Maison Bint Ahmed School for Basic Education(12-5)

Research title:

Parthenium effect on soil properties & its impact on environmental & climatic changes in Dhofar

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(2021 - 2022)

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Abstract:

Many countries of the world suffer from the problem of invasive plants, which are harmful and poisonous, ravaging and controlling ecosystems, thus causing a massive loss of biodiversity and exacerbate environmental and climatic problems, and negatively affect health and the economy.

There are many types of these plants, including the *parthenium*, which infiltrated Dhofar Governorate, and spread rapidly during the past ten years, despite governmental and civil efforts to extract the plant from its roots, the local plants did not grow again in the affected areas.

This field study aims to know the impact of the *parthenium* on soil properties and how its spread contributes to environmental and climatic changes, and these properties include: surface temperature and at different soil depths, conductivity, salinity, acidity, and moisture.

A time plan was set for the implementation of the study, by choosing the study site, which is Jebel Shihit, two adjacent sites were selected, one infested with Parthenium and the other not infested, and the measurements were repeated at each site three times, and then the results and data were collected and discussed within the team.

After applying the protocols and comparing the results between the two sites, the team found that some properties of the soil in the infested area differ significantly from the non-infested area, the results showed a decrease in salinity, conductivity and humidity and an increase in soil acidity within the infested area, as well as the difference in the appearance of the soil and the extent of its cohesion between the two areas. The results showed that the soil change prevented the native plants from growing again, which led to an increase in the temperature in the infested site and thus contributing to climate change in the area.

Key Words:

Parthenium: a type of flowering plant in the plant family Asteraceae. Native to the American tropics, this plant contains the toxic substance parthenin, which causes allergies and irritates the respiratory system and skin.

Soil moisture: the percentage of water in the soil.

Soil acidity: The pH of a soil solution.

Soil conductivity: A measure of a material's ability to absorb electrical charge transfer and used as a measure of soil salinity.

Surface Temperature: The radiant heat of the Earth's surface, including the heat of bare grass or soil.

Research questions:

1- What is the effect of the parthenium plant on soil properties?

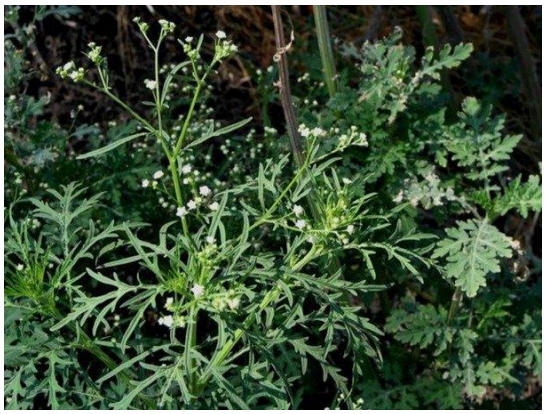
2- What are the effects of the parthenium plant on environmental and climate change?

Introduction:

Invasive plants are plants that have been intentionally or accidentally introduced into an environment and spread in an undesirable way.

Several studies have proven that plant invasive species in general affect ecosystems and biodiversity and change soil properties such as moisture and temperature (Tafese Bezuneh, 2015), acidity rate, and organic matter in the soil, and this leads to preparing the soil to be suitable only for the invasive type. Which leads to the mass extinction of all the weeds that are endemic to the place targeted by the invasion, as they spread widely on the shoulders of roads due to the attachment of their seeds to cars (Ansong and Pickering, 2013), thus eliminating biodiversity and the ecosystem.

During the past ten years, the mountainous strip in the Dhofar Governorate was exposed to the invasion of the parthenium plant, which is believed to have infiltrated the region's lands through imported fodder, as its seeds found a suitable environment for growth, and as a result of the abundance of seed production for this plant, it covered large areas of areas, especially on the shoulders of roads. The heavy traffic of cars in fall season helped the rapid spread of seeds between regions.



Parthenium plant

The Parthenium plant has caused a lot of damage to the local environment, and it is also a toxic plant because of the Parathinin substance in it that causes allergies to the respiratory system, skin irritation in humans, and harms the animals that feed on it, as well as the phenomenon of bitter milk for livestock.

