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Identification of an Easy, Reliable and Eco friendly treatment for Viability maintenance in TNAU Blackgram Cv.CO 6 (*Vigna Mungo* (L) Hepper)

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Abstract

In India, blackgram is the main edible crop ranking fourth among the pulses. The area under blackgram is 2.60 lakh hectares, production of 0.99 lakh tonnes. More than half of the Indian population is vegetarian and legumes play a very important role in human diet as vegetable protein which is an essential supplement to cereal based diet. Self sufficiency in the production of cereals could be achieved through green revolution, but not in pulses. Because of the need for nitrogen and its ecologically safe utilization in the expansion of crop production area, pulses play a vital role in the agriculture. Increase of pulse crop production is need of the hour in developing countries (particularly in Indian countries) to feed the human population. The poor performance of pulses may be attributed to several factors, of which preservation of seed is of great importance. Invariably the seeds have to be stored through the monsoon for the next sowing during which period the rise in the ambient relative humidity coupled with the prevailing high temperature can accelerate the ageing process of the seed, leads to deterioration, resulting in loss of vigour and viability. To overcome this deterioration problem, different easy and eco friendly invigouration treatments can be successfully employed to prolong the shelf life of unsold stock and highly useful for long term storage. Blackgram seeds of different vigour status of seeds could be invigourated (enriched) using eco friendly treatments like moist sand conditioning with 5% water holding capacity and 48h of duration, 24h of moisture equilibrium and 1h soaking and drying recorded an improvement in seed quality parameters viz., seed germination percentage, seedling length, dry matter production and maintained vigour and viability of seeds.

Keywords: Seed invigouration, Blackgram, soaking and drying, moisture equilibrium, moist sand conditioning.

Introduction

Seed invigouration treatments are physiological treatments that imply an improvement in physiological status of seed, thereby achieved improved germinability, greater storability and better performance than the corresponding untreated seeds[1]. The efficacy of hydration-dehydration treatment on vigour and viability maintenance has been studied extensively in number of crops[2-6]. This method is different from conventional pre-sowing treatment, where the short duration soaking and drying treatments are given to seeds with a sufficient time gap between treatment and sowing. The treatments are effective not only for viability maintenance, but also for increasing the productivity of resultant crop[7]. Pulses are poor storers. These seeds lost their viability in a very short period of storage because of the high protein content. As other pulses, blackgram seeds also lost their vigour within one year of storage period. The germination percentage of seeds is reduced below the standard germination (75 %) within a year. To improve the germinability of unutilized stock and as well as to prolong further storability and better field stand with high vigour, the pre sowing, pre storage and mid storage invigouration treatments are highly warranted. These treatments would invigourate the low vigour seeds to achieve better emergence and establishment. Hence, the study was made.

Material and Methods

Different methods were followed in seed invigouration. They were soaking - drying, moisture - equilibration drying, moist sand conditioning-drying of seeds these methods were tried in order to standardize an optimum method, suitable for invigouration of different vigour status of blackgram seeds. The variety taken for the study was TNAU blackgram Cv.CO 6 with a moisture content of the seeds was 8 per cent.

Standardization of methodology for pre sowing, pre storage and mid storage correction: Moist sand conditioning-drying: In this method, sterilized air-dry sand was pre-moistened with water to 5 and 10 percent water holding capacity and then seeds were thoroughly mixed with moist sand at the ratio of 3:1 (3 parts of sand and 1 part of seed) and kept covered for different duration for the slow absorption of moisture. Then the seeds were sieved and dried under shade to bring back its original moisture content (8 percent).

Moisture-equilibration-drying: The seeds were placed in a moisture saturated atmosphere, created by using plastic trays of equal size (45 x 30 x 8 cm), where the bottom tray was filled with water to half of its depth, into which a perforated plastic tray was placed upside down over which a germination paper

was spread to hold the seeds in a single layer on its surface, and the upper enamel tray was placed over the bottom one and this assembly was made completely airtight and was incubated at room temperature (28+1°C). In this assemblage, the seeds were kept for following duration and dehydrated back to the original moisture content (8 percent) under shade.

