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Influence of pre-germination treatments on germination dynamics of passion fruit (*Passiflora edulis* var. *flavicarpa*) seeds under polyhouse condition

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Abstract
The present investigation, entitled "Influence of pre-germination treatments on germination dynamics of passion fruit (*Passiflora edulis* var. *flavicarpa*) seeds under polyhouse condition" was carried out at Hi-Tech Horticulture Park, College of Horticulture, Junagadh Agricultural University, Junagadh during the year 2024. The experiment was laid out in a Completely Randomized Design (CRD) with seven treatments and three repetitions. The seven pre-germination treatments (T) *viz*., T_1-GA_3 100 ppm, T_2-H_2SO_4 5%, T_3-Thiourea 1%, T_4-Mechanical scarification and fermentation for 7 days in 10% Sucrose, T_5-Mechanical scarification and GA_3 100 ppm, T_6-Hot water at 50˚C for 10 minutes, T_7-Control. The result of this experiment revealed that among the pre-germination treatments on germination, GA_3 100 ppm (T_1) was found significantly the maximum germination percentage (97.33%) and the minimum days required for germination (9.07 days).

Keywords: Passion fruit, pre-germination treatments, germination percentage, days for germination

Introduction
Passion fruit (*Passiflora edulis* S.) belongs to the family Passifloraceae and is found in Brazil. It is a tropical and subtropical vine widely appreciated for its nutritional, medicinal, and aromatic properties. Among the cultivated types, the yellow passion fruit (*P. edulis* var. *flavicarpa*) is known for its vigorous growth, higher yield potential, and tolerance to soil-borne diseases, making it suitable for large-scale cultivation and juice processing industries. Despite its economic importance, commercial production of passion fruit in India remains limited due to poor seed germination and non-uniform seedling establishment. Seed propagation is commonly practiced in passion fruit cultivation due to its simplicity and effectiveness in producing rootstocks. However, the period of seed viability for the majority of *Passiflora* species is unknown and the prolonged period of natural or induced dormancy makes seed germination slow and uneven, which restricts the commercial use of promising materials (Marostega *et al.*, 2017) [10]. The germination of passion fruit seeds is less and uneven, which may be due to physical (integument impermeability to water and gas), chemical (presence of inhibitory substances), physiological immaturity (mechanisms of germination inhibition) and embryo immaturity (Favaris *et al.*, 2020) [3]. Such dormancy and delays in emergence hinder the timely production of uniform seedlings, which is crucial for successful crop establishment and productivity. To overcome seed dormancy and enhance germination, various pre-germination treatments have been recommended. These include the use of growth regulators like gibberellic acid (GA_3) and thiourea, acid scarification using sulfuric acid (H_2SO_4), hot water soaking, and mechanical scarification techniques. GA_3 is known to stimulate the synthesis of hydrolytic enzymes that mobilize stored food reserves in seeds, thus promoting early germination. Thiourea plays a pivotal role in germination by promoting gibberellic acid activity. Thus, it is used as a germination promoter chemical (Khan, 1971) [5]. Considering this, the present investigation was undertaken to assess the effectiveness of different pre-germination treatments on the germination behavior of passion fruit seeds under polyhouse condition.

Materials and Methods

Experimental Site

The present study was conducted from May to August 2024 at the High-Tech Horticulture Park, College of Horticulture, Junagadh Agricultural University, Junagadh, Gujarat.

Experimental Design and Treatments

The experiment was laid out in a Completely Randomized Design (CRD) comprising seven treatments, each replicated thrice. Each treatment included 25 seeds per replication, totalling 525 seeds. The treatments were:

T_1-GA_3 @ 100 ppm
T_2-H_2SO_4 @ 5%
T_3-Thiourea @ 1%
T_4-Mechanical scarification and fermentation in 10% sucrose (7 days)
T_5-Mechanical scarification and GA_3 @ 100 ppm
T_6-Hot water treatment at 50 °C for 10 minutes
T_7-Control (untreated)

Seed Collection and Preparation

Fully ripened yellow passion fruits were collected from farmers' fields in Theni district, Tamil Nadu. Seeds were extracted manually, thoroughly washed under running water to remove the pulp, then placed in water for three days (fermentation) and dried at room temperature.

Potting mixture

Treated seeds were sown in black polyethylene bags (punched for drainage) filled with a potting mixture prepared by mixing 1:1:1 parts of sand, well-fertilized soil and well-decomposed FYM.

Observations Recorded

Germination parameters recorded were:
Seed Germination Percentage (%):

$$\text{SGP}(\%) = \frac{\text{Total no. of seed germinated}}{\text{Total no. of seeds sown in all replicates}} \times 100$$

Days required for germination (Days): Calculated from the day of sowing to final germination.
The standard method of analysis of variance was used for analysing the data for the CRD design. (Panse and Sukhatme, 1985) [13].

