Proceedings of the Pakistan Academy of Sciences: Part B
Life and Environmental Sciences 59(3): 1-8 (2022)

ISSN (Print): 2518-4261; ISSN (Online): 2518-427X
http://doi.org/10.53560/PPASB(59-3)711

Pakistan Academy of Sciences

Research Article

Efficacy of Seed Priming through Plant Hormones on the Germination of Bitter Melon (*Momordica charantia* L.)

Qusay Abdulhamza Muttaleb[1*], Ahmed Falih Shamukh[2], and Dunia Mohi Mohsen[2]

[1]Department of Community Health, Technical Institute of Babylon,
Al-Furat Al-Awsat Technical University, Babil, Iraq
[2]Department of Animal Production, College of Agriculture, University of Misan, Maysan, Iraq

Abstract: TBitter melon (*Momordica charantia* L.) is a fast-growing vine and seeds germinated quickly in warm soil even if covered with shaded by crops. Due to its high medicinal benefits, it is the most essential vegetable crop. The findings of this study indicated that the germination percentage of the bitter melon variety i.e. Bitter gourd-1 (BG-1) was highly affected by the application of different concentrations of plant hormone. Such an effect was even prominent in comparison without the application of plant hormones. The seed germination was significantly highest (96.4 %) @ NAA 0.9 (900 mg/1000 ml). The germination time (days) was significantly lower 5.10 days @ NAA 0.3 (300 mg/1000 ml) and consistently increased at higher concentration of PGR (7.46 days at NAA 0.6 (600 mg/1000 ml) and 8.53 days at 1.5 (1500 mg/1000 ml), respectively. The germination index was 1.91 recorded higher at the control treatment. The results further indicated that the germination index of bitter gourd increased as the concentration of PGR increased. Overall, these findings indicated that the impact of PGR on the germination index was obvious, and the index enhanced as PGR concentration increased. The seedling vigour index was significantly maximum 1835 recorded at NAA 0.3 (300 mg/1000 ml) and followed by NAA 1.5 (1500 mg/1000 ml) with 1292, respectively. The results further showed that the seedling vigour index of bitter gourd decreased between 709 and 1024 at the control and distilled water treatments. We concluded that seed priming is a tool for sustainable agriculture.

Keywords: Bitter melon, Seed priming, plant hormones, germination

1. INTRODUCTION

Bitter gourd, *Momordica charantia* L. is one of the significant important vegetables belonging to the Cucurbitaceae family. It is well known as a tropical and subtropical vegetable vine with tendrils cultivated in Asia and Africa. Fruits and seeds both are soft, and vegetables are often harvested at an immature stage. Bitter gourd is more famous for its bitter taste and in fact, it is bitter than all other cucurbits but considered as an essential vegetable due to its highly nutritious values and medicinal purpose. Vegetable fruits contain ascorbic acid and iron which are highly worthless and necessarily required for the human body [1]. Though, it is annually cultivated but can also be grown as a perennial in warm areas having frost-free winters. It is reported that the ideal temperature range is 25-28 ºC for better germination of bitter gourd seeds [2]. However, the widespread practice of sowing bitter gourd is a direct seed, but direct seedlings can also be transplanted to the field. Due to the hard seed coat, delayed emergence is often caused because of slow water absorption. Thus, poor germination, delay in emergence after seedling, slow growth rate and survival of plants are the key issues for limiting the yield of bitter gourd. To notify the issue of seed dormancy, the imbibition process could perform a vital role, thus in hormonal activity, seeds of vegetables or fruits are pre-soaked with an ideal phytohormone concentration which increases the physiological activities of plants and result in better germination, progressive growth of seedlings, better root penetration or growth and which all come in better yield [3]. Apart from this, it also plays a vital role in signalling pathways of plants [4].

