# AI and Information Credibility Activity

Provide a handout for each group for their assigned AI tool: Gemini, ChatGPT, Poe, Claude, Consensus, and Google’s AI Overview. Each handout, included, has a link to the chat, the prompt, and the text of the chat.

## Instructions

Each group will be given / assigned one generative AI tools. On 25 Sept. 2024, each tool was fed the prompt: “Provide a summary of how biotechnology can be used with plants to make plants virus resistant. Please provide evidence and sources when applicable. The audience is college students in an entry-level biotechnology course.” (Two tools had modified prompts.)

Each group will evaluate the credibility of the text generated by their assigned tool. Pay special attention to[[1]](#footnote-1):

* **Purpose** - Why does this information exist in the way it does?
* **Objectivity** - What biases may exist in this information? Can you identify any?
* **Verifiability (Accuracy)** - Can you verify this information? Is the generated summary factual? Is there any way for you to know where the information originally came from?
	+ If it provides references or suggested resources, check them against [Google Scholar](https://scholar.google.com/). Do they exist? Or were they hallucinated?
* **Newness** - If it provides references or suggested resources, is the currency of those sources appropriate?

We will debrief as a whole class. Please be prepared to share your thoughts on these four factors for your assigned tool.

# Gemini (Google)

## Instructions:

Evaluate the credibility of the text generated by their assigned tool. Pay special attention to:

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## Access the chat:

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| <https://tinyurl.com/35rkjv64>  |  |

## Prompt (9/25/24):

Provide a summary of how biotechnology can be used with plants to make plants virus resistant. Please provide evidence and sources when applicable. The audience is college students in an entry-level biotechnology course.

## Text of chat (9/25/24):

Biotechnology and Plant Virus Resistance

Biotechnology has revolutionized the way we approach plant diseases, including viral infections. By leveraging genetic engineering techniques, scientists have developed strategies to make plants more resistant to viruses. Here are some key approaches:

1. **Transgenic Plants:**

* **Introduction of foreign genes:** The most common method involves introducing genes from other organisms into plant cells. These genes can encode proteins that interfere with the virus's life cycle.
* **Examples:**
	+ **Coat protein resistance:** Introducing the coat protein gene of a virus into a plant can induce immunity against that virus.
	+ **RNA interference (RNAi):** Introducing genes that produce small RNA molecules can target viral RNA and degrade it, preventing viral replication.

2. **Genome Editing:**

* **Precise modifications:** Genome editing techniques like CRISPR-Cas9 allow for precise modifications to the plant's DNA. This can be used to:
	+ **Disable viral receptors:** Modify genes that encode proteins on the plant cell surface that viruses use to enter the cell.
	+ **Enhance antiviral pathways:** Activate or modify genes involved in the plant's natural defense mechanisms against viruses.

3. **Induced Resistance:**

**Triggering plant defenses:** Biotechnology can be used to identify and activate plant genes that are involved in induced resistance. This involves triggering the plant's defense mechanisms, making it more resistant to a wide range of pathogens, including viruses.

4. **Disease Resistance Breeding:**

**Accelerated breeding:** Biotechnology can accelerate the process of breeding plants with desired traits, including disease resistance. By using molecular markers to identify individuals with resistance genes, breeders can select and cross plants more efficiently.

**Sources:**

* **National Academies of Sciences, Engineering, and Medicine:** <https://nap.nationalacademies.org/catalog/9889/transgenic-plants-and-world-agriculture>
* **Nature Reviews Microbiology:** <https://www.nature.com/articles/s41579-019-0232-3>
* **Annual Review of Phytopathology:** <https://www.annualreviews.org/content/journals/phyto>

In conclusion, biotechnology offers promising solutions for combating plant viruses. By understanding the molecular mechanisms of viral infection and utilizing genetic engineering techniques, scientists are developing plants that are more resilient to these devastating diseases.

# ChatGPT (OpenAI)

## Instructions:

Evaluate the credibility of the text generated by their assigned tool. Pay special attention to:

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## Access the chat:

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| <https://tinyurl.com/3rw6ybrt>  |  |

## Prompt (9/25/24):

Provide a summary of how biotechnology can be used with plants to make plants virus resistant. Please provide evidence and sources when applicable. The audience is college students in an entry-level biotechnology course.

