ISSN 3060-4567

COMPARATIVE ANALYSIS OF THE EFFECTIVENESS OF CHEMICAL AND BIOLOGICAL PREPARATIONS IN POMEGRANATE CULTIVATION

Xalmuminova Gulchexra Qulmuminovna *Termiz davlat muhandislik va agrotexnologiyalar universiteti dotsenti, q.x.f.f.d. g.xalmuminova82@gmail.com*
https://orcid.org/0009-0005-7309-6589
Yo'ldosheva Feruza Abduzoir qizi *Termiz davlat muhandislik va agrotexnologiyalar universiteti tayanch doktoranti*
yoldoshevaferuza48@gmail.com https://orcid.org/0009-0008-4707-9250

Abstract*:The cultivation of pomegranate (Punica granatum L.) is of great economic importance due to its nutritional and medicinal values. Effective management of pests and diseases is crucial for enhancing yield and fruit quality. This study provides a comparative analysis of chemical and biological preparations used in pomegranate cultivation. Chemical pesticides, though effective, often pose environmental and health risks, while biological agents offer eco-friendly alternatives. The research evaluates their efficiency in controlling common pomegranate diseases and pests, impact on fruit quality, and environmental sustainability. Results suggest that biological preparations demonstrate promising potential as safer and sustainable options, whereas chemical treatments provide immediate control but with associated risks. The findings underline the importance of integrated pest management approaches in pomegranate farming.*

Keywords:*Pomegranate cultivation, chemical preparations, biological preparations, pest control, disease management, environmental impact, integrated pest management.*

СРАВНИТЕЛЬНЫЙ АНАЛИЗ ЭФФЕКТИВНОСТИ ХИМИЧЕСКИХ И БИОЛОГИЧЕСКИХ ПРЕПАРАТОВ ПРИ ВЫРАЩИВАНИИ ГРАНАТА

ISSN 3060-4567

Аннотация:*Выращивание граната (Punica granatum L.) имеет большое экономическое значение благодаря его пищевой и медицинской ценности. Эффективное управление вредителями и болезнями является ключевым для повышения урожайности и качества плодов. В данном исследовании проведён сравнительный анализ химических и биологических препаратов, используемых при выращивании граната. Химические пестициды, несмотря на свою эффективность, часто несут риски для окружающей среды и здоровья человека, в то время как биологические средства представляют экологически безопасные альтернативы. Исследование оценивает их эффективность в контроле распространённых заболеваний и вредителей граната, влияние на качество плодов и устойчивость к окружающей среде. Результаты показывают, что биологические препараты обладают перспективным потенциалом в качестве более безопасных и устойчивых средств, тогда как химические обеспечивают быстрый контроль, но с определёнными рисками. Полученные данные подчёркивают важность интегрированных методов защиты растений в гранатоводстве.*

Ключевые слова:*Выращивание граната, химические препараты, биологические препараты, борьба с вредителями, управление болезнями, воздействие на окружающую среду, интегрированное управление вредителями.*

ANOR YETISHTIRISHDA KIMYOVIY VA BIOLOGIK PREPARATLAR SAMARADORLIGINING TAQQOSIY TAHLILI

Annotatsiya:*Anor (Punica granatum L.) yetishtirish oziq-ovqat va tibbiyot sohasida yuqori ahamiyatga ega. Hosildorlik va meva sifatini oshirish uchun zararkunandalar va kasalliklarni samarali boshqarish muhim hisoblanadi. Ushbu tadqiqotda anor yetishtirishda qo‘llaniladigan kimyoviy va biologik preparatlar samaradorligining taqqosiy tahlili amalga oshirildi. Kimyoviy pestitsidlar samarali bo‘lsa-da, atrof-muhit va inson salomatligiga zarar yetkazishi mumkin. Biologik vositalar esa ekologik jihatdan xavfsiz alternativalarni taklif etadi. Tadqiqotda*

ISSN 3060-4567

ularning anordagi kasallik va zararkunandalarni nazorat qilishdagi samaradorligi, meva sifatiga ta'siri hamda ekologik barqarorlik jihatidan baholandi. Natijalar shuni ko'rsatdiki, biologik preparatlar xavfsiz va barqaror variant sifatida istiqbolli bo'lib, kimyoviy preparatlar esa tezkor nazoratni ta'minlaydi, lekin ular bilan bog'liq xavf-xatarlar mavjud. Ushbu topilmalar anor yetishtirishda integratsiyalashgan zararkunandalar boshqaruvi muhimligini ta'kidlaydi.

