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RESEARCH ARTICLE

Vermicompost and biochar improve yield, yield components and fruit quality of Seewy date palm variety

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Abstract

This study aimed to investigate the effects of vermicompost and biochar applications on the yield, yield components, and fruit quality of the Seewy date palm cultivar grown in reclaimed sandy soils. The experiment evaluated different treatment levels of vermicompost (10, 15, and 20 kg/palm) and biochar (1000 and 2000 g/palm), applied individually and in combination, over two growing seasons of 2023 and 2024. Results indicate that the combined application of 20 kg vermicompost and 1000 g biochar per palm significantly enhanced fruit set percentage, yield per palm, and total number of bunches compared to individual applications or controls. The highest fruit weight (367.4 g) and pulp weight (321.8 g) were recorded in palms treated with 20 kg vermicompost per palm. Fruit size, length, and width also improved with vermicompost and biochar applications, with the best results observed in palms receiving 20 kg vermicompost alone or in combination with 1000 g biochar. In terms of fruit quality, total soluble solids (TSS), TSS/acid ratio, and sugar content were significantly enhanced by the combined application of 20 kg vermicompost and 1000 g biochar per palm. This treatment also resulted in the lowest fruit acidity and highest reducing sugar percentage, indicating improved fruit sweetness and consumer appeal. The findings suggest that integrating vermicompost and biochar amendments in sandy soils can significantly improve the productivity and quality of Seewy date palms, offering a sustainable alternative to chemical fertilizers for growers in arid regions.

Keywords: organic amendments, soil fertility, sustainable agriculture, date palm cultivation, fruit quality enhancement

1. Introduction

The date palm (*Phoenix dactylifera* L.), a monocotyledonous and dioecious species belonging to the Palmaceae family, is extensively cultivated in the arid regions of the Middle East and North Africa (Chao and Krueger, 2007; Marzouk, 2011; Alkaab et al., 2023). Globally, there are approximately 120 million date palm trees distributed across 30 countries, producing nearly 7.5 million tons of fruit annually (FAO, 2013). Arab countries account for 70% of the world's date palm population and contribute 67% of global date production (El-Juhany, 2010Alyafei et al., 2022). In Egypt, dates are among the most significant export fruit crops, harvested and marketed at three developmental stages. The crop ranks as the third most important fruit after oranges and grapes (Agricultural Economics Bulletin, 2005). The date palm is well-adapted to a wide range of soil and climatic conditions, making it a highly versatile crop. In Egypt, the total number of date palm trees is approximately 14,379,648, with an annual production of about 1,644,417 tons. Among these, *Seewy* date palms account for 3,526,974 trees, producing an estimated 381,003 tons annually (Statistics of the Ministry of Agriculture, 2019, Egypt).The Seewy date palm cultivar is one of the most prominent semi-dry cultivars grown across various regions in Egypt. However, low yield from Seewy date palms cultivated in sandy soils remains a significant challenge for

