ISSN 0100-2945 DOI: http://dx.doi.org /10.1590/0100-29452018528

Revista Brasileira de Fruticultura

Productive and qualitative parameters of four *Physalis* species cultivated under colored shade nets

Daniel Fernandes da Silva[1], Rafael Pio[2], Maurizio Micheli[3], Joyce Dória Rodrigues Soares[2], Adalvan Daniel Martins[4], Paulyene Vieira Nogueira[5]

Abstract - The genus *Physalis* L. has great importance in the framework of Brazilian biodiversity especially in the Amazon region. The use of colored shading nets allow manipulating the light spectrum, and thus supplying the appropriate quantity and quality of light for each species and maximizing production. The purpose of this study was to evaluate the effects of shade nets on fruit production and qualitative parameters of four species belonging to genus *Physalis*. The experimental design was random blocks with a 4 x 5 factorial scheme, four species of *Physalis* (*P. peruviana*, *P. pubescens*, *P. minima* and *P. ixocarpa*) and four colors of shade nets (white, blue, red and black), besides the control treatment under full sun exposure. Fruits were collected weekly and evaluated for longitudinal and transversal diameter and biomass with and without a calyx. Finally the percentage of calyx biomass compared to the total fruit biomass, number of fruits per plant and production were determined. A differentiated response was found among the species regarding the coloring of the converter shade nets. Plants of *P. peruviana* had the best productive and qualitative parameters of fruits when cultivated in full sunlight or under white shade nets, *P. pubescens* and *P. minima* when cultivated in full sunlight or under white and blue shade nets, and *P. ixocarpa* under red or black shade nets.
Index terms: *Physalis* L., light spectrum, productive performance.

Parâmetros produtivos e qualitativos de quatro espécies deFisális cultivadas sob telas fotoconversoras coloridas

Resumo - O gênero *Physalis* L. tem grande importância no âmbito da biodiversidade brasileira, especialmente na região amazônica. O uso de telas de sombreamento coloridas permitem a manipulação do espectro luminoso, e assim o fornecimento de luz em quantidade e qualidade adequadas para cada espécie maximizando a produção. Diante do exposto, objetivou-se com o presente trabalho avaliar os efeitos de telas de sombreamento na produção e nos parâmetros qualitativos de frutos (diâmetros longitudinal e transversal e a biomassa do fruto com e sem cálice, produção e número de frutos por planta) de quatro espécies pertencentes ao gênero *Physalis*. O delineamento experimental foi em blocos ao acaso, em esquema fatorial 4 x 5, sendo quatro espécies de fisális (*P. peruviana*, *P. pubescens*, *P. minima* e *P. ixocarpa*) e quatro cores de telas fotoconversoras (branca, azul, vermelha e preta), além do tratamento controle a pleno sol. Os frutos foram colhidos semanalmente e avaliados quanto ao diâmetro longitudinal e transversal, e a biomassa do fruto com e sem cálice. Ao final, foram determinados a percentagem de biomassa do cálice em à relação a biomassa total do fruto, o número de frutos por planta e a produção. Verificou-se resposta diferenciada entre as espécies em relação à coloração das telas fotoconversoras. Plantas de *P. peruviana* apresentaram melhores parâmetros produtivos e qualitativos de frutos quando cultivadas a pleno sol ou sob tela branca, *P. pubescens* e *P. minima* quando cultivados a pleno sol ou sob telas branca e azul; e *P. ixocarpa* sob telas vermelha ou preta.
Termos para indexação: *Physalis* L., espectro luminoso, desempenho produtivo.

Corresponding author:
daniel_eafi@yahoo.com.br
Received: Janeiro 03, 2017.
Accepted : October 02, 2017.

[1]PhD student in Applied Botany, Universidade Federal de Lavras- MG. E-mail: daniel_eafi@yahoo.com.br ; joycerodrigues01@yahoo.com.br
[2] Professor D.Sc, Universidade Federal de Lavras- MG. E-mail: rafaelpio@hotmail.com.br
[3] Professor D.Sc, Università per stranieri di Perugia. Italia. E-mail: maurizio.micheli@unipg.it
[4] Post doctoral researcher in Universidade Federal de Lavras- MG. E-mail: adantins@yahoo.com.br
[5] PhD student in Crop Science, Universidade Federal de Lavras- MG. E-mail: paulyene@gmail.com

Introduction

The genus *Physalis* L. belongs to the Solanaceae botanical family and its species are easily recognized by the peculiar morphology, especially in the fruit production, which are characterized by the presence of calix fruitful surrounding and inflated, it expands fully involving the fruit (CELY et al. 2015; TREVISANI et al. 2016; SILVA et al. 2017). The majority have herbaceous characters and are spread over various continents of the world, especially in tropical and subtropical regions, from Southern North America to South America (SILVA et al. 2017).

