

Effect of Niacin and Pyridoxine spraying and Vermicompost addition on the growth of two Kumquat varieties

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Summary

The experiment was conducted in one of the orchard belonging to the College of Agriculture, University of Diyala, during the 2025 growing season and aimed to demonstrate the response of two variety of kumquats (Marumi and Nagamil) were applied as foliar sprays at five nutrient levels (Niacin 0, 50 ,100mg/L, pyridoxine at 25 , 50 mg/ L) and vermicompost was applied at two soil levels (0 and 2 kg seedling⁻¹). The effects of these treatments on plant growth were investigated. The experiment was conducted using a randomized complete block design (RCBD). Differences between means were compared using Duncan's multiple range test at a probability level of 0.05. Results were analyzed using the SAS statistical software. The main findings can be summarized as follows:

Superiority of variety MARUMI showed the highest significant values in several vegetative growth characteristics, including increased plant height, number of leaves, dry weight, and chlorophyll content in leaves, while Nagami significantly outperformed it in leaf phosphorus content. Spraying with niacin at a concentration of 100 mg L⁻¹ resulted in the highest significant values for increased plant height, average number of leaves, dry weight, leaf chlorophyll content, and leaf phosphorus content. Adding 2 kg of vermicompost per seedling resulted in the highest significant values for increased plant height, average number of leaves, dry weight, leaf chlorophyll content, and leaf phosphorus content.

Keywords: Kumquat, Niacin, Pyridoxine, Vermicompost, Sustainable Agriculture

Introduction :

It is one of the variety of citrus fruits that are known *Fortunella Spp* Golden orange (Kumquat), There are four varieties of it, the two most commonly cultivated being the round and oval kumquats (1). The name "Quat" means golden, and the second "Kum" is composed of two words; the first comes from the Chinese language and means good luck. Kumquats, with their distinctive shape, color, size, and taste, are the smallest edible citrus fruit and are eaten whole with their peel. These fruits are rich in fiber, carotenes, vitamins, and minerals(2).

Kumquats are consumed as a fresh fruit, as they are highly nutritious. Every 100 grams of fresh

kumquats contains 274 calories, 3.8 grams of protein, 72.1 grams of carbohydrates, 266 mg of calcium, 97 mg of phosphorus, 1.7 mg of iron, 30 mg of sodium, 995 mg of potassium, and 253 IU of niacin (vitamin B3). Niacin plays a stimulating role in improving vegetative growth in plants, as it is an essential component in the formation of cofactors. It is linked to vital metabolic processes within the plant cell (4). Niacin contributes to activation NAD and NADP enzymes Oxidation-reduction processes lead to increased efficiency in energy production, which is necessary for cell division and elongation.

A study was conducted to evaluate the role of niacin (nicotinamide) as a growth-stimulating compound in improving the performance of cantaloupe plants under different conditions, through the use of niacin at a concentration of 300 mg/L by foliar spraying. The results showed that treating the plant with niacin led to a positive improvement in vegetative growth characteristics, as well as its positive effect on the efficiency of physiological processes within the plant (5). The most biologically active form of vitamin B6 (PLP) is considered. These compounds are important in intracellular metabolism, participating in numerous vital reactions essential for cellular activity. They have been shown to act as cofactors for enzymes in many metabolic reactions that extend beyond the cellular level. 140 reactions, most of which are related to amino acid metabolism. It also contributes to fatty acid synthesis and the oxidation of some compounds stored in living organisms. In addition, it participates in the formation of some (6) Plant hormones and the formation of compounds associated with cellular organelles such as chlorophyll

During an experiment to demonstrate the effect of foliar spraying with vitamin B6 on the productivity and quality of date palm fruits of the mother variety. The study indicated that foliar spraying with these vitamins led to a clear improvement in the percentage of fruit set, an increase in yield, and an improvement in the physical and chemical characteristics of date palm fruits. This effect is attributed to the role of these vitamins in promoting vital processes within the plant, such as activating enzymes and improving growth efficiency, which was reflected positively on productivity and fruit quality, especially when spraying was repeated three times during different growth stages (7).

