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Muzaffarnagar - 251001, NCR (U.P.)
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**Date: 05-10-2024**

**To,**

**Dr. Dinesh Panwar**
**Assistant Professor**
**Department of Microbiology**
**CCS University Campus**
**Meerut**

Respected Sir,

We are pleased to inform you that we are planning to organize a guest lecture titled "Advances in Gene Editing Technologies and their Applications in Biotechnology" in the Auditorium of SRC October 21, 2024, at 10:00 AM. As per our telephonic discussion, we are expecting your precious time to deliver the above lecture.

With regards,

**Dr. Vipin Kumar Saini**
**Head**
**Department of Bioscience**

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**Shri Ram College, Muzaffarnagar**
**Department of Bioscience**

**Date: 10-10-2024**

**NOTICE**

A guest lecture will be delivered by Dr. Dinesh Panwar, Assistant Professor, Department of Microbiology, CCS University, Meerut, on the topic "Advances in Gene Editing Technologies and their Applications in Biotechnology" in the Auditorium of SRC on 21 October 2024 at 10:00 AM. It is requested to arrive on time to make this program successful.

Dr. Vipin Kumar Saini
Head
Department of Bioscience

**Copy to: For Kind Information and Necessary Action**

1- *Dr. Prerna Mittal (Principal, Shri Ram College)*
2- *Dr. Ashok Kumar (Director, Shri Ram College)*
3- *Dr. Saurabh Mittal (Vice Principal, Shri Ram College)*
4- *Dr. Vinit Kr. Sharma (Dean, Academics, Shri Ram College)*
5- *Dr. Parmod Kumar (HoD, Physical Education)*
6- *Dr. Manoj Dhiman (Dean, Fine Arts)*
7- *Dr. Ashfaq Ali (HoD, Commerce)*
8- *Dr. Shweta Rathi (Dean, Home Science)*
9- *Dr. Pooja Tomar (HoD, Basic Science)*
10- *Dr. Vipin Kumar Saini (HoD, Biosçieces)*
11- *Dr. Ravi Gautam (HoD, JMC)*
12- *Dr. Vivek Kumar Tyagi (HoD, Business Administration)*
13- *Dr. Nayeem Ali (HoD, Agriculture)*

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Date: 21.10.2024

**To whom it may concern**

This is to certify that Dr. Dinesh Panwar, Assistant Professor, Department of Microbiology, CCS University, Meerut has delivered a guest lecture on the topic "Advances in Gene Editing Technologies and their Applications in Biotechnology" in the Auditorium of SRC for U.G. & P.G. students at 10:00 AM on 21.10.2024. His lecture was very effective and has enlightened our students and faculty members.

**Dr. Vipin Kumar Saini**
**Head**
**Department of Bioscience**

Co-ordinator
IQAC, Shri Ram College,
Muzaffarnagar

Chairman
IQAC, Shri Ram College,
Muzaffarnagar

Contact @ 9927028908, 99270114
Website : www.srgcmzn.com E-Mail : src_mzn@rediffmail.c

# ADVANCES IN GENE EDITING TECHNOLOGIES AND THEIR APPLICATIONS IN BIOTECHNOLOGY

BY
DR. DINESH PANWAR

## What is Gene Editing

- Precise alteration of DNA sequences within a living organism.
- Ability to add, remove, or modify genetic material at specific locations.
- A powerful tool for understanding gene function, developing new therapies, and improving crops.
- Moved beyond traditional genetic engineering by offering unprecedented precision.

## Evolution of Gene Editing Tools

**Early Methods (Non-specific):** Random mutagenesis, homologous recombination.

**First-Generation Tools:**

**Zinc Finger Nucleases (ZFNs):** Engineered proteins that bind to specific DNA sequences and cut the DNA.

**Transcription Activator-Like Effector Nucleases (TALENs):** Similar to ZFNs, but use a different DNA-binding domain, offering more flexibility.