Soaking-drying: In this method, seeds were soaked in equal volume of water for the following hours at room temperature (28+1°). After decanting the excess amount of water, the seeds were surface dried with blotters and dried back to the original moisture content (8 percent) under shade.

Fresh and three days accelerated aged seeds were subjected to the following seed invigouration treatments and evaluated for the seed and seedling quality characters.

Results and Discussion

In the present study, irrespective of the treatment and duration, all the treatments were found to be very effective and proved their superiority over the untreated seeds for all the seed lots (Fresh, aged treated and treated aged seeds).

The difference due to moisture holding capacity, duration of conditioning and their interactions for fresh, aged treated and treated aged seeds (Table 1) were not significant in germination percentage.

For both aged treated and treated aged seeds conditioning at 5 per cent moisture for 48 h produced longer shoots (14.57 cm and 13.48 cm), the increase being 20 and 11 per cent over control (table 2).

The root length of fresh seeds exhibited significant differences for moisture content and duration of exposure except their interactions. Seeds conditioned for 48 h @ 5 per cent moisture was found beneficial registering higher root length of 16.00 cm and the improvement was 25 per cent over control (12.76 cm) (figure-1a).

Highly significant results were obtained due to moisture content of media, duration of conditioning and their interaction for aged treated seeds. In treated aged seeds, moisture content of media alone significantly influenced the root length. Conditioning of seeds in 5 per cent moisture holding capacity for 48h recorded higher values (14.48 cm), the increase being 29 per cent over control for aged seeds (figure-1b) and conditioning at 5 per cent for 48 h could be beneficial for treated aged seeds, with a mean length of 12.69 cm and increase of 13 per cent over control (figure-1c).

Seed lot	Treatment	Seed: Solution Ratio	Duration of Soaking–drying
i) Fresh seeds ii) Aged seeds (3 days of accelerated ageing)	Moist sand conditioning–drying	1 : 3 (Seed : Sand with 5 and 10% moisture)	0, 24, 48, 72 h
	Moisture equilibrium – drying	-	0, 24, 48, 72 h
	Soaking and drying	1 : 1	0, 1,2,3 h

A portion of seeds was aged for three days under accelerated ageing conditions and treated as above (aged treated). Another portion of fresh seeds treated as above was aged artificially for three days (treated aged) and evaluated for seed quality characters *viz.,* germination, seedling length and dry matter production along with untreated control.

Table-1
Effect of moist sand conditioning on seed germination percentage in fresh seeds, aged treated and treated aged seeds of TNAU Blackgram CO 6

a) Fresh seeds

Duration	**5%**	**10%**	Mean
Control	88 (69.73)	88 (69.73)	88 (69.73)
24 h	95 (77.08)	95 (77.08)	95 (77.08)
48 h	98 (81.87)	93 (77.08)	96 (78.46)
72 h	95 (77.08)	88 (69.73)	92 (73.57)
Mean	91 (72.54)	91(72.54)	
	M	**D**	**M × D**
SE(d)	1.40	1.29	2.23
CD (P = 0.05 %)	NS	NS	NS
CD (P = 0.01%)	NS	NS	NS
Grand mean	93 (77.08)		