Worm fertilizer can also enhance soil fertility physically, chemically and biologically. Physically, soil treated with worm fertilizer has

better aeration, porosity, density and water retention. Chemical properties such as pH, electrical conductivity and organic matter content are also improved (8). It has also been proven that worm compost improves soil quality, increases the availability of essential nutrients, enhances crop productivity, and boosts resistance to pests and diseases. It acts as an organic fertilizer, enriching the soil with essential nutrients, humic acids, growth-regulating hormones, and enzymes, thus improving plant nutrition, photosynthesis, and crop quality (9).

Materials and working methods

The experiment was carried out in the orchard of the Department of Horticulture and Landscape Engineering, College of Agriculture, University of Diyala, during the 2025 growing season to study the effect of spraying with niacin (vitamin B3) and pyridoxine (vitamin B6) and adding vermicompost on the growth of two variety of kumquats aged 3 years ,grafted onto sour orange rootstock .The seedlings were brought from a nursery in Al-Krayat (Baghdad - Al-Adhamiya). A factorial experiment consisting of three factors and three replications was carried out for two types of kumquats.

Factors influencing the study and experimental design:

Types of kumquats in the experiment (Nagami and Marumi), Vitamins were applied to kumquat varieties (untreated, sprayed with distilled water only). Niacin at a concentration of 50 mg L⁻¹. Niacin at a concentration of 100 mg L⁻¹. Pyridoxine at a concentration of 25 mg L⁻¹. Pyridoxine at a concentration of 50 mg L⁻¹. Vermicompost was added to the soil at two levels (without adding soil): Vermicompost 2 kg seedling⁻¹, and with three repetitions RCBd conducted a factorial experiment using a completely randomized block design. With 60 experimental units and one plant in each

experimental unit. The Duncans Multiple Range Test was used to compare the means at a probability level of 0.05 (10).

Experimental readings and measurements:

Vegetative characteristics:

Average increase in plant height (cm)

The rate of plant height was measured using a metric tape, where the plant height was measured at the beginning of the experiment and measured again at the end of the experiment, and the rate was extracted by subtracting the height at the end of the experiment from the height at the beginning of the experiment for all experimental units.

Dry weight of leaves (g plant⁻¹):

Leaves samples were taken from each experimental unit at the end of the experiment (5 leaves). The sample was weighed while wet on a sensitive balance, then dried (sun-dried) by placing it in perforated paper bags until the weight stabilized. The dried leaf samples were then weighed, and the result was calculated according to the following equation.

Percentage of dry weight = (dry weight / wet weight) * 100 . (11)

Average number of leaves (leaf plant⁻¹).

The number of leaves per experimental unit for one replicate at the end of the experiment was calculated by multiplying the number of leaves per branch by the number of branches per experimental unit (per seedling) and calculating the average number of leaves per seedling.

Leaf chlorophyll content %

The relative chlorophyll content of the leaves was measured at the end of the experiment.

(Chlorophyll Meter, SPAD) Using a field device to measure chlorophyll

Phosphorus content in leaves

The phosphorus content of the plant leaves was estimated by taking a weight of (0.5 g) of the dried and ground sample and dissolving it in (5 ml) of concentrated sulfuric acid and (2 ml) of perchloric acid. Aluminum molybdate and ascorbic acid were used (color method), and then the results were measured using a spectrophotometer.

along my wavelength (700)nm

Results

Increase in plant height (cm)

Table1 showed significant differences between the two cultivated kumquat varieties with the first variety outperforming the second. Marumi, morally speaking, in the quality of increase in plant height, it has reached 43.00cm, While the variety Nagami the plant reached a height of 100.00 cm as foliar spraying of niacin at a concentration of 100 mg L⁻¹ significantly outperformed the other spray treatments, as the increase in plant height at this concentration reached 39.25 cm, while it reached 15.25 cm in the control treatment.

The same table showed that adding vermicompost made a significant difference when added at a rate of 2 kg seedling⁻¹, with an increase in plant height of 30.20 cm, while in the treatment without adding it, the increase was 22.80 cm.

The intraction coefficients differed significantly in their effect on the increase in plant height for each plant, as is evident from the table above, where the spraying treatment of the variety was superior, with 100 mg L⁻¹ of niacin, the plant experienced a maximum increase in height of 65.00 cm. Marumi it reached 3.00 cm Nagami,

while the lowest value was recorded when the variety was treated without spraying.

