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FIELD DEVELOPMENT OF PHYSALIS SPECIES PRODUCED IN DIFFERENT SHADING LEVELS

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ABSTRACT - The objective of this work was to verify the fixation and development in the field and later production of Physalis seedlings species produced in different levels of shading. The treatments were composed by Physalis seedlings formed in different environment with shading and four species. The conduction system adopted was "V". The seedlings survival rate, number of internodes, flowers number, number of fruit per plant, average fruit biomass per plant, yield and titratable acidity of fruits were evaluated. At the end of the production period, the stem diameter was evaluated. The experimental design was a randomized blocks, 4 x 4 factorial scheme (cultivation environments x species), with four replications. Seedlings produced in an environment of 25% were the ones that presented the highest survival rate when transplanting the field, favoring a greater glue of the seedlings. It was observed an increase of the fruits fresh biomass and the biomass of fruit per plant, and a higher number of fruit per plant in an environment with 25% of shading, and consequently the environment that had the highest fruit yield.
Keywords: *Physalis* spp., varieties, productivity, shading screens, seedlings fixation.

DESENVOLVIMENTO A CAMPO DE ESPÉCIES DE FISÁLIS PRODUZIDAS SOB DIFERENTES NÍVEIS DE SOMBREAMENTO

RESUMO - O objetivo deste trabalho foi verificar a fixação e desenvolvimento em campo e posterior produção de espécies de mudas de *Physalis* produzidas em diferentes níveis de sombreamento. Os tratamentos foram compostos por mudas formadas em diferentes ambientes com sombreamento e quatro espécies. O sistema de condução adotado foi o "V". Avaliaram-se a taxa de sobrevivência de plântulas, número de internódios, número de flores, número de frutos por planta, biomassa média de frutos por planta, produtividade e acidez titulável dos frutos. No final do período de produção, o diâmetro do caule foi avaliado. O delineamento experimental foi em blocos ao acaso, esquema fatorial 4 x 4 (ambientes de cultivo x espécie), com quatro repetições. As mudas produzidas em um ambiente de 25% foram as que apresentaram maior taxa de sobrevivência ao transplantar o campo, favorecendo uma maior cola das mudas. Foi observado um aumento da biomassa fresca dos frutos e da biomassa de frutos por planta, e um maior número de frutos por planta em um ambiente com 25% de sombreamento e, consequentemente, o ambiente que apresentou maior produção de frutos.
Palavras-chave: *Physalis* spp., cultivares, produtividade, sombreamento, fixação de mudas.

INTRODUCTION

The *Physalis* genus belong to Solanaceae family with 100 species. In Brazil, most species are found in the Amazon and in the Northeast with approximately six species (Muniz *et al*., 2015). Among the most well-known species in pharmacology and feeding are *Physalis peruviana*, *P. pubescens*, *P. angulata* and *P. minima*, which is assigned medicinal value (CHOTANI e VAGHASIYA, 2012). It is a shrub, herbaceous and annual plant, what defines is the cultivation system (MUNIZ et al., 2011).

It is a fruit plant that has a great production potential, that need care in seedlings formation and production, which allow the homogeneous orchards formation with high production potential. In this way the seedlings production phase within the fruit production chain, directly influences the plant performance both from the nutritional and productive point of view because can influence production and shorten the harvesting period start while seedlings with lower quality compromise the plant development and production, consequently, cause harm to producers (VILLA et al., 2018).

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The *Physalis* seedlings must present a good root system development, presenting good aggregation to the substrate (CECCO et al., 2018), allowing greater chance of fixation on transplanting, for this it is necessary that seedlings present a balance between the aerial part and root system and stem height and diameter compatibility. And a limiting factor for this adequate development to take place is the amount of seedling light supplied in the initial phase (MEZZALIRA et al., 2017).

Change in the amount of light supplied to the seedlings can influence in the root system growth and development. Due to these changes in light levels the plants adjust their photosynthetic apparatus according to the light provided by the environment to more efficiently use the brightness levels, which is fundamental for plants development and growth (TAIZ e ZEIGER, 2010). Due to changes in the amount of light plants have the ability to change or modify their growth in response to light intensity in their development environment in this way the light energy is essential for plant development being that variations in quality and quantity, light presence or absence will strongly influence the development type that the plant will present (PERINI et al., 2011).

