



Effects of Organic Manure and Nettle Extract on Growth and Fruit Quality of Three Apple (*Malus domestica* Borkh) Cultivars

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ABSTRACT

This study investigates the effect of spraying of liquid organic manure (Biofoliar) at three concentrations (0, 2, and 4 ml.L⁻¹) and plant extract Nettle extract (*Urtica dioica*) at three concentrations (0, 100, and 200 mg.L⁻¹) on three apple tree cultivars (Starking, Granny smith and Local) in private orchard in Majilmakht, Duhok, Iraq. During growing season of 2024. The data were collected and organized according to factorial randomized complete block design with tree replications, then the data were analyzed by SAS program, treatment means was compared for statistical significance using Duncan's Multiple Range Test at a p<0.05 probability level. The results indicate that the Granny Smith cultivar had the advantage in improving most of the taken traits except of total yield, the Starking cultivar bear high product, spraying of organic manure and nettle extract significantly enhanced vegetative parameters (shoot length, shoot diameter), leaf nutrient contents of (N, P, and K), and improve fruit traits (fruit weight, fruit size, fruit nitrogen content, fruit protein content and total yield) compared to the control. The highest rates of organic manure (4 ml.L⁻¹) and nettle extract (200 mg.L⁻¹) consistently produced the most pronounced effects. 'Granny Smith' emerged as the most responsive cultivar, recording the highest fruit weight (206.94 g), and leaf phosphorus content (0.743%). 'Starking' showed superior fruit yield (85.97 kg.tree⁻¹), vegetative growth, achieving the greatest shoot length (66.67 cm) and leaf potassium content (1.744%). The best interaction was organic manure (4 ml.L⁻¹) + nettle extract (200 mg.L⁻¹) with Granny smith cultivar lead to improve most studied traits.

Keywords: Apple fruit, Organic manure, Nettle extract, Granny smith, Starking.

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INTRODUCTION

Apple (*Malus domestica* Borkh.) is one of the most important fruits in the world due to its valuable nutrient content and processing uses. Its grow well in temperate climate area were Every year the commercial production reach over 86 million tons, and customers are calling for more high-quality apples that are grown sustainably. [1]. Apple tree cultivation in Iraq has been successful, especially in areas with low temperatures. These areas are located in the far north of Iraq, which is Duhok Governorate where a number of cultivars, including "Starking Delicious," "Golden Delicious," and "Barwari Bala," are extensively grown [2]. The bad quality of fruits resulted by poor soil fertility and the availability of nutrients in the soil even though applying chemical fertilizer to the soil [3].

People have known for a long time that organic manure is an important part of keeping soil fertile and increasing crop yields. It enhances the soil's structure, increases its water-holding capacity, increases microbial activity, and provides macro- and micronutrients in a manner that releases them gradually. [4 and 5]. The vegetative growth of apple trees was improved especially shoot length and shoot diameter by applying organic manure [6 and 7]. It very important to make balance between vegetative growth and fruit development, in order to achieve that the organic manure application is the best way to ensure the nutrient uptake by plant especially Macronutrients (N, P, and K) [8]. This lead to improve fruit characteristics (fruit size, weight, and total yield) as a results of nutrient absorption that in turn enhanced by organic manure application [9 and 10]. [11] Investigate the effect of organic manure application on apple trees of cv. Golden delicious, they found that the vegetative growth parameters (bud number, shoot diameter, shoot length and height of tree) were enhanced at different concentration of organic manure 0.5, 0.7, 1.0 and 1.2 kg.tree⁻¹ compared with control 0 kg.tree⁻¹.

Plant extracts are becoming more popular as environmentally friendly ways to boost plant growth in gardens. They

contain a lot of bioactive molecules, like phenolic, amino acids, vitamins, and natural plant growth regulators, that help with metabolic processes, stress tolerance, and nutrient uptake [12 and 13]. An investigation into the effects of plant extract and organic manure sprays on pomegranate transplants revealed a significant enhancement in key vegetative growth metrics. Specifically, the application led to increases in stem length, stem diameter, and leaf number. [14 and 15]. The fruit Nitrogen content, fruit set, and total yield were improved as a results of spraying plant extract [16]. Using of plant extract generally had a significant effect of fostering innovation of fruit chemical characteristics such as fruit protein and sugar content, this lead to improve the quality of fruits [17]. This study aimed to investigate the effect of organic manure and plant extracts on the vegetative growth and nutrient state and yield characteristics of three apple fruit tree cultivars. this research is interesting as a comparison of long-term and short-term plant-based fertilizers with mineral fertilizers.

