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COMPUTERIZED SYSTEM FOR THE SIZING OF FLORAL INDUCTION IN MANGO (*MANGIFERA INDICA* L.) IN THE SEMIARID OF BRAZIL

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ABSTRACT

We assessed the effectiveness of a computerized system for the planning and execution of floral induction in mango using plant growth regulators and water stress in commercial production areas of the Brazilian semi-arid region. The Microsoft Excel was used to perform the calculations following the methodology applied in northeastern Brazil for floral induction. To assess the efficiency of the computerized system, we compared the simulated and observed values using the "d" concordance index. Also, we applied non-parametric chi-square to compare the crop Evapotranspiration (Etc) found in scientific literature and the numbers simulated with our the system. The results showed a perfect agreement between the data (d = 0.92 and non-significant $\chi 2$). The computerized system allowed a fast and accurate calculation of irrigation blade and floral induction. Thus, our system can aid in irrigation management and floral induction of mango crops.

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INTRODUCTION

The mango tree (*Mangifera indica* L.) stands out as a highly commercial species, comprising a large parcel of the international fruit market, with Brazil accounting for about 5.5% of this production (around 33.5 million tons). The states of Bahia, Pernambuco, and São Paulo are the most significant producers, which together with the other Brazilian states have a harvested area of about 75,000 ha (Scalise *et al.*, 2009). In Brazil, the diversified production system and suitability of climatic conditions favor the production of mangoes year round, which contribute to the conquest of the foreign market beyond the domestic market (Scalise *et al.*, 2009). The diversified system of production comprises the association of plant growth regulators and management practices, such as irrigation and differentiated nutrition, which enable to stagger production and reduce seasonality of supply (Mouco and Albuquerque, 2004). The mango crop has biennial production due to the irregular flowering and fruit fall, causing alternation of yield in all climatic conditions. One or more factors may affect the alternation, such as physiological ripening of branches and climatic circumstances, which directly influence the flowering (Del'Arco Júnior, 2008). In the state of Rio Grande do Norte, the cultivation of the mangoes for exportation has expanded recently, with the primary use of the cultivars Tommy Atkins, Van Dyke, and Haden (Mendonça *et al.*, 2003). This expansion relates to a growth of the area planted with mango

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trees under different soil and climatic conditions (Medeiros *et al.*, 2005). The municipality of Mossoró and the Assú Valley, a region known as Chapada do Apodí, lead the production in the state (Mendonça *et al.*, 2003). Studies confirm the efficiency of the use of technologies already adopted in other regions of Brazil, such as in the state of São Paulo, and recommended these technologies for the Chapada do Apodí (Scalise *et al.*, 2009). Due to the local mango crops have a well-defined productive cycle, when exposed to intense water stress, it is possible to plan its harvest as soon as the flowering is induced (Medeiros *et al.*, 2005). Growth retardants are chemicals that inhibit plant growth hormones.

Among the several growth retardants, the paclobutrazol was the only one that became popular in the tropics, which is sold under the trademark Cultar (Verheij *et al.*, 2006). Paclobutrazol not only inhibits shoot growth but also stimulates flowering. However, its use is preferably limited due to the complex application, providing best results when the product is diluted and applied to the soil near the stem base or in the crown projection. Even so, it is difficult to predict how much of the retardant will reach the roots (Mouco and Albuquerque, 2004). However, a high dose causes deformation of the shoots and inflorescences. Besides, paclobutrazol is persistent, transferring its effects to the following years, hindering the correct dosage for the annual treatments (Verheij *et al.*, 2006). These statements were also evidenced for the fruit producing region of the semi-arid Northeastern region of Brazil (Mouco and Albuquerque, 2004). In tropical semi-arid conditions, the first step in the process of floral induction of the mango tree aims to cease vegetative growth. The plant can be prepared for flowering through irrigation management, restricting water replenishment, and causing the "water stress" of the plant (Fonseca *et al.*, 2005). The method consists in the gradual reduction of the amount of water, aiming at a faster and uniform maturation of the branches. When well conducted and depending on the nutritional state of the plant, the desired effect is reached in 30 to 70 days. However, this method is restricted to production to a certain period of the year (Mouco and Albuquerque, 2004).

