Original Research Article

Varietal differences in seed germination and seedling survival of bitter gourd(*Momordica charantia* L.) genotypes

ABSTRACT

Bittergourd (*Momordica charantia* L.) is a multipurpose vegetable renowned for its distinct bitter taste, nutritional richness and potential health benefits. Fourteen different bitter gourd genotypes were evaluated at Department of Horticulture, University of agricultural sciences, GKVK, Bengaluru.To know thevariationswith respect to germination percentage, days taken for germination and survival percentage. The seeds of thesegenotypes were pre-soaked for 12 hrs and sown in the protrays.The maximum germination percentage was seen in the genotype Pusa Purvi (91.67) followed by Konkan Karali (88.33%) and Konkan Tara (88.00%). The minimum days taken for germination were recorded in Hirkani (8.00 days), Punjab 14 (8.50 days), Pusa Rasdar (9.00 days) and Konkan Tara (9.00 days) making them favourable for faster germination. The maximum survival percentage was recorded inHirkani (97.30) followed by Pusa Purvi (97.81) and Phule Green Gold (97.31)while CO 1 exhibited lowest germination (40.33%) and survival (82.12%) percentage. These findings underscore the importance of genotype selection in optimizing germination and survival rates, which are critical for achieving high crop yields and robust plant growth.

Keywords: Bitter gourd; Genotypes; Germination Percentage

1. INTRODUCTION

Bitter gourd (*Momordica charantia* L.) known by various names such as balsam pear, bitter cucumber, or bitter melon, is a member of the cucurbitaceous vegetable family Cucurbitaceae. The genus *Momordica* encompasses several other species, including *M. balsamina, M. cochinchinesis, M. dioca, M. denudate, M. macrocarpa, M. subangulata, and M. tuberosa.* Bitter gourd is diploid, having chromosome number 2n = 2X = 22, and has its origin in the Indo-Burma region. Bitter gourd is cultivated primarily for its bitter and tender fruits, which are renowned for their rich nutritional compositions, vitamin A and C (Gopalan et al., 1993).

The characteristic bitter taste of bitter melon is attributed to specific compounds, including the cucurbitacin-like alkaloid momordicine and triterpene glycosides such as momordicoside K and L (Jeffrey, 1980 and Okabe *et al*., 1982). Beyond its culinary appeal, bitter melon has garnered attention for its potential health benefits, particularly in managing diabetes. Studies have revealed the presence of a hypoglycemic compound named ‘charantin’ in bitter melon, suggesting its efficacy in regulating blood sugar levels (Yeh *et al*., 2003). Studies have shown that bitter melon has anti-carcinogenic properties and can be used as a cytotoxic agent against many types of cancer (Grover and Yadav, 2004).

Seeds represent invaluable assets in global agriculture, crucially influencing crop establishment and productivity based on their physiological quality (Begatali et al., 2019; Struker et al., 2019). High-quality seeds are Proficient at producing uniform seedlings that exhibit robust growth potential and effective resource utilization within their environment (Caverzan et al., 2018). Conversely, seeds of lower quality impede seedling emergence, leading to uneven crop establishment in fields and ultimately reducing yields (Abati et al., 2017; Ebone et al., 2020).

Seed quality encompasses genetic, physical, physiological attributes, and seed health. Physiological quality pertains to a seed's capacity to germinate, emerge from the soil, and develop into a robust seedling, particularly under the challenging conditions often encountered in smallholder farmers' fields. Maintaining high physiological quality is crucial for achieving an ideal and consistent plant density while minimizing seeding rates.

Germination is a pivotal phase in the lifecycle of both weeds and crops, significantly influencing population dynamics and having substantial practical impacts (Huang et al., 2003). Successful germination is essential for species survival, making a low germination rate a critical issue (Yang et al., 2008). Consistent and quick germination is crucial for enhancing yield, quality, and profitability for vegetable growers (Jamil et al., 2016). However, in bitter gourd, the presence of a thick seed coat causes water absorption to occur slowly, leading to delayed germination and poor field emergence, even when seeds have high germination ability (Asna et al., 2020).