Regarding the intraction between variety and vermicompost addition, the vermicompost addition treatment was superior, with an increase in height of 48.00 cm, while the non-vermicompost addition treatment showed a lower increase. Marumi 2 kg seedling⁻¹ per variety less than that, as it reached 7.60 cm Nagami, for the class

Regarding the intraction between vitamins and vermicompost, the treatment of spraying niacin at a concentration of 100 mg L⁻¹ and adding vermicompost at 2 kg seedling⁻¹ was superior by 42.50 cm, while the control treatment was 13.009 cm.

The results of intraction shown in table 3 indicate the superiority of the spraying treatment. Bleniacin at a concentration of 100 mg L⁻¹ with the addition of vermicompost

Table 1 Effect of spraying niacin and pyridoxine and adding vermicompost on increasing plant height (cm) of Tow Kumquat Cultivars

Vitamins (mg L ⁻¹)	Vermicompost (kg)	Variety		Vitamins *Vermicompost
		Nagami	Marumi	
0 mg/L	0	1.00 m.	25.00 g	13.00 i
	2	5.00m	30.00 f	17.50 h
Niacin 100	0	12.00 j	60.00 b	36.00 b
	2	15.00 i	70.00 a	42.50 a
Niacin 50	0	10.00 k	30.00 f	20.00 g
	2	12.00 j	5.00 c	31.00 d
Pyridoxine 50	0	10.00 k	45.00 d	27.50 e
	2	20.00 h	50.00 c	35.00 c
Pyridoxine 25	0	5.00 i	30.00 f	17.50 h
	2	10.00 k	40.00 e	25.00 f
				Vitamin averages
Interaction of varieties with vitamins	0	3.00 j	27.50 e	15.25 E
	Niacin 100	13.50 g	65.00 a	39.25 A
	Niacin 50	11.00 h	40.00 c	25.50 C
	Pyridoxine 50	15.00 f	47.50 b	31.25 B
	Pyridoxine 25	7.50 i	35.00 d	21.25 D
				Vermicompost averages
Cross-pollination of varieties with vermicompost	0 kg	7.60 d	38.00 b	22.80 B
	2 kg	12.40 c	48.00 a	30.20 A
Variety		10.00 B	43.00 A	

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According to Duncan's polynomial test.

2 kg seedling⁻¹ yield the highest amount Marumi, Nagami recorded a 70.00 cm increase in plant height, while the control treatment recorded a lower increase which measured 1.00 cm

Dry weight (g plant⁻¹)

The results in table 2 show that the treatment with niacin spraying at 100 mg L⁻¹ was significantly superior to the other spraying treatments, giving the highest value of 48.47 g plant weight⁻¹, while the treatment without spraying gave the lowest dry weight of 34.53 g plant weight⁻¹.

The results in the same table show that the treatment with vermicompost addition was significantly superior, giving the highest dry weight value of 41.20 g Plant⁻¹, while in the treatment without addition, it was 40.54 g plant⁻¹.

The table results show a significant difference between the cultivated kumquat varieties, with the superior variety Marumi gave the highest dry weight value of 41.97 g plant, while the Nagami variety had a lower value of 39.77 g plant⁻¹. The results of the dual interaction between the varieties and the vitamin spraying treatment show that the variety spraying treatment is superior Marumi contains niacin at a concentration of 100 mg liter⁻¹ morally by giving it the highest value, which reached 50.72 g per plant, while the no-spray treatment for the Nagami variety yielded 32.80 g per plant.

The effect of interaction between varieties and the addition of vermicompost differed in terms of the dry weight of the vegetative parts, with the treatment of adding 2 kg of vermicompost/seedling of the variety being superior Marumi was significantly better, giving the highest dry weight value of 42.87 g plant⁻¹, while the treatment without addition to the Nagami variety gave the lowest value of 40.02 g plant⁻¹.

Regarding the interaction between spraying with vitamins and adding vermicompost, it is noted that the treatment of spraying with niacin at 100 mg L⁻¹ with the addition of vermicompost 2 kg seedling⁻¹ is significantly superior, as it gave the highest value of 50.22 g plant, while the control treatment gave the lowest dry weight of 32.12 g plant.

