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Physiological Potencial of Seeds of Physalis Peruviana L. Depending on Different Managements

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Abstract

In the process of agricultural production of Cape Gooseberry, the obtaining of new plants occurs commercially by the sexual route, being the seed the main form. The physiological potential of seeds may be influenced by some cultural tracts. This study aimed to evaluate the physiological potential of *Physalis peruviana* L. Seeds cultivated in different stoning, pruning and harvest time systems. The experiment was carried out in Londrina PR, using a completely randomized design, in a 5x4x2 factorial scheme, with four replications, containing five harvest times of the fruits (117, 124, 130, 137 and 141 days after transplanting), Four Tutoring systems ("UEL tutoring", "adaptive" V "tutoring", no tutoring and "vertical tutoring") and two types of pruning (with and without Desbrota). For the physiological potential of the seeds, first count germination, germination, germination speed index, seedling length and dry mass were performed. Data were subjected to analysis of normality and homogeneity and compared by Tukey's tests for qualitative variables, and by linear regression tests for quantitative variables, at a 5% probability level. It was found that the desbrotte, stoning and harvesting of fruits made at 117 days after transplanting positively influenced the physiological potential of seeds of *physalis peruviana* L. The adapted inverted V-tutoring presented Higher value for seedling dry matter.

Keywords: Fisális; Seed quality; Cultural tracts; Force

Abbreviations: 1st C-First Germination Count; G-Germination; IVG-Germination Speed Index; CP-Seedling Length; DM-Dry Mass; Co-Harvest Times; P-Poda; T-Tutor

Introduction

Physalis peruviana L. is an exquisite fruit with high added value, recently inserted in the ranking of small fruits [1]. It contains high levels of vitamins A and C, phosphorus, iron, in addition to flavonoids, alkaloids, phytosteroids, carotenoids and bioactive compounds (functional consid) [2,3]. Consumed in Natura or processed, Distinguand by the bittersweet flavor [4]. In the process of agricultural production of Fisális, the obtaining of new plants occurs commercially by the sexual pathway, the seed being the mainpropagation medium [5]. When this reproductive structure presents high physiological potential, it generates a positive reflection on canopy uniformity and crop production, becoming one of the main factors considered, seeingthe success of a crop [6,7]. Alterations in the plant's architecture can influence the source and drain ratio in such a way as to obtain higher seed quantity and quality. By presenting ramifications there is a need for adopting a system of budget tut [8], which has a direct influence on ventilation, radiation and solar distribution around the plant [9]. Since plant development depends on photosynthesis and translocation of photoassimilates for sites Dand utilization or storage [10], in phyalic plants, in most of its development the leaves are considered sources of photoassimilates and the fruits and seeds the pey drains [11]. The effectiveness of the stoning system can be potentiated with pruning, since this improves the plant's architecture, facilitating thecultural tract and harvesting [4]. Thus, during plant growth, high auxin concentrations are found in the apical meristem, by promoting pruning in this region, there is a deviation from the phytohormone to the lateral buds, and consequently the growth anddevelopment of the branches [12].

After the adequacy of the management practices, it is appropriate to pay attention to the harvest time in order to obtain seeds in quantity and quality. When analyzing the behavior of pumpkins (*curcubita pepo* L.) submitted to pruning, They observed an increase in the number of fruits, increased production and their influence on the chemical composition of the seeds. For the culture of the Fisális, studies on the pruned cultivation, in addition to scarce are usually correlated with physiological responses of the plant, not addressing aspects related to the development of the seeds [13]. Thus, the knowledge of the maturation of the seeds and the main factors involved is of fundamental importance for the

orientation of the producers, especially with regard to the planning and definition of the ideal harvest time [14]. However, knowledge about the physiology of *P. Peruviana* seeds is scarce.Therefore, the objective of this work was to evaluate the physiological potential of seeds of *Physalis peruviana* L. Cultivated in different stoning, pruning and harvested systems at distinct times.