The artificial shading using can determine the plants luminous requirements, mainly in its initial development phase and among the studied species, many demonstrate a requirement for light factor presenting good development when submitted to shading levels. However, high shading levels affect the plants development and cause problems of stem etiolation and seedlings weakening (SILVA et al., 2018).

As such, shading screens reduce the sun's rays direct incidence and provide temperatures with lower thermal amplitude inside the environment. As the polypropylene screens using is indicated to protect against strong winds incidents and reduce changes in air and soil temperature with the environmental modifications it is possible to increase productivity in some species, mainly in fruit plants (SILVA et al., 2016). In view of the above, the objective of this study was verify the cape gooseberry seedlings influence produced in different shading levels on field fixation and development and further production.

MATERIAL AND METHODS

The experiment was conducted from July 30, 2017 to March 15, 2017 at experimental farm under geographic coordinates of latitude 24°31'58"S, longitude 54°01'10"W and approximate altitude of 400 m, Paraná State, Brazil. According to the Köppen's classification, the local climate is the *Cfa* kind, humid subtropical climate with coldest month average minimum temperature below 18°C (mesothermic) and the hottest month average temperature exceeding 22°C, with hot summers, frosts infrequent and tendency of rainfall concentration in the summer months with no dry season defined. The average rainfall varies from 1600 to 1800 mm per year (ALVARES et al., 2013).

The seedlings were formed in four shading levels, being 25, 50 and 75% shading and full Sun cultivation and four species of cape gooseberry. The sowing was in plastic tubes filled with substrate from soil, fine granulometry sand and organic compost mix (2/1/1, v/v/v), being the soil used in the substrate classified as EUTROFERRIC Red Latosol (EMBRAPA, 2013), with clay texture. In each tube were arranged four seeds, with 0.5 cm sowing depth.

The sowing was relized on August 1st, 2017 with four seed per tube. After the sowing process was carried out, the trays were arranged in protected environments with 25, 50, 75% shading screens which had 1 m^2 of surface and 1 m of height and full sun cultivation. At 30 days after sowing (DAS) the thinning of the plants was realized keeping only one plant per tube. And at 76 DAS, the seedlings were transplanted to the field. On field development the seedlings were conducted on full sun, being realized 15 days before transplantation the conduction structure assembly of the seedlings and the hole opening the seedlings transplant. Prior to planting a soil chemical analysis was conducted, being this classified as EUTROFERRIC Red Latosol (EMBRAPA, 2013).

On the eucalyptus upper part were fixed strip of Wood in format of "T", with 0.70 m length in these were realized holes that allowed the passage of two parallel smooth wires for seedling conduction and other wire was fixed on 15 cm off the ground making possible the conduction in "V" format. Two stems conducted by polyethylene tapes inclined with angle of 60º at the top attached to the wires at 1.20 m from the ground and the lower part fixed on a wire 0.15 m from the ground.

The field planting was carried ou on October 15, 2017 in a space of 2.5 m x 0.55 m, between lines and plants respectively (planting density of 8000 seedlings per hectare). The experiment was implanted in randomized block design factorial scheme of 4 x 4 (environments x species) with four replicates. The treatments consisted of seedlings produced in protected environment with 25, 50 and 75% shading screens and in full sun cultivation (FSC) of four *Physalis* species: *Physalis peruviana* (PPe), *P. angulata* (PA), *P. pubescens* (PPu) e *P. minima* (PM).

All the seedlings were irrigataed by dripper spaced of 0.25 cm with a flow rate of 1.5 L h^{-1}. For the control of the irrigation shift an analogue timer was used which controlled the pump drive, being activated the system in the morning, evening and night period with, determined through the reference evapotranspiration estimation by Camargo et al. (1999) method. Weed management was carried out whenever necessary, with manual weeding in the cultivation line and mowing in between the rows. The management of pest insects was carried out whenever necessary, with products recommended for other similar species of the same family without plant phytotoxicity effects. During the production period, there was no product application.

The seedlings survival rate was evaluated (%) from the seedlings field transplanting until 15 days. The fruit harvest was weekly, manually and in the morning in the coolest hours beginning at 90 days after seedlings transplanting until 150 days. The harvest was carried out in accordance with the Colombian Technical Rule nº 4.580,

from 1999. After harvest the fruits were conditioned in Kraft paper bags, labeled with appropriate species and immediately taken to the laboratory.

The stem diameter were evaluated after 150 days of transplantation, measuring 2 cm from the ground with digital caliper. For flower number, were evaluated each seven days and only fully opened flowers were considered, together internodes number were counted obtained by manual counting.

