Agricultural Research & Technology
Open Access Journal
ISSN: 2471-6774

Research Article
Volume 22 Issue 4 - September 2019
DOI: 10.19080/ARTOAJ.2019.22.556208

Agri Res & Tech: Open Access J

Physiological Potential of Seeds of Fisális In Function of The Plant Conduction System and The Coloring of The Caprubble

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Submission: September 06, 2019; **Published:** September 19, 2019

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Summary

The *Physalis peruviana* L. Is a small fruit, belonging to the family of Solanaceaes, with great economic potential. However, little is known of its development, management and growth under different plant conduction systems, as well as the physiological potential of its seeds and the harvest point for seed production. In this sense, the objective was to determine the harvest point of fruits of *physalis peruviana* L. For seed production, according to the coloration of the capus from plants conducted in different systems. The study was carried out in a completely randomized design, with four replications, in a 5x2 factorial scheme, five colorations of the caprubble (green; yellowish-green; yellow and straw) and two tutoring systems (Vertical and no tutoring). To verify the physiological potential of seeds were evaluated: first germination count, germination, germination speed index, seedling length and dry mass. The data were analyzed for normality and homogeneity and when they attended the mathematical model, submitted to the analysis of variance by the F test ($P < 0.05$) and the averages compared by the Tukey test ($P < 0.05$). The harvest of the fruits of *physalis peruviana* L. Aiming the production of seeds should be carried out when the debris presents yellow-greenish coloration, yellow or straw. Vertical tutoring positively influences the physiological potential of *Physalis peruviana* L. Seeds.

Keywords: Germination; *Physalis peruviana L*; Harvest Point; Staking The force; Aguaymanto; Tocopherols; Carotenoids; Ventilation; Capuli; Ramifications; Londrina-PR

Introduction

The Cape gooseberry belongs to the family of Solanaceas and the genus Physalis, comprising more than one hundred species, among them the best known is the *physalis peruviana* [1], popularly called Aguaymanto, Juá-de-Capote, Capuli, Uchuba [2] or Goldenberry [3]. It is a tropical climate plant and can be found from South America to North America [4], being found in Brazil in all regions [5]. It is recognized for presenting fruits with high amounts of vitamins C, A and B complex, mineRais, Tocopherols and carotenoids [6]. It presents dense ramifications, requiring the adoption of a stoning system [7], which has a direct influence on ventilation, radiation and solar distribution around the plant [8]. In addition, it allows changes in the architecture of the plant that can influence the source-drain ratio, generating a positive reflection on canopy uniformity and crop yield. The propagation of this species is preferably done by means of seeds [9]. However, knowledge about seed physiology is still scarce, since there are no recommendations for *P. Peruviana* in the rules forseed nysis [10].

There is also scarcity of researches that indicate the ideal moment of harvesting the fruits of Cape gooseberry to obtain quality seeds. Some studies with *Physalis sp.* recommend harvesting for consumption when the calyx is yellow in color, due to the better fruit quality [7]. Other studies report that the harvest point for consumption depends on the coloration of the caprubble [11-14].

The appropriate time for fruit harvesting does not always coincide with the Fisi-ological maturity Point of theseeds [15], and it is relevant to study the Association of the Harvest Point of *Physalis peruviana* with the quality of Seeds and the plant's driving system. In this sense, the objective was to determine the harvest point of fruits of *physalis peruviana* L. For seed production, according to the coloration of the capus from plants conducted in different systems.

Material and Methods

The study was carried out in the municipality of Londrina-PR, in an experimental area of the State University of Londrina-UEL located at 23º 19 ' 42 ' 's, 51º 12 ' 11 "W and 574 meters of altitude. The climate of the region is of the CFA type according to the Köppen classification, with rainfall well distributed in summer.

