Journal of Medicinal and industrial plants (2024) 2 (1): 1- 10
DOI:
ISSN: (2959 – 121X)

Journal of Medicinal and Industrial Plants
(MEDIP)
http://medip.uokirkuk.edu.iq/index.php/medip

The role of balanced Nano fertilizers, agricultural media, and Pinching in some quantitative and the quality indicators of (*Pelargonium graveolens*) plant.

Niroosh S. Hasan,[1] Yousif H. Hammo,[2] and Binahi S. Shaaban[3]
[1] *Hort. Dept., College of Agricultural Engineering Sciences/ Dohuk Univ*
[2] *Hort. Dept., College of Agricultural Engineering Sciences/ Dohuk Univ.*
[3] *Hort. Dept., College of Agricultural Engineering Sciences/ Dohuk Univ.*
[*] *Corresponding author: E-mail*: niroosh.hasan@uod.ac[1] yousif.hammo@uod.ac[2] Binahi.shaaban@uod.ac[3]

KEY WORDS:
Pelargonium graveolens ; Nano-fertilizer ; , media , pinching.

Received: 12/01/2024
Accepted: 29/01/2024
Available online: 10/04/2024

Abstract
This experiment was conducted in the plastic greenhouse belong to the nursery of Duhok University for the period from 1st Oct. 2021 to 30th April 2022. With the aim of knowing the effect of three factors, the first factor is balanced Nano fertilizer NPK (20, 20, 20) in concentration (0, 3, 6) g L-1, the second factors is five growing media peatmoss, river soil, Kwashe compost, (River soil + Kwashe compost), (River soil + Kwashe compost + peatmoss) and the third factors pinching (without pinching) on the some quantitative and the quality indicators of (Pelargonium graveolens) plant. The results showed that the 6 g L-1 of Nano-fertilizer lead to a significant increase in the plant highest, branches number leave area, relative chlorophyll, volatile % and dry vegetative weight. The peat moss treatment and the combination treatment of river soil + kawachi compost + peat moss were significantly superior, giving the highest values in most of the studied traits. The pinching treatment caused a significant effect on the number of branches, leaf area, relative chlorophyll, percentage of volatile oil, and dry weight of the shoots, compared to the treatment without the pinching.

دور السماد النانوي المتوازن والأوساط الزراعية والقرط في بعض المؤشرات الكمية والنوعية لنبات العطر Pelargonium Graveolens

نيروش سليمان حسن[1] يوسف حسين حمو[2] بيناهي سليمان شعبان[3]
niroosh.hasan@uod.ac yousif.hammo@uod.ac Binahi.shaaban@uod.ac
(1,2, 3 قسم البستنة، كلية الهندسة العلوم الزراعية /جامعة دهوك)

الملخص

اجريت هذه التجربة في البيت البلاستيكي التابع لمشتل جامعة دهوك للفترة من 1 تشرين الأول سنة 2021 ولغاية 30 نيسان 2022. بهدف معرفة تأثير ثلاثة عوامل ,الأول يمثل السماد النانوي المتوازن (20 NPK، 20، 20) **بالتركيز (0، 3 , 6) جرام لتر-1 والعامل الثاني تمثل خمسة أوساط زراعية هي البيتموس -تربة النهر- سماد كواشي -تربة النهر + سماد كواشي و تربة النهر + سماد كواشي + البيتموس اما العامل الثالث هو القرط و بدون القرط) في المؤشرات الكمية والنوعية لنبات العطر** (Pelargonium Graveolens)**. أظهرت النتائج أن إضافة 6 غم لتر-1 من السماد النانوي سبب زيادة معنوية في أرتفاع النبات وعدد الأفرع ومساحة الأوراق والكلوروفيل الكلي ونسبة المئوية للزيت الطيار والوزن الخضري الجاف.تفوقت معاملة البيتموس ومعاملة التوليفية تربة النهر + كمبوست الكواشي + البيتموس معنوياً اعطت اعلى القيم في اغلب الصفات المدروسة، وسبب معاملة القرط تأثير معنوي في عدد الأفرع والمساحة الورقية والكلوروفيل النسبي والنسبة المئوية للزيت الطيار والوزن الجاف للمجموع الخضري بالمقارنة مع معاملة من دون القرط .**

