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Do planting methods and nitrogen management interfere with the economic viability of the melon crop?

Eduardo Pradi Vendruscolo[1]*, Fernanda Pacheco de Almeida Prado Bortolheiro[2], Murilo Battistuzzi Martins[1], Luiz Fernandes Cardoso Campos[3], Alexsander Seleguini[4], Sebastião Ferreira de Lima[5]

[1]State University of Mato Grosso do Sul, Cassilândia, Brazil
[2]São Paulo State University, Botucatu, Brazil
[3]Federal University of Goiás, Goiânia, Brazil
[4]Federal University of Triângulo Mineiro, Iturama, Brazil
[5]Federal University of Mato Grosso do Sul, Chapadão do Sul, Brazil
*Corresponding author, e-mail: agrovendruscolo@gmail.com

Abstract

Proper crop management results in higher profitability and the verification of economic viability is paramount to the definition of the methodologies used. This study aimed to verify the economic viability of seedlings or seeds use, associated with the inoculation with *Azospirillum brasilense* and nitrogen in topdressing fertilization in Cantaloupe melon production. The experiment was designed in randomized blocks with eight treatments. The treatments were composed of planting methods (seedling or seed), inoculation with *Azospirillum brasilense* (with or without), and partial application of 120 kg ha^{-1} of nitrogen as topdressing fertilization (with and without). It was verified that operations and seed acquisition represent the major cost factors. As for treatments, the use of seedling transplants with topdressing fertilization with nitrogen results in an increase of up to 37.01% in fruit production and, consequently, increases the indicators of economic viability. Also, *A. brasilense*, although not resulting in significantly higher production, raises the profitability. In this way, the seedling transplant, combined with the nitrogen in topdressing fertilization, results in higher profitability, and the use of *A. brasilense* is a technique with the potential for use in melon cultivation.

Keywords: Planting management, nitrogen fertilization, diazotrophic bacteria, economic viability, muskmelon

Introduction

Appropriate handling techniques adoption, which aims at a better quality of fruits and greater productivity, is fundamental to guarantee the product enhancement, as well as the profitability to the producer since melon is recognized as a profitable type of crop (Vendruscolo et al., 2017). Melon cultivation in a protected environment has responded to nitrogen fertilization (Queiroga et al., 2007) with gains in productivity and quality of Cantaloupe melon fruits.

Nitrogen is of utmost importance for melon culture, as it provides improvements in the physical characteristics of the fruits (Queiroga et al., 2011), in qualitative aspects and increases productivity (Queiroga et al., 2007). In this way, Silva et al. (2014) observed a 54% increase in Cantaloupe melon production with nitrogen fertilization increase. The same authors observed that the absence of nitrogen fertilization influenced the fruit phenotypic characteristics, with a reduction in netting and diameter, characteristics that promote the devaluation of the product in the market.

Concomitantly with the use of nitrogen fertilization, the possibility of inserting alternative technologies is envisaged to reduce the applications of mineral fertilizers. Thus, the application of plant growth-promoting bacteria, such as *Azospirillum brasilense*, can be a promising practice to improve crop growth and productivity. The utilization of *A. brasilense* has several benefits, such as significantly influence biological nitrogen fixation, increase nitrate reductase enzyme activity, promote hormones production, increase phosphate solubility, favor the beneficial association between mycorrhizae and plants and even protect the plant to pathogen attack (Lima et al., 2018).

Besides the correct agronomic techniques, it is important for the farmer to obtain information on the costs

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of implementing and handling the crop, to reduce costs and maximize profits. The determination of agricultural production costs is a primary tool in the productive activities management and obtaining information, which should act as a basis for decision making by the producer, as well as in the strategy formulation (Vasconcelos & Garcia, 2004).

The purpose of production cost determination is mainly to assist the producer in administration, in choice of crops and cultivars, and the practices used, such as the use of seedlings or seeds, inoculation with *A. brasilense*, among others. However, in the literature, there are no studies that show the economic viability of planting methods, associated with inoculation with *Azospirillum brasilense* and topdressing fertilization with nitrogen for melon cultivation.

Thus, this study aimed to verify the economic viability of seedlings or seeds use, associated with the inoculation with *Azospirillum brasilense* and nitrogen in topdressing fertilization in Cantaloupe melon grown in the Cerrado region.

