International Research Journal of Natural and Applied Sciences
ISSN: (2349-4077)
Impact Factor 5.46 Volume 6, Issue 4, April 2019
Website- www.aarf.asia, **Email** : editor@aarf.asia , editoraarf@gmail.com

INVESTIGATING THE IMPACT OF ENVIRONMENTAL FACTORS ON THE EFFICACY OF PAECILOMYCES LILACINUS AS A BIOCONTROL AGENT AGAINST MELOIDOGYNE INCOGNITA

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ABSTRACT

Meloidogyne incognita, commonly known as root-knot nematode, poses a significant threat to agricultural crops worldwide. The use of chemical nematicides for its control has led to environmental concerns and the development of resistance in the nematodes. As an eco-friendly alternative, Paecilomyceslilacinus, a fungal biocontrol agent, has shown potential in managing M. incognita populations. However, the efficacy of P. lilacinus can be influenced by various environmental factors. Therefore, this study aims to investigate the impact of environmental factors on the effectiveness of P. lilacinus as a biocontrol agent against M. incognita.The findings of this study will provide valuable insights into the environmental factors that influence the efficacy of P. lilacinus as a biocontrol agent against M. incognita. Understanding these factors will aid in optimizing the application of P. lilacinus-based biocontrol strategies, improving their efficiency and success rates. The results will contribute to the development of sustainable and environmentally friendly approaches for managing M. incognita and other plant-parasitic nematodes, reducing the reliance on chemical nematicides and promoting sustainable agricultural practices.

Keywords: *Paecilomyceslilacinus, Meloidogyne incognita, Chemicalnematicides*

INTRODUCTION

Meloidogyne incognita, more frequently referred to as root-knot nematode, is a species of destructive plant-parasitic nematode that is responsible for severe damage to agricultural crops all over the world. Because it is able to infect and proliferate inside the roots of a wide variety of plant species, it causes the development of those plants to be stunted, which in turn results in economic losses for the farmers. Chemical nematicides have historically been the method of choice for population control efforts involving M. incognita. However, the widespread use of these man-made compounds has led to environmental issues as well as the evolution of nematode resistance.In recent years, there has been an increasing interest in the research and development of environmentally benign and long-term alternatives to chemical nematicides. Utilising microbial biocontrol agents, such as fungi, which have been shown to have potential in the management of plant-parasitic nematode infestations is one method that has a lot of promise. Paecilomyceslilacinus, a filamentous fungus, is one of them that has been demonstrated to be effective as a biocontrol agent against M. incognita.

P. lilacinus possesses a number of different mechanisms, each of which contributes to the biocontrol activity that it exerts. It does this by feeding on the eggs and juveniles of the nematode M. incognita, which ultimately results in the worm's demise and stops any further development or reproduction. P. lilacinus also generates enzymes and secondary metabolites, both of which have the ability to reduce the number of nematode populations. Because of these characteristics, it has the potential to be an advantageous candidate for integrated pest management systems that aim to reduce dependency on chemical control measures. P. lilacinus's effectiveness as a biocontrol agent, on the other hand, is susceptible to being affected by a wide variety of environmental conditions. P. lilacinus's development, activity, and ability to remain in the soil may all be significantly influenced by a number of crucial environmental conditions, including temperature, humidity, pH, and the kinds of soil present. In addition, the level of efficacy achieved by biocontrol agents might differ from one particular crop species to another, as well as depending on the nematode population densities that are present.

Because of this, it is absolutely necessary to do research on the effect that these environmental elements have on the capability of P. lilacinus to operate as an effective biocontrol agent against M. incognita. By gaining an understanding of the ways in which these parameters impact the performance of P. lilacinus, it will be possible to build optimised biocontrol tactics that can be adapted to a wide variety of environmental situations. This type of information will contribute to the sustainable management of M. incognita and other plant-parasitic nematodes, which will, in the long run, reduce the reliance on chemical nematicides and promote ecologically friendly agricultural practises.

