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Effect of Wood Ash Soil Amendment on Growth, Yield and Fruit Quality of 'Early Swelling' Peach Trees

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Abstract: The combustion of pruning waste generates wood ash, which contains the highest concentration of mineral nutrients and trace elements among biomass sources. This study aimed to analyze the effects of wood ash on the growth parameters, yield, and quality of the peach cultivar 'Early swelling'. Wood ash was applied to the peach trees in their shade every season in early November at rates of 0, 1, 2, 3, 4 and 5 kg/tree. The findings showed a significant increase in all parameters related to vegetative growth and nutritional condition, such as leaf area, chlorophyll a and b concentrations, and total leaf chemical components (macro and microelements), when wood ash was applied at a rate of 3 kg. Additionally, an evident increase was observed in the number of fruits, alongside increases in yield and various physical parameters, including weight, size, length, diameter, flesh thickness, and fruit firmness. The treatment led to a significant rise in the content of soluble solids, acidity, total sugars, and anthocyanins, while reducing the contents of nitrates and nitrites in the fruits.

1 Introduction

The high nutritional content and pleasant flavor of peaches have made them one of the most popular fruits worldwide. The peach is among the most important deciduous trees; it can be consumed fresh, as jelly, or as jam. "Early Swelling" is considered one of the first mature peach cultivars; it requires chill hours ranging from 89 to 112 hours at 7°C or 563 to 577 hours at 10°C, with GDH ranging from 26014 to 15166 heat units, and fruit maturity time ranges from 74 to 83 days from the beginning of flowering until harvesting. It is characterized by good vegetative growth and good fruit quality; its yield per tree, fruit weight, and size are medium, the fruit shape is spherical-oval, and the fruit color is yellowish-red (Ezzat et al 2024). The Food and Agriculture Organization (FAO) estimated that the area planted with peaches worldwide in 2022 was 1,542,648 hectares, with a total fruit production of 26,354,497 tons (FAOSTAT 2022). The primary culprits behind poor yields can be traced back to two key issues: neglecting to replenish the soil's organic matter and inadequate or incorrect application of fertilizers. These factors can significantly undermine the health and productivity of the land, resulting in frustratingly low crop yields.

The ongoing reliance on fast-dissolving chemical fertilizers to boost crop production has a significantly negative impact on our health and ecosystems (Win 2010). Wood ash, the residue from burning wood (Wiklund 2017), can come from wood burned during tree trimming on farms or from home fireplaces. It is produced by burning wood and primarily consists of minerals that trees have absorbed throughout their lifespans (Pugliese et al 2014). Given the skyrocketing prices of mineral fertilizers and the more budget-friendly option of wood ash, the potential of ash as an alternative became clear. This research aims to investigate whether wood ash could help reduce chemical fertilizer use without compromising the health of soil or crops (Adekayode and Olojugba 2010).

The nutritional contents of wood ash that are vital for plant growth and its low cost have prompted exploration of wood ash as a substitute for artificial fertilizers (Ohno and Erich 1990). Wood ash is also a sustainable alternative to conventional chemical fertilizers (Huotari et al 2015). Adding wood ash to the soil promotes the development and growth of oats, corn, wheat, and green peas (Krejlsl and Scanlon 1996, Vance 1996, Dayo-Olagbende et al 2018). The effectiveness of wood ash on fruit trees suffers from incomplete information; therefore, this study aimed to investigate the effect of wood ash on the growth, quantity, and yield of the peach cultivar "Early swelling".