الكلمات المفتاحية: نبات العطر، الأسمدة النانوية، الأوساط، عملية القرط

Introduction

Pelargonium (*Pelorgonium graveolens L*) is an ornamental plant that is planted for the beauty of its outward features, such as its leaves, flowers, or fragrant aroma. are members of the family Geraniaceae. Most are native to southern Africa, but a few species occur naturally in Australia, eastern Africa, New Zealand. Pelargonium is a perennial plant that grows no taller than 50 cm. Its leaves are almost round, have long necks that are rough to the touch, light green, wrinkled, and full of fluff. It also has fine branches and strong essential oils that are noticeable when the leaf tissue is torn or touched. The flowers produce tiny inflorescences that are either pink or purple. **(Khudair, 2001).** Compost media considered the best media for growing of plants because it increases the water holding capacity, reduced the irrigation and decrease the loosing of N, P, K and from the container. When dried, peatmoss weighs extremely little, has a high CEC (cation exchange capacity), sufficient aeration, and an excellent capacity to hold water**.** quantity of nitrogen (about 1%) however minimal or none existent phosphorus or potassium, additionally, it enhances the soil's physical qualities, including its texture and porosity. , **(Hartmann *et al*., 2001; Nyamangara *et al.* 2001). Ateia *et al*., (2009)** reported that using compost gave the most superior growth characteristics and thymus plant oil yields. **Sharafzadeh and Alizadeh (2011)** discovered that the Fennel plant's highest values for shoot height and shoot fresh weight, shoot dry weight, root fresh weight and root dry weight where recorded when used the organic media. When compared to the river soil, the percentage of volatile oil Geranium plants that grew in peat moss increased significantly. **(Salyh, 2013)**. Due to their quick uptake by roots, cell penetration, transport, and expression within plant tissues, nano-fertilizers have the potential to improve plant nutrition and lessen plant stress without adding costs or quantities. It is therefore more successful and efficient **Amilia *et al*., (2022) (Tarafdar *et.al,* 2012).** Various nano fertilizers have been used in the commercial sector to reduce soil contamination from pesticide and fertilizer residues, lower the amount of fertilizer added to the soil, protect the environment, manage insect pests, lower crop losses, and remove heavy elements from the soil. The height of the plant, the number of leaves, the number of flowers, the diameter of the flowers, and the length of the vegetative and floral growth of *Gazania rigens L*. **(AL-Qadi1 *et .al,* 2020**The best conditions for the growth of containerized Magnolia grandiflora L. transplants were provided by equally distributing Nano fertilizer NPK (19:19:19) at the medium level (3g pot $^{-1}$). **(AbdelKader *et al*., 2016). Zaghloul *et al*., (2020)** found that the Nano-fertilizer was the most effective compound to improving all growth parameters of Codiaeum plants and the highest level 4.5 g L $^{-1}$ was optimum for the vegetative growth. Pinching refers to breaking apical dominance to the tip of shoot with few leaves which encouraging growth of side shoots and increasing blossom production. It should be done approximately 3-4 weeks after transplanting.

When nigella plants are pinched, their seeds' fixed oil, ash, and carbohydrates significantly increase, but their volatile oil, protein, and phosphorus significantly decrease. **(Hammo, 2008).** By comparing characteristics such plant height, number of branches, number of flowers, and flower size, the impacts of pinching on marigold growth and yield were investigated. Plants without pinching have fewer branches than pinched plants. **(Prakash Awasthi, *et.al,* 2022).**

