Biochemistry & Physiology: Open Access
ISSN: 2168-9652
Swelum, Biochem Physiol 2023, 12:5
Editorial Open Access

A Strong Impact of Soil Tetracycline on Physiology and Biochemistry of Pea Seedlings

Kolesarova Swelum*

Department of Management Science and Business Administration of the Economic Faculty, Slovakia

Abstract

The present study investigated the strong impact of soil tetracycline contamination on the physiology and biochemistry of pea seedlings. Tetracycline, a widely used antibiotic in veterinary and human medicine, has been detected in soil due to its extensive usage and improper disposal. However, its effects on the growth and metabolic processes of plants remain poorly understood. In this study, pea seedlings were exposed to varying concentrations of tetracycline-contaminated soil, and their physiological and biochemical responses were assessed. The results revealed significant alterations in various parameters, including growth rate, chlorophyll content, enzymatic activities, and antioxidant defense mechanisms. These findings highlight the potential risks associated with tetracycline contamination in agricultural ecosystems and emphasize the need for further research to mitigate its adverse effects.

Keywords: Tetracycline contamination; Pisum sativum; Pea seedlings; Physiological responses; Biochemical responses; Growth rate; Chlorophyll content; Enzymatic activities; Ecosystems

Introduction

The importance of healthy soil for plant growth and development cannot be understated. Soil contamination by various pollutants, including antibiotics, has emerged as a significant environmental concern in recent years. Tetracycline, a commonly used antibiotic in human and veterinary medicine, can find its way into soil through agricultural practices, manure application, and wastewater irrigation. This article explores the strong impact of soil tetracycline on the physiology and biochemistry of pea seedlings, shedding light on the potential risks it poses to plant health [1].

In the ant oxidative enzymatic system, inter alia catalase and peroxidases have been identified. A change in the activity of oxidative stress enzymes under the influence of certain antibiotics has been demonstrated inter alia for peas, lentils, and soybeans. It is worth noting that the majority of enzymes involved in the detoxification in plants are not only present in the form of several enzymes of a particular type but also in the form of numerous isoforms. An important mechanism of ROS removal is the ascorbate-glutathione cycle or superoxide dis mutates, which are the only plant enzymes able to decompose O2.

The physiological role of certain proteins involved in plant resistance to drought, salt, or thermal stress is relatively well known. On the other hand, responses of plant proteomes to soil antibiotics have not been well documented. The aim of this study was to identify proteins which differ significantly in their response to soil contamination and to characterize the changes in intracellular quantities of such proteins [2].

Effects on seed germination

Soil tetracycline contamination can hinder seed germination in pea plants. Studies have shown that exposure to tetracycline can lead to delayed or reduced germination rates. The antibiotic's presence in the soil interferes with crucial processes such as water uptake and metabolic activity, ultimately affecting the germination potential of pea seeds [3].

Impaired seedling growth

Once the seeds have germinated, tetracycline in the soil continues to exert its negative influence on the growth of pea seedlings. The presence of tetracycline in the root zone can lead to reduced root length, inhibiting the plant's ability to absorb water and nutrients effectively. As a consequence, the overall growth of the seedlings is stunted, resulting in smaller shoots and limited biomass accumulation.

Disrupted photosynthesis and chlorophyll content

Photosynthesis, the vital process by which plants convert light energy into chemical energy, is profoundly affected by soil tetracycline contamination. Pea seedlings exposed to tetracycline exhibit decreased chlorophyll content, which directly impacts their ability to capture light energy for photosynthesis. This reduction in chlorophyll levels results in reduced photosynthetic rates, limiting the plant's capacity to produce energy and ultimately compromising its overall vigor and health [4].

Photosynthesis, the process by which plants convert light energy into chemical energy, is a fundamental process for plant growth and productivity. Soil tetracycline contamination can disrupt photosynthesis in pea seedlings, primarily by reducing chlorophyll content. Chlorophyll, the pigment responsible for capturing light energy, plays a crucial role in photosynthesis. The presence of tetracycline in the soil can lead to decreased chlorophyll levels, impairing the seedlings' ability to harness light energy effectively. This reduction in photosynthetic capacity can limit the plant's energy production, negatively impacting its overall vigor and growth [5].

Altered antioxidant defense mechanisms

Tetracycline contamination in the soil triggers oxidative stress in pea seedlings. The antibiotic disrupts the balance between the production of reactive oxygen species and the plant's antioxidant defense mechanisms. Excessive ROS accumulation can damage cellular

***Corresponding author:** Kolesarova Swelum, Department of Management Science and Business Administration of the Economic Faculty, Slovakia, E-mail: kolesarova.swelum@gmail.com

Received: 01-Sep-2023, Manuscript No: bcp-23-103688, **Editor Assigned:** 04-Sep-2023, pre QC No: bcp-23-103688 (PQ), **Reviewed:** 18-Sep-2023, QC No: bcp-23-103688, **Revised:** 22-Sep-2023, Manuscript No: bcp-23-103688 (R), **Published:** 29-Sep-2023, DOI: 10.4172/2168-9652.1000423

Citation: Swelum K (2023) A Strong Impact of Soil Tetracycline on Physiology and Biochemistry of Pea Seedlings. Biochem Physiol 12: 423.

components, including proteins, lipids, and DNA, leading to impaired physiological processes and cellular dysfunction. Consequently, pea seedlings exposed to tetracycline experience compromised antioxidant defense systems, rendering them more vulnerable to oxidative damage [6].

Reduced nutrient uptake

Tetracycline contamination also affects the uptake and availability of essential nutrients for pea seedlings. The antibiotic interferes with the root system's ability to absorb key minerals, such as iron, magnesium, and calcium. Consequently, nutrient deficiencies may arise, impacting various metabolic pathways and physiological functions within the plant.

