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ARTICLE

Maturation and germination of *Trichosanthes cucumerina* L. seeds

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ABSTRACT: *Trichosanthes cucumerina* L. (Cucurbitaceae) is a traditional fruit vegetable grown by family farmers in the Amazon. This study aimed to evaluate seed maturation as a function of age and fruit morphological characteristics, and the effect of different temperatures on seed germination of accessions of the species. A completely randomized design was adopted in the maturation study, with five treatments (fruit age: 20, 30, 40, 50, and 60 days after anthesis – DAA) and four replications. Seed quality was evaluated through dry mass, water content, germination, and vigor variables, while the fruits were evaluated for physical characteristics and the number of seeds. A completely randomized design in a 3 (temperatures: 20, 25, and 30 ˚C) x 7 (accessions: PIN I, PIN II, TSA, MAO, UTB, ITA, and IMI) factorial scheme, with four replications was adopted in the study of germination temperatures. Seed quality was evaluated using germination and vigor tests. Seeds reach physiological maturity around 50 DAA. The fruits are partially or completely orange or reddish-orange in color at that time. The temperature of 30 ˚C favored the seed germination process, resulting in a higher percentage and germination rate.

Index terms: Cucurbitaceae, germination temperatures, physiological maturity, seed quality.

RESUMO: *Trichosanthes cucumerina* L. (Cucurbitaceae) é uma hortaliça-fruto tradicional cultivada por agricultores familiares na Amazônia. Neste trabalho, objetivou-se avaliar a maturação de sementes em função da idade e de características morfológicas dos frutos, e o efeito de diferentes temperaturas sobre a germinação de sementes de acessos da espécie. No estudo da maturação, adotou-se delineamento inteiramente casualizado, com cinco tratamentos [idade dos frutos: 20, 30, 40, 50 e 60 dias após a antese (DAA)] e quatro repetições. A qualidade das sementes foi avaliada por meio da massa seca, teor de água, germinação e variáveis de vigor; enquanto os frutos foram avaliados quanto a características físicas e número de sementes. No estudo de temperaturas de germinação, o delineamento foi o inteiramente casualizado, em esquema fatorial 3 (temperaturas: 20 °C, 25 °C e 30 °C) x 7 (acessos: PIN I, PIN II, TSA, MAO, UTB, ITA e IMI), com quatro repetições. A qualidade das sementes foi avaliada por meio da germinação e vigor. As sementes atingem a maturidade fisiológica aproximadamente aos 50 DAA. Neste momento, os frutos apresentam coloração parcial ou completamente alaranjada ou laranja-avermelhada. A temperatura de 30 °C favoreceu o processo germinativo das sementes, resultando em maior porcentagem e taxa de germinação.

Termos para indexação: Cucurbitaceae, temperaturas de germinação, maturidade fisiológica, qualidade de sementes.

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INTRODUCTION

Trichosanthes cucumerina L. (Cucurbitaceae) is an underused fruit vegetable popularly known as snake gourd or serpent gourd. The species is native to South and Southeast Asia, with a center of diversity extending across India, Australia (Esquinas-Alcazar and Gulick, 1983), and islands in the Western Pacific, where wild forms are found (Soladoye and Adebisi, 2004). In addition to Asia and Oceania, it is grown in other tropical areas of Africa and South America. In Brazil, it can be found in the states of Paraná, São Paulo, Minas Gerais, Goiás, Pernambuco (Lima, 2020), Pará, and Amazonas.

Trichosanthes cucumerina is propagated by seeds, which are extracted from ripe fruits (Soladoye and Adebisi, 2004). However, even though some fruit morphological characteristics can assist in determining the harvest, no studies have evidenced the relationship between fruit harvest and the physiological maturity of seeds of the species.

Physiological maturity and seed harvest time are different situations: maturation is a process characterized as an organized sequence of several physiological and biochemical events that culminate in physiological maturity, while harvest time is a decision based on technological and economic parameters associated with physiological maturity, production, and quality of seeds (Bareke, 2018).

Harvest of immature vegetable seeds or the unnecessary harvest delay has contributed to the obtaining of low-quality seeds. The longer the time elapsed between the point of maximum physiological quality of seeds (germination and vigor) and the harvest, the more exposed they will be to climate adversities and the incidence of pests and diseases. Thus, the harvest must coincide with, or the closest to, the physiological maturity point of seeds when deterioration is minimal (Dias and Nascimento, 2009). In this sense, studies on the seed maturation process are essential, as the resulting knowledge allows the determination of the moment when the seeds reach the ideal quality and the appropriate time for harvest (Diniz and Novembre, 2019).