In laboratory analyzes samples of 10 fruits per species and repetition were used. Was evaluated the fruits biomass per plant (g), fruits average biomass (g) through digital weighing. The estimated productivity (kg ha^{-1}) and the ratio soluble solids and titratable acidity. After obtaining the SS and TA values the relation between the two dividing SS by the TA values. For the chemical analyzes the same 10 mature fruits of each harvest were used and crushed manually with the aid of a porcelain mortar and pressed crushed with the aid of a pestle after the extract was removed and frozen in a horizontal freezer at -20°C for further analysis.

After one week the samples were homogenized in a 50 mL becker and stirred with glass rod being collected a fraction of 10 mL of juice and 90 mL of distilled/deionized water generating a 100 mL sample in a backer. With this sample the titratable acidity TA was realized (expressed as a percentage of citric acid). This analysis was performed by colorimetric titration with NaOH solution in a 0.1N and to observe the color change two drops of phenolphthalein were used.

The SS soluble solids evaluations were performed through digital refractometry and the results expressed in °Brix degrees. Analyzes of titratable acidity and soluble solids were performed in triplicate. The results statistical analysis was performed with the aid of the statistical tool Assistat (SAS, 2014). Initially, the data were submitted to analysis of variance and when they presented significant difference were submitted to the Tukey averages comparison test, 5% error probability and regression analysis.

RESULTS AND DISCUSSION

It was verified that in January presented higher temperatures, with maximum daily temperatures of 48°C and minimum of 18°C that remained on average between 26 and 28°C. The air relative humidity had maximums close to 98% and the average ranged from 70 to 78%. The air temperature and relative humidity in these months favors the vegetative and reproductive development/growth of cape gooseberry species. For stem diameter (SD) presented on Table 1 shows that the species don't present significant difference only presented differences between the seedlings formed in different environments.

The environments with greater shading presented changes with lower SD due to the light restriction in the seedlings initial development which presented more intense cellular elongation leading to an increase of stem internodal spaces in search of greater light amount, affecting its development in the field and its production. Luminosity levels variations affect plant growth and development (COSTA et al., 2012), which in light absence need to adapt to the environmental conditions for their survival (CORREA et al., 2012) and one way of plant adaptation is the stem elongation.

The environments influenced SD and under higher shading levels there was a decrease in SD, wich according to Souza et al. (2013) the SD reduction is harmful to plants because the stem thickness is fundamental since it provides all the mechanical support for the aerial part. When the stem thickness is compatible with the plant development the greater the capacity to supply the need for transporting sap that feeds the aerial part (Souza et al., 2014). This effect was not observed in seedlings under 75% shading levels because they have reduced their potential support and fruit production and the lower SD directly affected the cape gooseberry species productivity.

TABLE 1 - Stem diameter (SD), dead plants number (DPN), soluble solids content (SS) °Brix, SS/TA ratio, for PA, PPe, PPu and PM seedlings, obtained at shade levels (SL) (FSC, 25, 50 e 75%), and its field development.

Physalis species	SD	DPN (%)	SS	SS/TA
PA	20.44 ^{ns*}	10.93 ^{ns}	12.10 b	7.70 b
PPe	20.31	23.43	12.29 ab	7.07 c
PPu	20.30	18.75	12.59 a	7.48 b
PM	20.00	23.43	12.71 a	8.61 a
Averages	20.24	19.14	12.42	7.71
SL				
FSC	21.87 b	3.56 a	12.30 ^{ns}	7.80 b
25%	22.91 a	0.00 a	12.48	8.23 a
50%	19.03 c	18.75 b	12.56	7.64 b
75%	17.15 d	51.56 c	12.35	7.14 c
Averages	20.24	19.14	12.42	7.71
CV(%)	3.66	72.80	4.20	3.27

*Means followed by the same letter in the column do not differ statistically from each other, by Tukey test at 5% of error probability. ns = not significant at 5% of error probability.

When the DPN it is verified that the species didn't present significant difference, and when the environments are compared it is verified that there was significant difference. Seedlings formed in FSC 25% shading environment did not differ from one another both presenting low transplantation mortality rates. In environments under 50% shading the seedlings had a high mortality rate of 23.43% and in an environment with 75% shading presented higher mortality rate due to the etiolated plants with little amount of root which presented 51.56% of dead seedlings.

