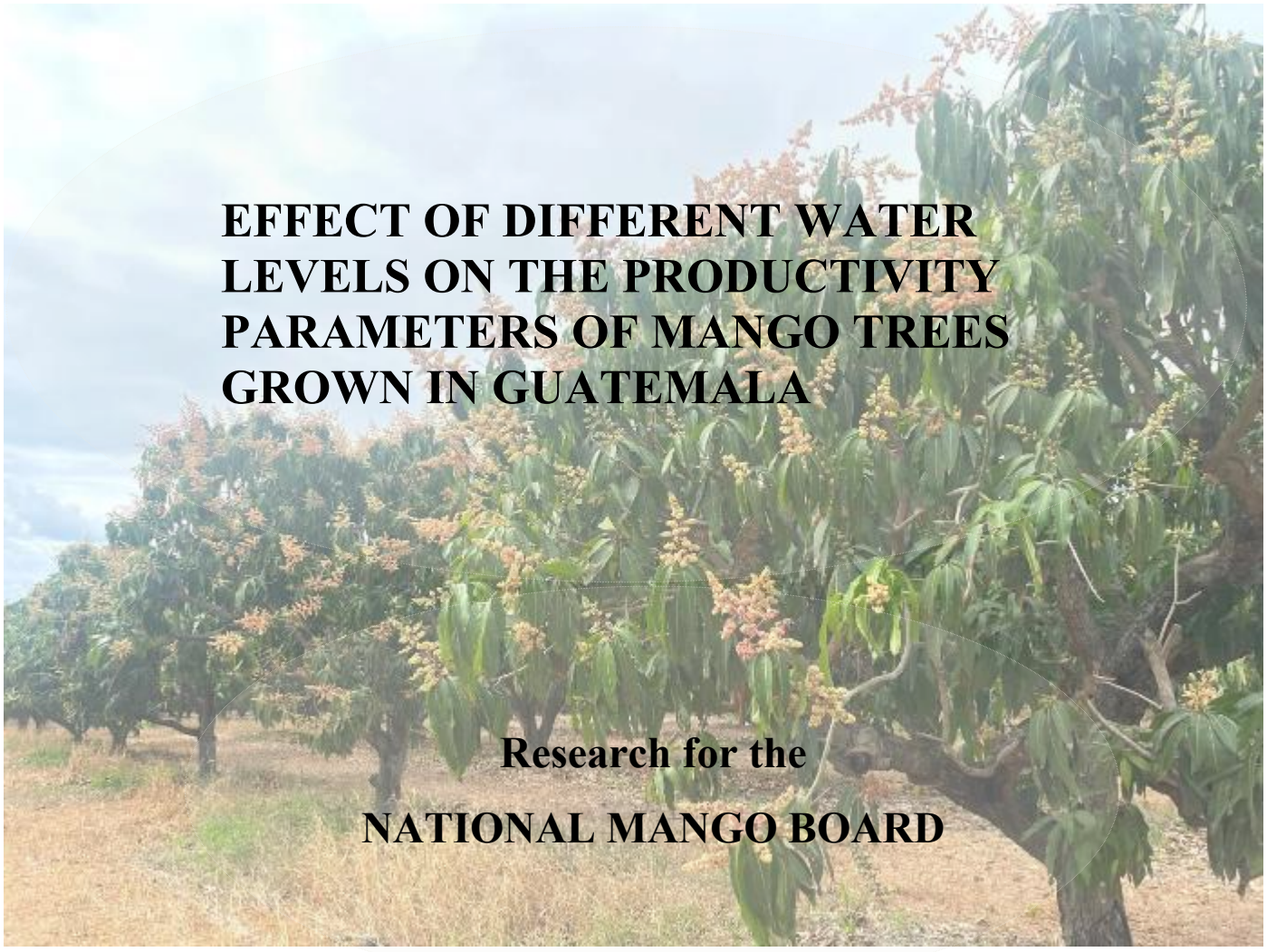
FINAL REPORT:



EFFECT OF DIFFERENT WATER LEVELS ON THE PRODUCTIVITY PARAMETERS OF MANGO TREES GROWN IN GUATEMALA

Research for the

NATIONAL MANGO BOARD

Rudy Cabrera
Researcher

June 2025, Guatemala

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1. INTRODUCTION

Since the end of the last century, mango cultivation in Guatemala has partially overcome the technological barriers of traditional and conventional methods, moving toward more technologically advanced production. This process has involved not only the genetic improvement of mango varieties but also advancements in agronomic management. In addition, post-harvest management, marketing, and the fruit quality standards required by destination markets have been addressed. Despite this, there are still many variables in the crop that must be evaluated, researched, and extrapolated to the various growing regions of the country.

In parallel with plant nutrition, this is complemented by basic knowledge regarding water consumption at the different stages of the crop. Based on this, this research has focused on determining an estimate of water consumption per phenological stage of the crop, which allows us to understand the dynamics of water uptake and consumption during the different growth stages.

Currently, there is a growing technological trend aimed at expanding the agronomic basis of crop management. Technologies have been adopted that are both experimental and proven in other mango-producing regions. These include plant nutrition, plant protection, flowering management, tissue and vegetative growth management, the use of locally resistant rootstocks, and the selection of varieties accepted in foreign markets. In this case, an experiment was conducted using irrigation sheets based on the phenological stage and flowering behavior.

In Guatemala, the main mango-producing regions—especially for the "Tommy Atkins" variety—are Retalhuleu and Zacapa. In these regions, the dry season is well defined and lasts up to six months, often coinciding with flowering. This highlights the importance of proper water management using irrigation schedules that align with the crop's various developmental stages, ensuring subsequent success in producing high-quality commercial fruit for export.

In both locations, the first and second cycles of the research have been completed, focusing primarily on meeting the crop's water needs based on different treatments previously defined in the research protocol. To achieve effective crop management, it is essential to know the amount of water to apply, not only to use this resource more efficiently but also to meet the crop's water demand at the right time—in this case, during the flowering-fruiting stage.

This report presents a summary and analysis of the results from the first (2023–2024) and second (2024–2025) phases of the research, based on providing daily irrigation rates according to the daily evapotranspiration rate.

Table 1. Summary of the research project in Guatemala aimed at evaluating irrigation rates in Tommy Atkins mango plantations in Guatemala.

Research Project:	Effect of Different Water Levels on the Production Parameters of Mango Trees Grown in Guatemala
Lead organization:	National Mango Board -NMB
Partner organization:	Comité de Mango de Guatemala - AGEXPORT
Project duration:	Years 2023–2025
Project implementation phase:	Phase 1 of the 2023–2024 Agricultural Research Program: Completed 2ª Fase de investigación agronómica 2024-2025: Concluida
Type of Consulting:	Agricultural sector: irrigation area
Project Coordinator:	Rudy Cabrera, Irrigation Researcher

The objective of the study was to evaluate different irrigation rates applied according to the phenological stage of mango cultivation by varying crop coefficients (Kc) based on daily evapotranspiration under controlled conditions. The study was conducted at two locations in Guatemala: one on the southern coast (Retalhuleu) and another in the east (Zacapa). The objectives of this study focused on evaluating different daily irrigation rates, assigning a coefficient to each treatment based on the daily evapotranspiration rate. The response variables evaluated were the number of fruits per tree and fruit weight. A completely randomized block design with 5 replicates of 6 treatments each was used for this purpose.

1.1 Reference Framework

The research trial on drip irrigation for the Tommy Atkins mango variety[1]/ was conducted at two locations in Guatemala where most of the plantations are located. One of these is located in the eastern part of Zacapa, and the other in the southern coastal region of Retalhuleu (Figure 1). Furthermore, the locations of the mango research trials are shown on the thematic maps presented in Figures 2, 3, 4, and 5.

[1] / Statistical records from the Guatemalan Mango Committee (AGEXPORT) indicate that nearly 95% of mango plantations and exports consist of the Tommy Atkins variety.

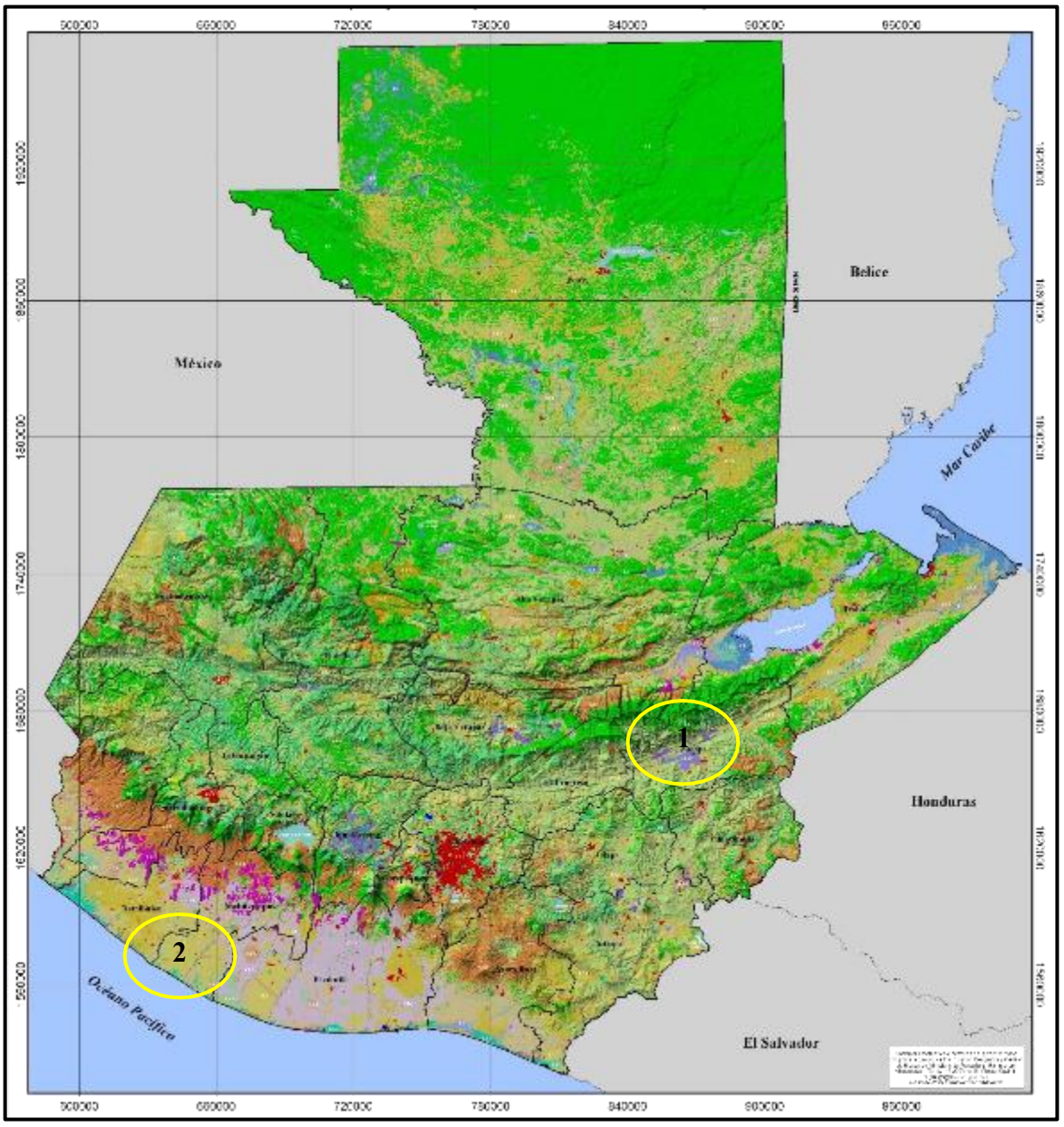

Figure 1. Nationwide locations of the research trials. East Site – Zacapa and South Site – Retalhuleu.

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15°1'0"N
15°0'30"N
15°0'0"N
14°59'30"N
14°59'0"N

RUDY OSBERTO CABRERA CRUZ

East Site
Lat. 14°59'47.80"
Long. 89°35'1608"

RESEARCH
Irrigation sheet demand for Mango Trees at Different Phenological Stages

East Site

Estanzuela, Zacapa

MAP LOCATION

Scale 1: 50,000

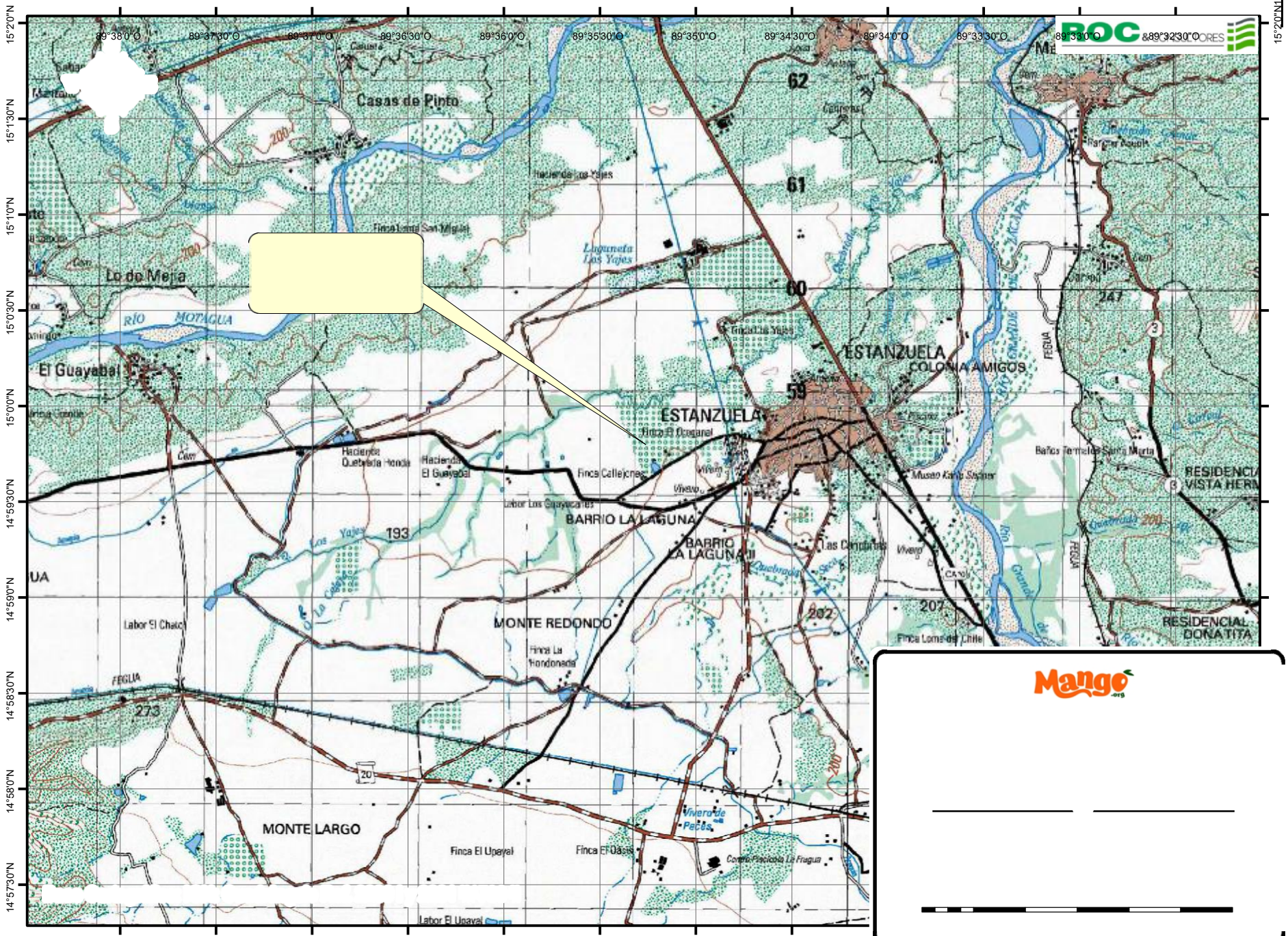
500 250 0 500 1,000 1,500 2,000 2,500

Metros

January 2024

Cartographic Database: IGN: Cuadrángulo Ref. 2260 I y 2261 II1760 II

r.sagastume@gmail.com



r.sagastume@gmail.com

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RUDY OSBERTO CABRERA CRUZ

15°0'30"N
15°0'0"N
14°59'30"N
14°59'0"N
14°58'30"N

East Site
Lat. 14°59'47.80"
Long. 89°35'1608"

RESEARCH
Irrigation sheet demand for Mango at Different Phenological Stages
East Site
Estanzuela, Zacapa

