



Effect of Invigoration Treatment of Different Soaking Periods on Germination Performance of Bottle Gourd Seeds

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Authors' contributions

This work was carried out in collaboration between both authors. Author KMP under the guidance of her advisor author PKR and author PKR has designed and managed the analyses of the study. Author PKR also approved the final manuscript. Both authors read and approved the final manuscript.

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ABSTRACT

This present experiment was conducted in a Seed Testing laboratory, Department of Genetics and Plant Breeding SHUATS, Allahabad, UP during 2021 with bottle gourd, in order to standardize the best method of invigoration of priming specific to bottle gourd. method of priming viz., halopriming were evaluated by screening a different range of durations and chemical concentrations viz., T₀ – Unprimed seeds (control), T₁ - 50 ppm KNO₃ (Potassium Nitrate) for 12 hrs, T₂ - 50 ppm KNO₃ for 18 hrs, T₃-100 ppm KNO₃ for 12 hrs, T₄- 100 ppm KNO₃ for 18 hrs, T₅-125 ppm KNO₃ for 12 hrs, T₆- 125 ppm KNO₃ for 18 hrs. Treated seeds were placed in between germination paper and in sand at control condition where data was subjected to factorial experiment laid out in completely randomised design (CRD). In which it was found that 6th treatment 125 ppm KNO₃ for 18 hrs., has the significant result as compared to all the treatments with the control, the highest germination %, seedling length, weight and vigor index I & II. This study showed that Seed priming with KNO₃ found to increase the seed quality parameters. In the present study proved market price- effective and most economical method. This study helps to improve the quality and performance of seeds with the help of seed priming treatments which have effect on market price and economic, non-toxic, eco-friendly sources.

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1. INTRODUCTION

Bottle gourd (*Lagenaria siceraria*), with chromosome number $2n=22$, is the crop of Cucurbitaceae family having different healthful importance, it's also known as a poor man's crop due to the social and economic limitations controlling its production and use [1]. There is distinct information is available on the officinal properties of bottle gourd. Bottle gourd is the adequate source of ascorbic acid, beta carotene, vitamin B complex, pectin and fibers. Bottle gourd is an excellent source of vitamins, carbohydrates, amino acids, and minerals. The plants of the Gourd family play the important role for economically beneficial and adapted species and are developed for officinal and alimental values [2]. Bottle gourd is grown in India in an area of 11.09 thousand hectares with an annual production of about 2186.20 million tons having productivity 18.07 million tons per hectare [3]. In India the share of vegetable production to the total cropped area is only 2.8% and our growing community is more than one billion which considers growth rate of 2.01% [4]. The major cultivation of bottle gourd in states of India are Rajasthan, Gujarat, Punjab, Uttar Pradesh, Bihar, West Bengal, Madhya Pradesh, Maharashtra, Andhra Pradesh and Tamil Nadu [5]. In the existent inspection, an effort to accomplish an end has been made to study the effect of different soaking periods and concentrations of priming agents on emergence of bottle gourd [6]. Seed invigoration is the treatment after harvesting the seeds to improve the seed viability and seedling vigor before using them for further production [7]. Priming is the enrichment in the physiological and biochemical changes in seeds during the temporary stoppage of germination by low potential of water and negligible potential of matrix, of the imbibing medium [8]. Increasing the germination rate in primed seeds ensures increase in the crop performance, higher tolerance to biotic and abiotic stress factors, better vigor, thus increases in the yield [9]. Proper uniformity of the pre-sowing seed treatment method for individual crops and variety is the major eminent factors of the which gives the success to the seed priming [10]. The most favorable invigoration technique for improving the rate and uniformity of plant vigor stand is halo-priming [11]. Seed priming with KNO_3 chemical is considered to be a helpful treatment to increase the germination of seed [12]. Some studies shows that KNO_3 primed

seeds have outstanding performance than over all other priming agents [13]. Seed priming with KNO_3 showed beneficial impact on seed germination, seedling emergence, vigor index in the different vegetable crops [14]. Priming melon seeds with KNO_3 , 1 percent resulted in improved germination index, and energy of emergence compared with all other treatments and control [15]. Potassium has been illustrating as the 'quality element', assuring desirable quality of yield [16]. Significance of the study is the Seed halopriming with KNO_3 chemical is beneficial for farmers and other growers due to it gives the improved germination percentage and growth index. Seed priming give rise to better emergence and growth, early blooming, increase seed tolerance to the unfavorable environmental condition, and higher yield than un-primed seeds [17]. Priming of the seeds with KNO_3 salt is having the economically beneficial values for farmers [18]. Seed enhancement through priming has precede to great progress in farmer's ability to achieve this goal in the field and under controlled environment/greenhouse too as higher yield and profitable income [19]. Seed pre-soaking process causes the combining of membrane proteins with water and origination of several metabolic processes and then desiccation of seeds restricts the process [20]. Due to seed priming physiological and biochemical changes occurs in seed during the seed treatments and it fastens the metabolic activities also raise the alpha-amylase activity, thus shows higher vigor index and well-developed root and shoot [21]. Keeping in view of the importance of seed treatments in bottle gourd, hence the present study was planned to assessed the "Effect of invigoration treatment of different soaking periods on germination performance of bottle gourd seeds" (variety-Mohini) was study to look at with the subsequent objectives: To make a decision the foremost efficient treatment and its soaking period duration on germination performance of calabash seeds, and to enlighten the effect of seed invigoration treatment on germination performance and seed quality parameters of the seeds of bottle gourd.

2. MATERIALS AND METHODS

2.1 Experimental Site and Design

The experiment was conducted in control condition of Seed Testing Laboratory of Department of Genetics and Plant Breeding,

Sam Higginbottom University of Agriculture, Technology and sciences, Allahabad (U.P.) during last week of January to first week of February of 2021 in control condition. This experiment laid out in a completely randomized design with four replications.

2.2 Selection of Seeds

The bottle gourd seeds has the many useful officinal aspects but as we can see now a days farmers other growers do not take its production that much so the present attempt was made to accomplish an end has been made to study the effect of different soaking periods and concentrations of priming agents on emergence of bottle gourd, so that it can be beneficial for farmers and other growers for the good source of profitable income, greater yield and with health benefits by consumption of its fruit juice other dishes as burfi, Kaporkand, halwa and it's a good source of vitamins, minerals, other nutritional values [6].

The number of seeds used 100 for each replication according to the rule of ISTA. Two germination methods were used between paper method and the sand method on local variety of bottle gourd 'Mohini'. Chemical used in the treatments is Potassium nitrate (KNO_3).

2.3 Preparation of Chemical and Process of Seed Soaking

The chemical was prepared by taking a weight of the KNO_3 chemical on electronic balance as 50 ppm for each 2 treatments, then 100 ppm for each two treatments and then 125 ppm for each two treatments, then added them in 1000 ml distilled water and prepared a stock solution by stirring it persistently, same for the sand method with different concentrations as per mention in the treatments. After preparation of chemical solution then deep the bottle gourd seeds in that solution for different duration as 12 & 18 hrs. as per respective 6 treatments, T_0 = Control, T_1 =50 ppm KNO_3 (12 hrs), T_2 =50 ppm KNO_3 (18 hrs), T_3 =100 ppm KNO_3 (12 hrs), T_4 =100 ppm KNO_3 (18 hrs), T_5 =125 ppm KNO_3 (12 hrs), T_6 =125 ppm KNO_3 (18 hrs). in control condition at 25°C in a beaker. Then the flask containing chemical solution with seeds seal with muslin cloth to avoid any contamination. After soaking the seeds, the solution was drained out from the beaker and pre-soaked seeds were air dried to original weight and then placed for germination in laboratory condition.