In addition to identifying the appropriate harvest time, knowledge of the most favorable conditions for seed germination is also essential for successful crop establishment. The germination process is influenced by factors intrinsic to the seeds (dormancy) and environmental factors (water, temperature, oxygen, and light) (Bareke, 2018). Each species has basic requirements for seed germination and, when there is no dormancy, the temperature is one of the environmental factors that condition the process. Therefore, seeds germinate within a certain temperature range, which varies between species and even between varieties of the same species, in which germination can occur more efficiently, that is, in a shorter period (Souto et al., 2017).

In this context, this research aimed to study seed maturation as a function of age and fruit morphological characteristics, and the effect of different temperatures on seed germination of *Trichosanthes cucumerina* accessions.

MATERIAL AND METHODS

Seed maturation

The study was conducted in the field at the *Universidade Federal do Amazonas* (UFAM) and in the laboratory at the National Institute for Amazonian Research (INPA), in Manaus, Amazonas. The regional climate is Af, that is, a tropical humid or super-humid climate with no dry season, with the following records of monthly averages of total accumulated rainfall, relative air humidity, and minimum, mean, and maximum temperatures during the field experiment: 364 mm, 88%, and 26, 29, and 34 ˚C, respectively (INMET, 2021).

Trichosanthes cucumerina seeds came from the collection of the Sector of Vegetables and Ornamental Plants at UFAM, being sown in 72-cell expanded polystyrene trays, using commercial substrate Vivatto Slim®. The seedlings with two true leaves were transplanted 16 days after sowing, totaling twelve plants.

The cultivation was carried out in a screen house with 30% shading. The plants were staked using the espalier system, aided by a plant tying machine, with a spacing of 1 m between rows and 4 m between plants. Soil tillage was carried out manually using a hoe. Planting fertilization was carried out with 5 $Kg.m^{-2}$ of poultry litter and 300 $g.m^{-2}$ of NPK (4-14-8). Topdressing fertilization was performed seven times by applying 1.7 $g.plant^{-1}$ of N and 0.8 $g.plant^{-1}$ of K_2O in the form of urea (45% N) and potassium chloride (60% K_2O), respectively. The first topdressing fertilization was conducted without potassium, after transplantation; the second one at the beginning of flowering; and the others during fruit development. Irrigation was performed daily, whenever necessary.

The experimental design was completely randomized, with five treatments, represented by the age at fruit harvest at 20, 30, 40, 50, and 60 days after anthesis (DAA). Female flowers were tagged at anthesis during the cultivation cycle, in accordance with the pre-established ages for the treatments. About 20 flowers were tagged at a time using wool yarn, with different colors for each treatment.

Ten fruits were harvested per treatment at the pre-established ages to evaluate their length (cm), equatorial diameter (cm), fresh mass (g), number of seeds, external and internal color of fruits, and external color of seeds. The seeds were manually extracted by cutting the fruit longitudinally, washed in running water on a sieve, and placed to dry on paper towels under laboratory conditions (average temperature of 28 ˚C) for 48 h.

Seed quality was evaluated using the following variables: a) seed water content (%): carried out by the oven method at 105 ± 3 ˚C for 24 h, with two replications of 5 g of seeds per treatment (Brasil, 2009); b) seed dry mass ($mg.seed^{-1}$): determined with two replications of 10 seeds per treatment, using the oven drying method at 105 ± 3 ˚C for 24 h (Brasil, 2009); c) germination (%): four replications of 50 seeds were sown on two sheets and covered by another with germitest paper; the substrate was previously moistened by adding a water volume (mL) equivalent to 2.5 times its weight without hydration (g) (Brasil, 2009). Then, the sheets were rolled up and the rolls were placed in plastic bags; the rolls were distributed, in the vertical position, in a germinator with a controlled temperature of 30 ˚C and a photoperiod of 12 h; the evaluation was performed every two days for up to fourteen days, considering the formation of normal seedlings (Brasil, 2009); d) germination speed index: carried out together with the previous test and calculated from the counts of normal seedlings (Maguire, 1962); e) emergence (%): four replications of 50 seeds were sown at 1.0 cm depth in plastic trays with Vivato Slim® substrate and kept in a greenhouse; the evaluation was carried out every two days for up to fourteen days, and seedlings with hypocotyl elongation above the substrate and expanded cotyledonary leaves were considered emerged since germination is epigeal (Soladoye and Adebisi, 2004); f) emergence speed index: performed together with the previous test and calculated from the counts of emerged seedlings (Maguire, 1962).

Fruit characteristics data were subjected to descriptive statistical analysis. The seed quality data were subjected to regression analysis of variance, accepting the significant adjustment of the highest level up to the third degree at 1% probability by the F-test.