## Text of chat (9/25/24):

Summary: Biotechnology and Virus-Resistant Plants: Biotechnology uses scientific techniques to modify plants in ways that improve their characteristics, such as resistance to viruses. Viral infections in plants can reduce yields and quality, which directly affects global food security. Here's how biotechnology helps:

1. Genetic Engineering

Biotechnology allows scientists to modify the genetic makeup of plants to make them resistant to specific viruses. The most common method involves introducing virus-resistant genes into the plant’s genome. This can be done using tools like:

Recombinant DNA technology: A desired gene is inserted into the plant's DNA, usually through a bacterium (such as Agrobacterium tumefaciens) or using biolistics (gene gun). For example, a gene encoding a viral protein (like coat proteins) may be inserted, triggering a defense response in the plant, similar to how vaccines work in humans.

CRISPR-Cas9: A more recent gene-editing technology, CRISPR allows for precise editing of the plant's genome to introduce mutations or resistance genes at specific locations, potentially making the plant immune to viruses.

2. RNA Interference (RNAi): Another advanced technique is RNA interference (RNAi), where plants are engineered to produce small RNA molecules that target and degrade viral RNA. When a virus tries to infect the plant, these small RNAs bind to the virus's RNA, stopping its replication. This technology has been used to create virus-resistant plants like papaya and squash. The Rainbow papaya is a famous example of a plant made resistant to the Papaya Ringspot Virus using this method.

3. Transgenic Plants: Transgenic plants have been engineered with virus-resistant genes from other organisms. For instance, the gene for a viral coat protein can be inserted into a plant's genome, giving it resistance to that virus. These transgenic plants exhibit immunity or significantly reduced symptoms of viral infections.

Example: Bt Crops

While Bt crops like corn and cotton are better known for their insect resistance, similar principles apply to developing virus-resistant plants. In both cases, biotechnology allows for the introduction of external genes to give plants a built-in defense mechanism against a specific threat.

4. Natural and Artificial Selection: Biotechnology can speed up traditional breeding methods by identifying and selecting natural virus-resistant traits found in wild relatives of crops. Through genetic markers, scientists can isolate and introduce these traits into commercial plant varieties more efficiently.

Evidence and Success Stories

Rainbow papaya is a classic example of a biotechnology success story. In the 1990s, Hawaiian papaya farmers faced near-total devastation from the Papaya Ringspot Virus. Genetic engineering saved the industry by making the papaya virus-resistant through the insertion of a viral coat protein gene.

Potatoes resistant to the Potato Virus Y (PVY) have been developed using RNAi technology, which significantly reduces crop loss due to viral infections.

Conclusion

Biotechnology offers a powerful set of tools to combat plant viruses, increasing crop yields and reducing economic losses. These approaches—whether through genetic engineering, RNA interference, or selection of resistant traits—demonstrate the critical role of biotechnology in modern agriculture.

References

Gonsalves, D. (1998). Control of Papaya Ringspot Virus in Papaya: A Case Study. Annual Review of Phytopathology, 36, 415–437.

Brodersen, P., & Voinnet, O. (2006). The diversity of RNA silencing pathways in plants. Trends in Genetics, 22(5), 268-280.

# Poe AI (Quora)

## Instructions:

Evaluate the credibility of the text generated by their assigned tool. Pay special attention to:

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## Access the chat:

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| <https://tinyurl.com/bdef3aaf>  |  |

## Prompt (9/25/24):

Provide a summary of how biotechnology can be used with plants to make plants virus resistant. Please provide evidence and sources when applicable. The audience is college students in an entry-level biotechnology course.

## Text of chat (9/25/24):

Biotechnology plays a crucial role in developing virus-resistant plants, utilizing various techniques that enhance plant immunity and genetic resilience. Here’s a summary of the key methods and their implications:

1. Genetic Engineering

Genetic engineering involves directly modifying a plant's DNA to enhance its resistance to viruses. This can be achieved through:

Transgenic Approaches: Scientists can insert specific genes from virus-resistant plants or other organisms into the target plant. For example, the introduction of the coat protein gene from a virus can induce a phenomenon known as "pathogen-derived resistance," where the plant produces proteins that inhibit viral replication. Evidence: The development of transgenic papaya resistant to the papaya ringspot virus (PRSV) is a notable success. This genetically modified papaya has been widely adopted in Hawaii, saving the industry from collapse (Futrell et al., 2016).

2. CRISPR-Cas9 Technology

CRISPR-Cas9 allows for precise editing of plant genomes. Scientists can knock out genes that make plants susceptible to viruses or enhance genes that bolster their immune response.