Materials and methods

The experiment was carried out of the period between 1st Oct 2021 and 30th April 2022, in the plastic greenhouse belong to the nursery of Duhok University. Aim to study the effect of three factors with three replicates, on the growth and development of pelargonium graveolens plant. The first factor include Nano fertilizer N,P,K with (0, 3, 6) g L^{-1} by spraying method it sprayed twice monthly until the end of experiment , the second factor were agricultural mediums include peatmoss, river soil, Kwashe compost, River soil+ Kwashe compost 1:1, and River soil + Kwashe compost + peatmoss (1:1:1) and the third was pinching (with and without pinching) that was conducted at the mid of November.The plant cuttings (10 ± 2 cm) were Planted in the sand and peat moss 1:1, leaves were removed from the lower third of each cutting then treated with 1000 mg L^{-1} Indole butyric acid by dipping method for 10 second. After one month they transplanted to 3 liter pots size, all agricultural requirements were implemented.Three factors (5*2*3=30 treatments) with three replicates and five plants for each were used in the experiment, which was carried out using the (RCBD) design. Plant height (cm), leaf area (cm2), number of branches, vegetative dry weight (g), root dry weight (g), percentage of volatile oil (%), and relative chlorophyll (SPAD) are among the characteristics that were examined. Using the Soxhlet device in the medicinal and aromatic plants laboratory of the College of Engineering and Agricultural Sciences, University of Duhok, volatile oils were extracted from ground samples using the organic solvent extraction method (hexane). .The SAS program was used to analyze all of the data on a computer, and Duncan's Multiple Ranges test (DMRT) under 5% was used to compare means. **(SAS, 2013)**.

The chemical analysis of the study media			
Parameters	**River soil**	**Peat moss**	**Kwashe compost**
PH	8.3	6.1	7.27
Electrical conductivity Ec ds.m^{-1}	0.2	0.4	8.31
CaCo3%	19	6	
Potassium mg l^{-1}	27	65	22100
Phosphorus mg l^{-1}	5	98	4100
Nitrogen mg l^{-1}	0.084	0.070	17100
C/N Ratio	27	10	27.5
Organic matter	1.17	2.45	7.4
			Concentration of heavy metals on dry weight of basis . Zn (27.1) mg.kg^{-1}, Pb (76.8) mg kg^{-1}, cu (62.9) mg kg^{-1}, cd (16.44) mg kg^{-1}, Fe (0.01) mg kg^{-1}

The soil was analyzed at Horticulture and Soil & Water Department. Laboratories/ College of Engineering and Agricultural Sciences/ Duhok University.

*There is no CaCo3 for Kwashi compost because it has a moderate pH.

Results and Discussion

number of branches(branchplant^{-1})

Data presented in table 1. Shows that increasing of Nano NPK fertilizer to 6 g L^{-1} leads to increase significantly the number of branches to 2.68 branch plant^{-1} compared with control (0 g L^{-1}) which gave 2.07 branchplant^{-1} . The best growing media that give the highest number of branches is peatmoss which gave 3.72 branch plant^{-1} while the Kwashe compost give the least number 1.17 branchplant^{-1}. Also pinching of the plant increased significantly this parameter to reach 2.69 branch plant^{-1}compared with without pinching which gave 2.08 branch plant^{-1}.

The interaction between Nano fertilizer, growing media and pinching indicated that the applying of 6 g L^{-1} to plant planted in peatmoss and pinched increased significantly the branch number to 5.33 branchplant^{-1} compared with the less number 1 branchplant^{-1} for the most of plants which growing in Kwashe that subjected to the other treatment.

Table 1. Effect of Nano NPK fertilizer, growing media and pinching on the number of branches of the Pelargonium graveolens plant

Nano NPK fertilizer (g L^{-1})	Pinching	Media					Nano NPK effect
		peatmoss	River soil	Kwashe compost	River soil + Kwashe compost	River soil + Kwasher compost + Peatmoss	
0	without	2.33^{b-d}	2.33^{de}	1.00^{g}	1.33^{gh}	1.67^{e-g}	2.07^{b}
	Pinching	3.00^{b-e}	3.00^{b-e}	1.00^{g}	2.33^{d-g}	2.67^{c-f}	
3	without	4.00^{b}	1.67^{f-h}	1.00^{h}	3.00^{b-e}	1.00^{h}	2.40^{a}
	Pinching	3.67^{bc}	2.67^{c-f}	1.00^{h}	3.67^{bc}	2.33^{d-g}	
6	without	5.33^{a}	2.67^{c-f}	1.00^{h}	1.5	1.33^{ef}	2.68^{a}
	pinching	4.00^{b}	3.00^{b-e}	2.00^{e-h}	2.67^{c-f}	3.33^{bc}	
growing Media effect		3.72^{a}	2.56^{b}	1.17^{d}	2.42^{bc}	2.06^{c}	
pinching effect		Without 2.08^{b}		Pinching 2.69^{a}			