2 Materials and Methods

2.1 Plant materials and experimental application

The current study was conducted over two consecutive seasons, 2020/2021 and 2021/2022, on peach trees (Prunus persica L.), cultivar "Early swelling, " which were budded on Nemaguard peach rootstock. The analyzed trees were six years old and grown in sandy soil with a drip irrigation system in a private orchard in Al Khatatbah, Monufia Governorate, Egypt. Following the Ministry of Agriculture's recommendations for sandy soil conditions, the trees were planted 4×5 meters apart and were subjected to irrigation and fertilization programs, along with other agricultural practices. Tables 1 and 2 present the soil and water analyses. The treatments involved adding wood ash to the soil around the trees at rates of 0, 0,1, 2, 3, 4, and 5 kg/tree; the wood ash analysis is presented in Table 3. The experiment was carried out on 36 uniformly selected trees regarding growth, productivity, and appearance, which were arranged in six treatments, each consisting of six trees as replicates. During the two seasons, wood ash treatments were applied once per season in early November, and the wood ash was spread in the shade of the trees and mixed with the soil. A single dose of 0.5 kg of agricultural sulfur and 0.5 liters of active microorganisms (EM) were applied to the soil after adding wood ash to each tree. As a straightforward experiment, the treatments were organized using a randomized complete block design.

Throughout the two seasons of the study, the following parameters were measured:

Table 1. Soil physical properties of the experimental site

Soil depth cm	**0 - 30**	**30 - 60**	**60 – 90**
Soil properties	**Values**		
Sand (%)	62.28	63.32	63.53
Clay (%)	14.75	15.07	15.29
Silt (%)	22.97	21.61	21.18
Soil texture	**Sand**		
pH	7.35	7.40	7.43
EC (dS/m)	2.64	2.64	2.65
Organic matter (%)	0.56	0.58	0.46
Available P (ppm)	7.10	9.7 0	8.60
Available K (ppm)	187.5	166.5	146.5
Available Ca (meq/l)	9.00	9.15	9.21
Available Mg (meq/l)	4.00	4.11	3.99
Available Na (meq/l)	14.50	14.00	15.00
HCO_3 (meq/l)	7.75	8.85	9.00
Cl (meq/l)	9.57	10.77	11.00
SO_4 (meq/l)	19.00	21.40	18.88

2.2 Vegetative growth

The selected measurements were as follows: Trunk girth (cm): After the growth season, it was measured at a fixed point 5 cm above the graft union zoon by Cloth Tape Measure Operating Instruction and was computed using the following equation

Trunk girth (cm) = final trunk diameter - beginning trunk diameter in the last growing season.

Shoot diameter (mm): it was measured at a fixed point 5 cm above the shoot base by a Digital Caliper within 300 mm of the Operating instructions in the last growing season.

Shoot length (cm): 3 shoots/trees × 6 replicates were dedicated to calculating the shoot length (cm) by Cloth Tape Measure Operating Instruction In the last growing season.

Table 2. Chemical properties of irrigation water

pH	EC dS/m	Soluble Salts (meq/l)								SAR	TDS ppm
		Ca^{++}	Mg^{++}	Na^{+}	K^{+}	CO_3^{--}	HCO_3^{-}	Cl^{-}	SO_4^{--}		
7.12	1.5	6.0	3.6	21.95	0.23	0.1	3.0	14	14.7	10	960

Table 3. The chemical composition and some properties of the wood ash used in the experiment

Humidity %	PH	EC dS/m	P %	K %	Ca %	Mg %	Na %	Fe mg/kg	Zn mg/kg	Mn mg/kg	Cu mg/kg	Co mg/kg	$CaCO^3$ %
2	10.4	3.1	0.4	2.13	0.3	0.05	0.03	121	33	160	343	310	43

Number of new shoots: The total number of shoots per tree was counted during the last growing season.
Leaf area (cm^2): using leaf area apparatus (C1-203 Area Meter CID, Ime) as an average of 10 leaves.

2.3 Chemical composition of leaf

2.3.1 Chlorophyll analysis (mg/100g)

A sample of a mature leaf's chlorophyll (a) and (b) content was measured using the Abdel-Hamid (2016) method. Measurements were conducted in May during both seasons of the study.