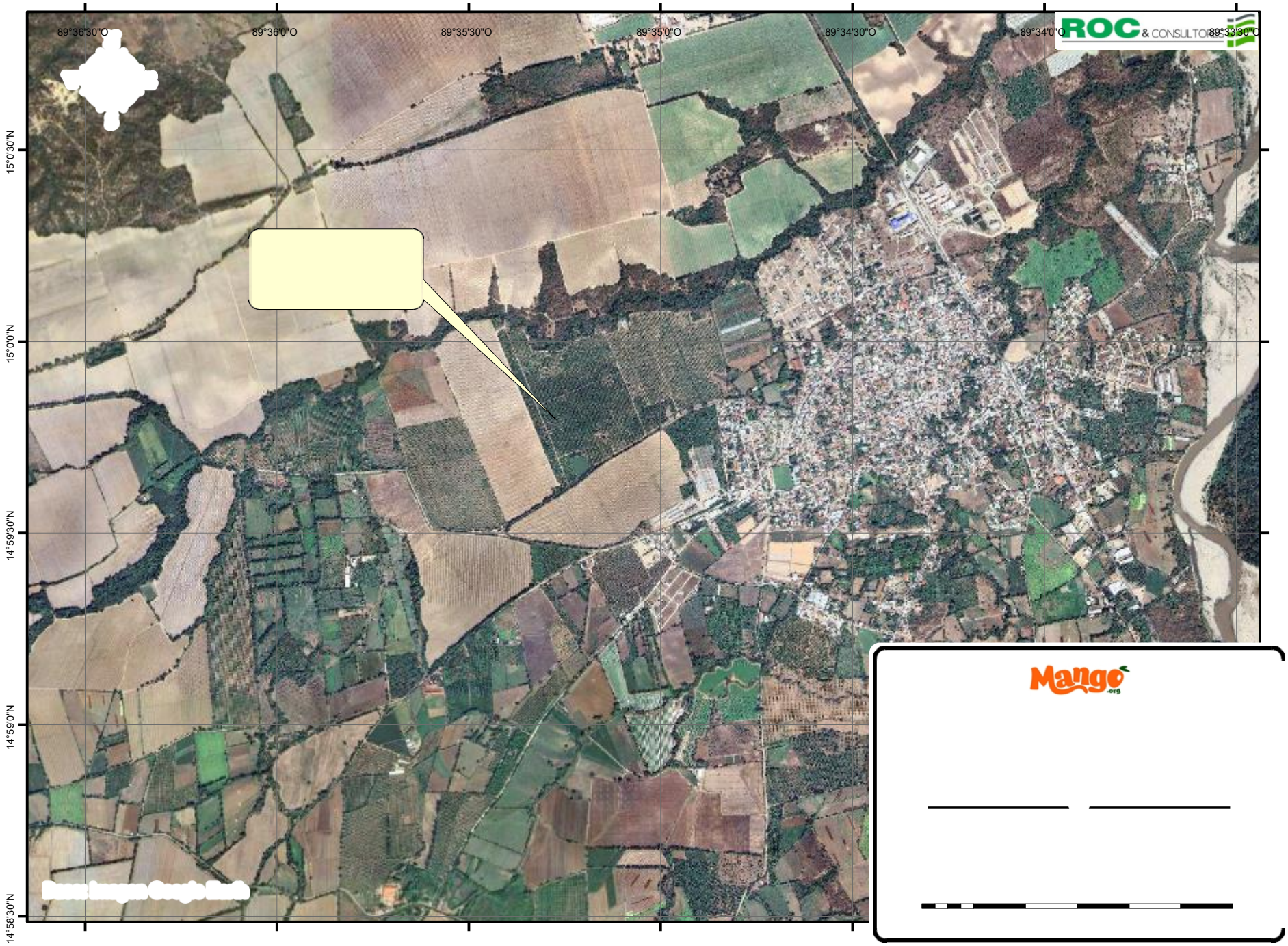
MAP LOCATION

Scale 1: 25,000

250 125 0 250 500 750 1,000 1,250
Metros
January 2024

Base: Imagen Google Earth

r.sagastume@gmail.com



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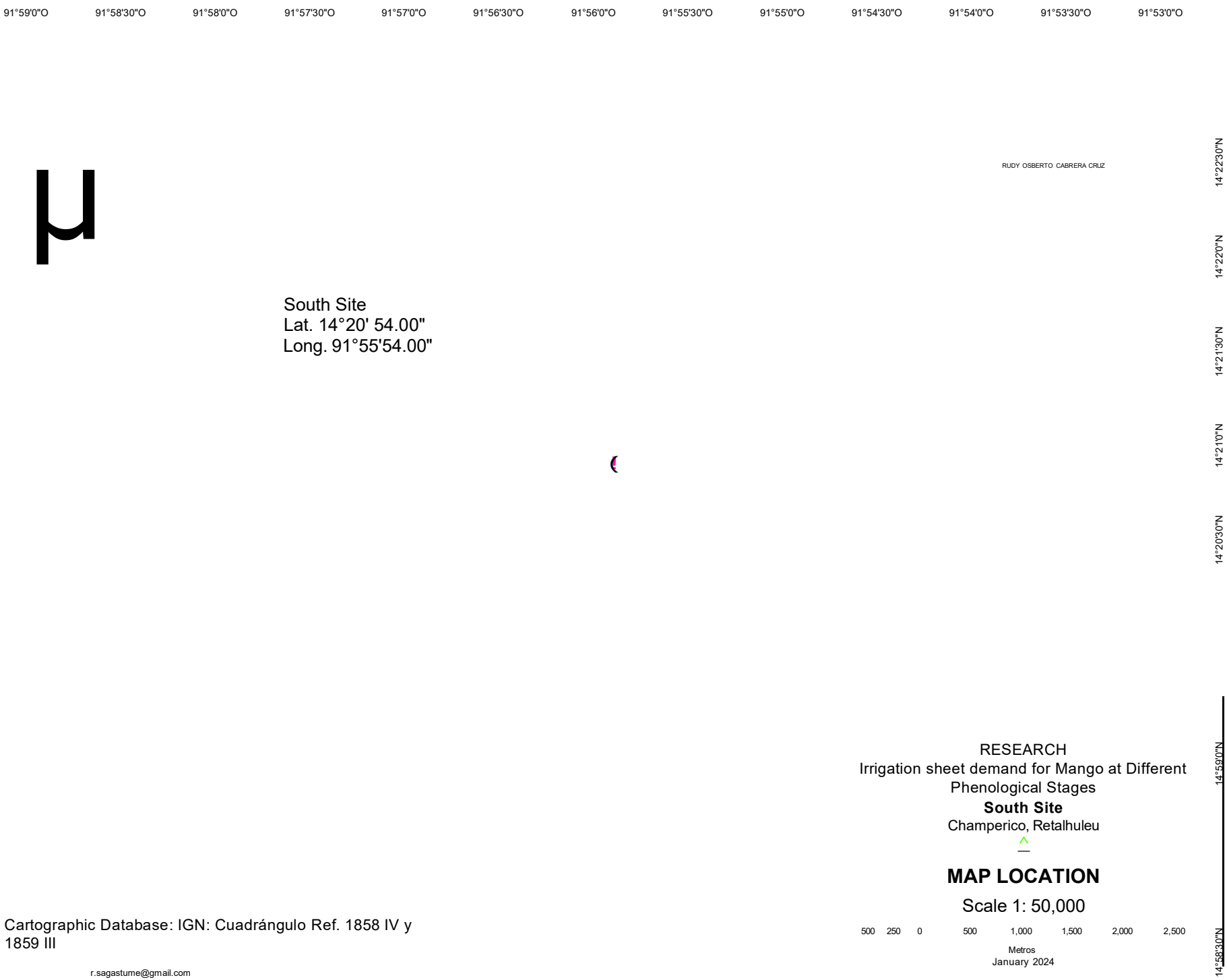
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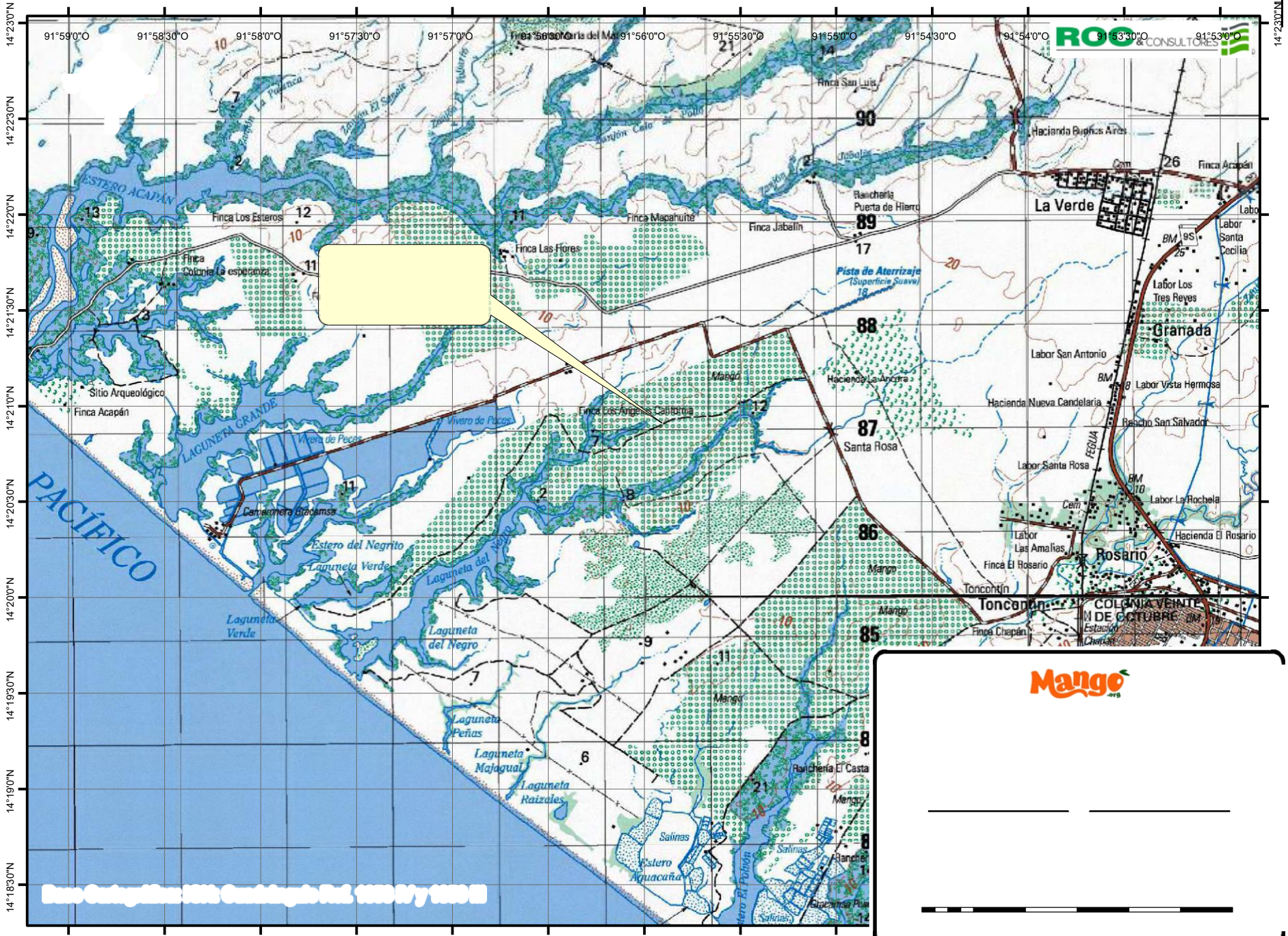
14°20'30"N
14°59'0"N
14°58'30"N
RUDY OSBERTO CABRERA CRUZ
South Site
Lat. 14°20' 54.00"
Long. 91°55'54.00"
RESEARCH
Irrigation sheet demand for Mango at Different Phenological Stages
South Site
Champerico, Retalhuleu
MAP LOCATION
Scale 1: 50,000
500 250 0 500 1,000 1,500 2,000 2,500
Metros
January 2024
Cartographic Database: IGN: Cuadrángulo Ref. 1858 IV y 1859 III
r.sagastume@gmail.com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ROC & CONSULTORES
Finca San Luis
Hacienda Buenos Aires
Finca Arcapán
La Verde
Ranchería Puerta de Hierro
Finca Los Esteros
Finca Mapahuite
Finca Jabalín
Finca Las Flores
Finca Colonia La esperanza
Pista de Aterrizaje
(Superficie Suave)
Granada
Labor San Antonio
Labor Vista Hermosa
Hacienda La Angora
Hacienda Nueva Candelaria
Rancho San Salvador
Sitio Arqueológico
Finca Acapán
Finca Los Angeles Tabloma
Vivero de Peces
Santa Rosa
Labor Santa Rosa
Labor La Rochela
Hacienda El Rosario
Rosario
Finca El Rosario
Toncontín
COLONIA VEINTE DE OCTUBRE
Finca Chapán
Ranchería El Casta
Salinas
Estero Aguacaña
ESTERO ACAPÁN
LAGUNETA GRANDE
PACÍFICO
Laguneta Verde
Laguneta del Negro
Laguneta Peñas
Laguneta Majagual
Laguneta Raizales
Estero del Negrito
Mango
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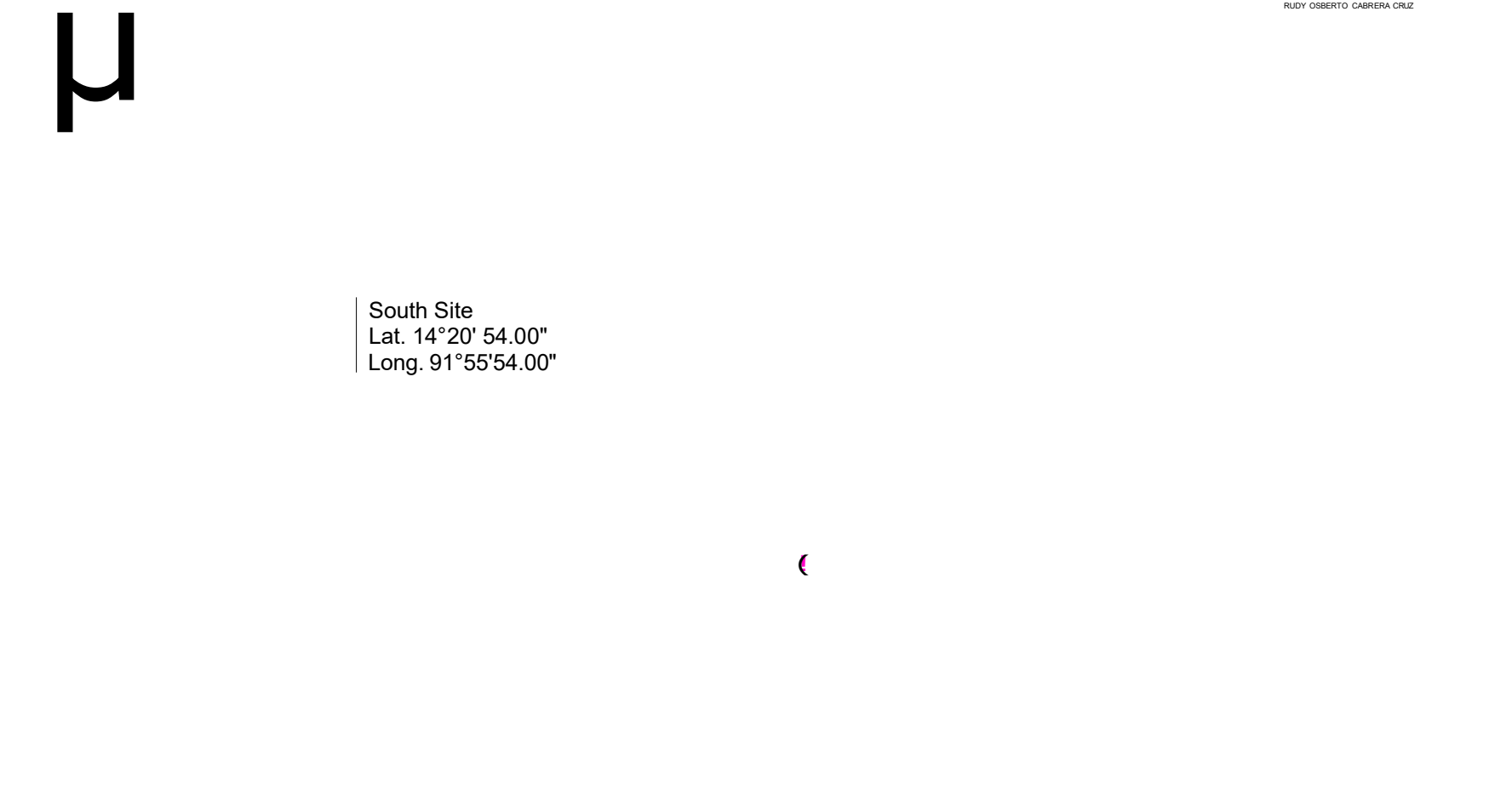

RESEARCH
Irrigation sheet demand for Mango at Different Phenological Stages
South Site
Champerico, Retalhuleu

LOCATION MAP

Scale 1: 25,000

250 125 0 250 500 750 1,000 1,250
Metros

Base: Imagen Google Earth

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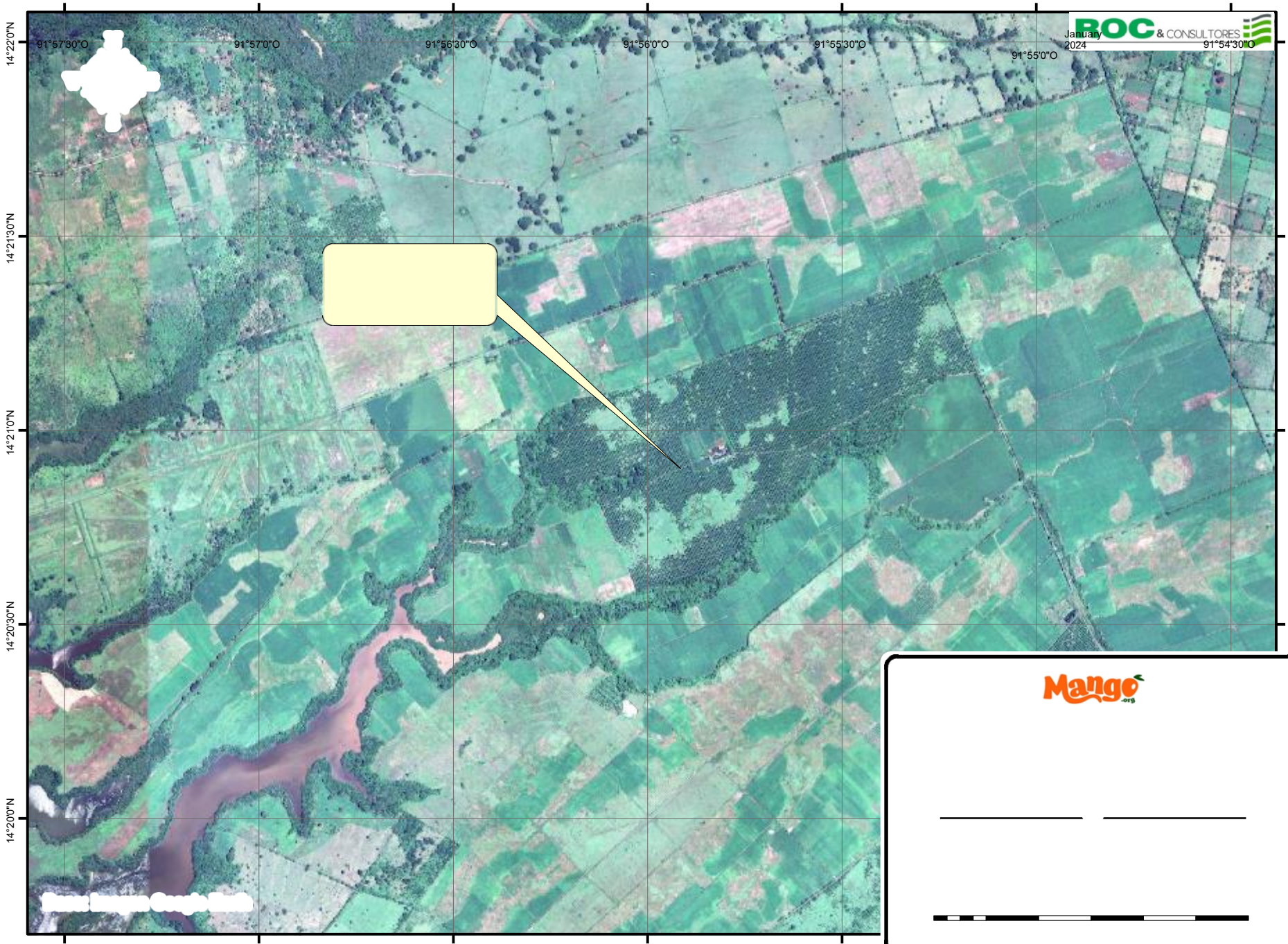

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2. DESCRIPTIVE OUTLINE OF THE RESEARCH

2.1 The Research Trial

Mango plantations in Guatemala are located primarily on the southern coast and in the eastern part of the country. The production facilities established in these areas focus on producing high-quality mangos for export. The organized mango sector in Guatemala, through the Mango Committee affiliated with AGEXPORT, has focused its efforts on all links in the supply chain in collaboration with the international organization National Mango Board (NMB) to ensure and promote export-quality fruit to the United States.

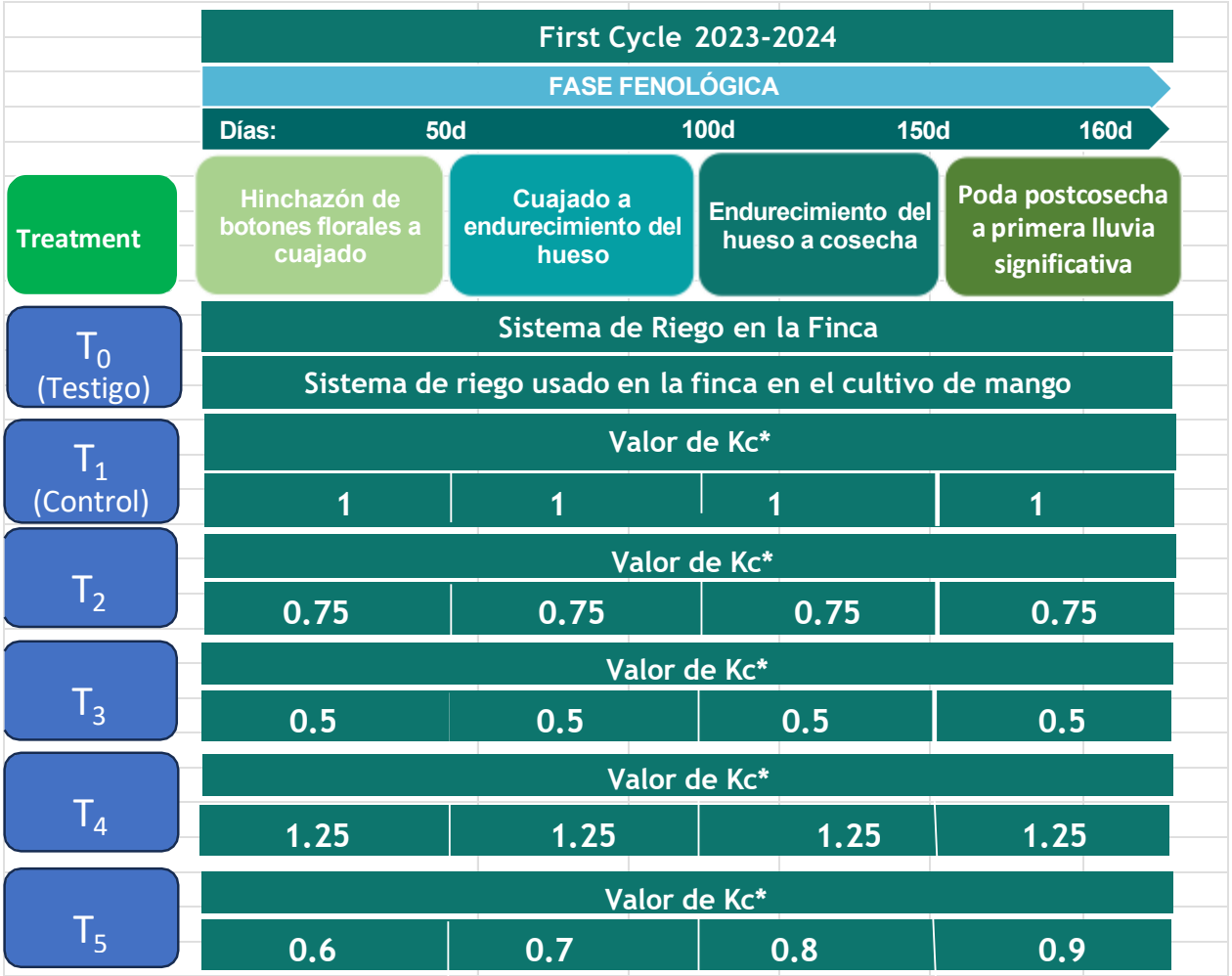
Based on the research objectives, which focused on evaluating the effect of different irrigation rates on the yield of the Tommy Atkins variety of mango (Mangifera indica, L.), two regions of the country and two growing seasons were evaluated (Phase 1: 2023–2024; Phase 2: 2024–2025).

In this case, the aim was to determine whether the application of different irrigation rates based on the phenological stage of flowering-fruiting, taking into account daily evapotranspiration, results in variability in mango production. As a general rule, the same agronomic management was applied to all proposed treatments, subject to local climatic variables. The same treatments were evaluated in both phases, taking into account the individual climatic variables.

The trials at the two locations were designed according to previously defined rules for accepting or rejecting the evaluated variables. In this regard, when evaluating the six irrigation rate treatments, two possible scenarios were anticipated: a variation in mango yield in response to the different treatments, or that all evaluated treatments would behave similarly, with yields showing little variation between the proposed treatments and the control.

In this regard, within the framework of the experimental methodology, the evaluation of 6 treatments with 5 replicates (30 experimental units) was proposed. The approach was based on using a crop coefficient (Kc) at each phenological stage, based on the daily evapotranspiration rate. These rates were applied by observing the phase changes in flowering and fruiting, as shown in Figures 6 and 7.

Due to the uniform agronomic management conditions and the assignment of treatments to experimental units through complete randomization, a completely randomized block design with 6 treatments and 5 replicates was used in the experimental trial. This design provided a total of 289 degrees of freedom for error management in the experiment. It should be noted that the decision to include 5 replicates was made to ensure the statistical analysis could be supported in the event of the loss of any replicate.



*Kc refers to the growth factor based on the phenological stage. The number represents the Kc value to be applied in conjunction with Evto. Daily irrigation is recommended to eliminate the factor related to irrigation frequency.

Figure 6. Distribution of treatments according to the flowering-fruiting phenological stage. Phase 1.

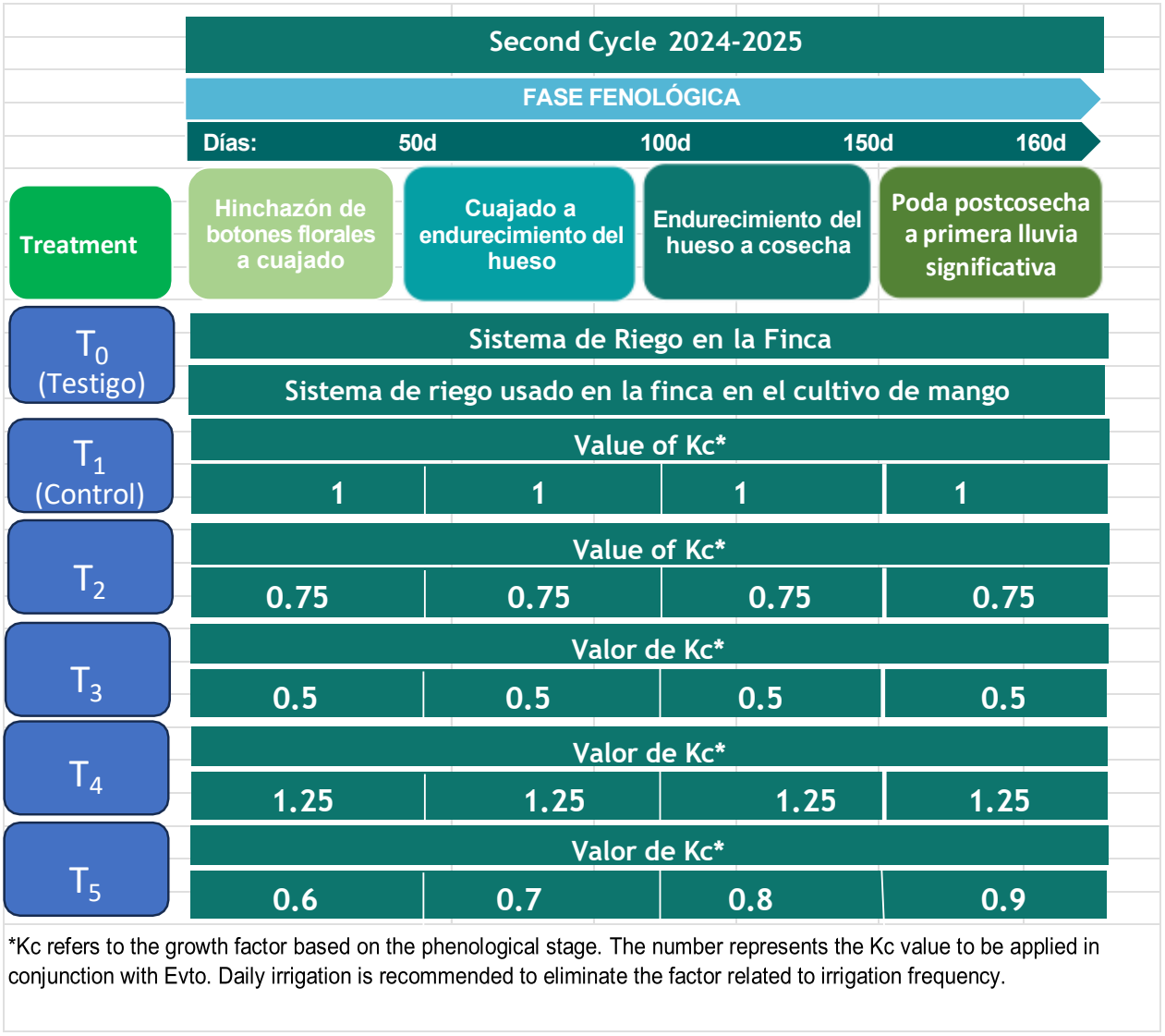


Figure 7. Application of treatments according to the flowering-fruiting phenological stage. Phase 2.

In each of the 30 experimental plots, 5 evaluation trees were included, following the farm's planting layout and the hydraulic design of the irrigation system. The original plan was to collect data from the 3 central trees, treating the two trees on the edges as an edge effect. However, due to the distance between trees (8 m x 7 m), this effect proved to be insignificant. Furthermore, this approach proved impractical during harvesting, so data were collected from all 5 trees. Agronomic management was uniform across both phases of the trial, using the same site and the same experimental layout or arrangement, as shown in Figure 8 and Figure 9.

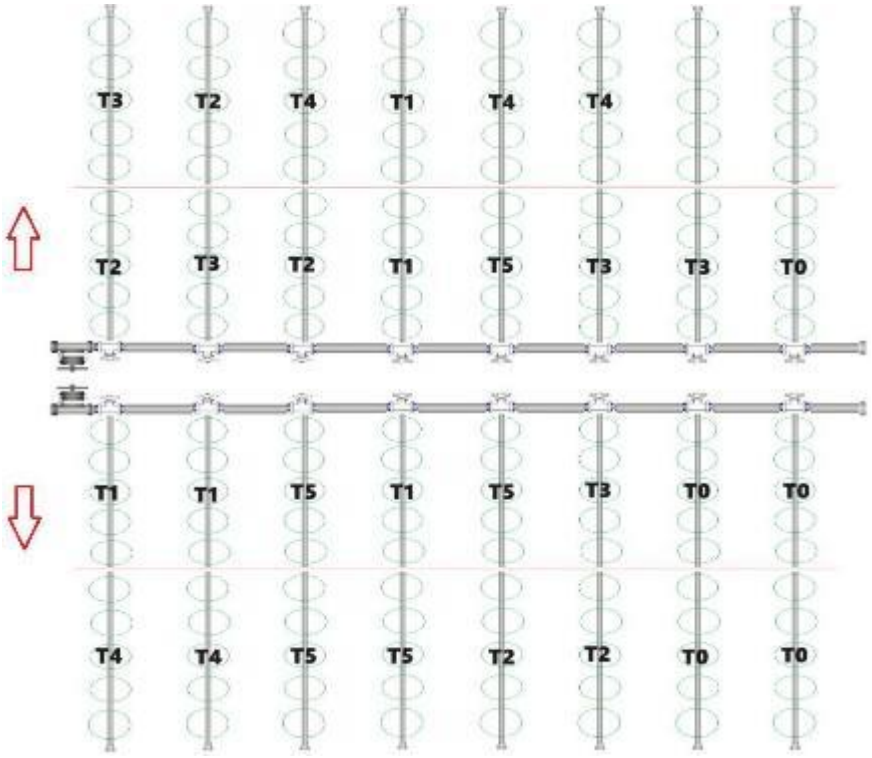


Figure 8. Field treatment layout, experimental design at the East Site in Zacapa.