Received: April 2022; Accepted: September 2022
*Corresponding Author: Qusay Abdulhamza Muttaleb <qusaymuttaleb@gmail.com>

Seed priming is a treatment performed before the sowing of seeds which produces a physiological change that leads the seed to germination more efficiently. Seed priming with phytohormones could alter the molecular and biochemical means which assist the plants to tolerate the stress of abiotic factors. Nowadays, such procedures are very likely [5]. Plant Growth Regulators (PGRs) are biochemical compounds that modulate the development and growth of plants. It takes place through changing the action of hormones. Through PGR, the yield of M. charantia could be increased by enhancing the fruit setting percentage. Globally, the awareness and realization regarding the usage of PGRs have been well documented for their imperative role to maximize crop yield and in this connection, Gibberellic acid (a PGRs) is a well-known growth regulator contributing to the physiological characteristics of plants particularly plant growth [6]. The gibberellic acid indirectly incites the cell extension of plant roots and shoots; meanwhile, Ethrel (another plant growth regulator) improvises the number of plant branches, fruit length, number of fruiting bodies, uniform ripening fruits and fruit colouration [7]. Keeping in view the significant effect of plant growth hormones on the germination and seedling growth of bitter gourd seeds, the present study was carried out to observe the effect of plant growth hormones on the seed germination and seedling growth of bitter gourd.

2. MATERIALS AND METHODS

Bitter gourd-1 (BG-1) is a commonly recommended variety of bitter melon grown in pots in a standardized soil medium at Misan city, South Iraq. Different quantities of synthetic plant hormone such as 1-Naphthaleneacetic acid (NAA) was mainly used throughout the study. Overall, five treatments for experiment were chosen including T1 = Control, T2 = Distilled water, T3 = NAA 0.3(g) (300 mg/1000 ml), T4 = NAA 0.9(g) (900 mg/1000 ml) and T5 = NAA 1.5(g) (1500 mg/1000 ml), respectively. In the experiment, these treatments were replicated thrice, and each replication contained three pots in a Completely randomized design (CRD). The observations to be recorded were Seed germination (%), Germination time (Days), Germination index (GI), and Seedling vigour index (SVI). The seed germination was observed up to one week of plantation and germination (%) was calculated by using the following formula given by Larsen and Andreasen (2004) [8].

$$GP = \sum n/N \times 100$$

Where n is number of germinated seeds at each count and N is the total seeds in each treatment. Meanwhile, the mean germination time (d) was calculated by using an equation. $MGT = \sum (n \times d)/\sum N$; Where n=number of seeds germinated on each day, d= number of days from the beginning of the test, and N= total number of seeds germinated. The Germination rate index (GRI) was calculated by the formula;

Germination rate index (GRI) = $G1/1+G2/2+....+Gi/i$;

where G1 is the germination percentage on day 1, G2 is the germination parentage on day 2; and so on. In last, the seedling vigour index (SVI) was calculated by the following formula,

(SVI) = Seedling length (cm) x germination %

Statistical Analysis

The recorded data were statistically analysed using Statistics computer software (SAS). The mean was separated using Least Significant Difference (LSD) at a probability p-value of 0.05.

3. RESULTS

3.1 Seed Germination (%)

The results for seed germination of BG1 were affected ($P < 0.05$) with the application of different concentrations of plant hormone as well as without the application of hormones as mentioned in (Figure 1). The seed germination was significantly highest (96. 4 %) @ NAA 0.9 (900 mg/1000 ml) followed by NAA 1.5 (1500 mg/1000 ml). The additional application of NAA (@1.5) decreased the germination percentage thus it shows an exact or balanced application of hormone is ideal to increase the germination percentage of bitter gourd. However, the low concentration of PGR 0.3 (300 mg/1000 ml)) also did not improve the seed germination percentage (71.4 %) but it was even better than the seed germination observed in

