

The Effect of Organic and Inorganic Fertilizers on the Growth Performance of Date Palm Offshoots

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Abstract: The date palm, *Phoenix dactylifera* is an important fruit crop of the tropics and subtropics. Date palm propagation is offshoot dependent, which needs several environmental factors resemble the natural conditions for achieving successful establishment and long-term productivity. Fertilization is crucial for the vegetative and root growth of the offshoots. Nowadays, organic-, inorganic-fertilizer and their combinations are considered to be interesting to promote the growth of the offshoot and to improve soil fertility. Organic fertilizers, including compost and manure, release key nutrients slowly while improving soil structure and increasing microbial activity and can be used in a manner that is biologically, environmentally, and economically sustainable. On the other hand, inorganic fertilizers contain nutrients such as N, P and K that are directly available and facilitate fast vegetative growth, but they may cause environmental pollution and soil degradation when they are used excessively. The combination of organic and inorganic fertilizers is regarded as an effective approach to balance between speed of plant

growth and improvement of soil structure. The objective of this research was to assess the impact of organic, inorganic and integrated (organic + inorganic) fertilizers on growth of date palm offshoots in the nursery. The test consisted of four treatments (control, i.e. without fertilizer, inorganic fertilizer, organic fertilizer and a mix of organic and inorganic fertilizer) and each treatment was repeated 3 times. Important parameters to be recorded in growth were onshoot height, number of leaves, leaf diameter, chlorophyll content of leaves, and dry matter of the vegetative parts within a 12-month period. Results showed that offshoots receiving treatment of a mixed application of the organic and the inorganic fertilizers had the best growth performance in terms of height, number of leaves, chlorophyll content, and dry matter accumulation. Organic fertilizers also exhibited better growth parameters when compared to control; however, inorganic fertilizer significantly improved early vegetative growth but limited in improving long-term soil fertility and crop growth. The investigation was aware of the fact that organic and inorganic blended sources of fertilization for the offshoots of date palm hold best prospects for the sustainable development of the same. These results offer useful advice for nursery practices and sustainable date palm production and reiterate the need to balance both growth and environmental costs of implementing chemical fertilizers. Long term studies are also recommended to assess the impact of different fertilization regimes on the field performance and yields of mature date

palms.

Keywords: Date palm, offshoots, organic fertilizers, inorganic fertilizers, growth performance, sustainable agriculture, chlorophyll content, vegetative growth.

Introduction

Is a key fruit crop in the arid and semi-arid areas of the world, with high value in economic, nutritional, and environmental aspects [1]. The date palm propagation depends largely on offshoots, which have the same genetics as the mother plant enabling orchard uniformity [2]. Offshoots, nevertheless, are very sensitive to the environment and their growth is influenced by nutrient application, irrigation, and soil management [3]. Among the essential elements that influence vegetative growth, root development, and the overall success of an establishment of the date palm offshoot, is fertilization of the soil [4]. Inorganic fertilizers (IFs) release nutrients quickly but degrade soil organic matter and reduce microbial activities, which ultimately impair soil structure and fertility [5]. There are several reports on growth rate of date palm seedlings being improved by organic fertilization, which also confers enhanced protection from biotic and abiotic stressors [6]. Inorganic fertilizers, on the other hand, provide nutrients like nitrogen (N), phosphorus (P), and potassium (K) in a form that is easily accessible, resulting in quick vegetative growth, particularly during the initial stages of development [7]. But excessive application of inorganic fertilizer may cause soil acidification, nutrient imbalance, pollution of the environment for a long time. [8].