Seed germination temperatures

The accession seeds came from cultivation in the open field, conducted at the Experimental Farm of UFAM, located at km 38 of BR 174, in Manaus, Amazonas. The regional climate is Af, that is, a tropical humid or super-humid climate without a dry season, with the following records of monthly averages of total accumulated rainfall, relative humidity, and minimum, mean, and maximum temperatures: 283 mm, 81%, and 22.5, 25.5, and 30 ˚C, respectively (INMET, 2021).

The following accessions were used, according to their origin: PIN-I (Parintins/AM), PIN-II (Parintins/AM), TSA (Terra Santa/PA), MAO (Manaus/AM), UTB (Urucurituba/AM), ITA (Itacoatiara/AM), and IMI (Ilha da Marchantaria – Iranduba/AM). The fruits of each accession were harvested separately at the ripe stage (orange or reddish-orange epicarp). Seed extraction was manual by cutting the fruits using a knife. Then, the seeds were washed in running water over a sieve and dried on newsprint paper in a covered and ventilated place for 72 h. The seeds were packed in plastic bottles and stored in a refrigerator at a temperature of 5–8 ˚C for five months before the experiment was set up.

The experiment was carried out in the Laboratory of Seeds at INPA in a completely randomized design under a 3 (germination temperatures) x 7 (*Trichosanthes cucumerina* accessions) factorial scheme, with four replications of 50 seeds each. Sowing was carried out as in the germination test of the previous experiment. Subsequently, the rolls were distributed, in the vertical position, in germinators with constant temperatures of 20, 25, and 30 ˚C and a photoperiod of 12 h.

Germination was evaluated every three days, starting at five days after sowing and ending at 14 days after sowing, as prescribed for *Citrullus lanatus* seeds (Brasil, 2009), also from the family Cucurbitaceae. Germination corresponded to the percentage of normal seedlings on the last day of evaluation, according to Brasil (2009). Finally, abnormal seedlings (%) and non-germinated seeds (%) were counted. The germination speed index was calculated from the normal seedling counts (Maguire, 1962).

The data were subjected to analysis of variance and the means were compared by Tukey's test at a 5% probability. Before the analysis, the percentage values were transformed into √ (x+0.5), with the original data being presented in the results.

RESULTS AND DISCUSSION

Fruit characteristics during maturation

Fruit length showed no great variations at the studied ages, indicating a stabilization at 20 DAA, with approximately 60 cm, with no significant increases from that age onwards (Table 1). This trend was also observed for the equatorial diameter, which was around 3.9 cm (Table 1). These data corroborate the description of Soladoye and Adebisi (2004) and Lima (2020), in which the *Trichosanthes cucumerina* fruit is an oblong, cylindrical, and fusiform berry, often twisted, measuring 30 to 200 cm in length and 2 to 10 cm in diameter.

The fresh mass showed no variation between 20 and 30 DAA (366 g) but showed a marked decrease during fruit maturation (50 DAA) and, mainly, senescence (60 DAA) (Table 1). According to Anwar et al. (2018), the ovary undergoes several cycles of cell division after fertilization, followed by the cell expansion phase, responsible for the significant increase in the volume and mass of fleshy fruits. Physiological and biochemical processes of synthesis and degradation occur during maturation, resulting in changes in the chemical and physical characteristics of fruits. The degradation processes in the senescence surpass those of synthesis, culminating in the death of fruit tissues.

The number of seeds per fruit was practically stable until 50 DAA, with an average of 59 seeds per fruit. However, a reduction of 39.7% was observed at 60 DAA relative to the average of the previous ages (Table 1) related to seed loss due to fruit rotting in the field.

Three distinct phases were observed in the evaluation of the color of the fruit epicarp (Figure 1). The first phase (20, 30, and 40 DAA) showed characteristic coloration of immature fruits (dark green with white stripes more evident at the apex) and without signs of color change. The second phase (50 DAA) showed partial or complete coloration of ripe fruit (orange or reddish-orange). Finally, the fruits were already darkened in the third phase (60 DAA) due to senescence

Table 1. Physical characteristics[1] of *Trichosanthes cucumerina* fruits harvested at 20, 30, 40, 50, and 60 days after anthesis (DAA).

DAA	Length (cm)	Equatorial diameter (cm)	Dry mass (g)	Number of seeds
20	59.9 ± 8.2	3.8 ± 0.3	366.3 ± 70.5	60.4 ± 11.1
30	60.3 ± 6.0	3.7 ± 0.4	366.3 ± 81.7	53.6 ± 11.4
40	58.9 ± 4.1	3.9 ± 0.3	348.9 ± 29.8	60.5 ± 6.1
50	59.1 ± 6.5	4.2 ± 0.3	288.3 ± 48.0	60.6 ± 8.7
60	53.5 ± 10.9	4.1 ± 0.8	91.0 ± 72.0	35.6 ± 15.0

[1]Values represent means ± standard deviations.