Materials and Methods

The study was conducted in a private orchard located in Majilmakht, Duhok City, Kurdistan Region, Iraq (37°00'52"N, 43°09'47"E; elevation: 1006 m) during growing season of 2024. The region experiences a continental climate with an average winter temperature of -2°C and a summer average of 35°C, with an annual rainfall of 1252 mm. three cultivars were chosen from orchard (Starking, Granny smith and Local) with homogenous age (12-year-old) and planting distance 6 x 6 meters. Orchard management practices included training trees with an open-center system, winter pruning, and drip irrigation. The experiment investigated the effects of two foliar sprays on vegetative growth and fruit yield and quality: Commercial liquid organic manure (OM) at concentrations of 0, 2, and 4 mL.L⁻¹ a natural biological fertilizer extracted from vermicompost, seaweed fermentation, drying and circulating in a system which contain (2.6% N, 1.7% K 13% amino acid from seaweed extract, 1.5 % fulvic acid, 3% Fe, 0.01% B and 2% Zn). Nettle extract (NE) at concentrations of 0, 100, and 200 mg.L⁻¹. Nettle leaves were collected from local plants and then dried for two days in an oven at 70°C before being crushed. Fifty grams of powdered leaves were added to 1000 mL of 80% ethanol for 24 hours, and then the solution was filtered using filter paper and sprayed as foliar spraying. The nettle plant analyzed in lab and contain (92.55% organic matter, 2.67% Crude fats, 9.75% Crude fiber, 15.31% protein , 2.45% Nitrogen, 0.63% phosphorus, 3.18% potassium and 2.04% calcium) A factorial experiment within a Randomized Complete Block Design (RCBD) was employed, with three replications. Each of the 81 trees represented an experimental unit. Treatments were applied in two foliar sprays: the first before full bloom (April 25, 2024) and the second after fruit set. Data was analyzed using the SAS program [18]. Treatment means was compared for statistical significance using Duncan's Multiple Range Test at a p<0.05 probability level [19].

Measurement

Shoot length, shoot diameter, leaf nutrient content of (N, P and K), fruit weight, fruit size, fruit Nitrogen content , fruit protein content and total yield of tree

Results

Shoot length (cm)

The data in table (1) clearly indicate that the shoot length of granny smith apple cultivar (50.81 cm) had a significant increase compared with Starking and local cultivar (47.85 and 44.78 cm) respectively. The shoot length gained a significant value at 4 mL.L⁻¹ of organic manure (53.81 cm) compared with control which was (42.96 cm). Also the spraying of nettle extract at 200 mg.L⁻¹ lead to increase shoot length of Apple trees (55.26 cm) compared with non-treated (39.15 cm).

Organic manure had a significant effect on shoot length of Granny smith and Starking cultivars in interaction especially at 4 mL.L⁻¹. Using nettle extract at 200 mL.L⁻¹ cause a significant effect on enhancing shoot length of three apple cultivars. The interaction between organic manure an nettle extract had a clear effect on shoot length of apple tree especially at O.M at 4 mL.L⁻¹ and NE at 200 mg.L⁻¹ . In the same table it show the best triple interactions affecting shoot length was OM at 4 mL.L⁻¹ with NE at 200 mg.L⁻¹ sprayed on Starking Apple fruits recorded (66.67 cm) compared with all other combinations.

Table (1) Effects of Organic Manure and Nettle Extract on shoot length (cm) of Three Apple Cultivars Starking, Granny Smith, and a Local

Cultivars	Organic manure ml.L ⁻¹	Nettle extract mg.L ⁻¹			Cultivars * Organic manure	Cultivars
		0	100	200		
Starking	0	30.33 l	46.67 e-g	46.67 e-g	41.22 de	47.85 b
	2	37.67 h-k	52.33 c-e	52.67 c-e	47.56 c	
	4	40.33 g-j	57.33 bc	66.67 a	54.78 a	
Granny Smith	0	44.00 f-g	48.67 d-f	55.33 b-d	49.33 bc	50.81 a
	2	46.67 e-g	48.00 ef	50.67 c-f	48.44 bc	
	4	48.33 ef	55.33 b-d	60.33 b	54.67 a	
Local	0	32.00 kl	36.00 i-l	47.00 e-g	38.33 e	44.78 c
	2	34.00 j-l	41.00 g-i	57.00 bc	44.00 d	
	4	39.00 h-j	56.00 bc	61.00 ab	52.00 ab	
Nettle extract		39.15 c	49.04 b	55.26 a		
Cultivars * Nettle extract	Starking	36.11 d	52.11 ab	55.33 a	Organic Manure	
	Granny smith	46.33 c	50.67 b	55.44 a		
	Local	35.00 d	44.33 c	55.00 a		
Organic manure *	0	35.44 g	43.78 de	49.67 c	0	42.96 c
	2	39.44 f	47.11 cd	53.44 b	2	46.67 b
Nettle extract	4	42.56 ef	56.22 b	62.67 a	4	53.81 a

Means for each factor and their interactions that share the same letter(s) are not statistically different at the 5% probability level, as determined by Duncan's Multiple Range Test.

Shoot diameter (cm)

The data in Table (2) show that the Starking cultivar recorded the highest average stem diameter (0.80 cm), but statistically not significant with the Granny Smith cultivar (0.79 cm), and local cultivar which had the lowest average (0.77 cm). When it came to organic manure, the application at 4 ml.L⁻¹ produced the largest increase in shoot diameter (0.93 cm), which was noticeably larger than the diameter at 2 ml.L⁻¹ (0.79 cm) and the control treatment (0.65 cm). Likewise, Nettle extract's primary effect also reveals that the thickest shoots (0.87 a) were produced at the highest concentration (200 mg.L⁻¹), followed by 100 mg.L⁻¹ (0.78 a) and the control (0.71 b). There was a notable interaction between organic manure and cultivars.

The Starking cultivar reached its maximum diameter (0.96 a) at 4 ml.L⁻¹ and reacted most favorably to increasing manure rates. By reaching a similar diameter (0.94 a), the local cultivar also demonstrated a strong response to the highest manure rate. The response from the Granny Smith cultivar was favorable but not as strong. The interaction between 200 mg.L⁻¹ lead to enhance shoot diameter of Granny smith compared with other combinations. Nettle extract and organic manure had a very important interaction. The largest shoot diameter (0.98 a) was obtained by combining the highest rates of nettle extract (200 mg.L⁻¹) and organic manure (4 ml.L⁻¹).