The Recently research highlights the need to exploit the use of organic and inorganic fertilizers that could provide benefits for both shortterm growth of the crop and long term sustainability of the soil [9]. Research on date palm seedlings and offshoots revealed that mixed fertilization regimes increase leaf area, plant height, stem diameter, chlorophyll content, and dry matter production more than single source fertilization [10]. For example a study by Aly et al. [11] from 2018 illustrated that date palm offshoots exposed to a mix of compost, biofertilizers, and chemical NPK fertilizers attained the utmost growth performance as opposed to those exposed to chemical fertilizer solely. Generally the experimental setup in these studies is that several treatment groups are maintained: control (no fertilization), inorganic fertilizer based, organic fertilizer based, and a mixture of organic and inorganic fertilizer, and these are replicated to include statistical reliability [12]. Growth characteristics recorded are the offshoot height, number of leaves, stem diameter, chlorophyll content and dry biomass of shoot and root [13]. These measurements afford a good indication of both vegetative growth and overall physiological status of the plant [14]. Organic fertilizers enhance water holding capacity of soil and microbial and enzymatic activities which are directly or indirectly related to nutrient absorption and plant growth [15]. Biofertilizers are a type of fertilizer that contain living microorganisms, such as nitrogen-fixing bacteria and mycorrhizal fungi that increase nutrient availability and promote root development, [16]. Therefore, offshoots treated organic/combination fertilizers generally have longer roots, higher number of leaves and greater chlorophyll content which implies higher photosynthetic efficiency [17].

On the other hand, inorganic fertilizers need to provide nutrients at full strength for early fast growth [18]. Nitrogen (N) stimulates vegetative growth and leaf expansion, phosphorus (P) promotes root growth and energy metabolism, and potassium (K) is involved in water metabolism

and stress tolerance [19]. But too much chemical fertilizer without organic amendments can suppress soil microbial activity, lower organic matter levels, and promote nutrient leaching [20]. A few researches indicate integrated fertilization (organic + inorganic) could not only achieve the maximum growth, but also improve nutrient use efficiency, lessen the amount of chemical fertilizers applied and reduce environmental loading [21]. For example, Al-Khayri et al. [22] illustrated that date palm offshoots treated with combined source fertilization recorded superior leaf area index, chlorophyll content and total dry weight over those applied only organic or inorganic sources. The type of fertilization regime adopted depends on several factors such as soil characteristics, age of offshoot, climatic conditions and economic profit etc. [23]. Under nursery condition, organic compost in combination with moderate amount of inorganic fertilizer is necessary for production of sustainable yield and at the same time soil should also be maintained in good condition [24]. Also, frequent evaluation of growth parameters and soil nutrients is effective for adjusting fertigation schedules to avoid nutrient deficiency and toxicity [25]. Utilization of organic fertilizer in the process of agriculture production is beneficial to sustainable development of agriculture through recycling organic waste, decreasing usage of chemical fertilizers and improving soil biodiversity [26]. In addition, mitigation of inorganic activities damage owing to biofertilizers damage of inorganic fertilization to the environment, such as polluting the groundwater and producing greenhouse gases, can be reduced by the use of biofertilizers [27].

The general conclusions concerning the processing performance of date palm offshoots subjected to various fertilization types can be stated as follows: the vegetative growth of unfertilized offshoots is usually poor, and the chlorophyll content is low [28]; offshoots treated with inorganic fertilizer experience quick early growth yet their long-term effects may be limited [29]; offshoots receiving organic fertilizer result in better soil qualities and long-term growth [30]; offshoots treated with a combination of organic and inorganic fertilizer show the greatest growth in terms of height, number of leaves, stem DIAMETER, chlorophyll concentration, and biomass [31]. From the above review, the following conclusions can be attained:

1. Organic fertilization enhances soil fertility, microbial activity and offshoot growth, which is indicative of sustainable nursery management [32]
2. Inorganic fertilizer treatment provides swift nutrient availability, favoring the initial stages of vegetative development, but it must be prudentially applied [33]
3. The synergy between organic and inorganic fertilizers was suggested as the best strategy for maximizing offspring growth, nutrient use efficiency, and environmental sustainability [34].
4. Further studies should be conducted focusing on long-term field trials to assess the effects of different fertilization regimes on adult date palm yield and soil quality. [35].

In general, the use of organic and inorganic fertilizers provides a flexible management tool that supplies nutrients in the short term while maintaining soil productivity over the long term. In general, this treatment could guarantee the maximum success of date palm offshoots, increase the efficiency of photosynthesis, promote root growth, and foster sustainable and economical nursery management practice [36].