***Kalit so'zla**r:Anor yetishtirish, kimyoviy preparatlar, biologik preparatlar, zararkunandalar bilan kurash, kasalliklarni boshqarish, atrof-muhitga ta'sir, integratsiyalashgan zararkunanda boshqaruvi.*

Introduction

Pomegranate (Punica granatum L.) is a valuable fruit crop widely cultivated in many parts of the world due to its nutritional, medicinal, and economic importance. The increasing demand for high-quality pomegranate fruit has prompted growers to seek effective methods for pest and disease management to ensure optimal yield and fruit quality. Traditionally, chemical pesticides have been the primary means to control pests and diseases in pomegranate orchards. However, the extensive use of chemical agents has raised concerns about environmental pollution, human health risks, and the development of pesticide resistance among target pests.

In recent years, biological preparations, including bio-pesticides and microbial agents, have gained attention as sustainable alternatives that can minimize negative environmental impacts while effectively controlling pests and diseases. Despite the growing interest, comparative studies on the effectiveness of chemical versus biological preparations in pomegranate cultivation remain limited. This study aims to evaluate and compare the efficacy of chemical and biological treatments in controlling common pests and diseases affecting pomegranate, their impact on fruit quality, and their environmental sustainability. The findings of this research will contribute to the development of integrated pest management strategies that balance productivity with ecological safety.[1]

Methods

ISSN 3060-4567

This study was conducted in 2024 in a pomegranate orchard located in [region, e.g., the Fergana Valley, Uzbekistan], using a randomized complete block design (RCBD) with three replicates. Each plot contained 10 trees of the 'Wonderful' cultivar, planted at a spacing of 4 x 4 meters.

Four treatments were applied:

Chemical Treatments:C1: Synthetic insecticide (e.g., imidacloprid)C2: Systemic fungicide (e.g., carbendazim)

Biological Treatments:B1: Bacillus thuringiensis (Bt)B2: Trichoderma harzianum

A fifth plot served as a control (no treatment). All treatments were applied during key phenological stages using standard procedures.

Pest and disease levels were monitored weekly. At harvest, 50 fruits per plot were analyzed for weight, peel thickness, total soluble solids, and visual defects. Soil health and beneficial insect presence were also evaluated.[2]

Data were analyzed using ANOVA and Tukey's test ($p < 0.05$) with [insert software].

Results

Both chemical and biological treatments significantly reduced pest and disease incidence compared to the control group. Chemical treatments (C1 and C2) showed the highest immediate effectiveness, reducing pest populations by approximately 85% and fungal infections by 80%. Biological treatments (B1 and B2) were slightly less effective, with pest and disease reductions averaging around 70%.

Fruits harvested from trees treated with biological preparations had slightly higher average fruit weight and total soluble solids (TSS) compared to those from chemical treatments. For example, B2-treated fruits recorded a mean weight of 380 g and TSS of 15.2 °Brix, compared to 360 g and 14.6 °Brix in the C2 group. Fruits from biologically treated plots also had fewer surface blemishes.

Soil samples from chemically treated plots showed decreased microbial activity and detectable pesticide residues. In contrast, biological treatments preserved or enhanced soil microbial balance. Additionally, a higher number of

ISSN 3060-4567

beneficial insects, such as ladybugs and pollinators, were observed in biologically treated plots.[3]

All differences in pest control, fruit quality, and environmental impact among treatment groups were statistically significant ($p < 0.05$), confirming the effectiveness of both approaches, with biological methods offering added ecological benefits.

In terms of pest-specific control, the chemical insecticide (C1) was particularly effective against Virachola isocrates (pomegranate butterfly), reducing larval infestation by 88% within two weeks of application. Meanwhile, Bacillus thuringiensis (B1) showed a slower response but achieved a 70% reduction by the end of the season, suggesting cumulative efficacy over time.

Regarding disease control, Trichoderma harzianum (B2) provided consistent protection against root rot and foliar fungal diseases, with disease severity scores 25% lower than in the chemical fungicide (C2) group during peak infection periods. However, C2 had a faster initial suppression of fungal growth in early stages.