The same manure rate plus 100 mg.L⁻¹ nettle extract came right after this (0.94 a). The control group, which received no treatments, had the smallest diameter (0.55 e). In the triple interaction (cultivar + OM + NE) revealed the most effective combination. The Starking cultivar treated with the highest rates of both organic manure (4 ml.L⁻¹) and nettle extract (200 mg.L⁻¹) produced the maximum shoot diameter of 1.00 cm, which was statistically equivalent to the Local cultivar under the same treatment (1.00 cm) and several other high-rate combinations. The smallest diameter (0.51 cm) was observed in the Starking cultivar without any organic manure or nettle extract.

Table (2) Effects of Organic Manure and Nettle Extract on shoot diameter (cm) of Three Apple Cultivars Starking, Granny Smith, and a Local

Cultivars	Organic manure ml.L ⁻¹	Nettle extract mg.L ⁻¹			Cultivars * Organic manure	Cultivars
		0	100	200		
Starking	0	0.51 h	0.54 h	0.61 f-h	0.55 e	0.80 a
	2	0.81 cd	0.91 ab	0.92 ab	0.88 b	
	4	0.93 ab	0.97 ab	1.00 a	0.96 a	
Granny Smith	0	0.61 f-h	0.71 ef	0.81 cd	0.71 d	0.79 a

	2	0.73 de	0.73 de	0.93 ab	0.80 c	
	4	0.74 de	0.93 ab	0.95 ab	0.87 b	
Local	0	0.54 h	0.60 gh	0.90 a-c	0.68 d	0.77 a
	2	0.64 e-g	0.70 ef	0.73 de	0.69 d	
	4	0.89 bc	0.94 ab	1.00 a	0.94 a	
Nettle extract		0.71 c	0.78 b	0.87 a		
Cultivars *	Starking	0.75 d	0.80 c	0.84 bc		Organic Manure
	Granny smith	0.69 e	0.79 cd	0.90 a		
	Local	0.69 e	0.75 d	0.88 ab		
Organic manure *	0	0.55 e	0.61 d	0.77 c	0	0.65 c
	2	0.73 c	0.78 c	0.86 b	2	0.79 b
	4	0.85 b	0.94 a	0.98 a	4	0.93 a

Means for each factor and their interactions that share the same letter(s) are not statistically different at the 5% probability level, as determined by Duncan's Multiple Range Test.

Leaf nitrogen content (%)

The nitrogen content in apple leaves was significantly affected by the applied treatments, as shown in Table (3). The Local cultivar had the highest leaf nitrogen content (1.711%), according to the main effect analysis, and it was statistically had no significant differences with the Granny Smith (1.417%) but both had significant increase than Starking (1.240%) cultivars. Spraying of organic manure at both concentration (2 and 4 mL.L⁻¹) had a significant effect on improving nitrogen content in leaves compared with control. In a similar vein, using high concentration of Nettle extraction cause better results of nitrogen content in leaves. The local cultivar showed the strongest reaction to the greatest manure rate (4 mL.L⁻¹) and Nettle extract (200 mg.L⁻¹). The cultivar that responded the least to rising manure levels was the Starking. Additionally, a noteworthy interaction between nettle extract and organic manure was noted. The greatest rate of organic manure (4 mL.L⁻¹) and the highest rate of nettle extract (200 mg.L⁻¹) produced the highest nitrogen content of 1.654%, making this combination the most effective for raising leaf nitrogen. Compared to all other treatment combinations, including the control group that received no adjustments (1.003%), this was noticeably better.

Furthermore, the triple interaction among all factors identified the specific combination that produced the absolute highest leaf nitrogen content. The Local cultivar, when treated with 4 mL.L⁻¹ of organic manure and 200 mg.L⁻¹ of nettle extract, recorded the peak nitrogen value of 1.857%, which was statistically superior to almost all other combinations.

Table (3) Effects of Organic Manure and Nettle Extract on leaf nitrogen content (%) of Three Apple Cultivars Starking, Granny Smith, and a Local

Cultivars	Organic manure mL.L ⁻¹	Nettle extract mg.L ⁻¹			Cultivars * Organic manure	Cultivars
		0	100	200		
Starking	0	0.757 g	1.007 fg	1.093 e-g	0.952 d	1.133 b
	2	1.167 d-f	1.210 d-f	1.247 c-f	1.208 bc	
	4	1.063 e-g	1.203 d-f	1.453 b-e	1.240 bc	
Granny Smith	0	1.200 d-f	1.293 c-f	1.300 c-f	1.264 bc	1.363 a
	2	1.290 c-f	1.397 b-f	1.540 a-d	1.409 bc	
	4	1.160 d-f	1.437 b-e	1.653 a-c	1.417 b	
Local	0	1.053 e-g	1.163 d-f	1.313 c-f	1.177 c	1.433 a
	2	1.360 b-f	1.413 b-f	1.463 b-e	1.412 b	
	4	1.560 a-d	1.717 ab	1.857 a	1.711 a	
Nettle extract		1.179 c	1.316 b	1.436 a		
Cultivars *	Starking	0.996 e	1.140 de	1.264 cd		Organic Manure
	Granny smith	1.217 cd	1.376 a-c	1.498 ab		
	Local	1.324 b-d	1.431 a-c	1.544 a		
Organic manure *	0	1.003 d	1.154 cd	1.236 bc	0	1.131 b
	2	1.272 bc	1.340 bc	1.417 b	2	1.343 a
	4	1.261 bc	1.452 b	1.654 a	4	1.456 a

Means for each factor and their interactions that share the same letter(s) are not statistically different at the 5% probability level, as determined by Duncan's Multiple Range Test.