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growers. Sandy soils are naturally poor in nutrients and organic matter, making them less favorable to optimal crop growth. The incorporation of organic materials, such as cow manure humus and vermicompost, has been shown to enhance vegetative growth and fruit production in a variety of fruit trees (William, 2012; Mosa et al., ؛2014Torshiz et al., 2017; Pawar et al., 2020; Jatin et al., 2020). Specifically, the intelligent and selective use of organic amendments, including vermicompost, in reclaimed sandy soils has demonstrated positive effects on soil conditioning and properties. Vermicompost improves humification, microbial activity, and enzyme production, which enhances soil structure and aeration (Ansari, 2008.(Vermicompost is widely regarded as an excellent soil amendment and biocontrol agent, making it an eco-friendly alternative to chemical fertilizers(Alneyadi et al., 2024). It promotes plant growth and yield while reducing environmental pollution (Joshi et al., 2014). Under salinity stress conditions, vermicompost has been found to increase leaf relative water content, total chlorophyll content, leaf area, and NPK mineral content in Medicago rigidula (Akhzari et al., 2016). Furthermore, vermicompost and compost can meet nutrient demands for both greenhouse and field-grown crops, significantly improving soil fertility and the quantity and quality of harvested produce without polluting the soil (Kowalchuk et al., 1999; Rodríguez et al., 2008; Castillo et al., 2002;Asif et al., 2023.(Biochar, an organic material composed largely of carbon, is produced through the pyrolysis of carbon-based materials and is commonly used as a soil conditioner. Biochar, a type of biochar produced under low or zero oxygen conditions, has been shown to improve soil aeration, water-holding capacity, and nutrient retention while reducing nutrient leaching (Verheijen et al., 2009; Abou Yuossef and Abou Hashem, 2005; Downie et al., 2009). The application of biochar has been reported to increase nutrient availability and retention and enhance the nutrient uptake ratio (Glaser et al., 2002; Lehmann et al., 2003). For example, Tryon (1948) observed that adding biochar to sandy soil increased moisture availability from 18% to 45%. Similarly, biochar and wood ash applications have been associated with higher soil pH and electrical conductivity due to their alkaline nature, although specific combinations with sulfur have been shown to decrease soil pH under Egyptian soil conditions (Major, 2010; Novak et al., 2009; Orman, 2012; El-Wakeel and Mansour, 2014.(Biochar and wood ash amendments have also been found to enhance crop growth and yield in both greenhouse and field settings (Vance, 1996). Organic manure mixed with biochar improves crop production and nutrient availability in the rooting zone (Steiner et al., 2007). For instance, adding 10 kg of biochar per square meter at a soil depth of 0–40 cm increased the number of flower buds and yield in apple trees compared to untreated controls (Sumedrea et al., 2013). Similarly, the combined application of wood ash (1000 g/tree/year) and sulfur (500 g/tree/year) improved leaf area, chlorophyll content, dry matter, and nutrient uptake in navel orange trees (El-Wakeel and Mansour, 2014). Biochar application has also been linked to larger, healthier fruits and nuts (Kelpie, 2015). In Hayany date palms, the application of biochar at a rate of 3 kg/tree resulted in higher yields, improved fruit quality, and increased leaf N, P, K, Ca, and Mg contents compared to control trees (El-Merghany et al., 2021). The objective of this study was to investigate the effects of vermicompost and biochar on the yield and quality of the Seewy date palm cultivar grown in reclaimed sandy soils .

2. Materials and Methods

2.1. Experimental design and plant material

This study was carried out the ExperimentalFarm of Faculty of Agriculture, Sohag University, Sohag University New Campus, New Sohag City, Sohag, Egypt in two successive seasons of 2023 and 2024.

Twenty one of nineteen year-old Seewy date palm is planted at 7 m apart. All the chosen trees were uniform in growth, free from insect damage and diseases. The soil of the research farm was reclaimed sandy soil. Drip irrigation was used to deliver nutrients and water. The agricultural practices were followed as recommended.

The study involved the following seven treatments:

(T1) Control (the recommended dose of mineral fertilizers only)
(T2) Vermicompost 10 kg/palm.
(T3) Vermicompost 15 kg/palm.
(T4) Vermicompost 20 kg/palm.
(T5) Vermicompost 10 kg/palm + Biochar at 1000g/palm.
(T6) Vermicompost 15 kg/palm + Biochar at 2000g/palm.
(T7) Vermicompost 20 kg/palm + Biochar at 1000g/palm.

The whole amount of Vermicompost was added in the 1st of February as a soil application. Biochar applied with a mixture of sheep manure and chemical fertilizers in winter horticulture practices as soil applications.

2.2. Measurements Fruit set.

Fruit setting was calculated in three bunches labeled just after fruit set by using equation of following

$$FS\,\% = \frac{\text{Number of fruitlets/panicle at time of set}}{\text{Number of flowers/panicle at full bloom}} x100$$

2.2.1. Palm yield (Kg)

All bunches of the selected palms were harvested through the first week of August during the fruit Rutab stage, bunch weight was recorded then yield per palm was calculated according to an equation described below.

Yield/palm (kg) = number of bunches x average bunch weight. Productivity

2.2.2.Fruit properties

Samples of twenty (20) dates from each palm (replicate) were taken randomly and the following physical and chemical characteristics were measured.

2.2.2.1 Physical characteristics

Average of fruit weight (g), pulp weight (g) and pulp/fruit weight ratio were determined. Fruit volume (cm3) was determined using water displacement.

2.2.2.2 Chemical characteristics

Total soluble solids % (T.S.S %): was determined by hand refracto meter. Total aciditywas determined as malic acid per 100 g pulp according to A.O.A.C., (1995). TSS/acid ratio wascalculated for each sample. Sugar contents including reducing and total sugars were determined according to Lane and Eynon described in A.O.A.C. (1995), while non-reducing sugars were calculated as the difference between total sugars and reducing sugars.