Although this problem appears to be local, many countries have been subjected to an invasion like what happened in Dhofar, such as India, Nepal, Tazman, Ethiopia, Somalia, and others.

These countries have made many attempts to get rid of this plant because of its great damage.

In this research, we will study the changes that occur on the soil due to this plant, including temperature, relative humidity, acidity, and conductivity, and compare them with areas not infested with this plant, and we will monitor its impact on different living organisms, especially plants, and its potential impact on the environment and climate change.

Search methods:

1) A study plan has been developed to organize work, fill gaps and redress potential errors.

1- Determine the exact location of the study.

2- Apply the selected protocols according to the proposed schedule.

3- Data collection and analysis.

4- Communicate with experts to discuss the team's results.

5- Writing the research and presenting it in the final form.

Table (1) research plan

work plan	the month
Globe team meeting and research title discussion.	October
An exploratory trip to the chosen site to determine its suitability for study.	November
Practice doing the protocols	December
Performing protocols and collecting samples	January
Analyze the results and communicate with the experts	February
Submit the research in its final form	March

It was agreed to divide the roles between the team as follows:

Table (2) division of roles among team members

Supervisors & Aya & Nojood	**Globe team meeting and research title discussion**
Supervisors & Aya & Nojood	**An exploratory trip to the chosen site to determine its suitability for study**
Aya & Nojood	**Practice doing the protocols**
Aya & Nojood	**Performing protocols and collecting samples**
Aya & Nojood	**Analyze the results and communicate with the experts**
Aya & Nojood	**Submit the research in its final form**

2) the study site:

The mountainous area of Shihet was chosen to conduct the research protocols on it, due to the spread of the parthenium plant there, as well as for its distinguished location, ease of access, and relative proximity to the school.

Photo (1): An aerial photo of the site via satellite.

Photo (2): the study site on the map.

Photo (1)

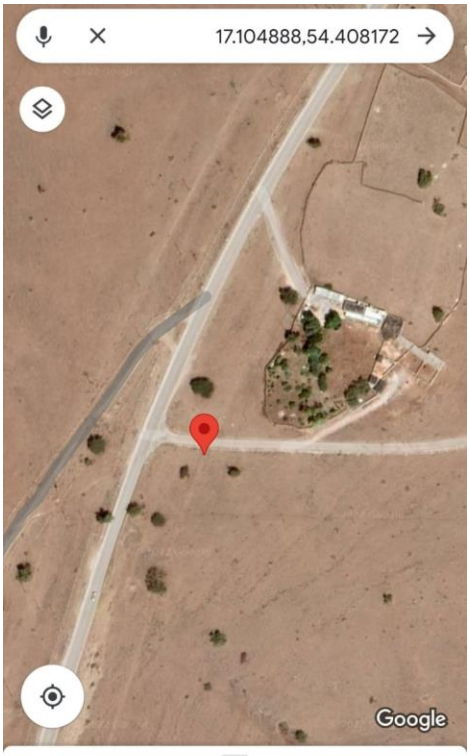
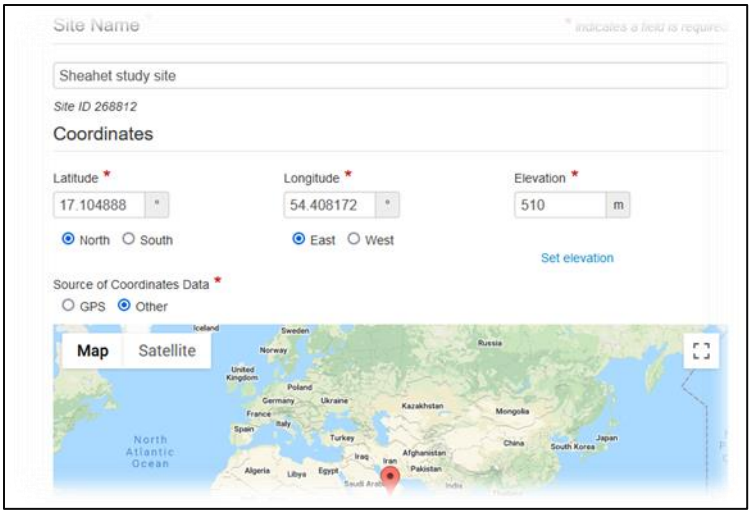


Photo (2)



It was registered on GLOBE as a study area.