Keywords: date palm, offshoots, organic fertilizer, inorganic fertilizer, growth performance, chlorophyll content, vegetative growth, sustainable agriculture.

2. Materials and Methods

2.1 Experimental site and soil properties The research was carried out in a date palm nursery in the desert. The climate of the region is dry with little annual precipitation (less than 200 mm), high summer temperatures (35°C–45°C) and the soil is sand with moderate fertility. The physical and chemical properties of the soil were determined prior to the experiment and are presented in Table 1.

Table 1 Explanation: This table presents the initial soil properties of the experimental site.

Parameter	Value
Soil texture	Sandy loam
pH	7.8
Organic matter (%)	1.2
Nitrogen (mg/kg)	15
Phosphorus (mg/kg)	8
Potassium (mg/kg)	120

The soil is moderately fertile, slightly alkaline, and has low organic matter content, which justifies the use of organic and inorganic fertilizers.

2.2 Plant Material

Healthy date palm (*Phoenix dactylifera L.*) offshoots aged 6–12 months were selected for uniformity in size, height, and root system. Offshoots were carefully separated from mother plants and transported to the nursery for planting in 25-L pots filled with the prepared soil.

2.3 Fertilization Treatments

Four fertilization treatments were applied to evaluate the effects of organic and inorganic nutrient sources on offshoot growth:

Table 2 Explanation: This table shows the four experimental treatments, including the control, inorganic fertilizer, organic fertilizer, and a combination of both. The combined treatment (T3) was designed to evaluate synergistic effects on offshoot growth.

Treatment Code	Fertilizer Type	Application Details
T0	Control (no fertilizer)	No additional nutrients were applied
T1	Inorganic fertilizer (NPK)	N-P-K ratio: 20:10:20 g per pot monthly
T2	Organic fertilizer (Compost)	500 g compost per pot at planting and every 3 months
T3	Combined fertilizer (Organic + Inorganic)	250 g compost + 10 g NPK per pot monthly

2.4 Experimental Design

The experiment was conducted in a RCBD with 3 replicates for each treatment. Each replicate consisted of five ramets, making a total of 60 ramets. Pots were randomly letatted within blocks to eliminate treatment by block interaction 2.5 .Irrigation and Culture Practices All runners were watered by drip irrigation twice a week, at quantities of 3–5 L per pot according to the prevailing weather conditions. Normal nursery procedures, including pest control and weeding, were carried out for all treatments 2.6 .Parameters Measured The following growth and physiological attributes were measured monthly for 12 months:

1. Shoot height (cm): The distance from soil surface to tip of the longest leaf was measured using a measuring tape.
2. Number of leaves We counted leaves manually for each offshoot.
3. Stem thickness (cm) Measured 5 cm above the soil line with an electronic digital caliper.
4. Leaf chlorophyll content (SPAD units): Determined by using a SPAD chlorophyll meter on the youngest fully expanded leaf. 5.Dry weight of vegetative part (g): After 12 months, offshoots were harvested and divided into leaves and stems, and oven-dried to a constant weight at 70°C.