2.3. Statistical analysis

A randomized Complete Block Design (RCBD) with six treatments and three replicates (one palm per replicate were used in this experiment. The obtained data was subjected to statistical analysis of variance (ANOVA) according to the methods described by Snedecor and Cochran (1989). Mean separation was done using Duncan multiple range test (Duncan, 1958) at 5 % level to determine the significance of differences between the treatments conducted.

3. Results

3.1. Effect of vermicompost and Biochar application on fruit set %, yield and yield components in Seewy variety

3.1.1. Fruit set (%)

Data presented in Table 1 clearly demonstrates that both individual and combined applications of vermicompost and biochar significantly enhanced fruit set percentage compared to the control. Notably, the combined application of vermicompost and biochar proved more effective than using either application alone.

Table 1. Effect of the soil application of Vermicompost and Biochar on fruit set percentage, bunch weight (Kg), yield per palm (Kg/ Palm) and total number of bunches per palm of Seewy date palm variety

Treatments	fruit set percentage of date palm		Bunch weight (Kg)		Yield/palm (Kg/ Palm)		Total number of Bunch per palm	
	2023	2024	2023	2024	2023	2024	2023	2024
Control	67.17^{B}	69.93^{E}	5.60^{A}	7.03^{A}	40.28^{D}	41.83^{C}	7.00^{C}	6.33^{D}
Vermicompost 10 kg/palm	85.83^{A}	82.80^{BC}	5.47^{A}	6.43^{AB}	50.67^{C}	49.50^{B}	9.33^{B}	7.67^{C}
Vermicompost 15 kg/palm	86.00^{A}	76.40^{D}	5.43^{A}	5.83^{BC}	52.67^{BC}	46.67^{BC}	9.67^{B}	8.00^{BC}
Vermicompost 20 kg/palm	85.53^{A}	80.64^{CD}	5.62^{A}	5.90^{BC}	42.50^{D}	45.00^{BC}	7.67^{C}	7.67^{C}
Vermicompost 10 kg/palm + Biochar at 1000g/palm	87.92^{A}	82.50^{BC}	5.76^{A}	5.97^{BC}	56.33^{B}	43.83^{BC}	10.00^{B}	7.33^{C}
Vermicompost 15 kg/palm + Biochar at 2000g/palm	87.03^{A}	86.90^{AB}	5.25^{A}	5.70^{C}	50.50^{C}	48.33^{B}	9.67^{B}	8.67^{B}
Vermicompost 20 kg/palm + Biochar at 1000g/palm	90.20^{A}	89.42^{A}	5.48^{A}	6.00^{BC}	62.00^{A}	58.00^{A}	11.33^{A}	9.67^{A}

Among the treatments, the application of 20 kg Vermicompost per palm combined with 1000 g Biochar per palm resulted in the highest fruit set percentage in both seasons, outperforming all other treatments. In contrast, control palms exhibited the lowest fruit set percentages. The results were consistent throughout both growing seasons.

3.1.2. Yield and yield components

Data presented in Table 1 indicate that yield per palm was significantly enhanced by the soil application of vermicompost and biochar, whether applied individually or in combination, compared to the control. Notably, combined applications of vermicompost and biochar outperformed their individual applications.The application of 20 kg vermicompost per palm combined with 1000 g biochar per palm resulted in a significantly higher yield than applying 20 kg vermicompost alone. The highest yield was recorded in palms receiving this combined treatment in both seasons. The highest total number of bunches per palm was observed in palms treated with 20 kg vermicompost plus 1000 g biochar per palm in both seasons, making it the most economically viable treatment. The maximum bunch weight was recorded in palms treated with 20 kg vermicompost per palm during the first season. However, in the second season, the highest bunch weight was unexpectedly observed in control palms.