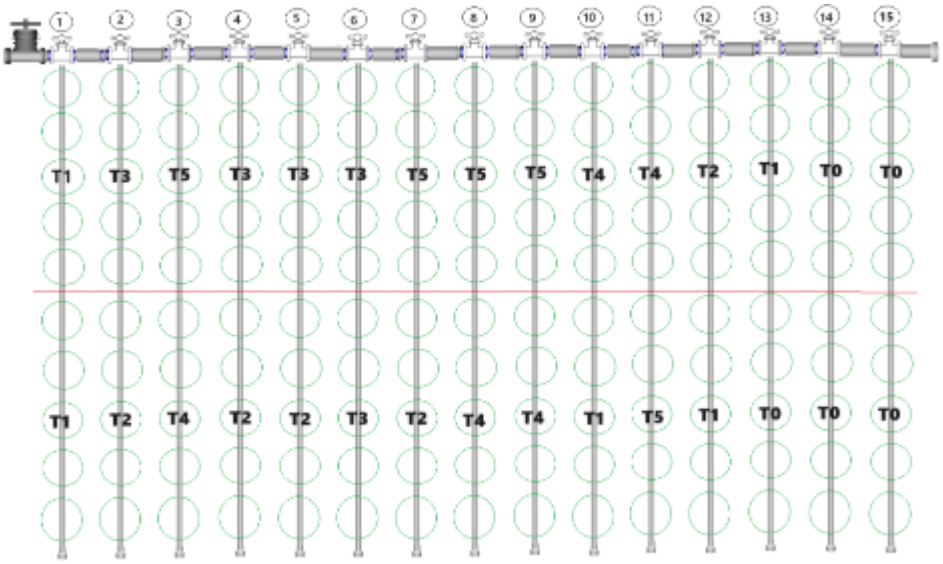


Figure 9. Field treatment layout, experimental design at the South Site – Retalhuleu.

The experiment was designed primarily to meet the crop's water demand based on daily evapotranspiration readings, adjusted according to the Kc value for each treatment and each phenological stage.

Prior to tree flowering, during the vegetative growth of shoots, water application began based on daily evapotranspiration rates in conjunction with the Kc value for each treatment. This was continued systematically every day until the harvest stage.

The operation of the evapotranspiration management and its adjustment, expressed as "daily irrigation time," was based on the development of an application. In this application, the field technician entered the daily evapotranspiration data (either for the current day or the previous day), and the application automatically provided the irrigation time in hours and minutes for each treatment. An example of this application is shown in Figure 10.

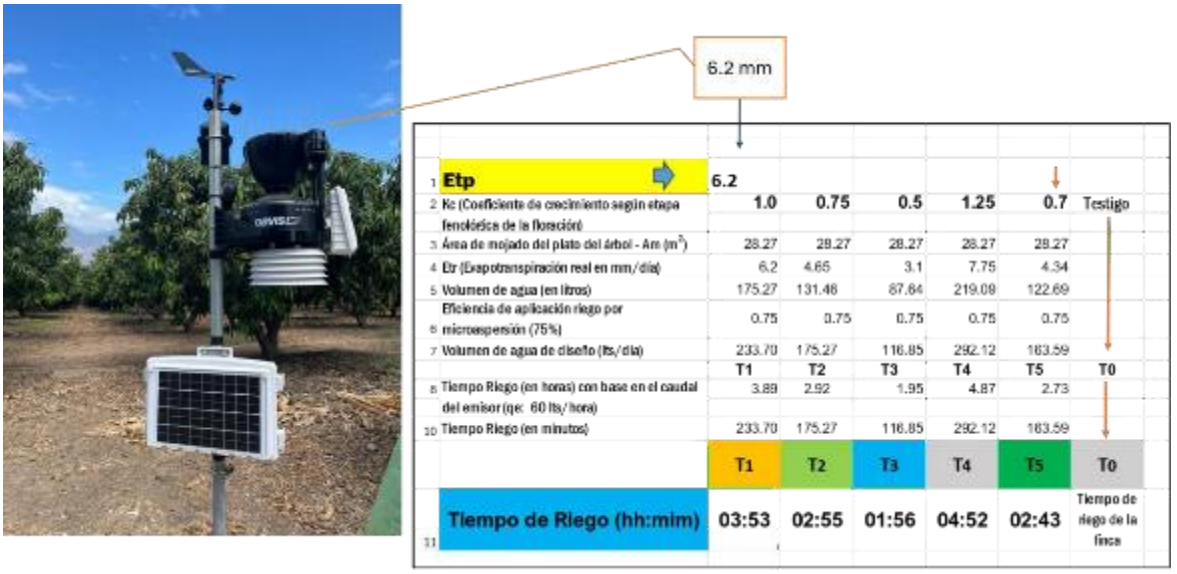


Figure 10. Application developed to calculate daily irrigation times based on irrigation schedules.

2.2 Data collection for the research

a. Response variables:

Yield was used as the response variable, focusing on the number of mangos per tree. These data were used to express production in tons per hectare. The harvest was conducted in two cuts: a first cut, followed approximately 30 days later by a second cut. The experimental trial allowed for data to be collected for each treatment and its respective replicates. Subsequently, the data were organized based on the categories indicated in Table 2.

Experimental design: The trial will use a quantitative approach and a completely randomized block design, with the following statistical-mathematical model:

$$Y_{ij} = \mu + T_i + \varepsilon_{ij}$$

Y_{ij} = response variable of the ij-th experimental unit.

μ = overall mean of the response variable.

T_i = the effect of the i-th treatment (factor level) on the dependent variable.

ε_{ij} = experimental error associated with the i-th experimental unit.

The response variables are as follows:

- Production
  - Number of fruit
  - Fruit weight

Table 2. Characteristics considered in the collection of data by treatment during the evaluation of irrigation patterns for the Tommy Atkins mango variety.

CHARACTERISTIC - SIZE	STATISTICAL EVALUATION
Mangos with low weight	No variance analysis for very large mangos – Not included in the statistical analysis
	Yield of low-weight mangos in tons/ha
Size 14	Mango variance analysis.
Size 12	
Size 10	
Size 9	
Size 8	Mango yield in tons per ton/ha
Size 7	
Size 6	
Mangos with excess weight	No variance analysis for very large mangos
	Yield of mangos with excess weight in tons/ha – Not included in the statistical analysis

b. Hypothesis:

- Ho: Applying irrigation according to treatments based on the mango crop's phenological stages has the same effect on fruit production.

- Ha: At least one of the irrigation methods applied in accordance with the phenological stage of the mango crop will promote fruit production (each method has different effects).

c. Harvest:

Through field visits, pre-harvest sampling was conducted in advance to assess the fruit's stage of development and health status, as well as its weight, size, and shape, and to estimate the harvest date. Subsequently, the harvest was scheduled; it was carried out manually, and the number of fruits per treatment and their weight in grams were recorded, ensuring that each box or basket contained 30 fruits.

Care was taken to ensure that each harvested box was labeled and the record was maintained until it reached the processing plant. There, the operator sorted each box into commercial and non-commercial (reject) sizes. This facilitated data collection and prevented confusion or mixing of fruit between treatments.

d. Statistical Analysis:

Based on the tabulated results, variance analysis was performed for each variable using the Infostat software. Depending on the results, a post-hoc test was conducted using Tukey's criterion with a significance level of 0.05 for those variables that showed statistically significant differences.

e. Results and Discussion:

The systematic consolidation of the results from the experimental trial, during its first and second evaluation phases, made it possible to assess compliance with the objectives and methodology established. The data collected by the plant operator were entered into a spreadsheet and processed for the corresponding statistical analysis.

3. RESULTS OF PHASE 1 (YEAR 1)

The trial was established: the East Site in Zacapa and the South Site in Retalhuleu. systematic consolidation of the experimental trial on the application of irrigation mats in Tommy Atkins at each of the sites yielded the following results, in accordance with the objectives and methodology employed. The following presents the results and their respective discussion corresponding to the first phase or production year (2023–2024). The data are derived from harvests conducted at two sites where the experimental

3.1 Results and Discussion: Phase 1: East Site – Zacapa.

Yield: Yield data are detailed in Table 3 and Figure 11, which show the treatment averages, expressed in tons per hectare. The T1R3 experimental unit stands out as the most productive, with 34.8 tons per hectare. In contrast, the T2R5 treatment was the least productive, with 0.0 tons per hectare. Treatments T2R5 and T3R1 showed significantly low production values, which can be attributed to agronomic management prior to the trial, during which the trees underwent extreme pruning that likely affected their productive capacity during the study.

Table 3. Results obtained in the Phase 1 experimental trial, East Site - Zacapa.

TREATMENT	T1	T1	T1	T1	T1	T2	T2	T2	T2	T2	T3	T3	T3	T3	T3
REPETITION	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5
YIELD PER HECTARE (t/ha)	21.3	20.1	34.8	23.8	16.3	5.1	21.7	2.88	19.6	0	0.26	19.9	14.4	8.4	4.03
TREATMENT	T4	T4	T4	T4	T4	T5	T5	T5	T5	T5	T0	T0	T0	T0	T0
REPETITION	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5
YIELD PER HECTARE (t/ha))	22.3	10.1	1.57	1.62	29.7	27.9	11.1	15.2	2.31	19.1	17.6	14.6	18.3	17.9	19.2

Figure 11. Results obtained in the Phase 1 experimental trial, East Site - Zacapa.

From the field data collection, the statistical analysis did not include a) underweight fruits with low physiological maturity, and b) overweight or overripe fruits. These data for the east site are summarized in Table 4.

Table 4. Data observed in the Phase 1 experimental trial at the East Site – Zacapa regarding underweight and overweight fruits.

EAST SITE - ESTANZUELA, ZACAPA*

FIRST CUT	
UNDERWEIGHT FRUIT (%)	OVERWEIGHT FRUIT (%)
0.09	0.02
SECOND CUT	
UNDERWEIGHT FRUIT (%)	OVERWEIGHT FRUIT (%)
0.07	0.99
INTEGRATED CUT 1o y 2o.	
UNDERWEIGHT FRUIT (%)	OVERWEIGHT FRUIT (%)
0.07	0.99

*/ Season 2023-2024.

Based on the results obtained, a variance analysis (ANOVA) was conducted for the yield variable in the mango crop during the first phase of evaluation, yielding the following results:

VARIANCE ANALYSIS (ANDEVA) EAST SITE - ZACAPA

Variance analysis (ANDEVA) for the First Cut

Variable	N	R^2	R^2 Aj	CV
Weight (g)	290	0.05	0.04	17.99

Variance Analysis Table (SC type III)

F.V.	SC	gl	CM	F	p-value
Treatments	127634.02	5	25526.80	3.19**	0.0081
Error	2274021.50	284	8007.12		
Total	2401655.52	289			

Test:DGC Alfa=0.05 PCALT=37.3522

Error: 8007.1180 gl: 284

Treatment	Averages	n	E.E.	
T0	525.00	50	12.65	A
T1	516.60	50	12.65	A
T5	506.20	50	12.65	A
T3	487.40	50	12.65	B
T4	477.60	50	12.65	B
T2	464.75	40	14.15	B

Means sharing the same letter are not significantly different (p > 0.05)

Based on the results of the variance analysis for the first fruit harvest, the coefficient of variation was initially found to be 17.99%. This indicates that the study was conducted properly, as the acceptable range is between 1% and 20% under uncontrolled conditions (open field). The F-value of 3.19** indicates that the results are statistically significant. Likewise, the p-value of 0.0081 (<0.05) indicates that a multiple comparison test (Tukey's test) should be performed.

The Tukey post-hoc test was performed due to the variance analysis, which revealed some differences. The results indicate that T0, T1, and T5 exhibited statistically similar behavior, so they can be used interchangeably. As a second grouping, T3, T4, and T2 were identified. This indicates that the different sheets applied in each treatment influenced yield, even though they did not result in differences in total production. In this phase, conducting a normality test (Q-Q plot) was not warranted.

VARIANCE ANALYSIS (ANDEVA) EAST SITE - ZACAPA

Variance analysis (ANDEVA) for the Second Cut

Variable	N	R^2	R^2 Aj	CV
Weight (g)	250	0.04	0.02	15.48

Variance Analysis Table (SC type III)

F.V.	SC	glCM	F	p-value	
Treatments	58240.77	5	11648.15	2.21	NS 0.0541
Error	1286928.83	244	5274.30		
Total	1345169.60	249			

Test:DGC Alfa=0.05 PCALT=33.1856

Error: 5274.2985 gl: 244

Treatment	Averages	n	E.E.	
T0	488.80	50	10.27	A
T5	485.25	40	11.48	A
T1	467.60	50	10.27	A
T3	466.33	30	13.26	A
T4	452.20	50	10.27	A
T2	447.67	30	13.26	A

Means sharing the same letter are not significantly different (p > 0.05)

Based on the results of the variance analysis for the second fruit harvest, a coefficient of variation of 15.48% was obtained, indicating that the study was conducted properly, since the acceptable range is between 1% and 20% under uncontrolled conditions (open field). The F-value of 2.21NS indicates that there are no significant differences in the results. This is reflected in the p-value of 0.0541 (<0.05). Nevertheless, a multiple comparison test (Tukey's test) was performed.

The Tukey's test, conducted following the variance analysis, showed no significant differences among the treatments. For this reason, the results indicate that treatments T0, T1, T2, T3, T4, and T5 can be used interchangeably. This indicates that the different irrigation rates applied in each treatment did not influence yield. At this stage, conducting the Q-Q plot normality test was not warranted.

VARIANCE ANALYSIS (ANDEVA) EAST SITE - ZACAPA

Variance analysis (ANDEVA) for the First Cut + the Second Cut

Variable	N	R^2	R^2 Aj	CV
Weight (g)	290	0.20	0.18	20.24

Variance Analysis Table (SC type III)

F.V.	SC	glCM	F	p-value
Treatments	2324948.07	5	464989.61	13.96** <0.0001
Error	9461324.00	284	33314.52	
Total	11786272.07	289		

Test:DGC Alfa=0.05 PCALT=76.1894

Error: 33314.5211 gl: 284

Treatment	Averages	n	E.E.			
T0	1013.80	50	25.81	A		
T1	984.20	50	25.81	A		
T4	929.80	50	25.81		B	
T5	894.40	50	25.81		B	
T2	800.50	40	28.86			C
T3	767.20	50	25.81			C

Means sharing the same letter are not significantly different (p > 0.05)

This analysis combines the first and second fruit harvests. Based on the results generated by the combined variance analysis of the two harvests, the coefficient obtained is 20.24%, which indicates that the second phase of the research was not properly managed, since the acceptable range falls between 1% and 20% under uncontrolled conditions (in the open field). The F-value of 13.96** indicates that the results are statistically significant. Furthermore, the p-value of 0.0001 (<0.05) indicates that a multiple comparison test (Tukey's test) should be performed to highlight differences between treatments.

The Tukey test was performed based on the results of the variance analysis, which showed differences between treatments. The results allowed the treatments to be grouped into three categories: T0 and T1 can be used interchangeably, T4 and T5 can be used as a second option, and T2 and T3 as a third option. This indicates that the different irrigation rates applied in each treatment influenced yield, even though they did not result in differences in total production. At this stage, conducting a Q-Q plot normality test was not warranted.

3.2. Results and Discussion Phase 1: South Site – Retalhuleu

Yield: Yield data are detailed in Table 5 and Figure 12, which show the treatment averages expressed in tons per hectare. The T4R5 experimental unit stands out as the most productive, with 7.1 tons per hectare, while the T1R4 treatment is the least productive, with 0.1 tons per hectare. Table 5 presents data showing generally low yields, which, according to field observations, can be attributed to atypical and irregular flowering, likely caused by annual yield alternation. This situation contributed to the low production.

Table 5. Yields obtained in the Phase 1 experimental trial, South Site - Retalhuleu.

TREATMENT	T1	T1	T1	T1	T1	T2	T2	T2	T2	T2	T3	T3	T3	T3	T3
REPETITION	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5
YIELD PER HECTARE (t/ha))	2.4	3.2	1.1	0.1	3.3	2.1	2.0	4.0	3.7	0.8	2.9	2.7	3.6	3.0	2.2

TREATMENT	T4	T4	T4	T4	T4	T5	T5	T5	T5	T5	T0	T0	T0	T0	T0
REPETITION	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5
YIELD PER HECTARE (t/ha))	2.0	4.0	1.9	3.9	7.1	4.6	5.8	4.5	3.0	2.4	1.4	1.6	1.1	2.2	1.4

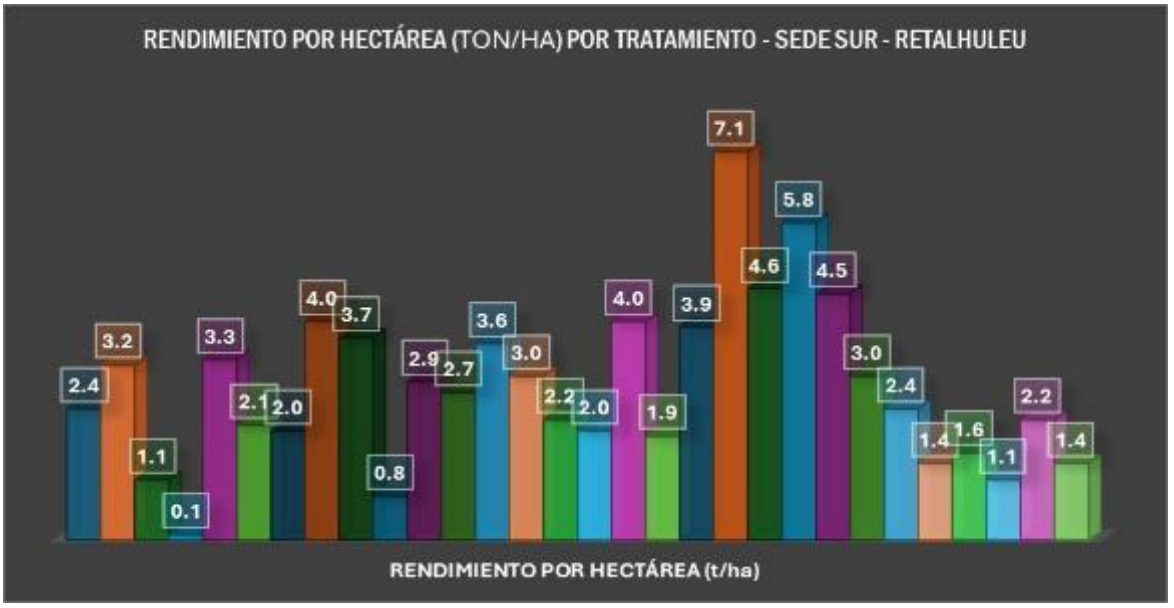


Figure 12. Results obtained in the Phase 1 experimental trial, South Site – Retalhuleu.

From the field data collection, the statistical analysis did not include a) underweight fruits with low physiological maturity, and b) overweight or overripe fruits. These data for the south site are summarized in Table 6.

Table 6. Data observed in the Phase 1 experimental trial at the South Site – Retalhuleu regarding underweight and overweight fruits.

SOUTH SITE - CHAMPERICO, RETALHULEU*	
FIRST CUT	
UNDERWEIGHT FRUIT (%)	OVERWEIGHT FRUIT (%)
0.84	0.72
SECOND CUT	
UNDERWEIGHT FRUIT (%)	OVERWEIGHT FRUIT (%)
0.35	0.30
INTEGRATED CUT 1o y 2o.	
UNDERWEIGHT FRUIT (%)	OVERWEIGHT FRUIT (%)
0.50	0.43

*/ Season 2023-2024.

Nevertheless, based on the results obtained, a variance analysis was conducted for the yield variable in mango cultivation during the first phase of the evaluation. The following results were obtained:

VARIANCE ANALYSIS (ANDEVA) SOUTH SITE - RETALHULEU

Variance analysis (ANDEVA) for the First Cut

CUT	Variable	N	R^2	R^2 Aj	CV
FIRST CUT	No.MANGOS	30	0.29	0.14	45.83

Variance Analysis Table (SC type III)

F.V.	SC	gl	CM	F	p-value
TREATMENTS	6262.27	5	1252.45	1.92	0.1283**ns**
Error	15659.60	24	652.48		
Total	21921.87	29			

Test:DGC Alfa=0.05 PCALT=35.4129

Error: 652.4833 gl: 24

TREATMENT	Averages	n	E.E.	
T4	77.20	5	11.42	A
T5	72.40	5	11.42	A
T3	54.40	5	11.42	A
T1	48.80	5	11.42	A
T2	43.80	5	11.42	A
T0	37.80	5	11.42	A

Means sharing the same letter are not significantly different (p > 0.05)

VARIANCE ANALYSIS (ANDEVA) SOUTH SITE - RETALHULEU

Variance analysis (ANDEVA) for the Second Cut

CUT	Variable	N	R^2	R^2 Aj	CV
SECOND CUT	No.MANGOS	30	0.32	0.18	52.19

Variance Analysis Table (SC type III)

F.V.	SC	gl	CM	F	p-value
TREATMENTS	47522.67	5	9504.53	2.29	0.0778**ns**
Error	99670.80	24	4152.95		
Total	147193.47	29			

Test:DGC Alfa=0.05 PCALT=89.3419

Error: 4152.9500 gl: 24

TREATMENT	Averages	n	E.E.	
T5	177.40	5	28.82	A
T4	158.20	5	28.82	A
T3	136.00	5	28.82	A
T2	123.60	5	28.82	A
T1	79.80	5	28.82	A
T0	65.80	5	28.82	A

Means sharing the same letter are not significantly different (p > 0.05)

VARIANCE ANALYSIS (ANDEVA) SOUTH SITE - RETALHULEU

Variance analysis (ANDEVA) for the First Cut + the Second Cut

CUT	Variable	N	R^2	R^2 Aj	CV
INTEGRATED CUT	No.MANGOS	30	0.34	0.20	45.75

Variance Analysis Table (SC type III)

F.V.	SC	gl	CM	F	p-value
TREATMENTS	83416.00	5	16683.20	2.48	0.0601**ns**
Error	161338.80	24	6722.45		
Total	244754.80	29			

Test:DGC Alfa=0.05 PCALT=113.6686

Error: 6722.4500 gl: 24

TREATMENT	Averages	n	E.E.	
T5	249.80	5	36.67	A
T4	235.40	5	36.67	A
T3	190.40	5	36.67	A
T2	167.40	5	36.67	A
T1	128.60	5	36.67	A
T0	103.60	5	36.67	A

Means sharing the same letter are not significantly different (p > 0.05)

Based on the results generated by the analysis of the first cut, second cut, and two combined cuts, the coefficients obtained were 45.83%, 52.19%, and 45.75%. This indicates that the study was not conducted properly, since the acceptable range is between 1% and 20% under uncontrolled conditions (in the open field). The F values obtained were 1.92, 2.29, and 2.48, indicating that the results are not statistically significant. This is reflected in the p-values of 0.1283^{NS}, 0.0778^{NS}, and 0.0601^{NS} (>0.05). Nevertheless, a multiple comparison test (Tukey's test) was performed.

Tukey's test was conducted because the variance analysis revealed no significant differences among the treatments. Thus, the results indicate that treatments T0, T1, T2, T3, T4, and T5 can be used interchangeably, since the different irrigation rates applied did not significantly affect total yield. At this stage, conducting a normality test (Q-Q plot) was not warranted.

4. RESULTS: 2nd PHASE (YEAR 2)

The analysis of the experimental trial on the application of drip irrigation to "Tommy Atkins" at each of the sites yielded the following results, in accordance with the objectives and methodology employed. The following presents the results and their respective discussion corresponding to the second phase or production year (2024–2025). The data are derived from harvests conducted at the two experimental sites: East Site—Zacapa and South Site—Retalhuleu.

4.1 Results and Discussion: Phase 2: East Site – Zacapa.

Yield: Yield data are detailed in Table 7 and Figure 12, which show the treatment averages in tons per hectare. Among the treatments listed, T4R4 stands out as the most productive with 13.3 tons per hectare, and T4R1 as the least productive with 0.54 tons per hectare. Overall, the treatments showed low production values compared to the 2024 growing season. Production values in 2025 were 54% lower than those recorded in the 2024 growing season.

This is attributed to the fact that various agronomic practices contributed to the low yield, such as:

- Unusual weather conditions caused by sporadic or erratic rainfall during the dry season.
- Management of plantations in which some experimental plots underwent extreme pruning of their foliage.
- Prune due to the presence of what is known as "witch's broom" in the flower buds.
- Lack of a backup pumping system to provide irrigation during emergencies or contingencies resulting from failures, repairs, or maintenance on the main irrigation system.

Table 7. Results obtained in the Phase 2 experimental trial, East Site - Zacapa.

