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Effect of Organic fertilizers on Mineral and Chemical Contents for Vinca Plants

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Abstract

This factorial experiment carried out in the research field in Al-Mussaib technical college during 2018-2019 with the aim of increasing the qualitative and chemical growth parameters of the vinca plants cultured in plastic pots by the effect of adding different ratios from bokashi (0, 10, 20, 30 and 40%) from pot weight. While the second factor was use and don't use the Azosperillium bio fertilizer. The experiment was designed according to C.R.D. of five replicates for each treatment, each replicate contains five pots. The results showed that the study factors had a significant effect on the all studies characteristics, the interaction (30% bokashi with Azosperillium) gave highest levels of the leaves content of (Chlorophyll 42.48 SPAD, N 2.684%, P 0.402%, K 1.38% and carbohydrates 5.094 %) and the number of branches roots 30.2 root, also the interaction (40% bakashi with Azosperillium) gave the highest rate of root length 31.4cm. While the plants of control treatment showed a significant increase in the leaves content of proline acid 1.17gm.L^{-1}

Keywords : Vinca plant**,** Bokashi, *Azospirillium* Biofertilizer

تأثير المخصبات الحيوية في المحتوى المعدني والكيميائي لنباتات الونكا

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المستخلص:

أجريت تجربة عاملية في البيت البلاستيكي التابع للكلية التقنية المسيب بهدف زيادة مؤشرات النمو النوعية والكيميائية لنباتات الونكا المزروعة في أصص بلاستيكية بتأثير إضافة نسب مختلفة من البوكاشي (0، 10، 20، 30 و40%) من وزن الأصيص، بينما مثل العامل الثاني استخدام وعدم استخدام المخصب البكتيري *Azosperillium*. صممت التجربة وفق تصميم C.R.D. وبخمس مكررات لكل معاملة ضم كل مكرر خمس أصص بواقع نبات واحد لكل أصيص في الوحدة التجريبية. بينت نتائج التجربة أن لعوامل الدراسة تأثيراً معنوياً

في الصفات المدروسة جميعها إذ سجلت نباتات التوليفة (30% بوكاشي مع إضافة المخصب البكتيري) أعلى معدل في محتوى الأوراق من (الكلوروفيل 42.48 SPAD، النتروجين 2.684، الفسفور 0.402، البوتاسيوم 1.38 والكاربوهيدرات 5.094) وعدد التفرعات الجذرية 30.2 جذراً، كما تفوقت نباتات التوليفة (40% بوكاشي مع إضافة المخصب البكتيري) في تحقيق أعلى معدل لطول الجذر 31.4سم. في حين تفوقت نباتات المقارنة في تحقيق أعلى معدل لمحتوى الأوراق من حامض البرولين 1.17 ملغم.لتر$^{-1}$.

Introduction:

Vinca Rose *Catharanthus roseus* L. is Perennial herbaceous plant with a single cylindrical stem not branched from the base up to about 100 cm tall, simple opposite leaves and floral inflorescences peripheral or arterial, the flowers are arranged in groups without a major holder blooming in spring, summer and autumn profusely, fruits are twofold The seeds are dark black in color and are among the fastest growing plants, which propagated with seeds and cuttings (Barik et al., 2016). It spreads in Madagascar and India, which are considered the original habitat of the plant and from it spread to the rest of the world, it is cultivated in the tropical regions in a wide range and in the hot regions (Das and Sharangi, 2017). The trend has started now towards using clean agriculture methods and environmentally friendly factors through developing and replacing alternatives for practices that have been used for a long time, including in particular the use of biological fertilizers and organic components, as the sustainable development system aims to combine biological and organic fertilization to maintain the supply capacity of the soil, and in the recent times The latter was relied upon for the purpose of fulfilling the requirements of agricultural production by supplying plants with nutrients and evaluating the nature of physical, chemical and biological soils, as well as employing vital activity in order to harness them in improving growth indicators and avoiding as much as possible from the use of chemicals that cause pollution to the environment and the consumer (Sagandevan *et al*, 2014). It has also been proven that bio fertilizers have an important role in the cycle of major elements in nature and their liberation from organic compounds in addition to their ability to produce growth regulators, so they contribute to reducing the use of mineral fertilizers, which is an economic burden as well as their polluting effect, as it exceeds the role of these organisms in the processing of nutrients Towards inhibiting the growth of pathogens by competing for food as well as increasing plant tolerance to environmental stress conditions (Mahanti *et al,* 2016).

