AN ORDINARY FIG STORY

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Joint project: Prirodoslovna i grafička škola Rijeka and Srednja škola Petrinja

Croatia

1.Abstract

This is a story about two ordinary figs, Rječanka and Petrinjka that live in different environments. School students collected GLOBE atmosphere data, soil data, and biosphere data in the places they live. They concluded that Rječanka has better atmosphere and soil conditions but that in the end both survive and come with fruits. Rječanka is happier because her students eat her fruits earlier, due to milder temperatures.

Humanity has been cultivating figs for over 5,000 years and the partially fossilized figs in the Jordan Valley date back to 9400 BC.

They have an important role in all of today's religions, Christianity, Buddhism, Judaism, Islam, and Hinduism, in mythologies in the Amazon and Africa, across the Mediterranean and the Middle East, and from the foothills of the Himalayas to the islands of the South Pacific. The ancient Greeks found inspiration for their masculinity in the fig tree, so it also became a symbol of masculinity in India, oriental countries, and Italy.

Both of them are not feeling good because the production of figs in Croatia diminished drastically and the number of their friends was reduced. From 6.240 t of fresh figs in 1996 to 2021. we are down to 3500 t.
Our goal is to help students improve their eating habits, and introduce figs to their diet. A lot of gardens in Rijeka have a fig trees but unfortunately, most of the figs go to waste.

2. Introduction

This story has two chapters:

Chapter I: Fig's story and

Chapter II: Student's story

I. Fig's Story

Rječanka: Hi, I am an ordinary fig tree, from the genus ficus carica (L.). I am the most varied group of plants on the planet, there are over 800 species of us (1). According to the variety, I am a petrovača, named Rječanka. Last autumn I became friends with another petrovača Petrinjka.
I've been known since ancient times.
The first marathon runner, who ran from the Marathon to Athens to tell the news of the victory over the Persians throughout the journey was refreshed only with figs.
In the opinion of the ancient Greek doctor Galen, I am one of the best sources of energy, able to quickly restore strength, and relieve people of fatigue and overload. According to the International Journal of Food Properties (4) when I am fresh I contain from 10 to 15% of fruit sugar and you can eat

me fresh or dried. With my nutritional composition and medicinal properties, I rise above many types of fruits. I am a better source of fiber than most fruits. 28% of my fiber is soluble so I help control blood sugar levels so that the brain makes proper use of glucose. It lowers cholesterol levels by binding it in the digestive tract. Tryptophan in my fruits will help if you suffer from insomnia. Due to the high magnesium content, they recommend me against tension, anxiety, and stress. When they dry me, I have three times more magnesium. In addition to magnesium, I am rich in vitamins B, C, A, and K, minerals potassium, calcium (which is why we can replace dairy products), phosphorus, manganese, iron, selenium, copper and zinc, and antioxidants. Purple figs contain the greatest amount of antioxidants (5). Based on mineral and phytochemical analyses, I recommend the consumption of whole fig fruit. In some cultures people use my leaves to make tea for its anti-diabetic properties, the consumption of these leaves reduces the need for insulin injections (6).

Humanity has been cultivating figs for over 5,000 years and the partially fossilized figs in the Jordan Valley date back to 9400 BC. I have an important role in all of today's religions, Christianity, Buddhism, Judaism, Islam, and Hinduism in mythologies in the Amazon and Africa, across the Mediterranean and the Middle East, and from the foothills of the Himalayas to the islands of the South Pacific (2). The ancient Greeks found inspiration for their masculinity in the fig tree, so it became a symbol of masculinity in India, oriental countries, and Italy, and in our country, the sign of „figa“ is shown when wishing someone luck. It comes from the word ficus, the thumb comes out between the index and middle finger (1).
I live in Prirodoslovna i grafička škola Rijeka, in the school's courtyard and, near the atmosphere station, students pass by me every day. They collect data about my environment, as students in Petrinja do.

Rječanka in February

Petrinjka: And I am a continental fig tree, named Petrinjka. Do you know that I come from the

mulberry family and am one of the sweetest fruits when fully ripe (7)? Yes, we can say that I have only recently been in these areas, I like the Mediterranean climate better, but I am trying to adapt to these harsher winters. And then I dream and wait for the sun because the Mediterranean is in my genes. Nevertheless, I am growing and developing, with a view of the chestnut forests and the beautiful Petrinjčica, and on summer days I listen to the buzzing of honey bees. But I'll let you in on a secret: we figs are not pollinated by bees or the wind, but by very small wasps from the Agaonidae family. Surely you don't know that my fruit is a flower turned inside out? So the tiny wasp gets inside the fruit, visiting many flowers, laying its eggs inside the future seeds that will feed its offspring, and also spread the pollen collected from the previous fig where it was born (8). But I think I've talked enough, do some research yourself, just to end by telling you that according to Islamic experts, in the science of dreams, if you dream of figs, it means wealth and prosperity (9). So plant figs and dream of us.

Petrinjka in October

Since we, Petrinjka and Rječanka are just ordinary figs (1) we thought it best that our friends, Arnela, Fran, Mia, Rebecca, Teo and Edoardo show you and comment on the data about our environment. They also shot a video about as and put it on the Internet to show everyone in the world how the ancient people enjoyed and respected us. They want to show how healthy we figs are and stimulate everyone to eat more figs. We are not feeling good because the production of figs in Croatia diminished drastically, from 6.240 t of fresh figs in 1996. (13) in 2021. we are down to 3500 t (14).