The averages of temperature in the municipality during the period of the work are presented in Figure 1. The soil of the experimental area was classified as an oxisol Eutroférrico [16] and its correction was made through the application of a chemical compound following the recommendations of [17], based on Results of soil chemical analysis (Table 1), from samples collected in the depth of 0-10 centimeters. The seeds for the production of *Physalis peruviana* L. Seedlings were extracted from commercially acquired fruits in a complete maturation stage, characterized by orange staining. The sowing was performed in Styrofoam trays containing 128 cells filled with commercial substrate and kept in greenhouse with controlled environment.

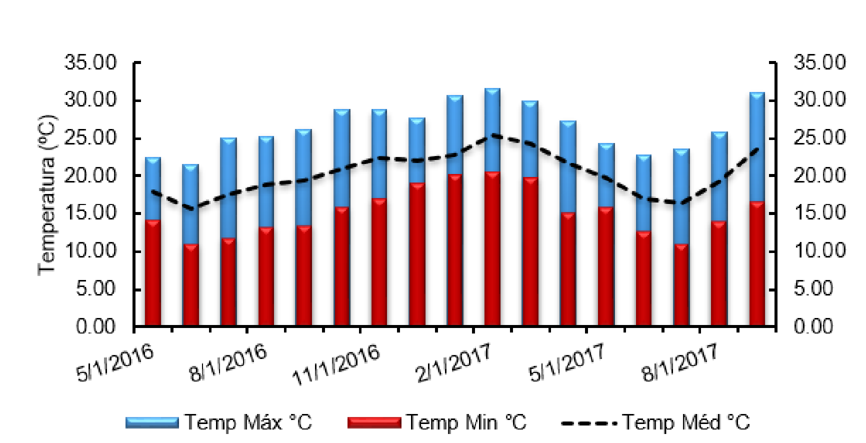

Figure 1: Maximum temperature values (T max. ºC), minimum (t min. ºC) and average (t med. ºC) in the municipality of Londrina-PR during the experiment of *physalis peruviana L.* (Years-2016/2017)- Londrina-PR, 2018.

Table 1: Chemical analysis of the soil of the cultivation area-Londrina-PR, 2018.

pH*	Ca^{+2}	Mg^{+2}	3	H + Al	K^{+}	SB	CTC	P	C	MO	V
----------------- cmolc dm^{-3} -----------------							mg dm^{3}	mg dm^{3}	%	g kg^{-1}	%
5	4,2	2,05	0,04	5,76	0,53	6,77	6,81	1,31	1,12	19,26	54,03

Seedling transplanting was performed when they presented 3 to 4 true leaves and approximately 20 centimeters in height. A plant was deposited per pit, with spacing of 3 meters between lines and 1 meter between plants. The cultural tracts followed the recommendations of the crop and the irrigation was performed according to the requirements of the same [7]. The experimental design was completely randomized, with four replications, in a 5x2 factorial scheme, being five colorations of the caprubble (green; yellowish-green; yellow and straw) and two stoning systems (tutoring Vertical and no tutoring). The stinging structure used (bamboos with 1.80 meters of height) was installed before transplanting, using bamboos arranged vertically to the soil, and the plants were supported by the tutors with the aid of Barbantes, as soon as they reached Approximately 30 centimetres in height. The plants without stoning had natural development, without interference in its architecture.