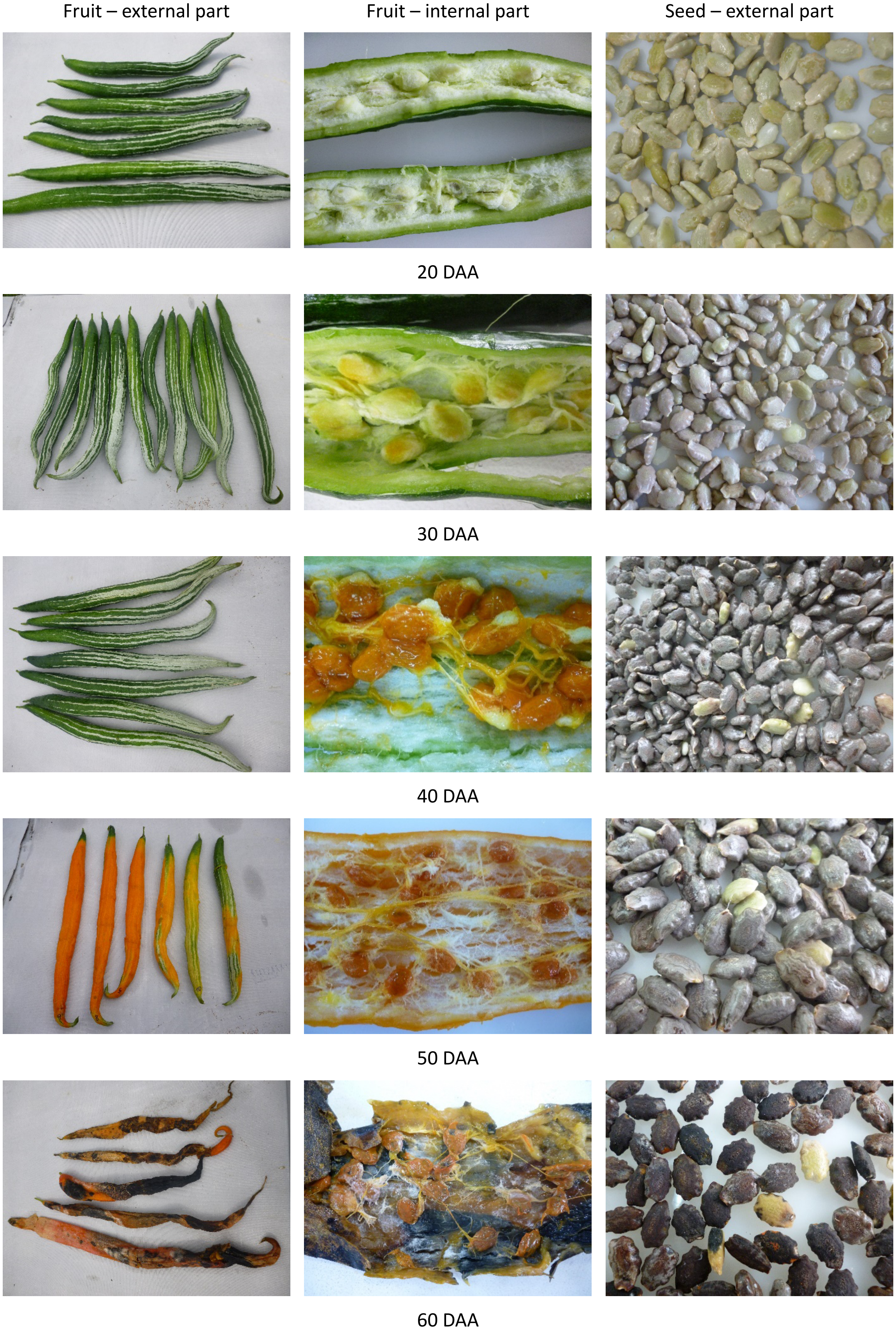

Figure 1. Appearance of the external and internal parts of fruits and external parts of seeds of *Trichosanthes cucumerina* harvested in Manaus, AM, Brazil, at 20, 30, 40, 50, and 60 days after anthesis (DAA).

and the incidence of microorganisms. Importantly, some *Trichosanthes cucumerina* varieties have immature fruits with a white-green color (Soladoye and Adebisi, 2004), white color with green stripes, and greenish, green, or light green with white stripes. Moreover, other varieties present ripe fruits with red (Lima, 2020) or dark red color (Soladoye and Adebisi, 2004).