The results of the three-way interaction between the experimental factors show that the spray treatment of the variety was superior. Marumi, treated with niacin at a concentration of 100 mg L⁻¹ and adding vermicompost at a rate of 2 kg seedling⁻¹, significantly resulted in the highest dry weight value of the vegetative parts, reaching 53.52 g per plant. When the treatment of not spraying with niacin and adding vermicompost to the variety was given Nagami had the lowest value of 31.14 grams of plant.

Number of leaves:

The results in Table 3 show that spraying with yacin at a concentration of 100 mg L⁻¹ significantly outperformed the other spraying treatments, as the number of leaves per plant reached 412.91 leaves per plant, while the treatment without spraying gave the lowest number of leaves, which reached 241.16 leaves per plant.

Adding vermicompost at a rate of 2 kg seedling⁻¹ resulted in the highest number of leaves per plant, with 341.20 leaves plant⁻¹ in this treatment, while the treatment without adding vermicompost gave the lowest number of leaves, 283.23 leaves plant⁻¹.

The results shown in the table indicate a significant difference between the two cultivated kumquat varieties in the number of leaves, with the first variety having the higher number Marumi gave the highest number of leaves, reaching 343.36 leaves plant⁻¹, while the Nagami variety gave the lowest number of leaves, reaching 276.06 leaves plant⁻¹.

Table2. Effect of spraying with niacin and pyridoxine and adding vermicompost on the percentage of dry matter (g) of Tow Kumquat Cultivars

Vitamins (mg L ⁻¹)	Vermicompost (kg)	Variety		Vitamins *Vermicompost
		Nagami	Marumi	
0	0	31.14 t	33.10 s	32.12 j
	2	34.47 r	39.42 n	36.94 l
Niacin 100	0	45.53 d	47.93 b	46.73 b
	2	46.91 c	53.52 a	50.22 a
Niacin 50	0	39.78 l	39.89 l	39.83 g
	2	40.94 j	41.41 g	41.18 d
Pyridoxine 50	0	43.32 f	43.36 e	43.34 c
	2	39.12 o	41.06 i	40.09 f
Pyridoxine 25	0	40.32 k	41.07 h	40.70 e
	2	36.. 21 q	38.95 p	37.58 h
				Vitamin averages
combinationof varieties with vitamins	0	32.80 j	36.26 l	34.53 D
	Niacin 100	46.22 b	50.72 a	48.47 A
	Niacin 50	40.36 f	40.65 e	40.51 C
	Pyridoxine 50	41.22 d	42.21 c	41.71 B
	Pyridoxine 25	38.27 h	40.01 g	39.14 D.
				Vermicompost averages
Cross-pollination of varieties with vermicompost	0 kg	40.02 c	41.07 b	40.54 B
	2 kg	39.53 c	42.87 a	41.20 A
Variety		39.77 B	41.97 A	

*Countries with the same letters do not differ significantly from each other at a probability level of 0.05 according to Duncan's polynomial test.

The interaction coefficients between the variety and vitamin spraying differed significantly in their effect on the number of leaves per plant, as shown in the table above, with the variety spraying treatment being superior Marumi with niacin at a concentration of 100 mg/L had the highest number of leaves, reaching 455.50 leaves per plant, while the treatment without spraying for the Nagami variety gave the lowest number of leaves, reaching 193.66 leaves per plant.

Regarding the interaction between the variety and the addition of vermicompost, the treatment of adding vermicompost at a rate of 2 kg seedling⁻¹ for the variety was superior Marumi was significantly better, producing the highest number of leaves at 364.93 leaves plant⁻¹, while Nagami produced the lowest number of leaves at 234.66 leaves plant⁻¹ under the no-add treatment.

Regarding the interaction between spraying plants with vitamins and adding vermicompost, the treatment for the interaction between spraying kumquat plants is superior. Niacin at a concentration of 100 mg L⁻¹ and the addition of vermicompost at 2 kg seedling⁻¹ significantly

outperformed the other treatments, as it gave a number Aura The number of leaves reached 440.50 per plant, while the lowest number of leaves for the (comparison) treatment was 194.66 leaves plant⁻¹.

