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News: Genetically Modified Mosquitoes

- Recently, the US conducted an open-air study of genetically engineered mosquitoes which shows promising results.
- The aim of the study is to reduce the population of wild *Aedes aegypti* mosquitoes that are a vector for viruses such as chikungunya, dengue, zika and yellow fever.
- The mosquitoes had already been field-tested in Brazil, Panama, the Cayman Islands, and Malaysia, but no such study was conducted in the United States.

Genetically Modified (GM) Mosquitoes

- Genetically Modified (GM) Mosquitoes are mass-produced in a laboratory to carry two types of genes.
- A self-limiting gene that prevents female mosquito offspring from surviving to adulthood.
- A fluorescent marker gene that glows under a special red light. This allows researchers to identify GM mosquitoes in the wild.
- GM mosquitoes produced in the laboratory lay eggs. These eggs carry the self-limiting and fluorescent marker genes.

- GM mosquito eggs that carry the self-limiting gene are released into an area. Once they have hatched and develop through to the adult stage, they are available to mate with wild females. The genes are passed on to offspring.
- The male mosquitoes have a protein (the tTAV-OX5034 protein) that prevents female offspring from surviving when male OX5034 mosquitoes mate with wild female mosquitoes.
- The female offspring die before they become adults. The expected result is that the number of *Aedes aegypti* mosquitoes in the area decreases.

Related Concerns

- Genetically modifying insects to control their population to curb the spread of a disease is not a novel idea. Similar efforts began a decade ago, with scientists now attempting to engineer ticks to prevent diseases.
- The concerns ranged from the modified mosquitoes harming people, its impact on mosquito-eating species and other unintended consequences such as the emergence of a deadly virus.
- Experts also believe that reducing the population of the virus spreading mosquito is not enough to curb a potential outbreak.

Genetically Modified Crops

- Genetic modification aims to transcend the genus barrier by introducing an alien gene in the seeds to get the desired effects. The alien gene could be from a plant, an animal or even a soil bacterium.
- In India, the Genetic Engineering Appraisal Committee (GEAC) is the apex body that allows for commercial release of GM crops.
- In 2002, the GEAC had allowed the commercial release of Bt cotton. More than 95% of the country's cotton area has since then come under Bt cotton.
- Use of the unapproved GM variant can attract a jail term of 5 years and fine of Rs. 1 lakh under the Environment Protection Act, 1986.
- Advantages of GM Crops include Higher Yields, Enhanced nutritional value, longer shelf life, Increased resistance to droughts, Increased resistance to insects, pests & locusts and increased resistance to herbicides.
- Disadvantages of GM crops are it may cause allergies, Antimicrobial resistance and may lead to Cancer.

Zika Virus

- Zika virus is a mosquito-borne flavivirus that was first identified in Uganda in 1947 in monkeys. It was later identified in humans in 1952 in Uganda and the United Republic of Tanzania.

- ZVD is caused by a virus transmitted primarily by **Aedes mosquitoes (AM)**, mainly **Aedes aegypti**. This is the **same mosquito that transmits dengue, chikungunya and yellow fever**.
- Zika virus is also transmitted from **mother to fetus during pregnancy**, through **sexual contact, transfusion of blood and blood products, and organ transplantation**.

Symptoms

- Symptoms are generally mild and include fever, **rash, conjunctivitis, muscle and joint pain, malaise or headache**. Most people with Zika virus infection do not develop symptoms.
- Zika virus infection during pregnancy can cause infants to be born with microcephaly (smaller than normal head size) and other congenital malformations, known as congenital Zika syndrome.
- There is **no vaccine or medicine for Zika**. Instead, the focus is on relieving symptoms and includes rest, rehydration and acetaminophen for fever and pain.
- Recently, **Zika Virus Disease (ZVD) was reported for the first time in Kerala**.
- The **Kerala Health Department has formulated an action plan** for coordinated efforts to check the spread of Zika infection in the State.

Dengue Fever

- Dengue Fever is a **mosquito-borne tropical disease caused by the dengue virus** (Genus Flavivirus), transmitted by several species of mosquito within the genus Aedes, principally **Aedes aegypti**.
- This **mosquito also transmits chikungunya, yellow fever and Zika infection**.
- There are **4 distinct, but closely related, serotypes** (separate groups within a species of microorganisms that all share a similar characteristic) of the virus that cause dengue (**DEN-1, DEN-2, DEN-3 and DEN-4**).
- Symptoms of dengue are **sudden high fever, severe headaches, pain behind the eyes, severe bone, joint, and muscle pain**, etc.
- Diagnosis of dengue infection is done with a **blood test**.
- There is **no specific medicine to treat** dengue infection.

Status of Dengue

- **Incidence of dengue has grown dramatically around the world**, in recent decades with a vast majority of cases underreported, according to the World Health Organization.
- WHO estimates 39 crore dengue virus infections per year, of which 9.6 crore show symptoms.

- India registered over 1 lakh dengue cases in 2018 and over 1.5 lakh cases in 2019, according to the National Vector-Borne Disease Control Programme (NVBDCP).
- National Vector-Borne Disease Control Programme (NVBDCP) is the central nodal agency for prevention and control of six vector borne diseases i.e. Malaria, Dengue, Lymphatic Filariasis, Kala-azar, Japanese Encephalitis and Chikungunya in India. It works under the Ministry of Health and Family Welfare.

Controlling Dengue Using Bacteria

- Recently researchers from the World Mosquito Program have used mosquitoes infected with Wolbachia bacteria to successfully control dengue in Indonesia.
- The scientists infected some mosquitoes with Wolbachia and then released them in the city where they bred with local mosquitoes, until nearly all mosquitoes in the area were carrying Wolbachia bacteria. This is called the Population Replacement Strategy.
- At the end of 27 months, the researchers found that the incidence of dengue was 77% lower in areas where Wolbachia-infected mosquitoes had been released, as compared to areas without such deployments.

Dengue Vaccine

- The dengue vaccine CYD-TDV or Dengvaxia was approved by the US Food & Drug Administration in 2019, the first dengue vaccine to get the regulatory nod in the US.
- Dengvaxia is basically a live, attenuated dengue virus which has to be administered in people of ages 9 to 16 who have laboratory confirmed previous dengue infection and who live in endemic areas.