The fruit harvests for seed analysis were performed manually or with the aid of scissors, in order to avoid the detachment of the chalice. The fruits were selected according to the color of the caprubble: green; Yellowish-green; Greenish-yellow; Yellow and Straw (Figure 2). Intact fruits were depulped in distilled water with the aid of a sieve until the removal of mucilage around the seeds. After removal of the pulp, the seeds were placed on filter paper and kept in a controlled environment, under temperature of 20 ± 1ºC, during 48 hours to eliminate excess water, and finally subjected to the tests. To analyze the physiological potential of the seeds, the first germination count (Pcg), germination (g), germination Speed Index (IVG), SEEDLING length (CP) and seedling DRY mass (DM) were performed. Seed germination was evaluated by the distribution of 50 seeds in blotting papers (10.5 x 10.5) inside Gerbox-type plastic boxes (11 x 11 x 3.5) moistened with distilled water in a quantity equivalent to 2.5 times the initial weight of Paper. The plastic boxes were packed in plastic bags of transparent colouring, to avoid the loss of moisture, and taken to BOD chambers with temperature adjustments at 25 º C constant, under light regime of 24 hours, according to recommendations for seeds Contained in the rules for seed analysis-RAS (Brazil 2009). The germination evaluations were performed with the protrusion of the primary root at the 7th day after sowing (1 º C) and number of normal seedlings at 28 days (G) after sowing. The results were expressed as percentage of normal plantlets [10]. To evaluate the germination Speed index (IVG), it was performed daily (from the seventh day) the seed count germinated, considering those with at least 2 mm of seedling length, following the forMule described by [18]: IVG = g1/N1 + G2/N2 +... + GN/Nn, in which: G1, G2 and gn = number of normal seedlings, computed in the first, second and last counts; N1, N2, Nn = number of sowing days at first, second and last count.

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Figure 2: Scale for the classification of the color of the caper: Green (1); yellowish-green (2); yellow-greenish (3); yellow (4) and Straw (5). Londrina-PR, 2018.

At the end of the germination test (28° days after sowing), the normal seedling length was evaluated by measuring 10 random seedlings with the aid of a graduated ruler. Subsequently, the seedlings were packaged in Kraft paper bags and kept in a forced air circulation greenhouse at 65°c with weighing monitoring on a precision scale until they reached constant weight. The results of seedling length were expressed in CM/seedling and the results of dry mass mg/seedlingRespectivamente [19]. The data were analyzed by the Sisvar statistical program regarding normality and homogeneity and when they met their assumptions were subjected to analysis of variance by the F test ($P < 0.05$) and the averages compared by the Tukey test at 5% probability.

Results and Discussion

Among the variables analyzed for the physiological potential of physic seeds in relation to the conduction system and the coloration of the capus, a significant difference was found for the isolated tutor factor in relation to the seedling length variable (CP) (table 2). There was interaction of the tutor with the coloring of the caprubble for the variables of first count of germination (PCG), germination (G) and germination Speed Index (IVG). Considering the variation attributed to the tutor in isolation, it is observed that vertically tutored plants presented higher averages for seedling length compared to non-tutored ones (table 3). These results can be justified because the tutoring provides the plants of Cape gooseberry better insolation and greater ventilation in the canopy and greater interception of the solar radiation, reducing the relative humidity of the air and renewing the concentration of carbonic gas in Atmosphere close to the leaves, which potentializes the photosyntic efficiency[20]. Thus, the vegetative development is favored and consequently there is greater availability of photoassimilates that directed to the fruits, increase their size and favor the vigor of the seeds.

Table 2: Analysis of variance with values of the mean square of the variables first count of germination (PCG) (%), Germination (G) (%), germination Speed index (IVG), seedling Length (CP) (cm), and seedling dry mass (DM) (MG) of fruits of physalis peruviana L. As a function of two stoning systems and five colorations of the caprubble. Londrina-PR, 2018.

	Middle Square				
Source of variation	PCG	G	Ivg	CP	MS
Tutor	2788,90**	2102,50**	59,75**	1,44*	8,7^{ns}
Coloring	2674,60**	1429,40**	38,65**	0,45^{ns}	1,03^{ns}
Tutor X Coloring	510,4*	680,50*	15,63*	0,04^{ns}	3,22^{ns}
CV (%)	28,59	18,49	21,96	8,35	14,67

Table 3: Seedling length of Physalis peruviana as a function of two tutoring systems (vertical and without tutor). Londrina-PR, 2018.