The internal cavity of fruits presented changes in the color of the placenta (Figure 1), that is, initially white (20 DAA), followed by slightly yellowish (30 DAA), reaching orange (40 DAA), and becoming orange or reddish-orange (50 DAA), corresponding to the same epicarp coloration of ripe fruits. *Trichosanthes cucumerina* varieties whose ripe fruits have a red or dark red epicarp present a red placenta (Soladoye and Adebisi, 2004).

Seeds also showed changes in color (Figure 1) at 20 DAA (beige color), 30 DAA (turned slightly gray), 40 and 50 DAA (turned completely gray), and 60 DAA (darker probably due to senescence and incidence of microorganisms in the fruits). Some *Trichosanthes cucumerina* varieties present grayish-brown seeds in ripe fruits (Soladoye and Adebisi, 2004; Lima, 2020). The placenta could be more easily separated from 50 DAA during seed extraction.

Seed maturation

The results of the water content of *Trichosanthes cucumerina* seeds were fitted to a cubic equation (Figure 2A). The initial water content of 74.5% (20 DAA) decreased continuously until it stabilized from 40 DAA (43.3%), being slightly above the value observed by Silva et al. (2019) in *Cucumis anguria* cv. Liso Gibão (38.2%). According to Dias and Nascimento (2009), seeds contained in fleshy fruits (solanaceous, cucurbits, and others) generally do not undergo a rapid dehydration phase nor do they undergo large fluctuations in their water content due to the relative humidity of the environment. The constitution of the fleshy fruit itself, with a thick pulp, keeps the humidity high inside, as well as reduces the interference of the relative humidity of the air in the water content of the seeds.

Dry mass accumulation of *Trichosanthes cucumerina* seeds showed an inverse trend to that of the water content, fitting a quadratic equation (Figure 2B). Seed dry mass increased as fruit age advanced and reached a maximum value of 2.06 g.seed^{-1} at 52 DAA, representing an increase of 139.5% relative to the seed dry mass in the first fruit harvest (20 DAA), which was 0.86 g.seed^{-1}. Physiological maturity, based on the maximum seed dry mass, should be considered a reference point to characterize the end of seed development and seed physiological independence from the mother plant (Bareke, 2018).

According to Dias and Nascimento (2009), dry mass accumulation occurs slowly after fertilization, as cell divisions predominate, followed by a continuous and rapid increase in the dry mass content until reaching the maximum value, which is maintained for a certain time. Seeds of *Cucumis anguria* cv. Liso Gibão showed the maximum dry mass accumulation at 47 DAA (Silva et al., 2019), while the highest dry mass of *Cucurbita pepo* was observed in seeds from fruits harvested at 49 DAA in the cultivar Caserta (Silva et al., 2017) and 50 DAA in the cultivar F1 Novita (Sanches et al., 2017). *Trichosanthes cucumerina* presented a small reduction in seed dry mass (1.89 g.seed^{-1}) at 60 DAA, possibly due to seed respiration (Silva et al., 2019).

Trichosanthes cucumerina seed germination, fitting a quadratic equation (Figure 2C), increased with increasing fruit harvest age until reaching the maximum value (72.3%) at 46 DAA before the point of maximum dry mass accumulation (Figure 2B). Maximum germination is reached concomitantly or immediately before the seeds reach maximum dry mass content (Dias and Nascimento, 2009) or even later, as observed in *Cucumis anguria* cv. Liso Gibão (Silva et al., 2019). It only occurs in species whose seeds do not have dormancy because the imbalance between growth-promoting and-inhibiting hormones, induced during the period of reserve accumulation, can directly affect seed germination (Bareke, 2018).

Germination in *Trichosanthes cucumerina* decreased after the maximum point and reached the lowest value at 60 DAA (52.0%), probably due to the loss of viability of the seeds that acquired germination potential earlier or the deterioration resulting from fruit rotting in the field, as also observed in *Capsicum baccatum* var. *pendulum* seeds from 74 DAA (Figueiredo et al., 2017). There is also the possibility that the seeds have acquired dormancy at the end of maturation, which may be associated with the seed coat impermeability and chemical inhibitors, that is, the