2.3.2 Mineral contents of leaf

Leaves were sampled from the middle of the shoots in mid-June, fully expanded, and well exposed to light. The samples were cleansed with faucet water, followed by distilled water, and then oven-dried at 70°C until they reached a consistent weight. The method for digestion used was Jackson's (1958) method, after the dry samples were ground using an electric mill. The determinations of various minerals were as follows:

Nitrogen content material becomes determined by the modified micro Kjeldahl method, according to Pregel (1945) expressed as g/100 g dry weight.
Phosphorus content was determined according to Truog and Meyer (1929).
Potassium contents according to AOAC (2023). expressed as g/100 g dry weight.
Leaf contents of Ca (%), Mg (%), Fe, Zn, and Mn were determined according to Piper (1950).

2.4 Yield parameters

The fruits from each tree were counted, and a sample of ten fruits was collected and sent directly to the laboratory to determine their physical and chemical properties, as well as the weight of each fruit (g). The average yield per tree (kg) was calculated by multiplying the average number of fruits per tree by the average fruit weight for each replicate. Additionally, the yield per faddan (ton) was calculated by multiplying the average yield per tree (kg) by the number of trees per faddan.

2.5 Fruit quality parameters

The physical and chemical characteristics were chosen by randomly selecting three fruits per tree for each replicate during each season.

2.5.1 Physical characteristics of fruits

Fruit volume (cm^3): Three fruits were randomly selected from each replicate and calculated by the water transfer method.

A digital caliper was utilized to measure the fruit's length (mm), diameter (mm), length-to-diameter ratio, and thickness (mm).

Fruit firmness (Lb./inch^2): Measured with IGV-O.SA to FGV-100A.Shimpo digital dynamometer.

2.5.2 Fruit chemical properties

Total soluble solids (TSS): It was evaluated by ATAGO digital refractometer according to (AOAC 2005).
Total acidity (%): The acidity was determined as malic acid according to (AOAC 2005).
T.S.S/acid ratio = Calculated T.S.S/ Total acidity.
Total sugar % was calculated using (AOAC 2005) methodology. The concentration was calculated using grams of glucose per 100 grams of dry-weight flesh.
Anthocyanin (mg/100g) was quantified using the Fuleki and Francis (1968) technique.
The methods described by Sen and Donaldson (1978) were utilized to determine the nitrate and nitrite content (ppm) in fruit juice.

2.6 Statistical analysis

A completely randomized block design was employed. A statistical analysis was performed to evaluate the differences among the treatments tested. According to Duncan (1965), the means were compared using Duncan's multiple range test with a probability of 0.05.

3 Results and Discussion

3.1 Effect of wood ash on vegetative growth characteristics and chlorophyll content

Data in **Tables 4** and **5** show that the most significant difference resulted from the addition of 4 kg of wood ash per tree in the first season and 3 kg per tree in the second season. Improvement was observed in trunk circumference, shoot diameter, length, number of new shoots, leaf area, and chlorophyll content (Chlorophyll a, b, and total) compared to the control treatment.

3.2 Effect of wood ash on leaf nutrient content

The statistics in **Table 6** indicated that adding wood ash at a rate of 5 kg per tree resulted in the highest significant difference in the levels of phosphorus, potassium, calcium, and magnesium in peach leaves across both seasons. In contrast, this treatment showed the least significant difference in the nitrogen and microelement levels in leaves during both seasons. The control treatment exhibited the highest significant difference in the leaf content of nitrogen, iron, zinc, and manganese throughout both seasons.

3.3 Effect of wood ash on yield

The data in **Table 7** showed that adding 4 kg of wood ash per tree in the first season and 3 kg/tree in the second season gave the highest significant difference in fruit weight, the number of fruits/tree, yield/tree and yield/fe compared to the control treatment.

