Effect of chemical fertilization on the production of melon *(Cucumis melo* L.*)* hybrids under greenhouse conditions.

Efecto de la fertilización química en la producción de híbridos de melón *(Cucumis melo* L.*)* bajo invernadero

Julio Gabriel Ortega[1]
Gema Burgos López [2]
Washington Narvaez Campana [3]
Fernando Ayón Villao [4]
Agustín Álvarez Plúa [5]
Heidi Flores Ramírez[6]

Published
Edwards Deming Higher Technological Institute. Quito - Ecuador

Periodicity
April - June
Vol. 1, Num. 25, 2025
pp. 15-29
http://centrosuragraria.com/index.php/revista

Dates of receipt
Received: December, 2024
Approved: February 28, 2025

Correspondence author
julio.gabriel@unesum.edu.ec

[1] PhD. Universidad Estatal del Sur de Manabí, Jipijapa, Ecuador. julio.gabriel@unesum.edu.ec, http://orcid.org/0000-0001-9776-9235
[2] Mg in Agriculture. Universidad Estatal del Sur de Manabí, Jipijapa, Ecuador. gema.burgos@unesum.edu.ec, https://orcid.org/0000-0002-0025-3679
[3] Mg. Universidad Estatal del Sur de Manabí, Jipijapa, Ecuador. washington.narvaez@unesum.edu.ec, https://orcid.org/0000-0002-6674-2088
[4] Mg. Universidad Estatal del Sur de Manabí, Jipijapa, Ecuador. fernando.villao@unesum.edu.ec, https://orcid.org/0000-0003-4772-9344,
[5] Mg. Universidad Estatal del Sur de Manabí, Jipijapa, Ecuador. agustin.alvarez@unesum.edu.ec, https://orcid.org/0000-0003-0176-1314
[6] Agronomist Eng. Professional graduate, Universidad Estatal del Sur de Manabí, Portoviejo, Ecuador. flores-heidi5476@unesum.edu.ec, https://orcid.org/0000-0001-9969-8864

Abstract: With the objective of determining the effect of chemical fertilization for melon *(Cucumis melo* L.*)* production under greenhouse conditions, three fertilization treatments (two doses and a control) were applied to two melon hybrids at three stages of plant development. The treatments were implemented in a completely randomized block experimental design in a 2 x 3 factorial arrangement with six treatments and five replications. The response variables were: plant height, stem diameter, fruit number, fruit uniformity, fruit volume, virus incidence, fruit weight and Brix degrees. The results showed that treatment T2 (E1: 14.54 g N/plant, 6.58 g P, 0.00 g K/plant, E2:14.54 g N/plant, 6.58 g P/plant, 12.19 g K/plant, and E3: 0.00 g N/plant, 0.00 g P/plant, 12.19 g K/plant) showed the highest stem diameter, fruit volume, fruit weight, brix degrees, yield, best fruit uniformity and lowest virus incidence.

Key words: Flowering, fruiting, developmental stages, crop physiology.

Resumen: Con el objetivo de determinar el efecto de la fertilización química para la producción de melón *(Cucumis melo* L.*)* bajo invernadero, se realizaron tres tratamientos (dos dosis y un testigo) de fertilización en dos híbridos de melón, que fueron aplicados en tres estadios de desarrollo de la planta. Los tratamientos fueron implementados en un diseño experimental de bloques completamente aleatorios en arreglo factorial 2 x 3 con seis tratamientos y cinco repeticiones. Las variables respuesta fueron: Altura de planta, diámetro de tallo, número de frutos, uniformidad de frutos, volumen de fruto, incidencia del virus, peso de frutos y grados Brix. Los resultados mostraron que el tratamiento T2 (E1: 14,54 g de N/planta, 6,58 g de P, 0,00 g de K/planta, E2:14,54 g de

N/planta, 6,58 g de P/planta, 12,19 g de K/planta, y E3: 0,00 g de N/planta, 0,00 g de P/planta, 12,19 g de K/planta) fue el que mostró mayor diámetro de tallo, volumen de fruto, peso de fruto, grados brix, rentabilidad, mejor uniformidad de fruto y menor incidencia de virus.

