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CLIMATE CHANGE AND THE SPREAD OF PEA PESTS: CHALLENGES FOR SUSTAINABLE AGRICULTURE

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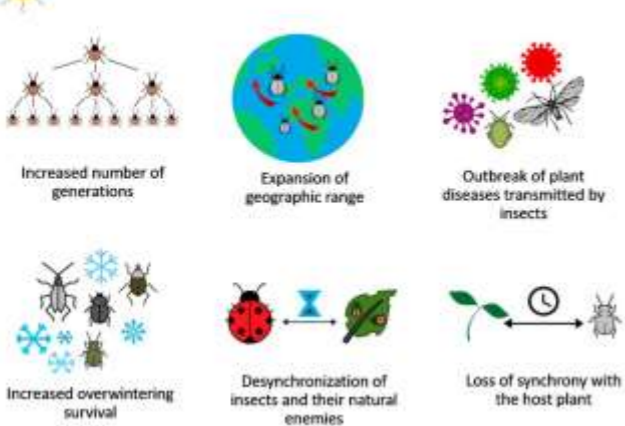
Abstract: Climate change has become a major driver of agricultural transformation, significantly influencing the distribution and behaviour of crop pests worldwide. In pea (*Pisum sativum*) cultivation, rising temperatures, altered precipitation patterns, and increased frequency of extreme weather events are creating favourable conditions for the expansion of pest populations. This shift not only intensifies pest pressure but also introduces new species into previously unaffected regions, posing serious risks to crop productivity and food security. Warmer climates accelerate pest life cycles, allowing multiple generations within a single growing season. At the same time, milder winters improve pest survival rates, leading to earlier infestations. Key pests affecting peas, such as aphids and weevils, are particularly sensitive to these environmental changes. Their increased abundance contributes to higher levels of plant damage and facilitates the transmission of plant diseases. Additionally, the unpredictability of pest outbreaks complicates integrated pest management strategies, requiring continuous adaptation and monitoring. To address these challenges, sustainable solutions must include improved pest forecasting systems, the development of resistant pea varieties, and the promotion of agroecological practices. Strengthening research and farmer education is essential to enhance resilience against climate-driven pest dynamics.

• Introduction

Climate change has emerged as one of the most significant global challenges affecting agricultural systems in the 21st century. Its impacts extend beyond abiotic stress factors such as drought, heatwaves, and flooding, to include profound changes in biotic interactions, particularly between crops and pests. Among agricultural crops, legumes such as pea (*Pisum sativum* L.) are of particular importance due to their dual role in food security and environmental sustainability. Peas contribute to human nutrition as a rich source of protein and essential micronutrients, while also enhancing soil fertility through biological nitrogen fixation. This ecological function reduces dependence on synthetic nitrogen fertilizers, thereby lowering greenhouse gas emissions and promoting sustainable agricultural practices.

However, the sustainability of pea production systems is increasingly threatened by the effects of climate change on pest dynamics. Insect pests represent a major constraint to crop productivity, and their behaviour, distribution, and life cycles are highly sensitive to climatic conditions. Temperature, precipitation, and atmospheric CO₂ levels directly influence pest development, survival, reproduction, and dispersal. As global temperatures rise, many pest species are experiencing accelerated life cycles, increased voltinism (number of generations per year), and expanded geographic ranges. These changes can lead to more frequent and severe pest outbreaks, ultimately compromising crop yields and food security.

HOW DOES TEMPERATURE INCREASE AFFECTS INSECT PESTS?



• Material and method

This study adopted a multidisciplinary approach combining field experimentation, climate data analysis, spatial mapping, and literature review to evaluate the effects of climate change on pea pest dynamics. The research was conducted over two consecutive growing seasons (2023–2025) across multiple agroecological zones, including temperate and semi-arid regions. These regions were selected to capture variability in climatic conditions, cropping systems, and pest pressures, thereby allowing for a comprehensive assessment of climate–pest interactions.

Field experiments were established in representative pea cultivation areas using a randomized block design. Each site included multiple plots with uniform agronomic practices to minimize variability unrelated to climatic factors. Standard pea varieties commonly grown in the region were used to ensure relevance to local farming systems. Agronomic practices such as planting dates, irrigation, and fertilization were recorded and standardized as much as possible.

• Results and discussions

The results of this research reveal significant relationships between climate variables and the dynamics of pea pest populations. One of the most prominent findings is the strong positive correlation between temperature increase and pest abundance. Warmer temperatures were associated with earlier onset of pest infestations, particularly for aphids. In several study sites, aphid populations began to increase two to four weeks earlier than historically observed, leading to prolonged periods of crop exposure to pest pressure.

The increase in temperature also contributed to higher reproductive rates and shorter generation times for key pest species. Aphids, for instance, exhibited rapid population growth under optimal temperature conditions, resulting in exponential increases in density within a short period. Similarly, the pea weevil showed improved overwintering survival rates, leading to higher initial populations at the beginning of the growing season.

Rainfall patterns also influenced pest dynamics, although the effects were more complex. Moderate rainfall supported plant growth and indirectly benefited pests by providing suitable host conditions. However, excessive rainfall was sometimes associated with reduced pest populations due to increased mortality and the proliferation of fungal pathogens. Conversely, prolonged dry conditions were linked to higher aphid populations, likely due to reduced natural enemy activity and lower incidence of diseases affecting pests.



• Conclusions

Looking ahead, future research should prioritize the development of robust predictive models that integrate climate projections with pest population dynamics. Such tools can support early warning systems and enable proactive decision-making. Furthermore, breeding programs should focus on developing climate-resilient and pest-tolerant pea varieties. Strengthening farmer knowledge through education, training, and extension services is equally important to ensure effective implementation of adaptive practices. Policymakers also have a critical role to play in facilitating the transition toward sustainable agriculture. This includes supporting research and innovation, providing financial incentives for sustainable practices, and promoting policies that encourage environmentally friendly pest management strategies.