Influence of different pre-sowing treatments on seed germination and seedling characteristics: A case study of Bitter Gourd (*Momordica charantia* L.), Bottle Gourd (*Lagenaria siceraria*) and Ridge Gourd (*Luffa acutangula*)

ABSTRACT

In order to study the influence of different pre-sowing treatments on seed germination and seedling characteristics of bitter gourd cultivar Co-1, bottle gourd cultivar Pusa summer prolific long and ridge gourd cultivar Arka sumeet an experiment was conducted at Horticulture orchard, Department of Horticulture, Annamalai University during zaid season 2022. Three cucurbits were soaked in various treatments like T_1-Control, T_2-Tap water @ 24 hours, T_3-GA_3 @ 100 ppm with 24 hours of soaking, T_4- GA_3 @ 200 ppm with 24 hours of soaking, T_5-100% Coconut water @ 24 hours of soaking, T_6-3% Panchagavya @ 24 hours of soaking, T_7-100% Fresh Milk @ 24 hours of soaking and T_8-Azospirillum @ 24 hours to determine the best treatment. The study findings generally indicate that the seeds of bitter gourd, bottle gourd and ridge gourd responded in a variety of ways depending on the pre-sowing techniques used. Based on the study, the results indicated that the treatments T_4- GA_3 @ 200 ppm with 24 hours T_5-100% Coconut water @ 24 hours and T_6-3% Panchagavya @ 24 hours of soaking have shown the highly significant compared to the T_1- control and enhanced the germination percentage, shoot length, root length, seedling length and vigour index on all the three cucurbits. These results can be used for developing future research on plant growth improvements and this approach has need to deliberate by modern farmers.

Keywords: Gibberellic acid, Panchagavya, Seed germination, Phytohormones

1. INTRODUCTION

"The Cucurbitaceous is a notable plant family, justifiable of attention because of its economic, aesthetic, cultural, medicinal and botanical importance" (Lebeda *et al.,* 2007). "India is blessed with a rich diversity of cucurbits and is believable to be the primary and secondary centres of origin of many groups of crops under the family *Cucurbitaceae.* Among various gourds, bitter gourd, bottle gourd and ridge gourd are some of the major cucurbitaceous vegetables and fruits. It has been identified as one of the promising vegetable crop for export by Agricultural Processed Products for Export and Development Authority" (APEDA) (Thangamani *et al.,* 2011). "Cucurbits have a problem of emergence and even with the seeds of high germinability due to thick seed coats. The major problems of restrictive yield of cucurbits are poor seedling germination, hindered emergence and slow growth rate due to seed coated embryo. To overcome this problem, pre-sowing treatments soaking or priming of seeds can be practice. Pre-sowing treatment that improves seedling emergence and stand establishment, is the most promising way to revive seeds" (Shreevastav *et al.,* 2023). "Pre-germinated seeds proved superior in the emergence and in stand establishment" (Nawaz *et al.,* 2013). "The additional advantages of this treatment include lower seed rate, dead seeds can be discarded before sowing and germinating, but low vigour seeds can be removed before sowing" (Rahman *et al.,* 2021).