Palabras clave: Floración, fructificación, estadios de desarrollo, fisiología del cultivo.

Introduction

Gabriel et al. (2023) proposed a chemical edaphic fertilization strategy for melon cultivation under greenhouse conditions. This strategy was developed based on the analysis of soil, water and crop requirements, using the Edisto melon hybrid, which is one of the most widely cultivated melons in the area. The farmers of Recinto Puerto la Boca in Puerto Cayo Parish in Manabi, Ecuador, developed strategies on basic soil fertilization with macronutrients for their crops, and generally manage them empirically, although they are aware of the need to achieve profitable harvests, with post-harvest quality and long shelf life. Therefore, they are aware of the need to implement crop management practices, including fertilization, which has a great impact on the quality of the harvested product. Therefore, the strategy developed consisted of elaborating a basic edaphic fertilization plan, in low, medium and high doses, which were applied at three stages of the crop (development, flowering and fruiting).

The best fertilization strategy was determined to be treatment T2 (E1: 11.22 g N, 5.29 g P, 0.00 g K, E2:11.22 g N, 5.29 g P, 11.12 g K, E3: 0.00 g N, 0.00 g P, 11.12 g K) and achieved fruits of 0.97 kg, which would be the equivalent of 2.48 t/1000 m2 and a total kernel solids content (°Brix), of 9.85 °Brix for treatment T1 (E1: N = 7.95, P = 1.80, K = 0, E2: N = 7.95, P = 1.80, K = 10.15, E3: N = 0, P = 0, K = 10.15) and 9.45 °Brix for Treatment T2 (Gabriel et al., 2023). However, it is known that chemical fertilization does not cause a uniform yield response and that much depends on soil chemical composition, soil type (texture, structure), climate, water, pH, temperature, cultivar genetics used and other factors (Bazán, 2015a; PROAIN, 2019; Massri & Labban, 2014).

Based on this background, it was decided to carry out a study on the effect of the two best chemical fertilization strategies on two new

entrosur e-ISSN:2706-6800
INSTITUTO TECNOLÓGICO CORPORATIVO EDWARDS DEMING

melon hybrids. Therefore, the present study aimed to validate the two best chemical fertilization strategies (medium and high) for melon (Cucumis melo L.) production under greenhouse conditions.

Methodology

Location

The research was carried out in a greenhouse at Recinto Puerto La Boca, Puerto Cayo Parish, Jipijapa Canton , located at 1°18'20" South latitude and 80°45'42" West longitude, at an altitude of 53 meters above sea level. The average temperature is 24.8 °C/year and average precipitation is 298 mm/year, with rainfall concentrated in February and the driest month being August. [Plan de Ordenamiento y Desarrollo Territorial de la parroquia Puerto Cayo (PODT, 2015)].

Treatments

Treatments were chosen from previous experience (Gabriel et al., 2023. Two of the best treatments were chosen to be validated in two new hybrids (H1: Cataloupe, H2: Hybrid 64068). Prior to the formulation of the treatments, chemical and physical analysis of the soil (greenhouse) and water was carried out at the soil laboratory of the National Institute of Agricultural Research (INIAP) in Pichilingue, Guayaquil. To prepare the fertilization doses, the following were used as sources of macronutrients: urea (46%), superphosphate (P_2O_5: 18-46-00) and potassium chloride (Cl K: 0-0-60), whose doses per plant are shown in Table 1.