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Environmental conditions during crop growth, harvesting, and storage significantly impact the physiological quality of seeds (Ghassemi Golezani and Mazloomi-Oskooyi, 2008). Germination capacity and physiological vigour are inherent characteristics of seeds that directly influence their overall quality. It is essential to categorize the variability among seed accessions to effectively manage and expand germplasm resources. The objectives of the study were, therefore, to determine varietal differences in seed germination percentage, days taken for germination and survival percentage among fourteen different bitter gourd genotypes.

2. MATERIALS AND METHODS

The experiment was conducted in the eastern dry zone of Karnataka at the Department of Horticulture, University of Agricultural Sciences, Bangalore. Fourteen genotypes (Plate 1.) collected from various sources for the experiment, along with their silent features, are presented in Table 1.

Table 1. Genotypes along with their source of collection and salient features

Sl. No.	Genotypes	Salient features	Source of collection
1	Punjab 14	Plants are bushy and bear light green fruits with average weight of 35 g. Yield 14 t ha^{-1}.	NSC, New Delhi
2	Hirkani	Fruits dark green, 15-20 cm long, spindle shaped with warts and prickles, yield t ha^{-1} in 160 days.	MPKV, Rahuri
3	Pusa Rasdar	Fruits juicy, smooth, non-prickled with tender skin, fleshy and dark green colour. Average fruit weight is 110 g with an average yield of 0.5 t/ 100 sqm in insect proof net-house.	IARI, New Delhi
4	Pusa Purvi	First small fruited variety, dark green colour fruits, small size (4-5 cm long and 3-4 diameter) and crispy flesh with high dry matter. Average yield is 8.78 t ha^{-1}.	IARI, New Delhi
5	Priya	Extralong green spiny fruits with white tinge at stylar end, average fruit length 39 cm. Average fruit weight 235 g with a productivity of 24.5 t ha^{-1}.	KAU, Thrissur
6	Konkan Tara	Fruits green, prickly, medium long (15-16 cm) and spindle shaped. Yield 24 t ha^{-1}.	KKV, Dapoli
7	Konkan Karali	Long attractive sharp prickled, dark shiny green colour fruits suitable for high rainfall areas with a yield of 16-18 t ha^{-1}.	KKV, Dapoli
8	Pant Karela 3	Cylindrical dark green fruits with a length of 24 cm, suitable for plain and hilly areas with a yield of 15-16 t ha^{-1}.	GBPUAT, Pantnagar
9	Pant Karela 4	Dark green fruits with a length of 30-35 cm. Yield 12.5-15 t ha^{-1}.	GBPUAT, Pantnagar
10	CO 1	Dark green fruits with medium length (20-25 cm) and weight (100-120 g). Yield 14 t ha^{-1}.	TNAU, Coimbatore
11	Preethi	Medium sized white fruits with spines, average fruit length 30 cm, average fruit girth 24 cm, average fruit weight 0.31 kg with a productivity 15 t ha^{-1}.	KAU, Thrissur
12	Phule Green Gold	Fruits dark green, 25-30 cm long, prickled, tolerant to downy mildew, yield 23 t ha^{-1} in 160-180 days.	MPKV, Rahuri
13	Pusa Do Mausami	Fruits are dark green, club like shape with 7-8 continuous ribs. Fruit weight is 100-120 g with a yield 12-15 t ha^{-1}.	IARI, New Delhi
14	Pusa Vishesh	Selection from a local collection and suitable for growing during summer. Fruits are glossy green in colour, medium long and thick.	IARI, New Delhi

The seeds of bitter gourd taken for the experiment were sorted manually based on appearance and colour to separate viable (plumpy, firm, and dark brown to black) and non-viable (shrivelled, papery, lightweight, and discoloured) seeds. Viable seeds are pre-soaked in water for about 12 hours and sown in the media containing sand, soil, and farm yard manure (FYM) in a 1:2:1 ratio with coir pith on top (Plate 2). Observations on germination percentage, days taken for germination, and survival percentage were recorded.

Plate 1. Variation among the seeds of 14 bitter gourd genotypes.

Plate 2. Variation in germination among different bitter gourd genotypes.

