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Impact of Seed Priming and Growing Media on Germination and Seedling Growth of Bitter Gourd

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Aims: The aim of this study was to determine the suitable growing media and priming treatments for seed germination and seedling growth of bitter gourd (cv. BARI hybrid Korola 2).
Study Design: The experiment was set up in a completely randomized design (CRD) with sixteen treatments, each containing fifteen seedlings.
Place and Duration of the Study: The experiment was conducted on Horticulture farm at Sher-e-Bangla Agricultural University; Dhaka, Bangladesh from March to April 2021.
Methodology: Four seed priming treatments were used in the experiments: T_0: Seed soak in distilled water for 12 h (control), T_1:Hot water treatment (45^0C for 5 min), T_2: Poly ethylene glycol (PEG) 6000 (5%), T_3: Sodium chloride solution (NaCl) (2%) soak for 12h and four growing media viz.,M_0: soil + cow dung (1:1), M_1: soil + cow dung + vermicompost (1:1:1), M_2: soil + cow dung + sawdust (1:1:1), M_3: soil + cow dung + cocopeat (1:1:1).

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Results: The maximum germination percentage (100%), highest shoot (21.00 cm) and root length (12.83 cm), seed vigor index (3383.3) was recorded in T_2M_3 treatment. However, the maximum photosynthetic pigment (30.31 mg/g), relative water content (96.99%) and shoot (3.53g) and root fresh weight (0.47 g) was found in T_2M_1 treatment.

Conclusion: It can be concluded that soil + cow dung + cocopeat (1:1:1) with PEG 6000 (5%) is the best treatment for bitter gourd seed germination, while soil + cow dung + vermicompost (1:1:1) with PEG 6000 (5%) is better for vigor and healthy seedlings.

Keywords: Germination percentage; photosynthetic pigments; bitter gourd; fresh weight.

1. INTRODUCTION

In Bangladesh, bitter gourd (*Momordica charantia* L.) is a popular summer vegetable. Its immature fruit is heavy in nutritional fibers, minerals, and vitamins (C and A), and it also functions as a blood purifier, which is extremely useful for diabetics [1]. There is an urgent need to boost production of bitter gourd due to rising demand for medicinal and culinary uses. Even though bitter gourd seeds have a high germinability, field emergence is always an issue because of the thick seed coat, which causes the seed to progressively consume water and result in delayed germination [2].

In many crops, seed priming is an effective, useful, and straightforward method to promote quick and consistent emergence, high seedling vigor, and yield in adverse environmental circumstances [3]. It has been demonstrated to help a variety of horticultural and agricultural crops in terms of seed germination, seedling establishment, and eventually yield [4]. Hot water treatment was shown to be effective due to its greater penetrative potential [5]. By enhancing water uptake and nutrient availability, seed priming with PEG is an effective treatment for boosting canola crop performance in terms of seedling growth, chlorophyll content, and yield [6]. It has been shown that halopriming with NaCl improves germination and seedling establishment in milk thistle [7]. Seed germination, development, and the effectiveness of the roots system are all directly impacted by the choice of growing media or substrates [8]. An ideal growing medium would give the plant enough anchoring or support, act as a reservoir for nutrients and water, diffuse oxygen to the roots, and facilitate gaseous exchange between the roots and the surrounding environment [9]. Vermicompost has a variety of phenolic and humic active ingredients, each with a unique dosage and genotype-dependent effects on seed germination and the early phases of seedling growth [10]. Organic-based media encourages superior root development when compared to soil-based media [11]. There has been little research published on the use of various growing media and priming treatments in bitter gourd production. Consequently, the goal of the study was to ascertain how different growing media and priming treatments affect seed germination and seedling growth of bitter gourd.

2. MATERIALS AND METHODS

2.1 Plant Materials and Growing Conditions

The experiment was conducted at the Horticulture Farm of Sher-e-Bangla Agricultural University, Dhaka, Bangladesh, located at 23°42′37″N (Latitude), 90°24′26″ E (Longitude) and has an average elevation of 4 meters. The experiment took place from March to April 2021. Bitter gourd seed cv. BARI hybrid Korola 2 was collected from Bangladesh Agricultural Research Institute, Gazipur, Bangladesh and planted under poly net house in plastic polybag (6 inch × 5 inch). The experiment was set up in a completely randomized design (CRD) with sixteen treatments having fifteen seedlings in each treatment. During the trial period of March to April 2021, the average minimum and maximum temperatures were 30.5°C and 33.2°C, respectively, with an average relative humidity 60%. Throughout the study, all critical cultural practices and plant protection measures were applied to all plants in the same way. For morphological and physiological observations, ten plants were chosen at random in each treatment.