Material and Mall

The study was conducted in the city of Londrina-PR, located at 23o19'42''s, 51o12'11"W and 574 meters of altitude, from may 2016 to november 2017. The climate of the region is of the CFA type according to the Köppen classification, with rainfall well distributed in summer. The temperature averages in the municipality are shown in Figure 1. Irrigation was used, which was linked weekly according to the requirements of the crop. The soil of the experimental area was classified as a red Oxisol [15] and its correction was performed by applying a Qhemical compound following recommendations [16], based on Results of soil chemical analysis (Table 1), from samples collected in the depth of 0-10 centimeters. The seeds of *Physalis peruviana* L. Were obtained by means of commercially acquired fruits in a complete maturation stage, characterized by orange staining. The sowing made in styrofoam trays containing 128 cells filled with commercial substrate and maintained in greenhouse with controlled environment. The transplant of the seedlings was carried out in April 2017, when the plants were 3 to 4 true leaves and approximately 20 centimeters high, using one per hole, adopting a spacing of 3.0 x 1.0 meters between lines and plants, respectively.Was defined as experimental area 255m^2 in the (15x17m), containing 16 plants distributed in four rows, totaling 64 plants.

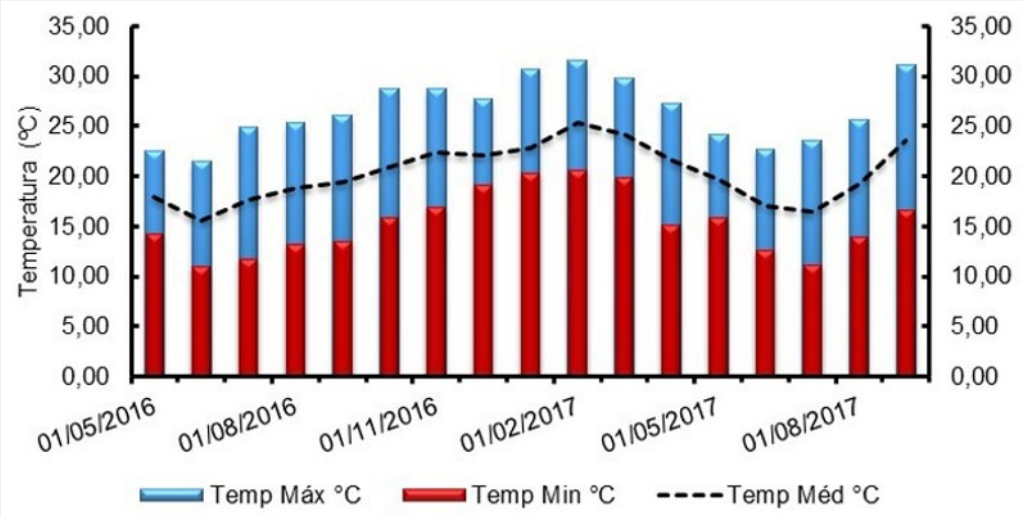

Figure 1: Maximum temperature values (T max.oC), minimum (t min. oC) and average (T med. oC) in the city of Londrina-PR during the experiment (years-2016/2017)-Londrina-PR.

Source: [36].

Table 1: Chemical analyses of the soil of the cultivation area-Londrina-PR.

pH*	Ca^{+2}	Mg^{+2}	$^{+3}$	H+Al	K^{+}	SB	CTC	P	C	MO	V
	---------- $cmol_c\ dm^{-3}$ ----------						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

*pH em CaCl2

SB calculated based on pH 7

Source: The author himself.