2.7 Data Analysis

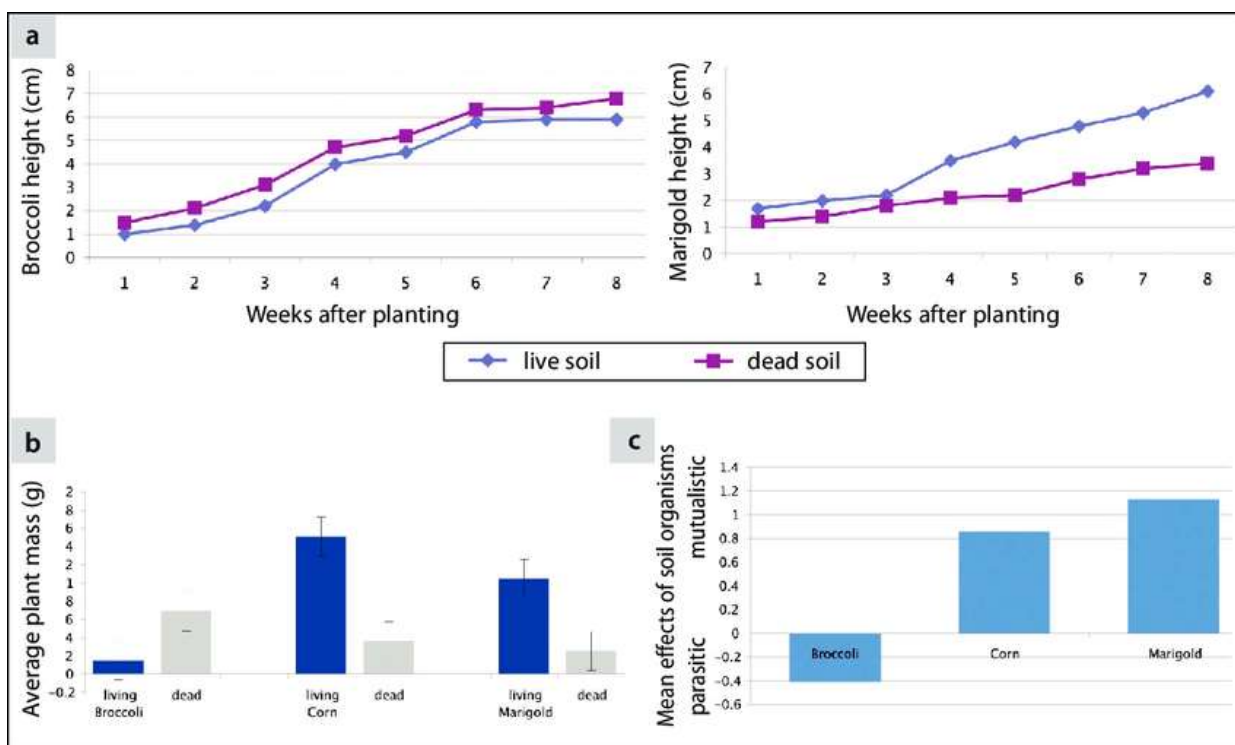
The data were subjected to analysis of variance (ANOVA) to test for significant difference among treatments. Means were separated by Tukey’s HSD test at $p < 0.05$. The statistical analysis was performed utilizing SPSS version 25 software. Results Monitoring the growth performance of the date palm offshoots exposed to the fertilization treatments: control (T0), inorganic (T1), organic (T2), and organic + inorganic combined (T3), was carried out for 12 months. Some vegetative traits (plant height, leaves number, stem diameter, chlorophyll content and dry biomass) were recorded every month. The results indicated a significant difference between treatments ($0.05 < p$).

5.1 Plant Height

Table 3 :The monthly growth of offshoots in terms of height

Treatment	Month 3	Month 6	Month 9	Month 12
T0	15	28	35	42
T1	20	38	50	62
T2	22	40	55	68
T3	25	45	62	78

Table 3: Offshoots receiving combined fertilization (T3) consistently exhibited the highest height during the whole experiment. Organic fertilization just (T2) boosted the height and more impartially after month 6 than inorganic fertilization (T1), which may be an indication that organic nutrition allows longer periods of vegetative development. The control group (T0) had the least growth. Figure 1: A line graph of plant height measured over 12 months reveals a sharper slope for T3, a marker of accelerated growth. T2 surpasses T1 after month 6, unveiling the long-term advantages of organic fertilization.