3) Data collection and analysis:

After selecting the site affected by the parthenium plant, the Globe team visited the site and collected samples, with three samples from a parthenium infested place, and another site about 200 meters away from the first site, and not infested with the plant. The team collected 3 samples from each site to ensure greater accuracy of the results The measurements and protocols used were:

- ✓ Surface temperature using an infrared thermometer.
- ✓ The temperature inside the soil at a depth of 5 cm and 10 cm using a soil thermometer.
- ✓ Soil moisture by weighing it accurately and then drying it in a thermal oven and calculating the percentage of water in it.
- ✓ Soil pH, soil salinity, soil conductivity, by making a soil extract by adding water and then measuring it with a pH and conductivity device.

Some pictures of the team in action:

Measuring surface temperature and temperature at a depth of 5 and 10 cm.


On site measurement of salinity, conductivity, and acidity:



Collecting soil samples to complete work in the school laboratory:

Team notes:

1- When examining the soil samples, a difference in texture and appearance was observed between the soil of the area infested with parthenium plant and the soil of the non-infested area, where the soil in the first site was very dry and lumpy and resembled hard rocks, while the soil in the second site was natural, attached pictures of the external shape of the soil in the two sites.

2- The team noticed that the vegetation in the infested site had almost disappeared, and the tree line had receded to a great distance inland from the road, although the residents of the area confirmed that years ago it was an area rich in plants and trees.

Results:

First site (infested):

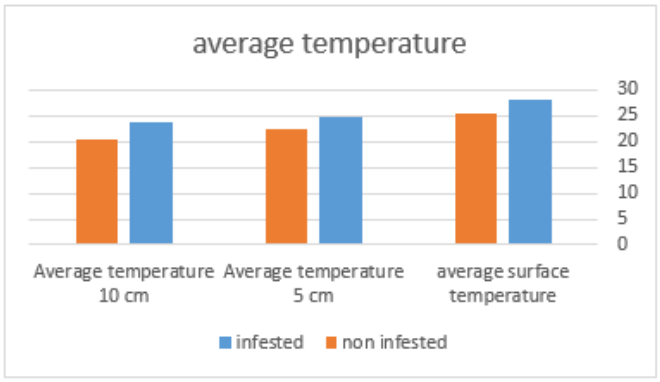
The protocol	Measure 1	Measure 2	Measure 3	Average
surface temperature	27.6	29.1	28.3	28.3
Temperature at a depth of 5 cm	24	25	25	24.67
Temperature at a depth of 10 cm	23	24	24	23.67
pH	6.60	6.62	6.81	6.68
conductivity µs	890	873	885	882.7
salinity ppm	410	400	427	412.3

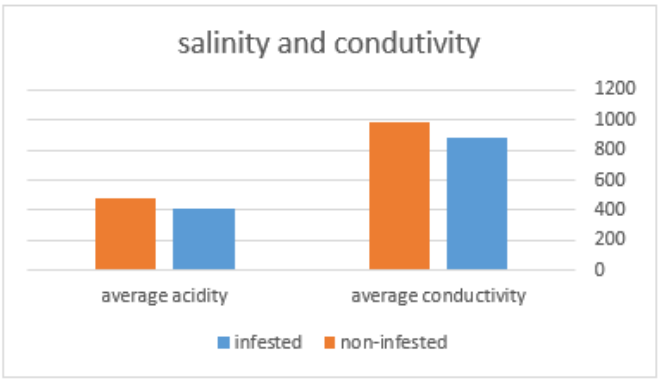
the sample	Sample mass before drying	Sample mass after drying	The difference between the two measurements	water percentage (moisture)
1	9.99	9.35	0.64	%6.4
2	10.02	9.44	0.58	%5.79
3	10.00	9.31	0.69	%6.9