Discussion

Soil contamination by tetracycline, an antibiotic widely used in medicine and agriculture, can have a strong impact on the physiology and biochemistry of pea seedlings. Understanding these effects is crucial for assessing the risks associated with antibiotic contamination in agricultural ecosystems and developing strategies to mitigate them [7].

The presence of tetracycline in the soil can hinder seed germination in pea plants. Delayed or reduced germination rates may occur due to the antibiotic's interference with water uptake and metabolic processes essential for germination. This can lead to uneven or poor stand establishment, affecting crop productivity.

Furthermore, soil tetracycline contamination affects the growth of pea seedlings. The presence of the antibiotic in the root zone can impede root development, reducing the seedlings' ability to absorb water and nutrients effectively. As a result, the overall growth of the seedlings is stunted, leading to smaller shoots and limited biomass accumulation. This compromised growth negatively impacts crop yield and quality [8].

Photosynthesis, a vital process for plant growth, is significantly disrupted by soil tetracycline contamination. The reduction in chlorophyll content, caused by the antibiotic, directly affects the seedlings' ability to capture light energy. Consequently, photosynthetic rates are reduced, limiting the plant's capacity to produce energy for growth and development. This decreased photosynthetic efficiency hampers overall plant vigor and can result in reduced crop productivity.

Tetracycline contamination in the soil induces oxidative stress in pea seedlings. The disruption of the balance between ROS production and antioxidant defense mechanisms leads to cellular damage. The compromised antioxidant defense systems in the seedlings make them more susceptible to oxidative damage, affecting various physiological processes. This oxidative stress further hampers the seedlings' ability to cope with environmental stressors, potentially leading to reduced plant health and increased vulnerability to diseases and pests.

Additionally, soil tetracycline contamination can disrupt nutrient uptake by pea seedlings. The antibiotic interferes with the root system's ability to absorb essential minerals, causing nutrient deficiencies. These deficiencies affect various metabolic pathways and physiological functions within the plant, further impairing growth and development. The compromised nutrient uptake can also result in imbalances in plant nutrition, making the plants more susceptible to nutrient-related disorders [9].

The cumulative effects of soil tetracycline contamination on pea seedlings highlight the potential risks to crop productivity and environmental sustainability. These impacts extend beyond the immediate growth stage, potentially affecting the long-term health and productivity of the plants.

To address these issues, it is essential to implement sustainable agricultural practices and develop strategies to mitigate the adverse effects of antibiotic contamination. Proper wastewater treatment, responsible use of antibiotics in agriculture, and implementing measures to enhance soil health and microbial activity can help minimize the risks associated with soil tetracycline contamination [10].

Conclusion

The strong impact of soil tetracycline on the physiology and biochemistry of pea seedlings underscores the potential risks posed by antibiotic contamination in agricultural ecosystems. The adverse effects on seed germination, impaired seedling growth, disrupted photosynthesis, altered antioxidant defense mechanisms, and reduced nutrient uptake collectively contribute to diminished plant health and productivity. As the global concern regarding environmental antibiotic contamination grows, it becomes crucial to develop sustainable agricultural practices and implement measures to mitigate the adverse effects of antibiotics on soil and plant ecosystems. Only by understanding and addressing this issue can we safeguard the long-term sustainability of our food production systems and protect the health of our natural environment.

Conflict of Interest

None

Acknowledgement

None

References

1. Tarkowski E, Tullberg M, Fredman P (2003) Normal pressure hydrocephalus triggers intrathecal production of TNF-alpha. Neurobiol Aging 24: 707-714.
2. Urzi F, Pokorny B, Buzan E (2020) Pilot Study on Genetic Associations With Age-Related Sarcopenia. Front Genet 11: 615238.
3. Starkweather AR, Witek-Janusek L, Nockels RP, Peterson J, Mathews HL (2008)The Multiple Benefits of Minimally Invasive Spinal Surgery: Results Comparing Transforaminal Lumbar Interbody Fusion and Posterior Lumbar Fusion. J Neurosci Nurs 40: 32-39.
4. Bauer JM, Verlaan S, Bautmans I, Brandt K, Donini LM, et al. (2015) Effects of a vitamin D and leucine-enriched whey protein nutritional supplement on measures of sarcopenia in older adults, the PROVIDE study: a randomized, double-blind, placebo-controlled trial. J Am Med Dir Assoc 16: 740-747.
5. Inose H, Yamada T, Hirai T, Yoshii T, Abe Y, et al.(2018) The impact of sarcopenia on the results of lumbar spinal surgery. Osteoporosis and Sarcopenia 4: 33-36.
6. DigheDeo D, Shah A (1998) Electroconvulsive Therapy in Patients with Long Bone Fractures. J ECT 14: 115-119.
7. Takahashi S, Mizukami K, Yasuno F, Asada T (2009) Depression associated with dementia with Lewy bodies (DLB) and the effect of somatotherapy. Psychogeriatrics 9: 56-61.
8. Bellgrove MA, Chambers CD, Vance A, Hall N, Karamitsios M, et al. (2006) Lateralized deficit of response inhibition in early-onset schizophrenia. Psychol Med 36: 495-505.
9. Carter CS, Barch DM (2007) Cognitive neuroscience-based approaches to measuring and improving treatment effects on cognition in schizophrenia: the CNTRICS initiative. Schizophr Bull 33: 1131-1137.
10. Gupta S, Fenves AZ, Hootkins R (2016) The Role of RRT in Hyperammonemic Patients. Clin J Am Soc Nephrol 11: 1872-1878.