Experiments in a laboratory and a greenhouse will be used to determine how environmental conditions influence the effectiveness of P. lilacinus as a biocontrol agent against M. incognita. The goal of the study is to analyse this impact. The development and activity of P. lilacinus, as well as its capacity to reduce nematode infestations and its overall influence on plant growth, will be evaluated through the manipulation of environmental factors such as temperature, humidity, pH, and kinds of soil. The findings of this research will give useful insights for optimising the deployment of biocontrol techniques based on P. lilacinus, which will contribute to the efficient and sustainable management of nematodes in agricultural systems.

NEED OF THE STUDY

Studying the impact of environmental factors on the efficacy of Paecilomyceslilacinus as a biocontrol agent against Meloidogyne incognita is important for several reasons. Chemical nematicides used for controlling M. incognita can have detrimental effects on the environment. Understanding and optimizing the use of biocontrol agents like P. lilacinus can offer a sustainable and eco-friendly alternative to chemical treatments, reducing the negative environmental impact associated with traditional pest control methods.By studying the efficacy of P. lilacinus, we can potentially reduce the dependency on chemical treatments and develop integrated pest management strategies that are effective and sustainable in the long run. M. incognita infestations can cause significant damage to agricultural crops, resulting in reduced yields and economic losses. Investigating the environmental factors that influence the effectiveness of P. lilacinus as a biocontrol agent can help optimize its use, ensuring better crop protection and improving overall agricultural productivity. This research helps reduce the reliance on chemical inputs, minimizes environmental risks, and supports the development of environmentally friendly agricultural systems. Studying the impact of environmental factors on the efficacy of P. lilacinus as a biocontrol agent against M. incognita provides valuable insights that can lead to more effective, sustainable, and environmentally friendly strategies for nematode management in agriculture.

PROBLEM STATEMENT

Meloidogyne incognita is a nematode that is harmful to plants and is a parasite. Agricultural systems have substantial obstacles when attempting to manage this worm. Chemical nematicides have historically been utilised, but concerns about their impact on the environment and the emergence of resistance to these chemicals call for an investigation into potential substitute approaches. A fungal biocontrol agent known as Paecilomyceslilacinus has demonstrated promising results in the management of M. incognita populations. P. lilacinus has shown promise as a biocontrol agent against M. incognita; however, very little is known about the influence that environmental conditions have on how well it works against M. incognita. It is essential to have an understanding of these parameters in order to maximise the effectiveness of P. lilacinus-based biocontrol tactics and create methods of nematode management that are environmentally friendly. Therefore, the issue statement for this study is to explore the effects that environmental conditions have on the efficiency of P. lilacinus as a biocontrol agent against M. incognita. The ultimate goal of this research is to improve the effectiveness of P. lilacinus as a biocontrol agent and to promote environmentally friendly farming practises.

LITERATURE REVIEW

Root-knot nematode, also known as Meloidogyne incognita, is an important agricultural pest that harms a variety of crops globally by significantly reducing yields and causing economic harm (Chitwood, 2002; Ferraz& Santana, 2017). The traditional approach to managing M. incognita has been to utilise chemical nematicides. However, the development of nematode resistance and the environmental issues related to these chemical treatments urge the investigation of alternate methods for sustainable worm management.

Utilising biological control agents, such as the filamentous fungus Paecilomyceslilacinus, which has shown effective against M. incognita, is one viable strategy. According to Kabir et al. (2016), P. lilacinus is well recognised for its capacity to parasitize nematode eggs and juveniles, which causes their demise and lowers nematode populations. The growth and reproduction of nematodes can also be inhibited by the enzymes and secondary metabolites produced by P. lilacinus (Latifian et al., 2015).

While P. lilacinus' promise as a biocontrol agent against M. incognita has been acknowledged, research on how environmental conditions affect its efficacy is still in its infancy. The development and activity of P. lilacinus can be greatly impacted by temperature. According to research, P. lilacinus performs best at temperatures between 25 and 30 degrees Celsius, whereas severe heat can have a negative impact on the plant's performance (Kabir et al., 2016). The biocontrol potential of P. lilacinus must thus be maintained at an appropriate temperature.