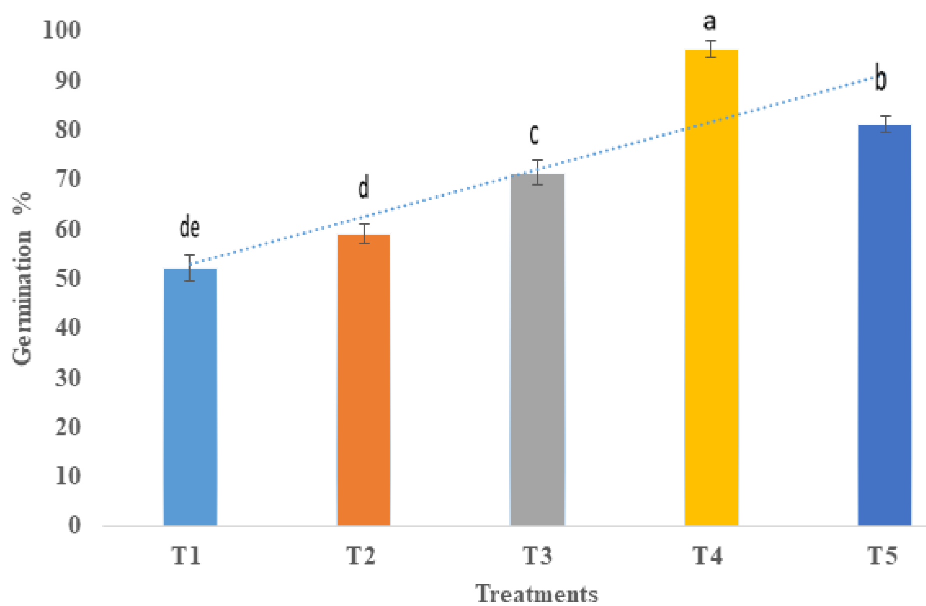

Fig 1. Seed germination percentage of bitter gourd at different hormones concentration

the control treatment (52.2 %) and with distilled water (59.1). The LSD test demonstrated that no significant difference in seed germination ($P > 0.05$) was observed at control treatment and distilled water. The overall results showed that there was a simultaneous improvement in the seed germination with increasing plant hormone concentrations but at a certain level of application.

3.2 Germination Time (Days)

The results for germination time of bitter gourd (BG1) showed a significant difference ($P < 0.05$) with and without plant hormones (at variable concentration) application (Figure 2). The germination time was significantly lower 5.10 days @ NAA 0.3 (300 mg/1000 ml) and consistently increased at higher concentration of PGR (7.46 days at NAA 0.6 (600 mg/1000 ml) and 8.53 days at 1.5 (1500 mg/1000 ml), respectively. However, the germination time was higher in distilled water and in the control treatment with a non-significant difference ($P > 0.05$) than the rest of the other treatments treated with variable concentrations of plant hormones. The highest time for germination of bitter gourd was 10.1 days observed in distilled water. These results clearly illustrated that germination time prominently influenced plant hormones. It suggests that we can get faster germination with the application of suitable plant hormones at exact concentrations.

3.3 Germination Index (GI)

The results regarding the germination index of the bitter gourd by different concentrations of plant hormones and without plant hormone is significantly different ($P < 0.05$) as presented in (Figure 3). The germination index was 1.91 recorded higher at control treatment (T1) followed by 1.89 at N.A.A 1.5 (1500 mg/1000 ml). The results further indicated that the germination index of bitter gourd was increased as the concentration of PGR increased. However, the minimum germination index (G.I) was recorded in distilled water. Meanwhile, there was no significant difference ($P > 0.05$) between T1 and T4 and similar, observations were recorded between T4 and T5. Overall, these findings indicated that the impact of PGR on the germination index was obvious, and the index enhanced as PGR concentration was increased.

3.4 Seedling Vigour Index (SVI)

The results for seedling vigour index (SVI) of BG1 bitter gourd for different concentrations of plant hormones and without hormones showed significantly different ($P < 0.05$) as presented in Figure 4. The seedling vigour index was significantly maximum 1835 recorded at NAA 0.3 (300 mg/1000 ml) and followed by N.A.A 1.5 (1500 mg/1000 ml) with 1292, respectively. The results