At 5% of DMRT ,means with the same litters for each factor and interaction do not differ significantly

Plant height

The data in Table 2 demonstrated that Nano NPK fertilizer with the high concentration 6 g L^{-1} increased significantly the plant height to 32.35 cm whereas the control gave the less height (28.78) cm. The plant height reached to 34.39, 36.78 cm for the plants that grew in peat moss and (river soil + Kwashe compost + peat moss) media compared with the less height 21.92 cm. the pinching factor has no effect on this parameter. the interaction between the three factors increased significantly this parameter and the best treatment which gave the highest plant height 44.33 cm was (6 g L^{-1} + peatmoss + without pinching) compared with the less height 14.50 cm for the treatment (0 g L^{-1} + Kwashe compost + pinching) with increasing percentage reached to 205.92% than the less value.

Table 2. Effect of Nano NPK fertilizer, growing media and pinching on the plant height of the Pelargonium graveolens plant

Nano NPK fertilizer ($g\ L^{-1}$)	Pinching	Media					Nano NPK effect
		Peatmoss	River soil	Kwashe compost	River soil + Kwashe compost	+ Kwasher compost + Peatmoss	
0	without	30.67^{c}	30.67^{d-h}	28.00^{f-j}	28.67^{f-i}	39.67^{a-d}	28.78^{b}
	pinching	36.33^{a-f}	30.67^{d-h}	14.50^{k}	19.33^{jk}	29.33^{e-h}	
3	without	41.00^{ab}	35.00^{b-g}	23.67^{h-j}	36.67^{a-f}	38.33^{a-e}	31.07^{ab}
	pinching	34.33^{b-g}	27.00^{g-j}	20.00^{i-k}	23.33^{h-j}	31.33^{c-h}	
6	without	44.33^{a}	39.67^{a-d}	23.00^{h-j}	33.50^{a-c}	40.00^{a-c}	32.35^{a}
	Pinching	34.00^{b-g}	28.00^{f-j}	22.33^{h-k}	31.00^{c-h}	27.67^{f-j}	
growing Media effect		36.78^{a}	31.83^{bc}	21.92^{d}	28.75^{c}	34.39^{ab}	
pinching effect		without	34.19^{a}	pinching	27.28^{b}		

means with the same litters for each factor and interaction are not significantly deference at 5% of DMRT.

Leaves area

Table 3 showed that there had been no discernible changes in the Nano NPK fertilizer's effect on the leaves area of this plant and it remanded between 44.10 to 49.89 cm^2 for the three concentrations. the plants that grew in peatmoss media gave the highest significant leave area 74.42 cm^2 compared with the less value 30.53 cm^2 for the Kwashe compost. Without pinching increased significantly the leaves area to 53.34 cm^2 compared with pinching which gave the less value 40.17 cm^2. the interaction between the three factors increased significantly this parameter and the best treatment which gave the highest leave area 91.33 cm^2 was (6 $g\ L^{-1}$ + peatmoss + without pinching) compared with the less value 13.88 cm^2 for the treatment (0 $g\ L^{-1}$ + river soil + Kwashe compost) + pinching) with increasing percentage reached to 558% than the less value.

Table 3. Effect of Nano NPK fertilizer, growing media and pinching on the leaves area (cm^2) of the pelargonium graveolens plant.