2.2 Treatments

The four priming treatments: T_0: Seed soak in distilled water for 12 h (control), T_1: Hot water treatment (45^0 C for 5 min), T_2: Poly ethylene glycol (PEG) 6000 (5%), T_3: Sodium chloride solution (NaCl) (2%) soak for 12h. Except for the hot water treatment, seeds were washed in the solution for 12 hours at room temperature in the dark. After priming, seeds were placed in plastic polybags containing various types of growth material, including M_0: soil + cow dung (1:1), M_1: soil +cowdung + vermicompost (1:1:1), M_2: soil + cow dung + sawdust (1:1:1), M_3: soil + cow dung + cocopeat (1:1:1). The nutrient level of the soil used in this experiment was measured at the soil research and development institution in Dhaka and the results are displayed in Tables 1 and 2.

2.3 Germination Percentage and Vigor Index of Bitter Gourd Seedling

The number of days to germination was determined from the beginning of germination to the end of germination. The following formula was used to calculate seedling vigor and germination percentage:

Germination percentage = total number of seeds germination/total number of seeds sown × 100 [12]

Vigor index = germination percentage × total length of seedling [13].

2.4 Length of Shoot and Root (cm)

At 11 days after sowing shoot and root length was measured. Shoot length was measured from the collar region to the apical bud of the shoot and root length was measured using a meter scale from the spot where the first root started up to the end tip of the main root. The average length of the shoot and root was measured in centimeters.

2.5 Fresh and Dry Weight of Shoot and Root (g)

At 11 days after sowing, the seedling was cleaned and chopped into the collar region after it had been uprooted. Then, shoot and root fresh weight was measured using an electric digital scale and the mean value was computed. After drying the shoot and root in an electric oven drier at 65℃ for 72 hours, the dry weight was measured and the mean value was computed.

2.6 Leaf Area (cm^2) and Number of Leaves/Plant

Leaf area was estimated by multiplying the leaf length and width. At 11 days after sowing, the total number of leaves was counted.The average leaf area, leaf number, and mean value were calculated.

2.7 SPAD Chlorophyll Meter Reading

A SPAD-502 chlorophyll meter (Minolta, Tokyo, Japan) was used to determine the amount of chlorophyll present in the first fully opened leaves. Measurements were taken from the middle of the leaf lamina of each treated and control plant [14].

Table 1. Physical and chemical characteristics of the experimental soil

Characteristics	Value
% Sand	27
% Silt	43
% Clay	30
Textural class	Silty Clay Loam (ISSS)
pH	5.6
Organic carbon (%)	0.45
Organic matter (%)	0.78
Total N (%)	0.03
Available P (ppm)	20
Exchangeable K (mg/100 g soil)	0.1
Available S (ppm)	45

Table 2. Initial nutrient composition of the following substrates

Properties	Nutrients		
	N%	P%	K%
Cow dung	0.42	0.18	0.30
Sawdust	0.45	0.009	0.018
Cocopeat	0.46	0.80	1.30
Vermicompost	1.23	1.13	1.18

2.8 Relative Water Content

The relative water content (RWC) was determined according to Smart and Bingham [15]. Ten leaves from ten plants were pooled for each treatment and their fresh weights (FW) were computed. The turgid tissue was swiftly blotted to remove excess water after soaking the leaves in room temperature for twelve hours and then turgid weight (TW) was measured. The samples were subsequently dried in an oven set at 65°C for 24 hours in order to calculate their dry weights (DW). The following formula was used:

$$RWC\ \% = ((FW-DW)/(TW-DW))*100.$$

2.9 Photosynthetic Pigments

Moran and Porath [16] approach was used to detect photosynthetic pigments. Liquid nitrogen was used to grind 0.2 g of leaf tissue into a powder, which was then homogenized with 1 ml of 100% N, N-dimethylformamide (DMF). To collect the supernatant, homogenized materials were centrifuged at 10,000 rpm for 10 minutes. The samples were centrifuged after another 1 ml of DMF was added. After removing the supernatant, 1 ml DMF was added. A spectrophotometer was used to measure absorbance at 663 and 645 nm. Calibration was performed with a 100% DMF blank. The following formulas were used to determine chlorophyll a, b, and total chlorophyll:

Chlorophyll *a* (mg g-1 tissue) =

$$\frac{[12.7(OD663)-2.69(OD645)]\times V}{1000}\times W$$

Chlorophyll *b* (mg g^{-1} tissue) =

$$\frac{[22.9(OD645)-4.68(OD663)]\times V}{1000}\times W$$

Total Chlorophyll (mg g^{-1} tissue) =

$$\frac{[8.02(OD663)+20.20(OD645)]\times V}{1000}\times W$$

Where OD denotes the optical density at each nm, V is the final volume of chlorophyll extract, and W denotes the fresh weight of the extracted tissue.

2.10 Statistical Analysis

Statistics 10 (IBM Corp, Armonk, NY, USA) was used for all statistical analyses. The mean value across treatments was refereed statistically significant when p<0.05.