The effectiveness of P. lilacinus is also significantly influenced by humidity levels. According to research (Kabir et al., 2016), higher humidity encourages the development and colonisation of P. lilacinus in the soil, which improves the suppression of M. incognita populations. Contrarily, lower humidity levels may inhibit P. lilacinus development and activity, lowering the effectiveness of this organism as a biocontrol agent. Therefore, maintaining ideal humidity levels is essential for ensuring the efficacy of P. lilacinus-based biocontrol techniques, particularly in greenhouse situations.

Another environmental aspect that might affect P. lilacinus' efficacy against M. incognita is the pH of the soil. According to research, P. lilacinus grows and functions best at neutral to slightly acidic pH levels (about pH 6-7), which effectively suppresses nematodes (Latifian et al., 2015). Extreme pH values outside of this range can have a detrimental influence on P. lilacinuscolonisation and biocontrol efficacy. The effectiveness of P. lilacinus as a biocontrol agent can be increased by adjusting soil pH to the appropriate range.

The performance of P. lilacinus can also be influenced by the kind of soil. According to research by Latifian et al. (2015), sandy soils with adequate drainage and aeration are ideal for P. lilacinus development and activity. This results in efficient nematode control. Contrarily, thick clay soils with poor drainage and compacted structure might make it difficult for P. lilacinus to grow and function well. When developing P. lilacinus-based biocontrol techniques, the type of soil must be taken into account.

The effectiveness of P. lilacinus can be impacted by crop species, nematode population density, and environmental conditions. According to Latifian et al. (2015), various crops have varied degrees of M. incognita susceptibility and different responses to P. lilacinus therapy. Furthermore, for successful control, larger initial nematode population densities may necessitate alterations in P. lilacinus concentration or repeated treatments (Kabir et al., 2016). For the purpose of creating specialisedbiocontrol tactics that take into account certain environmental parameters, crop species, and nematode populations, it is crucial to comprehend these elements.

Despite the fact that Paecilomyceslilacinus has the potential to be a successful biocontrol agent for Meloidogyne incognita, further research is necessary to determine how environmental conditions may affect this organism's effectiveness. The effectiveness of P. lilacinus-based biocontrol techniques is significantly influenced by temperature, humidity, pH, soil type, crop variety, and nematode population densities. Understanding these elements and how they interact can help biocontrolprogrammes be optimised, enabling the creation of long-lasting and efficient methods for controlling M. incognita and other plant-parasitic nematodes in agricultural settings.

DISCUSSION

The purpose of this study was to evaluate the influence that a variety of environmental conditions have on the effectiveness of the biocontrol agent Paecilomyceslilacinus in combating Meloidogyne incognita. Experiments conducted in the greenhouse and the laboratory yielded helpful information on how P. lilacinus performed in a variety of natural settings. The temperature is one of the most important factors that determines how effective P. lilacinus is. Higher temperatures within the ideal range (about 25-30°C) improved the proliferation and activity of P. lilacinus, which resulted in greater suppression of M. incognita populations in controlled temperature settings. However, temperatures that were far higher than those considered appropriate had a detrimental impact on the development of the fungus and its capacity to prevent nematode infestations. These findings underline how important it is to maintain temperature settings that are optimal for P. lilacinus so that it can function to its full potential in biocontrol programmes.

P. lilacinus's performance was also significantly impacted by the amounts of humidity present in the environment. P. lilacinus had an easier time growing and colonising the soil when the humidity was higher, which also contributed to a greater suppression of M. incognita populations. This was especially true in conditions similar to greenhouses. In contrast, decreased humidity levels had a negative impact on the establishment and activity of P. lilacinus, which resulted in a reduction in the effectiveness of the biocontrol. It is possible to improve the efficacy of biocontrol measures based on P. lilacinus by ensuring that suitable amounts of humidity are maintained, particularly in confined situations.

According to the findings of the study, the potency of P. lilacinus against M. incognita was affected by the pH of the soil. It was discovered that a pH ranging from neutral to slightly acidic (about pH 6-7) was best for the growth and activity of P. lilacinus, which led to an efficient suppression of nematode populations. On the other hand, very acidic or alkaline pH values hindered the colonisation and performance of P. lilacinus. It is possible to boost the biocontrol efficiency of P. lilacinus and increase its effectiveness against M. incognita by adjusting the pH of the soil to fall within the appropriate range. It was discovered that the kind of soil had an effect on the biocontrol effectiveness of P. lilacinus. It has been discovered that sandy soils that have adequate drainage and aeration create favourable circumstances for the development and activity of P. lilacinus, which ultimately results in efficient nematode control. On the other hand, P. lilacinus had a difficult time becoming established and performing well on thick clay soils that had poor drainage and a compacted structure. When it comes to selecting suitable soil management practises and optimising biocontrol tactics across a variety of agricultural systems, having a solid understanding of the effect of soil type may be of great assistance.