TREATMENT	T1	T1	T1	T1	T1	T2	T2	T2	T2	T2	T3	T3	T3	T3	T3
REPETITION	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5
YIELD PER HECTARE (Ton/ha)	6.9	6.88	5.72	2.9	5.77	5.9	6.61	10.3	6.2	6.86	5.21	6.41	6.93	9.3	10
TREATMENT	T4	T4	T4	T4	T4	T5	T5	T5	T5	T5	T0	T0	T0	T0	T0
REPETITION	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5
YIELD PER HECTARE (Ton/ha)	0.54	9.26	7.54	13.3	11.1	4.95	6.96	5.36	5.93	2.65	5.75	4.72	6.58	8.73	8.09

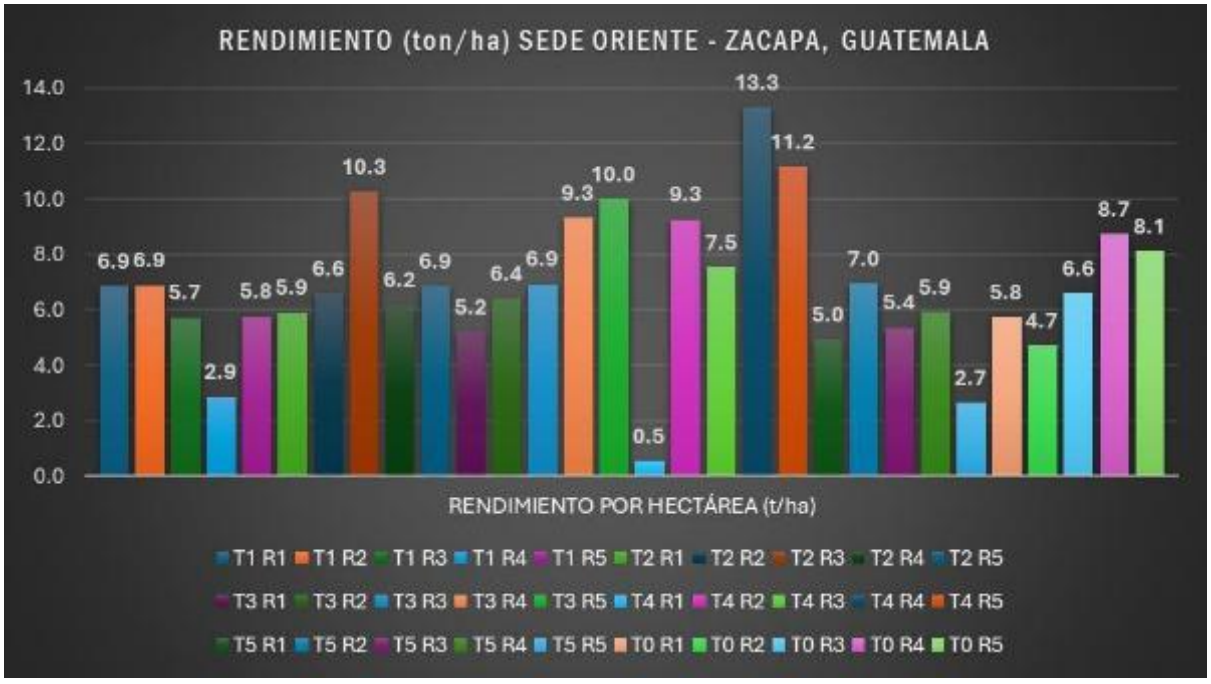


Figure 13. Results obtained in the Phase 2 experimental trial, East Site - Zacapa.

From the field data collection, the statistical analysis did not include a) underweight fruits with low physiological maturity, and b) overweight or overripe fruits. These data for the South site are summarized in Table 8.

Table 8. Data observed in the Phase 2 experimental trial at the East Site – Zacapa regarding underweight and overweight fruits.

EAST SITE - ESTANZUELA, ZACAPA*

SINGLE CUT	
UNDERWEIGHT FRUIT (%)	OVERWEIGHT FRUIT (%)
0.26	0.27

*/ Season 2024-2025.

Based on the results obtained from the 2025 harvest, a variance analysis was conducted for the yield variable in mango cultivation during its second evaluation phase, yielding the following results:

VARIANCE ANALYSIS
EAST SITE – ESTANZUELA, ZACAPA

1. MANGO UNITS PER TREATMENT

Variable	N	R^2	R^2 Aj	CV
MANGO UNITS PER TRE..	30	0.28	0.00	39.18

Variance Analysis Table (SC type III)

F.V.	SC	gl	CM	F	p-value
Model	143275.33	9	15919.48	0.86	0.5708
TREATMENT	92271.87	5	18454.37	1.00	0.4423
REPETITION	51003.47	4	12750.87	0.69	0.6063
Error	368628.13	20	18431.41		
Total	511903.47	29			

Test:DGC Alfa=0.05 PCALT=188.2157

Error: 18431.4067 gl: 20 TREATMENT

Averages	n	E.E.	
T4	422.40	5	60.71 A
T3	383.40	5	60.71 A
T2	376.60	5	60.71 A
T0	344.00	5	60.71 A
T1	293.60	5	60.71 A
T5	259.20	5	60.71 A

Means sharing the same letter are not significantly different (p > 0.05)

2. AVG WEIGHT PER MANGO (Kg)

Variable	N	R^2	R^2 Aj	CV
AVG WEIGHT PER MANGO (Kg)	30	0.44	0.19	5.19

Variance Analysis Table (SC type III)

F.V.	SC	gl	CM	F	p-value
Model	0.01	9	1.4E-03	1.75	0.1417
TREATMENT	2.7E-03	5	5.4E-04	0.67	0.6526
REPETITION	0.01	4	2.5E-03	3.11	0.0384
Error	0.02	20	8.1E-04		
Total	0.03	29			

Test:DGC Alfa=0.05 PCALT=0.0395

Error: 0.0008 gl: 20

TREATMENT	Averages	n	E.E.	
T5	0.56	5	0.01	A
T0	0.56	5	0.01	A
T4	0.55	5	0.01	A
T3	0.55	5	0.01	A
T1	0.54	5	0.01	A
T2	0.54	5	0.01	A

Means sharing the same letter are not significantly different (p > 0.05)

3. TOTAL WEIGHT PER TREATMENT (Kg)

Variable	N	R^2	R^2 Aj	CV
TOTAL WEIGHT PER TREATMENT..	30	0.35	0.05	36.94

Variance Analysis Table (SC type III)

F.V.	SC	gl	CM	F	p-value
Model	51972.45	9	5774.72	1.18	0.3615
TREATMENT	28261.39	5	5652.28	1.15	0.3672
REPETITION	23711.06	4	5927.76	1.21	0.3390
Error	98277.03	20	4913.85		
Total	150249.47	29			

Test:DGC Alfa=0.05 PCALT=97.1824

Error: 4913.8513 gl: 20 TREATMENT

Averages	n	E.E.	
T4	233.97	5	31.35 A
T3	212.04	5	31.35 A
T2	200.72	5	31.35 A
T0	189.68	5	31.35 A
T1	157.32	5	31.35 A
T5	144.72	5	31.35 A

Means sharing the same letter are not significantly different (p > 0.05)

4. YIELD PER HECTARE (Ton/ha)

Variable	N	R^2	R^2 Aj	CV
YIELD PER HECTARE(..	30	0.35	0.05	36.94

Variance Analysis Table (SC type III)

F.V.	SC	gl	CM	F	p-value
Model	66.30	9	7.37	1.18	0.3615
TREATMENT	36.05	5	7.21	1.15	0.3672
REPETITION	30.24	4	7.56	1.21	0.3390
Error	125.36	20	6.27		
Total	191.65	29			

Test:DGC Alfa=0.05 PCALT=3.4708

Error: 6.2678 gl: 20

TREATMENT	Averages	n	E.E.	
T4	8.36	5	1.12	A
T3	7.57	5	1.12	A
T2	7.17	5	1.12	A
T0	6.77	5	1.12	A
T1	5.62	5	1.12	A
T5	5.17	5	1.12	A

Means sharing the same letter are not significantly different (p > 0.05)

Based on the results of the analysis of variance for a single fruit harvest, the coefficient of variation was initially found to be 36.94%. This indicates that the study involved variations in management practices or was not managed properly, since the acceptable range is between 1% and 20% under uncontrolled conditions (open field). The F-values obtained of 1.18, 1.15, and 1.21, and the p-values of 0.36, 0.36, and 0.33 (>0.05) indicate that the results are not statistically significant. Despite this, a multiple comparison test (Tukey's test) was performed as a supplementary analysis.

The Tukey test was performed based on the analysis of variance and showed that no differences were observed when comparing the treatments. Thus, the results indicate that treatments T0, T1, T2, T3, T4, and T5 can be used interchangeably. This indicates that the different irrigation rates applied did not significantly affect total yield. At this stage, conducting a normality test (Q-Q plot) was not warranted.

4.2. Results and Discussion: Phase 2 – South Site – Retalhuleu

Yield: Yield data are detailed in Table 9 and Figure 14, which show the treatment averages in tons per hectare. Among the total yields, no outliers were observed. The treatments that stood out slightly were T1R1 and T4R2 as the most productive, with 4.13 tons/ha, and treatment T4R1 as the least productive, with 2.18 tons/ha.

Table 9 shows a generally low yield compared to the previous year evaluated. According to field observations, atypical and irregular flowering occurred, which can be attributed to annual yield alternation. This situation negatively affects production, and it is estimated that the 2025 yield was 31.5% higher than the 2024 yield.

Several treatments recorded values of 0.00 tons/ha, indicating a lack of production. The experimental units T1R4, T1R5, T2R3, T3R3, T4R3, T5R4, T0R2, T0R3, T0R4, and T0R5 were lost due to management practices that included severe vegetative pruning (stump pruning), which drastically limited the trees' productive capacity. (See photos in the Annexes).

Table 9. Yields obtained in the Phase 2 experimental trial, South Site - Retalhuleu.

TREATMENT	T1	T1	T1	T1	T1	T2	T2	T2	T2	T2	T3	T3	T3	T3	T3
REPETITION	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5
YIELD PER HECTARE (ton/ha)	4.13	2.50	3.67	0.00	0.00	3.72	2.89	0.00	3.09	0.00	3.63	3.80	0.00	3.41	2.72
TREATMENT	T4	T4	T4	T4	T4	T5	T5	T5	T5	T5	T0	T0	T0	T0	T0
REPETITION	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5
YIELD PER HECTARE (ton/ha)	2.18	4.13	0.00	3.68	3.20	2.88	3.77	3.52	0.00	3.58	3.02	0.00	0.00	0.00	0.00

Figure 14. Results obtained in the Phase 2 experimental trial, South Site – Retalhuleu.

From the field data collection, the statistical analysis did not include a) underweight fruits with low physiological maturity, and b) overweight or overripe fruits. These data for the southern site are summarized in Table 10.

Table 10. Data observed in the Phase 2 experimental trial at the South site (Retalhuleu) regarding underweight and overweight fruits.

SOUTH SITE - CHAMPERICO, RETALHULEU*

FIRST CUT	
UNDERWEIGHT FRUIT (%)	OVERWEIGHT FRUIT (%)
1.10	1.02
SECOND CUT	
UNDERWEIGHT FRUIT (%)	OVERWEIGHT FRUIT (%)
0.54	0.59
INTEGRATED CUT 1o y 2o.	
UNDERWEIGHT FRUIT (%)	OVERWEIGHT FRUIT (%)
0.76	0.76

*/ Season 2024-2025.

Based on the results obtained, an variance analysis was conducted for the yield variable during the second phase of the evaluation, yielding the following results:

VARIANCE ANALYSIS SOUTH SITE - RETALHULEU

1. MANGO UNITS PER TREATMENT

Variable	N	R^2	R^2 Aj	CV
MANGO UNITS PER TRE..	19	0.08	0.00	22.44

Unbalanced data in cells. For another decomposition of the SC, specify the appropriate contrasts... !!

Variance Analysis Table (SC type I)

F.V.	SC	gl	CM	F	p-value
Model	1218.28	9	135.36	0.09	0.9994
TREATMENT	449.94	5	89.99	0.06	0.9971
REPETITION	768.34	4	192.09	0.12	0.9707
Error	14087.83	9	1565.31		
Total	15306.11	18			

Test:DGC Alfa=0.05 PCALT=111.1767

Error: 1565.3139 gl: 9

TREATMENT	Averages	n	E.E.	
T5	180.75	4	19.78	A
T4	178.00	4	19.78	A
T2	177.67	3	22.84	A
T3	177.25	4	19.78	A
T1	171.00	3	22.84	A
T0	160.00	1	39.56	A

Means sharing the same letter are not significantly different (p > 0.05)

2. AVG WEIGHT PER MANGO (kg)

Variable	N	R^2	R^2 Aj	CV
AVG WEIGHT PER MANGO (kg)	19	0.50	0.00	5.10

Unbalanced data in cells. For another decomposition of the SC, specify the appropriate contrasts... !!

Variance Analysis Table (SC type I)

F.V.	SC	gl	CM	F	p-value
Model	0.01	9	7.3E-04	0.99	0.5068
TREATMENT	0.01	5	1.0E-03	1.38	0.3159
REPETITION	1.5E-03	4	3.6E-04	0.49	0.7414
Error	0.01	9	7.4E-04		
Total	0.01	18			

Test:DGC Alfa=0.05 PCALT=0.0762

Error: 0.0007 gl: 9

TREATMENT	Averages	n	E.E.	
T1	0.56	3	0.02	A
T3	0.54	4	0.01	A
T5	0.53	4	0.01	A
T0	0.53	1	0.03	A
T4	0.52	4	0.01	A
T2	0.51	3	0.02	A

Means sharing the same letter are not significantly different (p > 0.05)

3. TOTAL WEIGHT PER TREATMENT (kg)

Variable	N	R^2	R^2 Aj	CV
TOTAL WEIGHT PER TREATMENT..	19	0.09	0.00	21.72

Unbalanced data in cells. For another decomposition of the SC, specify the appropriate contrasts... !!

Variance Analysis Table (SC type I)

F.V.	SC	gl	CM	F	p-value
Model	371.01	9	41.22	0.10	0.9990
TREATMENT	170.91	5	34.18	0.08	0.9933
REPETITION	200.10	4	50.03	0.12	0.9714
Error	3721.25	9	413.47		
Total	4092.26	18			

Test:DGC Alfa=0.05 PCALT=57.1394

Error: 413.4719 gl: 9

TREATMENT	Averages	n	E.E.	
T5	96.23	4	10.17	A
T1	96.08	3	11.74	A
T3	94.96	4	10.17	A
T4	92.34	4	10.17	A
T2	90.50	3	11.74	A
T0	84.53	1	20.33	A

Means sharing the same letter are not significantly different (p > 0.05)

4. YIELD PER HECTARE (t/ha)

Variable	N	R^2	R^2 Aj	CV
YIELD PER HECTARE(..	19	0.09	0.00	21.72

Variance Analysis Table (SC type I)

F.V.	SC	gl	CM	F	p-value
Model	0.47	9	0.05	0.10	0.9990
TREATMENT	0.22	5	0.04	0.08	0.9933
REPETITION	0.25	4	0.06	0.12	0.9715
Error	4.75	9	0.53		
Total	5.22	18			

Test:DGC Alfa=0.05 PCALT=2.0404

Error: 0.5273 gl: 9

TREATMENT	Averages	n	E.E.	
T5	3.44	4	0.36	A
T1	3.43	3	0.42	A
T3	3.39	4	0.36	A
T4	3.30	4	0.36	A
T2	3.23	3	0.42	A
T0	3.02	1	0.73	A

Means sharing the same letter are not significantly different (p > 0.05)

Based on the results of the analysis of variance for a single fruit harvest, the coefficient of variation obtained is 21.72%. This indicates that the study involved variations in management practices or was not managed properly, since the acceptable range is between 1% and 20% under uncontrolled conditions (open field). The F-values obtained of 0.10, 0.08, and 0.12 and the p-value of 0.99 (>0.05) indicate that the results are not statistically significant. Nevertheless, a multiple comparison test (Tukey's test) was performed.

The Tukey test was performed based on the analysis of variance. Based on this test, no differences were observed when comparing the treatments. Therefore, treatments T0, T1, T2, T3, T4, and T5 can be used interchangeably. When comparing treatments, no differences were observed. Thus, the results indicate that the different irrigation rates applied did not significantly affect total yield. At this stage, conducting a normality test (Q-Q plot) was not warranted.

5. COMBINED RESULTS (PHASE 1 AND PHASE 2)

An integrated statistical analysis was conducted on the results obtained during the 2023–2024 and 2024–2025 growing seasons, combining the yields from the experimental plots of the trial based on the established objectives and methodology. The data come from harvests conducted at two sites where the experimental trial was set up: the East Site—Zacapa and the South Site—Retalhuleu. The results and their respective discussion for the two production years at each of the two experimental sites are presented below.

1.1 Results and Discussion: Integrated Phases 1 and 2: East Site – Zacapa.

Based on the results obtained, an analysis of variance was conducted for the various response variables of the experimental trial during its first and second integrated evaluation phases, yielding the following results:

VARIANCE ANALYSIS
EAST SITE - ZACAPA, GUATEMALA

1. UNITS/TREATMENT

Variable	N	R^2	R^2 Aj	CV
UNITS/TREATMENT	59	0.49	0.38	58.62

Variance Analysis Table (SC type III)

F.V.	SC	gl	CM	F	p-value	(Error)
Model	5980828.74	11	543711.70	4.18	0.0003	
YEAR	4357778.06	1	4357778.06	27.87	0.0004	(YEAR>TREATMENT)
YEAR>TREATMENT	1563459.11	10	156345.91	1.20	0.3150	
Error	6120049.80	47	130213.83			
Total	12100878.54	58				

Test:DGC Alfa=0.05 PCALT=208.0139

Error: 156345.9115 gl: 10

YEAR	Averages	n	E.E.	
2024	**891.12**	**29**	**73.68**	**A**
2025	**346.53**	**30**	**72.19**	**B**

Means sharing the same letter are not significantly different (p > 0.05)

Test:DGC Alfa=0.05 PCALT=486.8765

Error: 130213.8255 gl: 47

YEAR	TREATMENT	Averages	n	E.E.		
2024	T1	1321.20	5	161.38	A	
2024	T0	952.40	5	161.38	A	
2024	T5	885.80	5	161.38	A	
2024	T2	811.50	4	180.43	A	
2024	T4	782.40	5	161.38	A	
2024	T3	593.40	5	161.38		B
2025	T4	422.40	5	161.38		B
2025	T3	383.40	5	161.38		B
2025	T2	376.60	5	161.38		B
2025	T0	344.00	5	161.38		B
2025	T1	293.60	5	161.38		B
2025	T5	259.20	5	161.38		B

Means sharing the same letter are not significantly different (p > 0.05)

2. AVG WEIGHT/MANGO (kg)

Variable	N	R^2	R^2 Aj	CV
AVG WEIGHT/MANGO (kg)	59	0.54	0.44	12.01

Variance Analysis Table (SC type III)

F.V.	SC	gl	CM	F	p-value	(Error)
Model	0.20	11	0.02	5.10	<0.0001	
YEAR	0.15	1	0.15	24.09	0.0006	(YEAR>TREATMENT)
YEAR>TREATMENT	0.06	10	0.01	1.68	0.1139	
Error	0.17	47	3.6E-03			
Total	0.37	58				

Test:DGC Alfa=0.05 PCALT=0.0410

Error: 0.0061 gl: 10

YEAR	Averages	n	E.E.		
2025	0.55	30	0.01	A	
2024	0.45	29	0.01		B

Means sharing the same letter are not significantly different (p > 0.05)

Test:DGC Alfa=0.05 PCALT=0.0812

Error: 0.0036 gl: 47

YEAR	TREATMENT	Averages	n	E.E.		
2025	T5	0.56	5	0.03	A	
2025	T0	0.56	5	0.03	A	
2025	T4	0.55	5	0.03	A	
2025	T3	0.55	5	0.03	A	
2025	T1	0.54	5	0.03	A	
2025	T2	0.54	5	0.03	A	
2024	T0	0.51	5	0.03	A	
2024	T1	0.49	5	0.03	A	
2024	T4	0.47	5	0.03	A	
2024	T5	0.45	5	0.03	A	
2024	T2	0.40	4	0.03		B
2024	T3	0.38	5	0.03		B

Means sharing the same letter are not significantly different (p > 0.05)

3. TOTAL WEIGHT/TREATMENT (kg)

Variable	N	R^2	R^2 Aj	CV
TOTAL WEIGHT/TREATMENT (kg..	59	0.47	0.34	58.17

Variance Analysis Table (SC type III)

F.V.	SC	gl	CM	F	p-value	(Error)
Model	1286351.36	11	116941.03	3.71	0.0008	
YEAR	790339.57	1	790339.57	16.64	0.0022	(YEAR>TREATMENT)
YEAR>TREATMENT	474914.23	10	47491.42	1.51	0.1664	
Error	1479837.40	47	31485.90			
Total	2766188.75	58				

Test:DGC Alfa=0.05 PCALT=114.6454

Error: 47491.4231 gl: 10

YEAR	Averages	n	E.E.	
2024	421.66	29	40.61	A
2025	189.74	30	39.79	B

Means sharing the same letter are not significantly different (p > 0.05)

Test:DGC Alfa=0.05 PCALT=239.4134

Error: 31485.9021 gl: 47

YEAR	TREATMENT	Averages	n	E.E.		
2024	T1	651.19	5	79.35	A	
2024	T0	481.92	5	79.35		B
2024	T5	423.54	5	79.35		B
2024	T4	365.83	5	79.35		B
2024	T2	344.48	4	88.72		B
2024	T3	263.00	5	79.35		B
2025	T4	233.97	5	79.35		B
2025	T3	212.04	5	79.35		B
2025	T2	200.72	5	79.35		B
2025	T0	189.68	5	79.35		B
2025	T1	157.32	5	79.35		B
2025	T5	144.72	5	79.35		B

Means sharing the same letter are not significantly different (p > 0.05)

4. YIELD (t/ha)

Variable	N	R^2	R^2 Aj	CV
YIELD (t/ha)	59	0.47	0.34	58.17

Variance Analysis Table (SC type III)

F.V.	SC	gl	CM	F	p-value	(Error)
Model	1640.74	11	149.16	3.71	0.0008	
YEAR	1008.08	1	1008.08	16.64	0.0022	(YEAR>TREATMENT)
YEAR>TREATMENT	605.76	10	60.58	1.51	0.1664	
Error	1887.59	47	40.16			
Total	3528.33	58				

Test:DGC Alfa=0.05 PCALT=4.0945

Error: 60.5757 gl: 10

YEAR	Averages	n	E.E.	
2024	**15.06**	**29**	**1.45**	**A**
2025	**6.78**	**30**	**1.42**	**B**

Means sharing the same letter are not significantly different (p > 0.05)

Test:DGC Alfa=0.05 PCALT=8.5506

Error: 40.1615 gl: 47

YEAR	TREATMENT	Averages	n	E.E.		
2024	T1	23.26	5	2.83	A	
2024	T0	17.21	5	2.83		B
2024	T5	15.13	5	2.83		B
2024	T4	13.07	5	2.83		B
2024	T2	12.30	4	3.17		B
2024	T3	9.39	5	2.83		B
2025	T4	8.36	5	2.83		B
2025	T3	7.57	5	2.83		B
2025	T2	7.17	5	2.83		B
2025	T0	6.77	5	2.83		B
2025	T1	5.62	5	2.83		B
2025	T5	5.17	5	2.83		B

Means sharing the same letter are not significantly different (p > 0.05)

Based on the results of the combined variance analysis for the two years, the following was observed: The coefficient of variation exceeded 58% in some cases, while for the average weight per mango, it was only 12%. This indicates that the study had variations in its design or was not properly conducted, since the acceptable range falls between 1% and 20% under uncontrolled conditions (open field). The F-value obtained and the p-value of >0.05 indicate that the results are not statistically significant. This indicates that, to complement the analysis, a multiple comparison test (Tukey's test) should be performed as a supplementary analysis.

Tukey's test was conducted based on the variance analysis and showed no significant differences when comparing the treatments regarding 1) number of units, 2) weight per unit, and 3) average weight per experimental unit. On the other hand, significant differences were found regarding 4) yield/ha, with treatment T1 performing well for both the 2024 and 2025 production cycles. Thus, the results indicate that treatment T1 can be recommended as significant for the application of irrigation sheets. This indicates that the different irrigation sheets applied had a significant impact on the total yield of treatment T1. At this stage, conducting a normality test (Q-Q plot) was not warranted.