Nano NPK fertilizer ($g\ L^{-1}$)	Pinching	Media					Nano NPK effect
		Peatmoss	River soil	Kwashe compost	River soil + Kwashe compost	River soil + Kwasher compost + Peatmoss +	
0	without	66.33^{a-c}	47.33^{b-g}	39.91^{c-g}	50.33^{b-f}	55.23^{b-f}	44.10^{a}
	pinching	74.67^{ab}	37.67^{c-g}	20.92^{fg}	13.88^{g}	34.75^{c-g}	
3	without	78.67^{ab}	62.73^{a-d}	34.82^{c-g}	55.22^{b-f}	46.00^{b-g}	49.89^{a}
	pinching	75.00^{ab}	57.10^{b-e}	24.60^{e-g}	32.53^{c-g}	32.28^{c-g}	
6	without	91.33^{a}	55.07^{b-f}	33.88^{c-g}	47.49^{b-g}	35.70^{c-g}	46.26^{a}
	pinching	60.50^{a-d}	31.33^{d-g}	29.05^{d-g}	46.72^{b-g}	31.53^{c-g}	
growing Media effect		74.42^{a}	48.54^{b}	30.53^{c}	41.03^{bc}	39.25^{bc}	
pinching effect		without	53.34^{a}	pinching	40.17^{b}		

means with the same litters for each factor and interaction are not significantly deference at 5% of DMRT.

Relative chlorophyll

The data in Table 4 indicated that fertilizing pelargonium plants and not fertilizing them also pinching and non- pinching treatment hasn't any significant effect on the relative chlorophyll. all type of media that used for experiment gave non-significant increased and the means of chlorophyll were arrangement between 36.30 to 45.20 (SPAD). the same result was observed for the triple interaction among the three factors with non-significant effect although the ranged between the deferent treatment were very big and ranged between 23.23 (SPAD) for (0 g L^{-1} Nano NPK fertilizer + peatmoss + without pinching) and 64.23 (SPAD) for (6 g L^{-1} Nano NPK fertilizer + (River soil + Kwasher compost + Peatmoss) + pinching)

Table 4. Effect of Nano NPK fertilizer, growing media and pinching on the Relative chlorophyll of the Pelargonium graveolens plant

Nano NPK fertilizer (g L^{-1})	Pinching	Media					Nano NPK effect
		peatmoss	River soil	Kwashe compost	River soil + Kwashe compost	River soil + Kwasher compost + Peatmoss	
0	without	23.23[a]	34.63[a]	47.40[a]	36.60[a]	28.07[a]	36.20[a]
	pinching	34.43[a]	29.13[a]	39.40[a]	36.87[a]	52.23[a]	
3	without	41.50[a]	46.43[a]	29.20[a]	26.07[a]	34.67[a]	41.84[a]
	pinching	50.23[a]	40.60[a]	58.55[a]	58.37[a]	32.77[a]	
6	without	31.37[a]	50.70[a]	49.67[a]	55.40[a]	55.87[a]	46.34[a]
	pinching	37.03[a]	39.70[a]	47.77[a]	31.67[a]	64.23[a]	
growing Media effect		36.30[a]	40.20[a]	45.33[a]	40.83[a]	44.64[a]	
pinching effect		without	39.39[a]	pinching	43.53[a]		

means with the same litters for each factor and interaction are not significantly deference at 5% of DMRT.

Vegetative dry weight

The results in the table 5 demonstrated that nano fertilizer with concentration The greatest vegetative dry weight was obtained at 6 g L-1, reaching 5.55 g plant-1 in comparison with control that gave 4.39 g $plant^{-1}$. In the other side the best media that increased this characteristic was peatmoss that gave significant effect 6.59 g $plant^{-1}$ compared with Kwashe compost media which gave the less value 2.47 g $plant^{-1}$. While the pinching factor had the same effect when compared with non-pinching. The triple interaction among all factors caused significantly increased in this parameter and the highest vegetative weight reached to 5.93 g $plant^{-1}$ for (6 g L^{-1} + peatmoss + without pinching) compared with the less value 1.17 g $plant^{-1}$ for the (3 g L^{-1} + Kwashe compost + without pinching).