The best known and most cultivated species is *Physalis peruviana* L. However, the genus *Physalis* includes over one hundred species, many of which can be consumed, and some, such as *Physalis angulata*, are native to the North and Northeast regions of Brazil (LIMA et al. 2009). Genus *Physalis* has great importance in the framework of Brazilian biodiversity especially in the Amazon region where there are four species according to the list of plant species of Brazil (SILVA et al. 2016).

Besides being a food, the species of *Physalis* species are best known for their many properties as medication and their nutraceutic compounds (SILVA et al. 2013), including *Physalis pubescens* L., *Physalis ixocarpa* Brot. and *Physalis minima* L., besides *Physalis peruviana* L. .

Most of the plants respond to quality, quantity, direction and periodicity of light, and use it as a signal to optimize their growth and development in a given environment (OREN-SHAMIR et al. 2001). Since the importance and response of the plants to light are known, different forms of light manipulation have been used to cultivate plants of economic interest, under controlled cultivation conditions (COSTA et al. 2010). The use of a protected environment in horticulture allows much more effective use of physiological factors such as photosynthesis, evapotranspiration, respiration, water absorption and mineral elements and their transport, thus increasing precociousness and productivity, and enabling off season production (SHAHAK et al. 2008; LOBOS et al. 2013).

One of the techniques that has been used is colored shade nets over the plant canopy. These nets may be differently efficient in transmitting diffuse or dispersed light, and also in their capacity to spread the light that goes directly through them, according to their physical properties (OREN-SHAMIR et al. 2001). The colored shade nets used in protected cultivation are for the purpose of combining physical protection with differentiated filtering of solar radiation, obtaining desirable light-regulated physiological responses (SHAHAK et al. 2004).

Since species of *Physalis* are a high added value fruits, it is believed that using colored shade nets over the canopy of genus *Physalis* species may improve fruit production and quality. This study aimed at evaluating the productive and qualitative parameters of fruit under different colored shade nets for the protected cultivation of species belonging to genus *Physalis*.

Material and Methods

The experiment was set up in an area located in Brazil, in the south of Minas Gerais State, in the city of Lavras, with geographic coordinates 21º14’45º W, and altitude of 918 m. The climate is of the Cwa type, according to the Köppen climatic classification (DANTAS et al. 2007).

The shading structure over the plants was comprised of Pollysack Cromatinet® colored shade nets with 50% shading in four different colors: white, blue, red and black. The shade netting was fixed to a removable cubical wood structure measuring 3x3x1.5 m; the control treatment was full sunlight conditions with pots of the same size and distributed randomly with the same spacing between pots of the other treatments under shade nets.

During the experiment, the evaluated plants were surrounded by a boundary consisting of a line with *Physalis peruviana* plants in pots and shading structures were kept at a minimum distance of three meters apart, to avoid shading between them.

The colored shade nets have different transmittance spectra in the visible range with mesh density of 50% shading in the photosynthetically active radiation area. According to the manufacturer, the red shade net has greater transmittance at wavelengths in the range 590-750 nm, corresponding to red and far red; blue shade net reduces far-red spectrum and presents main peak transmittance at 470 nm (blue); and the black and white shading nets reduces the radiation intensity without changing the spectrum and the spread of transmitted light.

The most important differentiating factor between the shading nets is blue: red ratio (B:R), which is greater in the blue shading and smaller in the red shading net (SHAHAK et al. 2006). According to Massa et al. (2008) a red light is important in the development of the photosystem complex providing morphogenetic changes of phytochrome while blue has been identified as affecting chlorophyll concentrations, photomorphogenesis and stomatal openings, thus a combination of blue and red wavebands at intensities which vary according to the species, can result in higher photosynthetic activity and better photomorphogenetic characteristics than red or blue alone.