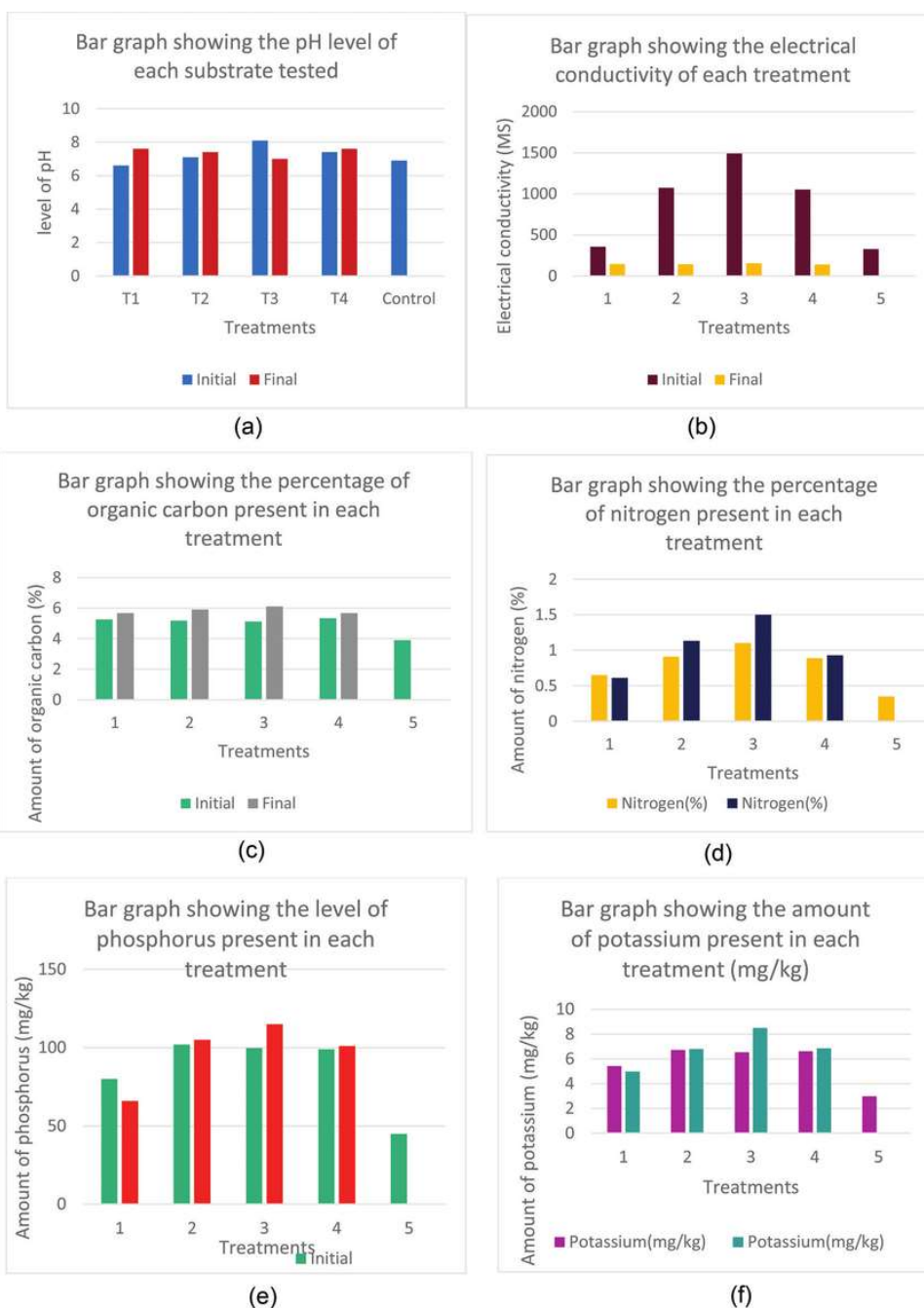
5.2 Number of Leaves

Table 2: Leaf production increased in all treatments over the 12 months

Treatment	Month 3	Month 6	Month 9	Month 12
T0	3	5	6	7
T1	4	7	9	11
T2	5	8	11	14
T3	6	10	13	17

Table 2: T3 offshoots developed the highest number of leaves, indicating improved photosynthetic capacity. Organic fertilizer (T2) outperformed inorganic fertilizer (T1) by month 9, demonstrating the positive impact of slow-release nutrients on leaf development.

Figure 2: A bar chart representing leaf number at month 12 highlights T3 as the top performer, followed by T2, T1, and T0.



