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Let's Beet Pesticides!

Neonicotinoids are **effective but harmful pesticides** that have been conditionally approved **4 years in a row** in the **UK**. The argument for this is the extermination of **aphids** who spread **Virus Yellows (VYs)**, which infects **sugar beets**. Sugar beet farming is the **single largest agriculture** in the UK, making its crop yield important to the nation's economy.

More **sustainable methods** of controlling aphids and VYs that do not sacrifice crop yield are needed as even the limited use of neonics has **profound negative effects**.

1 Sugar Beet Farming

7.6 million tonnes were produced in 2018.
Almost **all UK sugar** products are **domestically produced**.
110,000 hectares of land are dedicated to **sugar beets**.

- **116,000 hectares** are dedicated to **all UK vegetable crops combine**d.

UK consumes **~3690 tonnes** of free sugars per day.

- This exceeds the World Health Organisation's recommended allowance.

Excess land could be dedicated to **other crops**.
Adds a further **13-21%** of **topsoil loss** due to later harvest in autumn and wetter soil.

2 Neonicotinoids (Neonics)

Banned in EU since 2018.

- The UK left the EU in 2020.

The neonic **Cruiser SB**, which contains **thiamethoxam**, was approved in January 2024.

They are **neurotoxins**, having adverse impacts on the environment and humans:

- Relatively **persistent**
- **Water soluble** – found in **>10%** of **UK river systems**
- **~5%** of seed coating is **absorbed by crop** - remainder dispersed to environment
- Threaten **soil-dwelling biota** and **soil fertility**

3 Virus Yellows (VYs)

Complex of **3 viruses**:

- Beet Mild Yellowing Virus
- Beet Chlorosis Virus
- Beet Yellows Virus.

Reduces **photosynthetic capacity**.

- Impacts **growth**, **sugar content**, and **yield**.

It is spread by (peach potato) **aphids** during **summer**.

In 2020, national yield was **reduced by 20%**.
Threat level of VYs is **predicted annually**. If threat level **surpasses 64%**, neonics are **approved** for usage.

- Predictive model by Rothamsted tends to overestimate the threat level

Our SDGs:

Solutions

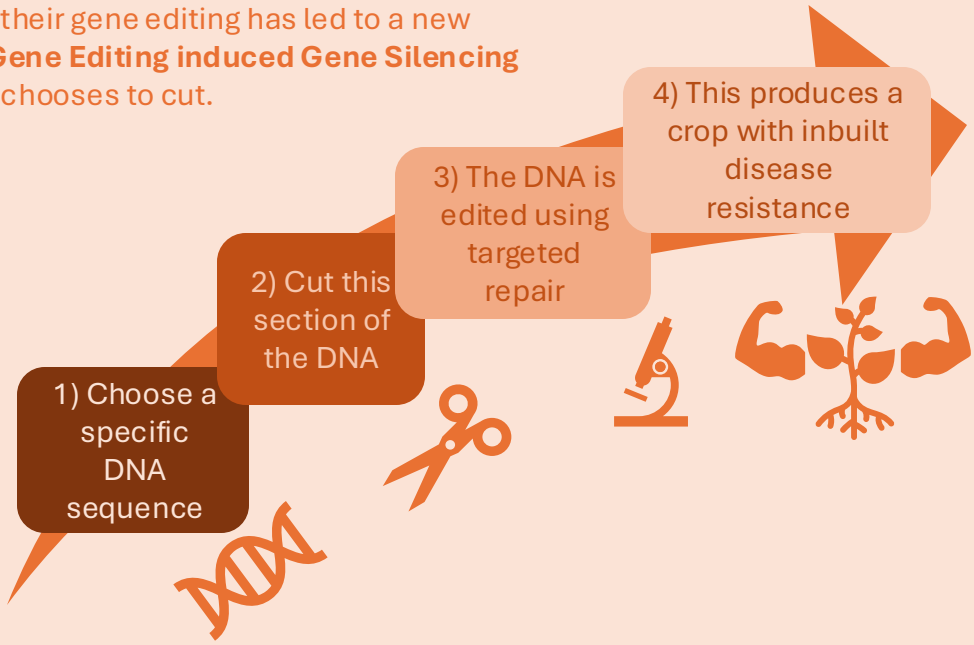
Gene editing:

- One way in which sugar beets are being protected from VYs is by **gene editing**. Currently this is being researched by a biotech company called **Tropic.**
- Gene editing involves making changes to the genome of an organism.
- This is done alongside **genetic silencing** which is a natural process where active parts of a DNA sequence are deactivated.

Challenges:

- This process can be seen as quite controversial due to its association with **genetic modification** which raises lots of concerns such as **increased food allergy sensitivity.** But unlike genetic modification, none of the inserted DNA comes from other species and the process occurs naturally too, just on a much slower timescale.
- This doesn't mean that gene editing doesn't have its issues. Generally, many of the methods used for gene editing can **affect non-target sites on the DNA.**

- However, Tropic's use of gene silencing in their gene editing has led to a new technological platform called **GEiGS®** or **Gene Editing induced Gene Silencing** which is more precise in the sequences it chooses to cut.



Our Proposed Solutions:

Other viable methods involve finding ways to use pesticides more safely such as by:

- **Limiting pesticide leakage** by planting **contour buffer strips**. These are strips of **long-term perennial plants** that are farmed contouring the topography of the land and they can be highly successful at **trapping pesticide run off**.
- **Vertical farming** could be used as the **shallow roots** common of root vegetables makes them suitable for this method of growth. This is also an incredibly effective way at making use of **available space** as the continuously **growing population** requires an increasing amount of food production, but **available arable land is decreasing**.

Integrated Pest Management:

Gene editing is very advanced and a long-term investment. What options are available to be employed in the **short-term?** So far, some methods of integrated pest management being used involve:

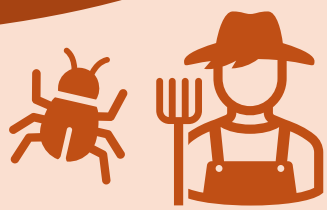
- **Camouflaging** sugar beets using **inter-row cover crops** or by exploring how **natural soil colourings** can confuse aphid detection systems.
- Aphids also detect the sugar beets by smell so **companion crops** such as onions, peppermint and garlic can be used to deter them from the crops.
- Work is being done to make conditions habitable for **natural predators** like lacewing larvae and ladybirds so that they can reduce the aphid population using **biological control**.

Implementation of Integrated Pest Management (IPM)

Farmer Tom Clarke in the Fens is being used as a **case study for implementing IPM** into local farming.
His successes include **high pest control** using **camouflage crops.** However, there was a notable **reduction in yield** as camouflage crops competed with the sugar beets for nutrients**.**
Reduced herbicides were also used which allowed for **more habitats for both the aphids and natural predators,** but again it caused competition between the crop and plant species.
Therefore, it is clear there is a need for new technological advancement such as **GEiGS** as IPM alone is not effective at both pest control and maintaining high yields.

Future of GEiGS:

In February, the Department for Environment, Food and Rural Affairs' Farming Programme donated £663,443 of the £1 million project cost to Tropic, British Sugar and the John Innes Centre of plant science (JIC) to allow the development of naturally resistant sugar beets to the Virus Yellows infection.



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Progress and next steps:

We hope our new proposed method of farming sugar beets in the UK can be used as a **model** to be followed in **other regions** and for **other crops**.

- Similar process, methodology and aims can be applied to agriculture in **different climates**

With a **food security** and **arable land crisis** on the horizon as **population rises**, sustainable farming will only get more crucial with time.

We hope our proposal is a viable way to avert said crisis.