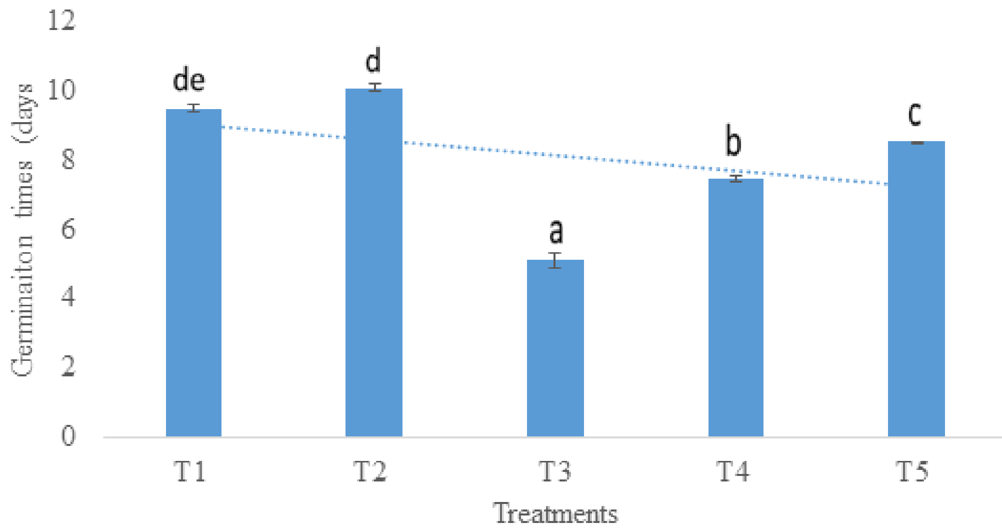

Fig. 2. Seed germination time (days) of bitter gourd at different hormone concentrations

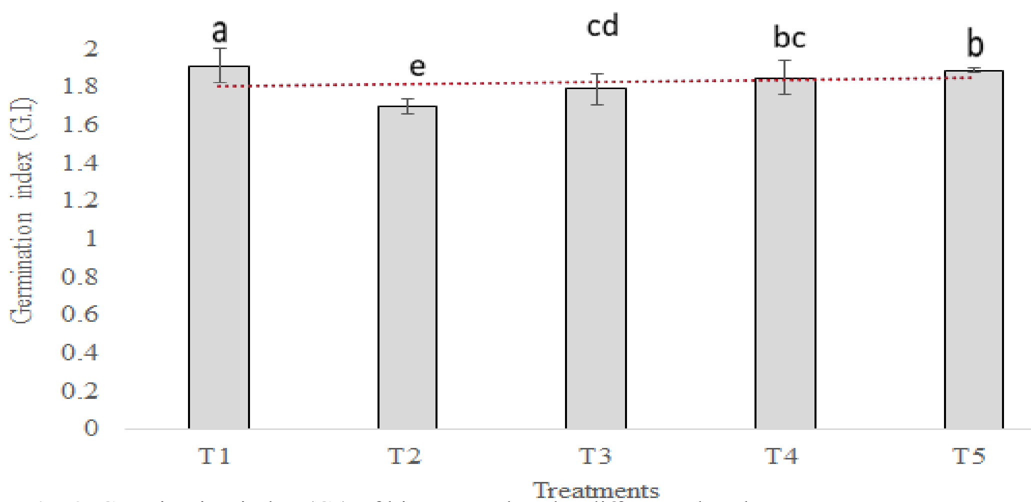

Fig. 3. Germination index (GI) of bitter gourd under different plant hormones

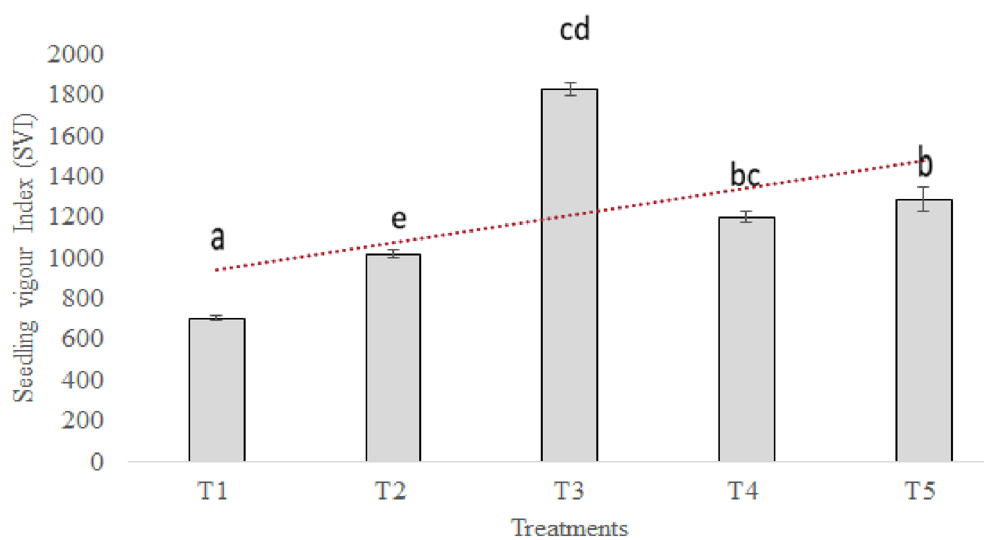

Fig. 4. Seedling vigour index (SVI) of sponge gourd varieties under different plant hormones

further showed that the seedling vigour index of bitter gourd decreased 709 and 1024 at the control and distilled water treatments.