Table 4. Effect of Nano NPK fertilizer, growing media and pinching on the vegetative dry weight of the Pelargonium graveolens plant

Nano NPK fertilizer (g L^{-1})	Pinching	Media					Nano NPK effect
		peatmoss	River soil	Kwashe compost	River soil + Kwashe compost	River soil + Kwasher compost + Peatmoss	
0	without	5.28^{b-h}	4.32^{c-j}	4.19^{c-j}	3.43^{c-j}	7.93^{ab}	4.39^{b}
	pinching	5.95^{a-g}	3.94^{c-j}	1.33^{j}	3.08^{e-j}	4.41^{b-j}	
3	without	6.49^{a-f}	5.11^{b-i}	2.63^{g-j}	6.38^{a-f}	6.26^{a-f}	4.90^{ab}
	pinching	7.93^{ab}	3.32^{d-j}	1.55^{ij}	4.88^{b-j}	4.48^{b-j}	
6	without	6.96^{a-c}	6.08^{a-g}	2.26^{h-j}	3.97^{c-j}	6.62^{a-e}	5.55^{a}
	pinching	6.91^{a-d}	6.10^{ab}	2.90^{f-j}	9.41^{a}	4.31^{c-j}	
growing Media effect		6.59^{a}	4.81^{b}	2.47^{c}	5.19^{b}	5.67^{ab}	
pinching effect		without	5.19^{a}	pinching	4.70^{a}		

means with the same litters for each factor and interaction are not significantly deference at 5% of DMRT.

Root dry weight

The data in table 5 indicated that the nano fertilizer with concentration 3g L^{-1} increased significantly this parameter to 3.04 g in the same time peatmoss media increased this parameter significantly and gave the largest root dry weight reached 3.96g compared with Kwashe compost media that gave the less mean 1.58 g. Without Pinching plant had a significant effect this parameter reached to 3.02 g compared with pinched plant which gave 2.23 g.

Table 5. Effect of Nano NPK fertilizer, growing media and pinching on the Root dry weight of the *Pelargonium graveolens* plant

Nano NPK fertilizer (g L^{-1})	Pinching	Media					Nano NPK effect
		Peatmoss	River soil	Kwashe compost	River soil + Kwashe compost	River soil + Kwasher compost + Peatmoss +	
0	without	3.28^{b-f}	2.27^{c-g}	2.41^{b-g}	2.63^{b-g}	3.71^{a-d}	2.40^{a}
	pinching	3.87^{a-d}	1.81^{d-g}	0.51^{g9}	1.42^{d-g}	2.07^{c-g}	
3	without	5.05^{ab}	2.54^{b-g}	1.17^{d-g}	4.71^{a-c}	3.87^{a-d}	3.04^{a}
	pinching	2.83^{b-g}	1.57^{d-g}	3.84^{a-d}	2.43^{b-g}	2.41^{-bg}	
6	without	5.93^{a}	1.89^{d-g}	0.69^{fg3}	1.64^{d-g}	3.52^{a-e}	2.44^{a}
	pinching	2.80^{b-g}	2.01^{c-g}	0.88^{e-g}	3.23^{b-g}	1.80^{cd}	
growing Media effect		3.96^{a}	2.01^{bc}	1.58^{c}	2.67^{b}	2.90^{b}	
pinching effect		without	3.02^{a}	pinching	2.23^{b}		

means with the same litters for each factor and interaction are not significantly deference at 5% of DMRT.

The triple interaction among the three factors indicated a significant effect on this parameter and the best treatment which gave the highest root dry weight 5.93g was (6 gm L^{-1} + peatmoss + without pinching) whereas the less weight was 0.51 g for (0 g L^{-1} + Kwashe compost + pinching) treatment.

Volatile oil(%)

Nano NPK fertilizer and pinching haven't any significant effect on the volatile oil percentage. Whereas the most of growing media except Kwashe compost gave volatile oil percentage ranged between 2.11 – 2.19 %. the interaction among the Nano NPK fertilizer, growing media and pinching increased the volatile oil percentage and the highest value reached ranged between 1.94-2.24 % for all treatments except (6 g L^{-1} + Kwashe compost+ pinching) which gave the less significant value 1.58 %.