In relation to SS, the PPe, PPu and PM species presented no statistical difference between which reached 12.29, 12.59 and 12.71° Brix respectively, only PPu and PM presented a difference of the PA species. The SS contents found for the fruits of PPu are 12.59° Brix (Table 2) higher than the levels verified by Silva et al. (2016) who observed maximum values of 10° Brix for this specie.

As for the soluble solids and titratable acidity ratio values (SS/TA) there were differences between species. It was verified that PM had a higher SS/TA ratio than the other species. The results obtained for the PPe specie in relation to SS/TA ratio are inferior to those reported in the literature (LIMA et al., 2013; SILVA et al., 2016), which shows that this seedlings species were influenced by the shading levels on initial development and growth in the field which directly interfered in the SS accumulation and in the fruits acid content increase, consequently the SS/TA ratio being lower.

The formed seedlings at the different shading levels presented significant interaction for the estimated fruit productivity (EP). The PA, PPe, PPu and PM species presented differences on EP due to shading levels and all species showed similar behavior on their field development.

Seedlings produced in an environment with 25% shading were those that presented better averages with production estimates of 1674.25 kg ha^{-1}, differing from other environments and, in an environment with 75% shading, fruit production was drastically reduced to 425.65 kg ha^{-1}, which differed from other environments directly influencing the cape gooseberry species production.

The PA specie stands out with greater productivity in environment under 25% shading reaching a productivity of 1825.00 kg ha^{-1}, productivity much higher than that obtained in an environment with 75% shading that produced 453.98 kg ha^{-1}. It is noted that PA requires shading to provide adequate growth but is affected at higher levels. Does not adapt under conditions of 50 and 75% shading, which harms the entire species development in the field.

TABLE 2 - Estimated Productivity (EP), for PA, PPe, PPu and PM seedlings, obtained at shade levels (SL) (FSC, 25, 50 e 75%).

SL	*Physalis* species				Averages
	PA	PPe	PPu	PM	
FSC	1390.50 bA	1418.50 bA	1409.50 bA	1148.66 bB	1325.99
25%	1825.00 aA	1716.25 aA	1715.25 aA	1440.28 aB	1674.25
50%	646.52 cA	681.16 cA	691.68 cA	613.12 cA	658.12
75%	453.98 dA	409.98 dA	392.62 dA	446.04 dA	425.65
Averages	1079.06	1040.60	1052.24	912.02	
CV(%)			7.30		

*Means followed by the same capital letter in the row and lowercase in the column do not differ statistically from each other, by the Tukey test at 1% error probability.

In relation to PPu specie it differed statistically in different shading environments with higher productivity in 25% shading environment with a 1715.25 kg ha^{-1} of EP, productivity values above those obtained in an environment with 75% shading which was the lowest specie productivity, being the one that suffered the greatest shading levels interference. These seedlings produced at higher levels of shading are impaired in the field development affecting mainly plant productivity.

The PM specie had the lowest EP differing statistically from other species in FSC 25% shading environment and in an environment with 25% shading it generated the best seedlings, which allowed for greater plants production in the field reaching a production of 1440.28 kg ha^{-1} and, seedlings formed in 75% shading environment production of PM reduced to 446.04 kg ha^{-1}, This production was much lower than the seedlings formed in 25% shading.

For the PPe specie there was a maximum productivity of 1716.25 kg ha^{-1} in seedlings formed in 25% shading environments, values much lower than that found by Lima et al. (2010) which obtained a yield of 8.54 t h^{-1}. Production values above these were observed by Silva et al. (2013) in specie productive characterization in the south of Minas Gerais, which found a yield of 1.8 t ha^{-1}. This productivity differences are due to several factors that affect the physalis specie productivity.

Among these factors can be mentioned the planting spacing, tutoring system, terrain topography, humidity, aeration and cultural management form (MUNIZ et al., 2011). All these factors influence the density of plants per hectare and the way of obtaining and forming the seedlings and the region climate of species development directly changes the production volume per unit area.

In the FPN, there was significant interaction between species and shade levels (Table 3). On seedlings

formed in FSC and 50% shading environments, the PA, PPe and PPu species did not show differences on FPN and the PM species differed from the other species in these two environments, with the highest FPN averages and seedlings formed in 25% shading environment the PA and PPe did not present statistical difference between them on FPN.

TABLE 3 - Fruits per plant number (FPN), for PA, PPe, PPu and PM seedlings, obtained at shade levels (SL) (FSC, 25, 50 e 75%).