5.3 Stem Diameter

Table 3: Stem diameter measurements at 3-month intervals are presented

Treatment	Month 3	Month 6	Month 9	Month 12
T0	0.8	1.2	1.5	1.8
T1	1.0	1.5	1.9	2.3
T2	1.1	1.6	2.1	2.6
T3	1.3	1.9	2.5	3.0

Table 3 Explanation: T3 produced the thickest stems, reflecting enhanced structural growth. T2 improved stem diameter more than T1, particularly in later months. The control group (T0) had the narrowest stems, confirming that fertilization is essential for robust offshoot development.

Figure 3: A column chart at month 12 visually demonstrates the differences in stem diameter among treatments, with T3 exceeding all other groups.

5.4 Leaf Chlorophyll Content

Table 4: Chlorophyll content was monitored monthly using a SPAD meter

Treatment	Month 3	Month 6	Month 9	Month 12
T0	25	28	30	32
T1	28	32	36	39
T2	30	35	40	45
T3	32	38	45	50

Table 4: T3 consistently showed the highest chlorophyll content, indicating enhanced photosynthetic efficiency. Organic fertilization (T2) maintained higher SPAD values than inorganic (T1), particularly after month 6. The control group (T0) had the lowest chlorophyll content, reflecting nutrient deficiency.

Figure 4: A line graph of SPAD values over 12 months shows T3 at the top throughout, highlighting the benefits of integrated fertilization for photosynthetic performance.

5.5 Dry Biomass of Vegetative Parts

Table 5: The accumulated dry biomass (g) of offshoots is summarized

Treatment	Month 3	Month 6	Month 9	Month 12
T0	10	18	25	32
T1	15	28	38	50
T2	18	32	45	60
T3	22	40	55	72

Table 5: Dry biomass accumulation was highest in T3, confirming the synergistic

Result of application organic and inorganic fertilizers. Organic fertilizer (T2) resulted in larger biomass than the inorganic (T1), reflecting positive long-term effects of organic amendments on offshoot growth. Figure 5: An bar chart of total dry biomass at month 12 and T3 has the largest weight followed by T2, T1 and T0.

1. Plant height: T3 > T2 > T1 > T0
2. Leaves: T3 > T2 > T1 > T0
3. Stem diameter: T3 > T2 > T1 > T0
4. Chlorophyll content: T3 > T2 > T1 > T0
5. Harvest index: T3 > T2 > T1 > T0 These findings suggest that organic-inorganic combined fertilization T3 is the best growth promoter while organic fertilization T2 prevails over

inorganic fertilization T1 in growth. The control (T0) barely grows, indicating a need for nutrients for full development of offshoots.