4. DISCUSSION

Bitter melon (*Momordica charantia* L.) is a fast-growing vine and seeds germinated quickly in warm soil even if covered with shaded by crops [9]. In most countries, these plants are cultivated in small plots in kitchen gardens for personal consumption with commercial cultivation being of secondary importance. However, it is established to appear in the international marketplace [10-11]. Generally, seed priming is a common practice used for improving the crop vegetables' physiology or morphological traits including crop status, germination and yield. A number of seed priming techniques have been introduced nowadays to promote plant growth including hormonal priming, halo-priming, solid matrix priming, Hydro-priming, Bio-priming and osmo-priming. Besides normal plant growth, seed priming is also useful to improve nutrient production and stress tolerance [12]. Keeping in mind the significant importance of seed priming, this study was proposed to know the effect of seed priming on the germination of bitter melon. The findings of this study indicated that the germination percentage of taken bitter melon variety i.e. BG1 was highly affected by the application of different concentrations of plant hormone. Such an effect was even prominent in comparison without the application of plant hormones. The seed germination was significantly highest (96.4 %) @ NAA 0.9 (900 mg/1000 ml) followed by NAA 1.5 (1500 mg/1000 ml). The additional application of NAA (@1.5) decreased the germination percentage thus it shows an exact or balanced application of hormone is ideal to increase the germination percentage of bitter gourd. However, the low concentration of PGR 0.3 (300 mg/1000 ml)) also did not improve the seed germination percentage (71.4 %) but it was even better than the seed germination observed in the control treatment (52.2 %) and with distilled water (59.1). As it is previously studied and reported that the thick coat of embryo confinement and germination is impaired by the application of a mechanical constraint on embryo development [13]. The rate of seed germination is not 100 per cent due to the presence of hard seed coats [13].

Crop priming is an effective method for enhancing seed germination and vigour. Priming increases, the rate of germination, speed of germination, time of germination and seed priming is one of the most critical aspects of improving the yield and consistency of bitter gourd [14]. Similarly, in our study germination time (days) for bitter gourd (BG1) was significantly lower at 5.10 days @ NAA 0.3 (300 mg/1000 ml) and consistently increased at higher concentration of PGR (7.46 days at NAA 0.6 (600 mg/1000 ml) and 8.53 days at 1.5 (1500 mg/1000 ml), respectively. However, the germination time was higher in distilled water and the control treatment than in the rest of the other treatments treated with variable concentrations of plant hormones. The highest time for germination of bitter gourd was 10.1 days observed in distilled water. These results clearly illustrated that germination time prominently influenced plant hormones. It suggests that we can get faster germination with the application of suitable plant hormones at exact concentrations. The germination index was 1.91 recorded higher at the control treatment. The results further indicated that the germination index of bitter gourd was increased as the concentration of PGR increased. However, the minimum germination index (G.I) was recorded in distilled water with no significant difference between T1 and T4 and similar observations were recorded between T4 and T5. Overall, these findings indicated that the impact of PGR on the germination index was obvious, and the index enhanced as PGR concentration was increased. Therefore, in a similar connection seedling vigour index (SVI) of BG1 bitter gourd for different concentrations of plant hormones and without hormones showed significantly different findings. The seedling vigour index was significantly maximum 1835 recorded at NAA 0.3 (300 mg/1000 ml) and followed by NAA 1.5 (1500 mg/1000 ml) with 1292, respectively. The results further showed that the seedling vigour index of bitter gourd decreased 709 and 1024 at the control and distilled water treatments.