II. Students' Story:

We are passing by our fig in the school garden every day. A long time ago the students who were in our school before, started taking care of her, they used GLOBE protocols to monitor her health. Now,

we are the ones to take care of and out of gratitude she gives us the sweetest fruits. We started talking with students from Malta, from the island of Gozo. They also have a fig in their garden and they started monitoring her last year. They do not know her species yet and are trying to determine it. That's why their data is not in this project.

3. Research questions

There are various types of figs, but in our project, at both research sites, we follow the Petrovača variety. The growth and development of figs and their sweetness depending on their variety, temperature, atmosphere humidity, rainfall, sun exposure, soil temperature, soil humidity, and soil quality (1).

- How does the same sort of Mediterranean fig growing in Rijeka and Petrinja cope in different climates?
- Will the leaves on the trees show different colors during the green-down and stay on the trees at the same time?
- Do high school students eat enough fruits?
- Can we do something to improve their eating habits?

4. Hypothesis

1. Figs in Rijeka and Petrinja survive in different climates
2. In Petrinja, the fig tree is very young, winter temperature never got below -15^0 C to freeze or above 40^{0}C to stop her photosynthesis
3. Figs are of the same variety but due to milder temperatures Rječanka's leaves will stay on longer and continue with the photosynthesis
4. From our previous investigations we suppose that high school students do not eat enough fruit

5. Student-led investigation plan

We follow two figs of the Petrovača variety. Riječanka is 52 years old and Petrinjka is 5 years old, on two different sites: one is in the Mediterranean climate (Rječanka) and the other in the Continental climate (Petrinjka)

The growth, development, and sweetness of figs depend on:

- Variety
- Atmosphere temperature
- Atmosphere humidity
- Rainfall
- Soil temperature
- Soil humidity and
- Soil quality
- Sun exposure.

6. Research methods

GLOBE protocols:

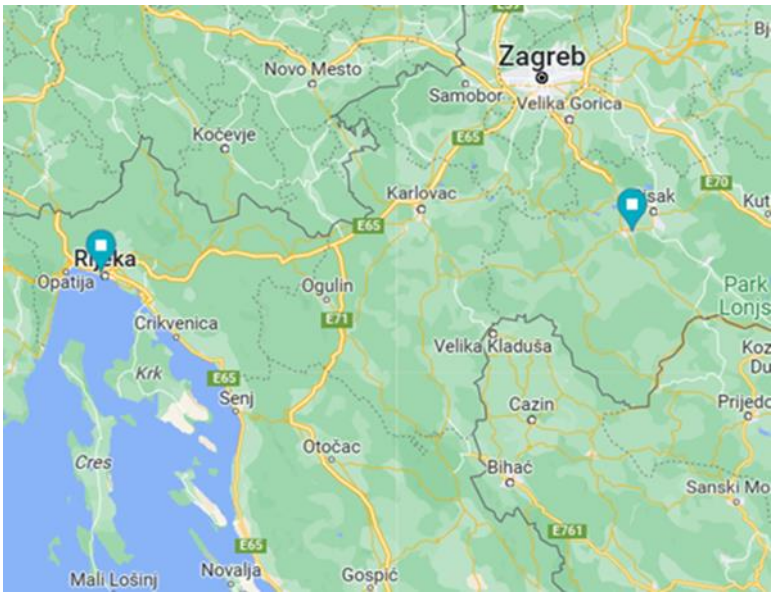
1. Atmosphere temperature
2. Atmosphere humidity
3. Rainfall

4. Soil temperature
5. Soil humidity
6. Soil quality (NPK test)
7. Biometry green-down

Other

- State hydrometeorological institute (DHMZ) data for the duration of sunshine and rainfall. There is no data for Petrinja and we used average data for Sisak which is only 9 km away
- Measurement locations

Picture 1A: Srednja škola Petrinja **Picture 1B:Prirodoslovna i grafička škola Rijeka**



Picture 2: The distance between schools is 144,4 km (12)