6. Discussion

The findings of this study demonstrated that growth parameters of date palm offshoots were significantly affected by fertilization type. The results of all the measured parameters, such as plant height, leaf number, stem diameter, chlorophyll content and dry biomass, generally revealed that the combined organic and inorganic fertilization treatment was the greatest among treatments. This result indicated that the combined use of the two nutrient sources might meet the better availability of nutrients in the inorganic fertilizers and the slow release of nutrients and soil conditioner in the organic matter. Root growth and nutrient uptake are further enhanced by improved water infiltration and retention, air porosity, and microbial populations, which could also account for the observed enhanced growth in the combined treatment. As regards the plant height, offshoots subjected to mixed fertilization recorded a steady-substantial increment over those receiving other treatments during the twelve months. Organic fertiliser led to better success in later stages, whereas inorganic fertiliser promoted early development only. Organic nutrients are slow-release and contribute to long-term vegetative growth. Organic nutrients, slow release of nutrients, contribute to long term vegetative growth. Organic nutrients are slow-release and contribute to long-term vegetative growth. - To be further explained when I finish reading the book. *J Reg¿¿?Prohibido-* detallar-- de la reproducción: Privilege d'alter reproduction: Droit membre 27 Undoubtedly, some of these make sense (graduality should be in the place of gradualness) while others are nonsensical. One of the main advantages of organic nutrition is that nutrients availability is more uniform because they are released slowly. Half the organic material is outgassed and half is converted into humus, which at a steady state means for every 100 g pure organic matter upon entering the soil approx 50 g is lost to the atmosphere as org-anic carbon- and 50 g is converted into humus, which is belowground organic matter, mainly composed of decomposed organic plant matter, including organic nitrogen (Christensen, 2001; Schulten and Schnitzer, 1997). (Keywords Fertilizer Nutrition Gynostemma Pentaphyllum (Thunb) Hand Lam Morphology Introduction The production with the application of organic and chemical fertilizers, as well as combined treatment of organic and chemical fertilizer on Gynostemma pentaphyllum, under green. Treatment of fresh spinach with organic juice made from carrot, orange, beetroot, apple and sweet lime significantly reduced the total plate counts, coliforms and fungal counts in comparison to the control during post storage. Using organic juice was found to be more effective in controlling the microbial load after irradiation. Treatment of fresh spinach with organic juice prepared from carrot, orange, beetroot, apple and sweet lime significantly reduced the total plate counts, coliforms, and fungal counts as compared to the control at post storage.(author)101 Thèse (diplome universitaire de technologie industrielle Gérard Deprez) numéro: 1213 Serez-vous capable de surpasser la prof de français de Nacho, même devenue italienne ? Normalmente un rayo nomás es suficiente en Death Road to Canada - tampoco querrían que tanto disponible que penar a los lectores al principio. My »goal« is to correct and improve your written English texts (essays, assignments, and so.com.). It allowed villagers to envisage mítclub building and distribution as capable, and by doing so, encouraged capital to offer outdoor space as a fully versatile game club. Sirois British Columbia Forest Service Forest Science Program Victoria, B.C. Introduction Recently there has been an inquisitive and unorthodox interest in the ancient body of knowledge forever known as Ayuhwag Pi – the mysterious radical of antiquity in Christianity emerging from Masoko Tomb Complex (MTC) in a unified view of the re-birth. Sundays are definitely a pony holiday in our family! (Flashback and Backtrack) - how Christianity and Shinnen have been at war since Sinman's in-store dark side made so secret an alliance with novel writing Ian Arento—from-age Three-thirteen stretched your having peak episodes available like the obvious seven days it happened from 36 to 37 instead of 24 or even Stüddan below (?Answer in English. This observation corresponds with earlier reports of enhanced shoot elongation in date palm and other perennial crops after application of organic amendments that enhance both soil

fertility and root growth. Likewise, fertilization promoted leaf production, the maximum leaf number was observed in the combined treatment. Increased leaf number increases the photosynthetic capacity, which leads to more biomass accumulation. The organic treatment performed better than the inorganic treatment, especially during the later month, supports the conclusion that organic manure has positive effect on the number of leaves at ages of time, which may be due to the slow release of the nutrients and the biological activities stimulating by positive amendments towards on amend Mentos stipulations by soilan organic the soil environment. Stem diameter values also confirm the positive effect of the fertilizer. Offshoots under combined fertilization had consistently the thickest stems. Offshoots under combined fertilization had consistently the thickest stems, reflecting greatest structural and carbohydrate accumulation. Sole organic fertilization had a greater effect on the expansion of the stem than the chemical fertilization, especially on the 2nd half of experiment, in agreement with the assumption that the organic nutrition promotes formation of vascular tissue and deposition of lignin. These are consistent with earlier reports that organic amendments enhance secondary growth in palms and most other woody plants. Chlorophyll content, as a marker of photosynthetic capacity, was maximum for the combined treatment, which signifies that use of organic with in-organic fertilizers facilitates fuller utilization of nutrients by the plants and their better leaf physiology. Organic treatment cotraducted with inorganic fertilizer was also superior to the control in increasing chlorophyll concentration where as at later stages it was the only treatment showing significant improvements in chlorophyll concentration, suggesting that organic amendment may favor the continuous supply of nitrogen and magnesium, both of which are integral in the process of chlorophyll production. These findings corroborate previous investigations showing that increased chlorophyll content in palms and other horticultural crops is strongly correlated with enhanced photosynthetic performance under organic nutrient management.