Material and Methods

The study was conducted in a protected environment, in Goiânia, Goiás, at the central region of the state, at following coordinates 16°40' S, 49°15' W and altitude of 750 m. In the region, there is a predominance of Aw type climate, according to the KÖPPEN-GEIGER classification (Cardoso et al., 2014), characterized by a tropical climate with a rainy season from October to April and a period with monthly rainfall below 100 mm between May and September. Average monthly temperatures range from 20.8°C, in June and July to 25.3°C in October (Cardoso et al., 2014). The climatic records of temperature and relative humidity in the protected environment (Figure 1), during the conduction of the experiment, were obtained through a digital data logger (AK172, Akso, São Leopoldo, RS, Brazil).

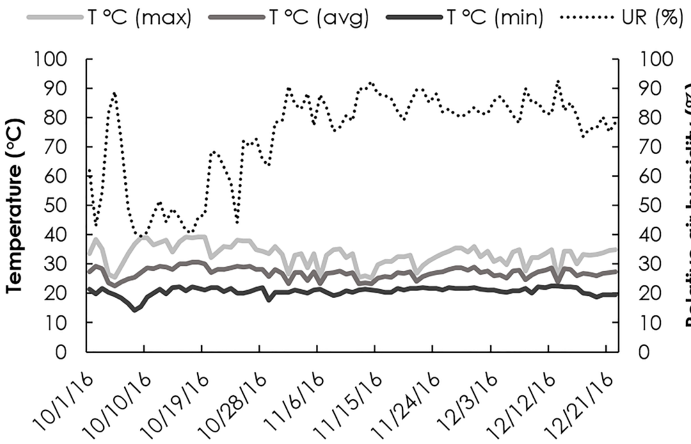

Figure 1. Relative air humidity, average, maximum, and minimum temperature during the experimental period.

The protected environment had 21 m length, 7 m width, and 4 m height, covered with transparent plastic canvas and a white anti-aphid screen on the sides. Also, two openings at the ends, equivalent to the upper arch, provided greater ventilation, preventing the accumulation of excessive heat inside the cultivation environment.

The soil used is a LATOSSOLO VERMELHO, classified according to the Brazilian classification system (Santos et al., 2013) or OXISOL (Soil Survey Staff, 2014). The soil had the following characteristics: Ca^{2+}: 5.70 $cmol_c$ dm^{-3}, Mg^{2+}: 3.00 $cmol_c$ dm^{-3}, K^+: 96.00 mg dm^{-3}, P (Mehlich I): 170.00 mg dm^{-3}, organic matter: 23.00 g kg^{-1}, Al^{3+}: 0.0 $cmol_c$ dm^{-3}, H+Al: 2.40 $cmol_c$ dm^{-3}, pH ($CaCl_2$): 5.50, cation exchange capacity: 11.35 $cmol_c$ dm^{-3}, base saturation: 79.00%, according to the methodologies for soil analysis established by Embrapa (Donagemma et al., 2011). The granulometric soil analysis showed 48.00 g kg^{-1} of clay in layer 0 - 0.20 m, following the analysis proposed by Silva (2009).

A randomized block design was used, with eight treatments distributed in five replications. The treatments were composed of planting methods (seedling or seed), inoculation with *Azospirillum brasilense* (with or without), and partial application of 120 kg ha^{-1} of nitrogen as topdressing fertilization (with and without). Each plot consisted of five plants, and the three central plants were used for the evaluations.

For seedlings formation, on September 7, 2016, sowing was carried out on peat moss substrate (Germinar, Bioflora, Prata, MG, Brazil) of Cantaloupe melon seeds, cv. Trinity. Twenty-three days after sowing, seedlings were transplanted to previously prepared seedbeds and fertilized with 4.0 dm^{-3} m^{-1} of cattle manure (O.M.: 88.00 g kg^{-1}; pH: 7.20; N: 82.00 g kg^{-1}; P (Mehlich-1): 3.10 g kg^{-1}; K: 20.80 g kg^{-1}; Ca: 3.00 g kg^{-1}; Mg: 3.00 g kg^{-1}; C: 50.00 g kg^{-1}; Fe: 0.19 mg kg^{-1}; Mn: 36.00 mg kg^{-1}; Zn: 26.50 mg kg^{-1}; Cu: 0.00 mg kg^{-1}; C:N ratio: 0.60) and 15 g m^{-1} of Yoorin Master. At this time, sowing was also carried out directly on the beds, according to the treatments. A spacing of 45 and 80 cm between plants and rows (seedbeds) was used, respectively (Vendruscolo et al., 2018).

