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Field management of yellow melon (*Cucumis melo* L.) with silicon sources

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ABSTRACT. This study aimed to evaluate the effect of silicon and acibenzolar-S-methyl sources on the development of yellow melon (*Cucumis melo* L.) in the field and the occurrence of diseases in different years. The treatments consisted ofthe silicon sources Agrosilício® (3 g L^{-1}), Rocksil® (3 g L^{-1}), and Chelal® Si (2 L 100 L^{-1}), the additional treatments acibenzolar-S-methyl (ASM) (2 mM) and the fungicide thiabendazole (400 mL 100 L^{-1}), and a control (sterile distilled water). The following characteristics were evaluated: natural incidence of diseases; gas exchange: CO_2 assimilation rate, transpiration, stomatal conductance, internal CO_2 concentration, water use efficiency, instantaneous water use efficiency, and carboxylation; postharvest aspects: fruit weight, pulp thickness, pulp firmness, titratable acidity, pH, soluble solids, and vitamin C content; productivity; and the enzymatic activity of peroxidases, polyphenol oxidases, and phenylalanine ammonia-lyase. No significant response was observed for naturally occurring diseases. Treatments with Chelal®Si, Rocksil®, and Thiabendazole® increased photosynthetic and transpiration rates in the yellow melon. The silicon and ASM sources did not influence the physicochemical characteristics or the enzymatic activity of fruits. No effect was observed on the biometric characteristics, productivity, and chemical quality of fruits in both years of cultivation. Si sources increased photosynthetic rate and transpiration. However, no diseases were observed during the experimental period. Leaf spraying with silicon and acibenzolar-S-methyl sources did not influence the biometric characteristics and fruit production of yellow melon. The silicon and acibenzolar-S-methyl sources did not induce an increase in the enzymatic activity of peroxidases, polyphenol oxidase, and phenylalanine ammonia-lyase. Fruit production was higher in 2020.

Keywords: enzymatic activity; gas exchange; postharvest quality; resistance induction.

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Introduction

The Brazilian semi-arid region is a privileged location for melon (*Cucumis melo* L.) cultivation due to its favorable environmental conditions. The Northeast region, specifically Mossoró/Açu, Rio Grande do Norte State and Baixo Jaguaribe, Ceará State, are the Brazilian's largest melon producers and exporters, reaching 80% of exports in the last decade. This production impacts socioeconomic development, generating approximately 25,000 direct and indirect jobs (Barbosa, Melo, Pimenta, Oliveira, & Silva, 2022).

The yellow melon is produced and exported at an rate of over 60%. The fruits are sweet (°Brix > 10), have a weight that ranges from 0.7 to 2.5 kg, and present smooth or wrinkled peel, juicy pulp of white-greenish color, no aroma, and non-climacteric characteristics (Barbosa et al., 2022). However, this cultivar still faces some production and commercialization challenges due to the lack of use of technologies adapted to production systems and the economic conditions of farmers (Cavalcante Neto, Ferreira, Aragão, Antônio, & Nunes, 2020).

In addition to these factors, there are still some limitations in the production and commercialization of the fruits, such as low quality due to the attack of pests and pathogens, which cause economic damage to the crop. Some phytopathogens occur naturally in cultivation areas, standing out *Macrophomina phaseolina* and

Fusarium solani, which cause several symptoms, such as stem canker, seedling wilt, root rot, dry rot, wilt, wilt in leaves, and tipping in pre-and post-emergence (Marquez, Giachero, Declerck, & Ducasse, 2021).

The use of alternative tools aimed at increasing production is essential to ensure the health and development of this crop. Silicon (Si) is a potential inducer of resistance against pests and diseases and also acts in the formation of silicate barriers in plants and fruits, in addition to activating a pre-existing defense mechanism (Etesami & Jeong, 2018). Si also increases water use efficiency, reduces the transpiration rate, which, consequently, reduces water loss by the plant, and increases nutrient uptake and metabolism, providing fruit quality under unfavorable conditions (Medeiros et al., 2020).

Studies have shown that Si application during plant development attenuates biotic and abiotic stresses, favors production, allows higher nutrient uptake, and promotes the postharvest quality of fruits (Lozano et al., 2018). The Si is transformed into amorphous silica when absorbed in the epidermal tissue, forming a thick Si-cellulose membrane. This cuticular Si confers higher rigidity, mechanically strengthening the plants against pests and diseases, in addition to forming complex organic compounds in cell walls, thus increasing their resistance to degradation by enzymes (Würz, Kowal, Fagherazzi, Santos, & Leite, 2020).