The cultural tracts carried out as re-Commendation [8]. The experimental design was completely randomized, with four replications, in a 5x4x2 factorial scheme, being five harvest times of the fruits (117, 124, 130, 137 and 141 days after the transplant of the seedlings), four tutoring systems ("Adaptive" V "tutoring", without tutoring and "vertical tutoring") and two types of pruning (with and without Desbrota). The stinging structure used (bamboos with 1.80 meters high) was installed before transplanting, and so the plants reached approximately 30 centimetres, conducted on the tutors with the aid of barbantes. For the tutoring of the UEL type, two bamboos were arranged in the form of "X", crossing each other at a height of approximately 60cm and their bases supported in the soil at 50cm away, so that the transplanted plant was located in the center. In the inverted "V" type adapted, two bamboos were crossed at the upper extremities and their bases were arranged at 50cm away from each other, and the plant was transplanted between them. For the vertical, it was made the use of a bamboo disposed vertically to the soil, and the plant transplanted at its

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base. And without tutoring natural development without changes in its architecture. The Debrots performed weekly simultaneously to the tutoring, with the help of pruning scissors, with partial removal of the lateral buds leaving only two stems per plant, which were conducted on the tutors. For plants without Desbrota, the stems were tutored. The harvests performed manually or with the aid of scissors, in order to avoid the detachment of the Chalice, the fruits being harvested according to Maturity Scale (4-yellow, 5-yellow-browned and 6- Brown-browned) and LOgo after undergoing the tests [17]. For the extraction of the seeds, the fruits were crushed manually with the aid of a macerator, and after left ferment in distilled water for 48 hours in glass container, then the seeds were washed in running water and dried to sobra (22°C) on paper [18,19], after stored under refrigeration (10°C) in glass container with polyethylene lids for one week.

Before the tests were made, seed moisture was verified, according to the recommendations of the rules for seed analysis [20], which presented humidity of 8%.To analyze the physiological potential of seeds, tests of first germination count (1°C) were performed, Germination (g), germination Speed Index (IVG), seedling Length (CP) and seedling dry mass (DM). The germination test was carried out with four replications of 50 seeds, sotted on paper of the type blotting (10.5×10.5cm), moistened with distilled water, in the amount equivalent to 2.5 times the dry paper mass, inside plastic boxes (11×11×3.5cm) [20]. These were packaged in plastic bags, and kept in germination cameras, previously regulated at 25°C, under 24 hours of light. The evaluation of germination performed on the twentieth day (28°C), according to the recommendations of the rules ptheSeed analysis [20] for other small seed species, considering the normal seedlings, the results expressed in Percentage rate. The first germination count consisted of a vigor test performed in conjunction with the germination test, and the protrusion of the primary root to the seventh (7th) day after sowing was computed. For the Germination Speed Index (IVG), using the same methodology of the other tests, performed daily until the end of the germination test the seed count germinated considering those with at least 2mm of seedling length, Following forMule described by: IVG=g1/N1+G2/N2+...+GN/Nn, in which: G1, G2 and gn=number of normal seedlings, computed in the first, second and last count; N1, N2, Nn=number of days of sowing to primary, second and last count [21]. Additionally, at the end of the germination test (28 days after sowing), the seedling length was evaluated by measuring the normal seedlings with the aid of a graduated ruler in centimeter (cm). Next to the evaluation of the dry mass of the seedlings, they were packaged in Kraft paper bags, kept in a forced air circulation greenhouse at 65°C and monitored by weighing on a precision scale until they reached constant mass. The results obtained were expressed in G/seedling. The data submitted to the analysis of normality and homogeneity, and met the standards, compared by the Tukey tests for the qualitative variables, and by the linear regression tests for the quantitative variables, at the level of 5% probability by the program Statistical Sisvar.