In the climatic conditions of Northeast Brazil, the application of paclobutrazol (pbz) on mango tree should be performed when the artificial induction to flowering is in the period of May to August (cooler season of the year), with night and day temperatures, respectively lower than 25°C and 35°C, and when the bud dormancy is programmed for the warmer period with night and daytime temperatures higher than 25 and 35°C, respectively (Mouco and Albuquerque, 2004; Ripardo *et al.*, 2009). The use of paclobutrazol in mango production areas can be quantified by the use of polynomial equations of the 1st and 2nd degrees obtained by the intersection of points of the curves, where the independent variable of the equation (the x-axis) is obtained by the canopy diameter (m) and the dependent variable (the y-axis) is formed by the amount of paclobutrazol to be used per plant ($plant^{-1}$). When the plant is in the development stage between 3.5 and 6.0 years of age is recommended the application of a first-degree polynomial equation, while second-degree polynomial equations should be used for plants over to 6 years (Mouco and Albuquerque, 2004). The objective of this work was to evaluate the efficiency in the use of a computerized system for the planning and execution of floral induction in mango tree using plant growth regulators and water stress of plants in commercial production areas of the Brazilian semi-arid region.

MATERIAL AND METHODS

System overview: We developed a computerized system called SISDI Flora M (Computerized System for the Sizing of Floral Induction in Mango). Windows XP version 2007 and the spreadsheet program "Excel" were used to operationalize the calculations. The methodology is widely disseminated and adopted in commercial areas of the semi-arid region of the Brazilian Northeast for floral induction in mango tree (Mouco and Albuquerque, 2004; Ripardo *et al.*, 2009).

Development of the methodology: We used a database containing the various concentrations of the artificial regulators of plant growth paclobutrazol (pbz), calcium nitrate ($CaNO_3$), potassium nitrate (KNO_3), potassium sulfate (K_2SO_4), etephon and thiourea found in the market. Besides, the database containing a set of information on health, nutrition and, stage of development of plants commonly found in production orchards, distributed in the form of a questionnaire, which helps the operator to systematize the situation found in the field with those available in the system (Figure 1). The amount of pbz content to be applied to the field, the system allows the following two simulation options, according to the plant diameter found in each orchard (diameters staggered every 0.5 m between the diameters 2.0 to 6.0 m): the first adopt quantities available in a linear scale of quantities and the second in a quadratic or parabolic scale of quantities (Mouco and Albuquerque, 2004), respectively, according to equations I and II, and presented in Figure 1.

$$Y_l = X \quad \text{(1)}$$

and

$$Y_p = 0.2433X^2 - 0.4961X + 1.7032 \quad \text{(2)}$$

Where:

Y_l → the amount of pbz to be applied in a linear scale per plant, in grams;
Y_p → the amount of pbz to be applied in a parabolic scale of quantities per plant, in grams;
X → the plant canopy diameter in meters.

We found a coefficient of determination (R^2) of 100% for the linear curve and 99.99% for the parabolic curve, using the graph editor of the Excel. After, the system provides the amount of pbz to be applied per linear meter ($g\ m^{-1}$) and area ($g\ m^{-2}$), using the equations III and IV (Figure 1).

We select the option that best match the local conditions.

$$\underset{i=l}{\overset{p}{Ap}} = \underset{i=l}{\overset{p}{Y}} \div d \quad \text{(3)}$$

and

$$\underset{i=l}{\overset{p}{Ap}} = \underset{i=l}{\overset{p}{Y}} \div \left(\pi \frac{d^2}{4} \right) \quad \text{(4)}$$

Where:

$\underset{i=l}{\overset{p}{Ap}}$ → the amount of pbz to be applied, calculated by the linear (l) and polynomial (p) curves, in $g\ m^{-2}$;

COMPUTERIZED SYSTEM FOR THE SIZING OF FLORAL INDUCTION IN MANGO - SISDIFlora M

Input data for system power:

Scheduled start date for fertilization (d / m / yyyy): Orchard Spacing:

1	5	2015	========> 01/mai/15	←TRANSFORMED	8 x 6

← POWERED BY THE OPERATOR

APPOINTMENT DATA REQUIRED FOR THE SIZE OF INPUTS:

Number of plants per hectare: 208 ; Average diameter per tree canopy (m): **4,0**

Evaluation of the stage of development of plants:

Attention: the evaluation referred to in the previous line should be made, based on field data and opting for an "X" in the box that identifies them.