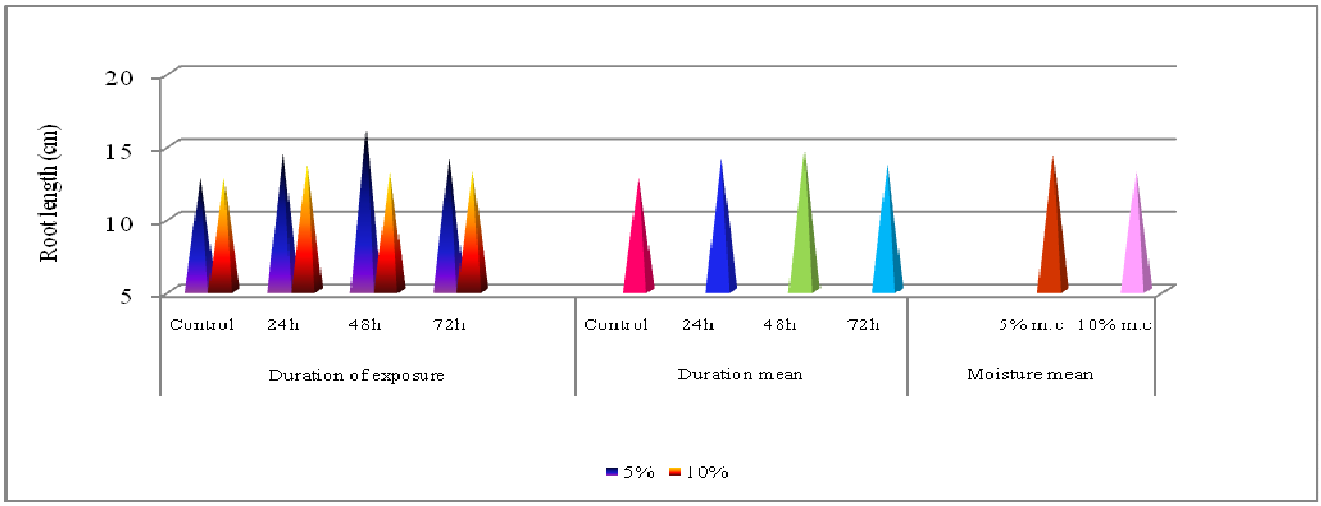
b) Aged seeds

Duration	**5%**	**10%**	Mean
Control	75 (60.00)	75(60.00)	**75 (60.00)**
24 h	83 (65.65)	88 (69.73)	**86 (68.02)**
48 h	83 (65.65)	88 (69.73)	**86 (68.02)**
72 h	80(63.43)	80 (63.43)	**80 (63.43)**
Mean	**81 (64.15)**	**83 (65.65)**	
	M	**D**	**M × D**
SE (d)	4.46	4.46	7.72
CD (P = 0.05 %)	NS	NS	NS
CD (P = 0.01%)	NS	NS	NS
Grand mean	**82 (64.89)**		

c) Treated aged seeds

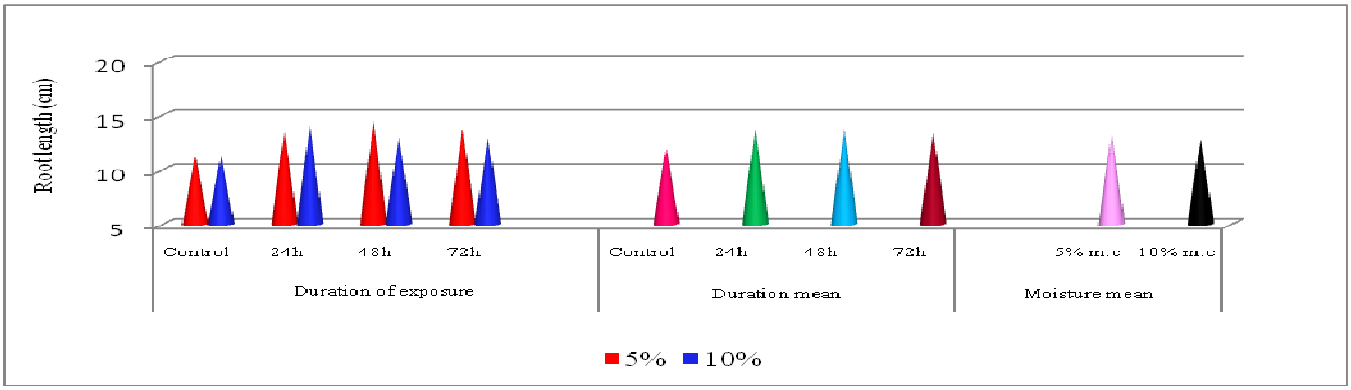
Duration	**5%**	**10%**	Mean
Control	75 (60.00)	75 (60.00)	75 (60.00)
24 h	83 (65.65)	87 (68.86)	85 (67.21)
48 h	87 (68.86)	80 (63.43)	84 (66.42)
72 h	75 (60.00)	75(60.00)	75 (60.00)
Mean	**80 (63.43)**	**79 (62.72)**	
	M	**D**	**M × D**
SE (d)	3.77	3.77	6.53
CD (P = 0.05 %)	NS	NS	NS
CD (P = 0.01%)	NS	NS	NS
Grand mean	**80 (63.43)**		