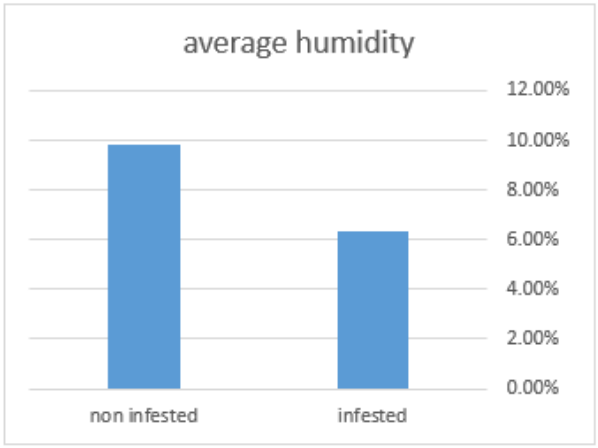
Second site (non-infested):

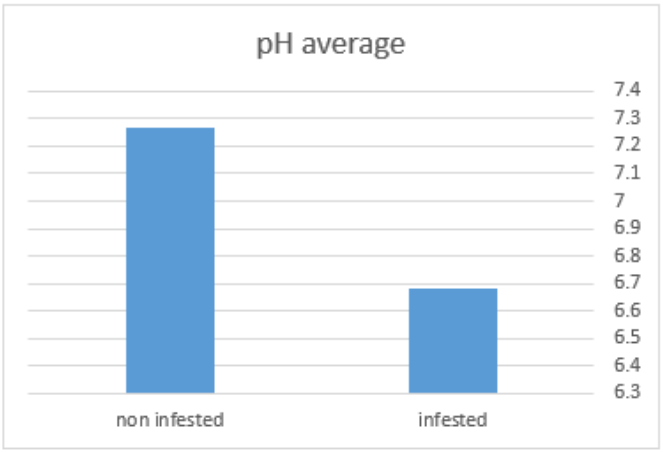
The protocol	Measure 1	Measure 2	Measure 3	Average
surface temperature	25.2	26.1	25.3	25.5
Temperature at a depth of 5 cm	22	23	22	22.3
Temperature at a depth of 10 cm	20	21	20	20.3
pH	7.33	7.28	7.20	7.27
conductivity µs	980	1007	975	987.3
salinity ppm	473	485	483	480.3

the sample	Sample mass before drying	Sample mass after drying	The difference between the two measurements	water percentage (moisture)
1	10.00	8.87	1.13	%11.3
2	10.01	9.22	0.79	%7.9
3	10.02	9.00	1.02	%10.2