Seeds of four *Physalis* species were used: *P. peruviana*, *P. pubescens*, *P. minima* and *P. ixocarpa*. The seeds were extracted from mature fruits, dried in the shade and then sown in August 2013 in expanded polystyrene trays, with 128 cells, filled with substrate formulated by a soil mixture (clayey dystroferric red latosol) and commercial substrate based on pinus bark and vermiculite, at a proportion of 1:1 v/v. The trays were kept in a shaded environment and irrigated periodically. After 50 days, when they reached the ideal conditions for transplanting (10-15 cm high), according to recommendations of Silva et al. (2013), seedlings were transplanted to pots with a 6 liter capacity. The substrate used in this phase was a mixture of soil (clayey dystroferric red latosol) and tenned cattle manure, at a proportion of 7:3 v/v, enriched with 20 g NPK 4-14-8 per pot volume.

The experimental design used was randomized blocks in a 4x5 factorial scheme, the first factor being the four *Physalis* species (*P. peruviana*, *P. pubescens*, *P. minima* and *P. ixocarpa*) and the second factor the four colored shade nets (white, blue, red and black, besides the control under full sunlight), with three repetitions of two pots with one plant per pot.

The harvesting began in the first week of December 2013, by looking at the mature fruit of *P. minima*, the harvesting point being the straw brown color of the calix. After this harvest, when the plants were 4 months old, the other harvesting were done weekly until the end of production of the last species, which occurred in March 2014. In order to later calculate the number of fruits and the accumulated production per plant (g), the total production of each plant and the number of fruits collected was determined.

In each harvest a sample of five fruits from each plot randomly selected randomly was evaluated to measure the individual biomass of the fruit (g), with and without the calix, longitudinal (mm) and transversal (mm) diameters of the fruits and the mean percentage of the biomass of the calyx in relation to the total biomass of the fruit.

At the end of all analyses, the data were submitted to analysis of variance for statistic software Sisvar (FERREIRA, 2011) and the means grouped using the Skott-Knott test.

Results and Discussion

Statistical analysis showed interaction ($p<0.05$) among all treatments except the mean percentage of biomass of the calyx in relation to the total biomass of the fruit.

Fruits of *P. peruviana*, *P. pubescens* e *P. minima* did not present variation in their longitudinal and transversal diameter because of the change in colored shade nets. Fruits of *P. ixocarpa* proved more sensitive to the conditions supplied by the colored shade nets, and had a greater longitudinal and transversal diameter when cultivated under red and black shade nets. Larger and smaller longitudinal and transversal diameters were found, respectively in *P. ixocarpa* and *P. minima*, in all colored shade nets (Table 1).

Regarding the change in fruit size when grown under different color shading nets, results corroborate Bastías et al. (2012) studing apple trees, who found changes in the growing of fruit cultivation under these conditions, however it does not necessarily occur in all species and cultivars. Shahak et al. (2004) also found that there are variations in the sizes of apples regarding the use of colored shade nets, but this influence does not occurs in all cultivars of this fruit.

The mean value of the longitudinal diameters found in this work on *P. peruviana* is below those observed by Silva et al. (2013) and Lima et al. (2009), who cite mean values of 18.5 and 19.0 mm for this variable in their respective works. For plants of *P. minima* cultivated under different colored shade nets, the fruits found in this study were larger than those reported by Patel et al. (2011), who cite mean values of 11 and 8 mm of longitudinal and transversal diameter, respectively. Jiménez-Santana et al. (2012), evaluating the longitudinal diameter of three genotypes of *P. ixocarpa*, found values that ranged between 32.2 and 34.7 mm.

No significance differences among species were found in fruit biomass under the different cored nets, excepted for *P. ixocarpa* (Table 1). A larger fruit biomass, with and without a calyx, in *P. ixocarpa*, occurred in plants cultivated under the red shade net, and the fruits with and without a calyx with a smaller biomass were found under the white and blue shade nets.