4.2 Results and Discussion: Integrated Phases 1 and 2: South Site – Retalhuleu.

Based on the results obtained, an variance analysis was conducted for the various response variables of the experimental trial during its first and second integrated evaluation phases, yielding the following results:

VARIANCE ANALYSIS
SOUTH SITE - RETALHULEU, GUATEMALA

1. MANGO UNITS PER TREATMENT

Variable	N	R^2	R^2 Aj	CV
MANGO UNITS PER TRE..	49	0.32	0.12	38.75

Variance Analysis Table (SC type III)

F.V.	SC	gl	CM	F	p-value	(Error)
Model	83962.71	11	7632.97	1.60	0.1386	
YEAR	257.77	1	257.77	0.03	0.8643	(YEAR>TREATMENT)
YEAR>TREATMENT	83865.94	10	8386.59	1.76	0.1033	
Error	176194.97	37	4762.03			
Total	260157.67	48				

Test:DGC Alfa=0.05 PCALT=54.4250

Error: 8386.5939 gl: 10

YEAR	Averages	n	E.E.	
2024	179.20	30	16.72	A
2025	174.11	19	23.73	A

Means sharing the same letter are not significantly different (p > 0.05)

Test:DGC Alfa=0.05 PCALT=125.6998

Error: 4762.0261 gl: 37

YEAR	TREATMENT	Averages	n	E.E.	
2024	T5	249.80	5	30.86	A
2024	T4	235.40	5	30.86	A
2024	T3	190.40	5	30.86	A
2025	T5	180.75	4	34.50	A
2025	T4	178.00	4	34.50	A
2025	T2	177.67	3	39.84	A
2025	T3	177.25	4	34.50	A
2025	T1	171.00	3	39.84	A
2024	T2	167.40	5	30.86	A
2025	T0	160.00	1	69.01	A
2024	T1	128.60	5	30.86	A
2024	T0	103.60	5	30.86	A

Means sharing the same letter are not significantly different (p > 0.05)

2. AVG WEIGHT PER MANGO (kg)

Variable	N	R^2	R^2 Aj	CV
AVG WEIGHT PER MANGO (kg)	49	0.58	0.46	7.85

Variance Analysis Table (SC type III)

F.V.	SC	gl	CM	F	p-value	(Error)
Model	0.08	11	0.01	4.68	0.0002	
YEAR	0.05	1	0.05	34.72	0.0002	(YEAR>TREATMENT)
YEAR>TREATMENT	0.01	10	1.5E-03	1.01	0.4506	
Error	0.05	37	1.5E-03			
Total	0.13	48				

Test:DGC Alfa=0.05 PCALT=0.0229

Error: 0.0015 gl: 10

YEAR	Averages	n	E.E.	
2025	0.53	19	0.01	A
2024	0.46	30	0.01	B

Means sharing the same letter are not significantly different (p > 0.05)

Test:DGC Alfa=0.05 PCALT=0.0697

Error: 0.0015 gl: 37

YEAR	TREATMENT	Averages	n	E.E.		
2025	T1	0.56	3	0.02	A	
2025	T3	0.54	4	0.02	A	
2025	T5	0.53	4	0.02	A	
2025	T0	0.53	1	0.04	A	
2025	T4	0.52	4	0.02	A	
2025	T2	0.51	3	0.02	A	
2024	T5	0.48	5	0.02		B
2024	T4	0.48	5	0.02		B
2024	T2	0.46	5	0.02		B
2024	T3	0.46	5	0.02		B
2024	T0	0.45	5	0.02		B
2024	T1	0.43	5	0.02		B

Means sharing the same letter are not significantly different (p > 0.05)

3. TOTAL WEIGHT PER TREATMENT (kg)

Variable	N	R^2	R^2 Aj	CV
TOTAL WEIGHT PER TREATMENT..	49	0.35	0.16	38.10

Variance Analysis Table (SC type III)

F.V.	SC	gl	CM	F	p-value	(Error)
Model	22234.11	11	2021.28	1.81	0.0878	
YEAR	705.56	1	705.56	0.33	0.5765	(YEAR>TREATMENT)
YEAR>TREATMENT	21166.69	10	2116.67	1.89	0.0777	
Error	41339.46	37	1117.28			
Total	63573.57	48				

Test:DGC Alfa=0.05 PCALT=27.3421

Error: 2116.6695 gl: 10

YEAR	Averages	n	E.E.	
2025	**92.44**	**19**	**11.92**	**A**
2024	**84.02**	**30**	**8.40**	**A**

Means sharing the same letter are not significantly different (p > 0.05)

Test:DGC Alfa=0.05 PCALT=60.8864

Error: 1117.2826 gl: 37

YEAR	TREATMENT	Averages	n	E.E.	
2024	T5	121.59	5	14.95	A
2024	T4	112.42	5	14.95	A
2025	T5	96.23	4	16.71	A
2025	T1	96.08	3	19.30	A
2025	T3	94.96	4	16.71	A
2025	T4	92.34	4	16.71	A
2025	T2	90.50	3	19.30	A
2024	T3	86.49	5	14.95	A
2025	T0	84.53	1	33.43	A
2024	T2	75.69	5	14.95	A
2024	T1	61.07	5	14.95	A
2024	T0	46.88	5	14.95	A

Means sharing the same letter are not significantly different (p > 0.05)

4. YIELD PER HECTARE (t/ha)

Variable	N	R^2	R^2 Aj	CV
YIELD PER HECTARE(..	49	0.37	0.18	37.26

Variance Analysis Table (SC type III)

F.V.	SC	gl	CM	F	p-value	(Error)
Model	26.97	11	2.45	1.95	0.0643	
YEAR	2.50	1	2.50	1.06	0.3276	(YEAR>TREATMENT)
YEAR>TREATMENT	23.55	10	2.35	1.87	0.0817	
Error	46.58	37	1.26			
Total	73.54	48				

Test:DGC Alfa=0.05 PCALT=0.9120

Error: 2.3549 gl: 10

YEAR	Averages	n		
E.E.	2025	3.30	19	
0.40	A			
2024	2.80	30	0.28	A

Means sharing the same letter are not significantly different (p > 0.05)

Test:DGC Alfa=0.05 PCALT=2.0437

Error: 1.2588 gl: 37

YEAR	TREATMENT	Averages	n	E.E.	
2024	T5	4.05	5	0.50	A
2024	T4	3.75	5	0.50	A
2025	T5	3.44	4	0.56	A
2025	T1	3.43	3	0.65	A
2025	T3	3.39	4	0.56	A
2025	T4	3.30	4	0.56	A
2025	T2	3.23	3	0.65	A
2025	T0	3.02	1	1.12	A
2024	T3	2.88	5	0.50	A
2024	T2	2.52	5	0.50	A
2024	T1	2.04	5	0.50	A
2024	T0	1.56	5	0.50	A

Means sharing the same letter are not significantly different (p > 0.05)

Based on the results of the combined variance analysis for the two years, the following was observed: The coefficient of variation exceeded 37% in some cases, while for the average weight per mango it was 7.85%. This indicates that the study had variations in its design or was not properly conducted, since the acceptable range falls between 1% and 20% under uncontrolled conditions (in the open field). The F-value obtained and the p-value of >0.05 indicate that the results are not statistically significant. This suggests that, to complement the analysis, a multiple comparison test (Tukey's test) should be performed as a supplementary analysis.

The Tukey test was performed based on the variance analysis, which revealed no significant differences when comparing the treatments with respect to 1) number of units, 2) weight per unit, 3) average weight per experimental unit, and 4) yield per hectare. Based on this test, no differences were observed when comparing the treatments. Therefore, treatments T0, T1, T2, T3, T4, and T5 can be used interchangeably. When comparing treatments, no differences were observed. Thus, the results indicate that the different irrigation rates applied did not significantly affect total production. At this stage, conducting a normality test (Q-Q plot) was not warranted.

6. THE CLIMATE AT THE EVALUATED SITES

The analysis of climate as a determining factor in the behavior of phenological stages in mango plantations during the productive phase influenced not only water demand but also the behavior of the various stages of flowering, primarily shoot formation, the onset of flowering, and fruit set.

4.3 Climate Conditions at the East Site - Zacapa.

Thanks to the weather station installed at the Las Ilusiones farm, at the Eastern Headquarters in Estanzuela, Zacapa, climate records were available from January 2024 through 2025. The weather station was established at an altitude of 202 meters above sea level at coordinates 14°59´47.8" North Latitude and 89°35´16.80" West Longitude. The recorded climate data served as the basis for calculating daily evapotranspiration, which was the fundamental record used to determine the daily irrigation rates applied, varying only the Kc coefficient.

During the two years of data collection, an average annual precipitation of 760 mm was recorded, with distinct dry seasons from November to May. The climadiagram in Figure 15 shows two precipitation peaks in June and September, marking the rainy season from June to October. The area's temperature regime indicates that average annual temperatures are 27.7°C, with extremes of 35.4°C and 22.5°C. The average annual relative humidity is 70.3%, with extremes during the dry season reaching as low as 62%. See Table 11.

It is important to note that the total evapotranspiration value calculated using the Blanney & Criddle method for the entire year is 1,656.7 mm; however, this analysis highlights daily evapotranspiration values ranging from 3.4 to 5.9 mm/day, which are very similar to those recorded daily by the NMB01 weather station. Figure 16 highlights the maximum recorded daily evapotranspiration value of 6.02 mm/day, which occurred on April 27, 2025.

Figure 15, which presents the water balance analysis, shows that only June and September are considered months with sufficient moisture for crop growth, and irrigation is not required to compensate for soil moisture deficits. It is also noteworthy that in July and August (see Figure 15), Guatemala experiences periods of climatic anomalies characterized by low precipitation, known as "canículas," and most crops require "supplementary irrigation" during this period. Another finding related to this area (see Table 12) is that, to compensate for water deficits throughout the year, a total of 9,482.8 m³ of water per hectare must be supplied to the crop.

Table 11. Climate records from Station NMB01, East Site – Zacapa.

STATION NMB01 ESTANZUELA, ZACAPA								
Latitude:	14° 59´ 47.80"		Altitude:	202 msnm		Years on Record	´2024	
Longitude:	89° 35´ 16.80"		Code:	NMB01			´2025	
Month	Temperatures °C			Rainfall (mm)	Relative Humidity (%)	Monthly Evapotranspiration (mm)	Daily average Evapotranspiration (mm)	Water Balance (mm)
	Maximum	Minimum	Averages					
January	33.7	21.1	26.3	2.0	68.0	126.7	4.1	-124.7
February	34.1	18.3	25.4	0.0	65.0	123.0	4.4	-123.0
March	38.5	22.9	29.7	0.0	62.0	183.0	5.9	-183.0
April	37.9	23.7	29.7	20.2	66.0	170.1	5.7	-149.9
May	40.9	25.6	31.9	4.4	66.0	173.7	5.6	-169.3
June	35.8	24.0	28.3	270.4	74.0	127.0	4.2	143.4
July	35.2	23.3	27.8	51.8	74.0	142.0	4.6	-90.2
August	35.2	23.3	27.8	50.4	74.0	139.0	4.5	-88.6
September	36.4	23.5	28.3	228	77.0	124.2	4.1	103.8
October	33.5	22.6	26.8	91.4	75.0	124.4	4.0	-33.0
November	32.4	21.4	25.9	40.4	72.0	118.3	3.9	-77.9
December	30.9	20.3	24.5	1.0	70.0	105.3	3.4	-104.3
Annual Total	35.4	22.5	27.7	760.00	70.3	1656.7	4.5	

Source: NMB01, 2024-2025.

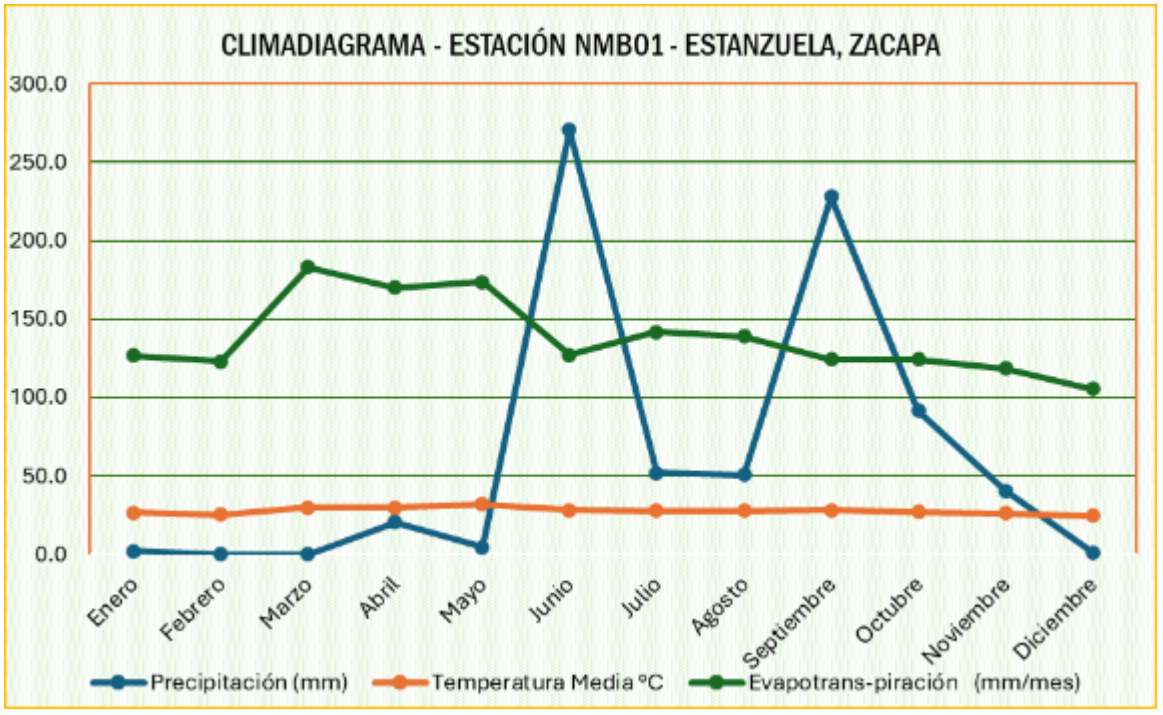


Figure 15. Climate diagram for Station NMB01, East Site – Zacapa.

Table 12. Water balance based on climate records from Station NMB01, East Site – Zacapa.

	Water Balance (mm)	Water requirements for micro-sprinkler irrigation (liters / tree / month)	Irrigation Efficiency (75%)	Net water demand per tree (liters/tree/month)	Mango tree density per hectare (179 trees/ha)	Water requirement via micro-sprinkler irrigation (liters/hectare)*	Water requirement via micro-sprinkler irrigation (m^3/ha)*
January	-124.7	3580.7	0.75	4774.3	179.0	854603.3	854.6
February	-123.0	3476.9	0.75	4635.8	179.0	829816.7	829.8
March	-183.0	5173.7	0.75	6898.3	179.0	1234791.9	1234.8
April	-149.9	4810.1	0.75	6413.4	179.0	1148001.4	1148.0
May	-169.3	4911.8	0.75	6549.1	179.0	1172287.8	1172.3
June	143.4	No irrigation required					
July	-90.2	4013.2	0.75	5350.9	179.0	957812.6	957.8
August	-88.6	3929.5	0.75	5239.3	179.0	937841.5	937.8
September	103.8	No irrigation required					
October	-33.0	3515.5	0.75	4687.4	179.0	839039.4	839.0
November	-77.9	3344.1	0.75	4458.8	179.0	798122.3	798.1
December	-104.3	2976.7	0.75	3969.0	179.0	710447.9	710.4
Annual Total							9,482.8

During the flowering induction phase in the mango orchards at the Las Ilusiones farm in Estanzuela, Zacapa—a stage that requires water stress—rainfall occurred for eight consecutive days, totaling 34.6 mm. This situation disrupted the crop's flowering dynamics and consequently led to a reduction in production. See Table 13.

Table 13. Sudden rainfall events during the flowering induction phase. NMB01 Station, East Site – Zacapa.

NOVEMBER 2024 - Estanzuela, Zacapa GTM

LOCAL CLIMATOLOGICAL DATA

DAVIS INSTRUMENTS, WEATHERLINK NETWORK

	TEMPERATURE °C					DEG DAYS BASE 18.3°		PRECIP. (mm)
14	33.9	22.4	26.9	20.8	22.6	0.000	8.565	0.4
15	28.6	22.1	24.2	21.0	21.9	0.000	5.875	0.2
16	26.3	21.7	23.0	21.0	21.6	0.000	4.694	14.8
17	28.6	22.4	24.3	22.2	22.8	0.000	6.009	4.0
18	30.4	23.0	25.7	23.0	23.7	0.000	7.338	0.8
19	36.2	23.6	28.2	22.9	24.3	0.000	9.824	0.2
20	35.8	22.1	27.3	22.7	23.9	0.000	8.975	10.6
21	28.9	19.4	24.0	20.5	21.6	0.000	5.690	3.6
								34.6

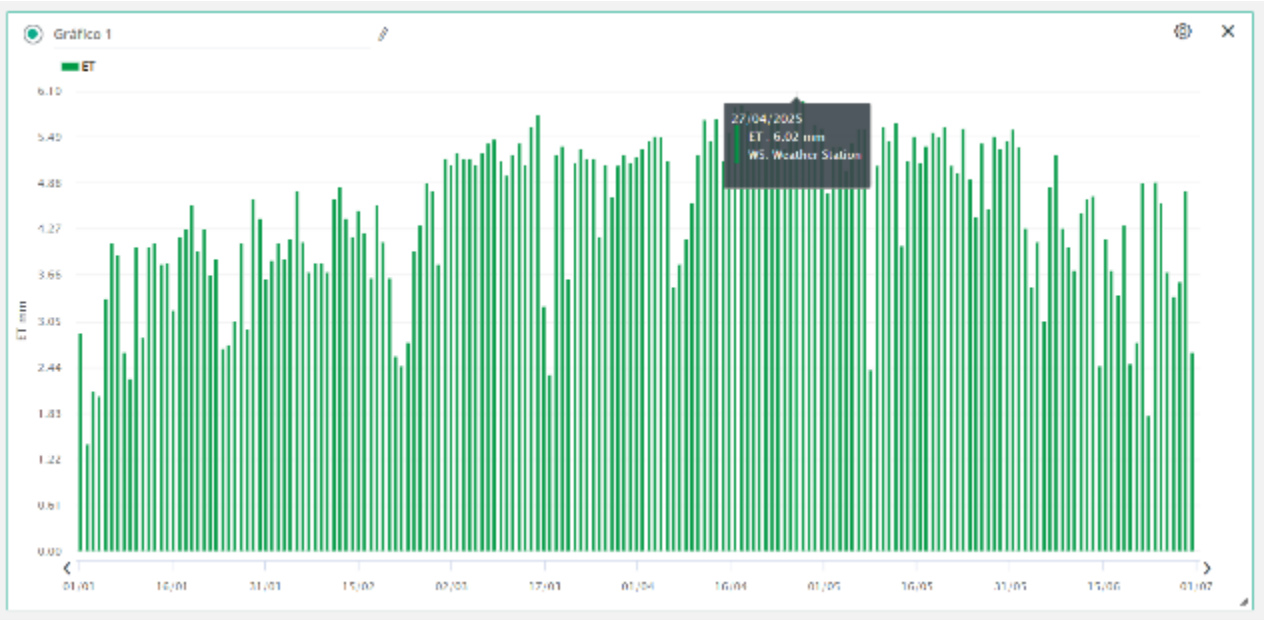


Figure 16. Daily evapotranspiration rates for the year 2025. Station NMB01, East Site – Zacapa.

4.3 Weather Conditions at the South Site - Retalhuleu.

The coastal area climate is largely determined by the geographical location of the mango plantations; the weather station was situated within the subtropical zone at an elevation of 12 meters above sea level. The station was located at coordinates 14° 20' 54“ North latitude and 91° 55' 54” West longitude.

During the two years of data collection, an average annual precipitation of 1,771.4 mm was recorded, with distinct dry seasons from December to April. The climate diagram in Figure 17 shows three precipitation peaks in the months of June, September, and November, thus marking the rainy season from May to November. The thermal regime of the area indicates that average annual temperatures are 27.4°C, with extremes of 33.5°C and 23.8°C. The average annual relative humidity is 70.3%, with extremes during the dry season reaching as low as 62%. See Table 14.

It is important to note that the total evapotranspiration value calculated using the Blanney & Criddle method for the entire year is 1,629.81 mm; however, this analysis highlights daily evapotranspiration values ranging from 3.2 to 5.9 mm/day—values very similar to those recorded daily by the NMB02 weather station. Figure 18 highlights the maximum recorded daily evapotranspiration value of 5.56 mm/day, which occurred on May 12, 2025.

In Figure 17, in the water balance analysis, it is notable that only the months of May through November are considered to have sufficient moisture for crop vegetative growth, and irrigation is not required to compensate for soil moisture deficits. It also highlights that in the months of July and August (see Figure 17), Guatemala experiences periods of climatic anomalies characterized by low precipitation, known as heat

waves, and most crops require "supplementary irrigation" during this period. Another finding related to this area (see Table 15) is that, to compensate for water deficits throughout the year, a total of 5,283 m³ of water per hectare must be supplied to the crop.

Table 14. Climate records from Station NMB02, South Site – Retalhuleu.

STATION NMB02 CHAMPERICO, RETALHULEU

Latitude:	14° 20´ 54"		Altitude:	12 msnm		Years on Record	´2024	
Longitude:	91° 55´ 54"		Code:	NMB02			´2025	

Month	Temperatures °C			Rainfall (mm)	Relative Humidity (%)	Monthly Evapotranspiration (mm)	Daily average Evapotranspiration (mm)	Water Balance (mm)
	Maximum	Minimum	Averages					
January	33.9	21.4	24.2	2.2	68.0	99.43	3.2	-97.2
February	33.7	21.7	27.1	5.0	65.0	117.59	4.2	-112.6
March	34.5	22.9	28.2	0.0	62.0	148.12	4.8	-148.1
April	35.1	26.7	26.5	4.4	66.0	150.02	5.0	-145.6
May	34.9	25.1	29.5	214.8	66.0	183.65	5.9	31.2
June	32.1	24.2	27.3	498.0	74.0	128.41	4.3	369.6
July	33.7	26.1	29.9	106.8	74.0	159.12	5.1	-52.3
August	33.8	24	27.9	147.6	74.0	142.00	4.6	5.6
September	33.1	24.2	27.7	324.4	77.0	137.80	4.6	186.6
October	32.9	24.1	27.7	172.6	75.0	137.74	4.4	34.9
November	31.9	23.2	26.7	295.6	72.0	117.28	3.9	178.3
December	32.6	21.6	26.3	0.0	70.0	108.65	3.5	-108.6
Annual Total	**33.5**	**23.8**	**27.4**	**1771.4**	**70.3**	**1,629.81**	**4.5**	

Source: NMB02, 2024-2025.

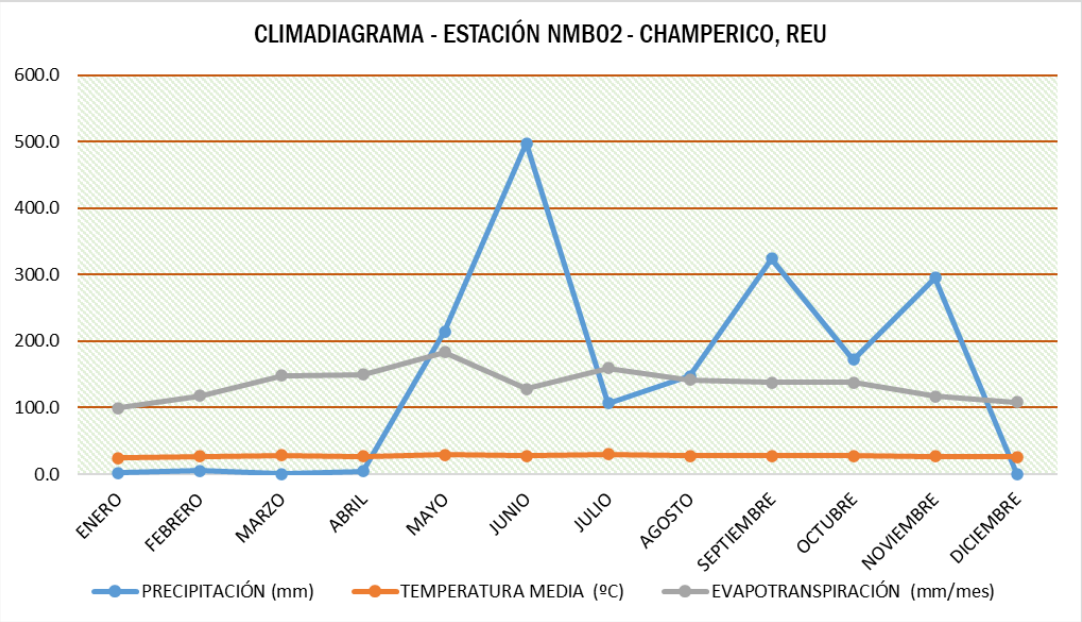


Figure 17. Climate diagram for Station NMB02, South Site – Retalhuleu.

Table 15. Water balance based on climate records from Station NMB02, South Site – Retalhuleu.