The nitrogen applications as topdressing fertilization, in the treatments composed by this action, were carried out manually, diluting the urea equivalent to the dose of 40 kg ha^{-1} in 500 ml of water and applying the solution throughout plot extension, at 15, 30 and 45 days after planting. *A. brasilense* was applied together with the first nitrogen fertilization in a drench way. It was applied the dose of 10 mL L^{-1} of the commercial product NITRO1000 Gramíneas®.

The plants were conducted vertically, using plastic tapes as staking, and the irrigation was performed by drip irrigation tapes with drippers spaced at 20 cm. Fungicides based on Metiram and Pyraclostrobin (55% and 5% a.i., respectively) and insecticides based on Thiamethoxam (25% a.i.) and Lambda-cyhalothrin (25 % a.i.) were applied to control fungal diseases, whiteflies, and borers, respectively, at 10, 15 and 64 days after planting.

The harvest started at 72 days after planting and continued for ten days until all fruits were harvested. The fruits were harvested when there was a natural cracking of the stalk next to the fruit, characterizing the species harvest point. Then, the fruits were weighed on a digital scale (W15, Welmy, Sta. Bárbara d'Oeste, SP, Brazil) and the production calculated in boxes (boxes) of 14 kg ha^{-1}, which is the form that the fruits are marketed in the region.

For determining the production cost of a Cantaloupe melon production cycle, the total operational cost (TOC) structure was used. In this, the TOC is obtained by the sum of expenses with operational costs, depreciation, other expenses. The effective operational cost (EOC) is composed of the expenses of the operations and inputs used (Martin et al., 1998).

The economic analysis was made considering the different treatments as commercial crops. Considering the existence of structural elements such as the greenhouse, irrigation system, and other elements used by more than one harvest in the cultivation area, the costs paid for their implementation were disregarded in the present study.

The values practiced in the first half of 2018, at CEASA-GO, in Goiânia, were considered as average prices received by the producers. The average price of the 14 kg box received by the producers was R$ 48.00, which was used in the present study. The fertilizer values were obtained from the Instituto de Economia Agrícola (IEA). The values of the other inputs were obtained from companies specialized in the commercialization of agricultural products in the region of Goiânia. The values were converted in U$ dollars, considering USD 1.00 = R$ 3.77, which was the quotation for the time.

Labor costs were calculated using the index generated by the need for manual operations for each operation, obtained in men/day (MD), then multiplied by the average value of labor force in the region in 2018 (R$ 70.00). For inputs, the cost was calculated based on the average product value in the region and the amount of material used. A rate of 5% of the total expenses with the EOC was considered for other expenses, and the interest costs are taken as 6.5% at a year about 50% of the EOC (Martin et al., 1998).

The following indexes were calculated to determine the profitability of each treatment, according to Martin et al. (1998):

a) gross revenue, obtained between the quantity produced (14 kg boxes) and the average price received by the producer in the period from January to May 2016;

b) operational profit, such as the difference between gross revenue and total operational cost;

c) profitability index, understood as the proportion of gross revenue that represents the final amount after covering the total operational cost of production;

d) equilibrium price, obtained at a given level of total operational cost of production, as the minimum price necessary to be obtained to cover TOC, considering the average productivity obtained by the producer;

e) equilibrium productivity, obtained at a given level of total operational cost of production, as the minimum productivity necessary to cover the TOC.

The data from the productivity of melon were submitted to analysis of variance, and the means were compared by the Tukey test at 5% probability.

Results and Discussion

A cost of R$ 4,825.99 was observed for 1000 m^2 of Cantaloupe melon production. From this amount, it was found that the largest share was due to the need for operations, mainly concerning the conduct and management of the crop. It was also found that the seed participates with 94.40% of the total amount related to the acquisition of inputs, being a factor that significantly affects the Cantaloupe melons production (Table 1).

Table 1. Total operational cost estimated for a Cantaloupe melon crop in 1000 m^2.

