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Initial growth of seedlings in two yellow melon cultivars with seed reuse

Crescimento inicial de plântulas em duas cultivares de melão amarelo com reutilização de sementes

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ABSTRACT

Farmers adopt sowing in melon seedling production using hybrid seeds, which increases production costs, making crop management more expensive. At the same time, small producers reduce these costs by reusing seeds over successive generations. The objective of this study was to evaluate the physiological quality of seeds from two yellow melon cultivars across two generations based on the initial growth components of the seedlings. A 2 x 2 factorial experiment was tested (2 yellow melon cultivars (cv. Gladial and Gold Mine) × 2 generations - F1 and F2), using 5 replicates with 20 seeds per replicate, totaling 100 plants. To determine the physiological quality of the seeds, the following measurements were made: dry mass of the aerial part (g per plant), height of the aerial part (cm), stem diameter (cm), dry root mass (g per plant), germination percentage (%), seedling emergence (%), speed of emergence (index), abnormal seedlings (%) and non-viable seeds (%). The variable values were subjected to analysis of variance with the application of the F-test at the 5% probability level. The cultivars influence the dry mass of the root, emergence percentage, and emergence speed index. The results obtained from the generations show negative effects on various variables, mainly on unviable and abnormal seeds, due to the attack of phytopathogenic fungi. The Gold Mine cultivar presents seeds of better physiological quality and are more vigorous.

Keywords: generations F1 and F2, sowing, *Cucumis melo* L., cultivars Gladial and Gold Mine, Roraima savanna.

RESUMO

Produtores adotam semeadura na produção de mudas de melão utilizando sementes híbridas, o que aumenta custos de produção, tornando o manejo da cultura mais onerosa enquanto pequenos produtores reduzem esses custos reutilizando sementes por gerações sucessivas. Objetivou-se com este trabalho avaliar qualidade fisiológica de sementes de duas cultivares de melão amarelo em duas gerações pelos componentes de crescimento inicial de plântulas. Testaram-se fatorial 2 x 2 (2 cultivares de melão amarelo (cv. Gladial e Gold Mine) × 2 gerações - F1 e F2), utilizando 5 repetições com 20 sementes por repetição, totalizando 100 plantas. Para a determinação da qualidade fisiológica das sementes, foram realizadas as determinações: massa seca da parte aérea (g planta^{-1}), altura da parte aérea (cm), diâmetro do caule (cm), massa seca de raiz (g planta $^{-1}$), porcentagem de germinação (%), emergência de plântulas (%), velocidade de emergência (índice), plântulas anormais (%) e sementes inviáveis (%). Os valores das variáveis foram submetidos à análise de variância com aplicação do teste F ao nível de 5% de probabilidade. As cultivares influenciam na massa seca da raiz, porcentagem de emergência e índice de velocidade de emergência. Os resultados obtidos das gerações apresentam efeitos negativos em diversas variáveis, principalmente em sementes inviáveis e anormais, devido ao ataque de fungos fitopatogênicos. A cultivar Gold Mine apresenta sementes de melhor qualidade fisiológica e são mais vigorosas.

Palavras-chave: gerações F1 e F2, semeadura, *Cucumis melo* L., cultivares Gladial e Gold Mine, savana de Roraima.

1 INTRODUCTION

Melon (*Cucumis melo* L.) represents a crop of significant global economic importance, and in Brazil in particular is a vegetable mainly exported in natura to the European market (MEDEIROS et al., 2015; BESSA et al., 2018).

The diversity of melon cultivars available on the market is wide, making the selection of plant materials a crucial step. This selection aims to obtain more productive varieties, which offer fruit with high tolerance to transport, attractive appearance, standardized size and distinct sensory characteristics, such as taste and texture, to meet the consumer's requirements. However, it is important to highlight that these cultivars also differ in their adaptability to the varied cultivation conditions (NUNES et al., 2011).

Companies specializing in seed production invest annually in advanced technologies to raise both the quality and productivity of highly specialized melons (SILVA et al., 2016). The effectiveness of melon production, or of vegetable production in general, is closely linked to the quality of seed germination. The period between sowing and the establishment of the seedlings is therefore a critical phase for the success of production (ARAÚJO et al., 2011). Silva and Cícero (2014) stress that the use of seeds with high physiological potential is vital to ensure the development of quality seedlings and, as a consequence, the establishment of robust plant populations.