3. RESULTS AND DISCUSSION

3.1 Germination Percentage and Vigor Index

Statistically significant variation was recorded for germination percentage due to combined effect of priming treatment and growing media (Fig. 1A). Results of the experiment indicated that highest germination percentage (100%) was recorded from T_2M_3 treatment whereas the lowest germination percentage (76.67%) was recorded from T_0M_0 treatment. Osmo primed seeds have a higher germination rate and improved uniformity in seedling emergence, which help to crop establishment and thus yield [17]. PEG is non-damaging to proteins and has no negative effects on seed embryos, resulting in increased germination [18]. The physical and chemical features, structure, texture, pH, and nutrients of coco peat and peat moss are constrictive [19]. Organic matter like coco dust and sawdust increased the germination rate, which might be due to contain of higher amounts of essential nutrients (N, P, K) [20].

The effect of several priming treatments and growth media on vigor index varied dramatically (Fig.1B).The results revealed that highest vigor index (3383.3) was recorded from T_2M_3 treatment while the lowest vigor index (1631) was recorded from T_0M_0 treatment. PEG may help with seed vigor index by seed priming since this treatment is suitable for the metabolic response, improving seed germination efficiency, seedling establishment, and boosting seedling growth in soybean [21]. Islam *et al*. [22] stated that the vigor index reflects the health of the seedling and, ultimately, the plant's output. The use of coco peat with soil as a growing media, increased germination percentage and reduced the incidence of damping off seedling, plant height of tomato seedlings will enhance the final production of healthy and vigorous tomato seedlings which provide better yields [23].

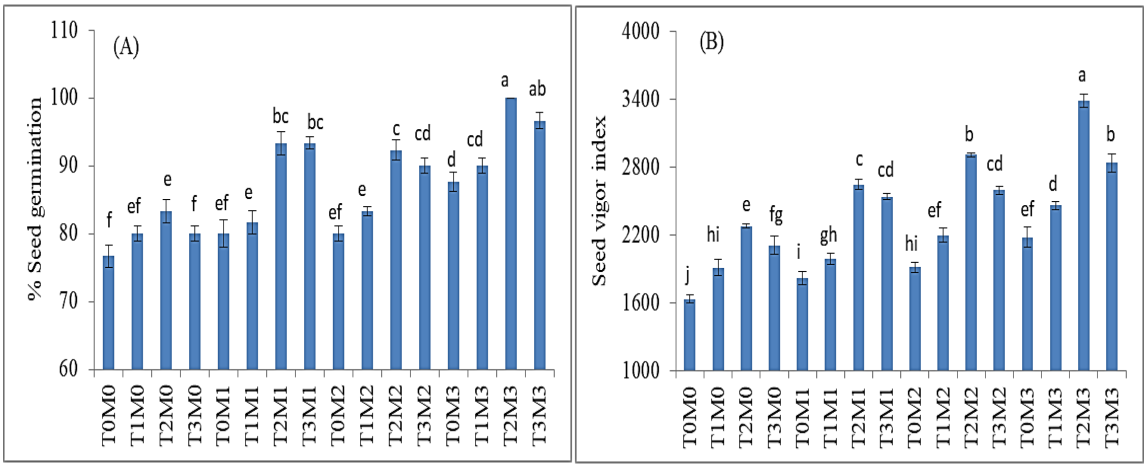

Fig.1. Effect of seed priming treatments and growing media on seed germination (%) (A) and vigor index (B) of bitter gourd seedling

T_0=Distilled water, T_1= Hot water, T_2= Polyethelene glycol (PEG), T_3=Sodium Chloride (NaCl), M_0=soil+cow dung, M_1=soil + cow dung + vermicompost, M_2= soil + cow dung + sawdust, M_3= soil + cow dung + cocopeat. Means in a column that are followed by the same letter (s) do not differ significantly at the 5% level of LSD.

3.2 Shoot and Root Length (cm)

Combined effect of different priming and growing media showed significant variation for shoot and root length of bitter gourd (Table 3). Results revealed that the tallest shoot (21.00 cm) was recorded from T_2M_3 treatment whereas the shortest shoot (14.29 cm) was recorded from T_0M_0. The longest root length (12.83 cm) was found from T_2M_3 treatment while the shortest root length (6.83 cm) was found from T_0M_1 treatment. Osmo priming with PEG primed wheat seeds resulted in a faster and longer elongation of shoot and root of wheat seedling than non-primed seeds [24].The maximum seedling length of bitter gourd occurs in Poly Ethylene Glycol over control treatment [25]. Organic manure like cocodust contain macro and micro nutrients in available forms during mineralization and improving physico-chemical properties of soils which led to taller seedling [26].