2.4 Between Paper Method Procedure

In between paper method, all the 6 treatments with 4 replications were performed. In which pre-soaked seeds place on one layer of germination paper and put another germination paper on those seeds, then cover it with butter paper and make rolls. That means seeds are placed in between two layers of germination paper. Then kept them in a tray at 45°. Then keep them in germination chamber for 14 days. Then took the first count on 4th day, observe the seeds and final count on 14th day of the germinated seeds. Note the data of the germinated seeds and Seedling vigor parameters, which indicative of the ability to produce a normal plant under favourable conditions.

2.5 Sand Method Procedure

In sand method, take well sterilized sand then placed those pre-soaked seeds in sand trays. By the same way as in between paper same in sand method took the first count on 4th day observe the seeds and final count on 14th day of the germinated seeds. Noted the data of the germinated seeds and Seedling vigor parameters, which indicative of the ability to produce a normal plant under favourable/field conditions.

2.6 Data Analysis

This experiment laid out in a completely randomized design with four replications. By using one way Analysis of Variance (One way ANOVA), to examine the difference between individual's treatments. When significant difference was observed for each parameter except shoot length in between paper method, multiple comparisons using the, post hoc- Tukey HSD test to show the Least Significant Difference (LSD) were calculated to determine the treatment that differed significantly from the other treatment [22]. All LSD tests were performed at .05 significance level. This study is not based on comparison in between paper method and sand method. Here, between paper method and sand method are the two separate germination methods in which seed performance was analyse to check the effect of chemical concentration and soaking duration by invigoration technique using halopriming with chemical KNO_3 .

The data obtained by these formulas:

Germination percentage is calculated by-

$$\text{Germination (\%)} = \frac{\text{Number of seeds germinated}}{\text{Total Number of seeds}} \times 100$$

Seedling vigor parameters as follows:

a) Root Length(cm)

Root length was calculated after germination on the final day, for measuring radicle length of the seedlings or randomly selected to seedlings/replication in centimeter.

b) Shoot Length (cm)

Shoot length was calculated after germination on the final day, for measuring shoot length of the seedling on randomly selected to seedlings/replication in centimeter.

c) Seedling Length(cm)

It was calculated by taking the length of 10 normal seedling in moist towel paper by placing it at optimum temperature is measured in centimeter on the day of final count. The lot which shows the highest seedling length is examine as vigorous.

d) Seedling fresh weight (gm)

The weight of seedling without including the cotyledon was taken on 14th day on the final count. The lot which shows the highest seedling fresh weight is examine as vigorous.

e) Dry seedling weight (gm)

The weight of seedling without including the cotyledon was taken on 14th day on final count, after over drying at 130°C for 24 hrs, in hot air oven. The lot which shows the maximum seedling dry weight is examine as vigorous.

f) Seedling vigor index I

Germination percentage x seedling length on the day of final count (cm).

g) Seedling vigor index II

Germination percentage x seedling dry weight on the day of final count

3. RESULTS AND DISCUSSION

According to the results, all studied traits were affected by the treatments and there was

difference observed in between control (non-primed seeds) and in primed seeds. As the primed seeds performs more vigorously than unprimed seeds as shows seed pre-soaking with KNO₃, causes the combining of membrane proteins with water and beginning of several metabolic processes and if the desiccation of seeds done it restricts the further growth process [23]. Due to seed priming physiological and biochemical changes occurs in seed during the seed treatments and it fastens the activities of metabolism which give rise to faster seed germination led to development of root and shoot in less time than usually it takes, thus shows higher vigor index. Analysis of variance for seedling traits of Bottle gourd seeds for between paper method, shown in the (Table 1) and Analysis of variance for seedling traits of Bottle gourd seeds for sand method, shown in the (Table 2).

All seedling characters viz. Germination percent, Root length (cm), Shoot length (cm), Seedling length (cm), seedling fresh weight (g), seedling dry weight (g), Seedling vigour index I, Vigor index II were affected by KNO₃ 125 ppm concentration with 18 hrs of soaking duration compare to all other treatments, recorded maximum. In this study, in the between paper method the suitable treatment is 7th treatment with chemical concentration of 125 ppm KNO₃ soaking period for 18 hrs having higher results as germination % (81%), Root Length (11.5 cm), Shoot Length(8.7cm), Seedling Length (25.96 cm), Seedling Fresh Weight(10.57gm), Seedling Dry Weight (0.807 gm) and Seed Vigour Index I (2100.95), Seed Vigour Index II (6& 5.37). Mean comparison of germination and vigor traits of Bottle gourd seeds in between paper method as shown in (Table 3). In the case of Sand method compare to all other treatments 7th treatment with chemical concentration of 125 ppm KNO₃ Soaking period 18 hrs reports as highest results having germination % (76.5%), Root Length (11.5 cm), Shoot Length (9.9 cm), Seedling Length (23.16 cm), Seedling Fresh Weight (9.21 gm), Seedling Dry Weight (0.768 gm) and Seed Vigour Index I (1773.4), Seed Vigour Index II (58.83). Mean comparison of germination and vigor traits of Bottle gourd seeds in the sand method as shown in (Table 4).

Table 1. Analysis of variance for seedling traits of Bottle gourd seeds for Between Paper Method

	DF	Germination Percentage	Root length	Shoot length	Seedling length	Fresh weight of seedling	Dry weight of seedling	Seedling vigor Index-I	Seedling vigor Index-II
A	6	148.667 ***	7.944 ***	4.186	70.619 ***	6.945 ***	0.035 ***	710217	460.508 ***
Error A	21	4.667	1.339	2.828	3.845	0.707	0.002	18122.53	8.68
Total	27	36.667	2.807	3.13	18.684	2.093	0.009	171921.3	109.086
General Mean	1	72	9.679	7.629	20.239	8.915	0.709	1478.183	51.512
CV%	1	3	11.957	9.148	9.689	9.429	5.566	9.107	5.719
CD 5% _{Ai} - A _j A	11	3.177	1.702	2.473	2.884	1.236	0.058	197.959	4.332

significant at 5% and 1 % level of significance, respectively

Table 2. Analysis of variance for seedling traits of Bottle gourd seeds for Sand Method

	DF	Germination Percentage	Root length	Shoot length	Seedling length	Fresh weight of seedling	Dry weight of seedling	Seedling vigor Index-I	Seedling vigor Index-II
A	6	84.310 ***	13.004***	18.451***	116.320***	16.354**	0.112 ***	796575.000***	793.031***
Error A	21	3	2.008	2.922	16.689	2.859	0.018	90197.69	98.704
Total	27	21.069	4.451	6.373	38.829	5.857	0.039	247170.4	252.999
General Mean	1	69.429	9.246	7.082	16.441	6.633	0.545	1164.776	38.604
C.V. %	1	2.495	15.325	24.136	24.848	25.49	24.601	25.784	25.736
C.D. 5% _{Ai} - A _j A	11	2.547	2.084	2.514	6.007	2.486	0.197	441.636	14.61

significant at 5% and 1% level of significance, respectively

Table 3. Mean comparison of germination and vigor traits of Bottle gourd seeds in between paper method