Table 1. *Treatments performed on two honeydew hybrids n.*

Trat	Stadiums	UREA (46%) (g)	P2O5 (18-46-0) (g)	KCl (0-0-60) (g)	N (g/plant)	P (g/plant)	K (g/plant)
T1	E1	40,07	11,50	0,00	11,22	5,29	0,00
T1	E2	40,07	11,50	18,53	11,22	5,29	11,12
T1	E3	0,00	0,00	18,53	0,00	0,00	11,12
T2	E1	51,93	14,30	0,00	14,54	6,58	0,00
T2	E2	51,93	14,30	20,32	14,54	6,58	12,19
T2	E3	0,00	0,00	20,32	0,00	0,00	12,19
T3		Control (without fertilization)			Control (without fertilization)		

Experimental design

The research was implemented in a completely randomized block experimental design (CRBED) in a 2 x 3 factorial arrangement with six treatments and five replications (Gabriel *et al*., 2021).

The response variables evaluated were the Plant height (cm) (AP). stem diameter (mm) (DT) at 50% flowering, number of fruits (Nfru), melon mosaic virus incidence in percentage (Incivirus) (Gabriel et al., 2017), fruit uniformity (Unifru), fruit volume (cm^3) (VolFru) (Moreno, 2000) and fruit weight (kg) (Y) (Gabriel, 2021).

The experimental plot was implemented in a 1000 m greenhouse^2. Three doses of chemical fertilization (T1, T2 and T3) were applied at three stages of plant development (E1: at foliage (15 days after transplanting), E2: at flowering (40 days after transplanting) and E3: at fruiting (60 days after transplanting), to two melon hybrids (1: Cataloupe, 2: Hybrid 64068). Each row/treatment had 28 plants and the experimental unit for each treatment was 84 plants.

For soil preparation, the soil was removed manually, then the soil was shredded to obtain finer particles for the development of the seedlings in the beds. Organic matter (biocompost) was applied to provide adequate soil for the plants at the time of transplanting. The biocompost was applied at a rate of 75 kg per 33 m row. The soil was measured with the help of a winch, for the formation of the 0.80 m

entrosur e-ISSN:2706-6800
INSTITUTO TECNOLÓGICO CORPORATIVO EDWARDS DEMING

wide by 33 m long and 0.15 m high strips, and finally, the strips were leveled.

For planting in seedling trays, the substrate was prepared with biocompost, guava leaf and local soil in a 2:1:1 ratio. Ten kilograms of humus and a bag (10 g) of mycorrhiza were added to prevent the attack of pathogens that cause damping off. Once the substrate was prepared, the holes were filled with it, taking care to moisten it. Then the seeds of the parents were sown in these trays. The trays were irrigated twice a day to maintain humidity. A broad spectrum fungicide (carboxin + captan 3g/L) was applied to prevent disease attack.

Transplanting was carried out in rows, for which holes were made with a depth of 15 cm at a distance of 0.40 m between plants within the row and a distance of 1.20 m between rows, then proceeded to transplant one plant per hole. When transplanting, 50 g of earthworm humus (one hand) was applied to encourage root development.

For the control of downy mildew caused by the Oomycete *Pseudoperonosphora cubensis* and other leaf spots, Metalaxy + Mancozeb (Ridomil) (2.5g/l) was applied alternately with Chlorothalonil (2.5 mL/L), *Trichoderma* (3.0 mL/L) and *Bacillus subtilis* (3.0 mL/L) from the eighth day after transplanting (Gabriel, 2021).

Pest control was carried out according to the monitoring and application of the damage threshold for insect control of pests such as whitefly (*Bemisia tabaci*), blackfly *(Prodiplosis longifilia*) and aphids (*Myzus persicae*), the application of Thiamethoxan (0.25 mL/L) was used, alternating with Avemectin (2.25 mL/L), Confidor (0.60 g/L) and Neen (4 mL/L), starting 10 days after transplanting (Gabriel, 2021).

Pruning was performed on a single main branch and eliminating the remaining branches. Old leaves and shoots were removed to avoid the formation of other secondary branches. Trellising was performed after pruning, and after each pruning, a contact fungicide (Mancozeb 0.47 g/L) was used to prevent diseases caused by the wounds.

