Research Title : Soil Properties Affecting Grasshopper Egg Hatching Rate

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Abstract

This study aims to analyze the soil properties that affect the hatching rate of Patanga succincta (locust) eggs, considering key factors such as soil type (sandy soil, loamy soil, clay soil, and sandy loam), pH, and soil salinity (EC). The experiment was conducted by burying locust eggs in different soil types and measuring the hatching rate under controlled conditions of these factors.The results revealed that soil type significantly influenced the hatching rate of the locust eggs. Loamy soil and sandy loam provided the highest hatching rate at 92%, with loamy soil having a pH of 6.8 and sandy loam a pH of 6.4, both within the optimal range (6.4-6.8). Additionally, both soils had high porosity (50-55%), allowing for proper water and air drainage, which helped supply the eggs with sufficient oxygen for development. Sandy soil, with a pH of 6.2, showed a hatching rate of 63%, but despite good aeration, the pH was below the optimal range, reducing egg development. Clay soil, with a pH of 5.8, had the lowest hatching rate at 54% due to its high density and poor aeration, which reduced oxygen levels in the soil and delayed the hatching process.In addition to pH, soil salinity (EC) also played an important role in the hatching rate. It was found that soil with a salinity lower than 2.5 μS/cm showed the highest hatching rate, while clay soil, with a salinity of 3.5 μS/cm, had a reduced hatching rate of 54%.From the experimental results, it can be concluded that loamy soil and sandy loam are the most suitable soil types for the hatching of Patanga succincta eggs due to their balanced pH and low salinity, which are not harmful to egg development. These findings can be applied in selecting appropriate soil conditions to enhance hatching rates, both in agricultural breeding and in the conservation of locust populations in the wild.

Introduction

Soil is a critical factor influencing the hatching rate of Patanga succincta (Patanga locust) eggs, as locusts exhibit egg-laying behavior in soil. The physical and chemical properties of soil play a significant role in the development and hatching of these eggs. Studying the soil properties that affect the hatching rate of locust eggs can improve breeding methods and enhance the efficiency of locust production.

Key factors influencing the hatching rate of locust eggs include temperature, moisture, soil porosity, and chemical composition, such as pH levels and nutrient content. Investigating the relationship between soil properties and the hatching rate of locust eggs will help identify optimal soil conditions for egg-laying and lead to the development of more efficient egg-hatching systems.

Additionally, Patanga succincta is a promising alternative protein source with high nutritional value, gaining global popularity as 16.9% of global insect consumption consists of locusts. Sustainable production of locusts can be achieved by optimizing egg-hatching efficiency through controlled environmental factors. This approach supports commercial insect production and reduces the environmental impact of traditional protein production methods.

Objectives

1. To study the soil properties affecting the hatching rate of Patanga succincta eggs.
2. To analyze factors influencing the development and hatching of locust eggs.
3. To test and compare the hatching rates of locust eggs in different soil types.

Research questions

- How do soil properties affect the hatching rate of Patanga succincta eggs?

Hypothesis

- Soil with an optimal structure can increase the hatching rate of Patanga succincta eggs compared to soil with less favorable conditions.

Methodology

This study on soil properties and soil quality analysis beneficial for the hatching of Locusta migratoria eggs involves a review of relevant literature and research. Consequently, the experiment has been designed as follows:

3.1 Part 1 Comparative Study of Soil Properties Affecting the Hatching Rate of Locust Eggs

Measuring Devices

1. Soil Test Kit: Model HI3896, used for testing pH and NPK nutrient levels in the soil.
2. Soil Moisture Meter: Model DM-15 by TAKEMURA, used for measuring soil moisture content.

Experimental Method

1. Soil Property Data Collection: Selection of four soil types for Locusta migratoria incubation—sandy soil, loamy soil, clay soil, and sandy loam soil.

   - Soil Moisture Measurement: The DM-15 soil moisture meter is used to determine the moisture content of each soil type.
   - Soil pH and Nutrient Measurement: The HI3896 soil test kit is used to measure the pH and the levels of essential nutrients (NPK) in each soil sample.

2. Data Analysis: The collected data is analyzed to determine the correlation between soil properties and the hatching rate of Locusta migratoria eggs.