	Germination Percentage	Root length	Shoot length	Seedling length	Fresh weight of seedling	Dry weight of seedling	Seedling vigor Index-I	Seedling vigor Index-II
A: 1	62.250	7.475	5.825	13.963	6.838	0.534	872.075	33.291
A: 2	67.750	8.425	7.025	16.657	7.850	0.657	1126.650	44.467
A: 3	69.750	9.225	7.275	18.228	8.338	0.680	1268.755	47.370
A: 4	72.500	9.875	7.725	20.725	9.090	0.738	1502.225	53.484
A: 5	74.750	10.400	8.200	22.500	9.663	0.761	1680.125	56.917
A: 6	76.000	10.825	8.600	23.638	10.050	0.785	1796.500	59.684
A: 7	81.000	11.525	8.750	25.963	10.575	0.807	2100.950	65.372
Overall Mean	72.000	9.679	7.629	20.239	8.915	0.709	1478.183	51.512
C.D. (5%) Ai-Aj	3.177	1.702	2.473	2.884	1.236	0.058	197.959	4.332
F (Prob)	0.000	0.001	0.233	0.000	0.000	0.000	0.000	0.000

Table 4. Mean comparison of germination and vigor traits of Bottle gourd seeds in sand method

	Germination Percentage-SM	Root length-SM	Shoot length (Final Count)-SM	Seedling length (Final Count)-SM	Fresh weight of seedling (Final Count)-SM	Dry weight of seedling (Final Count)-SM	Seedling vigor Index-I (SM)	Seedling vigor Index-II (SM)
A: 1	62.500	6.200	3.825	8.750	3.738	0.316	548.075	19.77
A: 2	66.750	7.650	5.150	10.915	4.675	0.374	729.780	25.052
A: 3	67.000	9.050	6.350	14.600	5.905	0.484	985.475	32.705
A: 4	69.750	9.800	7.225	16.675	6.695	0.553	1167.075	38.757
A: 5	70.250	10.000	8.175	19.195	7.468	0.606	1351.325	42.708
A: 6	73.250	10.500	8.875	21.788	8.738	0.714	1598.300	52.407
A: 7	76.500	11.525	9.975	23.163	9.213	0.768	1773.400	58.828
Overall Mean	69.429	9.246	7.082	16.441	6.633	0.545	1164.776	38.604
C.D. (5%) Ai-Aj	2.547	2.084	2.514	6.007	2.486	0.197	441.636	14.609
F (Prob)	0	0.001	0.001	0	0.001	0.001	0	0

3.1 Germination Percentage

FOR BETWEEN PAPER METHOD

In this study, in the between paper method the maximum increase in germination percentage occurs significantly by the 7th treatment (T₆) with 125 ppm KNO₃ soaking period is 18 hrs obtained germination % is 81% followed by the 6th treatment (T₅) with 125 ppm of KNO₃ for 12 hrs is 76% then treatment 5th (T₄) 100 ppm KNO₃ for 18 hrs having germination percentage 74.75% then treatment 4th (T₃) 100 ppm KNO₃ for 12 hrs germination percentage 72.5%, then followed by the 3rd treatment (T₂) 50 ppm KNO₃ 18 hrs reported the germination percentage is 69.75% and then treatment 2nd (T₁) 50 ppm KNO₃ for 12 hrs obtained germination percentage is 67.75%, while the lowest germination percentage 62.25% was observed with unprimed control (T₀) 1st treatment.

One Way ANOVA test, using F distribution df (6,21) for between paper method

H₀ hypothesis is, since p-value at significance level .05, H₀ is rejected. Some of the treatments' averages consider to be not equal. In other words, the difference between the averages of some treatments is big enough to be statistically significant. As per the one-way ANOVA statistic F value is 31.85 to [F-Tab value: 2.57]. The value of p is 0.00000 ***.

FOR SAND METHOD

In the sand method the maximum increase in germination percentage occurs significantly by the 7th treatment (T₆) with 125 ppm KNO₃ soaking period for 18 hrs is 76.5% followed by the 6th treatment (T₅) with 125 ppm chemical concentration of KNO₃ for 12 hrs is 73.25% then treatment 5th (T₄) 100 ppm KNO₃ for 18 hrs having germination percentage 70.25% then treatment 4th (T₃) 100 ppm KNO₃ for 12 hrs germination percentage 69.75%, then followed by the 3rd treatment (T₂) 50 ppm KNO₃ 18 hrs of soaking period reported the germination percentage is 67% and then treatment 2nd (T₁) 50 ppm KNO₃ soaking period of seeds is 12 hrs obtained germination percentage is 66.75%, while the lowest germination percentage 62.5% was observed with unprimed control (T₀) 1st treatment.

One Way ANOVA test, using F distribution df (6,21) for the sand method

H₀ hypothesis is, since p-value at significance level .05, H₀ is rejected. Some of the treatments' averages consider to be not equal. In other words, the difference between the averages of some treatments is big enough to be statistically significant. As per the one-way ANOVA statistic F value is 28.10 to [F-Tab value: 2.57]. The value of p is 0.00000 ***.

Figure Germination percentage of bottle gourd seeds in between paper method and sand method should be given below the in Fig. 1.

3.2 Root Length

FOR BETWEEN PAPER METHOD

This study reports that in the between paper method, the lowest root length of the seedling is 7.4 cm was observed with unprimed control 1st treatment (T₀), then treatment 2nd (T₁) 50 ppm KNO₃ for 12 hrs is 8.4 cm, 3rd treatment (T₂) 50 ppm KNO₃ for 18 hrs reported the 9.2 cm root length, treatment 4th (T₃) 100 ppm KNO₃ for 12 hrs having root length 9.8 cm, treatment 5th (T₄) 100 ppm KNO₃ for 18 hrs of soaking period having root length 10.4 cm, the 6th treatment (T₅) with 125 ppm of KNO₃ for 12 hrs is 10.8 cm, The maximum increase in root length occurs significantly by the 7th treatment (T₆) with chemical concentration 125 ppm KNO₃ soaking period is 18 hrs is 11.5 cm.

One Way ANOVA test, using F distribution df (6,21)

H₀ hypothesis is, since p-value at .05, H₀ is rejected. Some of the treatments' averages consider to be not equal. In other words, the difference between the averages of some treatments is big enough to be statistically significant. As per the one-way ANOVA statistic F value is 5.93 to [F-Tab value: 2.57]. The value of p is 0.00095 ***.

FOR SAND METHOD

In the sand method the lowest root length of the seedling is 6.2 cm was observed with unprimed control 1st treatment (T₀) then treatment 2nd (T₁) 50 ppm KNO₃ soaking period of seeds is 12 hrs obtained root length 7.6 cm, 3rd treatment (T₂) 50 ppm KNO₃ for 18 hrs reported the 9.05 cm, treatment 4th (T₃) 100 ppm KNO₃ for 12 hrs

having root length 9.8 cm, treatment 5th (T₄) 100 ppm KNO₃ for 18 hrs having root length 9.93 cm, the 6th treatment (T₅) with 125 ppm KNO₃ for 12 hrs is 10.5 cm, The maximum increase in root length occurs significantly by the 7th treatment (T₆) with chemical concentration 125 ppm KNO₃ soaking period is 18 hrs is 11.5 cm.