3.4 Effect of wood ash on fruit physical characteristics

According to **Table 8**, adding 4 kg of wood ash per tree in the first season and 3 kg per tree in the second season resulted in the most significant differences in fruit volume, fruit length, fruit diameter, and flesh thickness compared to the control treatment. In contrast, for fruit firmness, the 5 kg treatment showed the highest significant difference across the two seasons. Finally, the measurement of the L/D ratio did not reveal any significant differences between the treatments in both seasons.

3.5 Effect of wood ash on Fruit chemical analysis

The data in Table 9 demonstrated that adding 4 kg of wood ash per tree in the first season and 3 kg per tree in the second season resulted in the highest significant differences in percentages of TSS %, TSS/acid ratio, total sugar, and anthocyanin (mg/100g) compared to the control treatment. It was also observed that the total acidity of peach fruits receiving a treatment of 4 kg of wood ash per tree in the first season and 3 kg per tree in the second season showed the least significant difference. Furthermore, adding wood ash to the tree soil significantly reduced the nitrate and nitrite content of the fruits in comparison to the control treatment during both seasons.

Table 4. Effect of wood ash treatments on vegetative growth characteristics of "Early swelling" peach trees during 2020/2021 and 2021/2022 seasons

Treatment / Character.	Trunk circumference (girth) (cm)	Shoot diameter (mm)	Shoot length (cm)	No. of new shoots	Leaf area (cm^2)
2020/ 2021 seasons					
T1: Control	8.05 b	6.18 ab	43.16 c	820 e	58.66 be
T2: Wood Ash 1 Kg/tree/year	8.21 b	7.03 ab	45.83 b	970 d	64.50 c
T3: Wood Ash 2Kg/tree/year	8.56 ab	7.92 a	46.16 b	1011 c	60.83 d
T4: Wood Ash 3Kg/tree/year	8.69 ab	8.22 a	48.50 b	1141 b	70.33 b
T5: Wood Ash 4Kg/tree/year	9.34 a	8.83 a	51.00 a	1258 a	74.16 a
T6: Wood Ash 5Kg/tree/year	7.02 c	5.14 b	40.66 d	665 f	57.33 e
2021/ 2022 seasons					
T1: Control	8.23 abc	7.22 d	41.16 d	936 d	51.83 d
T2: Wood Ash 1 Kg/tree/year	8.67 ab	7.67 c	43.33 c	1025 c	56.16 c
T3: Wood Ash 2Kg/tree/year	8.87 a	8.33 b	50.66 b	1077 b	58.33 b
T4: Wood Ash 3Kg/tree/year	9.06 a	8.86 a	54.66 a	1149 a	61.00 a
T5: Wood Ash 4Kg/tree/year	7.77 bc	6.77 e	37.06 e	871 e	50.00 e
T6: Wood Ash 5Kg/tree/year	7.34 c	5.80 f	34.16 f	776 f	47.00 f

Means with the same letter (s) in each column are not significant differences at level ($p \leq 0.05$)

Table 5. Effect of wood ash treatments on leaf content of total chlorophyll of "Early swelling" peach trees during 2020/2021 and 2021/2022 seasons

Treatment / Character.	Chlorophyll (a) (mg/100g)	Chlorophyll (b) (mg/100g)	Total Chlorophyll
2020/ 2021 seasons			
T1: Control	0.35 bc	0.18 e	0.54 c
T2: Wood Ash 1 Kg/tree/year	0.38 ab	0.19 d	0.57 b
T3: Wood Ash 2Kg/tree/year	0.38 ab	0.20 c	0.59 b
T4: Wood Ash 3Kg/tree/year	0.39 a	0.21 b	0.60 ab
T5: Wood Ash 4Kg/tree/year	0.41 a	0.22 a	0.63 a
T6: Wood Ash 5Kg/tree/year	0.33 c	0.17 f	0.51 d
2021/ 2022 seasons			
T1: Control	0.38 b	0.20 bc	0.57 b
T2: Wood Ash 1 Kg/tree/year	0.39 ab	0.20 abc	0.59 ab
T3: Wood Ash 2Kg/tree/year	0.39 ab	0.20 ab	0.60 ab
T4: Wood Ash 3Kg/tree/year	0.41 a	0.21 a	0.62 a
T5: Wood Ash 4Kg/tree/year	0.35 c	0.19 cd	0.54 c
T6: Wood Ash 5Kg/tree/year	0.34 c	0.18 d	0.52 c