For the difference in biomass between fruits of the *Physalis* species the response was similar to that observed in the evaluation of fruit size. Fruits with a greater biomass in *P. ixocarpa* plants cultivated under a red shade net can be explained by the greater intensity of rays in the red and far red range, which, according to Costa et al. (2010), have a positive influence of the development of the chloroplasts, ensuring a more efficient survival of the plants, affecting the photosynthesis capacity and leading to a higher photoassimilate content, thus allowing greater development of the fruit. Lobos et al. (2013) also found an increased biomass of blueberries when cultivated under black and red shade nets, strengthening the capacity of the light spectrum to act on the biomass fruit.

The *Physalis* species were divided into two distinct groups, regarding importance of the calyx biomass and the total biomass of the fruit: a group comprising *P. ixocarpa* and *P. minima*, which presented a calyx with a smaller biomass than the total biomass of the fruit, around 3.22 and 4.89% of the total biomass of the fruit and a second group, comprising *P. peruviana* and *P. pubescens* insert which presented a calyx with a greater biomass compared to the biomass of the fruit, values being respectively 8.52 and 9.16% (Table 2).

By studying fruits of low economic importance in order to incorporate them into commercial production systems, aspects of their post harvest conservation are one of the main factors that should be taken into consideration, seeking to extend fruit shelf life without there is deterioration or loss of their properties. In this respect the maintenance of the calix with the fruit in *Physalis* species can prolong the post-harvest durability (SILVA et al. 2013), however for the final consumer, non-edible parts should represent the smallest fraction of the total weight of the fruit.

The calyx has a major function in *Physalis* fruits from the beginning of their development. Among the main functions performed by this verticile are protection against predators and climate variations; nutrition, in that it serves as a source of carbohydrates during the first 20 days of growth; post-harvesting conservation, extending post-harvesting life of the fruit by up to 2/3, besides providing an indicator of the harvesting point through their color, since the fruit is completely wrapped in it (LIMA et al. 2009).

The values founded in this study for percentage of calyx biomass in relation to the total biomass of the fruit are similar to those found by Silva et al. (2013) (8.12%) and inferiors to those reported by Lima et al. (2009) found the percentage of the calyx biomass in relation to total biomass of the fruit of 13.12% for *P. peruviana* with yellow colored calyces, a point at which the fruit presents a greater biomass. Thus the values found here do not indicate an excessive growth of the calix in relation to the fruit, favoring the final consumer.

All species presented a significant difference in fruit number per plant among the different shade nets to which they were submitted (Table 3). The greater number of fruits presented under the white shade net for *P. peruviana*, *P. pubescens* and *P. minima*, as well as under the blue shade net for *P. pubescens* and *P. minima*, may be associated with the greater growth of branches under these two colors, since the rise of flowers in *Physalis* species occurs in the foliar axil and the larger the branch the greater the amount of fruit (VÁSQUEZ et al. 2010).

The low performance regarding the number of *P. ixocarpa* fruits under the white and blue shade net contrasts with the result found in the other species. The low performance regarding the number of *P. ixocarpa* fruits under the white and blue shade net contrasts with the result found in the other species. Although it also presented high vegetative growth under these shade conditions, a nutritional imbalance probably occurred between the amount of nutrients for vegetative growth and fruit formation. The vegetative growth of plants is a strategy to make up for the lack of light in environments where there is little of it, which according to Atinkson et al. (2006), in blue shade nets leads to a greater investment in photoassimilates in the vegetative part through a redistribution of photoasssimilates to increase the leaf area, with little energy left over for fruit growth.

For the accumulated production, the responses of the *Physalis* species under the different colored shade nets and in the full sunlight were similar (Table 3). Among the species, the highest productions were found for *P. minima* in the full sunlight and under the blue and white shade nets and *P. ixocarpa* in the full sunlight and under red and black shade nets (Table 1).

The highest productions founded in *P. minima* in the full sunlight and under the blue and white shade nets, as a consequence of the great number of fruit presented by the species in this light condition, although of reduced size fruit and for *P. ixocarpa* in the full sunlight and under red and black shade nets was a result of the greater biomass and greater size of the fruit in this condition, when compared to the others (Table 1).

In accordance in your different studies, Silva et al. (2013) and Moura et al. (2016) explain that several factors can affect the production of *Physalis* plants. Moura et al. (2016) also emphasize that the pot condition restricted much of the productivity. However, cultivation in the field or in larger capacity pots may result in greater production.