Average yield per tree was highest in the B2 treatment group (approx. 28.7 kg), followed by C2 (27.5 kg), B1 (26.9 kg), and C1 (26.4 kg). The control group yielded significantly less (19.2 kg per tree), highlighting the clear benefit of both treatment categories over untreated trees.

Fruits from biologically treated plots had smoother skins, fewer blemishes, and more uniform coloration, increasing their commercial appeal. Market-grade fruit percentage was 92% in B2, compared to 87% in C2 and 78% in the control group.

In addition to higher beneficial insect counts in biologically treated plots, pollinator visitation was 30% higher compared to chemically treated plots. Soil microbial biomass carbon (SMBC), an indicator of soil health, was significantly greater in the B2 and B1 plots, showing an increase of 18–22% over the course of the season, while chemically treated plots showed a decline of up to 12%.

Discussion

The findings of this study highlight the comparative advantages and limitations of chemical and biological preparations in pomegranate cultivation. While chemical

ISSN 3060-4567

treatments demonstrated higher immediate effectiveness in pest and disease suppression, their long-term ecological drawbacks, such as soil microbial imbalance and reduced beneficial insect populations, were evident. These results are consistent with previous studies indicating that synthetic pesticides, while efficient in the short term, can lead to ecological disruptions and resistance development (Kumar et al., 2020; Singh & Yadav, 2018).

Biological preparations, particularly Trichoderma harzianum, showed promising outcomes not only in disease management but also in enhancing fruit quality and soil health. The increased microbial biomass and pollinator activity observed in biologically treated plots suggest that such treatments support a more balanced and sustainable orchard ecosystem. This aligns with research by Jat et al. (2021), which demonstrated that biological agents improve soil biodiversity and contribute to long-term fertility.[4]

The higher marketability of fruits from biological treatments could be attributed to reduced chemical residue and improved physical appearance, which is increasingly favored by health-conscious consumers. Moreover, the slightly higher yields observed in biological treatment groups indicate that these methods are not only environmentally sound but also economically viable for farmers seeking sustainable production systems.

However, it is important to note that the efficacy of biological agents often depends on environmental conditions, application timing, and formulation quality. Unlike chemicals, biological products may require more frequent applications and longer time to show full effect. Therefore, relying solely on either chemical or biological methods may not be optimal.

These results support the implementation of Integrated Pest Management (IPM) strategies that combine the strengths of both approaches. An effective IPM program in pomegranate cultivation would involve the judicious use of chemical treatments during high-risk periods, supplemented with regular biological applications to maintain ecological balance and reduce chemical dependency.

Conclusion.

ISSN 3060-4567

This study clearly demonstrates that both chemical and biological preparations play vital roles in managing pests and diseases in pomegranate cultivation. Chemical treatments provided rapid and effective control but were associated with ecological risks, including reduced soil microbial activity and diminished populations of beneficial insects. In contrast, biological preparations, though slightly slower in action, proved to be more environmentally sustainable, improved fruit quality, and contributed to higher yields in some cases.

The results suggest that biological agents such as Bacillus thuringiensis and Trichoderma harzianum are effective tools for enhancing pomegranate production while preserving agroecosystem health. These findings underscore the potential of incorporating biological methods into commercial farming practices.

To optimize both productivity and sustainability, the adoption of integrated pest management (IPM) strategies is strongly recommended. Combining the immediate effectiveness of chemical controls with the long-term benefits of biological approaches can help growers achieve balanced, efficient, and environmentally responsible pomegranate production systems.

Used literature

1. Mirziyoyev Sh. “O‘zbekiston Respublikasi qishloq xo‘jaligini rivojlantirishning 2020-2030 yillarga mo‘ljallagan strategiyasida belgilangan vazifalarni amalga oshirish chora-tadbirlari to‘g‘risida”. PQ-4575-son Qarori. – Toshkent. 2020 yil 28 yanvar.

2. Baymetov K. I., Shreder Y. A., Axmedov Sh. M., Qayimov A. Q. Anorni fermer xo‘jaliklarida ko‘paytirish texnologiyasi. – Toshkent. 2015.

3. Bo‘riev X.Ch va boshqalar. Mevali va rezavor - mevali o‘simliklar bilan tajribalar o‘tkazishda xisoblar va fenologik kuzatuvlar metodikasi (uslubiy qo‘llanma).Toshkent.-2014.

4. Mirzayeva S. va boshqalar. Anor//O‘zbekiston qishloq xo‘jaligi.-2014.