"Seed soaking in different phytohormonal solutions with high osmotic potential enriches the metabolic processes requisite for germination" (Nawaz *et al.*, 2013). "Phytohormones are chemical molecules produced by plants and have important roles in regulating plant growth and development. Auxins (IAA, IBAs), gibberellins (GAs), cytokinins (CKs), abscisic acid (ABA) and ethylene (ET) are eminent phytohormones that are necessary for plant growth and development" (Muhei, 2018). "Also these phytohormones obtained in various organic products like panchagavya, coconut water, fresh milk and azospirillum which synthesize hormones and promotes plant growth. A plant hormone called Gibberllic acid (GA_3) plays a very important function in plant growth and development like seed germination, stem elongation and flower development. Different kinds of stimuli such as developmental, environmental and hormonal regulated GA_3 biosynthesis. Soaking the seeds with suitable concentrations of GA_3 will have positive effects on germination, growth and producing various plant varieties" (Ayaz *et al.*, 2019). "Panchagavya having enriched with the essential macro and micro nutrients favours for the growth of the crop under biotic and abiotic stress conditions" (Patil *et al.*, 2021). "Coconut (*Cocos nucifera* L.) is an important fruit tree. Coconut water (coconut liquid endosperm) have many applications and consumed worldwide as it is nutritious and beneficial for health. Some of the most significant and useful components in coconut water are cytokinins (kinetin and *trans*-zeatin) which is a class of phytohormones, indole-3-acetic acid (IAA). The primary auxin in plants and other components like sugars, sugar alcohols, lipids, amino acids, nitrogenous compounds, organic acids and enzymes and they play different functional roles in plant and human systems due to their distinct chemical properties" (Dunsin *et al.*, 2016). "Milk is considered as better pre-sowing treatment or priming agent than that of water. Fresh cow milk had 0.012 µg mL^{-1} for IAA and IBA. The good performance of fresh cow milk in breaking the dormancy in bitter gourd seeds could be attributed to the presence of hormones such as IAA and ABA" (Adelani and Maisamari, 2016). "In hormonal seed treatment, seeds are pre-soaked with a prime concentration of phytohormone, which enhances the seed germination, seedling growth. Phytohormones have a substantial role in biochemical, defence and signalling pathways of plants" (Sytar *et al.*, 2018). Thus, the purpose of the study is to recover dormant seeds, increase plant growth, lift the root and shoot growth and improve the seed germination through pre-sowing treatments.

2. MATERIALS AND METHODS

The present investigation was carried out in Horticulture orchard, Department of Horticulture, Annamalai University, Chidambaram, Tamilnadu during *zaid* season in 2022. The experiment was laid out in Completely Randomized Design (CRD) with three different cucurbits *i.e.*, bitter gourd cultivar Co-1 (*Momordica charantia* L.), bottle gourd cultivar Pusa summer prolific long (*Lagenaria siceraria*) and ridge gourd cultivar Arka Sumeet (*Luffa acutangula*). The details of experimental techniques, materials and method adopted for the study are presented in this chapter.

The experimental setup comprised of eight different treatments *viz.*, T_1-Control, T_2-Tap water @ 24 hours, T_3-GA_3 @ 100 ppm with 24 hours of soaking, T_4- GA_3 @ 200 ppm with 24 hours of soaking, T_5-100% Coconut water @ 24 hours of soaking, T_6-3%

Panchagavya @ 24 hours of soaking, T_7-100% Fresh Milk @ 24 hours of soaking and T_8-Azospirillum @ 24 hours. Observations were recorded in five randomly selected plants in each replication for germination percentage, shoot length, root length, seedling length and vigour index. Germination percentage were calculated using equation.

$$i. Germination\ percentage = \frac{Number\ of\ germinated\ seeds}{Number\ of\ total\ seed\ sown} \times 100$$

Vigour index was calculated on the basis of mean seedling length and mean seedling dry weight by adopting the formula (Adebisi, 2004).

$$ii. Seedling\ vigour\ index = \frac{Germiantion\ \% \times Mean\ seedling\ length\ (cm)}{100}$$

2.1 Procedure

Control: The seeds are not soaked in any treatment were considered as control.

Tap water: The seeds were soaked in the normal tap water for 24 hours.

GA_3 100 ppm: The concentration of gibberellic acid 100 ppm was prepared by dissolving 100 mg of GA_3 in a little quantity of ethyl alcohol solution and volume was make up to 1000 ml with distilled water to get 100 ppm solution. The seeds were soaked in such solution for 24 hours under the room temperature.

GA_3 200 ppm: The concentration of gibberellic acid 200 ppm was prepared by dissolving 200 mg of GA_3 in a little quantity of ethyl alcohol solution and volume was make up to 1000 ml with distilled water to get 200 ppm solution. The seeds were soaked in such solution for 24 hours under the room temperature.