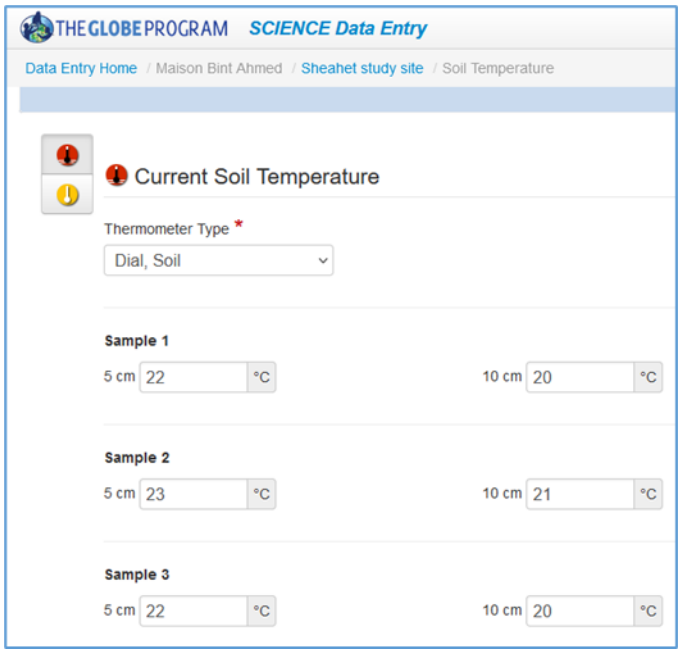


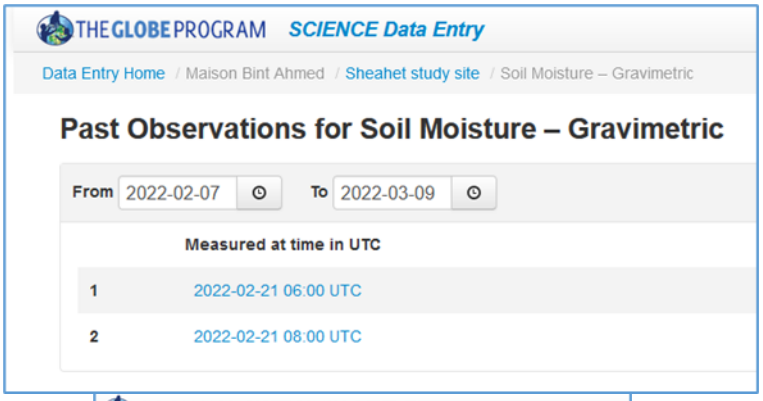


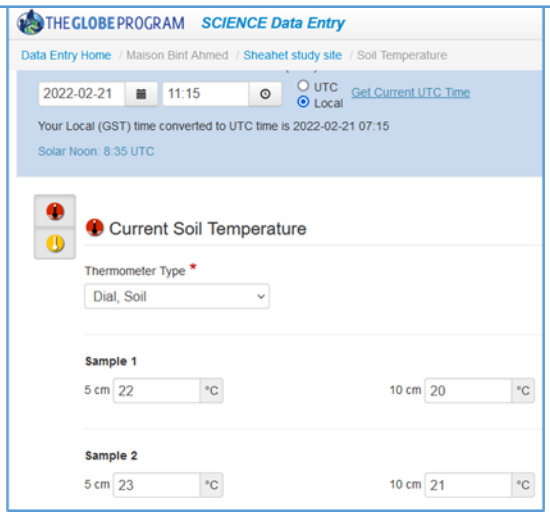




** Data entry to the GLOBE website:







Discussion:

After obtaining the results and displaying them appropriately, we came to the following:

In a good answer to the first question, "What is the effect of the parthenium plant on soil properties?" Based on the collected data, it has already been confirmed that there are changes in the nature of the soil in the area infested with parthenium, starting from the external shape of the soil, the soil was very cohesive, lumpy, and solid in the affected area, while it was normal in the non-infested area.

When conducting a moisture test to find out the percentage of water in the samples collected from the two sites, we noticed a significant decrease in the moisture content in the infested area, while it was at higher rates, which is suitable for the growth of plants in the non-infested area.

As for the surface temperature and the temperature at a depth of 5 and 10 cm from the surface, where there was a noticeable difference, in the infested area it was higher than the non-infested area.

As for the pH, the pH was lower in the infested area (acidic soil), while it tended to be neutral in the non-infested area.

There were also differences in the degree of conductivity and salinity, which were lower in the infested area than in the non-infested area.

temperature	higher in the infested area
pH	Less in infested area (acid soil)
Humidity	Less in the infested area
conductivity	Less in the infested area
salinity	Less in the infested area

As for the second research question, which is "What are the effects of the parthenium plant on environmental and climate change?"

Through direct observation while working on the site, it was clear that most of the other plants disappeared from the infested area because of fierce competition with the parthenium plant, which absorbed soil moisture and changed its chemical properties to become only suitable for it, thus eliminating vegetation cover.

On the other hand, after referring to previous reports and research, the danger of this plant to other living organisms such as cattle was shown. For example, it causes the phenomenon of bitter milk in cattle, and it causes harm to humans. And the respiratory system, while pollen of this plant stimulates allergies and asthma.

The spread of the parthenium plant caused a change in the ecological diversity in the endemic areas, as the disappearance of plants led to the disappearance of the organisms that depend on them as well.

As a direct result of the drying of the soil, and the disappearance of trees and plants that absorb carbon dioxide and cool the atmosphere, the temperature of the region has risen significantly, and this may exacerbate the problem of global warming.