M- Moisture holding capacity of media D- Duration of exposure, * Significant at 0.5 % level ** Significant at 1% level NS – Non Significant, (Figures in parenthesis indicate arcsine values)



a.) Fresh seeds

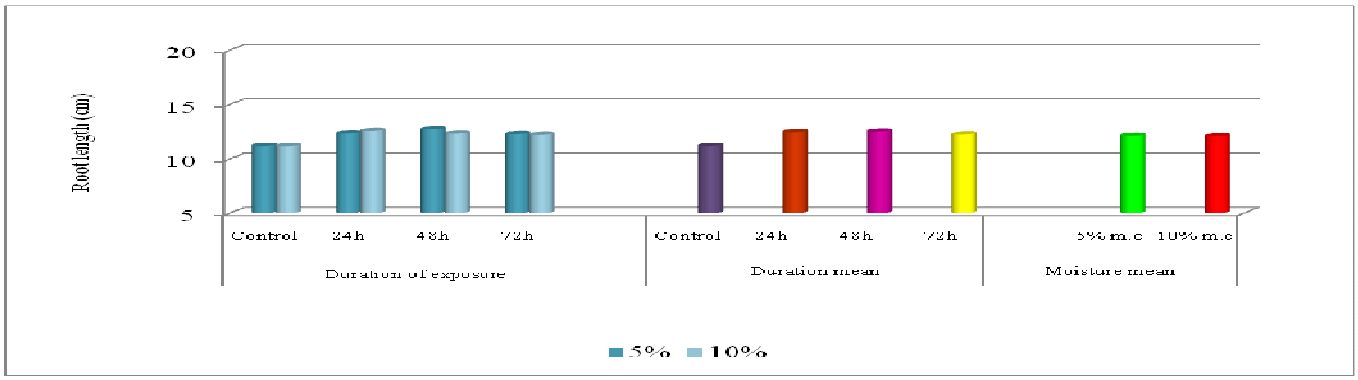
	M	**D**	**M×D**
SE (d)	0.268	0.268	0.465
CD (P = 0.05%)	0.564**	0.564*	NS
CD (P = 0.01%)	0.773**	0.773*	NS



b) Aged treated seeds

	M	D	M×D
SE (d)	0.471	0.471	0.816
CD (P = 0.05%)	0.990**	0.990**	1.714**
CD (P = 0.01%)	1.356**	1.356**	2.349**

M- Moisture content of media D- Duration of exposure * Significant at 5% level, ** Significant at 1% level NS – Non Significant m.c – Moisture content



c) Treated aged seeds

	M	D	M×D
SE (d)	0.321	0.321	0.557
CD (P = 0.05%)	0.675*	NS	NS
CD (P = 0.01%)	0.926*	NS	NS

M- Moisture content of media D - Duration of exposure * Significant at 5% level, ** Significant at 1% level NS - Non significant m.c - Moisture content

Figure-1
Effect of moist sand conditioning on root length (cm)

Highly significant differences were observed for duration of exposure for fresh seeds. Seeds exposed for 48h registered higher dry matter production of 0.287 g and was on par with 24h (0.281 g). The minimum dry matter was recorded in control (0.265 g). Low moisture holding capacity of 5 per cent at 48 h gave better results (0.296 g) (table 3a).

The values for dry matter production were significant due to moisture content of media. However, duration and their interactions were not significant for both the seed lots. The seeds conditioned in 5 per cent moisture for 48h produced higher dry matter in aged treated and treated aged seeds respectively and the values (0.282 and 0.270g) were significantly different, the increase being 107 and 95 per cent over their respective control (table 3b and 3c).

Effect of moisture equilibrium treatment on seed quality parameters: Significant differences could be observed for dry matter production in fresh seeds whereas germination percentage, shoot and root length were not significant. Lower

duration (24h) performed better (0.284 g) compared to higher duration (0.265 g) and over control (0.207 g) (table 4a).

