Germination of yellow passion fruit (*Passiflora edulis*) seeds subjected to different dormancy overcoming methods

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Abstract – Despite a high cultivation in Brazil, passion fruit may present seed dormancy and heterogeneous production. This study evaluated the effect of conventional dormancy overcoming methods in yellow passion fruit (*Passiflora edulis* Sims) by means of a completely randomized experimental design, with eight replications for each of the six treatments used, namely: thermal scarification, acid scarification, mechanical scarification, hydro conditioning with and without subsequent BOD (Biochemical Oxygen Demand) drying and control. Germination was performed on germitest paper in a BOD incubator at 25°C. Germination percentage (G), germination speed index (GSI), Mean Germination Time (MGT) and Average Germination Speed (AGS) were the variables analyzed. Excepting T4, all other treatments were efficient in germination, but dormancy could not be proved cause germination occurred in the control batch.

Index terms: Passion fruit; Conventional methods; Propagation.

Germinação das sementes de maracujá-amarelo (*Passiflora edulis)* submetidas a diferentes métodos de superação de dormência

Resumo – Apesar do alto cultivo de maracujá no Brasil, a frutífera pode apresentar dormência em suas sementes e heterogeneidade da produção. O presente trabalho foi realizado com o objetivo de avaliar o efeito de métodos convencionais para superação da dormência de sementes de maracujá-amarelo (*Passiflora edulis* Sims). O delineamento experimental utilizado foi o inteiramente casualizado, com 6 tratamentos e 8 repetições. Os tratamentos foram: estratificação térmica, estratificação ácida, escarificação mecânica, hidro condicionamento com e sem posterior secagem em incubadora BOD (*Biochemical Oxygen Demand)* e um tratamento controle. Adotou-se o método de germinação sobre papel germitest em incubadora BOD a uma temperatura de 25°C. Foram analisadas as variáveis de porcentagem de germinação (G), índice de velocidade de germinação (IVG), tempo médio para germinação (TMG) e velocidade média de germinação (VMG). Com exceção do T4, os demais tratamentos foram eficientes na germinação, no entanto, não foi possível comprovar a dormência visto que ocorreu germinação no lote controle.

Termos para indexação: Cultivation; Métodos Convencionais; Propagação.

Usually, passion fruit propagation for forming commercial orchards takes place using seeds due to low cost and large availability. But implementing and obtaining a uniform and productive orchard depend on the uniform germination and development of the seeds used in commercial seedlings, which can be limited by dormancy issues (ZAIDAN & BARBEDO, 2004). According to Perez et al. (2004), dormant seeds are those which fail to germinate even under favorable development conditions. Sour passion fruit seeds often present temporary dormancy, which can be overcome with controlled storage for 30 to 40 days, especially in subtropical regions, as Petry et al. (2016) suggest. It is therefore useful to study methods for obtaining uniformity in the commercial production of *Passiflora* seedlings (JÚNIOR et al., 2021). Thus, this study evaluates the effects of different conventional dormancy overcoming methods on *P. edulis* sims.

The experiment was conducted at the Microbiology Laboratory, Instituto Federal Catarinense – Campus Araquari, from May to July 2021 with seeds obtained from fruits harvested at the institution's own orchard. The collected seeds were placed in a blender with water to remove mucilage (JÚNIOR et al., 2010) and then transferred into another container with water for separation and disposal of floating seeds according to Ruggiero et al. (1996). A completely randomized experimental design was used, with six conventional treatments and eight replications each. The treatments were labeled as follows: T1 – control (no treatment applied); T2 – chemical scarification with sulfuric acid for 10 minutes; T3 – mechanical scarification with scraping of the integument using a A257 sandpaper sheet; T4 – thermal scarification with hot water (80°C for 5 minutes) on a thermal shaker; T5 – hydro conditioning (seeds immersed in water for 144h) and subsequent drying at room temperature; T6 – hydro conditioning (seeds immersed in water for 144h) and subsequent drying in a