3. Data Storage and Utilization: The recorded data is stored in a database for future reference and published via the GLOBE system https://www.globe.gov/globe-data/data-entry.

4. The results of this study will contribute to improving locust farming techniques in agriculture and conservation by selecting soil with the most suitable properties for egg incubation. This aims to enhance the hatching success rate.

3.2 Part 2 Determining the Efficiency of Locusta migratoria Egg Hatching

1. **Locust Egg Incubation in Different Soil Types**

    - Experiments are conducted to incubate locust eggs in four soil types: sandy soil, loamy soil, clay soil, and sandy loam soil.
    - Each soil type is carefully prepared and managed to ensure uniform experimental conditions.

2. **Data Collection**

    - The incubation period of eggs in each soil type is monitored and recorded.
    - The number of successfully hatched eggs and unhatched eggs is counted to calculate the hatching rate for each soil type.

3. **Data Analysis**

    - The collected data is analyzed to assess the correlation between soil properties and hatching efficiency.
    - This analysis helps identify the most suitable soil type for Locusta migratoria egg incubation by evaluating both the incubation period and the successful hatching rate.

4. **Application of Experimental Results**

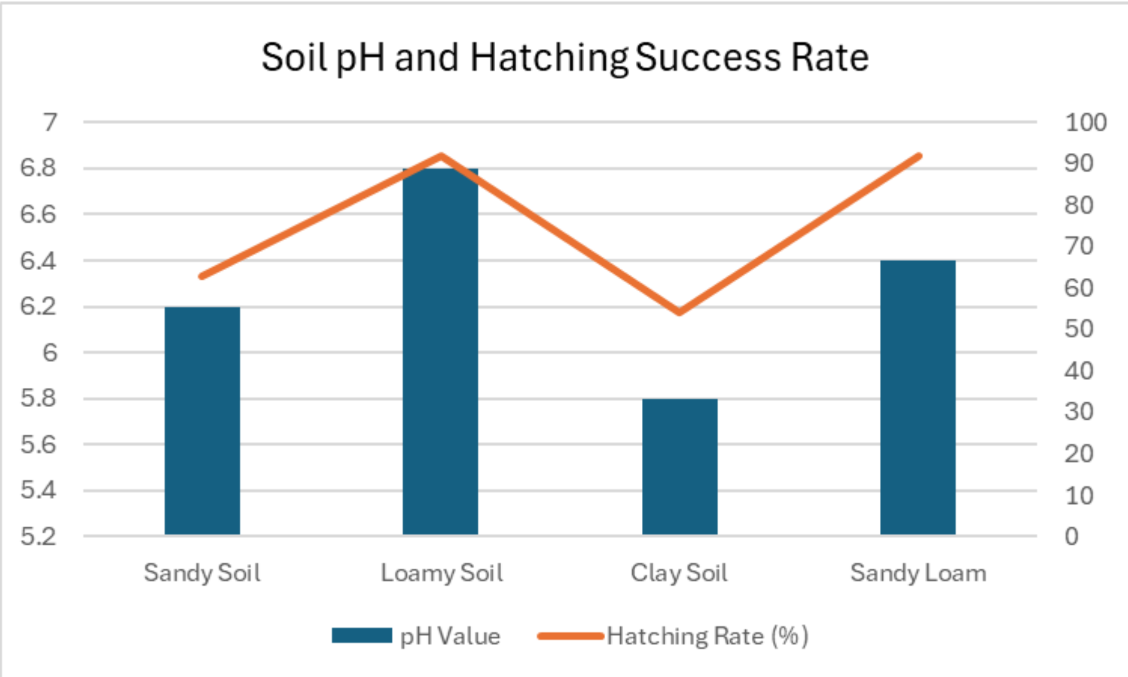
    - The findings of this study will contribute to optimizing locust farming conditions, benefiting both agricultural breeding and conservation efforts.
    - The data can be used to select the most suitable soil for egg incubation, thereby increasing hatching success and improving locust farming efficiency.