3.2. Effect of vermicompost and Biochar application on fruit characteristics in Seewy variety

Data presented in Table 2 indicate that fruit size (cm^3), fruit length (cm), and fruit width (cm) were significantly influenced by the application of vermicompost and biochar in both seasons. The largest fruit volume (cm^3) was recorded in palms treated with 20 kg of vermicompost per palm in both seasons. Similarly, the application of 20 kg of vermicompost per palm resulted in the greatest fruit length in the first season. However, in the second season, the highest fruit length was observed in palms treated with a combination of 10 kg of vermicompost and 1000 g of biochar per palm.A similar trend was noted for fruit width, where the highest value was obtained with 20 kg of vermicompost per palm in the first season. In contrast, during the second season, the maximum fruit width was

Table 2. Effect of the soil application of Vermicompost and Biochar on fruit volume (cm^3), fruit length (cm) and fruit width (cm)of Seewy date palm variety

Treatments	Fruit volume $(cm)^3$		Fruit length (cm)		Fruit width (cm)	
	2023	2024	2023	2024	2023	2024
Control	217.00^{B}	210.70^{B}	3.19^{C}	3.05^{C}	2.02^{B}	1.72^{C}
Vermicompost 10 kg/palm	245.30^{B}	255.00^{A}	3.65^{B}	3.61^{B}	1.91^{C}	1.84^{BC}
Vermicompost 15 kg/palm	240.30^{B}	252.30^{A}	3.59^{B}	3.59^{B}	1.99^{BC}	1.97^{AB}
Vermicompost 20 kg/palm	338.30^{A}	272.00^{A}	4.08^{A}	3.62^{B}	2.26^{A}	1.98^{A}
Vermicompost 10 kg/palm + Biochar at 1000g/palm	240.30^{B}	227.00^{B}	3.64^{B}	3.77^{A}	2.01^{B}	2.01^{A}
Vermicompost 15 kg/palm + Biochar at 2000g/palm	242.00^{B}	259.90^{A}	3.63^{B}	3.76^{A}	2.07^{B}	2.01^{A}
Vermicompost 20 kg/palm + Biochar at 1000g/palm	214.20^{C}	258.70^{A}	3.65^{B}	3.55^{B}	1.98^{BC}	1.93^{AB}

recorded in palms treated with 10 kg of vermicompost plus 1000 g of biochar per palm. Conversely, control palms consistently produced the smallest fruit size, length, and width across both seasons. Data presented in Table 3 indicate that fruit weight (g) and fruit pulp weight (g) were significantly influenced by the soil application of vermicompost and biochar in both seasons. The highest fruit weight was recorded in palms treated with 20 kg vermicompost per palm across both seasons. A similar trend was observed for fruit pulp weight, with the maximum values also obtained from palms receiving 20 kg vermicompost per palm in both seasons. In contrast, control palms consistently exhibited the lowest fruit weight and pulp weight across both growing seasons.

3.3. Effect of Vermicompost and Biochar application on fruit quality in Sweey variety

Data presented in Tables 4 and 5 indicate that total soluble solids percentage (TSS %), acidity, TSS/acid ratio, total sugars (%), reducing sugars (%), and non-reducing sugars (%) were significantly influenced by the soil application of vermicompost and biochar in both seasons. The highest TSS values were recorded in palms treated with 10 kg vermicompost + 1000 g biochar per palm in the first season, while in the second season, the maximum TSS was obtained from palms receiving 20 kg vermicompost + 1000 g biochar per palm. The lowest total acidity was observed in palms treated with 15 kg vermicompost per palm during the first season. However, in the second season, the lowest acidity was recorded in palms treated with 20 kg vermicompost + 1000 g biochar per palm. The highest TSS/acid ratio was found in palms treated with 15 kg vermicompost per palm in the first season, whereas in the second season, the highest values were recorded in palms treated with 20 kg vermicompost + 1000 g biochar per palm. The maximum total sugar content was obtained from palms treated with 15 kg vermicompost per palm in the first

Table 3. Effect of the soil application of Vermicompost and Biochar on fruit weight (g) and pulp weight (g) of Seewy date palm variety

Treatment	Fruit weight (g)		Pulp weight (g)	
	2023	2024	2023	2024
Control	230.70^{D}	225.70^{C}	194.50^{D}	161.00^{D}
Vermicompost 10 kg/palm	275.10^{B}	277.10^{A}	231.50^{B}	210.60^{C}
Vermicompost 15 kg/palm	261.20^{BC}	278.90^{A}	212.00^{BCD}	230.10^{B}
Vermicompost 20 kg/palm	367.40^{A}	290.00^{A}	321.80^{A}	249.20^{A}
Vermicompost 10 kg/palm + Biochar at 1000g/palm	271.30^{B}	251.70^{B}	225.20^{BC}	203.30^{C}
Vermicompost 15 kg/palm + Biochar at 2000g/palm	263.60^{BC}	278.60^{A}	222.70^{BC}	233.00^{B}
Vermicompost 20 kg/palm + Biochar at 1000g/palm	244.70^{CD}	282.70^{A}	202.90^{CD}	211.00^{C}