A- Operations	Unity	Quant.	Unitary value	Total value		Participation
	-	-	(R$)	(R$)	(USD)	(%)
Soil preparation	HD	0.67	70.00	46.67	12.38	0.97
Seedling transplant	HD	1.33	70.00	93.33	24.76	1.93
Conducting and handling	HD	28.67	70.00	2,006.67	532.27	41.58
Weed control	HD	2.67	70.00	186.67	49.51	3.87
Fertirrigation	HD	4.00	70.00	280.00	74.27	5.80
Spraying	HD	2.00	70.00	140.00	37.14	2.90
Harvest	HD	6.00	70.00	420.00	111.41	8.70
Subtotal A				3,173.33	841.73	65.76
	B- Inputs					
B1 - Fertilizers and correctives						
Limestone	kg	46.67	0.09	3.97	1.05	0.08
Simple Superphosphate	kg	8.00	1.31	10.48	2.78	0.22
KCl	kg	12.00	1.91	22.92	6.08	0.47
Yoorin	kg	8.00	1.90	15.20	4.03	0.31
B2 – Seeds						
Cultivar Trinity	Package	2.67	450.00	1,200.00	318.30	24.87
B3 – Pesticides						
Insecticide Mospilan®	100 g	0.17	27.00	4.50	1.19	0.09
Insecticide Actara®	100 g	0.13	28.43	3.79	1.01	0.08
Fungicide	1,000 g	0.20	120.00	24.00	6.37	0.50
Subtotal B				1,284.86	340.81	26.62
Effective Operational Cost				4,458.19	1,182.54	92.38
C – Other expenses				222.91	59.13	4.62
D – Cost Interest				144.89	38.43	3.00
Total Operational Cost				4,825.99	1,280.10	100.00

The factor that most affected the Cantaloupe melon production was the increased need for labor to carry out the transplanting of preformed seedlings to the field, followed by the application of *A. brasilense* and urea, respectively. Thus, the most expensive treatment was the combination of these three factors (Table 2).

Table 2. Cost variation factors participation in the total operational cost (TOC) for Cantaloupe melon cultivation in 1000 m^2.

Treatment	Planting		Nitrogen		*A. brasilense*		TOC increase
	(R$)	(USD)	(R$)	(USD)	(R$)	(USD)	(%)
S+Az	-	-	-	-	28.80	7.64	0.60
S+Az+N	-	-	23.50	6.23	28.80	7.64	1.08
S	-	-	-	-	-	-	0.00
S+N	-	-	23.50	6.23	-	-	0.49
Ps+Az	72.00	19.10	-	-	28.80	7.64	2.09
Ps+Az+N	72.00	19.10	23.50	6.23	28.80	7.64	2.58
Os	72.00	19.10	-	-	-	-	1.49
Ps+N	72.00	19.10	23.50	6.23	-	-	1.98

S = seed; Ps = preformed seedlings; Az = *A. brasilense*; N = nitrogen fertilization.

The increase in the TOC provided by *A. brasilense* application was high when compared to other studies that used this bacterium application for the composition of their treatments. This is mainly due to the method of application since, in other studies, the application is carried out via seed treatment (Kaneko et al., 2015) or leaf (Nakao et al., 2014), decreasing the amount of product applied by area.

For the production, it was observed that the combined use of seedlings transplanting and topdressing fertilization with nitrogen resulted in a production 37.01% higher than the treatment with the lowest performance, composed of seedlings transplanting and without topdressing fertilization with nitrogen or application *A. brasilense*. However, there was no significant difference concerning other treatments studied (Table 3).

This same behavior was observed for the variables related to the economic viability, gross revenue, operational profit, and profitability index, in which it was observed that the transplant of seedlings, combined with topdressing fertilization with nitrogen, provided increments (Table 3).

Although the use of seeding directly in the field for some cucurbit species is observed, such as watermelon (Silva et al., 2013), pumpkin (Balin et al., 2017), cucumber (Sahin et al., 2015), and melon (Rashidi & Keshavarzpour, 2011), in different management forms, this method can result in lower development of plants than the seedlings transplanting (Dalastra et al., 2016). This is due to the time that the seed, in pre- or post-emergence, remains under environmental variations influence (Dalastra et al., 2016), exposed to biotic and abiotic factors.

