# EFFECT OF DIFFERENT ORGANIC FERTILIZERS ON THE GROWTH INDICATORS OF KUMQUAT SEEDLINGS

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- **Abstract:**

The study investigated the effect of different organic fertilizers on the vegetative growth of kumquat seedlings of various cultivars. The experimental results showed that the application of decomposed manure, compost, and vermicompost increased seedling height, the number of shoots, and average shoot length. The highest growth parameters in all cultivars were recorded in the treatment receiving 20 t/ha of vermicompost. In particular, the Meyva cultivar showed the greatest response, with a significant improvement in seedling growth and development. The results demonstrate that organic fertilizers are an effective agrotechnological practice for producing vigorous kumquat seedlings.

**Keywords:** organic fertilizer, vermicompost, compost, decomposed manure, kumquat, seedling, shoot, vegetative growth, cultivar, agrotechnology.

- Introduction

In recent years, the global demand for healthy nutrition has increased considerably. Fruits and vegetables rich in natural vitamins and biologically active compounds play an important role in improving human health. In this regard, citrus fruits, especially kumquat (*Citrus japonica*), have attracted increasing attention in recent years. Due to its high content of vitamin C, organic acids, minerals, and antioxidants, kumquat is regarded in many countries as a natural source of vitamins. Furthermore, its bioflavonoids strengthen the immune system, contribute to the

prevention of cardiovascular diseases, and help eliminate harmful substances from the human body.

Vermicompost contains humic acids, fulvic acids, enzymes, and beneficial microorganisms that activate physiological processes in seedlings, particularly photosynthesis and nitrogen and phosphorus metabolism, thereby accelerating shoot growth. In addition, vermicompost enriches soil microflora and improves nutrient absorption through the root system.

- Aim of the Study

The objective of this research was to evaluate the influence of organic fertilizers on the growth and development of vigorous kumquat seedlings and their shoot growth.

- Materials and Methods

The experimental materials consisted of four kumquat cultivars: **Nagami, Derevo, Pestrolistniy, and Meyva**. Three organic fertilizers—decomposed manure, compost, and vermicompost—were used in the study.

- Results

The experimental results showed that the application of different organic fertilizers had a significant effect on the growth performance of **Pestrolistniy** kumquat seedlings. Under unfertilized conditions, seedling growth was relatively weak, with an average height of **12.4 ± 0.3 cm**, **3.4 ± 0.3** shoots per seedling, and an average shoot length of **5.6 ± 0.5 cm**.

Application of **20 t/ha of decomposed manure** improved growth performance. Seedling height reached **14.3 ± 0.4 cm**, the number of shoots increased to **4.2 ± 0.4**, and the average shoot length reached **6.9 ± 0.6 cm**. These results confirm a clear improvement compared with the unfertilized control treatment.

**Table 1.**

**Effect of Organic Fertilizers on Shoot Growth of Kumquat Seedlings**

| Navlar | Кўчат баландлиги, см | Новдалар сони, дона | Новдаларнинг ўртача узунлиги, см |
|---|---|---|---|
| Нагами нави | | | |
| Ўғитсиз | 18,6 ±0,4 | 4,2 ±0,3 | 7,8 ±0,5 |
| 20 т/га чириган гўнг | 24,8 ±0,6 | 6,0 ±0,4 | 9,6 ±0,6 |
| 20 т/га компост | 26,5 ±0,7 | 6,4 ±0,3 | 10,2 ±0,5 |
| 20 т/га биогумус | 29,3 ±0,8 | 7,2 ±0,4 | 11,4 ±0,6 |
| Пестролистний нави | | | |
| Ўғитсиз | 12,4 ±0,3 | 3,4 ±0,3 | 5,6 ±0,5 |
| 20 т/га чириган гўнг | 14,3 ±0,4 | 4,2 ±0,4 | 6,9 ±0,6 |
| 20 т/га компост | 15,3 ±0,5 | 5,1 ±0,3 | 7,8 ±0,5 |
| 20 т/га биогумус | 17,3 ±0,1 | 5,8 ±0,4 | 8,7 ±0,6 |
| Дерево нави | | | |
| Ўғитсиз | 16,3 ±0,4 | 3,7 ±0,3 | 6,2 ±0,5 |
| 20 т/га чириган гўнг | 17,7 ±0,6 | 4,9 ±0,4 | 7,3 ±0,6 |
| 20 т/га компост | 18,3 ±0,7 | 5,9 ±0,3 | 8,9 ±0,5 |
| 20 т/га биогумус | 20,5 ±0,8 | 6,2 ±0,4 | 10,7 ±0,6 |
| Мейва нави | | | |
| Ўғитсиз | 19,8 ±0,4 | 5,2 ±0,3 | 9,8 ±0,5 |
| 20 т/га чириган гўнг | 26,4 ±0,6 | 7,0 ±0,4 | 11,6 ±0,6 |
| 20 т/га компост | 30,0 ±0,7 | 9,4 ±0,3 | 13,2 ±0,5 |
| 20 т/га биогумус | 34,3 ±0,8 | 12,2 ±0,4 | 17,4 ±0,6 |

Results

In the treatment fertilized with 20 t/ha of compost, seedling growth was more vigorous. Seedling height reached 15.3 ± 0.5 cm, the number of shoots was 5.1 ± 0.3, and the average shoot length was 7.8 ± 0.5 cm.