Results and Discussion

Among the variables analyzed for the physiological potential of physic seeds in relation to the conduction system, the Desbrotte and the Harvest time (Table 2) A significant difference was contacted only for the harvest factor to the variable velocity index of Germination (IVG) and for the pruning factor to the germination variable (G). For the factors harvesting and pruning in isolation, the first germination count (1stC) and seedling length (CP) were significant. For the three isolated factors, the variable that showed significance was the seedling dry mass (DM). There was interaction of pruning (P) and Tutor (T) for first germination count, germination and germination speed index. Considering in isolation the variation attributed to the Desbrota, it is observed that the plants that received this cultural tract presented the highest averages for the first count of germination, germination, seedling length and seedling dry mass (Table 3) compared to the without Desbrota. The increase in physiological quality according to this cultural practice can be explained due to the pruning exerts a vegetative equilibrium in the plants, increasing the fraction of the dry mass aloeach to the reserve organs [21], which results in greater Accumulation of photoassimilates in seeds, which favored the physiological potential. Similar results werefound in work performed with okra, which found an increase in the physiological quality of the seeds originated from planTas that were submitted to pruning [23]. Andm study on the effects of sowing density and pruning on the final productivity of *Crotalariajuncea* L., This cultural RAL practiceis recommendedfor seed production [24]. The responses verified for seedling dry mass in relation to the stoning systems show that the plants tutored in the inverted "V" system adapted (stoning 2) had higher averages compared to the others (Table 3).

Table 2: Analysis of variance with values of the mean square of the variables first count of germination (1st C), germination (G), germination Speed Index (IVG), seedling Length (CP), and seedling dry mass (DM) of fruits of *Physalis Peruviana* L. Depending on five harvest seasons (Co), two types of pruning (P) and four stoning systems (T). Londrina-PR, 2018.

	Middle Square				
Source of variation	**1aC**	**G**	**Ivg**	**CP**	**MS**
Harvest (Co)	5470,31**	27,06ns	14,65**	1,32*	0,00000200**
Pruning (P)	2356,22**	65,02*	1,21^{ns}	2,96**	0,00000300**
Tutor (T)	312,69^{ns}	37,82^{ns}	0,98^{ns}	0,27^{ns}	0,00000200**
CoxP	673,41^{ns}	13,96^{ns}	0,31^{ns}	0,32^{ns}	0,00000003^{ns}

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CoxT	456,37^{ns}	7,17^{ns}	0,46^{ns}	0,39^{ns}	0,00000001^{ns}
PxT	968,22*	58,69*	3,47**	0,32^{ns}	0,00000003^{ns}
CoxPxT	340,41^{ns}	8,21^{ns}	0,53^{ns}	0,47^{ns}	0,00000003^{ns}
CV (%)	36,51	3,98	6,53	10,16	16,27

**Significant to 1%; *Significant to 5%; ^{NS}Not significant by the F test ($p < 0.05$).

Table 3: Mean values of first germination count (1st C), germination (G), seedling Length (CP) and seedling dry mass (DM) of *Physalis peruviana*, in function of two types of pruning (with and without desbrota) and four stoning systems (1-Tutoring UEL, 2-tutoring inverted "V" adapted, 3-without tutoring 4-vertical stoning). Londrina-PR, 2018.

	1aC	G	CP	MS
Give				
With	49,65 A	99,32 A	6,38 A	0,0035 A
Without	41,97 B	98,05 B	6,10 B	0,0032 B
Tutoramento				
1	45,70	97,25	6,18	0,0032 B
2	41,90	99,20	6,16	0,0036 A
3	47,95	98,95	6,27	0.0034 From
4	47,70	99,35	6,34	0,0023 B

Averages followed by different letters differ from each other in the columns by the Tukey test at 5% probability.