One Way ANOVA test, using F distribution df (6,21)

H₀ hypothesis is, since p-value at .05, H₀ is rejected. Some of the treatments' averages consider to be not equal. In other words, the difference between the averages of some treatments is big enough to be statistically significant. As per the one-way ANOVA statistic F value is 6.47 to [F-Tab value: 2.57]. The value of p is 0.00056 ***.

Figure Root length of bottle gourd seeds in between paper method and sand method should be given below the in Fig. 2.

3.3 Shoot Length

FOR BETWEEN PAPER METHOD

This study reports that in the between paper method, the lowest shoot length of the seedling is 5.8 cm was observed with unprimed control 1st treatment (T₀), then treatment 2nd (T₁) 50 ppm KNO₃ for 12 hrs obtained shoot length 7.0 cm, 3rd treatment (T₂) 50 ppm KNO₃ 18 hrs of soaking period reported the 7.2 cm shoot length, treatment 4th (T₃) 100 ppm KNO₃ for 12 hrs having shoot length 7.7 cm, treatment 5th (T₄) 100 ppm KNO₃ for 18 hrs having shoot length 8.2 cm, the 6th treatment (T₅) with 125 ppm chemical concentration of KNO₃ for 12 hrs is 8.6 cm shoot length, The maximum increase in shoot length occurs significantly by the 7th treatment (T₆) with chemical concentration 125 ppm KNO₃ soaking period is 18 hrs is 8.7 cm.

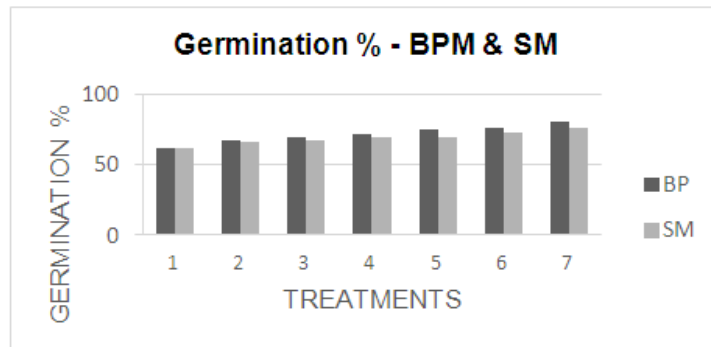


Fig. 1. Effect of different treatments on germination % of bottle gourd seeds. (Where, BP= Between Paper Method & SM= Sand Method)

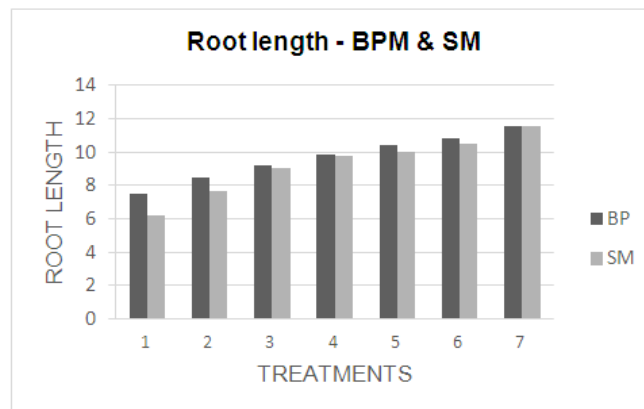


Fig. 2. Effect of different treatments on Root length of bottle gourd seeds. (Where, BP= Between Paper Method & SM= Sand Method)

One Way ANOVA test, using F distribution df (6,21)

H_0 hypothesis is, since p-value at .05, H_0 is accepted. Some of the treatments' averages consider to be equal. In other words, the difference between the averages of some treatments having very less variation to be statistically non-significant. As per the one-way ANOVA statistic F value is 1.48 to [F-Tab value: 2.57]. The value of p is 0.23285.

FOR SAND METHOD

In the sand method the lowest shoot length of the seedling is 3.8 cm was observed with unprimed control 1st treatment (T_0) then treatment 2nd (T_1) 50 ppm KNO_3 soaking period of seeds is 12 hrs obtained shoot length 5.1 cm, 3rd treatment (T_2) 50 ppm KNO_3 18 hrs of soaking period reported the 6.3 cm shoot length, treatment 4th (T_3) 100 ppm KNO_3 for 12 hrs having shoot length 7.2 cm, treatment 5th (T_4) 100 ppm KNO_3 for 18 hrs having shoot length 8.1 cm, the 6th treatment (T_5) with 125 ppm chemical concentration of KNO_3 for 12 hrs shoot length is 8.8 cm, The maximum increase in shoot length occurs significantly by the 7th treatment (T_6) with chemical concentration 125 ppm KNO_3 soaking period is 18 hrs is 9.9 cm.

One Way ANOVA test, using F distribution df (6,21)

H_0 hypothesis is, since p-value at .05, H_0 is rejected. Some of the treatments' averages consider to be not equal. In other words, the difference between the averages of some treatments is big enough to be statistically significant. As per the one-way ANOVA statistic F value is 6.31 to [F-Tab value: 2.57]. The value of p is 0.00065 ***.

Figure Shoot length of bottle gourd seedlings in between paper method and sand method should be given below the in Fig. 3.

3.4 Seedling Length

FOR BETWEEN PAPER METHOD

This study reports that in the between paper method, the lowest seedling length of the seedling is 13.96 cm was observed with unprimed control 1st treatment (T_0), then treatment 2nd (T_1) 50 ppm KNO_3 soaking period of seeds is 12 hrs obtained seedling length 16.65 cm, 3rd treatment (T_2) 50 ppm KNO_3 18 hrs reported the 18.22 cm is seedling length,

treatment 4th (T_3) 100 ppm KNO_3 for 12 hrs of soaking period having seedling length 20.72 cm, treatment 5th (T_4) 100 ppm KNO_3 for 18 hrs of having seedling length 22.5 cm, the 6th treatment (T_5) with 125 ppm chemical concentration of KNO_3 for 12 hrs seedling length is 23.63 cm, The maximum increase in seedling length occurs significantly by the 7th treatment (T_6) with chemical concentration 125 ppm KNO_3 soaking period is 18 hrs is 25.96 cm.

One Way ANOVA test, using F distribution df (6,21)

H_0 hypothesis is, since p-value at .05, H_0 is rejected. Some of the treatments' averages consider to be not equal. In other words, the difference between the averages of some treatments is big enough to be statistically significant. As per the one-way ANOVA statistic F value is 18.365 to [F-Tab value: 2.57]. The value of p is 0.00000 ***.

FOR SAND METHOD

In the sand method the lowest seedling length of the seedling is 8.75 cm was observed with unprimed control 1st treatment (T_0), then treatment 2nd (T_1) 50 ppm KNO_3 soaking period of seeds is 12 hrs obtained seedling length 10.91 cm, 3rd treatment (T_2) 50 ppm KNO_3 18 hrs of soaking period reported the seedling length is 14.6 cm, treatment 4th (T_3) 100 ppm KNO_3 for 12 hrs having seedling length 16.67 cm, treatment 5th (T_4) 100 ppm KNO_3 for 18 hrs having seedling length 19.19 cm, the 6th treatment (T_5) with 125 ppm KNO_3 for 12 hrs is 21.78 cm seedling length, The maximum increase in seedling length occurs significantly by the 7th treatment (T_6) with chemical concentration 125 ppm KNO_3 soaking period is 18 hrs is 23.16 cm.