Table 3. Production, gross revenue, operational profit, and profitability index for the melon crop grown with different planting methods, topdressing fertilization with nitrogen, and inoculation with *A. brasilense*.

Treatment	Production*	GR		OP		PI
	(cx 14 kg)	(R$)	(USD)	(R$)	(USD)	(%)
S+Az	160 ab	7,680.00	2,037.14	2,825.21	749.39	36.79
S+Az+N	189 ab	9,072.00	2,406.37	4,193.71	1,112.39	46.23
S	172 ab	8,256.00	2,189.92	3,430.01	909.82	41.55
S+N	170 ab	8,160.00	2,164.46	3,310.51	878.12	40.57
Ps+Az	207 ab	9,936.00	2,635.54	5,009.21	1,328.70	50.41
Ps+Az+N	195 ab	9,360.00	2,482.76	4,409.71	1,169.68	47.11
Ps	154 b	7,392.00	1,960.74	2,494.01	661.54	33.74
Ps+N	211 a	10,128.00	2,686.47	5,206.51	1,381.04	51.41
Average	182.77	-	-	-	-	-
DMS	54.24	-	-	-	-	-
CV%	15.91	-	-	-	-	-

S = seed; Ps = preformed seedlings; Az = *A. brasilense*; N = nitrogen fertilization; GR = gross revenue; OP = operational profit; PI = profitability index. *Averages followed by the same letter do not differ by Tukey's test at 10% probability.

The seedlings formation also means that, when transferred to the field, the plant will have its root system developed, being able to start absorption of water and nutrients. This explains the superior result obtained with the seedling transplanting and topdressing fertilization with nitrogen. Since it is verified the high responsiveness of the species to this nutrient, in this sense, for net melon, linear and positive responses were obtained concerning nitrogen application, up to the dose of 160 mg dm^{-3} of soil, for biometric and organoleptic variables of the fruits (Silva et al., 2014).

The effects inherent to nitrogen presence are numerous. However, it is possible to highlight this nutrient influence on leaf blade expansion, which is favored by the increase in the doses used (Castellanos et al., 2011). A larger photosynthetically active area means a higher amount of available photoassimilates for the continuity of vegetative development and an increase in productivity and quality of the fruits (Queiroga et al., 2008; Vendruscolo et al., 2016).

It was also found that inoculation with *A. brasilense* in the field of transplanted seedlings also raised the economic parameters (Table 3). This result is also related to a larger root volume presence, allowing the survival and performance of the bacteria in terms of atmospheric nitrogen fixation (Moreira et al., 2010). Also, despite the large number of studies aimed at the application of this bacterium in grasses, positive results are observed for the application in different species such as tomatoes, peppers (Madhaiyan et al., 2010) and cucumbers (Pereyra et al., 2010; Mangmang et al., 2015). These effects resulted from the nitrogen fixation, and its action on plant development, as mentioned above.

The lowest equilibrium production was obtained in the treatment consisting only of sowing in the field. At the same time, the highest was observed for the treatment that consisted of seedling transplanting, nitrogen fertilization, and the use of *A. brasilense* (Table 4). These results are expected due to the sum of expenses with labor and product acquisition. However, it was observed that the equilibrium production remained, on average, 44.12% below the average production obtained with the treatments.

In general, the equilibrium price was significantly below the sales value practiced in the region (R$ 48.00 per box with 14 kg^{-1}), following the production trend, due to its direct relationship with it. Also, the treatment consisting of seedling transplanting and topdressing fertilization with nitrogen favored the drop in this variable (Table 4), which reduces the producer's risks. The low equilibrium prices obtained can provide a good safety margin for producers in the face of market variations, which can occur in cases of fluctuations in the supply-demand ratio (Oliveira et al., 2015).

From the results obtained in the present study, there is a high profitability of Cantaloupe melon production for the region, regardless of the techniques used, which may be an option for vegetable species producers. Concomitantly, it is inferred that the use of topdressing fertilization with nitrogen results in higher profitability rates and greater stability in the face of market fluctuations, and the use of *A. brasilense* is a technique with potential for use in melon cultivation.

Table 4. Production and equilibrium price for the melon crop grown with different planting methods, topdressing fertilization with nitrogen, and inoculation with *A. brasilense*.