Table 4. Effect of the soil application of Vermicompost and Biochar on total soluble solids percentage (TSS %), acidity and TSS/ acidity of Seewy date palm variety

Treatments	Total soluble solids percentage (TSS %)		Acidity		TSS/ acidity	
	2023	2024	2023	2024	2023	2024
Control	14.64^{C}	15.53^{C}	4.00^{AB}	4.97^{A}	3.29^{C}	3.22^{D}
Vermicompost 10 kg/palm	19.00^{A}	19.07^{AB}	3.20^{C}	4.03^{B}	6.43^{B}	4.80^{C}
Vermicompost 15 kg/palm	19.00^{A}	19.67^{A}	2.37^{D}	3.17^{CD}	8.24^{A}	6.65^{B}
Vermicompost 20 kg/palm	17.33^{B}	19.45^{A}	4.33^{A}	3.67^{BC}	4.22^{C}	5.36^{C}
Vermicompost 10 kg/palm + Biochar at 1000g/palm	19.50^{A}	19.37^{A}	3.33^{BC}	3.10^{D}	5.92^{B}	6.61^{B}
Vermicompost 15 kg/palm + Biochar at 2000g/palm	18.30^{AB}	17.67^{B}	3.33^{BC}	4.17^{B}	5.66^{B}	4.33^{CD}
Vermicompost 20 kg/palm + Biochar at 1000g/palm	19.27^{A}	20.43^{A}	3.50^{BC}	2.77^{D}	5.58^{B}	8.05^{A}

Table 5. Effect of the soil application of Vermicompost and Biochar on total sugars (%), reducing sugars (%) and non-reducing sugars (%) of Seewy date palm variety

Treatments	Total sugars (%)		Reducing sugar (%)		Non-reducing sugars (%)	
	2023	2024	2023	2024	2023	2024
Control	11.68^{D}	12.25^{C}	6.18^{C}	6.15^{D}	5.49^{D}	6.10^{AB}
Vermicompost 10 kg/palm	14.67^{BC}	15.33^{AB}	7.63^{B}	7.60^{C}	7.03^{BC}	7.73^{A}
Vermicompost 15 kg/palm	16.33^{A}	15.50^{AB}	7.50^{B}	8.97^{AB}	8.83^{A}	6.53^{AB}
Vermicompost 20 kg/palm	13.83^{C}	14.85^{B}	5.80^{C}	8.57^{B}	8.03^{AB}	6.28^{AB}
Vermicompost 10 kg/palm + Biochar at 1000g/palm	16.00^{A}	15.73^{AB}	7.70^{B}	8.80^{B}	8.30^{A}	6.93^{AB}
Vermicompost 15 kg/palm + Biochar at 2000g/palm	13.90^{C}	14.57^{B}	6.83^{BC}	8.73^{B}	7.07^{BC}	5.83^{B}
Vermicompost 20 kg/palm + Biochar at 1000g/palm	15.43^{AB}	16.67^{A}	8.93^{A}	9.80^{A}	6.50^{CD}	6.87^{AB}

season, while in the second season, the highest values were recorded in palms treated with 20 kg vermicompost + 1000 g biochar per palm. The highest reducing sugar percentage was consistently recorded in palms treated with 20 kg vermicompost + 1000 g biochar per palm across both seasons. The maximum non-reducing sugar percentage was observed in palms treated with 15 kg vermicompost per palm in the first season, while in the second season, the highest values were obtained from palms treated with 10 kg vermicompost per palm.