Means with the same letter (s) in each column are not significant differences at level ($p \leq 0.05$)

Table 6. Effect of wood ash treatments on leaf mineral content of "Early swelling" peach trees during 2020/2021 and 2021/2022 seasons

Character. / Treatment	N (%)	P (%)	K (%)	Ca (%)	Mg (%)	Fe (ppm)	Zn (ppm)	Mn (ppm)
2020/ 2021 seasons								
T1: Control	2.48 a	0.19 b	1.22 f	1.14 f	0.13 c	49.27 a	40.50 a	43.29 a
T2: Wood Ash 1 Kg/tree/year	2.44 b	0.20 ab	1.25 e	1.37 e	0.14 c	48.16 ab	37.74 b	39.72 b
T3: Wood Ash 2Kg/tree/year	2.33 c	0.20 ab	1.34 d	1.61 d	0.18 b	46.61 bc	34.56 c	37.98 bc
T4: Wood Ash 3Kg/tree/year	2.24 d	0.20 ab	1.38 c	1.65 c	0.20 b	45.05 c	30.11 d	36.75 cd
T5: Wood Ash 4Kg/tree/year	2.03 e	0.21 a	1.45 b	1.68 b	0.23 a	42.49 d	27.78 dc	34.95 d
T6: Wood Ash 5Kg/tree/year	1.82 f	0.22 a	1.48 a	1.70 a	0.25 a	41.11 d	25.31 e	34.09 d
2021/ 2022 seasons								
T1: Control	2.38 a	0.20 b	1.24 e	1.40 e	0.13 e	47.95 a	40.65 a	43.44 a
T2: Wood Ash 1 Kg/tree/year	2.35 b	0.20 b	1.29 d	1.48 d	0.16 d	46.63 ab	36.29 b	40.33 b
T3: Wood Ash 2Kg/tree/year	2.33 c	0.20 b	1.32 c	1.59 c	0.18 c	46.08 b	23.79 c	38.63 c
T4: Wood Ash 3Kg/tree/year	2.26 d	0.21 b	1.36 b	1.66 b	0.19 c	45.19 bc	31.47 cd	36.80 d
T5: Wood Ash 4Kg/tree/year	2.06 e	0.21 b	1.40 a	1.68 b	0.23 b	43.77 cd	30.53 d	35.46 e
T6: Wood Ash 5Kg/tree/year	1.92 f	0.22 a	1.40 a	1.71 a	0.25 a	43.25 d	25.39 e	35.03 e

Means with the same letter (s) in each column are not significant differences at level ($p \leq 0.05$)

Table 7. Effect of wood ash treatments on tree yield of "Early swelling" peach trees during 2020/2021 and 2021/2022 seasons

Character. / Treatment	Fruit weight (g)	No. of fruits per tree	Yield/tree (Kg)	Yield/Fed. (Ton.)
2020/ 2021 seasons				
T1: Control	60.30 d	529 c	31.94 e	6.70 e
T2: Wood Ash 1 Kg/tree/year	61.42 d	539 b	33.10 d	6.95 d
T3: Wood Ash 2Kg/tree/year	66.53 c	542 b	36.08 c	7.58 c
T4: Wood Ash 3Kg/tree/year	69.85 b	542 b	37.90 b	7.96 b
T5: Wood Ash 4Kg/tree/year	77.52 a	547 a	42.40 a	8.90 a
T6: Wood Ash 5Kg/tree/year	53.59 e	525 d	28.13 f	5.90 f
2021/ 2022 seasons				
T1: Control	63.92 d	526 b	33.62 d	7.05 d
T2: Wood Ash 1 Kg/tree/year	66.01 c	531 b	35.09 c	7.37 c
T3: Wood Ash 2Kg/tree/year	71.66 b	537 a	38.53 b	8.19 b
T4: Wood Ash 3Kg/tree/year	75.61 a	541 a	40.96 a	8.60 a
T5: Wood Ash 4Kg/tree/year	60.32 e	517 c	31.21 e	6.55 e
T6: Wood Ash 5Kg/tree/year	57.29 e	511 d	29.29 f	6.15 f