Table (3) Effect of spraying with niacin and pyridoxine and adding vermicompost on the average number of leaves.of Tow Kumquat Cultivars

Vitamins (mg L ⁻¹)	Vermicompost (kg)	Variety		Vitamins *Vermicompost
		Nagami	Marumi	
0 mg/L	0	162.00 o	227.33 m	194.66 j
	2	225.33 m	350.00 g	287.66 f
Niacin 100	0	320.33 h	450.33 b	385.33 c
	2	420.33 c	460.66 a	440.50 a
Niacin 50	0	210.00 n	320.33 h	265.16 g
	2	401.00 e	414.00 d	407.50 b
Pyridoxine 50	0	280.33 j	360.33 f	320.33 e
	2	300.33 i	350.00 g	325.16 d
Pyridoxine 25	0	200.66 o	300.66 i	250.66 h
	2	240.33 l	250.00 k	245.16 i
				Vitamin averages
Interaction of varieties with vitamins	0	193.66 h	288.66 e	241.16 E
	Niacin 100	370.33 b	455.50 a	412.91 A
	Niacin 50	305.50 d	367.16 b	336.33 B
	Pyridoxine 50	290.33 e	355.16 c	322.75 C
	Pyridoxine 25	220.50 g	275.33 f	247.91 D
				Vermicompost averages
Cross-pollination of varieties with vermicompost	0 kg	234.66 d	331.80 b	283.23 B
	2 kg	317.46 c	364.93 a	341.20 A
Variety		276.06 B	348.36 A	

*Countries with the same letters do not differ significantly from each other at a probability level of 0.05 according to Duncan's polynomial test.

The results of interaction shown in table 3 indicate the superiority of the spraying treatment Marumi with niacin concentration 100 mg L⁻¹ with the addition of vermicompost 2 kg seedling⁻¹ significantly resulted in the highest number of leaves, reaching 460.66 leaves plant⁻¹. Compared to spray treatment of the variety

Nagami with distilled water, which gave the lowest number of leaves, 162.00 leaves plant⁻¹.

Percentage of chlorophyll in leaves %

The results in Table 4 show that the niacin spray treatment at a concentration of 100 mg/L was significantly superior to all other spray

treatments, as the chlorophyll content in the leaves reached 60.02%, while the no-spray treatment yielded 49.56%. The results of the same study mentioned above showed that the treatment of adding vermicompost 2 kg/seedling was significantly superior, giving the highest value for the percentage of chlorophyll in the leaves, which reached 58.38%, while it was 55.26% in the treatment of not adding it.

Table 8 shows a significant difference between the cultivated kumquat varieties, with the superior variety Significantly, it gave the highest value for the percentage of chlorophyll in the leaves, reaching 61.01%, while it recorded Marumi 52.64%. The lowest value reached by Nagami Niacin at a concentration of 100 mg L⁻¹ was significantly superior. Marumi shows that the results of the dual interaction show that spraying the variety, the highest value for chlorophyll content in the leaves was 65.58%, while the value reached this level when the variety was treated without spraying. Nagami had the lowest percentage at 45.96%.

The results of interaction between the varieties and vermicompost show a significant effect on the chlorophyll content in the leaves. The treatment of adding vermicompost 2 kg/seedling significantly outperformed the variety Marumi, where it reached 63.05%. While it was in the case of non-addition treatment of the Nagami 51.56%.

The results show that the interaction between vitamins and vermicompost has a significant effect on the chlorophyll content, as the treatment of spraying with niacin 100 mg L⁻¹ with the addition of vermicompost 2 kg seedling was superior, reaching 62.05%, while it was 45.16% in the control treatment. However, the results of the three-way interactions between the experimental treatments showed that the treatment of spraying the variety was superior Marumi, Niacin at a concentration of 100 mg L⁻¹ and the addition of vermicompost at 2 kg L⁻¹

significantly increased the value to 69.53%, while the control treatment for the other variety Nagami 40.16%.

Phosphorus content of the leaves %

The results in Table 11 show that the treatment with niacin spray at a concentration of 100 mg/L was superior to the other spray treatments, giving the highest significant value for the percentage of phosphorus in the leaves, reaching 0.22%, while the treatment without niacin spraying gave the lowest percentage, reaching 0.13%.

The results of the table also showed that the treatment of adding vermicompost 2 kg seedling⁻¹ was significantly superior in the percentage of phosphorus in the leaves, as it reached 0.20%, while it was 0.16% in the control treatment.

The results in the table show a significant difference between the two cultivated kumquat varieties, with the first variety outperforming the second Nagami the phosphorus content in the leaves was significantly higher, reaching 0.19%, while it was higher in the variety 0.17 Marumi.