In harmony with other melon producing nations, Brazil has also adopted the use of hybrid seeds (LALLA et al., 2010). However, given this reality, additional studies are needed, especially when considering the use of second-generation (F2) seeds, to assess issues such as vigor and possible pest infestations.

Seed re-use is especially relevant for small producers. In accordance with Normative Instruction No 9 of 2005, Annex III (MAPA), the use of seeds of the F2 generation is permitted for the production of natural fruits, provided that they are not seeds patented by manufacturers (MAPA, 2005).

Thus, the objective in this work was to evaluate the physiological quality of seeds of two yellow melon cultivars, of two consecutive generations, focusing on the components of initial growth of the seedlings.

2 MATERIAL AND METHODS

The experimental procedure started with obtaining the material for the first generation was made up of the seeds of the hybrids (F1 Hybrid, of the Gladial trademark of Rijk Zwaan) and (Gold Mine da Seminis) planted under mulching in the municipality of Bonfim-RR, whose geographical coordinates are: 03º 37' 14" north latitude, 60º13' 23" west longitude of Greenwich and 118 m altitude. Productivity of the F1 generation obtained in the first field planting under plastic mulching, was 61 t ha^{-1} to grow Gladial and 45 t ha^{-1} to grow Gold Mine, planted in the period 30 October 2021 to 13 December 2021.

The seeds of the F2 generation were obtained after the first planting of the F1 seeds of the two cultivars, where the fruit was picked manually, and then the fruit was transported to the Post-Harvest Laboratory of Embrapa Roraima, in the municipality of Boa Vista.

The seeds were extracted from the large fruit, manually depolpated, washed in running water for 5 minutes to remove the mucilage present in the seed, and then placed to dry in laboratory conditions over a period of 72 hours. After cleaning, the seeds were treated with insecticide thiametoxan (Atara®) and methyl thiophanate (Cercobin®) in the proportions 0.5g (each) and immersed in 3 mL of distilled water for 30 minutes for 100 seeds and then dried.

According to (BRAZIL, 2009), the water content in the seeds of the cultivars and generations determined by the greenhouse method of air circulation at 105 +3 ºC during 24 hours in the phytopathology laboratory of Embrapa Roraima, using 100 seeds per generation presenting Gladial F1 11.33%, Gladial F2 9.91%, Gold Mine F1 8.33% and Gold Mine F2 10.33%.

The design used in the experiment was entirely casualized (DIC) where the treatments constituted a factor 2 x 2 (2 cultivars of yellow melon (Gladial and Gold Mine × 2 generations F1 and F2 cultivars), with 5 repetitions, 20 seeds per repetition and totaling 100 plants.

For the assessment of the physiological quality of the seed, the following tests/determination were carried out: germination percentage, seedling emergence percentage, emergence rate index, percentage of abnormal and unviable seeds, seedling height, stem diameter, air dry mass and root dry mass.

The germination rate index (IVG) test was used five repetitions of 20 seeds each repetition, sown in towel paper moistened with distilled water in proportion 2.5 times the weight of the paper and packed in a germination chamber of type B.O.D (Biological Oxygen Demand) at a controlled temperature of 25 °C with 12-hour photoperiod (BRAZIL, 2009). Germination was considered when the seed had a root of 1 cm.

For emergence of seedlings was carried out in plastic trays and transported to the home of vegetation where daily measurements of temperature and humidity of the place were made, and daily counts were made in the experiment at 9:00 am. The water used in the experiment was determined the electrical conductivity which was 0.03 dS m^{-1}. The average temperature of the site was 35.5 oC and the average humidity was 64%.

In the trays, 20 seeds were distributed in five repetitions, totaling 100 seeds for each treatment. The irrigation was daily and the initial assessment of the emergence was from the third day and the final one was carried out 9 days after sowing, made from seedlings emerged to those whose cotyledonar leaves no longer touched the soil, calculating in percentage the number of plants emerged each day.

The results obtained in the seedling emergence variable were used to calculate the emergency velocity index according to the formula proposed by Maguire (1962). These daily counts were made from seedlings emerged to those whose cotyledonar leaves no longer touched the soil.