1) The time of induction of the orchard coincides with the transition period between SUMMER-WINTER of the region (period of occurrence of greater thermal amplitudes). [ ]
2) The season of induction of the orchard coincides with the hottest periods of the year with occurrence of night / day temperatures above 25^0C / 35^0C respectively or periods of shorter thermal amplitudes in the region. [**x**]
3) Orchard requires greater care to reduce large plant incidences vegetating (improving K/N ratio and increasing capohydrate content). [**x**]
4) Orchard requires the use of Ethrel (Etefon) in the process of floral induction. [**x**]
5) Orchard requires the use of Thiourea (Dithiocarbamide) in the process of floral inductior [**x**]

Plot Size: **1,00** ha

Table A- Characteristics of the inputs used in Floral Induction.

INPUT	Chemical formula	Commercial name	Concentration
1 - calcium nitrate	$CaNO_3$	Calcium nitrate	**100,00%**
2 - potassium nitrate	KNO_3	Potassium nitrate	**100,00%**
3 - potassium sulphate	K_2SO_4	Potassium sulphate	**100,00%**
4 - Paclobutrazol	-	PBZ	**25,00%**
5 - ethrel	-	Ethrel	**15,00%**
6 - Thiourea	-	Thiourea	**100,00%**

Assuming maximum orchard blade (L /month) = 698.400

INDEX OF CHOICE: [4] Orchard age (years): **12**

Table B- Dosage recommendation of Paclobutrazol

Diameter of tree canopy (m)	Doses governed by a linear system				Doses governed by a parabolic system			
	Área (m^2)	PBZ (gr)	PBZ (gr/m linear)	PBZ (gr/m^2)	Área (m^2)	PBZ (gr)	PBZ (gr/m linear)	PBZ (gr/m^2)
2,00	3,14	2,00	1,00	0,64	3,14	1,65	0,83	0,53
2,25	3,98	2,25	1,00	0,57	3,98	1,80	0,80	0,45
2,50	4,91	2,50	1,00	0,51	4,91	2,00	0,80	0,41
2,75	5,94	2,75	1,00	0,46	5,94	2,20	0,80	0,37
3,00	7,07	3,00	1,00	0,42	7,07	2,45	0,82	0,35
3,25	8,30	3,25	1,00	0,39	8,30	2,70	0,83	0,33
3,50	9,62	3,50	1,00	0,36	9,62	2,90	0,83	0,30
3,75	11,04	3,75	1,00	0,34	11,04	3,20	0,85	0,29
4,00	12,57	4,00	1,00	0,32	12,57	3,60	0,90	0,29
4,25	14,19	4,25	1,00	0,30	14,19	4,00	0,94	0,28
4,50	15,90	4,50	1,00	0,28	15,90	4,45	0,99	0,28
4,75	17,72	4,75	1,00	0,27	17,72	4,90	1,03	0,28
5,00	19,64	5,00	1,00	0,25	19,64	5,35	1,07	0,27
5,25	21,65	5,25	1,00	0,24	21,65	5,80	1,10	0,27
5,50	23,76	5,50	1,00	0,23	23,76	6,30	1,15	0,27
5,75	25,97	5,75	1,00	0,22	25,97	6,80	1,18	0,26
6,00	28,27	6,00	1,00	0,21	28,27	7,35	1,23	0,26
6,25	30,68	6,25	1,00	0,20	30,68	8,10	1,30	0,26
6,50	33,18	6,50	1,00	0,20	33,18	8,90	1,37	0,27

For the case of the PBZ (Paclobutrazol) doses of the floral induction process to be determined by of a parabolic system of equations one must mark an "**X**" in the picture to the side. [**x**]

Figure 1. Questionnaire with input data and database for feeding SISDIFlora M. 2015

$\overset{p}{\underset{i=l}{Y}}$ → the amount of pbz to be applied, calculated by the linear (l) and polynomial (p) curves, in g;

π → the dimensionless constant for circular areas;

d → the plant canopy diameter in meters.