3.3 Leaf Area and Number of Leaves/Plant

Different seed priming and growing media showed significant variation for leaf area and leaf number of bitter gourd plant^{-1} (Table 3). The maximum leaf area plant^{-1} (100.83 cm^2) was recorded in T_2M_1 and the minimum leaf area plant^{-1} (50.33cm^2) was found in T_0M_0 treatment. The application of organic manure such as vermicompost increased the leaf area of watermelon plant because it improves the soil physical, chemical and biological properties and creates optimum conditions for vigorous plant growth and development [27]. Seeds treated with PEG400 for 24 h produced maximum leaf area of okra than other treatments [28].

In most of the treatments, there was no significant difference on leaf number plant^{-1} of bitter gourd (Table 3). However, the highest leaf number plant^{-1} was recorded (5.00) fromT_1M_1, T_2M_1 and T_1M_3 treatment and the lowest leaf number plant^{-1}(3.50) was found from T_0M_0 treatment. Osmo priming with PEG significantly increased leaf number of rape seed as compared to un-primed seeds [29]. Plants treated with vermicompost developed a large leaf area. It could be because of increased nutritional availability, which results in increased production of photo synthetically effective leaves.

3.4 Fresh Weight of Shoot and Root

Growing media and seed priming caused a considerable variation in the fresh weight of the shoot and root (g) at bitter gourd seedlings (Table 4). The bitter gourd treatment T_2M_1 produced the maximum fresh weight of the shoot (3.53 g) and root (0.47 g), while the treatment T_0M_0 produced the lowest fresh weight of the shoot (2.07 g) and root (0.16 g) (Table 4). Poly Ethylene Glycol 5% for 12 hrs showed a substantially higher fresh weight of shoot of bitter gourd [30]. When compared to unprimed seeds, PEG priming increased the biomass of shoots and roots because primed seeds had faster metabolisms, which facilitated faster imbibition [31].Organic manure, such as vermicompost, improves the physico-chemical properties of soil, which promotes nutrient availability and, as a result, increases the fresh weight of shoots and roots of cucumber seedlings [32].

3.5 Dry Weight of Shoot and Root

The maximum shoot (0.32 g) and root (0.035 g) dry weight of bitter gourd seedling was recorded from T_2M_1, while the minimum dry weight of shoot (0.18 g) and root (0.019 g) was recorded from T_0M_0 (Table 4).Seed priming with PEG significantly increased dry biomass of rice seedling [33]. According to Lenin *et al.* [34], using vermicompost as growing media resulted in the greatest increase in plant dry weight of groundnut. Vermicompost significantly improves photosynthetic rate, dry matter production, and fresh and dry weight of tomato seedling [35].Vermicompost increased water and nutrient mobilization, which may have resulted in better photosynthetic product production and transport to different plant sections, resulting in higher seedling growth of papaya and thus more fresh and dry weight [36].

3.6 Photosynthetic Pigment

The highest content of chlorophyll a, chlorophyll b and total chlorophyll were found in T_2M_1 treatment (18.94 mg/g, 11.37 mg/g and 30.31 mg/g respectively) and the lowest was found in T_0M_0 treatment (13.79 mg/g, 6.94 mg/g and 20.73 mg/g respectively) (Table 5). Seed priming protects chlorophyll breakdown and increases pigment concentrations in photosynthetic pigments [37]. The application of PEG markedly elevated the amounts of carotenoids and chlorophylls a, b in date palm plantlets [38].Organic manure like vermicompost acts as nutrient reservoir and these nutrients are released slowly during entire growth period leading to accumulate more photosynthates accumulation as well as yield of crop [39].

3.7 Relative Water Content (RWC) and SPAD Value

There was a significant difference in relative water content in different seed priming and growing media (Table 5). The maximum RWC was recorded in T_2M_1treatment (96.99%) and the minimum RWC was recorded T_0M_0 treatment (69.32%). When compared to non-primed seeds, primed seeds with PEG solution significantly improved RWC in wheat plants [40]. Vermicompost increased the relative water content of guava seedlings [41].

Table 3.Effect of seed priming and different growing media on shoot and root length, leaf area and leaf number of bitter gourd