Given the observed results it appears that different *Physalis* species behave in particular ways when subjected to the light conditions afforded by the presence of shade nets with of different colors, there is therefore the need of selecting a suitable coloring shade net according to the species to be grown and with it also appears that the use of this technology has become an alternative that combines benefits for the producer when performed appropriately, being an advance for *Physalis* cultivation in Brazil, as it previously this study reports on the plant response to the use of colored shading nets in fruit production of *Physalis* culture had not been reported in the literature.

Table 1. Longitudinal diameter (LD) and transversal diameter (TD), mean biomass with (CC) and without a calyx (SC), of fruits of four species of *Physalis* cultivated under differently colored shade nets.

Colors of shade nets	*P. peruviana*		*P. pubescens*		*P. minima*		*P. ixocarpa*	
	Longitudinal and transversal diameter of fruits (mm)							
	LD	TD	LD	TD	LD	TD	LD	TD
Sunlight	16.27Ab*	15.69Ab	17.14Ab	16.55Ab	13.02Ac	12.59Ac	20.73Ba	23.84Ba
White	16.25Ab	16.10Ab	16.92Ab	16.42Ab	12.87Ac	12.62Ac	19.06Ca	21.08Ca
Blue	15.64Ab	15.69Ab	16.39Ab	15.23Ab	13.75Ac	13.34Ac	21.17Ba	23.12Ba
Red	15.73Ab	17.38Ab	16.43Ab	16.12Ab	13.80Ac	13.59Ac	22.87Aa	27.61Aa
Black	15.75Ab	15.62Ab	16.28Ab	16.94Ab	12.82Ac	12.46Ac	22.77Aa	25.92Aa
CV (%)	5.6	6.4	5.6	6.4	5.6	6.4	5.6	6.4
	Mean biomass with and without a calyx (g)(1)							
	CC	SC	CC	SC	CC	SC	CC	SC
Sunlight	2.75Ab	2.49Ab	3.09Ab	2.81Ab	1.38Ac	1.31Ac	7.57Ca	7.48Ca
White	2.72Ab	2.53Ab	3.00Ab	2.76Ab	1.37Ac	1.28Ac	5.30Da	5.08Da
Blue	2.54Ab	2.36Ab	2.75Ab	2.50Ab	1.53Ab	1.47Ab	6.33Da	5.91Da
Red	2.71Ab	2.44Ab	2.84Ab	2.56Ab	1.63Ac	1.57Ab	11.53Aa	11.23Aa
Black	2.55Ab	2.32Ab	2.82Ab	2.53Ab	1.33Ac	1.27Ac	9.66Ba	9.48Ba
CV (%)	18.2	18.4	18.2	18.4	18.2	18.4	18.2	18.4

*Means followed by the same lower case letter on the line and upper case on the column are not different from each other according to the Skott-Knott test at 5% probability.

Table 2. Percentage of mean biomass of the calyx in relation to the total biomass of fruit of four species of *Physalis*.

Species	Percentage of mean biomass of the calyx (%)
P. peruviana	8.52b*
P. pubescens	9.16b
P. minima	4.89a
P. ixocarpa	3.22a
CV (%)	34.6

*Means followed by the same lower case letter on the line and upper case on the column are not different from each other according to the Skott-Knott test at 5% probability.

Table 3. Number of fruits and accumulated production per plant of four species of *Physalis*, cultivated under different colored shade nets.

Colors of shade nets	*P. peruviana*	*P. pubescens*	*P. minima*	*P. ixocarpa*
	Number of fruits per plant			
Sunlight	20.38Ab*	14.25Ab	159.13Aa	30.00Ab
White	14.00Ab	11.50Ab	156.50Aa	20.63Bb
Blue	6.63Bb	10.38Ab	126.38Aa	11.63Bb
Red	6.38Bc	4.50Bc	74.38Ba	33.00Ab
Black	5.38Bb	2.38Bb	48.88Ba	36.88Ab
CV (%)	---16.5---			
	Production (g)			
Sunlight	95.67Ab	79.33Ab	368.67Aa	375.66Aa
White	77.00Ac	74.33Ac	355.67Aa	187.00Cb
Blue	37.33Bb	47.00Ab	303.67Aa	110.00Cb
Red	36.33Bc	30.33Bc	194.67Bb	638.67Aa
Black	18.00Bc	10.67Bc	104.00Bb	518.33Aa
CV (%)	---20.1---			

*Means followed by the same lower case letter on the line and upper case on the column are not different from each other according to the Skott-Knott test at 5% probability.