The plants were irrigated inside the greenhouse using a drip irrigation system and the frequency of use was three times per week. Harvesting began approximately 120 days after transplanting, depending on temperature. Commercial maturity corresponds to the firm ripe stage or "3/4 detached", which is identified when the fruit is gently cut and detaches from the plant.

Statistical analysis

Based on the defined model and prior analysis of normality and homogeneity of variance for each case, analysis of variance (ANOVA) was performed to test hypotheses of fixed effects, as well as and comparisons of treatment means using Tukey's test at $P<0.05$ probability. ANOVA of the data was also used to estimate variance components for random effects. The indicated analyses were performed using Proc GLM of SAS (SAS, 2020).

The economic analysis was performed to determine the benefit/cost of each treatment applied. This analysis allowed defining the profitability or not of the treatments (Boardman et al., 2018).

Results

Analysis of variance

Table 2 shows that there were significant differences at $P<0.05$ for plant height (PA) for hybrids (Cataloupe and Hybrid 64068), and highly significant differences at $P<0.01$ for stem diameter (DT), fruit number (NFru), incidence of melon mosaic virus (Incivirus), fruit uniformity (Unifru), fruit volume (Volfru) and weight (Y). Likewise, it was observed that in the hybrids there were highly significant differences at $P<0.01$ for fruit number (NFru), incidence of melon mosaic virus (Incivirus) and fruit uniformity (Unifru), fruit volume (Volfru) and weight (Y). The coefficients of variation (CV) were within the range allowed for this type of research (11 to 31%), with the exception of PA, which had a coefficient of variation of 45%.

entrosur e-ISSN:2706-6800
INSTITUTO TECNOLÓGICO CORPORATIVO EDWARDS DEMING

Table 2. Analysis of variance for morphological and productive characters.

FV	gl	Mean squares						
		AP	**DT**	**NFru**	**Incivirus**	**Unifru**	**Volfru**	**Y**
Rep	4	0,39	6,74	34,47	400.92	14,31	246583542	0,09
Trat	2	0,33	**0,55****	**4,56****	**632,38****	**3,15****	**13074731172****	**0,89****
Hybrids	1	**0,33***	28,66	**68,99****	**321,60****	**56,30***	**10617892022****	**2,51****
Treated*hybrids	2	1,15	1,02	**126,07***	**93,95***	**0,83****	198754414	**0,50***
Error	125	0,42	0,06	13,96	30,44	1,37	458857131	0,06
total	134							
CV		45,48	10,64	30,90	30.44	16,84	31,28	15,52

*: Significant at P<0,05, **: Highly significant at P<0,01

Average analysis

In Table 3, the comparison of means by Tukey's test at P<0.05 probability, showed that Strategy 2 was better for DT, NFru, Incvirus, Unifru, Volfru and Y. It was noted that the virus drastically affected the control treatment (no fertilizer application).

Comparison of means of the number of pest insects determined in the period 2019, Puerto La Boca.

Table 3. Mean comparison of plague insect numbers determined on 2019, Puerto La Boca.

Treatment	NE	MMIN	PUL	POL	TRIPS	MBL
T4	42 b	18 b	8 b	17 b	46 b	876 a
T1	33 a	12 ab	6 b	11 a	25 a	842 a
T3	32 a	12 a	4 ab	10 a	19 a	697 a
T2	32 a	10 a	0 a	9 a	16 a	545 a
DSH	10,32	6,05	4,74	5,13	12,64	697,57

Means with a common letter are not significantly different (p > 0.05), **Strategy 1**: (E1: 11.22 g N, 5.29 g P, 0.00 g K, E2:11.22 g N, 5.29 g P, 11.12 g K, E3: 0.00 g N, 0.00 g P, 11.12 g K. **Strategy 2:** (E1: 14.54 g N, 6.58 g P, 0.00 g K, E2: 14.54 g N, 6.58 g P, 12.19 g K, E3: 0.00 g N, 0.00 g P, 12.19 g K). **Control**: No fertilization.