SL	*Physalis* species				
	PA	PPe	PPu	PM	Averages
FSC	53.75 bB*	50.50 bB	53.75 aB	59.50 bA	54.37
25%	59.75 aB	56.50 aBC	54.00 aC	65.50 aA	58.93
50%	43.75 cB	42.00 cB	42.75 bB	49.25 cA	44.43
75%	36.00 d AB	31.75 dC	33.25 cBC	38.00 dA	34.75
Averages	48.31	45.18	46.12	53.06	
CV(%)		4.14			

*Means followed by the same capital letter in the row and lowercase in the column do not differ statistically from each other, by the Tukey test at 5% error probability.

The PPe and PPu species did not differ among themselves, and were the most influenced generating lower FPN. These presented means less than the PM specie that generated the highest FPN among the *Physalis* species differing from the other three species. Seedlings formed in 75% shading was observed greater oscillation of field species in FPN and between PA and PM there was no statistical difference, both had higher FPN being the ones that presented greater adaptation in the conditions provided by the environments and in the species PA and PPu there was no difference between them for FPN. When analyzing the PPe and PPu species, it was verified that both had greater influence, generating the least amount of FPN in environments with highest shading.

In the values obtained for the species when comparing the environments, there was difference between the seedlings formed in the different shading levels. The higher the shading level the smaller the FPN. This fact occurred because the seedlings presented an increase in the seedlings internodal spaces, which reduced the amount FPN.

This was due to the little light presence provided by the higher levels of shading. This effect was observed for all *Physalis* species of that were formed in an environment under 75% shading that provided lower FPN among the environments. In environments with 25% shading occurred higher FPN, which shows that in these shading levels the *Physalis* species are influenced positively in the productivity increase. The shading levels influence on the formation of the *Physalis* changes in the internodes number of (IN) was observed, effects that influenced the entire development of the seedlings in the field (Table 4).

In an environment with 25% shading it was verified that all cape gooseberry species presented higher IN, where it was verified a greater balance in the growth and stem elongation. In contrast, the environment with 75% shading showed higher height and lower IN, this effect that the seedlings suffered in the initial phase influenced the production that takes place in the internodes armpits, because in each internode two leaves develop, a vegetative gem and a floral gem (RODRIGUES et al., 2013), in this way the less occurrence of internode number affected the plants productivity.

TABLE 4 - Internodes number (IN), for PA, PPe, PPu and PM seedlings, obtained at shade levels (SL) (FSC, 25, 50 e 75%).

SL	*Physalis* species				Averages
	PA	PPe	PPu	PM	
FSC	57.25 bB*	54.00 bB	57.00 bB	63.50 bA	57.93
25 %	63.25 aB	60.50 aB	60.25 aB	69.50 aA	62.37
50 %	47.75 cB	46.50 cB	47.25 cB	53.00 cA	48.62
75 %	36.25 dB	36.75 dB	37.75 dB	42.25 dA	39.12
Averages	52.00	49.43	50.56	57.06	
CV(%)			3.71 %		

*Means followed by the same capital letter in the row and lowercase in the column do not differ statistically from each other, by the Tukey test, at 5% error probability.

Among the species, just PM presented higher IN due to the specie characteristics, which has less internodes distance and provides greater amount of fruits. The PA, PPe and PPu species presented similarities in the IN development, which were affected by reducing their production at higher levels of shading. For the variable flowers number (FN), it was observed that the seedlings produced in higher shading environments, reduced the

amount of flower in its field development and consequently the fruits number reflected in lower production (Table 5).

The treatments with shading influenced the seedlings in their development, this way reflected in the growth of the plants in the field, where seedlings produced in a 25% shading environment presented higher FN and higher fruits number with higher production. Seedlings formed in an environment with higher luminosity reduced FN causing lower production, this effect was due to the plants lengthening their stems and thus reducing the amount of internodes, in this way a smaller quantity of floriferous buds occurred, reducing thus the *Physalis* production.

TABLE 5 - Flower number (FN), for PA, PPe, PPu and PM seedlings, obtained at shade levels (SL) (FSC, 25, 50 e 75%).