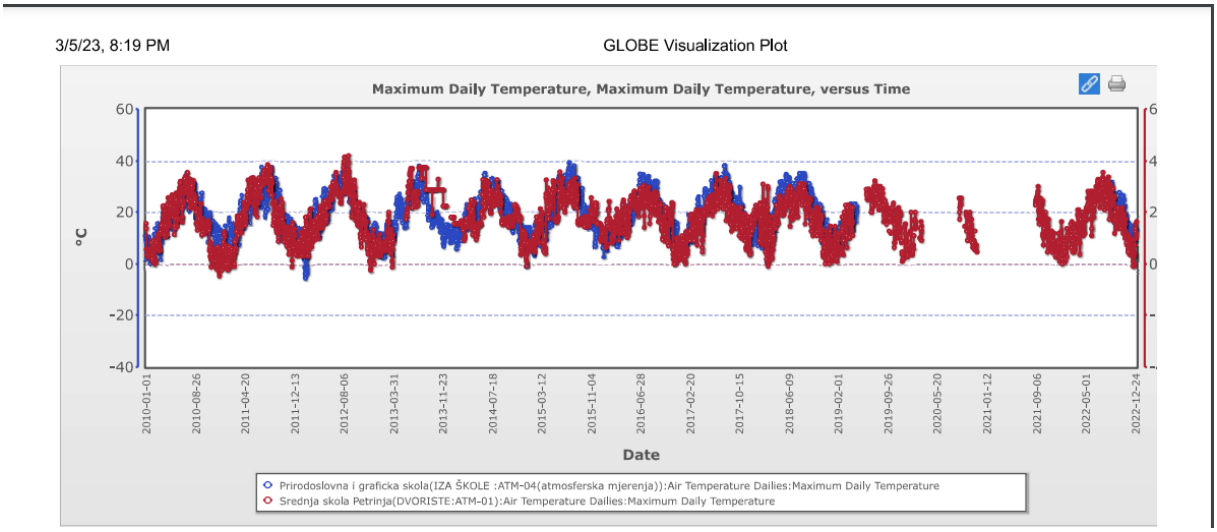
- Period

Both schools have been measuring by GLOBE protocols for more than twenty years and we took old data to compare the atmosphere and soil differences. Prirodoslovna i grafička škola Rijeka (PGSRi) has been monitoring their fig since September 2008. and Srednja škola Petrinja (SSP) since September, 2022. Both schools are part of the Trees Around the GLOBE Student Research Campaign starting with the EuroAsia Autumn campaign.

7. Data display

7.1. GLOBE data visualisation

Graph 1: Maximum Daily Temperature from 01.01. 2010. to 31.12.2022.

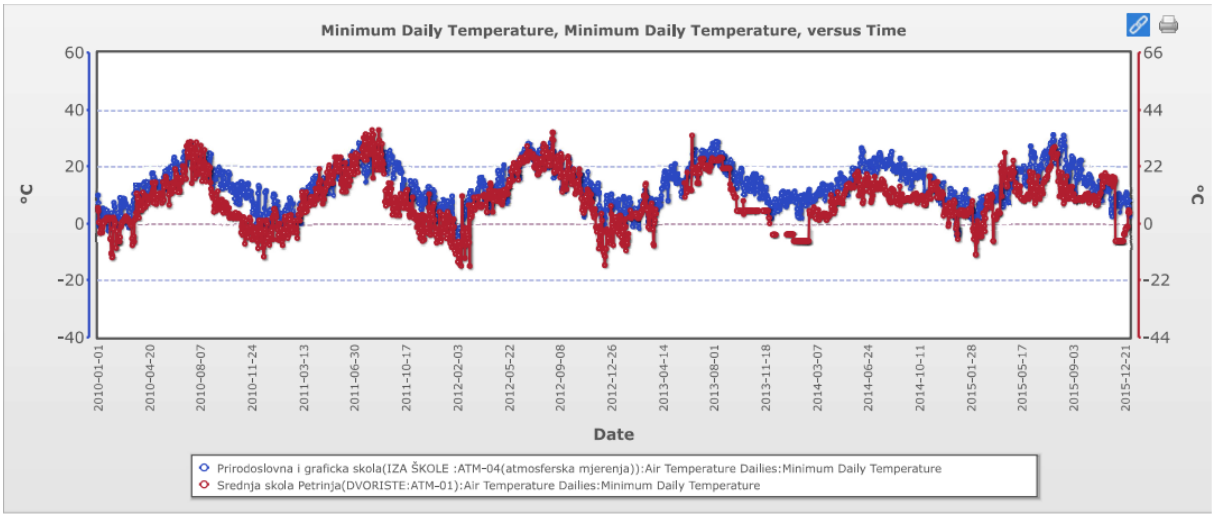


We can observe that on the PIGSRi site temperatures have never been above 40^{0}C.

On the SSP site, maximum temperatures reach over 40^{0}C.

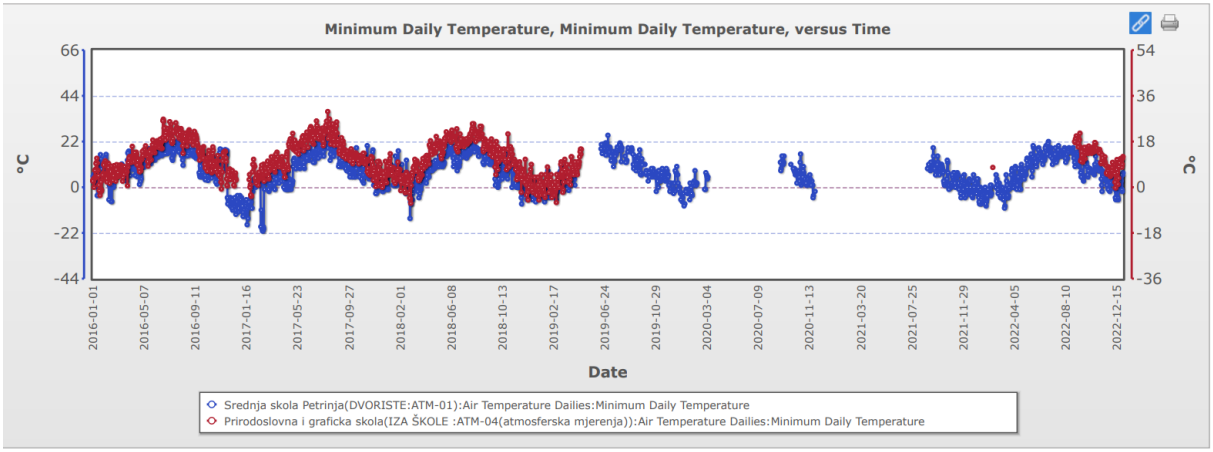
We decided to show Minimum Daily Temperature in two graphs, Graph 2 and Graph 3 because of too much data we could not observe the most important temperatures.

Graph 2: Minimum Daily Temperature from 01.01. 2010 to 31.12.2015.