Results and Discussion

Seed Germination Percentage (%)

The data presented in Table 1 showed that pre-germination treatments had a significant influence on the germination percentage of passion fruit seeds. Among the treatments, T_1 (GA_3 @ 100 ppm) recorded the highest germination percentage (97.33%), which was statistically at par with T_2 (H_2SO_4 @ 5%). The lowest germination percentage (64.00%) was observed in T_7 (Control).
This might be because the exogenous application of GA_3 antagonises the effect of inhibitors and increases endogenous gibberellin-like substances. Another reason is that GA_3 stimulates seed germination by the formation of α-amylase enzymes, which convert insoluble starch into soluble sugars. It also initiates radical growth by removing some metabolic blocks, as suggested by Gillard and Walton (1973) [4]. Similarly, the H_2SO_4 treatment likely enhanced germination by chemically breaking down the impermeable seed coat, thereby improving water uptake and gas exchange.
These results conform with the findings of Palanisamy and Ramamoorthy (1987) [11], Babu *et al.* (2010) [2] and Anjanwe *et al.* (2013) [1] in papaya, Kumar *et al.* (1991) [7] in guava, Maiti *et al.* (2003) [9] in jackfruit, Venkatrao and Reddy (2005) [20], Kumar *et al.* (2008) [8], Shaban (2010) [18], Patel *et al.* (2016b) [16] and Kolekar *et al.* (2017) [6] in mango.

Days required for germination

The assessment of data in Table 2 showed that the minimum days required for germination (9.07 days) were recorded in seeds treated with T_1 (GA_3 @ 100 ppm), which was statistically at par with T_2 (H_2SO_4 @ 5%). In contrast, the maximum days required for germination (24.00 days) were observed in T_7 (Control), indicating a delayed and less synchronized germination process in untreated seeds.
This might be due to the fact that GA_3 showed to increase germination and overcome physiological dormancy in seeds with dormant embryos. Seed dormancy may be caused by an inadequate development of the embryo or the existence of chemical inhibitors. It acts on the embryo and causes de novo synthesis of hydrolyzing enzymes, particularly amylase and protease and this hydrolyzed food is utilized for the growth of the embryo and thereby enhances the germination (Paleg, 1965) [12].
These results conform with the findings of Anjanwe *et al.* (2013) [1] in papaya, Singh *et al.* (2002) [19] in jackfruit, Patil *et al.* (2012) [17] in rangpur lime, Patel *et al.* (2016a) [14] and Patel *et al.* (2017) [15] in custard apple.

Table 1: Effect of pre-germination treatments on seed germination percentage of passion fruit

Treatment No.	Treatments	Seed Germination Percentage (%)
T_1	GA_3 100 ppm	97.33
T_2	H_2SO_4 5%	96.00
T_3	Thiourea 1%	88.00
T_4	Mechanical scarification and fermentation for 7 days in 10% Sucrose	70.67
T_5	Mechanical scarification and GA_3 100 ppm	84.00
T_6	Hot water at 50˚C for 10 minutes	76.00
T_7	Control	64.00
S.Em.±		2.417
C.D. at 5%		7.33
C.V.%		5.09

Table 2: Effect of pre-germination treatments on days required for germination of passion fruit

Treatment No.	Treatments	Days required for germination (DAS)
T_1	GA_3 100 ppm	9.07
T_2	H_2SO_4 5%	9.44
T_3	Thiourea 1%	11.53
T_4	Mechanical scarification and fermentation for 7 days in 10% Sucrose	13.07
T_5	Mechanical scarification and GA_3 100 ppm	12.44
T_6	Hot water at 50˚C for 10 minutes	11.13
T_7	Control	24.00
S.Em.±		0.144
C.D. at 5%		0.44
C.V.%		1.93