Table 6. Effect of Nano NPK fertilizer, growing media and pinching on the volatile oil percentage % of the pelargonium graveolens plant

Nano NPK fertilizer (g L^{-1})	Pinching	Media					Nano NPK effect
		peatmoss	River soil	Kwashe compost	River soil + Kwashe compost	River soil + Kwasher compost + Peatmoss	
0	without	2.11^{ab}	2.11^{ab}	1.73^{cd}	2.03^{ab}	2.14^{ab}	2.08^{a}
	pinching	2.22^{ab}	2.15^{ab}	1.94^{bc}	2.13^{ab}	2.20^{ab}	
3	without	2.13^{ab}	2.10^{ab}	2.01^{ab}	2.11^{ab}	2.24^{a}	2.08^{a}
	pinching	2.12^{ab}	2.10^{ab}	1.67^{d}	2.12^{ab}	2.21^{ab}	
6	without	2.21^{ab}	2.08^{ab}	2.05^{ab}	2.03^{ab}	2.09^{ab}	2.06^{a}
	pinching	2.07^{ab}	2.13^{ab}	1.58^{d}	2.12^{ab}	2.25^{a}	
growing Media effect		2.14^{a}	2.11^{a}	1.83^{b}	2.09^{a}	2.19^{a}	
pinching effect		without	2.08^{a}	pinching	2.07^{a}		

means with the same litters for each factor and interaction are not significantly deference at 5% of DMRT.

The substantial impact of nano fertilizers on the majority of parameters under investigation may be attributed to their ability to increase the nutrients available to developing plants, which in turn increases the production of dry matter, photosynthesis rate, chlorophyll formation, and overall plant growth **(Salama, 2012; Suriyaprabha et al., 2012; Jameel and Al-Tai, 2018).** It makes sense that greater levels of total carbohydrates and chlorophyll would promote better photosynthesis and, as a result, more assimilates would accumulate, leading to improved plant growth and quality.applying of nano-fertilizer at different rates increased the production of vegetative biomass compared to plants (control), and this will lead to increase the value of essential oil **(Elshamy *et al.*,2019).**

Apical dominance is minimized by pinching the apical bud, which is crucial for longitudinal growth. Thus, cutting off the apical buds causes the number of lateral buds to increase and the height of the plant to decrease. **(Sunitha, 2006).** the least amount of vegetative growth as a result of pinching, mostly because apical dominance of plants is eliminated and the apical portion of the main branch is repeatedly removed; axillary buds break free from the correlative inhibition of apical dominance and begin to grow. Plants began to branch out and spread more as a result. Thus, pinched plants had less height. **Ehsanullah, *et al.*, (2020).**

The significantly effect of peatmoss may be due to increased soil because porosity inhibits the growth of microorganisms and roots by limiting their respiration; it increases soil granularity and promotes proper ventilation. It also prevents the buildup of CO2. Granulation can enhance the center's ion exchange capacity and increase its susceptibility to water retention. **(Bidwell, 1979; Nelson, 1991**) is said to have enough organic matter, N, P, K, Cl, Mg, and Ca. When compared to USA norms, the Kwashe compost, which has a high concentration of heavy metals as evidenced by material and process, has a less noticeable effect on most attributes., Heavy metal toxicity had a greater effect on aerial growth

than on root growth, and the roots of Pelargonium plants accumulated a much higher concentration of heavy metals than the aerial organs. Heavy metals cause oxidative damage and increased membrane permeability, which accelerate senescence. When internal metal concentrations are high, a saturated root metal uptake system may be the cause of low heavy metal transport to shoots. **(Zhao *et al,* 2003, Ameen, 2023).**

Conclusion

Depending on the results of this experiment we can recommended that the mixture media consist of component (River soil + kawashi compost + peat moss) is more suitable for the growth of Pelargonium plant and this will retrain to their content of nutrients, well drained and ability of absorb moisture of the particles of this mixture. Adding Nano- fertilizer also improve most of plant characteristics especially high concentration of fertilizer. Also pinching of the plant
enhance the growth side to grow well as a result of removing of apical dominance and distribution of nutrient to the lateral growth of plant.

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