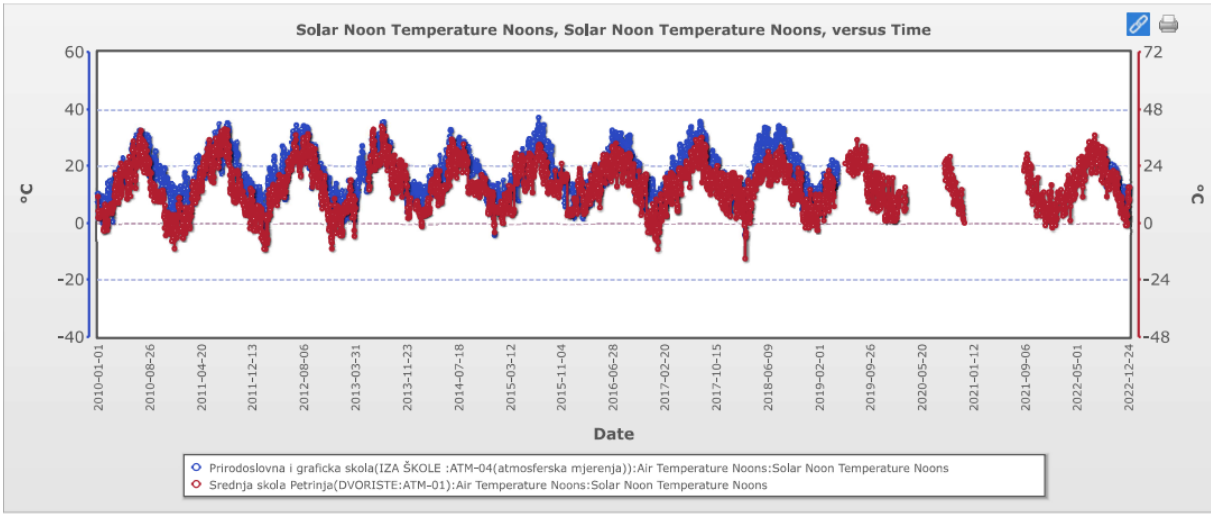
The graph shows the minimum temperatures from 2010. to 2015. on the PIGSRi site never dropped below 0^{0}C. The temperatures at the SSP site are much lower and on some days are lower than -10^{0}C.

Graph 3. Minimum Daily Temperature from 01.01. 2016 to 31.12.2022.



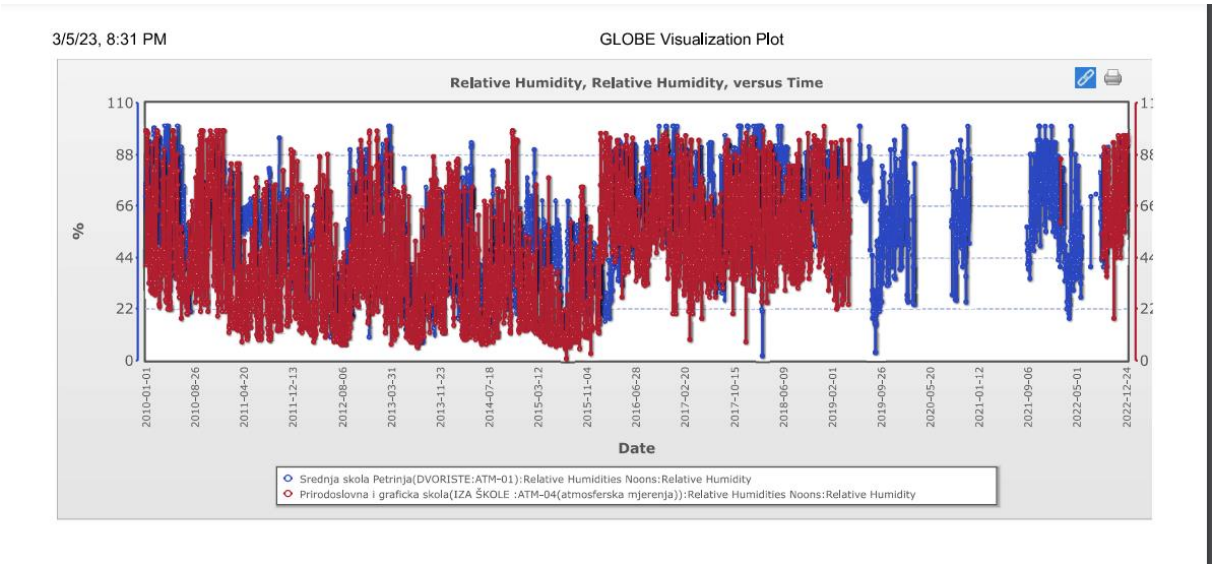
Again the minimum daily temperatures in the period from 2016.to 2022. show that the temperatures on the SSP site are below -1^{0}C up to -10^{0}C. On the PIGSRi site, minimum temperatures never go below -1^{0}C.

Graph 4. Solar Noon Temperatures noons from 01.01. 2010 to 31.12.2022.