Conclusions

The species present a response that allows distinguishing them according to the colored shade net.

Physalis peruviana and *Physalis pubescens* appear to be more insensitive to changes in the light spectrum and light intensity while *P. ixocarpa* showed greater sensitivity to changes in light quality.

Physalis peruviana presents better productive and qualitative parameters when cultivated in the sunlight or under a white shade net; *Physalis pubescens* and *Physalis minima*, on the other hand, present a better quality of fruit when cultivated under the sunlight or under white and blue nets; and *Physalis ixocarpa* under red or black nets.

References

ATINKSON, C.J.; DODDS, P.A.A.; FORD, Y.Y.; MIÈRE, J.L.; TAYLOR, J.M.; BLAKE, P.S.; PAUL, N. Effects of cultivar, fruit number and reflected photosynthetically active radiation on *Fragaria x ananassa* productivity and fruit ellagic acid and ascorbic acid concentrations. **Annals of Botany**, Londres, v.97, n.3, p. 429-441, 2006.

BASTÍAS, R.M.; MANFRINI, L.; GRAPPADELLI, L.C. Exploring the potential use of photo-selective nets for fruit growth regulation in apple. **Chilean Journal of Agricultural Research**, Chillán, v.72, n.2, p.224-231, 2012.

CELY, J.A.B.; RODRIGUEZ, F.E.; ALMARIO, C.G.; L.S.B. Genetic variability of parentals and inter and interspecific f1 populations of *Physalis peruviana* L. and P. *floridana* Rydb**. Revista Brasileira de Fruticultura**, Jaboticabal, v.37, n.1, p.179-192, 2015.

COSTA, L.C.B.; PINTO, J.E.B.P.; CASTRO, E.M.; ALVES, E.; BERTOLUCCI, S.K.V.; ROSAL, L. F. Effects of coloured shade netting on the vegetative development and leaf structure of *Ocimum selloi*. **Bragantia**, Campinas, v.69, n.2, p.349-359, 2010.

DANTAS, A.A.A.; CARVALHO, L.G.; FERREIRA, E. Classificação e tendência climática em Lavras, MG. **Ciência e Agrotecnologia**, Lavras, v.31, n.6, p.1862-1866, 2007.

FERREIRA, D.F. Sisvar: a computer statistical analysis system. **Ciência e Agrotecnologia**, Lavras, v.35, n.6, p.1039-1042, 2011.

JIMÉNEZ-SANTANA, E.; ROBLEDO-TORRES, V.; BENAVIDES-MENDOZA, A.; RAMÍREZ-GODINA, F.; RAMÍREZ-RODRÍGUEZ, H.; CRUZ-LÁZARO, E. Calidad de fruto de genotipos tetraploides de tomate de cáscara (*Physalis ixocarpa* Brot.). **Universidad y Ciencia**, Villahermosa, v.28, n.2, p.153-161, 2012.

LIMA, C.S.M.; SEVERO, J.; MANICA-BERTO, R.; SILVA, J.A.; RUFATO, L.; RUFATO, A.R. Características físico-químicas de Physalis em diferentes colorações do cálice e sistemas de condução. **Revista Brasileira de Fruticultura**, Jaboticabal, v.31, n.4, p.1060-1068, 2009.

LOBOS, G.A.; RETAMALES, J.B.; HANCOCK, J.F.; FLORE, J.A.; ROMERO-BRAVO, S.; POZO, A. Productivity and fruit quality of *Vaccinium corymbosum* cv. Elliott under photo-selective shading nets. **Scientia Horticulturae**, Amsterdam, v.153, p.143-149. 2013.

MASSA, G.D.; KIM, H.; WHEELER, R.M.; MITCHELL, C.A. Plant Productivity in Response to LED Lighting. **Hortscience**, Alexandria, v.43, n.7, p.1951-1956, 2008.

MOURA, P.H.A.; COUTINHO, G.; PIO, R.; BIANCHINI, F.G.; CURI, P.N. Plastic covering, planting density, and prunning in the production of cape gooseberry (*Physalis peruviana* L.) in subtropical region. **Revista Caatinga**, Mossoró, v.29, n.2, p.367-374, 2016.