Leaf phosphorous content (%)

As seen in Table (4) In terms of the effect of individual cultivars, Granny Smith significantly outperformed all cultivars, as it recorded the highest average phosphorus content (0.520%), while Starking variety came in second place (0.228%), and the local variety had the lowest content (0.220%). The maximum phosphorus content (0.380%) was obtained with the highest rate of organic manure (4 ml.L⁻¹), which was considerably higher than the control (0.276%) and the 2 ml.L⁻¹ rate (0.311%). The highest phosphorus content in leaves of Apple trees was obtained when spraying 200 mg.L⁻¹ of nettle extract which was (0.369 %) compared with control (0.283 %). The phosphorus content of leaves of Granny smith recorded high value (0.601 %) when using 4 ml.L⁻¹ compared with all other combination treatments. The interaction between nettle extract and cultivars showed that Granny Smith cultivar maintained the highest concentration of phosphorus compared to the rest of the cultivars in all treatments, recording the highest value (0.576%) at a concentration of 200 mg.L⁻¹ of nettle extract. Additionally, the maximum leaf phosphorus content (0.471% a) was obtained by combining the highest rates of organic manure (4 ml.L⁻¹) and nettle extract (200 mg.L⁻¹). This combination was significantly superior to all other treatment interactions. Ultimately, the best combination for raising leaf phosphorus was identified via the triple interaction. The Granny Smith cultivar treated with the greatest rates of nettle extract (200 mg.L⁻¹) and organic manure (4 ml.L⁻¹) had the highest phosphorus content (0.743%). Compared to all other treatment combinations, this value was much greater. Without any organic manure or nettle extract, the Starking cultivar had the lowest phosphorus level (0.154%).

Table (4) Effects of Organic Manure and Nettle Extract on leaf phosphorous content (%) of Three Apple Cultivars Starking, Granny Smith, and a Local

Cultivars	Organic manure ml.L ⁻¹	Nettle extract mg.L ⁻¹			Cultivars * Organic manure	Cultivars
		0	100	200		
Starking	0	0.154 f	0.213 ef	0.220 ef	0.196 cd	0.228 b
	2	0.172 f	0.203 ef	0.300 d-f	0.225 cd	
	4	0.228 ef	0.248 ef	0.310 d-f	0.262 cd	
Granny Smith	0	0.429 b-d	0.462 bc	0.468 bc	0.453 b	0.520 a
	2	0.488 bc	0.511 bc	0.516 bc	0.505 b	
	4	0.520 b	0.540 b	0.743 a	0.601 a	
Local	0	0.170 f	0.175 f	0.192 f	0.179 d	0.220 b
	2	0.194 f	0.206 ef	0.212 ef	0.204 cd	
	4	0.195 f	0.273 ef	0.360 c-e	0.276 c	
Nettle extract		0.283 b	0.315 b	0.369 a		
Cultivars * Nettle extract	Starking	0.185 d	0.221 cd	0.277 c	Organic Manure	
	Granny smith	0.479 b	0.504 ab	0.576 a		
	Local	0.186 d	0.218 cd	0.255 cd		
Organic manure * Nettle extract	0	0.251 c	0.283 bc	0.294 bc	0	0.276 b
	2	0.285 bc	0.307 bc	0.343 b	2	0.311 b
	4	0.314 bc	0.354 b	0.471 a	4	0.380 a

Means for each factor and their interactions that share the same letter(s) are not statistically different at the 5% probability level, as determined by Duncan's Multiple Range Test.

Leaf potassium content (%)

The data in table (5) show that there are no significant differences among cultivars affecting potassium content in leaves. While the application of organic manure at 4 ml.L⁻¹ had the greatest potassium content (1.456%), which was significantly higher than the control treatment (1.131%). Similarly, potassium level increased gradually and significantly after increasing the concentration of nettle extract spraying.

In comparison to the 100 mg.L⁻¹ treatment (1.320%) and the control (1.090%), the highest potassium percentage (1.467%) was obtained with the maximum concentration of nettle extract (200 mg.L⁻¹). There was a considerable interaction between organic manure and cultivars. With a significantly higher potassium content (1.528% a), the Starking cultivar showed the strongest reaction to the greatest manure rate (4 ml.L⁻¹). The local cultivar responded to rising manure levels the least. likewise, a noteworthy interaction between nettle extract and cultivars was noted. The Starking cultivar reached its maximal potassium content (1.534% a) and responded most favorably to the highest nettle extract rate. The combination of 4 ml.L⁻¹ organic manure and 200 mg.L⁻¹ nettle extract produced the highest leaf potassium content (1.663%), while the control recorded the lowest (0.864%).

In triple interaction. The highest leaf potassium content (1.744%) was obtained in the Starking cultivar treated with 4

ml.L⁻¹ organic manure and 200 mg.L⁻¹ nettle extract, while the lowest (0.841%) was found in the untreated local cultivar.