**Third-Generation & Beyond:**

**CRISPR-Cas9:** Revolutionary system inspired by bacterial immune defense.

## CRISPR-Cas9: The Game Changer

**CRISPR:** Clustered Regularly Interspaced Short Palindromic Repeats.

**Cas9:** CRISPR-associated protein 9 (a nuclease).

Guide RNA (gRNA) directs Cas9 to a specific DNA sequence.

Cas9 makes a precise cut (double-strand break) in the DNA.

Cell's natural repair mechanisms (NHEJ or HDR) are then leveraged to introduce desired changes.

**Advantages:** Simpler, faster, cheaper, and more efficient than previous methods.

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## Applications in Medicine: Gene Therapy

**Monogenic Disorders:**
**Sickle Cell Disease:** Correcting the faulty gene in hematopoietic stem cells.
**Cystic Fibrosis:** Targeting the CFTR gene.
**Huntington's Disease:** Silencing disease-causing genes.
**Cancer Immunotherapy:**
Modifying T-cells (CAR T-cells) to enhance their ability to target and destroy cancer cells.
**Viral Infections:** Developing resistance to HIV and other viruses by targeting viral DNA.

## Applications in Medicine: Drug Discovery & Diagnostics

**Drug Discovery:**
Creating disease models (in vitro and in vivo) to study disease mechanisms.
High-throughput screening for potential drug targets and compounds.
**Diagnostics:**
CRISPR-based diagnostic tools (e.g., SHERLOCK, DETECTR) for rapid and sensitive detection of pathogens (viruses, bacteria) and genetic mutations.
Potential for point-of-care diagnostics.

## Applications in Agriculture

**Crop Improvement:**
**Increased Yield:** Enhancing photosynthesis efficiency.
**Disease Resistance:** Engineering crops to resist pathogens (e.g., powdery mildew in wheat, blight in potatoes).
**Stress Tolerance:** Developing crops resilient to drought, salinity, and extreme temperatures.
**Nutritional Enhancement:** Increasing vitamin content or reducing allergens.
**Livestock Improvement:**
Disease resistance (e.g., African swine fever).
Improved growth rates and meat quality.

## Industrial and Environmental Applications

**Biofuel Production:** Engineering microorganisms for more efficient biofuel synthesis.
**Bioremediation:** Developing microbes to degrade pollutants (e.g., plastics, oil spills).
**Material Science:** Creating novel biomaterials with enhanced properties.
**Pest Control (Gene Drives):** Potential for controlling invasive species or disease vectors (e.g., mosquitoes carrying malaria) by spreading specific genes through a population. (Note: High ethical scrutiny).

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## Ethical Considerations and Challenges

**Germline Editing:** Ethical debate around editing genes in embryos/gametes (heritable changes).
**Off-target Effects:** Unintended edits at non-target sites.
**Mosaicism:** Some cells edited, others not.
**Accessibility & Equity:** Ensuring equitable access to gene therapies.
**Societal Impact:** Potential for "designer babies" and exacerbating inequalities.
**Regulatory Frameworks:** Need for robust and adaptable regulations.

## Future Prospects and Innovations

**Base Editing:** Directly changing single DNA bases without double-strand breaks.
**Prime Editing:** "Search and replace" genome editing, allowing for precise insertions, deletions, and all 12 possible base-to-base changes.
**New Cas Enzymes:** Discovery of smaller, more specific, or versatile Cas proteins (e.g., Cas12, Cas13 for RNA editing).
**Improved Delivery Methods:** Developing safer and more efficient ways to deliver gene editing tools to target cells (e.g., AAV vectors, nanoparticles).
**CRISPR-based Epigenetic Editing:** Modifying gene expression without altering the underlying DNA sequence.

## Conclusion

Gene editing technologies, particularly CRISPR-Cas9, have revolutionized biological research and hold immense promise. They offer unprecedented precision to address some of humanity's greatest challenges in health, food security, and environmental sustainability.
Continued research, responsible innovation, and robust ethical discussions are crucial to harness their full potential safely and equitably.
The future of biotechnology is being written, one gene edit at a time.

