.14
T_7	74.4 (59.59)	26.7	91.8	98.26	20.78	8.83	5.88	19.95	1468.36
T_8	73.4 (58.95)	27.7	92.3	94.75	19.91	8.81	5.82	19.86	1467.33
T_9	67.7 (55.35)	29.0	92.7	94.17	18.89	8.46	5.66	18.06	1320.04
T_{10}	64.7 (53.54)	29.0	92.4	87.63	16.73	8.41	5.63	16.71	1224.21
S.E.m(±)	0.239	0.68	0.38	0.983	0.330	0.253	0.327	0.113	14.275
$C.D._{0.05}$	0.709	2.03	1.12	2.922	0.980	NS	NS	0.335	42.414
C.V. (%)	0.736	4.256	0.708	1.825	3.048	5.096	9.855	2.790	1.822

From the harvested produce of crop raised from primed seeds, the pod and seed characteristics were recorded and the results presented in Table 4. The mean pod length of various treatments ranged from 2.94 to 2.99 cm, though the differences among the treatments were statistically non-significant. Among the treatments, MSC-24 hours (T_6) and hydropriming of kernels both were recorded slightly higher 100-pod weight (58.16 g), followed by unprimed seed (T_1 - 57.81 g), though the difference was statistically non-significant. The crop raised from MSC-72 hours (T_{10}) produced the lowest pod weight (56.83 g). The priming treatments as well as the Control showed no significant difference with regards to the number of kernels per pod and shelling percentage. However, hydropriming-2 hours (T_2) and MSC-60 hours (T_9) both gave slightly higher number of kernels per pod (1.58). Among the treatments, MSC-24 hours (T_6) recorded slightly higher shelling percentage of 74.06% followed by MSC-36 hours (T_7 - 73.67%). Unprimed seed (T_1) recorded slightly higher 100-kernel weight (31.46 g), followed by MSC-24 hours (T_6 - 30.73 g), though the difference was statistically non-significant. Hydropriming-4 hours (T_4) and MSC-72 hours (T_{10}) recorded relatively lower 100-kernel weight. The results of the present investigation are contradictory to works of a few previous authors. Many authors have reported increase in the pod and seed characters as a result of seed priming. Rehman *et al.* [17] reported that various priming treatments gave higher number of pods and seeds per pod. Chatterjee *et al.* [24] reported that the groundnut crop raised from seed kernels treated with water had appreciably higher number of pods per plant and higher 100-seed weight of kernels. Similarly, Basra *et al.* [25] in canola and Rashid *et al.* [26] in mungbean reported that primed seed plants produced more grains per pod.

The differences in oil content among various priming treatments as well as the unprimed Control were found to be statistically non-significant. Among the priming treatments, MSC-24 hours (T_6) gave slightly higher oil content (44.84%) followed by unprimed Control (T_1 - 44.82%), while hydropriming-5 hours (T_5) and MSC-72 hours (T_{10}) recorded relatively lower oil content (44.58% in both). Similarly, priming treatments had no significant effect on the protein content of the produced seeds. However, among the treatments, MSC-24 hours (T_6) recorded slightly higher protein content (26.69%) followed by unprimed Control (T_1- 26.10%), while hydropriming-5 hours (T_5) and MSC-72 hours (T_{10}) recorded relatively lower protein content (25.06% in both). However, these results are in contradiction to the reports of some earlier workers. Naphade *et al.* [23] soaked the seeds of groundnut in water and reported that oil content was significantly higher in soaking of seed in water (43.90%) over unprimed Control (42.40%). Subbaraman and Selvaraj [27] reported that soaking of groundnut (JL-24) seeds in 0.50% $CaCl_2$ solution for 32 hours followed by 10 hours drying resulted in higher oil content (50.72%), compared to that in water soaking (47.19%). Similarly, Moosavi *et al.* [28] found that various hydropriming treatments had a positive role in increasing the oil content of soybean. Kouchebagh *et al.* [29] also reported that oil content of sunflower was enhanced as a result of various priming treatments.