Treatment	Shoot length (cm)	Root length(cm)	Leaf area (cm^2)	Leaf number
T_0M_0	14.29^{f}	7.00^{ij}	50.33^{j}	3.50^{d}
T_1M_0	16.02^{e}	7.83^{g-i}	61.50^{h}	4.67^{ab}
T_2M_0	18.33^{c}	9.00^{ef}	76.67^{e}	4.67^{ab}
T_3M_0	18.00^{c}	8.33^{f-h}	69.58^{f}	4.33^{bc}
T_0M_1	15.50^{ef}	6.83^{j}	72.08^{f}	4.33^{bc}
T_1M_1	16.00^{e}	8.33^{f-h}	81.75^{cd}	5.00^{a}
T_2M_1	19.00^{bc}	9.33^{de}	100.83^{a}	5.00^{a}
T_3M_1	18.50^{c}	8.67^{e-g}	92.25^{b}	4.33^{bc}
T_0M_2	16.27^{e}	7.67^{h-j}	54.50^{i}	4.00^{cd}
T_1M_2	17.67^{cd}	8.67^{e-g}	68.58^{fg}	4.67^{ab}
T_2M_2	20.17^{ab}	11.33^{b}	84.08^{c}	4.67^{ab}
T_3M_2	18.83^{bc}	10.00^{cd}	78.75^{de}	4.67^{ab}
T_0M_3	16.50^{ed}	8.33^{f-h}	65.33^{g}	4.33^{bc}
T_1M_3	18.33^{c}	9.00^{ef}	71.50^{f}	5.00^{a}
T_2M_3	21.00^{a}	12.83^{a}	94.41^{b}	4.67^{ab}
T_3M_3	19.00^{bc}	10.33^{c}	82.83^{c}	4.67^{ab}
LSD (0.05)	1.39	0.99	3.71	0.65
CV (%)	4.73	6.66	2.96	8.64

T_0=Distilled water, T_1= Hot water, T_2= Polyethelene glycol (PEG), T_3=Sodium Chloride (NaCl), M_0=soil+cow dung, M_1=soil + cow dung + vermicompost, M_2= soil + cow dung + sawdust, M_3= soil + cow dung + cocopeat. Means in a column that are followed by the same letter (s) do not differ significantly at the 5% level of LSD.

Table 4. Effect of different seed priming treatments and growing media on shoot and root fresh and dry weight of bitter gourd

Treatment	Shoot fresh weight(g)	Root fresh weight(g)	Shoot dry weight(g)	Root dry weight(g)
T_0M_0	2.07^{g}	0.16^{h}	0.18^{g}	0.01^{9h}
T_1M_0	2.37^{fg}	0.21^{f}	0.29^{a-d}	0.022^{f-h}
T_2M_0	2.80^{b-e}	0.30^{d}	0.26^{de}	0.027^{b-d}
T_3M_0	2.84^{b-d}	0.23^{ef}	0.28^{b-d}	0.023^{d-g}
T_0M_1	2.56^{c-f}	0.29^{d}	0.21^{fg}	0.026^{c-f}
T_1M_1	2.46^{d-f}	0.35^{c}	0.22^{ef}	0.028^{bc}
T_2M_1	3.53^{a}	0.47^{a}	0.32^{a}	0.035^{a}
T_3M_1	2.62^{c-f}	0.41^{b}	0.26^{de}	0.034^{a}
T_0M_2	2.33^{fg}	0.18^{gh}	0.19^{fg}	0.020^{gh}
T_1M_2	2.64^{b-f}	0.25^{e}	0.30^{ab}	0.022^{e-h}
T_2M_2	2.66^{b-f}	0.37^{c}	0.26^{d}	0.029^{bc}
T_3M_2	2.89^{bc}	0.30^{d}	0.30^{ab}	0.026^{c-e}
T_0M_3	2.43^{e-g}	0.21^{fg}	0.21^{fg}	0.023^{e-g}
T_1M_3	2.62^{c-f}	0.30^{d}	0.29^{a-d}	0.026^{c-f}
T_2M_3	3.01^{b}	0.42^{b}	0.29^{a-d}	0.031^{ab}
T_3M_3	2.94^{bc}	0.36^{c}	0.27^{cd}	0.029^{bc}
LSD (0.05)	0.39	0.03	0.03	4.05
CV (%)	8.64	5.98	7.85	9.16

T_0=Distilled water, T_1= Hot water, T_2= Polyethelene glycol (PEG), T_3=Sodium Chloride (NaCl), M_0=soil+cow dung, M_1=soil + cow dung + vermicompost, M_2= soil + cow dung + sawdust, M_3= soil + cow dung + cocopeat. Means in a column that are followed by the same letter (s) do not differ significantly at the 5% level of LSD.

Table 5. Effect of different seed priming and growing media on chlorophyll a, chlorophyll b, total chlorophyll, relative water content and SPAD value of bitter gourd