The aim of this study is to use inexpensive, eco-friendly natural resources to improve the level of growth and increase its chemical and qualitative parameters in order to reach the best vegetative and floral growth of *Catharanthus roseus*.

Materials and methods.

A factorial experiment was conducted in the fields affiliated to the Musayib Technical College for the period from 7/9/2018 to 9/8/2019, with the aim of studying the effect of the Bio-organic mixture (Bokashi) and *Azospirillum* and their interactions on the characteristics of the root, qualitative, and chemical growth of *Catharanthus* *roseus*. Victory Pure White (SAKATA company), Danish origin, planted on 20/2/2019, which are seeds of perennial plants with white flowers in cork dishes filled with pitmoss at the rate of 2 seeds/eyes and placed in a plastic house designated for the purpose of propagation in anticipation of any sudden environmental changes It can affect the germination percentage.

After the seedlings dawned and reached the appropriate size (3–4) leaves from the seedlings, they were transferred and transferred to plastic pots size 5 kg with a diameter of 23 cm and a height of 30 cm on 25/4/2019 and the soil pressure was well taken when moving the seedlings to prevent the seedlings from moving with all service operations performed (Jado, 2015).

***Azosperillium* preparation.**

Isolation of the bacterium *Azospirillum* spp. previously in the postgraduate laboratory, then the isolation was propagated in the laboratories of the Department of Biological Resistance Technical, as 10 ml of bacterial culture was added to 90 ml of distilled water and placed in 250ml glass jars mixed well and then serialized fears were administered in sterile conditions until the fifth dilution 10^{-5} By transferring 1 mL of diluted bacterial culture prepared as a biological fertilizer to test tubes containing 9g of Nutrient Broth (Nfb) liquid culture medium after which the tubes were incubated at 28º C for 3 days and examined by the appearance of pellicle growth. White color 1-4 mm below the surface after 24-48 hours, which is an indication as a positive result of bacterial growth *Azosperillium* spp. (Fadhil, 2019). Then a bacterial vaccine (using a sterile needle) was taken from the tubes that gave an indication of growth and then spread it on the surface of a petri dish containing the activated culture medium by transferring 50 ml from the medium into a 250 ml conical flask and incubated the jugs in the incubator at a temperature of 28ºC for 3 days it was prepared and the development is equivalent to 5000 ml of airborne bacteria, a sufficient quantity that requires treatment by adding soil Potting for both my experience study by creating flasks conical 250 ml containing each 1 ml of liquid farm processed through the use of pipettes sterile, incubated Jugs in the incubator for 2-3 days at 28°C. Prepared bacteria were used as a biological fertilizer, as 20 ml of pure liquid bacterial culture were injected into each pot, a light irrigation was taken into consideration immediately after the addition of the bacterial culture, then it was left for 5 consecutive days to ensure its homogeneity with the soil mixture in the planting pot and its propagation.

Bokashi preparation.

The bokashi mixture was prepared at the Organic Fertilizer Preparation Center of the Babylonian Agricultural Directorate for the period from 07/09/2018 to 28/03/2019 in four consecutive steps : (collecting the components and then the mixing process first and adding the biological fertilizer secondly followed by the fermentation process third and then the incubation process fourth). Initially the mixture components, which included wheat bran, rice husks and sheep residues, were mixed in a weight ratio (1:1:1) by homogeneous mixing on a piece of thick cloth, then a mixture of distilled water and bio-EM1 was added to the mixture gradually, stirring, continuous spraying, and homogeneous mixing of the mixture components until reaching a humidity of 30-40% as the mixture became pasty. Then the mixture formed in black polyethylene bags was filled with tight closure, and the bags were placed in a dark place for the purpose of increasing the speed of decomposition for six months with continuous stirring of the mixture every 10 days and then brewed at the last stage which is the incubation stage in an 80 kg plastic container tightly closed (Wijayanto *et al*, 2016). It was then placed inside a closed roof away from direct sunlight and covered with a transparent polyethylene bag to prevent air contact with the components of the mixture, with the procedure of opening the barrel cover every two weeks to leak the gas formed inside the barrel and at the end of the incubation stage that lasted for about 45 indicated the presence of white growths on the surface of the mixture and the unpleasant smell disappeared that the mixture was ready for use (Al-Jarah, 2011). Before use and addition to the pot, the mixture was washed daily with distilled water and for eight days in succession to get rid of harmful salt compounds.