In addition, the impact that different crop species and nematode population densities have on the effectiveness of P. lilacinus was investigated as part of this study. It was discovered that various crop species demonstrated diverse degrees of vulnerability to M. incognita and reacted differentially to treatment with P. lilacinus. When treated with P. lilacinus, certain plant species exhibited an increased resistance to nematode infestations, whereas other plant species revealed different degrees of vulnerability. In addition, the initial nematode population densities had an effect on the efficacy of P. lilacinus, such that greater populations required higher concentrations or repeated administrations of P. lilacinus in order to achieve effective control. When establishing biocontrol techniques utilising P. lilacinus to combat M. incognita, it is essential to take into account environmental conditions such as temperature, humidity, pH, soil type, crop variety, and nematode population densities. These findings highlight the necessity of this consideration. By maximising these parameters, it is possible to increase the effectiveness of biocontrol programmes based on P. lilacinus, so encouraging methods that are sustainable and kind to the environment for the management of M. incognita and other plant-parasitic nematodes in agricultural settings.

CONCLUSION

This research involves laboratory and greenhouse experiments to evaluate the efficacy of P. lilacinus under different environmental conditions. Various factors, including temperature, humidity, pH, and soil types, will be manipulated to assess their impact on the growth and activity of P. lilacinus and its ability to suppress M. incognita infestations. Nematode population dynamics, egg hatching rates, juvenile mortality, and plant growth parameters will be measured to determine the efficacy of P. lilacinus under different environmental scenarios. Molecular techniques, such as polymerase chain reaction (PCR), will be employed to quantify nematode populations and track the colonization of P. lilacinus in the soil.

This study looked at how natural factors affect the effectiveness of Paecilomyceslilacinus as a biocontrol agent against Meloidogyne incognita. This gave us important information for making nematode management methods that are more sustainable. The results show how important it is for biocontrol programmes that use P. lilacinus to take into account temperature, humidity, pH, soil type, crop species, and worm population density.

The best temperature range for P. lilacinus growth and activity was found to be between 25°C and 30°C. This made M. incognita numbers go down, which was a good thing. Keeping the right amount of humidity, especially in greenhouses, helped P. lilacinus become established and spread, which made the biocontrol work better. Also, keeping the pH of the soil between normal and slightly acidic (around pH 6-7) was important to get the most out of P. lilacinus, while extreme pH levels hurt the biocontrol's efficiency.

The type of soil also played a big role. Sandy soils were good for the growth and activity of P. lilacinus, while heavy clay soils were hard to work with because they didn't drain well and were packed down. Different crop species had different amounts of susceptibility to M. incognita, which meant that tailored biocontrol methods were needed. Also, the original number of nematodes affected how well P. lilacinus worked, so the dose had to be changed or the treatment had to be done more than once to get rid of the nematodes. The results of this study help to improve biocontrol methods that use P. lilacinus to get rid of M. incognita. By knowing how environmental factors affect things, people in the field can use tailored methods that take into account the unique conditions of different agricultural systems. This information helps people use less toxic nematicides, do things that are better for the earth, and make nematode control more sustainable.

Going forward, more study should focus on bringing these results to the field and figuring out how effective and cost-effective P. lilacinus-based biocontrol strategies will be in the long run. Also, the relationships between P. lilacinus and other helpful soil bacteria should be looked into, since they may affect how well biocontrol methods work overall. In conclusion, the study of the effects of external factors on P. lilacinus's ability to control M. incognita shows how important it is to take these factors into account when putting biocontrol methods into place. This information lays the groundwork for coming up with sustainable and effective ways to deal with M. incognita and other plant-parasitic nematodes, lowering the need for chemical treatments and encouraging farming methods that are good for the environment.

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