Table (5) Effects of Organic Manure and Nettle Extract on leaf potassium content (%) of Three Apple Cultivars Starking, Granny Smith, and a Local

Cultivars	Organic manure ml.L ⁻¹	Nettle extract mg.L ⁻¹			Cultivars * Organic manure	Cultivars
		0	100	200		
Starking	0	0.847 g	1.379 b-e	1.425 a-e	1.217 cd	1.333 a
	2	1.155 e-g	1.176 d-g	1.433 a-e	1.255 b-d	
	4	1.295 b-e	1.545 a-d	1.744 a	1.528 a	
Granny Smith	0	0.905 fg	1.290 b-e	1.371 b-e	1.189 cd	1.307 a
	2	1.161 e-g	1.350 b-e	1.390 b-e	1.300 b-d	
	4	1.292 b-e	1.343 b-e	1.658 ab	1.431 ab	
Local	0	0.841 g	1.220 c-f	1.273 c-e	1.111 d	1.237 a
	2	1.091 e-g	1.280 b-e	1.319 b-e	1.230 cd	
	4	1.222 c-f	1.301 c-e	1.588 a-c	1.370 a-c	
Nettle extract		1.090 c	1.320 b	1.467 a		
Cultivars * Nettle extract	Starking	1.099 de	1.366 a-c	1.534 a	Organic Manure	
	Granny smith	1.119 de	1.327 bc	1.473 ab		
	Local	1.051 e	1.267 cd	1.393 a-c		
Organic manure *	0	0.864 d	1.296 bc	1.356 b	0	1.172 b
	2	1.136 c	1.268 bc	1.381 b	2	1.262 b
Nettle extract	4	1.270 bc	1.396 b	1.663 a	4	1.443 a

Means for each factor and their interactions that share the same letter(s) are not statistically different at the 5% probability level, as determined by Duncan's Multiple Range Test.

Fruit weight (g)

Fruit weight was significantly affected by cultivar, organic manure, and nettle extract treatments, as well as their interactions. Among cultivars, Granny Smith produced the heaviest fruits (171.27 g), followed by Starking (145.83 g) and Local (105.27 g).

Fruit weight of apple trees was increased by increasing the concentration of organic manure and nettle extract sprays compared with control, 4 ml.L⁻¹ of organic manure resulted in higher fruit weight (155.70 g) as compared with control (124.06 g). and 200 mg.L⁻¹ lead to increase fruit weight (154.35 g) compared with control (124.68 g). Granny smith apple fruit weights gained higher value when sprayed with 4 ml.L⁻¹ of organic manure compared with other combination of cultivars with concentration of organic manure.

The similar case was observed with 200 mg.L⁻¹ of nettle extract with Granny smith produce higher fruit weight value which was (188.57 g) compared with lower fruit weight (90.04 g) recorded with local cultivar with 0 mg.L⁻¹ of nettle extract.

The interaction between organic manure and nettle extract had a significant effect on improving fruit weight of apple trees, especially at 4 ml.L⁻¹ and 200 mg.L⁻¹ which record (164.93 g) fruit weight compared with control (94.23 g). The best triple interaction affecting fruit weight of apple trees was 4 ml.L⁻¹ of organic manure + 200 mg.L⁻¹ nettle extract with Granny smith apple fruit which record (204.94 g) compared with all other combinations.

Table (6) Effects of Organic Manure and Nettle Extract on fruit weight (g) of Three Apple Cultivars Starking, Granny Smith, and a Local

Cultivars	Organic manure ml.L ⁻¹	Nettle extract mg.L ⁻¹			Cultivars * Organic manure	Cultivars
		0	100	200		
Starking	0	86.90 kl	132.79 hi	159.57 d-g	126.42 e	145.83 b
	2	141.45 gh	146.53 f-h	147.48 f-h	145.15 d	
	4	162.22 d-g	163.84 c-f	171.69 c-e	165.92 c	
Granny Smith	0	115.80 ij	155.77 f-g	163.78 c-f	145.12 d	171.27 a
	2	165.41 c-f	173.90 c-e	194.99 ab	178.10 b	
	4	180.20 b-d	184.59 bc	206.94 a	190.58 a	
Local	0	79.97 l	108.34 j	113.66 ij	100.65 f	105.27 c

	2	86.75 kl	111.98 ij	114.86 ij	104.53 f	
	4	103.40 jk	112.28 ij	116.16 ij	110.61 f	
	Nettle extract	124.68 c	143.34 b	154.35 a		
Cultivars *	Starking	130.19 e	147.72 d	159.58 c		Organic Manure
	Granny smith	153.80 cd	171.42 b	188.57 a		
	Local	90.04 g	110.87 f	114.89 e		
Organic manure *	0	94.23 d	132.30 c	145.67 b	0	124.06 c
	2	131.21 c	144.14 b	152.44 b	2	142.59 b
	4	148.61 b	153.57 b	164.93 a	4	155.70 a

Means for each factor and their interactions that share the same letter(s) are not statistically different at the 5% probability level, as determined by Duncan's Multiple Range Test.

Fruit size (cm³)

The results in Table (7) revealed significant effects of cultivar, organic fertilizer, and nettle extract on apple fruit size. In terms of the individual cultivar effects, Granny Smith significantly outperformed, recording the highest fruit size (190.37 cm³), while Starking came in second (165.19 cm³), and the local cultivar performed the least (102.76 cm³).

As for the effect of organic fertilizer, increasing its concentration led to a steady increase in fruit size, with the 4 ml/L⁻¹ concentration recording the highest value (169.13 cm³) compared to lower concentrations.

Similarly, treatment with nettle extract significantly increased fruit size, with the 200 mg/L⁻¹ concentration recording the highest significant value (166.74 cm³), followed by lower treatments. The interaction between cultivar type and organic fertilizer showed a clear superiority for the Granny Smith cultivar at an organic fertilizer concentration of 2 ml/L⁻¹, where it recorded the highest value (201.11 cm³).