For the determination of the recommended water stress blade, we choose the initial induction date (Figure 1) and then simulate the values of the irrigation blade for the conduction of a mango orchard for five months (the period required to carry out a complete reproductive cycle of the crop).

The values of the crop coefficient (kc) are applied for each phase of the crop reproductive cycle (FAO, 2011) and applied factors of progressive reduction of the necessary irrigation blade followed by the progressive increase to the total water supply to the plant for the period, which in the system can vary from one to five weeks, as recommended in the literature for the culture consulted (Mouco and Albuquerque, 2004; Ripardo *et al*., 2009). After that, the results of the dimensioned water stress are given (figure 2). The values of the irrigation blade simulated for mango tree were obtained according to a study by Paula *et al*. (2011), using local climatological data collected at the Jerônimo Rosado Meteorological Station of the Federal Rural Semiarid University (UFERSA) for the period of 23 consecutive years (from 1978 to 2000) (Table 1) for the period of twelve months (1 year). The values obtained for the evolution of the reference irrigation blade were calculated according to equation V (R^2 = 90.84%).

$$I.D. = -2.113m^3 + 48.681m^2 - 294.61m + 1200.8 \quad \ldots\ldots\ldots\ldots(5)$$

Where:

I.D. → the irrigation blade to supply the reference evapotranspiration of each month of the year for the 23 year survey conducted in $m^3 month^{-1}$;
m → the months used for the study (dimensionless);

All data is simulated on excel functions (mathematical, conditional, search and conditional formatting functions) and are presented together with the results of other substances and suggested management strategies by the system (Figure 2).

Table 1. Annual average climatological data collected at the Meteorological Station of the Federal Rural Semiarid University (UFERSA), Mossoró - RN. 2017

Month	Precipitation (mm)	Number of days ($month^{-1}$)	Evapotranspiration reference value (ET_0)
January	41.6	31	5.68
February	114.6	28	5.34
March	177.1	31	4.62
April	164.1	30	4.43
May	104.2	31	4.28
June	42.9	30	4.27
July	34.3	31	4.48
August	6.4	31	5.31
September	5.1	30	6.23
October	1.5	31	6.72
November	3.1	30	6.56
December	19.3	31	6.08

Source: Paula (2002).

Operating system and its demonstration

The SISDIFlora M operating system was dynamically developed giving the operator the possibility to select one, some or all of the options, from which the stage of conduction of the plants is identified at the time of pre-induction and determines which model fit better to the process, or instead of adopting a single model, a combination of two or more models must be made as they describe situations found in the scientific bibliography adopted for the system (Mouco and Albuquerque, 2004; Ripardo *et al*., 2009). After choosing the methodology, the system interacts with the database, dimensioning the amounts of paclobutrazol (pbz) and other substances components of the induction, their respective distribution in the various dosages throughout the induction process and shows the results through of "reports" (Figure 3). The values of paclobutrazol (pbz) found by Mendonça *et al*. (2001), Lucena (2006) and Silva (2006) for floral induction in mango under climatic conditions of the semi-arid region were used to compare with simulated values and validate the system. To measure the efficiency, the concordance index "d" (Willmott *et al*., 1985) was used between the values obtained and the simulated values. The efficiency of the values found by the system for cultural evapotranspiration (Etc) and water replenishment blade was compared with the recommendations of Bassoi *et al*. (2004). The Kc values found by Bassoi *et al*. for flowering, fruit formation, fruit drop, and fruit maturation were respectively 0.44, 083, 0.65 and 084. We used the chi-square test (χ^2) at 1% and 5% of probability to verify the difference between ETc and the expected values. The results provided by simulations were used to test in an experiment. We use the tool Cultar to monitor the use of paclobutrazol and other substances (CaNO3, KNO3, K2SO4, Etefon and, Thiourea) at commercial concentrations. The experiment was performed in an orchard of 1 ha, located in the Paulicéia Farm (geographical coordinates 4º98'S and 37º43'W). The climate of this region is of type BSwh' according to the classification of Köppen, characterized as very hot and dry, with annual average rainfall of 610 mm, mean minimum and maximum temperatures of 29 ºC and 33 ºC, respectively. The orchard under study was implanted at an area of 8 X 6 m. The orchard had 12 years old with a 4m canopy diameter and in a persistent vegetative stage of development. The plants were irrigated by a drip system with 2.3 L h^{-1} of flow rate drippers. The orchard had no history of the application of pbz from the previous induction and irrigation blade as recommended by FAO (2011) for the phase under study.