In Table 4, the comparison of means by Tukey's test at P<0.05 probability showed that Cataloupe was better for NFru, Volfru and Y. Hybrid 64068 had lower incivirus.

Table 4. Analysis of means for hybrids .

Hybrid	AP	DT	NFru	Incivirus	Unifru	Volfru	Y
Cataloupe	1,22 a	8,25 a	**6,97 a**	20,24 a	2,60 a	**79020 a**	**2,84 a**
64068	1,09 a	8,08 a	5,25 b	16,43 b	2,58 a	60030 b	1,77 b
DSH	0,26	0,29	0,65	66,66	0,14	66,67	66,67

Means with a common letter are not significantly different (p > 0.05).

In Table 5, the comparison of means by Tukey's test at P<0.05 probability, showed that strategy 2 applied to Cataloupe was better for DT, NFru, lower Incivirus and good Unifru; but for Strategy 1, applied to hybrid 64068 was better for Volfru and Y. The control treatment (no fertilization) applied to the two hybrids was the worst for all the variables evaluated, which were shown to be the most affected by melon mosaic virus.

entrosur e-ISSN:2706-6800
INSTITUTO TECNOLÓGICO CORPORATIVO EDWARDS DEMING

Table 5. Analysis of means for the interaction strategy x hybrids**.**

Treatment	**Hybrid**	AP	DT	NFru	Incivirus	Unifru	Volfru	Y
Strategy 2	Cataloupe	1,28 a	**9,08 a**	**8,24 a**	**3,80 b**	**3,80 a**	74379.35	2.07 bc
Witness	64068	1,27 a	8.87 ab	3,40 c	6,50 a	1,75 c	59191.93 cd	2.26 bc
Strategy 2	64068	1,20 a	8.19 bc	6,30 b	4,50 b	**3,75 a**	**97655,17 20 a**	**3,69 a**
Strategy 1	64068	1,20 a	8,11 c	6,05 b	6,00 a	2,25 b	80214.05 20 ab	2,57 b
Strategy 1	Cataloupe	1,02 a	7.48 cd	6,56 b	4,00 b	2,60 b	61337.44 cd	1,48 c
Witness	Cataloupe	0,97 a	7,28 d	6,12 b	6,00 a	1,40 c	44372,63 d	1.76 bc
DSH		0,44	0,74	1,64	1,32	0,37	18348,65	0,81

Means with a common letter are not significantly different (p > 0.05), **Strategy 1**: (E1: 11.22 g N, 5.29 g P, 0.00 g K, E2:11.22 g N, 5.29 g P, 11.12 g K, E3: 0.00 g N, 0.00 g P, 11.12 g K. **Strategy 2**: (E1: 14.54 g N, 6.58 g P, 0.00 g K, E2: 14.54 g N, 6.58 g P, 12.19 g K, E3: 0.00 g N, 0.00 g P, 12.19 g K). **Control**: No fertilization.

Correlation analysis

Pearson's correlation analysis of the treatments between fruit volume, yield and brix did not show significant correlations (Table 6). The average Brix for Strategy 1 was 7.7%, for Strategy 2 4.88% and for Strategy 3 (control) 4.22%. It was not possible to detect the relationship of these variables among the enhanced treatments. With the exception of Strategy 3, where a negative correlation between volume and yield was observed, indicating that the lack of micronutrients apparently affected the relationship between these variables. It was noted that the volume in Strategies 1 and 2 were inversely proportional, which, although not significant, would indicate that the greater the volume, the lower the sugar content.

Table 6. Pearson's correlation for evaluated characters.