Highly significant differences for germination shoot length, dry matter production with different durations of exposure could be observed for aged treated and treated aged seeds. In aged treated seeds, seed quality parameters decreased with increased duration of exposure. After 24 h of equilibrium, the germination was improved by 11 per cent accompanied by longest shoot (18.82 cm), root (16.22 cm) and dry weight (0.264 g). The effect was lower beyond 48 h (Table 4b). The highest germination (85 %), longest shoot (17.06 cm) and root (16.83 cm) and dry matter (0.243 g) were recorded by moisture equilibrium for 24 h in treated aged seeds. The other durations were less effective for the seed quality parameters studied but better than control (table 4c).

Table-2

Effect of moist sand conditioning on shoot length in fresh seeds, 3 days accelerated aged seeds and fresh treated and aged seeds of TNAU Blackgram CO 6

a)Fresh seeds

Duration	**5%**	**10%**	Mean
Control	13.62	13.62	**13.62**
24 h	14.46	14.43	**14.45**
48 h	14.94	14.31	**14.63**
72 h	14.18	14.20	**14.19**
Mean	**14.30**	**14.14**	
	M	D	M × D
SE (d)	0.345	0.345	0.597
CD (P = 0.05 %)	NS	NS	NS
CD (P = 0.01%)	NS	NS	NS
Grand mean	**14.21**		

b) Aged seeds

Duration	**5%**	**10%**	Mean
Control	12.15	12.15	**12.15**
24 h	14.29	14.12	**14.21**
48 h	14.57	13.45	**14.01**
72 h	13.75	13.53	**13.64**
Mean	**13.69**	**13.31**	
	M	**D**	**M × D**
SE (d)	0.269	0.269	0.466
CD (P = 0.05 %)	0.563**	NS	NS
CD (P = 0.01%)	0.774**	NS	NS
Grand mean	**13.57**		

c) Treated aged seeds

Duration	**5%**	**10%**	Mean
Control	12.15	12.15	**12.15**
24 h	12.61	12.68	**12.65**
48 h	13.48	12.59	**13.04**
72 h	12.11	12.17	**12.14**
Mean	**12.59**	**12.40**	
	M	**D**	**M × D**
SE (d)	0.089	0.089	0.154
CD (P = 0.05 %)	0.187**	0.187**	0.325*
CD (P = 0.01%)	0.257**	0.257**	0.446*
Grand mean	**12.48**		

M- Moisture holding capacity of media D- Duration of exposure, * Significant at 5% level ** Significant at 1% level NS – Non Significant

Table-3
Effect of moist sand conditioning on dry matter production (g 10 seedlings $^{-1}$) in fresh, aged and treated aged seeds of TNAU Blackgram CO 6

a)Fresh seeds

Duration	**5%**	**10%**	Mean
Control	0.265	0.265	**0.265**
24 h	0.284	0.278	**0.281**
48 h	0.296	0.277	**0.287**
72 h	0.247	0.225	**0.236**
Mean	**0.273**	**0.261**	
	M	**D**	**M × D**
SE (d)	0.006	0.006	0.010
CD (P = 0.05 %)	NS	0.013**	NS
CD (P = 0.01%)	NS	0.017**	NS
Grand mean		**0.267**	

b) Aged seeds

Duration	**5%**	**10%**	Mean
Control	0.136	0.136	**0.136**
24 h	0.224	0.261	**0.243**
48 h	0.282	0.301	**0.292**
72 h	0.212	0.267	**0.240**
Mean	**0.214**	**0.241**	
	M	**D**	**M × D**
SE(d)	0.013	0.013	0.023
CD (P = 0.05 %)	0.028**	NS	NS
CD (P = 0.01%)	0.039**	NS	NS
Grand mean		**0.227**	

c) Treated aged seeds

Duration	**5%**	**10%**	Mean
Control	0.136	0.136	**0.136**
24 h	0.242	0.244	**0.243**
48 h	0.270	0.231	**0.251**
72 h	0.189	0.161	**0.175**
Mean	**0.209**	**0.193**	
	M	**D**	**M × D**
SE(d)	0.012	0.012	0.022
CD (P = 0.05 %)	0.026**	NS	NS
CD (P = 0.01%)	0.036**	NS	NS
Grand mean		**0.201**	

M- Moisture holding capacity of media D- Duration of exposure, * Significant at 5% level ** Significant at 1% level NS – Non Significant

Effect of soaking and drying on seed quality parameters: In fresh seeds, highly significant results were observed for germination percentage, root length, shoot length and dry matter production for different durations of soaking.