4. Discussion

Our findings clearly demonstrate that the application of vermicompost and biochar significantly improved all studied traits, except for bunch weight in the second season, compared to the control. Although control palms exhibited the highest bunch weight, they had the lowest number of bunches per palm, ultimately resulting in lower overall yield than palms treated with vermicompost and/or biochar. The combined application of vermicompost and biochar was more effective than either amendment applied alone. Significant differences were observed among all treatments, highlighting the beneficial effects of these organic amendments on date palm growth, yield, and fruit quality. Sandy soil is known for its poor nutritional, chemical and physical characteristics. So, it needs the continuous addition of amendments, especially organic amendments. Vermicompost is an ideal organic amendment that enhances plant growth and yield. Its positive effects can be attributed to improvements in soil structure, increased water-holding capacity, and enhanced root development, all of which promote efficient nutrient and water uptake, leading to increased biomass production (Ansari, 2008; Joshi et al., 2014). Vermicompost contains essential plant nutrients such as nitrates, phosphates, exchangeable calcium, and soluble potassium in readily available forms (Orozco et al., 1996). Additionally, it harbors beneficial plant growth-promoting microorganisms, making it a key component of sustainable agriculture while reducing reliance on chemical fertilizers (Joshi *et al*., 2014; Akbasova *et al*., 2015). The presence of beneficial microbiota, including fungi, bacteria, and actinomycetes, further enhances its suitability for plant growth (Tomati et al., 1987). Vermicompost has been shown to increase total yield, bunch number per palm, chlorophyll content, acidity, total soluble solids (TSS), and both micro- and macronutrient concentrations in fruit. Additionally, it enhances carbohydrate and protein content, leading to improved fruit quality. These beneficial effects may be attributed to the production of plant growth regulators, such as cytokinins and auxins, by microorganisms present in vermicompost (Tomati et al., 1987). Krishnamoorthy and Vajrabhiah (1986) reported that organic waste processed by earthworms leads to the production of these essential plant hormones, further promoting plant growth and productivity.

The enhancement of leaf nutrient content following biochar application can be attributed to its positive effects on soil physical properties, fertility, and biological conditions (Ishii and Kadoya, 1994). Biochar increases soil water-holding capacity and nutrient retention while reducing nutrient leaching (Abou Yuossef & Abou Hashem, 2005). It also enhances nutrient uptake efficiency (Glaser et al., 2002; Lehmann et al., 2003). Tryon (1948) reported that incorporating biochar into sandy soils increased available moisture from 18% to 45%, which in turn enhanced nutrient uptake. Similarly, Steiner et al. (2007) found that combining organic manure with biochar improved nutrient availability in the root zone, further supporting plant growth. The positive effects of biochar on vegetative growth may be attributed to its ability to improve soil aeration, water-holding capacity, and nutrient retention, while simultaneously reducing nutrient leaching (Abou Yuossef & Abou Hashem, 2005; Downie et al., 2009). These improvements lead to enhanced leaf area, increased chlorophyll content, and overall better plant performance. Tryon (1948) demonstrated that biochar application in sandy soils significantly improved water retention, which in turn promoted better water utilization, increased leaf chlorophyll content, and stimulated plant growth.

Biochar has also been shown to enhance root nutrient uptake, thereby improving leaf nutrient content (Vance, 1996), leading to increased fruit set and overall yield. This effect may be linked to its ability to enhance chlorophyll content, thereby promoting photosynthesis (El-Wakeel & Mansour, 2014). Several studies have reported increased fruit set and yield in various fruit crops following biochar application, including apple (Sumedrea et al., 2013), nut trees (Kelpie, 2015), and date palm (El-Merghany et al., 2021).

The beneficial effects of biochar on fruit quality can be attributed to its role in promoting photosynthesis by improving leaf chlorophyll content and facilitating the efficient transport of assimilates to storage organs. Thus, it increased net photosynthetic rate, enhanced root uptake of nutrients, and improved leaf nutrient content (Vance, 1996; El-Wakeel & Mansour, 2014; Kelpie, 2015), ultimately leading to superior fruit quality.

5. Conclusions

The soil application of vermicompost and biochar significantly improved fruit set, yield, and fruit quality in the *Seewy* date palm variety compared to the control. The combined application of vermicompost and biochar proved to be more effective than using either amendment alone. Among the tested treatments, the application of vermicompost at 20 kg per palm plus biochar at 1000 g per palm consistently resulted in the highest improvements in fruit yield, physical characteristics, and chemical composition. Additionally, vermicompost at 15 kg per palm showed notable enhancements in fruit quality attributes, particularly total soluble solids (TSS) and sugar content. These improvements can be attributed to enhanced soil fertility, water retention, and nutrient availability provided by both amendments. Vermicompost contributes essential nutrients and beneficial microorganisms that promote plant growth and productivity, while biochar improves soil structure, aeration, and nutrient retention, leading to better root development and nutrient uptake. Based on these findings, it is recommended to apply vermicompost (20 kg per palm) combined with biochar (1000 g per palm) as an effective soil amendment strategy for improving the growth, yield, and fruit quality of *Seewy* date palms cultivated in sandy soils. Further research on long-term soil health benefits and economic feasibility is suggested to optimize the application rates for sustainable date palm production.

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