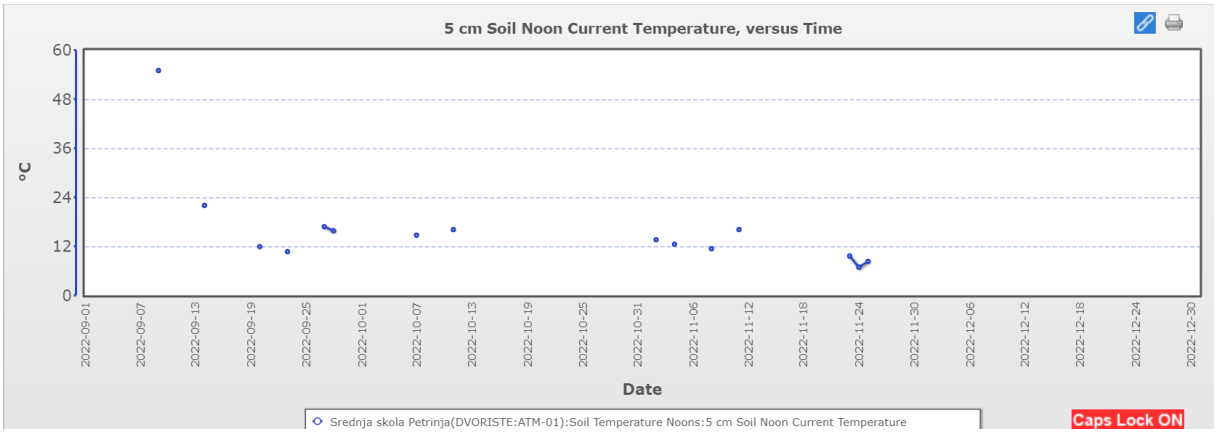
The graph shows milder temperatures on the PGSRi site

Graph 5: Relative humidity from 01.01. 2010 to 31.12.2022.

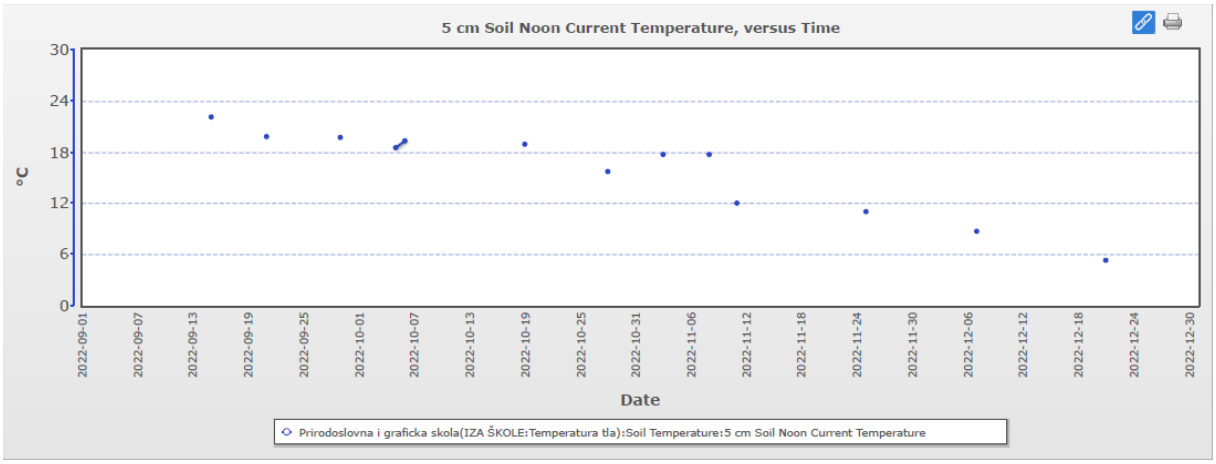


In this graph, we can observe that during the maturation, from May to August Petrinjka has more humidity than Rječanka.

Graph 6: 5cm Soil Noon temperature SSP, 09.-12.2022.

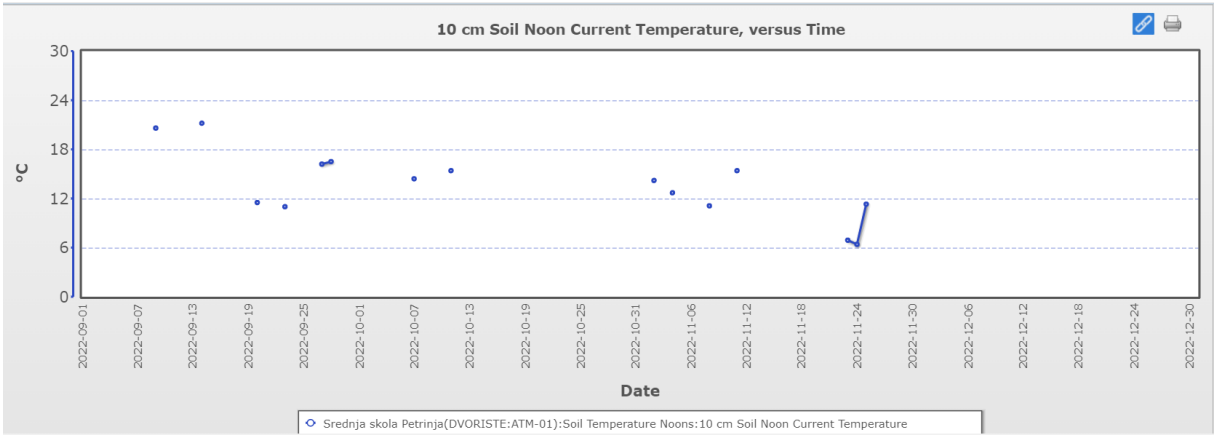


Graph 7: 5cm Soil Noon temperature PGSRi, 09.-12.2022.