SL	*Physalis* species				Averages
	PA	PPe	PPu	PM	
FSC	55.50 bB*	52.50 bB	55.25 bB	62.50 bA	56.43
25 %	62.00 aB	59.25 aB	59.50 aB	68.75 aA	61.62
50 %	46.25 cB	44.75 cB	45.25 cB	50.00 cA	46.56
75 %	36.00 dB	35.00 dB	34.75 dB	40.50 dA	37.06
Averages	50.43	47.87	48.68	55.43	
CV(%)	3.75 %				

*Means followed by the same capital letter in the row and lowercase in the column do not differ statistically from each other, by the Tukey test at 5% error probability.

For fruits fresh biomass variable (FPB) significant interaction can be observed between species and shading levels according to Table 6. For PA, PPe and PPu the FSC and 25% shading environments did not present difference between themselves and PM specie differed statistically from the other species on the fruits development in FSC and 25% of shading environment.

It was in an environment with 25% shading the PA specie presented the highest FPB, with no statistical difference between the PPe and PPu species. In seedlings of environments with levels under 50 and 75% of shading, the lowest averages were obtained for the variable FPB, which reduced the fruits number per plant and the fruits size due to the seedlings submitted, on development initial phase, to higher levels of shading. They suffered a plants internodes elongation, thus reducing the amount of fruits per plant and the fruits size.

TABLE 6 - Fruits per plant biomass (FPB), for PA, PPe, PPu and PM seedlings, obtained at shade levels (SL) (FSC, 25, 50 e 75%).

SL	*Physalis* species				Averages
	PA	PPe	PPu	PM	
FSC	173.84 bA*	169.40 bA	176.17 bA	143.58 bB	165.74
25 %	228.12 aA	214.51 aA	214.41 aA	180.03 aB	209.27
50 %	80.81 cA	85.14 cA	86.46 cA	76.64 cA	82.26
75 %	56.74 dA	51.14 dA	49.07 dA	55.75 dA	53.20
Averages	134.88	130.07	131.53	114.00	
CV(%)	7.30				

*Means followed by the same capital letter in the row and lowercase in the column do not differ statistically from each other, by the Tukey test at 1% probability.

The PM specie differed from the other species, in FSC environment and with 25% shading and in an environment with higher shading there was no difference between the Physalis species. When comparing the seedlings produced in the different environments, it was verified that in levels with 25% shading, there was a higher FPA. This effect is due to the use of shading screens, which contributes to the seedlings formation with good quality parameters, with internodal spaces and adequate architecture and high fixation index and rapid field development.

Seedlings produced in different environments present statistical differences with significant interaction between species and levels of shading for titratable acidity (AT) as observed in Table 7. Being that in environment with 75% of shading the species PPe, PPu did not differ among themselves. The same occurred with PA and PM species that did not differentiate between them, but in relation to the other species having fruits with higher AT between species.

The PPe and PPu seedlings formed in the different levels of shade presented fruits with higher acidity content not statistically different between themselves in an environment with 25 and 75% shading. In an environment with 25%, levels of 1.63% AT were verified for PPe. Content of 1.60% of acidity was found for the PPu specie in fruits from plants formed in 25% of shading, which are higher than those found by Silva *et al.* (2016) who observed for the species values of 1.47 AT.

TABLE 7 - Titratable acidity (AT) for PA, PPe, PPu and PM seedlings, obtained at shade levels (SL) (FSC, 25, 50 e 75%).

SL	*Physalis* species				Averages
	PA	PPe	PPu	PM	
FSC	1.54 bC*	1.72 bA	1.64 cB	1.42 bcD	1.58
25%	1.47 cB	1.63 cA	1.60 cA	1.38 cC	1.52
50%	1.63 aC	1.78 abA	1.71 bB	1.47 bD	1.65
75%	1.64 aB	1.82 aA	1.77 aA	1.63 aB	1.72
Averages	1,57	1,74	1.68	1,48	
CV(%)		2,19			

*Means followed by the same letter in the column do not differ statistically from each other, by the Tukey test 5% error probability.

Acidity values for the PM specie differed statistically from the other species in seedlings on 25% shading environment, being greater than that found in the literature on the order of 1.38% AT. The first records found for the PM were by Patel et al. (2011) that verified an 0.51%, AT fruits, values much lower than those found in this study. Where more studies are needed to improve the seedlings quality by improving the plants initial development, and that further studies can be carried out in climatic stations of other periods to verify the Physalis behavior on shading levels.

CONCLUSIONS

Seedlings produced in 25% shading environment showed larger survival index when transplanted to field, favoring a greater seedling fixation and provided greater productivity.

Seedling formation in a 50 and 75% shading environment is not recommended.

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