Percentage of abnormal and unviable seeds were carried out at the end of the emergency assessment, where all seeds that did not emerge were removed to evaluate the percentage of abnormal seeds and unviable seeds that did not germinate as empty seeds or with pathogens, according (BRASIL, 2009).

IVE= E1/N1 + E2/N2 +.... Em/Nn

LVI = emergency speed index;

E1, E2 and Em = number of plants emerged, shown in the first, second and last count;

N1, N2 and Nn = number of sowing days at first, second and last counting.

At the end of 16 days after sowing in the trays, the height of the seedlings and the length of the root were evaluated when the plants showed the second true leaf.

For seedling height were removed 10 normal seedlings and obtained from five repetitions. The measurements of each repetition were added up and divided by the number of normal seedlings, and the results expressed in cm seedlings^{-1}. For characteristic of the neck diameter was measured using digital caliper, and expressed in millimeters (mm).

Dry mass of the aerial part and dry mass of the root were used (NAKAGAWA, 1999), the aerial parts and roots of the seedlings that were placed separated in paper bag and packed in forced circulation oven at 65 °C for 48 hours, then weighed in electronic balance (0,001 g) and expressed in (g plant^{-1}).

The analysis of variance was carried out by the Sisvar statistical program and the averages compared by the Tukey test at 5% probability (FERREIRA, 2014).

3 RESULTS AND DISCUSSION

The result of the analysis of variance (Table 1), for the variables showed that the effect of the interactions between cultivars and generations was significant only for percentage germination (%GERM). The isolated effect of the cultivars was observed in the studied variables, and only dry root mass (DRM), percent emergence (%EMERG) and emergence rate index showed significant effect. For the effect isolated generations, it was significant for air dry mass (MSPA), seedling height (APA), stem diameter (DC), emergency percentage (%EMERG), emergency speed index (IVE) and abnormal seeds (SA).

Table 1. Summary of variance analysis for air dry mass (MSPA); seedling height (APA); stem diameter (DC); dry root mass (MSR); germination percentage (%GERM); emergence percentage (%EMERG); emergency velocity index (IVE); abnormal seeds (AS); unviable seeds (SI) obtained from melon cultivars fruit in two generations. Boa Vista, Roraima, 2022.

Variables	Overall Average	"F-Test"			
		CV (%)	C	G	C x G
G.L	-	-	1.	1.	1.
MSPA	0.04	25.74	0.002 ^{ns}	6.2*	2.26 ^{ns}
APA	9.53	7.81	0.3 ^{ns}	13.9 **	0.5 ^{ns}
DC	2.34	6.87	0.1 ^{ns}	10.2 *	0.13 ^{ns}
MSR	0.029	35.02	8.82 **	0.04 ^{ns}	0.78 ^{ns}
%GERM	80.75	11.99	9.7 ^{ns}	49.6 ^{ns}	4.8 *
%EMERG	75.75	16.8	7.4 *	10.57 **	0.06 ^{ns}
ENI	3.43	22.68	5.9 *	0.02 **	0.3 ^{ns}
SA	8.5	85.75	1.5 ^{ns}	18.44 **	0.8 ^{ns}
SI	15.25	74.41	4.2 ^{ns}	2.1 ^{ns}	0.2 ^{ns}

^{*,**,ns} - significant at 5%, 1% and non-significant, respectively, by the ‘F’ test.
Source: Author

With regard to the dry mass of the aerial part, it was not influenced by the cultivars and the Gold Mine cultivar resulted in 0.0402 grams and the Gladial in 0.0403 grams (Table 2).

Comparing the means between generations, there was a simple effect response, with an average of 0.046 achieved by the F1 generation that exceeded 26% of the average obtained with the F2 generation. Testing cultivars of melon, Gonçalves Araújo et al. (2016) observed the variation of 0.0249 to 0.0307 g in the dry mass of the aerial part between them, however occurring significance between the cultivars tested, different from that verified in this work.

Table 2. Average dry mass of the aerial part and height of melon seedlings obtained in two cultivars and two generations. Boa Vista, Roraima, 2022.