The highest results were observed in the treatment receiving 20 t/ha of vermicompost. In this treatment, seedling height reached 17.3 ± 0.1 cm, the number of shoots increased to 5.8 ± 0.4, and the average shoot length reached 8.7 ± 0.6 cm.

Thus, the experimental results demonstrated that among the tested organic fertilizers, vermicompost had the most positive effect on seedling growth. This superiority is probably associated with its high content of biologically active substances and beneficial microorganisms.

The study also revealed that different types of organic fertilizers significantly influenced the growth performance of the Derevo kumquat cultivar. In the unfertilized control treatment, seedling growth was relatively weak. The average seedling height was 16.3 ± 0.4 cm, the number of shoots was 3.7 ± 0.3, and the average shoot length was 6.2 ± 0.5 cm, indicating limited vegetative development under nutrient-deficient conditions.

Application of 20 t/ha of decomposed manure noticeably improved growth. Seedling height increased to 17.7 ± 0.6 cm, which was approximately 8–9% higher than the control. The number of shoots reached 4.9 ± 0.4, representing nearly a 1.2-fold increase, while the average shoot length increased to 7.3 ± 0.6 cm, confirming enhanced vegetative activity.

The 20 t/ha compost treatment produced even better growth performance. Seedling height reached 18.3 ± 0.7 cm, the number of shoots increased to 5.9 ± 0.3, and the average shoot length reached 8.9 ± 0.5 cm. These values were approximately 12–15% higher than those of the control. The humus and mineral nutrients supplied by compost may have promoted the active development of growing tissues.

The highest growth parameters were recorded in the 20 t/ha vermicompost treatment. Seedling height reached 20.5 ± 0.8 cm, the number of shoots increased to 6.2 ± 0.4, and the average shoot length reached 10.7 ± 0.6 cm. Compared with the unfertilized treatment, these values were 25.8%, 67.6%, and 72.6% higher, respectively. These findings demonstrate the high agrobiological value of

vermicompost, whose biologically active compounds and beneficial microorganisms effectively stimulate seedling growth.

The experimental results also demonstrated the important role of organic fertilizers in the growth of the Meyva kumquat cultivar.

In the unfertilized control treatment, vegetative growth remained relatively weak. The average seedling height was 19.8 ± 0.4 cm, the number of shoots was 5.2 ± 0.3, and the average shoot length was 9.8 ± 0.5 cm. These values indicate that limited nutrient availability in the soil restricted seedling development.

Application of 20 t/ha of decomposed manure resulted in a marked improvement. Seedling height increased to 26.4 ± 0.6 cm, the number of shoots reached 7.0 ± 0.4, and the average shoot length increased to 11.6 ± 0.6 cm. Compared with the control, these parameters increased by 33.3%, 34.6%, and 18.4%, respectively.

The 20 t/ha compost treatment produced even greater vegetative growth. Seedling height reached 30.0 ± 0.7 cm, the number of shoots increased to 9.4 ± 0.3, and the average shoot length reached 13.2 ± 0.5 cm. These values represented increases of 51.5%, 80.7%, and 34.7% over the control treatment. The high content of humus, nitrogen, phosphorus, and beneficial microorganisms in compost may have promoted intensive tissue development.

The greatest growth performance was obtained with 20 t/ha of vermicompost. Seedling height reached 34.3 ± 0.8 cm, the number of shoots increased to 12.2 ± 0.4, and the average shoot length reached 17.4 ± 0.6 cm. Compared with the unfertilized treatment, these values were 73.2%, 134.6%, and 77.5% higher, respectively. The superior effectiveness of vermicompost is associated with its biologically active compounds, enzymes, and beneficial microorganisms, which improve soil structure, enhance nutrient availability, and stimulate physiological processes in the root system.

Organic fertilizers also exerted a broad positive effect on leaf development. This influence is mainly attributed to the organic matter, macro- and micronutrients, and biologically active compounds that regulate plant physiological processes.

Conclusion

The results of this study confirmed that organic fertilizers significantly improve the vegetative growth of kumquat seedlings. In all cultivars, fertilized treatments produced greater seedling height, a higher number of shoots, and longer average shoot length than the unfertilized control.

The highest growth indicators were recorded with the application of 20 t/ha vermicompost. The Meyva cultivar exhibited the greatest response, reaching 34.3 cm in seedling height, 12.2 shoots, and an average shoot length of 17.4 cm. The Nagami cultivar also responded positively, with values of 29.3 cm, 7.2 shoots, and 11.4 cm average shoot length. Although compost and decomposed manure also stimulated vegetative growth, their effectiveness was lower than that of vermicompost.

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