Treatment	Chlorophyll a (mg/g)	Chlorophyll b (mg/g)	Total chlorophyll (mg/g)	Relative water content (%)	SPAD value
T_0M_0	13.79^{g}	6.94^{h}	20.73^{h}	69.32^{g}	30.67^{f}
T_1M_0	15.57^{c-g}	8.76^{e-g}	24.34^{e-g}	76.94^{f}	34.73^{e}
T_2M_0	16.52^{b-d}	9.89^{b-d}	26.41^{b-e}	85.21^{d}	35.97^{de}
T_3M_0	14.50^{e-g}	8.26^{fg}	22.76^{gh}	80.15^{ef}	34.60^{e}
T_0M_1	15.00^{d-g}	8.85^{e-g}	23.86^{fg}	85.38^{d}	35.33^{de}
T_1M_1	17.83^{ab}	10.82^{ab}	28.65^{ab}	89.99^{bc}	40.07^{a-c}
T_2M_1	18.94^{a}	11.37^{a}	30.31^{a}	96.99^{a}	42.00^{a}
T_3M_1	16.93^{b-d}	9.36^{c-e}	26.29^{c-e}	93.50^{ab}	37.02^{b-e}
T_0M_2	14.11^{fg}	7.11^{h}	21.22^{h}	71.34^{g}	34.67^{e}
T_1M_2	16.61^{b-d}	9.43^{c-e}	26.04^{d-f}	76.49^{f}	38.00^{b-e}
T_2M_2	17.46^{a-c}	10.01^{bc}	27.47^{b-d}	86.84^{cd}	38.30^{a-e}
T_3M_2	15.86^{b-f}	8.41^{fg}	24.27^{e-g}	78.69^{f}	35.80^{de}
T_0M_3	14.27^{e-g}	8.06^{g}	22.34^{gh}	78.63^{f}	36.18^{c-e}
T_1M_3	17.44^{a-c}	9.99^{bc}	27.44^{b-d}	84.13^{de}	38.70^{a-d}
T_2M_3	17.84^{ab}	10.74^{ab}	28.58^{a-c}	91.62^{b}	40.37^{ab}
T_3M_3	16.26^{b-e}	$9.04d^{ef}$	25.31^{d-f}	86.18^{cd}	37.40^{b-e}
LSD (0.05)	2.00	0.94	2.33	4.07	3.89
CV (%)	7.43	6.13	5.50	2.94	6.33

T_0=Distilled water, T_1= Hot water, T_2= Polyethelene glycol (PEG), T_3=Sodium Chloride (NaCl), M_0=soil+cow dung, M_1=soil + cow dung + vermicompost, M_2= soil + cow dung + sawdust, M_3= soil + cow dung + cocopeat. Means in a column that are followed by the same letter (s) do not differ significantly at the 5% level of LSD.

The treatment combination of T_2M_1 showed the highest chlorophyll (SPAD value) content of 42.00, whereas the treatment combination of T_0M_0 showed the lowest chlorophyll content of 30.67 (Table 3). Chlorophyll is essential for absorbing photon energy during the light-dependent process of photosynthesis, and seed priming with PEG 6000 protects chlorophyll degradation and enhances chlorophyll levels in chilli pepper [42].Vermicopost increased the availability of nitrogen, which may have aided in the synthesis of amino acids and chlorophyll [43]. Vermicompost increased leaf chlorophyll content of tomato [44] and chili seedlings [45].

4. CONCLUSION

Seed priming treatments showed rapid seed germination and strong seedling growth of bitter gourd. Among the priming treatments, PEG 6000 (5%) seed priming increased seed germination percentage, vigor index, and seedling length. The best treatment for bitter gourd seed germination is soil + cow dung + cocopeat (1:1:1) with PEG 6000 (5%). However, soil + cow dung + vermicompost (1:1:1) with PEG 6000 (5%) is beneficial for vigor and healthy seedling.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Yibchok-Anun S, Adisakwattana S, Yao CY, Sangvanich P, Roengsumran S,Hsu WH.. Slow acting protein extract from fruit pulp of *Momordica charantia* with insulin secretagogue and insulinomimetic activities. Biol. Pharm. Bull. 2006;29(6): 1126-1131.
2. Asna AC, Joseph J, Joseph John K. Botanical Description of Bitter Gourd BT—The Bitter Gourd Genome. In: Kole C, Matsumura H, Behera TK, editors. Cham: Springer International Publishing; 20207–31.
3. Guo Y, Li D, Liu L, Sun H, Zhu L, Zhang K, Zhao H, Zhang Y, Li A, Bai Z, Tian L. Seed priming with melatonin promotes seed germination and seedling growth of Triticale hexaploide L. under PEG-6000 induced drought stress. Front. Plant Sci. 2022;13:932912.
4. Farooq M, Basra SMA, Rehman H, Saleem BA. Seed priming enhances the performance of late sown wheat (*Triticum aestivum* L.) by improving chilling tolerance. J. Agron. Crop Sci. 2008; 194(1):55–60.
5. Maude RB.Seed-borne diseases and their control: principles and practice. CAB International. 1996. Wallingford. UK. 178 P.
6. Elahi NN, Farrukh NU, Jalaluddin S, Ahmed HM, Saima S, Mustafa S, Alahmadi TA, Ansari MJ, Battaglia ML, Danish S. Comparing the Positive Impacts and Stress Induction by Polyethylene Glycol (PEG 6000) Variable Levels on Canola (*Brassica napus* L.) Growth, Yield, and Oil Contents. ACS omega. 2023; 8(32):29046-59.
7. Sedghi M, Nemati A, Amanpour-Balaneji B, Gholipouri A. Influence of different priming materials on germination and seedling establishment of milk thistle (Silybummarianum) under salinity stress. World Appl. Sci. J. 2010; 11(5):604-9.
8. Meena SK, Rakshit A, Singh HB, Meena VS. Effect of nitrogen levels and seed bio-priming on root infection, growth and yield attributes of wheat in varied soil type. Biocatal. Agric. Biotechnol. 2017; 12:172-8.
9. Abad M, Noguera P, Puchades R, Maquieira A, Noguera V. Physico-chemical and chemical properties of some coconut coir dusts for use as a peat substitute for containerised ornamental plants. Bioresour. Technol. 2002; 82(3):241-5.
10. Ievinsh G, Vikmane M, Ķirse A, Karlsons A. Effect of vermicompost extract and vermicompost-derived humic acids on seed germination and seedling growth of hemp. In Proceedings of the Latvian Academy of Sciences. Section B. Natural, Exact, and App. Sci. 2017; 71(4): 286-292.
11. Kumawat R, Maji S, Meena DC. Studies on seed germination and seedling growth of papaya (*Carica papaya* L.) cv. Coorg Honey Dew as influenced by media and chemicals. J. crop weed. 2014; 10(2):281-6.
12. Hossain F, Islam N, Ali S, Kayes A, Choudhury S. 2023. GA_3 and growing medium influence papaya seed