Soaking of seeds in Coconut water: Tender coconuts are procured from coconut farm, extracted the fresh coconut water. Soaked the seeds in 100% coconut water for 24 hours duration without any addition of water. Later the seeds were dried under shade and used for sowing.

Soaking of seeds in Panchagavya solution: Panchagavya, it is a fermented product literally prepared from five products of a cow *viz.*, milk, urine, dung, curd and ghee. These ingredients were placed in a pot and mixed twice daily to enhance the microbial activity, on the 15th day the enriched product panchagavya was made. To prepare 3% solution; 30 ml of fermented panchagavya was put in a beaker and then 1000 ml distilled water was added with constant stirring to get mixed up properly. After preparation, seeds of bitter gourd, bottle gourd and ridge gourd were soaked in required solution for 24 hours at room temperature. After 24 hours of soaking the solution drained out from beaker and pre-soaked were air dried to original weight and then placed for germination in laboratory under controlled condition (Patil *et al.*, 2021).

Soaking of seeds in cow milk: The seeds are soaked in 100% freshly milched cow milk for 24 hours duration. Later the seeds were dried under shade and used for sowing. Fresh cow

milk consistently, quickly and uniformly affects the physiology of the seeds and breaks their physiological dormancy.

Seeds soaking in Azospirillum: Azospirilllum is a biofertilizer, 100 gm of azospirillum was mixed with cooked rice water to make semi liquid. Then the seeds were soaked for 24 hours under the room temperature to have uniform coating of the inoculants over the seeds. Treated seeds were shade dried for 20 minutes and used for sowing.

3. RESULTS AND DISCUSSION

The germination capacity of a seed is based on dual response (germinated or non-germinated), is one of the qualitative attribute of the germination process generally converted in a quantitative attribute, commonly in percentage. The results shown in (Table 1) that there are significant differences (at 5% level) between effective treatments on germination traits and other treatments, resulted in significant differences among various characters.

3.1 Germination Percentage

In this research, the results showed that the germination percentage of bitter gourd increased due to the application of different pre-sowing treatments. According to the attained results, treatment (T_4) GA_3 @ 200 ppm with 24 hours of soaking (90.15) soaking duration which is shown highest significant among all treatments of seed germination, followed by (T_5) 100% Coconut water @ 24 hours of soaking (88.74) and (T_3) GA_3 @ 100 ppm with 24 hours of soaking (84.19). In bottle gourd, the maximum number of normal seedlings found in the treatment (T_5) 100% Coconut water @ 24 hours of soaking (88.67) followed by (T_6) 3% Panchagavya @ 24 hours of soaking (88.33) and (T_4) GA_3 @ 200 ppm with 24 hours of soaking (88.00). In ridge gourd, the treatment (T_6) 3% Panchagavya @ 24 hours of soaking (100) shown highest germination percentage followed by (T_4) GA_3 @ 200 ppm with 24 hours of soaking (91.67) and (T_5) 100% Coconut water @ 24 hours of soaking (85).

Fig: 1 Germination percentage of bitter gourd, bottle gourd and ridge gourd under various treatments

3.2 Shoot Length (cm)

The maximum shoot length of (11.84) was shown by treatment (T_5) 100% Coconut water @ 24 hours of soaking followed by (T_4) GA3 @ 200 ppm with 24 hours soaking (11.40) and

(T_6) 3% Panchagavya @ 24 hours of soaking (11.08) in bitter gourd. In bottle gourd, the maximum shoot length can observe in (T_4) GA3 @ 200 ppm with 24 hours soaking (14.87) followed by (T_1) Control (14.03) and (T_6) 3% Panchagavya @ 24 hours of soaking (13.80). And in ridge gourd, the maximum shoot length shown in the treatment (T_6) 3% Panchagavya @ 24 hours of soaking (13.90) followed by (T_5) 100% Coconut water @ 24 hours of soaking (13.07) and (T_3) GA3 @ 100 ppm with 24 hours of soaking (12.97).