Seedling Length (cm)	
No Tutor	5,56B*
Tutor Vertical	5,94A

Table 4: Interaction between the factors stoning systems (T) (vertical and SEM) and colorations of the caper (V-Green; Yellowish-green V-A; A-and greenish-yellow; A-Yellow and P-straw) for the variables of first germination count, germination and germination Speed index (IVG). Londrina-PR, 2018.

T X C	V	V – A	A- e	A	P
First germination count (%)					
No tutor	3,50 Bb*	14,00 Bb	45,00 Aa	56,00 Aa	57,00 Aa

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Tutor vertical	28.00 From	54,50 Aa	57,50 Aa	58,50 Aa	60,50 Aa
Germination (%)					
No tutor	37,00 Bc	53,00 Bbc	81,50 Aab	79,50 Aa	82,00 Aa
Tutor vertical	68,00 Aa	90,00 Aa	84,50 Aa	88,00 Aa	83,00 Aa
Ivg					
No tutor	3,58 Bb	5,39 Bb	10,52 Aa	10,32 Aa	10,95 Aa
Tutor vertical	8,34 Aa	11,46 Aa	10,81 Aa	11,54 Aa	11,08 Aa

According to [21], the fruits of Cape gooseberry are classified in four classes with the diameter with mantle, A, B, C and D. In TR-some work performed by [22], with phenology, stoning and production of *P. Peruviana* na Region of Pelotas RS, the authors contacted that fruits conducted in the triangular systems and inverted "V", Fit in class "B", and the fruits conducted in the vertical system had higher averages, were in class "A". For the variables first germination count, germination and germination speed index, stoning plants with yellow-greenish, yellow and straw staining produced seeds with better germinative performance, more vigorous and Efficient compared to seeds produced without stoning with green and yellowish-green debris (table 4).The stoning system, in addition to facilitating the management of the crop, promotes changes in the architecture of the plant to which facilitates light penetration in the canopy and betterto aeration [23]. This behavior can cause a direct effect on seed vigor due to the greater efficiency of the tissues of the phyalic plants in converting solar radiation into dry matter during the growth period. On the other hand, low conversion may be a result of low light penetration in plants, which affects the chlorophyll content and, consequently, reduces the efficiency in converting solar radiation into chemical energy, with low production and translocation of photoassimilated [24, 25].

The fruits of *P. Peruviana* in the coloration stages of green (v) and yellowish-green (V-A), harvested from untutored plants showed reduced physiological potential when compared with more advanced stages (greenish-yellow (A-E), yellow (A) and Straw (P)), except for the characteristic of germination in plants without a tutor with yellow-greenish-green, which did not differ from plants with yellowish greener.

This behavior is observed due to fruits with green and yellowish-green coloration, not reaching their complete physiological maturation [26,12]. Therefore, the occurrence of dormancy associated with the physiological immaturity of the seeds is based on the germination and reduced vigor of the seeds from fruits with green and yellowish-green debris. According to [27], immature fruits of green color, in most cases, generate seeds with low physiological potential. On the other hand, the highest germination and vigor values of the seeds from fruits harvested with yellow-greenish, yellow and straw coloration, can be explained by their physiological maturity, presenting the complete Development of enzymatic mechanisms involved in germination. In a work area of [28] with a Solanaceae, it was verified that the physiological quality of the pepper seeds was maximal when the fruits were red and red-intense, respectively, because it was in this period more Advanced development that the activity of the endo-β-mananase enzyme, which is the key in the germination of pepper seeds was higher.

In species of carnose fruits, such as fisális, the maximum values of germination, vigor and accumulation of dry matter are observed when the seeds reach Physioló gica maturity [29].

Conclusion

The harvest of the fruits of *Physalis peruviana* L. Aiming the production of seeds should be carried out when the debris presents yellow-greenish coloration, yellow or straw. Vertical tutoring positively influences the physiological potential of *Physalis peruviana* L. Seeds.

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