The results of the interaction between the different treatments show that the spraying treatment of the variety Nagami Niacin at a concentration of 100 mg L⁻¹ was superior, giving the highest phosphorus percentage of 0.23%, while the no-spray treatment for the variety yielded the lowest. Nagami the lowest percentage was 0.12%.

The table results also showed that the treatment of adding vermicompost at 2 kg seedling⁻¹ for the variety was superior to that of the interaction treatment Nagami significantly, it gave the highest percentage of phosphorus in the leaves, reaching 0.21%, while it was lower when the no-phosphorus treatment was applied to the

same variety Marumi the lowest percentage was 0.15%.

The results of the interaction between vitamins and vermicompost showed that the treatment of spraying with niacin at a concentration of 100

Table(4) Effect of spraying with niacin and pyridoxine and adding vermicompost on the chlorophyll content (%) of Tow Kumquat Cultivars

mg L⁻¹ with the addition of vermicompost at a rate of 2 kg seedling⁻¹ was significantly superior in terms of the percentage of phosphorus in the leaves, reaching 0.24%, while it was 0.12% in the control treatment.

Vitamins (mg L ⁻¹)	Vermicompost (kg)	Variety		Vitamins *Vermicompost
		Nagami	Marumi	
0 mg/L	0	40.16 m	50.16 l	45.16 h
	2	51.76 k	56.16 g	53.96 g
Niacin 100	0	54.36 i	61.63 d	58.00 e
	2	54.56 i	69.53 a	62.05 a
Niacin 50	0	53.46 j	60.20e	56.83 f
	2	53.16 j	67.43 b	60.30 b
Pyridoxine 50	0	56.56 f	62.36 c	59.46 c
	2	55.63 h	61.63 d	58.63 d
Pyridoxine 25	0	53.23 j	60.46 e	56.85 f
	2	53.46 j	60.50 e	56.98 f
				Vitamin averages
Interaction of varieties with vitamins	0	45.96 h	53.16 g	49.56 E
	Niacin 100	54.46 f	65.58 a	60.02 A
	Niacin 50	53.31 g	63.81 b	58.56 C
	Pyridoxine 50	56.10 e	62.00 c	59.05 B
	Pyridoxine 25	53.35 g	60.48 d	56.91 D
				Vermicompost averages
Cross-pollination of varieties with vermicompost	0 kg	51.56 d	58.96 b	55.26 B
	2 kg	53.72 c	63.05 a	58.38 A
Variety		52.64 B	61.01 A	

*C

according to Duncan's polynomial test.

The results of the interaction show the superiority of the spray treatment for the variety Nagami Niacin at a concentration of 100 mg L⁻¹ and the addition of vermicompost at a rate of 2 kg seedling⁻¹ significantly resulted in the highest

phosphorus value, reaching 0.25%, while the control treatment showed a lower value for the variety Marumi it reached 0.11%.

5. Effect of foliar spraying with niacin and pyridoxine and the addition of vermicompost on the phosphorus content in plants of Tow Kumquat cultivars

Vitamins (mg L ⁻¹)	Vermicompost (kg)	Variety		Vitamins *Vermicompost
		Nagami	Marumi	
0 mg/L	0	0.13 l	0.11 n	0.12 j
	2	0.16 j	0.13 l	0.14 h
Niacin 100	0	0.22 d	0.20 g	0.21 d
	2	0.25 a	0.23 c	0.24 a
Niacin 50	0	0.18 h	0.14 k	0.16 g
	2	0.23 c	0.21 f	0.22 c
Pyridoxine 50	0	0.21 e	0.18 i	0.19 e
	2	0.24 b	0.22 e	0.23 b
Pyridoxine 25	0	0.14 k	0.12 m	0.13 i
	2	0.20 g	0.16 j	0.18 f
				Vitamin averages
Interaction of varieties with vitamins	0	0.14 h	0.12 i	0.13 E
	Niacin 100	0.23 a	0.21 c	0.22 A
	Niacin 50	0.20 d	0.17 f	0.19 C
	Pyridoxine 50	0.22 b	0.20 e	0.21 B
	Pyridoxine 25	0.17 g	0.14 h	0.15 D
				Vermicompost averages
Cross-pollination of varieties with vermicompost	0 kg	0.18 c	0.15 d	0.16 B
	2 kg	0.21 a	0.19 b	0.20 A
Variety		0.19 A	0.17 B	

*Countries with the same letters do not differ significantly from each other at a probability level of 0.05 according to Duncan's polynomial test.