Treatment	Equilibrium production (bx 1000 m^{-2})	Equilibrium price (R$ bx 14 kg^{-1})	(USD bx 14 kg^{-1})
S+Az	101.14	30.34	8.05
S+Az+N	101.63	25.81	6.85
S	100.54	28.06	7.44
S+N	101.03	28.53	7.57
Ps+Az	102.64	23.80	6.31
Ps+Az+N	103.13	25.39	6.73
Ps	102.04	31.81	8.44
PS+N	102.53	23.32	6.19

S = seed; Ps = preformed seedlings; Az = *A. brasilense*; N = nitrogen fertilization; bx = boxes.

Conclusions

The seedling transplanting, together with nitrogen in topdressing fertilization, increases the profitability of Cantaloupe melon production.

Azospirillum brasilense represents a promising technique, when combined with the use of preformed seedlings, to obtain higher profitability with Cantaloupe melon crop.

References

Balin, N.M., Bianchini, C., Ziech, A.R.D., Luchese, A.V., Alves, M.V., Conceição, P.C. 2017. Soil fauna under different soil management systems with oats and crops cucurbits. *Scientia Agraria* 18: 74-84.

Cardoso, M.R.D., Marcuzzo, F.F.N., Barros, J.R. 2014. Climatic classification of Köppen-Geiger for the state of Goiás and the federal district. *Acta Geográfica* 8: 40-55.

Castellanos, M.T., Cabello, M.J., Cartagena, M.D.C., Tarquis, A.M., Arce, A., Ribas, F. 2011. Growth dynamics and yield of melon as influenced by nitrogen fertilizer. *Scientia Agricola* 68: 191-199.

Dalastra, G.M., Echer, M.M., Hachmann, T.L., Guimarães, V.F., Schmidt, M.H., Corbari, F.L. 2016. Desenvolvimento e produtividade da melancia em função do método de cultivo. *Revista de Agricultura* 91: 54-66.

Donagemma, G.K., Campos, V.D.B., Calderano, S.B., Teixeira, W.G., Viana, J.H.M. 2011. *Manual de métodos de análise de solo*. 2.ed. Empresa Brasileira de Pesquisa Agropecuária, Rio de Janeiro, Brazil. 230 p.

Kaneko, F.H., Sabundjian, M.T., Arf, O., Ferreira, J.P., Gitti, D.D.C., Nascimento, V., Leal, A.J.F. 2015. Análise econômica do milho em função da inoculação com Azospirillum, fontes e doses de N em cerrado de baixa altitude. *Revista Brasileira de Milho e Sorgo* 14: 23-37.

Lima, N.S.A., Vogel, G.F., Fey, R. 2018. Rates of application of *Azospirillum brasilense* in tomato crop. *Revista de Agricultura Neotropical* 5: 81-87.

Madhaiyan, M., Poonguzhali, S., Kang, B.G., Lee, Y.J., Chung, J.B., Sa, T.M. 2010. Effect of co-inoculation of methylotrophic *Methylobacterium oryzae* with *Azospirillum brasilense* and *Burkholderia pyrrocinia* on the growth and nutrient uptake of tomato, red pepper and rice. *Plant and soil* 328: 71-82.

Mangmang, J.S., Deaker, R., Rogers, G. 2015. Optimal plant growth-promoting concentration of *Azospirillum brasilense* inoculated to cucumber, lettuce and tomato seeds varies between bacterial strains. *Israel Journal of Plant Sciences* 62: 145-152.

Martin, N.B., Serra, R., Oliveira, M.D.M., Ângelo, J.A., Okawa, H. 1998. Sistema "Custagri": sistema integrado de custo agropecuário. *Informações Econômicas* 28: 7-28.

Moreira, F.M.D.S., Silva, K., Nóbrega, R.S.A., Carvalho, F. 2010. Bactérias diazotróficas associativas: diversidade, ecologia e potencial de aplicações. *Comunicata Scientiae* 1: 74-99.

Nakao, A.H., Dickmann, L., Souza, M.F.P., Rodrigues, R.A.F., Tarsitanto, M. 2014. Análise Econômica da produção de milho safrinha em função de fontes e doses de nitrogênio e inoculação foliar com *Azospirillum brasilense*. *Enciclopédia Biosfera* 10: 278-290.