germination and seedling growth. Trends in Hort. 2023; 6(2):3263.
13. Bewley JD, Black M. Physiology and biochemistry of seeds in relation to germination: volume 2: viability, dormancy, and environmental control. Springer Science & Business Media; 2012 Dec 6.
14. Choudhury S, Ali S, Sarker MR, Islam, N. 2023. Salinity tolerance in tomato genotypes at an early plant growth stage: Morphological and physiological responses. Trends in Hort. 2023;6(2): 3490.
15. Smart RE, Bingham GE. Rapid estimates of relative water content. Plant physiol. 1974;53(2):258-60.
16. Moran R, Porath D. Chlorophyll determination in intact tissues using N, N-dimethyl formamide. Plant physiol. 1980; 65(3):478-9.
17. Adhikari B, Dhital PR, Ranabhat S, Poudel H. Effect of seed hydro-priming durations on germination and seedling growth of bitter gourd (*Momordica charantia*). PloS one. 2021;16(8):0255258.
18. Lei C, Bagavathiannan M, Wang H, Sharpe SM, Meng W,Yu J. Osmopriming with PEG for abiotic stress tolerance in germinating crops seeds: A review. Agron. 2021;11: 1-12.
19. Riaz A, Arshad M, Younis A, Raza A, Hameed MA. Effects of different growing media on growth and flowering of Zinnia elegans cv. Blue point. Pak. J. Bot. 2008; 40(4):1579-85.
20. Atif MJ, Jellani G, Malik MH, Saleem N, Ullah H, Khan MZ, Ikram S. Different growth media effect the germination and growth of tomato seedlings. Sci. Technol. Dev. 2016; 35(3):123-7.
21. Sadeghi H, Khazaei F, Yari L, Sheidaei S. Effect of seed osmopriming on seed germination behavior and vigor of soybean (*Glycine max* L.). ARPN J. Agric. Biol. Sci. 2011; 6(1):39-43.
22. Islam MS, Abdul MB, Hossain T, Ahmed JU, Khan HI. Priming on embryo emergence and seedling vigour of small-fruited bitter gourd (*Momordica charantia* L.) under sub-optimal temperature. Int. J. Agril. Sci. Res. 2012; 2: 1-10.
23. Panthi S, Neupane P, Bhusal A. Effect of Different Nutrient Media in Growth and Health of Tomato Seedlings in Arghakhanchi District (Nepal). Asian J. Agric. Horti. Res. 2023; 10(4) :40-8.
24. Faijunnahar M, Baque A, Habib MA, Hossain HM. Polyethylene glycol (PEG) induced changes in germination, seedling growth and water relation behavior of wheat (*Triticum aestivum* L.) genotypes. Univers. J. Plant Sci. 2017;5(4):49-57.
25. Saini R, Rai PK, Bara BM, Sahu P, Anjer T, Kumar R. Effect of different seed priming treatments and its duration on seedling characters of Bitter gourd (*Momordica charantia* L.). J. Pharmacog. Phytochem. 2017; 6(5):848-50.
26. Uranw R, Kumari A., Singh A, Sidharth S,Priyadharshini V. Response of organic and inorganic fertilizer on growth and yield of bitter gourd: A review.PharmaInnov. *J*. 2022;11(5): 1558-1562.
27. Dalorima TL, Zakaria AJ, Majrashi A, Mahmud K, Mohd KS, Muhammad H, Khandaker MM. Impacts of vermicomposting rates on growth, yield and qualities of red seedless watermelon. Australian J. Crop Sci. 2018; 12(11):1765-73.
28. Mabuza M, Tana T. Effects of osmo-priming on germination, growth and green pod yield of okra *[Abelmoschus esculentus* (L.) Moench] at Luyengo, Middleveld of Eswatini. World J. Adv. Res.Rev. 2021; 11(1):029-38.
29. Adnan M, Rehman HA, Asif M, Hussain M, Bilal HM, Adnan M, Rehman F, Ahmad S, Khalid M. Seed priming; an effective way to improve plant growth. EC Agric. 2020; 6(6):1-5.
30. Rawat M. Effects of seed priming and it's duration on bitter gourd. J. Pharmacog. Phytochem. 2020; 9(6):1950-1953.
31. Guan B, Cao D,Yu JB. Eco-physiological responses of seed germination of sweet sorghum to seed prime plant growth.EC Agric. 2018; 6(6): 1-5.
32. Jankauskiene J, Lauzike K, Kavaliauskaite D. Effects of vermicompost on quality and physiological parameters of cucumber (*Cucumis sativus* L.) seedlings and plant productivity.Horticulturae.2022; 8: 1-13.
33. Salah SM, Yajing G, Dongdong C, Jie L, Aamir N, Qijuan H, Weimin H, Mingyu N, Jin H. Seed priming with polyethylene glycol regulating the physiological and molecular mechanism in rice (*Oryza sativa* L.) under nano-ZnO stress. Sci. Reports. 2015; 5(1):14278.
34. Lenin M, Selvakumar G, Thangadurai R. Growth and nutrient content variation of groundnut Arachishypogaea L. under