RESULTS AND DISCUSSION

Results obtained in the system efficiency test: The agreement index "d" (Willmott *et al*., 1985) (Table 2) was d = 1, which is a good result. A perfect agreement between the efficiency of the system about the parameters tested would result in d = 1, and values of d> 0.7 were still acceptable (Teixeira *et al*. 2005). The result demonstrated the efficiency in the use of the tool to elaborate the dosages of the substances used in the methodology adopted. The results of simulated crop evapotranspiration rates for the period from pre-flowering to the flowering of 50% of plants (from the first application of pbz to May 1 of 2015) varied from 1.88 to 2.34 mm day-1. For the production period (August 6, 2015, to October 1, 2015) the evapotranspiration rates varied from 3.45 to 5.64 mm day-1 (Table 3). These results were like those found by Coelho *et al*. (2008) in the locality of Cruz das Almas (Table 4).

Results obtained in the practical example of system application: The results of the number of days for the stoppage of the vegetative growth (86 days) and to obtain 50% of the flowering (12 days) were like the found by Mendonça *et al*. (2003) for the best treatment tested (1000 mg L^{-1} paclobutrazol 10%). The choice of the period for the induction process (May 1, 2015 to August 21, 2015) and the good development stage of the plants presented in the commercial production area (aspects of nutrition, irrigation and, maturation of leaves) influenced the success of the research. The average minimum (29ºC) and maximum (33ºC) temperatures during the studied period (May 1, 2015, to October 1, 2015) are close to what is recommended in the literature for obtaining the best results (Mouco, and Albuquerque, 2004).

COMPUTERIZED SYSTEM FOR THE SIZING OF FLORAL INDUCTION IN MANGO - SISDIFlora M

DIMENSIONING AND CHRONOGRAM OF IMPLEMENTATION OF FLORAL INDUCTION

Evaluation of the behavior of plants in the pre-induction phase:

Attention: the evaluation referred to in the previous line should be made, based on field data and opting for an "X" in the box that identifies them.

1) This is the 1^0 year PBZ application.	
2) There is a history of use of the PBZ in the area equal to or greater than the 1^0 year	X
3) The plants are presented with compacted vegetation.	

Report of the Technical Recommendations envisaged for the process of induction (THEORETICAL):

DATE	OPERATION TO EXECUTE
01/mai/15	*- Spraying with PBZ:* *Apply Paclobutrazol at the dosage of 1.0g per meter cup diameter.*
29/mai/15	*- Spraying with Potassium Sulphate:* *Do 03 sprays at 2.5% with a 12 day interval from one to another.* *The first 30 days after application of PBZ.*
10/jul/15	*- Spraying with ethrel:* *Do 02 spraying, using a concentration of 0.02%, with a 12 day interval* *from one to another and after 12 days of the last potassium sulphate spray.*
07/ago/15	*- Hydrical stress :* *Gradually reduce irrigation after 80 days of application of PBZ '* *(avoid yellowing and falling leaves) until maturation first flow.*
18/set/15	*- Breaking the numbness:* *Do 06 spraying, intercalating calcium nitrate with potassium nitrate, using concentration* *of 2% and 4% respectively, with an interval of 08 days from one to another.*
21/set/15 e 28/set/15	*- Spray with Thiourea:* *Do 02 spraying of 0.5% Tiurea followed or intercalated with nitrate for the* *the same intervals between spraying with nitrates.*

Assuming that to water the plant is necessary: **5,000** L/plant

Report on the Sizing of Floral Induction:

DATE	OPERATION TO EXECUTE				
	- Spraying with PBZ:				
01/mai/15	To apply : PBZ	3,61 g/plant ;	144,464 mL/plant;	30,10 L/area	
	- Spraying with Potassium Sulphate:				
29/mai/15	To apply : Potassium sulphate	2,50%	125 g/plant	50 kg/tank	
12/jun/15	To apply : Potassium sulphate	2,50%	125 g/plant	50 kg/tank	
26/jun/15	To apply : Potassium sulphate	2,50%	125 g/plant	50 kg/tank	
	- Spraying with ethrel:				
10/jul/15	To apply : Ethrel	0,02%	6,67 mL/plant	2,667 L/tank	
24/jul/15	To apply : Ethrel	0,02%	6,67 mL/plant	2,667 L/tank	
	- Hydrical stress :				
07/ago/15	up until	13/ago/15	Irrigation time (hours): 4	; Irrigation blade (in L/day):	18.810,73
14/ago/15	up until	20/ago/15	Irrigation time (hours): 3	; Irrigation blade (in L/day):	14.282,22
21/ago/15	up until	27/ago/15	Irrigation time (hours): 2	; Irrigation blade (in L/day):	9.753,71
28/ago/15	up until	03/set/15	Irrigation time (hours): 2	; Irrigation blade (in L/day):	9.753,71
04/set/15	up until	10/set/15	Irrigation time (hours): 3	; Irrigation blade (in L/day):	16.176,81
11/set/15	up until	17/set/15	Irrigation time (hours): 4	; Irrigation blade (in L/day):	21.306,05
	- Breaking the numbness:				
18/set/15	To apply : Potassium nitrate	4,00%	200 g/plant	80 kg/tank	
21/set/15	To apply : Thiourea	0,50%	25 g/plant	10 kg/tank	
25/set/15	To apply : Potassium nitrate	4,00%	200 g/plant	80 kg/tank	
28/set/15	To apply : Thiourea	0,50%	25 g/plant	10 kg/tank	
02/out/15	To apply : Potassium nitrate	4,00%	200 g/plant	80 kg/tank	
09/out/15	To apply : Potassium nitrate	4,00%	200 g/plant	80 kg/tank	

Assuming that 01 spray tank has the capacity of: **2000,00 L**

Figure 2. Result of the sizing and timing of the floral induction of SISDIFlora M. 2015

There was a yield of 22.0 ton ha^{-1} in a single crop, which was higher then the average productivity by the Paulicéia farm at 2.5 harvests per year (17.6 ton ha^{-1}) and the average yield indicated by IBGE (2011) in permanent crops in Rio Grande do Norte for the harvest of 2010, which was about 13.1 ton ha^{-1}.

Final discussions of SISDIFlora M: The results showed a high efficiency of the execution of SISDIFlora M in generating reports of the technical recommendations of floral induction (Figure 2 and Table 5) and reports of the sizing of floral induction (Figure 2 and Table 6).