Consultation with environmental experts and activists:

While working on the research, we encountered the problem of the scarcity of Arabic sources and studies on the plant parthenium, so the Globe team contacted the researcher, Professor **Muhammad Akak**, who thankfully helped the team obtain previous foreign studies on this plant and suggested some ideas for improving and developing the research in the future.

GLOBE's team contacted **Mahad bin Saeed Suhail Al-Awaed**, a member of the Gibjat volunteer team, where he gave us some information about this plant and the government and private efforts to get rid of it:

Parthenium is a parasitic plant that is harmful to agricultural areas and is combated in various ways, as it greatly affects their cultivated areas due to its rapid spread, damage to the soil and its consumption of water.

It is classified as a plant harmful to nature. It is not eaten by livestock. It causes declining green spaces and soil erosion. It has a great competitive ability to grow, survive, and occupy large areas of pasture. In addition, it is one of the most natural distortions of the landscape.

As a participating member of the Gigabat Volunteer Team, its volunteer efforts are continuing to eradicate this harmful plant that has spread to vast areas, and eliminating this plant is not easy, but rather through continuous concerted efforts by the competent authorities and voluntary teams.

We thank the efforts of government agencies for their continuous support of these teams and the support of community efforts and initiatives by supporting their continuity; By providing the supplies needed to combat the plant and activating the awareness of the community about the effects of its spread.

Conclusion:

This research sought to study the parthenium plant and the effects of its rapid spread in the Governorate of Dhofar on the composition of the soil and its impact on the local environment.

Where it was proven that there is a difference in soil properties between two close regions, one infested with Parthenium and the other not infested. The pH, conductivity, salinity, and humidity were lower in the infested region, while the temperature was higher in the same region.

This proves the effect of this plant on the soil and as a result other plants disappeared, which affected the biodiversity in the region and caused a major environmental problem, in addition to the plant's direct impact on humans and animals.

Recommendations and Suggestions:

After the team's work was completed, a brainstorming session was held to discuss the next step, what should we do with these results, and the answer was to go to the responsible government agencies such as municipalities, to submit proposals and get rid of the effects of the plant, even removing the plant from its roots is not enough, the soil must also return to its previous nature, by:

-1Breaking up the soil by plowing the land, for example.

-2Restore the chemical composition of the soil to its previous nature by adding fertilizers or other materials.

-3Cultivation of infested areas after treatment. Government and civil efforts can be combined, and even tourists who visit the governorate, by spreading good seeds while touring in mountainous areas.

A page has also been created on social networking sites to publicize this problem, suggested solutions, and recommendations to eliminate it.

https://instagram.com/2no_ay?utm_medium=copy_link

As for proposals to develop research, it is possible to repeat the work and add other soil tests, and this can be achieved by cooperating with research institutions, universities, or municipalities to obtain more accurate tools, equipment, and results.

Of course, it is possible to re-search over a larger area of the governorate and by choosing multiple locations for work.

Badges:

1- **I am a Collaborator**: Our team was cooperative and everyone in the team did an excellent job. We divided the roles since the beginning of work on the project (the table is attached in research methods) and we helped each other to complete the research.

2- **I Make an Impact**: Our research is based on a local and global problem, we worked to identify the problem and find solutions, and we made recommendations to government and private agencies to work on fixing the problem based on our results.

3**- I Am an Engineer**: We tried to think like engineers about the problem, find solutions to it, and apply it as well.

Thanks:

The GLOBE team at Maison Bint Ahmed School extends its thanks and appreciation to all who helped us to the completion of this research, whether through moral, logistical, or informational support, and we particularly mention:

Mrs. Tofool Al-Mashani, Principal of Maison School.

Mr. Muhammad Akak.

Mr. Mahad bin Saeed Suhail Al-Awaed, member of the Gibjat Volunteer Team.

Dhofar Governorate Central GLOBE Team.

GLOBE colleagues who have already had experience in this field.

The supervisors of the program, Asma Zaitoun and Fatima Al-Mishkhi.

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