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# SHRI RAM COLLEGE, MUZAFFARNAGAR
## DEPARTMENT OF BIOSCIENCE

## GUEST LECTURE ON ADVANCES IN GENE EDITING TECHNOLOGIES AND THEIR APPLICATIONS IN BIOTECHNOLOGY

### LIST OF PARTICIPANTS

**2024-25** **Date-21-10-2024**

| S.No. | STUDENTS | CLASS | SIGNATURE |
|---|---|---|---|
| 1 | AAFIYA KHAN | M.Sc. Biotechnology 1st Year | |
| 2 | AAKANSHA SHARMA | M.Sc. Biotechnology 2nd Year | Aakansha |
| 3 | AASTHA TOMAR | M.Sc. Microbiology 1st Year | Aastha Tomar |
| 4 | AAYRA | M.Sc. Microbiology 2nd Year | Aayra |
| 5 | ABHISHEK | B.Sc. Biotechnology 3rd Year | Abhishek |
| 6 | ABHISHEK | B.Sc. Biotechnology 3rd Year | Abhishek |
| 7 | ADITYA PAL | B.Sc. Biotechnology 3rd Year | Aditya |
| 8 | AFREEN | B.Sc. Microbiology 3rd Year | Afreen |
| 9 | AFROJ RATHOUR | M.Sc. Biotechnology 2nd Year | Afroj |
| 10 | AKANSHA AHALAWAT | M.Sc. Microbiology 2nd Year | Akansha |
| 11 | AKDAS | B.Sc. Microbiology 1st Year | Akdas |
| 12 | AKSHAY KUMAR | M.Sc. Biotechnology 1st Year | Akshay |
| 13 | AKSHI TYAGI | M.Sc. Microbiology 2nd Year | Akshi Tyagi |
| 14 | AKSHITA SHARMA | M.Sc. Microbiology 1st Year | Akshita |
| 15 | ALISHA | B.Sc. Microbiology 3rd Year | Alisha |
| 16 | ALISHA BABY | B.Sc. Microbiology 1st Year | Alisha baby |
| 17 | ALIYA | B.Sc. Biotechnology 3rd Year | Aliya |
| 18 | ALVEERA | B.Sc. Biotechnology 3rd Year | Alveera |
| 19 | AMAN | B.Sc. Microbiology 2nd Year | Aman |
| 20 | AMANKUMAR | M.Sc. Biotechnology 2nd Year | Aman |

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| | | | |
|---|---|---|---|
| 21 | ANAM | M.Sc. Microbiology 2nd Year | Anam |
| 22 | ANANDITA DESHWAL | B.Sc. Microbiology 3rd Year | Anandita |
| 23 | ANANT KUMAR | B.Sc. Microbiology 1st Year | Anant |
| 24 | ANAS | M.Sc. Microbiology 2nd Year | Anas |
| 25 | ANCHAL PAL | M.Sc. Microbiology 2nd Year | Anchal Pal |
| 26 | ANJALI | B.Sc. Microbiology 1st Year | Anjali |
| 27 | ANJALI DANGAR | B.Sc. Microbiology 1st Year | Anjali |
| 28 | ANJALI TOMAR | M.Sc. Biotechnology I Year | ,, Anjali |
| 29 | ANSHIKA SEN | M.Sc. Microbiology 1st Year | Anshika sen |
| 30 | ANSHU | B.Sc. Microbiology 3rd Year | Anshu |
| 31 | ANTIM | M.Sc. Microbiology 2nd Year | Antim |
| 32 | ANU | B.Sc. Microbiology 1st Year | Anu |
| 33 | ANUJ | B.Sc. Microbiolcgy 3rd Year | Anuj |
| 34 | ANUJ KUMAR | M.Sc. Microbiology 2nd Year | Anuj |
| 35 | ANUP KUMAR | B.Sc. Microbiology 1st Year | Anup kumar |
| 36 | ANURAG SHARMA | B.Sc. Microbiology 3rd Year | Anurag |
| 37 | ANUSHKA | B.Sc. Biotechnology 3rd Year | Anushka |
| 38 | APARAJEETA ARYA | B.Sc. Biotechnology 3rd Year | Aparajeeta |
| 39 | ARANSHA ANJUM | B.Sc. Microbiolcgy 2nd Year | Aransha |
| 40 | ARASALAN | B.Sc. Microbiology 1st Year | Arasalan |
| 41 | AREEBA USMANI | B.Sc. Microbiology 2nd Year | Areeba Usmani |
| 42 | ARPAN SINGH | M.Sc. Microbiology 1st Year | Arpan Singh |
| 43 | ARSHI CHOUDHARY | M.Sc. Biotechnology 2nd Year | Arshi |
| 44 | ARYA SHARMA | B.Sc. Microbiology 2nd Year | Arya |
| 45 | ARYAN TOMAR | B.Sc. Microbiolcgy 3rd Year | Aryan |
| 46 | ARYAN TYAGI | M.Sc. Microbiology 2nd Year | Aryan tyagi |
| 47 | ASBA | M.Sc. Microbiology 1st Year | Asba |