Oliveira, C., Lazarini, E., Tarsitano, M.A.A., Pinto, C.C., Sá, M.E. 2015. Custo e lucratividade da produção de sementes de soja enriquecidas com molibdênio. *Pesquisa Agropecuária Tropical* 45: 82-88.

Pereyra, C.M., Ramella, N.A., Pereyra, M.A., Barassi, C.A., Creus, C.M. 2010. Changes in cucumber hypocotyl cell wall dynamics caused by *Azospirillum brasilense* inoculation. *Plant Physiology and Biochemistry* 48: 62-69.

Queiroga, F.M., Costa, S.A.D., Pereira, F.H.F., Maracajá, P.B., Sousa Filho, A.L. 2011. Efeito de doses de nitrogênio na produção e qualidade de frutos de melão gália. *Revista Verde de Agroecologia e Desenvolvimento Sustentável* 6: 96-100.

Queiroga, R.C.F., Puiatti, M., Fontes, P.C.R., Cecon, P.R. 2008. Produtividade e qualidade de frutos de meloeiro variando número de frutos e de folhas por planta. *Horticultura Brasileira* 26: 209-215.

Queiroga, R.C.F., Puiatti, M., Fontes, P.C.R., Cecon, P.R., Finger, F.L. 2007. Influência de doses de nitrogênio na produtividade e qualidade do melão *Cantalupensis* sob ambiente protegido. *Horticultura Brasileira* 25: 550- 556.

Rashidi, M., Keshavarzpour, F. 2011. Response of crop yield and yield components of melon to different tillage methods in the arid lands of Iran. *Middle East Journal of*

Scientific Research 8: 429-433.

Sahin, U., Kuslu, Y., Kiziloglu, F.M. 2015. Response of cucumbers to different irrigation regimes applied through drip-irrigation system. *The Journal of Animal and Plant Sciences* 25: 198-205.

Santos, H.G., Jacomine, P.K.T., Anjos L.H.C., Oliveira V.Á., Lumbreras, J.F., Coelho, M.R., Almeida, J.Á., Cunha, T.J.F., Oliveira, J.B. 2013. *Sistema brasileiro de classificação de solos*. 3.ed. Empresa Brasileira de Pesquisa Agropecuária, Brasília, Brazil. 353 p.

Silva F.C. 2009. *Manual de análises químicas de solos, plantas e fertilizantes*. 2.ed. Empresa Brasileira de Pesquisa Agropecuária, Brasília, Brazil. 627 p.

Silva, M.C., Silva, T.J.A., Bonfim-Silva, E.M., Farias, L.N. 2014. Características produtivas e qualitativas de melão rendilhado adubado com nitrogênio e potássio. *Revista Brasileira de Engenharia Agrícola e Ambiental* 18: 581-587.

Silva, M.G.O., Freitas, F.C.L., Santos, E.C., Mesquita, H.C., Carvalho, D.R. 2013. Interference of weeds in quality systems in watermelon and conventional tillage. *Revista Caatinga* 26: 53-61.

Soil Survey Staff. 2014. *Keys to Soil Taxonomy*. 12.ed. U.S. Department of Agriculture, Natural Resources Conservation Service, Washington, USA. 372 p.

Vasconcelos, M.A.S., Garcia, M.E. 2004. *Fundamentos de economia*. 2.ed. Saraiva, São Paulo, Brazil. 246 p.

Vendruscolo, E.P., Seleguini, A., Campos, L.F.C., Rodrigues, A.H.A., Lima, S.F. 2018. Desenvolvimento e produção de melão Cantaloupe em função do espaçamento e ambientes de cultivo no Cerrado brasileiro. *Revista Colombiana de Ciências Hortícolas* 12: 397-404.

Vendruscolo, E.P., Campos, L.F.C., Seleguini, A., Martins, A.P.B., Lima, S.F. 2017. Economic viability of muskmelon cultivation in different planting spacing in Brazil central region. *Revista Facultad Nacional de Agronomía* 70: 8319-8325.

Vendruscolo, E.P., Montelo, L.S., Martins, A.P.B., Campos, L.F.C., Semensato, L.R., Seleguini, A. 2016. Número de folhas por planta e ponto de colheita para produção de mini melão Cantaloupe. *Caderno de Ciências Agrárias* 8: 22-27.

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