Means with the same letter (s) in each column are not significant differences at level ($p \leq 0.05$)

Table 8. Effect of wood ash treatments on fruit physical characteristics of "Early swelling" peach trees during 2020/2021 and 2021/2022 seasons

Character. / Treatment	Fruit volume (cm^3)	Fruit length (mm)	Fruit diameter (mm)	L / D ratio	Flesh Thickness (mm)	Fruit firmness ($Lb./inch^2$)
2020/ 2021 seasons						
T1: Control	59.44 e	67.11 c	55.46 d	1.02 a	17.55 e	11.73 b
T2: Wood Ash 1 Kg/tree/year	69.72 d	60.51 b	58.48 c	1.03 a	18.41 d	11.75 b
T3: Wood Ash 2Kg/tree/year	72.78 c	61.12 b	59.69 bc	1.02 a	19.12 c	10.23 b
T4: Wood Ash 3Kg/tree/year	75.83 b	62.53 b	61.83 ab	1.01 a	20.22 b	9.73 b
T5: Wood Ash 4Kg/tree/year	78.89 a	65.48 a	46.29 a	1.01 a	21.82 a	6.73 c
T6: Wood Ash 5Kg/tree/year	55.55 f	54.18 d	52.41 e	1.03 a	16.32 f	14.93 a
2021/ 2022 seasons						
T1: Control	68.05 c	60.22 c	58.31 c	1.03 ab	19.98 a	17.33 b
T2: Wood Ash 1 Kg/tree/year	70.27 b	62.14 b	59.08 bc	1.05 a	20.12 a	16.83 bc
T3: Wood Ash 2Kg/tree/year	73.75 a	62.56 ab	59.86 b	1.57 a	20.29 a	16.08 c
T4: Wood Ash 3Kg/tree/year	74.30 a	63.05 a	62.78 a	1.00 bc	20.69 a	14.83 d
T5: Wood Ash 4Kg/tree/year	60.97 d	57.10 d	57.97 c	0.98 c	18.79 b	19.10 a
T6: Wood Ash 5Kg/tree/year	56.11 e	55.85 e	54.33 d	1.03 ab	17.85 b	19.35 a

Means with the same letter (s) in each column are not significant differences at level ($p \leq 0.05$)

Table 9. Effect of wood ash treatments on fruit chemical analysis of "Early swelling" peach trees during 2020/2021 and 2021/2022 seasons