Month	Water Balance (mm)	Water requirements for micro-sprinkler irrigation (liters / tree / month)	Irrigation Efficiency (75%)	Net water demand per tree (liters/tree/month)	Mango tree density per hectare (179 trees/ha)	Water requirement via micro-sprinkler irrigation (liters/ha)*	Water requirement via micro-sprinkler irrigation (m^3/ha)*
January	-97.2	2811.0	0.75	3747.9	179.0	670880.5	670.9
February	-112.6	3324.3	0.75	4432.4	179.0	793400.4	793.4
March	-148.1	4187.4	0.75	5583.2	179.0	999396.2	999.4
April	-145.6	4241.0	0.75	5654.7	179.0	1012195.3	1012.2
May	31.2	No irrigation required					
June	369.6	No irrigation required					
July	-52.3	4498.3	0.75	5997.7	179.0	1073596.3	1073.6
August	5.6	No irrigation required					
September	186.6	No irrigation required					
October	34.9	No irrigation required					
November	178.3	No irrigation required					
December	-108.6	3071.5	0.75	4095.4	179.0	733070.6	733.1
Annual Total							5,283

Source: NMB02, 2024-2025. **/Se estima una densidad de 179 arboles/ha

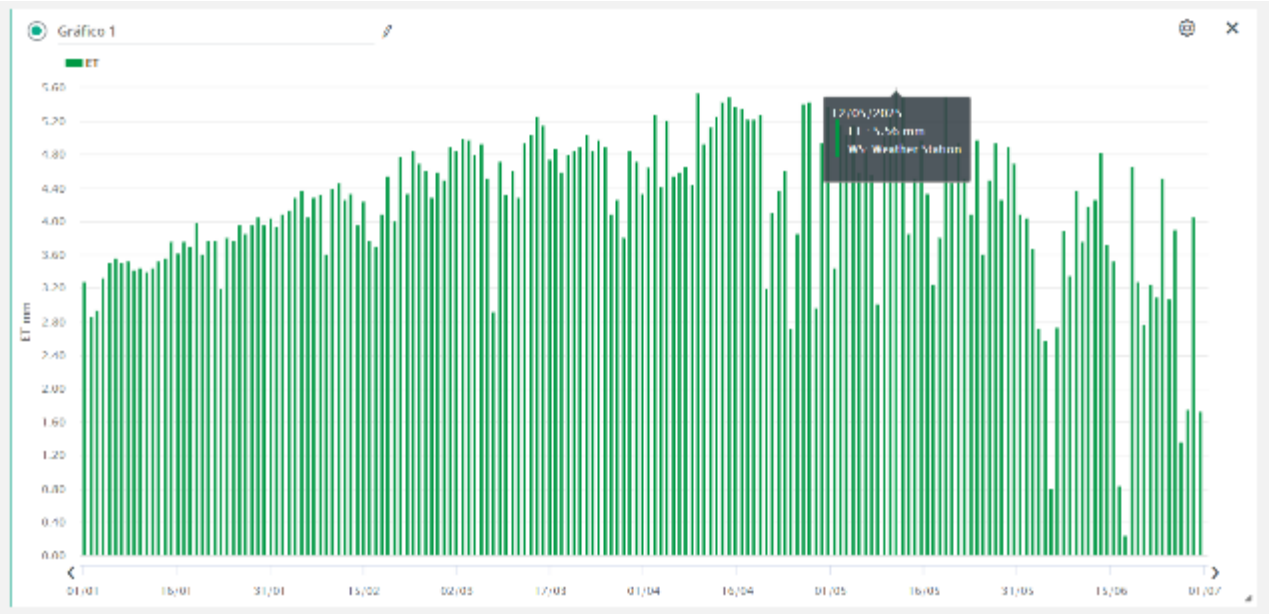


Figure 18. Daily evapotranspiration rates for the year 2025. Station NMB02, South Site – Retalhuleu.

7. CONCLUSIONS

The following conclusions stand out from the research conducted on the incorporation of different water depths according to the phenological stages of mango cultivation:

1. The sites selected for the study, as outlined in the protocol, met the requirements regarding soil and climate conditions, with some variations inherent to each location. Both sites exhibited homogeneous characteristics, primarily in terms of soil conditions and terrain slope, mango variety, and similar production systems or agronomic management practices.

2. The distribution of treatments (6 treatments, 5 replicates, equivalent to 30 experimental units) followed the principle of randomization without restrictions regarding agronomic management, being conditioned solely by the management of irrigation water application according to the daily demand of the treatment.

3. At the East site—Zacapa—during the 2023–2024 growing season, a comparison of treatments using Tukey's test revealed some differences. The results indicated that treatments T0 and T1 can be used interchangeably, with treatments T4 and T5 as a second option, and treatments T2 and T3 as a third option. This indicates that the different liner options used in each treatment affected yield and, therefore, total production.

4. At the South – Retalhuleu site during the 2023–2024 growing season, no differences were observed when the Tukey test was performed to compare treatments. Thus, the results indicate that treatments T0, T1, T2, T3, T4, and T5 can be used interchangeably. This indicates that the different types of sheets used in each treatment did not affect yield and therefore did not significantly favor total production.

5. The results of the 2024–2025 production cycle at the Oriente–Zacapa and Sur–Retalhuleu sites, based on experimental trials and ANDEVA statistical analyses conducted on the treatments established in the field, showed no significant difference in the variables of weight and yield per hectare. This was confirmed using the Tukey test. In conclusion, all treatments produced the same effect.

6. The results obtained based on the variance analysis for the various response variables of the experimental trial, during the first and second phases of the integrated evaluation for the 2023–2024 and 2024–2025 production cycles at the two sites—East (Zacapa) and South (Retalhuleu)—were as follows: 1) East (Zacapa) Site: For the response variables of total weight per treatment and yield per hectare, treatment T1 proved to be significant and performed best, particularly in the 2024 harvest. 2) South Site (Retalhuleu): No differences were observed across the various irrigation sheet application treatments, indicating that they did not significantly affect total production.

7. Throughout the research process, climatic and agronomic management factors influenced the research results. These included the following:

a. Climate disruption caused by erratic rainfall during the dry season, which affected flowering behavior, resulting in two flowering phases;

b. Severe pruning during the vegetative growth stage, which disrupted the development of flower buds;

c. The presence of flower deformities (witch's broom), which led to pruning of flowering shoots throughout the plantation, including the trial site; this occurred at the Zacapa-Oriente site.

d. Disruption of the daily irrigation schedule due to malfunctions in the pumping systems on the farm; this condition prevailed at the Retalhuleu-Costa Sur site.

e. Low irrigation efficiency (70–75%) in the system due to having only one micro-sprinkler per tree on the irrigation line. To address this issue, the irrigation system must be modified at both evaluated sites.

7. RECOMMENDATIONS

Based on the results of the research conducted in two locations in Guatemala and the crop performance over two growing seasons, the following recommendations are presented:

1. During the course of the research, the field operator was consulted to determine irrigation schedules based on the phenological stage during the following phases: pre-flowering, flowering, fruit set, fruit growth, and through harvest. The above variables were controlled in the field based on weather conditions during the relevant growing season. However, erratic rainfall occurred during the flowering induction period, which altered the plant's physiological conditions and resulted in different flowering phases.

2. Pruning was carried out throughout the plantation, including the trial site, without consulting the researcher. The pruning performed at the South Site site in Retalhuleu effectively eliminated two rows of five treatments (10 experimental plots), leaving a total of 20 experimental units for data collection. Regarding the East Site in Zacapa, pruning was applied to the entire plantation. Based on the above, in future trials, farm management should inform its field technicians that any alteration or intervention at the research sites must be carried out with the principal investigator's knowledge. This will allow for consideration of whether it is feasible to carry out the farm's planned activities within the framework of the research trial.

3. Given the unsatisfactory results obtained, it is recommended that the different water depths continue to be evaluated based on crop demand. During the trials, significant year-to-year climatic variability and fluctuations in crop yield were observed. Therefore, it is recommended to evaluate two harvest cycles with some variations in the irrigation system design.

4. To increase irrigation efficiency, the recommendation is to install two micro-sprinklers per fruit tree, each covering a 180° semicircle. This modification will improve the irrigation system's efficiency to between 85% and 90%. Additionally, it is recommended that the farm have a backup pump to address emergencies and ensure continuous irrigation for the research trial.

5. It is important to assess the crop's water requirements in conjunction with other management practices, such as plant nutrition and flower induction, among others.

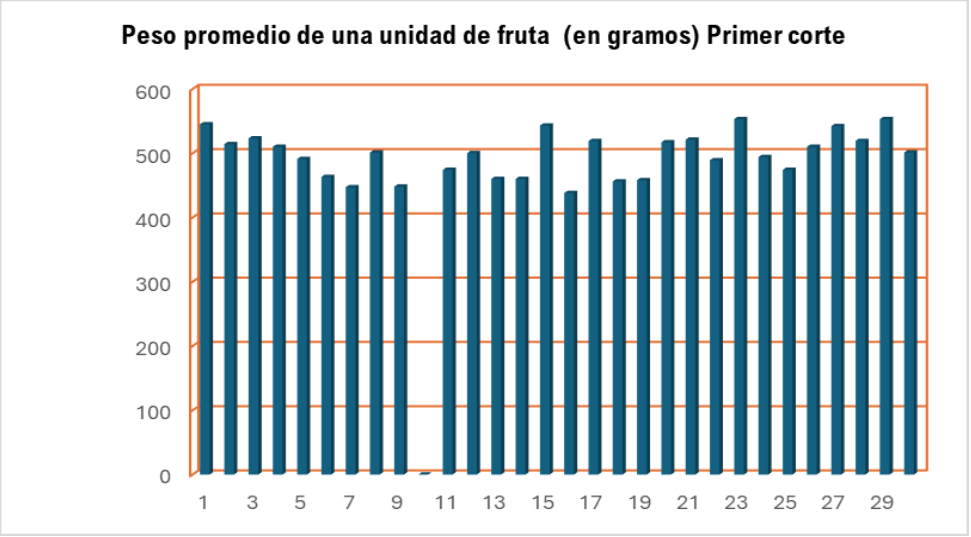
8. ATTACHMENTS

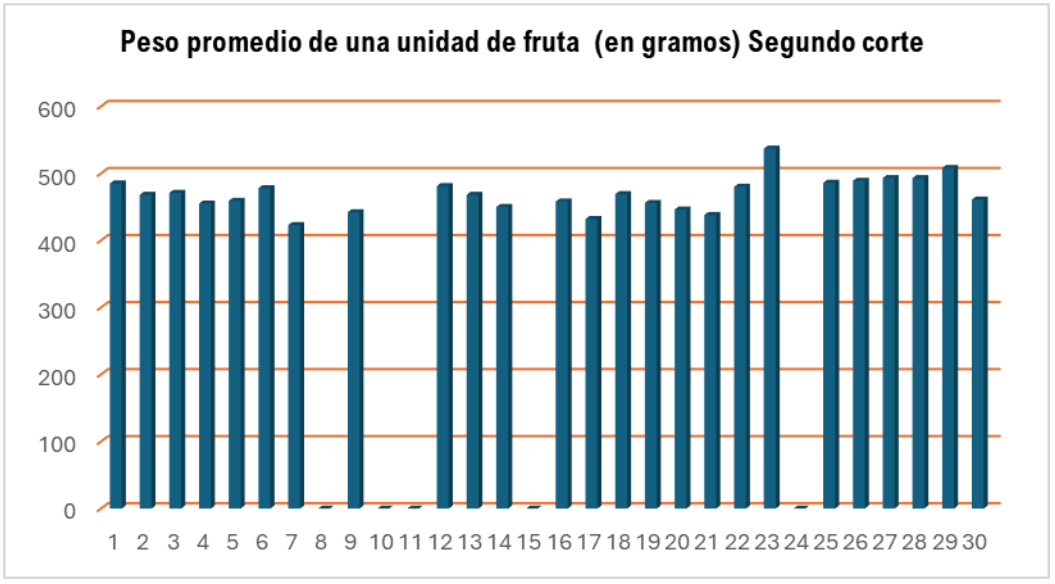
Attachment 1. Harvest results from the experimental trial at the East Site - Zacapa. Phase 1 - 2023–2024

EFFECT OF DIFFERENT WATER LEVELS ON THE PRODUCTION PARAMETERS OF MANGO TREES GROWN IN GUATEMALA

Treatments	T1R1	T1R2	T1R3	T1R4	T1R5	T2R1	T2R2	T2R3	T2R4	T2R5	T3R1	T3R2	T3R3	T3R4	T3R5	T4R1	T4R2	T4R3	T4R4	T4R5	T5R1	T5R2	T5R3	T5R4	T5R5	T0R1	T0R2	T0R3	T0R4	T0R5
Weight in grams/fruit	560	420	480	640	710	390	560	500	430	0	410	520	600	390	420	430	630	480	520	410	370	690	560	400	640	420	370	590	420	480
First Cut	430	400	530	360	420	420	400	440	380	0	430	510	410	520	460	420	710	400	520	420	630	360	380	510	450	480	630	560	480	510
	640	590	640	600	430	450	430	650	370	0	460	400	540	480	500	400	470	460	350	420	500	450	720	630	560	460	500	450	620	500
	750	370	500	470	430	530	430	430	380	0	520	430	630	550	650	430	600	450	340	490	430	480	600	440	580	600	540	480	600	540
The weight of a sample of 10 mangos per treatment was recorded	460	490	410	560	490	480	510	400	460	0	460	480	350	430	450	430	460	430	430	470	620	500	470	450	430	530	620	500	570	470
	490	580	500	620	390	470	500	510	520	0	520	700	360	490	610	500	380	410	640	600	620	480	520	670	370	440	620	480	560	670
	560	610	630	520	600	410	440	600	400	0	530	540	350	360	620	460	590	480	410	630	460	600	580	420	540	490	560	590	580	420
	430	630	710	410	630	540	370	710	430	0	480	500	460	430	610	380	510	580	500	700	420	450	490	510	410	570	420	560	490	510
	610	430	380	370	380	380	390	370	720	0	400	440	400	520	500	390	420	470	480	440	580	370	670	550	360	600	580	470	670	550
	520	620	450	550	430	560	440	400	390	0	530	480	500	430	610	540	420	400	390	590	580	510	540	360	400	510	580	510	540	360
Average weight for a unit of fruit (in grams)	545	514	523	510	491	463	447	501	448	0	474	500	460	460	543	438	519	456	458	517	521	489	553	494	474	510	542	519	553	501

Treatments	T1R1	T1R2	T1R3	T1R4	T1R5	T2R1	T2R2	T2R3	T2R4	T2R5	T3R1	T3R2	T3R3	T3R4	T3R5	T4R1	T4R2	T4R3	T4R4	T4R5	T5R1	T5R2	T5R3	T5R4	T5R5	T0R1	T0R2	T0R3	T0R4	T0R5
Weight in grams/fruit	510	410	400	410	540	490	430	0	380	0	0	530	610	430	0	360	490	500	410	500	410	390	510	0	500	500	370	590	420	480
Second Cut	430	380	510	480	400	380	420	0	410	0	0	400	370	420	0	410	420	450	430	430	380	630	440	0	530	430	530	560	480	410
	620	450	630	530	430	410	430	0	440	0	0	400	420	460	0	480	400	420	430	420	390	560	400	0	510	410	500	450	420	450
	480	390	680	400	520	400	420	0	430	0	0	430	450	440	0	510	540	480	560	400	450	420	680	0	470	590	540	480	450	540
	430	510	370	450	600	530	450	0	430	0	0	520	430	460	0	530	350	620	490	420	470	480	640	0	410	560	430	440	570	470
The weight of a sample of 10 mangos per treatment was recorded	510	400	420	400	400	600	390	0	410	0	0	480	410	520	0	450	390	390	500	440	490	460	520	0	400	490	520	480	560	420
	460	630	410	380	470	710	410	0	500	0	0	510	440	360	0	390	370	590	540	490	470	600	530	0	430	470	560	490	480	420
	580	520	500	490	400	430	440	0	590	0	0	410	410	420	0	370	490	410	350	540	470	430	690	0	500	440	420	460	490	510
	440	510	390	510	390	430	440	0	410	0	0	500	500	510	0	620	460	420	430	410	510	410	430	0	490	610	480	470	670	550
	390	480	400	500	440	400	400	0	420	0	0	630	640	480	0	460	410	410	420	410	340	420	530	0	620	390	580	510	540	360
Average weight for a unit of fruit (in grams)	485	468	471	455	459	478	423	0	442	0	0	481	468	450	0	458	432	469	456	446	438	480	537	0	486	489	493	493	508	461





FIRST CUT

	T1 R1	T1 R2	T1 R3	T1 R4	T1 R5	T2 R1	T2 R2	T2 R3	T2 R4	T2 R5	T3 R1	T3 R2	T3 R3	T3 R4	T3 R5	T4 R1	T4 R2	T4 R3	T4 R4	T4 R5	T5 R1	T5 R2	T5 R3	T5 R4	T5 R5	T0 R1	T0 R2	T0 R3	T0 R4	T0 R5
No. of Baskets	36	35	63	44	29	7	46	10	38	0	1	36	26	14	14	46	18	3	3	56	53	20	24	6	34	32	26	33	31	34
Size																														
UNDERWEIGHT	0	1	1	0	0	0	2	0	0	0	0	3	1	0	0	1	0	0	0	3	0	0	2	0	2	1	0	2	0	2
14	1	2	1	10	1	0	2	1	1	0	0	1	0	0	1	18	1	0	0	2	1	2	3	0	0	0	2	3	0	0
12	106	82	157	105	81	16	72	29	81	0	0	64	28	18	44	218	48	5	2	114	98	52	69	4	40	64	56	71	48	45
10	255	242	391	226	209	57	210	83	206	0	1	156	109	70	107	441	145	9	7	352	318	168	156	26	143	188	173	176	234	164
9	171	181	294	199	136	36	199	47	212	0	3	141	106	64	68	230	100	6	6	256	264	105	116	19	150	165	105	155	177	202
8	300	308	513	362	244	60	405	93	348	0	14	312	230	138	110	287	134	20	24	482	448	153	201	49	294	260	253	295	192	294
7	160	149	293	227	124	21	270	34	185	0	9	202	143	84	52	104	63	24	16	255	270	93	103	41	203	156	101	170	171	190
6	98	88	244	176	67	14	215	23	118	0	4	190	150	57	34	74	51	14	24	230	176	33	62	32	190	123	98	115	122	113
OVERWEIGHT	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
TOTAL	1092	1053	1895	1306	862	204	1376	310	1151	0	31	1069	767	431	416	1373	542	78	79	1694	1575	606	712	171	1022	958	788	987	944	1010
No. of Baskets	36	35	63	44	29	7	46	10	38	0	1	36	26	14	14	46	18	3	3	56	53	20	24	6	34	32	26	33	31	34

Frutos comerciales

SECOND CUT

	T1 R1	T1 R2	T1 R3	T1 R4	T1 R5	T2 R1	T2 R2	T2 R3	T2 R4	T2 R5	T3 R1	T3 R2	T3 R3	T3 R4	T3 R5	T4 R1	T4 R2	T4 R3	T4 R4	T4 R5	T5 R1	T5 R2	T5 R3	T5 R4	T5 R5	T0 R1	T0 R2	T0 R3	T0 R4	T0 R5
No. of Baskets	2	3	2	2	3	3	1		3			2	3	3		1	2	1	1	1	2	1	2	3	3	1	0	1	0	1
Size																														
UNDERWEIGHT	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	1	0	1	3	0	3	0	0	2	0	0	1	7	0	0	0	0	1	0	2	0	0	2	0	0	0	0	0	0	0
10	4	10	4	13	7	11	1	0	10	0	0	4	21	1	0	5	9	0	1	5	8	3	7	7	7	3	0	1	0	2
9	12	21	14	13	13	22	4	0	18	0	0	6	14	10	0	1	15	5	9	11	10	6	16	10	10	7	0	3	0	5
8	12	9	18	8	22	26	5	0	23	0	0	8	14	14	0	3	10	2	5	2	7	9	15	11	11	6	0	7	0	5
7	8	15	13	12	19	15	2	0	18	0	0	15	16	16	0	6	11	5	4	7	9	10	14	22	22	3	0	4	0	1
6	27	38	16	23	38	23	10	0	11	0	0	29	30	43	0	5	8	4	1	9	20	8	14	39	39	9	0	12	0	7
OVERWEIGHT	0	1	0	1	1	0	1	0	0	0	0	3	0	0	0	0	0	0	0	0	0	2	1	2	2	0	0	0	0	0
SUMA	64	94	66	74	100	100	23	0	82	0	0	66	102	85	0	20	53	17	20	36	54	38	69	91	91	28	0	27	0	20
No. of Baskets	2	3	2	2	3	3	1	0	3	0	0	2	3	3	0	1	2	1	1	1	2	1	2	3	3	1	0	1	0	1

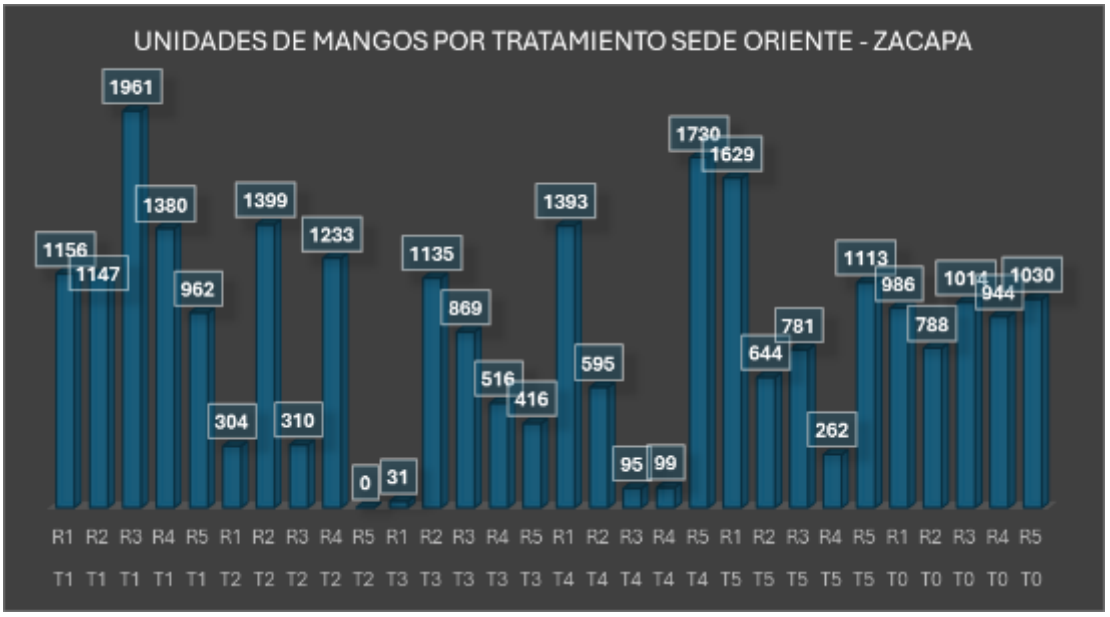
Frutos comerciales

INTEGRATED CUT (1 +2)

	T1 R1	T1 R2	T1 R3	T1 R4	T1 R5	T2 R1	T2 R2	T2 R3	T2 R4	T2 R5	T3 R1	T3 R2	T3 R3	T3 R4	T3 R5	T4 R1	T4 R2	T4 R3	T4 R4	T4 R5	T5 R1	T5 R2	T5 R3	T5 R4	T5 R5	T0 R1	T0 R2	T0 R3	T0 R4	T0 R5
No. of Baskets	38	38	65	46	32	10	47	10	41	0	1	38	29	17	14	47	20	4	4	57	55	21	26	9	37	33	26	34	31	35
Size																														
UNDERWEIGHT	0	1	1	1	0	0	2	0	0	0	0	3	1	0	0	1	0	0	0	3	0	0	2	0	2	1	0	2	0	2
14	1	2	1	10	1	0	2	1	1	0	0	1	0	1	1	18	1	0	0	2	1	2	3	0	0	0	2	3	0	0
12	107	82	158	108	81	19	72	29	83	0	0	65	35	18	44	218	48	6	2	116	98	52	71	4	40	64	56	71	48	45
10	259	252	395	239	216	68	211	83	216	0	1	160	130	71	107	446	154	9	8	357	326	171	163	33	150	191	173	177	234	166
9	183	202	308	212	149	58	203	47	230	0	3	147	120	74	68	231	115	11	15	267	274	111	132	29	160	172	105	158	177	207
8	312	317	531	370	266	86	410	93	371	0	14	320	244	152	110	290	144	22	29	484	455	162	216	60	305	266	253	302	192	299
7	168	164	306	239	143	36	272	34	203	0	9	217	159	100	52	110	74	29	20	262	279	103	117	63	225	159	101	174	171	191
6	125	126	260	199	105	37	225	23	129	0	4	219	180	100	34	79	59	18	25	239	196	41	76	71	229	132	98	127	122	120
OVERWEIGHT	1	1	1	2	1	0	2	0	0	0	0	3	0	0	0	0	0	0	0	0	0	2	1	2	2	1	0	0	0	0
TOTAL	1156	1147	1961	1380	962	304	1399	310	1233	0	31	1135	869	516	416	1393	595	95	99	1730	1629	644	781	262	1113	986	788	1014	944	1030
No. of Baskets	39	38	65	46	32	10	47	10	41	0	1	38	29	17	14	46	20	3	3	58	54	21	26	9	37	33	26	34	31	34

Frutos comerciales

TREATMENT	T1	T1	T1	T1	T1	T2	T2	T2	T2	T2	T3	T3	T3	T3	T3
REPETITION	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5
YIELD PER HECTARE (t/ha)	21.3	20.1	34.8	23.8	16.3	5.1	21.7	2.88	19.6	0	0.26	19.9	14.4	8.4	4.03
TREATMENT	T4	T4	T4	T4	T4	T5	T5	T5	T5	T5	T0	T0	T0	T0	T0
REPETITION	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5
YIELD PER HECTARE (t/ha)	22.3	10.1	1.57	1.62	29.7	27.9	11.1	15.2	2.31	19.1	17.6	14.6	18.3	17.9	19.2



Attachment 2. Harvest results from the experimental trial at the South Site in Retalhuleu. Phase 1 – 2023–2024