One Way ANOVA test, using F distribution df (6,21)

H_0 hypothesis is, since p-value at .05, H_0 is rejected. Some of the treatments' averages consider to be not equal. In other words, the difference between the averages of some treatments is big enough to be statistically significant. As per the one-way ANOVA statistic F value is 6.97 to [F-Tab value: 2.57]. The value of p is 0.00035 ***.

Figure Seedling length of bottle gourd seeds in between paper method and sand method should be given below the in Fig. 4.

3.5 Seedling Fresh Weight

FOR BETWEEN PAPER METHOD

This study reports that in the between paper method, the lowest seedling fresh weight of the seedling is 6.84 gm was observed with unprimed control 1st treatment (T₀), then treatment 2nd (T₁) 50 ppm KNO₃ soaking period of seeds is 12 hrs obtained seedling fresh weight 7.85 gm, 3rd treatment (T₂) 50 ppm KNO₃ 18 hrs reported the

8.33 gm is seedling fresh weight, treatment 4th (T₃) 100 ppm KNO₃ for 12 hrs having seedling fresh weight 9.09 gm, treatment 5th (T₄) 100 ppm KNO₃ for 18 hrs having seedling fresh weight 9.66 gm, the 6th treatment (T₅) with 125 ppm chemical concentration of KNO₃ for 12 hrs seedling fresh weight is 10.05 gm, The maximum increase in seedling fresh weight occurs significantly by the 7th treatment (T₆) with chemical concentration 125 ppm KNO₃ soaking period is 18 hrs is 10.57 gm.

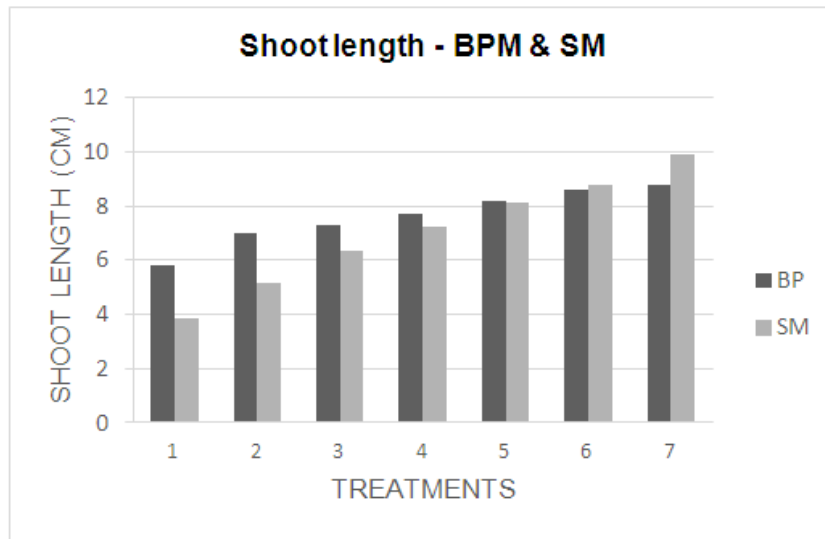


Fig. 3. Effect of different treatments on Shoot length of bottle gourd seeds. (Where, BP= Between Paper Method & SM= Sand Method)

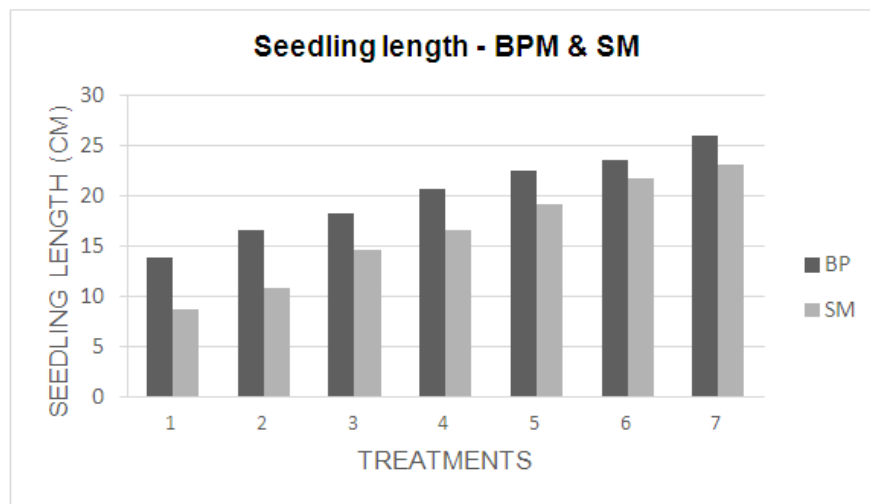


Fig. 4. Effect of different treatments on Seedling length of bottle gourd seeds. (Where, BP= Between Paper Method & SM= Sand Method)

One Way ANOVA test, using F distribution df (6,21)

H₀ hypothesis is, since p-value at .05, H₀ is rejected. Some of the treatments' averages consider to be not equal. In other words, the difference between the averages of some treatments is big enough to be statistically significant. As per the one-way ANOVA statistic F value is 9.82 to [F-Tab value: 2.57]. The value of p is 0.00003 ***.

FOR SAND METHOD

In the sand method the lowest seedling fresh weight of the seedling is 3.74 gm was observed with unprimed control 1st treatment (T₀), then treatment 2nd (T₁) 50 ppm KNO₃ soaking period of seeds is 12 hrs obtained seedling fresh weight 4.68 gm, 3rd treatment (T₂) 50 ppm KNO₃ 18 hrs reported the seedling fresh weight is 5.91 gm, treatment 4th (T₃) 100 ppm KNO₃ for 12 hrs having seedling fresh weight 6.70 gm, treatment 5th (T₄) 100 ppm KNO₃ for 18 hrs of soaking period having seedling fresh weight 7.47 gm, the 6th treatment (T₅) with 125 ppm chemical concentration of KNO₃ for 12 hrs is 8.74 gm seedling fresh weight, The maximum increase in seedling fresh weight occurs significantly by the 7th treatment (T₆) with chemical concentration 125 ppm KNO₃ soaking period is 18 hrs is 9.21 gm.

One Way ANOVA test, using F distribution df (6,21)

H₀ hypothesis is, since p-value at .05, H₀ is rejected. Some of the treatments' averages consider to be not equal. In other words, the difference between the averages of some treatments is big enough to be statistically significant. As per the one-way ANOVA statistic F value is 5.72 to [F-Tab value: 2.57]. The value of p is 0.00118 **.

Figure Seedling Fresh weight of bottle gourd seeds in between paper method and sand method should be given below the in Fig. 5.

3.6 Seedling Dry Weight

FOR BETWEEN PAPER METHOD

This study reports that in the between paper method, the lowest seedling dry weight of the seedling is 0.534 gm was observed with unprimed control 1st treatment (T₀), then

treatment 2nd (T₁) 50 ppm KNO₃ soaking period of seeds is 12 hrs obtained seedling dry weight 0.657 gm, 3rd treatment (T₂) 50 ppm KNO₃ 18 hrs reported the 0.679 gm seedling dry weight, treatment 4th (T₃) 100 ppm KNO₃ for 12 hrs having seedling dry weight 0.737 gm, treatment 5th (T₄) 100 ppm KNO₃ for 18 hrs having seedling dry weight 0.761 gm, the 6th treatment (T₅) with 125 ppm chemical concentration of KNO₃ for 12 hrs seedling dry weight is 0.785 gm, The maximum increase in seedling dry weight occurs significantly by the 7th treatment (T₆) with chemical concentration 125 ppm KNO₃ soaking period is 18 hrs is 0.807 gm.