The interaction between cultivar type and nettle extract also highlighted the superiority of the Granny Smith cultivar, which recorded the highest response to the extract, with fruit volume reaching (201.11 cm³) at a concentration of 200 mg/L⁻¹. As for the interaction between organic fertilizer and nettle extract, it was observed that the combination of the two highest concentrations (4 ml.L⁻¹ organic manure + 200 mg.L⁻¹ nettle extract) was the most effective, producing the highest significant value for fruit volume (182.50 cm³).

Here, the three-way interaction (variety × organic fertilizer × extract) showed that the best treatment of all was the application of organic fertilizer 4 ml.L⁻¹ with nettle extract 200 mg.L⁻¹ on the Starking variety, which recorded the highest value for fruit volume of (215.00 cm³).

Table (7) Effects of Organic Manure and Nettle Extract on fruit size (cm³) of Three Apple Cultivars Starking, Granny Smith, and a Local

Cultivars	Organic manure ml.L ⁻¹	Nettle extract mg.L ⁻¹			Cultivars * Organic manure	Cultivars
		0	100	200		
Starking	0	120.00 h-k	138.33 g-j	155.00 e-g	137.78 c	165.19 b
	2	145.00 g-i	165.00 c-g	185.00 a-e	165.00 b	
	4	163.33 d-g	200.00 ab	215.00 a	192.78 a	
Granny Smith	0	150.00 f-h	177.50 b-e	183.33 a-e	170.28 b	190.37 a
	2	195.83 a-c	200.00 ab	207.50 ab	201.11 a	
	4	191.67 a-d	195.00 a-c	212.50 a	199.72 a	
Local	0	75.00 m	104.17 k-m	106.17 kl	95.11 e	102.76 c
	2	79.17lm	100.00 k-m	116.17 i-k	98.44 e	
	4	110.83 jk	113.33 jk	120.00 h-k	114.72 e	
	Nettle extract	136.76 a	154.81 b	166.74 c		
Cultivars *	Starking	142.78 d	167.78 c	185.00 ab		Organic Manure
	Granny smith	179.17 bc	190.83 ab	201.11 a		
	Local	88.33 f	105.83 e	114.11 e		
Organic manure *	0	115.00 d	140.00 c	148.17 c	0	134.39 c
	2	140.00 c	155.00 bc	169.56 ab	2	154.85 b
	4	155.28 bc	169.44 ab	182.50 a	4	169.07 a

Means for each factor and their interactions that share the same letter(s) are not statistically different at the 5% probability level, as determined by Duncan's Multiple Range Test.

Fruit nitrogen content (%)

The data in table (8) indicate that the nitrogen content in the fruit of Granny smith significantly gather more value (0.864 %) than Starking (0.511 %) and Local cultivar (0.406 %). Spraying of organic manure especially at 4 ml.L⁻¹ had a significant effect on increasing fruit N content in fruits of apple. Similarly, the spraying of 200 mg.L⁻¹ lead to increase fruit N content which record (0.616 %) compared with control (0.570 %).

The percentage of N content in the fruits of Granny smith cultivar that sprayed with 4 ml.L⁻¹ of organic manured produced higher value which was (0.913 %) compared with lowest value (0.355 %) which recorded with Local fruit + 0 ml.L⁻¹.

The interaction between nettle extract and cultivar shown in same table, using nettle extract at high concentration with Granny smith had a significant effect on N content in fruits. In the other hand, the interaction between organic manure and nettle extract had a valuable effect on N percentage in fruit of apple, especially at 4 ml.L⁻¹ organic manure + 200 mg.L⁻¹ nettle extract which record (0.672 %) compared with control (0.485 %).

The N content in fruits of Granny smith which sprayed with both 4 ml.L⁻¹ organic manure + 100 and 200 mg.L⁻¹ nettle extract produced higher value which was (0.920 and 0.924 %) compared with all other combinations.

Table (8) Effects of Organic Manure and Nettle Extract on fruit nitrogen content (%) of Three Apple Cultivars Starking, Granny Smith, and a Local

Cultivars	Organic manure ml.L ⁻¹	Nettle extract Mg.L ⁻¹			Cultivars * Organic manure	Cultivars
		0	100	200		
Starking	0	0.315 p	0.363 o	0.397 mn	0.358 h	0.511 b
	2	0.534 i	0.569 h	0.617 f	0.573 e	
	4	0.583 gh	0.606 fg	0.617 f	0.602 d	
Granny Smith	0	0.813 e	0.815 e	0.832 de	0.820 c	0.864 a
	2	0.841 c-e	0.861 cd	0.874 bc	0.859 b	
	4	0.894 ab	0.920 a	0.924 a	0.913 a	
Local	0	0.327 p	0.358 o	0.379 m-o	0.355 h	0.406 c
	2	0.374 no	0.410 lm	0.431 kl	0.405 g	
	4	0.452 jk	0.452 jk	0.474 j	0.459 f	
Nettle extract		0.570 c	0.595 b	0.616 a		
Cultivars * Nettle extract	Starking	0.477 e	0.513 d	0.544 c	Organic Manure	
	Granny smith	0.849 b	0.865 ab	0.877 a		
	Local	0.384 h	0.407 g	0.428 f		
Organic manure *	0	0.485 h	0.512 g	0.536 f	0	0.511 c
	2	0.583 e	0.613 d	0.641 c	2	0.612 b
Nettle extract	4	0.643 bc	0.659 ab	0.672 a	4	0.658 a

Means for each factor and their interactions that share the same letter(s) are not statistically different at the 5% probability level, as determined by Duncan's Multiple Range Test.