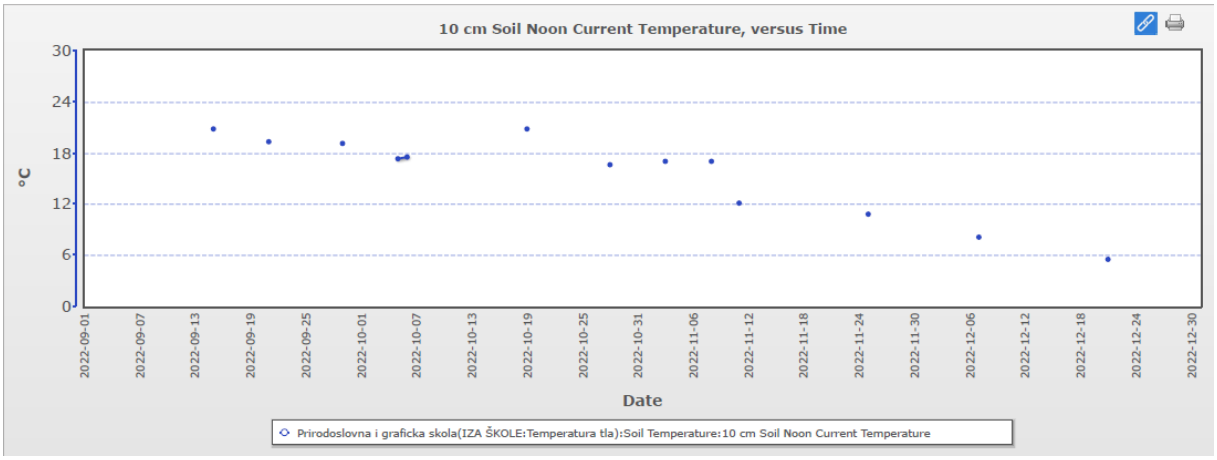


We can observe higher 5 cm soil temperatures on the PGSRi site

Graph 8: 10 cm Soil Noon temperature SSP, 09.-12.2022.



Graph 9: 10 cm Soil Noon temperature PGSRi, 09.-12.2022.

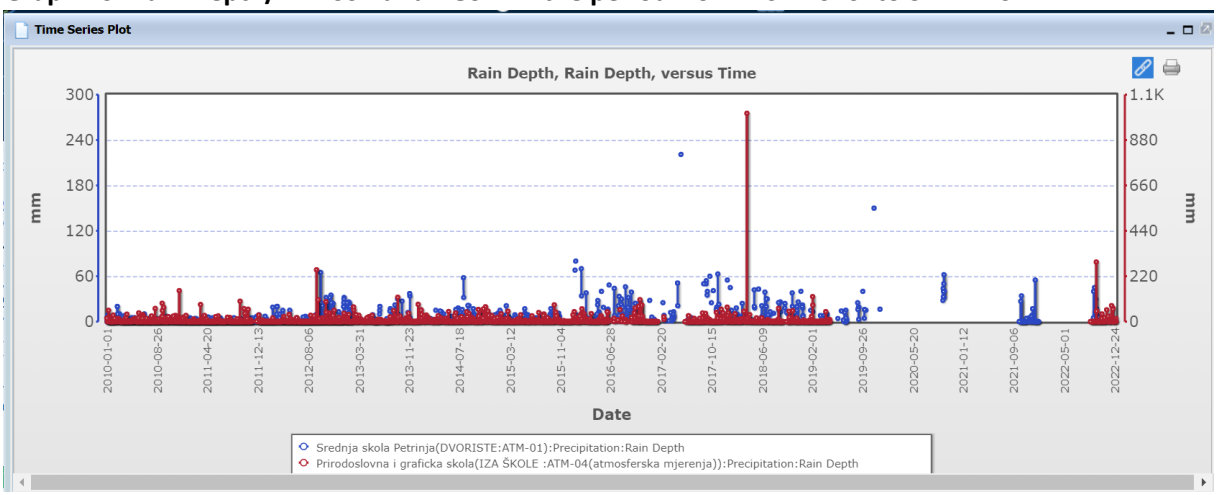


We can observe higher 10 cm soil temperatures on the PGSRi site than on the SSP site.

Graphs 6, 7, 8, and 9 show higher soil temperatures during the observing period from September to December on the PGSRi site.

GLOBE visualization system did not allow to compare both school's sites on one plot.

Graph 10: Rain Depth/mm SSP and PGSRi in the period from 1.01.2010. to 31.12.2022.



We can observe that the quantity of rain depth is higher on the PGSRi site in autumn and winter and lesser in spring and summer.