	Volume	**Performance**	**Brix degrees**
		Strategy 1	
	Volume	**Performance**	**Brix degrees**
Volum	1,00	0,44 **	-0.40 ns
Performance		1,00	0.53 ns
Brix degrees			1,00
		Strategy 2	
	Volume	**Performance**	**Brix degrees**
Volume	1,00	-0.18 ns	-0.33 ns
Performance		1,00	0.17 ns
Brix degrees			1,00
		Strategy 3	
	Volume	**Performance**	**Brix degrees**
Volume	1,00	-0,60**	0.12 ns
Performance		1,00	0.05 ns
Brix degrees			1,00

*: Significant at P<0.05 of probability, **: Highly significant at P<0.01 of probability, ns: Not significant

Benefit-Cost Analysis (USD)

For supermarket

In general, all treatments showed a B/C>1, when the product was marketed at $0.50/kg fruit (Table 7). Treatments T1 and T2 were the most profitable, with a B/C ratio=1.53 and 1.32, respectively. This indicates that, for each dollar invested in T1, a profit of US$1.53 is achieved; likewise in the case of treatment T2, where for each dollar invested, US$1.32 would be earned.

entrosur e-ISSN:2706-6800
INSTITUTO TECNOLÓGICO CORPORATIVO EDWARDS DEMING

Table 7. B/C analysis of the product marketed in supermarkets.

Cultivate	NP (1000 m2)	Weight/harvest (Kg)	Weight/harvest (Kg)	Price/kg (USD)	Profit (1000 m2)	Cost (1000 m2)	BN (USD) MARKET	B/C Ratio	Profitability
T1	2352	1,96	4609,92	0,5	2304,96	800	1504,96	1,53	Profitable
T2	2352	2,79	6562,08	0,5	3281,04	800	2481,04	1,32	Profitable

B/C > 1.0 = Profitable.

For supply market

When the product was marketed in the local market only treatments T1 and T2 were profitable with a B/C ratio of 2.37 and 1.68, respectively (Table 8).

Table 8. B/C analysis of the product marketed in the supply market.

Trat	NP	P/C	PT/C	Pr/Kg	Benefit	Cost	Net benefit	B/C	Profitability
T1	3135	0,65	2037,75	0,3	611,33	371,15	240,18	0,65	Not profitable
T2	3135	0,97	3040,95	0,3	912,29	371,15	541,14	1,46	Profitable
T3	3135	0,89	2790,15	0,3	837,05	371,15	465,90	1,26	Profitable
T4	3135	0,58	1818,30	0,3	545,49	371,15	174,34	0,47	Not profitable

B/C > 1.0 = Profitable

A comparison analysis between the product sold in supermarkets and the local market showed that profits from supermarket sales are greater than 50% in both cases.

Bazán, (2015b), reported an experiment to determine the effect of different fertilization levels (NPK) on yield and fruit quality and to determine the most appropriate dose to obtain the highest efficiency in melon production. The fertilization level 150-100-150 kg/ha of N - P - K, obtained the highest commercial yield with 47.97 t/ha, likewise, as fertilization levels increase, the amount of non-commercial fruit decreases. The fertilization level 200 - 150 - 200 and the level without fertilization 0 - 0 - 0 kg/ha of N - P - K, registered the highest non-commercial yield with 16.26 t/. ha-1 and 12.5 t. ha-1 respectively.

Quiroz (2008), states that, to achieve 1000 kg of fruit, the melon crop extracts 1.5 kg N, 0.65 kg P and 3.37 kg K. Thompson (2012), mentions that melon is a relatively demanding crop in nutrient elements; a 1000 kg/1000 m2 crop extracts from the soil: 2.1 kg N, 0.8 kg P_2O_5, 4 kg K_2O and recommends a fertilization of 10 to 15 kg N, 5 to 7 kg P, and 10 to 15 kg K for 1000 m2. This also shows that crop needs are different in the different sites where they were evaluated, this will depend on crop genetics and environment (fertility of the soil, soil type, temperature, pH, organic matter, etc.) (Molina, 2006).