Results

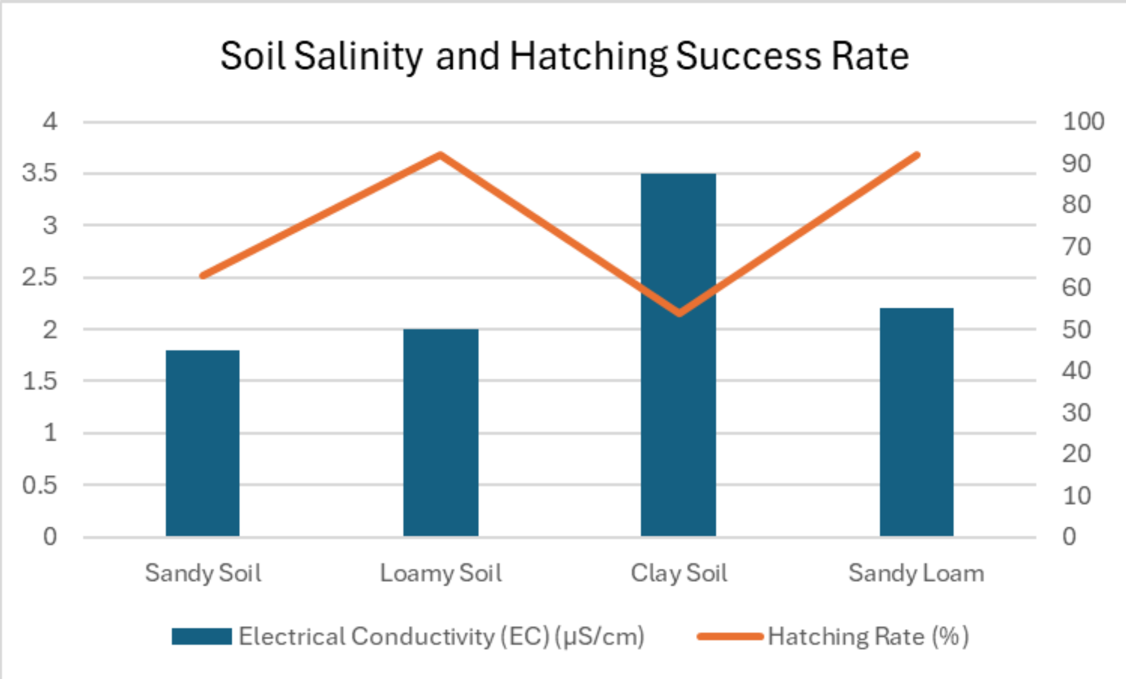
4.1Part 1 A comparative Study of Soil Properties Affecting the Hatching Rate of Patanga succincta Eggs

In this study, soil samples were randomly collected to represent four types of soil: sandy soil, loamy soil, clay soil, and sandy loam. The primary objective was to analyze how different soil properties affect the hatching rate of Patanga succincta (Patanga grasshopper) eggs. The key soil properties measured included pH, moisture content, and salinity.

The data obtained from soil property measurements revealed significant differences among the soil types at different sampling sites. The moisture content, pH, and salinity of each soil type were recorded and analyzed to determine their impact on the hatching rate of Patanga succincta eggs.



Analysis showed that soil pH significantly affects the hatching rate of Patanga succincta eggs. The highest hatching rates were observed in soils with a pH range of 6.0 to 7.0. Loamy soil and sandy loam had the highest hatching rates, whereas soils with excessively high or low pH levels exhibited lower hatching rates. This may be due to the adverse effects of unsuitable pH levels on egg development.



Soil salinity (electrical conductivity, EC) is another important factor affecting the hatching rate. The highest hatching rates were observed in soils with low salinity (below 2.5 µs/cm). In contrast, soils with salinity levels above 3.5 µs/cm exhibited lower hatching rates. Notably, clay soil and sandy loam, which had moderate salinity levels, resulted in relatively high hatching rates.

4.2 Part 2 Efficiency of Patanga succincta Egg Hatching

This study involved an experimental incubation of Patanga succincta eggs using four soil types: sandy soil, loamy soil, clay soil, and sandy loam. High-quality eggs were selected for the experiment, and they were buried in each soil type under controlled environmental conditions, including optimal temperature, humidity, and light exposure for hatching.