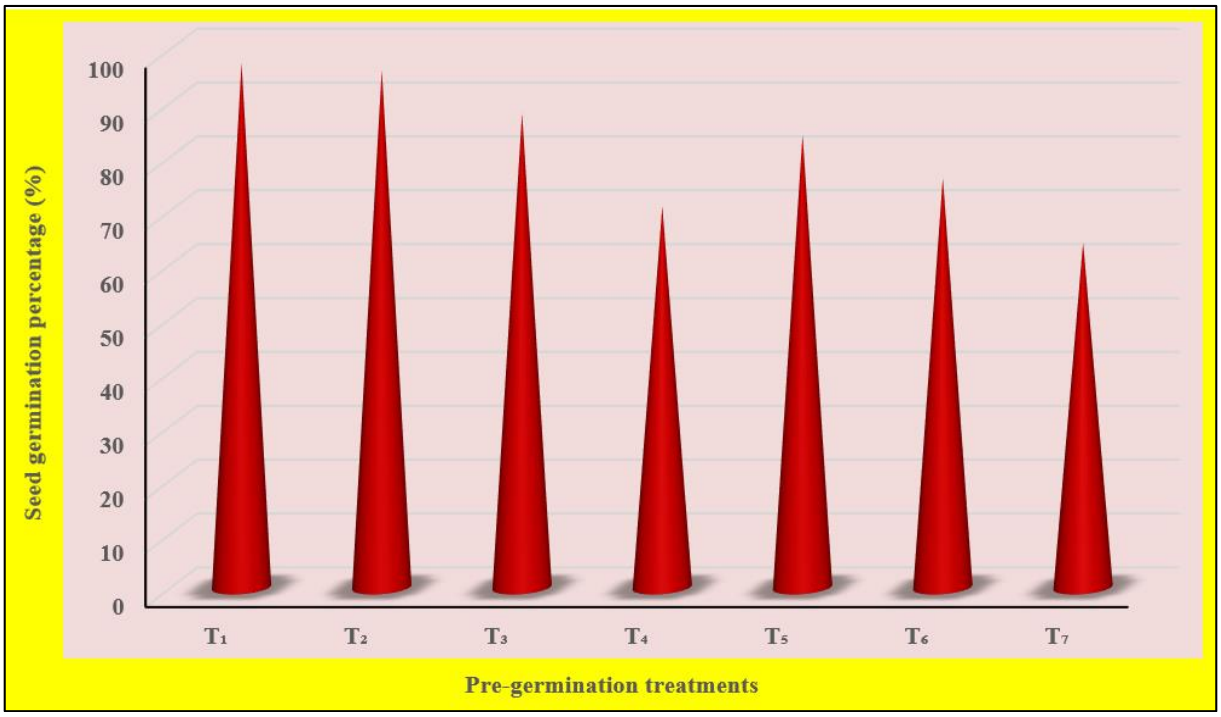

Fig 1: Effect of pre-germination treatments on seed germination percentage

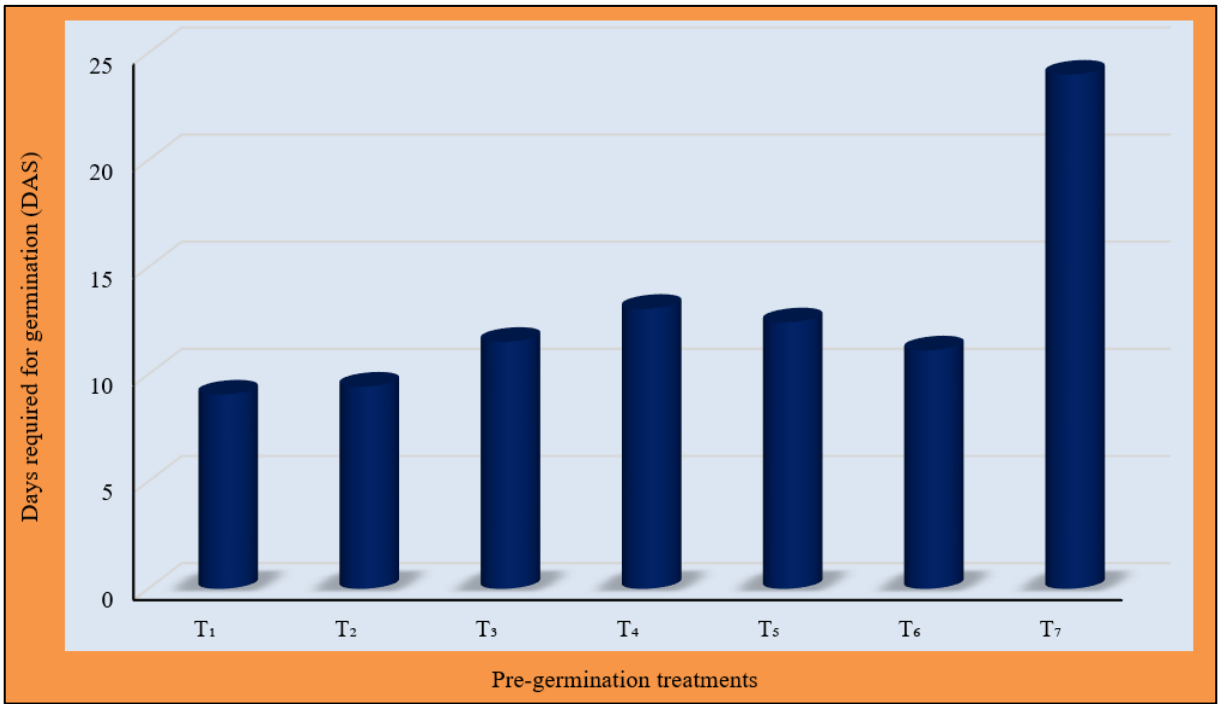

Fig 2: Effect of pre-germination treatments on days required for germination

Conclusion

Based on the results found from the present experiment, it can be comprehended that the pre-germination treatment of passion fruit seeds with GA_3 100 ppm for one hour under polyhouse condition greatly improved the highest germination percentage (97.33%) and the shortest days required for germination (9.07 days), indicating its superior efficiency in breaking physiological dormancy. H_2SO_4 treatment at 5% also proved highly effective, likely by weakening the seed coat to enhance water imbibition. These findings confirm that pre-germination treatments, particularly those involving GA_3 and acid scarification, play a pivotal role in enhancing both the speed and uniformity of seed germination.

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