Factor	MSPA (g plant $^{-1}$)	APA (cm)
Cultivate		
Gladial	0.0403 to	9.43a
Gold Mine	0.0405 to	9.63 a
Generation		
F1	0.046 to	10.15a
F2	0.034 b	8.91 b

The mean values followed by the same letter in the column do not differ by the Tukey test ($p \geq 0.05$).
Source: Author

For seedling height there was no influence between cultivars obtaining values of (9.43) cm for Gladial and (9.63) for Gold Mine. Comparing the mean of the generations there was a significant difference, being the F1 generation with 10.15 cm and the F2 generation with 8.81 cm (Table 2).

Considering the reuse of seeds, the use of F2 genotypes treats a breeding species with low genetic load occurring depression by endogamy, this allows obtaining of uneven plants and low production.

Analyzing the averages of the DC variable it was noted that there was a significant effect for generation, where the F2 generation was higher than the F1 (TABLE 3). With the previous result of the height of the upper part (Table 2) the F1 generation was shown to be the highest height of seedlings and associating the (Table 3) of the stem diameter to F1 was lower than F2. Because the F1 seedlings probably styled more due to the low luminosity of the experiment site.

According to Pelloso et al. (2020), stem diameter is crucial for efficient transport and nutrient storage as well as for providing adequate structural support to seedlings. Therefore, seedlings with reduced stem diameters are prone to suboptimal growth, and are at increased risk of tipping, warps, and overall losses.

For dry root mass, significance of 1% was observed for cultivars where the cultivar Gold Mine produced 0.035 g and the Gladial 0.022 g (Table 3). The results in the present study were lower than those observed by Freitas et al. (2014), who found averages between 0.035 and 0.067 g plant^{-1} for the Gold Mine cultivar using the commercial substrate (Tropstrato HT®, whose composition includes pine bark, peat and expanded vermiculite).

Table 3. Averages of the diameter of the stalk and dry mass of melon seedling root obtained for two cultivars and two generations. Boa Vista, Roraima, 2022.

FACTORS	**DC (mm)**	**MSR (g plant $^{-1}$)**
Cultivate		
Gladial	2.35a	0.022 b
Gold Mine	2.33a	0.035 to
Generation		
F1	2.22 b	0.029 to
F2	2.45a	0.028 to

The mean values followed by the same letter in the column do not differ by the Tukey test ($p \geq 0.05$).
Source: Author

Significant interaction between factors was observed in the germination percentage analysis (Table 4). When compared with the generations, the F2 showed a lower germination value of the seeds, independent of the cultivar. With regard to cultivating, there were no differences, where the Gold Mine cultivar obtained a higher percentage of germination.

Table 4. Breakdown of the interaction between two cultivars and two generations in the germination percentage of melon seeds. Boa Vista, Roraima, 2022.

	Germination (%)	
	Generation	
Cultivate	G1	G2
Gladial	94.00 aA	54.00 bB
Gold Mine	98.00 aA	77.00 aA

Averages followed by the same letter, uppercase in the column and lowercase in the row, do not differ statistically by the 5% Tukey test.
Source: Author

The F1 and F2 generations in the experiment showed incidence of fungi. *Aspergillus* spp and *Penicillium* spp. which were common to the seeds of both generations used. These are storage fungi, typical causes of rotting in seeds and responsible for losses in the viability and longevity of seeds, including production of mycotoxins, which cause reduction in the physiological quality of seeds (FANTAZZINI et al., 2016).

For the percentage of emergence and the rate of emergence, significant differences were

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observed for isolated cultivar factors and generations (Table 5).

For the Gold Mine cultivar obtained better IVE vigor and emergence percentage, for seeds of Generation F1 was superior in the two characteristics evaluated.

Unlike the observations of Godoy et al. (2006), which evaluated seeds from six generations of cucumber, endogamy did not affect the quality of the seeds. The fall in the emergency speed index for generations evidences the loss of vigor of F2 seeds, from the F3 generation the heterozygosity begins to decrease, thus providing the increase of homozygote heirs. The LI results obtained in the present study were similar to those obtained by Pelizza et al. (2013), where, evaluating yellow melon, they recorded (LI) of 4.43.

Table 5. Average emergency rate and emergency percentage of melon seedlings obtained for two cultivars and two generations. Boa Vista, Roraima, 2022.