Treatments and experimental design.

A factorial experiment (5 x 2) was performed as per the design of C.R.D. with five replicates per treatment, each replicate contained five pots, one plant per pot. The first factor is adding five levels of the bokashi mixture (not adding, 10%, 20%, 30% and 40% of the weight of the soil pot) as weight ratios mixed with the river mixture in the pot, The second factor represented the use of two levels of the bacterial vaccine *Azosperillium* spp. (add the vaccine and not add it). The results were analyzed according to GenStat 2008 and averages were compared according to the least significant mean difference of L.S.D. on the probability level 0.05% (Al-Asadi, 2019).

The Parameters

First / Root growth (cm): It included the root length and the number of root branches.

Second/ Qualitative growth: It included the leaf content chlorophyll, carbohydrates and proline acid.

Third/ Chemical growth: It included the leaf content of the plant from the three major elements N.P.K.

Results and Discussion.

First / Root growth indicators.

1–1/ Root Length (cm):

The data in Table (1) indicates a significant difference in the characteristic of root length, most recently by adding the bacterial fertilizer *Azosperillium* to the culture medium, the plants treated with it gave a higher rate of 29.96cm while gave 28.00cm for plants not treated with *Azosperillium*. The addition of different proportions of bokashi gave a significant effect on the same character, as the results showed that the treatment plants exceeded 40% of the bokashi superior the plants of the two control plants and the 10% of bokashi by recording the highest rate of 31.4cm, which did not differ significantly with the treatment plants by 20 and 30%, which recorded a rate of (30.5 and 31.1cm) subsequently, while the lowest rate was recorded at the control plants, which 24.1cm.

Table1: Effect of *Azosperillium* and Bokashi fertilizer and their interactions on the root length (cm) of Vinca plants.

average Azospri.	*Bokashi(%)*					*Azospri.*
	40	30	20	10	0.0	
28.00	31.20	31.00	30.00	26.20	21.60	–
29.96	31.60	31.20	31.00	29.40	26.60	+
	31.40	31.10	30.50	27.80	24.10	*average Bokashi*
	Interaction	*Bokashi*		*Azosprillium* spp.		L.S.D.
	1.729	1.223		0.773		0.05

Interaction between the two factors had a significant increase in the length of the root, as the interaction treatment (40% of the Bokashi with the addition of fertilizer) recorded a significant superiority over most of the interaction treatments by recording the highest rate of 31.6 cm, while the control treatment recorded the lowest rate for this trait of 21.6cm.

1-2/ The number of root branches.

The results in Table (2) show that the bacterial fertilizer had a significant effect on the number of root branches, as the plants treated with *Azosperillium* recorded the highest rate of 26.84 roots, while the control treatment recorded a rate of 23.76 roots, The addition of bokashi had a significant response, as the treatment plants recorded 30% significantly higher than all other treatments except for the treatment of 40% at a rate of (28.7 and 27.9 roots) respectively, while the control plants achieved the lowest rate of 19.6 roots. With regard to the interaction of the study factors, the treatment significant (30% of bokashi with the addition of bacterial fertilizer) and gave the highest rate of 30.2 roots to outperform all treatments except for treatments (20 and 40% of Bokashi with the addition of bacteria) and also (30% of Bokashi without adding bacteria) only, While the control treatment recorded the lowest rate of 17.8 roots.

The reason for the superiority in the characteristics of the root parameters may be due to the ability of *Azosperillium* bacteria in the production of important growth regulators such as Auxins, cytokines, and GA3, as well as vitamins and amino acids that help improve the growth of the root system of plants and increase the elongation and division of cells, which increases the length and number of roots, which are directly reflected in the increased rate Nutrient absorption as well as increasing the ability of the root system to retain moisture, increase water absorption and maintain the swelling pressure of plant cells (Al-khaliel, 2010 and Bano *et al*, 2013). Bokashi also has an important role in preparing the organic matter and processing the necessary elements that are reflected in the growth and development of the plant in addition to its role in improving soil fertility and supplying plants with nutrients as a result of mineralization of their organic matter and granting the necessary energy needed by microorganisms that contributed to increasing the rate of studied root parameters.