Cent per cent germination (100 %), longest shoot (17.71 cm) and root (16.78 cm), maximum dry matter (0.327 g) were recorded by soaking for 1h (table 5a) followed by drying.

In aged treated seeds, highly significant results were exhibited only for dry matter production. Soaking drying for 1h recorded highest germination (86%), longest shoot (14.02 cm), root (14.63 cm) and dry matter production (0.257 g) (table 5b).

In treated aged seeds, highly significant differences were observed. The highest germination (88 %), longest shoot (16.61 cm) and root (16.60 cm), dry matter (0.284 g) were recorded by soaking and drying for 1h. The other durations were less effective for the seed quality parameters studied but better than control (table 5c).

The physiological seed treatments, depending on the kind of seed and initial seed vigour status, would significantly extend storability and improve subsequent crop performance. Dry physiological treatments are only effective when employing to harvest fresh high vigour seed. Mid storage hydration – dehydration treatments (wet) are very much effective in slowing down seed deterioration under subsequent storage conditions[8,9].

Pre sowing seed treatment though proved beneficial, the efficacy was inconsistent and mainly aimed towards protection against deterioration during storage in harvest fresh seeds[10,11]. Soaking and drying treatments of high vigour seeds would reduce storability[12,8] and in legumes, this has resulted in soaking injury in soybean[13,14].

Even with beneficial effects, most of the hydration - dehydration treatments, the methodology suffers owing to non responsiveness of harvest fresh seeds and also handling of bulk quantities and can be recommended only for low volume and high value seeds. Keeping this in view, treatments were imposed to high medium vigour and their efficacies have been compared immediately after treatment, aged treated and treated aged for recommendation as pre storage, pre sowing and mid storage seed treatments.

Being a legume, blackgram seeds are most susceptible for soaking injury. Alternative invigouration treatments would prove beneficial. Based on specific imbibitional behaviour of crops, modified form of hydration-dehydration treatments are suggested *viz.,* moist sand and moist cloth hydration[15,16] in soybean.

In the present study, moist sand conditioning – drying was attempted for fresh, aged and treated aged seeds by keeping in 5 and 10 per cent moist sand at 1:3 seed to sand ratio for different durations ranging from 24 to 72h. In the same way, another form of slow imbibition was attempted through moisture equilibration for different durations similar to moist sand conditioning-drying. It was evident that germination was not altered in moist sand conditioning for fresh seeds, however the improvement on vigour in terms of seedling length and dry matter production was more in aged treated and treated aged seeds for both the forms of hydration followed by drying. To test and verify the effect of imbibitional injury by soaking drying on seed germination, seeds were soaked for 1 to 3h in equal volume of water using fresh, aged and treated aged seeds. In the present instance, 1h soaking followed by drying has improved all the seed quality parameters. However, for aged and treated aged seeds, the improvement was evident only for dry matter production implying the improvement only on vigour parameters and gain support[17].

Table-4
Effect of Moisture equilibrium treatment on seed quality parameters in fresh, aged treated and treated aged seed of TNAU Blackgram CO6.