One Way ANOVA test, using F distribution df (6,21)

H₀ hypothesis is, since p-value at .05, H₀ is rejected. Some of the treatments' averages consider to be not equal. In other words, the difference between the averages of some treatments is big enough to be statistically significant. As per the one-way ANOVA statistic F value is 22.73 to [F-Tab value: 2.57]. The p value is 0.00000 ***.

FOR SAND METHOD

In the sand method the lowest seedling dry weight of the seedling is 0.316 gm was observed with unprimed control 1st treatment (T₀), then treatment 2nd (T₁) 50 ppm KNO₃ soaking period of seeds is 12 hrs obtained seedling dry weight 0.374 gm, 3rd treatment (T₂) 50 ppm KNO₃ 18 hrs reported the seedling dry weight is 0.484 gm, treatment 4th (T₃) 100 ppm KNO₃ for 12 hrs having seedling dry weight 0.553 gm, treatment 5th (T₄) 100 ppm KNO₃ for 18 hrs having seedling dry weight 0.606 gm, the 6th treatment (T₅) with 125 ppm chemical concentration of KNO₃ for 12 hrs is 0.714 gm seedling dry weight, The maximum increase in seedling dry weight occurs significantly by the 7th treatment (T₆) with chemical concentration 125 ppm KNO₃ soaking period is 18 hrs is 0.768 gm.

One Way ANOVA test, using F distribution df (6,21)

H₀ hypothesis is, since p-value at .05, H₀ is rejected. Some of the treatments' averages consider to be not equal. In other words, the difference between the averages of some treatments is big enough to be statistically significant. As per the one-way ANOVA statistic F value is 6.21 to [F-Tab value: 2.57]. The value of p is 0.00072 ***.

Figure Seedling dry weight of bottle gourd seeds in between paper method and sand method should be given below the in Fig. 6.

3.7 Seedling Vigor Index I

FOR BETWEEN PAPER METHOD

This study reports that in the between paper method, the lowest seedling vigor index I is 872.063 was observed with unprimed control 1st treatment (T₀), then seedling vigor index I for treatment 2nd (T₁) 50 ppm KNO₃ soaking period

of seeds is 12 hrs obtained 1126.63, then seedling vigor index I for 3rd treatment (T₂) 50 ppm KNO₃ 18 hrs reported the 1268.8, For treatment 4th (T₃) 100 ppm KNO₃ for 12 hrs having vigor index I is 1502.213, treatment 5th (T₄) 100 ppm KNO₃ for 18 hrs having seedling vigor index I is 1680.1, seedling vigor index I for the 6th treatment (T₅) with 125 ppm chemical concentration of KNO₃ for 12 hrs is 1796.5, The maximum increase in seedling vigor index I occurs significantly by the 7th treatment (T₆) with chemical concentration 125 ppm KNO₃ soaking period is 18 hrs is 2100.95.



Fig. 5. Effect of different treatments on Seedling Fresh weight of bottle gourd seeds. (Where, BP= Between Paper Method & SM= Sand Method)

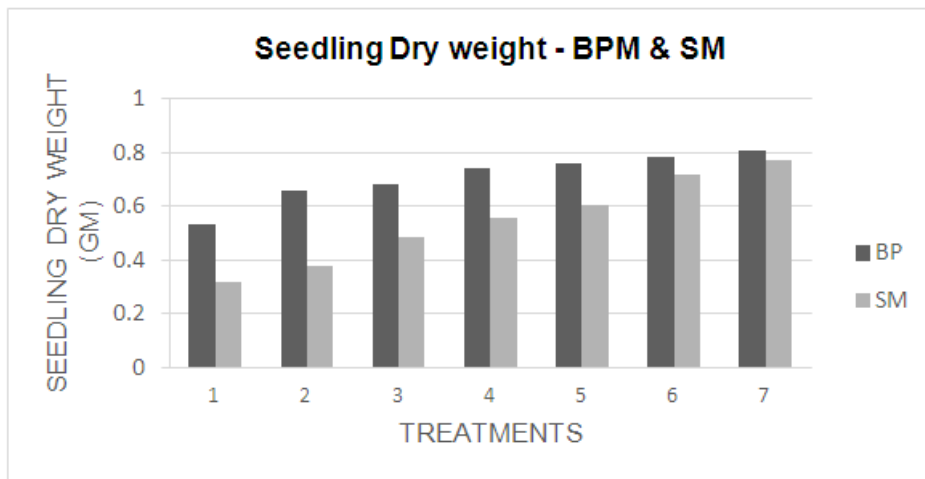


Fig. 6. Effect of different treatments on Seedling dry weight of bottle gourd seeds. (Where, BP= Between Paper Method & SM= Sand Method)

One Way ANOVA test, using F distribution df (6,21)

H₀ hypothesis is, since p-value at .05, H₀ is rejected. Some of the treatments' averages consider to be not equal. In other words, the difference between the averages of some treatments is big enough to be statistically significant. As per the one-way ANOVA statistic F value is 39.19 to [F-Tab value: 2.57]. The value of p is 0.00000 ***.

FOR SAND METHOD

This study reports that in the sand method, the lowest seedling vigor index I is 548.1 was observed with unprimed control 1st treatment (T₀), then seedling vigor index I for treatment 2nd (T₁) 50 ppm KNO₃ soaking period of seeds is 12 hrs obtained 729.8, then seedling vigor index I for 3rd treatment (T₂) 50 ppm KNO₃ 18 hrs of soaking period reported the 985.5, For treatment 4th (T₃) 100 ppm KNO₃ for 12 hrs having vigor index I is 1167.1, treatment 5th (T₄) 100 ppm KNO₃ for 18 hrs having seedling vigor index I is 1351.33, seedling vigor index I for the 6th treatment (T₅) with 125 ppm of KNO₃ for 12 hrs 1598.3, The maximum increase in seedling vigor index I occurs significantly by the 7th treatment (T₆) with chemical concentration 125 ppm KNO₃ soaking period is 18 hrs is 1773.4.

One Way ANOVA test, using F distribution df (6,21)

H₀ hypothesis is, since p-value at .05, H₀ is rejected. Some of the treatments' averages consider to be not equal. In other words, the difference between the averages of some treatments is big enough to be statistically significant. As per the one-way ANOVA statistic F value is 8.83 to [F-Tab value: 2.57]. The value of p is 0.00007 ***.

Figure Seedling Vigour Index I of bottle gourd seeds in between paper method and sand method should be given below the in Fig. 7.

3.8 Seedling Vigor Index II

FOR BETWEEN PAPER METHOD

This study reports that in the between paper method, the lowest seedling vigor index II is 33.29 was observed with unprimed control 1st treatment (T₀), then seedling vigor index II for treatment 2nd (T₁) 50 ppm KNO₃ soaking period

of seeds is 12 hrs obtained 44.46, then seedling vigor index II for 3rd treatment (T₂) 50 ppm KNO₃ 18 hrs reported the 47.36, For treatment 4th (T₃) 100 ppm KNO₃ for 12 hrs having vigor index II is 53.48, treatment 5th (T₄) 100 ppm KNO₃ for 18 hrs of soaking period having seedling vigor index II is 56.91, seedling vigor index II for the 6th treatment (T₅) with 125 ppm chemical concentration of KNO₃ for 12 hrs is 59.68, The maximum increase in seedling vigor index II occurs significantly by the 7th treatment (T₆) with chemical concentration 125 ppm KNO₃ soaking period is 18 hrs is 65.37.