In the research carried out to validate the strategies 2 in the hybrid cathaulope in its different stages (E1: 14.54 g N, 6.58 g P, 0.00 g K, E2: 14.54 g N, 6.58 g P, 12.19 g K, E3: 0.00 g N, 0.00 g P, 12.19 g K), was the best for stem diameter, number of fruits, lower incidence of virus and greater volume of fruit manifested by Tapia et al. (2010) the fertilizers used in the Cantaloupe melon crop, as a base were urea, triple calcium superphosphate and potassium sulfate through the irrigation system, the variables evaluated were: total foliar N and K concentration (%) from the sixth to the eighth leaf from the apex to the base of the main guide at 35 and 62 days after planting (dds); similarly, N-NO3 and K+ were evaluated at the beginning of flowering (29 days), beginning of fruiting (35 days) and beginning of harvest (62 days). The results indicate that there was an effect of the nutritional doses applied on yield and fruit quality; increasing the dose of nitrogen increased yield and quality, up to a maximum value of 61 t-ha-1 with 240 kg-ha-1 of N in 2006 and 44.3 t-ha-1 with 180 kg-ha-1 of N in 2007.

González et al. (2021), mentions that, the current demand for food causes large amounts of chemical fertilizers to be used in vegetable production systems, leaving soils deteriorated and with low fertility in the long term, organic or chemical fertilizers mixed with biofertilizers can be a viable alternative to maintain and/or increase melon yields and at the same time reduce the use of chemical fertilizers in vegetable production systems.

Finally, we determined that in general all treatments showed a B/C > 1, when the product was marketed at $0.50/kg fruit. However, treatments T1 and T2 were the most profitable, with a B/C ratio = 1.53 and 1.32, respectively. This indicates that in the case of treatment T1,

entrosur e-ISSN:2706-6800
INSTITUTO TECNOLÓGICO CORPORATIVO EDWARDS DEMING

for each dollar invested, it would earn 1.53 dollars; likewise in the case of treatment T2, where for each dollar invested, it would be earning 1.32 dollars, the difference between the two treatments is that T2 requires a greater amount of fertilizer. In this regard, Kumar et al. (2007) found that optimal N and P fertilization improved crop yield and profitability. Likewise, we were able to find through a comparative analysis between the product sold in supermarkets and the local market that the profits from supermarket sales are greater than 50% in all cases.

Conclusions

Treatment T2 was the best for stem diameter, fruit number, lower virus incidence, better fruit uniformity, higher fruit volume and better yield.

Both hybrids were drastically affected by the non-application of fertilizers, determining an incidence of 6.22% plants affected by virus on average. T2 interacted with Cataloupe. T3 (control) had the worst response to morphological, agronomic and yield variables.

The T1 strategy was the one that showed the highest percentage of Brix degrees in the fruit in general, followed by the T2 strategy. Both treatments were profitable in the supermarket and in the market.

References

Bazán, D. A. (2015a). Four levels of N-P-K fertilization in melon (*Cucumis melo* var. reticulatus L.) crop under Cañete Valley conditions [thesis, Universidad Nacional Agraria La Molina, Lima, Peru]. https://repositorio.lamolina.edu.pe/bitstream/handle/20.500.12996/1630/

Bazán, D. A. (2015b). Nitro-phospho-potassium fertilization in melon (*Cucumis melo*) crop under Cañete valley conditions. [Thesis, Universidad Nacional Agraria La Molina, Lima, Peru]. https://repositorio.lamolina.edu.pe/handle/20.500.12996/1630

Boardman, N. E., Greenberg, D., Vining, A., & Weimer, D. (2018). Cost-benefit Analysis: Concepts and Practice (5st edition).