a) Fresh seeds

Treatments	Germination percentage	Shoot length (cm)	Root length (cm)	Dry matter production (g 10 seedlings $^{-1}$)
Control	89 (70.07)	19.01	15.93	0.207
24 h	93 (76.39)	19.88	17.19	0.284
48 h	93 (76.39)	19.46	17.78	0.271
72 h	92 (75.57)	19.50	16.41	0.265
Mean	**92 (73.57)**	**19.46**	**16.83**	**0.254**
SE(d)	3.498	0.892	0.940	0.020
CD (P = 0.05 %)	NS	NS	NS	0.061*
CD (P = 0.01%)	NS	NS	NS	0.043*

b) Aged seeds

Treatments	Germination percentage	Shoot length (cm)	Root length (cm)	Dry matter production (g 10 seedlings $^{-1}$)
Control	75 (60.00)	14.01	13.40	0.186
24 h	86 (68.02)	18.82	16.22	0.264
48 h	83(65.65)	18.65	15.26	0.242
72 h	83 (65.65)	17.67	14.48	0.250
Mean	**82 (64.89)**	**17.29**	**14.84**	**0.2381**
SE(d)	2.06	1.180	0.940	0.018
CD (P = 0.05 %)	4.752*	3.607**	NS	0.055**
CD (P = 0.01%)	6.915*	2.573**	NS	0.039**

c) Treated aged seeds

Treatments	Germination percentage	Shoot length (cm)	Root length (cm)	Dry matter production (g 10 seedlings $^{-1}$)
Control	75 (60.00)	14.01	13.40	0.168
24 h	85 (68.02)	17.06	16.83	0.243
48 h	83 (65.65)	15.53	16.77	0.208
72 h	82(64.89)	14.87	16.56	0.188
Mean	**81(64.15)**	**15.90**	**15.91**	**0.201**
SE(d)	1.04	0.518	0.930	0.0154
CD (P = 0.05 %)	2.412*	1.583**	2.841**	0.0470**
CD (P = 0.01%)	3.511*	1.129**	2.026**	0.0335**

* Significant at 5% level ** Significant at 1% level NS – Non Significant, (Figures in parenthesis indicate arcsine values)

Table-5
Effect of soaking and drying on seed quality parameters in fresh, aged treated and treated aged seed of TNAU Blackgram CO6.

a) Fresh seeds

Treatments	Germination percentage	Shoot length (cm)	Root length (cm)	Dry matter production (g 10 seedlings $^{-1}$)
Control	89 (65.34)	14.83	14.23	0.220
24 h	100 (89.71)	17.71	16.78	0.327
48 h	90 (70.98)	15.15	14.99	0.270
72 h	87 (70.40)	14.95	14.70	0.277
Mean	**90 (79.98)**	**15.66**	**15.17**	**0.273**
SE(d)	2.681	0.240	0.235	0.017
CD (P = 0.05 %)	5.841**	0.523**	0.513**	0.040**
CD (P = 0.01%)	8.189**	0.733 **	0.719**	0.059**

b) Aged seeds

Treatments	Germination percentage	Shoot length (cm)	Root length (cm)	Dry matter production (g 10 seedlings $^{-1}$)
Control	70 (57.27)	11.51	10.80	0.180
1 hr	86 (68.02)	14.02	14.63	0.257
2hrs	85 (68.02)	12.11	14.25	0.231
3hrs	83 (65.65)	11.72	15.38	0.229
Mean	**81(64.15)**	**12.39**	**13.76**	**0.224**
SE(d)	5.09	0.705	0.375	0.008
CD (P = 0.05 %)	NS	NS	0.818**	0.020**
CD (P = 0.01%)	NS	NS	1.147**	0.029**

c) Treated aged seeds

Treatments	Germination percentage	Shoot length (cm)	Root length (cm)	Dry matter production (g 10 seedlings $^{-1}$)
Control	70 (57.27)	11.51	10.80	0.155
1 hr	88 (69.73)	16.61	16.60	0.284
2hrs	88 (69.73)	14.20	13.20	0.282
3hrs	83 (65.65)	13.02	13.00	0.230
Grand mean	**83 (65.65)**	**13.85**	**13.40**	**0.225**
SE (d)	2.550	0.592	0.559	0.031
CD (P = 0.05 %)	NS	NS	NS	0.072**
CD (P = 0.01%)	NS	NS	NS	0.105**

* Significant at 5% level ** Significant at 1% level NS – Non Significant, (Figures in parenthesis indicates arcsine values)

Conclusion

The present study highlighted that, blackgram seeds could invigourated using different eco friendly treatments recorded an improvement in germination and maintaining vigour and viability of different vigour status of seeds lots.

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