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BOD (Biochemical Oxygen Demand) oven for 24h. Each replication used 50 seeds, totaling 400 seeds per treatment. To avoid possible contamination by microorganisms during the experiment, the seeds were sanitized with 2% hypochlorite for 2 minutes and then washed in distilled water for 2 minutes. Germination was performed on germitest paper sheets rolled into a roulade and moistened with distilled water in an ratio of 2.5 x the weight of the paper. The seeds were stored in plastic bags inside the BOD greenhouse at 25°C for 26 days according to RAS criteria (Rules for Seed Analysis) (BRASIL, 2009), and the number of seeds were counted every two days. Germinated seeds were those which showed development of the essential embryo structures (root system, aerial part, terminal buds and cotyledons) (BRASIL, 2009). Germination percentage (G), Germination Speed Index (IVG), Average Germination Time (TMG) and Average Germination Speed (VMG) were the variables calculated (CARVALHO et al., 2009). Data normality was evaluated by Shapiro-Wilk testing and homogeneity of variance by Bartlett's test. Data were then subjected to analysis of variance. Means of treatments with significant differences were compared using Scott-Knott's test at a 5% significance level. If the variance assumptions were not met even after data transformation, means were compared using non-parametric Kruskal-Wallis and Bonferroni tests. All statistical analyses were performed using R software version 4.2.2.

Figure 1 shows the percentage of final and accumulated seed germination. Germination of *P. edulis* started on the 2nd day of experiment and except for T2 (chemical scarification) and T4 (thermal scarification), the other treatments showed a progressive increase in the percentage of germinated seeds until the 6th and 18th day, when stability was reached. After this period, the seeds started to develop only the essential seedling structures, without new germinations. T4 batch had a low germination percentage, but not statistically significant when compared with the other treatments. Using water at 80°C for 5 minutes to overcome dormancy proved to be an inefficient method, since using hot water at a temperature above 50°C can harm the seeds by putting the embryo and its germination potential at risk (JÚNIOR et al., 2010). For T2, submerging the seeds in sulfuric acid for 10 minutes may have damaged the embryo and stunted its development. T3 (mechanical scarification) showed the best germination percentage at the end of the experiment, when compared with the other treatments. According to Morley-Bunker (1980), Passifloraceae seeds can become dormant due to their coat impermeability which controls the amount of water inside, called physical dormancy. The integumentary rupture thus favors the entry of water on the scarified side allowing the embryo to develop (DE ABREU et al., 2014; JÚNIOR et al., 2021). Hydropriming treatments T5 (with drying at room temperature) and T6 (with drying in a BOD oven) had similar germination percentages. Hydropriming favors increased germination uniformity or speed, as it provides sufficient water for activating the metabolic reactions and cell expansion (JÚNIOR et al., 2021). Drying the seeds in a BOD after hydropriming opens fissures in the seed coat making water entry possible (TAIZ et al., 2017). Even without receiving any type of treatment, T1 (control) achieved high germination, thus hindering proof of dormancy in the *P. edulis* seeds used for the experimental batch. Lots that received treatment and failed to germinate suggest a possible physiological dormancy of the seeds. Unlike physical dormancy, physiological dormancy is not directly linked to external environmental factors, but to the embryo and its ability to germinate (CARDOSO, 2009).

Germination speed (GSI) was calculated based on the daily counting of germinated seeds during the 26 days of testing, suggesting that the higher the germination speed, the more vigorous the batch of seeds (FERREIRA et al., 2004). T3 showed a higher germination speed compared with the other treatments, indicating that in case of physical dormancy helping the entry of water into the seed favors embryo

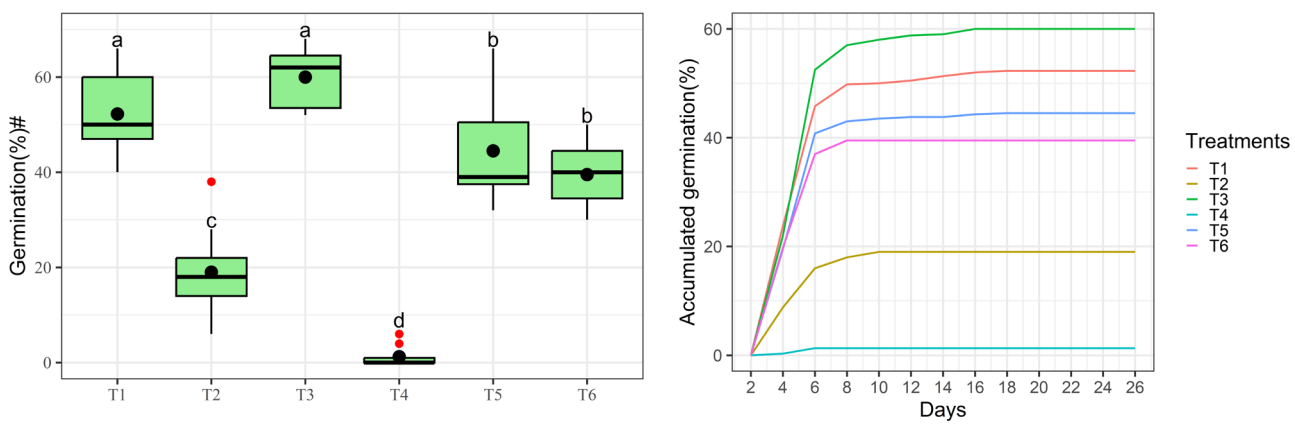

Figure 1. Percentage of final and accumulated germination of *P. edulis* seeds after subjection to different dormancy overcoming treatments. Means followed by the same letter do not differ from each other by Scott-Knott test (p>0.05). Red and black markers indicate outlier and mean, respectively. #Angular data transformation.