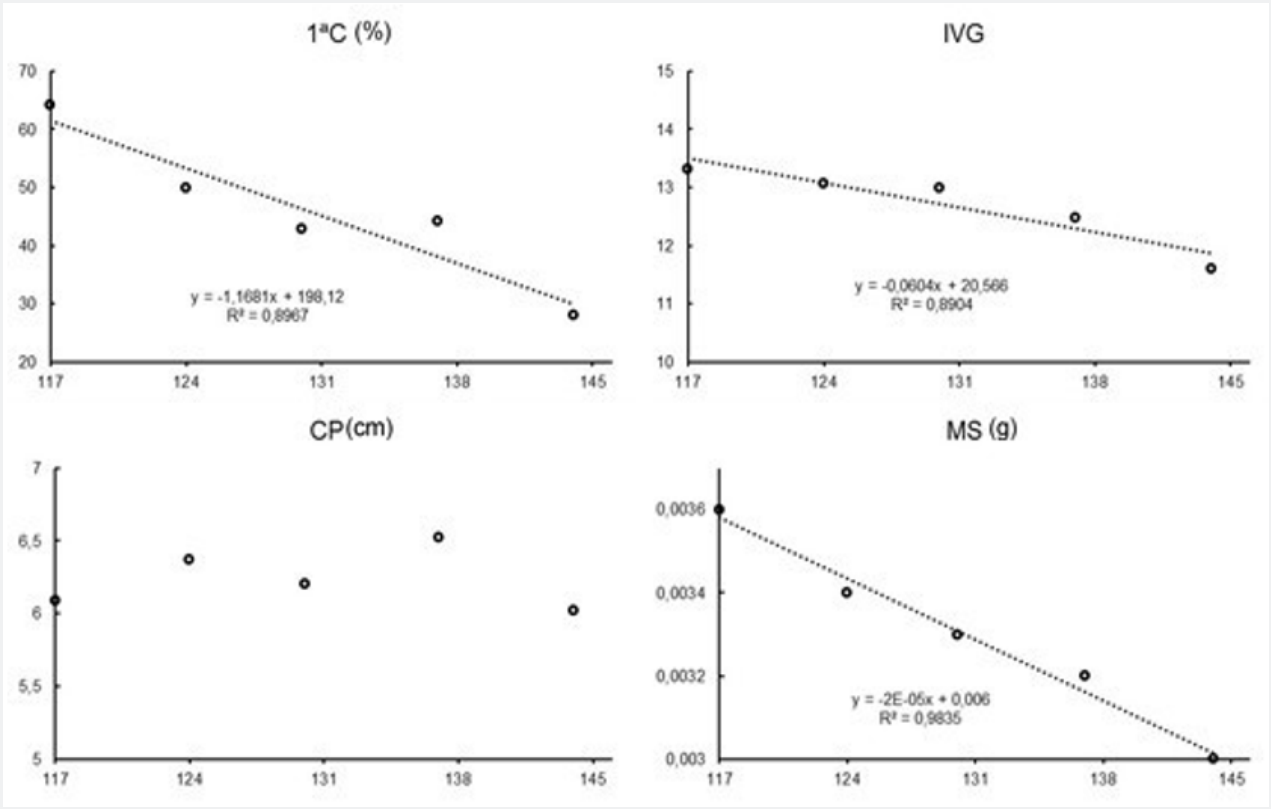

Figure 2: mean values of first germination count (1stC), germination Speed Index (IVG), seedling Length (CP) and seedling dry mass (DM) of *Physalis peruviana*, in function of five harvest Times (Co) (117, 124, 131, 138 and 145 days after transplanting). Londrina-PR, 2018.

These results can be justified because this stoning system provides the plants of Cape gooseberry greater insolation, thus resulting in greater interception of solar radiation and greater ventilation in the canopy, which reduces the humidity Air and renews the concentration of carbonic gas in the atmosphere adjacent to the leaves, enhancing the photosynthetic efficiency [25]. Thus, the favoring of vegetative development, and consequently greater availability of photoassimilates that, directed to the seeds

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increase its vigor. In a study carried out with stoning systems and planting times of the culture of the Cape gooseberry, it was found that the first transplant date of the seedlings (21/11/2007) associated with the inverted "V" stoning systems and Triangular are the most suitable for the planting of Phyalis because they provide better development, production and quality of the fruits [26]. For the harvest factor in isolated form (Figure 2), it was found that the seeds of fruits harvested at 117 days after transplanting (DAT) had higher averages than the other seasons, for the first germination count, germination speed index and Seedling dry Mass. The characteristic seedling length was not adjusted to the polynomial regression model until the second degree.