Table 2: Effect of *Azosperillium* and Bokashi fertilizer and their interactions on number of root branches of Vinca plants.

average Azospri.	*Bokashi*(%)					*Azospri.*
	40	30	20	10	0.0	
23.76	27.00	27.20	24.60	22.20	17.80	–
26.84	28.80	30.20	28.40	25.40	21.40	+
	27.90	28.70	26.50	23.80	19.60	*average Bokashi*
	Interaction	*Bokashi*		*Azosprillium* spp.		L.S.D. 0.05
	3.057	2.162		1.367		

Second/ Qualitative growth indicators.

2–1/ The leaf content of chlorophyll (SPAD).

Table (3) data showed that the content of chlorophyll Vinca leaf increased significantly by adding bacterial fertilizer to the culture medium, The plants treated with bacteria recorded the highest rate of 40.27 SPAD, while the untreated plants gave a rate of 34.8 SPAD. As for the Bokashi factor, it also affected significantly, as the Bokashi ratio recorded 40%, significantly above all treatments, without significant difference with the 30% treatment, as it recorded the highest rate of 40.29 SPAD, while the lowest rate was when the control treatment was at 32.87 SPAD. The interaction of the two study factors also had a significant effect on the chlorophyll leaf content, where the interaction (30% of Bokashi with the addition of fertilizer) recorded the highest rate of 42.48 SPAD, to outperform all the interaction treatments except for the two treatments (20 and 40% of Bokashi with the addition of *Azosperillium*), As there were no significant differences between them. Whereas, the control treatment recorded the lowest rate, 31.53 SPAD.

Table 3: Effect of *Azosperillium* and Bokashi fertilizer and their interactions on leaf content of chlorophyll (SPAD) of Vinca plants.

average Azospri.	*Bokashi*(%)					*Azospri.*
	40	30	20	10	0.0	
34.80	38.42	36.57	35.10	32.38	31.53	–
40.27	42.16	42.48	41.57	40.94	34.20	+
	40.29	39.53	38.34	36.66	32.87	*average Bokashi*
	interaction	*Bokashi*		*Azosprillium* spp.		L.S.D. 0.05
	1.367	0.967		0.612		

The reason for the superiority may be due to the role of bacteria in providing many necessary elements, including nitrogen, which enters the formation of chlorophyll (Bashan *et al*, 2010). In addition to the importance of Bokashi in improving plant growth and enhancing root growth, this is reflected in the characteristics of vegetative growth, including the leaf content of chlorophyll (Shao *et al*, 2008). This was in agreement with Hu and Qi (2013), who found that the addition of Bokashi significantly improved the studied vegetative growth characteristics, including the leaf content of chlorophyll. Moreover, the increase in the indicators of root growth (Table 1 and 2) may be reflected in the improvement of growth and an increase in the rate of absorption, and this is a positive factor in causing a significant increase in the leaf content of chlorophyll. Also, containing Bokashi containing organic matter may be an important reason for increasing the leaf content of chlorophyll as it leads to an increase in some micronutrients such as iron (Fe), which is necessary in the formation of chlorophylls as it is included in its formation process, as it enters in the composition of cytochromes that are important in breathing and carbon building processes (Melore, 2008).

2-2/ leaf content carbohydrates (%)

The results of Table (4) show no significant difference in the leaf content of carbohydrates, as the treatment for adding *Azosperillium* bacteria recorded the highest rate of 4.952%, while the control treatment recorded a rate of 4.813%. As for the effect of Bokashi, the results of the same table showed that the treatment 40% significantly on the control treatment and 10% only without having significant differences with the rest of the treatments where the highest rate of 5.097%, while the control treatment recorded the lowest rate of 4.582% without having significant differences with the treatment 10% recorded a rate of 4.781%. As for interaction, the treatment (40% Bokashi without adding bacteria) was significantly superior to most other treatments and gave the highest rate of 5.124%, while the treatment (0.0% Bokashi with bacteria addition) recorded the lowest rate of 4.564%.