The experiment aimed to examine the relationship between soil properties, such as pH and salinity, and the hatching rate of Patanga succincta eggs. Data on hatching rates and the duration required for hatching in each soil type were recorded.

The results showed that loamy soil and sandy loam had the highest hatching rates, with eggs hatching in approximately 11.67 ± 1.37 days and a hatching rate of 92%. In contrast, clay soil and sandy soil exhibited lower hatching rates. The dense texture and poor aeration of clay soil delayed egg development, resulting in a hatching rate of 54%, while sandy soil had a hatching rate of 63%.

Data analysis further confirmed that soil pH affects egg development. Soils with a pH range of 6.0 to 7.0 supported the highest hatching rates, with pH 6.5-7.0 yielding hatching rates of up to 85%. Soils with pH below 5.5 or above 7.5 exhibited reduced hatching rates, averaging around 54%.

Regarding salinity, soils with an electrical conductivity (EC) below 2.5 µs/cm were found to be optimal for hatching. Soils with 1.5-2.0 µs/cm salinity levels had hatching rates of 80-90%, whereas soils with salinity levels above 3.0 µs/cm showed significantly lower hatching rates of around 50-55%.

Summary and Discussion

The comparison of soil types suitable for hatching Patanga succincta (Patanga locust) eggs found that loamy soil and sandy loam soil had the highest hatching rate. The eggs hatched within approximately 11.67±1.37 days, with a hatching rate of 92%, which was higher than other soil types. In this experiment, loamy soil and sandy loam soil provided an optimal environment for egg development due to their aeration properties, which allowed for efficient oxygen circulation within the soil. Regarding pH levels, the most suitable pH range for hatching Patanga succincta eggs was found to be 6.5–7.0, with the highest hatching rate of around 92%. In contrast, soil with a pH lower than 5.5 or higher than 7.5 resulted in a significantly lower hatching rate. This is because unsuitable pH levels may negatively affect egg development and growth. In terms of soil salinity, salinity directly influenced the hatching rate. Soil with a salinity level below 2.5 µs/cm had the highest hatching rate of 90-92%, making it the most suitable for egg incubation. When salinity increased to 3.0 µs/cm, the hatching rate dropped to 75-80%, and at 3.5 µs/cm, it further declined to 60-65%. This indicates that soil salinity significantly impacts egg development and hatching success.

This study provides valuable insights into selecting suitable soil types to improve the hatching rate of Patanga succincta eggs for agricultural purposes and conservation efforts. By choosing soil with appropriate pH and salinity levels, the success rate of egg incubation can be significantly enhanced.

Discuss the results of the experiment

The data collected from the experiment on soil properties affecting the hatching of Patanga succincta eggs clearly demonstrate the relationship between pH, salinity (EC), and hatching rate. It was found that soil with a pH range of 6.5–7.0 was the most suitable for hatching Patanga succincta eggs, with the highest hatching rate of 92%, which is beneficial for embryo development. Regarding salinity (EC), soil with a salinity level below 2.5 µs/cm resulted in the best hatching success. In contrast, when salinity increased to 3.0 µs/cm or higher, the hatching rate significantly decreased, indicating that salinity directly affects egg development and hatching. Additionally, well-aerated soil types, such as loamy soil and sandy loam soil, contributed to a high hatching success rate. These soil types effectively retain moisture and provide proper oxygen circulation, which is essential for egg and embryo development. This study highlights that selecting soil with suitable properties, such as optimal pH, low salinity, and good aeration, is a crucial factor in increasing the hatching rate of Patanga succincta eggs. These findings can be applied to breeding and conservation efforts for agricultural purposes efficiently.

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Media Release Form

NASA Media Release Form for Parent or Guardian of Minor

Event name or description (reason for text, photographs, and/or video-recordings):

Soil Properties Affecting Grasshopper Egg Hatching Rate Ivss project

Event date(s):

05/03/2025

I, the undersigned, am the parent or legal guardian or legal representative of the child named below, and I do hereby give permission for this minor child (hereinafter "Minor") to be interviewed, photographed, and/or video-recorded by NASA or its representatives in connection with a NASA production.