In this context, this study aimed to evaluate the effect of silicon sources and acibenzolar-S-methyl on the development of yellow melon (*Cucumis melo*) in the field and disease occurrence in different years.

Material and methods

Study site and treatments

Experiments were conducted in two cultivation seasons: the first experiment was from September 12 to November 29, 2019, while the second experiment was from February 19 to May 14, 2020. A500-m^2experimental field located in the Center for Agricultural Sciences (CCA) Federal University of Paraíba (UFPB), Campus II, Areia, Paraíba State, Brazil (6°58′1.74″ S and 35°42′48.69″ W, with an altitude of 623 m),was used. Temperature, precipitation, and humidity recorded during the period in which the experiments were conducted were obtained from the database of the weather station of the university campus (Figure 1).

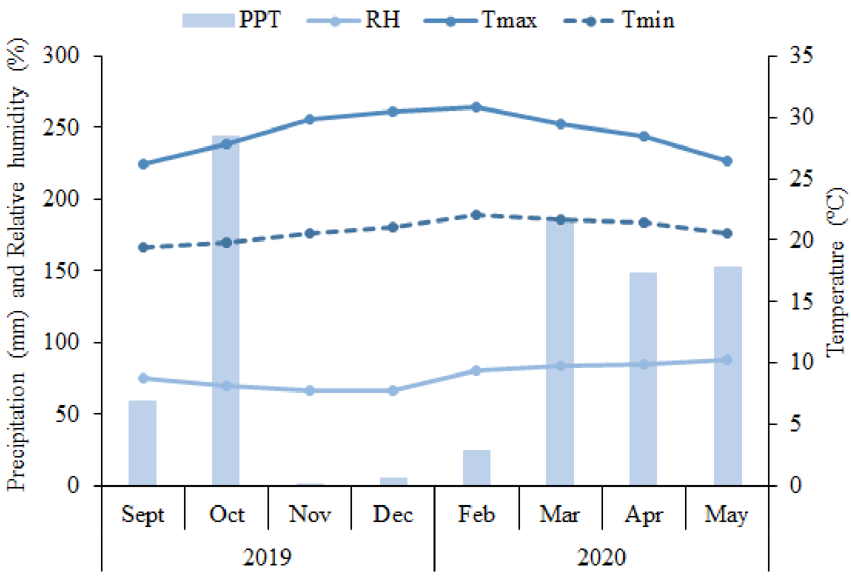

Figure 1. Meteorological data obtained from the weather station of the Center for Agricultural Sciences of the Federal University of Paraíba, Campus II, during the 2019 and 2020 growing seasons.

The planting area was plowed and deep-harrowed. Fertilization was performed as recommended by Cavalcanti (2008). The experimental area has a loamy sandy-textured soil. Organic seeds of the yellow melon cv. Goldex were obtained from the company Agrícola Famosa, Rio Grande do Norte State, Brazil, for seedling production in a greenhouse. The seedlings were planted in the experimental area14 days after sowing.

A randomized block experimental design was used in a 6 × 2 factorial scheme, with four repetitions. The experimental plot consisted of four 5-m rows, with 1.0 m between rows and 1.0 m between plants. The treatments consisted of the silicon sources Agrosilício® (3 g L^{-1}), Rocksil® (3 g L^{-1}), and Chelal® Si (2 L 100 L^{-1}), the additional treatments acibenzolar-S-methyl (ASM) (2 mM) and the fungicide thiabendazole (400 mL 100

L^{-1}), all diluted in sterile distilled water (SDW), and the control consisting of SDW. The treatments were sprayed on the plants at 23 and 46 days after emergence (DAE), using a TM20C knapsack sprayer with a fan nozzle until the point of leaf runoff. Manual irrigation was performed for 15 days after transplanting (until the crop was established in the field). Weeds were controlled by manual weeding. Yellow sticky traps (Yellow Trap Pro) were used for pest control.

Acibenzolar-S-methyl (ASM) has a fungicidal function and can induce the defense system of plants. It was used in this study as a positive and comparative control relative to silicon sources in the management of naturally occurring diseases.

Cultivation was performed for two consecutive years. Rescue irrigation was conducted when necessary. Thinning was performed at 40 days after planting, leaving two to three fruits per plant. Harvest was carried out in the morning between 6:00 and 8:00 a.m. at 78 days after sowing when the fruits reached maturation characteristics (Barbosa et al., 2022). The fruits were taken from the plant with pruning shears, packed in plastic boxes, and sent to the Laboratory of Phytopathology of the Federal University of Paraíba.

Natural incidence of diseases

The natural incidence of diseases was analyzed through daily monitoring of the cultivation area by observing plants that presented characteristic symptoms, such as wilting, yellowing, tipping over, and collar rot. Plants with symptoms were sent to the Laboratory of Phytopathology for confirmation of the causative agent (Koch's postulates). All collected plants were identified and placed in styro foam boxes until the analyses were carried out.

Gas exchange

Gas exchange analyses were conducted on two leaves of the middle third portion of the plant, with two plants for each treatment. Readings were performed from 9:00 to 11:00 am at 30 days after transplanting using an ADC Bio Scientific LCPro + infrared gas analyzer (IRGA), with a PAR of 1,200 μmol m^{-2} s^{-1}. The photosynthetic rate (A, μmol CO_2 m^{-2} s^{-1}), transpiration (E, mmol H_2O m^{-2} s^{-1}), stomatal conductance (gs, mol m^{-2} s^{-1}), internal CO_2 concentration (Ci, μmol CO_2 mol air^{-1}), water use efficiency (WUE = A/E), instantaneous water use efficiency (iWUE = A/gs), and instantaneous carboxylation efficiency (iCE = A/Ci) were evaluated.

Post-harvest analyses

Fruit weight (FW) was measured on a semi-analytical digital scale and the results were expressed in percentages. Pulp thickness (PT) was determined using fruits cut in half, with measurements taken using a digital caliper, with values expressed in mm. Pulp firmness (PF) was measured at opposite points in the equatorial region on both sides of the fruits, using a digital penetrometer (Soil Control®) (8-mm diameter tip). The results were expressed in Newton (N).

Titratable acidity (TA) was determined by titrating an aliquot of approximately 10 mL of juice with sodium hydroxide NaOH (0.1M), with results expressed as % citric acid. The pH was measured with a pH meter (Quimis®) (Association of Official Analytical Chemists [AOAC], 1990). The soluble solids (SS) content was measured in °Brix with a DHR-60 digital refractometer (Schmidt Haensch®) (Instituto Adolfo Lutz [IAL], 2005). Vitamin C was determined according to the methodology described by IAL (2005). Productivity was calculated considering the average fruit weight (kg) × number of fruits harvested per treatment (m), and the result was converted into kg ha^{-1}.

Enzymatic activity

The enzymatic activity of peroxidase (POX), polyphenol oxidase (PPO), and phenylalanine ammonia-lyase (PAL) was determined in samples composed of four leaflets collected at 25 and 50 days after transplanting. The collection was conducted in the early hours of the morning (6:00 to 7:30 a.m.). For enzymatic extraction, 1.0 g of leaves were homogenized in a porcelain crucible with 10 mL of 0.1 M phosphate extraction buffer at pH 6.0. The suspension was centrifuged for 15 minutes at 12,000 rpm and the supernatant was collected.

The reactions to determine the enzymatic activity were performed in triplicates. The determinations of protein content in the extracts were carried out according to the method described by Bradford (1976). All readings were performed and expressed in absorbance units (AU $min.^{-1}$ mg^{-1}) of protein in a spectrophotometer (Thermo UV-vis model GENESYS 10S).

Statistical analysis

The data were subjected to analyses of variance (ANOVA) using the F-test, with means being compared by the Tukey test ($p \leqslant 0.05$). Pearson's correlation analysis ($p \leqslant 0.05$) was performed to study the interrelationship between variables. All statistical analyses and charts were performed in the R statistical software, using functions from the packages *easyanova*, *metan*, *cowplot*, egg, and ggplot2 (R Core Team, 2022).

Results and discussion

The natural incidence of diseases showed no significant difference, as disease occurrence was minimal. Some diseases occur naturally in melon production areas, especially those caused by soil-dwelling pathogens. Treatments that have a proven effect in inducing a defense response in plants and action against phytopathogens were used in the present research. However, the low occurrence of diseases can be explained by the unfavorable weather conditions recorded during the research (Figure 1).

No interaction ($p < 0.01$) was observed between melon plants treated with different resistance inducers. However, an isolated effect was observed for the photosynthetic rate (A) and transpiration (E) when years of cultivation were evaluated. Stomatal conductance (gs) and internal CO_2 concentration (Ci) showed no difference between treatments, with an isolated effect, and only the year factor was significant (Table 1).

Table 1. Photosynthetic rate (A), stomatal conductance (gs), internal CO_2 concentration (Ci), and transpiration (E) in yellow melon plants (*Cucumis melo*) during two years of cultivation.

Treatment	A (μmol CO_2 m^{-2} s^{-1})		Mean	gs (mol H_2O m^{-2} s^{-1})		Mean
	2019	2020		2019	2020	
Control	24.34	12.45	18.40 ab	1.28	0.26	0.77 a
Agrosilício®	19.60	10.82	15.21 b	1.00	0.23	0.62 a
Acibenzolar-S-methyl (ASM)	22.33	14.20	18.27 ab	1.21	0.41	0.81 a
Chelal® Si	26.28	16.44	21.36 a	1.45	0.50	0.98 a
Rocksil®	25.48	16.01	20.75 a	1.51	0.43	0.97 a
Thiabendazole	23.79	19.92	21.86 a	1.07	0.79	0.93 a
Mean	23.64 A	14.97 B		1.26 A	0.44 B	
CV (%)	14.36			37.51		
Treatment	Ci (μmol CO_2 mol air^{-1})			E (mmol H_2O m^{-2} s^{-1})		
	2019	2020		2019	2020	
Control	307.56	275.07	291.32 a	10.14	4.84	7.49 ab
Agrosilício®	298.01	273.92	285.96 a	8.00	3.99	6.00 b
Acibenzolar-S-methyl (SMA)	301.96	281.11	291.54 a	8.64	5.51	7.07 ab
Chelal® Si	310.80	286.33	298.56 a	10.34	6.65	8.50 a
Rocksil®	310.72	284.72	297.72 a	9.64	5.91	7.78 ab
Thiabendazole	308.59	288.46	298.52 a	9.76	7.86	8.81 a
Mean	306.27 A	281.6 B		9.42 A	5.79 B	
CV (%)	3.02			16.91		

Means followed by uppercase letters compare the effects of treatments within the years of cultivation, while lowercase letters compare the effects of treatments by the Tukey test ($p \leqslant 0.05$).

Plants treated with Chelal® Si, Rocksil®, and thiabendazole showed the highest values of A and E in both years of cultivation, indicating that these treatments provided the normal functioning of the plants under adverse conditions. Plants under stress tend to decrease their photosynthetic rate and transpiration in response to low water availability and high temperatures, resulting in higher water use efficiency (Medeiros et al., 2020).

This physiological change occurs when plants are subjected to stress conditions. Moreover, gs and Ci increase, consequently improving the photosynthetic rate and attenuating the effects of water stress (Weng et al., 2022). This behavior was expected, as water availability for the plants was higher due to the occurrence of rains in the first year of cultivation, although it was not ideal.

Changes observed for A and E in treated plants may be related to the presence of Si in the composition of the treatments Chelal® Si and Rocksil®. This element acts on cellular osmotic regulation, increasing the uptake of K^+ (the ion that regulates osmotic pressure), responsible for stomatal opening regulation (Gomes & Nascimento, 2018; Verma et al., 2020).

An interaction was observed for the intrinsic water use efficiency (iWUE) and instantaneous carboxylation efficiency (iCE), both between treatments and years of cultivation (Table 2).

Table 2. Intrinsic water use efficiency (iWUE) and instantaneous carboxylation efficiency (iCE) in yellow melon (*Cucumis melo*) plants.

Treatment	iWUE (μmol CO_2 mol^{-1}H_2O)		Mean	iCE (μmol mol^{-1} CO_2)		Mean
	2019	2020		2019	2020	
Control	19.74	51.05	35.39 ab	0.080	0.046	0.063 ab
Agrosilício®	24.14	54.48	39.31 a	0.066	0.039	0.053 b
Acibenzolar-S-methyl (SMA)	24.64	46.70	35.67 ab	0.074	0.050	0.062 ab
Chelal® Si	15.16	36.61	25.88 b	0.085	0.057	0.071 a
Rocksil®	14.35	42.06	28.20 b	0.082	0.056	0.069 a
Thiabendazole	18.70	34.22	26.46 b	0.077	0.069	0.073 a
Mean	19.46 B	44.19 A		0.077 A	0.053 B	
CV (%)	22.71			14.04		

Means followed by uppercase letters compare the effects of the years of cultivation, while lowercase letters compare the effects of treatments by the Tukey test ($p \leq 0.05$).

Si may enhance water uptake and transport, along with increased antioxidant enzyme activities and photosynthetic gas exchange of the leaves (Ma, Yamaji, Tamai, & Mitani, 2007). We observed an increase in iWUE and iCE in plants treated with Agrosilício® and salicylic acid. Silicon associated with these treatments may have provided the highest values for these variables.

The photosynthetic activity and the other variables showed a significant increase in the first year of cultivation, which can be attributed to the low precipitation during the experiment. Low soil moisture impairs plant development by altering physiological and biochemical mechanisms, as well as photosynthetic performance, nutrient uptake, ion translocation, respiration, and productivity (Ahmad et al., 2019).

The analysis of variance showed that the treatments did not influence the physical characteristics of the fruit, such as diameters, peel thickness, pulp, and firmness of fruits, but showed a significant interaction between the years of cultivation. This interaction is probably related to water restriction during the experiment, with the fruits showing a superior diameter, firmness, and weight in the second year of cultivation (2020) compared to those harvested in 2019.

The mean fruit mass of yellow melon reached 1.255 kg (Figure 2), which is similar to that observed by Dalastra, Echer, Klosowski, and Hachmann (2016), with values of 1.182 kg for yellow melon grown in a protected environment with application of Si at doses of 0.0, 0.3, 0.6, 0.9,and 1.2 g L^{-1} of Si. In addition, the authors observed that the doses did not influence the physical characteristics of the fruits (length and diameter), as observed in the present study.

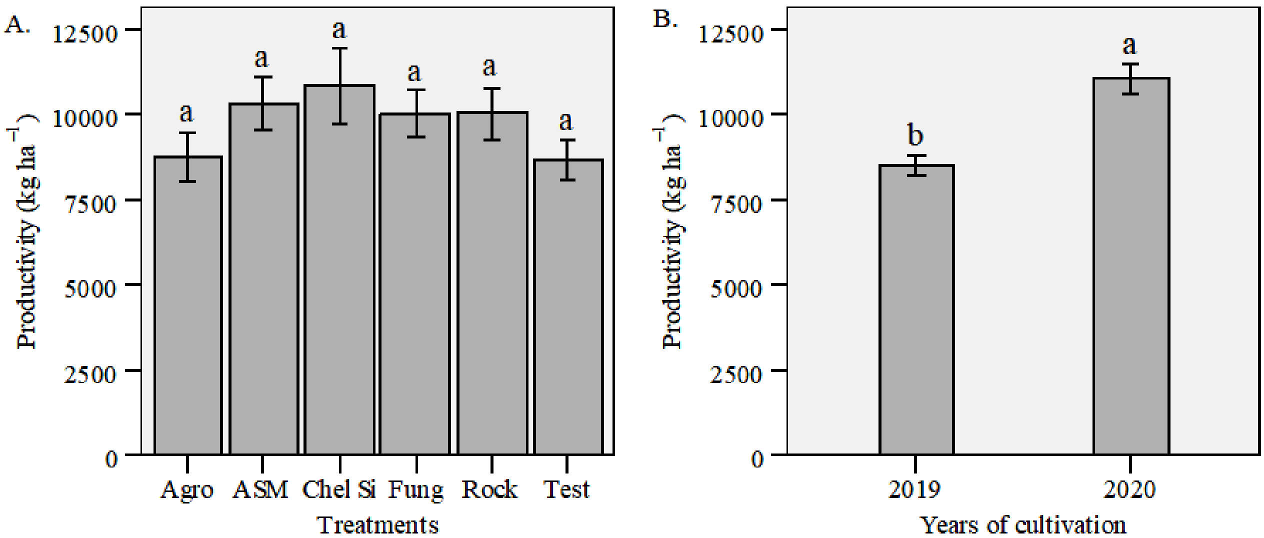

Figure 2. Mean productivity in response to treatments (A) and years of cultivation (B) of yellow melon (*Cucumis melo*) fruits. Different lowercase letters indicate statistical differences by the Tukey test ($p \leq 0.05$). Agro-Agrosilício® (3 g L^{-1}), acibenzolar-S-methyl (ASM) (2 mM), Chel-Chelal® Si, fung-Thiabendazole (400 mL 100 L^{-1}), Si (2 L 100 L^{-1}), Rock-Rocksil® (3 g L^{-1}), and Test-control (untreated).

The chemical variables pH, soluble solids (SS) content, titratable acidity (TA), and vitamin C in fruits treated with resistance inducers showed no significant interaction (Table 3). However, a significant interaction was observed in the first year of cultivation, which showed the highest values for these variables.

Table 3. pH, soluble solids (SS), titratable acidity (TA), and vitamin C in yellow melon (*Cucumis melo*) fruits.

Treatments	pH		Mean	SS		Mean
	2019	2020		2019	2020	
Control	5.89	6.09	5.99 a	8.18	5.50	6.84 a
Agrosilício®	5.74	6.06	5.90 a	7.48	6.20	6.84 a
Acibenzolar-S-methyl (SMA)	5.66	6.01	5.83 a	7.52	6.07	6.79 a
Chelal® Si	5.98	6.19	6.09 a	8.62	6.13	7.37 a
Rocksil®	5.80	6.13	5.96 a	8.41	6.37	7.39 a
Thiabendazole	5.77	6.09	5.93 a	7.52	5.93	6.73 a
Mean	5.81 B	6.09 A		7.95 A	6.03 B	
CV (%)	3.88			13.23		
Treatment	TA (g 100 g^{-1})			Vitamin C (mg 100 g^{-1})		
	2019	2020		2019	2020	
Control	0.164	0.096	0.130 a	5.00	3.72	4.36 a
Agrosilício®	0.170	0.104	0.137 a	4.75	3.47	4.11 a
Acibenzolar-S-methyl (SMA)	0.141	0.110	0.125 a	5.44	3.30	4.37 a
Chelal® Si	0.144	0.099	0.121 a	5.93	3.57	4.75 a
Rocksil®	0.177	0.111	0.144 a	5.06	3.72	4.39 a
Thiabendazole	0.171	0.103	0.137 a	4.70	2.95	3.83 a
Mean	0.161 A	0.103 B		5.15 A	3.45 B	
CV (%)	21.10			33.39		

Means followed by uppercase letters compare the effects of years of cultivation, while lowercase letters compare the effects of treatments by Tukey test ($p \leqslant 0.05$).

TA and pH significantly determine fruit quality, whereas SS is correlated with sugar concentration and is used as an indispensable measure of fruit marketing (Alam, Hariyanto, Ullah, Salin, & Datta, 2021). The SS of fruits grown in 2019 ranged from 7.48 to 8.62%, which is higher than the values obtained in 2020. The low SS observed in fruits harvested in the second year may be related to early harvest (70 days) due to pest attacks, mainly by the melon worm moth (*Diaphania nitidalis* and *D. hyalinata*).

Some protocols have been used to determine the internal quality of exported melons, including the soluble solids (SS) concentration, which must range from 9 to 10.99%, a standard for fruits of "good internal quality" and 11% or above for fruits of "very good internal quality" (Vendruscolo, Seleguini, Campos, Rodrigues, & Lima, 2018). Considering these standards, the fruits obtained in our study were below the reference values, especially those harvested in 2020 (SS of 5.5 to 6.37).

Fruits harvested in 2020 had the highest pH, with values ranging from 6.01 to 6.19 (Table 3). The melon pH is inversely related to TA, considering that a higher content of organic acids has been commonly associated with a lower pH (Park et al., 2018). Vendruscolo et al. (2018), observed no difference in diameter, TA, peel thickness, or SS in response to different cultivation environments (protected and field) and different spacings (15, 25, 35, 45, and 55 cm) for the cantaloupe melon cultivar.

No significant effect ($p \leqslant 0.05$) was observed in the productivity in response to the treatments, despite the interaction between the years of cultivation (Figure 2). Environmental conditions may have influenced the low productivity, given that adequate available water promotes crop productivity increments, which may justify the results obtained in our study. In addition, melon is considered a low Si accumulator, presents slow uptake, and its efficiency depends on how it is provided to the plants (Preston et al., 2021).

The estimated fruit yield of two melon hybrids (F 4945 and Medellín), fertilized with slag (17.2 t ha^{-1}) was not significantly different from those obtained from unfertilized plants (Preston et al., 2021), which corroborates the findings of our study. Si applied to the melon crop at the dose of 77.24 kg Si ha^{-1} under different water availability levels resulted in a yield of 1,280.36 g plant^{-1} (Santos et al., 2021).

The evaluated factors did not affect the enzymatic activity of peroxidase (POD), polyphenol oxidase (PPO), and phenylalanine ammonia-lyase (PAL) (Figure 3). The increased enzymatic activity is usually related to the presence of biotic or abiotic stress (temperature, water, or salinity) (Sami et al., 2021). This result may be related to the effect imposed by the environmental conditions, such as temperature, humidity, and precipitation, as all plants were under the same stress, thus nullifying the individual effect of the treatments.

The use of resistance inducers promotes an increased accumulation of secondary metabolites, which are important for plant defense (Dima et al., 2020). However, the plant metabolism response depends on the concentration and timing of the stimulus, as well as the commercial nature of the product (Gulzar, Shah, & Kamili, 2021). Antioxidant enzymes are variably distributed in plants, and their activity is influenced by stress, as they act in the plant's cellular protection against oxidative reactions, which causes dysfunction in the plant metabolism and cell death (Siegel, 1993).

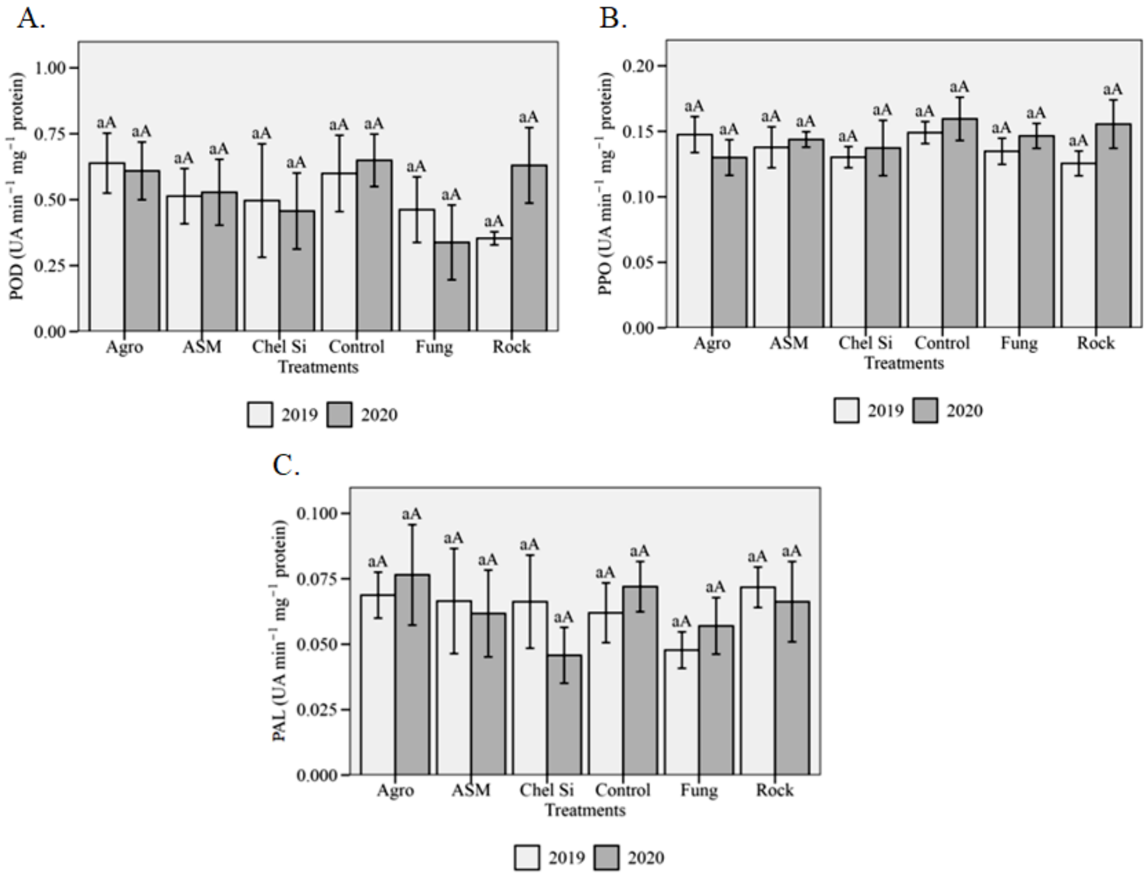

Figure 3. Enzymatic activity of peroxidase (POD) (A), polyphenol oxidase (PPO) (B), and phenylalanine ammonia-lyase (PAL) (C) in yellow melon (*Cucumis melo*) plants. Means followed by the same lowercase letters (treatments) and uppercase letters (years of cultivation) do not differ from each other by Tukey's test ($p \leq 0.05$).

Pearson's correlation revealed that the photosynthetic factors were positively correlated in the first year of cultivation. The gas exchange showed a high positive correlation between internal carbon concentration and photosynthetic rate (r = 0.97), transpiration, and photosynthetic rate (r = 0.93). The instantaneous carboxylation efficiency showed a high positive correlation with the photosynthetic rate (r = 1), stomatal conductance (r = 0.65), internal carbon concentration (r = 0.96), and transpiration (r = 0.93*) (Figure 4A).