Table 4: Pod and seed characteristics of groundnut crop cv. ICGV 91114 raised after various seed priming treatments

Treatment	Pod length (cm)	100-pod weight (g)	No. of kernels per pod	Shelling (%)	100-kernel weight (g)	Oil content (%)	Protein content (%)
T_1	2.94	57.81	1.56	72.89	31.46	44.82	26.10
T_2	2.96	57.39	1.58	71.99	30.54	44.63	25.38
T_3	2.97	57.72	1.46	72.33	30.36	44.67	25.43
T_4	2.96	58.16	1.47	71.99	29.96	44.63	25.38
T_5	2.95	56.88	1.46	70.81	30.38	44.58	25.06
T_6	2.99	58.16	1.49	74.06	30.73	44.84	26.69
T_7	2.99	57.72	1.45	73.67	30.54	44.73	25.56
T_8	2.97	57.39	1.56	72.33	30.38	44.67	25.43
T_9	2.96	57.36	1.58	71.99	30.36	44.63	25.38
T_{10}	2.95	56.83	1.49	70.81	29.96	44.58	25.06
S.E.m.(±)	0.011	0.179	0.037	1.341	0.103	0.900	1.087
$C.D._{0.05}$	NS	0.531	NS	NS	0.307	NS	NS
C.V. (%)	0.672	0.538	4.232	3.213	0.588	3.491	7.369

The germination and vigour parameters from harvested produce of crop raised from primed seeds were recorded and the results presented in Table 5. Priming treatments had no significant effect on the seed germinability of the produce. However, the mean seedling length and mean seedling dry weight were highest in MSC-24 hours (T_6). The vigour indices and accelerated ageing test did not show any significant differences among the priming treatments. Lowest EC of seed leachate (0.27 dS/m) was recorded in MSC-24 hours (T_6). The seed produced from unprimed Control recorded highest electrical conductivity (0.39 dS/m).

Table 5: Germination and vigour of groundnut seeds cv. ICGV 91114 from crop raised after various seed priming treatments

Treatment	Germination (%)	Seedling length (cm)	SVI-I	Seedling dry weight (mg)	SVI-II	Germination (%) after AA	EC of seed leachate (dS/m)
T_1	79.58 (8.92)	16.36	1301.95	251.61	20.02	55.18	0.390
T_2	79.50 (8.91)	16.57	1316.62	249.36	19.82	54.93	0.340
T_3	80.25 (8.96)	16.77	1345.79	250.47	20.10	55.26	0.330
T_4	79.50 (8.91)	16.56	1316.51	249.36	19.82	54.93	0.340
T_5	78.33 (8.85)	16.58	1297.62	249.12	19.51	54.67	0.370
T_6	80.75 (8.99)	16.83	1359.01	252.73	20.41	55.57	0.270
T_7	80.50 (8.97)	16.81	1353.23	251.76	20.27	55.48	0.290
T_8	80.25 (8.96)	16.77	1345.80	250.47	20.10	55.26	0.330
T_9	79.50 (8.92)	16.55	1316.53	249.36	19.82	54.93	0.340
T_{10}	77.50 (8.80)	16.48	1277.15	249.12	19.31	54.67	0.370
S.E.m.(±)	0.069	0.029	21.042	0.104	0.307	0.931	0.009
$C.D._{0.05}$	NS	0.087	NS	0.308	NS	NS	0.027
C.V. (%)	1.336	0.304	2.755	0.072	2.669	2.926	4.624

From the present investigation, it was observed that seed priming has a positive effect on the sowing quality of groundnut seeds, as well as its performance, leading to higher yield. Out of the treatments, moist sand conditioning of kernels for 24 hours and 36 hours (@ 1 part seed : 3 parts sand moistened with water 10% of its weight), followed by drying to the original moisture content, proved to be the best treatments in enhancing seed quality and subsequent performance leading to higher yield. This may mainly be due to the fact that moist sand conditioning treatment almost simulates the conditions that the seed is likely to encounter in the field. However, since the moisture content of the sand is not high enough for initiation of seedling growth, this method of hydration helps in achieving the favourable effects of priming on the seeds, due to slow imbibition, thus suspending the seeds for a longer period in phase-II (lag phase) of the germination process. The hydration is followed by drying back to the original moisture content. Though hydropriming has been reported to be effective in improving seed quality and performance in several crops, moist sand conditioning appears to be more effective in a leguminous crop like groundnut, in which there is rapid rate of imbibition. Therefore, moist sand conditioning for 24 to 36 hours, followed by slow dry-back to the original moisture content, can be taken up as a low cost technique of improving the quality and performance of partially-deteriorated groundnut seeds.

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