Study Title\

Study on the Effectiveness of Fertilization with Harmal Plant in Killing or Inhibiting the Movement of Nematodes in Plants

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Abstract:

The research aimed to study the effectiveness of using Peganum harmala (Harmal) plant fertilization in killing or inhibiting the movement of nematodes in plants. Conducted in Al Buraimi Governorate, Oman, the study was prompted by observations of declining tree growth, yellowing leaves, and gradual plant death. The Globe Environmental Team collaborated with relevant authorities and the STEM team to investigate the issue and develop solutions.

Field visits were conducted, and soil properties at the study site were analyzed, including pH, color, conductivity, and salinity. A Harmal extract was prepared by drying the plant's leaves and applying it to nematode-infected plants. Two soil samples were studied: a control sample (untreated soil) and an experimental sample (soil treated with Harmal leaves). The team also collaborated with Sultan Qaboos University to analyze Harmal leaves using High-Performance Liquid Chromatography (HPLC) to identify chemical compounds and determine the optimal extract concentration for combating nematodes.

Key Findings:

Harmal extract demonstrated strong effectiveness against nematodes, particularly at higher concentrations.

Plants treated with Harmal extract showed improved growth compared to untreated plants.

Harmal's efficacy is attributed to natural compounds such as alkaloids (harmaline and harmine) and flavonoids (quercetin and kaempferol), which have anti-parasitic properties.

Recommendations:

Further research to understand the precise mechanism of Harmal's effectiveness against nematodes.

Testing Harmal's impact on a wider range of crops and soil types.

Evaluating the economic feasibility of using Harmal as a natural pesticide.

Producing and distributing natural Harmal extracts for sustainable agriculture.

Conducting additional studies to assess the extract's effects on other nematode species and under varying environmental conditions.

This study highlights the potential of Harmal as a natural alternative to chemical pesticides, contributing to sustainable and environmentally friendly agricultural pest control. If further validated, Harmal could reduce farmers' reliance on harmful chemicals, enhancing productivity and environmental health.

Research Questions:

What is the effectiveness of using Harmal in fertilizing plants infected with nematodes?

What are the appropriate concentrations of Harmal needed to achieve an anti−nematode effect?

Can commercial products be developed from Harmal to replace chemical fertilizers, and what challenges might this development face?

Research Plan:

1. **Identifying the Problem:** Through observing weak growth of newly planted trees, yellowing leaves, and gradual plant death.
2. **Selecting the Research Problem:** Defined through discussions with the GLOBE environmental team.
3. **Determining Study Tools:** GPS, soil catalog, pH meter, conductivity, and salinity meters to apply atmospheric and soil protocols.
4. **Formal Communication:** Contacting the Ministry of Agriculture and Sultan Qaboos University to present the project idea and collaborate on finding solutions and analyzing samples.
5. **Conducting Meetings:** With agricultural specialists from the Ministry of Agriculture and Sultan Qaboos University to discuss proposed solutions and how to reduce the problem.
6. **Determining Study Locations Using GPS.**
7. **Applying Protocols:** Soil and atmospheric protocols and entering data into the GLOBE website.
8. **Collecting, Analyzing, and Converting Data into Charts.**
9. **Extracting, Interpreting, and Comparing Results with Other Research and Writing Recommendations.**

Study Location:

- (Sultanate of Oman, Al Buraimi Governorate), Ard Jaw area (Latitude 24.24696), (Longitude 55.82804), (Elevation 313 m). Soil and vegetation cover protocols were applied.

Conclusion:

In this research, we aimed to demonstrate the effectiveness of Peganum harmala (Harmal) plant fertilization in killing or inhibiting nematodes in plants. By applying GLOBE environmental protocols and conducting field visits, we reached the following conclusions:

Harmal's Anti-Nematode Properties: Harmal contains effective compounds with anti-nematode properties, making it a natural and safe alternative to chemical pesticides for controlling nematodes.

Need for Further Research: Additional studies are required to determine the optimal concentrations and most effective application methods for Harmal extracts.

Recommendations:

- Utilize Harmal as a natural pesticide for nematodes.
- Develop efficient, low-cost methods for extracting active compounds from Harmal.
- Source healthy seedlings from reliable providers and space them properly to prevent infection spread, while minimizing environmental and agricultural stressors.
- Educate farmers on the benefits and proper use of Harmal as a natural and safe alternative.

Broader Impact:

- We recommend sharing this research with the international community and presenting the findings and recommendations to relevant authorities to actively address agricultural pest issues. The research highlights the potential of locally available plants like Harmal to solve environmental problems and contributes to developing strategies for sustainable agricultural practices. If adopted, these recommendations could significantly reduce reliance on chemical pesticides and promote environmentally friendly solutions, particularly in the Gulf region

Strengths of the Research:

Provides a sustainable solution using locally available resources.

Enhances knowledge, skills, and research strategies for addressing environmental challenges.

Offers practical recommendations for farmers and policymakers to improve agricultural practices.

This research is a valuable step toward solving agricultural pest problems in an eco-friendly manner, with potential for broader application if supported by officials and stakeholders.

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