OREN-SHAMIR, O.M.; GUSSAKOVSKY, E.E.; SHPIEGEL, E.; LEVI, A.N.; RATNER, K.; OVADIA, R.; SHAHAK, Y. Coloured shade nets can improve the yield and quality of green decorative branches of *Pittosporum variegatum*. **Journal of Horticultural Science and Biotechnology**, Ashford, v.76, n.3, p.353-361, 2001.

PATEL, P.R.; GOL, N.B.; RAO, T.V.R. Physiochemical changes in sunberry (*Physalis minima* L.) fruit during growth and ripening. **Fruits**, Montpellier, v.66, p.37-46, 2011.

SHAHAK, Y.; GUSSAKOVSKY, E.E.; COHE, Y.; LURIE, N.S.; STERN, R.; KFIR, S.; NAOR, A.; ATZMON, I.; DORON, I.; GREENBLAT-AVRON, Y. ColorNets: A new approach for light manipulation in fruit trees. **Acta Horticulturae**, Leuven, v.636, p.609-616, 2004.

SHAHAK, Y.; GUSSAKOVSKY, E.E.; GAL, E.; GANELEVIN, R. Colornets: crop protection and light-quality manipulation in one technology. **Acta Horticulturae**, Leuven, v.659, p.143-51, 2006.

SHAHAK, Y.; RATNER, K.; GILLER, Y.E.; ZUR, N.; OR, E.; GUSSAKOVSKY, E.E.; STERN, R.; SARIG, P.; RABAN, E.; HARCAVI, E.; DORON, I.; GREENBLAT-AVRON, Y. Improving solar energy utilization, productivity and fruit quality in orchards and vineyards by photoselective netting. **Acta Horticulturae**, Leuven, v.772, p.65-72, 2008.

SILVA, D.F.; PIO, R.; SOARES, J.D.R.; NOGUEIRA, P.V.N.; PECHE, P.M.; VILLA, F. The production of *Physalis* spp. seedlings grown under different-colored shade nets. **Acta Scientiarum - Agronomy**, Maringá, v.38, n.2, p.257-263, 2016.

SILVA, D.F.; VILLA, F.; BARP, F.K. ROTILI, M.C.C.; STUMM, D.R. Conservação pós-colheita de fisális e desempenho produtivo em condições edafoclimáticas de Minas Gerais. **Revista Ceres**, Viçosa, MG, v.60, n.6, p.826-832, 2013.

SILVA, D.F.; PIO, R.; NOGUEIRA, P.V.; SILVA, P.A.O.; FIGUEIREDO, A.L. Pollen viability and quantification of pollen grains in species of Physalis. **Revista Ciência Agronômica**, Fortaleza, v.48, n.2, p.365-373, 2017.

TREVISANI, N.; SCHMIT, R.; BECK, M.; GUIDOLIN, A.F.; COIMBRA, J.L.M. Selection of fisális populations for hibridizations, based on fruit traits. **Revista Brasileira de Fruticultura**, Jaboticabal, v.38, n.2, p.e-568, 2016.

VÁSQUEZ, N.Y.G.; GONZÁLES, O.T.; TORRES, J.M.C.; OROZCO, L.F.O. Estudios de fertilidad de polen en accesiones de uchuva (*Physalis peruviana* L.). **Revista Facultad de Ciencias Basicas**, Cajicá, v.6, n.1, p.42-51, 2010.

ERRATUM

http://dx.doi.org/10.1590/0100-29452018528erratum

Erratum of article: Silva, D. F. da S., Pio, R., Micheli, M., SOARES, J. D. R., Martins, A. D., & Nogueira, P. V. Productive and qualitative parameters of four *Physalis* species cultivated under colored shade nets. *Rev. Bras. Frutic., 40*(2), e-528. https://dx.doi.org/10.1590/0100-29452018528

In the **page 1**, Authors' affiliations

where it reads:

[1]PhD student in Applied Botany, Universidade Federal de Lavras- MG. E-mail: daniel_eafi@yahoo.com.br

should read:

[1] PhD student in Applied Botany, Universidade Federal de Lavras- MG.
E-mails: daniel_eafi@yahoo.com.br; joycerodrigues01@yahoo.com.br