FACTORS	ENI	EMERG (%)
Cultivate		
Gladial	3.03 b	68b
Gold Mine	3.89a	83 a
Generation		
F1	4.08 to	85a
F2	2.84 b	66 b

The mean values followed by the same letter in the column do not differ by the Tukey test (p≥0.05).
Source: Author

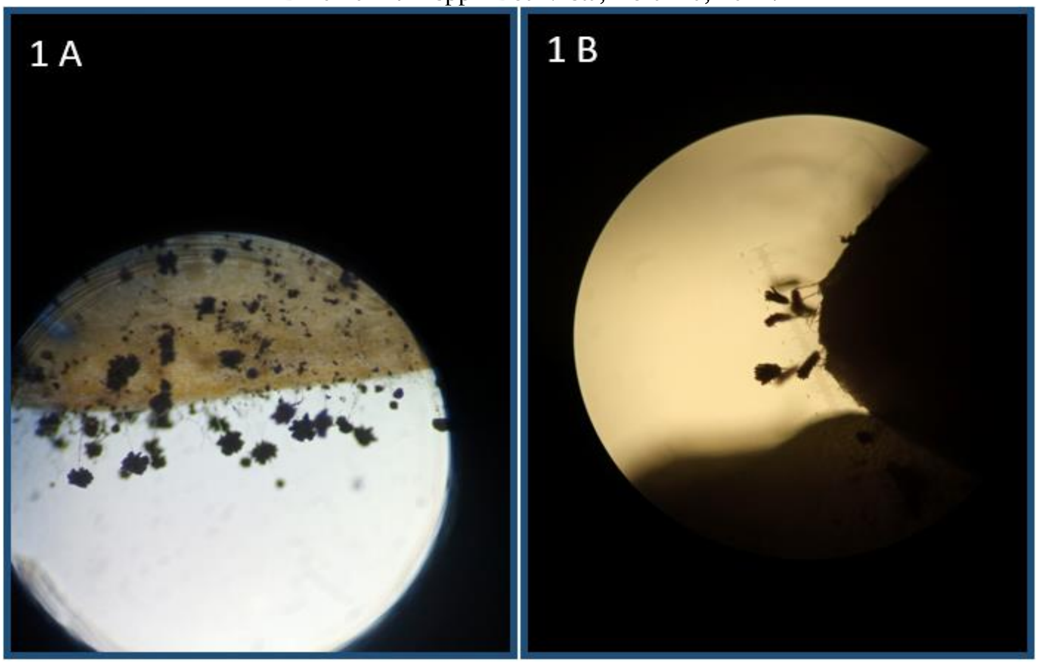
In the evaluation of unviable seeds or melon shocks, there was no significant difference for any of the factors evaluated (Table 6), and the Gladial cultivar showed superior results of 100% more unviable seeds. And when F1 generation was higher than F2, this was possibly due to the occurrence of fungi in the seeds (*Aspergillus* spp and *Penicillium* spp), and some seeds being chochas (Figure 1 A and 1 B). As for the abnormal seeds to grow Gladial obtained negative superiority of the abnormal seeds presenting 10% and the Gold Mine 7% of the percentage of abnormal seeds.

Table 6. Average abnormal melon seeds obtained for two cultivars and two generations. Boa Vista, Roraima, 2022.

FACTORS	SI (%)	SA (%)
Cultivate		
Gladial	20.5 to	10.5 to
Gold Mine	10a	6.5a
Generation		
F1	11.5 to	1.5a
F2	19.5 to	15.5 b

Averages followed by the same letter in the column, for the same variable and within the same factor, do not differ from each other by Tukey's test at the 5% probability level.
Source: Author

Figure 1 a and 1 B - View under the microscope of fungi in melon seeds in Figure 1 A *Aspergillus* spp and Figure 1 B *Penicillium* spp> Boa Vista, Roraima, 2022.



Source: CARMO, I.L.G.S

4 CONCLUSIONS

Cultivars influence the dry mass of the root, emergence percentage and emergence rate.

The results obtained from the generations show effects on almost all variables, mainly on unviable and abnormal seeds, due to the attack of phytopathogenic fungi.

The Gold Mine cultivar has better physiological quality seeds and are more vigorous compared to Gladial.

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