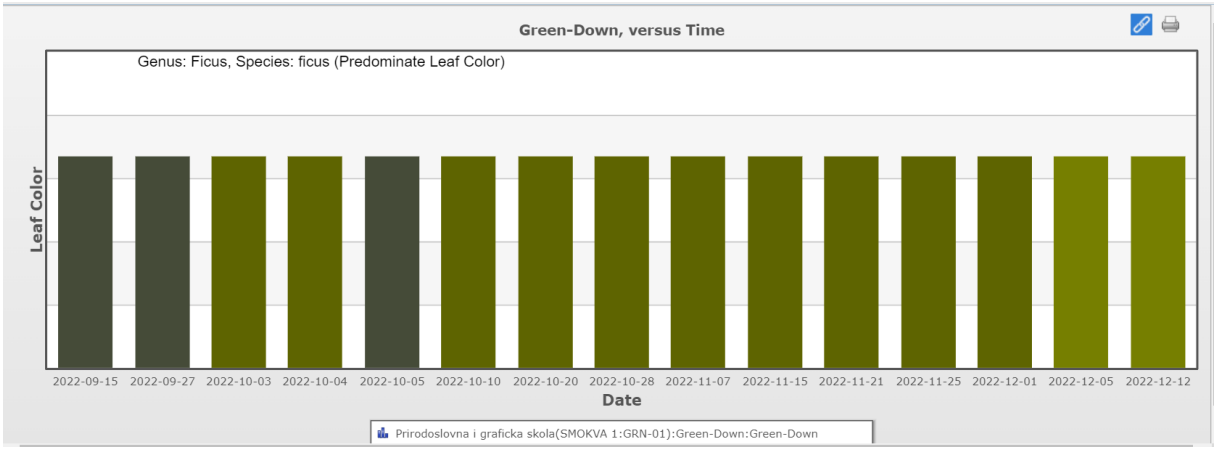


Figure 1.:Leaf color of PIGSRi fig in the period from September to December

The figure shows Green-Down color changes, due to mild temperatures the leaf's color changes are minor, but in December a gale combined with rain blew away all leaves.

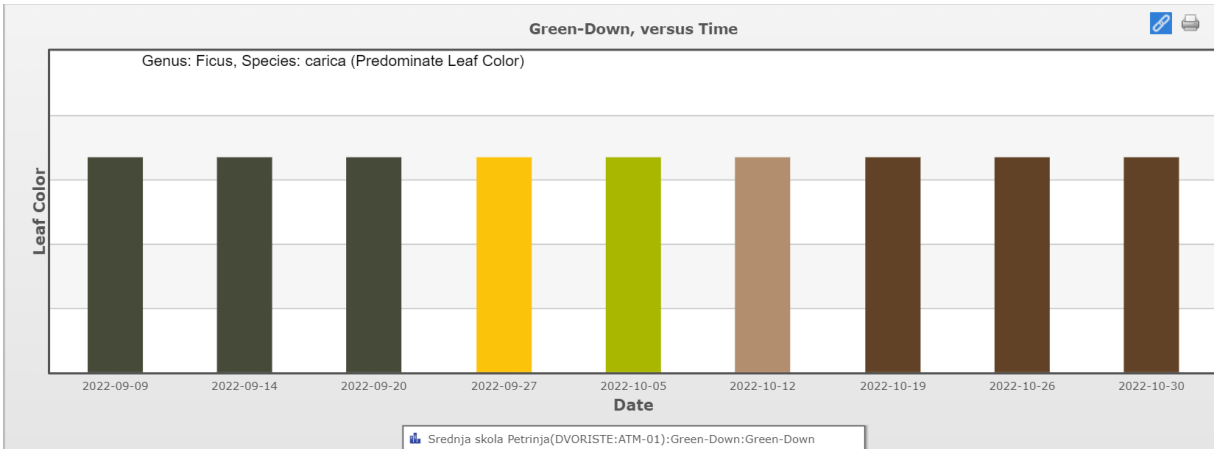
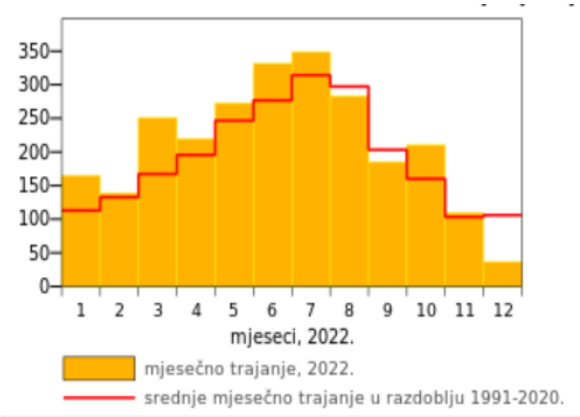


Figure 2.:Leaf color of SSP fig in the period from September to December

In difference from Rječanka Petrinjka leaves started changing in September and were gone by the end of October.

7.2. Other sources

For the duration of sunshine, we used DHMZ data. There is no DHMZ data for the duration of sunshine for Petrinja and we used average data for Sisak which is only 9 km away



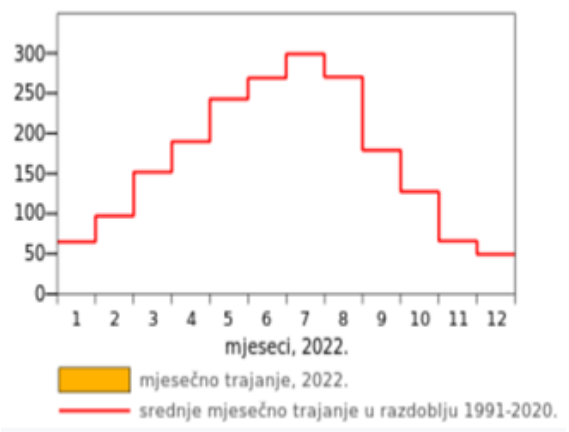


Figure 3. Rijeka, monthly duration of sunshine/h and average monthly duration from 1991-2020

Figure 4. Sisak, monthly duration of sunshine/h and average monthly duration from 1991-2020

Figures 3 and 4 show less sunshine in Sisak during the months of January, February, November, and December, and average sunshine hours from March to August are almost the same (slightly lesser in Sisak) and from September we see a drop of sunshine hours in Sisak.