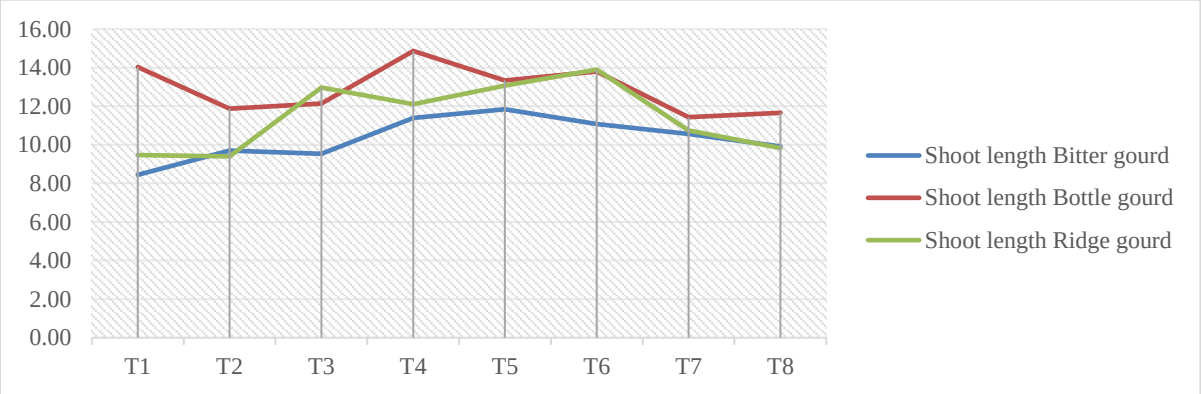


Fig: 2 Shoot length of bitter gourd, bottle gourd and ridge gourd under various treatments

3.3 Root Length (cm)

Among all the treatments, the treatment (T_6) 3% Panchagavya @ 24 hours of soaking (5.52) shown the significant highest followed by (T_5) 100% Coconut water @ 24 hours (5.07) and (T_4) GA3 @ 200 ppm with 24 hours of soaking (5.00) in bitter gourd. In bottle gourd, the maximum root length observed in the treatment (T_4) GA3 @ 200 ppm with 24 hours of soaking (11.17) followed by (T_5) 100% Coconut water @ 24 hours of soaking (10.73) and (T_6) 3% Panchagavya @ 24 hours of soaking (10.33). In ridge gourd, the treatment (T_6) 3% Panchagavya @ 24 hours of soaking (9.13) shown significant highest of root length among all treatments at par with (T_2) Tap water @ 24 hours (9.13) followed by (T_5) 100% Coconut water @ 24 hours of soaking (8.93).