Figura 1. Porcentagem de germinação final e acumulada de sementes de P. edulis*, após serem submetidas a diferentes tratamentos de quebra de dormência. Médias seguidas pela mesma letra não diferem entre si pelo teste de Scott - Knott (p>0,05). Marcadores vermelhos e pretos indicam Outlier e média, respectivamente. # Transformação angular dos dados.*

development and rapid germination. T4 and T2 had GSI below 3.00, showing that heat treatments with water at 80°C and sulfuric acid do not favor germination at the same speed as other treatments. Exposing the seeds to acid (for 10 minutes) and hot water (for 5 minutes) may have compromised the reserves contained in the seeds and the starch hydrolysis process, reducing their ability to express physiological and genetic characteristics (JÚNIOR et al., 2021). Average Germination Speed (AGS index), expressed in days, was calculated based on the total number of seeds germinated divided by the experiment's total number of days. Except for T4, the other treatments showed similar average speed. Average Germination Time (AGT) was calculated based on the experiment duration for each treatment (Figure 2). Except for T4, the other treatments presented similar AGT. Hydropriming treatments T5 and T6 showed a small drop in MGT, but there was no difference between the two treatments. Bernardinelli (2016) obtained similar results.

Overall, except for thermal stratification (T4), all other treatments showed good germination, including the control. This result may be explained by a probable heterogeneity in the seed lot used in this experiment.

Temporary physical or physiological dormancy of the passion fruit could not be proved with the seedlings used. Further studies on the dormancy of the sour passion fruit tree are needed. In T4, the temperature of 80°C, above that appropriate for Passifloraceae seeds, possibly caused damage to the embryo.

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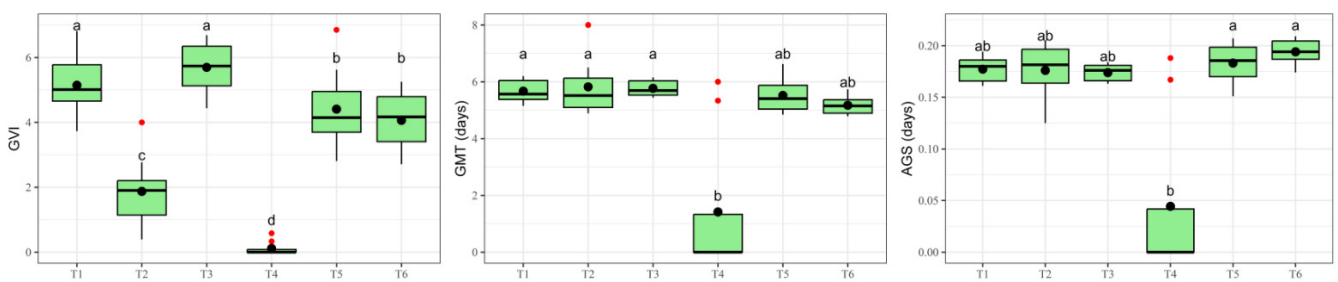

Figure 2. Germination Speed Index (GSI), Mean Germination Time (MGT), and Average Germination Speed (AGS) of *P. edulis* seeds after subjection to different dormancy overcoming treatments. For GSI, means followed by the same letter do not differ from each other by Scott-Knott test (p>0.05). For GMT and AGS, means followed by the same letter do not differ from each other by Bonferroni test (p>0.05). Red and black markers indicate outlier and mean, respectively. #Angular data transformation.

Figura 2. Índice de Velocidade Germinação (IVG); Tempo Médio de Germinação (TMG); Velocidade Média de Germinação (VMG) de sementes de P. edulis, *após serem submetidas a diferentes tratamentos de quebra de dormência. Para IVG, médias seguidas pela mesma letra não diferem entre si pelo teste de Scott-Knott (p>0,05). Para TMG e VMG, médias seguidas pela mesma letra não diferem entre si pelo teste de Bonferroni (p>0,05). Marcadores vermelhos e pretos indicam Outlier e média, respectivamente.*