Fruit protein content (%)

It clears in table (9) that the protein percentage in fruit of Granny smith had a significantly higher than protein content in Starking and Local cultivar. Spraying of organic manure especially at 4 ml.L⁻¹ had a significant effect on enhancing fruit protein content in fruits of apple. Similarly.

Table 9 Effects of Organic Manure and Nettle Extract on fruit protein content (%) of Three Apple Cultivars Starking, Granny Smith, and a Local

Cultivars	Organic manure ml.L ⁻¹	Nettle extract mg.L ⁻¹			Cultivars * Organic manure	Cultivars
		0	100	200		
Starking	0	1.967 p	2.270 o	2.480 mn	2.239 h	3.195 b
	2	3.337 i	3.557 h	3.857 f	3.583 e	
	4	3.647 gh	3.787 fg	3.857 f	3.763 d	
Granny Smith	0	5.082 e	5.094 e	5.200 de	5.125 c	5.399 a
	2	5.258 c-e	5.382 cd	5.462 bc	5.367 b	
	4	5.588 ab	5.749 a	5.778 a	5.705 a	
Local	0	2.042 p	2.239 o	2.370 m-o	2.217 h	2.540 c

	2	2.340 no	2.560 lm	2.693 kl	2.531 g
	4	2.824 jk	2.826 jk	2.962 j	2.871 f
Nettle extract		3.565 c	3.718 b	3.851 a	
Cultivars *	Starking	2.983 e	3.204 d	3.398 c	Organic Manure
	Granny smith	5.309 b	5.408 ab	5.480 a	
	Local	2.402 h	2.542 g	2.675 f	
Organic manure	0	3.030 h	3.201 g	3.350 f	0
*	2	3.645 e	3.833 d	4.004 c	2
Nettle extract	4	4.020 bc	4.121 ab	4.199 a	4

Means for each factor and their interactions that share the same letter(s) are not statistically different at the 5% probability level, as determined by Duncan’s Multiple Range Test.

Spraying of 200 mg.L⁻¹ lead to improve fruit protein content which record (3.854 %) compared with control (3.565 %). The percentage of protein content in the fruits of Granny smith cultivar that treated with 4 ml.L⁻¹ of organic manured produced higher value which was (5.705 %) compared with lowest value (2.217 %) which recorded with Local fruit + 0 ml.L⁻¹. The interaction between nettle extract and cultivar shown in same table, using nettle extract at high concentration with Granny smith had a significant effect on protein content in fruits. In the other hand, the interaction between organic manure and nettle extract had a valuable effect on protein percentage in fruit of apple,

especially at 4 ml.L⁻¹ organic manure + 200 mg.L⁻¹ nettle extract which record (4.199 %) compared with control (3.030 %). The protein content in fruits of Granny smith which sprayed with both 4 ml.L⁻¹ organic manure + 100 and 200 mg.L⁻¹ nettle extract produced higher value which was (5.778 and 5.749 %) compared with all other combinations.

Total yield (kg.tree⁻¹)

It’s clear in figure 1 that the total yield of apple trees affected by spraying organic manure and nettle extract, according to the data that in the figure it noticed that the Starking bear higher yield per tree which reached to (85.97 kg.tree⁻¹) comparted with Granny smith (69.66 kg.tree⁻¹) and Local cultivar (58.52 kg.tree⁻¹).

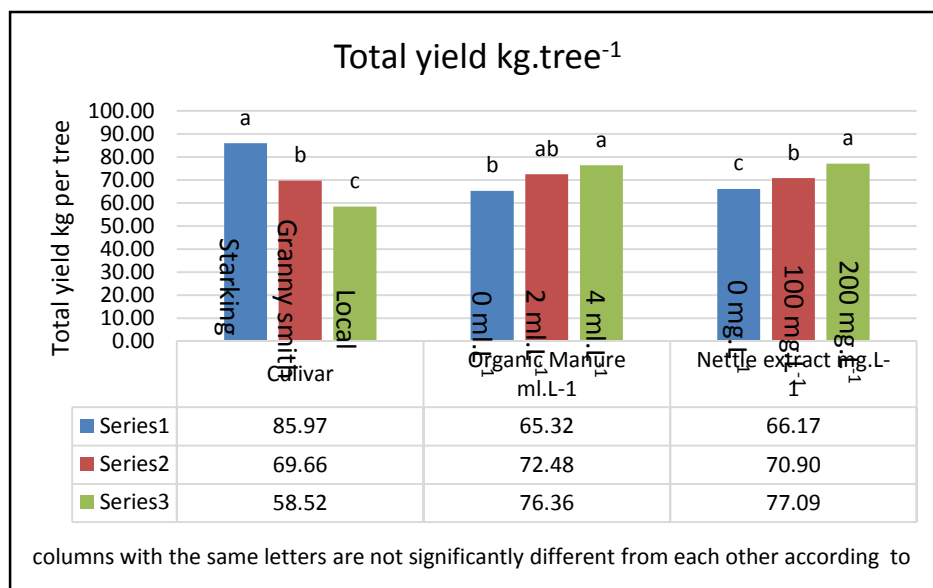


Figure 1 Effect of organic manure, nettle extract on total yield of three Apple cultivars (Starking, Granny smith, and Local)

Also the using organic manure at 4 ml.L⁻¹ lead to increase fruit production per tree (76.34 kg.tree⁻¹) compared with control (65.32 kg.tree⁻¹). Finally spraying nettle extract had a significant effect in increasing the yield of apple tree especially when gradually increasing the concentration of spraying as shown the figure the 200 mg.L⁻¹ resulted higher production rate per tree which was (77.09 kg.tree⁻¹) compared with control which record (66.17 kg.tree⁻¹).