The mean values of germination percentage, days taken for germination, and survival percentage values of replications following the method given by Panse and Sukhatme. The significance of the differences among all the treated lines was tested by a F-test using the error variance. The complete data was analyzed using randomized design (CRD) and OP-Stat

software.

3. RESULTS AND DISCUSION

3.1 Germination Percentage

The analysis of the germination performance across different genotypes, based on the number of seeds germinated out of 50 sown and the resulting germination percentages, reveals significant variability (Table 2.).Pusa Purvi (91.67%) followed by Konkan Karali (88.33%), Konkan Tara (88.00%), Pusa Do Mausami (80.00%), Pusa Vishesh (78.33%),Phule Green Gold (74.33) and Hirkani (75.00%), exhibited the highest germination percentage, indicating superior germination performance. Conversely, genotypes like CO 1 (40.33%), Punjab 14 (48.33%), and Priya (50.00%)exhibited lowest germination percentage. This variability highlights the impact of genotype on germination success, underscoring the importance of selecting genotypes with higher germination percentages for agricultural practices.

Table 2.Meanvariation of germination percentage among 14 different bitter gourd genotypes

Genotypes	**No. of seeds germinated out of 50 seeds sown**	**Germination percentage**
Punjab 14	24.16	48.33
Hirkani	37.05	75.00
Pusa Rasdar	28.33	56.67
Pusa Purvi	45.83	91.67
Priya	25.00	50.00
Konkan Tara	44.00	88.00
Konkan Karali	44.17	88.33
Pant Karela 3	30.67	61.33
Pant Karela 4	32.00	64.00
CO 1	20.17	40.33
Preethi	29.00	58.00
Phule Green Gold	37.17	74.33
Pusa Do Mausami	40.00	80.00
Pusa Vishesh	39.17	78.33
C.D.	**7.34**	**14.69**
SE(m)	**2.52**	**5.05**
SE(d)	**3.56**	**7.14**
C.V.	**12.82**	**12.82**

3.2 Days taken for germination

The analysis of the days taken for germination across different genotypes reveals a notable range in mean germination times, from 8.00 days for Hirkani to 13.00 days for Pant Karela 4 as shown in the Table 3. Genotypes Hirkani (8.00 days), Punjab 14 (8.50 days), Pusa Rasdar (9.00 days) and Konkan Tara (9.00 days) exhibited shortest germination periods, making them favourable for faster germination. In contrast, genotypes like Pant Karela 4 (13.00 days), CO 1 (12.00) and Konkan Karali (12.00 days) displayed the longest germination times, indicating potential delays in the germination process. Genotypes with moderate germination times, such as Pant Karela 3 (10.49 days), Phule Green Gold (11.00 days), and Pusa Vishesh (11.00 days), present potential for further improvement. The diversity in germination time among genotypes is influenced by genetic disparities, encompassing factors like seed dormancy and size. Additionally, environmental conditions during maturation, storage and germination, along with variations in seed coat characteristics, contribute significantly to the observed differences.

Table 3. Meanvariation of days taken for germinationamong 14 different bitter gourd genotypes

Genotypes	**Days taken for germination**
Punjab 14	8.50
Hirkani	8.00
Pusa Rasdar	9.00
Pusa Purvi	9.50
Priya	10.00
Konkan Tara	9.00
Konkan Karali	12.00
Pant Karela 3	10.49
Pant Karela 4	13.00
CO 1	12.00
Preethi	9.50
Phule Green Gold	11.00
Pusa Do Mausami	10.00
Pusa Vishesh	11.00
C.D.	**2.17**
SE(m)	**0.74**
SE(d)	**1.05**
C.V.	**12.61**

3.3 Survival Percentage

The survival percentage of germinated seeds varies significantly among the different genotypes, ranging from 82.12% (CO 1) to 97.81% (Pusa Purvi) as shown in the Table 4. Genotypes such asPusa Purvi, Hirkani,Phule Green Gold and Punjab 14 exhibited highest survival rate above 95% indicating robust performance post-germination while genotypeCO 1

(82.12%)exhibited lower survival percentage, suggesting potential challenges in sustaining growth after germination. These findings highlight the critical impact of genetic variation (Fig 1.) on the survival of seedlings, emphasizing the importance of selecting genotypes with higher survival percentages for improved agricultural outcomes.