vermicompost application. J. Exp. Sci. 2010;1(8):12–16

35. Hazarika M, Saikia J, Gogoi S, Kalita P, Saikia L, Phookan DB, Kumar P. Different growing media effect on seedling quality and field performance of Tomato (*Solanum lycopersicum*L.). J. Pharm. Innov. 2022; 11(11): 308-314
36. Anjanawe SR, Kanpure RN, Kachouli BK, Mandloi DS.Effect of plant growth regulators and growth media on seed germination and growth vigour of papaya. Ann. Plant Soil Res. 2012;15(1):31-34.
37. Piri R, Moradi A, Balouchi H, Salehi A. Improvement of cumin (*Cuminum cyminum*) seed performance under drought stress by seed coating and biopriming.Sci. Hortic.2019; 257: 108667.
38. Din AF, Ibrahim MF, Farag R, El-Gawad HG, El-Banhawy A, Alaraidh IA, Rashad YM, Lashin I, El-Yazied AA, Elkelish A, Elbar OH. Influence of polyethylene glycol on leaf anatomy, stomatal behavior, water loss, and some physiological traits of date palm plantlets grown in vitro and ex vitro. Plants. 2020; 9(11):1440.
39. Khan MZ, Era MD, Islam MA, Khatun R, Begum A,BillahSM. Effect of coconut peat on the growth and yield response of *Ipomoea aquatic.* American J. Plant Sci. 2019; 10: 369-381.
40. Baque MA, Faijunnahar M, Habib MA,Motmainna M.PEG induced germination, seedling growth and water relation behavior of wheat genotypes under salt stress condition. Univ. J. Plant Sci. 2018; 6(3): 21-31.
41. Abou El Seoud II, El Adly R, Abd El Fattah H, Fedalah W, Thabet Y. Vermicompost and biochar effects on the mycorrhizal symbiosis and soil microbial community associated with guava seedlings. Alex. J. Soil Water Sci. 2022; 6(1), 15-35.
42. Rachmawati D, Aisy SP, Novanursandy NB. Effect of seed priming on growth and physiological responses of chili pepper (*Capsicum frutescens* L.) under salinity stress. In IOP Conference Series: Earth and Environmental Science 2023;1165(1): 012016. IOP Publishing.
43. Dayeswari D, Auxcilia J, Vijayakumar RM, et al.Role of KNO3, KCl, KH2PO4, GA3, halopolymer and PPFM on seed germination, seedling growth and vigour of TNAU papaya CO. 8 (*Carica papaya* L.). J. Biotech. Crop Sci. 2018; 7(11): 140–146.
44. Kaur P, Bhardwaj M,BabbarI. Effect of vermicompost and vermiwash on growth of vegetables.Res. J. Anim.Vet. Fishery Sci. *2015;* 3(4): 9-12.
45. Narkhede, S. D., Attarde, S. B. and Ingle, S. T.Study of effect of chemical fertilizer and vermicompost on growth of chilli pepper plant (*Capsicum annum).* J. App. Sci. Environ. Sanitat. 2011; 6(3): 327-332.

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