Application: By targeting specific genes associated with susceptibility, researchers have created plants with improved resistance profiles. For instance, modifying the SWEET gene family, which some viruses exploit, can lead to reduced viral load in crops. Evidence: A study demonstrated successful CRISPR-mediated editing in tomato plants, resulting in enhanced resistance against the tomato yellow leaf curl virus (Zhang et al., 2019).

3. RNA Interference (RNAi)

RNAi is a natural cellular process that can be harnessed to silence specific genes. By introducing small interfering RNAs (siRNAs) that target viral RNA, plants can effectively reduce viral replication.

Mechanism: When a virus infects a plant, the introduced siRNAs bind to viral RNA, leading to its degradation before it can replicate. Evidence: Research has shown that RNAi techniques have been successfully applied to develop virus-resistant potato and tomato varieties against viral infections, providing a sustainable method to manage viral outbreaks (Dorr et al., 2018).

4. Marker-Assisted Selection (MAS)

This method involves identifying and selecting plants with desirable traits based on specific genetic markers linked to virus resistance.

Process: By using molecular markers associated with resistance traits, breeders can accelerate the development of virus-resistant varieties without directly modifying the plant’s genome. Evidence: In breeding programs for cassava, MAS has been employed to select for resistance against cassava mosaic disease, significantly improving the efficiency of developing resistant cultivars (Hahn et al., 2019).

Conclusion

Biotechnology offers several powerful tools to enhance virus resistance in plants, combining traditional breeding approaches with modern genetic techniques. The success of these methods not only contributes to food security but also reduces the reliance on chemical pesticides, promoting sustainable agriculture.

References

Futrell, J., et al. (2016). "Genetic Engineering in Papaya: The Fight Against Papaya Ringspot Virus." Plant Biotechnology Journal.

Zhang, Y., et al. (2019). "CRISPR/Cas9-mediated editing of the tomato genome for virus resistance." Nature Biotechnology.

Dorr, S., et al. (2018). "RNA interference as a tool for the development of virus-resistant plants." Molecular Plant Pathology.

Hahn, S.K., et al. (2019). "Marker-assisted selection for cassava virus resistance." African Journal of Agricultural Research.

This summary underscores the innovative applications of biotechnology in enhancing plant health and resilience, vital for future agricultural practices.

# Claude (Anthropic)

## Instructions:

Evaluate the credibility of the text generated by their assigned tool. Pay special attention to:

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* **Newness** - If it provides references or suggested resources, is the currency of those sources appropriate?

## Prompt (9/25/24):

Provide a summary of how biotechnology can be used with plants to make plants virus resistant. Please provide evidence and sources when applicable. The audience is college students in an entry-level biotechnology course.

## Text of chat (9/25/24):

Here's a summary of how biotechnology can be used to make plants virus-resistant, suitable for college students in an entry-level biotechnology course:

Biotechnology offers several approaches to developing virus-resistant plants:

1. Coat Protein-Mediated Resistance: This technique involves introducing the gene for the viral coat protein into the plant's genome. When expressed, this protein interferes with the virus's ability to replicate and spread within the plant.

Evidence: In 1986, researchers at Washington University in St. Louis developed tobacco plants resistant to tobacco mosaic virus using this method. This work, published in PNAS, was a groundbreaking demonstration of the concept.

Source: Powell-Abel, P., et al. (1986). Delay of disease development in transgenic plants that express the tobacco mosaic virus coat protein gene. Science, 232(4751), 738-743.

1. RNA Interference (RNAi): RNAi is a natural defense mechanism in plants that can be enhanced through genetic engineering. By introducing sequences complementary to viral genes, plants can produce small interfering RNAs (siRNAs) that target and degrade viral RNA.

Evidence: A study on cassava plants engineered to express siRNAs targeting cassava brown streak virus showed significant resistance to the virus.

Source: Vanderschuren, H., et al. (2012). Transgenic resistance to Cassava brown streak disease in East African cassava cultivars. Plant Biotechnology Journal, 10(3), 343-352.

1. CRISPR-Cas9 Gene Editing: This newer technique can be used to modify plant genes to enhance natural resistance or to target viral genomes directly.

Evidence: Researchers used CRISPR-Cas9 to engineer resistance to bean yellow dwarf virus in Nicotiana benthamiana plants by targeting the viral genome.

Source: Ali, Z., et al. (2015). CRISPR/Cas9-mediated viral interference in plants. Genome Biology, 16(1), 238.

1. Antimicrobial Peptides: Some plants can be engineered to produce antimicrobial peptides that have antiviral properties.

Evidence: A study showed that tobacco plants expressing a synthetic antimicrobial peptide exhibited resistance to tobacco mosaic virus.

Source: Tripathi, S., et al. (2006). Expression of a synthetic antimicrobial peptide in tobacco confers resistance to plant viruses. Molecular Plant-Microbe Interactions, 19(7), 792-798.

These biotechnological approaches have shown promise in developing virus-resistant plants, potentially reducing crop losses and the need for chemical controls. However, it's important to note that each method has its own set of challenges, including regulatory hurdles and public acceptance of genetically modified organisms.

For students interested in learning more, I recommend exploring review articles on plant biotechnology and virus resistance in journals such as "Trends in Plant Science" or "Annual Review of Phytopathology" for more comprehensive coverage of these techniques and their applications.

# Consensus

## Instructions:

Evaluate the credibility of the text generated by their assigned tool. Pay special attention to:

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## Access the chat:

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| <https://tinyurl.com/53xdjrb9>  |  |

## Prompt (9/25/24):

Can biotechnology be used with plants to make plants virus resistant?

## Text of chat (9/25/24):

**Look for provided references on the online version.**

## **Summary**

Beta

10 papers analyzed

These studies suggest that biotechnology, including genetic engineering and CRISPR/Cas systems, can be used to make plants virus resistant.

### **Introduction**

Biotechnology has emerged as a powerful tool in agriculture, particularly in developing virus-resistant plants. This approach is crucial for mitigating yield losses caused by plant viruses, which pose significant threats to global food security. Various biotechnological strategies have been explored to enhance plant resistance to viruses, leveraging genetic engineering, CRISPR technology, and RNA-based methods.

### **Key Insights**

* **Genetic Engineering for Virus Resistance**:
	+ Genetic engineering can introduce viral genes into plants to confer resistance, overcoming limitations of conventional breeding such as long lead times and loss of desirable traits[1](https://consensus.app/results/?q=Can%20biotechnology%20can%20be%20used%20with%20plants%20to%20make%20plants%20virus%20resistant%3F&synthesize=on&copilot=on#result-1) [4](https://consensus.app/results/?q=Can%20biotechnology%20can%20be%20used%20with%20plants%20to%20make%20plants%20virus%20resistant%3F&synthesize=on&copilot=on#result-4) [6](https://consensus.app/results/?q=Can%20biotechnology%20can%20be%20used%20with%20plants%20to%20make%20plants%20virus%20resistant%3F&synthesize=on&copilot=on#result-6).
	+ Engineered virus resistance is feasible in both monocots and dicots and can be successful in all major crops[5](https://consensus.app/results/?q=Can%20biotechnology%20can%20be%20used%20with%20plants%20to%20make%20plants%20virus%20resistant%3F&synthesize=on&copilot=on#result-5).
* **CRISPR/Cas Technology**:
	+ CRISPR/Cas systems have been successfully used to develop virus-resistant plants by targeting and cleaving viral DNA or RNA, or by mutating host factors required for viral infection[3](https://consensus.app/results/?q=Can%20biotechnology%20can%20be%20used%20with%20plants%20to%20make%20plants%20virus%20resistant%3F&synthesize=on&copilot=on#result-3) [7](https://consensus.app/results/?q=Can%20biotechnology%20can%20be%20used%20with%20plants%20to%20make%20plants%20virus%20resistant%3F&synthesize=on&copilot=on#result-7) [8](https://consensus.app/results/?q=Can%20biotechnology%20can%20be%20used%20with%20plants%20to%20make%20plants%20virus%20resistant%3F&synthesize=on&copilot=on#result-8) [9](https://consensus.app/results/?q=Can%20biotechnology%20can%20be%20used%20with%20plants%20to%20make%20plants%20virus%20resistant%3F&synthesize=on&copilot=on#result-9).
	+ Plant viruses can also be used as vectors to deliver CRISPR components into plants, enhancing the efficiency of this technology[3](https://consensus.app/results/?q=Can%20biotechnology%20can%20be%20used%20with%20plants%20to%20make%20plants%20virus%20resistant%3F&synthesize=on&copilot=on#result-3).
* **RNA-Based Technologies**:
	+ RNA interference (RNAi) technologies, including the use of small RNAs and double-stranded RNAs, can be employed to engineer virus resistance in plants[7](https://consensus.app/results/?q=Can%20biotechnology%20can%20be%20used%20with%20plants%20to%20make%20plants%20virus%20resistant%3F&synthesize=on&copilot=on#result-7).
	+ RNA-guided CRISPR-Cas systems have been deployed to inhibit plant virus infections, offering a comparative advantage over traditional RNAi approaches[7](https://consensus.app/results/?q=Can%20biotechnology%20can%20be%20used%20with%20plants%20to%20make%20plants%20virus%20resistant%3F&synthesize=on&copilot=on#result-7).
* **Synthetic Gene Design**:
	+ Synthetic gene design, such as modifying the Arabidopsis thaliana translation initiation factor eIF4E1, can lead to broad and efficient resistance to potyviruses without impairing plant development[2](https://consensus.app/results/?q=Can%20biotechnology%20can%20be%20used%20with%20plants%20to%20make%20plants%20virus%20resistant%3F&synthesize=on&copilot=on#result-2).
* **Pathogen-Derived Resistance**:
	+ The expression of viral coat protein genes in transgenic plants can induce protective effects similar to classical cross-protection, known as 'coat-protein-mediated' protection[10](https://consensus.app/results/?q=Can%20biotechnology%20can%20be%20used%20with%20plants%20to%20make%20plants%20virus%20resistant%3F&synthesize=on&copilot=on#result-10).
	+ Non-coding viral RNA has also been shown to trigger virus resistance, leading to the discovery of RNA silencing as a novel innate resistance mechanism in plants[10](https://consensus.app/results/?q=Can%20biotechnology%20can%20be%20used%20with%20plants%20to%20make%20plants%20virus%20resistant%3F&synthesize=on&copilot=on#result-10).

### **Conclusion**

Biotechnology offers several promising strategies for developing virus-resistant plants, including genetic engineering, CRISPR/Cas technology, RNA-based methods, and synthetic gene design. These approaches can provide broad-spectrum and durable resistance, addressing the limitations of conventional breeding and chemical control methods. As these technologies continue to advance, they hold significant potential for enhancing crop protection and ensuring global food security.

# Google’s AI Overview

## Instructions:

Evaluate the credibility of the text generated by their assigned tool. Pay special attention to:

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## Access the chat:

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| <https://tinyurl.com/5d5d4e9v>  |  |

## Prompt (9/25/24):

How can biotechnology be used with plants to make plants virus resistant?

## Text of chat (9/25/24):

**Look for links to reference websites on the online version.**

Biotechnology can be used to make plants virus resistant by employing genetic engineering techniques, primarily using tools like CRISPR-Cas9, to introduce genes from viruses or modify existing plant genes that provide resistance mechanisms against viral infections, essentially allowing the plant to "fight off" the virus more effectively; this can involve directly targeting the viral genome within the plant cell or manipulating specific host plant genes that are crucial for viral replication.

Key mechanisms of virus resistance through biotechnology:

* Pathogen-derived resistance (PDR):

Introducing a specific viral gene (like the coat protein gene) into the plant, causing the plant to produce a viral protein that interferes with the virus's ability to infect, essentially "priming" the plant's defense system.

* RNA interference (RNAi):

Engineering plants to produce small RNA molecules that target and degrade viral RNA, preventing the virus from replicating.

* CRISPR-Cas9 gene editing:

Precisely modifying plant genes to enhance resistance by either directly targeting the viral genome within the plant cell or altering host plant genes essential for viral infection.

Examples of virus-resistant plants developed using biotechnology:

* Papaya resistant to Papaya ringspot virus:

Transgenic papaya plants expressing the viral coat protein gene have been successfully commercialized.

* Tomato plants resistant to Tomato mosaic virus:

Researchers have used CRISPR-Cas9 to edit specific tomato genes, making them more resistant to the virus.

Important considerations:

* Specificity:

The resistance needs to be targeted against specific viruses to avoid unintended effects.

* Regulatory concerns:

Genetically modified plants often face strict regulations before they can be commercially grown.

* Potential for resistance breakdown:

Viruses can evolve to overcome resistance mechanisms, requiring ongoing research to develop durable resistance strategies.

1. This list of criteria is based on and modified from the ["P.R.O.V.E.N. Source Evaluation Process"](https://projectcora.org/assignment/proven-source-evaluation-process) by [Ellen Carey](https://projectcora.org/users/buddhabrarian). [CC BY-NC-SA 3.0](https://creativecommons.org/licenses/by-nc-sa/3.0/deed.en). [↑](#footnote-ref-1)