Table 4.Meanvariation of Survival percentage among 14 different bitter gourd genotypes

Genotypes	**Survival percentage**
Punjab 14	95.86
Hirkani	97.30
Pusa Rasdar	92.94
Pusa Purvi	97.81
Priya	86.00
Konkan Tara	93.18
Konkan Karali	90.93
Pant Karela 3	93.46
Pant Karela 4	90.62
CO 1	82.12
Preethi	88.66
Phule Green Gold	96.05
Pusa Do Mausami	92.50
Pusa Vishesh	92.34
C.D.	**18.31**
SE(m)	**6.63**
SE(d)	**9.38**
C.V.	**12.47**

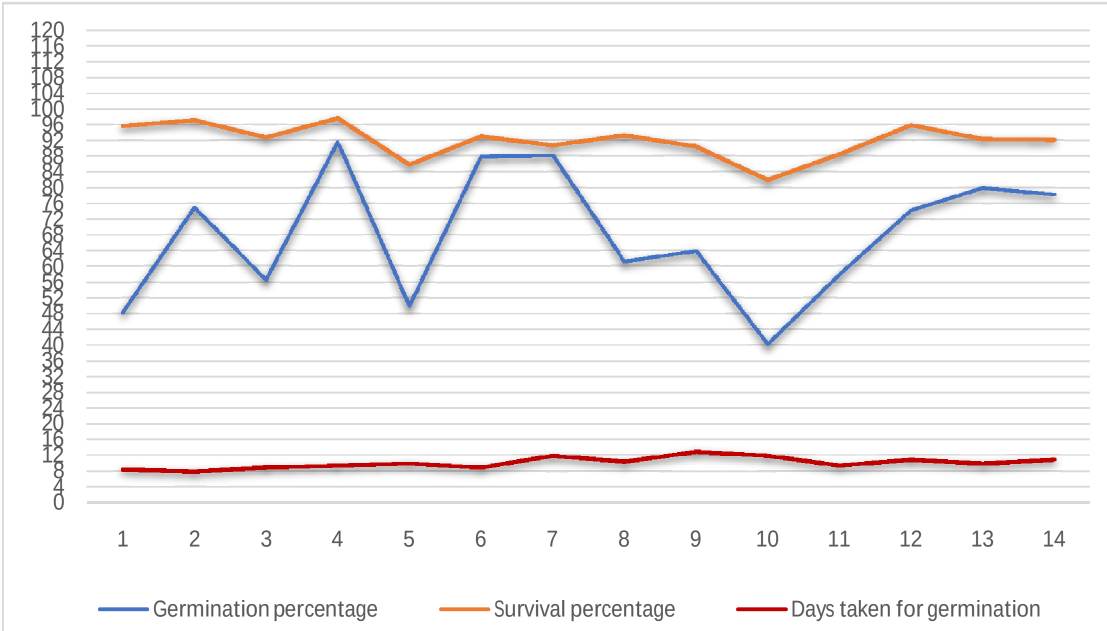

Fig 1. Variation among bitter gourd genotypes on germination percentage, survival percentage and days taken for germination.

4. CONCLUSION

The study on the seed germination and survival of different bitter gourd genotypes reveals significant variability.Genotypes such as Hirkani, Punjab 14, Pusa Rasdar, and Konkan Tara exhibited shorter germination periods, suggesting favorable traits for rapid establishment. Conversely, Pant Karela 4, CO 1, and Konkan Karali displayed longer germination times, indicating potential delays in establishment. High germination percentages were observed in genotypes like Pusa Purvi, Konkan Karali, and Phule Green Gold, highlighting their robust germination potential. Post-germination survival rates varied widely, with genotypes such as Pusa Purvi and Phule Green Gold showing exceptional resilience, while CO 1 exhibited lower survival percentage. These findings underscore the importance of genotype selection in optimizing germination and survival rates, which are critical for achieving high crop yields and robust plant growth. Future research should focus on developing strategies to improve the germination and survival rates of less robust genotypes, potentially through genetic enhancement or optimized growing conditions.

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