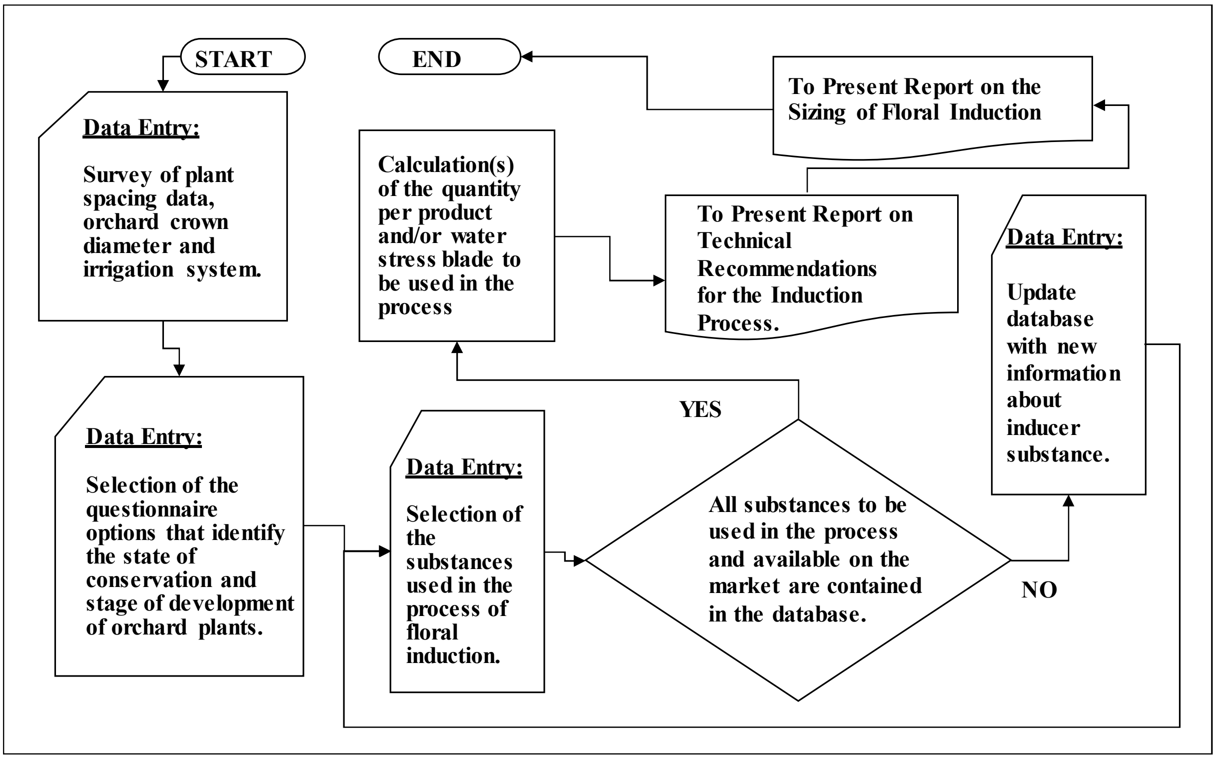

Figure 3. Flowchart of computerized system execution, 2017

Table 2. Data of works developed in the scientific research with mango, used for the validation of the system, and simulated values. Mossoró-RN, 2015

Author	Plant age (years)	Canopy diameter (m)	Adopted spacing in the orchard (m)	Concentration of Paclobutrazol (%)	Dosage of active ingredient applied (g/m)	Dosage of simulated active ingredient in the system (g/m)
Mendonça *et al.* (2001)	5	2.00	10 x 10	10	0.70	0.7
Lucena (2006)	21	4.00	10 x 10	25	0.85	0.7
Silva (2006)	8	3.75	7 x 7	10	0.80	0.8

Table 3. Determination of evapotranspiration coefficient of mango crop cv. Tommy Atkins for a complete reproductive cycle of the plant in the town of Mossoró-RN. 2015

Stage*	Month	Evapotranspiration reference (Et_0) (mm day^{-1})	Date boundary per phase (days)	Cumulative value of Duration per phase (days)	Irrigation time (hs)	k_c**	Evapotranspiration of crop (Etc) (mm day^{-1})	Total irrigation blade required for the period (m^3 ha^{-1})
Pre-flowering	May	4.28	31	-	6	0.44	1.88	583.79
	June	4.27	30	-	6	0.44	1.88	563.64
	July	4.48	24	85	6	0.44	1.97	473.09
Flowering of 50% of plants	July	4.48	31	-	6	0.44	1.97	611.07
	August	5.31	5	12	7	0.44	2.34	116.82
Fruit fall	August	5.31	18	13	11	0.65	3.45	621.27
Fruit development	August	5.31	31	-	14	0.83	4.41	572.95
	September	6.23	7	20	16	0.83	5.17	361.96
Ripeness	September	6.23	30	-	16	0.84	5.23	1.203.64
	October	6.72	1	24	17	0.84	5.64	56.45
			Total:	154				

*- Results from the recommendations of Mouco and Albuquerque (2004) and Silva (2000) for the entire reproductive phase of the plant during the studied period;
** - Coefficient of cultivation of the mango as recommended by Bassoi *et al.* (2004).