One Way ANOVA test, using F distribution df (6,21)

H₀ hypothesis is, since p-value at .05, H₀ is rejected. Some of the treatments' averages consider to be not equal. In other words, the difference between the averages of some treatments is big enough to be statistically significant. As per the one-way ANOVA statistic F value is 53.054 to [F-Tab value: 2.57]. The p value is 0.00000 ***.

FOR SAND METHOD

In the sand method, the lowest seedling vigor index II is 19.77 was observed with unprimed control 1st treatment (T₀), then seedling vigor index II for treatment 2nd (T₁) 50 ppm KNO₃ soaking period of seeds is 12 hrs obtained 25.05, then seedling vigor index II for 3rd treatment (T₂) 50 ppm KNO₃ 18 hrs of soaking period reported the 32.71, For treatment 4th (T₃) 100 ppm KNO₃ for 12 hrs having vigor index II is 38.76, treatment 5th (T₄) 100 ppm KNO₃ for 18 hrs having seedling vigor index II is 42.71, seedling vigor index II for the 6th treatment (T₅) with 125 ppm chemical concentration of KNO₃ for 12 hrs 52.41, The maximum increase in seedling vigor index II occurs significantly by the 7th treatment (T₆) with chemical concentration 125 ppm KNO₃ soaking period is 18 hrs is 58.83.

One Way ANOVA test, using F distribution df (6,21)

H₀ hypothesis is, since p-value at .05, H₀ is rejected. Some of the treatments' averages consider to be not equal. In other words, the difference between the averages of some treatments is big enough to be statistically significant. As per the one-way ANOVA statistic F value is 8.034 to [F-Tab value: 2.57]. The value of p is 0.00014 ***.

Figure Seedling Vigour Index II of bottle gourd seeds in between paper method and sand method should be given below the in Fig. 8.

Post hoc analysis - Tukey (HSD) for traits of bottle gourd seeds in the between paper method and in the sand method

By using one way Analysis of Variance (One way ANOVA) to examine the difference between individual's treatments. When significant difference was observed for each parameter except shoot length in between paper method, multiple comparisons using the, post hoc- Tukey HSD test to show the Least Significant Difference (LSD) were calculated to determine the treatment that differed significantly from the other treatment [22]. All LSD tests were performed at .05 significance level. Shows in the Table 5 for between paper method and in Table 6 for the sand method.

FOR BETWEEN PAPER METHOD

In the between paper method positive and honest significant difference were observed in the traits of bottle gourd seeds as, for germination percentage (CV= 2.61, p value= .00, CD at 5%= 2.80, CD at 1%= 3.83), for root length (CV= 6.81, p value= .00, CD at 5%= 0.98, CD at 1%= 1.34), for shoot length (CV= 6.80, p value= .00, CD at 5%= 0.77, CD at 1%= 1.05), for seedling length(CV= 9.71, p value= .00, CD at 5%= 2.92, CD at 1%= 4.00), for seedling fresh weight (CV= 6.09, p value= .00, CD at 5%= 0.80, CD at 1%= 1.10), for seedling dry weight (CV= 5.51, p value= .00, CD at 5%= 0.05, CD at 1%= 0.08), for seedling vigor index I (CV= 9.50, p value= .00, CD at 5%= 208.63, CD at 1%=285.84), for seedling vigor index II (CV= 5.62, p value= .00, CD at 5%= 4.30, CD at 1%= 5.89).

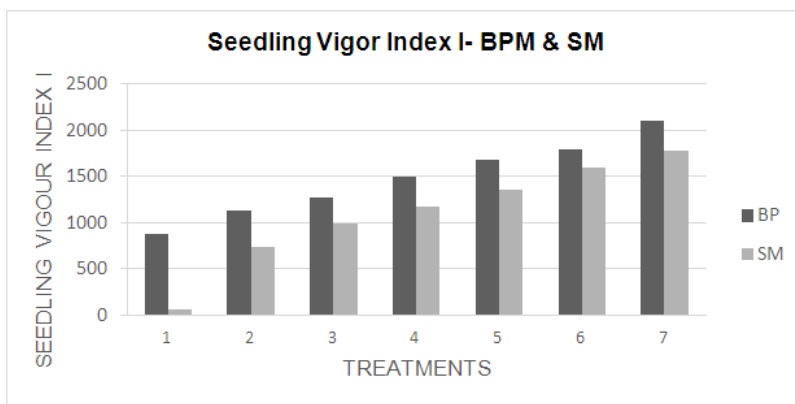


Fig. 7. Effect of different treatments on Seedling Vigour Index I of bottle gourd seeds. (Where, BP= Between Paper Method & SM= Sand Method)

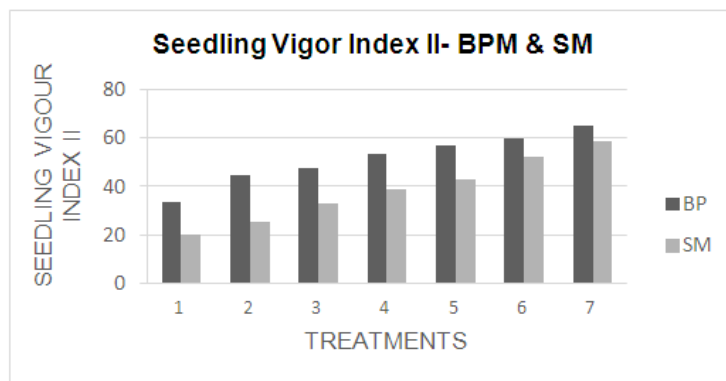


Fig. 8. Effect of different treatments on Seedling Vigour Index II of bottle gourd seeds. (Where, BP= Between Paper Method & SM= Sand Method)

Table 5. Post hoc analysis - Tukey (HSD) for traits of bottle gourd seeds in the between paper method