Discuss of the results

From the results shown in the previous tables, it is observed that niacin spraying, its interactions, and its effects have a significant impact on plant characteristics. it have a major and important role, as niacin treatments significantly outperformed all other characteristics. This may be due to niacin's role in stimulating and improving vegetative growth in plants, as it is a key component in the formation of coenzyme co-factors NAD and NADP, it is linked to vital metabolic processes within the plant cell. Niacin contributes to activation

Oxidation-reduction processes lead to increased efficiency in energy production, which is necessary for cell division and elongation. Niacin also activates various metabolic systems and protects plant tissues from stress, in addition to promoting the formation of some important secondary compounds. Therefore, its effect is positively reflected in vegetative growth characteristics by increasing vigor, improving leaf and stem formation, and enhancing photosynthetic efficiency, thus contributing to increased growth. Niacin also plays an important role in signaling pathways.(4) Plants in general. in plant tissues, it contributes to stimulation NAD is linked to the regulation of

growth and environmental response, and increasing its content

Gene expression is associated with defense processes, regulation of oxidative signals, and improvement of plant nutritional value, as well as enhancing resistance to environmental stress. Therefore, the availability of niacin to the plant contributes to raising the efficiency of vital processes, improving plant vegetative growth, and increasing the plant's ability to adapt to different environmental conditions. This is what happened during this study, as adding niacin increased(12).

The absorption of mineral elements increased the efficiency of photosynthesis thus increasing the plant's carbohydrate stores which positively impacted all growth and yield indicators. Niacin deficiency leads to a severe decrease in growth and yield indicators, and vice versa. This aligns with the findings of previous studies(13). Adding (7) niacin improves productivity and fruit quality, which is consistent with what has been concluded.

Regarding the application of vermicompost and its interactions and effects on all properties, it plays a significant and effective role. All vermicompost application treatments were significantly superior, which may be attributed to the role of worm compost in enhancing soil fertility physically, chemically, and biologically. Physically, soil treated with worm compost has better aeration, porosity, density, and water retention. Chemical properties such as pH, electrical conductivity, and organic matter content are also improved, leading to better crop yields. This means that the materials...Other factors affecting plant growth are available in worm compost (8).

Worm fertilizer has also been shown to improve soil quality, increase the availability of essential nutrients, boost crop productivity, and enhance resistance to pests and diseases. It acts as an

organic fertilizer, enriching the soil with essential nutrients, humic acids, growth-regulating hormones, and enzymes, thus improving plant nutrition and metabolism.

It also leads to a decrease in soil pH.(9) Photosynthesis and crop quality

It also promotes microbial activity and overall soil health. Furthermore, worm compost protects plants from oxidative stress caused by various abiotic factors by enhancing their antioxidant defense system. This is what happened during this study. The perceived superiority in traits may be attributed to (14). The vegetative, fruiting, and overall quality of plants treated with vermicompost are enhanced by its high levels of essential nutrients such as nitrogen, phosphorus, potassium, and micronutrients. Vermicompost also improves soil properties in terms of aeration, porosity, and water retention capacity, which positively impacts root growth and nutrient absorption. Furthermore, vermicompost is rich in beneficial microorganisms, humic substances, and plant growth regulators such as auxins, gibberellins, and cytokinins. These compounds stimulate cell division, increase vegetative growth, and improve flowering and fruiting. It has been shown that these compounds increase plant activity.

Enzymes and microorganisms in the soil lead to improved decomposition of organic matter and increased availability of nutrients for the plant(15), This is consistent with (17)(16) what he concluded from the results shown in Tables (1-2-3-4-5), a difference in vegetative growth characteristics between the two varieties is observed, with the first variety being superior.Marumi significantly outperformed the Nagami variety in some traits (increase in plant height, number of leaves,dry weight , leaf chlorophyll content,) while the Nagami variety significantly outperformed in other trait, including leaf, phosphorus, content. This is due

to the genetic difference between them, which affects the degree of each variety's response to different treatments, as well as the extent to which they are affected by the local environmental conditions surrounding them (18).

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