I understand and agree that the text, photographs, and/or video-recordings thereof containing the Minor's name, image, and voice, including transcripts thereof, may be used in the production of instructional and promotional materials produced by or on behalf of NASA and for other purposes that NASA deems appropriate, and that such materials may be distributed to the public and displayed publicly one or more times and in different formats, including but not limited to websites, cablecasting, broadcasting, and other forms of transmission to the public. I also understand that my permission to use the text, photographs, video-recordings, or name in such material is for an unlimited duration and that neither I nor the Minor will receive any compensation for granting this permission.

I acknowledge that NASA has no obligation to use the Minor's name, image, or voice in the materials it produces, but if NASA so decides to use them, I acknowledge that it may edit such materials. I hereby waive the right to inspect or approve any such use, either in advance or following distribution or display.

I hereby unconditionally release NASA and its representatives from any and all claims and domains arising out of the activities authorized under the terms of this agreement.

By signing below, I represent that I am at least 18 years of age and am the parent / legal guardian / legal representative of the Minor named below. I have read the foregoing agreement and am familiar with all the terms and conditions thereof, and I consent to the execution by the Minor. I agree that neither I nor the Minor will revoke or disaffirm this agreement at any time.

NASA Media Release Form for Parent or Guardian of Minor
(continued)

Name of Minor (First and Last):

Mr. Krittanai Riancharoen

Name of Parent / Legal Guardian / Legal Representative of Minor (First and Last):

Mrs. Yupaporn Riancharoen

Signature of Parent / Legal Guardian / Legal Representative of Minor:

By signing your name below, you agree that you have read the foregoing and fully understand its contents.

ยุภาพร

Relationship to Minor: Mother

Today's Date: 5/03/25

Contact information for Parent / Legal Guardian / Legal Representative of Minor:

Address: 77 kalasin yangtalad kao pranon

Telephone: 087-958-0395

Email Address: autokufocus19@gmail.com

NASA Media Release Form for Parent or Guardian of Minor
(continued)

Name of Minor (First and Last):

Mr. Aitthimon Bandasak

Name of Parent / Legal Guardian / Legal Representative of Minor (First and Last):

Mr. saytong Bandasak

Signature of Parent / Legal Guardian / Legal Representative of Minor:

By signing your name below, you agree that you have read the foregoing and fully understand its contents.

ສາຍທອງ

Relationship to Minor: father

Today's Date: 05/03 / 2025

Contact information for Parent / Legal Guardian / Legal Representative of Minor:

Address: 18/15 Song Poy Subdistrict, Na Mon District, kalasin province, Thailand

Telephone: 097 2813263

Email Address: Taibanbs5@gmail.com

NASA Media Release Form for Parent or Guardian of Minor
(continued)

Name of Minor (First and Last):

Mr. Natpawin Suntornpakdee

Name of Parent / Legal Guardian / Legal Representative of Minor (First and Last):

Mrs. Natchasorn Suntornpakdee

Signature of Parent / Legal Guardian / Legal Representative of Minor:

By signing your name below, you agree that you have read the foregoing and fully understand its contents.

ณัฐชสรณ์

Relationship to Minor: Mother

Today's Date: 23/04/2008

Contact information for Parent / Legal Guardian / Legal Representative of Minor:

Address: 175/4 Pontong Subdistrict Ban Nong Bua Kalasin Province Thailand

Telephone: 0824791535

Email Address: nutpawin.tonkar@gmail.com

NASA Media Release Form for Parent or Guardian of Minor
(continued)

Name of Minor (First and Last):
Mr. Thanphisit Krasaewath

Name of Parent / Legal Guardian / Legal Representative of Minor (First and Last):
Mrs. Chompunut Saenjaiwat

Signature of Parent / Legal Guardian / Legal Representative of Minor:
By signing your name below, you agree that you have read the foregoing and fully understand its contents.

[signature]

Relationship to Minor: Mother

Today's Date: 05/03/2025

Contact information for Parent / Legal Guardian / Legal Representative of Minor:

Address: 249/7 Bueng wichai Subdistrict Mueang District Kalasin Province, Thailand

Telephone: 0966404538

Email Address: