

# Can a spray make our crops better?



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## Abstract

LOWER READING LEVEL

Did you know the first genetically modified crop was a tomato with delayed ripening? Genetically modified organisms (GMOs) have been around for decades now. And they offer a lot of benefits. For example, they may grow more food or be more resistant to diseases. But there are a few downsides as well. Producing GMOs takes a lot of time and is often expensive. Plus, many people think they are unsafe. This is because they have some foreign DNA. But

what if we can change the crops without changing their DNA?

We tried using special molecules. They can change cell activity. First, we have to insert them into plant cells. For this, we tested sprays with nanocarriers. It turned out to be a success! Many nanocarriers were able to enter the plant cells. Then, we tried spraying nanocarriers with the special molecules. This was also a success! So, we could make the cell do what we wanted.

## Introduction

You might have heard of **genetically modified organisms** (GMOs). But do you know how scientists make them? It usually takes 4 steps:

1. They look for a trait that can improve the **organism**. For example, resistance to **drought** or disease. Then they find another organism that already has that trait. They also find the **DNA** responsible.
2. They copy the desired DNA.
3. They insert the DNA into the organism they wish to change. So, the organism, for example a plant, has some foreign DNA. It makes the plant cells do what the scientists want. The modified DNA also carries on to future generations.
4. Finally, the scientists grow the new organisms, for example plants that are resistant to diseases, drought, insects, etc.

GMOs can definitely be very helpful. But there are some downsides. For one, GMOs take a long time to make. They can also be quite expensive. Plus, many people think GMOs are harmful to our bodies and the environment.

We wondered: what if we can change a plant to have the desired traits without changing its DNA? So that it won't take so much time to produce and it would be cheaper? And much easier to do? This is what we wanted to achieve.

## Methods

Some molecules (for example, DNA) can adjust cells' activity. So we can insert such molecules to control the cells. This way we won't actually change the DNA. It sounds simple enough. But achieving it is not easy! Plus, we wanted an easy application method – one that people can use in agriculture. We decided to try spraying these molecules on the plants.

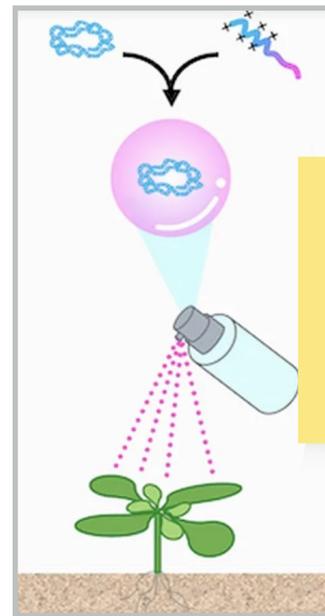
We considered different nanocarriers. Maybe they could insert the special molecules into the cells?

We performed three separate experiments.

**Experiment 1:** Do nanocarriers work as a spray? Which one would be best at entering the plant's cells? To find out, we tagged the nanocarriers with glowing yellow dye. Next, we sprayed this complex (nanocarrier + dye) on the plants' leaves. We then measured the glow.

**Experiment 2:** We wanted to test if these nanocarriers could insert DNA into the cells. So, we combined them with a special DNA complex. If the DNA entered the plants' cells we would see blue spots.

**Experiment 3:** We wanted to see if we could switch off some genes. Our test subject was a modified plant that glows in yellow. We sprayed it with nanocarriers and a special molecule. This molecule should try and block the glow. So if we succeeded, we should see no (or less) glow.



**Figure 1:**  
Spraying the leaves with a nanocarrier with bioactive molecules (DNA or RNA).

## Results

Our experiments showed us that:

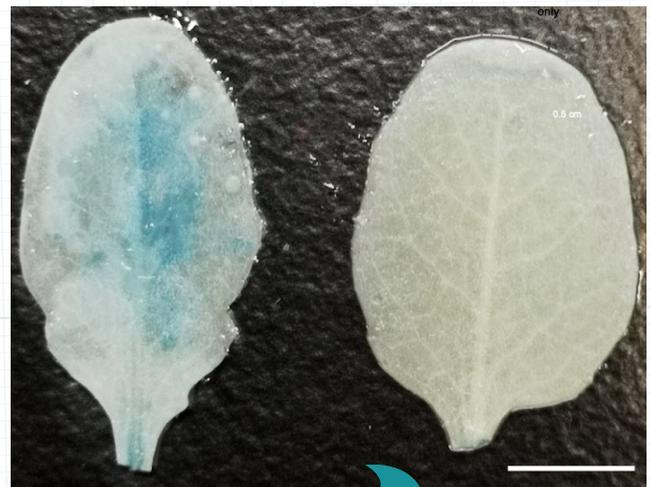
1. The various nanocarriers showed glows with different levels of brightness. So, some nanocarriers were better than others at entering the plants' cells.
2. When we sprayed the plants with the carrier + DNA, there were blue spots. When we sprayed the plants with only DNA, there were no blue spots. (See Fig. 2.) That means the DNA can't enter on its own.
3. Spraying the glowing plant with only the nanocarrier didn't stop the glow. But when we sprayed it in combination with the special molecule, there was less glow.

**Figure 2:**

On the left, we sprayed the plants' leaves with the nanocarrier and DNA complex. On the right, we only sprayed them with the DNA. The blue spots show that the DNA has entered the plants' cells.

**Nanocarrier and DNA**

**Only DNA**



Why are there blue spots in the left image and no blue spots in the right one?

## Discussion

**Our results are quite promising! We were able to control the cells with sprays.** Many natural nanocarriers were able to enter the leaves. The brighter the glow in Experiment 1, the better the carrier enters the cells. They were also able to deliver DNA to the plants' cells. This is what the blue spots in Experiment 2 tell us.

We were also able to switch off some genes. Sometimes, this is as important as inserting new

genes. In Experiment 3, we first sprayed the glowing plant with a nanocarrier. But the glow didn't change. We then sprayed it with a nanocarrier + a special molecule. This molecule should switch off the gene which makes the plant glow. And indeed, the glow was not as bright!

## Conclusion

We were able to change a plant without changing its DNA. Plus, we were able to do so for a lot less time and money! And even better, we found a very easy way of doing it. A handheld spray!

This doesn't mean we should ignore GMOs, though. Do some research to find out what genetically modified crops are grown in your country. What are their benefits? What about their downsides?

## Glossary of Key Terms

**DNA (DeoxyriboNucleic Acid)** – a molecule that carries genetic information. All living organisms read this information for growth, development, function, and reproduction.

**Drought** – a long period with unusually little rain, causing there to be not enough water.

**Gene** – a small section of DNA with the instructions for characteristics of the organism.

**Genetically modified organism (GMO)** – an organism whose DNA has been changed intentionally (in the lab).

**Nanocarrier** – a very tiny material that can transport other substances, such as special molecules, and drugs.

**Organism** – an individual living thing, like a plant or animal.

## REFERENCES

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Kiddle: Nanotechnology Facts for Kids

<https://kids.kiddle.co/Nanotechnology>

National Geographic: Genetically Modified Organisms

<https://education.nationalgeographic.org/resource/genetically-modified-organisms>

## Check your understanding

1 What is the difference between GMOs and the plants we changed with special molecules?

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2 In Experiment 3, there was less glow after we sprayed the nanocarrier + special molecule. Why?

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3 In the same experiment (3) we switched off a gene responsible for the glow. This is not a very important trait. Can you think when switching off a gene can be useful?

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4 Positive traits in crops include resistance to drought or diseases. Can you think of any other positive traits?

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5 Do you support GM crops? Why or why not? Consider how they have helped to address global hunger as well as the risks they present to humans and the environment. Discuss this in small groups in class, or do some research online!

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