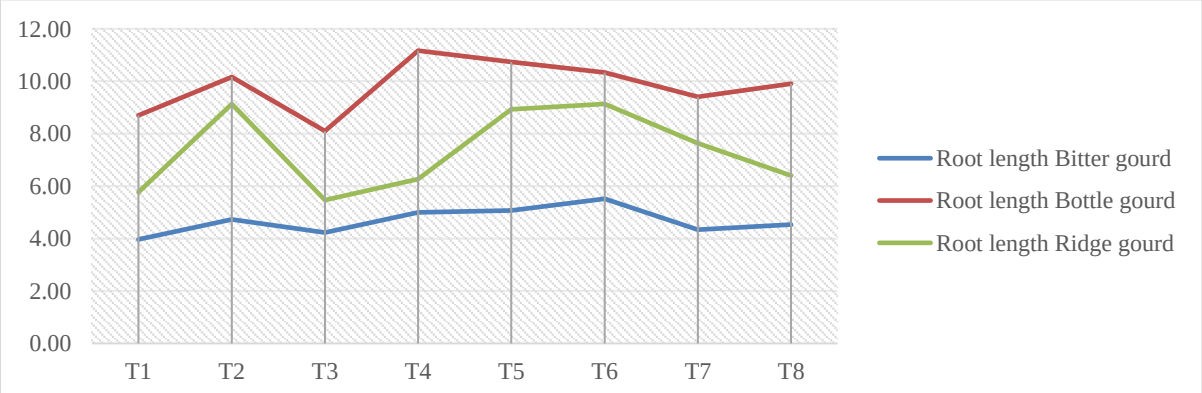
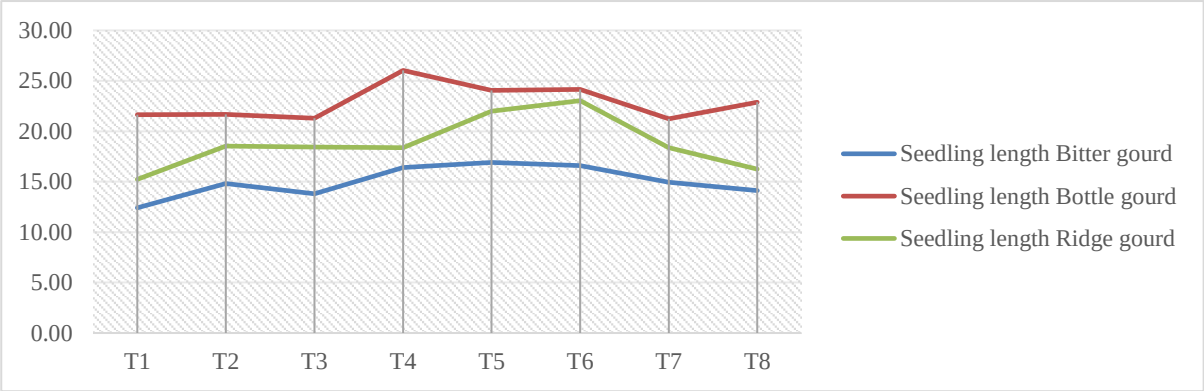


Fig: 3 Root length of bitter gourd, bottle gourd and ridge gourd under various treatments

3.4 Seedling Length (cm)

The effect of pre-sowing treatment on seedling length of bitter gourd, bottle gourd and ridge gourd. From the results (Table 1), it was concluded that (T_5) 100% Coconut water @ 24

hours of soaking (16.91) is at par with (T_6) 3% Panchagavya @ 24 hours of soaking (16.60) and (T_4) GA3 @ 200 ppm with 24 hours of soaking (16.40) in bitter gourd. In bottle gourd,



the treatment (T_4) GA3 @ 200 ppm with 24 hours of soaking (26.03) shown significantly highest, followed by (T_6) 3% Panchagavya @ 24 hours of soaking (24.13) and (T_5) 100% Coconut water @ 24 hours of soaking (24.07). In ridge gourd, the maximum seedling length shown in the treatment (T_6) 3% Panchagavya @ 24 hours of soaking (23.03) followed by (T_5) 100% Coconut water @ 24 hours of soaking (22.00) and (T_3) GA3 @ 100 ppm with 24 hours of soaking (18.43).

Fig: 4 Seedling length of bitter gourd, bottle gourd and ridge gourd under various treatments

3.5 Vigour Index

Pre-sowing treatment with (T_5) 100% Coconut water @ 24 hours of soaking (15.07) were showed significantly highest vigour index in bitter gourd followed by (T_4) GA3@ 200 ppm with 24 hours of soaking (14.84) and (T_6) Panchagavya @ 24 hours of soaking (12.75). In bottle gourd, significantly highest vigour index shown in treatment (T_4) GA3 @ 200 ppm with 24 hours of soaking (23.00) followed by (T_5) 100% Coconut water @ 24 hours of soaking (21.53) and (T_6) 3% Panchagavya @ 24 hours of soaking (21.43). In ridge gourd, the treatment (T_6) Panchagavya @ 24 hours of soaking (23.03) were shown significantly highest vigour index followed by (T_5) 100% Coconut water @ 24 hours of soaking (18.91) and (T_4) GA3 @ 200 ppm with 24 hours of soaking (17.05).