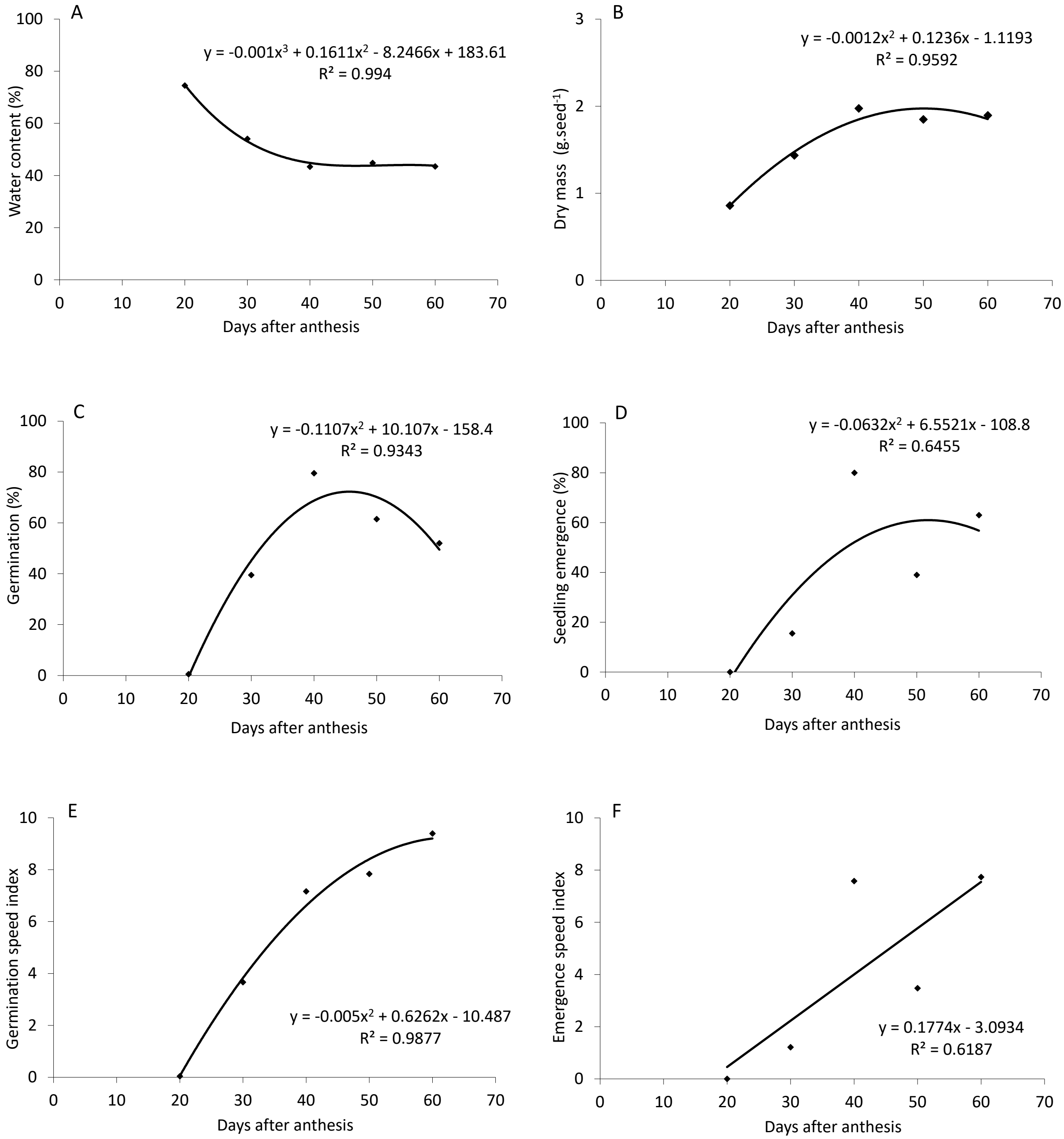

Figure 2. Water content (A), dry mass (B), germination (C), emergence (D), germination speed index (E), and emergence speed index (F) of *Trichosanthes cucumerina* seeds obtained from fruits harvested at 20, 30, 40, 50, and 60 days after anthesis.

prevalence of abscisic acid (ABA) relative to gibberellin (GA), among other factors (Bareke, 2018). Dormancy has been observed in seeds of several cucurbits and may be related to the period of fruit and/or seed maturation (El-Keblawy et al., 2017). Thus, there is a need for further investigations on *Trichosanthes cucumerina* seeds at the advanced stage of maturation to resolve the doubt of whether they enter dormancy or lose viability as a result of fruit deterioration.

The trend of seedling emergence was similar to that of germination, also fitting a quadratic equation (Figure 2D). The maximum value (61.0%) was reached at 52 DAA, coinciding with the point of maximum dry mass accumulation (Figure 2B).