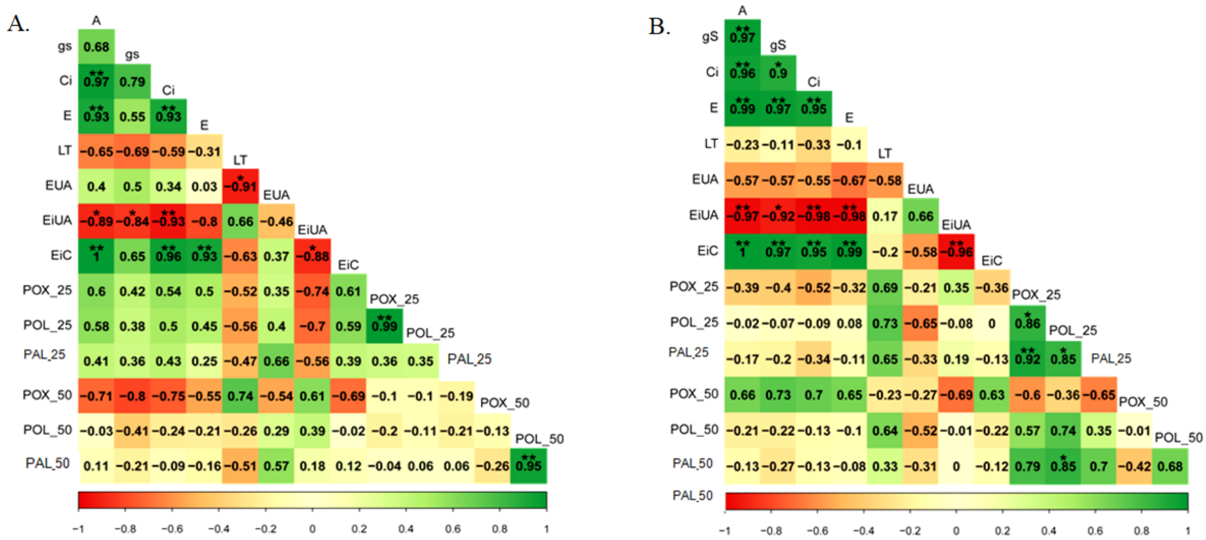

Figure 4. Pearson's correlation between the photosynthetic rate (A), stomatal conductance (gs), internal carbon concentration (Ci), transpiration (E), leaf temperature (LT,°C), instantaneous water use efficiency (iWUE), intrinsic water use efficiency (iWUE), instantaneous carboxylation efficiency (iCE), and enzymatic activity of peroxidase (POX), polyphenol oxidase (POL), and phenylalanine ammonia-lyase (PAL) at 25 and 50 days after transplanting of yellow melon seedlings. A - 1st year of cultivation, B - 2nd year of cultivation.

A moderate positive correlation was found between the enzymatic activity and gas exchange at 25 and 50 days after transplanting (DAT). POD activity presented a correlation with the photosynthetic rate (r = 0.6), internal carbon concentration (r = 0.54), and instantaneous carboxylation efficiency (r = 0.61). In contrast, PPO showed a low positive correlation between the photosynthetic rate (r = 0.58), internal carbon concentration (r = 0.5), and instantaneous carboxylation efficiency (r = 0.59).

The enzymatic activity of POX at 50 DAT showed a high positive correlation with the intrinsic water use efficiency (r = 0.61) and leaf temperature (r = 0.74). In the first year, PAL activity showed a low (< 0.5) positive correlation between gas exchange variables, except for the instantaneous water use efficiency, with a high positive correlation at 25 days (r = 0.66) and 50 DAT (r = 0.57) (Figure 4A).

In the second year, a similar behavior was observed for gas exchange variables, except for the enzymatic activity, in which an opposite performance was observed. The POX enzyme analyzed at 50 DAT showed a high positive correlation between photosynthetic rate (r = 0.66), stomatal conductance (r = 0.73), internal carbon concentration (r = 0.7), and transpiration (r = 0.65) (Figure 4B).

The high positive correlation between the antioxidant enzymatic activity and gas exchange can be attributed to the production of reactive oxygen species (ROS), which may compromise plant metabolism when produced in excess (Malik, Kumar, & Nadarajah, 2020). Plants are always subjected to some stress. In response, they produce and activate enzymatic antioxidant mechanisms to mitigate the effects of ROS, directly influencing net photosynthesis, stomatal conductance, transpiration, and water absorption (Yoshioka, Mase, Yoshioka, & Kobayashi, 2011).

Conclusion

No natural occurrence of diseases was observed during the research. Leaf spraying with silicon and acibenzolar-S-methyl sources did not influence physiological responses, biometric characteristics, and fruit production of yellow melon. The silicon and acibenzolar-S-methyl sources did not induce an increase in the enzymatic activity of peroxidases, polyphenol oxidase, and phenylalanine ammonia-lyase. Fruit production was higher in 2020.

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