8. Data summary

Figs grow best and produce quality crops in areas with an average temperature above 12 ^{0} C. Sudden drop in temperature during the vegetative period is dangerous for figs. They develop best if the temperature does not drop below -10^{0}C in the winter period (3). For the development of the fig tree, the precipitation schedule should be uniform, with more summer and fewer autumn showers of rain. The ideal annual average should be 1000 mm/m2. There must be enough rain during the five to six weeks after flowering. According to DHMZ rainfall in Rijeka increases from October to February, but in the time of maturing, there is enough rain for the figs. The annual average is above 1000 mm/m^{2} on both sites.

Graphs 1 to 5 show that there are no temperature spikes on the PIGSRi site, and temperatures are almost evenly distributed, while on the SSP site, you can see minimum and maximum spikes.

Graph 1 shows temperatures over 40^{0} C on the Petrinjka site but fortunately, for her, who is only 5, the last five years did not show such temperatures.

The fig tree likes deeper soil; if not, it can develop roots up to 12 m (1). We found a lot of Rječanka roots when arranging the garden.

The quality and sweetness of fig fruits depend on the number of leaves. A fig with more leaves has better photosynthesis, faster flow from the roots to the top of the tree, and faster metabolism. The intensity of photosynthesis in plants increases up to a temperature of 28 °C, then decreases, and at temperatures of 40-45 °C, photosynthesis stops completely.

Temperature and air humidity, soil quality, and the amount of water retained in the soil in case of drought greatly influence fruit development.

Soil temperature shows the milder temperature on the PGSRi site but on both sites temperatures are above 0^0 C.

PGSRi determined soil quality more than 11 years ago with the GLOBE NPK test and could not repeat the tests because lacking funding for more tests. For the same reason, Srednja škola Petrinja never performed the tests.

Table 2. Prirodoslovna i grafička škola Rijeka showing results of the NPK tests

ELEMENT	QUANTITY (2001)	QUANTITY (2012)
N	LOW	LOW
P	LOW	LOW
K	HIGH	HIGH

As Rječanka has grown on the same soil for 52 years, the results show she has enough nutrients to grow.
The soil composition hasn't changed in the last ten years because we started the site in 2001. and the composition in 2012. showed no change.

Green-down data shows the difference in leaf color, Rječanka had more sunny days for photosynthesis, and her leaves remain green for a long time.

9. Conclusion

Our data show that both, Rječanka and Petrinjka have good temperature conditions for growth and development, although in winter the temperatures are significantly lower for Petrinjka. That's why her leaf color changes begin earlier. Rječanka can enjoy more sunny days.
Both sites have enough rainfall but are arranged differently: Rječanka has more rain during autumn and winter and Petrinjka during spring and summer, but both have enough water for maturation.

As for soil temperature and humidity, the same as for air apply: Rječanka has warmer soil, but less humidity during the spring and summer.

We can say that Rječanka feels good about her Mediterranean surrounding but Petrinjka has to suffer the inconvenience of the continental climate. But in her 5 years of life, she successfully adapted to the environment because of milder winter temperatures. The maximum summer temperatures in Petrinja tend to go over 40^0C which would threaten Petrinjka's young life. Fortunately, it did not happen yet and we hope will not happen for another ten years when she will be mature and able to survive (1).
Now we are all waiting impatiently to eat their sweet fruits. A lot of gardens in Rijeka have a fig trees but unfortunately, most of the figs go to waste.

We are also concerned about our eating habits. We know that we have to eat more fruit, but we seem to forget it. Our two schools have formed a questionnaire about eating habits. PIGSRi has done it in 2011. and started with lessons about healthy eating on the school's video. After that, the eating habits of PIGSRi students improved by about 4%. Not great but we have to improve their parent's habits too.

We will continue our efforts and do the best that we can, we have a lot of material. Perhaps we will share another story with you next time.

And here is the recipe Rječanka promised you:

INTEGRAL FRUITCAKE WITH DRIED FIGS, HONEY, AND WALNUTS (10)

200 g wholemeal flour

50 g potato starch

200 g yogurt, 0% fat

3 eggs

2 tablespoons sugar

3 tablespoons honey

100 ml olive oil

1 teaspoon of baking powder

10 dried figs

50 g chocolate chips

80 g walnut

Soak the dried figs in water.
With the help of an electric mixer, beat the eggs with the sugar until they double in volume (therefore whisking for about 10 minutes). This step is essential to make your fruitcake soft and voluminous.
Also add the honey, the yogurt, and the oil, always using the whips in action.
Sift the flour and baking powder and add them to the mixture.
Once everything is mixed, add the dried figs drained from the water and cut them into small pieces, together with the chocolate drops and half of the coarsely chopped walnuts.
Cover the fruitcake mold with baking paper, pour the mixture, level, and sprinkle the surface with whole walnut kernels.
Bake in a preheated oven at 180^0 C for about 40/45 minutes. Do the toothpick test and pull out.

Let everything cool down and enjoy it with a nice cup of hot coffee or tea.

NOTE: This is a calorie bomb but you can share it with a whole class. Everyone will be happy and get enough nutrients to get them through the long hours at school.

10. Sources

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7. Jasmin Poljak, B.Sc.Chem.eng.,teacher,Prirodoslovna i grafička škola, Rijeka

Be a Collaborator: We collaborated getting data, helping each other enter and visualise, and compare the results. We also reached out to another school from Malta and are going to compare all data together. It will help us be better conversing in English and get aquainted with new traditions

Be a Data Scientist: We analysed our present and past data, in all report we used GLOBE protocols to compare our two schools data and collaborated with scientists from Universities, specialized institutions

Be a STEM Storyteller: We wrote our report as a story and made a video in which we shared our story with the whole Internet