Germination speed values increased with advancing age at fruit harvest, resulting in a quadratic equation (Figure 2E), although without showing the maximum point in the studied period. Likewise, the seedling emergence speed increased with fruit age, fitting a linear model (Figure 2F). Generally, changes in seed vigor occur in parallel with the transfer of reserve nutrients from the mother plant (Bareke, 2018). Seed vigor in *Trichosanthes cucumerina* gradually increased throughout the maturation process, indicating that the seeds were physiologically mature at the end of the evaluated period.

Trichosanthes cucumerina seeds showed higher germination at 46 DAA and higher seedling emergence and mass maturity at 52 DAA. *Cucurbita pepo* cv. Caserta showed maximum values of mass, germination, and vigor at 49 DAA (Silva et al., 2017). The harvest of the cultivar F1 Novita of the same species carried out at 50 DAA was the most suitable for presenting the best results on seed quality (Sanches et al., 2017). On the other hand, *Capsicum baccatum* var. *pendulum* seeds reached maximum mass at 74 DAA, and the physiological maturity of seeds (maximum germination and vigor) occurred between 70 and 81 DAA (Figueiredo et al., 2017). *Physalis peruviana* seeds showed higher germination and vigor when obtained from fruits harvested from 75 DAA and 60 DAA, respectively, after mass maturity (Diniz and Novembre, 2019).

According to Dias and Nascimento (2009), following the evolution of each of these variables related to seed quality at maturation is difficult under field conditions. Therefore, it is important to know other parameters that allow detecting physiological maturity, such as morphological characteristics of the plant, fruits, and/or seeds (Bareke, 2018).

The date or time for the occurrence of the physiological maturity of seeds is also difficult to be fixed in the field because they can present differences for the same species and cultivar due to climate conditions and nutritional status of plants, among other factors (Dias and Nascimento, 2009). However, the number of days after anthesis in *Cucurbita pepo* cv. Caserta, which presents continuous flowering and fruits whose color shows few changes during maturation, can be characterized as the most promising technique to identify the stage of maximum seed quality (Silva et al., 2017).

Trichosanthes cucumerina seeds reached the maximum quality around 50 DAA, when the fruits, placentas, and seeds had the characteristic color of ripe fruits, which can facilitate the identification of the fruit harvest point by farmers. This result supports the Soladoye and Adebisi (2004) recommendation, in which fruits at full maturity should be used for seed extraction.

Seed maturation in many species with fleshy fruits occurs as changes in the color of the fruit epicarp occur. The best time to harvest *Cucumis anguria* cv. Liso Gibão seeds is from 49 to 56 DAA when the fruits are yellowish (Silva et al., 2019). The physiological maturity point of *Lagenaria siceraria* seeds (maximum dry mass content, germination, and vigor) was reached at 100 DAA when the fruits presented a whitish-yellow external color and the plants started senescence (Buzaglo et al., 2019).

Trichosanthes cucumerina plants have an indeterminate growth habit, in which flowering and fruiting occur continuously, generating great unevenness in the maturation stages of fruits and seeds. Thus, the number of days after anthesis and changes in fruit color can be used as parameters in identifying the physiological maturity of seeds and the best time for the fruit harvest. Seeds, when harvested fully mature, are better for sowing and more likely to maintain viability for a longer period of storage.

Seed germination temperatures

The analysis of variance showed a significant interaction effect between the factors germination temperatures and *Trichosanthes cucumerina* accessions for all response variables.

Seeds of all accessions showed a higher percentage of germination at 30 ˚C (Table 2), with a lower value for the accession TSA (48.8%) and a higher value for IMI (82.5%). The percentages of germination varied from 0.0% (ITA) to 32.0% (PIN-II) at 25 ˚C and 2.0% (TSA) to 19.2% (UTB) at 20 °C.

The occurrence of abnormal seedlings was more expressive at temperatures of 20 and 25 ˚C, with the highest values recorded in the accessions ITA (44.2%) and MAO (59.5%), respectively. Moreover, the highest percentages of

Table 2. Germination, abnormal seedlings, non-germinated seeds, and germination speed index of seeds from different accessions of *Trichosanthes cucumerina* submitted to different germination temperatures (GT).[1]