Discussion

The study's results demonstrate that applying nettle extract and organic manure together enhances growth and yield characteristics of Apple trees. The results are likely as a result of a synergistic effect from soil quality, nutrient and nettle extract availability, and the bio stimulant effect of nettle extract. [20]. The Granny Smith apple tree had a high yield and large fruit size due to its genetic superiority in absorbing and using nutrients. In contrast, the Local cultivar performed poorly, indicating a need for genetic improvement to ensure profitable orchard operations. [21 and 22]. The use of organic manure significantly improves shoot growth (length and diameter) because it enhances the soil's physical condition and organic matter. This improvement works by gradually releasing essential nutrients and creating a better soil structure, which leads to healthier roots and, consequently, more vigorous shoot growth [23, 5 and 24]. Both organic manure and nettle extract were effective at increasing nitrogen, phosphorus, and potassium levels in leaves [25, 26 and 27]. The manure improved soil fertility, while the nettle extract acted as a natural bio-stimulant, providing nutrients, minerals, and hormones. When applied to leaves, this combination was directly absorbed, leading to more efficient photosynthesis and nutrient use, creating a synergistic effect that boosted plant growth [28, 29 and 30]. The improved plant nutrition and vigor ultimately led to better yield and fruit quality, including increased fruit weight, size, and protein content. This is because the combination of organic manure and nettle extract provided continuous nutrients and support, which reduced fruit drop and improved fruit set. These findings align with other research showing that such organic treatments enhance apple yield and quality by improving soil biological activity [31, 32 and 33]. The most significant finding was a powerful synergistic effect between the highest doses of organic manure (4 ml L⁻¹) and nettle extract (200 mg L⁻¹). The manure built long-term soil health, while the nettle extract acted as a catalyst to boost the plant's ability to use those nutrients. This result strongly supports the use of integrated nutrient management, showing that combining resources is more effective than using either one alone this agreed with [34 and 35]

Conclusion

According to the results of the research, it concluded that the Granny Smith cultivar had the advantage in improving most of the taken traits. Compared with Starking and Local cultivar. Organic manure at 4 ml L⁻¹ and Nettle extract at 200 mg L⁻¹ lead to enhance all studied traits including shoot growth, leaf nutrient content (N, P, and K), and ultimately fruit yield and quality, similarly the interaction between thus concentration make strong combination.

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تأثير السماد العضوي ومستخلص نبات القراص على نمو وجودة ثمار ثلاثة أصناف من التفاح

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الخلاصة

هذه الدراسة لمعرفة تأثير السماد العضوي (البيوفولير بثلاثة تراكيز 0 و 2 و 4 مل.لتر-1) و (مستخلص نبات القراص *Urtica dioica* بثلاثة تركيزات 0 و 100 و 200 ملجم.لتر-1) على الخصائص الخضريّة والمحصولية لثلاثة أصناف من التفاح (ستاركينج وجراني سميث و الصنف المحلي) خلال موسم النمو لعام 2024 في بستان خاص في محافظة دهوك بالعراق. تم استخدام وقتين مختلفين للرش الورقي. تم الرش الأول في 25 أبريل 2024 والثاني في 25 مايو 2024. تم استخدام التجربة العاملية ضمن تصميم القطاع العشوائية بثلاثة مكررات. اجريت التحليل الإحصائي باستخدام برنامج SAS مع اختبار دنكن متعدد النطاق ($p \leq 0.05$) تشير النتائج إلى أن صنف جراني سميث كان متفوقاً في طول الأفرع 50.81 سم و محتوى النيتروجين في الأوراق 1.36% و الفسفور 0.52% و وزن الثمار الرطب 171.27 غم و حجم الثمار 190.37 سم³ و محتوى النيتروجين و البروتين في الثمار 0.86% و 5.39% علي التوالي، حيث أن صنف ستاركينج تفوق معنوياً مع جراني سميث و صنف المحلي في الحاصل الكلي، كما أن رش السماد العضوي بتركيز (4 مل.لتر⁻¹) له تأثير معنوي في جميع صفات المدروسة و أيضا رش المستخلص نبات القراص أدى إلى تحسين صفات الخضريّة و محتوى الأوراق من (*NPK*) وتحسين صفات الفاكهة (وزن الثمار وحجمها ومحتوى النيتروجين في الثمار ومحتوى البروتين في الثمار والحصول الكلي) مقارنةً بالأشجار الغير معاملة. أنتجت تداخل بين السماد العضوي (4 مل.لتر⁻¹) ومستخلص نبات القراص (200 ملجم.لتر⁻¹) تأثيراً واضحاً في تحسين صفات المدروسة. و بالنسبة للتداخل الثلاثي فان صنف ستاركينج مع السماد العضوي (4 مل.لتر⁻¹) ومستخلص نبات القراص (200 ملجم.لتر⁻¹) أدت الي تحسن من طول الافرع 66.67 سم و قطر الافرع 1 سم و محتوى البوتاسيوم في الأوراق 1.74% و كمية الحاصل الكلي 85.97 كغم للشجرة كما ان رش السماد العضوي (4 مل.لتر⁻¹) ومستخلص نبات القراص (200 ملجم.لتر⁻¹) مع صنف جراني سميث.

الكلمات المفتاحية: تفاح ، سماد عضوي ، مستخلص نبات القراص ، جراني سميث و ستاركينج.