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| | | | |
|---|---|---|---|
| 48 | ASTHA | B.Sc. Microbiology 1st Year | Astha |
| 49 | ATIKA | B.Sc. Microbiology 3rd Year | |
| 50 | ATUL BHARDWAJ | B.Sc. Microbiology 2nd Year | |
| 51 | AVNI SHARMA | M.Sc. Microbiology 2nd Year | Avni |
| 52 | AYESHA | M.Sc. Biotechnology 1st Year | Ayesha |
| 53 | AYUSHI DHIMAN | B.Sc. Microbiology 2nd Year | |
| 54 | BHAWANA | M.Sc. Microbiology 1st Year | |
| 55 | CHHAVI SINGHAL | B.Sc. Biotechnology 3rd Year | |
| 56 | CHIRAG | B.Sc. Microbiology 2nd Year | chirag |
| 57 | DHEERAJ | B.Sc. Microbiology 2nd Year | |
| 58 | DIKSHA TYAGI | M.Sc. Microbiology 1st Year | |
| 59 | DIPANSHU | M.Sc. Microbiology 1st Year | Dipanshu |
| 60 | DISHA DIXIT | B.Sc. Microbiology 3rd Year | Disha Dixit |
| 61 | DIVAM | B.Sc. Biotechnology 3rd Year | Divam |
| 62 | FARHEEN BANO | B.Sc. Microbiology 1st Year | Farheen Bano |
| 63 | GARIMA | B.Sc. Microbiology 1st Year | Garima |
| 64 | GARIMA KUMARI | B.Sc. Microbiology 2nd Year | Garima Kumari |
| 65 | GAUTAM KUMAR | M.Sc. Biotechnology 2nd Year | Gautam Kumar |
| 66 | GHANSHYAM SHARMA | B.Sc. Microbiology 1st Year | Ganshyam |
| 67 | HIMANSHU | M.Sc. Biotechnology 1st Year | Himanshu |
| 68 | HRITIKA CHOUDHARY | M.Sc. Biotechnology 1st Year | Hritika |
| 69 | IQRA | B.Sc. Microbiology 1st Year | Iqra |
| 70 | IQRA PARVEEN | M.Sc. Biotechnology 2nd Year | Iqra |
| 71 | IRAM PARVEEN | B.Sc. Microbiology 1st Year | Iram |
| 72 | ISHA | M.Sc. Biotechnology 2nd Year | Isha |
| 73 | ISKANT | B.Sc. Microbiology 1st Year | |
| 74 | JOYAPARVEEN | M.Sc. Microbioligy 1st Year | |