GT	Accessions						
	PIN-I	PIN-II	TSA	MAO	UTB	ITA	IMI
				Germination (%)			
20 °C	3.5 cB	3.0 cB	2.0 cB	7.5 bAB	19.2 bA	5.0 bB	17.3 bA
25 °C	13.2 bBC	32.0 bA	13.5 bABC	6.0 bCD	17.2 bAB	0.0 bD	6.0 cBCD
30 °C	65.8 aAB	59.0 aAB	48.8 aB	65.0 aAB	71.2 aAB	72.0 aAB	82.5 aA
				Abnormal seedlings (%)			
20 °C	24.0 aB	26.8 aAB	24. 5 bB	42.8 aA	27.0 bAB	44.2 aA	24.5 aB
25 °C	31.5 aBC	35.0 aBC	42.5 aABC	59.5 aA	44.5 aAB	33.0 aBC	26.0 aC
30 °C	23.0 aAB	23.2 aAB	34.5 abA	23.5 bAB	14.0 cBC	17.0 bB	7.0 bC
				Non-germinated seeds (%)			
20 °C	72.5 aA	70.2 aAB	73.5 aA	49.7 aC	53.8 aBC	50.8 bC	58.2 aABC
25 °C	55.3 bAB	33.0 bC	44.0 bBC	34.5 bC	38.3 bC	67.0 aA	68.0 aA
30 °C	11.2 cA	17.8 cA	16.7 cA	11.5 cA	14.8 cA	11.0 cA	10.5 bA
				Germination speed index			
20 °C	0.136 bA	0.072 cA	0.046 bA	0.179 bA	0.913 bA	0.117 bA	0.783 bA
25 °C	0.671 bB	2.292 bA	0.634 bB	0.182 bB	0.939 bAB	0.000 bB	0.188 bB
30 °C	7.918 aCD	7.118 aD	5.368 aE	8.689 aBC	9.891 aAB	10.091 aAB	11.187 aA

[1]Means followed by the same lowercase letter in the column and uppercase letter in the row do not differ statistically from each other by Tukey's test at a 5% probability.

non-germinated seeds were obtained at a temperature of 20 ˚C, being above 50% in practically all evaluated accessions.

The germination speed index showed the same trend as the germination results regarding the temperature, that is, the seeds of all accessions showed significantly higher performance at the temperature of 30 ˚C. The accessions with the highest germination rates were IMI, ITA, and UTB at this temperature.

Seed germination in laboratory tests is carried out under appropriate conditions and allows the assessment of the maximum germination potential of seed lots (Brasil, 2009). The ideal temperature for germination varies between species, and temperature may affect both the percentage and speed of germination; in general, low temperatures tend to decrease the germination rate, while high temperatures tend to increase it (Cândido et al., 2016).

Among all evaluated temperatures, 30 ˚C allowed for determining the maximum germination potential of *Trichosanthes cucumerina* seeds. A temperature of 30 ˚C is recommended when conducting germination tests for other cucurbits, such as in *Citrullus lanatus*, *Luffa acutangula*, *Luffa aegyptiaca*, and *Momordica charantia* (Brasil, 2009). The temperature of 25 ˚C is indicated for germination of *Citrullus lanatus*, *Cucumis anguria*, *Cucumis melo*, *Cucumis sativus*, *Cucurbita argyrosperma*, *Cucurbita maxima*, *Cucurbita moschata*, and *Cucurbita pepo*, while the temperature of 20 ˚C is prescribed in alternating use with 30 ˚C for *Citrullus lanatus*, *Cucumis anguria*, *Cucumis melo*, *Cucumis sativus*, *Cucurbita argyrosperma*, *Cucurbita maxima*, *Cucurbita moschata*, *Cucurbita pepo*, *Lagenaria siceraria*, *Luffa aegyptiaca*, and *Momordica charantia* (Brasil, 2009). The constant temperature of 30 ˚C and the alternating temperature of 20–30 ˚C were the most suitable for *Melothria campestris* seed germination (Cândido et al., 2016).

In contrast, Adebooye et al. (2009) evaluated the effects of temperatures on seedling emergence in two Nigerian accessions of *Trichosanthes cucumerina* and found that emergence occurred in only 1/3 of seeds sown at 20 ˚C, while seeds sown at 25 and 30 ˚C provided emergence of approximately 100%. Thus, these varieties, being local, traditional, or creole, are likely to be adapted to the places where they were developed through plant selection carried out by farmers over time (Fischer et al., 2016).

The accessions of *Trichosanthes cucumerina* presented a difference in the seed germination response at the tested temperatures, indicating that germination and vigor depend on the place of origin and/or the genetic dissimilarity between them, which needs to be further investigated. In general, the accession IMI presented superior physiological quality compared to the others.

CONCLUSIONS

Trichosanthes cucumerina seeds reach physiological maturity around 50 DAA. The fruits are partially or completely orange or reddish-orange in color at this age, which is an indication of the fruit harvest point to obtain high physiological potential seeds.

A difference in seed germination response was observed among the accessions of *Trichosanthes cucumerina* at the tested temperatures. The temperature of 30 ˚C favors the seed germination process, resulting in a higher percentage and germination rate. Thus, this temperature can be recommended in the evaluation of the seed quality of this species.

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