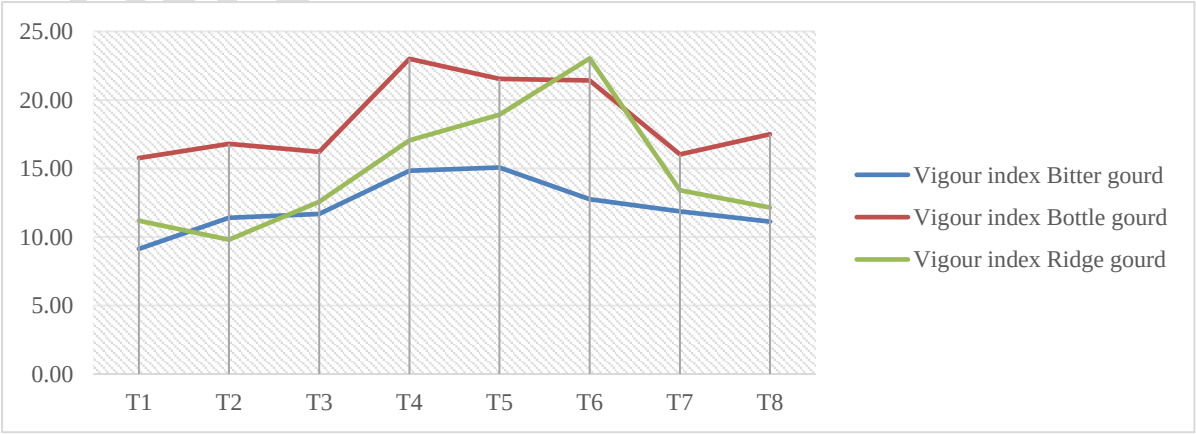


Fig: 5 Vigour index of bitter gourd, bottle gourd and ridge gourd under various treatments

3.6 Discussion

Pre-sowing seed treatments are where seeds were exposed to an external water potential low enough to hamper germination by various treatments like panchagavya, GA_3, coconut water, azospirillum. So it allows pre-germinative physiology and biochemical activities (Mavi *et al.,* 2006). Pre-sowing seeds were significantly regulates the different types of seed dormancy as well as improves the vigority. Thus, various pre-sowing treatment can be potentially used in crop production to increase the uniformity of germination along with better growth and developments (Rao *et al.,* 2019). It may bring certain alternation in bio-chemical process, catalyze enzyme activities, cytokines content changes, water absorption capacity of seed and it is inability to sense when the genetic and physiological differences are established.

In this regard, the germination characters of cucurbits (bitter gourd, bottle gourd and ridge gourd) were significantly influenced by the use of biological treatments. The treatment T_4 shown the maximum germination percentage. The treatment T_5 were observed the significantly highest in shoot length (cm), seedling length (cm) and vigour index. The treatment T_6 were shown the significantly highest root length (cm) in bitter gourd. In bottle gourd, the treatment T_5 shown the significantly better germination percentage. The treatment T_4 were observed the highest among the shoot length (cm), root length (cm), seedling length (cm) and vigour index. In ridge gourd, the treatment T_6 were observed the highest germination percentage, shoot length (cm), root length (cm), seedling length (cm) and vigour index. Similar results were observed by Kumari *et al* (2021) in ridge gourd. The maximum germination percentage with GA_3 may be due to induced enzyme activity during germination that digest the endosperm rapidly and efficiently that reduces the mechanical restraints to endosperm, thus providing energy to start and sustain embryo growth which produced rapidly during the early stage of germination. Similar findings were reported by Sowmya *et al* (2018) in bitter gourd.