Similarly, our results are further supported by many research workers such as Hidayatullah *et al.* [6] applied different concentrations of Maleic hydrazide (MH 200 to 800 µmol L^{-1}), Gibberellic Acid (GA 15 to 45 at 3, -1 -1 & 60 µmol L^{-1}) and -1 ethrel (from 500 to 2000 µmol

L⁻¹) on Lagenaria siceraria Molina) plants and achieved significant effects of these PGRs on the reproductive performance of bitter melon. Cong *et al*. [15] concluded the efficacy of salicylic acid (SA) on sponge gourd when stored for 2 days @ 20 °C for checking its shelf life at the concentration of 1.5 mmol L^{-1}. They found CI postharvest was effective with a significant reduction. Therefore, all these reviews highly support our findings and are in accordance to obtained results of this study. Choudhary and Prakash [16] stated that the practice of seed priming is crop hydration controlled to a certain level which allows metabolic activity to continue at pre germinative. It is a physiological process where seeds of crops are pre-soaked prior to planting, which allow imbibition partially [17]. Saleem *et al.* experienced that to increase the growth and germination of cultivars of seedlings and seeds, seed soaking for 12 hrs are ideal [18]. Similarly, Lin and Sung reported that seed soaking is a prerequisite because it triggers the embryo of the seed which affects germination and results in seedling establishment [19]. Crop soaking is thus considered a fundamental step for successful seedling establishment and even it works better under sub-optimal temperature conditions. Thirusenduraselvi and Jerlin stated that for better seedling development and 100 % pre-germination of bitter gourd seeds, treatment of PGR like panchakavya at 3 % solution for 9 hrs was ideal and similarly for soaking in KNO_3 @ 2 percent [20]. Sher *et al*. also reported various PGRs including NAA, Kinetin, GA3 and ascorbate admiring their role in priming seeds [21]. Ullah et al. experienced that pre-soaking of seeds with gibberellic acid for 24 hrs ppm for the period of the seeds treated with gibberellic acid @ 100 ppm resulted in increased germination of certain hrs improved the genotype of bitter melon water particularly for germination [22]. Besides, it also targeted digestive enzymes of the plant and increased its permeability.

5. CONCLUSION

It has been concluded that seed priming effectively enhanced and improved the seed germination of *M. charantia* based on the selected parameters. The highest seed germination of 96.4 % @ NAA 0.9 (900 mg/1000 ml) was found. The germination time (days) for bitter gourd (BG1) was lower 5.10 days @ NAA 0.3 (300 mg/1000 ml). However, the germination time was higher in distilled water and the control treatment than the rest of the other treatments treated with variable concentrations of plant hormones. The germination index of bitter gourd was increased as the concentration of PGR increased. The seedling vigour index was significantly maximum 1835 recorded at NAA 0.3 (300 mg/1000 ml). Thus, seed priming is the best tool for sustainable agriculture for a number of crops, vegetables and fruits and should be encouraged further for local farmers' usage.

6. ACKNOWLEDGEMENTS

We acknowledge this study to the Community Health Department, Technical Institute of Babylon. Al-Furat Al-Awsat Technical University Babil Iraq for providing necessary facilities to the authors.

7. CONFLICT OF INTEREST

We declare no conflict of interest among all authors of this manuscript

8. REFERENCES

1. A.H. Subratty, A. Gurib-Fakim, and F. Mahomoodally. Bitter melon: an exotic vegetable with medicinal values. *Nutrition & Food Science* (2005).
2. T.K. Behera, S. Behera, L.K. Bharathi, K.J. John, P.W. Simon, and J.E. Staub. 2 bitter gourd: botany, horticulture, breeding. *Horticultural reviews* 37: 101 (2010).
3. Y. Kim, C. Seo, A.L. Khan, B.G. Mun, R. Shahzad, J.W. Ko, B.W. Yun, S.K. Park, and I.J. Lee. Exo-ethylene application mitigates water logging stress in soybean (Glycine max L.). *Journal of Plant Biology* 18: 254-255 (2018).
4. R. Manoharlal, G.V.S. Saiprasad, and A. Kovarík. Gene-specific DNA demethylation changes associates with ethylene induced germination of soybean. *Journal of Plant Physiology* 24: 272–277 (2019).
5. P. Król, R. Igielski, S.K. Pollmann, and E. Enska. Priming of seeds with methyl jasmonate induced resistance to hemibiotroph Fusarium oxysporum f. sp. lycopersici in tomato via 12-oxo-phytodienoic acid, salicylic acid, and flavonol accumulation. *Journal of Plant Physiology* 17: 122–132 (2015).
6. T. Hidayatullah, T. Mahmood, M. Farooq, and

M.A Khokhar. Plant growth regulators affecting sex expression of sponge gourd (Lagenaria siceraria Molina) plants. *Pakistan Journal of Agriculture Research* 25: 50-54 (2015).