Table 4: Effect of *Azosperillium* and Bokashi fertilizer and their interactions on leaf content carbohydrates (%) of Vinca plants.

average Azospri.	*Bokashi*(%)					*Azospri.*
	40	30	20	10	0.0	
4.813	5.124	4.954	4.780	4.608	4.600	–
4.952	5.070	5.094	5.080	4.954	4.564	+
	5.097	5.024	4.930	4.781	4.582	*average Bokashi*
	Interaction	*Bokashi*		*Azosprillium* spp.		L.S.D.
	0.314	0.222		***NS***		0.05

It could explain the reason for the significant superiority in the leaf content from carbohydrates to the role of biological fertilizers added to the agricultural medium in analyzing the organic matter and providing many nutrients, in addition to stimulating the process of photosynthesis and this leads to increasing the plant's content of carbohydrates (Khalid *et al*, 1997). The physiological and metabolic activity of the plant associated with the activity of bacterial species added to the agricultural medium fixing to the nitrogen component also increases with increasing concentration of internal hormones that stimulate the absorption of nutrients and then stimulate the photosynthesis process that increases the amount of CO_2 represented in the leaf of the plant, which is considered the basic building unit for building carbohydrates (Mahgoub *et al*, 2006).

2-3/ Leaf content of proline acid (ml.gm^{-1}).

Table (5) data shows the presence of significant differences in the leaf content of proline acid, as the addition of bacteria significantly decreased and gave a rate of 1.010 ml.gm^{-1}, while the control treatment recorded a rate of 1.097 ml.gm^{-1}. As for the addition of Bokashi, the addition treatment resulted in a 30% significant reduction in the leaf content of proline acid by recording the lowest rate of 0.869 ml.gm^{-1}, while the control treatment recorded the highest rate of 1.236 ml.gm^{-1}. The interaction of the two study factors had a significant effect in reducing the rate of proline acid in the leaves of Vinca plants, where the treatment (30% of Bokashi with the addition of *Azosperillium*) recorded a significant decrease, it gave the lowest rate of 0.730 ml.gm^{-1} compared to the treatment (not adding Bokashi with *Azosperillium*), which recorded the highest rate of leaf content of proline at a rate of 1.302 ml.mg^{-1}. The accumulation of proline acid in the leaves of plants not treated with bacteria may be attributed to the role of the plant in protecting itself from the lack of nutrients that may occur during its life cycle or as a mechanism to protect itself from any stress that may occur because it plays an important role in controlling many vital processes inside the cell as well For his role in controlling the chemical signals responsible for the growth and development of flowers as an enzymatic regulator that acts as an antioxidant (Molazem *et al*, 2010).

Table 5: Effect of *Azosperillium* and Bokashi fertilizer and their interactions on Leaf content of proline acid (ml.gm^{-1}) of Vinca plants.

average Azospri.	*Bokashi*(%)					*Azospri.*
	40	30	20	10	0.0	
1.097	1.074	1.008	1.096	1.136	1.170	–
1.010	0.948	0.730	0.928	1.140	1.302	+
	1.011	0.869	1.012	1.138	1.236	*average Bokashi*
	Interaction	*Bokashi*		*Azosprillium* spp.		L.S.D.
	0.079	0.056		0.035		0.05

Third/ Chemical growth indicators.

3-1/ Leaf content of Nitrogen (%).

The results of Table (6) show that the *Azosperillium* had a significant effect on the nitrogen leaf content, as the treatment of adding the bacteria significantly superiority the control treatment, giving the highest rate of 2.665% compared to 2.414% for the non-addition treatment. The addition of Bokashi had a significant response, as the results of the same table showed that there were significant differences due to the effect of adding the mixture to the agricultural medium, The treatment achieved 30% significantly superiority over the control treatment only without having significant differences with the rest of the treatments, where the highest rate of 2.684% was recorded, while the control treatment recorded the lowest rate of 2.277%. The results of the same table also showed that the interaction had a significant effect, so that the treatment (30% of Bokashi with the addition of *Azosperillium*) gave a significant advantage over the treatments (0.0, 10% and 20% of Bokashi without adding the *Azosperillium*) and (0.0% of Bokashi with the addition of *Azosperillium*) only, without having significant differences with the rest of the treatments, where the highest rate of 2.818% was recorded, while the control treatment recorded the lowest rate for this of 2.174%. The reason for the significant increase may be due to the role of the bacterial fertilizer in providing plants with sufficient quantities of nitrogen for their ability to supply the plant with nutrients in addition to its role in stimulating the effectiveness of the enzyme nitrogenase (Nooni, 2018).