Table 4. Results of statistical-test for the evapotranspiration coefficient of the productive period in mango cv. Tommy Atkins in the town of Mossoró - RN. 2015

Type of Values	Minimum	Maximum	□^{2}
Evapotransp. Expected [1]	2.900	5.700	–
Evapotransp. Obtained	3.450	5.640	–
Calculated	–	–	0.109 n.s.
Test value (DF = 1 and 1% of significance)[2]	–	–	6.635
Test value (DF = 1 and 5% of significance)[2]	–	–	3.841

[1] Source: Coelho *et al.* (2008);
[2] Source: Gomes (2009)

Table 5. Report on the Technical Recommendations of Floral Induction. Mossoró, RN, 2015

DATE	OPERATION TO EXECUTE
May 01, 15	- Sprays Apply 70% Paclobutrazol dosage of 0.5g per cup diameter.
May 29, 15	- Spraying with Potassium Sulphide: Two sprays at 2.0% with a 12-day interval from one to another. The first 30 days after application of PBZ.
June 26, 15	- Spraying with etefon: Two spraying, using a concentration of 0.02%, with a 12-day interval from one to another and after 12 days of the last sulpho spray. of potassium.
July 24, 15	- Hydrical stress: Gradually reduce irrigation after 80 days of PBZ application (avoiding yellowing and leaf drop) until maturation of the next flow.
August 07,15	- Breaking the numbness: Six spraying, inserting nit. of calcium with nit. of potassium, using a concentration of 2% and 4% respectively, with an interval of 08 days from one to another.
August 10, 15 and August 17, 15	- Pulverizations with Thiourea: Two sprayings of 0.5% Tiurea followed or intercalated with nitrates therefor intervals between spraying with nitrates.

Table 6. Floral Induction Sizing Report. Mossoró, RN, 2015

DATE	OPERATION TO EXECUTE[1]							
	- Spraying with:		*← Transforming values 01→*			*← Transforming values 02→*		
May 01, 15	Apply: PBZ		1.81	g/tree ;	72.232	mL/tree;	15.05	L/area
	- Spraying with:							
May 29, 15	Apply: Potassium sulphate			2.00%	100	g/tree	40	kg/tank
June 12, 08	Apply: Potassium sulphate			2.00%	100	g/tree	40	kg/tank
	- Spraying with:		*← Transforming values 01→*			*← Transforming values 02→*		
June 26, 15	Apply: Ethrel			0.02%	6.67	mL/tree	2.667	L/tank
July 10, 15	Apply: Ethrel			0.02%	6.67	mL/tree	2.667	L/tank
	- Estresse hídrico :			*←←←← Transforming values →→→→*				
July 24, 15	To	July 30, 15	Irrigation time (h):		2	; Irrigation blade (L/day):		8232.9
July 31,15	To	August 06, 15	Irrigation time (h):		2	; Irrigation blade (L/day):		8232.9
	- Quebra da dormência :		*← Transforming values 01→*			*← Transforming values 02→*		
August 07, 15	Apply: Potassium nitrate			4.00%	200	g/tree	80	kg/tank
August 10, 15	Apply: Thyroid			0.50%	25	g/tree	10	kg/tank
August 14, 15	Apply: Potassium nitrate			4.00%	200	g/tree	80	kg/tank
August 17, 15	Apply: Thyroid			0.50%	25	g/tree	10	kg/tank
August 21, 15	Apply: Potassium nitrate			4.00%	200	g/tree	80	kg/tank

[1] Assuming that to water the plant is required 5.00 L/tree and capacity of the spray tank to 2,000.00 L.

There is a great flexibility in the handling of the computerized tool, which allowed to change one or more stages of the process in the light of the response revealed by the plants during the driving process, availability of products on the market and financial resources available to the producer (Figures 1 and 2 and Tables 5 and 6). This is because SISDIFlora M is a fully operator-controlled tool. It should also be noted that the preparation of the diagnosis, the obtaining of its results and the possible changes were obtained with high speed and precision.

Conclusion

- There was perfect agreement between the dosage of Paclobutrazol obtained in the experiment and dosage simulated by the computerized system;
- The evapotranspiration on the experiment and the evapotranspiration calculated by the computerized system were similar; and
- The use of the developed computerized system allowed to calculate the irrigation blade and the floral induction with speed and precision, serving as a great tool in crop management.

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