7. S. Shah, U.S. Khan, A. Khan, M.A. Farooq, K.R. Chattha, M. Javed, Z.A. Gurmani, M.A. Hussain, and M.A. Iftikhar. Effects of gibberellic acid on growth, yield and quality of grape cv. *Journal of Plant Science* 12: 499-503 (2015).

8. S.U. Larsen, and C. Andreasen. Light and heavy turfgrass seeds differ in germination percentage and mean germination thermal time. *Crop Science* 44: 1710 -1720 (2004).

9 D. Whitehead, and G.R. Edwards. Assessment of the application of gibberellins to increase productivity and reduce nitrous oxide emissions in grazed grassland. *Journal of Agriculture Ecosystem and Environment* 20: 40-50 (2015).

10 Z. Liang, Y. Ma, T. Xu, T. Cui, Y. Liu, Z. Guo, and D. Yang. Effects of abscisic acid, gibberellin, ethylene and their interactions on production of phenolic acids in salvia miltiorrhiza bunge hairy roots. *Journal of Plant Science* 8: 728-735 (2013).

11 V. Ramteke, D.H. Paithankar, M.M. Baghel, and V.K. Kurrey. Impact of GA3 and propagation media on growth rate and leaf chlorophyll content of papaya seedlings. *Research Journal of Agriculture Science* 7: 169-171 (2016).

12 M. Rawat. Effects of seed priming and it's duration on bitter gourd. *Journal of Pharmacognosy and Phytochemistry* 9: 1950-1953 (2020).

13 V.K. Pandita, and S. Nagarajan. Improvement in emergence of bittergourd (*Momordica charantia* L.) seedlings by presowing treatments. *Indian Journal of Horticulture* 61: 280-281 (2004).

14 M. Farooq, R. Tabassum, and I. Afzal. Enhancing the performance of direct seeded fine rice by seed priming. *Plant Production Science* 9: 446-456 (2006).

15 H. Cong, Z. Jin, Q. Wang, and H.Z. Dong. Salicylic acid alleviates postharvest chilling injury of sponge gourd (Luffa cylindrica). *Journal of Integrated Agriculture* 16: 735-741 (2017).

16 D.K. Choudhary, B.N. Johri, and A. Prakash. Volatiles as priming agents that initiate plant growth and defence responses. *Current Science 595-604 (2008).*

17 W.M. Nascimento, and F.A.S.D. Aragão. Muskmelon seed priming in relation to seed vigor. *Scientia Agricola* 61: 114-117 (2004).

18 M.S. Saleem, M. Sajid, Z. Ahmed, S. Ahmed, N. Ahmed, and M.S. Ul-Islam. Effect of Seed Soaking on Seed Germination and Growth of Bitter Gourd Cultivars *Journal of Agriculture and Veterinary Science* 6: 7-11 (2014).

19 J.M. Lin, and J. M. Sung. Pre-sowing treatments for improving emergence of bitter gourd seedlings under optimal and sub-optimal temperatures. *Seed Science And Technology* 29:39-50 (2001).

20 D. Thirusenduraselvi, and R. Jerlin. Osmopriming of seeds to improve the performance of bitter gourd cv. co-1. *International Journal of Plant Sciences* 4:182-187 (2009).

21 A. Sher, T. Sarwar, A. Nawaz, M. Ijaz, A. Sattar, and S. Ahmad. Methods of Seed Priming. In: *Priming and Pre-treatment of Seeds and Seedlings:* Hasanuzzaman, M., Fotopoulos, V. (Ed.), Springer, Singapore, p. 1-10 (2019).

22 H. Ullah, J.G. Chen, S. Wang, and A.M. Jones. Role of a heterotrimeric G protein in regulation of Arabidopsis seed germination. *Plant Physiology* 129: 897-907 (2002).