Character. / Treatment	TSS %	Total acidity %	TSS /acid ratio	Total sugars %	Anthocyanin (mg/100g)	Nitrates (ppm)	Nitrites (ppm)
2020/ 2021 seasons							
T1: Control	9.16 c	0.29 a	31.31 d	7.52 b	4.91 e	39.81 a	2.20 a
T2: Wood Ash 1 Kg/tree/year	9.73 c	0.27 a	36.10 c	7.87 ab	5.11 d	39.51 a	1.94 b
T3: Wood Ash 2Kg/tree/year	10.73 b	0.27 a	39.75 bc	8.19 ab	5.82 c	35.13 b	1.83 c
T4: Wood Ash 3Kg/tree/year	10.96 b	0.27 a	40.61 b	8.25 ab	6.23 b	34.53 b	1.72 d
T5: Wood Ash 4Kg/tree/year	13.50 a	0.20 b	65.48 a	8.49 a	6.78 a	31.41 c	1.66 e
T6: Wood Ash 5Kg/tree/year	8.99 c	0.29 a	29.61 d	7.48 b	4.48 f	31.11 c	1.55 f
2021/ 2022 seasons							
T1: Control	9.78 cd	0.27 c	35.36 cd	7.52 d	5.76 d	36.84 a	2.09 a
T2: Wood Ash 1 Kg/tree/year	10.31 c	0.27 c	38.20 c	7.93 c	6.22 c	36.54 a	1.82 b
T3: Wood Ash 2Kg/tree/year	10.91 b	0.25 d	42.55 b	8.21 b	6.36 b	33.79 b	1.82 b
T4: Wood Ash 3Kg/tree/year	13.50 a	0.23 e	57.58 a	8.54 a	6.58 a	33.59 b	1.77 c
T5: Wood Ash 4Kg/tree/year	9.83 de	0.28 b	33.34 de	7.41 e	5.54 e	28.23 c	1.76 cd
T6: Wood Ash 5Kg/tree/year	8.86 e	0.29 a	30.21 e	7.32 f	5.21 f	28.07 c	1.75 d

Means with the same letter (s) in each column are not significant differences at level ($p \leq 0.05$)

Wood ash consists of elements that trees have accumulated throughout their lives. Consequently, applying it to the plant growth medium increases levels of calcium, magnesium, potassium, and phosphorus, thereby enhancing their concentrations in the leaves (Bougnom et al 2011, Pugliese, et al 2014). Moreover, it contains various micronutrients in adequate amounts, along with a mix of carbonates, hydroxides, oxides, and silicates (Demeyer et al 2001). Additionally, wood ash provides a stable and slow release of nutrients, maintaining an excellent carbon-to-nitrogen ratio, while also improving water retention and supporting beneficial microbes in the soil (Yadav et al 2010). Wood ash enhances water penetration (Yunusa et al 2006) and exhibits several advantageous effects on the hydraulic properties of the soil. It has been observed that the application of wood ash improves hydraulic conductivity (Chang et al 1977) and promotes root development (Nabeela et al 2015). Microbial activity in the soil can be positively affected by small amounts of wood ash, as it solubilizes nutrients and makes them accessible to plants (Weber et al 1985). According to studies by Nottidge et al (2005), Mbah et al (2010), and Akanbi et al (2014), wood ash resulted in a significant increase in the growth and production of many crops, especially corn. Zuševica et al (2023) emphasized the benefits of utilizing bio-waste blends to enhance leaf physiological conditions, suggesting an increase in productivity. Studies found that fertilization with wood ash intensifies the rates of photosynthesis and chlorophyll, which is reflected in the enhancement of vegetative characteristics of trees, as well as the physical and chemical properties of fruits, ultimately boosting the total yield of trees.

However, adding a high amount of wood ash (5 kg treatment) had the opposite effect, which could be attributed to the observed increase in soil pH and EC, facilitating the absorption of certain nutrients and thus impacting the vegetative growth measurements of trees, along with the physical and chemical characteristics of the fruits. Therefore, the suitable amount of wood ash should be assessed before application in each environment.

4 Conclusion

According to these findings, waste materials can be valued and reincorporated into the economy, bringing them within the realm of the circular economy. During the two experimental seasons, the addition of wood ash to the soil had a clear impact on improving the vegetative parameters, yield, and fruit quality of the treated trees. The treatment with 3 kg of wood ash proved to be the most effective, as it enhanced most of the characteristics under study. Wood ash increased peach crop production while potentially reducing the need for readily soluble mineral fertilizers. It may be recommended to replace a portion of chemical fertilization with wood ash to produce a healthy, high-quality fruit crop suitable for safe consumption.

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