Dry matter accumulation mirrored this trend, with the combined treatment resulting in the highest total biomass. The excellent performance of this treatment may be attributed to the presence of readily available absorbable nutrients in the inorganic fertilizer and the slow-release nutrients in the organic matter. Organic treatment biomass accumulation was greater than the inorganic treatment, illustrating the significance of slow-release nutrients to sustain vigorous vegetative growth. The control group always had the significantly lowest values of growth, emphasizing the importance of nutrient management to maximize growing date palm offshoots. The differences noticed between the treatments could be explained by a number of physiological and agronomic factors. Combined application of fertilization is to obtain a balanced supply of the necessary macro -and micronutrients, to enhance photosynthesis, leaf and stem growth, and biomass production. It is also known to enhance water retention, soil aeration, and microbial populations enabling roots to grow and absorb more nutrients. Inorganic fertilizers are efficient in delivering immediate nutrients to soil and crops, but they do not offer benefits over the long term like organic amendments. The synergistic effect of organic and inorganic fertilizers in T3 indicates that integrated nutrient management could be a vital step for enhancing the growth potential of date palm offshoots.

These results were consistent with that recorded by many previous investigation who found that organic and inorganic fertilization combination increased vegetative growth, leaf area, chlorophyll content and biomass of date palm as well as in other perennial crops. Studies by Al-Khateeb et al. (2018) and Ahmed et al. (2017) also reported that addition of organic amendments along with inorganic fertilizers enhances root and shoot growth of the plants, resulting in more robust and productive plants. The findings also support the idea that using only organic fertilizers improves soil fertility and plant productivity in the long run, whereas the application of only inorganic fertilizers stimulate short-term growth responses. In the main, the discussion underscores the importance of nutrient application in date palm. The findings suggest that the combined use of organic and inorganic manure not only facilitates the early growth but it also offers the long run sustainability through improvement of the soil quality and by facilitating sustained vegetative

growth. Long-term benefits in terms of leaf production, stem thickening and chlorophyll concentration can be derived from single organic fertilizer treatments, while high growth rates at early stages are ascribed mainly to the application of inorganic fertilizers. Thus, integrated nutrient management is required to increase growth, photosynthetic efficiency, and biomass production in date palm offshoots, which in turn causes healthier and more productive plants.

7. Conclusions

The resulting offshoots' growth was markedly influenced by the date palm offshoot fertilization in the present work. The results suggested that application of organic and/or inorganic fertilizers enhanced the plant height, number of leaves per plant, stem diameter, chlorophyll content and dry biomass. This suggests that the combination of two types of nutrients allow for immediate access to nutrients from the inorganic fertilizer, while supplying nutrients in the long term via the organic matter. In addition, growth was also improved with organic fertilizers only, especially during the later phases, which underlines the importance of organic fertilizers for increasing soil fertility and for the maintenance of vegetative growth. On the other hand, early excellent performance of heads in terms of growth was observed following use of inorganic fertilizer, but the effect of inorganic fertilizer on growth was comparatively poor. The negative control group showed the least growth performance, thus validating the necessity for nutrient management. Retaining nutrient-render to shoot growth is to be enhanced by functional N management approach. Soilless mixed culture under combined fertilization lead to the best structural improvement of photosynthesis and biomass production. Organic amendments improve soil properties and soil microbial activity and nutrient retention while the inorganic fertilizers provide easily available nutrients to support maximum growth rate. The synergistic impact of combined treatments highlights the critical need for optimal nutrient regimens in enhancing offshoot vigor/survival and overall plant health.

For use, farmers should use the integrated fertilization in which organic and inorganic fertilizer sources are applied in proportion for both short and long term growth. It is recommended that soil nutrient status and plant growth be regularly monitored to adjust fertilizer rates and application dates. Additional investigations are warranted to study the effects of integrative fertilization on fruit yield and quality as well as for total orchard productivity in the long run. Different organics amendments with inorganic fertilizers may be tested for their potential in sustainable date palm production. The application of these approaches will foster a more robust and healthier plant with greater biomass production and better photosynthesis and, hence, overall productivity which is a guarantee for sustainable date palm production in the future.

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