The induction of membrane reliability and quantifiable changes of seeds biochemical content is due to priming. Pre-sowing treatment enhances the physiological activities during seed germination and soaking the seeds in GA_3 stimulates biochemical processes like hydrolysis, metabolism of growth inhibitors, activation of enzymes required for plant germination (Ayaz *et al.,* 2019). Treatment with coconut water were found to be the effective in enhancing seed germination in bottle gourd. Due to the presence of growth hormones like cytokinins (kinetin and *trans*-zeatin) in coconut, breaks the hard seed coat and enhances the germination percentage. Panchagavya having enriched with the essential macro and micro nutrients favours the growth of the crop. Panchagavya exhibits highest amount of macro and micro nutrients like nitrogen, potassium, magnesium, sodium, iron, molybdenum. Also, highest amount of phyto-hormones likes auxin, gibberellin and cytokinin were present in panchagavya (Uthirapandi *et al.,* 2018).

4. CONCLUSION

Pre-sowing treatment using plant hormones and substitutes of plant hormones like panchagavya, coconut water and azospirillum shown to be a promising technique in improving germination parameters of various cultivars of cucurbits. The present experiment

results indicates that pre-sowing treatment is an alternate strategy to maintain the vigour of a seed under various factors. It is concluded that seeds of bitter gourd, bottle gourd and ridge gourd give best results after treating with GA_3 @ 200 ppm for 24 hours of soaking followed by 100% Coconut water @ 24 hours of soaking and 3% Panchagavya @ 24 hours of soaking. The gathering of phytohormones, including GA_3, cytokinin, auxin, ethylene and abscisic acid can adversely affect seed germination parameters. This emerging plan has proven to be an effective seed treating technique for many crops. Though, phytohormones concentration and priming duration may varies from crop to crop. These results can be used for developing future research on plant growth improvements and this approach has need to deliberate by modern farmers. Consequently, researchers and farmers may use the findings.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Table: 1 Mean performance on effect of germination percentage of bitter gourd, bottle gourd and ridge gourd

Treatments	Germination %			Shoot length (cm)			Root length (cm)			Seedling length (cm)			Vigour index		
	Bitter gourd	Bottle gourd	Ridge gourd	Bitter gourd	Bottle gourd	Ridge gourd	Bitter gourd	Bottle gourd	Ridge gourd	Bitter gourd	Bottle gourd	Ridge gourd	Bitter gourd	Bottle gourd	Ridge gourd
T1	73.36	72.75	73.33	8.44	14.03	9.47	3.97	8.70	5.77	12.41	21.63	15.23	9.13	15.76	11.19
T2	76.67	77.22	50.00	9.70	11.87	9.40	4.73	10.17	9.13	14.83	21.67	18.53	11.41	16.79	9.80
T3	84.19	76.00	66.67	9.53	12.13	12.97	4.23	8.10	5.47	13.80	21.30	18.43	11.67	16.22	12.56
T4	90.15	88.00	91.67	11.40	14.87	12.10	5.00	11.17	6.27	16.40	26.03	18.37	14.84	23.00	17.05
T5	88.74	88.67	85.00	11.84	13.33	13.07	5.07	10.73	8.93	16.91	24.07	22.00	15.07	21.53	18.91
T6	76.60	88.33	100.00	11.08	13.80	13.90	5.52	10.33	9.13	16.60	24.13	23.03	12.75	21.43	23.03
T7	78.84	75.33	71.67	10.57	11.43	10.74	4.33	9.40	7.63	14.93	21.23	18.37	11.86	16.03	13.40
T8	78.15	76.33	75.00	9.92	11.67	9.83	4.53	9.90	6.40	14.12	22.87	16.23	11.11	17.49	12.15
MEAN	**80.84**	**80.33**	**76.67**	**10.31**	**12.89**	**11.43**	**4.67**	**9.81**	**7.34**	**15.00**	**22.87**	**18.78**	**12.230**	**18.530**	**14.760**
SE (m)	**3.72**	**4.1**	**9.37**	**0.65**	**0.74**	**1.10**	**0.25**	**0.35**	**0.50**	**0.94**	**1.03**	**1.35**	**1.24**	**1.78**	**2.46**
CD AT 5%	**11.16**	**12.28**	**28.1**	**1.95**	**2.21**	**3.29**	**0.75**	**1.04**	**1.48**	**2.82**	**3.08**	**4.03**	**3.73**	**5.34**	**7.39**