MANGO WEIGHT VARIABLE PER TREATMENT, SOUTH SITE - RETALHULEU													
CUT 1			PESO (gr)										Promedio
1	T1	R1	480	443	420	475	365	390	480	385	480	405	438
2	T1	R2	543	487	507	487	497	430	540	430	415	465	483
3	T1	R3	447	420	400	373	403	373	393	357	520	370	398
4	T1	R4	567	435	470	425	460	300	300	380	380	0	511
5	T1	R5	593	603	520	503	467	547	430	390	453	443	495
6	T2	R1	493	433	423	385	545	480	485	355	420	450	440
7	T2	R2	500	380	473	443	400	427	430	475	420	465	438
8	T2	R3	423	363	360	467	383	437	447	507	463	413	426
9	T2	R4	417	483	380	433	390	390	380	423	527	443	427
10	T2	R5	610	497	423	570	540	465	405	535	425	500	480
11	T3	R1	460	417	413	423	500	487	407	483	477	390	446
12	T3	R2	470	453	423	453	410	430	480	443	447	450	446
13	T3	R3	450	430	437	420	350	393	430	363	390	317	398
14	T3	R4	487	420	470	553	350	353	477	453	393	497	445
15	T3	R5	487	417	383	400	417	440	397	525	510	415	434
16	T4	R1	557	417	403	417	415	680	590	410	410	430	455
17	T4	R2	453	443	430	490	430	473	470	413	423	433	446
18	T4	R3	537	497	497	443	380	513	483	570	470	470	479
19	T4	R4	580	503	503	530	473	470	543	453	447	457	496
20	T4	R5	460	597	483	490	493	467	463	457	497	450	486
21	T5	R1	493	413	507	447	427	423	463	447	370	423	441
22	T5	R2	613	520	420	453	513	473	553	457	403	483	489
23	T5	R3	440	513	560	527	407	500	500	525	625	425	494
24	T5	R4	527	453	473	570	475	375	465	450	500	600	495
25	T5	R5	380	397	403	533	467	500	437	443	487	417	446
26	T0	R1	483	447	427	400	487	430	515	395	420	460	447
27	T0	R2	433	487	463	400	427	430	515	395	420	460	448
28	T0	R3	453	433	463	427	503	430	515	395	420	460	455
29	T0	R4	523	487	450	400	487	430	515	395	420	460	469
30	T0	R5	463	443	440	480	487	430	515	395	420	460	463

MANGO WEIGHT VARIABLE PER TREATMENT, SOUTH SITE - RETALHULEU													
CUT 2													
			PESO (gr)										Promedio
1	T1	R1	457	500	530	537	557	523	443	400	420	517	488
2	T1	R2	580	527	507	530	550	567	527	487	600	533	541
3	T1	R3	595	355	400	445	440	400	445	420	550	400	445
4	T1	R4	0	0	0	0	0	0	0	0	0	0	0
5	T1	R5	525	595	445	420	610	435	415	410	385	535	478
6	T2	R1	407	430	417	470	490	517	473	443	600	423.333	467
7	T2	R2	510	525	405	440	485	505	550	515	425	415	478
8	T2	R3	383	420	343	500	523	397	367	600	467	453	445
9	T2	R4	507	410	540	497	483	473	507	457	550	510	493
10	T2	R5	540	380	450	310	460	510	550	590	430	730	495
11	T3	R1	510	620	505	425	510	415	385	585	425	355	474
12	T3	R2	450	443	450	460	400	560	540	483	577	507	487
13	T3	R3	420	430	407	587	490	400	453	433	533	483	466
14	T3	R4	463	417	393	547	440	433	440	483	533	527	468
15	T3	R5	463	537	493	540	443	407	517	540	503	573	502
16	T4	R1	510	500	577	463	390	550	403	460	473	490	482
17	T4	R2	463	477	513	563	533	427	440	493	460	570	494
18	T4	R3	440	430	415	600	475	400	550	525	485	495	482
19	T4	R4	497	430	557	453	530	477	480	390	443	430	469
20	T4	R5	507	483	523	450	437	407	450	560	483	463	476
21	T5	R1	430	547	467	530	420	537	507	523	437	457	485
22	T5	R2	557	483	600	480	630	560	500	527	400	547	528
23	T5	R3	610	517	570	417	460	507	473	553	453	440	500
24	T5	R4	440	430	595	575	575	420	525	530	490	375	496
25	T5	R5	580	500	433	397	507	500	397	437	440	475	466
26	T0	R1	420	650	420	550	540	400	400	490	390	310	457
27	T0	R2	435	510	415	470	440	450	450	535	465	450	462
28	T0	R3	420	470	477	480	460	400	400	490	390	310	441
29	T0	R4	443	440	403	397	447	495	415	500	355	380	426
30	T0	R5	500	445	445	415	530	535	425	415	495	405	461

FIRST CUT																														
TREATMENT	T1	T1	T1	T1	T1	T2	T2	T2	T2	T2	T3	T3	T3	T3	T3	T4	T4	T4	T4	T4	T5	T5	T5	T5	T5	T0	T0	T0	T0	T0
REPETITION	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5
No. DE MANGOS/ TREATMENT	31	96	28	15	74	36	37	64	56	26	60	29	64	48	71	23	100	50	109	104	90	101	80	44	47	26	41	33	47	42

SECOND CUT																														
TREATMENT	T1	T1	T1	T1	T1	T2	T2	T2	T2	T2	T3	T3	T3	T3	T3	T4	T4	T4	T4	T4	T5	T5	T5	T5	T5	T0	T0	T0	T0	T0
REPETITION	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5
No. DE MANGOS/ TREATMENT	124	93	52	0	130	103	94	211	187	23	131	144	187	149	69	103	153	67	131	337	207	239	194	139	108	70	64	42	102	51

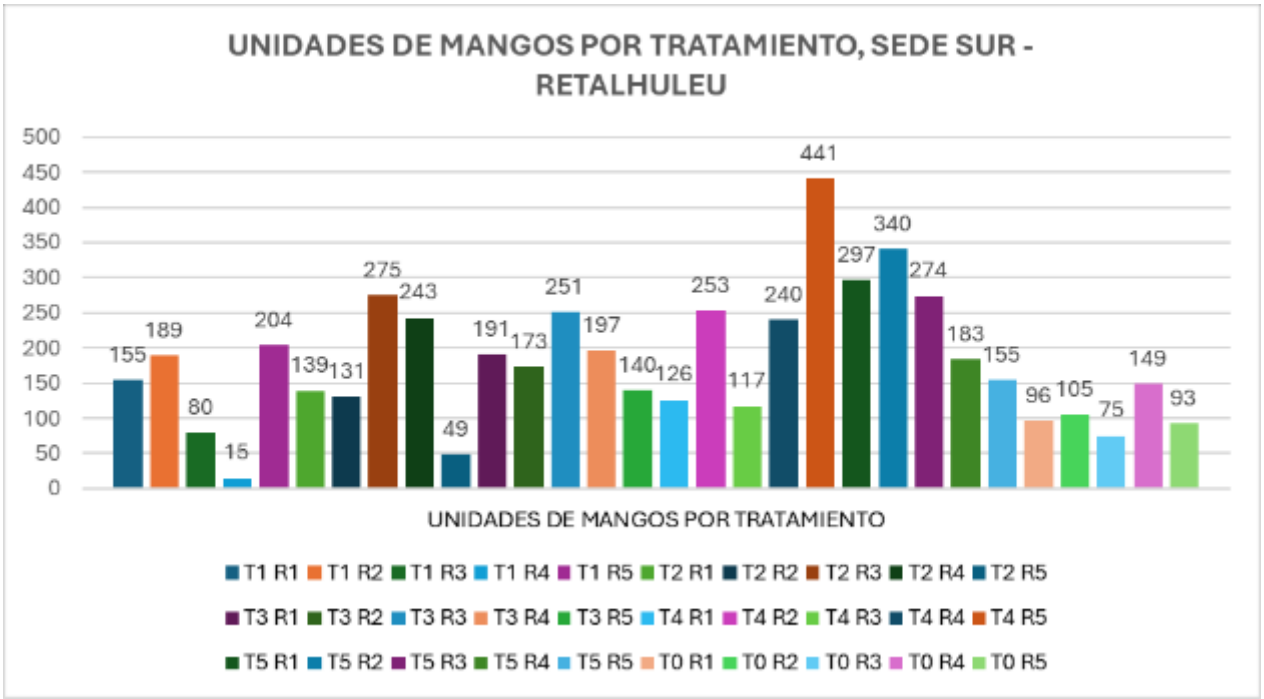
INTEGRATED CUT (1+2)																														
TREATMENT	T1	T1	T1	T1	T1	T2	T2	T2	T2	T2	T3	T3	T3	T3	T3	T4	T4	T4	T4	T4	T5	T5	T5	T5	T5	T0	T0	T0	T0	T0
REPETITION	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5
No. DE MANGOS/ TREATMENT	155	189	80	15	204	139	131	275	243	49	191	173	251	197	140	126	253	117	240	441	297	340	274	183	155	96	105	75	149	93

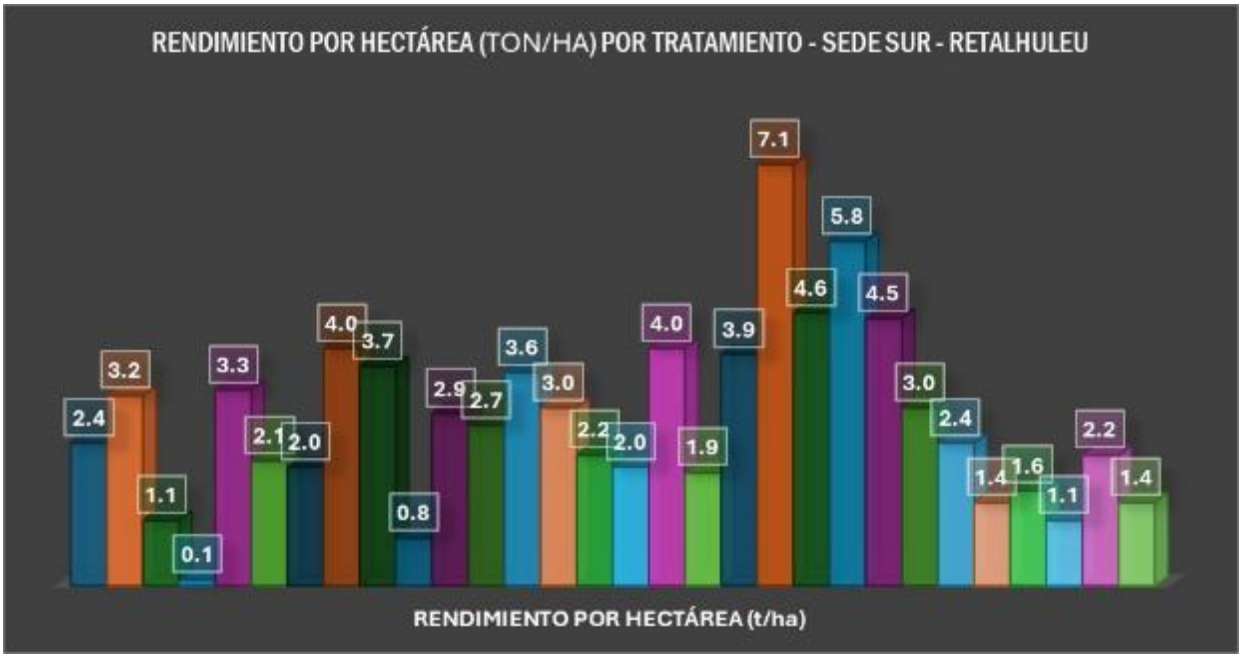
TREATMENT	T1	T1	T1	T1	T1	T2	T2	T2	T2	T2	T3	T3	T3	T3	T3	T4	T4	T4	T4	T4	T5	T5	T5	T5	T5	T0	T0	T0	T0	T0
REPETITION	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5
UNIDADES DE MANGOS POR TREATMENT	155	189	80	15	204	139	131	275	243	49	191	173	251	197	140	126	253	117	240	441	297	340	274	183	155	96	105	75	149	93
AVG WEIGHT PER MANGO (kg)	0.46	0.51	0.42	0.26	0.49	0.45	0.46	0.44	0.46	0.49	0.46	0.47	0.43	0.46	0.47	0.47	0.47	0.48	0.48	0.48	0.46	0.51	0.50	0.50	0.46	0.45	0.46	0.45	0.45	0.46
TOTAL WEIGHT PER TREATMENT (kg)	71.8	96.8	33.7	3.8	99.2	63.0	60.0	119.8	111.8	23.9	87.9	80.7	108.4	89.9	65.5	59.0	118.9	56.2	115.8	212.1	137.5	172.9	136.2	90.7	70.7	43.4	47.8	33.6	66.7	43.0
YIELD PER HECTARE (t/ha)	2.4	3.2	1.1	0.1	3.3	2.1	2.0	4.0	3.7	0.8	2.9	2.7	3.6	3.0	2.2	2.0	4.0	1.9	3.9	7.1	4.6	5.8	4.5	3.0	2.4	1.4	1.6	1.1	2.2	1.4

FIRST CUT																														
TREATMENT	T1	T1	T1	T1	T1	T2	T2	T2	T2	T2	T3	T3	T3	T3	T3	T4	T4	T4	T4	T4	T5	T5	T5	T5	T5	T0	T0	T0	T0	T0
REPETITION	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5
No. DE MANGOS/ TREATMENT	31	96	28	15	74	36	37	64	56	26	60	29	64	48	71	23	100	50	109	104	90	101	80	44	47	26	41	33	47	42
UNDERWEIGHT PESO	0	1	0	0	0	0	1	0	0	0	0	2	1	0	0	1	0	0	0	1	0	0	2	0	1	1	0	2	0	1
MANGOS CON OVERWEIGHT	1	0	0	2	0	0	0	0	0		0	1	0	0	1	0	0	1	0	3	0	0	1	0	0	1	0	0	0	1

SECOND CUT																														
TREATMENT	T1	T1	T1	T1	T1	T2	T2	T2	T2	T2	T3	T3	T3	T3	T3	T4	T4	T4	T4	T4	T5	T5	T5	T5	T5	T0	T0	T0	T0	T0
REPETITION	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5
No. DE MANGOS/ TREATMENT	124	93	52	0	130	103	94	211	187	23	131	144	187	149	69	103	153	67	131	337	207	239	194	139	108	70	64	42	102	51
UNDERWEIGHT PESO	1	0	1	0	0	1	0	1	0	1	0	0	1	0	0	1	0	0	2	0	0	1	0	0	2	0	0	0	1	0
MANGOS CON OVERWEIGHT	0	1	0	1	1	0	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0

INTEGRATED CUT (1+2)																														
TREATMENT	T1	T1	T1	T1	T1	T2	T2	T2	T2	T2	T3	T3	T3	T3	T3	T4	T4	T4	T4	T4	T5	T5	T5	T5	T5	T0	T0	T0	T0	T0
REPETITION	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5
No. DE MANGOS/ TREATMENT	155	189	80	15	204	139	131	275	243	49	191	173	251	197	140	126	253	117	240	441	297	340	274	183	155	96	105	75	149	93
UNDERWEIGHT MANGOS	1	1	1	0	0	1	1	1	0	1	0	2	2	0	0	2	0	0	2	1	0	1	2	0	3	1	0	2	1	1
MANGOS CON OVERWEIGHT	1	1	0	3	1	0	2	0	0	0	0	3	0	0	1	0	0	1	0	3	0	1	2	1	1	1	0	0	0	1


UNIDADES DE MANGOS POR TRATAMIENTO, SEDE SUR - RETALHULEU
500
450
400
350
300
250
200
150
100
50
0
155 189 80 15 204 139 131 275 243 49 191 173 251 197 140 126 253 117 240 441 297 340 274 183 155 96 105 75 149 93
UNIDADES DE MANGOS POR TRATAMIENTO
T1 R1 T1 R2 T1 R3 T1 R4 T1 R5 T2 R1 T2 R2 T2 R3 T2 R4 T2 R5
T3 R1 T3 R2 T3 R3 T3 R4 T3 R5 T4 R1 T4 R2 T4 R3 T4 R4 T4 R5
T5 R1 T5 R2 T5 R3 T5 R4 T5 R5 T0 R1 T0 R2 T0 R3 T0 R4 T0 R5


RENDIMIENTO POR HECTÁREA (TON/HA) POR TRATAMIENTO - SEDE SUR - RETALHULEU
2.4 3.2 1.1 0.1 3.3 2.1 2.0 4.0 3.7 0.8 2.9 2.7 3.6 3.0 2.2 2.0 4.0 1.9 3.9 7.1 4.6 5.8 4.5 3.0 2.4 1.4 1.6 1.1 2.2 1.4
RENDIMIENTO POR HECTÁREA (t/ha)

Attachment 3. Photos related to the management of the experimental trial. Phase 1 – 2023–2024

EXPERIMENTAL TRIAL SOUTH SITE - RETALHULEU

EXPERIMENTAL TRIAL EAST SITE - ZACAPA

Attachment 4. Harvest results from the experimental trial at the East Site - Zacapa. Phase 2 - 2024–2025

EFFECT OF DIFFERENT WATER LEVELS ON THE PRODUCTION PARAMETERS OF MANGO TREES GROWN IN GUATEMALA

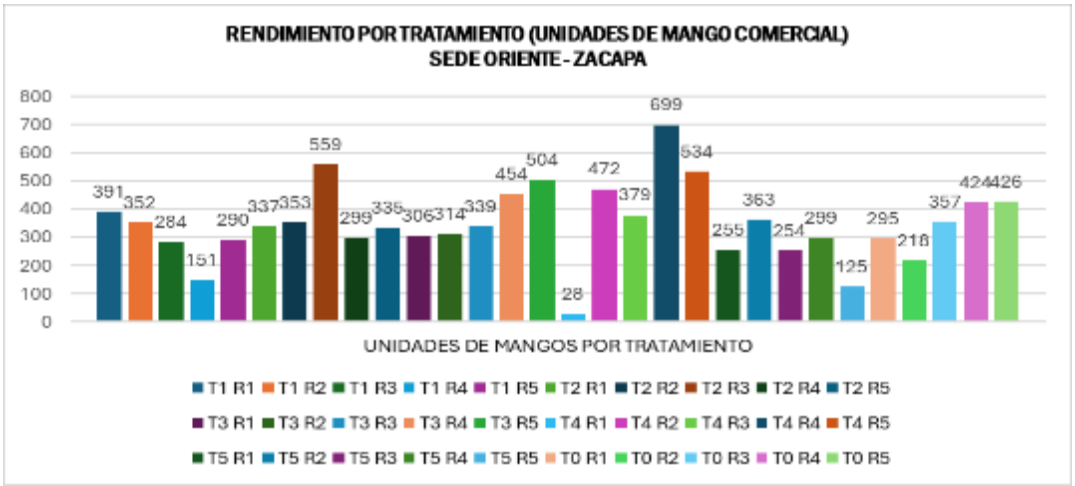
EAST SITE - ZACAPA, GUATEMALA

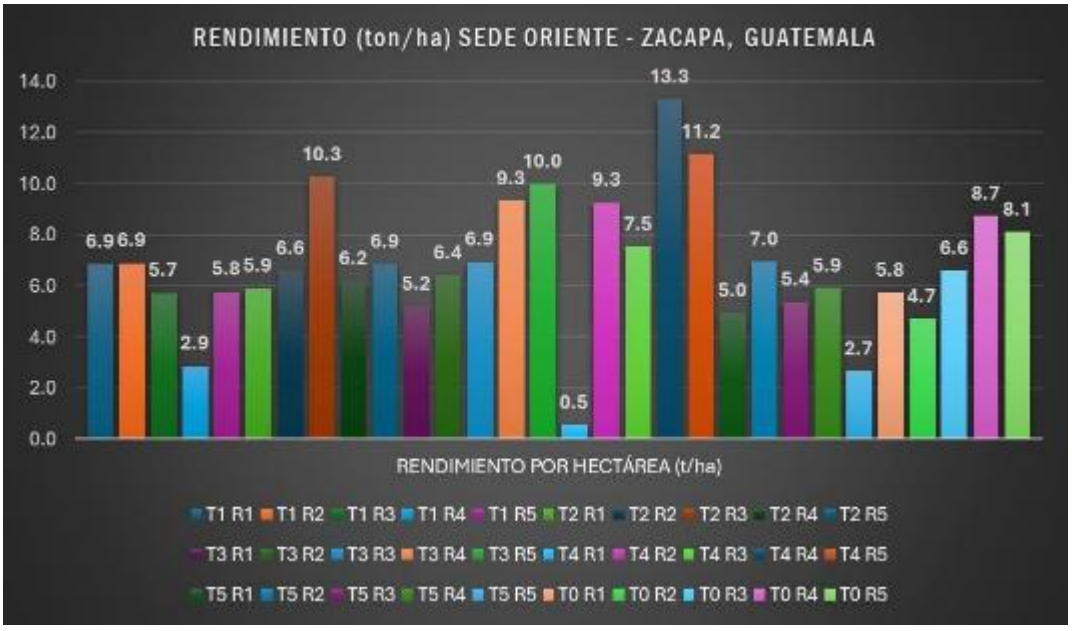
Treatments	T1R1	T1R2	T1R3	T1R4	T1R5	T2R1	T2R2	T2R3	T2R4	T2R5	T3R1	T3R2	T3R3	T3R4	T3R5	T4R1	T4R2	T4R3	T4R4	T4R5	T5R1	T5R2	T5R3	T5R4	T5R5	T0R1	T0R2	T0R3	T0R4	T0R5
Weight in grams/fruit	500	500	580	580	600	620	480	400	740	540	560	620	840	480	340	0	560	660	680	700	580	500	520	500	700	620	640	500	600	620
Primer Corte	400	700	440	520	500	510	460	450	540	600	360	520	380	540	440	0	480	620	580	620	420	420	700	400	600	500	680	600	400	510
	700	510	660	480	600	400	620	460	400	660	600	440	680	680	640	0	420	540	500	740	480	480	640	700	520	520	700	400	480	400
	520	640	500	520	520	420	480	490	640	540	640	840	400	400	680	0	380	640	400	600	400	500	520	480	800	580	800	500	600	420
Weighed a sample of 25mangos per treatment	540	440	540	340	600	340	560	480	740	640	440	740	620	460	540	0	360	520	400	620	560	520	580	620	500	320	840	600	500	340
	500	600	660	400	420	0	520	580	540	760	360	580	400	500	450	0	440	380	500	560	720	480	500	480	520	480	640	620	600	580
	440	660	600	500	480	0	460	680	680	480	440	540	420	700	700	0	600	640	460	840	420	0	640	700	560	500	660	600	700	460
	500	560	500	520	700	0	560	700	520	700	460	360	580	620	600	0	500	760	680	510	500	500	540	580	600	460	600	340	800	530
	440	720	600	500	620	0	440	560	700	440	340	520	600	540	620	0	400	560	500	560	580	720	500	440	940	420	700	500	600	460
	500	580	560	400	660	0	580	600	480	520	360	720	600	380	580	0	520	600	580	600	680	560	500	700	640	600	800	640	600	340
	560	620	520	660	520	440	600	520	520	540	680	520	620	520	650	0	340	600	520	580	720	560	700	600	620	720	500	500	620	340
During this production cycle, only a single cut was made as the only harvest	520	520	500	540	600	380	460	520	500	520	0	600	500	600	700	0	640	420	500	620	700	480	660	800	640	640	500	450	560	380
	520	540	620	520	440	500	580	520	520	900	0	480	580	380	720	0	760	460	650	520	640	560	700	500	840	580	500	680	480	640
	700	700	620	580	460	500	580	500	600	620	0	660	520	620	400	0	720	440	640	320	520	580	560	600	860	640	520	540	500	620
	500	500	640	780	620	580	480	400	620	520	0	620	580	480	410	0	520	490	400	500	400	680	580	600	540	560	600	580	560	500
	0	520	680	400	450	600	480	450	560	600	0	540	680	620	780	620	480	620	0	800	480	720	400	600	500	600	340	480	720	600
	0	500	620	700	500	460	600	530	500	500	0	580	560	600	400	420	480	500	0	580	540	540	680	580	420	520	380	400	440	400
	0	380	580	400	580	700	480	470	680	500	0	560	430	620	500	540	920	640	0	500	440	580	540	440	400	520	360	450	480	800
	0	520	500	600	560	440	360	580	400	400	0	600	380	640	500	960	580	380	0	500	600	340	700	520	600	580	400	500	480	780
	0	480	460	420	640	360	380	460	700	600	0	500	360	600	460	680	680	600	0	340	480	500	580	580	500	800	480	520	490	600
	440	560	580	640	560	460	520	540	620	540	0	600	720	700	700	620	600	620	0	540	0	500	600	420	600	460	520	640	500	600
	600	500	500	500	720	500	720	540	0	440	0	600	900	840	700	360	480	660	0	640	0	820	820	580	560	340	660	600	700	500
	500	440	620	640	540	700	700	400	0	500	0	560	580	540	600	440	580	560	0	620	0	580	500	480	500	480	720	640	700	700
	380	480	500	500	500	660	400	0	0	620	0	580	680	660	400	380	800	450	0	500	0	680	480	420	400	680	800	320	800	620
	380	520	520	600	540	560	600	0	0	660	0	420	700	640	380	340	500	560	0	700	0	620	640	560	460	520	820	300	500	560
Average weight for a unit of fruit (in grams)	**491.3**	**547.6**	**564.0**	**529.6**	**557.2**	**490.3**	**524.0**	**514.3**	**581.0**	**573.6**	**476.4**	**572.0**	**572.4**	**574.4**	**555.6**	**536.0**	**549.6**	**556.8**	**532.7**	**584.4**	**543.0**	**536.8**	**591.2**	**555.2**	**592.8**	**545.6**	**606.4**	**516.0**	**576.4**	**532.0**
AVG WEIGHT (kg):	0.49	0.55	0.56	0.53	0.56	0.49	0.52	0.51	0.58	0.57	0.48	0.57	0.57	0.57	0.56	0.54	0.55	0.56	0.53	0.58	0.54	0.54	0.59	0.56	0.59	0.55	0.61	0.52	0.58	0.53