	Germination Percentage	Root length	Shoot length	Seedling length	Fresh weight of seedling	Dry weight of seedling	Seedling vigour Index-I	Seedling vigour Index-II
A: 1	62.25 ^{E[†]}	7.475 ^{C^e}	5.825 ^{B^d}	13.963 ^{D^e}	6.838 ^{C[†]}	0.534 ^{D^e}	872.075 ^{E^e}	33.291 ^{E^e}
A: 2	67.750 ^{D^e}	8.425 ^{C^{de}}	7.025 ^{B^c}	16.657 ^{C^{de}}	7.850 ^{C^e}	0.657 ^{C^d}	1126.650 ^{D^d}	44.467 ^{D^d}
A: 3	69.750 ^{D^{de}}	9.225 ^{B^{cd}}	7.275 ^{B^c}	18.228 ^{C^{cd}}	8.337 ^{C^{de}}	0.680 ^{C^{cd}}	1268.755 ^{D^d}	47.370 ^{D^d}
A: 4	72.500 ^{C^{cd}}	9.875 ^{B^{bc}}	7.725 ^{A^{bc}}	20.725 ^{B^{bc}}	9.090 ^{B^{cd}}	0.737 ^{B^{bc}}	1502.225 ^{C^c}	53.484 ^{C^c}
A: 5	74.750 ^{B^{bc}}	10.400 ^{B^b}	8.200 ^{A^{ab}}	22.500 ^{B^b}	9.663 ^{B^{bc}}	0.761 ^{B^{ab}}	1680.125 ^{B^{bc}}	56.917 ^{B^{bc}}
A: 6	76.000 ^{B^b}	10.825 ^{A^{ab}}	8.600 ^{A^a}	23.637 ^{A^{ab}}	10.050 ^{A^{ab}}	0.785 ^{A^{ab}}	1796.500 ^{B^b}	59.684 ^{B^b}
A: 7	81.000 ^{A^a}	11.525 ^{A^a}	8.750 ^{A^a}	25.963 ^{A^a}	10.575 ^{A^a}	0.807 ^{A^a}	2100.950 ^{A^a}	65.372 ^{A^a}
Gen.	72.000	9.679	7.629	20.239	8.915	0.709	1478.183	51.512
Mean								
C.V.	2.619	6.818	6.801	9.719	6.097	5.516	9.501	5.622
F Prob.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
S.E.M.	0.943	0.330	0.259	0.983	0.272	0.020	70.219	1.448
C.D. 5%	2.801	0.980	0.771	2.922	0.807	0.058	208.632	4.302
C.D. 1%	3.838	1.343	1.056	4.003	1.106	0.080	285.841	5.894

Table 5 Determination of the treatment that differed significantly from the other treatment in between paper method.

Table 6. Post hoc analysis - Tukey (HSD) for traits of bottle gourd seeds in the sand method

	Germination Percentage-SM	Root length-SM	Shoot length (Final Count)-SM	Seedling length (Final Count)-SM	Fresh weight of seedling (Final Count)-SM	Dry weight of seedling (Final Count)-SM	Seedling vigour Index-I (SM)	Seedling vigour Index-II (SM)
A: 1	62.500 ^{E^e}	6.200 ^{C^d}	3.825 ^{B^e}	8.750 ^{C[†]}	3.738 ^{C^e}	0.316 ^{C^e}	548.075 ^{C[†]}	19.770 ^{C^e}
A: 2	66.750 ^{D^d}	7.650 ^{C^{cd}}	5.150 ^{B^{de}}	10.915 ^{C^{ef}}	4.675 ^{C^{de}}	0.374 ^{C^e}	729.780 ^{C^{ef}}	25.052 ^{C^{de}}
A: 3	67.000 ^{D^d}	9.050 ^{C^{bc}}	6.350 ^{B^{cd}}	14.600 ^{B^{de}}	5.905 ^{B^{cd}}	0.484 ^{B^d}	985.475 ^{B^{de}}	32.705 ^{B^{cd}}
A: 4	69.750 ^{C^c}	9.800 ^{B^{ab}}	7.225 ^{A^{bc}}	16.675 ^{B^{cd}}	6.695 ^{B^{bc}}	0.553 ^{B^{cd}}	1167.075 ^{B^{cd}}	38.757 ^{B^{bc}}
A: 5	70.250 ^{C^c}	10.000 ^{B^{ab}}	8.175 ^{A^b}	19.195 ^{B^{bc}}	7.467 ^{B^b}	0.606 ^{B^{bc}}	1351.325 ^{B^{bc}}	42.707 ^{B^b}
A: 6	73.250 ^{B^b}	10.500 ^{A^{ab}}	8.875 ^{A^{ab}}	21.787 ^{A^{ab}}	8.738 ^{A^a}	0.714 ^{A^{ab}}	1598.300 ^{A^{ab}}	52.407 ^{A^a}
A: 7	76.500 ^{A^a}	11.525 ^{A^a}	9.975 ^{A^a}	23.162 ^{A^a}	9.213 ^{A^a}	0.768 ^{A^a}	1773.400 ^{A^a}	58.827 ^{A^a}
Gen.	69.429	9.246	7.082	16.441	6.633	0.545	1164.776	38.604
Mean								

	Germination Percentage-SM	Root length-SM	Shoot length (Final Count)-SM	Seedling length (Final Count)-SM	Fresh weight of seedling (Final Count)-SM	Dry weight of seedling (Final Count)-SM	Seedling vigour Index-I (SM)	Seedling vigour Index-II (SM)
C.V.	2.404	13.098	15.705	15.149	12.623	13.349	16.732	14.843
F Prob.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
S.E.M.	0.835	0.606	0.556	1.245	0.419	0.036	97.447	2.865
C.D. 5%	2.479	1.799	1.652	3.700	1.244	0.108	289.531	8.512
C.D. 1%	3.397	2.465	2.264	5.069	1.704	0.148	396.679	11.662

Table 6 Determine the treatment that differed significantly from the other treatment in the sand method

FOR SAND METHOD

In the sand method positive and honest significant difference were observed in the traits of bottle gourd seeds, as for germination percentage (CV= 2.40, p value= .00, CD at 5%= 2.47, CD at 1%= 3.39), for root length (CV= 13.09, p value= .00, CD at 5%=1.79, CD at 1%= 2.46), for shoot length (CV= 15.70, p value= .00, CD at 5%=1.65, CD at 1%= 2.26), for seedling length(CV= 15.14, p value= .00, CD at 5%= 3.70, CD at 1%= 5.06), for seedling fresh weight (CV= 12.62, p value= .00, CD at 5%= 1.24, CD at 1%= 1.70), for seedling dry weight (CV= 13.34, p value= .00, CD at 5%= 0.10, CD at 1%= 0.14), for seedling vigor index I (CV= 16.73, p value= .00, CD at 5%= 289.53, CD at 1%=396.67), for seedling vigor index II (CV= 14.84, p value= .00, CD at 5%= 8.51, CD at 1%= 11.66).

4. CONCLUSION

Among all the Invigoration methods, halopriming with 125 ppm with soaking period 18 hrs was found the best for seed quality parameters by using two different germination methods as between paper method and sand method. It shows that, in both the germination methods the seeds having chemical concentration 125 ppm with 18 hrs of soaking duration reports the higher germination and better growth performance than unprimed seeds and other treatments. So, it is concluded that different concentration and different soaking period of halopriming treatments with chemical KNO_3 enriches the seed quality parameters of Bottle gourd seeds.

The success or failure of priming treatments are influenced by a complex interlinkage of factor including species of the plant, liquid potential of priming agent, time of priming, temperature factor, vigor of the seed, desiccation and conditions of the storage succeeds the priming.

The suggested techniques could be adopted by the producers in order to obtain quick and better emergence, production of elite seedlings, and in turn good crop and yield.

In Future, there is a need for investigating the mechanisms of seed improvement due to halo priming with different chemical concentration and different duration of priming, with these priming techniques, if any in field crops for better understanding of physiological seed enrichment. It is better to develop a package for on-farm

priming that can be adoptable by the farmers for value addition and improved crop performance.

Considering the situation of the present experiment needs, more study on it and with different techniques should be used to increase the accuracy of the study. Advance studies in the following areas may be suggested:

1. It needs to conduct more experiments using some other seed priming concentrations in field condition whether it can regulate the growth, yield and seed quality of bottle gourd.
2. It needs to conduct related experiment with other varieties of bottle gourd.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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