Cambridge Universoty Prees, UK. http://students.aiu.edu/submissions/profiles/resources/onlineBook/E5V5H3_Cost456 benefit%20analysis%20_%202018.p

Gabriel, J. (2021). Green book: Agro-UNESUM Informa. Editorial Grupo Compas, Universidad Estatal del Sur de Manabí, Guayaquil, Ecuador. 212 p. http://142.93.18.15:8080/jspui/handle/123456789/638

Gabriel, J., Pérez, R., Narváez, W., Morán, J., Castro, A., & Burgos, G. (2023). Chemical fertilization of melon (*Cucumis melo* L.) in greenhouse. A proposal to improve yield and quality. *Journal of the Selva Andina Biosphere*, *11*(1), 84-93. https://doi.org/10.36610/j.jsab.2023.110100081

Gabriel, J., Ortuño, N., Vera, M., Castro, C., Narváez, W., and Manobanda, M. (2017). Manual for disease damage assessment in agricultural crops. Grupo COMPAS, Universidad Estatal del Sur de Manabí, Jipijapa, Ecuador. https://revistas.unesum.edu.ec/agricultura/index.php/ojs/article/view/3. https://revistas.unesum.edu.ec/agricultura/index.php/ojs/article/view/3

Gabriel, J., Valverde, A., Indacochea, B., Castro, C., Vera, M., Alcívar, J. and Vera, R., (2021). Experimental designs: Theory and practice for agricultural experiments. Second edition, Editorial Grupo Compás. Universidad Estatal del Sur de Manabí. Guayaquil, Ecuador. http://142.93.18.15:8080/jspui/handle/123456789/625

González, S. U., Gallegos-Robles, M. Á., Preciado, R. P., García, C. M., Rodríguez, H. M. G., García, H. J. L., & Guzmán, S. T. L. (2021). Effect of organic and inorganic sources of nutrition mixed with biofertilizers on melon fruit production and quality. *Terra Latinoamericana*, *39*, http://www.scielo.org.mx/scielo.php?pid=S0187-57792021000100130&script=sci_abstract&tlng=en

entrosur e-ISSN:2706-6800
INSTITUTO TECNOLÓGICO CORPORATIVO EDWARDS DEMING

Kumar, M.; Kumar Singh, M; Malik, S.; Prakash, S.; Baboo, R. (2007). Studies on yield and economic returns of long melon as affected by nitrogen and phosphorus fertilizat. *Prog. Agric. 7* (1/2),149-150. https://www.researchgate.net/publication/319755583

Massri, M., & Labban, L. (2014). Comparison of differ-ent types of fertilizers on growth, yield and quality properties of watermelon *(Citrullus lanatus*). *Agric. Sci, 5*(6):475-82. https://doi.org/10.4236/as. 2014.56048

Molina, E. (2006). Effect of mineral nutrition on melon quality. *Agronomic Information,* 63: 1-16. Retrieved from http://www.ipni.net/publication/ia-lahp.nsf/

Moreno, J. M. (2000). Formulas and volumes for the determination of areas and volumes. *Guiniguada, 9*(8/9), 291-3187. https://ojsspdc.ulpgc.es/ojs/index.php/ElGuiniguada/article/view/685.

PODT (2015). Plan de Ordenamiento y Desarrollo Territorial de la parroquia Puerto Cayo. Puerto Cayo - Jipijapa. Decentralized Autonomous Government of the Puerto Cayo Parish.

PROAIN (2019). Agricultural Technology. Nutritional needs of melon. https:// proain.com/blogs/blogs/notas-tecnicas/necesidades-nu-trimentales-del-melon.

Quiroz, M. (2008) Determination of macronutrient (N, P, K, Ca, Mg) uptake curves in melon *(Cucumis melo* L.) cv. Honey Dew Flesh under different fertilization doses. Universidad Nacional Agraria La Molina, Lima, Peru. https://agris.fao.org/agris-search/search.do;jsessionid

SAS University (2020). An Introduction to SAS University Edition https://www.oreilly.com/library/view/an-introduction-to/9781629600079/

Thompson, C., & Kelly, W. (2012). Vegetable crop 5th Edition. Editorial Mc. Graw Hill Book Company. Inc. New York, USA.