SINGLE CUT

	T1 R1	T1 R2	T1 R3	T1 R4	T1 R5	T2 R1	T2 R2	T2 R3	T2 R4	T2 R5	T3 R1	T3 R2	T3 R3	T3 R4	T3 R5	T4 R1	T4 R2	T4 R3	T4 R4	T4 R5	T5 R1	T5 R2	T5 R3	T5 R4	T5 R5	T0 R1	T0 R2	T0 R3	T0 R4	T0 R5
Size																														
UNDERWEIGHT	4	0	5	0	2	7	0	1	0	0	1	1	0	1	0	0	0	1	2	2	0	0	0	0	0	0	0	0	0	0
14	1	4	2	3	1	1	2	1	3	0	4	3	2	2	5	0	6	4	3	7	6	5	0	3	1	0	0	1	2	5
12	19	21	21	23	16	23	19	40	36	21	28	15	28	40	45	1	54	30	39	42	28	32	16	36	8	17	15	17	59	19
10 Frutos comer Ciales	42	34	37	38	23	39	32	59	51	50	42	24	49	51	49	1	110	38	68	60	35	56	51	51	18	37	25	48	97	45
9	61	53	50	18	50	55	54	82	41	57	64	47	64	77	83	4	95	60	117	112	41	57	40	41	16	34	26	59	95	59
8	93	66	62	27	58	75	84	115	61	66	63	66	64	96	111	6	95	86	143	104	43	77	52	61	32	69	49	78	82	84
7	84	75	53	30	71	64	67	122	53	78	65	67	62	79	97	8	68	73	165	104	50	82	43	53	19	73	46	78	44	110
6	85	96	53	12	68	73	92	139	52	62	39	90	70	107	109	7	44	87	162	102	52	52	52	52	31	65	57	76	45	102
OVERWEIGHT	2	3	1	0	1	0	3	0	2	1	0	1	0	1	5	1	0	0	0	1	0	2	0	2	0	0	0	0	0	2
TOTAL	391	352	284	151	290	337	353	559	299	335	306	314	339	454	504	28	472	379	699	534	255	363	254	299	125	295	218	357	424	426
No. OF BASKETS	13	12	9	5	10	11	12	19	10	11	10	10	11	15	17	1	16	13	23	18	9	12	8	10	4	10	7	12	14	14

TREATMENT REPETITION	T1 R1	T1 R2	T1 R3	T1 R4	T1 R5	T2 R1	T2 R2	T2 R3	T2 R4	T2 R5	T3 R1	T3 R2	T3 R3	T3 R4	T3 R5	T4 R1	T4 R2	T4 R3	T4 R4	T4 R5	T5 R1	T5 R2	T5 R3	T5 R4	T5 R5	T0 R1	T0 R2	T0 R3	T0 R4	T0 R5
MANGO UNITS PER TREATMENT	391	352	284	151	290	337	353	559	299	335	306	314	339	454	504	28	472	379	699	534	255	363	254	299	125	295	218	357	424	426
AVG WEIGHT PER MANGO (kg)	0.49	0.55	0.56	0.53	0.56	0.49	0.52	0.51	0.58	0.57	0.48	0.57	0.57	0.57	0.56	0.54	0.55	0.56	0.53	0.58	0.54	0.54	0.59	0.56	0.59	0.55	0.61	0.52	0.58	0.53
TOTAL WEIGHT PER TREATMENT (kg)	192	193	160	80	162	165	185	288	174	192	146	180	194	261	280	15	259	211	372	312	138	195	150	166	74.1	161	132	184	244	227
YIELD PER HECTARE (t/ha)	6.9	6.9	5.7	2.9	5.8	5.9	6.6	10.3	6.2	6.9	5.2	6.4	6.9	9.3	10.0	0.5	9.3	7.5	13.3	11.1	4.9	7.0	5.4	5.9	2.6	5.7	4.7	6.6	8.7	8.1





TREATMENT	T1	T1	T1	T1	T1	T2	T2	T2	T2	T2	T3	T3	T3	T3	T3
REPETITION	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5
YIELD PER HECTARE (t/ha)	6.9	6.9	5.7	2.9	5.8	5.9	6.6	10.3	6.2	6.9	5.2	6.4	6.9	9.3	10.0
TREATMENT	T4	T4	T4	T4	T4	T5	T5	T5	T5	T5	T0	T0	T0	T0	T0
REPETITION	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5
YIELD PER HECTARE (t/ha)	0.5	9.3	7.5	13.3	11.1	4.9	7.0	5.4	5.9	2.6	5.7	4.7	6.6	8.7	8.1

Attachment 5. Harvest results from the experimental trial at the South Site – Retalhuleu. Phase 2 – 2024–2025

EFFECT OF DIFFERENT WATER LEVELS ON THE PRODUCTION PARAMETERS OF MANGO TREES GROWN IN GUATEMALA

SOUTH SITE - RETALHULEU, GUATEMALA

FIRST CUT

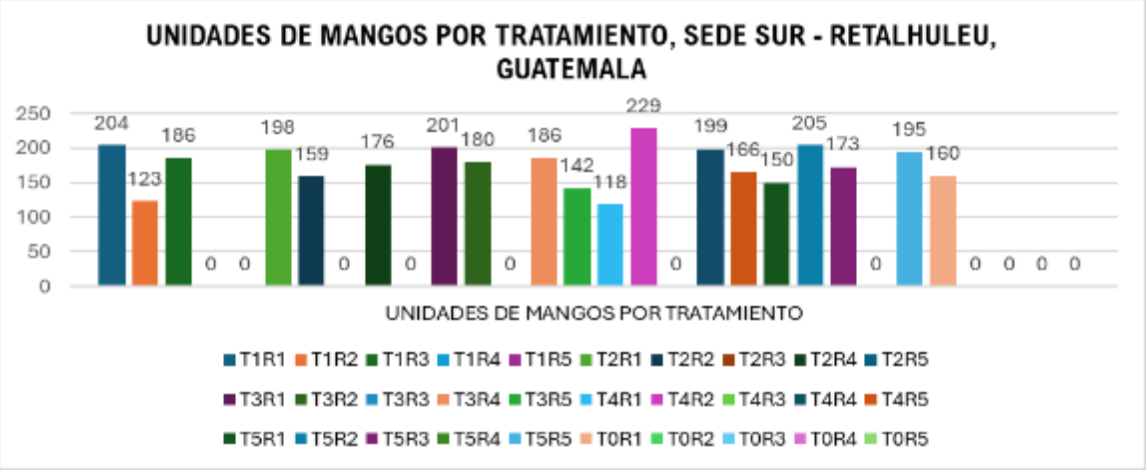
Treatments	T1R1	T1R2	T1R3	T1R4	T1R5	T2R1	T2R2	T2R3	T2R4	T2R5	T3R1	T3R2	T3R3	T3R4	T3R5	T4R1	T4R2	T4R3	T4R4	T4R5	T5R1	T5R2	T5R3	T5R4	T5R5	T0R1	T0R2	T0R3	T0R4	T0R5
Weight in grams/fruit	450	710	470			490	550		450		680	580		370	450	580	500		450	460	520	460	710		580	580				
Primer Corte	550	550	500			550	550		460		970	560		500	550	610	450		600	660	540	660	550		440	560				
	390	550	520			550	550		390		580	530		450	390	540	470		430	510	550	510	550		450	530				
	460	420	770			550	560		550		560	480		470	460	780	500		430	538	610	538	420		410	480				
The weight of all the mangos harvested in the treatment group was recorded	420	460	560			560	320		390		530	550		500	420	550	520		610	510	690	510	460		480	550				
	430	790	480			320	890		460		480	580		520	430	290	338		350	390	350	390	790		370	580				
	580	640	350			890	710		420		550	610		338	580	370	420		770	360	440	360	680		440	610				
	620	520	460			710	550		430		580	540		420	620	560	500		440	600	490	600	970		320	540				
	480	540	460			550	550		580		610	780		500	480	490	430		750	400	618	400	580		400	780				
	460	550	600			550	420		620		540	550		430	460	550	450		400	560	510	560	560		410	550				
	560	610	670			420	460		480		780	290		450	560	550	700		390	600	538	600	530		440	290				
In this production cycle, only one harvest was obtained as the sole harvest.	520	690	410			460	790		460		550	370		700	520	550	290		330	350	800	350	480		460	370				
	550	350	500			790	640		560		290	560		290	550	560	370		430	500	520	500	550		490	560				
	550	440	450			640	520		520		370	490		370	550	320	410		490	610	550	610	580		340	490				
	550	490	600			520	540		550		560	550		410	550	890	820		420	400	550	400	610		540	550				
	560	618	760			540	550		550		490	550		820	560	710	400		430	460	550	460	540		560	550				
	320	510	850			550	610		550		550	550		400	320	550	420		490	370	560	370	780		550	550				
	890	538	540			610	690		560		550	560		420	890	550	570		410	390	320	390	550		340	560				
	710	800	550			690	350		320		550	320		570	710	420	400		540	500	890	500	290		530	320				
	550	520	450			350	440		890		560	890		400	550	460	460		450	420	710	420	370		400	450				
	550	550	400			440	490		710		320	710		460	550	790	400		530	400	550	400	560		480	550				
	420	550	800			490	618		550		890	550		400	420	640	430		440	400	550	400	490		490	390				
	460	550	510			618	510		550		710	550		430	460	520	560		420	550	420	550	550		420	460				
	790	560	560			510	538		420		550	420		560	790	540	260		340	500	460	500	550		500	420				
	640	320	660			538	580		460		550	460		260	640	550	280		480	430	790	430	550		490	430				
	520	890	550			800	610		790		420	790		280	520	610	350		540	560	640	560	560		530	580				
	540	710	600			550	540		640		460	640		350	540	690	660		450	660	520	660	320		430	620				
	580	550	360			420	780		520		790	520		660	580	350	500		340	470	540	470	890		450	480				
	680	550	390			460	550		540		640	540		500	680	440	240		420	550	580	550	710		600	460				
	970	420	480			790	290		580		520	550		240	970	490	350		330	510	680	510	550		390	560				
	580	460	500			640	370		680		540	610		350	580	618	400		670	360	970	360	550		500	520				
	560	790	450			520	560		970		550	580		400	560	510	530		430	500	240	500	420		400	550				
	530	640	470			540	490		580		610			530	530	538	400		360	450	560	450	460		400	550				
	480	520	500			550	550		560		690			400	480	800	470		420	460	550	460	790		260	550				
	550	540	520			610	550		530		350			470	550	550	360		390	390	800	390	640		320	560				
	580	580	338			690	550		480		440			360	580	420	480		470	450		550	520		400	320				
	610	680	420				560		550		490			480	610	460	430		520	550		390	540		500	890				
	540	970	500				320		580		618			430	540	790	490		500	390		460	550		450	710				
	780	240	430				890		610		510			490		640	550		430	460		420	610		470	550				
	550	560	450				710		540		538			550		520	550		510	420		430	690		500	550				
	290		700				550		550		580			550		540	550		550	430		580	350		520	420				
	370		290				550		550		610			550		550	560		670	580		620	440		338	460				
	560		370				420		550		540			560		610	320		410	620		480	490		420	790				
	490		410				460		560		780			320		690	890		590	480		460	618		500	640				
	550		820				790		320		550			890		350	710		520	460		560	510		430	520				
	550		400				640		890		290			710		440	550		450	560		520	538		450	540				
	550		420				520		710		370			550		490	550		540	520		550	580		700	450				
	560		570				540		550		560			550		618	420		530	550		550	610		290	480				
	320		400				550		550		490			420		510	460		550	550		550	320		370	550				
	890		460				610		420		550			460		538	790		600	550		560	890		410					
	710		400				690		460		550			790		800	640		470	560		320	710		820					
	550		430				350		790		550			640		520	520		500	320		890	550		400					
	550		560				440		640		560			520		550	540		490	890		710	550		420					
	420		260				490		520		320			540		550	550		510	710		550	420		570					
	460		280				618		540		890			550		550	610		550	550		550	460		400					
	790		350				510		550		710			610		560	690		460	550		420	790		460					
	640		660				538		610		550			690		320	350		470	420		460	640		400					
	520		500				800		690		550			350		890	440		550	460		790	520		430					
	540		240				550		350		420			440			490		510	790		640	540		560					
	550		350				420		440		460			490			618		500	640		520	580		260					
	610		400				460		490		790			618			510		540	520		540	680		280					
	690		530				790		618		640			510			538		400	540		580	970		350					
	350		400				640		510		520			538			800		500	580		680	580		660					
	440		470				520		538		540			800			550		420	680		970	560		500					
	490		360								550			550			420		460			580	530		240					
	618		480								610			420			460		670			560	480		350					
	510		430								690			460			790		610			530	550		400					
	538		490								350			790			640		730			480	580		530					
	800										440			640			520		620			550	610		400					
											490			520			540		510			580	540		470					
Average weight for a unit of fruit (in grams)	556.8	573.2	489.2			568.2	558.5		553.5		561.2	556.6		503.2	557.4	559.0	523.0		464.6	508.7	575.9	530.3	564.2		485.4	530.6				
AVG WEIGHT (kg)	0.56	0.57	0.49	0.00	0.00	0.57	0.56	0.00	0.55	0.00	0.56	0.56	0.00	0.50	0.56	0.56	0.52	0.00	0.46	0.51	0.58	0.53	0.56	0.00	0.49	0.53	0.00	0.00	0.00	0.00
No of mangos pertreatment	69	40	68			36	64		64		124	32		76	38	58	104		103	64	35	96	109		111	49				

SECOND CUT

TREATMENTS	T1R1	T1R2	T1R3	T1R4	T1R5	T2R1	T2R2	T2R3	T2R4	T2R5	T3R1	T3R2	T3R3	T3R4	T3R5	T4R1	T4R2	T4R3	T4R4	T4R5	T5R1	T5R2	T5R3	T5R4	T5R5	T0R1	T0R2	T0R3	T0R4	T0R5
1	580	550	680			450	500		580		370	710		450	470	450	450		710	490	460	460	580		520	580				
2	560	550	970			550	450		440		500	550		600	500	460	550		550	550	660	660	560		540	610				
3	530	550	580			390	470		450		450	550		430	520	390	390		550	550	510	510	530		550	540				
4	480	560	560			460	500		410		470	420		430	770	550	460		420	550	538	538	480		610	780				
5	550	320	530			420	520		480		500	460		610	560	390	420		460	560	510	510	550		690	550				
6	580	890	480			430	338		370		520	790		350	480	460	430		790	320	390	390	580		350	290				
7	610	710	550			580	420		440		338	680		770	350	420	580		640	890	360	360	610		440	370				
8	540	550	580			620	500		320		420	970		440	460	430	620		520	710	600	600	540		490	560				
9	780	550	610			480	430		400		500	580		750	460	580	480		540	550	400	400	780		618	490				
10	550	420	610			460	450		410		430	560		400	600	620	480		540	550	560	560	550		618	490				
Avg weight per treatment (gr)	576.0	565.0	615.0			484.0	457.8		430.0		449.8	627.0		523.0	517.0	475.0	486.0		572.0	572.0	498.8	498.8	576.0		542.6	526.0				
AVG WEIGHT (k	0.58	0.57	0.62			0.48	0.46	0.00	0.43		0.45	0.63		0.52	0.52	0.48	0.49		0.57	0.57	0.50	0.50	0.58		0.54	0.53				
No de mangos por tratamiento	135	83	118			162	95		112		77	148		110	104	60	125		96	102	115	109	64		84	111				

INTEGRADO

TREATMENT REPETITION	T1 R1	T1 R2	T1 R3	T1 R4	T1 R5	T2 R1	T2 R2	T2 R3	T2 R4	T2 R5	T3 R1	T3 R2	T3 R3	T3 R4	T3 R5	T4 R1	T4 R2	T4 R3	T4 R4	T4 R5	T5 R1	T5 R2	T5 R3	T5 R4	T5 R5	T0 R1	T0 R2	T0 R3	T0 R4	T0 R5
TREATMENT/ REPETITION	T1R1	T1R2	T1R3	T1R4	T1R5	T2R1	T2R2	T2R3	T2R4	T2R5	T3R1	T3R2	T3R3	T3R4	T3R5	T4R1	T4R2	T4R3	T4R4	T4R5	T5R1	T5R2	T5R3	T5R4	T5R5	T0R1	T0R2	T0R3	T0R4	T0R5
MANGO UNITS PER TREATMENT	204	123	186	0	0	198	159	0	176	0	201	180	0	186	142	118	229	0	199	166	150	205	173	0	195	160	0	0	0	0
AVG WEIGHT PER MANGO (kg)	0.57	0.57	0.55	0	0	0.53	0.51	0	0.49	0	0.51	0.59	0	0.51	0.54	0.52	0.50	0	0.52	0.54	0.54	0.51	0.57	0	0.51	0.53	0	0	0	0
TOTAL WEIGHT PER TREATMENT (kg)	115.5	70	102.7	0	0	104.2	80.8	0	86.6	0	101.6	106.5	0	95.4	76.3	61.01	115.5	0	103.1	89.7	80.6	105.5	98.6	0	100.2	84.5	0	0	0	0
YIELD PER HECTARE (t/ha)	4.13	2.50	3.67	0	0	3.72	2.89	0	3.09	0	3.63	3.80	0	3.4	2.72	2.18	4.13	0	3.68	3.20	2.88	3.77	3.52	0	3.58	3.02	0	0	0	0



TREATMENT	T1	T1	T1	T1	T1	T2	T2	T2	T2	T2	T3	T3	T3	T3	T3
REPETITION	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5
YIELD PER HECTARE (t/ha)	4.13	2.50	3.67	0.00	0.00	3.72	2.89	0.00	3.09	0.00	3.63	3.80	0.00	3.41	2.72
TREATMENT	T4	T4	T4	T4	T4	T5	T5	T5	T5	T5	T0	T0	T0	T0	T0
REPETITION	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5
YIELD PER HECTARE (t/ha)	2.18	4.13	0.00	3.68	3.20	2.88	3.77	3.52	0.00	3.58	3.02	0.00	0.00	0.00	0.00

Attachment 6. Photos related to the management of the experimental trial. Phase 2 – 2024–2025

EXPERIMENTAL TRIAL EAST SITE - ZACAPA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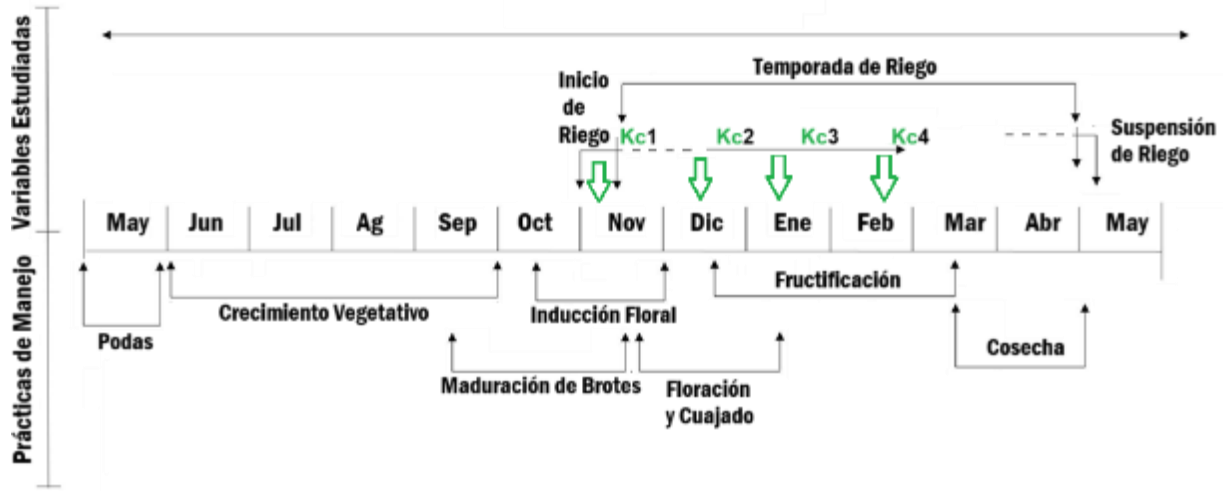
EXPERIMENTAL TRIAL
SOUTH SITE - CHAMPERICO RETALHULEU

Attachment 7. Agronomic management related to the experimental trial and management of the Tommy Atkins mango plantation at the East (Zacapa) and South (Retalhuleu) sites.

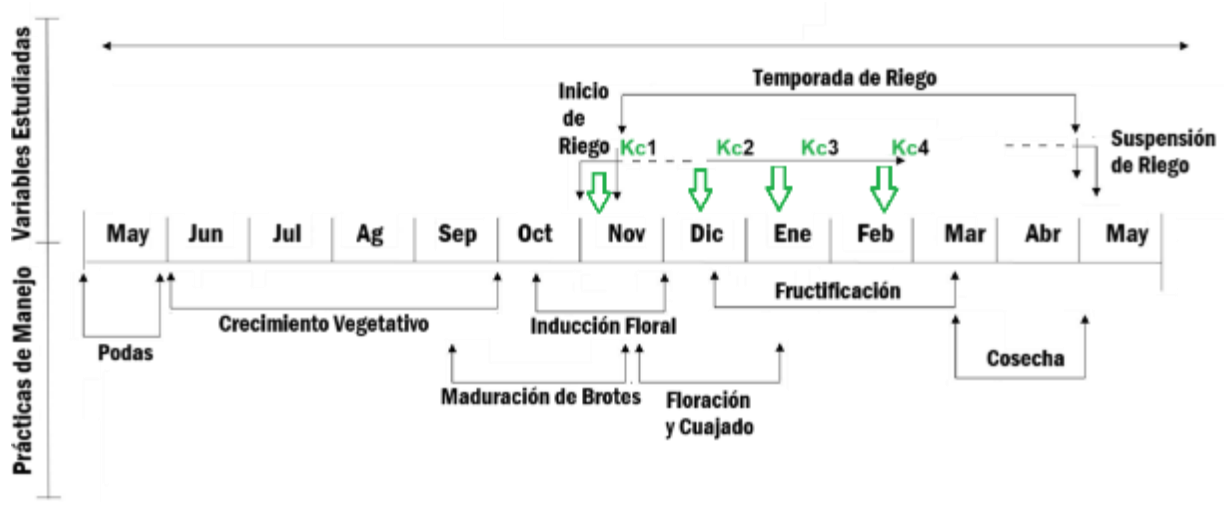
SCHEDULE OF AGRICULTURAL ACTIVITIES AT THE EAST SITE - ZACAPA

ACTIVIDADES	June	July	August	Sepbre	October	Novbre	December	January	February	March	April	May
CONTROL DE PLAGAS Y ENFERMEDADES												
PODAS DE FORMACIÓN												
FERTILIZACION AL SUELO												
FERTILIZACIONES FOLIARES												
APLICACIÓN DE PACLOBUTRAZOL												
RIEGO Y DRENAJE												
INDUCCIÓN FLORAL												
CONTROL DE MALEZAS												
COSECHA												



SCHEDULE OF AGRICULTURAL ACTIVITIES SOUTH SITE - RETALHULEU

ACTIVITIES	June	July	August	Sepbre	October	Novbre	December	January	February	March	April	May
PEST AND DISEASE CONTROL												
PRUNING												
SOIL FERTILIZATION												
FOLIAR FERTILIZATIONS												
PACLOBUTRAZOL APPLICATIONS												
IRRIGATION AND DRAINAGE												
FLORAL INDUCTION												
WEED CONTROL												
CULTURAL TASKS												
FIELD INDIRECT COSTS												
HARVEST												
FARM RENTAL												



1. Pest and disease control.
First application: beginning of flowering.
Asoxistrobin: 180 g/ha
Calcium Boron Zinc: 3 liters/ha
Second application:
Copper pentahydrate: 0.6 liters/ha
Potassium phosphite: 2 liters/ha
Third application:
Copper oxychloride: 2.4 Kg/ha
2. Pruning
Side pruning to clear pathways and topping to keep trees at a height of 5.0 m
3. Soil fertilization
Application of 3.0 pounds per tree of 15-15-15 fertilizer after pruning.
4. Application of paclobutrazol.
15 g of i.a./tree. Applied to the soil.
5. Irrigation:
160 liters/tree/day from flowering to harvest. The irrigation method used is micro-sprinkler irrigation.
6. Flowering inductions
4 foliar applications of 4% calcium nitrate
7. Weed control
These are carried out before flowering using mowers, both along the aisles and between the trees.
8. Cultural tasks
Fruit-fly monitoring: A trapping network is set up in January.
Fruit fly control: Traps containing Torula yeast are set up.
9. Harvest
It is packed by temporary workers into 17-kg baskets.