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| 76 | KAIF ANWAR | B.Sc. Microbiology 1st Year | |
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| 79 | KANIKA RANI | M.Sc. Microbiology 1st Year | |
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| 83 | KHUSHI | B.Sc. Microbiology 2nd Year | |
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| 87 | KM TANU | M.Sc. Biotechnology 2nd Year | |
| 88 | KM. MUSKAN | M.Sc. Biotechnology 2nd Year | |
| 89 | KRISH VEER | B.Sc. Microbiology 1st Year | |
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| 91 | MAHAK PUNDIR | B.Sc. Biotechnology 2nd Year | |
| 92 | MAHITYAGI | M.Sc. Biotechnology 2nd Year | |
| 93 | MANSI RANI | B.Sc. Biotechnology 2nd Year | |
| 94 | MANSI SHARMA | M.Sc. Microbiology 1st Year | |
| 95 | MANTASHA PARVEEN | M.Sc. Biotechnology 1st Year | |
| 96 | MOHAMMAD ANAS | B.Sc. Microbiology 2nd Year | |
| 97 | MOHAMMAD HABIBULLAH | B.Sc. Biotechnology 2nd Year | |
| 98 | MOHD BASHARAT | B.Sc. Microbiology 2nd Year | |
| 99 | MOHD ANAS | B.Sc. Biotechnology 2nd Year | |
| 100 | MOHD DANISH CHAUDHARY | M.Sc. Biotechnology 2nd Year | |
| 101 | MOHD KADIR | B.Sc. Microbiology 2nd Year | |

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| 103 | MOHD SALMAN | B.Sc. Biotechnology 2nd Year | Salman |
| 104 | MOHD. FAISAL | B.Sc. Biotechnology 2nd Year | Faisal |
| 105 | MUSKAN SAIFI | B.Sc. Biotechnology 3rd Year | Muskan |
| 106 | NAMRA PARVEEN | B.Sc. Biotechnology 2nd Year | Namra |
| 107 | NANDANI TYAGI | M.Sc. Microbiology 1st Year | Nandini |
| 108 | NARGIS SHAHZAD | M.Sc. Microbiology 1st Year | Nargis |
| 109 | NAZISH | M.Sc. Microbiology 1st Year | Nazish |
| 110 | NAZIYA | B.Sc. Biotechnology 1st Year | Naziya |
| 111 | NIKITA | B.Sc. Biotechnology 3rd | Nikita |
| 112 | NIRDESH KUMAR | B.Sc. Biotechnology 1st Year | Nisha |
| 113 | NISHA IRFAN | B.Sc. Biotechnology 2nd Year | Nisha |
| 114 | NITISH PAL | B.Sc. Biotechnology 1st Year | Nitish |
| 115 | PAYAL RAJPUT | B.Sc. Biotechnology 2nd Year | Payal |
| 116 | PRANSHU MALIK | B.Sc. Biotechnology 1st Year | Pryanshu |
| 117 | PRINCE SHARMA | B.Sc. Biotechnology 1st Year | Prince |
| 118 | PRIYA KUMARI | B.Sc. Biotechnology 1st Year | Priya kumari |
| 119 | PRIYANKA | B.Sc. Microbiology 2nd Year | Priyanka |
| 120 | PRIYANSHU RANA | B.Sc. Biotechnology 3rd Year | Priyanshu Rana |
| 121 | PUJA KUAMRI | B.Sc. Biotechnology 2nd Year | Puja |
| 122 | PUJA KUMARI TUDU | B.Sc. Biotechnology 2nd Year | Puja kumari |
| 123 | RAKHI | B.Sc. Biotechnology 3rd Year | Rakhi |
| 124 | RAZIYA ABDUR RAUF | B.Sc. Microbiology 3rd Year | Raziya |
| 125 | RISHABH SINGH | B.Sc. Microbiology 2nd Year | Rishab |
| 126 | RIYA | B.Sc. Biotechnology 3rd Year | Riya |
| 127 | ROHIT KUMAR | B.Sc. Microbiology 2nd Year | Rohit |
| 128 | RONAK SINGH | B.Sc. Biotechnology 3rd Year | RONAK |

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|---|---|---|---|
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| 130 | SAJALCHAUHAN | B.Sc. Microbiology 2nd Year | Sajal |
| 131 | SAKSHI SINGH | B.Sc. Biotechnology 2nd Year | Sakshi |
| 132 | SALONI | M.Sc. Microbiology 1st Year | Saloni |
| 133 | SALONI KUMARI | B.Sc. Biotechnology 2nd Year | Saloni |
| 134 | SAMEER AHMAD | B.Sc. Biotechnology 2nd Year | Sameer ahamad |
| 135 | SAMIYA | B.Sc. Biotechnology 2nd Year | Samiya |

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