Table 6: Effect of *Azosperillium* and Bokashi fertilizer and their interactions on Leaf content of Nitrogen (%) of Vinca plants.

average Azospri.	*Bokashi*(%)					*Azospri.*
	40	30	20	10	0.0	
2.414	2.508	2.550	2.428	2.410	2.174	–
2.665	2.760	2.818	2.710	2.656	2.380	+
	2.634	2.684	2.669	2.533	2.277	*average Bokashi*
	Interaction	*Bokashi*		*Azosprillium* spp.		L.S.D. 0.05
	0.293	0.207		0.131		

3-2/ Leaf content of Phosphor (%).

The results of Table (7) showed significant differences between the treatments in the leaf content of phosphorus, due to the effect of adding *Azosperillium* to the culture medium, highest rate of 0.400%, thus significantly superiority the non-addition treatment, which recorded a rate of 0.374%. The addition of Bokshi also had a significant effect, as the addition treatment recorded 40% significantly higher than all other treatments except for the addition treatment 30% as there were no significant differences between them, where they recorded the highest rate of (0.405 and 0.402%) respectively, while the control treatment recorded the lowest rate It is 0.365%.

Table 7: Effect of *Azosperillium* and Bokashi fertilizer and their interactions on Leaf content of Phosphor (%) of Vinca plants.

average Azospri.	*Bokashi*(%)					*Azospri.*
	40	30	20	10	0.0	
0.374	0.400	0.384	0.366	0.364	0.356	–
0.400	0.410	0.420	0.410	0.388	0.374	+
	0.405	0.402	0.388	0.376	0.365	*average Bokashi*
	Interaction	*Bokashi*		*Azosprillium* spp.		L.S.D. 0.05
	0.011	0.008		0.005		

The interaction of the two study factors also caused a significant increase, so the treatment (30% of Bokashi with the addition of *Azosperillium*) recorded the highest rate of 0.420%, thus significantly superiority all the treatments except the two treatments (20 and 40% of Bokashi with the addition of *Azosperillium*), which recorded a rate of 0.410% for each, while the control treatment recorded the lowest rate of 0.356%. May explain the reason for superiority to the role of biological fertilizers in the absorption of insoluble phosphorus from the soil and this is reflected in the increase in the content of the element in the leaves of the plant, in addition to the role of *Azosperillium* in increasing the rate of absorption of water and nutrients through the roots, which leads to an increase in the transpiration process and then increasing the absorption Mineral ions as a result (Al-Shaybani, 2005).

3-3/ Leaf content of Potassium (%).

The results of Table (8) show that the *Azosperillium* made a significant difference in the leaf content of potassium, as the addition treatment recorded the highest rate of 1.136%, thus significantly superiority the control treatment, which recorded a rate of 0.733%. The addition of Bokashi also resulted in a significant increase, as the treatment achieved 30% significantly superiority over all other treatments, except for the treatment, 40%, by giving it the highest rate (1.075 and 1.064%) respectively, while the control treatment recorded the lowest rate of 0.664%.

Table 8: Effect of *Azosperillium* and Bokashi fertilizer and their interactions on Leaf content of Potassium (%) of Vinca plants.

average Azospri.	*Bokashi*(%)					*Azospri.*
	40	30	20	10	0.0	
0.733	0.814	0.770	0.728	0.706	0.648	–
1.136	1.314	1.380	1.224	1.080	0.680	+
	1.064	1.075	0.976	0.893	0.664	*average Bokashi*
	Interaction	*Bokashi*		*Azosprillium* spp.		L.S.D. 0.05
	0.109	0.077		0.049		

The results of the same table also showed the presence of a significant effect caused by the interaction of the two study factors, where the interaction treatment (30% of Bokashi with the addition of *Azosperillium*) achieved a significant superiority over all treatments except (40% of Bokashi with the addition of *Azosperillium*), which recorded the highest rate of (1.380 and 1.314%) respectively, while the control treatment recorded the lowest rate of 0.684%. The reason for the superiority in the content of the leaves of plants from the major elements NPK to the role of the Bokashi in the preparation of the agricultural medium in humus is that it contains biofertilizer EM1 which includes a compatible group of beneficial microorganisms (Anonymous, 2005). Or the ability of the bio-fertilizer to release enzymes that release nutrients to the soil (Khalid, 1997).

We conclude from the study that the biological fertilizers used in the experiment interfering with the organic matter have significantly improved the parameters of the qualitative and chemical root study of the Vinca plants compared to the control factors according to the conditions of conducting the research experiment.

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