After this period, the production of new leaves cedes due to the processes of leaf senescence and abscission and the mobilization of photoassimilates present in the leaves and storage organs for the expanding reproductive structures [27], Presenting a decrease in the source and drain ratio which guarantees a lower accumulation of photoassimilates for the reserve organs. Similar results were observed in Cucurbitaceae in relation to the ideal harvest time, in which the best germination and vigor values were obtained when the harvest of the fruits wasreported early in pumpkin [28], in Italian zucchini [29] and, Also, in cucumber [30]. Unsatisfactory effects on seed quality were observed when the late harvest was performed in watermelon, due to the posabledeterioration of the fruits [31].

In contrast to the variables of first germination count and speed index of germination, in the interaction between pruning factors and stoning systems (Table 4), freely conducted plants (tutoring 3) without Desbrota, presented Averages lower than the others. The change in plant architecture with stoning systems facilitates management and promotes better aeration and light penetration in the canopy [32]. This performance can cause a direct effect of seed vigor on the efficiency of the tissues of the phyalic plants in converting solar radiation into dry matter during the growth period. The low conversion may be a result of low light penetration in plants, affecting the chlorophyll content and, consequently, reducing the efficiency in the conversion of solar radiation into chemical energy, which, in turn, influences the translocation of fo assimilated [33,34]. Also in the interaction of pruning factors and stoning systems, the variables of first count of germination, germination and germination speed index, showed lower averages in plants that were desbroted in the UEL conduction system (Tutoring 1) (Table 4) compared to the others. In the first germination count, plants with pruning in the adapted and vertical "V" tutoring systems (tutoring 4) did not differ from the others. This stoning system associated with Desbrota, provided the phyalic plants with greater shading due to the transpasse of the tutors in the form of "X", resulting in lower distribution of solar radiation, and thus favoring the growth in Length of the main branches, due to the higher SAP intensity for the higher and illuminated parts of the plant. However, this conduction system associated with the pruning may have negatively compromised the physiological quality of the seeds due to the reduction of leaf area to a level detrimental to its development. The same results wereobserved in a study carried out with physiological quality of chili (*capsicum annuum* L.) seeds associated with pruning, dead cover and location of the fruit in the plant, which evidenced that the vigor Of the seeds was higher in the treatments without pruning in relation to the podice [35].

Table 4: Mean values of the interaction between pruning factors (P) (with and without desbrota) and stoning (T) (1-Tutoring UEL, 2-tutoring "V" inverted adapted, 3-without tutoring 4-vertical tutoring) for the variables of first germination count (1st C), germination (G) and germination Velocity index (IVG). Londrina-PR, 2018.

1aC				
P x T	1	2	3	4
With	44.00 Ab	46,30 Aab	58,10 Aa	50,20 Aab
Without	47,40 Aa	37,50 Aa	37,80 Ba	45,20 Aa
G				
P x T	1	2	3	4
With	94,80 Bb	99,20 Aa	99,00 Aa	99,20 Aa
Without	99,70 Aa	99,20 Aa	98,90 Aa	99,50 Aa
Ivg				
P x T	1	2	3	4
With	12,17 Bb	12,99 Aa	12,90 Aa	13,02 Aa
Without	12,87 Aa	12,48 Aa	12,32 Ba	12,74 Aa

Averages followed by distinct capital letters differ from each other in the columns and averages followed by different lowercase letters differ from each other in the lines by the Tukey test at 5% probability.

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Conclusions

The Desbrotte, stoning and harvesting of fruits made at 117 days after transplanting positively influenced the physiological potential of *Physalis peruviana* L. Seeds. Theadapted Inverted V-tutoring showed higher value for seedling dry matter.

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